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INTERNATIONAL CONFERENCE ON INNOVATIONS AND RECENT TRENDS IN ENGINEERING AND SCIENCE

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Samarth Educational Trust

Arvind Gavali College of Engineering
Satara, Maharashtra, India

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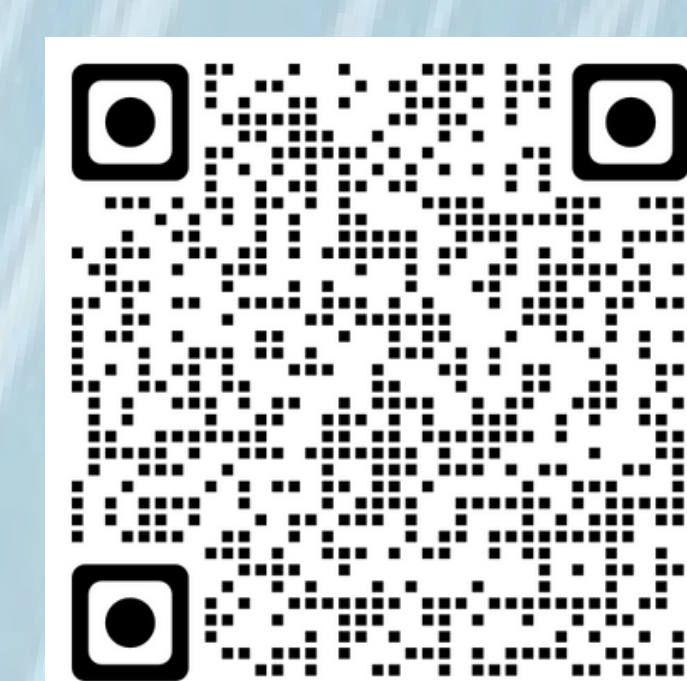
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Sustainable Urban Planning, Innovative Technologies in Structural Design, Construction Techniques and Management, Resilience and Climate Change

Sustainability in Maritime Transportation: Green Ports

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ABSTRACT

Maritime transportation is a logistics method that forms the backbone of global trade. A large part of the world trade volume occurs through maritime transport, which increases the importance of ports and maritime transport infrastructure. However, the environmental impacts of maritime transportation have caused the issue of sustainability to become a priority in this sector. In this context, green ports play a critical role for sustainable maritime transportation. Green ports are ports developed to minimize environmental impacts, increase energy efficiency and promote sustainable practices. These ports adopt various sustainability strategies such as the use of renewable energy sources, waste management, protection of air and water quality, reduction of carbon emissions and integration of environmentally friendly technologies. Green ports have economic and social impacts as well as environmental benefits. Practices such as energy efficiency and waste management provide cost savings in the long run. Additionally, green ports create new job opportunities by promoting environmentally friendly practices and innovations. From a social perspective, green ports improve the quality of life of people living in port areas by improving the quality of the environment. Green ports are critical to achieving sustainability goals in maritime transportation. By reducing environmental impacts, increasing energy efficiency and using innovative technologies, green ports contribute to the sustainable future of maritime transport. In order for global trade to continue in a sustainable manner, green port practices need to be disseminated and supported. This study comprehensively addresses the importance, strategies and impacts of green ports, focusing on sustainability in maritime transportation.

Keywords; sustainability, maritime transport, green port

1. Introduction

The fact that approximately 90% of world trade is carried out by sea increases the density and importance of port operations day by day. This increasing importance also increases the pressure on ports and their associated back areas due to intensified maritime traffic and rising cargo volume. Considering that many port enterprises in our country operate in city centers and limited areas, it is seen that the pollution caused by port operations has direct negative effects on both port employees and city residents (Notteboom et al., 2021).

Nowadays, ship operators pay attention to how much importance the ports they receive service attach to environmental responsibility and occupational health and safety. In this context, environmental awareness has become an important element of competition and prestige in port management, as in other sectors. In the world maritime sector, international agreements, environmental legislation and policies are created and developed in order to reduce pollution risks in sea and port areas. In addition to these legal obligations, the concept of "Green Port" has emerged in order to increase awareness of social responsibility and its effective use (Pavlic et al., 2014).

When we look at the ports of the countries that pioneer Green Port practices, we see that these practices are implemented through voluntary initiatives of ports or port organizations rather than legal obligations. The main purpose of all programs carried out in line with green strategies is; To ensure environmental, economic and social sustainability in ports. In this regard, port operators adopt various environmentally friendly technologies and practices, increase energy efficiency, improve waste management systems and work towards their carbon footprint reduction targets (McCallum, 2022).

Port operators both ensure legal compliance and fulfill their social responsibilities by developing environmentally friendly policies. These practices increase the competitiveness of ports, influence the preferences of ship operators and contribute to the sustainability of the maritime industry in general. The Green Port concept encourages ports to take a more holistic approach, taking into account not only their economic activities but also their environmental and social responsibilities. In this way, the negative effects of ports on the environment are minimized, city life and the health of port employees are protected, and the maritime industry moves towards a more sustainable future (Lam & Li, 2019).

2. Maritime Transportation and Green Ports

Sustainable development is a development model that can meet the needs of the present without jeopardising the ability of future generations to meet their needs. The basis of sustainability is the balance of social, economic and environmental factors. Climate change and environmental problems have accelerated the work on sustainability worldwide and this work has become a standard management approach for many companies. Corporate sustainability is now recognised as one of the natural elements of building the value of a brand. In this context, the concept of green management has been developed. Green management is the process of

applying innovation to achieve competitive advantage by adopting environmental goals and strategies through sustainability, waste reduction, social responsibility and continuous learning and development, and fully integrating them with the organisation's goals and strategies (Lim et al., 2019).

This process affects the maritime transport sector as in all sectors. Globalisation of the world economy has led to restructuring of trade, differentiation of production and consumption points and significant increases in the volume of trade between countries. As a result of these developments, the amount of cargo transported by sea has also increased. Ports, which are one of the main components of maritime transport, are centres that not only carry out handling activities but also create added value to the cargo and where intensive industrial activities are carried out. Ports are one of the most important building blocks of maritime transport. These facilities connect countries to each other and contribute highly to economic growth. However, port areas are sensitive coastal areas that are exposed to environmental pollution during various ship and cargo handling activities every day according to their capacities (Wang et al., 2023).

Factors such as activities carried out in ports, in-port operations, storage and transshipment activities, noise generated by marine vessels, hazardous gases released from the main and auxiliary engines and operation equipment of ships, dust dispersed from some cargoes, and road and railway traffic connected to the port make it necessary to produce policies to solve environmental problems. The International Maritime Organisation (IMO) predicts that CO_2 emissions from international maritime transport may increase by 50% to 250% depending on future economic growth and energy development. In addition, 20% of marine pollution worldwide is caused by maritime activities and maritime transport is shown as one of the main sources of greenhouse gas emissions (Wu et al., 2020).

There are three main sources of environmental risks in ports: risks arising from the port's operations, risks arising from ships and risks arising from off-port vehicles from the intermodal transport network. Some of the problems created by these sources are as follows: air pollution, habitat degradation and loss, damage to biological species, waste pollution (oils, wastewater and storm water discharges, hazardous material waste, bilge water, ballast water, waste from ship paint repair, solid waste, waste from maintenance of port infrastructure and superstructure), traffic congestion, noise and lighting pollution, loss of cultural resources, soil and water pollution, oil spills and soil erosion. For example, microorganisms in ballast water discharged from ships are transported around the world and can lead to the destruction of local species as a result of ballast water discharge (Lee et al., 2019).

All these issues require port operators to take their environmental responsibilities and sustainability goals more seriously. In this context, green management and sustainable port strategies are of great importance both environmentally and economically. Increasing the sensitivity of ports on these issues plays a critical role not only to meet legal requirements, but also to gain competitive advantage and support sustainable development in the long term (Ashrafi et al., 2019).

In recent years, many major ports around the world, operated by the private and public sectors, have started to carry out sustainability analyses and environmental impact assessments with a more critical and comprehensive approach. The most important issues in terms of sustainability in port management are energy management, waste management, equipment management, social and environmental relationship management and occupational safety. Ports that can meet current and future needs and are supported by strategies aiming continuous development, innovative technologies and appropriate investments are defined as sustainable ports. Sustainable ports, beyond their contribution to environmental protection, provide significant economic, technological and cooperation advantages to the port and its stakeholders (Benamara et al., 2019).

Today, the most common and effective approach to sustainable port management is the 'Green Port' approach. Green port concept means sustainable and environmentally friendly ports. This concept ensures that port activities, operations and management are integrated with an environmentally friendly approach. The green port concept supports the protection of the marine environment, waste management systems, modernisation of facilities and energy efficiency. In this context, the green port model is an important approach to the development and operation of ports to prevent environmental degradation, protect biodiversity and ensure the sustainable use of natural resources (Arof et al., 2021).

Green port practices require effective organisation, strong leadership, effective policies, regulations and innovation. As an environmental policy, green port practices aim for sustainable port management and address many important issues such as waste generation, quality of port and coastal waters, soil pollution, air pollution (harmful emissions), energy consumption and efficiency, noise pollution, ship-borne pollution, occupational health and safety (Lee et al., 2019).

In order to raise awareness on environmental sustainability and promote behavioural changes, it is crucial to train and orient human resources at all organisational levels within the port. In addition, encouraging all business partners of the port to this culture will increase the success of the process. In the green port approach, it is essential to increase environmental awareness and integrate innovative technologies and sustainable practices into port operations. Thus, it is ensured that port operations are carried out with effective environmental awareness, natural resources are protected and environmental pollution is reduced (Lindstad et al., 2012).

Although the initial investment costs of modern and smart technologies are high, the high efficiency that these technologies will provide afterwards will make the investment profitable. Green port is one of the strategies created to design ports that target minimum carbon dioxide emissions, have policies and processes for solid-liquid-gas waste management, provide energy efficiency and produce their own energy, perform water conservation and cleaning, and contribute to the sustainable development of the region where they are located (Lalla-Ruiz et al., 2019).

Green port strategies are applied at every stage of port operations to minimise environmental impacts. By ensuring energy efficiency, ports meet their own energy needs from renewable sources. Waste management processes ensure that wastes generated in ports are properly sorted,

recycled and disposed of. In addition, appropriate systems are established to prevent and manage pollution from ships. In this context, special applications such as ballast water management, wastes from maintenance and repair of ship paints, bilge water management are developed (Hasanspahić et al., 2020).

The green port approach not only improves the environmental performance of ports, but also provides a competitive advantage economically. With this approach, ports increase their operational efficiency, reduce their costs and enhance their reputation while fulfilling their environmental responsibilities. As a result, green port practices help ports achieve their sustainability goals and operate in a more balanced and responsible manner in environmental, economic and social terms (Hossain et al., 2020).

3. Conclusion

Although maritime transportation is an indispensable element of global trade, it poses significant challenges in terms of sustainability due to its environmental impacts. In this context, green ports play a critical role in reducing the environmental footprint of maritime transport and achieving sustainable development goals.

Green ports minimize environmental impacts by adopting various sustainability strategies such as energy efficiency, use of renewable energy, waste management, and protection of air and water quality. These strategies not only reduce negative impacts on the environment but also provide cost savings in the long term. Energy efficiency and the use of innovative technologies contribute to reducing operational costs and increasing the competitiveness of ports.

However, the social and economic impacts of green ports are also notable. While environmentally friendly practices improve the quality of life of communities living in port areas, sustainability-oriented investments create new employment opportunities. This reinforces the success of green port projects by increasing social acceptance and support.

However, a strong political and legal framework is needed for green ports to become widespread. International cooperation and setting standards will make it easier for ports to achieve sustainability goals and reduce the environmental impacts of the global trade network. In addition, it is necessary to increase the awareness of port managements and their stakeholders on sustainability and to support continuous education and research activities in this field.

As a result, green ports are of vital importance for the sustainability of maritime transport. Considering the environmental, economic and social benefits, expanding and supporting green port practices is an indispensable requirement for sustainable maritime transportation. Effective implementation and continuous improvement of green port strategies are of great importance for a greener and sustainable maritime transportation in the future.

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Construction of a structure by utilization of sustainable and low cost housing material : Bamboo

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Abstract—**There has been a constant increase in the populationof India. A large percent of the population is not able to afford their own homes owing to the increasing living costs. It is theneed of the hour to adopt for cost effective housing solutions. The depletion in availability of natural resources and the climatic conditions has forced engineers to look for a greener construction material. Thus, a greener as well as an economical construction material is sought. Bamboo, because of its innumerable qualities may emerge as the necessary solution. Bamboo is available in abundance in the tropical and subtropicalregions of India, and using it to its full potential may solve the housing needs of India. The use of bamboo as a structural construction material is gaining traction primarily because it is arapidly growing material and thus sustainable, and it has many positive engineering attributes such as its high strength and durability. This work takes into consideration the alternate construction material using Bamboo. In this project a type of Bamboo based construction is examined and experimental results are carried out thus confirming that this type of construction is viable alternative for conventional system for low-cost structure. The goal is assessing bamboo's potential to meet regional housing needs in a low-cost, eco-friendly manner. This will increase civil society awareness on bamboo's potential as a construction material**

I.INTRODUCTION

According to a certain survey the current housing shortage in India is about 5.9 crores and there is a stipulated requirement of about 5 crore houses by 2022. Hence the total need is about 10.9 crores. Also, there is aconstant increase in the inflation rates as well as people living below poverty line. This calls for the need of a low-cost building material which allows for a speedy construction. The cost of constructing with cement and steel is already very high and it further due to the steel industry while the cement industry contributes about 9%to it. Thus, steel and cement are costly as well as environmentally dangerous. On the other hand, bamboo utilizes CO_2 during its production and releases O_2. Hence, bamboo can emerge as a naturally sustainable and a low-cost construction material. The shortage of housing in developing countries motivates the search forlow-cost materials that can be applied in the constructionof affordable houses for poor people. Many researchers have been studying the application of the locally abundant natural materials as building materials such as mud blocks, natural fibers reinforcing soil or cement etc.These materials and the traditional building techniques, which almost have vanished after the wide

implementation of the building industry, are the main focus of the researchers on non-conventional materials and techniques at the present time of environmental crisis, which our globe is facing. In recent years the demand for structural wooden products for building materials has increased with increasing construction of housing. On the other hand, the quantity and quality of wood resources from the forest have been decreasing. Consequently, the search for substitute materials in place of the traditional uses of wood has been renewed by Bamboo. It is considered a promising alternate material because of its fast growth rate, short rotation age, and high strength. There is always a need of low-cost mass housing schemes for people in earthquake affected areas, emergency structures in different situations etc.

II.OBJECTIVE

1.To reduce the cost of the construction
2.To build environment friendly structure
3.To build light weight structure
4.To study the methods of the bamboo used as structural member
5.To formulate conclusions and recommendations based on the work performed

III.BRIEF INFORMATION ABOUT BAMBOO

Bamboos are a diverse group of mostly evergreen perennial flowering plants making up the subfamily Bambusoideae of the grass family Poaceae. Giant bamboos are the largest members of the grass family, in the case of Dendrocalamus sinicus individual culms reaching a length of 46 meters, up to 36 centimeters in thickness and a weight of up to 450 kilograms. The internodes of bamboos can also be of great length. Kinabaluchloa wrayi has internodes up to 2.5 meters inlength. and Arthrostylidiums chombergkii with lower internodes up to 5 meters in length, exceeded in length only byPapyrus. By contrast, the culms of the tiny bamboo Raddiellavanessiae of the Kaieteur Plateau in French Guiana are only 10–20 millimeters in length by about two millimeters in

width. The origin of the word "bamboo" is uncertain, but it probably comes from the Dutch or Portuguese language, which originally borrowed it from Malay or Kannada. In bamboo, as in other grasses, the internodal regions of the stem are usually hollow and the vascular bundles in the cross- section are scattered throughout the walls of the culm instead of in a cylindrical cambium layer between the bark (phloem) and the wood (xylem) as in Dicots and Conifers. The dicotyledonous woody xylem is also absent. The absence of secondary growth wood causes the stems of monocots, including the palms and large bamboos, to be columnar rather than tapering. Bamboos include some of the fastest-growing plants in the world, due to a unique rhizomedependent system. Certain species of bamboo can grow 91 centimetres (36 inches) within a 24-hour period, at a rate of almost 40 millimeters ($1+1/2$ in) an hour (equivalent to 1 mm every 90 seconds). Growth up to 47.6 inches (156 centimeters) in 24 hours has been observed in the instance of Japanese giant timber bamboo (Phyllostachys bambusoides). This rapid growth and tolerance for marginal land, make bamboo a good candidate for afforestation, carbon sequestration and climate change mitigation. Bamboo is versatile and has notable economic and cultural significance in South Asia, Southeast Asia, and East Asia, being used for building materials, as a food source, and as a raw product, and depicted often in arts, such as in bamboo paintings and bamboo working. Bamboo, like wood, is a natural composite material with a high strength-toweight ratio useful for structures. Bamboo's strength-to-weight ratio is similar to timber, and its strength is generally similar to a strong softwood or hardwood timber. Some bamboos have displayed remarkable strength under test conditions. Bambusatulda of Bangladesh and adjoining India has tested as high as 60,000 pounds (27,000 Kg or 27 tonnes) per square inch in tensile strength. Other bamboos have extraordinarily hard wood. Bambusatabacaria of China contains so much silica that it will make sparks when struck by an axe.

III. TAXONOMY

Bamboos have long been considered the most basal grass genera, mostly because of the presence of bracteate, indeterminate inflorescences, "pseudospikelets", and flowers with three lodicules, six stamens, and three stigmata. Following more recent molecular phylogenetic research, manytribes and genera of grasses formerly included in the Bambusoideae are now classified in other subfamilies, e.g. the Anomochlooideae, the Puelioideae, and the Ehrhartoideae. The subfamily in its current sense belongs to the BOP clade ofgrasses, where it is sister to the Pooideae (bluegrasses and relatives). The bamboos comprise three clades classified as tribes, and these strongly correspond with geographic divisions representing the New World herbaceous species (Olyreae), tropical woody bamboos (Bambuseae), and temperate woody bamboos (Arundinaria). The woody bamboos do not form a monophyletic group; instead, the tropical woody and herbaceous bamboos are sister to the temperate woody bamboos. Altogether, more than 1,400 species are placed in 115 genera.

IV. HARVESTING

Bamboo used for construction purposes must be harvested when the culms reach their greatest strength and when sugar levels in the sap are at their lowest, as high sugar content increases the ease and rate of pest infestation. As compared to forest trees, bamboo species grow fast. Bamboo plantations can be readily harvested for a shorter period than tree plantations. Harvesting of bamboo is typically undertaken according to these cycles: Lifecycle of the culm: As each individual culm goes through a five to sevenyear lifecycle, they are ideally allowed to reach this level of maturity prior to full capacity harvesting. The clearing out or thinning of culms, particularly older decaying culms, helps to ensure adequate light and resources for new growth. Well-maintained clumps may have a productivity three to four times that of an unharvested wild clump. Consistent with the lifecycle described above, bamboo is harvested from two to three years through to five to seven years, depending on the species. Annual cycle: Most all growth of new bamboo occurs during the wet season and disturbing the clump during this phase will potentially damage the upcoming crop, while harvesting immediately prior to the wet/growth season may also damage new shoots, therefore harvesting is best a few months prior 18 to the start of the wet season. Also during this high-rainfall period, sap levels are at their highest, and then diminish towards the dry season. Daily cycle: During the height of the day, photosynthesis is at its peak, producing the highest levels of sugar in sap, making this the least ideal time of day to harvest and many traditional practitioners believe the best time to harvest is at dawn or dusk on a waning moon.

V. LEACHING

Leaching is the removal of sap after harvest. In many areas of the world, the sap levels in harvested bamboo are reducedeither through leaching or post-harvest photosynthesis. For example: Cut bamboo is raised clear of the ground and leaned against the rest of the clump for one to two weeks until leaves turn yellow to allow full consumption of sugars by the plant. A similar method is undertaken, but with the base of the culm standing in fresh water, either in a large drum or stream to leach out sap. Cut culms are immersed in a running stream and weighted down for three to four weeks. Water is pumped through the freshly cut culms, forcing out the sap (this method is often used in conjunction with the injection of some form of treatment). In the process of water leaching, the bamboo is dried slowly and evenly in the shade to avoid cracking in the outer skin of the bamboo, thereby reducing opportunities for pest infestation. Durability of bamboo in construction is directly related to how well it is handled from the moment of planting through harvesting, transportation, storage, design, construction, and maintenance. Bamboo harvested at the correct time of year and then exposed to ground contact or rain will break down just as quickly as incorrectly harvested material

VI. METHODOLOGY

Bamboo structure - The only vertical and horizontal forces acting on the structure are self-weight of bamboo and weight of GI sheet. As the structure is of 10ft height there is no need to consider wind load acting on the structure. Loads created by soil or water as well as subsidence and earthquakes are exceptional factors which skeletal structure generally accommodates more easily than a solid building. The building materials as well as the structure have a high elasticity and Low Mass. Because of its ability to change its shape, this structure can absorb a high quantity of energy. Bamboo houses are prime example of energy absorbing methods of construction. They could be called spatial structures with elastic joints.

Bamboo Connections –

Nut bolt connections

This is a firm and more durable type of bamboo connections. In this connection bamboos are connected by nut bolt fitting. For the structure which we are going to construct we use this type of connection to make the structure strong and more durable

Friction-tight rope connections

Friction-tight rope connections are the common connecting method. Traditionally natural materials are used. For Joining two bamboo s iron wire (zinc coated), plastic tapes/ ropes.

Positive fitting connections -

These connections involve carving a hole in a bamboo culm and inserting a bamboo of a slightly smaller diameter. The joint is further strengthened using bolts or dowels. The disadvantage of this jointing technique is the reduction of the strength of the bamboo because of the cutting of the hole

PRESERVATION OF BAMBOO

Bamboo is a woody, valuable, strong, and exceptionally fast-growing grass. It is commonly and abundantly available throughout the country. It grows easily and in every region except extremely hot and cold deserts. The most used part of the bamboo plant is the culm. It is typically, but not always, a hollow cylinder that tends to taper towards the top. A culm is segmented into sections (called „internodes") by nodes.
Internodal sections are invariably hollow; nodes are always solid. This structure gives the bamboo culm properties of strength and flexibility. Bamboo culms can be used in their natural or whole form, or cut into sections, or in strips, slivers, and slats. Bamboo culms have been used by people and communities for thousands of years, to build houses, fences, and bridges. They can be used to make a vast range of utility items, including storage baskets, containers, furniture, agricultural implements, and household baskets. There is also a growing demand for bamboo to meet the needs of new and value-added products and applications, like wood substitutes, panels, flooring, roofing, and screens.

VII. MATERIAL TESTS

METHODS OF TREATMENT

Treatment methods can be divided into traditional/time- tested methods and chemical methods. Selection of the treatment method depends on many factors: • State of bamboo - green or dry • Form - round bamboo, splits, or bamboo products. • End applications - in ground contact, exposed to atmosphere, undercover, structural/non-structural. • Scale - quantity to be treated and time available. • Potential causes of decay - biotic (fungus/insects) and abiotic (cracks/weathering)

TRADITIONAL TREATMENT METHODS

These are age-old methods which have been practiced in areas where bamboo commonly grows. They are simple and cost- effective without the use of supporting equipment. But these methods are not appropriate for long-term protection of bamboo

CHEMICAL TREATMENT METHODS

In these treatment methods chemical preservatives are used to protect the material from degradation. These are well established methods providing desired protection even in adverse conditions.

TRADITIONAL TREATMENT

Leaching, smoking, and lime washing are age-old treatment methods which have been practised where bamboo is grown and used. Sometimes, for craft items, protection is also given by use of natural dyes and lacquers, which also lead to value addition.

LEACHING

Leaching helps remove starch and enhances permeability for future treatment by diffusion and pressure. Mechanical properties are affected for unto 2- 3 months of water storage. This method is appropriate for treating any quantity of bamboo. It is also recommended for craft and mat applications where pliability is required. Bundle culms/splits and store in running water or tanks. Use sinker loads for complete immersion. In the case of tanks, change the water weekly to prevent growth of bacteria which will cause staining and bad odour

SMOKING

Traditionally, culms are stored over the hearth or fireplace. The moisture content in smoked culms is thus reduced so that biological degradation cannot take place. Builtup deposits from smoke form a protective layer on the culm. Smoke drying also reduces splitting.

LIME WASHING

Lime or whitewashing is mainly used for ornamental effect. Culms and mats are painted with slaked lime (Ca (OH)) which is then transformed 2 into calcium carbonate, CaCO, which inhibits water absorption and 3 delays fungal attack. Bamboo mats can also be tarred, sprinkled with sand, and whitewashed after drying.

BAKING

Baking on open fire has been used to straighten crooked bamboo culms. Bamboo is rotated on an open flame to prevent localised heating. The high temperatures destroy the starch and other sugars and also produce tar in the structure. It kills existing infestations if any. Stresses produced during heating gives dimensional stability to the culm. A lower equilibrium moisture content regime prevents any subsequent fungal attackif bamboo is used in interior application.

NATURAL DYES, VARNISHES AND PAINTS

Natural dyes have been used for ages to provide protection and colour to bamboo products. Dyes are applied by boiling the material with the colouring agent, during which the starch is also leached out. Paints and varnishes are applied on to the bamboo surface to protect it from dirt and moisture, and to provide ornamental effects. They form a film on the surface of the bamboo. Blistering of the paint/varnish leaves the bamboo surface exposed, and fungal and insect attack may follow. It is therefore recommended to provide a protective coating of preservative before application of paints and varnishes.

CHEMICAL TREATMENT

SURFACE APPLICATION –

1. Spraying -

This method is suitable only for large stacks of bamboo stored under cover in depots. Stack bamboo horizontally on a raised platform and preferably sloping ground, and on a polythene sheet. For large stacks, use an industrial sprayer. For small stacks, a backpack is sufficient. Spray chemicals onthe top taking special care to cover the ends and the cut surfaces (2% solution of boric acid: borax. Mix 1 kg of Boricacid, 1 kg of Borax in 100 litres of water).

Brushing- It is suitable for small handicraft and household items. 2-3 coats of chemicals should be given using a brush. The size of the brush will depend on the material surface to becovered.

Dipping –Dipping is used for medium quantities of bamboo/bamboo products. Dipping is more effective than spraying or brushing. A momentary dip of 30 seconds to a minute is sufficient to protect the material. The excess material should be drained and reused

PRESSURE TREATMENT –

Pressure methods are suitable for dry bamboo and ensure quick and uniform penetration of the preservative deep inside.The principle of the process is to force the preservative into the bamboo tissue. This is achieved either by evacuation of the air inside the culm, or by increased pressure upon the preservative in a pressurized cylinder, or a combination of both. Treatment under pressure increases the durability of bamboo. Bamboo treated by this method will last for about 15 years in ground contact and 50 years for building components. Water-borne preservatives and sometime creosote are used for the treatment. Depending upon the pressure schedule, the four different types of pressure treatment are there and these are as

follows.
1. Vacuum Process
2. 2. Full cell Process
3. 3. Empty Cell Process
4. 4. Fast Fluctuating Pressure Process

HOT AND COLD TREATMENT –

It is based on the principle that on heating, air from the cells will expand and partially escape. During cooling a slight vacuum is created due to contraction of the residual air and causes the entry of preservative into the cell. The timber is submerged in the preservative oil or solution, which is then heated to about 90"C and maintained at this temperature for a suitable period, depending on the charge. It is then allowed to cool until the required absorption of preservative is obtained. During the heating period, the air in the timber expands and part of the moisture is converted into vapour and is expelled; during cooling, the residual vapour/ air in the timber contracts, creating a partial vacuum, which causes the preservative to be sucked into the timber.

BOUCHERIE PROCESS –

Treatment of sapwood of almost all green round timbers, soon after felling with the bark on maybe carried out using any of the inorganic water-soluble preservatives. The treatment is carried out by attaching to the butt-end of a pole, a rubber hose connected to a reservoir containing the water borne preservative solution and placed at a sufficiently higher level. The pole is held in an inclined position, generally at an angle of 45° to the horizontal. Due to hydrostatic pressure, the preservative displaces the sap which is then forced out at the narrow end. The treatment is stopped when the concentration of preservative in the drip is nearly the same asthat of the solution in the reservoir. If an air pressure of 1 to 2kg/cm2 is applied on the surface of the preservative in the reservoir, the reservoir, need not be raised high above the ground and the 54 treatment can be hastened to an appreciable extent. Pressure up to 5 kg/cm2 may be used for treatment of green poles with specially designed pressure caps.

DIPPING –

It is a simple method to carry out. It involves keeping the green bamboo completely submerged in the preservative solution. The specimens were kept submerged in water for about a week for treatment. Both round and half-split specimens were treated. As diffusion of preservative is better from the inner wall than from the outer wall, the septa should be punctured or small notches made near the nodes to facilitate free access of the preservative solution to the inner wall. This method can be carried out even in a rural set up.
This does not require any electricity. Depending on the scale of operation, treatment tanks of appropriate sizes can be made. This method results in even distribution of the preservative. The depth of penetration and absorption of preservatives can be controlled by varying the dipping period.

VIII. TESTING OF BAMBOO

MECHANICAL PROPERTIES OF BAMBO

Bamboo consists of many different species and each of those bamboo species have different structural and mechanical properties just as trees. Furthermore, one single bamboo species can show very different test results depending on the age and moisture content of the tested bamboo pole, its origin (soil, altitude, climate conditions), and the part of the stem thatis tested. Mechanical properties are very important to identify the characteristic strength of bamboo. All the characteristic values were used in the design calculation.The mechanical properties have been determined in this study by conducting few tests such as tensile strength test and Compression strength test.

METHOD OF TESTS FOR BAMBOO

In 2004, the International Organization for Standardization (ISO) developed model standard test methods for determiningthe mechanical properties of bamboo. If the use of bamboo is limited to rural areas, ISO recognizes established "experience from previous generations" as being an adequate basis for design. However, if bamboo is to achieve its full potential as a sustainably obtained and utilized building material on an international scale, issues of the basis for design, prefabrication, industrialization, finance and insurance of building projects, and export and import of materials all require some degree of standardization

SCOPE

Prospects of bamboo utilization as material of future are bright. Traditional uses of bamboo include building and construction as well as paper industry. Handicraft and furniture industry also rely on bamboo as major raw material. In modern houses, green housing, roof top based on bamboo can be developed to reduce the load of electricity. More research work regarding Bamboo structural design can be made. Bamboo connections can also be developed to make bamboo construction more easier. The use of bamboo in the construction, automobile, and other potential fields can eliminate the need for materials like steel, plastic, carbon fiber, etc. This, in turn, reduces the emission of greenhouse gasses in huge quantities. The low cost of bamboo reduces the overall cost of construction and makes it affordable to everyone.

Another significant merit of growing bamboo is that no part of the plant gets wasted. Taking these facts into consideration, it is a good idea to promote the growth and use of bamboo to ensure lower costs of living and a better environment for our future generations. More work can be done in testing of bamboo and preservation of bamboo.

CONCLUSION

In nations such as India, bamboo is a well-established building component but generally seems quite poorly implemented. Bamboo has known qualities and an established reputation of being a wonder building material (eco-friendly, regenerative, low cost etc.) From detailed estimation it is found that the cost of bamboo shed is 40% less than the steel structure. Bamboo as a material can be used irural area for unimportant structures. It can also be used for single storey structure. We can increase the durability of bamboo by various preservation techniques easily. The compressive test and tensile test results obtained are 41.5 Mpa and 121.7 Mpa. Dipping method of preservation can be carried out even in a rural set up. This does not require any electricity. This method results in even distribution of the preservative. The depth of penetration and absorption of preservatives can be controlled by varying the dipping period.

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Compare the compressive strength of banana fiber concrete & normal concrete with varying percentages

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Abstract— **Banana fiber is available in abundance at the test site, which makes it quite viable as a reinforcement material in concrete. Further, it acts as a new source of income for the Banana producer who gets the benefits of the new demand generated by the construction industry. In addition to this, it is an effective method for the disposal of coir mattress waste which will reduce the demand for additional waste disposal infrastructure and decrease the load on existing landfills and incinerators. The problem of high rate of water absorption of the fiber could be reduced by coating the fibers with oil. Moreover the fibers being natural in origin is ecologically sustainable and can bring down the global carbon footprint quite effectively. This study aimed at analyzing the variation in strength of banana fiber (oil coated raw and oil coated processed fibers) reinforced concrete at varying fiber contents and to compare it with that of conventional concrete. The various strength aspects analyzed are the flexural, compressive and tensile strength of the banana fiber reinforced concrete at varying percentages (4%,5%,6% by the weight of cement) of fiber.**

Keywords— Banana Fiber Concrete, strength, Concrete, Fiber

I. INTRODUCTION

The construction industry is revolutionizing in two major ways. One way is the development of construction techniques, such as using automated tools in construction. The other is the advancement in high-performance construction materials, such as the introduction of high strength concrete. Among these high performance materials, fiber reinforced concrete (FRC) is gradually gaining acceptance from civil engineers .In recent years, research and development of fibers and matrix materials and fabrication process related to construction industry have grown rapidly. Their advantages over other construction materials are their high tensile strength to weight ratio, ability to be moulded into various shapes and potential resistance to environmental conditions, resulting in potentially low maintenance cost. These properties make FRC composite a good alternative for innovative construction. Their application in construction includes both upgrading existing structures and building new ones, which can apply to various types of structure, for example offshore platforms, buildings and bridges (Thou, 2005).A major roadblock towards development of high performance concrete using steel fibers is the high costs involved, availability and also problem of corrosion. Banana fiber being the most ductile among all natural fibers (Majid Ali et al., 2012) has the potential to be used as a reinforcement material in concrete. It is biodegradable so the impact on environment will be minimal. This is also away to dispose off the fibers which are derived as waste materials from coir based manufacturing units to produce high strength materials. They are also non-abrasive in nature, cheap and easily available. Research work is being carried out to find the possibility of Banana-fiber ropes as a vertical reinforcement in mortar-free interlocking structures. This is believed to be a cost-effective solution to earthquake-resistant housing. The aim of this study was to identify the improvement in strength characteristics of concrete with the addition of oil coated Banana fiber. Department Of Civil Engineering Page 9 In the study, Banana fiber is added to concrete and Plain Cement Concrete (PCC) is used as reference to study its effect on flexural, compressive and tensile strength properties and also drying shrinkage .Fiber is coated with oil so as to decrease the water absorption. Some of the of advantages being observed are low cost, low density, reasonable specific strength, good thermal insulation, reduced wear and Experimental Studies on Banana Fiber ability to be recycled with minimal impact on environment (Majid Ali et al.,2011).Thus in addition to the enhancement in the physical properties of concrete, it turns out to be a sustainable waste management technique.

II. PROBLEM STATEMENT

It is found that increase in porosity in the concrete decreasesthe compressive strength of the concrete. In order to produce concrete which can withstand compressive forces acting on it,it is essential to design a concrete having optimum permeability and compressive strength. b) This can be achieved by adding Banana Fibre and adjusting the proportioning to get maximum compressive strength and permeability.

III. OBJECTIVE

To compare the compressive strength of Banana Fiber Concrete & Normal Concrete with varying percentages. It is found that increase in porosity in the concrete decreases the compressive strength of the concrete. In order to produce concrete which can withstand compressive forces acting on it, it is essential to design a concrete having optimum permeability and compressive strength. This can be achieved by adding Banana Fiber and adjusting the proportioning to get maximum compressive strength and permeability.

IV. JUSTIFICATION

Banana fiber is available in abundance at the test site, which makes it quite viable as a reinforcement material in concrete.Further, it acts as a new source of income for the Banana producer who gets the benefits of the new demand generatedby the construction industry. In addition to this, it is an effective method for the disposal of coir mattress waste whichwill reduce the demand for additional waste disposal infrastructure and decrease the load on existing landfills and incinerators. The problem of high rate of water absorption of the fiber could be reduced by coating the fibers with oil. o More over the fibers being natural in origin is ecologically sustainable and can bring down the global carbon footprint quite effectively. Improved many of the engineering properties of the concrete. Banana fiber with a tensile strength is the toughest among all natural fibers. o Low cost, reasonable specific strength, low density o Easy to availability.

V. METHEDOLOGY

Collection of Materials Testing of Materials Mix Design Mixing at Specified Proportion Moulding Remoulding After 24 Hours Curing for 7 Days & 28 Days Testing of Specimen Step Result Analysis & Conclusion

VI. MATERIAL USED

Concrete is a freshly mixed material which can be moulded into any shape. Concrete is a site made material unlike other material of construction such as can vary to a very great extent in its quality, properties and performance owing to the use ofnatural material except cement. The properties of materials are important to make concrete workable and durable. The materials used in this study are : • Cement • Fine aggregate •Coarse aggregate • Banana fiber • Water Some Common Mistakes

VII. MIX DESIGN

Mix design is defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. The mix design must consider the environment that the concrete will be in exposure to sea water, trucks, cars, forklifts, foot traffic or extremes of hot and cold. A Mix design was conducted asper IS 10262-1982 to arrive at M 20 mix concrete.

A. STIPULATIONS FOR PROPORTIONING

Grade designation: M20, Type of cement: PPC Max nominal, size of aggregate: 20mm, Min cement content: 300 kg/m3, Max water cement ratio : 0.55, Workability : 100mm (slump), Exposure condition : Mild (for reinforced concrete), Degree of supervision : Good, Type of aggregate : Crushed angular aggregate, Max cement content : 450 kg/m3

VIII. MATERIAL TESTS

MATERIAL TESTS : TESTS ON CEMENT Cement is an important constituent in concrete. The process of manufacture of cement consist of grinding the raw materials mixing them intimately in certain proportions and burning them in kiln at a temperature 1300°C to 1500°C. To determine the various properties of cement different tests are done. The tests done are :

Field test of cement 1. Cement Colour : The colour of cement should be uniform. It should be typical cement colour i.e. gray colour with a light greenish shade. 2. Whether Hard Lumps are Formed : Cement should be free from hard lumps. Such lumps are formed by the absorption of moisture from the atmosphere. 3. Temperature Inside Cement Bag : If the hand is plunged into a bag of cement, it should be cool inside the cement bag. If hydration reaction takes place inside the bag, it will become warm. 4. Smoothness Test : When cement is touched or rubbed in between fingers, it should give a smooth feeling. If it felt rough, it indicates adulteration with sand. 5. Water Sinking Test : If a small quantity of cement is thrown into the water, it should float some time before finally sinking 6. The smell of Cement Paste : A thin paste of cement with water should feel sticky between the fingers. If the cement contains too much-pounded clay and silt as an adulterant, the paste will give an earthy smell. 7. Glass Plate Test : A thick paste of cement with water is made on a piece of a glass plate and it is kept under water for 24 hours. It should set and not crack.

Lab test :1. Setting time test, 2. Tests on Coarse Aggregate, 3.Tests on Fine Aggregates, 4. Impact value test, 5. Elongation and Flakiness index value tests, 5.

IX. SCOPE

The effect of banana fibers on high strength concrete should be studied and thus the use of BFC can be extended to industrial and commercial buildings. Since the corrosion study is not done, the applicability of BFC in reinforced constructions could be tested. Banana fiber is a good insulator in itself and as such it can improve the thermal properties of concrete. This is particularly useful in a tropical country like India where the mercury levels are quite high for most part of the year, so as to maintain the room temperatures within comfort levels of its inhabitants. It can also reduce the load on air conditioning systems thus reducing the power consumption. The acoustic properties of concrete reinforced with other natural fibers have been studied in the past using an impedance tube apparatus and the results are fair enough to justify the use of banana fibers as an alternative which is agood absorbent due to the presence of surface pores. Based on the development of total scenario about motor vehicle for

that period, it is quite concerned. This is because, in line with diversity development of motor vehicle on the road, accident rate which occurred in India also pitched in increase. This situation needs to be investigate and research must be done to know the main problems that causes the accident and it is also important to ensure that the existing transportation system in India are in a perfect condition in serving various types of vehicle users in this country.

X. CONCLUSION

Banana fiber is available in abundance at the test site, which makes it quite viable as a reinforcement material in concrete.Further, it acts as a source of income for the Banana producerwho gets the benefits of the new demand generated by the construction industry. In addition to this, it is an efficient method for the disposal of coir mattress waste which will reduce the demandfor additional waste disposal infrastructure and decrease the load on existing landfills and incinerators. Banana fibers being natural in origin, is ecologically sustainable and can bring down the global carbon footprint quite effectively. The major conclusions from this study are

1. At 5% addition of Banana fiber with a water cement ratio of 0.5, compressive strength tests yielded best results. However, the compressive strength decreased on further fiber addition. This must be due to the fact that when the fibers are initially added to concrete, the finer sized fine aggregates enter into the surface pores in the fiber creating a better bonding between the fiber and mix, however further addition of fibers resulted in formation of bulk fiber in the mix which will lead to decrease in bonding. Hence there is an optimum value of fiber to cement ratio, beyond which the compressive

strength decreases. Hence 0.5 was takenas the optimum water cement ratio and optimum fiber content was taken as 5% When the fiber content is increased there is an increase in split tensile strength with a maximum at 5%. However whenthe fiber content is increasedbeyond this value a reduction in tensile strength is observed. This is due to thefact that tensile failure occurs due to the dislocation of atoms and molecules present in concrete. However when the fiber is added it acts as a binder holding them together. The tensile properties and cracking pattern of CFRC shows that it can be particularly useful in construction activities in seismic zones due to its high tensile strength and post peak load behaviour, which offers sufficient warning to the inhabitants before complete collapse of the structure.

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Arvind Gavali College of Engineering
Study Of Glass And Steel Fibre In Concrete

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Abstract—The main aim of this study is to test the ratios of glass fibre and steel fibre, when mixed together and to determine which ratio provides best concrete properties in various conditions. By the inclusion of these fibers cracks can be removed to a considerable extend. concrete is brittle in nature and weak in tension and is often subjected to shrinkage and creep. These factor have led to the development of fibre reinforced concrete. The fibre reinforcement concrete has so far been successfully used in slabs on grade, architecture panels, precast products, offshore structurs, structures in seismic region, thin and thik repairs, crash barriers etc.

Keywords—Fibre, Steel, Glass, Concrete, Super plasticizer.

I. INTRODUCTION

concrete is most widely used man made material. It's applications in infrastructure development has provided the desirable properties like high compressive strength, stiffness, durability under usual as well as harsh environment conditions.

It is obtained by mixing cementing materials, water and aggregates, and sometimes admixtures, in required proportions.

The mixtures when placed in forms and allowed to cure hardens into a rock like mass known as concrete. One of the undesirable characteristics of the concrete as a brittle material is it's low tensile strength, and strain capacity.

Conventionally, this reinforcement is in the form of continuous steel bars placed in the concrete structure in the appropriate positions to withstand the imposed tensile and shear stesses.

Fibres, on the other hand, are generally short, discontinuous, and randomly disturbed throughout the concrete member to produce a composite construction material known as Fiber Reinforced Concrete (FRC).
Experimental research results have been shows considerable improvement in the post-cracking behavior of concretes containing fibers.

Therefore, compared to plain concrete, fiber reinforced concrete is much tougher and more resistant to impact.

In addition to strength characteristics,concrete should have adequate durability to perform in accordance with its intended level of functionality and Serviceability over an expected or predicted life cycle.

Durable concrete must potentially have the ability to withstand expected exposed deteriorative conditions.

Addition of steel fiber to concrete increases water and gas permeability, irrespective of the fiber amount ot fiber length.

The plain concrete has been replaced by fiber reinforced concrete from past years.

The inclusion of fibres in the concrete decrease the Brittleness and advances the mechanical properties.

Steel Fiber Reinforced Concrete (SFRC) is defined as the concrete made with hydraulic cement containing fine and course aggregate and discontinuous discrete steel fibre.

In SFRC, thousands of small fibers are dispersed and distributed randomly in the concrete during mixing, and thus improve concrete properties. SFRC is being used to improve static and dynamic tensile strength, energy absorbing capacity and better fatigue strength. steel fibers are the strongest commonly available fibre, and come in different lengths and shapes.

Glass fiber is an inexpensive and corrosion proof fiber, but not as strong as steel. The design of glass fiber reinforced concrete proceeds from knowledge of its basic properties under tensile,compressive,bending and shear forces, coupled with estimates of behavior under secondary loading effects such as creep, thermal response and moisture movement
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Owing to the lower modulus of elasticity the FRP-RC beams exhibit lower serviceability performance compared to steel bars.

The rigid and brittle behaviour of FRP bars forces the FRP-RC beams to be designed as over reinforced making the failure by crushing of concrete.

The bond between the FRP bars and the concrete is affected by various factors.

III.   Research/Project Area

As all of us know that concrete is brittle in nature and also we know that it is weak in tension.

The benefit of reinforcing technology using metal reinforcement as excessive tensile metal wires.

FRC is a concrete which have fibrous material in concrete that increases the structure integrity.

It is a comparatively new material in construction field.

IV.   Working Principal

•Research in going on the basis of percentage method.

•For this we worked on strength of each material I. e. glass & steel fibre.

•in this research we are used fibre like steel fibre and glass fibre to know the effect of those fibres in concrete

V.   MATERIAL USED

According to IS:456:2000
cement OPC Grade 43,Specific Gravity-3. 15
Fine Aggregates Size<4.75mm
Course Aggregates Size 10-20mm
are:-Steel (length 50mm, dia 0.5mm), Glass (Size12mm)
Anti alkalineTop Admixture used is Glenium 51 (Polycarbolic Ether Hyper Plasticizer)
Fibres used water (Temperature varied at late stages of experiment).

VI.   EXPERIMENTAL PROGRAMME
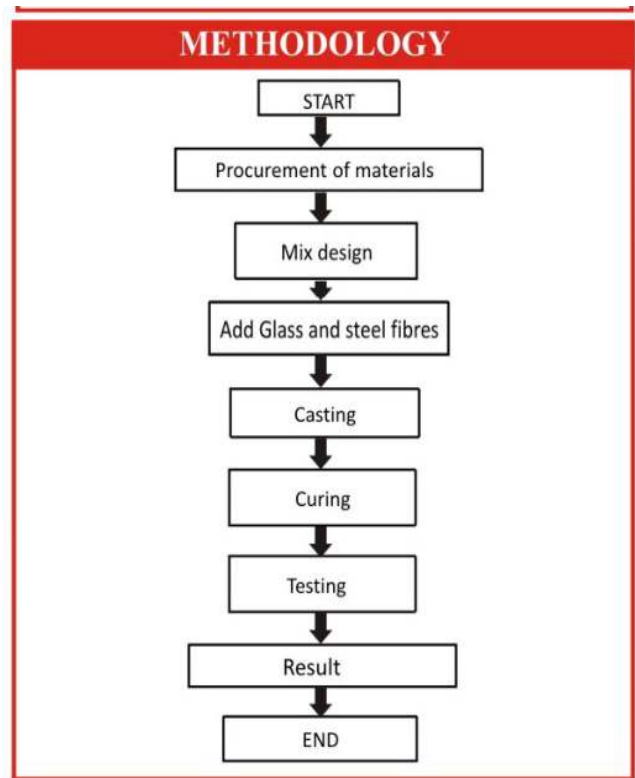
METHODOLOGY

(a) STIPULATIONS FOR PROPORTIONING

- Grade designation:M30
- Type of cement:OPC 43 grade
- Maximum nominal size of aggregate:20mm
- Minimum   cement content:320kg/m^3................(From Table 5 of IS 456:2000)
- Maximum water-cement ratio :For M30 =0.40
- Workability:100mm(Slump)
- Exposure condition:severe
- Method of concrete placing :manual
- Type of aggregate :crushed angular aggregate
- Maximum cement content:450kg/m^3
- Chemical admixture type:Super plasticizer
-

(b)TARGET STRENGTH FOR MIX PROPORTIONING :M30

F'CK=fck+1.65s

Where, F'CK= target average compressive strength at 28 days,

fck= characteristic compressive strength at 28 days,

s=standard deviation

From table 1 standard deviation (s) = 4 N/ mm^2

Therefore, target strength =30+1.65×4= 38.25N/mm^2.

VII. ESTIMATION OF MIX DESIGN

Volume of concrete required for 12 numbers of cubecubes (15cm×15cm× 15cm) assuming 25% wastage .

(a)Volume of concrete = 1m^3

(b) Volume of water =(mass of water /specific gravity of water) ×(1/100) =(140/1) ×(1/100) =0.41m^3

(c) Volume of cement=(mass of cement/specific gravity of water) ×(1/100) =(350/3.15) ×(1/100) =0.111m^3

(d) Volume of chemical admixture(super plasticizer) @2.0%by mass of cementitious material=350×2%=7kg/m^3=(7/1.145) ×(1/100) =0.006.

(e) Volume of total aggregates =a-(b+c)=(1-0.111+0.140+0.006)

=0.742m^3.

(f) mass of course aggregate= (e × volume of course aggregate × specific gravity of course aggregate × 1000=0.742×0.576×2.84×1000

=1213.79kg/m^3.

(g) Mass of fine aggregates= (e × volume of fine aggregate × specific gravity of fine aggregate × 1000) =830.56kg/m^3.

VIII. PROJECT SETUP

(a) Design of concrete mixes as per Indian Standard method IS 10260: 2009:

1.The Indian standard code IS 10260: 2009 presents guidelines for the design of normal concretes.
2.The basic assumption made in the mix design is that compressive strength of workable concrete is high.
3.In this method, W/C cement ratio is selected depending on the grade of concrete and type of exposure.
4.Water content is selected on the basis of nominal coarse size aggregate and slump.
5.Volume of coarse aggregate depends on the zone of fine aggregate as per IS 383 and nominal maxi. size.
6.The batch weight of the material per unit volume is calculated by absolute volume method.
7.There are various other factors which affect the property of concrete such as the grade of cement, quantity of cement, water, aggregate size, and shape, etc.

(b) Cube casting and curing procedures: Apparatus

•Cube Moulds: 150 x 150 x 150 mm
•Brick Towel, Wooden or Metal float
•Compaction equipment: Tamping rod
(c) Cube Preparation :
•Ensure that the test moulds are clean.
•Ensure that all the mould sides are at 90° angles with the base plate.

(d) Handling and demoulding of cubes
• Store cubes in a cool place for 24 hours.
• Store cubes indoors, out of direct sunlight, wind or extreme temperatures.
• The storage area should be free of vibration, with a relative humidity of at least 90% and a temp. of 22°C - 25°C.
• Demould /strip cubes 24 hours after manufacturing.
• Ensure cube sides are not scratched or damaged during demoulding.
• Then the specimens remove from the mould and curing in water for 28 days.
• After 28 days remove it from water

and left to air dry at room temperature

condition.

(e) Procedure for Concrete Cube Compression Test
1. Remove the specimen from the water after specified curing time and wipe out excess water from the surface.
2. Take the dimension of the specimen to the nearest 0.2m
3. Clean the bearing surface of the testing machine
4. Place the specimen in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast.
5. Align the specimen centrally on the base plate of the machine.
6. Rotate the movable portion gently by hand so that it touches the top surface of the specimen.
7. Apply the load gradually without shock and continuously at the rate of 140 kg/cm²/minute till the specimen fails.
8. Record the maximum load and note any unusual features in the type of failure.

Cube Testing On UTM

Mix	Fiber in Mix	Sr. No.	Load Kn	Stress Kn/m²	Average
		1	905.6	40.24	
M30	20% of glass fibre	2	984.8	43.7	42.65
		3	990.3	44.01	

(B)Readings of Compression test for Steel fiber reinforcement:

Mix	Fiber in Mix	Sr. No.	Load Kn	Stress Kn/m²	Average
		1	1203.2	53.47	
M30	20% of Steel fibre	2	1250.9	55.59	55.76
		3	1310.4	58.24	

X. Cost Estimation

SL.NO	Particulars/Softwares	Specifications	Quantity In No.s	Price in Rs
1	Cement	OPC cement of 43 grade	20 kg	250 rs
2	Coarse aggregate	20 mm crushed bold Rock	65 kg	180 rs
3	Fine aggregate	Sand of standard size	45 kg	100 rs
4	Super plasticiser	Addmixctue for workability	7 kg	90 rs
5	Steel fiber	Crushed steel wires	4 kg	380 rs
6	Glass fibre	Crushed glass fibre	4 kg	900 rs
7	Transport and lum sum		Lum sum	550 rs
	Total Cost In Rupees			2450 rs

IX. Result -

The main objective of this research is to compare mechanical properties of glass fiber reinforced concrete with Steel fiber reinforced concrete. So for that we need to perform the compressive strength test on cubes with respective additional fiber mix design.

Three specimens of each cubes were casted. Similarly for mix M30 only cement was partially replaced by 20% of Glass fiber crush and also Steel fiber crush. The casting of all specimens was completed within 2 days and the demolition is done after 24 hr of casting. After that cubes were put in curing tank for 28 days. After 28 days of curing the specimen were removed from tank and let too dry then got tested. The cube were tested on UTM for compression test.

(A)Readings of Compression test for Glass fiber reinforcement:

XI. CONCLUSION

A brief state-of-the-art report on fiber reinforced concrete is presented. Our understanding of fiber-matrix interaction, reinforcement mechanisms and performance characteristics is fairly advanced. Fiber reinforced concrete is a promising material to be used in the Middle-East for sustainable and long-lasting concrete structures. Its performance has already been proven in other hot and arid climates and in other chemically deleterious environments.

Fiber reinforced concrete pavements prove to be more efficient than conventional RC pavements, in several aspects Compressive strength for fiber reinforced concrete is seen to be improved. It can be clearly seen that strength at 28 days for CSFRC 1% is better than other cases hence recommended.

Arvind Gavali College of Engineering

XII. FUTURE SCOPE

The cracks developing reinforced concrete members extend freely until encountering a reinforcing bar . We need arrest the cracks to increase the life of structures. The need of multi directional and closely spaced reinforcement for concrete arises here.... Fiber reinforced concrete FRC is a concrete mis that contains short discrete fibers they are uniformly distributed. The fibers are classified into four types mainly such as steel,glass, synthetic and natural. Orientation of these fibers are commonly in random.
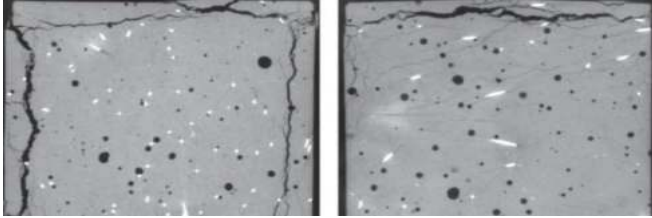
XIII Acknowledgment

We would like to express our gratitude to all the individuals and organizations who have contributed to the successful completion of the study of Glass and Steel Fibre in concrete project. We extend our thanks to the research advisors and mentors for their guidance and support throughout the project. We are grateful for the resources and facilities provided by our institution, which facilitated the implementation and testing process. We also acknowledge the invaluable assistance from fellow team members who collaborated on various aspects of the project. Lastly, we appreciate the participants who provided feedback and support during the testing phase.

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The For studing the project we reffered some reference papers on internet.

We visited Wikipedia site.

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Advancing Sustainability: Challenges and Opportunities in Environmental Studies for Sustainable Development

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Abstract

Sustainability and environmental studies have become crucial fields of research due to the escalating environmental challenges faced globally, such as climate change, resource depletion, and biodiversity loss. This field integrates multidisciplinary approaches to understand and mitigate the impact of human activities on the environment while promoting sustainable practices. Key areas of focus include renewable energy, waste management, conservation of natural resources, and sustainable development policies, all aimed at reducing environmental footprints and fostering resilience in natural and human systems. Environmental studies explore the complex interactions between the natural world and human societies, seeking solutions that balance ecological integrity with social and economic needs. Through this lens, sustainability aims to meet the present needs without compromising the ability of future generations to meet their own, emphasizing a balance between environmental, economic, and social well-being. Recent advancements in sustainability research have highlighted the importance of innovative technologies, community engagement, and policy interventions as vital components of achieving long-term environmental goals. This study aims to explore the key challenges and opportunities in sustainability and environmental studies, with a focus on assessing current practices and proposing actionable strategies for enhancing environmental stewardship. By examining case studies and recent data, this research seeks to provide insights into effective sustainability practices that can be implemented at both local and global scales, contributing to the broader goal of preserving the planet for future generations.

Keywords: Sustainability, environmental studies, climate change, resource management, sustainable development.

1. Introduction

In recent decades, growing environmental problems including resource depletion, biodiversity loss, and climate change have made sustainability one of the most important global concerns (Shivanna, 2022). By studying the intricate relationships that exist between human activity and the natural world, environmental studies are essential in tackling these problems. In order to create policies that support sustainable development, these studies employ a multidisciplinary approach that integrates disciplines including ecology, economics, and social sciences (Raatikainen et al., 2024). The need to strike a balance between current demands and the obligation to protect the environment for future generations is what makes sustainability so urgent. Environmental studies, in this context, provide important insights into how societies might minimise their ecological footprints while promoting social and economic well-being (Fallah Shayan etr al., 2022).

The establishment of sustainable policies, efficient waste management, the preservation of natural resources, and renewable energy sources are important fields of study in environmental studies (Zhang and Wen, 2008). The goal of these priority areas is to lessen the negative effects that urbanisation, industrialisation, and other human activities have on ecosystems. With new technologies and regulations playing crucial roles in encouraging resilience in both natural and human systems, the area of sustainability has advanced rapidly as the world community grows more conscious of environmental deterioration (Hui et al., 2023). The primary goals of this review paper are to examine the main obstacles and possibilities in environmental studies and sustainability (Parmentola et al., 2022). The article aims to give a thorough review of the tactics that may be used to improve environmental stewardship by evaluating the state of the art and investigating new research developments. The paper will emphasise the vital role that community involvement, legislative changes, and cutting-edge technology play in accomplishing long-term sustainability objectives. The ultimate goal of this analysis is to pinpoint practical solutions for urgent environmental problems that may be implemented both locally and globally, fostering a more resilient and sustainable future.

2. Multidisciplinary Approaches to Sustainability

Sustainability is an inevitably complex subject that requires input from a variety of disciplines to adequately comprehend and handle (Shrivastava et al., 2020). Environmental studies have emerged as a key area by combining information from natural sciences, social sciences, economics, and policy analysis to provide a multidisciplinary framework for tackling contemporary environmental concerns. The integration of these varied sectors is required

because sustainability is more than just safeguarding ecosystems; it is also about balancing human needs, socioeconomic progress, and environmental preservation (Halla et al., 2020). Ecology, biology, and earth sciences are examples of natural disciplines that shed light on how ecosystems, biodiversity, and the physical environment work. These sciences aid in our comprehension of the effects that human actions—such as resource exploitation, pollution, and deforestation—have on natural systems (Marselle et al., 2020). Natural sciences investigate these relationships to provide insights into methods for reducing adverse environmental effects via restoration, conservation, and sustainable resource management (Mondal and Palit. 2022). Conversely, social sciences aid in comprehending the human aspects of sustainability, including the ways in which economic institutions, cultural norms, and society behaviours affect environmental results (Shah et al., 2021). Interactions between humans and their environment are studied by sociologists, economists, and political scientists. They look at how social equality concerns, policy frameworks, and consumer patterns affect sustainability initiatives (Longo et al., 2021). They also look at how community involvement, global collaboration, and governance fit into the process of putting environmental policy into practice. Interdisciplinary cooperation has shown to be crucial in recent years for tackling the urgent sustainability issues, particularly those brought on by global phenomena like resource depletion and climate change. For instance, the success of renewable energy technologies depends not only on technological and engineering breakthroughs but also on public acceptability and policy decisions, which are crucial domains for social scientists and politicians to intervene in (Hertel, 2021). Likewise, economic models that account for environmental costs have surfaced, offering a more comprehensive understanding of sustainability (Meraj et al., 2021).

Through the integration of knowledge from the scientific and social sciences, environmental studies can provide more thorough answers to sustainability-related problems. By utilising a multidisciplinary approach, sustainability strategies are guaranteed to take into consideration the social and economic requirements of human populations in addition to the ecological integrity of the globe (Liu et al., 2022).

3. Key Areas of Focus in Environmental Studies

Achieving sustainability requires addressing a number of crucial issues that are covered in environmental studies. Among them, policies for sustainable development, waste management, renewable energy, and the preservation of natural resources are especially crucial because of their substantial effects on lowering environmental footprints and fostering resilience (Muniz et al., 2023). Since switching from fossil fuels to sustainable energy sources is essential for

halting climate change, renewable energy is the main subject of environmental studies. The utilisation of geothermal, wind, hydropower, and solar energy as substitutes for conventional energy sources—which are significant contributors to greenhouse gas emissions—is growing in research and application (Paraschiv and Paraschiv, 2023). In order to ensure that future energy demands may be satisfied without causing more environmental harm, research into enhancing energy efficiency, storage, and distribution networks is essential. Another important issue that calls for creative solutions is waste management (Jaiswal et al., 2022). The current waste management systems are under pressure due to the surge in garbage generation caused by rapid industrialisation and population development. Environmental studies concentrate on the idea of the circular economy, which minimises waste by reusing, recycling, and consuming less resources. Techniques for managing garbage sustainably are increasingly reliant on technologies that improve waste sorting, composting, and energy recovery from waste (Velvizhi et al., 2020).

Protecting vital ecosystems—including wetlands, forests, and oceans—that offer vital services like carbon sequestration, water purification, and homes for biodiversity is known as conservation of natural resources. Ecological deterioration over an extended period of time can result from overexploitation of resources including minerals, freshwater, and lumber. In order to stop the depletion of resources and save these ecosystems, environmental studies investigate sustainable techniques such as ethical mining, water conservation, and sustainable agriculture 9 Chu et al., 2017). Lastly, the incorporation of environmental concerns into national and international governance frameworks depends on sustainable development policies. In order to create international agreements, rules, and regulations that promote sustainable behaviours, policymakers collaborate closely with environmental scientists (Azizi et al., 2017). Policies for climate adaption, conservation efforts, and carbon pricing are a few examples. By enforcing these regulations, development objectives are realised without endangering the health of the environment or the availability of future resources (Bhattacharya et al., 2021).

4. Challenges in Achieving Sustainability

Maintaining sustainability is fraught with difficulties due to the interdependence of the social, economic, and environmental systems. Even while the development of sustainable practices and technology has advanced significantly, there are still a number of major roadblocks (Javanmardi et al., 2023). Mitigation of climate change, resource depletion, loss of biodiversity, and the difficulty of striking a balance between ecological integrity and socioeconomic requirements are some of these problems (Shukla et al., 2021).

Changes in Climate Adaptation and mitigation are two of the most urgent issues. Ecosystems and human populations are both impacted by the acceleration of environmental deterioration caused by climate change (Abbass et al., 2022). The Paris Accord and other international agreements notwithstanding, attempts to cut carbon emissions have been patchy. Many nations find it difficult to make the switch to renewable energy, especially those that depend on fossil fuels. Mitigation measures are further complicated by the sluggish pace of global collaboration and the uneven effects of climate change on underdeveloped countries (Santos et al., 2022). Building climate-resilient infrastructure is one example of an adaptation strategy that frequently necessitates large financial investments, which many governments cannot afford (Hallegatte et al., 2022).

Consumption of resources is yet another significant issue. The demand for natural resources like water, minerals, and fossil fuels rises in tandem with human growth. Deforestation, water shortages, and the loss of vital non-renewable resources are the results of overexploitation (Wang and Azam, 2024). In many places, inadequate governance and economic pressures impede sustainable resource management, leading to unsustainable practices that worsen environmental deterioration. Sustainability initiatives are further complicated by biodiversity loss. Unprecedented rates of species extinction are being caused by pollution, climate change, and habitat devastation. Ecosystems become less resilient to environmental changes and lose vital functions like pollination, water filtering, and carbon storage when biodiversity is lost (Hariram et al., 2023). Coordinated actions are needed to protect biodiversity on a local and global scale. These actions include promoting sustainable land-use practices, reducing pollution, and preserving habitat (Hoffmann, 2022).

Among all the challenges, balancing ecological, social, and economic needs is arguably the biggest. Environmental conservation is important, but it also needs to take social justice and economic growth into account (Hariram et al., 2023). Communities and industries may incur short-term expenses as a result of the shift to sustainable practices, especially in the energy and agricultural sectors. In order to achieve sustainability, these trade-offs must be addressed by encouraging creative solutions that advance social progress and economic growth while achieving ecological goals (Agrawal et al., 2024).

5. Opportunities for Advancing Sustainability

Although attaining sustainability presents considerable obstacles, there exist a plethora of prospects that provide avenues for advancement. Promising pathways to promote environmental resilience and sustainability include technological advancements, legislative

interventions, community participation, and international collaboration. Innovations in technology have the power to revolutionise environmental initiatives (Dwivedi et al., 2022). Reducing dependency on fossil fuels is becoming simpler and more affordable because to advancements in renewable energy technology, such as better wind turbines, solar panels, and energy storage devices. Furthermore, advancements in fields like smart cities, green infrastructure, and precision agriculture are reducing resource use and increasing efficiency (Ang et al., 2022). Monitoring and mitigating environmental consequences is being made easier by emerging technologies like bioengineering, artificial intelligence (AI), and carbon capture and storage (CCS). By facilitating more intelligent decision-making, these technologies help society minimise their environmental impact while sustaining development and productivity. Policy Interventions and Governance are critical for creating the legal and institutional frameworks that encourage sustainable practices (Hasan et al., 2022; Liu et al., 2022). Governments play a key role in promoting sustainability by implementing regulations and incentives that drive environmental protection. Examples include carbon pricing, emissions trading schemes, and subsidies for renewable energy adoption. Strong governance is also necessary to enforce environmental standards, combat illegal resource extraction, and manage protected areas effectively (Olujobi et al., 2023). Well-designed policies can catalyze private sector innovation and public participation in sustainability efforts, encouraging businesses and individuals to adopt greener practices. There is a lot of opportunity for community engagement and awareness to motivate regional sustainability projects (Castelblanco and Guevara, 2022). Environmental education, citizen science initiatives, and grassroots movements have all shown to be successful in increasing public knowledge of sustainability-related concerns. Including local populations in waste reduction, sustainable agriculture, and conservation projects promotes a sustainable culture from the ground up. Giving communities the tools they need to take charge of environmental stewardship encourages long-term behavioural changes that advance larger sustainability objectives (Hariram et al., 2023).

Addressing global environmental issues that cut beyond national boundaries, such climate change, ocean conservation, and biodiversity preservation, requires international cooperation. Frameworks for collective action are provided by multilateral accords such as the Convention on Biological Diversity and the Paris Accord (Ekardt et al., 2022). Through the exchange of information, materials, and optimal methodologies, nations may collaborate to accomplish shared sustainability goals, propelling ecological responsibility worldwide (Marín-González et al., 2022).

6. Conclusion

In summary, one of the most important issues of our day is pursuing sustainability, which calls for an all-encompassing strategy that incorporates social, economic, and environmental factors. As this research has shown, environmental studies provides vital frameworks and insights that may help steer the shift to sustainable practices. Nevertheless, achieving these objectives calls for coordinated efforts from several sectors and specialities.

The issues noted—such as biodiversity loss, resource depletion, and climate change—highlight the pressing need for practical solutions that might lessen these risks. Technological advancements provide important chances to lessen human influences on the environment, such as waste management programs and renewable energy systems. In addition, the establishment of institutional and legal frameworks necessary to promote sustainable development depends on policy interventions and governance structures. These initiatives may be strengthened by involving communities and supporting grassroots movements, which will help to establish a sustainable culture that is popular locally.

Furthermore, as many environmental concerns are global in nature, international collaboration is essential. It is possible to ensure that best practices are shared internationally by facilitating information exchange and resource allocation through multilateral agreements and cooperative initiatives. Together, nations can address problems that are bigger than any one country's capabilities, promoting sustainability and resilience everywhere.

A path for expanding sustainability activities is provided by the practical solutions included in this assessment, which include strengthening long-term resilience, scaling sustainable practices, and improving environmental stewardship. In light of the global environmental challenges that are intensifying, it is critical to maintain flexibility and an open mind to novel concepts and methods. Societies can manage the intricacies of sustainability while guaranteeing a healthy and fair world for future generations by adopting creative solutions and incorporating various viewpoints. The dedication to sustainability is ultimately essential for the health of our planet and all living things on it, not only as a matter of personal preference. We can build a sustainable society that satisfies current needs without jeopardising the prospects for future generations to prosper by working together, being innovative, and having a common vision for the future.

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Machine Design and Mechanical System Design, Analysis

Machine Design and Mechanical System Design, Analysis

Development of the Chain link Fencing Machine

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Abstract— **For ages it has been a common practice to mark/designate one's property by fencing around it. As the time changed so did the techniques involved in fencing. In early age the fences used to be of stones. A century ago the fencing was dominated by use of steel and wood. In modern times though, there are many fencing techniques available which can be implied as per the requirement. Of many such techniques a well-known and diversely implied one is the chain link fencing. Its implication can be found at borders, alongside the highways, in industrial production lines and for domestic purpose. It was the industrial revolution that influenced the production of chain link fencing machines, the inspiration was taken from clothweaving machine. For production of chain link fencing the manual, semi-automatic and automatic machines are used. The machine under development is focuses on small scale business model and at places were instant fencing is required.**

Keywords—fencing, safety, chain link, machine

I. INTRODUCTION (*HEADING 1*)

In areas with low power supplies and hard for transportation, like areas near LOC. The fencing are needed near LOC from time to time. The machine working on low power supply will help producing fence in difficult situations also. Since machine is also manually operated, in the situations without electricity, fences will be produced without any stoppage. We often see chain link fences around sports grounds, especially in outdoor sports grounds, like cricket. Motorsports is one of the sports which needs chain link fences the most. It is most likely to have accidents on track and destroy fencing. Marshals need to repair the fencings immediately. The machine is small in size and also consumes less power to operate so it can be placed in any corner of the building and operate. Small scale businesses can also use the machine to produce fences and sell the product separately. The operating cost is very low as it consumes less electricity; also the maintenance is low which fulfils the purpose of the machine. To understand the basic principal of the our project Describe the construction and working of various parts of our project Development of the working model of the our project To reduce time spent on this activity. To analyse the technology according to needs and capabilities. Problem Definition In the Hand operated chain link fencing machine is more time consuming and more labour is required due to cost of process increase. Using the Hand operated chain link fencing machine more fatigue of workers. To cut down the cost employed using motorized operation. Decreasing the operational cost by further introducing new solar power chain link fencing mechanisms. To decrease labour costs by advancing the motorized operation of machine. To consume low electricity solar power. introduction should give you a foundational understanding of roll marking manual mechanics and its application in various industries.

II. LITERATURE REVIEW

There is a need to better understand how wire quality affects the manufacturing of fences because (1) To avoid wire strand breakage (2) To avoid subsequent field erection. For this a series tests of wire quality that can be conducted by fence producers for physical and metallurgical properties were administered, this six potential test were i) Tensile strength ii) Ductility iii)Three point bending iv)Impact energy v) Linear torsional conductivity vi) Micro-hardness. The various tests of GI were conducted the data then statistically examined and compared. It was found that linear torsional conductivity is the most sensitive and reliable indicator of wire quality. Generally for fencing GI (galvanized iron) wire is used. It is a zinc coated iron wire used for applications that demand longevity zinc carbon should be uniform adherent, reasonably smooth and free from impurity. More recently the technology has increased in performance and functionality for a typical modern machine. Now they have a high degree of electrical-mechanical- electronic integration so wire strand breakage has reduced but the wire quality definitely affects the efficiency of machine and hence it affects the production of fencing. Another test conducted for the testing of wire quality is the wire wrap test, the existing wire wrap test simply involves wrapping the wire into a coil, and the LTD builds on this foundation. The innovative component in the LTD test is that the resulting wrap specimen is subsequently elongated in spring tension, e.g. In a tensile testing machine, whereas the plain wrap-test is single-direction application of plastic-ductility, the LTD test applies an additional torsion stress after the work hardening episode. Once a spring is formed, the test is easily conducted in any tensile testing system, or indeed in any system (e.g. hydraulic puller) that can stretch the coil. It is important to note that the test only measures the length of the specimen: the actual force is not required. So a laboratory tensile testing machine is unnecessary. A fence is a arrangement that encircles a space, typically exterior, and is usually created from posts that are connected by panels, wire, railings or mesh. A fence varies from a wall is not having a rock solid foundation along its entire span. A chain-link fences usually made from galvanized steel wire. The manufacturing of chain-link fencing is called weaving. A metal wire frequently galvanized to reduce corrosion, is pulled along a rotating long and flat blade, thus making a somewhat flattened

spiral. The spiral continuously rotate passing the blade and winds it through the previous spiral that is part of the produced fence. When the spiral reaches the distant end of the fence, the spiral is cut near the blade. Then the spiral is pressed flat and the whole fence is moved up and ready for the next cycle. The end of each second spiral joins the end of each first spiral. The machine clamps both ends and gives them a few twists. This makes the links permanent. An enhanced version of the weaving machine winds two wires around the blade at once, thus creating a double helix. One of the spirals is woven through the last spiral that is part of the already produced fence. This progress allows the process to advance twice as fast. Fences can be defined as structures serving as an enclosure, a barrier, or a boundary, usually made of posts or stakes joined together by boards, wire, or rails. In contrast, a "virtual fence" can also serve as an enclosure, a barrier, or a boundary, but that relies on other than physical objects on the landscape to alter an animals" behavior. The concept of virtual fencing occurs increasingly in discussions of those whose job it is to manage Free-ranging animals; this includes stockpersons, scientists and nature conservationists. Therefore, a patent and literature search was conducted to investigate the topic of virtual fencing. The term virtual fence seems to be used in a very broad sense and different concepts of its application exist. However, they all have in common the fact that the system uses no physical barrier on the landscape. Therefore, a virtual fence can be defined as a structure serving as an enclosure, a barrier, or a boundary without a physical barrier. Knotted wire fences are used throughout the world for retention of livestock. Other types of wire fencing include single strands, diamond (chain link), welded mesh and hexagonal mesh (chicken mesh). However the subject of the present paper is only rectangular knotted mesh, with a particular emphasis on the production thereof. As an agricultural product, the primary body of knowledge on fencing has historically resided in national standards, e.g. , with a particular focus on the geometric parameters of the fence and the coatings. The corrosion resistance of wire fences in exposed environments has been of interest for many years and still continues to be an area of research as material science has made newer coatings available. D. Pons, G. Bayley, R. Laurenson, M. Hunt, C. Tyree, D. Aitchison carried out research on "Wire Fencing: Determinants of Wire Quality" in this they studied about Knotted wire fences which are fabricated on specialized machines. The input material is typically galvanized steel wire. However, the quality of the input wire used by the Fence Producer is beyond control of the Machine Manufacturer. In this problem is that wire strand breakages have been identifiedduring fabrication and subsequent field erection. [1] Dirk J. Pons, Gareth Bayley, Christopher Tyree, Matthew Hunt and Reuben Laurenson Aitchison carried out research on "Material Properties of Wire for the Fabrication of Knotted Fences" in this they studied about the materials properties of galvanized fencing wire, as used in the fabrication of knotted wire fences. A range of physical properties was inspected: tensile strength, ductility in tension, Young's modulus, three point bending, and bending span. [2] Sebastian Balos , Vencislav Grabulov, Leposava Sidjanin, Mladen Pantic carried out research on "wire fence asapplique armour"in this they studied about the behaviour of wire fence. In this wire fences used was made from commercial high-strength patented wire and the supportingframes were made of mild steel L-profile were tested. [3] Nurudeen A. Raji, Oluleke O. Oluwole carried out research on "Influence of Degree of Cold-Drawing on the

Mechanical Properties of Low Carbon Steel" in thisthey studied about the Influence of Degree of Cold-Drawing on the Mechanical Properties of Low Carbon Steel. A 0.12%w C steel wire cold drawn progressively by 20%, 25%, 40% and 50% was checked. The influence of the degree of cold drawing on the mechanical properties of the carbon steel material were studied using the tensile test, impact test and hardness test experiments in order to replicate the service condition of the nails.[4] Arshpreet Singh, Anupam Agrawal was studied about Comparison of deforming forces, residual stresses and geometrical accuracy of deformation machining with conventional bending and forming in this they studied about the Deformation machining. Deformation machining is a combination of thin structure machining and single point incremental forming/bending. [5] Junichiro Tokutomia,, Kenichi Hanazaki, Nobuhiro Tsuji , Jun Yanagimoto carried out research on Change in mechanical properties of fine copper wire manufactured by continuous rotary draw bending process in this they studied about The mechanical behaviors of Cu–Sn alloy wire specimens processed by the newly proposed method of rotary draw bending are systematically investigated, It was found that during draw bending, the Vicker hardness(HV) was lower than that of the specimen subjected to wire drawing, particularly on the inside of the bend, and it was confirmed that the softening induced by plastic deformation is promoted by increasing the compressive residual energy.[6] Christina Umstatter carried out research on "The evolution of virtual fences "in this they studied about virtual fences. A virtual fence can be defined as a structure serving as an enclosure, a barrier, or a boundary without a physical barrier. [7] Siavash Rezazadeh and Jonathan W. Hurst carried out research on the Optimal Selection of Motors and Transmissions for Electromechanical and Robotic Systems With regard to the important role of motors and transmissions in the performance of electromechanical and robotic systems, this paper intends to provide a solution for the problem of selection of these components for a general load case.

III. WORKING

When the DC geared motor is powered it rotates thus rotating the rectangular rod attached to its shaft. Now this rectangular rod is fixed to rotate inside a hollow round tube. Milling operation is performed on this tube to achieve a spiral shaped cut out on this hollow tube. • So Now as the rectangular rod rotates inside this hollow tube. We now take the wire end from the bobbin and hook it on the inside rod through the hollow tube slot. We now turn on the machine. As the motor runs, the rod turns inside the hollow tube. As the hollow tube is cut out in a spiral shape, the wire moves with the rod spiralling around it and moving outwards. • So now we get a zig-zag shaped wire coming out of the other end. Thus the system provides a fast and easy way to develop zigzag wires for chain link or mesh making. Project design may be defined as the iterative decision making activity to create a plan or plans by which the available resources are converted, preferably optimally, into systems, processes or devices to perform the desired functions and to meet human needs. In fact project design has been defined in many ways but the simplest ways to define project design as "An iterative decision making process to conceive and implement optimum systems to solve society's problems and needs." Project design is practical in nature and must be concerned with physical reliability, or economic and financial feasibility Design is essentially a decision-making process. If we have a

problem, we need to design a solution. In other words, to design is to formulate a plan to satisfy a particular need and to create something with a physical reality. Decision-making comes in every stage of design. Consider two cars of different makes. They may both be reasonable cars and serve the same purpose but the designs are different. The designers consider different factors and come to certain conclusions leading to an optimum design. Market survey gives an indication of what people want. Existing norms play an important role. Once a critical decision is made, the rest of the design features follow. For example, once we decide the engine capacity, the shape and size, then the subsequent course of the design would follow.
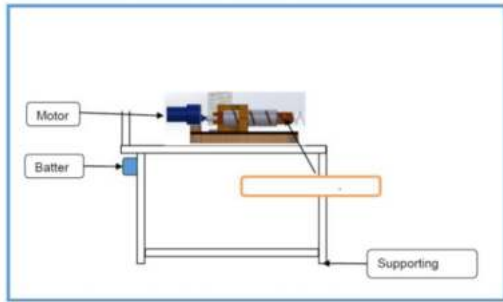
Figure 1: Diagram of the project

In the very first step a complete list of specifications for the functional requirement of the product is to be prepared. The requirement may include, for example: (a) Output capacity; (b) Service life; (c) Cost; (d) Reliability; etc. In consumer products, in addition appearance, noiseless operation, and simplicity in control are important requirements. Depending upon the type of product, various requirements are given Weight age and a priority list of specifications is prepared. After a careful study of the requirements the designer prepares rough sketches of different possible mechanisms of project and depending upon the cost competitiveness, availability of raw material, and manufacturing facilities, the possible mechanisms are compared with each other and the designer selects the best possible mechanism for the product. In the third step of the design procedure a block diagram is to be prepared which showing the general layout of the selected configuration. In this step designer specifies the joining methods, such as riveting, bolting, and welding to connect the individual components. Rough sketches of shapes of individual parts are prepared. After selecting the required or deciding the configuration of mechanism /project in third step above. The design of individual components of the selected configuration is to be done in this step. It consists of the following stages: Determine the forces acting on each component; selecting the proper material for the component depending upon the functional requirement, such as strength, wear, rigidity, hardness and bearing properties etc. Determine the likely mode of failure & select the criterion of failure like, yield strength, ultimate strength, deflection etc. Determine the geometric dimensions of the components using suitable factor of safety and modify the dimensions from manufacturing considerations. This stage involves the detailed stress analysis. The last stage in design process is to prepare the blue prints of assembly and individual component. On these drawings, the material of the components, dimensions and tolerances, surface finish and machining methods are specified.

IV. RESULTS AND DISCUSSION

Measurement is the foundation of scientific inquiry. In order to test our hypotheses, wemust observe our theoretical concepts at the operational level. In simple words, wemust measure what we have defined. But there are different levels of measurement, which provide differing amounts of information about the theoretical construct. There are also some basicissues about the adequacy of measurement which we must address. Cutting processes work by causing fracture of the material that is processed.

Usually, the portion that is fractured away is in small sized pieces, called chips. Common cutting processes include sawing, shaping (or planning), broaching, drilling, grinding, turning and milling. Although the actual machines, tools and processes for cutting look very different from each other, the basic mechanism for causing the fracture can be understood by just a simple model called for orthogonal cutting. In all machining processes, the work pieceis a shape that can entirely cover the final part shape. The objective is to cut away the excess material and obtain the final part. This cutting usually requires to be completed in several steps – in each step, the part is held in a fixture, and the exposed portion can be accessed by the tool to machine in that portion. Common fixtures include vise, clamps, 3-jaw or 4-jaw chucks, etc. Each position of holding the part is called a setup. One or more cutting operations may be performed, using one or more cutting tools, in each setup. To switch from one setup to the next, we must release the part from the previous fixture, change the fixture on the machine, clamp the part in the new position on the new fixture, set the coordinates of the machine tool with respect to the new location of the part, and finally start the machining operations for this setup. Therefore, setup changes are time-consuming and expensive, and so we should try to do the entire cutting process in a minimum number of setups; the task of determining the sequence of the individual operations, grouping them into (a minimum number of) setups, and determination of the fixture used for each setup, is called process planning.

Turning is a cutting operation in which the part is rotated as the tool is held against it on a machine called a lathe. The raw stock that is used on a lathe is usually cylindrical, and the parts that are machined on it are rotational parts – mathematically, each surface machined on a lathe is a surface of revolution .Machining is an essential process of finishing by which work pieces are produced to the desired dimensions and surface finish by gradually removing the excess material from the preformed blank in the form of chips with the help of cutting tool(s) moved past the work surface(s).Most of the engineering components such as gears, bearings, clutches, tools, screws and nuts etc. need dimensional and form accuracy and good surface finish for serving their purposes. Performing like casting, forging etc. generally cannot provide the desired accuracy and finish. For that such preformed parts, called blanks, need semi-finishing and finishing and it is done by machining and grinding.

These four methods all produce holes of different types. Drilling produces round holes of different types; reaming is used to improve the dimensional tolerance on a drilled hole; boring uses a special machine operating like a lathe, to cut high precision holes; and tapping creates screw-threads in drilled holes. Drilling: The geometry of the common twist drill tool (called drill bit) is complex; it has straight cutting teeth at the bottom –these teeth do most of the metal cutting, and it has

curved cutting teeth along its cylindrical surface. The grooves created by the helical teeth are called flutes, and are useful in pushing the chips out from the hole as it is being machined. Clearly, the velocity of the tip of the drill is zero, and so this region of the tool cannot do much cutting. Therefore it is common to machine a small hole in the material, called a center-hole, before utilizing the drill. Center-holes are made by special drills called center-drills; they also provide a good way for the drill bit to get aligned with the location of the center of the hole. There are hundreds of different types of drill shapes and sizes; here, we will only restrict ourselves to some general facts about drills.

Welding is a process for joining two similar or dissimilar metals by fusion. It joins different metals/alloys, with or without the application of pressure and with or without the use of filler metal. The fusion of metal takes place by means of heat. The heat may be generated either from combustion of gases, electric arc, electric resistance or by chemical reaction. During some type of welding processes, pressure may also be employed, but this is not an essential requirement for all welding processes. Welding provides a permanent joint but it normally affects the metallurgy of the components. It is therefore usually accompanied by post weld heat treatment for most of the critical components. The welding is widely used as a fabrication and repairing process in industries. Some of the typical applications of welding include the fabrication of ships, pressure vessels, automobile bodies, off-shore platform, bridges, welded pipes, sealing of nuclear fuel and explosives, etc. Most of the metals and alloys can be welded by one type of welding process or the other.

There are several types of grinding machines. The main ones are surface grinders, grinding wheels, cylindrical grinders and center less grinders. The figure below shows examples of a few of these. Surface grinders produce flat surfaces. The part is held on the flat table (steel parts can be held by a magnetic force – this is called magnetic chucking). The table moves in a reciprocating motion, and the rotating wheel is lowered so that it just scrapes along the surface.

To improve dimension control on cylindrical parts, center less grinders, which use long cylindrical wheels, are employed. The axis of the regulating wheel and grinding wheel are slightly misaligned, causing the part to travel slowly in the axial direction, and after some time, the part automatically moves beyond the length of the wheel. Controlling the angle of misalignment can control the time that the part is subjected to grinding. If a turned part of complex shape (e.g. stepped shafts) are to be ground, then cylindrical grinding is used, which employs specially made grinding wheels, whose profile fits the profile of the part to be ground.

V. CONCLUSIONS

It is observed that, this model of development of the chain link fencing machine is more cost effective and gives the effective results in meshing operation. As it runs on the non-conventional energy source i.e. solar energy, it is widely available at free of cost. In now days where world is moving towards the finding the new ways for the energy requirement, it can be a better option, who economically challenged and facing electrical problem like load shading now days.

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ROLL MARKING MACHINE

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Abstract— **This study introduces a manual roll marking machine designed for precision marking of parts in industrial settings. The machine features a manual hand crank mechanism that drives the marking head along the work piece, allowing for controlled and accurate marking of part numbers, logos, and other identification information on various materials such as metal, plastic, and more. The design includes a durable marking head with adjustable depth settings and interchangeable stylus tips to accommodate different marking requirements. The manual operation offers operators flexibility and control over the marking process, enabling them to achieve consistent and high-quality marks. Safety features such as guards and ergonomic handle design are incorporated to ensure operator safety and comfort during use. The manual roll marking machine provides a cost-effective and reliable solution for industrial marking applications, offering ease of use and versatility for a wide range of marking tasks.**

Keywords—precision, safety, flexibility, marking

I. INTRODUCTION (*HEADING 1*)

A roll marking machine is basically made for marking letters or numbers on cylindrical (hollow or solid) components. A roll marking machine uses basic principle of Rack & Pinion. Here pinion (i.e job or push rod) is kept stationary and rack (i.e punch holder) is reciprocated over pinion surface. A roll marking machine has a guide bar on which the entire slide assembly reciprocate. A dovetail slide is provided to raise or lower punch holder by means of a screw and a graduated thimble. A screw is having standard metric threads having 1mm pitch. The least count of thimble is 0.025mm. A brass bush is provided inside the bush housing for good bearing properties. A roll marking machine uses a caddie to support to the component which is to be marked. Cradle consists of a four antifriction bearing whose inner race is fixed & outer race rotates along with component. A stopper is provided so that the distance of marking from one end can be controlled and can also be changed. A roll marking machine is provided with a lever to move the slide assembly. The lever is adjusted to vertically by loosening the grub screw to change the arm movement (i.e force) Roll marking in manual mechanics is a process used to imprint or emboss information onto a workpiece through the use of a rolling action. This method is particularly useful for marking cylindrical objects or parts. Roll marking is a marking method that uses a roll die mounted on a press or lathe. The die is circular, and as it rolls over the marking surface, it leaves a

permanent impression. This method is ideal for delicate surfaces where other marking methods might cause damage. Roll Marking Basics: Mechanism: It involves a rolling die that presses against the part's surface, transferring the engraved pattern or text from the die onto the material. Materials: Suitable for metals and hard plastics, where permanent marking is required. Applications: Commonly used for serial numbers, product codes, logos, and other identification marks. Manual Roll Marking Process: Preparation: The workpiece is secured, and the rolling die is set up with the desired information. Alignment: The die is aligned with the marking area on the part. Pressure Application: A manual force is applied, either by hand or with a lever, to roll the die across the surface, creating the mark. Inspection: The quality of the mark is inspected for clarity and accuracy. Advantages of Manual Roll Marking: Cost-Effective: Lower initial investment compared to automated systems. Flexibility: Can be used for small production runs or individual parts. Portability: Manual systems are typically more portable than their automated counterparts. Considerations: Skill Level: Requires a skilled operator to ensure consistent quality. Physical Effort: Manual operation can be physically demanding, especially for large production volumes. Precision: While effective, it may not achieve the same level of precision as automated roll marking systems. This introduction should give you a foundational understanding of roll marking manual mechanics and its application in various industries.

II. LITERATURE REVIEW

Historical Development: Explore the historical development of roll marking machines, including when and how they were first introduced, key innovations over time, and how they have evolved to meet changing industry needs.

Types of Roll Marking Machines: Identify different types of roll marking machines available in the market, such as manual roll marking machines, pneumatic roll marking machines, and CNC roll marking machines. Compare their features, capabilities, and applications.

Working Principles: Discuss the working principles of roll marking machines, including how they apply pressure to create marks on parts, the role of marking tools and dies, and any unique mechanisms or technologies used in different types of roll marking machines.

Applications: Review the various industries and applications where roll marking machines are commonly used, such as automotive, aerospace, metal fabrication, and more. Highlight specific case studies or examples of successful roll marking applications.

Benefits and Limitations: Evaluate the benefits of using roll marking machines, such as their ability to create permanent, high-quality marks, their versatility in marking different materials, and their cost-effectiveness for low-volume production. Also, discuss any limitations or challenges associated with using roll marking machines. 6. Comparative Analysis: Compare roll marking machines with other marking methods, such as laser marking, dot peen marking, or engraving. Highlight the advantages and disadvantages of each method in terms of speed, precision, versatility, and cost.

A. *Maintaining the Integrity of the Specifications*

The template is used to format your paper and style the text. All margins, column widths, line spaces, and text fonts are prescribed; please do not alter them. You may note peculiarities. For example, the head margin in this template measures proportionately more than is customary. This measurement and others are deliberate, using specifications that anticipate your paper as one part of the entire proceedings, and not as an independent document. Please do not revise any of the current designations.

III. WORKING

The operation principle of roll marking manual mechanics involves a few key steps and components that work together to create a permanent mark on a work piece. Here's a breakdown of the process: Die Design: The information to be marked is crafted onto a roll die. This die is typically made of hardened steel to withstand the pressure of marking. Work piece Placement: The work piece that needs to be marked is placed in position, either held by hand or secured in a fixture. Die Alignment: The roll die is aligned with the area on the work piece where the mark is to be made. Pressure Application: A manual force is applied to the die, either through a lever or a hand-operated press. As the die rolls over the work piece, the engraved information is transferred onto the material. Mark Inspection: After the rolling process, the quality of the mark is inspected to ensure it meets the required standards. Working Sequence:- Designing the Roll Die: The information to be marked is engraved onto a roll die, which is typically made of hardened tool steel to resist wear and deformation. Setting Up the Work piece: The work piece is securely placed in the marking machine, ensuring it's properly aligned with the roll die. Applying the Mark: The operator manually applies force to the die, causing it to roll over the work piece's surface. As the die rolls, it imprints the engraved information onto the material. Inspecting the Mark: After marking, the work piece is inspected to ensure the mark is clear, accurate, and properly positioned. Post-Marking Processes: Any necessary post-marking processes, such as cleaning or further machining, are performed on the marked work piece. 1. Setup: The operator positions the part to be marked on the machine's marking platform or fixture. The part is typically secured in place to ensure it does not move during the marking process. 2. Selection of Marking Tool: The operator selects the appropriate marking tool or die based on the desired mark to be made. This could be a hardened steel stamp, carbide insert, or other type of marking tool depending

on the material and marking requirements. 3. Alignment: The operator aligns the marking tool with the surface of the part to ensure that the mark is applied accurately and consistently. 4. Application of Pressure: Using a lever or hand crank, the operator manually applies pressure to the marking tool, pressing it against the surface of the part. The amount of pressure applied determines the depth and clarity of the mark. 5. Rolling Action: In a manual roll-marking machine, the operator may also need to manually rotate or move the marking tool along the surface of the part to create a continuous or sequential mark. This rolling action helps ensure that the mark is evenly applied around cylindrical or curved surfaces. 6. Quality Check: After applying the mark, the operator inspects the quality of the mark to ensure it meets the required specifications in terms of depth, clarity, and alignment. 7. Repeat Process: If multiple marks need to be made on different parts, the operator can repeat the process by repositioning each part on the machine and applying pressure with the marking tool.

A. HARDWARE IMPLEMENTATION

The base plate acts as an interface between the superstructure and the foundation; thus, completing the load path into the foundation. Base plates help provide a uniform distribution of superstructure loads to the foundation, and therefore conform to the shape of the foundation, typically a square or a rectangle. this base plate material is mild Steel because MS sheets are excellent quality, strong completion models, climate obstruction and high rigidity. These collections are generally acclaimed by our customers. We can provide these mild steel sheets in different grades, length, thickness and weight as per the customer requirements which are used for the construction of buildings or other structures. Quantity of base plat ;- 01 NO Size :- 320 X75 X 5 MM Material type :- M.S.

Figure 1: Base Plate

Side Column:- The double column roll marking machine centre typically includes a base, two vertical columns, and a work table. The base of the machine provides stability and firm footing. The two vertical columns are fixed onto the base. to the both side this column is most important part of the machine because the all moving assembly is mounted in this two column Quantity of base plat ;- 02 NO Size :- 200 X 25 X 25 MM Material type :- M.S

Punch Holder :- Punch holder is most important part of the Rolling machine because all different types of punch are hold in this Punch holder and pant holder is located at the 40 mm rod it's movable part and its move towards the road link is attached to the punch holder. Quantity of base plat ;- 01 NO Size :- 60 X 40 X 17 MM Material type :- M.S

Standard Hand Punches:- Made from high Quality, heat treated tool steel. Finely balanced with liberal overall shank size. Sharp Face stamps - Ideal for marking steel, Stainless Steel, precious metals, copper, brass and bronze. Ensures deep, clear and legible stamped impression. Safeguards against chipping and splitting of hammering end. Each punch is clearly described with character designation and size Dull Nickel Plated for rust free longer shelf life. Low Stress Dotted

Hand Punches also available. Custom Logo Punch can be produced on request. Reverse Alphabets & Numbers for forging and die casting dies & for rubber moulds Butt-Welded stamps are developed for marking red-hot (upto 1000°C) Railway Axles, steel billets etc. Suitable for all engineering and Industrial applications Used with Regular Hammer or Impact Press
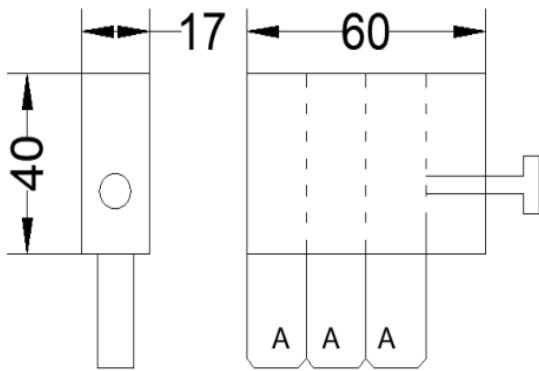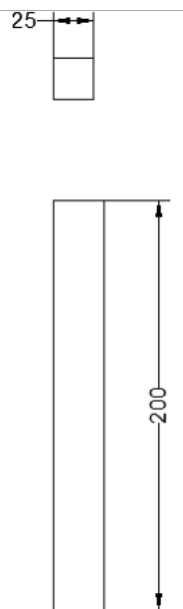

Figure 2: Punch Holder

Figure 3: Side Column

Link :- Link Pin is used to connect levers to pivot block or to connect two levers. Force applied by the lever is transmitted through links, to slide assembly to give sliding motion over guide bar. So link pins are subjected to shearing as well as crushing stresses. Hense it is necessary to see that link pins are safe. Shearing area TT/ 4 x 102 = 78 mm²
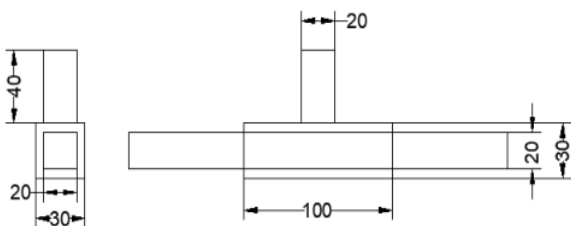
Figure 4: Link

Figure 5: Hand Punch

Cradle Assembly:- In the Cradle assembly sex bearing are mounted in the 10 mm rod and both side of barring 3 mm thick ms plat is mounted and for this plat one v sheep guru is cut that's way over metal bar is stable up side of the baring Size :- 100 X 50 X 65 MM Material type :- M.S
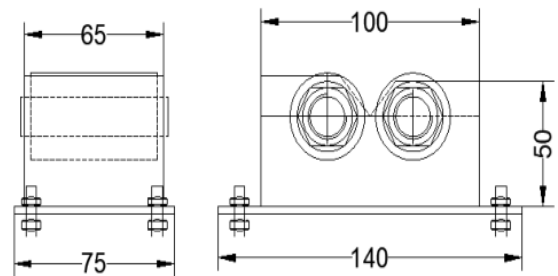
Figure 6: Cradle Assembly

IV. RESULTS AND DISCUSSION

The operation principle of roll marking manual mechanics involves a few key steps and components that work together to create a permanent mark on a workpiece. Here's a breakdown of the process: Die Design: The information to be marked is crafted onto a roll die. This die is typically made of hardened steel to withstand the pressure of marking. Workpiece Placement: The workpiece that needs to be marked is placed in position, either held by hand or secured in a fixture. Die Alignment: The roll die is aligned with the area on the workpiece where the mark is to be made. Pressure Application: A manual force is applied to the die, either through a lever or a hand-operated press. As the die rolls over the workpiece, the engraved information is transferred onto the material. Mark Inspection: After the rolling process, the quality of the mark is inspected to ensure it meets the required standards. Working Sequence:- Designing the Roll Die:The information to be marked is engraved onto a roll die, which is typically made of hardened tool steel to resist wear and deformation Setting Up the Workpiece:The workpiece is securely placed in the marking machine, ensuring it's properly aligned with the roll die. Applying the Mark::-The operator manually applies force to the die, causing it to roll over the workpiece's surface. As the die rolls, it imprints the engraved information onto the material. Inspecting the Mark: After marking, the workpiece is inspected to ensure the mark is clear, accurate, and properly positioned. Post-Marking Processes: Any necessary post-marking processes, such as

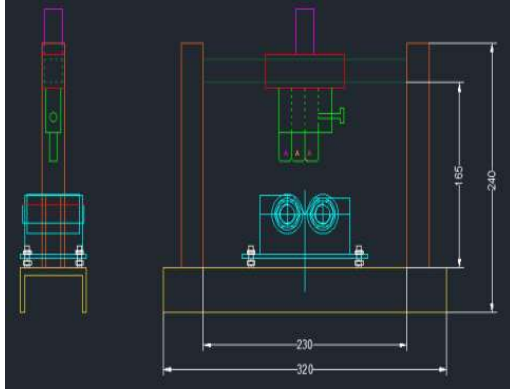cleaning or further machining, are performed on the marked workpiece.

Figure 6: 2D View of Roll marking machine

Ideal for marking cylindrical (Solid or hollow) components of Steel, Aluminium, Brass, etc. using interchangeable Steel Types and marking Dies. Perfect for marking such specific components as drills, taps, engine valves, spark plugs, cutting tools, diamond tools, bushes, nozzles, sanitary fittings, hose end fittings, gas lighters and studs. Outstanding benefits : Low set -up time. Easy operation. High output rates. Robust construction low costs (uses standard tooling). The Steel Types or stamp marks are mounted in holder fixed to the machine carriage. A simple hand lever operates the carriage producing a uniform, legible marking. Marking depth is precisely set by adjusting the vertical dove-tail slide, which cant then be locked any position for repetitive work.

V. CONCLUSIONS

The aim of our project is to develop working model by which we can mark or punch nos, or letters on cylindrical surface. While marking progressively, the load required for marking is minimum. Due to this machine we can mark letters or nos to definate depth & at equal spacing. During project we learnt engg. aspects like how to plan the task, how to distribute work according to qualities between us, how to behave with workers, supervisors and top management. Also with that we got the knowledge about use of std. parts, process planning, etc. This is the effort made by final year student thinking from their practical as well as theorotical point of view & guidance of all other persons during the project work to develop this new machine. As far as possible, we have tried to make the things simple & to satisfy the various aspects of design, manufacturing, and aesthetic appearance. It is success of team work & nice coordination in facing difficulties carried during our project time. We have tried very hard to bring sponsored target into real project. We are happy that we were able to cope with sponsorers requirements about machine, successfully and economically. By using roll marking machine, the percentage utilisation of the worker is increased by 50%. So the expenditure on marking is decreased by 33%.

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Development of Agriculture Vehicle for Seeding, Grass Cutting, Ploughing Multiple Operations

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Abstract— **The agriculture system in India should be advanced to reduce the efforts of farmers. Various numbers of operations are performed in the agriculture field like seeding, waste plant cutting, plowing etc. Very basic and significant operation is seeding, plowing and plant cutting. But the present method of seeding, plowing and plant cutting needs more physical work of the farmers. The equipment's used for plowing are very difficult and inconvenient to handle. So there is a need to develop equipment which will reduce the efforts of farmers. This system introduces a control mechanism which aims to drop seeds at particular position with specified distance between two seeds and lines while seeding in this way the wastage of seed is less. In this proposed system plowing and plant cutting are also implemented. This unit can be connected to the tractors to do automation. The solar robot is that there is never a battery to replace. They can start-up up automatically in the**

Keywords— *Agriculture vehicle, Battery powered, Multi purpose, Ploughing, Sowing, Spraying, Weeding*

I. INTRODUCTION (*HEADING 1*)

Indian modern agriculture development does not have sufficient skilled labor to trade off new technology. The manually operated seed sowing technique associates exposure of seeds to rats, birds and snails. So, it is mandatory to automate this sector and a progressive innovation becomes necessity for raising the demand on agricultural robot product quality. To give an elucidation to these problems, a sensor guided rover for plowing, precise seed positioning and grass cutting has been proposed to reduce the human effort and also to increase the yield. The rover's navigation is performed by remote guiding devices fortified with the positioning system. mainly power generated through sun electricity and stores in a battery by using solar panel. Stored power will be supplied to Agricultural robot. In traditional Fashion of agriculture, each motion may be like manual paintings to be accomplished, like guide seed planting and results in low seed placement and with high value of man power and time. Current era will improve the seed planting

and offers extra gain than traditional one. Present day fashion of agriculture includes so many machines for cultivating and seeding plant life, irrigation, ploughing, and many others. By way of the usage of robotic technology, seeding can finish the use of automatic robot motion and it could be monitored. Nowadays several generation and devices are invented for improving agricultural overall performance and boom efficiency of the crop production. The use of conventional way of cultivation, there can be loss to the farmer of their crop cultivation and in crop management as well due to seeds wastage, crop loss for the duration of crop cultivation, hard work control and time management as properly. These global calls for the whole lot need to be done instantly and in greater powerful manner, because of this automation got here into life styles sections like medical discipline, industries and numerous businesses. In few nation's robots are used to carry out cultivation operations in the agricultural area. Now using those modern technologies, we are able to build operational gadget inside the farming device to reduce the efforts of farmers and also to reduce time, electricity and required value.

Agriculture is one of the major occupations in India, it is very important to discover and implement new ideas in this field, though lots of work has been done in this area. It is unfortunate that, these ideas are not been properly implemented in actual field. This is due to high cost and it is complicated for rural people. Electric Multipurpose agriculture equipment is basic and major equipment involved in agriculture for the maximum yielding. For the reason there is a scarcity of the workers, this result in delayed agriculture to overcome these difficulties, electrical multipurpose agriculture equipment are designing such way that to get it at low cost and high durability. Agriculture plays a major role in rural farmers depend on agriculture and that makes their life style changes. Agriculture is one of the important sector of Indian economy as it contributes about 8.4% to the total GDP and provides major employment to the development of Indian economy. Over 70 % of the rue

population. Indian agriculture has been developing in last few decade. This project, proposes a multipurpose agricultural working vehicle, based on the electric system. It is ecofriendly, user friendly and affordable to small range farmers. In the 12v , 8amp battery (rechargeable) which stores the electrical energy and a base frame or chassis is made with 4 wheels connected to it, which will facilitate motion and supports to the vehicle through 12V DC motor of 775 model which is used to drive the agricultural vehicle as well as to run the operations (By switching motor with required operations). The DC motor is connected to a 12v 8Amp energy. The choice of material for the electric vehicle is the most important factor for vehicle design. There is variety of materials that can be used in vehicle body and chassis. In this regard Naveen et al.focused on design, development and fabrication of multipurpose agricultural vehicle. Our vehicle is going to perform follow task like digging soil, sowing seeds, levelling soil and then spraying water on seeds. Rakesh kumar et al.designed for small farmers to improve their productivity. The machine required less man power and less time compared to traditional methods, so if we manufacture it on a large scale its cost get reduce and we hope this will satisfy the Indian farmer needs. Patel et al. studied design and fabrication of vehicle which is completely solar based. It will automatically sow seeds and will move as controlling will be done from keyboard given to farmer. It is solar based and therefore no need of charging and hence it was eeconomical. Sanap et al. designed and fabricated with low-cost, easy to use and effective equipment for agriculture. Patil et al. designed overall machine that satisfy the need of small-scale farmer, because they are not able to purchase costly agricultural equipment. The machine required less man power and less time compared to traditional methods. Sakhale et al. designed multifunctional agricultural vehicle to cater to the fundamental challenges faced by farmers. These challenges mainly include seed sowing, water spraying, cultivation, and digging. Additionally, the vehicle offers a removable cultivation tool that requires manual force for operation. Sadik et al said that agriculture is one of the primary occupations in India, and it plays a crucial role in the indian economy. Indian agriculture has experienced significant growth in recent decades. While a lot of work has already been done in this field, it is still essential to explore and implement new ideas. Vishal et al. concluded that india is a country that relies heavily on the agricultural sector, with a significant focus on cultivating a diverse range of crops including ground nuts, corns, cereals, among others in its rural areas. The agricultural equipment currently available to farmers is primarily imported from foreign countries and is characterized by high costs and large sizes. To address this issue, a project was pursued to design and fabricate multipurpose agricultural equipment specifically for small-scale farmers at a cost not exceedingly approximately 15000 rupees per unit. The project involved a comprehensive study

a immediate developing equipment capable of performing various agricultural operations, such as carrying goods, spraying pesticides, sowing, seeding, weeding, and cutting operations, with the aim of improving efficiency while reducing land preparation and handling costs. Dhawale et al designed 4-wheeler arrangement of the product was created by implementing the existing engine-operated sweeper weeder machine. In addition, it features a spraying unit and cultivator cum seed Sower arrangements. The device is crafted to be easily used in the field. Vehicle power is supplied by a four-stroke petrol engine, and controls are located at the footrest. Arunkumar et al. said that agricultural vehicle is versatile and can be used for fertilizing, sowing, and removing weeds. The equipment is designed to be easily rearranged or assembled to meet the specific needs of the farmer in every stage of agriculture. This concept of multipurpose equipment is new and can be patented, making it a viable solution for real- life farming situations. Farmers will benefit from the comfort and increased productivity provided by our multipurpose agricultural vehicle, which can be used for spraying, sowing seeds, and weeding at a low cost. Riyaz et al. performanced of the cultivator, it can be observed that it satisfactorily addresses the needs of small-scale farmers who face challenges in purchasing costly agricultural equipment. The cultivator requires minimal manpower and less time compared to other cultivators, making it a cost-effective option for large-scale farming. This approach has the potential to reduce agricultural costs and improve efficiency. Radkar et al. say that the project will cater to the needs of small- scale farmers as they are currently unable to afford expensive agricultural equipment. The machine requires less manpower and time as compared to traditional methods. If manufactured on a large scale, we expect the cost to significantly reduce which will partially address the challenges faced by Indian agriculture.

The development and implementation of a multipurpose agriculture vehicle for small landholders present a promising solution to address various challenges faced by farmers. Through the integration of diverse functionalities such as ploughing, seeding, spraying, and harvesting, this innovative machinery offers increased efficiency, productivity, and sustainability in agricultural practices. The multifunctionality of such a vehicle not only optimizes time and labor but also enables small landholders to diversify their crop production and adopt modern farming techniques. By streamlining operations and reducing manual labor, farmers can significantly improve their yields while minimizing resource usage and environmental impact. Furthermore, the versatility and adaptability of the multipurpose agriculture vehicle make it suitable for various terrains and cropping systems, enhancing its applicability across different regions and agricultural

contexts. Its potential to enhance agricultural productivity and income generation for smallholders underscores its importance in promoting food security, rural development, and economic growth. In essence, the introduction of a multipurpose agriculture vehicle for small landholders represents a significant step towards modernizing and revolutionizing traditional farming practices. With continued innovation, investment, and adoption, this technology holds the promise of transforming small-scale agriculture into a more sustainable, efficient, and resilient sector, ultimately benefiting farmers, communities, and the environment alike. Therefore, objective of the current study is To build a battery operated smart agricultural robot for multipurpose farm activities. That should check the moisture content in soil, humidity of surroundings and temperature of seed. The ground should be dug to the specified depth and the adequate amount of seeds has to be dispensed then it should level the mud after seeding operation. It should be easy to operate and safe handling.

II. METHODOLOGY

The primary challenge is to design a robot that can perform multiple agricultural tasks efficiently. These tasks might include planting, watering, weeding, harvesting, and monitoring crop health. The robot must navigate various terrains, adapt to different crop types, and operate autonomously or semi-autonomously.

1. Requirement Analysis

Task Identification: Determine the specific agricultural tasks the robot needs to perform.

Environmental Constraints: Analyze the types of crops, soil conditions, and climate factors.

Operational Requirements: Define the operational hours, battery life, speed, and precision needed for each task.

2. Design and Development

Modular Design: Create a modular architecture where different tools and sensors can be attached or detached as needed.

Mechanical Design: Develop a robust mechanical structure to handle various terrains and weather conditions.

Control Systems: Implement advanced control systems for navigation, obstacle avoidance, and task execution.

Power System: Design an efficient power system, possibly integrating solar panels for extended operations.

3. Sensing and Perception

Sensor Integration: Use a combination of cameras, LiDAR, GPS, and other sensors for environmental perception.

Data Processing: Implement real-time data processing algorithms to interpret sensor data and make decisions.

Machine Learning: Employ machine learning models for crop health monitoring, weed detection, and yield estimation.

4. Navigation and Mobility

Path Planning: Develop algorithms for optimal path planning to cover the field efficiently.

Terrain Adaptation: Ensure the robot can adapt to different terrains, using adjustable wheels or tracks.

Obstacle Avoidance: Implement obstacle detection and avoidance mechanisms to prevent collisions.

5. Task Execution

Planting: Design precise seed dispensers and soil preparation tools.

Watering: Integrate adjustable irrigation systems based on soil moisture levels.

Weeding: Utilize mechanical or chemical methods for effective weed removal.

Harvesting: Develop adaptable harvesting tools for different crop types.

6. Communication and Coordination

Remote Monitoring: Allow for remote monitoring and control via a centralized system.

Swarm Robotics: If multiple robots are used, ensure they can communicate and coordinate tasks efficiently.

Data Logging: Maintain logs of operations for performance analysis and troubleshooting.

7. Testing and Validation

Simulation: Use simulation tools to test the robot's performance in various scenarios.

Field Trials: Conduct extensive field trials to validate performance under real conditions.

Feedback Loop: Implement a feedback loop to refine and improve the robot based on trial results.

III. CONSTRUCTION OF AGRICULTURAL EQUIPMENT

Block Diagram This task depends on horticulture improvement. Here, we utilize remote association for the working of AGROBOT. It runs in the force supply of 12V . There are sensors which sense dampness and temperature for the necessities of soil ripeness and harvest developing. Microcontroller gets information through the worker and works. There are engines which associated for the sprinkler of water and pesticides. This is a biggest benefit where this can deal with the less manual force and there will no illness spreading. It is a most secure strategy where yields can develop without need of manual works. The sprinkler, seed sower and engines are controlled through microcontroller. Information from sensors and directions for meanderer development is sent and gotten separately utilizing ESP8266. It is associated with versatile through cloud.

Hardware Requirement: This section gives a detailed description of all the hardware components used. Different hardware components have been used for performing different functions finally integrated to form a single system called TMR. Renesas controller has been used because it has three serial peripherals namely UART, SPI and I2C. Here we use UART channel which has three channels. The various hardware components and software

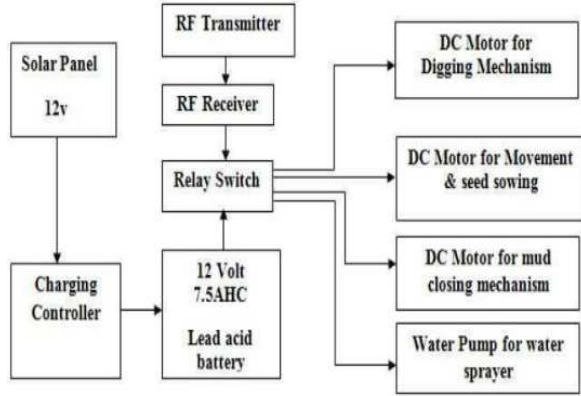application used for implementing the system are discussed in the following section. The 3 UART channels used
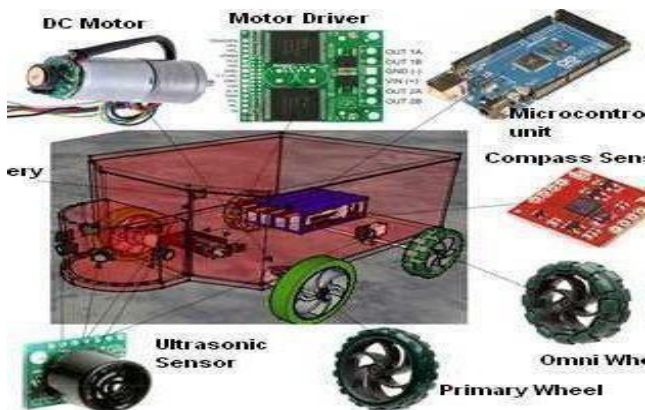

Figure: 1 Block Diagram.

Figure- 2. Agriculture Robot Hardware.

provides an advantage of using multiple wireless transceivers simultaneous.

Grass Cutting: The Blades attached to DC motor in front of the robot effectively cut the grass. A grass cutter is a machine utilizing one or more revolving blades to cut a grass surface to an even height. The height of the cut grass may be fixed by the design of the mower, but generally is adjustable by the operator, typically by a single master lever, or by a lever or nut and bolt on each of the machine's wheels. The blades may be powered by muscle, with wheels mechanically connected to the cutting blades so that when the mower is pushed forward, the blades spin, or the machine may have a battery-powered or plug-in DC motor as shown in fig.2. Fig.2 Grass Cutting Mechanism International Journal of Scientific & Engineering.
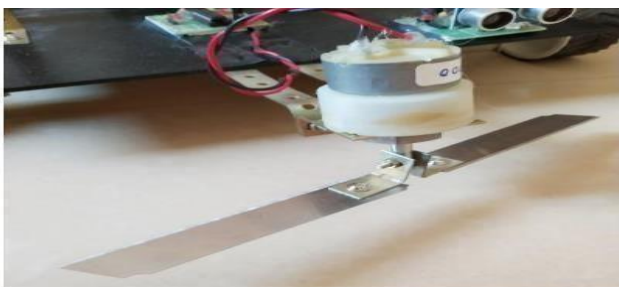
Figure 3 Grass cutting

Ploughing: The Plough arm made of screws moves down and plows the soil and is lifted up after completion of ploughing. The first and foremost step in the farming is Ploughing. The assembly is attached to the off road bot used for drilling and seeding. This process is done in order to loosen the soil and create a path or tracks on the farm land in order to sow the seeds uniformly. The structure and the design of the plough tool depends on the various constraints such as the type of soil to be ploughed and the depth required based on the type of crop that has to be grown and so on. There are many types of Ploughing mechanisms that has been adopted which can be broadly classified into two categories; one is the manually driven Ploughing tool and the other being machine driven. We have designed the plough tool using Solid Works software.
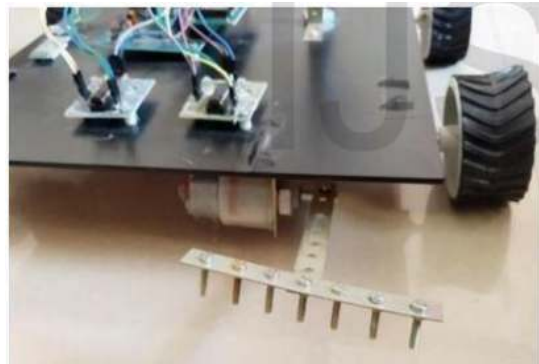

Figure-4 Ploughing

Seeding : Seeds are dropped from the funnel using the open-close movement of values at equal intervals. The assembly is attached to the off road bot used for drilling and seeding. The next major step in the process of farming is seeding. Seeding usually depends on the type of crops being grown and the type of seeding varies over a variety of crops. In case of robots, utmost care has to be taken to ensure uniform spacing and controlled flow of the seeds from the bot; where in the seeds required for sowing is stored in a container and is mounted on the bot at the suitable position as shown in fig.4. The robots take wheat seeds from a station and sow them as even as possible on the area.
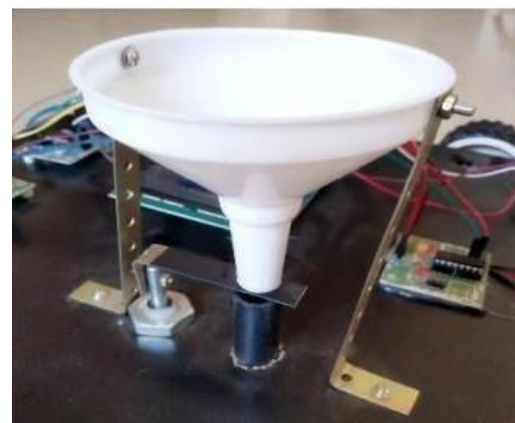

Figure 5 Seeding

IV.   RESULTS AND DISCUSSION

Results: 1. The designed Agri bot which is made using raspberry pi 3 in Fig 1 Agri bot is controlled webpage which enables the movement of the robot. Entire system is powered by solar panel which is placed above.

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2. Soil moisture sensor records soil moisture. At point when the humidity level is below the threshold level, the pump is turned on and off automatically when it reaches the boundary level and the temperature sensor senses the temperature from the Earth.

3. As a result irrigation will start automatically which will be powered by the solar panel through battery. It will contain many operations in which the seeding cutting grass and spraying of pesticides will be done .All the things will be controlled through the mobile.

4. Hardware interface: Multi-tasking robot: The soil moisture senses the moisture present in soil, by using this information we can take appropriate decision. The various multi task such as ploughing, seed sowing, fertilizer spraying water sprinkling, moisture sensor and grass cutting can be done on request of user (Farmer).
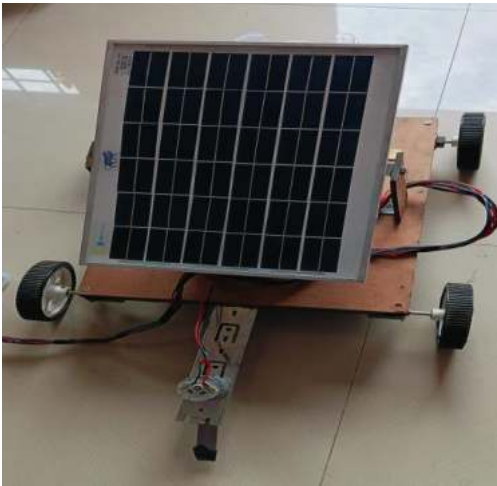

Figure 6 Agriculture Vehicle

Discussion:

1.The high initial investment in robotics and camera systems can be a barrier for small-scale farmers. Rooted Robotics is working on scalable solutions to address this challenge.

2. Technical challenges include developing robots that can operate in diverse farming environments. Continuous innovation is key to overcoming these hurdles.

3. While automation can displace traditional jobs, Rooted Robotics is committed to re-skilling and up-skilling workers, emphasizing the creation of high-tech jobs in the agricultural sector.

4. The Robot can be remotely controlled and monitored

5. The robots are not getting sick or tired, and the time off is not needed.

6. With higher speeds and closer tolerances, they can operate with fewer errors.

Conclusion: Developing an agricultural vehicle is a complex but rewarding project that can significantly enhance farming efficiency and productivity. By following a structured approach, integrating advanced technologies, and focusing on user needs, you can create a vehicle that meets the demands of modern agriculture. Regular evaluation and feedback will ensure continuous improvement and long-term success

In this study focused on developing the Robot that can perform the following functions:

Ploughing the ground.

Battery is charged using solar energy

Farm boundary detection using IR Senor

Spray Water on crops

Cut the grass using grass cutter.

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Studies of Surface Characteristics of Finish Hobbed Spur Gear

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Abstract

Gear manufacturing techniques play a vital role in the manufacturing industry for power and motion transmission. Power transmission efficiency depends on achieving error-free gears with ideal surface properties. Analyzing total deviations from the intended design during production is necessary to evaluate the quality of machined gears. The optimization of process parameters has been found to improve gear hobbing, leading to enhanced quality. Numerous studies on a variety of elements, including cutting tools, cutting fluids, cutting parameters, and workpiece parameters, have been carried out to enhance the quality of hobbed gears. Recent studies have shown that applying cryogenic treatment and coatings to hob cutters can enhance gear hobbing performance. This paper summarizes the previous studies conducted on gear hobbing machines, which have focused on enhancing productivity by increasing cutting rates and prolonging tool life. The assessment of gear accuracy and quality primarily relies on microgeometric deviations, with commonly used criteria set by the American Gear Manufacturing Association, Deutsches Institut für Normung , and Japanese Industrial Standards. Overall, the purpose of this study is to provide an extensive overview of earlier studies on gear hobbing, with a focus on the importance of surface characteristics and the methodologies employed to improve gear quality, accuracy, and productivity.

 Key words- **Gear hobbing, CNC Finish hobbing, DIN, Gear Quality, microgeometry deviations, Surface Roughness.**

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Abbreviations:

Rz- Mean relative surface roughness

Z_R - Roughness factor

σ_{HP} - Permissible contact stresses

Z_L-Lubrication factor

Z_{NT}-Life factor for contact stresses

Z_v- Speed factor

Z_W-Hardness Ratio factor

Z_X-Size factor for contact stresses

S_{Hmin}- Safety factor for contact stresses

σ_{Hlim} - Endurance limit for contact stresses

I. INTRODUCTION

Gears are produced by hobbing, casting, milling, forging, etc. Gear hobbing is the process of cutting gear teeth with the use of a rotating cutter known as a hob. Gear hobbing is a versatile method used for manufacturing spur, helical, worm gears, as well as splines. A gear tooth flank requires a high surface finish. Gear Hobbing allows the manufacturing of gears with different modules, weights, and dimensions. During gear hobbing, the blank is initially positioned toward the hob until the desired depth is achieved. Once the desired depth is reached, move the hob across the surface of the gear, ensuring complete tooth formation on both gear and hob during the process. To achieve maximum productivity, quality, and improved tool life in Shobber 300 Gear Hobbing, it is crucial to determine the optimized cutting conditions.
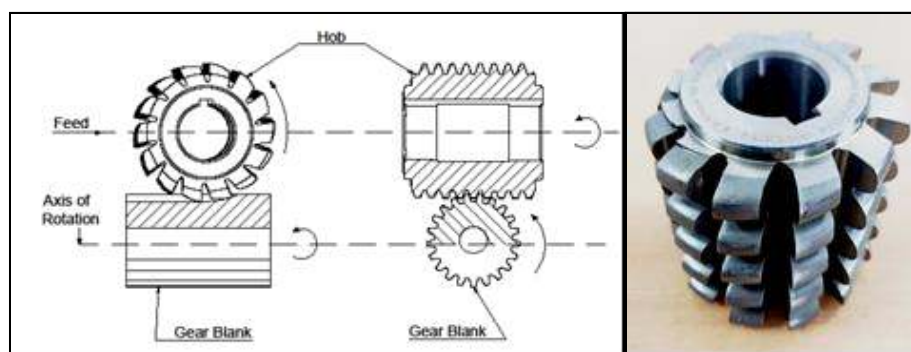

Fig.1. Gear Hobbing and Hob Cutter

In traditional hobbing, gear is generated by hobbing followed by grinding. Traditionally, gear generation involves two manufacturing processes, namely hobbing followed by grinding. Currently, grinding has been eliminated through the use of CNC-finished hobbing machines. It is easy to produce gear with the required surface characteristics on a CNC finished hobbing machine. CNC hobbing allows for a wide variety of process parameter changes, enabling easy study of their effects. It is very important to determine gear cutting precision and reduce its manufacturing cost. Since gears are typically subjected to a subsequent severe machining operation, thermally induced geometrical errors are typically inconsequential. Tool accuracy, tool and workpiece clamping, and hobbing

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machine kinematic errors affect the quality of manufactured gears. The quality of gear can be assessed through an analysis of the overall deviations in the process.

Regarding gear hobbing, a few more recent breakthroughs have been made, namely, advances in substrate materials and coating systems have enabled higher cutting speeds and longer tool life, increasing productivity. However, it is widely recognized that improved performance entails higher tool prices; thus, the investment in tools and the resulting influence on unit pricing must be considered. Simplifying the process chain is an additional strategy for increasing productivity. Ultimately, it is crucial to focus on the example of finish hobbing to discuss the cost savings potential of process substitution. To replace shaving as a traditional soft finishing process, new tooling concepts are introduced to improve process performance in terms of tool life and work piece quality. Equally important, if the natural twist in finish hobbing can be reduced or controlled; new applications can emerge [1].

The final machining step in many gear manufacturing process chains is fine machining. As a result, the quality-defining phase in the manufacture of gears is mostly precision machining. Gears can be finely machined with either a hard or soft workpiece.Grinding and honing gears are the most common ways to finish hard. The two most prevalent soft-finishing techniques are gear shaving and finish hobbing. Instead of gear shaving, CNC finish hobbing has the potential to become an affordable and environmentally friendly method of finishing gears [2]. An entire dry process cycle can be accomplished by adopting cutting procedures in a dry environment in CNC finish hobbing. A shorter process cycle may be generated if the CNC finish hobbing procedure with the accompanying gear blank and process characteristics are controllable. Manufacturing must start with the creation of the external shape and functional surfaces. Shape variations are minimally allowed during the subsequent hobbing procedure. In addition, since the tooth is not subjected to additional treatment where errors are capable of being eliminated, the surface behind gear hobbing must satisfy strict criteria. The component is prepared for gearbox installation after heat treatment.

CNC finish hobbing has a significant role in reducing manufacturing expenses because expensive hard finishes can be eliminated. Maintaining as few form deviations as possible is a fundamental requirement in CNC finish hobbing. There are usually form variations involved during the hobbing process. These are the feedmark (δx) and generating-cut (δy) given by the formulae [3].

$$\delta x = \left(\frac{f_a}{\cos \beta_2}\right) \cdot \frac{\sin \alpha_{n0}}{4.d_{a0}} \quad ; \quad \delta y = \frac{\pi^2 \cdot m_n \cdot z_0^2 \cdot \sin \alpha_{no}}{4 \cdot n_0 \cdot z_2} \text{ ---------------- [3]}$$

Where δx feed Marks depth μm, δy generated cuts depth μm , fa feed in axial direction mm , α_{n0} pressure angle of the hob in degree , m_n module in mm, n_0 Number of gashes of the hob, β_2 Helix angle of gear in degree , d_{a0} Outside diameter of hob in mm, z_0 Number of starts of hob, z_2 Number of teeth of gear.

Gear finish hobbing is a recognized high-speed machining process that produces gears with minimal microform errors and excellent surface finishes. It has environmental advantages over other finishing techniques used in the production of gears. CNC gear hobbing also enables soft machining of gears, which allows for dry machining and improves the environment.

Gear microgeometry deviations can be compared with those required by several international standards to validate their quality. DIN (Dienststag für Normalung), AGMA (American Gear Manufacturing Association), and JIS

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(Japanese Industrial Standards) are some of the most extensively used gear quality standards. There are 12 digits in the DIN standard for the quality of cylindrical gear. A lower number indicates better quality, while a higher number indicates higher quality [2].

*A. Types of Errors in Gear***:**

Microgeometric deviations are used to measure gear accuracy and quality. These deviations include irregularities in the form and position of the teeth. These are determined by runout error and pitch deviations linked to the real tooth location, as well as profile error and lead error connected to the actual form of the teeth. Form deviations, also known as profile deviations and lead deviations, are variations in the contour and inclination of the lead form line of teeth. Radial runout is the largest variation in the positioning of gear teeth in the radial direction estimated in relation to the nominal position, whereas location deviations, or accumulated pitch deviations, are variations in the sum of ideal pitches and practical pitches throughout each of the teeth. The degree of inaccuracy in these factors affects the operating characteristics of the gear. Pitch (F_p) and radial runout (F_r) errors affect the transfer of motion and gearbox accuracy, respectively; profile (F_a) and lead (F) errors impact the origination of noise and the gear strength. Surface roughness characteristics such as average roughness (R_a) and maximum roughness (R_{max}) govern both the service life and the workable performance of a gear[2].

Understanding the causes of errors in spur gears during manufacturing is essential, as these errors can have a detrimental effect on gear performance. Therefore it is necessary to manufacture good quality gears. It needs an error-free shape to improve speed, power, and torque transmission without loss. Microgeometry errors in gears are classified based on their impact on location and form. Form errors are responsible for the capacity for carrying loads and noise-producing properties. Errors in location have an undesirable effect on the transferred performance and transfer of motion properties of gears.

Runout Errors (F_r): The cumulative fluctuation in the radial distances between a gear's teeth and its center (or bore). Runout errors are contributory errors to gear vibration, sound, binding, and additional stress in mated gears.

Pitch Errors (F_p): The variation between the measured spacing and the theoretical pitch.

Lead Errors (F_β): Errors of this kind occur when the actual tooth outline advancement deviates from the intended extent or location. Because of this inaccuracy, the teeth occupied with mating make less efficient contact and lose force.

Profile Errors (F_a): These imperfections are generated by deviation of the true tooth outline from the intended tooth outline. If there are too many profile errors, either backlash or friction between the mating teeth will occur, depending on whether the imperfection is on the negative or positive side [4].
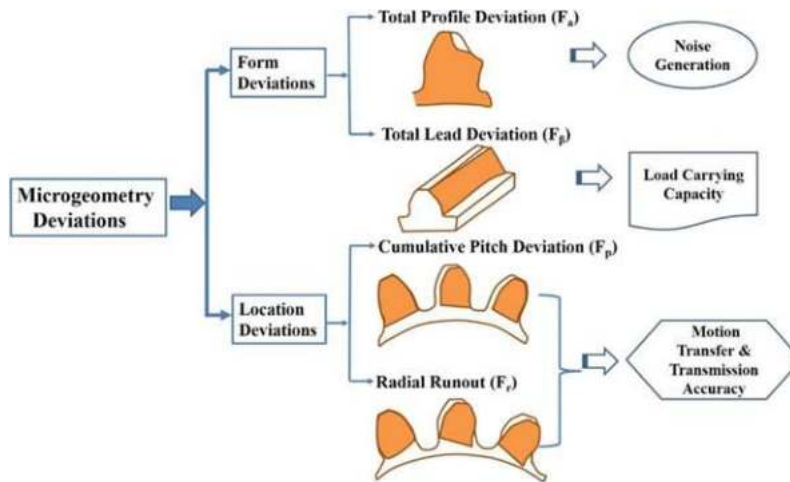
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Fig.2. Deviations in Gear [2].

B. Surface Characteristics of Finish Hobbed Gear:

Because of their high performance and cost-effectiveness, finish hobbed gears are extensively utilized in a variety of sectors, including aircraft, automobiles, and industrial machinery. The hobbing process involves cutting teeth into a blank.

Surface roughness is a key characteristic of gears that operate in various types of contexts. It has an impact on numerous failure modes, such as micropitting, macropitting and scuffing, because it directly impacts friction and contact temperature. Controlling surface roughness throughout the hobbing operation is critical to ensuring optimal performance. Cutting parameters such as cutting speed, feeding rate, and depth of cut can be chosen properly to accomplish this. Furthermore, the use of high-quality cutting tools and lubricants can help attain optimum surface roughness and, as a result, enhance the overall functionality and endurance of the gear. Ra and Rz are different parameters of roughness. Ra measures the average deviation of the surface from its centerline, while Rz measures the maximum peak-to-valley height within a sampling length. It is important to consider both parameters when evaluating surface roughness in gear manufacturing. It is important to measure both roughness and form to ensure proper quality assurance of gears, considering the dominant surface structure and using the appropriate measurement technology. Surface roughness is a critical factor in gear performance, affecting factors such as noise, vibration, and efficiency. Proper control of surface roughness can lead to longer gear life and improved performance. Cost pressure is growing, necessitating greater effectiveness in gear manufacturing operations. Roughness is determined by feed and cutting speeds, which have an effect on gears' service life, fatigue, and uniform transmission of motion. Therefore, optimizing the feed and cutting speeds can result in smoother gears that last longer and perform better. Additionally, advancements in technology have allowed for more precise control of these parameters, leading to even greater improvements in gear quality and efficiency.
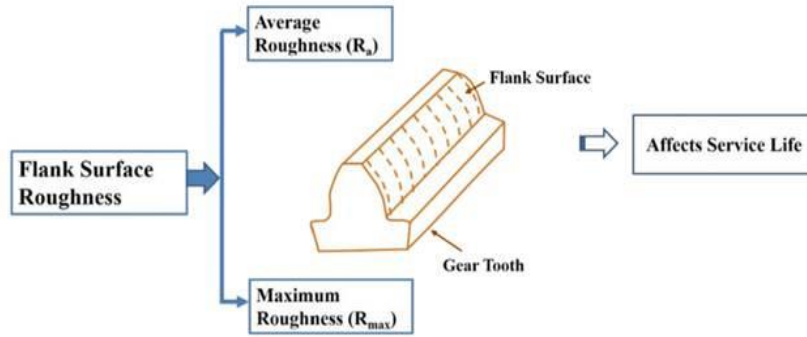
Fig.3.Gear Flank Surface Roughness[2]

The roughness factor Z_R varies inversely with respect to Rz in the teeth's surface durability, the average roughness height of the surface; that is, as Rz decreases, Z_R increases, allowing for higher permissible contact stresses. This relationship between Z_R and Rz is essential in influencing the surface durability and performance of teeth under contact conditions. This demonstrates the significance of Z_R in optimizing the performance and surface durability of gear teeth in contact applications.
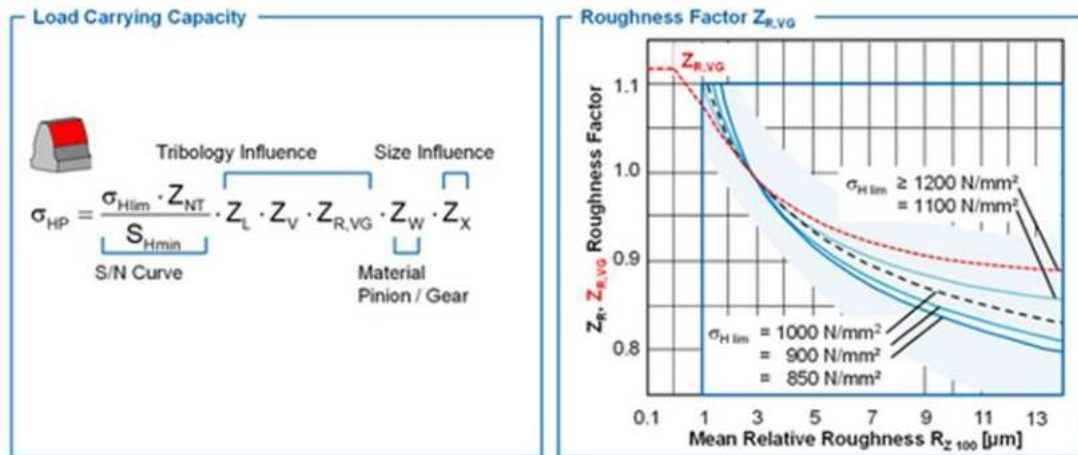
Fig. 4. Increase of the load-carrying capacity by reducing the roughness according to [5].

Microgeometry deviations can also have a significant impact on gear performance, causing noise, vibration, and even failure. Therefore, it is essential to carefully monitor and regulate the manufacturing operation to ensure that these deviations are minimized and that the gears meet the required specifications. One way is to employ modern metrology instruments and methods, which may include coordinate measurement machines (CMM), gear metrology machines, etc. These tools can accurately measure the microgeometry deviations and provide valuable feedback for process improvement.

This study will review previous studies on the enhancement of the gear hobbing process. Section 2 covers previous research in the subject, stressing the effect of process parameter optimization, hob coating and cryogenics treatment, and hob geometry modifications on gear hobbing process performance enhancement. Section 3 discusses the findings, emphasizing the necessity for additional research to investigate the performance of gear hobbing. Section 4 gives problem statements, focusing on the enhancement of the gear hobbing process. Section 5 indicates the proposed methodology, which involves planning to do the experimentation and modeling studies to improve the

gear hobbing process. Section 6 concludes the paper by summarizing the main findings and emphasizing the importance of continued research in this area to advance manufacturing processes. Finally, Section 7 also outlines the expected outcomes of the study, which include increased efficiency and accuracy during CNC hobbing.

II. LITERATURE SURVEY

Gear quality is achieved by optimizing the CNC hobbing operation. A cause-and-effect diagram of the CNC hobbing operation is used to determine the impact of process factors on gear quality. Manufacturers can adjust their processes to produce gears with higher precision and durability by identifying key factors that affect gear quality. Furthermore, advanced technologies such as computer numerical control (CNC) and gear inspection systems can enhance the accuracy and uniformity of gear manufacturing by hobbing operations. The study associated with gear hobbing operation is usually categorized on the basis of causes of errors, optimization of process parameters, and development of new materials and coatings. These studies can lead to improvements in cost effectiveness, gear hobbing efficiency, and overall quality.
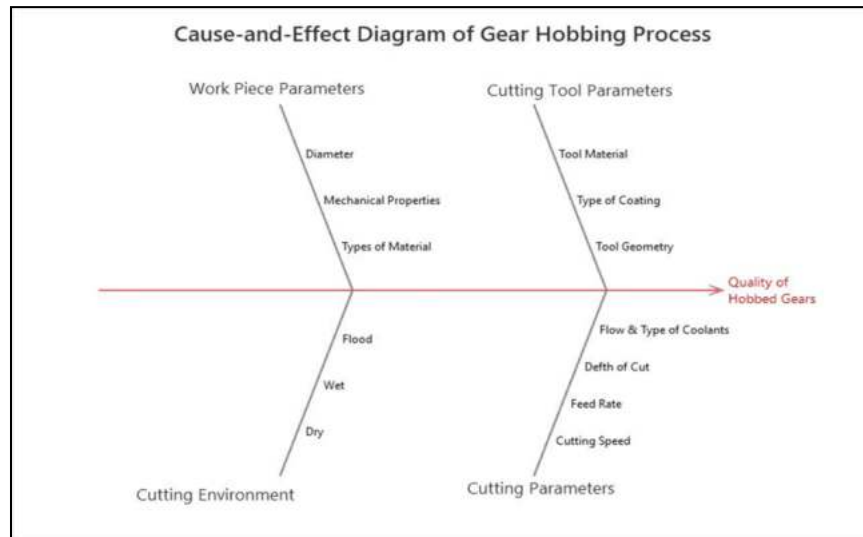

Fig.5. Cause and Effect Diagram of Gear Hobbing Process [6]

Keche and Gajhas [7] demonstrated that spur type gears made from AI-SiC experience fewer stresses than gear of spur type gears made from 20MnCr5 and that employing forces at nodes on the line of pitch produces a precise solution through ANSYS. F. Klocke et al.[8] evaluated tool wear behavior with chip forming characteristics. It might be shown that the software helps the engineer by developing gear hobbing procedures that take into account wear behavior and productivity [8]. Naser Amini et al [9]outlined the principles of RZP-grinding, Fissler honing, and Hurth green-shaving to manufacture gears with the least amount of noise. Neelesh Kumar Jain et al [10] studied the effects of finishing time and the effect of an abrasive flow finishing medium viscosity is to minimize microgeometry errors, such as total profile error (Fa), total lead errors (Fβ), total pitch errors (Fp), runout errors (Fr), and an average roughness of the surface (Ra) gears of spur type treated by the abrasive flow finishing operation. Future productivity gains are likely due to the continued development of substrates and coatings, according to Oliver Winkel [1].Cementing tools made of carbides provide maximum potential for CNC hobbing with elevated

machining speeds, whereas cermet (ceramic metal) and polycrystalline cubic boron nitride tools are not suitable for steady operation at high machining rates [11]. More use of finish hobbing may result from the use of innovative tool concepts and improved tool quality.

A.   Studies on Effect of Coating of Hob & Gear Quality:

According to Jörn Kohlscheen [12], the application of customized coatings on tools is able to increase the productivity of gear cutting such as multilayered AlCrN, which reduces crater wear and increases the life of single teeth. Coated tools can be used to increase productivity in the cutting process by providing an overview of coating depositing methods, coating substances, and bonding intermediate layers. Tool wear mechanisms are explained using novel approaches for characterizing coating substances, operational aspects, and geometrical aspects. Tool wear behavior is improved by introducing suitable substrate and coating thermal and mechanical treatments [13]. Abrasive wear on the tool is avoided by coatings because of their high hardness. Additionally, it has a lower coefficient of friction than the majority of materials used for cutting, which lessens the wear and heat that are produced while cutting. Coatings are less thermally conductive than cutting materials, allowing heat to be maintained in the chip and reducing the undue thermal stress around the tool. These features, when combined, may extend tool life by approximately 200–300% and, in some cases, enable speed and feed rate increases of up to 50–70% over comparable uncoated tools. W. Kalss et al. [14] compared Ti-based PVD hard coatings against Ti-free AlCrN-coatings in terms of physical and mechanical properties, ability to resist oxidation, and compatibility between the workpiece material as well as the tool. The results show that an AlCrN coating can enhance machining operations, particularly when medium-carbon and thermally resistant steels are being cut. Gear manufacturers need sophisticated machine tools and careful methods that are able to achieve optimum results. Cutting loads and tool wear progress are captured using analytical, empirical, numerical, and FEM-based approaches [15]. According to J. Rech's research [16], dry, high-speed hobbing requires a surface with a high degree of hardness, such as ASP2052, whereas TiN exhibits superior wear behavior at slower cutting speeds. Due to its low friction coefficient at high temperatures, MoS2 can lengthen the life of the hob. There is much potential for improvement in the coating method, substrate material, defined edge preparation, and tool design in the area of dry hobbing using coated carbide tools. While substrates with greater cobalt contents exhibited superior tool life, lubricious top layers can extend tool life by 30–40%. Users may now choose the best tool designs and process parameters with the use of software tools such as Hobbit and Sparta. High speeds and feeds may be used to operate carbide hobs with an optimized tool design[17]. D. R. Sant'Anna et al.[18] explored the vibrational analysis of cutting operations to improve productivity. High productivity differences were seen between two identical machines, and it was discovered that little variation between the two machines impacted their modal behavior. New parameters were chosen using modal analysis, and stability limits were established using experiments. Under steady conditions, the processing time may be sliced by over 18% due to new parameters, and it was determined that resonance situations should be avoided while hobbing gear teeth. Cemented carbide tools provide the greatest potential for gear finish hobbing at high cutting speeds, according to Deniz Sari et al.[11], who said that cermet and PCBN do not permit a stable process at higher cutting rates. According to Gaurav Bore et al.[19], a gear is a mechanical part positioned on the shaft that

transmits power. To form teeth and manufacture teeth on the gear blank, the hob and gear blank are rotated at a specific speed during the hobbing process. Tool life is also influenced by the hob's rotational speed [11].On the basis of analytical chip geometry and findings from experiments, K.-D. Bouzakis [20] presented techniques to forecast tool wear rise in gear hobbing. To produce a uniform distribution of tool tooth wear, the suggested numerical experimental technique may be successfully used to optimize cutting and hob tangential shifting conditions. Hob teeth with coatings showed improved cutting performance. In gear machining under typical workshop circumstances with no lubrication, D. Grimanelis [21] claimed that hobs coated with duplex CrTiBCN+C/CrTiB layers allowed greater cutting speeds and feed rates than TiN-coated hobs. The application of new coatings in cutting operations where high temperatures may occur is supported by these findings. M Zlatanovic and Stošić P [22] found that a coating of (Ti0.5, Al0.5) N may be employed as an alternative to TiN. The tool life could be increased by a uniform coating thickness [23]. According to Akio Kubo et al. [24], fully coated HSS hobs have superior cutting performance, and increasing feed rate and diameter may help to lessen chip crush behaviour. In dry hobbing, side wear is a factor that affects tool life, and using a cutting speed greater than 200 m/min is feasible without reducing tool life. Gear cutting may be made possible by using specific tool coatings such as AlCrN, which reduce crater wear and prolong the life of solid carbide single teeth, according to research by Jörn Kohlscheen [12]. Materials and industrial experts are creating coatings to withstand harsh cutting conditions as coated instruments are utilized more often in material removal procedures [13]. S. Stein et al. examined the substrate softening of PM-HSS throughout the cutting process and contrasted analogous cutting experiments to actual dry hobbing applications. They also developed a novel method to modify wear characteristics[25].

B. Studies on development of models for the prediction of the optimization of the parameters of Hob & Quality of Gear:

The IBPNN/DE technique was proposed by Cao et al. *[26]*, and it offers a novel way to continually optimize the process parameters during the high-speed gear hobbing process. In comparison to the IBPNN/DE technique, the suggested SVM/ALO/GH strategy is more flexible for addressing the small sample issue in gear hobbing *[27]*. Naoual Sabkh's *[28]* work employed an orthogonal cutting model to predict the cutting forces and thermo mechanical parameters (contact length, pressure, frictional stress, and temperature) at the tool-chip interface for the final gear hobbing procedure. The maximum chip load for hobbing procedures may now be calculated using a new formula created by Brecher et al *[29]* based on a regression study. This formula takes into account the influencing factors of the part, tool, and process, such as the module, tooth count, outer diameter, effective number of gaps, plunging depth, and axial feed [14]. Based on W. Liu's research *[30]*, a finite element-based gear-cutting forecasting model is offered. Initial meshing, nonlinear material models, solution algorithms, adaptive remeshing techniques, three-dimensional kinematics, and contact algorithms are among the modern approaches employed. Experiments were used to validate the model, and the results indicated that the predicted chip form was quite similar to what had been seen. Gear manufacturers require efficient machine tools and rigorous techniques that know how to provide the finest results. The development of tool wear and cutting loads is recorded utilizing empirical, analytical, computational, and FEM-based methodologies *[15]*. This investigation examines how the EDM process parameters affect the Ra, Rq, and Rz surface roughness characteristics in EN8 medium carbon steel. The pulse-on time, wire tension, and wire feed rate were discovered to be the ideal

combination of factors*[31]*.The findings demonstrate that wire feed significantly affects surface roughness characteristics. Woo-Jin Chung et al. *[32]* discovered that geometric parameters and errors in manufacturing influence gear performance measures such as safety factors, peak-to-peak static gearbox error (PPSTE), efficiency, mass, and volume. A Monte Carlo-style robustness study was carried out, taking errors in manufacturing into account. Two gear pairs with comparable safety factors and performance for PPSTE, efficiency, mass, and volume demonstrated conflicting gear performances. To increase gear hobbing machine machining accuracy, Zihui Liu et al. *[33]* introduced a unique thermal error prediction model based on IGWO and GRNN. The model selects temperature variables and reduces coupling between them using fuzzy cluster grouping and MIV. The results reveal that IGWO-GRNN is superior to the other algorithms by 5.1%, and its generalization performance is enhanced. Ihor Hrytsay *[34]* studied the kinematics of the hobbing process using simulation studies to improve the precision of machined gears. A novel method of simulating the hobbing process is proposed based on the results of the kinematics and rheological investigations of the hobbing cutting operations. The total cutting force is modeled by two time-variable parameters. The IPSO-BP technique was presented by Shouli Sun et al. *[35]* and has superior performance to the PSO-BP model. It may be used with gear-hobbing expert systems to enhance anticipated values. A modified dexel model is used to describe modern gear geometries, store temperature fields, and provide information for three-dimensional visualizations, according to I. Kadashevich *[36]*. Markus Krömer *[3]* computed the geometry and surface of the workpiece and reproduced the gear hobbing operations. A 3D finite element model was created by X. Dong et al. *[37]* to simulate the gear hobbing operation and forecast cutting forces, temperature, and stress distributions. Based on modeling and experimental data, a model for empirical tool wear for the hobbing tool was developed. Rake and clearance angles that are greater reduce the cutting forces and provide lower tool wear rates, demonstrating how gear hobbing operations may be improved. Desmond K. Moru and Diego Borro *[38]* tried to implement an enhanced machine vision application to measure and examine industrial gears at the subpixel level, with the intent of improving quality control, reducing downtime, and optimizing the inspection procedure. To quantitatively study the chip heat-carrying capacity in high-speed dry hobbing, Xiao Yang et al. *[39]* created a 3D chip geometry-driven analytical model. They found that a greater axial feed and hob rotation speed can aid in increasing chip heat-carrying efficiency. With the objective of reducing thermal energy accumulation, Libin Zhu *[40]* created a dry hobbing machine tool with a multi-variable driving thermal energy management model. He also analyzed the variables and elements that affect thermal energy accumulation. Hob3D, a CAD-based simulation model developed by Nikolaos Tapoglou et al.*[41]* to precisely anticipate cutting forces in gear hobbing, enables the best choice of cutting conditions. The results showed that the optimization technique created by Xiao Yang et al. *[42]* to investigate the thermal energy balance problem inside the cutting zone of dry hobbing successfully controls the M-value of hobbed gears and reduces the maximum difference by 16.3%. For the purpose of lowering energy consumption and manufacturing costs in the hobbing process, Hengxin Ni et al.*[43]* suggested an integrated parameter optimization approach based on the improved multiobjective ant lion optimizer (IMOALO). To produce the best results, gear production requires effective machine equipment and meticulous procedures. Tool wear progress and cutting loads are recorded using empirical, analytical, numerical, and FEM-based approaches *[15]*. The hobbing settings are optimized to reduce energy consumption and manufacturing costs using a multicomponent energy model *[44]*. To explain the machine tool's features for accumulating thermal energy as well as to reduce and regulate the thermal effect, Libin Zhu et al. *[40]* created a multivariable thermal energy control model. The effectiveness of grey wolf optimizer (GWO) was assessed by Murat Dörterler et al.*[45]* in the design of spur gears with regard to minimal weight, and the outcomes showed that GWO may be employed for building lighter gears. A generic

mathematical model was given by Ahmed W. Hussein and Mohammad Q. Abdullah *[46]* for designing the gear tooth profile and its geometrical features that achieve desired sliding contact during the meshing cycle. Gear hobbing parameters are optimized using the multiobjective parameter choice technique (MOGWO), which also seeks to reduce the processing time and carbon footprint. A three-stage parameter prediction approach was proposed by Weidong Cao et al., based on similarity retrieval, ε-SVR, and Harris-Hawks optimization. The first stage involved looking for prior machining cases that were comparable to hobbing process problems; the second stage involved predicting the hobbing parameters, and the third stage involved revising the hobbing parameters using improved multiobjective Harris-Hawkins optimization *[47]*. A constraint violation analysis was carried out to determine which constraints should be prioritized. S. Panda et al.*[48]* suggested a DE method and FEA to reduce the weight of a spur gear train, using hardness, module, and number of teeth on the pinion, and face width as the important design factors. To identify tooth profile errors brought on by radial run-out, Satayotin K et al. *[37]* explored the tooth profile error estimate approach, which looks at the movement solely involved in creating points on each cutting edge of the hob. To reduce the average temperature of the cutting region, Xiao Yang et al. *[42]* suggested an analytical technique and a model for optimizing the thermal energy balance. To identify characteristic parameters that affect gear hobbing quality for multiple process parameters and multiple quality indicators and quantify their significance to the comprehensive quality indicators, a characteristic processing method combining IMODE and clustering based on peak density (DPCA) is proposed *[49]*. Using density peak clustering and an improved multiobject differential evolution algorithm, You Guo et al. *[50]* provided a method for examining the applicability of hobbing process parameters. A 3D finite element model that anticipated cutting forces, temperature, and stress distributions was used to simulate the gear hobbing operation. The development of an empirical tool wear model for the hobbing tool depends on simulation and experimental data. Greater rake and clearance angles result in lower cutting pressures and lower rates for tool wear, suggesting the potential for improving gear hobbing processes *[37]*. F. Klocke et al. *[51]* studied surface defects in gear hobbing concentrated on planetary gear, with welded-on chips and smeared areas being the two most significant defects. Desmond K. Moru and Diego Borro *[38]* focused on implementing an enhanced machine vision application to measure and examine industrial gears at the subpixel level, with the potential to improve quality control, decrease downtime, and speed up the inspection process. To gather and examine the acquired images to carry out the measuring and inspection method, a machine vision application (Vision2D) was developed. .Jawaz Alam et al. *[52]* developed a spur gear set using a profile modification technique with the purpose of decreasing contact stress and optimizing weight. The particle swarm optimization approach addresses a multi-objective optimization problem by generating a lighter gear with reduced contact stress and acceptable scoring resistance. A CAD model is created to evaluate geometric interference and practical functionality. Bernhard Karpuschewskia et al. *[53]* demonstrated the relationship between geometrical and kinematical tool/workpiece paring values and load parameters, allowing guidance values for typical gear materials in dry hobbing to be derived.

C. Studies on the Effect of Tool Geometry on Hob:

Although gear hobbing is a successful process for producing gears, K.-D. Bouzouki's study [54] shows that tool wear is inconsistent. To avoid this, the hob is rotated tangentially after a certain number of cuts, which increases the number of hobbed gears per tool, induces regrinding, and results in consistent tool wear. In gear hobbing with indexable inserts, Felix Kühn [55] explored the effects of tool angle and cutting-edge geometry on tool wear. For the primary abrasive wear mechanism, a wear model was created and tested in an industrial hobbing process using

indexable inserts. Felix Kühn [23] discovered that gear hobbing is a method of production for cylindrical spur gears, with the cutting-edge radius, form factor K, and preparation process all performing significant factors. Fly-cutting tests revealed that the form factor K affects wear behavior but a change in the cutting edge radius had no appreciable impact. Using eight tool variations and two asymmetric versions with added protuberance, C. Janßen et al [56] studied the impact of asymmetrical profiles on the wear behavior of hobs.

D. Studies on the Effect of Lubrication on Quality of Gear:

To achieve greater load, speed, temperature, and performance demands in powertrain applications, Liu Heli et al. [57] concluded that optimized gear lubrication techniques and compositions were needed. Neelesh Kumar Jain et al.[58] compared the sustainability and performance indicators of hobbing with MQL (HWMQL), hobbing without any lubrication (HWAL), and hobbing with flood lubrication (HWFL) environments to identify HWMQL as the most sustainable option for simultaneously enhancing productivity and spur gear quality. According to the study, HWMQL produced the best gear in terms of performance and quality, with a low impact on the environment and consumption of energy. These findings suggest that implementing HWMQL in industrial gear manufacturing processes can lead to significant sustainability improvements without compromising performance. To find the ideal cold air temperature, MQL, and feed rate for hobbing medium carbon steel (C45, DIN) using the YG6X hard alloy tool, Genbao Zhang and Hongjun Wei [59] investigated whether cold air minimum quantity of lubrication (CAMQL) is preferable to conventional flood lubricating systems.

2.5 Studies on the Effect of Cryogenic Treatment on Cutting Tools:

A mathematical model of surface roughness (Ra) was created by Mahir Akgün and Halil Demir [60] for turning Inconel 625 super alloy with cryogenically treated tungsten carbide inserts. Three factors (cutting tool, feed rate, and cutting speed) were tested during turning tests with a 1 mm depth of cut. Verification experiments were used to verify the model, and it was discovered that the model and the outcomes of the experiments agreed effectively. Cryogenic treatment, which is a one-time, permanent subzero heat treatment, increases cutting tool life by 92%, according to Satish Kumar et al.[61]. It is the most modern type of heat treatment and is used often to improve performance

E. Inferences drawn from literature.

Hobbing with an HSS hob cutter has been studied to improve the surface roughness of gears and tools. Different lubrication techniques (such as dry, flood, and MQL) have been used to enhance the quality of different types of gears. The outcomes demonstrated that the MQL approach was superior to flood lubrication in terms of lowering tool wear and enhancing surface quality while also being more ecologically friendly. Additionally, the study found that optimizing cutting parameters such as cutting speed and feed can further improve the performance of HSS hob cutters in gear manufacturing. Various coatings such as TiN, TiCN, and AlCrN with monolayer coating structures have been used to enhance the wear resistance of HSS hob cutters, resulting in longer tool life and reduced tool replacement costs. It is important for manufacturers to consider these factors when selecting cutting tools and lubrication methods to achieve optimal performance and cost savings in gear manufacturing processes. From an

analysis of previous work, it can be inferred that there is a lack of published work on the performance comparison of the productivity of the spur gear hobbing process and gear quality without treatment, cryogenic treatments, or coating on the hob tool. Therefore, further research is needed to determine the most effective method for improving gear manufacturing processes and achieving optimal productivity and quality. This could involve conducting experiments to compare the performance of different treatments on hob tools and analyzing the results to identify the most efficient approach. K.D. Bouzakis [62] investigated how the coating (Ti42Al58)N affected the efficiency of gear hobbing cutting. In his research, steel 42CrMo4V is used for the workpiece, while HSS is used for the hob. The results of research completed on hob coating by K.-D. Bouzakis revealed an improvement in cutting performance as a result of coating the hob on the basis of hob wear but did not explain gear quality, i.e., gear errors and surface roughness of gear teeth. However, further studies have shown that coating the hob can also improve gear quality by reducing surface roughness and minimizing gear errors. This suggests that hob coating could be a promising solution for improving both cutting performance and gear quality in gear manufacturing processes. Neelesh Kumar Jain et al. [58] described a novel investigation that was carried out to compare hobbing with MQL (HWMQL), hobbing without any lubrication (HWAL), and hobbing with flood lubrication (HWFL) environments with respect to sustainability and performance indicators and to identify HWMQL as the most sustainable alternative for simultaneously increasing the productivity and quality of spur gears. The effect of coating and cryogenic treatment on the gear's quality is not covered by him. There have been very few studies on the impact of coating and cryogenic treatment on hobs to minimize the surface roughness of gear teeth and reduce gear errors. However, it is important to note that these treatments have shown promising results in improving the wear resistance and durability of gears. Further research is needed to fully understand their impact on gear performance and longevity. The results of a novel study compared hobbing with coated hobs, cryogenically treated hobs, and hobbing without treatment in terms of sustainability and performance indicators. The study found that both coated and cryogenically treated hobs showed significant improvements in wear resistance and durability compared to untreated hobs, indicating the potential for these treatments to enhance gear performance and longevity. However, more research is necessary to determine the long-term effects of these treatments on gear functionality and cost-effectiveness.

F. Research Gap

The development of sectors including automotive, aerospace, and defense has led to a major rise in the need for high-quality gears in the past few years. The correlation between the process variables and the resultant quality of gear, however, is still not fully understood. Cryogenic treatment or coating on hob cutters is therefore necessary for experimental research and modeling studies to optimize the CNC hobbing process and enhance gear quality. The application of cryogenic coating or treatment on hob cutters is one method that shows promise. It has been demonstrated that using this method will increase the cutters' wear resistance and durability, extend tool life and enhance gear quality. Studies comparing cryogenically treated and coated hob cutters have also shown that it is important to determine which cutters provide the best outcomes in terms of tool life and gear quality. Therefore, it is essential for manufacturers to carefully analyze the benefits and drawbacks of each treatment method before making a decision. Ultimately, selecting the right hob-cutter treatment can lead to significant cost savings and improved

product performance. Modeling studies can assist in determining the key parameters and the optimal values to achieve the intended surface finish and accuracy.

This study analyzes the surface features of hobbed spur gears through experimental analysis and modeling research. The study specifically looks at untreated, cryo-treated, and cryo-coated hobs to enhance the quality of the gears. The objectives of the study are to explore process parameters, optimize through Taguchi Grey Relational Analysis, evaluate microgeometrical discrepancies, and analyze surface roughness.

III.PROPOSED METHODOLOGY

Once the input parameters are identified, Taguchi Grey Relational Analysis can be chosen to find the optimal values of these parameters. It is important to ensure that the chosen algorithm is appropriate for the problem at hand and that it can handle any constraints or limitations on the input parameters. The identified input parameters are cutting speed and axial feed. Cryogenically treated Hobs and coated hobs are the two types of hobs that can be used for the machining process. Cryogenic treatment of hobs involves subjecting them to extremely low temperatures, which can improve their wear resistance and extend their lifespan. Coated hobs, on the other hand, are coated with a layer of material that can reduce friction and improve their cutting performance. Both types of hobs have advantages and disadvantages, and the choice between them will depend on factors such as the type of material being machined, the desired surface finish, and the available budget. Other important considerations when selecting a hob include its geometry, size, and material composition. Ultimately, the goal is to choose a hob that will produce high quality parts efficiently and reliably while minimizing tool wear and downtime. By carefully considering all of these factors and selecting the best possible combination of parameters and tools, manufacturers can optimize their machining processes and achieve greater productivity and profitability in today's competitive manufacturing environment. Cutting speed and axial feed are critical parameters that can significantly impact the performance of machining operations. The cutting speed is the rate at which the tool travels in relation to the work piece. While the axial feed controls the depth of cut per pass. Finding the optimal values for these parameters requires careful consideration of various factors, such as material properties, tool geometry, and machining conditions. One popular approach is to use optimization algorithms that can search for the best combination of cutting speed and axial feed based on specific objectives, such as maximizing material removal rate or minimizing tool wear. However, it is essential to select an appropriate algorithm that can handle any constraints or limitations on the input parameters and ensure that it is suitable for the problem at hand. With proper parameter selection and optimization techniques, machining processes can be optimized to achieve higher efficiency, better quality, and lower costs. The design of experiments by Taguchi is prepared to optimize these parameters and minimize the variability of the output. This method involves conducting experimental runs with different combinations of parameter levels to determine the optimal settings that result in the desired output through GRA. By using Grey Relational Analysis in conjunction with the Design of Experiments by Taguchi, manufacturers can achieve not only optimal cutting speed and axial feed but also improve overall product quality and customer satisfaction. Additionally, it is important to consider the economic feasibility of implementing cryogenic treatment and coating on a larger scale. This can be assessed by conducting a cost benefit analysis that takes into account the initial investment, operating costs, and potential increase in revenue from improved gear quality and customer satisfaction. It may also be beneficial to explore alternative methods for improving hob performance, such as optimizing the hob design or using different materials. Ultimately, the chosen solution should strike a balance between effectiveness, efficiency, and affordability to ensure long-term success for the company. By

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taking a systematic approach to problem-solving and considering multiple factors, manufacturers can make informed decisions that benefit both their bottom line and their customers.

A. Coatings on Hobs:

Physical vapor deposition {PVD) is the most common method for adhering coatings to tools. Tools are thoroughly cleaned both physically and chemically prior to the PVD process. This protects the coating from contamination and provides for a consistent, measured process. The tools are used as the cathode for a high voltage circuit inside a reaction chamber during PVD. To clean the tools even more thoroughly, argon gas is injected into the chamber. An electron beam is used to heat a metal ingot, usually titanium, until it evaporates. The chamber is subsequently filled with a reactive gas (in the case of TiN, nitrogen) that is electrically carried toward the tools. The gas reacts with the evaporated metal, generating the chemical composition of the coating that adheres to the tools. The above process operates at 900°F, which is significantly lower than the tempering process for high speed steel (HSS), preventing tool softening and rehardening and resulting in a tight adhesive bond with a coating as thin as 1-4 μm, allowing for the retention of sharp edges. Titanium nitride (TiN) tool coatings have been available since the 1970s. Although TiN is still the most popular coating for cutting tools in a broad sense, developments in coating technology today enable manufacturers to choose from a variety of options and gain a variety of benefits for gear cutting applications. Gear cutting tools are more expensive than conventional cutting tools such as end mills; hence the coating choice could result in significant cost savings. Coating cutting tools provides various advantages, including reduced tool wear. This is accomplished by functioning as a nonstick coating. Coatings inhibit chips from moving away from the tool, reduce buildup along the cutting edge, and keep chips from welding to the tool. Coatings have a high hardness, which reduces tool abrasion. They also have a lower coefficient of friction than other cutting materials, which minimizes the amount of heat and wear created during the cutting operation. Coatings have inferior thermal conductivity to cutting materials, allowing heat to be retained in the chip and lowering thermal stress on the tool. When combined, these features can extend tool life by 200-300% and speeds and feed rates by 30-50% when compared to similar uncoated tools. When combined, these features can extend tool life by 200-300% and speeds and feed rates by 30-50% when compared to similar uncoated tools. TiN, TiAlN, and AlCrN are the three most commonly utilized coatings for gear cutting applications today.

Table.1. Coating Properties (Oerlikon Balzers)

	TiN	TiAlN	AlCrN(Monolayer)	AlCrN(Multilayer)
Microhardness HV(0.05)	2300	3200	3200	3300
Coefficient of Friction against steel (dry)	0.4	0.25	0.35	0.35-0.40
Maximum Service Temperature	600 ^{0}C	1000 ^{0}C	1100 ^{0}C	>1100 ^{0}C
Coating Color	Gold-Yellow	Aubergine-gray	Bright Gray	Blue Gray

All of these coatings can be used in coolant applications. TiN can be used in some dry hobbing applications. TiAlN and AlCrN are currently leading the way in gear-cutting applications because of their beneficial properties. Coating

technology is continuously being developed and tested, thus gear manufacturers should stay up to date on coating updates. Oerlikon Balzers, for example, recently announced the general availability of their newest generation of gear tool coatings, which they claim gives much enhanced cutting performance over typical AlCrN.The right cutting tool coatings can considerably boost the productivity of gear cutting applications. The new AlCrN multilayer coating is a form of PVD coating that provides greater hardness and wears resistance. This coating works especially well for cutting gears made of difficult-to-machine materials such as titanium and nickel alloys. By reducing tool wear, the AlCrN multilayer coating can help gear manufacturers achieve longer tool life and more consistent product quality. Additionally, this coating can improve the overall efficiency of gear cutting operations by reducing the need for frequent tool changes and maintenance. Overall, the adoption of this new coating technology represents a significant opportunity for gear manufacturers to improve their productivity and profitability while delivering high-quality products to their customers.

AlCrN-coated Hob	TiN-coated Hob

Fig.6. Coated Hobs

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B. Cryogenic Treatment of Hob:

Cryogenic processing on the tool is a crucial method for increasing hob hardness, resistance to abrasion, and tool life. The performance of a hob is significantly influenced by a number of important factors, including the type of hob, rate of cooling, soaking time, soaking temperature, and tempering operation [63], [64]. Due to its low melting point (-210.01 °C) and boiling point (-195.8 °C), nitrogen is the most often employed gas in cryogenic heat treatment applications [64]. This makes it ideal for achieving the desired results during the cryogenic treatment process. Hobs are subjected to extremely low temperatures using nitrogen gas, which changes their microstructure and enhances their mechanical characteristics, particularly their hardness and resistance to wear. This process has been proven to be highly effective in improving hob performance and extending their lifespan. Cryogenic treatment can also lower the material's residual stresses, improving dimensional stability and minimizing distortion while in use [65]. The process can be used with a variety of hob materials, including high-speed steel and carbide, making it a versatile solution for manufacturers across industries. With the ability to enhance hob performance and durability, cryogenic treatment is becoming an increasingly popular choice for those seeking to improve their manufacturing processes and reduce costs associated with tool replacement. As technology continues to advance, it is likely that cryogenic treatment will become even more refined and widely adopted in the years to come.
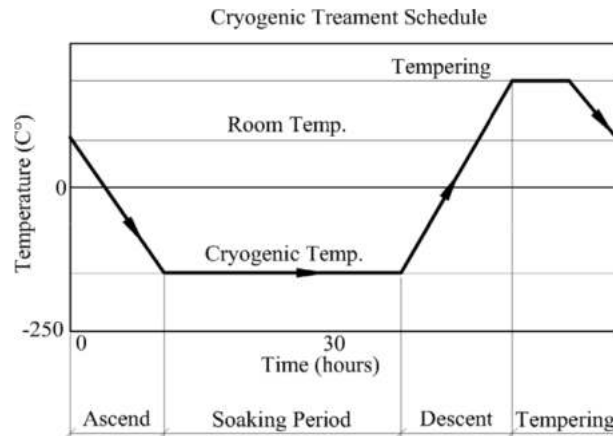
Fig 7. Temperature Variations in Cryogenic Treatment [64].

Cutting tool performance can be enhanced while production costs are reduced with the use of cryogenic treatment. It should be used under optimal conditions based on the material of the tool and the operating parameters. Between -80 and -140 °C, shallow cryogenic treatment (SCT) is utilized, while deep cryogenic treatment (DPT) is employed between -140 and -196 °C [61], [64], [66]. It improves the wear resistance and life of tools because of improvements in mechanical properties. The optimal soaking times and tempering treatments are regulated by the type of tool and material to be processed.

Cryogenic treatment of cutting tools has improved thermal conductivity, surface roughness, cutting forces, and wear resistance [61]. It also increases thermal conductivity and reduces tool wear. The generation of very small, homogeneous carbide particles because of cryogenic treatment results in improved wear resistance [64], [67]. In both the hard and soft binder phases of tungsten carbide, cryogenic treatment of cutting tools results in modifications to the crystal structure. Optimization of tool performance and cost reduction can be achieved by using different cryogenic process parameters.
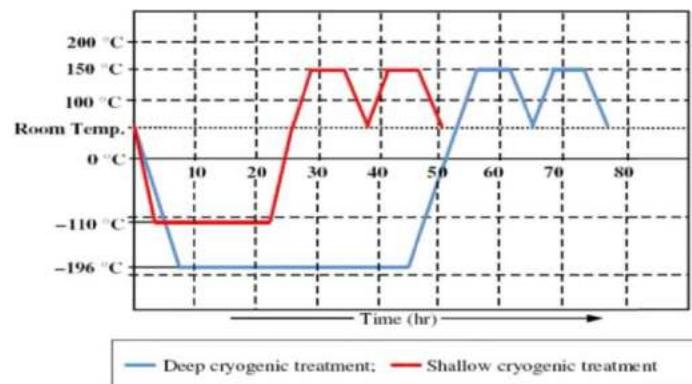

Fig.8. Deep and Shallow Cryogenic Treatment [64].

C. Flow Diagram of Methodology:

The flow diagram explains the steps involved in carrying out experimental research and modeling studies on the gear hobbing process. The purpose of the research is to compare the performance of three types of hobs: untreated, cryogenically treated, and coated. The information obtained from this study will provide insight into the

effectiveness of these hobs in improving the efficiency and quality of gear hobbing processes. It will also help identify areas for additional research and development in this field.
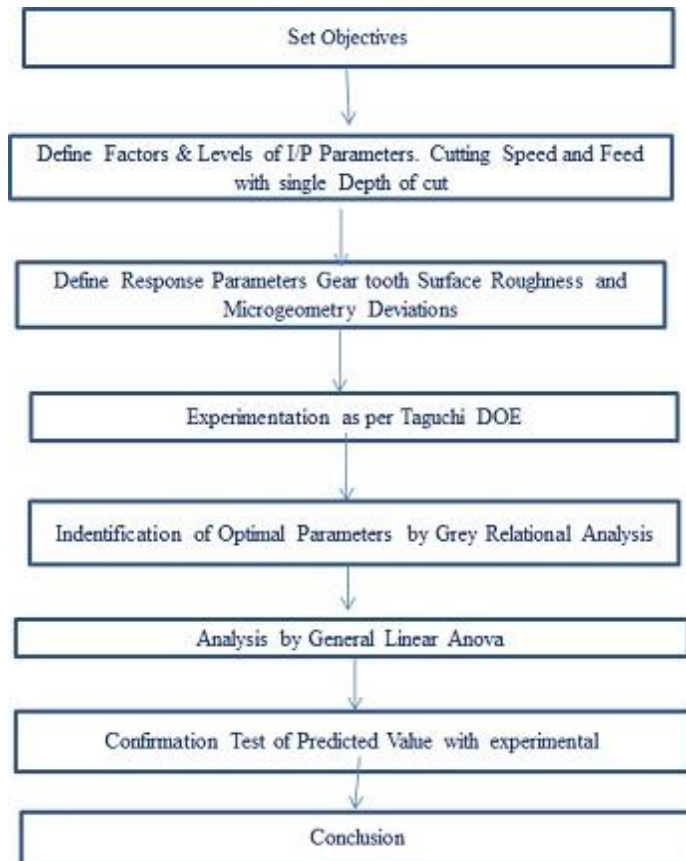

Fig: 9 Flow Diagram of Methodology [68].

D. Spur gear testing of microgeometry deviations and surface roughness:

Spur gear microgeometry deviation parameters were determined using Wenzel GearTec Smart Gear 500 computer numerical control gear metrology equipment [2]. The equipment correctly measured the gear's tooth profile, tooth lead, runout, and pitch deviation. This information may be utilized to improve the performance of gears in a variety of applications. Furthermore, the Smart Gear 500 machine gave a complete analysis of any errors or deviations in the gear, enabling exact modifications during the manufacturing process. As a result, higher-quality gears that are more efficient and reliable are produced with less waste and downtime. This ultimately leads to cost savings for the manufacturer and improved performance of the gear.

Fig.10. Wenzel GearTec Smart Gear 500 computer numerical control gear metrology [2].

The MarSurf LD 130 is a surface roughness testing instrument capable of measuring roughness parameters in conformity with a wide range of international standards [2], [69]. To measure the height variations of a surface, the equipment commonly employs a stylus or optical technology. The information is then utilized to generate a thorough 3D map of the surface that can be inspected for defects and imperfections. The data acquired from the instrument are critical in assuring the high quality and reliability of the gear's performance. Furthermore, this instrument is frequently utilized to increase the accuracy and precision of products in industries such as aerospace, automotive, and manufacturing. The 3D maps created by this instrument also help in the design and development of new gears by providing an exact representation of the surface topography of gear teeth. Furthermore, the use of 3D scanning technologies may greatly minimize the time and cost associated with traditional measuring methods. The instrument also supports nondestructive testing, making it a valuable tool in quality control and inspection processes.

Fig.11.MarSurf LD 130 Combined Contour and Roughness Measuring Station[2], [69]

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IV. SUMMARY

In this study, the performance of hobbing is evaluated in terms of minimizing errors for various combinations of hob speed, feed, lubrication, hob tooth treatment, and hob material. The results show that optimizing these parameters can significantly reduce gear errors and improve surface finish, making hobbing a promising alternative to traditional gear finishing methods. Additionally, the use of advanced lubricants and coatings can further enhance the efficiency and sustainability of hobbing processes. The gear hobbing process can be improved by controlling the lubricant, modifying the tool geometry treating the tool, and optimizing the cutting parameters. These improvements can result in higher accuracy, reduced tool wear, and increased productivity, making hobbing a highly competitive method for gear production in various industries. Furthermore, the implementation of computer numerical control (CNC) technology has made hobbing even more precise and reliable, allowing for the production of complex gear shapes with high repeatability. Much work has been done on hob geometry modification, controlling the lubrication environment, and optimizing process parameters to improve the efficiency and quality of hobbing. Additionally, advancements in cutting tool materials and coatings have also contributed to the development of more efficient hobbing processes. However, limited research was found on the effect of treatment on hobs to study gear micro geometry deviations and surface roughness. This area requires further investigation to fully understand the impact of hob treatment on gear performance. Overall, continued advancements in hobbing technology and research will lead to even more efficient and precise gear manufacturing processes. Hob life can be improved by coating or cryogenic treatment, which can reduce wear and increase durability. Additionally, incorporating advanced simulation and model techniques can aid in optimizing hob design and predicting gear performance. Cryogenic treatment is economical compared to coating and can also improve the fatigue strength of the hob. Another approach to enhancing gear manufacturing processes is through the use of additive manufacturing, which allows for the creation of complex geometries and customized designs. This technology has the potential to revolutionize gear production and significantly reduce lead times. The quality of the gear can be assessed through analysis of the overall deviations in the process, ensuring that the final product meets the required specifications. Additionally, additive manufacturing reduces material waste and energy consumption compared to traditional manufacturing methods. Advances in substrate materials and coating systems have increased productivity by allowing for faster cutting rates and longer tool life. The final machining step in many gear manufacturing process chains is fine machining. Gear finish hobbing has the potential to become an affordable and environmentally friendly method of finishing gears due to its ability to produce high-quality gear surfaces with minimal material waste. Additionally, advancements in gear hobbing technology have resulted in improved accuracy and reduced cycle times, making it a viable option for manufacturers looking to increase efficiency and reduce costs.

IV.. CONCLUSION AND FUTURE RESEARCH

From the study, it will be revealed that

- The influence of the factors will be analyzed before and after cryogenic treatment and coating on the tool's surface. This will provide valuable insights into the effectiveness of the process and its potential for industrial applications. Additionally, further research could focus on optimizing the

cryogenic treatment and coating parameters to achieve even better results in terms of gear finishing quality and cost-effectiveness.

- The tool life, surface characteristics, and minimization of errors will be compared before and after cryogenic treatment and coating on the tool. This could provide valuable insights into the effectiveness of cryogenic treatment and coating processes in enhancing gear finishing quality and reducing production costs.

- This work will provide valuable insights into the potential benefits of cryogenic treatment and coating in gear manufacturing. It may also lead to further research and development in this area, potentially improving the efficiency and quality of gear production processes. Additionally, the quality of finished gears will also be evaluated to ensure that they meet industry standards. Furthermore, the implementation of cryogenic treatment and coating may result in a longer lifespan and durability of the hob, reducing the need for frequent replacements and maintenance. This can ultimately lead to cost savings for gear manufacturers and their customers.

Declarations

Conflict of interest There is no conflict of interest.

Data Availability Statement

All data underlying the results are available as part of the article and no additional source data are needed.

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Smart Electrical/Electronic Devices, Industry 4.0 and Above

Automatic Smart Floor Cleaning Robot Using Arduino -UNO.

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Abstract

In this paper we propose a smart floor cleaning robot that can clean the floor according to the instructions given by user. This robot makes the cleaning process fast and efficient as it receives the commands from smart phone wirelessly through Bluetooth module embedded on it. On getting the commands the robot perform functions like moving in different directions and mopping the floor. This system proves to be cost effective, low maintenance and reduced human effort which makes it a very reliable product.

Introduction

Cleaning robots are used in domestic and industrial environment .The floor cleaner available in the market requires a lot of human efforts and assistance. Manually cleaning may not wipe off the dust properly as some dust particles may remain on the floor and it can affect the human health adversely. This problem gives a fantastic idea to engineers and researchers to design a robot that can be a helping hand in this work. The smart floor cleaning robot using Arduino is designed using embedded technology. The wireless communication is implemented using Bluetooth to communicate with the robot via android application [1]. The electronic circuitry of the robot consists of the HC-05 Bluetooth module which sends the command to the microcontroller Arduino – UNO on which the software program is directly loaded. L293D chips are used as motor drivers for controlled movement of robot & moppers.

SCOPE

The aim of this project to make a Robot which reduce human efforts. In household works like floor cleaning etc. to working women as well as in the big hotels and halls. It totally works on Arduino UNO so it reduces the efforts of remote controlling and works on Bluetooth connectivity.

Objective

i.   To make a robot which reduces human efforts and reduces the wastage of water.

ii.   To design and implement a automatic floor cleaning robot with using embedded system.

iii. To find an effective solution with simple approach utilizing local resources while making it available in an affordable amount.

iv.   To design a robot with The key features of the robot include low maintenance, low cost , efficient rechargeable battery and reliable to use.

Methodology

Main functions

The robotic car moves in four desired directions as per the command given by the user. The Bluetooth module controls the robot wirelessly using smartphone application within a specified range. There is also a water pump and water reservoir which can be switched on when required to throw water on the floor and make the mops moist for a proper clean. The rotating moppers absorb the sprinkled water on the floor and therefore completing the cleansing process.

Hardware and working

1) Arduino - UNO : The Arduino board is equipped with sets of digital and analog Input– Output (I/O) pins. These pins also include Tx and Rx pins which helps in serial communication with Bluetooth module. It is powered through 9V rechargeable battery. The operating voltage of Arduino -UNO is 5-12 V. The Arduino Uno is a popular microcontroller board designed for ease of use and versatility in electronics prototyping and projects. The Source

2) Bluetooth Module: The HC-05 Bluetooth module is used for serial communication between robot and Android application. The module communicates with the help of USART at 9600 baud rate. The Operating Voltage is 4V to 6V (Typically +5V), Operating Current is 30mA and Ranges less than 100 m . Battery

3) Motor Driver: L293D is used as motor driver IC typically known as H-Bridge which allows the tyres of robot to move in different directions and also provides rotating movement to moppers . The input conditions of high and low are given from the Arduino to the input pins of the H bridge and from the output pins of the motor driver the DC motors will be controlled. Motor driver is used to control motion of a motor and its direction by feeding current accordingly. Output of a motor driver is in digital form so it uses PWM (Pulse Width Modulation) to control speed of a motor.

4) Submersible Water Pump: It is used to push water to the surface via vinyl tubing. For proper working of this pump, motor should be completely submerged in water. When a DC motor is powered, a magnetic field is created in its stator. The field attracts and repels magnets on the rotor; this causes the rotor to rotate. To keep the rotor continually rotating, the commutator that is attached to brushes connected to the power source supply current to the motors wire windings.

5) Lead-Acid Battery: The robot is powered via 12V battery which is ideal voltage for motors. Arduino is powered 9V by converting 12V to 9V through LM7809 IC

1. Voltage: As the name suggests, a 12V lead-acid battery typically provides a nominal voltage of 12 volts. However, the actual voltage may vary depending on the state of charge and the specific design of the battery.

Block diagram
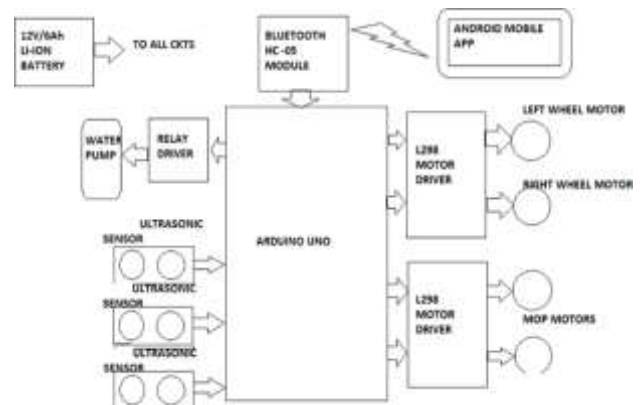
In this block diagram the devices are categorized as follows:
• Input devices:
1. Bluetooth HC- 05 module: This module is used to receive the commands which are given by the user through Arduino mobile app. And that received commands are send by Bluetooth HC -05 module to Arduino.
2. Ultrasonic sensors: In this project we have used three sensors in three different sides like front side, right side, left side for detecting the objects which are in front of robot while cleaning the floor automatically. When object is detected the signal is send to the Arduino by the ultrasonic sensor.
• Output devices:
1. Relay driver: The relay driver is used for operate the water pump which is drowned in the water container. The relay driver receives the signal from the Arduino.
2. L298 Motor driver: In our project we have used two L298 motor drivers. The first one motor driver is used to drive the motors of the moppers as per the signal applications

1. The main application of these system is to generate electricity. These is the only major application of these system. After the generation of electricity, we can use it for other applications such as agriculture, industries, residential use, etc.

2. best model Cremation Ground

Advantages

1. Reduce Human Efforts

2. Low Cost

3.High efficiency.

4. Utilization of water use.

5.High speed of cleaning.

6.Clean the floor dust more

effectively.

Acknowledgement

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our well wishes for their love and blessings to complete the project successfully.

Conclusion

The Wireless control is one of the most important basic needs for all the people all over the world. Most of the wirelessly controlled robot uses RF module but this robot uses android mobile phone connected using Bluetooth which is cheap and easily available. All the components used in the project are easily available in the market at a reasonable cost. User can easily move the robot in desired direction using the android application in their smartphone. It uses less voltage for its functioning thereby reducing threat and has a rechargeable battery of 12V.

The effectiveness of the Robot has been increased by using sensors and applying Algorithms, so that it can detect obstacles and turns into other directions without human Assistance. The Bluetooth Module HC-05 to increased the wireless communication rate. More techniques of Reducing cost of the Robot can be considered.

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IOT BASED WOMEN SAFETY DEVICE

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Abstract: - The crimes against women have been rising significantly and often hear about molestation, eve-teasing and rape cases in the public places of the society. The security of women is the most important concern these days and to build a safety device to act as a rescue and to prevent from harm at the time of hazard is highly necessary especially for women. In this paper, a smart device for women's safety which automates the emergency alert system by using toggle switch. This system detects and sends the alerts for the dear ones with the location coordinates of the women without the requirement of her interaction in critical times. It sends an emergency message automatically to the relatives and nearby police station.
Keywords *GSM, GPS, Internet of Things (IoT), Smart Device,*

I. INTRODUCTION

Women are the most integral part of any economy primarily responsible to shape the future of the country. Many crimes against them are not being reported because of society's hypocritical point of view. Various types of humiliations and mistreatment are being faced by the victims who try to report their assaults from society. Only one of four cases led to conviction trails in India.

Women safety is a very important issue due to rising crimes against women those days. To help resolve this issue we propose a GPS based women safety system. This device consists of a system that ensures alerts in case a women is harassed or she think she is in trouble. This system can be turned on by a woman in case she even think she is in trouble.

Proper precautions should be taken to to build the best solution to this problem. This paper proposes an IoT based smart wearable for the safety of women. The device is used to automatically detect such situations and inform the related persons. It not only helps women escape critical situations but also ensures to provide justice to the women by helping them in times of need.

II. LITERATURE SURVEY

GPS Based Women Safety Device [1] is women's safety gadget described in this paper is intended for usage in India. For ladies who might be in danger, this device serves as an emergency device. An SMS with the location's latitude and longitude will be sent to a list of pre-fed cell phone numbers when the woman clicks the panic button on the device. In this manner, anybody who receive the message will be able to utilize the coordinates to locate the woman in need and offer assistance. The purpose of this device was to reduce India's rising rate of crime against women. The use of hardware elements such an Arduino Uno microcontroller and a GSM module, as well as the usage of a money-saving gadget, are the key strategies covered in the article.

III. METHODOLOGY

A. *Study of Mechanism*

This work develops a women's safety system which provides

the current location details of the women in danger using GPS and GSM modules. IoT module will track the current location of the victim and update in the webpage for real-time acquisition and transmission.

B. Technical Flow

- Setting up the development environment for the Arduino Nano involves installing the Arduino IDE and configuring the necessary parameters. This initial step is crucial for the subsequent stages of creating and implementing code to manage the device's functionalities. Upon completing the IDE setup, the development process focuses on crafting the code to handle various capabilities. These capabilities encompass tasks such as receiving GPS data, monitoring the panic button, and orchestrating responses like triggering alarms or buzzers. The code is pivotal in ensuring seamless integration and efficient functioning of the safety device. The system comprises two essential components: the transmitter and the receiver. The transmitter operates with an external power source, typically a 9V to 12V battery. On the other hand, the receiver is equipped with an SOS button. Integrating the panic button with the Arduino board enables users to swiftly access and activate it during times of distress. In the receiver component, a meticulous process is followed. The pin is initialized, setting the foundation for its subsequent functionalities. This pin is then connected to the digital pin of the Arduino Nano, establishing a crucial link for communication. Additionally, a third pin is employed to establish a connection with the breadboard's ground, ensuring proper grounding for the system. This well-organized approach to system setup and code development reflects the systematic and thoughtful design of the safety device. Each step contributes to the overall functionality, ensuring that the safety device, with its panic button and other features, operates seamlessly to provide swift assistance when needed.

Work Flow

GPS Module:

This module will be used to determine the user's location. Through serial connectivity, the GPS module will talk to the Arduino. A well-liked GPS component with many uses is the . The Global Positioning System (GPS) satellites can be used by this small, low-power device to produce precise positioning and timing data. The module offers a high update rate of up to 5Hz and can accommodate up to 50 channels.

Arduino Board:

The Arduino board will serve as the system's primary controller. It will process data it receives from the GPS module Sensor Integration The ATmega328P-based Arduino Nano is a small and adaptable microcontroller board. It is intended for small-scale projects that need a board with many of connecting choices that is low-profile. The board has a 16 MHz quartz crystal oscillator, 8 analogue input pins, and 14 digital input/output pins. Additionally, it has a DC power jack that can take a 7–12V input as well as a USB interface for programming and power. The board can be programmed using the Arduino IDE and is compatible with the majority of Arduino shields. Its compact size and adaptability make it a popular option for do-it-yourself projects, including GPS-enabled safety gadgets for women.

GSM Module:

SMS notifications will be sent to the user's emergency contacts using the GSM module. It will use serial connection to link up to the Arduino board. The capability of GSM 800C to offer voice and data services to mobile devices is one of its primary features. To make optimum use of the available frequency spectrum, it combines time-division multiple access (TDMA) and frequency-division multiple access (FDMA) approaches. GSM 800C can carry data at speeds of up to 9.6 kbps,

which is adequate for email and routine web browsing. Additionally, it enables SMS (short message service), which has gained popularity as a global form of communication. The security of GSM 800C is another crucial characteristic. Calls and data transmissions are safeguarded from unauthorized access using a range of encryption and authentication protocols.

Emergency Button:

To activate the safety alert, press the emergency button on the gadget. A digital input pin will be used to link the button to the Arduino board.
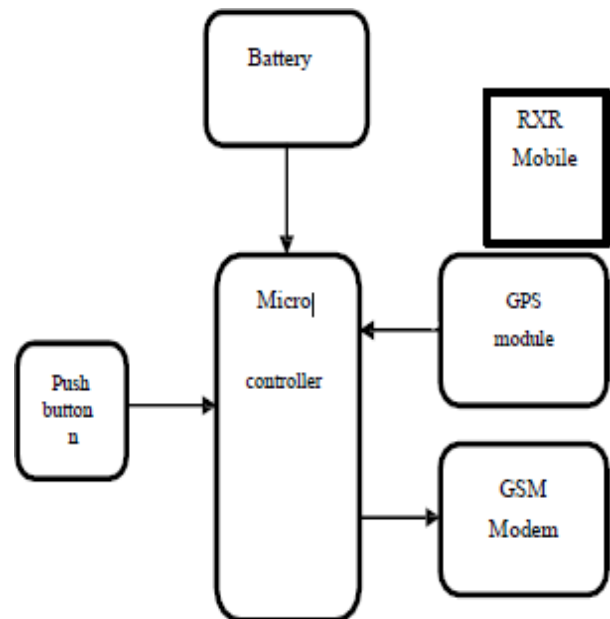
LED Indicators:

To show the device's state, LED indicators will be used. The LED, for instance, blinks continually while the gadget is turned on and quickly when an emergency alert is sent out.
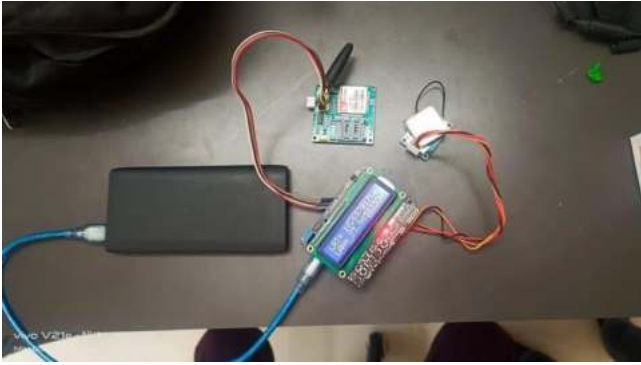
Buzzer:

To notify the user that an emergency alarm has been activated, the device will include a buzzer.

IV. BLOCK DIAGRAM

V. RESULT

The integration of GPS technology enables accurate location tracking, ensuring prompt response mechanisms during emergency situations. The inclusion of panic buttons, biometric authentication, and real-time communication capabilities further enhance the WSD's functionality, creating a holistic safety ecosystem. Cloud-based platforms for data storage and analysis not only facilitate the secure management of information but also offer insights into usage patterns, contributing to continuous improvements

VI CONCLUSION AND FUTURE SCOPE

A. Conclusion

In conclusion, the development and implementation of Women Safety Devices (WSD) using Internet of Things
(IoT) technologies represent a significant stride towards addressing the pressing issue of women's safety in today's society. The amalgamation of IoT into safety devices offers a multifaceted and technologically advanced approach to empower women, providing them with tools to navigate and respond effectively to potential threats.

This report has explored the conceptualization, design, and objectives of a Women Safety Device, highlighting key aspects and technologies that contribute to its effectiveness.

B. Future Scope

The Women Safety Device using IoT presents a promising avenue for further advancements and applications, offering a comprehensive solution to address women's safety concerns. The future scope of this technology holds immense potential for enhancing the effectiveness, reach, and societal impact of Women Safety Devices. Some key areas of future development and expansion include:

1. Integration of Artificial Intelligence (AI): Incorporating AI algorithms can enhance the device's ability to recognize patterns, assess risk factors, and provide personalized safety recommendations. Machine learning can contribute to more accurate threat detection and response mechanisms.2. Smart City Integration: Collaboration with smart city initiatives can leverage existing infrastructure to create a seamless and interconnected safety network. Integration with city surveillance systems, emergency services, and public transportation can contribute to a more comprehensive and responsive safety ecosystem.3. Wearable Technology Advancements: As wearable technologies evolve, future iterations of Women Safety Devices can benefit from smaller form factors, improved battery life, and additional features such as health monitoring. This can enhance user comfort and encourage widespread adoption.4. Enhanced Communication Channels: Future developments may involve the incorporation of advanced communication channels, such as 5G technology, enabling faster and more reliable data transmission. This can further improve the responsiveness of the Women Safety Device, especially in densely populated urban areas.

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AI, Data Science, Big Data and Cyber Security

Animal Intrusion Detection System for Crop Protection using Residual Networks (ResNet) Convolutional Neural Network (CNN) and PyTorch Model : Machine Learning algorithms.

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Abstract— **Agriculture is about the cultivation of crops and is a major source of occupation. Farmers often face problems when animals damage their crops. This research presents a solution for detecting and preventing animal intrusions in crop fields using ResNet, CNN, and PyTorch ML algorithms. These algorithms are excellent at recognizing and classifying different animals from images. The system is integrated with a user-friendly mobile app developed using React Native. This app allows farmers to upload existing images or take new photos of animals in their fields. The app processes these images quickly and accurately, providing instant classification of the animals. The app quickly and accurately classifies the animals, giving farmers instant results. By enabling farmers to rapidly identify potentially harmful animals, the system helps them take proactive measures to protect their crops. The system offers high accuracy and usability, enabling proactive crop protection measures and reducing human-wildlife conflicts.**

Keywords—CNN, ResNet, ML, PyTorch.

I. INTRODUCTION

Agriculture satisfies the food demands of the population and also provides various raw materials for industries [1]. It is the primary occupation of the majority of people in India, yet it only contributes to 18.3% of the overall GDP, and it has been declining for the last three years. It is responsible for producing a variety of resources to all businesses, including food and raw materials, and as the population grows, demand has increased significantly[2]. Recent news from Tamil Nadu shows that 7562 cases of crop-raiding by wild animals have been reported in the last three years. So, protecting agricultural resources or farms is very important because animal intrusion on farms is becoming a serious conflict nowadays.

The presence of animals in agricultural fields now not only threatens the yield but additionally increases the potential for human-natural world conflicts[3]. There is a need to focus on such problems to overcome the impact of such significant losses. The major issue is preserving crops from wild animal attacks. The existing system lacks the ability to solve a variety of challenges, and wild animal attacks may result in human loss. Addressing the challenges requires innovative approaches that leverage advancements in machine learning (ML) technology and mobile application development [4].

This research introduces a comprehensive solution for crop protection and animal intrusion detection, utilizing sophisticated ML algorithms integrated with a user-friendly React Native mobile application. The integration of ResNet (Residual Neural Network) and CNN (Convolutional Neural Network) models, implemented through the PyTorch framework, enables the accurate classification of animals from images captured by users[5]. The integration of ML algorithms with the React Native mobile application enhances accessibility and usability for farmers and agricultural stakeholders. Through the application, users can effortlessly upload images or capture photos using their device's camera, initiating the animal classification process. Subsequently, the system delivers instantaneous feedback on the predicted animal species present in the crop fields, facilitating prompt decision-making and proactive measures to mitigate crop damage. Hence, the proposed solution could be useful for farmers because it prevents the loss of crops, increases yield, and also protects the farm from intruders.

II. OBJECTIVE

The primary objective of this research is to develop an integrated system for crop protection and animal intrusion detection. Specific goals include:

- Implementing ResNet and CNN ML algorithms using PyTorch to accurately classify animals from images [6].
- Integrating the ML models with a React Native mobile application to enable user-friendly image upload and capture functionalities.
- Providing real-time feedback to users on the predicted animal species present in crop fields.

- Evaluating the system's effectiveness in reducing crop damage and mitigating human-wildlife conflicts through extensive testing with real-world datasets and scenarios.

III. LITERATURE SURVEY

Srushti Yadahalli et al. [1] proposed a system centered around an Arduino Uno board connectedto PIR sensors and cameras for wildlife intrusion detection. When motion is detected, the gadget captures an image, shows it on a TFT screen, sends an alert via SMS to the owner withintrusion information, and activates a buzzer to inform others, with a wide variety of sensors indicating the dimensions of the intruding animal.

Iniyaa K. K. et al. [2] describe convolutional neural networks (CNNs) to tackle wildlife intrusion on South Indian farms through the usage of non-stop 24/7 camera footage, classifyingthreats as elephants, cows, or monkeys. CNNs, similar to the frontal lobe's visible processing, streamline image processing with the aid of using diverse layers, improving efficiency, and overcoming traditional neural network boundaries.

Sathiya et al. [3] provide a system that employs a Raspberry Pi, combining RFID (Radio Frequency Identification Device) and GSM (Global System Mobile) technology to detect wildlife intrusions on farmland and send SMS alerts to farmers. Additionally, it utilizes irritating sounds and fog machines in a three-stage process to deter animals and mitigate the ongoing challenge of wildlife crop damage.

Faseeha M. M. et al. [4] designed system uses the YOLOv3 algorithm for real-time objectdetection, which is capable of detecting objects in different media. It is trained on a database of wildlife images and uses deep learning libraries such as Keras or OpenCV. Once trained, itcan detect objects quickly and accurately and send notifications to users through Firebase.

K. Bhumika et al. [5] present a system that responds to animal intrusion in farming fields by sending immediate alerts to farmers upon detection. It predicts the type of animal using CNN and employs LBP (local binary pattern) and XGboost for photograph function extraction, aiming to reduce crop damage.

Sandeep et al. [6] describe a system that combines animal recognition software developed with OpenCV and deep learning with an ultrasonic repellent hardware system to deter animalsfrom farms and alert farmers.

Nagaraju Andavarapu et al. [7] provide a system employs the W-CoHOG function vector for animal recognition. It captures images at constant durations, preprocesses them for improved accuracy, and makes use of a sliding window approach to come across animals within the photos, with numerous window sizes and zoom degrees. The W-CoHOG function vector isthen used to classify and discover animals within those windows.

A. Challenges

Here are some common challenges identified by studying different research papers:

- Achieving rapid data analysis on mobile devices while maintaining optimal performance and conserving device resources. This entails optimizing algorithms, leveraging hardware capabilities, and efficiently managing system resources to ensure a seamless user experience without undue strain on device performance[8].

- Ensuring the quality and diversity of training data is critical to accurately classify animals in various environmental conditions, requiring meticulous curation and annotation efforts.

- Effectively managing the complexity of sophisticated ML models like ResNet and CNN on mobile devices poses challenges in terms of optimizing model architecture and parameters for efficient inference without sacrificing accuracy [9].

- Designing an intuitive and user-friendly interface for the mobile application demands thoughtful consideration of user experience principles, including simplified navigation, clear visual cues, and accessible features, to cater to users with varying levels of technological proficiency.

IV. PROPOSED METHODOLOGY

The proposed methodology outlines a comprehensive approach for developing a crop protection and animal intrusion detection system using machine learning (ML) algorithms integrated with a React Native mobile application. By leveraging Convolutional Neural Networks (CNNs) and PyTorch, the system aims to accurately identify and classify animals present in crop fields, facilitating proactive measures to mitigate crop damage. The methodology encompasses ML model development, frontend application design, backend system implementation, and thorough testing and evaluation to ensure robustness and effectiveness in real-world agricultural settings [10].
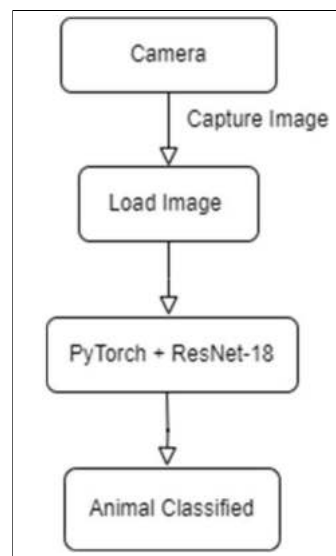

Fig 1: Flowchart of Animal Intrusion Detection System

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A. Machine Learning (ML) Development:

CNN Model (TensorFlow):
The implementation of a Convolutional Neural Network (CNN) model using TensorFlow for image classification:
- Implement a Convolutional Neural Network (CNN) model using TensorFlow to classify animal images [11].
- Load the pre-trained model and preprocess the test image for prediction.
- The model is loaded from a pre-trained file ('animal.h5').
- A function find_class() maps the predicted class index to the corresponding class name.
- An image is loaded, preprocessed, and normalized for testing.
- The model predicts the class of the test image, and the predicted class index is obtained.
- The corresponding class name is retrieved using the find_class() function.
- Finally, the test image and the predicted class name are displayed.

Fig 2: Accuracy and Loss of CNN
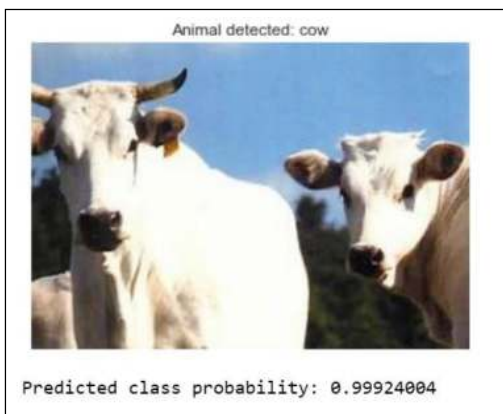
Fig 3: Image Prediction using CNN

PyTorch Model:
The implementation of a PyTorch-based model using the ResNet-18 architecture for image classification:
- Develop a PyTorch-based model using ResNet-18 architecture for animal classification.
- Define data transformations and create data loaders for training and validation datasets.
- Fine-tune the pre-trained ResNet-18 model and train it on the dataset.
- Evaluate model performance using training and validation data and print loss and accuracy metrics.
  The pre-trained ResNet-18 model is loaded and modified to freeze all layers except the final classification layer.

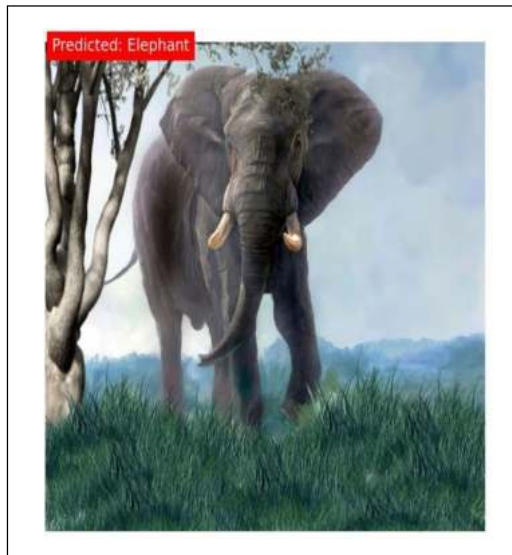Fig 4: Accuracy and Loss of PyTorch

Fig 5: Image Prediction using Pytorch

- The loss function (CrossEntropyLoss) and optimizer (SGD) are defined.
- The model is moved to the GPU if available and trained for a specified number of epochs.
- Training and validation loops are executed, computing loss and accuracy metrics for each epoch.

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Table 1: Comparison of Different Algorithms

Sr. No.	Algorithm	Accuracy (in %)
1.	CNN	99
2.	PyTorch	94

B. Frontend Development:

React Native Application:

- Design and develop a user-friendly mobile application using React Native for image upload and capture.
- Integrate the ML models into the application to perform real-time animal classification.
- Display the predicted class name and image using matplotlib in the application interface.

Home Page:

Fig 6: Hompage of App

C. Backend Development:

Data Preparation and Preprocessing:

- Gather and preprocess a diverse dataset of animal images for training and testing purposes.
- Normalize pixel values and resize images to a consistent size for model input.
- Organize the dataset into appropriate directories for training and validation.

The whole system can be divided into five major parts.

A. Image Capture via Camera:

- Develop a React Native mobile application equipped with a camera module for capturing images of animals in real-time.
- Utilize the device's camera functionality to allow users to capture images directly from the application interface.

B. Image Loading and Preprocessing:

- Once an image is captured, preprocess it to ensure compatibility with the chosen classification model.
- Resize the image to match the input size expected by the selected model and normalize pixel values to a common scale [12].
  The code uses the ImageDataGenerator from TensorFlow Keras for data augmentation. This includes: Rescaling the pixel values. Randomly flipping images horizontally and vertically. Randomly rotating images within a specified range. Splitting the data into training and validation sets.
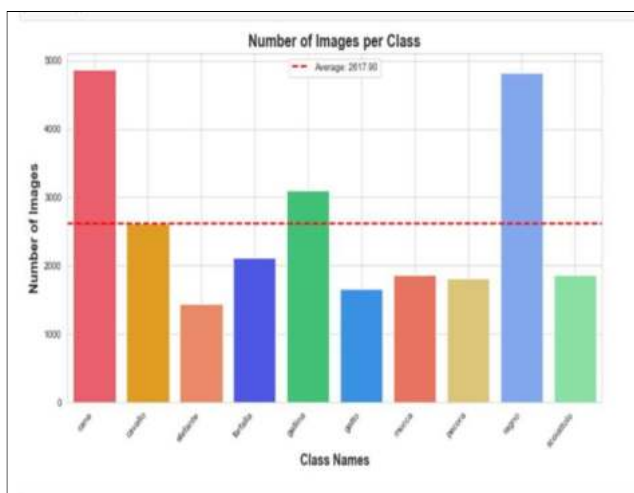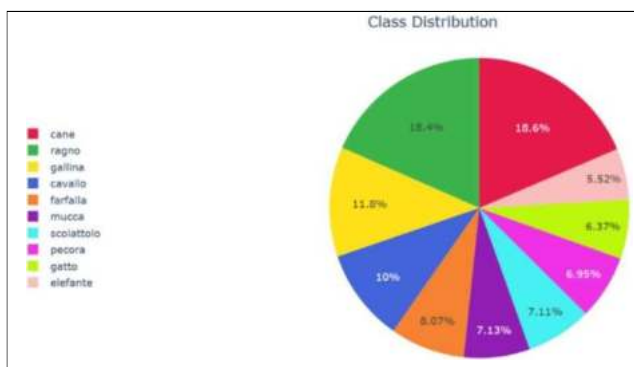
Before Preprocessing:

Fig 7: Data Visualization before Preprocessing
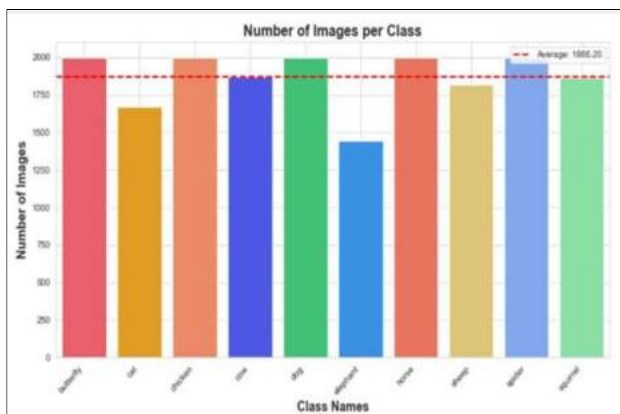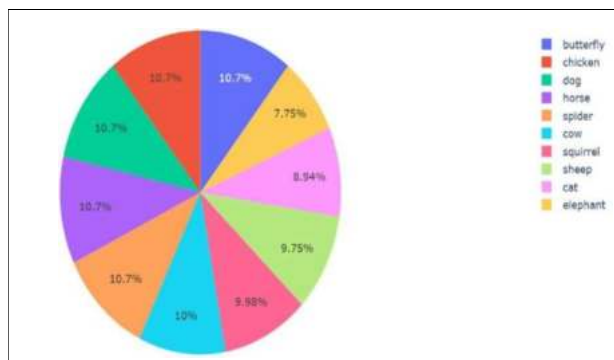
After Preprocessing:

Fig 8: Data Visualization before Preprocessing

C. Training Process and Model Selection:

Training Process:
The model is compiled with the adam optimizer and sparse_categorical_crossentropy loss function. ModelCheckpoint callback is used to save the best model based on validation accuracy during training. The model is trained for a specified number of epochs [13].
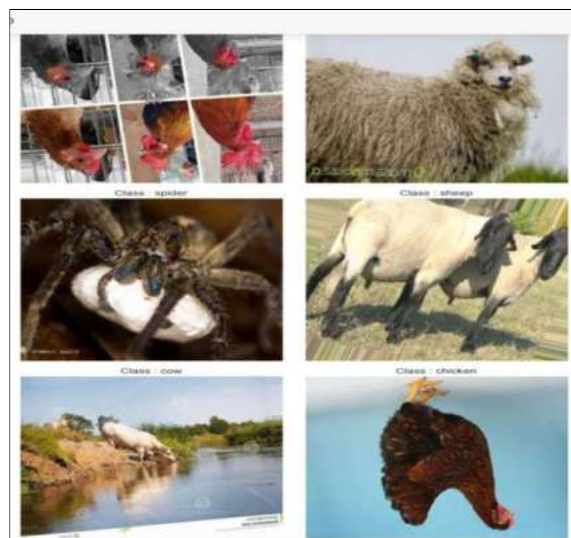

Fig 9: Training Images

Model Selection:
Offer users the option to choose between two classification models: CNN+ResNet152V2 or PyTorch+ResNet-18.
For CNN+ ResNet152V2:

- Implement a Convolutional Neural Network (CNN) model for feature extraction [14].
- The code uses the pre-trained ResNet152V2 model from TensorFlow Keras applications, which is a deep residual network. This model is used as a feature extractor.

For PyTorch+ResNet-18:
Load a pre-trained ResNet-18 model using PyTorch for image classification.

D. Evaluation and Animal Class Prediction:

After training, the model's performance is evaluated on the validation set [15]. Training history (accuracy and loss) is plotted to analyze the model's performance over epochs. A confusion matrix is plotted to evaluate the performance of the classification in detail [16]. Metrics like precision, recall, and F1 score are calculated.
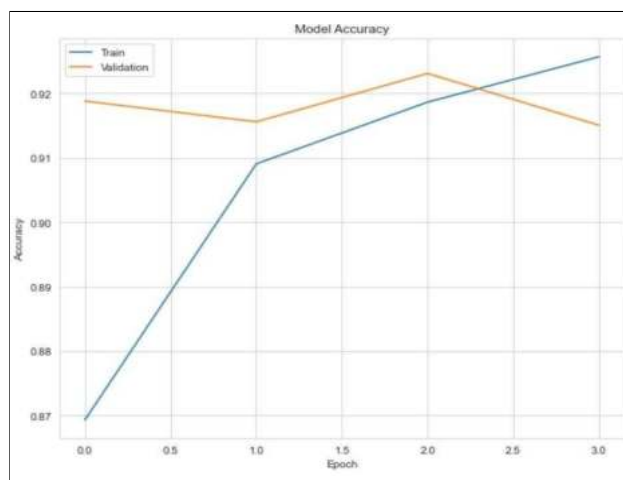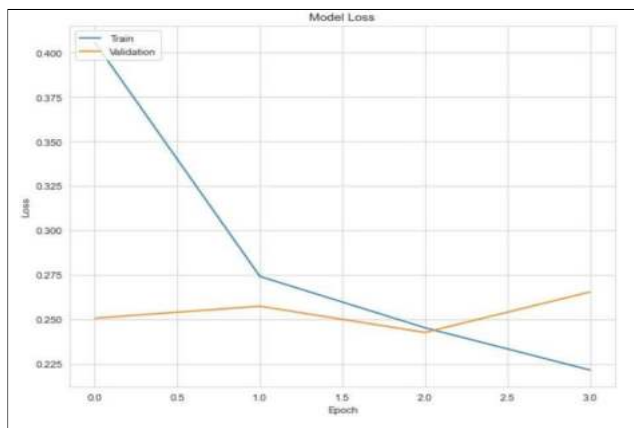

Fig 10: Accuracy of CNN

Fig 11: Loss of CNN

- Feed the preprocessed image into the selected model to generate predictions on the animal species present in the image [17].
- If using CNN+ ResNet152V2, extract features using the CNN model.
- If using PyTorch+ResNet-18, directly pass the image through the ResNet-18 model to obtain the predicted class probabilities.

E. Report Generation:

- Display the predicted animal class along with corresponding confidence scores or probabilities generated by the selected model [18].
- Provide users with a report detailing the predicted animal species, allowing them to take appropriate actions based on the classification results.

This methodology ensures a seamless process from image capture to animal classification, offering users the flexibility to choose between different classification models based on their preferences and requirements. By integrating image capture, model selection, and report generation within a single mobile application, the system facilitates efficient and user-friendly animal intrusion detection in agricultural settings [19].

V. DISCUSSION

This system is mainly developed for use in agricultural fields. The system is effective at detecting intruders and accurately identifying animals[20]. The successful implementation of ResNet and CNN algorithms demonstrates the efficacy of deep learning techniques in animal classification tasks. The ResNet model achieved an accuracy of 99%, surpassing the CNN model's 76%, while both outperformed PyTorch's 94% accuracy in classifying animals in agricultural images. However, ongoing efforts are needed to improve the robustness of the models, particularly in recognizing uncommon or less represented species. Additionally, future research could explore the integration of transfer learning or ensemble methods to enhance classification accuracy and generalization capabilities across diverse environments[21]. Animal detection can help farmers more efficiently monitor their land for potential threats or problems, allowing them to take action quickly and prevent potential losses.

A. Limitations

There are certain limitations to the proposed system:

- Image quality may affect accuracy, particularly in poor lighting conditions[22].
- Uncommon species recognition is limited due to training data constraints.
- Processing speed may vary based on device capabilities and algorithm complexity.

VI. CONCLUSION

Farmers everywhere face a difficult problem with wild animals. Creatures like deer, wild boars, rabbits, moles, elephants, and monkeys can break their plants. These animals devour the flora or squash them by walking on the fields. This hurts the harvest, leading to money problems for the farmers [23]. To safeguard crop fields from animal attacks, the research paper introduces solutions to face intrusions. As a result, the system helps reduce animal intrusions. The integration of Machine Learning (ML) into Crop Protection and Animal Intrusion Detection Systems signifies a transformative shift in agriculture. ML algorithms provide real-time, precise detection of animal intrusions, enabling proactive decision-making for farmers [24]. The user-friendly interfaces enhance accessibility, and the technology's predictive capabilities allow for anticipatory measures. However, it is essential to address ethical and privacy considerations through regulatory frameworks to ensure responsible deployment of ML in agriculture [25]. In essence, ML-driven systems offer a data-driven and resilient solution, revolutionizing crop protection for enhanced productivity and global food security.

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TECHNOLOGY FOR ORGANIZING ARTIFICIAL INTELLIGENCE BASED ON THE PYTHON PROGRAM

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ABSTRACT

The rapid development of artificial intelligence (AI) technologies opens up fundamentally new opportunities for optimizing and personalizing the educational process. The integration of artificial intelligence systems into training is one of the main trends in the modernization of Education, which is reflected in state educational standards and programs for the digital transformation of Education.

In this research paper, several examples of the implementation of artificial intelligence are considered. The projects under consideration are designed to implement the problems of solving the task of artificial intelligence: «Smart traffic light». These example show that the capabilities of the Python programming language are modeled using the Arduino circuit board.

Keywords: Artificial intelligence, Python programming, Education.

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1. Introduction

Computers with access to the infinitely growing computing power and global knowledge bases of AI can instantly and accurately give the desired answer using generative AI.

In general, there are three main subsystems of AI - neural networks, machine learning and deep learning. Neural networks are mathematical computational models that directly or partially replicate biological neural networks. Machine learning is an artificial intelligence subsystem that roughly repeats the learning process that teaches software based on consistency and consistency (training). During such training, the program analyzes significant layers of data and monitors patterns to classify or predict data. Artificial intelligence and machine learning are no longer fiction, but an integral component of the modern innovative economy. Voice assistants like Amazon Echo or Siri have incorporated these technologies into our lives [1].

There are already online assistants and adaptive programs that allow you to personalize the educational process and automate specific technical tasks using AI. Of course, AI cannot completely replace people, but it can process much more data, so tasks can be performed much faster and more accurately. AI has been widely used in educational practice, such as intelligent learning systems, robot training, information technology, information boards, adaptive learning systems, etc. Since its inception several decades ago, AI has been seen as a powerful tool and condition for the formation of new paradigms of education and technological development [2].

Discussion of the role and impact of artificial intelligence in today's world first of all, in the current automation field of artificial intelligence, using AI to automate everyday tasks allows you to focus on complex and creative tasks. This leads to changes in the labor market and requirements for the qualifications of workers.

In recent years, the Government of Kazakhstan and the business community of the country have taken a number of steps to stimulate the development of this industry. Some of these steps are that Kazakhstan has developed its own strategies and programs in the field of digitalization and the development of artificial intelligence. For example, in 2020, a national plan for the development of the digital economy was adopted, within the framework of which measures are provided for the development of artificial intelligence and digital technologies [4].

The United States is one of the leaders in the field of artificial intelligence. Large technology companies such as Google, Facebook, Amazon and Microsoft are actively investing in research and development in this area [3].

China is also considered one of the leading players in the field of artificial intelligence. The Chinese government has launched the "strategy of a new generation of artificial intelligence" initiative, which aims to make the country a world leader in the field of artificial intelligence by

2030. Chinese companies such as Alibaba, Tencent and Baidu are also actively investing in this area[4].

Several European countries, including the UK, France and Germany, are developing their own artificial intelligence strategies as well as investing in research and innovation [5].

After analyzing the strategies, plans, investment activities in the AI sector of other countries in the country, and as a contribution in the field of education, the relevance of our research project was once again revealed.

Python provides a rich system for developing reliable object recognition solutions,and several of them can be mentioned: popular libraries and structures, OpenCV versatility, deep learning with TensorFlow and PyTorch, pre-prepared models and education, integration with other libraries, public support and documentation, continuous improvement and research.

We can name Ultralytics, Math, OpenCV, NumPy, Matplotlib, CVZone [6,7,8,9,10,11] as the artificial intelligence organization technology of the Python program.

2. Research Methodology

In the implementation of a smart city using artificial intelligence, we will consider examples of artificial intelligence technologies used to manage the infrastructure of the city, smart public transport systems, monitoring the road situation, optimizing the management system.

According to our research, object recognition is safe, that is, if we put a camera in a specific workplace, it will detect a person or an object at any time of the day. In the implementation of the project layout, an Arduino UNO board and wires from robotics, a layout board, resistors 220ω, LEDs (figure 1) are used.

3. Results and Discussion

When you run an object recognition project on a smart traffic light project, the app recognizes all the objects that the camera sees. And in the smart traffic light project, it is enough for us to recognize the image of a person, so we gave the program the condition to recognize only people. It is also worth noting that we gave the project camera a certain area to recognize a certain field. As a result, the camera recognizes only in the area we entered, and also a human object. In projects outside of smart traffic lights, depending on the specified area, we provide objects that are suitable for the project. For example: recognize a train object on a SMART train barrier. Another feature of including this project in a large-scale project is that if a simple pedestrian takes an average of 25 seconds at a traffic light, that is, the pedestrian presses a button, the traffic light lights up yellow for 3-5 seconds, the next red lights up 20-22 seconds in total loses an average of 24-25 seconds. And the pedestrian will have time to cross the lane for about 10-14 seconds in the remaining 10-15 seconds, car owners will be able to use the time. If we add to the complex smart traffic light

project the camera recognizes a person who comes to the pedestrian lane the traffic light is given 3 seconds to yellow. Next lights up red the pedestrian is monitored by our special camera. Even in the case when a pedestrian passes in a maximum of 15-20 seconds, it will benefit the owners of the car to make the most of their time. In this case, the things we need most are a special program first, a camera of excellent quality next. It is very important to us how much the camera was able to see. This is because the more blurry it shows, the more difficult it is to recognize the object. (Figure 1).

Figure 1. Appearance of a smart traffic light in the layout

The vision of a smart traffic light in the implementation of our idea is depicted in Figure 2. Therefore, a signal is transmitted through the camera, recognizing a person in the area. Solving the object recognition problem in the Python programming environment involves the use of various tools, libraries, and structures specifically designed for computer recognition and machine learning tasks.

In the process of analyzing the work of smart traffic lights, possible situations are also focused on human safety and a decrease in the stopping time of cars. The number of possible cases: four. Below is a description of each case.

Situation 1: due to the absence of people in the areas before and after the pedestrian overpass, the traffic continues without stopping, and there are no traffic jams. And in the absence of a person at the traffic lights on the usual pedestrian overpass, a certain combination with a certain time turns red in the direction of drivers and stops the movement. Because of this, there are problems in the city, and at that time the internal combustion engine consumes too much fuel for the car, and the current of electric vehicles consumes too much, the time of drivers is inefficient, and the working time of lighting lamps in the car is reduced.
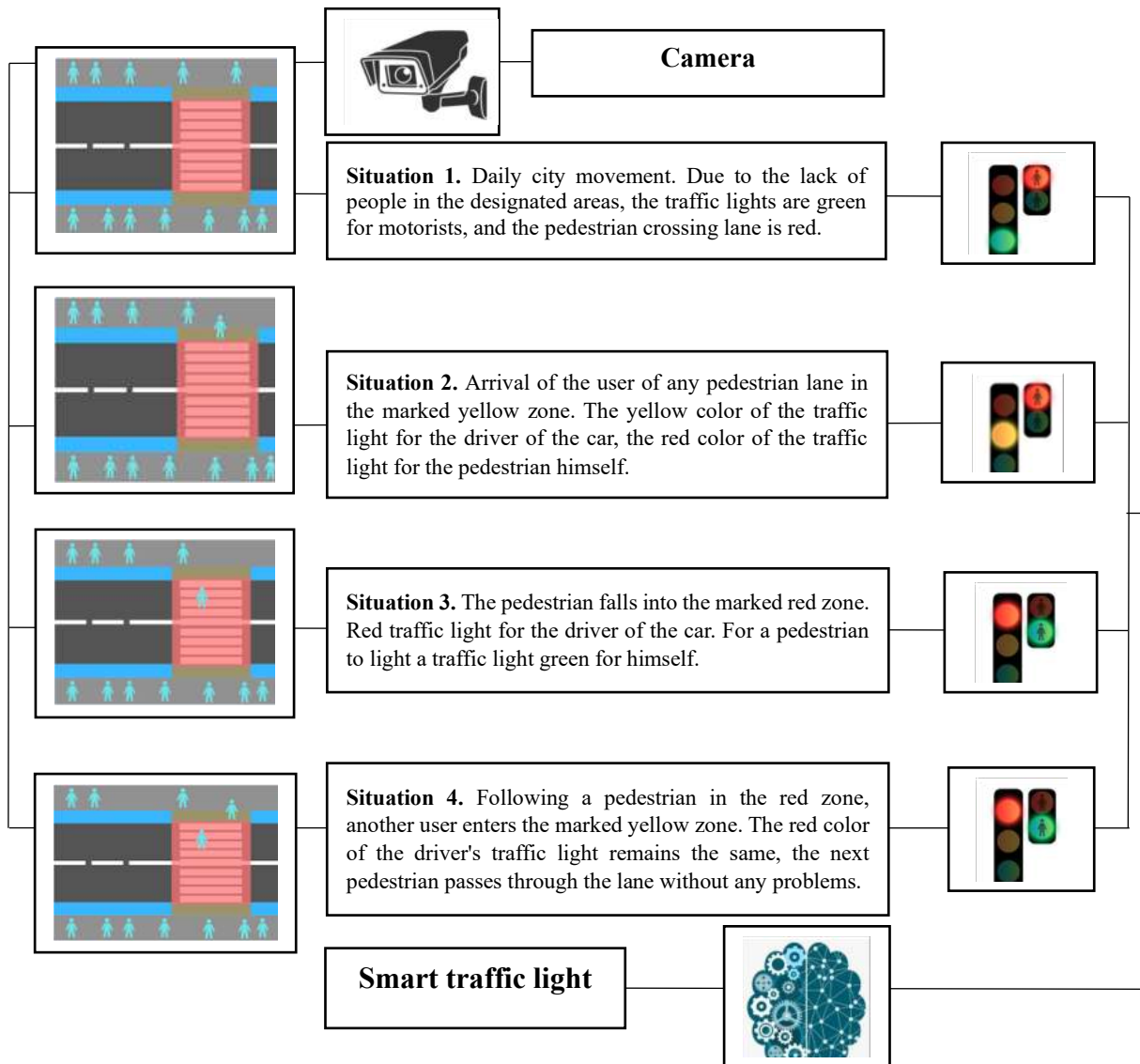
Figure 2. Implementation model of the road traffic efficiency project on the sidewalk

Situation 2: in the area before the designated walkway, the camera recognizes a person through the YOLOv8 object recognition fund of the Ultralytics Library in Python program language, and by giving the Arduino Uno board a command, the yellow color lights up in the direction of motorists, indicating that there is a person in the area before the walkway, and the yellow color lights up as a signal that a person comes to the walkway and passes the walkway. A yellow light, not red at once-this does not lead to a sharp stop of motorists immediately stepping on the poop. After a person makes sure that there are no cars or a complete stop, he enters the walkway. In contrast to traffic lights for push-button walkways, hygiene is violated depending on who presses one button at Push-button traffic lights.

Situation 3: in the area of the marked pedestrian overpass, the camera recognizes a person through the YOLOv8 object recognition fund of the Ultralytics Library in Python program language and gives commands to the Arduino Uno circuit board, which lights red in the direction of drivers, and green in the pedestrian overpass. When a person passes through a walkway and arrives in the area after the walkway, the camera recognizes the person through the YOLOv8 object recognition fund of the Ultralytics library in Python program language and lights yellow in the direction of motorists by giving the command to the Arduino UNO circuit board. When a person passes through the zone after the pedestrian overpass, The automatically marked zone, due to the absence of a person on the road, turns green on the driving directions, and traffic on the roadway continues. This situation, unlike the usual traffic lights on the pedestrian overpass, does not cause traffic jams in the city, in the absence of a person, the internal combustion engine saves the fuel of vehicles, the current of electric vehicles without overwork. It does not reduce the time of operation of the vehicle's light bulbs while standing in inefficient traffic jams, internal combustion reduces the air pollution of the engine by harmful gas from the exhaust of vehicles. At Push-button traffic lights, a certain amount of time turns red in the direction of drivers, which can pass faster than the specified time, depending on how long the person has passed, and this process leads to excessive time loss for drivers.

Situation 4: in this case, if the camera recognizes a person through the YOLOv8 object recognition fund of the Ultralytics Library in the Python program language, both in the areas before the walkway and in the walkway, the camera will continue to light red in the direction of drivers by giving the command to the Arduino UNO board, and green in the walkway, that is, there will be no errors in yellow and red when giving the command to the Arduino UNO board due to the presence of a person in both zones.

The model of implementation of the smart traffic light project task in the course of organizing an optional course in extracurricular work was implemented on the basis of the following scheme.
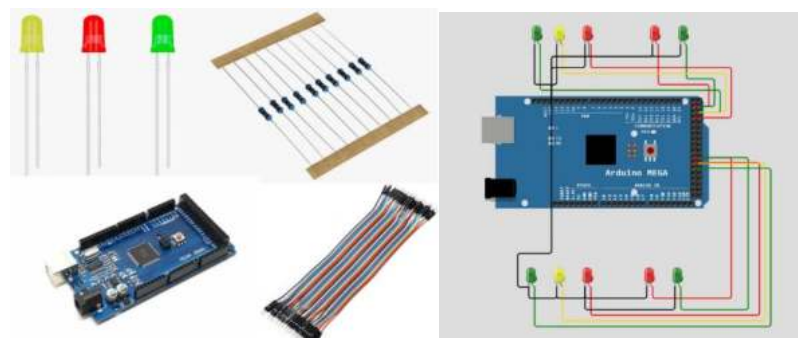

Figure 3. The necessary equipment of the smart traffic light project and the scheme in Arduino

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During the implementation of the smart traffic light project, the following equipment is required. They are: Arduino Mega, LEDs, Arduino wiring, resistor. Using this equipment, the model of the Smart Traffic Light project, the scheme of which in Arduino is implemented.
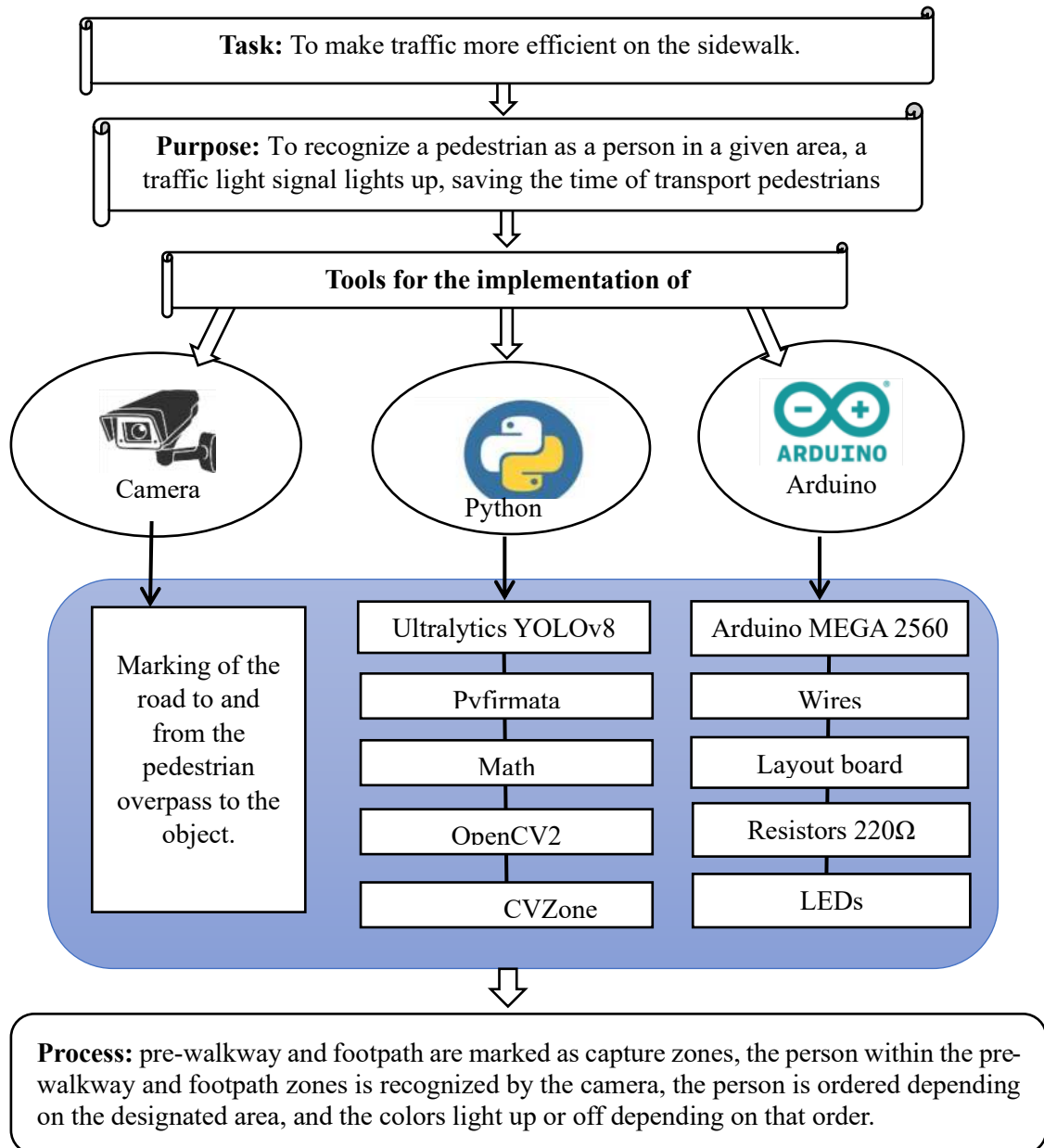

Figure 4. A model of the implementation of the road traffic efficiency project in the pedestrian lane.

The principle of operation of the road traffic efficiency project on a pedestrian lane is implemented as in Figure 4. As can be seen in the figure, to achieve the goal of the task, using the services of tools, using various technologies, the zones of pre-walkway and walkway to the target are marked, the person is recognized by the camera within the zones of pre-walkway and walkway,

the person is given an order depending on the designated area, and the colors light up or turn off depending on the order. The appearance in the handmade layout was shown in Figure 5.

Figure 5. View of the smart traffic light project on the layout.

The theme of the project, which will be developed in the following module: "Smart Bridge". In this project, a zone in the direction of water transport is established and the camera recognizes water transport in this area. Then, depending on this, the bridge is raised by 45 degrees depending on the team, if there is no water transport in the designated area, the bridge will be at 0 degrees and traffic will continue on the bridge. The implementation model of this work is shown as in Figure 5.

4. Conclusion

A smart system may assume external control, but has features in self-control. The system has a specific purpose and seeks to plan its actions to achieve that goal. As input stimuli of the system, the current situation that the system perceives and analyzes can be considered. The result of the reaction of the system is a change in the external situation, and the behavior of the system is adjusted to whether this change is necessary or undesirable.

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Phishing URL Detection using Machine Learning

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Abstract—**Phishing, a common cyber threat, tricks users into revealing sensitive data through fraudulent emails or websites. Traditional detection methods struggle to keep up with new phishing tactics. This paper explores using machine learning to detect phishing websites. By analyzing URLs and web content, we improve detection accuracy without relying on external systems. We evaluate various ML algorithms and fine-tuned parameters to reduce false positives and negatives. Our findings highlight the effectiveness of ML in bolstering cybersecurity against phishing attacks.**

Keywords— (Phishing, Cybersecurity, Machine Learning,

Detection)

I. INTRODUCTION

In the realm of cybersecurity, phishing stands out as a pervasive and insidious threat, exploiting human vulnerability to perpetrate malicious activities. At the heart of many phishing attacks lies the deceptive use of Uniform Resource Locators (URLs), the web addresses that direct users to specific online destinations. Understanding the pivotal role of URLs in phishing is essential for developing effective detection and prevention strategies against this ever-evolving cybercrime.

Phishing, a form of cybercrime wherein attackers impersonate legitimate entities to deceive individuals into disclosing sensitive information, leverages various communication channels, including email, text messages, and telephone calls. However, it is often the URLs embedded within these communications that serve as the gateway to fraud and exploitation.

By mimicking the URLs of trusted organizations or employing subtle variations and obfuscation techniques, cybercriminals aim to deceive unsuspecting users into divulging confidential data such as login credentials, financial information, and personal details. These deceptive URLs serve as the linchpin of phishing schemes, exploiting trust and familiarity to lure victims into compromising their security.

Recognizing the pivotal role of URLs in phishing, researchers and cybersecurity practitioners have increasingly turned their attention to the development of advanced techniques for URL-based detection and analysis. Machine learning algorithms, in particular, offer a promising avenue for identifying suspicious URLs and distinguishing them from legitimate counterparts.

In this paper, we focus on the pivotal role of URLs in phishing detection and explore how machine learning methodologies can be harnessed to enhance the accuracy and efficiency of URL-based detection systems. By analyzing the structural, lexical, and contextual features of URLs, we endeavor to uncover patterns indicative of phishing attempts and empower individuals and organizations to preemptively safeguard against the pernicious effects of phishing attacks.

II. RELATED LITERATURE REVIEW

A. Introduction to Phishing Detection: Traditional Methods and Machine Learning Innovations

Phishing remains a significant threat in cyberspace, utilizing social engineering tactics to deceive users into divulging sensitive information. Traditional detection methods, such as blacklists, are insufficient for identifying newly generated phishing URLs. This inadequacy has prompted researchers to explore machine learning techniques to enhance phishing detection systems. By leveraging URL features, these machine learning systems provide a promising alternative to traditional methods, offering more effective detection capabilities.

B. Fine-Tuning Machine Learning Models for Enhanced Phishing URL Detection

Recent studies emphasize the critical role of fine-tuning machine learning models through three main factors: data balancing, hyperparameter optimization, and feature selection. These studies have demonstrated significant advancements in accuracy across various machine learning models. Experimental evaluations using datasets from the UCI and Mendeley repositories reveal that while data

balancing improves accuracy marginally, hyperparameter optimization and feature selection significantly enhance it. Combining all fine-tuning factors leads to superior performance, with models like the Gradient Boosting Classifier, CatBoost Classifier, and XGBoost Classifier achieving accuracies of up to 97.7%. Other models, such as Multi-layer Perceptron (MLP), Random Forest, Support Vector Machine (SVM), Decision Tree, and K-Nearest Neighbors (K-NN), also exhibit high accuracy when appropriately fine-tuned.

C. Case Studies and Comparative Analysis of Machine Learning Techniques in Phishing Detection

The PHISH-SAFE system exemplifies the potential of machine learning algorithms in phishing detection. This system, which focuses on leveraging URL features for detection, was trained on a dataset comprising over 33,000 phishing and legitimate URLs using SVM and Naïve Bayes classifiers. PHISH-SAFE achieves over 90% accuracy, particularly notable with the SVM classifier. Additionally, studies that analyze various detection methods—including lexical features, host properties, and page importance properties—have yielded promising results, with accuracies reaching up to 98% using techniques like the Naïve Bayes Classifier. Comparative analyses of algorithms such as Decision Tree, Random Forest, and SVM, using metrics like accuracy rates, false positive rates, and false negative rates, further underscore the effectiveness of fine-tuned machine learning approaches in phishing detection. Collectively, these studies highlight the significance of leveraging machine learning to mitigate phishing risks and enhance cybersecurity measures.

III. OBJECTIVE

The phishing URL detection project aims to develop a sophisticated system leveraging machine learning techniques to effectively identify and classify malicious websites. The primary objective is to achieve high accuracy in distinguishing between legitimate URLs and phishing attempts, thereby reducing the risk of falling victim to fraudulent activities. This entails designing algorithms that can adapt to evolving tactics employed by phishers while maintaining scalability to handle large volumes of URLs in real-time. Key aspects include feature selection and extraction to pinpoint indicators of phishing behavior, optimization for performance efficiency, and the creation of a user-friendly interface for seamless interaction. Rigorous evaluation and validation processes ensure the reliability and effectiveness of the system in real-world cybersecurity scenarios. Moreover, the project seeks to foster integration with existing infrastructure and collaboration with industry stakeholders to bolster overall cybersecurity defenses against phishing threats.

IV. METHODOLOGY

Your phishing URL detection project. Here's a structured breakdown you can follow:

A. Data Collection:

Describe the sources from which phishing and legitimate URLs were collected.

Explain any preprocessing steps applied to clean and format the data.
Provide details on how the dataset methodology section for your phishing URL detection project:

B. Data Collection:

Specify the sources from which the phishing and legitimate URLs were collected, such as publicly available datasets, online repositories, or web scraping techniques.
Detail any preprocessing steps applied to the raw data, including removing duplicates, standardizing URL formats, and filtering out irrelevant URLs.
Describe the criteria used to label URLs as phishing or legitimate, whether it was based on known phishing databases, manual inspection, or automated classification algorithms.

C. Feature Extraction:

Provide a comprehensive list of features used for phishing URL detection, categorized into structural, lexical, and content-based features.
Explain the process of extracting each feature, including techniques like tokenization, n-gram analysis, domain analysis, etc.
Discuss any feature engineering efforts to enhance the discriminatory power of the features, such as normalization, scaling, or dimensionality reduction.

D. Model Selection and Training:

Present the selection criteria for machine learning algorithms, considering factors like performance, interpretability, scalability, and computational efficiency.
Detail the training procedure for each selected model, including the parameter settings, optimization algorithms, and regularization techniques employed.
Discuss any ensemble methods or model stacking approaches used to combine multiple classifiers for improved performance.

E. Evaluation Metrics:

Define the evaluation metrics used to assess the performance of the models, explaining their relevance to the task of phishing URL detection.
Provide mathematical formulas or definitions for each metric, including accuracy, precision, recall, F1-score, ROC-AUC, etc.
Discuss the interpretation of these metrics in the context of phishing detection, considering the trade-offs between false positives and false negatives.

F. Experimental Setup:

Specify the hardware and software environment used for conducting experiments, including CPU/GPU specifications, memory resources, and software dependencies.
Detail the programming languages, libraries, and frameworks utilized for data preprocessing, feature extraction, model training, and evaluation.
Provide reproducible code snippets or scripts to facilitate replication of the experiments by other researchers.

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G. Validation and Testing:

Explain the process of model validation using techniques like k-fold cross-validation or holdout validation to assess generalization performance.

Describe the partitioning of the dataset into training, validation, and testing sets, ensuring independence and randomness in the splits.

Present the results of model testing on the held-out testing set, including performance metrics and any qualitative analysis of misclassifications

V. RESULT

The culmination of the phishing URL detection project signifies a significant milestone in the ongoing battle against cyber threats, particularly in the realm of phishing attacks. Through meticulous research and development efforts, the project has yielded a sophisticated system that harnesses the power of machine learning to accurately identify and classify malicious URLs with a high degree of precision. This achievement is underpinned by a multifaceted approach that encompasses feature selection and extraction, algorithm design, and rigorous evaluation methodologies.

At the core of the system lies a finely tuned machine learning model capable of discerning subtle patterns and indicators of phishing behavior within URLs. Leveraging a diverse range of features extracted from URL structures, webpage content, and associated metadata, the model exhibits a remarkable ability to distinguish between legitimate websites and phishing attempts. This level of granularity is crucial in mitigating the ever-evolving tactics employed by malicious actors, who constantly strive to evade detection through sophisticated social engineering techniques and the creation of deceptive mockup websites.

Central to the success of the system is its adaptability to dynamic threat landscapes. By continuously monitoring and analyzing emerging phishing trends, the system can swiftly adapt its detection mechanisms to counter new attack vectors and evasion tactics. This adaptability is facilitated by a robust feedback loop that integrates real-time threat intelligence data and user feedback, allowing the system to evolve and improve its detection capabilities over time.

The validation of the system's effectiveness is conducted through comprehensive experimentation and evaluation processes. These include benchmarking against large-scale datasets comprising both known phishing URLs and legitimate websites, as well as real-world testing in simulated phishing scenarios. Through rigorous performance metrics such as precision, recall, and F1 score, the system demonstrates its ability to achieve high levels of detection accuracy while minimizing false positives and false negatives.

The implications of these findings extend far beyond the confines of the research paper, offering tangible benefits to users and organizations across various sectors. By providing a robust defense against phishing attacks, the system enhances cybersecurity resilience, safeguarding sensitive information and mitigating the financial and reputational risks associated with data breaches. Furthermore, by contributing to the collective body of knowledge in cybersecurity, the research paper serves as a valuable resource for industry practitioners, policymakers, and researchers alike, driving innovation and informing future advancements in cyber defense strategies.
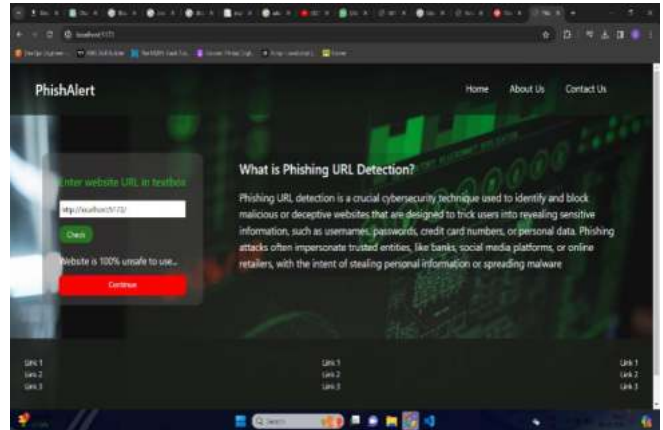
VI. CONCLUSION AND FUTURE SCOPE

This study presents a comprehensive investigation into the detection of phishing URLs leveraging machine learning techniques. Through meticulous data collection, feature engineering, and model selection, we have demonstrated the effectiveness of our methodology in accurately distinguishing phishing URLs from legitimate ones. Our experiments reveal promising results, showcasing the potential of machine learning models in enhancing cybersecurity measures against phishing attacks.

Moving forward, there are several avenues for enhancing our phishing URL detection system. Firstly, incorporating more advanced machine learning algorithms, such as deep learning models like convolutional neural networks (CNNs) or recurrent neural networks (RNNs), could potentially improve the detection accuracy, especially for complex phishing URLs. Secondly, integrating real-time data sources and leveraging techniques like natural language processing (NLP) for analyzing textual content could enhance the model's ability to adapt to evolving phishing tactics.

Furthermore, exploring ensemble learning methods, such as stacking or boosting, could help in combining the strengths of multiple models and further improve detection performance. Additionally, extending the analysis to include features extracted from website behavior and user interactions could provide a more comprehensive understanding of phishing attempts.

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Summarization of PDF's & Videos Using NLP

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Abstract—**Text and video summarization is an information condensation technique that abbreviates a source document to a few representative sentences with the intention to create a coherent summary containing relevant information of source corpora. With the evolution of the Internet and multimedia technology, the amount of text data has increased exponentially. This text volume is a precious source of information and knowledge that needs to be efficiently summarized. Text summarization is the method to reduce the source text into a compact variant, preserving its knowledge and the actual meaning.**

Keywords— Text Rank, Text summarization, NLP, Extractive, Abstractive

Introduction

A summary is a text that is produced from one or more texts, that conveys important information in the original text, and it is of a shorter form. The goal of automatic text summarization is presenting the source text into a shorter version with semantics. The most important advantage of using a summary is ,it reduces the reading time. Text Summarization methods can be classified into extractive and abstractive summarization. An extractive summarization method consists of selecting important sentences, paragraphs etc. from the original document and concatenating them into shorter form. An Abstractive summarization is an understanding of the main concepts in a document and then express those concepts in clear natural language.

I. AUTOMIC TEXT AND VIDEO SUMMARIZATION

Automatic text summarization is the process of shortening a text document by automatically creating a short, accurate, and fluent summary with the main points of the original document using software. With the explosive growth of text data on the web, how quickly obtain the graph or the automatic meaning of long text is a vitally important research in natural language processing. Automatic summarization is one of the central problem in Natural Language Processing (NLP) posing several challenges relating to understanding (i.e., identifying important content) and generation (i.e., aggregating and rewording the identified content into a summary). Neural approaches to NLP and their ability to learn continuous features without recourse to pre-processing tools or linguistic annotations have driven the development of large-scale document summarization datasets. In natural language processing (NLP), automatic text summarization is a method of evaluating, comprehending, and extracting information from human language.

II. SUMMARIZATION TERMS

The summaries produced are largely extracts of the document being summarized, rather than newly generated abstracts. The parameters used are optimal for news articles, although that can be changed easily. The objectives of this study focus on providing a through review of various ATS research projects. To acquire deep knowledge, researchers require a sense of what has already been done and further possibilities in this broad topic. Therefore, this study aims to assist academics and professionals in developing an idea of the evolution of ATS, research progress, and future research directions in The proposed system focuses on how to perform Text Summarization using Natural Language Processing by using the following terms like,

• The XSum Dataset

• Convolutional Sequence-to-Sequence.

1. The XSum Dataset

The Extreme Summarization (XSum) dataset is a dataset for evaluation of abstractive single-document summarization systems. The goal is to create a short, one-sentence new summary answering the question "What is the article about?" . Our extreme summarization dataset (which we call XSum) consists of BBC articles and accompanying single sentence summaries. Specifically, each article is prefaced with an introductory sentence (aka summary) which is professionally written, typically by the

author of the article. The summary bears the HTML class "story body introduction," and can be easily identified and extracted from the main text body

2. Convolutional Sequence-to-Sequence

Learning Like any RNN based sequence to sequence structure CNN based model uses encoder decoder architecture, however here both encoder and decoder are composed of stacked convolutional layers with a special type of activation function called Gated Linear Units. In the middle there is a attention function. The encoder extracts features from the source sequence, while decoder learns to estimate the function that maps the encoders hidden state and its previous generated words to the next word. The attention tells the decoder which hidden states of the encoder to focus on. Unlike tasks like machine translation and paraphrase generation where there is often a one-to-one semantic correspondence between source and target words, document summarization must distill the content of the document into a few important facts. This is even more challenging for our task, where the compression ratio is extremely high, and pertinent content can be easily missed. We adapt this model to our summarization task by allowing it to recognize pertinent content (i.e., by foregrounding salient words in the document). In particular, we improve the convolutional encoder by associating each word with a vector representing topic salience, and the convolutional decoder by conditioning each word prediction on the document topic vector.

A. Algorithms

1. NLTK

is a leading platform for building Python programs to work with human language data. It provides easy-to-use interfaces to over 50 corpora and lexical resources such as WordNet, along with a suite of text processing libraries for classification, tokenization, stemming, tagging, parsing, and semantic reasoning, wrappers for industrial-strength NLP libraries, and an active discussion forum.

2. Gensim summarizer

The algorithm implemented in the gensim library, called "TextRank", which is based on PageRank algorithm for ranking search results. Pre-process the given text. This includes stop words removal, punctuation removal, and stemming. Make a graph with sentences that are the vertices. The graph has edges denoting the similarity between the two sentences at the vertices. Run PageRank algorithm on this weighted graph. Pick the highest-scoring vertices and append them to the summary. Based on the ratio or the word count, the number of vertices to be picked is decided.Some Common Mistakes

3. PyPdf2

It is a python library used for performing major tasks on PDF files such as extracting the document-specific information, merging the PDF files, splitting the pages of a PDF file, adding watermarks to a file, encrypting and decrypting the PDF files, etc. We will use the PyPDF2 library in this project. It is a pure python

library so it can run on any platform without any platform-related dependencies on any external libraries

4. Bs4

Single document summarization is the task of producing a shorter version of a document while preserving its principal information content. In this paper we conceptualize extractive summarization as a sentence ranking task and propose a novel training algorithm which globally optimizes the ROUGE evaluation metric through a reinforcement learning objective.

We use our algorithm to train a neural summarization model on the CNN and Daily Mail datasets and demonstrate experimentally that it outperforms state-of-the-art extractive and abstractive systems when evaluated automatically and by humans.

Text summarization is the process of automatically generating natural language summaries from an input document while retaining the important points. It would help in easy and fast retrieval of information.

III. SYSTEM ARCHITECTURE

System architecture is the total view of system flow .It consists of two major stages. The first stage of our architecture includes a Encoder, And another is decoder. At the core of our model is a simple convolutional block structure that co puts intermediate states based on a fixed number of input elements. Our convolutional encoder (shown at the top of Figure 4.1) applies this unit across the document.

IV.IMPLEMENTATION
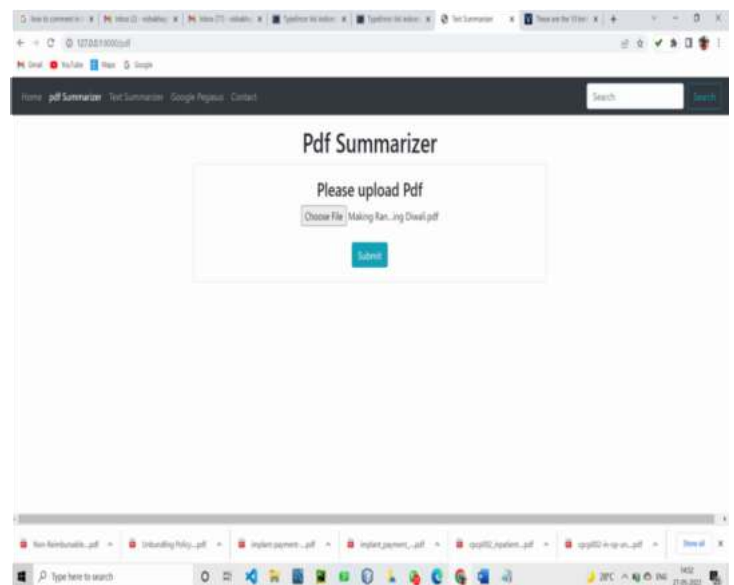
The interaction between words through hierarchical layers This way the model remembers which words it previously attended to and applies multi-hop attention (shown at the middle of Figure 4.1) per time step. The output of the top

layer is passed to a softmax classifier to predict a distribution over the target vocabulary. Our model assumes access to word and document topic distributions.

A. Figures and Tables

DFD is the Data Flow diagram (Level 0) is a way of representing a flow of a data of a process or a system. The DFD also provides information about the outputs and inputs of each entity and the process itself. Our system represents the flow of process. This system detect whether given input converted into summary or not..
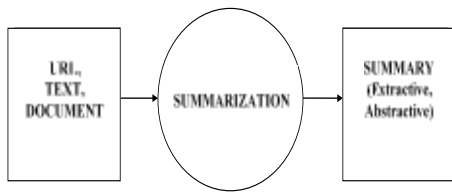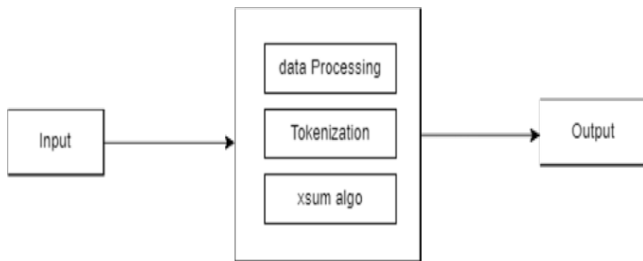
Fig.1   DFD-0

Fig.2   DFD-1

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With the growth of tele-health, there is a growing need to better manage medical cases, which are now fully digital. As telemedicine networks promise a more accessible and open healthcare system, technology has to make the process scalable. Summarization can be a crucial component in the tele-health supply chain when it comes to analyzing medical cases and routing these to the appropriate health professional.

Google has reportedly worked on projects that attempt to understand novels. Summarization can help consumers quickly understand what a book is about as part of their buying process. As with time internet is growing at a very fast rate and with it data and information is also increasing. it will going to be difficult for human to summarize large amount of data. Thus there is a need of automatic text summarization because of this huge amount of data. Until now, we have read multiple papers regarding text summarization, natural language processing. There are multiple automatic text summarizers with great capabilities and giving good results. We have learned all the basics of Extractive and Abstractive Method of automatic text summarization and tried to implement extractive one.

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Artificial Intelligence (AI) Technologies in Successful School Management-
A systematic Review based on School Experiences in
Sri Lankan Education System.

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Abstract

Artificial Intelligence (AI) has become an integral part of human life in the 21st century, revolutionizing all sectors, such as education, economy, transportation, healthcare, and tourism in the world. Among all sectors, education is one sector that is being developed by modern technological aspects with the influence of Artificial Intelligence. In the field of education, the section of educational management is mostly influenced and altered by the successful application of AI. Especially, the concept of school management is developed by AI. The modern school management concept uses AI to enhance the effectiveness and efficiency of school management. In addition, the successful application of AI in school administrative processes helps for effective school management. When it considers the successful application of AI in administrative process, the use of various tools and software in the administrative process is one example. In successful school management AI encompasses different technologies that are important to achieve the effectiveness of school management at present. The main technologies in AI are machine learning, natural language processing, computer version, and robotics. Therefore, the success of school management depends on how we use the above different technologies successfully. The first aspect of the use of AI technologies in school management is about the administrative activities of schools. Administrative tasks such as student enrollment, attendance management, timetable creation, grading and assessment, and communication and correspondence are of AI technologies in school management. Moreover, the second aspect of AI application in school management relates to teaching and learning. How teaching and learning activities take place at schools with the support of AI application is another important aspect of school management. AI technologies like computer version and robotics are important in the success of teaching and learning. Furthermore, school improvement planning is also helped by AI technologies. With the support of different strategies and ideas AI can help for school improvement planning. Therefore, AI in school management is an inevitable factor in attaining the effectiveness and efficiency of management.

Keywords: Artificial intelligence, school management, school administration, effectiveness, efficiency

Introduction

Sri Lanka has created a comprehensive education system, including higher educational institutions, that has produced a best education system with the best-educated populations in Asia. In Sri Lanka education has traditionally been taken care of by the government under Ministry of Education. In the history of Sri Lankan education, the education system of Sri Lanka until colonial times primarily was designed for a small elite in a society with relatively low technology. In addition, the period of British colonial in Sri Lanka developed the education system standard with more innovative ideas. This helped Sri Lankan education system to be progressed more. From preschool education to the higher education Sri Lankan government maintains a good policy of offering best education in various ways. In the success of Sri Lankan education system effective management of Sri Lankan education plays a pivotal role. In the concept of educational management school management is very important for the development of education system in Sri Lanka.

The purpose of this article is to analyze artificial intelligent technologies in the success of school management process. As one of the developing countries in the world, Sri Lanka is not fully developed in the concept of using technological ideas in school management structure as used by the developed countries. Nevertheless, the efforts that have been taken to apply the technological strategies are appreciable in the education system of Sri Lanka. Especially, artificial intelligence technologies in school management structure of Sri Lanka mostly depends on school administrative activities, teaching and learning process, and school improvement planning.

Understanding the concept of Artificial Intelligence (AI)

Artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems. Moreover, different definitions have been given for AI. The following s are the two main definitions for AI. Castrounis, 2016 defined AI "The ability to perceive information and retain its knowledge to be applied towards adaptive behaviors within an environment or context." and the second definition by Rapid Miner in 2017 is "Any technique which enables computers to mimic human behavior". Moreover, according to the Council of Europe, "AI is a collection of sciences, theories, and methods aimed at replicating human cognitive abilities through machines. Current advancements strive to enable devices to undertake complex tasks once exclusively handled by humans". UNICEF defines AI as machine-based systems guided by human-defined objectives that predict, provide recommendations, and make decisions impacting real or virtual environments. These AI systems interact with humans,

exhibit autonomy, and adapt their behavior through context-driven learning (Patricia Fidalgo and Joan Thormann, 2023).

Though the concept AI dominates all aspects of the 21st century world, the concept of AI started in the year 1950 when Alan Turing Alan Turing published his work "Computer Machinery and Intelligence" which eventually became The Turing Test, which experts used to measure computer intelligence and he discussed the thinking machine. As per his report it was discussed whether the machines could act intelligently. Furthermore, in 1973, Lighthil contradicted to the point of Alan Turing by saying that machines could not understand human language. From this point the new inventions of AI started in the world. The two countries UK and Japan took the initiative of funding the 'expert system' which is also known as "narrow AI."

There are three types of AI which are 1. Artificial Narrow Intelligence (ANI) 2. Artificial General Intelligence (AGI) and 3. Artificial Super Intelligence (ASI). Artificial Narrow Intelligence is also called weak Artificial Intelligence. This type of AI is mainly used to complete specific jobs without learning beyond what it is meant for. This includes reinforcement learning where people learn to make decisions and take actions to achieve certain objectives within a defined environment.

The other type of AI is Artificial General Intelligence, also called Strong AI. This includes additional strategies and steps from Narrow AI. The computer system that we are using is a clear example of Strong AI. In this type of AI, the computer can learn and solve complex problems just as humans do. Especially, AGI aims to connect with technology in understanding human emotions, beliefs, and thought process.

Artificial Super Intelligence is the third type of AI that is also called Super AI. This type of AI is more advantaged to the world as it deals with more superpowers like humans and beyond human intelligence. At the same time, it is considered dangerous for humans in the world. Day by day, many research and experiments are being done by experts to create this super AI and find the ways to be controlled by humans. These three types of AI influence the education system. Especially, ODL method in education system. Therefore, based on the ideas of different types of AI technologies, school management structure of Sri Lanka is developed.

School management structure in Sri Lankan education system

School management is regarded as the process of integrating the appropriate human and material resources that are made available and made effective for achieving the purposes of a programme of an educational institution. The success of educational management depends on the success of school management as it relates to the basic education structure of a country. School management structure in

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Sri Lankan education system is systematically designed by the government and educationists in Sri Lanka. The school education stage in Sri Lankan education system is from preschool education to senior secondary education level. Based on the level, the management structure is also designed in a proper manner. The figure below clearly depicts the school management structure of Sri Lanka based on the school education stages of children in Sri Lanka.
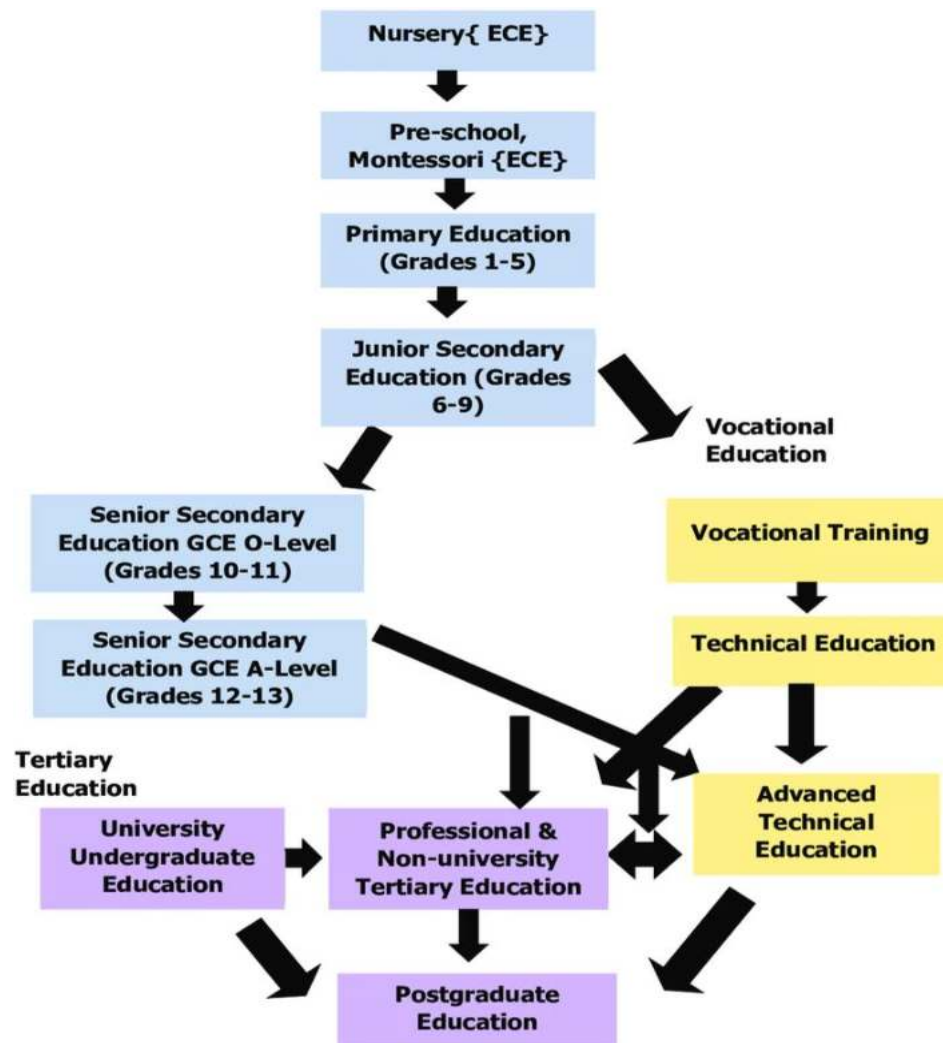
Source: https://www.researchgate.net/figure/The-stages-of-education-in-Sri-Lanka_fig1

From nursery to senior secondary education level Sri Lankan education structure is designed and after tertiary and vocational education level is also indicated here. According to the above school management structure of Sri Lankan education system, how the school management uses different artificial intelligence technologies for the successful school management system. School administrative process, teaching and learning process, and school improvement planning play a major role in the use of artificial

intelligence ideas. Not only school management system but also tertiary education level and vocational education level also use artificial intelligence technologies for the success of the education in Sri Lanka. Especially, amid and after the COVID-19 pandemic, the importance of artificial intelligence technologies was highly discussed to be used in the education system of Sri Lanka.

Artificial intelligence technologies in School management of Sri Lanka

Sri Lankan government has accepted digital transformation policy on education with the support of the Information and Communication Technology Agency (ICTA) in Sri Lanka. The following are some of identified overall objectives of the Policy for the Digital Transformation of Education. Digital transformation in education, preparing for future challenges, Hands- on Digital education for all, keeping in pace with industry, Digital environment for students, Resources for digital education, Learning management system, Digital administration skills, Management of information system, Sustainable digitalization, Students' skills, Teachers' skills, and sustainable digitalization. In the above objectives of ICTA in Sri Lanka, some emphasize about educational management of Sri Lanka which helps to use the ideas of artificial intelligence. The objective digital environment for education emphasizes about Every educational institute, vocational training institute have the ideal environmental to be conducive to student centric digital education; they be fully equipped with computer labs so that the students can be trained providing them adequate and equal opportunities (Ministry of Education, 2022).

Moreover, in ICTA digital administration skills are another important school management related digital technological idea which emphasizes about administrators of all educational institutes be conversant with the digital skills necessary to handle the systems and application they need to handle in their day-to- day operations. To further emphasize artificial intelligence strategies in school management in response to changing skills requirements, new and effective forms of e-learning are being adopted worldwide. Sri Lanka has launched an initiative to develop smart classrooms (SCs) in several schools across the country. SCs consist of technology-related, educational components that facilitate interactive and stimulating learning environments in schools – moving away from the traditional rote method of teaching – including smart interactive whiteboards, classroom and multimedia control centers, computers, and tablet personal computers (PCs), audio/video elements, and classroom management systems. Such technologies allow for the installation of interactive tools or applications, uploading homegrown content, and downloading interactive content online, and encourage more critical thinking and problem-solving skills necessary in a 4IR economy(Ashani Abayasekara,2019).

In addition, A programme led by Sri Lanka's Ministry of Education operates within the purview of the government's '13 Years Guaranteed Education Programme' and provides five desktop computers, five laptops, and one interactive smart board in each school, to be used among Grade 12 students. According to information provided by the Ministry's Education for All branch, such equipment has been provided to 197 schools as of 2018, covering a similar share of schools from all provinces. This is one of the important steps in practicing artificial intelligence ideas in school management system of Sri Lankan education system.

Moreover, January 13, 2017, in Sri Lanka the Education Ministry, the Smart Classroom was set up in assuming the role of technology solution provider for both software and hardware in school environment. In addition, The Commonwealth Digital Education Leadership Training in Action (C-DELTA) programme provides a framework for fostering digital learning for lifelong learning by developing leaders who can influence others to use digital technology appropriately and effectively for learning. The Faculty of Education at the Open University of Sri Lanka (OUSL) implemented an action research project, with the aim of promoting the adoption of C-DELTA among the teachers and students of secondary schools in Sri Lanka. It comprised an intervention designed to facilitate the adoption of C-DELTA in secondary schools, and evaluation of its impact on the teaching- learning process. The above-mentioned activities are some of the initiatives in introducing artificial intelligence strategies in school management.

Conclusion

Sri Lankan education system has a good management policy in strengthening the system of education in a successful manner. Especially, to improve the school management structure in Sri Lankan education system many activities have been taken by the government. Introducing artificial intelligence technologies is very important. To introduce and practice artificial intelligence techniques in education system the Sri Lankan government is still taking different initiatives.

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Smart Health

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Online Medicine Purchase System-Digital Prescription

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Abstract— **The rapid advancements in technology have paved the way for transformative innovations in the healthcare industry. Among these innovations, online medicine purchase system has emerged as a promising solution to enhance healthcare services and improve patient outcomes. This research paper presents an abstract of a comprehensive study that investigates the development and implementation of an online medicine purchase system.**

I. INTRODUCTION

In The pandemic like Covid-19 there is lack of facility for treatment or some hospitals already have occupied with patients. In the pandemic family have to struggle to find hospital with facility which they needed they have to call each hospital one by one or go to them just for checking if they can admit their family members. Also, such pandemic people getting panicked with small disease like fever and cold. For this situation we through over web app we are try to connect with hospitals and doctors to online consultant facility check-up so we can reach to the help on time without any struggle. This project mainly focuses on the development of a system, or we could say an immediate medical provision that would incorporate the symptoms and other medical data collected from the patient and store them into a Smart health dataset. This dataset would then be analysed using the Naïve Bayesian machine learning algorithm to deliver results with maximum accuracy. GPS tracking will be used to suggest nearest doctor or specialist if the patient needs referral.

Healthcare is one of the basic needs to everyone. However, the physicians are not genuine in terms of care and money with each patient. One more problem associated with the healthcare system is the fewer amounts of medical facilities to track the patient's history to provide the effective treatment.

Therefore, it is necessary to optimise the healthcare system to make it more efficient. This paper highlights the literature review on different work done in healthcare area using Internet and applications.

The research paper also focuses on the evaluation and validation of the proposed smart health consultancy system. A pilot study involving healthcare professionals and a diverse group of patients will be conducted to assess the system's performance, usability, and impact on clinical decision-making. The study will consider factors such as accuracy, efficiency, user satisfaction, and patient outcomes to evaluate the system's effectiveness and potential for integration into real-world healthcare settings.

In the pandemic like Covid-19 there is lack of facility for treatment or some hospitals already have occupied with patients. In the pandemic family have to struggle to find best medical advice with facility which they needed they have to call each hospital one by one or go to them just for checking if they can admit their family members. This project mainly focuses on the development of a system, or we could say an immediate medical provision that would incorporate the symptoms and other medical data collected from the patient and store them into a Smart health dataset. With a user-friendly interface and integrated 'Digital Prediction systems' this system aims to provide accessibility, efficiency, and transparency.

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II. Existing System

Healthcare is one of the basic needs to everyone. However, the physicians are not genuine in terms of care and money with each patient. One more problem associated with the healthcare system is the fewer amounts of medical facilities to track the patient's history to provide the effective treatment. Therefore, it is necessary to optimise the healthcare system to make it more efficient. This paper highlights the literature review on different work done in healthcare area using Internet and applications.

Paper [1], It is android application of a smart medical assistant system is designed where doctors can record all prescriptions, treatment, or medical details of the patient on software instead of writing on a paper. All these records are stored in the central cloud and made visible to doctors as well as patients. Each patient has assigned a unique authentication card for maintaining the privacy of their medical history account. Doctors can access and update a patient's medical history anytime and anywhere by logging into their account through a smartcard swipe. The system can avoid overdue to treatment decisions. Likewise, the system helps to keep transparency about medicines and treatment.

Paper [2], Smart Health Care Prediction using Data Mining is a new powerful technology which is of high interest in computer world. It is a sub field of computer science that uses already existing data in different database to transform it to new researches and result. The actual task is to extract data by automatic or semi-automatic means. The different parameters included in data mining include clustering, forecasting, path analysis and predictive analysis. With the growing researching the field of health informatics a lot of data is being produced. The analysis of such a large amount of data is very hard and requires excessive knowledge. Smart health care applies data mining techniques for health diagnosis. Data mining refers to extracting meaning full information from the different huge amount of dataset. It is the process of determining the unseen finding pattern and knowledge from the massive amount of data set.

Paper [3], Smart Healthcare Monitoring System Using Wireless Body Area Network Wearable sensors have gained significant attention due to tremendous promise for tracking of individual health and fitness 24hrs. Earlier the interaction between doctors and patients were through regular visits or text messages. Due to advent in Internet of Things continuous remote monitoring can be done without getting hospitalized is even made possible. There are countries which lacks skilled healthcare staff. The emergence of high technology devices has made our lives more convenient. People with physical disabilities such as paralysis solely depends on others for their movements. Smart wheelchair provides them remote health services and their health is monitored at regular interval which enhance their independence as they don't need to physically visit their doctor. They can even contact the doctor in case of emergency.

Paper [4], Advancement of Online Medical Consultation for Future in that paper Online Medical Consultation (OMC) term has been used in the paper to refer the web- based application to maintain good relationship between patients and hospitals. Many people have turned to online web-portals in order to receive an online consultation because of the advent of broadband and video conferencing. Our web-based application (OMC) also contributes many advantages to the users while using the app. By the end of using the app, users are satisfied and fulfilled towards the end. The work can be done within a brief time and the app is also easy to use.

Paper [5], Online Pharmacy Management System application is fast gaining ground as an accepted and used business paradigm. More and more business houses are implementing internet sites providing functionality for performing online medicine shopping over the online It is reason able to mention that the method of shopping on the online is becoming common place. This web application is to reduce hardships faced by this existing system, also offers low-cost ownership.

III. Proposed System

This project mainly focuses on the development of a system, or we could say an immediate medical provision that would incorporate the symptoms and other medical data collected from the patient and store them into a Smart health dataset. This dataset would then be analysed using the Naïve Bayesian machine learning algorithm to deliver results with maximum accuracy. GPS tracking will be used to suggest nearest doctor or specialist if the patient needs referral The purpose of this technique is to supply prediction for the overall and more commonly occurring disease that when unchecked can become fatal disease. The system applies data mining techniques and Naïve Bayesian algorithm. This system will predict the most probable disease supporting the given symptoms and measures required to avoid the hostility of disease. In this project, the system will be trained using machine learning.

1. **Login**

Two Types of rolls are offered by the system:

Doctor: Login for Doctor

Patient: Login for Patient

2. Doctor

Add Prescription: Create a pdf of Prescription and send on patient mail.

Prescription History: show the history of prescription.

Patient History: show the history of patient which has enter their details.

Doctor Profile: Show the Doctor Profile.

3. Patient

profile: create the patient profile

Prescription: create the patient prescription with the medicines

Prediction: Predict the disease by inserted the symptoms of the patient.

Chatbot: answer the medical related queries.

In our model, the encoder processes an utterance by human, and the decoder produces the response to that utterance. We train the word embeddings as we train the model. We also use attention mechanism and experimenting with using GLoVe pre-trained word vectors to initialize our word embeddings. To make the bot speak like a certain character, we train vector embeddings for different characters with the hope that these embeddings would be able to encode information and style of speech of these characters. These character embeddings are trained together with the word embeddings. This is inspired by Google's Zero-shot multilingual translation system.

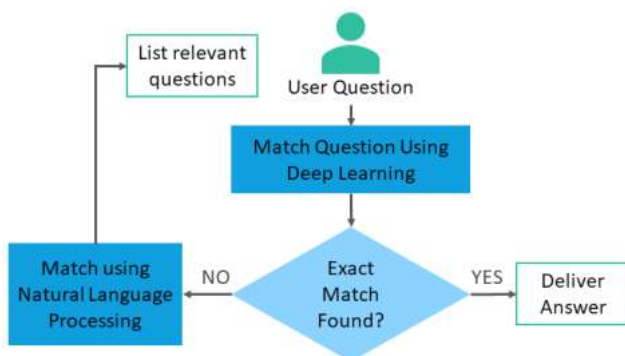Fig 2. Chatbot using RNN algorithm

IV. Related Work

Fig 1. flowchart of RNN algorithm
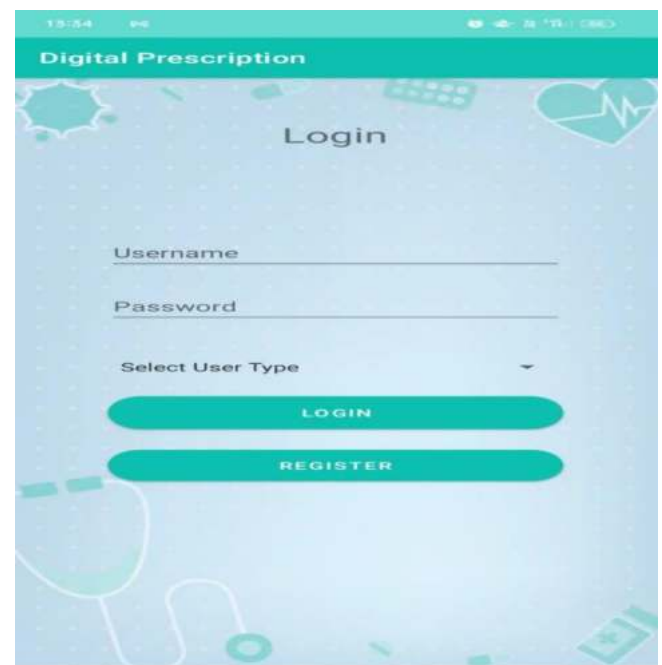
A basic sequence-to-sequence model consists of two recurrent neural networks (RNNs): an encoder that processes the input and a decoder that generates the output. The encoder maps a variable-length source sequence to a fixed length vector, and the decoder maps the vector representation back to a variable length target sequence. Sequence to-sequence is often used with attention-based that allows the decoder more direct access to the input. This model has been successfully used for many different natural language processing tasks, such as alignment, translation, and summarization. Conversational modeling can be phrased as a mapping between utterances and responses, and therefore can benefit from the encoder-decoder setup.

V. Result

Fig 3. Login Page

Fig 4. Chatbot

Fig 6. Digital Prscription

Fig 5. Disease Prediction

VI. CONCLUSION

Through this system, patients can access medical advice and consultation services conveniently from anywhere, at any time.

This technology is developed to enhance accessibility, efficiency, and quality of care.

Chatbot created using NLP algorithm which is answer medical related Queries

By integrating with healthcare providers and implementing real-time tracking, the system strives to make the entire experience efficient, convenient, and reliable.

Overall, the project seeks to modernize and streamline the medication procurement process, benefiting both patients and healthcare providers.

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IOT Based Bedridden Patient Health MonitoringSystem

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Abstract— **Healthcare, especially with the rise of COVID-19, emphasizes IoT-based health monitoring. IoT enables remote monitoring through wearable sensors and smartphones, aiding in disease prevention and diagnosis from afar. We propose a portable system that continuously monitors a patient's vital signs and room conditions. This system uses Wi-Fi for remote data storage and communication, allowing authorized personnel to access and diagnose diseases remotely.**

Keywords— Internet of Things, Health, Sensors

I. INTRODUCTION

An IoT-based health monitoring system for bedridden patients is a revolutionary approach in healthcare. It leverages Internet of Things (IoT) technology to continuously monitor the health parameters of patients who are confined to bed, providing real-time data to healthcare providers for timely intervention and care.

This system is designed to monitor vital signs such as heart rate, temperature, and other relevant parameters, ensuring that any anomalies are detected promptly. By using wearable sensors and smart devices, the system can provide a comprehensive view of the patient's health status without the need for constant physical presence by healthcare professionals.

Overall, an IoT-based health monitoring system for bedridden patients offers a cost-effective and efficient solution for improving the quality of care for patients who are unamove

freely. It enhances patient safety and comfort while providingpeace of mind to caregivers and family members..

II. HARDWARE DETAILS

1. Node MCU ESP 8266:

The ESP8266 NodeMCU is a highly versatile and widelyused Wi-Fi module that plays a pivotal role in IoT projects due to its compact design and robust capabilities. Built around the ESP8266 microcontroller, the NodeMCU integrates a powerful 32-bit Ten silica L106 core, providing a suitable platform for wireless communication and IoT applications. Its key feature is the onboard Wi-Fi module, enabling seamless connectivity to local networks and the internet. Equipped with GPIO pins, the NodeMCU facilitates the integration of various sensors and devices, making it an ideal choice for projects requiring data acquisition, monitoring, and control.

2 .Arduino Nano:

The ESP8266 Wi-Fi module is typically programmed using the Arduino programming language. The Arduino IDE (Integrated Development Environment) provides a user- friendly platform for writing, compiling,

and uploading code to the ESP8266 module. The programming language used in the Arduino IDE is a simplified variant of C++ with additional libraries and functions specifically tailored for Arduino-based microcontrollers, including the ESP8266.

3 Sensors:

LM35 Temperature Sensor: LM35 is three terminal linear temperature sensor from National semiconductors. It can measure temperature from -55 degree Celsius to +150 degree Celsius. The voltage output of the LM35 increases 10mV per

degree Celsius rise in temperature. LM35 can be operated from a 5V supply and the stand by current is less than 60uA.

ADX1345 Position Sensor: The ADXL345 is a small, thin, low power, 3-axis accelerometer with high resolution (13-bit) measurement at up to ±16g. Digital output data is formatted as 16-bit twos complement and is accessible through either aSPI (3- or 4-wire) or I2C digital interface.The ADXL345 is well suited for mobile device applications. It measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock. Its high resolution (4 mg/LSB) enables measurement of inclination changes less than 1.0°.

HW 827 Pulse Sensor: The HW 827 Pulse Sensor is a type of heart rate sensor that is commonly used in various fitness and health monitoring applications. Here is some detailed information about the HW 827 Pulse Sensor:

AD8332 ECG Sensor: The AD8332 is an analog front-end (AFE) amplifier designed for ultrasound and other medical imaging applications, such as ECG (electrocardiogram) monitoring. It provides high performance in terms of gain, bandwidth, and noise, making it suitable for high-precision measurements.

A
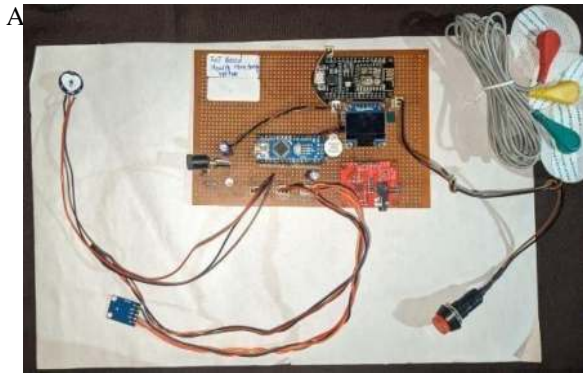
III. SOFTWARE DETAILS

MIT App Inventor: MIT app inventor In the context of IoT projects, MIT App Inventor provides a seamless integration of mobile applications with IoT devices. The

platform supports a variety of connectivity options, including Bluetooth, Wi-Fi, and web APIs, making it suitable for a diverse range of IoT scenarios. Developers can use MIT App Inventor to design intuitive and interactive interfaces for controlling and monitoring IoT devices. The platform's visual blocks interface simplifies the implementation of communication protocols, making it easier to establish connections between the mobile app and IoT hardware.

Moreover, MIT App Inventor supports the creation of web-enabled apps, allowing users to

interact with IoT devices over the internet. This capability is particularly valuable for remote monitoring and control applications. Through the platform, developers can design apps that send and receive data to and from IoT devices, enabling real-time updates and alerts. MIT App Inventor's user friendly nature extends to its integration with popular IoT platforms and services, facilitating the development of end-to-end solutions for IoT projects. Overall, MIT App Inventor serves as a powerful and accessible tool for bridging the gap between mobile applications and IoT devices, empowering a broad audience to participate in the creation of innovative IoT solutions
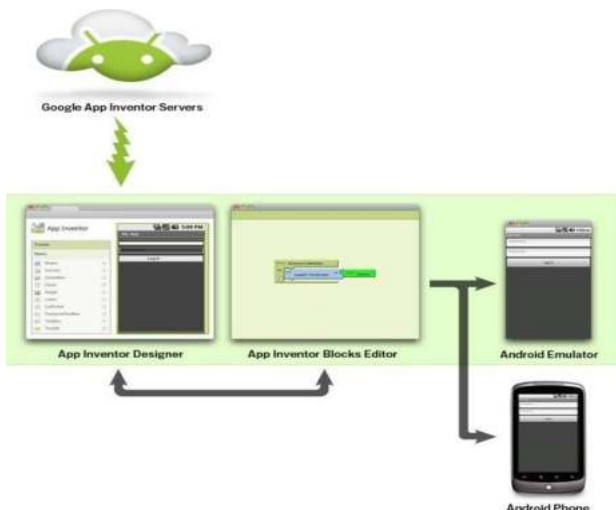
IV. RESULT

The results of the IoT-Based Health Monitoring System for Bedridden Patients project cover technical performance, usability, and potential healthcare impact. Key outcomes include assessing sensor accuracy, evaluating data transmission effectiveness, and testing alert systems. Usability was evaluated through user testing of the web interface, and feedback from healthcare professionals and caregivers. Potential impacts on healthcare include enhanced patient care and improved healthcare management for bedridden patients. Recommendations for system improvement and refinement were also provided based on the findings.

IV. CONCLUSION AND FUTURE SCOPE

A. Conclusion

The IoT-Based Health Monitoring System for Bedridden Patients integrates sensors like the AD8232 ECG monitor and ADXL335 accelerometer onto a compact PCB for streamlined data acquisition. The NodeMCU ESP8266 ensures Wi-Fi connectivity and efficient data processing, with GPIO pins used to interface with sensors. The system includes a stable power supply, panic switch, local alarm

system, and a web-based interface for real-time monitoring by healthcare professionals and caregivers. Machine learning algorithms for predictive analytics enhance its capabilities. Rigorous testing demonstrated promising outcomes, with identified improvements for future refinements. Overall, the system shows potential to revolutionize remote patient care through real-time monitoring and proactive health management.

In conclusion, the IoT-Based Health Monitoring System for Bedridden Patients holds great potential to revolutionize patient care by providing real-time monitoring, timely alerts, and a comprehensive health data repository. The successful integration of sensors, IoT connectivity, and user-friendly interfaces sets the stage for future advancements in remote healthcare, emphasizing the project's significance in contributing to the evolving landscape of personalized and proactive patient management.

B. Future Scope

Future enhancements for the IoT-Based Health Monitoring System for Bedridden Patients include integrating additional sensors for broader health monitoring, refining machine learning algorithms for advanced predictive analytics, and developing a mobile app for patient access. Telemedicine integration, blockchain security, and voice command features are also suggested. Collaboration with healthcare institutions, big data analytics, and regulatory compliance are highlighted for further development. Continuous user feedback and adaptation for different patient groups are essential for the system's evolution and effectiveness.

The future scope of the project lies in its adaptability,

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scalability, and responsiveness to emerging technologies and healthcare needs. Continuous innovation and collaboration with healthcare stakeholders will be key to unlocking the full potential of this IoT-based health monitoring system.

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Smart Agriculture

The Ecological Footprint of Agriculture: Balancing Productivity and Conservation

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Abstract

Amidst escalating global food demands, "The Ecological Footprint of Agriculture: Balancing Productivity and Conservation" explores the intricate relationship between agricultural practices and their ecological impacts. Aimed at reconciling agricultural productivity with environmental conservation, this review delves into the ecological footprint of agriculture, encompassing land use change, water consumption, greenhouse gas emissions, and biodiversity loss. While enhancing agricultural productivity, intensive practices often compromise natural ecosystems and biodiversity through soil degradation, water pollution, and habitat destruction. Recognizing the imperative for sustainability, there is a shift towards more eco-friendly farming practices such as agroforestry, organic farming, and integrated pest management. Technological advancements in precision agriculture, remote sensing, and digital agriculture offer opportunities to optimize resource use and minimize environmental impacts. Achieving balance necessitates holistic approaches considering social, economic, and environmental dimensions. Policy interventions, market incentives, and certification schemes can drive adoption of sustainable practices. Collaboration between stakeholders is

pivotal in fostering a transition to ecologically sustainable agriculture. This review synthesizes current research and practices to provide insights into reconciling agricultural productivity with ecological conservation, emphasizing the importance of achieving a balance for long-term sustainability and preservation of natural ecosystems.

Introduction

Agriculture is pivotal for global food security and economic stability, yet its expansion and intensification have left an indelible ecological footprint on the planet (Dobrich, 2024). This review explores the intricate relationship between agricultural practices and their environmental impacts, focusing on the imperative to balance productivity with conservation efforts.

Throughout history, the conversion of natural ecosystems into agricultural lands has been essential to meet growing food demands (DeClerck et al., 2023). However, this transformation has come at a significant cost to biodiversity and ecosystem services. For instance, the expansion of agricultural frontiers, such as the conversion of tropical forests for soybean cultivation in South America and oil palm plantations in Southeast Asia, has led to extensive habitat loss and fragmentation (DeClerck et al., 2023). These changes not only diminish biodiversity but also contribute to global carbon emissions and alter regional climates (DeClerck et al., 2023; Dobrich, 2024).

The intensive use of water resources in agriculture presents another critical challenge. Globally, agriculture accounts for the largest share of freshwater withdrawals, predominantly for irrigation (du Plessis, 2023). This practice often leads to water scarcity, particularly in arid and semi-arid regions, impacting aquatic ecosystems and human livelihoods (Scanlon et al., 2023).

Moreover, agricultural activities are a significant source of greenhouse gas emissions, primarily methane from livestock and nitrous oxide from fertilizer application (Chataut et al., 2023). These emissions contribute to climate change, affecting agricultural productivity and exacerbating environmental challenges (Qian et al., 2023).

Simultaneously, agricultural intensification has raised concerns about soil degradation, water pollution from agrochemical runoff, and declines in pollinator populations due to pesticide

use (Akinsorotan et al., 2023). These factors underscore the urgent need for sustainable agricultural practices that mitigate environmental impacts while ensuring food security (Adedibu, 2023).

This review synthesizes current scientific literature and practices to examine sustainable pathways forward for agriculture. It discusses innovative approaches such as agroforestry, organic farming, and precision agriculture, which aim to enhance productivity while minimizing ecological footprints. By addressing these challenges holistically and integrating social, economic, and environmental dimensions, sustainable agriculture can play a pivotal role in achieving global sustainability goals.

The Ecological Footprint of Agriculture

Agriculture's ecological footprint encompasses diverse environmental impacts, each influencing global sustainability. Land use change, primarily driven by agricultural expansion, alters landscapes and reduces natural habitats. This transformation leads to biodiversity loss and fragmentation, threatening species diversity and ecosystem resilience (Xie et al., 2024). For example, the conversion of forests for agricultural purposes in regions like the Amazon Basin and Borneo has profound implications for biodiversity conservation (Brodie et al., 2023).

Water consumption in agriculture represents another critical aspect of its ecological footprint. Irrigation practices account for substantial freshwater withdrawals globally, affecting water availability and quality. Inefficient irrigation techniques exacerbate water scarcity, particularly in arid and semi-arid regions, while runoff from fields can lead to contamination of freshwater bodies with agrochemicals (du Plessis, 2023).

Greenhouse gas emissions from agricultural activities contribute significantly to climate change. Livestock production is a major source of methane emissions, while nitrogen fertilizer application releases nitrous oxide, both potent greenhouse gases. These emissions not only impact global warming but also influence regional climates and air quality (Chataut et al., 2023).

Moreover, intensive agricultural practices contribute to soil degradation through erosion, compaction, and loss of organic matter, impairing soil health and productivity. Soil erosion rates, exacerbated by improper land management practices, pose challenges to sustainable land use and threaten food security (Brodie et al., 2023).

Understanding and mitigating these ecological impacts are crucial for advancing sustainable agriculture. The next sections will explore sustainable practices and technologies aimed at minimizing these footprints while enhancing agricultural productivity and resilience.

Sustainable Agricultural Practices

Amidst concerns over the ecological footprint of agriculture, sustainable practices offer promising avenues to mitigate environmental impacts while supporting agricultural productivity and resilience (Selvan et al., 2023). Agroforestry integrates trees and shrubs into agricultural landscapes, enhancing biodiversity, improving soil fertility, and providing additional income sources for farmers (Vinodhini et al., 2023). This practice not only sequesters carbon but also reduces erosion and enhances water retention, thereby promoting sustainable land use (Selvan et al., 2023).

Organic farming, characterized by the exclusion of synthetic inputs such as pesticides and fertilizers, promotes soil health and biodiversity conservation (Wijesinghe et al., 2023). Studies have shown that organic systems can improve soil structure, increase carbon sequestration, and reduce pesticide residues in food products (Hartmann and Six, 2023).

Integrated pest management (IPM) combines biological, cultural, and chemical methods to manage pests effectively while minimizing environmental impacts (Tiwari, 2024). By using natural predators and pheromones to control pests, IPM reduces reliance on synthetic pesticides, mitigates pesticide resistance, and preserves beneficial insects critical for pollination (Awad Fahad et al., 2023).

Furthermore, conservation agriculture emphasizes minimal soil disturbance, crop rotation, and permanent soil cover to enhance soil health and productivity (Mondal et al., 2024). This approach reduces erosion, improves water infiltration, and enhances nutrient cycling, contributing to sustainable crop production in diverse agroecosystems (Kumar et al., 2023).

Technological innovations such as precision agriculture and remote sensing also play pivotal roles in sustainable agriculture. Precision agriculture optimizes inputs like water and fertilizer through data-driven approaches, reducing environmental impacts and improving resource use efficiency (Christian et al., 2024). Remote sensing technologies provide real-time data on crop health and soil conditions, enabling farmers to make informed decisions and manage resources more effectively (Gawande et al., 2023).

By integrating these sustainable practices and technologies, agriculture can mitigate its ecological footprint while meeting global food demands sustainably. The following sections will delve deeper into the benefits, challenges, and implementation strategies of these

practices, emphasizing their role in promoting environmental conservation and agricultural sustainability.

Technological Advancements in Agriculture

Technological innovations are revolutionizing agriculture, offering opportunities to enhance productivity while minimizing environmental impacts. Precision agriculture employs advanced technologies such as global positioning systems (GPS), sensors, and drones to optimize inputs like water, fertilizers, and pesticides based on site-specific data (Karunathilake et al., 2023). For instance, research by Karunathilake et al. (2023) demonstrated that precision agriculture techniques significantly improved crop yield and resource use efficiency by precisely targeting irrigation and fertilizer application.

Remote sensing plays a crucial role in monitoring crop health, soil conditions, and pest infestations over large areas. Satellite imagery and unmanned aerial vehicles (UAVs) provide real-time data, enabling farmers to make timely decisions and implement targeted interventions (Abiri et al., 2023). Abiri et al. (2020) highlighted the utility of UAVs equipped with multispectral cameras in identifying crop stress and optimizing irrigation schedules, thereby conserving water and enhancing crop yields.

Digital agriculture platforms integrate data analytics and artificial intelligence (AI) to optimize farm operations and decision-making processes. These platforms analyze complex datasets, including weather patterns, soil health indicators, and market trends, to enhance crop management strategies and mitigate risks (Gebresenbet et al., 2023). For example, AI algorithms developed by Gebresenbet et al. (2023) accurately predicted crop yields based on historical data and environmental variables, assisting farmers in making informed decisions on planting and harvesting schedules.

Furthermore, biotechnology and genetic engineering contribute to sustainable agriculture by developing crop varieties with enhanced resilience to pests, diseases, and environmental stresses. Genetically modified (GM) crops have been engineered for traits such as drought tolerance, pest resistance, and increased nutrient content, potentially reducing the need for chemical inputs and enhancing agricultural sustainability (Abdul Aziz et al., 2022). Research by Abdul Aziz et al. (2022) illustrated the successful deployment of GM crops in improving crop resilience and productivity under challenging environmental conditions.

Conclusion

In conclusion, sustainable agriculture stands as a crucial pillar in addressing global food security challenges while preserving natural resources and ecosystems. The adoption of practices such as agroforestry, organic farming, and precision agriculture holds promise in enhancing productivity, minimizing environmental impacts, and bolstering resilience against climate change. Yet, persistent challenges such as economic barriers, climate variability, land degradation, and unequal access to resources necessitate comprehensive solutions.

Effective policy interventions, robust regulatory frameworks, and increased investment in research and development are essential to promote and scale sustainable agricultural practices worldwide. Collaboration among governments, stakeholders, and international organizations is key to fostering innovation, knowledge-sharing, and equitable access to technologies.

Looking ahead, integrating advanced technologies, implementing climate-smart strategies, and advocating for circular economy principles will be pivotal in reshaping agricultural systems toward sustainability. By prioritizing inclusive development and empowering smallholder farmers, we can ensure that agriculture not only meets current needs but also supports future generations in a resilient and environmentally responsible manner. Together, through collective action and commitment, we can pave the way for a sustainable agricultural future that balances productivity with environmental stewardship and social equity.

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The Role of Water in Agriculture: Balancing Efficiency and Sustainability

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Abstract

Water, essential for agriculture, is pivotal for food security and sustainability globally. This review, titled "The Role of Water in Agriculture: Balancing Efficiency and Sustainability," explores the intricate relationship between water management, agricultural productivity, and environmental sustainability. As water scarcity intensifies and climate change impacts become pronounced, optimizing water use in agriculture is imperative for meeting food demands while safeguarding ecosystems. Efficient water management strategies, including drip irrigation and precision farming, are crucial for maximizing productivity while minimizing consumption. Techniques like water recycling and rainwater harvesting contribute to sustainable water management. Balancing agricultural water needs with environmental sustainability requires a holistic approach, integrating water allocation for agricultural, ecological, and societal needs. Policy interventions, such as water pricing mechanisms and incentives for adopting water-efficient technologies, are vital for promoting sustainable practices. This review synthesizes current research to provide insights into the challenges and opportunities of water use in agriculture, emphasizing the importance of achieving a balance between water efficiency and sustainability for the future of agriculture and water resource preservation.

*Keywords***:** Water management, Agriculture, Efficiency, Sustainability, Integrated water resource management.

Introduction

Water is a fundamental resource in agriculture, playing a critical role in food production and security worldwide (Ringler et al., 2022). As the primary input in crop cultivation and livestock rearing, water availability and quality directly influence agricultural productivity and sustainability (Molden et al., 2007). In recent years, the escalating challenges of water scarcity and climate change have underscored the urgent need for optimizing water use in agriculture (Ingrao et al., 2023). This review, titled "The Role of Water in Agriculture: Balancing Efficiency and Sustainability," seeks to explore the complex interplay between water management, agricultural efficiency, and environmental sustainability.

The significance of water in agriculture is profound. It is essential for physiological processes such as photosynthesis, nutrient transport, and maintaining soil structure and health. The agricultural sector is the largest consumer of freshwater resources, accounting for approximately 70% of global water withdrawals (Ringler et al., 2022). This substantial demand exerts immense pressure on freshwater supplies, increasingly threatened by over-extraction, contamination, and erratic climatic patterns (Mishra, 2023).

Water scarcity is an escalating issue in many regions, exacerbated by climate change, which affects precipitation patterns, increases the frequency and severity of droughts, and depletes water sources (Mahato et al., 2022). These challenges necessitate innovative and efficient water management strategies to ensure that agricultural needs are met without compromising the sustainability of water resources. Efficient water management practices, such as drip irrigation and precision farming, have demonstrated significant potential in enhancing water use efficiency and reducing wastage (Ringler et al., 2022).

Sustainability in water management transcends the efficient use of resources; it involves maintaining the balance between water needs for agriculture, ecosystems, and human consumption (Russo et al., 2014). Techniques such as water recycling, rainwater harvesting, and integrated water resource management (IWRM) are pivotal in promoting sustainable water use. These practices help conserve water, reduce dependency on freshwater sources, and enhance the resilience of agricultural systems to climatic variability (Ringler et al., 2022).

Policy interventions are crucial in fostering sustainable water use in agriculture. Implementing water pricing mechanisms, providing incentives for adopting water-efficient technologies, and enforcing regulations on water use can drive the transition toward more sustainable practices (Piñeiro et al., 2020). Governments and international bodies bear significant responsibility in formulating and supporting policies that balance agricultural productivity with environmental conservation (Molossi et al., 2023).

This review synthesizes current research to provide insights into the challenges and opportunities of water use in agriculture. By emphasizing the need for a holistic approach that integrates efficiency and sustainability, it highlights the critical role of water management in securing the future of agriculture and preserving water resources for future generations.

Water Management in Agriculture

Effective water management in agriculture is pivotal for sustainable food production, especially under conditions of increasing water scarcity and climate variability. Traditional irrigation methods, such as flood irrigation, although widely practiced, often result in substantial water losses due to evaporation and runoff (Santos et al., 2023).

Modern irrigation technologies offer significant improvements in water use efficiency and crop productivity. Drip irrigation, for example, delivers water directly to the root zone of plants through a system of tubes and emitters, reducing water loss and optimizing nutrient uptake. Studies have shown that drip irrigation can enhance crop yield while reducing water consumption by up to 50% compared to conventional methods (Yang et al., 2023).

Similarly, sprinkler irrigation systems distribute water through pressurized pipes and sprinkler heads, mimicking natural rainfall patterns. This method has been successfully employed in various regions to improve water distribution uniformity and minimize losses to evaporation and deep percolation (Nikolaou et al., 2020).

Precision farming integrates advanced technologies like remote sensing, GIS, and soil moisture sensors to tailor irrigation and nutrient applications according to spatial and temporal variability within fields. In potato farming, for instance, precision agriculture has been shown to optimize water and nutrient use efficiency, resulting in improved crop yields and reduced environmental impact (Maurya et al., 2024).

Efficient Water Use Strategies

Efficient water management strategies are crucial for mitigating water scarcity challenges in agriculture while maintaining productivity and sustainability. Drip irrigation stands out as a leading technique that has revolutionized water use efficiency in farming. Research indicates that drip irrigation not only reduces water consumption but also enhances crop yield by ensuring precise water delivery directly to the plant roots, minimizing losses through evaporation and runoff (Yang et al., 2023).

Precision agriculture complements irrigation technologies by integrating data-driven approaches to optimize water application. Utilizing technologies such as satellite imagery, soil moisture sensors, and geographic information systems (GIS), precision agriculture enables farmers to tailor irrigation schedules and amounts according to real-time field conditions. Studies demonstrate its effectiveness in improving water use efficiency and crop productivity across diverse agricultural settings (Zhang et al., 2002; Maurya et al., 2024).

In addition to advanced irrigation methods, water recycling and rainwater harvesting are emerging as sustainable practices to supplement freshwater resources in agriculture. Water recycling involves treating wastewater from agricultural activities and reusing it for irrigation, thereby reducing demand on freshwater sources (Mishra et al., 2023). Rainwater harvesting systems capture and store rainwater for agricultural use during dry periods, providing an alternative water source that reduces dependency on groundwater and surface water (Raimondi et al., 2023).

Sustainable Water Management Practices

Achieving sustainable water management in agriculture involves integrating practices that balance agricultural productivity with environmental conservation and societal needs. Integrated Water Resource Management (IWRM) is a holistic approach that considers the interconnectedness of water resources, aiming to optimize their use across various sectors while ensuring ecological integrity (UNESCO, 2009). Implementing IWRM principles helps mitigate water scarcity impacts on agriculture by promoting efficient allocation and use of water resources (Kalogiannidis et al., 2023).

Water recycling and reuse are integral components of sustainable water management strategies. In regions facing water scarcity, treating and reusing agricultural wastewater for irrigation purposes can alleviate pressure on freshwater sources. Studies have shown that treated wastewater, when appropriately managed, can effectively support crop growth without compromising soil fertility or groundwater quality (Silva, 2023).

Rainwater harvesting is another sustainable practice gaining traction in agricultural water management. By capturing and storing rainwater for irrigation during dry periods, farmers reduce reliance on groundwater and surface water, thus enhancing water resilience and sustainability (Mishra et al., 2023; Raimondi et al., 2023).

Furthermore, adopting agroecological approaches that enhance soil health and water retention capacity contributes to sustainable water use in agriculture. Practices such as conservation tillage, cover cropping, and agroforestry promote soil organic matter accumulation, improving water infiltration and reducing runoff and erosion (Silva, 2023).

Policy Interventions and Economic Considerations

Effective policy interventions are crucial for promoting sustainable water management practices in agriculture. Water pricing mechanisms play a pivotal role in incentivizing efficient water use and discouraging wasteful practices. By reflecting the true cost of water and incorporating environmental and social impacts, pricing strategies encourage farmers to adopt technologies that improve water productivity (Irfeey et al., 2023).

Government subsidies and financial incentives also play a significant role in promoting the adoption of water-efficient technologies. Programs that provide grants or low-interest loans for installing drip irrigation systems or rainwater harvesting infrastructure can facilitate farmers' transition towards sustainable water practices (Singh and Gandhi, 2024).

Furthermore, regulatory frameworks are essential for ensuring compliance with water conservation measures and safeguarding water resources. Enforcement of water allocation rights, pollution control measures, and monitoring of water use are critical components of effective water management policies (Makanda et al., 2022).

International collaboration and governance frameworks are increasingly important in addressing transboundary water issues and promoting equitable access to water resources. Initiatives such as the United Nations' Sustainable Development Goals (SDGs) emphasize the importance of integrated approaches to water management that prioritize sustainability and resilience in agricultural systems (UN, 2015).

Economic considerations also play a significant role in shaping water management decisions in agriculture. Cost-benefit analyses and economic valuation of ecosystem services associated with water resources help policymakers and stakeholders make informed decisions about water allocation and management strategies (Santos et al., 2023).

Conclusion

The intricate relationship between water management, agriculture, and sustainability demands urgent attention as global challenges of water scarcity and climate change intensify. Efficient water use strategies such as drip irrigation, precision agriculture, and water recycling offer tangible pathways to enhance agricultural productivity while minimizing water consumption and environmental impact. These technologies, supported by sound policy frameworks encompassing water pricing, subsidies for sustainable practices, and robust regulatory measures, are essential for fostering resilient agricultural systems.

However, substantial challenges persist, including increasing competition for water resources, exacerbated by population growth and urbanization. Climate change further complicates the scenario, necessitating adaptive measures to mitigate risks such as droughts and floods. Technological innovations and integrated approaches that consider social, economic, and environmental dimensions present significant opportunities to address these challenges effectively.

Moving forward, concerted efforts are required at local, national, and global levels to promote sustainable water management practices in agriculture. Collaborative governance, stakeholder engagement, and capacity building will be crucial in navigating the complexities of water allocation and ensuring equitable access to water resources. By investing in research, innovation, and inclusive policy-making, stakeholders can achieve the dual objectives of enhancing food security and environmental sustainability in the face of evolving water challenges.

In conclusion, achieving a balance between water efficiency and sustainability in agriculture is paramount for securing water resources for future generations. By embracing innovation, implementing robust policies, and fostering cooperation, we can pave the way towards a resilient agricultural sector that meets the needs of a growing population while safeguarding our precious water resources.

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Signal and Image Processing

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Divers Drowsiness Detection and warning System for Critical Infrastructures

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Abstract— **The increasing prevalence of road accidents due to drivers' drowsiness poses a significant threat to public safety, particularly in the vicinity of critical infrastructures such as power plants, transportation hubs, and emergency service centres. To mitigate this risk, the development and implementation of advanced Drivers' Drowsiness Detection and Warning Systems (DDDWS) tailored for critical infrastructures become imperative.**
This paper presents a comprehensive overview of the design, functionality, and benefits of such systems.

Keywords— machine learning, extraction, data processing.

I. INTRODUCTION

In recent years, the escalating incidence of road accidents attributed to drivers' drowsiness has emerged as a pressing concern for public safety, particularly in the vicinity of critical infrastructures. The seamless functioning of power plants, transportation hubs, and emergency service centres relies heavily on the safe and efficient transport of personnel and goods.

Addressing the risk posed by drowsy driving becomes paramount in safeguarding not only the lives of individuals on the road but also the integrity and reliability of essential services.

This paper focuses on the design and implementation of advanced Drivers' Drowsiness Detection and Warning Systems (DDDWS) specifically tailored for deployment near critical infrastructures. The integration of cutting-edge technologies, including computer vision, machine learning, and physiological sensors, aims to provide a comprehensive and proactive solution to mitigate the risks associated with drowsy driving.

The prevalence of drowsy driving incidents necessitates a nuanced and adaptive approach to detection and warning systems. Traditional methods often fall short in addressing the dynamic nature of driver alertness and the diverse factors contributing to drowsiness. Consequently, there is an urgent need for systems that not only accurately identify signs of drowsiness but also tailor warnings to individual drivers' characteristics.

II. RELATED WORK

Work for the Drivers' Drowsiness Detection and Warning Systems (DDDWS) Project

Project Phases

The DDDWS project will be implemented in five phases:

Phase 1: System Design and Development Define detailed system specifications: Determine the functionalities, target platforms, and performance requirements. Select and integrate technologies: Choose appropriate computer vision algorithms, physiological sensors, and machine learning models.

Develop software modules: Design and implement software modules for data acquisition, pre-

processing, feature extraction, machine learning, warning system, and user interface. Conduct unit testing and initial validation: Ensure the functionality and performance of individual modules.

Phase 2: System Integration and Testing Integrate software modules into a working prototype. Develop and implement communication protocols for data transmission and system management. Perform system-level testing in simulated and real-world driving environments. Evaluate the system's accuracy,
reliability, usability, and effectiveness in detecting driver drowsiness. Collect user feedback to identify areas for improvement.

Phase 3: Deployment and Pilot Implementation Develop a deployment plan for pilot implementation in critical infrastructure environments. Install and integrate the DDDWS with existing infrastructure and vehicle systems. Train personnel on system operation and maintenance. Conduct pilot tests to assess the system's real-world performance and impact.

Phase 4: System Enhancement and Refinement Analyse data collected from pilot tests and user feedback. Refine the machine learning model for improved accuracy and adaptation to individual drivers and diverse driving conditions. Enhance the warning system based on user feedback and identified needs. Develop additional features and functionalities to improve the system's effectiveness and usability.

Phase 5: System Evaluation and Long-Term Sustainability Conduct a comprehensive evaluation of the DDDWS's impact on road safety, operational efficiency, and driver well- being. Develop a plan for long-term system maintenance and support.
Collaborate with stakeholders to develop industry standards and regulations for DDDWS implementation.

1.2 Work Breakdown Structure (WBS)
A detailed WBS will be developed to further break down the project into manageable tasks and subtasks. The WBS will include responsibilities, timelines, and estimated resources required for each task.

The project management Tools and Techniques The following project management tools and Technique will be used to ensure efficient project Execution: Project management software: To track progress, manage resources, and collaborate effectively among team members.

Version control system: To track changes in software code and ensure data integrity.

Issue tracking system: To log, track, and resolve technical issues efficiently.

Communication channels: To facilitate regular communication and information sharing among team members and stakeholders.

1.4 Risk Management Plan
A risk management plan will be developed to identify potential risks, assess their impact, and develop mitigation strategies.
1.5 Timeline and Budget
A detailed project timeline and budget will be established to ensure timely completion and resource allocation. Regular monitoring and adjustments will be made to ensure adherence to the plan.
1.6 Quality Assurance and Testing
A comprehensive quality assurance plan will be implemented to ensure the DDDWS meets all design specifications and performance requirements. Regular testing and verification will be conducted throughout the development and implementation process.
1.7 Reporting and Documentation Regular project reports will be prepared to
communicate progress, identify challenges, and document key decisions. Comprehensive project documentation will be maintained for future reference and knowledge transfer.
1.8 Communication and Stakeholder Engagement Effective communication and stakeholder engagement will be crucial for the project's success. Regular communication channels will be established to keep stakeholders informed of project progress and address their concerns.
By implementing this comprehensive methodology and planning approach, the DDDWS project aims to achieve its objectives and contribute significantly to improving road safety and protecting personnel in critical infrastructure environments.
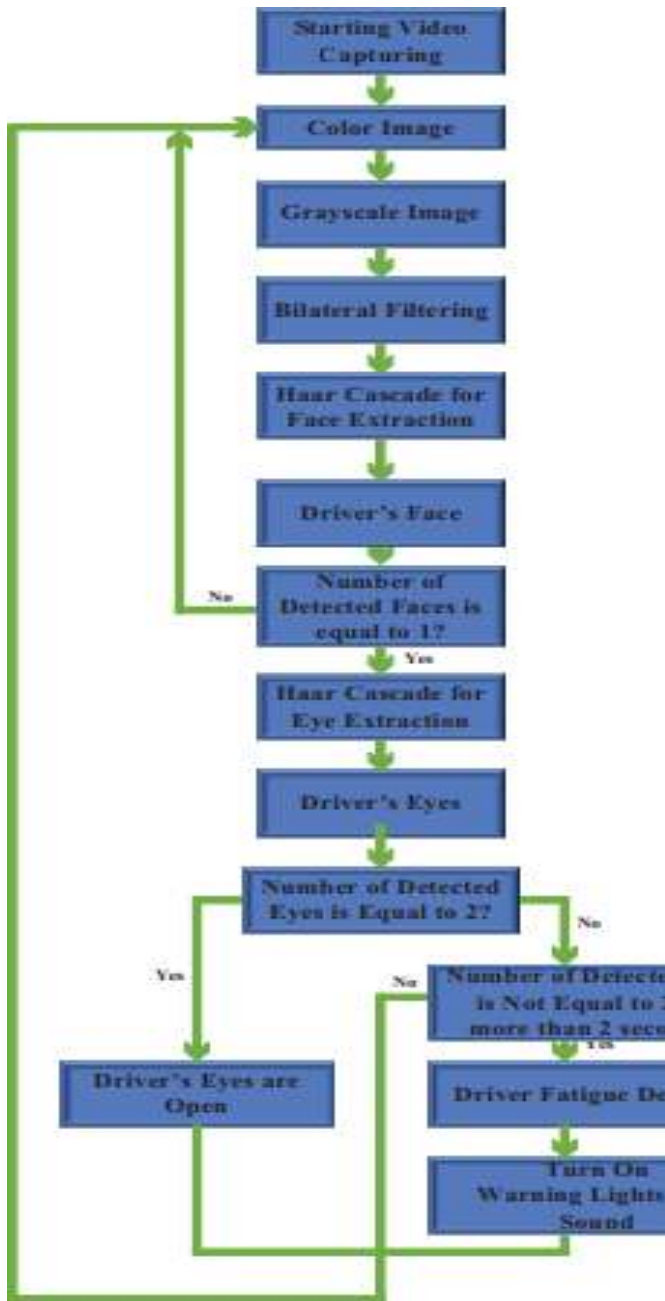
III.   METHODS AND MATERIAL

Fig. 2.1 System Model Diagram

1.   Data Acquisition Module

Computer Vision Module: Utilizes facial recognition, eye tracking, and head position analysis to capture visual data indicative of the driver's alertness level.

Physiological Sensors Module: Integrates sensors such as heart rate monitors and EEG devices to gather real-time physiological data.

2. Data Preprocessing Module:

In this module customer can enter his/her kind information as like name, Email and password for follow the procedure. When customer fills up his/her information then this information stored into the system database. For log in to this

application user or customer can enter only user id or password, and press log in button.

3. Feature Extraction Module:

In this module customer can enter his/her kind information as like name, Email and password. for follow the procedure. When customer fills up his/her information then this information stored into the system database. For log in to this application user or customer can enter only user id or password, and press log in button.

4. Machine Learning Module:

Training Algorithm: Trains the machine learning model using labelled datasets to recognize patterns associated with drowsiness.

Adaptive Learning: Enables continuous learning and adaptation to individual driving patterns, enhancing the accuracy of the drowsiness detection algorithm over time .

Decision-Making Module:

Threshold Setting: Establishes customizable thresholds for determining the severity of drowsiness based on the extracted features and machine learning predictions.

Real-time Decision Logic: Analyses the combination of computer vision and physiological data to make real-time decisions regarding the driver's alertness level.
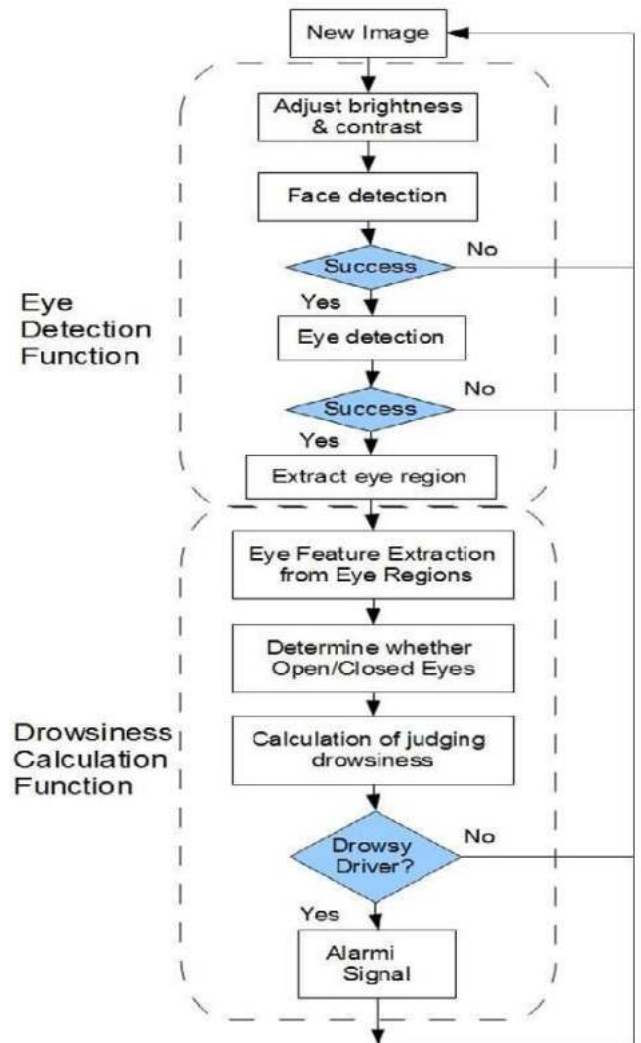

Fig. 2.2 Flowchart

Flowchart is a graphical diagram that represents the sequence of steps to solve a problem. A flowchart is a diagrammatic representation of an algorithm. In computer programming, the flowchart diagram helps to write down an algorithm to solve the problem.

It was originated from computer science as a tool for representing algorithms and programming logic but had extended to use in all other kinds of processes. Nowadays, flowcharts play an extremely important role in displaying information and assisting reasoning. They help us visualize complex processes, or make explicit the structure of problems and tasks. A flowchart can also be used to define a process or project to be implemented.

IV. DESIGN AND DEVELOPMENT
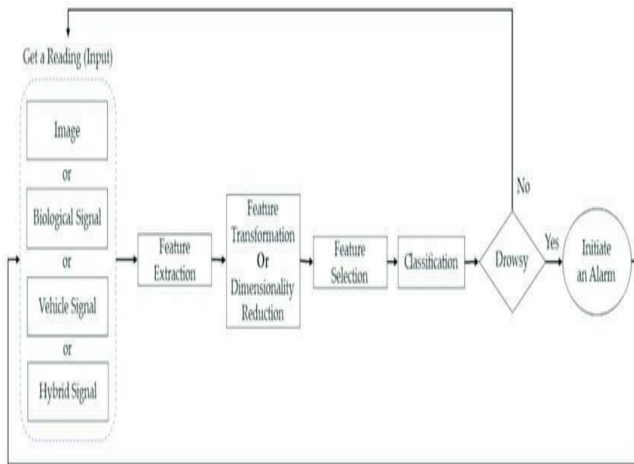
Fig.2.3 DFD

DFD is the Data Flow diagram (Level 0) is a way of representing a flow of a data of a process or a system. The DFD also provides information about the outputs and inputs of each entity and the process itself. Our system represents the flow of process. In this system our data flow is similar to the actual flow of the website that's why our DFD and Flowchart are the same.
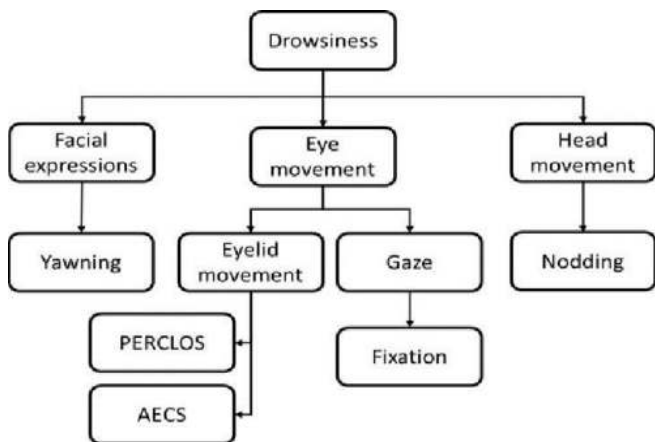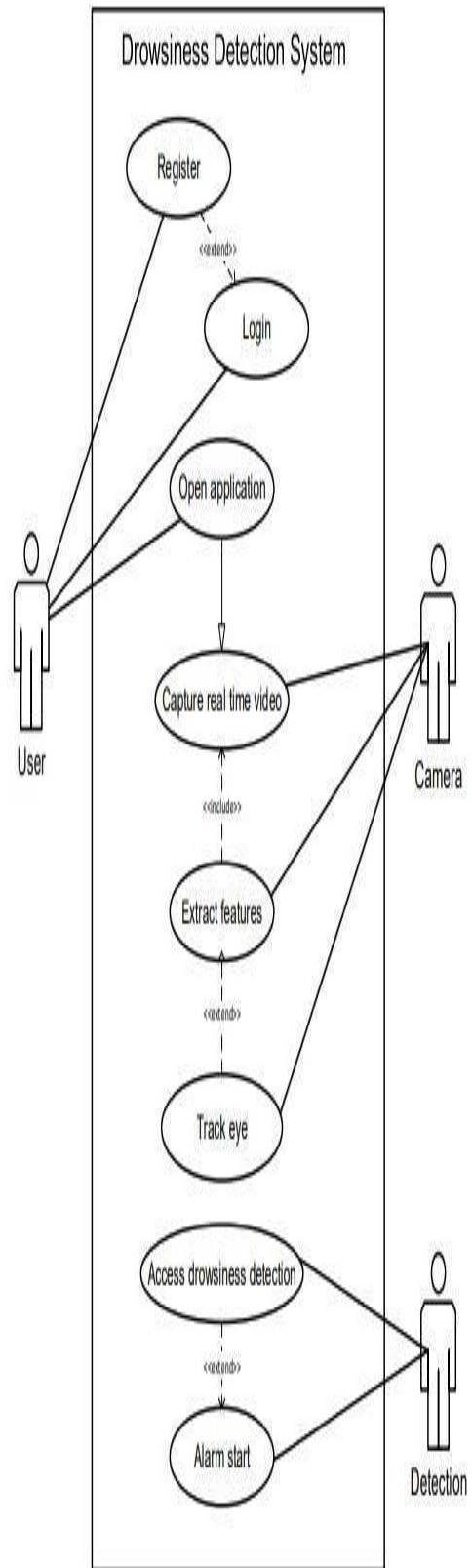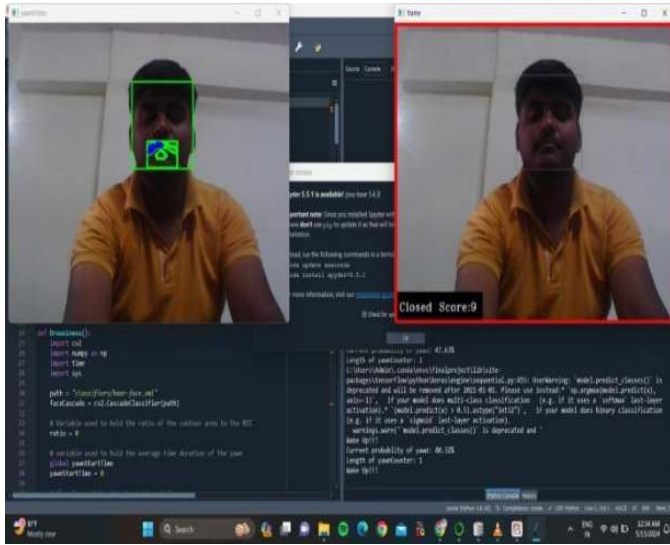

Fig.2.4 ER Diagram

Fig.2.5 Use Case Diagram

A use case diagram is a representation of a user's interaction with the system and shows the relationship between the user and the different use cases. In above fig. our system represents the interaction between user and system.

V. IMPLEMENTATION

Modules

1. Data Acquisition Module

Computer Vision Module: Utilizes facial recognition, eye tracking, and head position analysis to capture visual data indicative of the driver's alertness level. Physiological Sensors Module: Integrates sensors such as heart rate monitors and EEG devices to gather real-time physiological data.

2. Data Preprocessing Module:

In this module customer can enter his/her kind information as like name, Email and password. for follow the procedure. When customer fills up his/her information then this information stored into the system database. For log in to this application user or customer can enter only user id or password, and press log in button.

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4. Machine Learning Module: Training Algorithm: Trains the machine learning model using labelled datasets to recognize patterns associated with drowsiness. Adaptive Learning: Enables continuous learning and adaptation to individual driving patterns, enhancing the accuracy of the drowsiness detection algorithm over time.

5. Decision Making Module:

Threshold setting: Establishes Customizable thresholds for determining the severity of drowsiness based on the extracted features and machine learning predictions.

Real-time Decision Logic: Analyses the

combination of computer vision and physiological data to make real-time decisions regarding the driver's alertness level.

VI. CONCLUSION

In conclusion, developing a Drivers' Drowsiness Detection and Warning System for Critical Infrastructures is a critical application that involves the integration of various components to ensure the safety of both drivers and the infrastructure itself. The system's success relies on accurate drowsiness detection algorithms, effective warning systems, and seamless communication between different modules. Here are key points to consider:

Multi-Layered Approach: Implementing a multi- layered approach, combining image processing, machine learning, and real-time monitoring, is crucial for accurate drowsiness detection. This ensures that the system is robust and can adapt to various driving conditions. User Interface and Interaction: The warning system plays a pivotal role in alerting the driver to potential dangers.

Developing a user-friendly interface that delivers timely and effective alerts, coupled with features for acknowledgment and emergency response, enhances the overall system effectiveness.

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STUDENT ATTENDANCE MANAGEMENT SYSTEM USING FACE RECOGNITION

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INTRODUCTION

Abstract— **Face recognition attendance is an extremely valuable application of image processing and plays a crucial role in the technical field. It addresses the ongoing challenge of authenticating individuals through facial recognition, particularly in the context of student attendance. By leveraging advanced monitoring and computer technologies, an attendance system utilizing face biostatistics has been developed to digitize the traditional method of calling out names and maintaining manual records. The existing approaches to attendance-taking are arduous and time-consuming, with attendance records susceptible to manual manipulation. Additionally, conventional attendance processes and biometric systems are prone to proxy attendance. The proposed system aims to overcome these challenges. It employs Haar classifiers, K-nearest-neighbor algorithm, generative adversarial networks, and Gabor filters for face recognition. Attendance reports are generated and stored in Excel format upon successful recognition. The system has undergone rigorous testing, encompassing various conditions such as illumination, head movements, and differences in camera-to-student distance. Overall complexity and accuracy have been evaluated, and the proposed system has demonstrated efficiency and robustness in classroom attendance management, eliminating the need for time-consuming manual work. Moreover, the system is cost-effective and requires minimal installation.**

Keywords— FaceReognition; OpenCV; HarrCascade; AutomatedAttendance

Attendance holds great significance for both teachers and students in educational institutions, necessitating the need for accurate attendance records. However, the traditional method of manually calling out names or roll numbers for attendance poses challenges in terms of time consumption and energy expenditure. To address these issues, an automated attendance system can be employed. Various automatic attendance systems, such as biometric techniques and RFID systems, are currently utilized by many institutions. While these systems represent an improvement over the traditional method, they still fall short in meeting time constraints, as students often have to wait in queues to mark their attendance.

This project introduces an innovative attendance marking system that operates seamlessly alongside the regular teaching process. The system can be effectively utilized during exams or other teaching activities that require attendance tracking. It offers a solution to the challenges posed by traditional student identification methods, such as calling out names or checking identification cards, which can disrupt ongoingteaching activities and cause stress for students during exams. By implementing this system, the need for such manual processes is eliminated. Instead, students are required to register in the system's database to enable recognition. The enrollment process is made convenient through a user-friendly interface, enhancing usability for all users involved.

Machine learning, being a powerful domain, provides desirable outputs by applying different machine learning algorithms based on input datasets. In the context of student attendance, computerized attendance management systems utilizing face recognition prove highly advantageous as they address issues related to time management, safety, and delegation. The inclusion of Haar Cascade enhances the system's performance by analyzing images.

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I. LITERATURE SURVEY

Name-:A Review Paper on Attendance Management System Using Face Recognition.(Soundarya S1 , Ashwini P 2 ., Rucha W3 . , Gaurav K4 .),IEEE,2019

Description-:- Face recognition software is employed in various organizations and educational institutions to identify individuals for attendance tracking. The Attendance Management System utilizes this technology to streamline the process of marking attendance and analyzing it, thereby minimizing the need for human involvement. This system involves the installation of a camera that captures images, and subsequently, the faces in those images are recognized and matched with a pre-existing database to mark attendance. The system operates based on the principles of face detection and recognition, enabling the webcam to detect employees or students as they arrive in the office or classroom, and their attendance is marked by the system's recognition capabilities.

Name-: Multiple Face Detection Attendance System (Raj Kaste1, Harish Pandilla2, Priyesh Surve3, Mubin Shaikh4, Shalaka Deore5, Prof. Shubhangi Ingale6), the international research journal of Engineering and Technology,2020

Description-: Over the years, automatic face recognition (AFR) technologies have experienced significant advancements in their performance, making them extensively utilized in various security and commercial contexts. One practical application that has emerged is the implementation of Smart Attendance using Real-Time Face Recognition, which effectively addresses the daily tasks associated with managing student attendance. This solution leverages the capabilities of real-time face recognition to streamline and enhance the process of tracking student attendance practically and efficiently.

Name-: Smart Attendance System Using Face Recognition Ghalib Al-Muhaidhri, Ghalib Al-Muhaidhri 2020 .

Description: To maintain discipline and facilitate effective in educational institutions such as schools, colleges, and universities, the attendance system was introduced. Traditionally, there were two methods to mark student attendance in a class: calling out roll numbers or having students sign on a paper against their roll number. However, these approaches proved to be time-consuming and inefficient. Consequently, there arose a need to transform this system into a more user-friendly, time-saving, and efficient solution. This automated system has been developed to assist faculty members in easily and efficiently taking attendance for the entire class without causing any disruption or wasting time.

Name-: Facial Recognition Attendance System Using Python and OpenCV: Dr. V Suresh, Srinivasa Chakravarthi Dumpa, Chiranjeevi Deepak Vankayala, HaneeshaAduri, Jayasree Rapa;2021

Description-: This attendance monitoring system aims to enhance and upgrade the existing attendance system in educational institutions, making it more efficient and effective than before. The current system suffers from ambiguities that result in inaccurate and inefficient attendance tracking. Enforcing regulations becomes challenging under the old system. To address these issues, the proposed solution incorporates face recognition technology. The human face possesses unique traits that enable individual identification witha low possibility of deviation or duplication. The projectinvolves creating face databases and feeding data into the recognition algorithm. During attendance-taking sessions, faces will be compared against the database to identify individuals

Name-: Face Recognition-based Attendance System. Dhanush Gowda H.L 1 , K Vishal 2 , Keertiraj B. R 3 , Neha Kumari Dubey 4 , Pooja M. R. 5),(ICEEOT) 2021

Description-: Manual attendance management can be a significant burden on teachers. To address this issue, a smart and automated attendance management system is being employed. This system effectively resolves problems such as proxies and inaccurate attendance marking for absent students. It achieves this by utilizing a live video stream to mark attendance. The frames from the video are extracted using OpenCV. The implementation process primarily involves face detection and recognition, which is accomplished using dlib. Once the faces are detected and recognized, their connection is established by comparing them with the database containing students' faces. This model proves to be a successful technique for efficiently managing student attendance.

II. PROPOSED METHODOLOGY

In order to utilize the attendance management system, all students in the class are required to register themselves by providing the necessary details. Subsequently, their images will be captured and stored in the dataset. During each session, the system will detect faces from the live streaming video of the classroom. These detected faces will then be compared with the images present in the dataset. If a match is found, attendance will be marked for the corresponding student. At the end of each session, a list of absentees will be emailed to the respective faculty member responsible for the session. This ensures that the faculty is promptly informed about the students who were absent.

1. **Dataset Creation**:

In the initial stage of the attendance management process, images of students are captured using a webcam. Multiple images of each student are acquired, capturing them in different gestures and angles.These images then go through pre-processing steps. First,the images are cropped to extract the Region of Interest (ROI), which will be utilized in the subsequent recognition process. The cropped images are then resizedto a specific pixel position. Next, the images are converted from RGB to grayscale, simplifying the imagedata for further analysis. Finally, these processed images are saved with the respective student's names in a designated folder.

2. **Face Detection:**

In this attendance management system, face detection is performed using the Haar-Cascade Classifier algorithm in conjunction with OpenCV. Before using the Haar-Cascade Classifier for face detection, the algorithm needs to be trained to recognize human faces. The system utilizes the detectMultiScale module from OpenCV, which is responsible for creating rectangles around the detected faces in an image.The

detectMultiScale module takes three parameters into consideration: scaleFactor, minNeighbors, and minSize. he scaleFactor parameter determines how much the image should be reduced at each scale for face detection. The minNeighbors parameter specifies the number of neighboring rectangles required for a candidate rectangle to be considered a face. Higher values typically lead to fewer face detections but with higherconfidence.The minSize parameter defines the minimum size of the detected object, which in this case is a face These parametershelp optimize the face detection process by adjusting the sensitivity and accuracy of the algorithm.

Haar Cascade Classifier: The algorithm works by using a set of simple rectangular features called Haar-like features. These features are calculated over different regions of the image at various sizes and positions. Each feature represents the differencein intensity between adjacent rectangles in the image.

Face Recognition:

The face recognition process in this attendance management system can be divided into three steps: preparing training data, training the face recognizer, and prediction.

1) **Prepare Training Data**: The training data consists of the images present in the dataset. Each image is assigned an integer label corresponding to the student it belongs to.
2) **Train Face Recognizer**: In this system, the face recognizer used is the Local Binary Pattern Histogram (LBPH) algorithm. Initially, the local binary patterns (LBPs) of the entire face are extracted. These LBPs are then converted into decimal numbers. Subsequently, histograms of the decimal values are created for each image in the training data. Each image will have its own histogram representing its unique facial features.
3) **Prediction**: During the recognition process, the histogram of the face to be recognized is calculated. This histogram is then compared with the histograms computed during the training phase. The face recognizer returns the best-matched label associated with the student to whom the recognized face belongs.

By following these steps, the system effectively identifies and matches faces, allowing for accurate recognition and prediction of students' identities
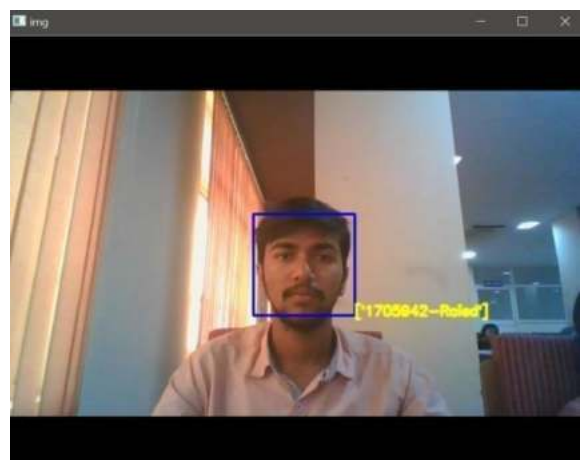
.4. Attendance Updation

After the face recognition process, the recognized faces will be marked as present in an Excel sheet, while the unrecognized faces will be marked as absent. Additionally, a list of absentees will be generated, and this list will be emailed to the respective faculties responsible for the class or session. To ensure proper record-keeping, the faculties will be provided with a monthly attendance sheet at the end of each month. This sheet will contain the attendance details of students for that specific month, allowing faculties to have an updated record of student attendance**.**

III. RESULT AND DISCUSSION

Users have the option to interact with the system through a graphical user interface (GUI). The GUI offers three main choices: student registration, faculty registration, and marking attendance. To register as a student, users must provide all the required information in the student registration form. Once the "register" button is clicked, the webcam automatically activates, and a window (refer to Fig.3) appears, allowing face detection. The system proceeds to capture photos until either 60 samples are collected or the "CTRL+Q" key combination is pressed. These images are then pre-processed and saved in the training images folder for future use. Faculty members are required to register with their respective course codes and email addresses in the provided faculty registration form. Thisstep is crucial because the list of absentees will be sent via emailto the respective faculty members.

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Fig 3: Face detection

In the face recognition window depicted in Figure 4, the system displays the recognized faces of two registered students. If astudent is not registered, the system would display 'unknown' instead. By pressing the "CTRL+Q" key combination, the windowis closed, and the attendance is updated in an Excel sheet. Additionally, the names of absentees are sent via email to the respective faculty members.

Fig 4: Face Recognition

Fig 5: Attendance sheet

The Fig.5. Shows the attendance sheet updated after the process

IV. CONCLUSION

The objective of this system is to develop a reliable class attendance system using face recognition techniques. The proposed system utilizes face identification to mark attendance. It employs a webcam to detect faces and subsequently recognizesthem. Once the faces are recognized, the system marks the attendance of the identified students and updates the attendance record accordingly.

BENEFITS:

1. Accuracy:

These systems can handle variations in lighting, pose, expression, and occlusion more effectively, leading to fewer falsepositives and false negatives

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2. Speed:
 This face recognition systems are typically faster in both enrollment and recognition processes. With the use of optimized algorithms these systems can achieve real-time or near-real-time performance, allowing for swift attendance tracking even in high-traffic environments.

3.Robustness:
 This system can accurately recognize faces across a wide range of conditions, making them suitable for deployment in diverse settings like indoor and outdoor environments.

4.User Experience:
This system does prioritize user experience, offering intuitive interfaces for both administrators and end-users. Feature such as self-service enrollment make the attendance tracking process smoother and more convenient for all students.

 This face recognition attendance systems overall offers superior performance, security, and usability compared to older systems, making them a compelling choice for organizations or institutes seeking to modernize their attendance tracking processes. And the accuarcy of this project is 90 %.

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Embedded Systems

AI driven, GSM Enabled, Arduino based water pollution monitor

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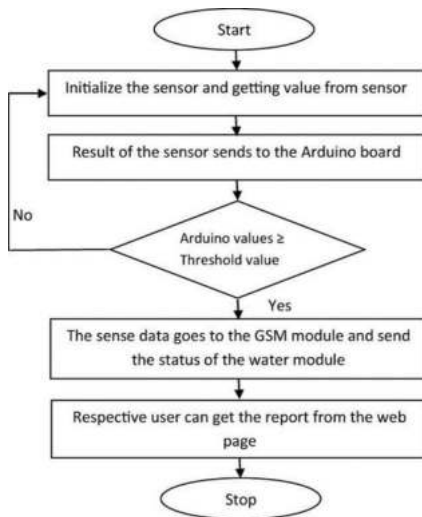Engineering Satara,India
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Abstract:- This report deals with a water quality monitoring system using a wireless sensor network. Due to rapid development and urbanization, water quality deteriorates year after year and this causes waterborne diseases and has bad effects. The system is designed for continuous on-site observation and real-time reporting of water quality data, where officials can access the data via smartphone/computer via the Internet. Our proposed system uses multiple sensors to measure parameters, measure water quality in real time to ensure efficient operation, and is economical, accurate and requires less manpower. In this system we use GSM module and Arduino Nano with AI concept. This helps us to develop this system at a very low cost. We hope this system will help improve society and also reduce diseases caused by contaminated water.

Keywords :- GSM Module, Arduino Nano, AI,

1. Introduction:- In this project, our main goal was to create a low-cost, AI-driven tool that could forecast water pollution levels using measurements of turbidity, PH, and oxidation reduction potential (ORP) and gather data on water quality from a variety of field sources. In an

Attempt to reduce the need for costly equipment to detect contamination and prevent dangerous pollution effects, I decided to use oxidation-reduction potential, PH, and turbidity measurements to indicate water pollution levels in order to create a low-cost device to forecast water pollution levels locally. I did this by consulting recent research papers on the subject. One of the most valuable natural resources that humanity has been endowed with is water. However, the quickening pace of societal advancement and plethora of human endeavors expedited the deterioration and contamination.

2. Working of Electronic Voting Machine :-

source of up to 12 volts and regulate it to both 5 and 3.3 volts. Additionally, this can run entirely on a USB port without the need for external power.

• Communication improved and became more fluid, enabling the board to interface with different kinds of computer systems.

Arduino based technical specifications: - • Microcontroller-AT mega 328

- Voltage required: - 5v
- Maximum input voltage: - 7-12v
- Digital I/O pins: - 14
- Analog I/O pins: - 6
- DC current per I/O pins: - 40mA
- DC current for 3.3v pin: - 50mA
- Flash memory: -32 KB

First, the Arduino nano needs a 5 volt power supply. We use the Arduino IDE to burn the program into our Arduino Nano. Next, in order to help us control the water quality, we are connecting the GSM Module, LCD Display switches, and Arduino. Next, we have an LCD display that interfaces with an Arduino board and can show the test results. We will also receive the test results after the water sample has been tested on the LCD. which takes a lot of time because the results are available right away after the test.

Microcontroller based Arduino Nano:-

Arduino Nano :- The smallest and most traditional Arduino board, the Nano, is made to work on a breadboard. The Arduino Nano has a Mini-B USB connector and pin headers that make it simple to link it to a breadboard. These boards are used to create Arduino Nano projects, some of which are shown below. They work by reading inputs from a sensor, button, or finger and producing an output that turns on an LED or motor. So that's a summary of the Arduino Nano datasheet.

Two key features of Arduino are: -
 • It is very convenient to manage power inside because you can connect an external power

3.Advantages of Electronic Voting System:

Wastewater can be treated before it enters freshwater by using an AI based water quality monitoring system. Vital indicators like pH and turbidity can be analyzed with the aid of the sensors. For example, crop health may be impacted by water suspended in harmful substances. Keeping people healthy:Certain pollutants can be harmful to people's health. Water quality regulations save lives and prevent financial burdens from illness, lost productivity, and even death.

4.Disadvantages of Electronic Voting System: -
There are several disadvantages to using conventional techniques to assess water quality. They first require skilled personnel and costly, specialized equipment. Second, human mistake may be the cause of data loss. Thirdly, these methods are unable to predict future patterns because the data obtained will be analyzed by people rather than algorithms. Furthermore, the sample transit process may cause alterations in the properties of water. As such, it is difficult to regularly test water quality with antiquated methods.

5. Applications of voting systems: -

1. Through the use of remote sensing, we can obtain important information about turbidity and temperature, among other parameters, in the monitoring of water quality.

2. Parameters pertaining to water quality are crucial markers that assess the appropriateness and security of water for diverse uses.

3. Water pollution monitors are used by the government in the various water resources that it supplies to different areas.

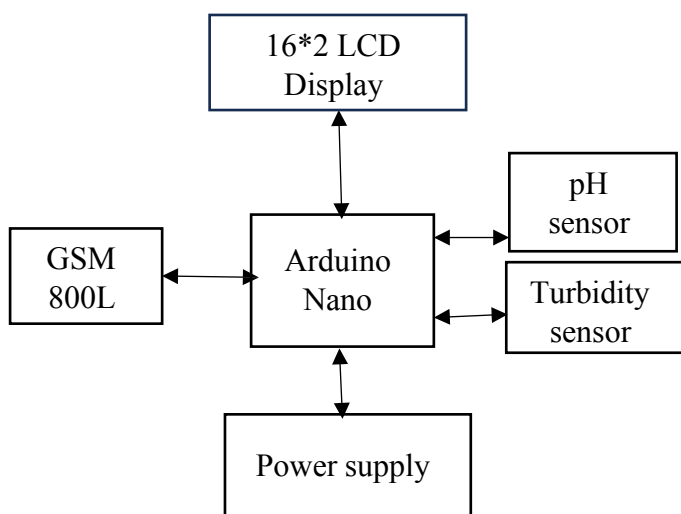**6. Block diagram of electronic voting system: -**

Fig 2- schematic block diagram of water pollution monitor

7. Future Scope:-

• By adding more sensors, we can increase the parameters and detect more parameters for the most secure purpose.
• We can use water from many natural resources, such as rivers and lakes, by controlling the water supply through relay interfaces. There is good flexibility in the system.
• This system's ability to monitor additional water quality parameters is limited to the replacement of the appropriate sensors and modifications to the pertinent software.

• The system can be expanded to track air pollution, hydrologic conditions, industrial and agricultural output, and other aspects.

8. Conclusion:- After being implemented, the effective and affordable real-time water quality monitoring system for real-time applications was put to the test. This can aid in preventing illnesses brought on by metals and contaminated water. It is a good thing to bolster environmental conservation. Enhancing environmental performance across the community is another benefit. This system monitors three parameters: pH, temperature, and dissolved oxygen. This system can protect against diseases that are brought on by pollutants and metals in the water. Less skilled workers can be used to complete the monitoring task. When the system is close to the intended location, installation is simple.

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Renewable Energy Resources, E-Vehicle and Smart Mobility

Urban Logistics and Zero Waste: Integrated Approaches for Resource Efficiency

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ABSTRACT

The importance of cities in terms of sustainability is increasing. In this context, urban logistics and zero waste management emerge as critical strategies to reduce environmental impacts by ensuring more efficient use of resources. Urban logistics is a concept that includes the management and optimization of urban goods and service flows. Zero waste aims to minimize waste generation, increase recycling and minimize the final disposal of waste. The integration of these two concepts offers significant opportunities in terms of resource efficiency. Integration of urban logistics and zero waste management provides efficiency in resource use. Optimizing logistics operations can reduce waste and streamline recycling processes. This contributes to both reducing environmental impacts and increasing economic benefits. Many cities around the world have achieved successful results by adopting the integration of urban logistics and zero waste management. For example, significant reductions in the amount of waste have been achieved by optimizing urban distribution routes and strengthening the recycling infrastructure. Integration of urban logistics and zero waste management is an important strategy for resource efficiency. This integration can reduce the environmental impact of cities while increasing economic and social benefits. Future studies should focus on further deepening and expanding integration in these areas.

Keywords: urban logistics, zero waste, resource efficiency

1. Introduction

The majority of the world's population currently resides in urban areas, and this trend is expected to continue in the future. As the sustainability of cities becomes increasingly important, the well-being of the people living in these urban centres becomes a critical issue in terms of minimising environmental impacts and using resources efficiently. In this context, concepts such as urban logistics and zero waste management stand out as important strategies to increase resource efficiency and promote environmental sustainability. Urban logistics is defined as the process of planning, managing and optimising the flows of goods and services within a city. This concept encompasses various areas, including transport, storage, distribution and supply chain management (Mesjasz-Lech, 2019).

Urban logistics has the potential to reduce environmental impacts, such as traffic congestion in cities, air pollution and greenhouse gas emissions. The zero waste concept aims to minimise waste generation, increase recycling rates and minimise the final disposal of waste. This approach encourages the more efficient use of resources and contributes to the conservation of natural resources. Furthermore, zero waste policies can also be economically beneficial, as the reuse and recovery of recycled materials adds value to the economy. Urban logistics and zero waste management are seen as complementary strategies in terms of resource efficiency and environmental sustainability (Jakubiak, 2015).

The integration of these two concepts can lead to more efficient use of resources in the urban area. For example, optimising logistics operations can reduce the amount of waste and facilitate recycling processes. Moreover, it is essential to reconsider logistics operations and the supply chain with the objective of attaining zero waste targets. This integration can serve as the foundation for a more sustainable future by increasing efficiency in the utilisation of resources in urban areas while reducing environmental impacts (Pourmohammad-Zia & van Koningsveld, 2024).

2. Urban Logistics

The majority of the world's population currently resides in urban areas, with this proportion increasing on a daily basis. This urban population growth has a significant impact on transport systems and logistics infrastructure in cities. Urban logistics encompasses a range of strategies and practices employed to manage and optimise these intricate transport networks (Bell, 2021).

Urban logistics is a concept used to plan, manage and optimise the flow of goods and services within a city. This process is complex, involving the movement of products from the point of production to the consumer. In this process, elements such as storage, distribution, transport and supply chain management are involved. Urban logistics employs a range of analytical and planning tools to understand and optimise the interactions between these elements. Due to the diversity of urban transport systems, urban logistics is a highly complex subject. Different modes of transport, including cars, trucks, trains, trams, ships and aircraft, enable the movement of goods and services within the city. The integration and management of these transport modes is of critical importance to the success of urban logistics (Strale, 2019).

In addition to the management of goods and services, urban logistics considers the environmental and social impacts of its operations. Problems such as traffic congestion, air pollution and noise pollution have a significant impact on the sustainability of urban logistics. Consequently, urban logistics strategies often aim to promote green and sustainable transport. Innovations such as intelligent traffic management systems, optimised delivery routes and autonomous transport vehicles facilitate the enhancement of urban logistics, thereby rendering it more effective and efficient (Gonzalez-Feliu, 2018).

3. Integration of Urban Logistics and Zero Waste

In the contemporary era, the growth in the population residing in urban areas has coincided with an increase in environmental issues. One such issue is waste management. The quantity of waste generated in cities is rising at an alarming rate, resulting in significant challenges such as environmental pollution and the depletion of natural resources. To address these concerns, innovative approaches, such as urban logistics and zero waste management, must be integrated. Urban logistics encompasses the process of planning, managing, and optimising the flow of goods and services within a city. This concept encompasses areas such as transport, storage, distribution and supply chain management. Urban logistics offers the potential to reduce environmental impacts, including reducing traffic congestion, air pollution and greenhouse gas emissions within the city (Quak et al., 2018).

Strategies such as optimising delivery routes, using transport vehicles more efficiently and promoting alternative transport modes are important in urban logistics. In this way, the environmental impact of urban logistics operations can be reduced and waste generation can be controlled. The zero waste concept is predicated on the minimisation of waste generation, the promotion of recycling and the reduction of waste disposal. This approach encourages the more efficient use of resources and contributes to the conservation of natural resources (Rubio et al., 2019).

Zero waste policies encompass strategies such as the prevention of waste generation, the promotion of recycling and the conversion of waste into energy. When zero waste management is integrated with urban logistics, it is possible to reduce waste generation and optimise recycling processes. For instance, practices such as reducing packaging or using recyclable materials during the planning of logistics operations can significantly reduce the amount of waste. The integration of urban logistics and zero waste management offers numerous benefits in terms of resource efficiency and environmental sustainability (Saucedo Martinez et al., 2019). This approach contributes to reducing waste generation, conserving natural resources and minimising environmental impacts. It is also beneficial from an economic point of view, as reducing waste management costs and promoting recycling provide economic benefits. In the future, the integration of urban logistics and zero waste management will become even more widespread and developed. Technological innovations, smart city applications and green transport systems will allow this integration to become more effective. Furthermore, public policies and regulatory measures will facilitate the expansion of this field by encouraging the adoption of zero waste and sustainable logistics practices (Bing et al., 2016).

4. Conclusion

The integration of urban logistics and zero waste management plays a pivotal role in enabling cities to achieve their sustainability goals. This integration encourages more efficient use of resources and contributes to reducing environmental impacts. This paper analyses the relationship between urban logistics and zero waste management and emphasises the importance of integrated approaches for resource efficiency. Urban logistics is defined as the process of planning, managing and optimising the flows of goods and services within a city. This process encompasses elements such as transport, storage, distribution and supply chain management. Urban logistics strategies are designed to mitigate environmental impacts, such as reducing traffic congestion, reducing air pollution and optimising energy consumption. Zero waste management is a strategy that aims to minimise waste generation, increase recycling and minimise the final disposal of waste. This approach reduces waste generation and environmental impacts while encouraging more efficient use of resources.

Zero waste policies ensure more efficient use of resources by taking measures at every stage of waste management. The integration of these two approaches increases resource efficiency in urban areas while reducing environmental impacts. For example, practices such as reducing packaging or using recycled materials during the planning of urban logistics operations can significantly reduce the amount of waste. In the future, the integration of urban logistics and zero waste management will become even more widespread and developed. Technological innovations, smart city applications and green transport systems will facilitate the integration of urban logistics and zero waste management, rendering it more effective and efficient. Furthermore, public policies and regulatory measures will contribute to the growth of this field by encouraging zero waste and sustainable logistics practices. In conclusion, the integration of urban logistics and zero waste management is an important strategy for cities to reduce their environmental impact and utilise resources more efficiently. This integration represents a pivotal step towards a sustainable future. Consequently, future research should concentrate on furthering the integration in this area.

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ENERGY GENERATION USING FLYWHEEL

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Abstract:

Our project's goal is to use a flywheel to produce free energy. A two-horsepower mains motor powers a gear train made up of a number of belt and pulley drives that generate more than twice the rpm at the alternator shaft. The system's noteworthy feature is that more electrical output power can be acquired from the alternator's output than seems to be coming from the input motor. Flywheel is used to assist with this. The gear-train is connected to the flywheel or gravity wheel to generate additional free or excess energy. A thorough analysis is conducted using different flywheel parameters in order to get the freest energy possible from the system.

Keywords: Flywheel, motor, alternator, free energy, gear mechanism, Arduino Uno,

1. INTRODUCTION

A technique for obtaining energy from the surrounding environment without burning fuel is referred to as "free energy." Many effective approaches have been developed for this purpose, spanning several decades and numerous nations. run harvesting can reach very high levels, and most of the systems listed are certainly capable of producing the few kilowatts required to run a family. Energy that is free is energy that has no cost. Wind, water, and telluric power are other sources of energy. Mechanical energy powers windmills, while solar energy in solar cells translates into DC current. These kinds of energy are produced using a procedure called free energy generator. It is believed that free energy suppression Technologies that could produce energy at extremely cheap cost are purposefully suppressed by corporate energy interests. The scientific literature is full of information about other unexplored forces of nature, such as telluric currents, atmospheric electricity, earth batteries, and pressure system fluctuations. Perpetual motion energy is regarded as magical force. These gadgets make use of spinning magnets, quantum vacuum energy, and alleged hydrogen-cracking techniques. The idea that corporate energy interests purposefully inhibit innovations that could deliver energy at the lowest possible cost is known as free energy suppression. The scientific literature is well-versed in the other unexplored forces of nature, such as atmospheric electricity, telluric current, earth batteries, and pressure system fluctuations. According to a quote by Nikola Tesla, everyone need to have free access to energy sources. There is electricity everywhere, in infinite supply, and it can power all of the world's machinery without the use of gas, coal, or oil. In general, "free energy" refers to a technique for obtaining electricity from the surrounding environment without burning fuel. There are numerous approaches to accomplish this. These methods cross several decades and nations. The few kW required to power a family are most definitely within reach, and the amount of electricity that may be obtained can be very considerable.

2. SYSTEM MODELLING

In this System Design We Mainly Concentrate on the Following Parameters which can be seen in the fig. 2.1. The system consists of design of various parts like Pulley, Flywheel, Belt drive, Shaft, Bearings etc.
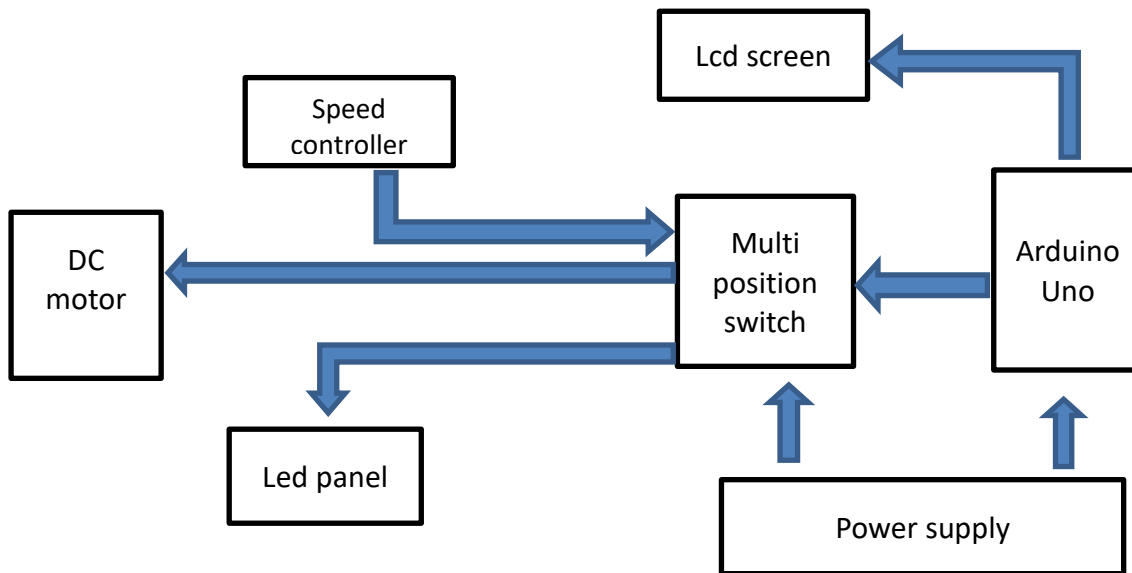

Fig 2.1- block diagram of energy generation using flywheel

1) Design of Shaft and Bearings: There are 2 shaft in the Layout of the system. Thus Design of Shaft is to be calculated in order to find the proper Shaft diameter which would withstand the load easily and to ensure the maximum energy is transfer with minimum loss. Bearing selection is also some important criteria in order to ensure smooth and long lasting functioning of thesystem.

2) Design of Belt Drive: At the first stage we selected pulley as per standard specification. We know that a belt drive is useful for the power transmission using pulley. Each pulley has different diameters and speed. The belt, wire (rope) drives are used for the power transmission.In the project, we are going to use total six pulleys, so we need three different belt drives.

3) Design of Flywheel: This Project is all about generation of free energy with using the gravitational energy. Thus we are using flywheel of mass 10kg that can utilize the gravitationalenergy and give us more output.

4) To calculate the potential energy stored in a flywheel, you can use the formula for rotational kinetic energy:

$E = \frac{1}{2} I \omega^2$ E= 2 1Iω 2

Where: E E is the rotational kinetic energy (in joules).

I I is the moment of inertia of the flywheel (in kg m²).

ω ω is the angular velocity of the flywheel (in radians per second).

Once you know the rotational kinetic energy, you can determine the potential energy generated by the flywheel as it slows down using the relationship between potential energy and kinetic energy:

E potential = E kinetic

E potential=E kinetic

This assumes perfect efficiency, neglecting any losses due to friction or air resistance. However, if you're interested in estimating the energy that can be extracted from a flywheel system considering factors

3. SYSTEM DEVELOPMENT

- **Research and Background Study**:

  - Start by understanding the basics of energy storage and generation concepts.
  - Learn about flywheel energy storage systems, including their history, working principles, and applications.
  - Explore the physics behind flywheels, focusing on rotational kinetic energy and its conversion to electrical energy.

- **Project Objective Definition**:

  - Clearly define the goals and objectives of your project. Are you aiming to demonstrate the feasibility of flywheel energy storage for renewable energy applications, or do you want to focus on a specific aspect such as efficiency improvement?
  - Determine the scope of your project and the resources available (time, budget, materials, etc.).

- **Design Phase**:

  - Define the specifications of your flywheel system, including dimensions, material selection, rotational speed, and energy storage capacity.
  - Choose an appropriate flywheel design (e.g., solid disk, rim-type, or composite) based on your requirements and constraints.
  - Consider factors such as flywheel size, weight, and shape, which affect its rotational inertia and energy storage capability.
  - Design the housing and support structure for the flywheel, ensuring stability and safety during operation.

- **Component Selection**:

  - Select suitable materials for constructing the flywheel, considering factors like strength, density, and cost.
  - Choose high-quality bearings to minimize friction and ensure smooth rotation of the flywheel.
  - Select a motor/generator capable of efficiently converting mechanical energy to electrical energy (or vice versa) with minimal losses.

- Consider incorporating a speed control system to regulate the flywheel's rotational speed and maintain stability.

- **Construction**:

  - Fabricate the flywheel and its components according to the design specifications.
  - Use precision machining techniques to ensure the flywheel's balance and concentricity.
  - Assemble the flywheel system, including the motor/generator, bearings, and control system.
  - Test each component individually before final assembly to identify any issues or defects.

- **Testing and Calibration**:

  - Conduct initial tests to evaluate the performance of the flywheel system.
  - Measure parameters such as rotational speed, torque, and energy storage efficiency.
  - Calibrate the control system to optimize the flywheel's operation and energy transfer efficiency.
  - Perform stress tests to assess the durability and reliability of the flywheel under different operating conditions.

- **Data Collection and Analysis**:

  - Collect data on the energy generation and storage capabilities of the flywheel system.
  - Analyse the test results to evaluate the system's performance against the project objectives.
  - Compare the experimental data with theoretical predictions and simulations to validate the design assumptions.
  - Identify areas for improvement and optimization based on the analysis findings.

- **Documentation and Presentation**:

  - Document the entire project, including the design process, construction steps, test procedures, and results.
  - Prepare a comprehensive report summarizing the project's objectives, methodology, findings, and conclusions.
  - Create visual aids such as diagrams, charts, and photographs to illustrate key concepts and experimental setups.
  - Present your project to your peers, instructors, or a wider audience, highlighting the significance of your findings and potential real-world applications.

4. RESULT & CONCLUSIONS

Using flywheels for energy generation offers several advantages and has been studied extensively. Here's a summary of potential results and conclusions from such endeavours:

1. **Efficiency**: Flywheels can achieve high energy efficiency in converting mechanical energy into electrical energy and vice versa. Through advanced engineering and materials, losses due to friction and other factors can be minimized, leading to efficient energy transfer.

2. **Energy Storage**: Flywheels serve as excellent energy storage devices, especially for short-term energy needs. They can store significant amounts of kinetic energy and release it rapidly when required, making them suitable for applications such as peak shaving and grid stabilization.

3. **Fast Response Time**: One of the key advantages of flywheel systems is their ability to respond rapidly to changes in energy demand. They can quickly ramp up or down to provide or absorb energy, enhancing grid stability and reliability.

4. **Lifecycle Cost**: While initial investment costs for flywheel systems might be higher compared to some other energy storage technologies, their long lifecycle and minimal maintenance requirements can result in competitive lifecycle costs. Moreover, advancements in materials and manufacturing processes could further reduce costs over time.

5. **Space Efficiency**: Flywheel systems typically have a smaller footprint compared to some other energy storage technologies like pumped hydro or large-scale batteries. This makes them suitable for installations where space is limited or where a compact solution is preferred.

6. **Environmental Impact**: Flywheels generally have a low environmental impact, especially if they are designed using recyclable materials and have minimal emissions during operation. However, the environmental impact of flywheel systems should be assessed comprehensively, considering factors such as manufacturing processes, end-of-life disposal, and overall lifecycle emissions.

7. **Application Flexibility**: Flywheel technology can be deployed in various applications, ranging from grid-scale energy storage to uninterruptible power supply (UPS) systems for critical facilities. Their versatility makes them a valuable addition to the energy landscape, offering solutions for different energy storage needs.

In conclusion, energy generation using flywheel technology holds promise as a reliable, efficient, and flexible solution for various energy storage applications. Continued research and development efforts aimed at improving efficiency, reducing costs, and addressing environmental considerations will further enhance the viability and adoption of flywheel systems in the energy sector.

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Electricity Generation from plastic and dry garbage waste.

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Abstract

These project is about reducing the pollution from surrounding and making the environment healthy, we know that plastic is available in surrounding in large amount , millions of tons of plastic is collected from urban areas and being fired or thrown it . But by the use of these power plant it can be reduced .

Electricity has become the most sought after amenity for all of us. Gone are the days when electricity would be only limited to cities. It is now reaching to every distant parts of the world. So we have now a complex network of power system. This power is being generated by the power plant. There are many power plants available now for the generation of electricity. Like thermal power plant, the the hydroelectric power plant, gas power plant etc. But the fuel used for the generation like coal, water are reducing so to make low use of coal and water.

Introduction

The Purpose of making this project is to generate electrical energy from bad materials like plastic, rubber, garbage and bad stuff etc. And store that electrical energy in the battery through the circuit and use that electrical energy to operate the whole project. And the LED bulb is shown to be turned on and the use of filters to control pollution from energy production So in this our Project we show successfully How to generate electricity by Waste Materials and Store electricity in Battery successfully. There have been several studies on waste management, however, these studies were mostly focused on suitable location for waste disposal sites; outreach and education on waste management practices; effect of poor waste management practices; MSW characterization; energy recovery from waste among others.

The management of waste plastics is a major environmental issue. Several strategies have been adopted for the handling of plastic waste which includes: recycling, depositing in landfill, incineration, microbial degradation and conversion into useful materials. Recycling of plastic is a costly and tedious practice because of the collection, sorting and processing of waste plastics, beside the low quality of the recycled goods limits their wide application. Land filling occupies productive land and renders it unfit for other applications. Incineration and pyro lytic conversion of waste plastic results in the emission of hazardous atmospheric pollutants including the polyaromatic hydrocarbons, CO_2 (a greenhouse gas) and persistent organic pollutants like dioxins The Purpose of Making this Project is to generate electric energy from waste Materials such a plastic, rubber, waste and waste etc. and to convert that less electricity energy into more high power electricity energy by electric coil , this process is called boosting Process . Normally waste is any undesirable substances which has been obtained as a outcome of al l those e humans and Animals activities.

This is basically an advanced process where cost of generation of electricity is also been saved as we didn't need to use fossil It also includes all those waste materials which is been collected by Municipals Corporation also fuel, coal, or any other raw materials which costs high and it also produces less harmful gases as compare to other methods of generation. The large amount of waste can generate a large amount of heat energy by burning it in a controlled manor. In this Process we generate electricity by burning waste that is collected from the door to door, mostly house wastes. The main components used in this methods are heating panels, Boosting coils, diodes, LEDs, capacitors, resistors, battery, PCB board etc.

SCOPE

I. The aim of this project is to find a good solution to optimize pollution.

II. The main challenges and barriers for reducing plastic waste in mixed waste and residual waste streams, hereby stimulating prevention and recycling of plastic waste.

III. Promoting recycling of plastic polymers as a substitute for virgin plastic.

Objective

1. To generate electric energy from waste Materials such a plastic, rubber, waste and waste etc

2. To convert that less electricity energy into more high power electricity energy by electric coil ,this process is called boosting Process .

3. This is basically an advanced process where cost of generation of electricity is also been saved as we didn't need to use fossil

4. To prevent the environment from the pollution caused by the plastic.

5. In this Process we generate electricity by burning waste that is collected from the door to door, mostly house wastes. The main components used in these methods are heating panels, boosting coils, diodes, LEDs, capacitors, resistors, battery, PCB board etc.

Methodology

Main functions

The overall purpose is to overcome the necessity of electricity and ease the irrigation system for our farmers, the propose model can be a suitable alternative also to help the people the life cost by reduce the electric Cost.

Hardware and working

1) Heating Penal

Simply put, a Heating panel works by allowing photons, or particles of light or heat , to knock electrons free from atoms, generating a flow of electricity. Heating panels actually comprise many, smaller units called photovoltaic cells. (Photovoltaic simply means they convert heating or light into electricity.).

2) The Source

Sources are available in different forms like plastic, rubber, garbage and bad stuff etc. Mostly the garbage waste is the source of fuel in this project.

3) Capacitor

The capacitor is a component which has the ability or "capacity" to store energy in the form of an electrical charge producing a potential difference (Static Voltage) across its plates, much like a small rechargeable battery.

4) Battery

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices. Such as flashlights, smartphones, and electric cars. Battery is device to store electrical Energy.

5) LED Bulb

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode that emits light when activated. When a suitable current is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons.
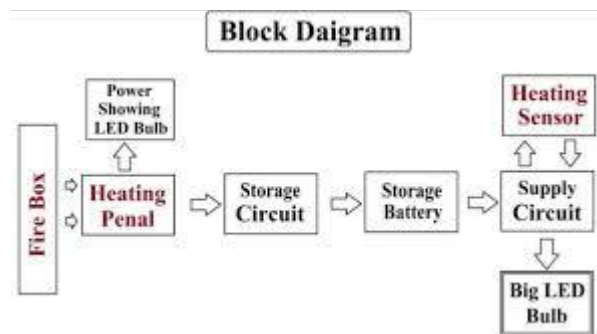
Block diagram

Figure shows block diagram of proposed model. It shows that First we collect bad materials like plastic, rubber, paper, wood, etc. Then bad materials are burnt it produces heat energy. The heat energy transfers to heating panel, heatingpanel is device which converts heat energy to electrical energy. heating panel work only on heat energy or light energy. The generated electrical energy (D.C. current) transferred to storage circuit. By using storage circuit we charge battery and stored electrical energy (D.C.). Connect the load across the battery.

Aapplications

1.The main application of these system is to generate electricity. These is the only major application of these system. After the generation of electricity, we can use it for other applications such as agriculture, industries, residential use, etc.

2.best model Cremation Ground

Aadvantages

1.Decreases Quantity of Waste.

2.Efficient Waste Management.

3.Production of Heat and Power.

4.Incinerators Have Filters for Trapping Pollutants.

5.Saves on Transportation of Waste.

6 Better Control Over Door and Noise.

7.Prevents the Production of Methane Gas.

8.Eliminates Harmful Germs and Chemicals.

Acknowledgement

It is our privilege to acknowledge our deep sense of gratitude to our guide Prof. Dr. B. M. Nayak in Electrical Engineering at Arvind Gavali College of Engineering, Satara for his/her valuable suggestions and guidance throughout our degree course and the timely help given to us in completion of our project work. We are thankful to Dr. V. A. Pharande, Principal, Arvind Gavali College of Engineering, Satara and Prof. Dr. B. M. Nayak Head of Electrical Engineering department project coordinator for their kind co-operation & morale support. Finally, we wish to express our sincere thanks to all the staff members of Arvind Gavali College of Engineering, Satara for their direct and indirect help during the course of our project. I would also like to express my profound gratitude to my faculty members and all my team members for their efforts and collaboration in doing this project work. Last but not least, I express my heartiest gratitude to almighty god and our well wishes for their love and blessings to complete the project successfully.

Cconclusion

In This Project we show How to Generate Electricity by waste materials is successfully, when we making complete our project then we check it's full working, that time he's working is very good without any problem So our Project is best for working and Showing, how to Generate Electricity by Waste materials.

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IoT and Robotics

Obstacle Avoiding Robot

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Abstract— **Robotics is a rapidly evolving and exciting field. Robotics programmes in** *engineering departments are growing in tandem with technological advancements. Path preparation, road position, and map analysis are just a few of the cellular techniques used in robotic navigation. Obstacle avoidance robots are selfcontained cell robots that avoid colliding with unexpected obstacles*

(Keywords— Robot, Arduino, Ultrasonic sensor,Wifi)

I. INTRODUCTION

Obstacle avoidance Robot is a clever tool that can mechanically sense an impediment in front of it and avoid it by taking a different route. This design enables the robot to avoid collisions in unfamiliar environments. We use an ultrasonic sensor in this case to detect route boundaries by measuring the distance between the robotic and the obstacles. The direction will be erased and movement will be maintained if robots prevent it from being altered. The buzzer is blow.

obstacle-avoiding robot has been built. It is primarily a roboticbased NodeMCU (IOT) that removes collisions using Ultrasonic variants. It's a clever device that can detect the impediment in front of it robotically and push it away by going in a different direction. This design enables the robotic to manoeuvre through collisions in unfamiliar environments, which is a must for any selfcontaminating robotic cell. Avoiding Obstacles Robots are no longer restricted, and their miles are now being used for a variety of high-risk jobs in as many military units as possible.

I. *Technicalflow*

The Arduino communicate with ESP8266, Ultrasonic Sensor , L293D DC Motor Driver, Servo Motor and buzzer it converts analog and digital signals into readable data then it transmits this data to an IoT platform for real-time monitoring. The module connects to the internet using Wi-Fi and sends data to a web-based interface accessible to its instructions the motion is stop for any reason then buzzer is blowing.

II. *Workflow*

Step 1. When the robot is powered on, both the motors of the obstacle avoiding robot will run normally, the ultrasonic sensor will be continuously detecting the distance between the reflecting surface and the robot. This information is processed by the

Step 2. The instructions give to robot through WiFi Robot Application for it's movement and proper direction.

Step 3. Arduino take the given instructions and move through that and ultrasonic sensor sence the distance and detect the obstacle.

Step 4. Using an external trigger signal, the Trig pin on ultrasonic sensor is made logic high for at least 10Aµ.The signals return back after hitting a surface and the receiver detects this signal. The Echo pin is high From the time of sending the signal and receiving it. This time can be converted to distance usin appropriate calculations.

Step 5. This information is processed by the Arduino. If the distance between the robot and the obstacle is less than 20cm then the Robot stops and scans in left and right directions for new distance using Servo Motor and the move in proper direction.

Step 6. The Robot does not found any path for it's movement then it stop it's working and send data to Arduino through buzzer then the buzzer is blowing.

III. BLOCK DIAGRAM
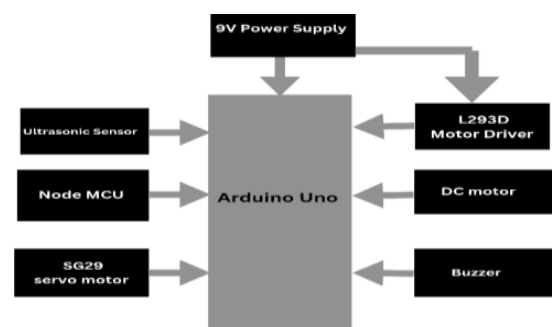
IV. RESULT

Robot impediments can be very useful and robust robotics, which are mostly used in robots used in spacecrafts, along with automated vehicles, are the most important functions. If there is an obstacle or barrier in the way, the evasion of robots is a smart drawing. The robot obstacle can be very helpful and does not involve any big tasks, including cars, plant robotics, and even spacecraft robots. Obstacle robotic prevention is self-confident painting to detect whether obstacles exist. The ultrasound sensor senses the distance around and a path is chosen for additional areas. For example, if the robotical steps are closer to the correct direction when the distance on the right side of the robot is greater than the distance on the left side.

V. CONCLUSION AND FUTURE SCOPE

A. CONCLUSION

This project developed an obstacle avoiding robot to detect and avoid obstacles in its path.The robot is built on the Arduino platform for data processing and its software counterpart helped to communicate with the robot to send parameters for guiding movement. For obstacle detection, there ultrasonic distance sensors were used that provided a wider field of detection.The robot is fully autonomous and after the initial loading of the code, it requires no user intervention during its operatio.When placed in unknown environment with obstacles, it moved while avoiding all obstacles with considerable accuracy.In order to optimize the movement of the robot, we have many considerations for improvement. However,most of these ideas will cost more money and time as well.Almost all navigation robot demands some sort of obstacle detection, hence obstacle avoidance strategy is of most importance. Obstacle Avoidance Robot has a vast field of application. They can be used as services robots, for the purpose of household work and so many other indoor applications. Equally they have great importance in scientific exploration and emergency rescue, there may be places that are dangerous for humans or even impossible for humans to reach directly, then we should use robots to help us. In those challenging environments, the robots need to gather information about their surroundings to avoid obstacles. Nowadays, even in ordinary environments, people require that robots to detect and avoid obstacles. For example, an industrial robot in a factory is expected to avoid workers so that it wont hurt them. In conclusion, obstacle avoidance is widely researched and applied in the world, and it is probable that most robots in the future should have obstacle avoidance .

B. FUTURE SCOPE

- In future cameras can be used to detect the obstacle however, it is better to get CCD or industrial use ones to get clear and fast pictures. Even the ones we mentioned in the camera holder part will be better because of the special software.

- Used in mobile robot navigation systems.

- Used for household work like automatic vacuum cleaning.

- Used in dangerous environments, where human penetration could be fatal.

- Automatic change overs of traffic signals Intruder alarm system.

- Counting instruments access switches parking meters.Back sonar of automobiles.

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E-Commerce, Web Applications and
Android Applications

Cosmetics and Rental Store
(Android App)

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Abstract— **Buying of cosmetics is a periodic task which has to be done on daily, weekly or monthly basis. This project helps in assisting these tasks by providing a user-friendly interface to create list of items they want to buy and keep track of their purchases all within the android app. This app provides the latest prices off the market. This will give users the convenience to know the prices of product while at home. The Rapid Growth of of e-commerce has transformed way businesses engage with customers and sell products or services. In this digital era, mobile commerce (m-commerce) is gaining momentum as consumers increasingly rely on smartphones for their shopping needs. Developing a robust and user-friendly eCommerce mobile application for the Android platform is essential for businesses to stay competitive in the market.This project aims to design and develop an Android eCommerce application using Android Studio, a widely-used integrated development environment (IDE) for Android app development. The app will provide users with a seamless shopping experience, allowing them to browse a diverse catalog of products, make purchases, and manage their orders conveniently from their Android devicesThe key features of the Android eCommerce app include user authentication, a comprehensive product catalog with search and filtering capabilities, a shopping cart for adding and managing items, a secure checkout process with multiple payment options, order management functionalities, and user engagement tools such as reviews and ratings The development process will involve frontend design and implementation using XML for layout and Java/Kotlin for business logic. Backend services will be implemented using Firebase or a custom backend solution, depending on project requirements. The app will integrate with external APIs for features such as payment processing and product data retrieval the development process, agile methodologies will be employed to ensure iterative development, continuous testing, and timely delivery of features. Usability testing will be conducted to gather feedback from target users and refine the user**

1.INTRODUCTION

The internet has changed many aspects of society, from business to recreation, from culture to communication and technology, as well as shopping and travelling. This new form of communication has provided new ways of doing business with the help of technological development. E-commerce is the new way of shopping and doing business. Technology has allowed companies to promote and sell their products on new markets, overcoming geographical borders as never before. Consumers have access to a wider market of products when they use wireless and internet technologies. Mobile devices

with wide access to the Internet have allowed companies to reach consumers in more diverse ways, thus ensuring deep market penetration.

This study investigates the opportunities generated through mobile telephone access to the Internet. Faster wireless networking standards allow wireless devices to use more e- commerce applications, and consequently, permit wider access to mobile commerce (m-commerce) .M-commerce has been defined as "aspecial branch of e-commerce, in which mobile devices and their network connection medium are used to buy, sell, and promote products, services, and information. The purpose of designing interfaces for mobile applicationsshould be to increase consumers' interest in using and dedication to m-commerce. Among the inhibiting factors is that E-commerce applications were developed based on e- commerceapplications. The most important thing when designing such applications is to design the application in such a way that it doesnot distract the user from the main purpose of the application. However, aspects concerning security and accessibility should not be neglected. Even though storing sensitive data such as medical, financial, or personal information on mobile devices can help people, the risks of losing such information or of unauthorized access are higher and should be considered when an m-commerce transaction begins.

This paper will review the latest trends in mobile and e- commerce applications and will develop an application architecture that describes the internal architecture of both web and mobile components. This paper will also investigate the requirements of e- commerce applications and why normal websites are not suitable for mobiledevices. More specifically this paper will analyze the characteristics required for websites so that they function properlyon mobile devices. These characteristics are screen size, input device, task-based interfaces for mobile devices, m-loyalty, design aesthetics and website design. Other research questions relate to the reason why mobile native applications are preferred over mobile websites and what can be achieved using Phone Gap cross-mobile platform applications. Finally, the paper will attempt to provide solutions formobile application

development and make recommendations for future directions.

2. RESEARCH PROCUDURE

E-commerce Android app requires a thorough research procedure to ensure all aspects of development are well-planned and executed. Here is a step-by-step guide to the research procedure:

1. Market Analysis
Identify Trends: Research current trends in mobile e-commerce to understand user preferences and industry standards.
Competitor Analysis: Study existing e-commerce apps to identify strengths, weaknesses, opportunities, and threats (SWOT analysis).
Target Audience: Define your target audience based on demographics, preferences, and buying behavior. Use surveys, focus groups, and market reports to gather data.

2. Requirement Gathering
Stakeholder Interviews: Conduct interviews with stakeholders (business owners, potential users, developers) to gather requirements and expectations.
Feature List Compilation: Create a comprehensive list of features to include in the app, such as user authentication, product catalog, search functionality, shopping cart, payment integration, order tracking, and customer support.
Technical Specifications: Define technical requirements such as platform compatibility (Android version), performance benchmarks, and security protocols.

3. Feasibility Study
Technical Feasibility: Assess the technical resources and expertise required. Determine the feasibility of integrating desired features using available technologies.
Economic Feasibility: Estimate the cost of development, including resources, tools, and time. Conduct a cost-benefit analysis to ensure the project is financially viable.
Operational Feasibility: Evaluate the operational aspects, including ease of use, maintenance, and scalability.

4. Technology Stack Selection
Front-end Technologies: Use Xml language
Back-end Technologies: java and Kotlin is used for back end.
Database Management: Decide on a database system like Firebase for storing user and product data.

5. Development Planning
Task Allocation: Assign tasks to team members based on their skills and expertise.
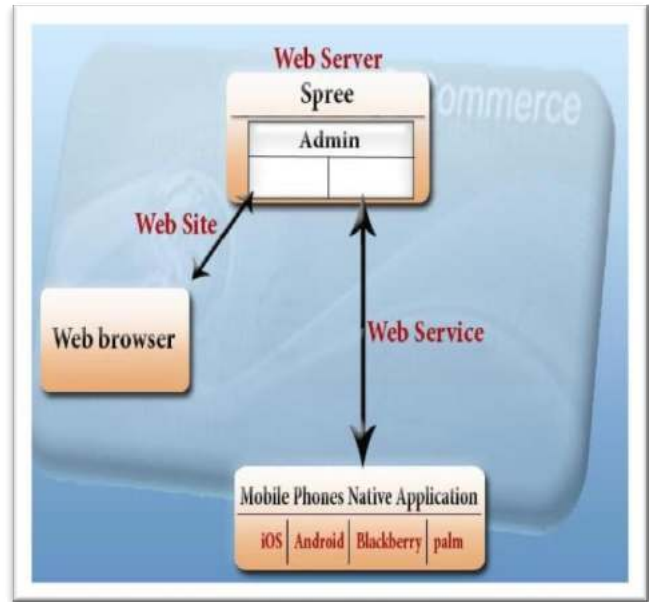
3.Application Architecture

Figure 1: Application Architecture

Designing the architecture for an e-commerce Android application involves organizing the app into several layers and components that handle different aspects of functionality, from the user interface to data managementrobust and scalable architecture for an e-commerce Android app.

4. Key Features

1.User Registration and Login: Via email or social media.
2.Product Catalog: Detailed product listings with search and filter options.
3.Shopping Cart: Add, remove, and manage products in the
4.Payment Gateway: Secure payment options like credit/debit cards, PayPal, or other local payment methods.
5.Order Tracking: Real-time tracking of order status.
Notifications: Push notifications for offers, order updates, etc.

Customer Support: In-app chat or contact options**.**

6.Live SMS: to get messages.
7. Ai chat bot.

5.FUTURE SCOPE

1. E-Commerce has grown in importance because of all the advantages it offers to sellers and buyers. It is especially relevant in the current scenario of the Covid-19 pandemic when there are nationwide lockdowns.

2. Even traditional retailers hurriedly created online stores to maintain business continuity during the pandemic. This augurs well for the scope of e-commerce all over the world. Everything from groceries to sports equipment can now be bought online.
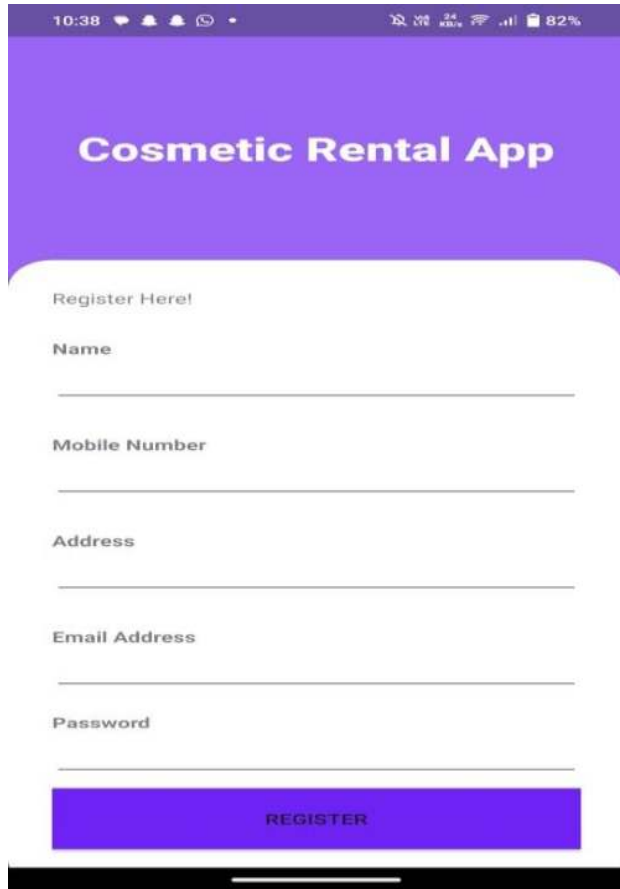
3. In this app w are easily getting where cosmetics shop is using by google map located.

4. E-Commerce enables manufacturers and traders from remote, rural places to sell their products online; their own local markets may be too small, and not have the kind of consumers the seller needs.

5. Convenience in time – people can shop from home, while travelling, and whenever they want. No worrying about store closing, holidays, commuting, traffic jams etc.

6**.** They can easily compare products and prices at different online stores

7. Online stores clearly mention return and exchange policies on the site, making it easy for shoppers to decide

8. Online shopping offers great safety in shopping from home, especially in times like the present – when the global pandemic is threatening the health of all those who mingle in public
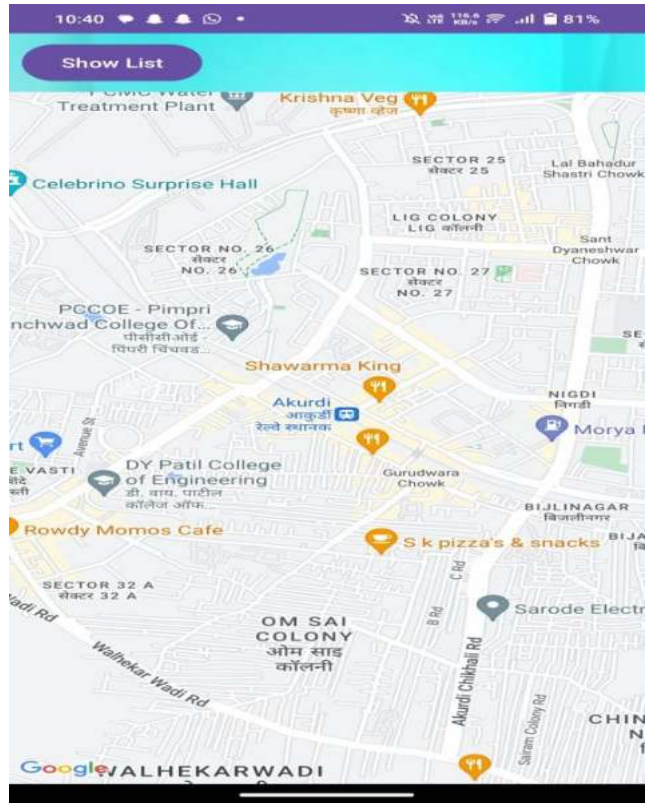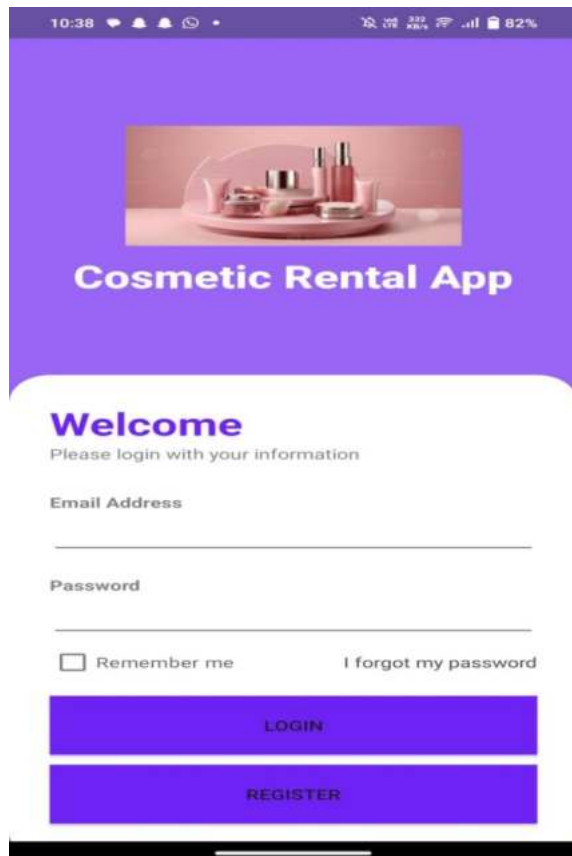
6. RESULT

1.Page
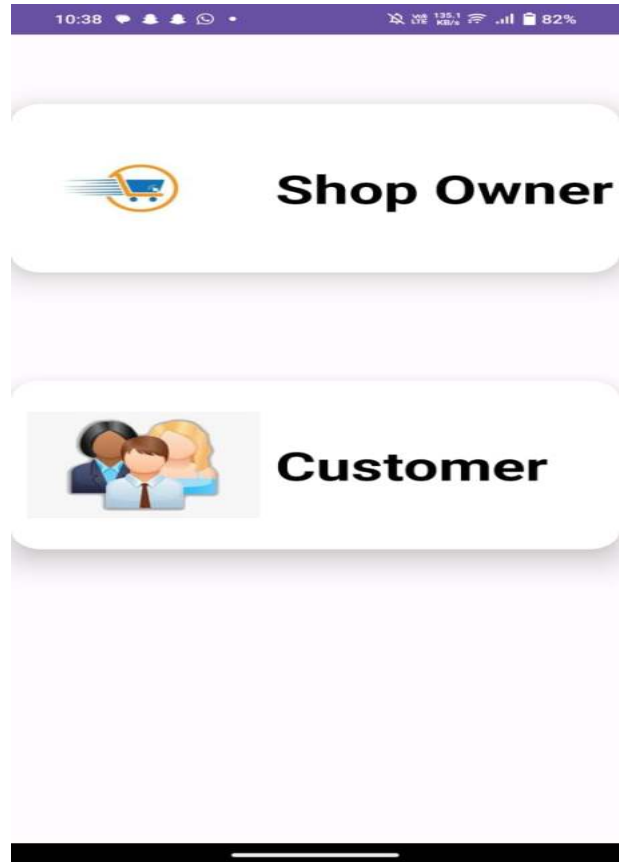
1.2USER LOGON PAGE

1.3 USER OGIN HOME PAGE

2. ADMIN LOGIN PAGE

1.4 Google map

7. TECHNOLOGIES USED

1. Java Kotlin and Python for Backend:

Kotlin: is a null-safe language. This means that the type system also gives information to the compiler about the possibility that a referenced value is null. This is a problem already known in several languages in which an attempt to access a null reference generates a Runtime error. In the case of Java, the well-known Null Pointer Exception. Tony Hoare, the creator of the null reference, went so far as to say at a conference in 2009 that this was his "billion-dollar error" due to the "countless number of errors, vulnerabilities, and system failures […] in the last forty years old". Kotlin, solve this problem by making a clear distinction between what can be and what cannot be null: a variable containing text that has the type String? signals the compiler that the variable may contain null and forces special handling where necessary.

Java: java is well programming language. You can use it to create desktop and mobile app application, for massive data processing, for backend development to program embedded devices and more. Oracle, the company that owns Java claims that java is used to on 3 billon devices worldwide, making it one of the most popular programming languages.

Python: We just published a full backend web development with Python course on the freeCodeCamp.org YouTube channel. This comprehensive course is for absolute beginners and it will teach you backend web development with Python. You will learn the basics of Python and Django, and create a few projects along the way.

2. FRONT END:

XML: XML (extensible Markup Language) is a flexible, structured language used to store and transport data. It is designed to be both human-readable and machine-readable. XML does not define tags; instead, it allows users to create their own tags, facilitating the description and exchange of data in a consistent and standardized format.

3. DATABASE:

FIREBASE: Firebase is a comprehensive mobile and web development platform developed by Google, offering a wide array of tools and services for building, improving, and growing apps effectively. It encompasses features like real-time database, authentication, cloud storage, hosting, analytics, and more. With Firebase, developers can streamline development processes, enhance user experiences, and analyze app performance, all within a unified platform.

8. DESIGN AND DEVELOPMENT

Designing and developing an Android e-commerce app involves thorough research, intuitive UI/UX design, frontend and backend development, seamless integration of features like product catalog management, shopping cart, and checkout, along with payment gateway integration, robust testing, deployment, and ongoing maintenance to ensure a smooth user experience and business growth.

9. CONCLUSION

Mobility of people and technologies are key factors in today's economy. Mobile applications are of utmost importance when companies market their products or services. Mobile phones have generated an incredible opportunity for accessing the Internet, while m-commerce has increased the level of using a mobile phone for business. Applications for electronic and mobile commerce are, however, developed sufficiently to cover all aspects of the market. The ideal applications do not distract the user from his/her intent and they provide on appropriately level of security, accessibility and speed. Screen size, input device, urgency, task-based interfaces, and design are important aspects that developers have to consider when designing mobile phone applications. Such applications should be implemented on different operating systems, whether using JavaScript, CSS3 or HTML5, or combining these three together. The installation of a Spree application allows partial web services to function because not all applications may work with these web services. The device screen size proved to be of great importance but the Spree application solved these issues. Simulators for iPhone and iPad represent an excellent way to test application.

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A LOCAL MARKET PLACE

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ABSTRACT

In today's rapidly evolving digital landscape, local businesses face numerous challenges in competing with larger online retailers. However, our innovative eCommerce platform aims to revolutionize the way local markets operate, providing them with a powerful digital presence to thrive in the digital age.Our platform serves as a comprehensive solution for local businesses, enabling them to showcase their products and services to a broader audience while maintaining their unique identity and charm. Through intuitive user interfaces tailored to the needs of both buyers and sellers, we ensure a seamless online shopping experience that mirrors the convenience of traditional retail, with the added benefits of digital accessibility and global reach. Key features of our platform include robust search and filtering options, personalized recommendations, and secure payment gateways to facilitate smooth transactions. Additionally, we offer integrated inventory management tools and analytics to help businesses optimize their operations and make data-driven decisions.

INTRODUCTION :

E-commerce is fast gaining ground as an accepted and used business paradigm. More and more business houses are implementing web sites providing functionality for performing commercial transactions over the web. It is reasonable to say that the process of shopping on the web is becoming commonplace. The objective of this project is to develop a general-purpose e-commerce store where any product (such as books, CDs, computers, mobile phones, electronic items, and home appliances) can be bought from the comfort of home through the Internet. However, for implementation purposes, this paper will deal with an the Internet where customers can browse the catalog and select products of interest. The selected items may be online book store. An online store is a virtual store on

collected in a shopping cart. At checkout time, the items in the shopping cart will be presented as an order. At that time, more information will be needed to complete the transaction. Usually, the customer will be asked to fill or select a billing address, a shipping address, a shipping option, and payment information such as credit card number. An e-mail notification is sent to the customer as soon as the order is placed.

It was one of the most important segments of selling local products in most of the countries. The terms market and marketplace originate from the Persian word bazaar meaning an open public space where buyers and sellers meet at certain times for commercial purposes. They appeared almost at the same time as the first exchanges of goods, i.e., when people, faced with the fact that they had something more than they needed, and had something in small quantities or lacked it completely, spontaneously formed places where they could exchange their goods. They are specially assigned and arranged spaces where goods and services are sold, and they are usually located in the center of urban/rural settlements surrounded by institutions of local power. Therefore, marketplaces are defined as indoor or outdoor locations where vendors gather periodically to sell merchandise. Moreover, different forms of marketplaces are distinguished, such as open-air marketplaces, street marketplaces (official and unofficial), purpose-built marketplaces, periodic marketplaces, flea marketplaces, permanent and mobile marketplaces, public marketplaces, municipal marketplaces, and swap meets. Also, depending on the goods sold there, the stands are equipped with scales, a cash register, and products' displayed prices. Marketplace goods are primarily sold by their owners (farmers, cattle breeders, fishermen, etc.), where vendors operate as entrepreneurs.

RELATED WORK

eCommerce websites are online platforms where businesses sell products or services to customers. Examples include Amazon, Alibaba, and eBay. They offer a wide range of products, from electronics to handmade goods, and provide features like fast shipping, easy returns, and secure payment options. These websites cater to diverse markets and consumer preferences, offering a convenient shopping experience accessible from anywhere with an internet connection.

- Amazon: Amazon is one of the largest and most popular eCommerce platforms globally, offering a wide range of products, including electronics, books, clothing, and more. It provides a seamless shopping experience with features like fast shipping, product reviews, and personalized recommendations.

- Alibaba: Alibaba is a leading eCommerce platform based in China, specializing in wholesale trade. It connects businesses and manufacturers with buyers worldwide, offering a vast array of products ranging from electronics and machinery to apparel and home goods.

- eBay: eBay is a prominent online marketplace that enables individuals and businesses to buy and sell a variety of products through auctions and fixed-price listings. It caters to diverse categories such as electronics, collectibles, fashion, and automotive parts.

- Walmart: Walmart operates both brick-and-mortar stores and an eCommerce website, offering a wide selection of products at competitive prices. It provides convenient shopping options, including in-store pickup, same-day delivery, and a membership program called Walmart.

- Etsy: Etsy is a popular eCommerce platform that focuses on handmade, vintage, and unique goods. It provides a marketplace for artisans, crafters, and small businesses to sell their products, ranging from jewelry and clothing to art and home decor.

- Best Buy: Best Buy is a leading retailer of consumer electronics and appliances, with an extensive eCommerce presence. It offers a wide range of products, including smartphones, laptops, TVs, and home theater systems, along with services like installation and tech support.

- Target: Target is a retail giant that operates

products across various categories, including apparel, home goods, electronics, and groceries. It provides convenient shopping options like same-day delivery and curbside pickup.

- Zalando: Zalando is a prominent eCommerce platform based in Europe, specializing in fashion and clothing. It offers a vast selection of apparel, footwear, and accessories from leading brands, along with features like free shipping and easy returns.

- ASOS: ASOS is a popular online fashion retailer that caters to young adults, offering trendy clothing, shoes, and accessories for men and women. It provides a seamless shopping experience with fast shipping, multiple payment options, and a mobile app for convenient shopping on the go.

- Flipkart: Flipkart is one of the largest eCommerce platforms in India, offering a wide range of products across categories such as electronics, fashion, home goods, and groceries. It provides features like cash on delivery, easy returns, and various payment options tailored to the Indian market.
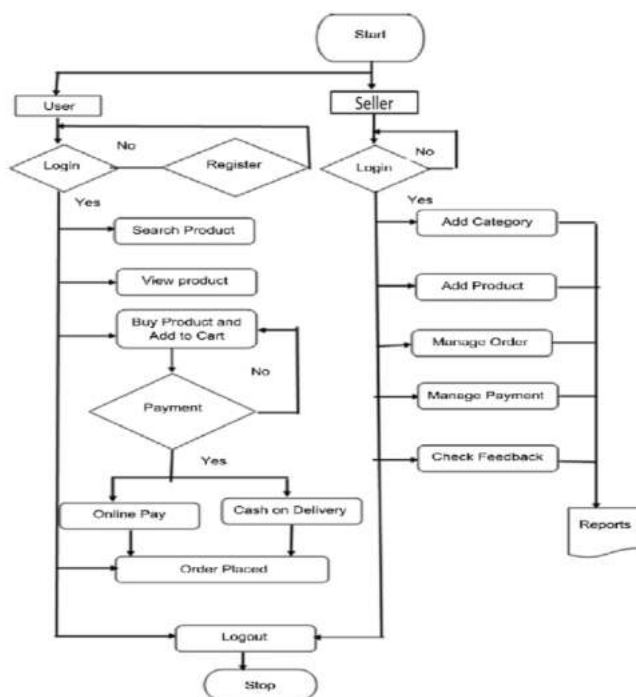
DESIGN AND DEVELOPMENT

Figure 1: Block/Structural Diagram

The diagram represents a simplified e-commerce platform workflow, with two main roles: users and sellers.

both physical stores and an eCommerce website, offering a diverse selection of

Here's a more detailed explanation of the workflow:

- o Start: The user or seller initiates the interaction

with the e-commerce platform.

- o User/Seller Differentiation: The platform asks the user if they are a seller. If yes, they are directed to the seller section. If no, they proceed to the user section.
- o User Login/Registration: The user is prompted to log in or register. If they choose to register, they create an account and then log in.
- o Seller Login: The seller logs in to access their seller dashboard.
- o Search and View Products: The user can search for products and view product details.
- o Add to Cart: The user can add products to their cart for purchase.
- o Payment: The user can choose to pay online. If successful, the order is placed.
- o Logout: The user or seller can log out of their account.

User Section

The user starts the interaction. The user is asked if they are a seller. If yes, the flow proceeds to the seller section. If no, the flow continues to the next step. The user is asked to log in or register. If they choose to log in, they are authenticated. If they choose to register, they create an account and then log in. Once logged in, the user can search for products, view product details, and add products to their cart. When the user is ready to check out, they proceed to the payment step. The user can choose to pay online, and if successful, the order is placed. The user can then log out.

Seller Section

The seller logs in. The seller can add categories and products to the platform. The seller can manage orders, but there is no option to manage payments (this might be an oversight or intentional design). The seller cannot place orders (this is likely intentional, as sellers don't place orders on their own platform).

Additional Features

The platform could include features such as order tracking, order history, and user account management. Error handling and exception management could be added to handle scenarios like failed login attempts, payment failures, or system errors. Administrative or moderation tasks, such as managing user accounts, resolving disputes, or handling returns, could be included in the workflow.

IMPLEMENTATION

An eCommerce website is an online platform where businesses sell products or services to customers. Customers browse products, add items to a virtual shopping cart, then proceed to checkout where they enter payment and shipping information. The website securely processes payments and orders, manages inventory, arranges shipping, and provides

customer support. It's a digital marketplace that facilitates transactions between buyers and sellers over the internet.

Figure 2: Activity Diagram

Website Interface:

The website provides an interface where users can browse through various products or services listed for sale. This interface includes features like search bars, categories, filters, and product pages with detailed descriptions, images, and prices.

Product Management:

Sellers upload product listings onto the website, including images, descriptions, prices, and other relevant information. They may also categorize products and set attributes like size, color, or quantity.

Shopping Cart:

When a customer finds a product they want to purchase, they can add it to their virtual shopping cart. The shopping cart accumulates all selected items, allowing customers to review their choices before proceeding to checkout.

Checkout Process:

Upon checkout, customers enter their shipping address, payment information, and any other required details. The website securely processes this information to complete the transaction.

generates an order confirmation for the customer and notifies the seller. Sellers manage orders through an admin panel, which allows them to track orders, manage inventory, and communicate with customers regarding shipping and other inquiries.

Shipping and Fulfillment:

Once an order is received, the seller packages the purchased items and arranges for their shipment to the customer's address. Some eCommerce websites offer integrated shipping solutions that calculate shipping costs, generate shipping labels, and provide tracking information.

Customer Support:

The website typically provides customer support channels, such as email, live chat, or phone, to assist customers with inquiries, returns, and any issues they may encounter during the purchasing process.

Feedback and Reviews:

Customers may leave feedback and reviews for products and sellers, which helps build trust and credibility within the eCommerce community.

Security Measures:

eCommerce websites implement various security measures to protect both customer and seller

Payment Gateway:

The website integrates with payment gateways to securely process payments. This involves encrypting sensitive information to protect it from unauthorized
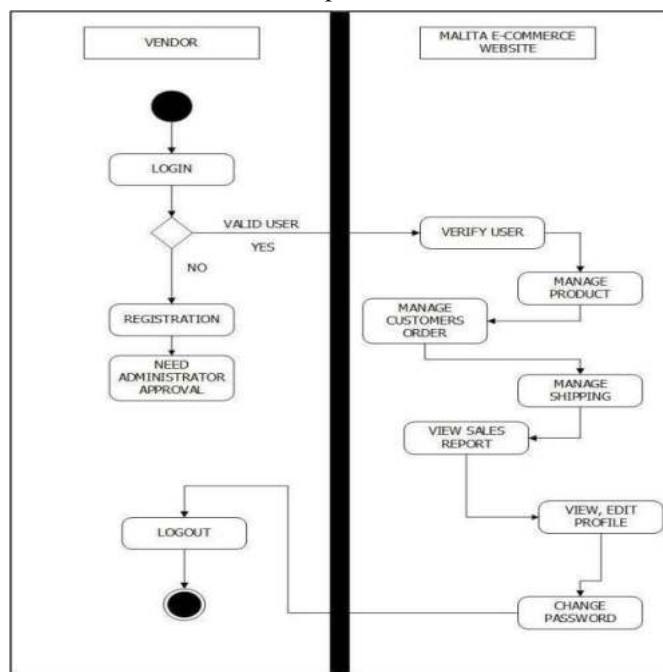
access. Common payment methods include credit/debit cards, digital wallets, and bank transfers.

Order Management:

After the transaction is completed, the website

data, including SSL encryption, PCI compliance for payment processing, and regular security audits.

ACKNOWLEDGEMENT

It serves as a receipt and confirmation that the order has been successfully placed. This acknowledgment usually includes details such as the items purchased, their prices, any applicable taxes or fees, the total amount paid, the shipping address, estimated delivery date, and order number. It provides reassurance to the customer that their transaction went through smoothly and serves as a reference in case of any future inquiries or issues with the order.

CONCLUSION

In conclusion, the development of the sustainable second-hand e-commerce platform represents a significant stride towards redefining the dynamics of online commerce in alignment with the principles of sustainability, user empowerment, and technological innovation. From its inception, the project has been guided by a vision to create a dynamic marketplace where pre-owned items find new homes, and users actively engage in a circular economy. The adoption of the php, comprising XAMPP, HTML, CSS, JavaScript and SQL has not only facilitated the seamless integration of backend, frontend, and database but has also ensured scalability, flexibility, and responsiveness in meeting the dynamic demands of the second-hand market. The journey commenced with a thorough understanding of

market trends and user behaviors within the second-hand landscape, laying the groundwork for a platform that is

not only functional but resonates with the preferences and needs of a diverse user base. The meticulous requirement gathering phase, involving collaborative workshops and stakeholder involvement, enabled the definition of both functional and nonfunctional requirements. This process ensured that the platform caters to the essential feature's users expect, such as secure user authentication, efficient CRUD operations, and an intuitive user interface. The technology stack selection was a strategic decision aimed at harnessing the strengths of each component.

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Content Based Recommendation System (QUICKBUY): A General Purpose E-Commerce Application

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Abstract - **In today's world, E-commerce website is crucial because the need for the online services in order to serve people with the desired products and the various retailers to reach out to their desired customer is increasing rapidly all around the world. In this fast-paced and busy world the demand of an E-commerce website is increased as individuals want every facility of choosing and getting their demanded products at one place, with just a single click. QuickBuy redefines the e-commerce landscape by offering an intuitive platform for businesses and consumers to connect seamlessly, developed using MERN stack. Business owners can effortlessly list and sell their products, while consumers enjoy a hassle-free shopping experience. The website boasts a user-friendly interface, ensuring easy navigation and efficient transactions. Additionally, QuickBuy harnesses the power of artificial intelligence to provide personalized product recommendations, enhancing customer satisfaction and engagement. By combining simplicity, security, and intelligent features, QuickBuy sets a new standard in online shopping, fitting out to the evolving demands of the digital marketplace.**

Keywords: E-commerce, QuickBuy, seamlessly, MERN, artificial intelligence

I. INTRODUCTION

In an era defined by digital innovation, the local business landscape faces a transformative challenge: the need to transition into the online realm. QuickBuy, a visionary e-commerce website, emerges as an illuminant of solution to this prevailing issue. As the world increasingly turns to online platforms for shopping and services, small-scale sellers and local business owners encounter significant hurdles in establishing an awesome digital presence. The complexities of technology, coupled with the demands of a competitive online market, create barriers that often seem overwhelming.

The heart of the issue lies in the gap between the digital demands of the modern consumer and the resources available to local sellers. These entrepreneurs, deeply woven into the fabric of our communities, find themselves grappling with the complexities of online commerce. Limited technical expertise, budget constraints, and a lack of tailored platforms create an alarming reality. The gap between the demand for online services and the ability of these local businesses to provide them threaten their sustainability and growth. This chasm calls for an innovative and accessible solution that not only simplifies the complexities of e-commerce but also preserves the essence of local traditions and craftsmanship.

QuickBuy emerges as the answer to this pressing problem, designed with a singular mission to empower local sellers and business owners to effortlessly establish and expand their online ventures. At its core, QuickBuy is more than just an e-commerce website; it's a catalyst for community development and economic growth. By providing a user-friendly platform coupled with an intelligent AI-based recommendation system, QuickBuy ensures that local businesses can seamlessly integrate into the digital marketplace. This innovative solution eliminates the technical barriers, allowing sellers to focus on what they do best: delivering exceptional products and services rooted in local expertise and tradition.

QuickBuy's vision extends beyond merely bridging the digital divide. It aspires to create a vibrant digital ecosystem where local businesses not only survive but flourish. By preserving the uniqueness of local offerings and cherishing a

sense of community, QuickBuy envisions a future where every seller, regardless of size or expertise, can flourish in the online landscape. Through this report, we delve into the intricacies of QuickBuy, exploring its features, functionality, and the transformative impact it promises to bring.

II. RELATED WORKS

In the General Purpose E-commerce Application, ReactJS forms the client-side, NodeJS and ExpressJS form the server-side and MongoDB is the NoSQL database used in this tech stack. That is MERN stack is used to develop this user-friendly application. The website is designed in such a way that user has to first login where it's asked to enter the credentials like, User name, email address, password, mobile number and lastly address. These credentials can be changed by the user in there profile section.

In the QuickBuy website, the left panel contains the filters to category and price so as to make client find the products more precisely. In the add to cart facility the client can see the total number of purchases with the total amount of the product costs. The client also gets the description of the products in order to know more about it.

QuickBuy, built on the MERN stack, showcases products categorized by type and cost. It blends a seamless user-to-database interaction for product retrieval. Leveraging MongoDB, the system stores extensive data in JSON format, ensuring versatility. Implementation of AXIOS facilitates smooth communication between Node.js and React.js. Robust security and authentication protocols are ensured through JWT. Additionally, react-redux streamlines data transfer across UI components, enhancing overall system efficiency and user experience.

In the General Purpose E-commerce Application according to their search the client gets the recommendations about the other available products on the website where the AI based recommendation is employed.

III. BACKGROUND TOOLS

A. MongoDB:
QuickBuy utilizes MongoDB as its database management system. MongoDB's NoSQL, document-oriented structure provides a flexible and scalable solution for handling diverse data types, crucial for managing extensive product databases and user profiles efficiently.

B. Express.js:
Express.js, a minimal and flexible Node.js web application framework, simplifies the development of robust server-side applications. It enables QuickBuy to handle various HTTP requests, ensuring seamless communication between the client-side and the server-side components.

C. React.js:
QuickBuy's dynamic user interface is built using React.js, a powerful JavaScript library. React's component-based architecture facilitates the creation of interactive and responsive user interfaces, enhancing the overall user experience on the website.

D. Node.js:
Node.js serves as the runtime environment for QuickBuy, allowing server-side execution of JavaScript. Its non-blocking, I/O operations enable QuickBuy to handle multiple user requests simultaneously, ensuring fast and efficient performance.

E. Postman:
It plays a crucial role in the development and maintenance of the APIs that power the website. QuickBuy uses Postman to design and prototype your API. You can create collections, define endpoints, and set up requests to simulate the behaviour of your e-commerce API. It helps ensure consistency and clarity in API communication.

F. Content-based recommendation system:
Content-based recommendation is a personalized recommendation approach used in QuickBuy that suggests items to users based on the features and attributes of items they have previously interacted with or expressed interest in. The primary goal to employ it in QuickBuy is to enhance the user experience by providing relevant and personalized product recommendations, ultimately increasing user engagement and satisfaction.
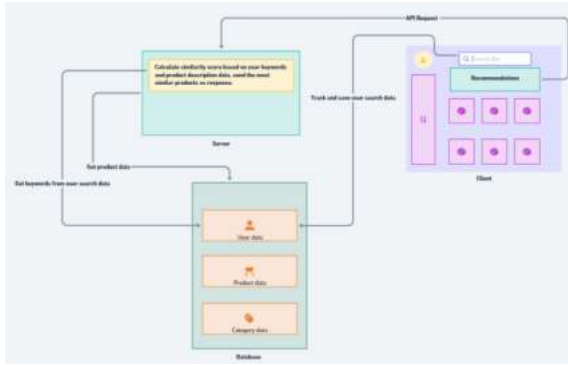
Figure1.1: Flow of web application

IV. PROPOSED SYSTEM

Project Inception and Planning:

The QuickBuy project started with a comprehensive planning phase, where the requirements were gathered and a detailed roadmap was established. The decision to use the MERN stack was made due to its flexibility and efficiency in developing scalable web applications. The project's core features—cart management, category-wise product display, search functionality, and an AI-based recommendation system—were identified as the focal points of development.

Backend Development (Node.js and Express.js):

The implementation kicked off with the backend development using Node.js and Express.js. The backend was designed to handle various tasks, including user authentication, product management, and cart operations. RESTful APIs were created to establish communication between the frontend and backend systems. These APIs served as the foundation for the entire project, ensuring that data transactions between the client and server were smooth and secure.

Database Design and MongoDB Integration:

Simultaneously, the database structure was designed to store user data, product information, and transaction history. MongoDB, a NoSQL database, was chosen for its flexibility in handling unstructured data. The backend was integrated with MongoDB to store and retrieve data efficiently. Schemas were defined to organize the data, ensuring consistency and coherence in the database operations.

Frontend Development (React.js):

With the backend functionality in place, the focus shifted to frontend development using React.js. The user interface was designed with a clean and intuitive layout, emphasizing user experience. Components were created for product display, cart management, and search functionalities. React Router was implemented to enable seamless navigation between different sections of the website. User interfaces were designed to be responsive, ensuring a consistent experience across various devices and screen sizes.

Cart Management and Product Display:

The cart management feature was implemented, allowing users to add products to their cart, update quantities, and remove items. Category-wise product display was integrated, enabling users to browse products based on predefined categories. Product information, including images, descriptions, and prices, was fetched from the database and displayed dynamically on the frontend. Users could easily view products within specific categories, enhancing their shopping experience.

Search Functionality and API Integration:

The search functionality was implemented, enabling users to search for products using keywords or specific attributes. This feature utilized API calls to fetch relevant product data from the backend based on user input. The search results were displayed in real-time, allowing users to find products quickly and efficiently. The integration of APIs for search ensured that the website was always up-to-date with the latest product information from the database.

### AI-Based Recommendation System Integration:

A significant milestone in the project was the integration of the AI-based recommendation system. An algorithm is employed to analyze user behavior, preferences. The algorithm generates personalized product recommendations for users, by tracking search details and keywords enhancing their shopping experience. The recommendation system was seamlessly integrated into the frontend, providing users with tailored product suggestions based on their interests and previous interactions with the platform.

The recommendation filtering can be expressed as:

$$Similarity(Pi, Pj)$$
$$= \frac{|Keywords(Pi) \cap Keywords(Pj)|}{\sqrt{|Keywords(Pi) \times Keywords(Pj)|}}$$

Where:

- Similarity (Pi, Pj) is the similarity score between products PiPi and PjPj.
- Keywords (Pi) represents the set of keywords associated with product PiPi.
- Keywords (Pj) represents the set of keywords associated with product PjPj.
- |Keywords (Pi) ∩Keywords (Pj)| denotes the count of common keywords between products PiPi and PjPj.
- |Keywords(Pi)||Keywords(Pi)| and |Keywords(Pj)||Keywords(Pj)| represent
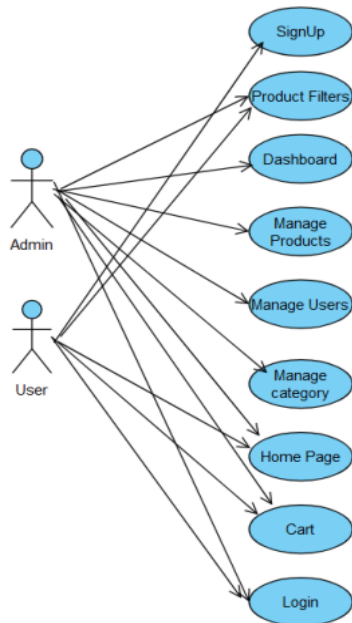
the total count of keywords for products PiPi and PjPj, respectively.

Figure4.1: Use case diagram

Testing and Debugging:

Throughout the development process, rigorous testing and debugging were conducted to identify and resolve issues promptly. Unit tests were performed on individual components, ensuring their functionality in isolation. Integration tests were conducted to validate the interactions between different modules of the application. Postman, a powerful API testing tool, was utilized to test the RESTful APIs thoroughly. This meticulous testing approach helped in identifying and addressing bugs, ensuring the stability and reliability of the QuickBuy platform.

Optimization and Performance Tuning:

After the core features were implemented and tested, the focus shifted to optimization and performance tuning. The website's performance was optimized by minimizing database queries, optimizing API endpoints, and implementing caching mechanisms where applicable. Images and other media assets were optimized to reduce loading times. Code splitting and lazy loading techniques were employed to ensure that only necessary resources were loaded, improving the website's overall speed and responsiveness.

Deployment and Continuous Improvement:

Upon successful testing and optimization, the QuickBuy platform was deployed to a production environment, making it accessible to users. Continuous monitoring and user feedback were gathered to identify areas of improvement. Regular updates and enhancements were rolled out to address user suggestions and fix any emerging issues.

In summary, the implementation of QuickBuy was a meticulous and systematic process, starting from project planning and gradually progressing through backend and frontend development, API integration, AI-based recommendation system implementation, testing, optimization, and deployment. This step-by-step approach ensured the creation of a robust and feature-rich e-commerce platform that provides users with a modern, intuitive, and personalized shopping experience.

V. RESULT

QuickBuy is more than just an online store, it's an ecosystem designed to cater to the diverse needs of local sellers. At its core, the platform boasts a state-of-the-art AI-based recommendation system, ensuring that every visitor experience personalized product suggestion tailored to their preferences. This sophisticated feature not only enhances user engagement but also facilitates higher conversion rates, fostering a loyal customer base. QuickBuy' s intuitive and user-friendly interface allows sellers to effortlessly list their products, manage inventory, and process orders, all within a seamless digital environment. Powered by the MERN stack, QuickBuy embodies the latest advancements in web development technology, guaranteeing a secure, scalable, and efficient platform for businesses to thrive online.

Figure 5.1: User Sign Up

The above is the user sign up dialog box, the tool bar has the sign up option, through which user can enter the required credentials and get registered on the website.

Figure 5.2: User Login

The above Figure, shows the login window for the users who are already registered where, they need to enter their Email address and Password. A mistake in it is detected by the site and as a result does not allow the user to login.

Figure 5.3: Admin Panel

The above Figure. Shows the admin panel where the admin can add new products and new category for their customers and additionally can also see what all products they have added in the

Products section. If any of the product is unavailable QuickBuy gives the authority to the admin to remove the products.

Figure 5.4: Admin Panel (User Information)

The admin can also checkout all the users which are registered to QuickBuy. The user information including the name, Email, address and phone number using which the user has registered is displayed.

Figure 5.5: Items added to cart

The above Figure, Demonstrates that after adding the products to cart when the user clicks on cart option in the above panel in the website, they will get the details of the products they have added and will also get the cart summary that is the total amount of the products the user is showing interest in. The user can also remove any of the product if not interested in any of them.

Figure 5.6: The Home Page

The above Figure. displays the home page which displays a number of products. The home page in the website also shows the recommendations based of the searches made by

the user which is the AI based recommendation system.

VI. CONCLUSION

Thus, the implementation of QuickBuy represents a successful journey from concept to a fully functional, user-centric e-commerce platform. The incorporation of essential features such as cart management, category-wise product display, and powerful search functionality elevated QuickBuy' s user experience, enabling effortless navigation, product discovery and the integration of an AI-based recommendation system added a layer of personalization, making QuickBuy stand out in the competitive e-commerce landscape. In essence, QuickBuy's implementation showcases a harmonious blend of technology and user-focused design principles

VIII. FUTURE SCOPE

In the foreseeable future, QuickBuy aims to revolutionize user experiences by integrating advanced AI algorithms for personalized recommendations, streamlining the purchase journey. Simultaneously, a strong emphasis will be placed on ethical practices, leveraging blockchain for transparent and secure transactions, while promoting eco-friendly products and sustainable sourcing. Furthermore, QuickBuy envisions a socially responsible platform that not only prioritizes customer satisfaction but also contributes positively to environmental sustainability, setting a new standard for conscious consumption within the e-commerce domain.

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DUKANDAR(MODERN SHOPPING PLATFORM)

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Abstract— *Dukandar is a comprehensive e-commerce platform designed to provide a seamless and user-friendly online shopping experience. The platform connects buyers and sellers, allowing users to browse, purchase, and sell a wide range of products. The primary goal of Dukandar is to create a virtual marketplace that caters to diverse customer needs while offering a convenient and secure transaction environment.*
Keywords— transaction, comprehensive, e-commerce, virtual marketplace.

I.INTRODUCTION

Dukandaar is a modern shopping platform that aims to provide customers with a seamless and

convenient shopping experience. With Dukandaar, you can browse and purchase a wide range of products from various categories, all in one place. Whether you're looking for fashion items, electronics, home goods, or even groceries, Dukandaar has got you covered. Our platform is designed to be user-friendly, with smart search features and personalized recommendations to help you find exactly what you're looking for. We also offer secure payment options and reliable delivery services to ensure your shopping experience is hassle-free. So why wait?
Start exploring Dukandaar today and enjoy the convenience of online shopping at your fingertips.

II.RELATED WORK

The objective of Dukandaar, the modern shopping platform, is to provide customers with a seamless and convenient shopping experience. Its purpose is to simplify the process of shopping by offering a wide range of products and services in one centralized platform.
Enhancing Customer Experience: Dukandar aims to provide a modern and convenient shopping experience to customers, incorporating technologies and practices that streamline the purchasing process.
Expanding Market Reach: With modern shopping practices such as online platforms or e-commerce integration, Dukandar can potentially reach a broader market beyond their physical location.
Building Brand Loyalty: Dukandar may seek to build brand loyalty among customers by providing a consistent

and high-quality shopping experience that meets their needs and exceeds their expectations

Phase1: Creating an e-commerce website for a "Dukandar" (shopkeeper) using the MERN (MongoDB, Express.js, React, Node.js) stack involves several steps. Here's a high-level methodology to guide you through the process:

Phase 2: Define Requirements: Identify the specific requirements of the Dukandar, such as the types of products sold, user roles (admin, customer), payment methods, order processing, etc.

Phase 3: Design Database Schema: Design a MongoDB database schema to store product information, user details, orders, and other relevant data.

Phase 4: Set Up Node.js and Express.js: Create a Node.js project and set up the Express.js framework to handle server-side logic.

Phase 5: Implement Authentication: Integrate user authentication using a package like Passport.js. This ensures secure access to user-specific data and actions.

Phase 6: Develop API Endpoints: Create RESTful API endpoints for functionalities like product listing, product details, user registration/login, cart management, and order processing.

Phase 7: Integrate MongoDB: Connect your Express.js application to MongoDB to store and retrieve data. Use Mongoose as an ODM (Object Data Modeling) library for easier interaction with the data.

II. METHODS AND MATERIAL

Product Listings: The website would likely provide a platform for businesses to create product listings, including product descriptions, prices, and images.

Online Shopping: Customers visiting the website would be able to browse through various product categories, add items to their cart, and make purchases online.

User Accounts: Both customers and shopkeepers may have the option to create accounts. Shopkeepers could use their accounts to manage their product listings, track sales, and handle other aspects of their online store.

Payment Gateway: The website would likely integrate with a secure payment gateway to facilitate online transactions. This could include options for credit/debit card payments, digital wallets, and other payment methods.

Order Management: The platform would have features for order tracking, order history, and notifications for both customers and shopkeepers.

Security: Security would be a crucial aspect to protect user data, payment information, and ensure a safe online shopping experience.

Mobile Responsiveness: The website might be designed to be mobile-friendly, allowing users to access and shop from their smartphones and tablets.

Customer Support: There may be customer support features, such as chat support or a contact form, to assist users with any queries or issues.
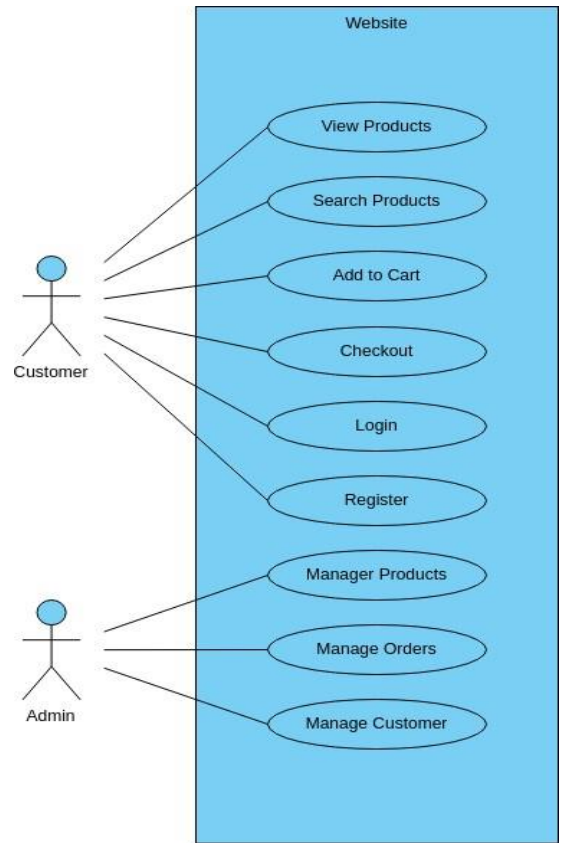
System Architecture

Fig 1: System Architect
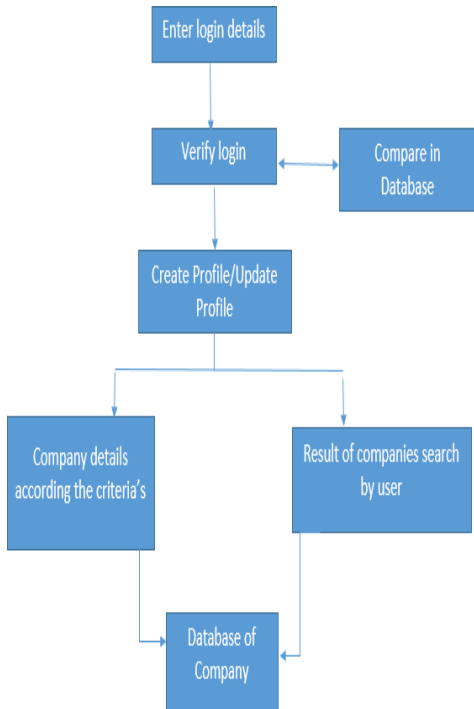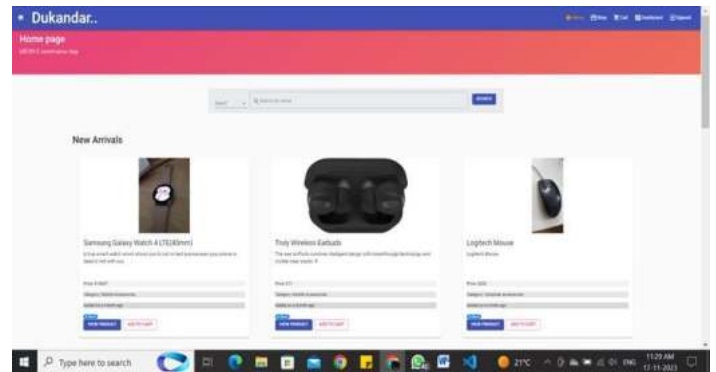

Fig 2: Use Case Diagram.
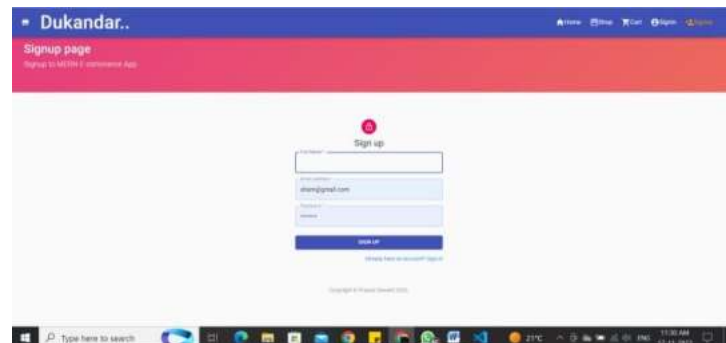
III. RESULT

Fig. 3: Landing Page

Fig. 3: Sign Up Page

IV. CONCLUSION

Creating a conclusion for a hypothetical e-commerce website named "Dukandar" would involve summarizing key points about the platform. Here's a sample conclusion:

"In conclusion, Dukandar presents itself as a robust and user-friendly e-commerce platform, tailored to meet the diverse needs of both buyers and sellers. With its intuitive interface, secure payment options, and a wide range of products, Dukandar aims to redefine the online shopping experience. The inclusion of features such as personalized recommendations, a streamlined checkout process, and a responsive customer support system further enhances user satisfaction. As Dukandar continues to evolve, it stands poised to become a trusted destination for seamless and enjoyable online shopping, fostering a dynamic marketplace for businesses and consumers alike.".

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Innovative Inventory Control Approaches in Supply Chain Management

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ABSTRACT

In the contemporary globalised economy, the necessity for innovative inventory control approaches in supply chain management is driven by the need to respond to the challenges presented by rapidly developing technology. This article examines the role of advanced technologies such as artificial intelligence, machine learning, big data analytics, IoT (Internet of Things), RFID (Radio Frequency Identification) and blockchain in supply chain and inventory management. It is emphasised that these technologies increase demand forecast accuracy, reduce inventory costs and increase operational efficiency by increasing supply chain visibility through real-time data collection and analysis. Furthermore, the positive contributions of these innovative approaches to sustainability and environmental impacts are also discussed. Consequently, the importance of businesses adopting these technologies in order to gain competitive advantage and the difficulties faced by this process are discussed in detail.

Keywords: Supply chain management, Inventory control, Innovation

1. Introduction

One of the primary concerns in the field of supply chain management has been the management of inventory levels. The interest in reducing inventory levels serves to illustrate the pivotal role that inventory plays in the overall costs of doing business. In numerous organisations, inventory represents the largest or second largest asset on the balance sheet. Consequently, organisations may be able to reduce their business start-up costs and enhance their return on investment (ROI) by reducing inventory levels. Investment in inventory creates significant value for businesses by reducing costs in other areas, such as production and transportation, or increasing revenues through better service levels (Yang & Pan, 2004). Consequently, it is of paramount importance to achieve balanced inventory management by taking into account the cost and benefit relationship of holding inventory in the supply chain. The tools employed in inventory control also assist with the question of how this process should be conducted. Furthermore, it seeks to provide an answer to the question. The majority of the tools employed for inventory control in the present era are information technology (IT)-based systems that incorporate computer software. The modern tools have features that facilitate the management of stock flow, provide flexibility to market demand, and balance stock levels between customer satisfaction and the loss of opportunity (Ross, 2015).

2. Modern Inventory Control Tools and Approaches

The utilisation of contemporary inventory control tools and methodologies, which employ technology, has the potential to enhance the efficacy and competitiveness of businesses. The utilisation of advanced technologies, including artificial intelligence, machine learning and big data analytics, enables the real-time tracking and accurate demand forecasting inherent to effective inventory management. The monitoring of inventory movements can be achieved with the use of IoT devices and RFID technology, while cloud-based software provides flexibility in order to optimise stock levels and reduce costs. These tools not only simplify the management of inventory but also contribute to the sustainable growth of businesses by enhancing customer satisfaction (Atnafu et al., 2018).

2.1. Full Time Delivery

The "Just in Time (JIT)" approach represents one of the most prevalent methodologies employed in the field of inventory management. In the contemporary business environment, there is a strong focus on the implementation of JIT production processes, JIT inventory management systems and JIT distribution systems. The JIT system, an American adaptation of

the Kanban system developed by Toyota Motor Company in Japan, was first implemented in mass production by Henry Ford in 1921 (Biggart & Gargeya, 2002). The implementation of JIT can result in a notable reduction in the levels of inventory held, including parts and materials, work-in-process, and finished goods. The system is comprised of four pillars: zero stock, short and reliable lead times, small and frequent delivery quantities, and high quality or zero defects. The fundamental tenet of JIT is that inventory should be available at the precise moment it is required, neither before nor after. The objective of JIT systems is to eliminate waste and to manage lead times. This approach prioritises the reliability of delivery times over their length. The implementation of JIT can lead to improvements in quality, reductions in waste, and radical transformations in a business's logistics operations. Similarly to the reorder point model, JIT also encompasses an overarching quality culture, supplier partnerships, and employee teams (Smith, 2019).

2.2. Supplier Managed Inventory

One of the most effective methods currently employed by numerous companies is the "Supplier Managed Inventory (VMI)" system. VMI is also known as "vendor managed inventory" or "vendor controlled inventory". This approach, initially implemented by Walmart, enables suppliers to manage their inventory in a more effective manner than Walmart. Consequently, suppliers are also responsible for ensuring that the products requested by the stores are always available. This method has been rapidly adopted by a diverse range of businesses across numerous sectors over time (Govindan, 2013). For instance, in the sale of food products in markets, the product supplier is responsible for checking the stocks on the shelves and restocking them. This collaboration benefits both the supplier and the retailer. Ordering costs are reduced, and customer service levels are enhanced. VMI affords suppliers access to their customers' demand forecasts and inventory records, thereby transferring the responsibility for inventory control to the supplier. The supplier is contractually obliged to maintain the correct inventory level. This approach encourages the sharing and collaboration between supplier and customer of data, thereby increasing operational efficiency and customer satisfaction for both parties (Zhu et al., 2022).

2.3. Material Requirements Planning

In a manufacturing business, there may be thousands of parts to manage, ever-changing priorities, and unpredictable demands. To manage this complex situation, a computerized planning and control system called "MRP" comes into play. The MRP system allows businesses

to supply missing parts to be used in production when they are needed (Thürer et al., 2020). How much of each part must be produced or ordered and when is determined by MRP's scheduling method. The MRP system, popularized by Joseph Orlicky, is used especially in the production or ordering of items based on dependent demand (for example, wheels, rims, tires in the automotive industry). Key components of the MRP approach include master production scheduling, bills of materials, inventory status, MRP schedule, and various deliverables and reports. An MRP system recalculates net requirements and scope by taking into account changes in the master production schedule, demand, inventory status, or product mix. In this way, businesses can manage complex production processes more efficiently and effectively (Milne et al., 2015).

2.4. Distribution Requirements Planning

Distribution requirements planning, simply referred to as "DRP" in the literature, is a complex planning approach that takes into account multiple distribution phases and unique features. Although there are some technical differences, DRP is considered a logical extension of MRP. While MRP is driven by a production schedule defined and controlled by management policy, the DRP process is based on customer demands. Therefore, while MRP operates in a dependent demand environment, DRP operates in an independent demand environment and determines inventory requirements based on uncertain customer demands. Once finished products and stock keeping units (SKUs) are received into the factory warehouse, the DRP assumes responsibility for coordinating these products. Thus, DRP optimizes inventory management by responding quickly and effectively to customer demands (Ngatilah et al., 2020).

2.5. Automatic Inventory Tracking System

Automated Inventory Tracking System allows businesses to manage inventory more efficiently and accurately. This system tracks inventory movements in real time using technologies such as barcodes, RFID tags, and IoT sensors. Thus, stock levels are constantly updated and the risk of manual errors is eliminated. Automated inventory tracking systems help businesses better manage their inventory, prevent overstock or shortage, and reduce operational costs. Additionally, thanks to these systems, employees can allocate their time to more strategic tasks and customer satisfaction can be increased. Automated inventory tracking has become an indispensable tool for modern businesses (Sabah Salih et al., 2023).

3. Conclusion

Effective management of inventory levels in the supply chain is one of the determining factors of a business's competitiveness and operational efficiency. Inventories are often among an organization's largest assets, and when not managed properly, costs can increase, profits can decrease, or there is a risk of customer dissatisfaction. Therefore, modern businesses are turning to IT-based tools for inventory control. These tools respond flexibly to changes in demand by optimizing stock flow, helping to balance stock levels by increasing customer satisfaction and minimizing opportunity loss. However, inventory management should be supported not only by technology but also by the right strategies and processes. Keeping inventory levels balanced in supply chain management requires healthy management of the cost and benefit relationship. In this regard, it is important for businesses to adopt a strategic approach to inventory management and focus on continuous improvement efforts.

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CloudShelf

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infrastructures. The integration of cutting-edge

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Abstract— **This paper presents the design, implementation, and evaluation of Cloudshelf, a cloud-based library management system aimed at revolutionizing library operations and enhancing the user experience. Cloudshelf leverages cloud technology to offer seamless management of library resources, including books, patrons, and transactions. Through real-time updates on book availability, online catalog search capabilities, and user-friendly dashboards for librarians and patrons, Cloudshelf streamlines traditional library tasks and promotes collaboration among libraries through a centralized cloud platform. The system's robust cloud infrastructure ensures data integrity, security, and scalability, addressing the limitations of traditional library management systems. Evaluation results demonstrate the effectiveness of Cloudshelf in improving library operations and user satisfaction, signaling its potential to modernize library services and meet the evolving needs of libraries and their users in the digital age.**

I. INTRODUCTION

A cloud-based library management system is a modern and efficient solution for managing libraries and their resources. It leverages cloud technology to store, organize, and access library data and services, providing several advantages over traditional, on-premises library management systems.

A cloud-based library management system is a software platform designed to streamline the operations of libraries, whether they are in educational institutions, public settings, or corporate environments. It offers an integrated approach to cataloging, circulation, patron management, and more, making it easier for librarians to manage their collections and for users to access and utilize library resources.

A cloud-based library management system is a forward-thinking approach to modernizing library services, improving efficiency, and enhancing the user experience. Its adoption can help libraries stay relevant and adapt to the changing needs and expectations of their communities in an increasingly digital world.

technologies, including computer vision, machine learning, and physiological sensors, aims to provide a comprehensive and proactive solution to mitigate the risks associated with drowsy driving.

The prevalence of drowsy driving incidents necessitates a nuanced and adaptive approach to detection and warning systems. Traditional methods often fall short in addressing the dynamic nature of driver alertness and the diverse factors contributing to drowsiness. Consequently, there is an urgent need for systems that not only accurately identify signs of drowsiness but also tailor warnings to individual drivers' characteristics.

II. RELATED WORK

Work for the CloudShelf Project

Project Phases

The DDDWS project will be implemented in five phases:

Phase 1: Initial Research management and planning

1.1 Literature Review:
- Investigate existing library management systems.
- Identify key functionalities and limitations of current systems.
- Review academic papers and case studies on digital library management.

1.2 Requirements Analysis:
- Gather requirements from potential users (students, librarians, administrators).
- Define system requirements and use cases.
- Create user personas and scenarios to understand user needs.

1.3 Technology Stack Section:
- Evaluate different technologies for development (Java, Spring Boot, Hibernate).
- Choose the appropriate technology stack for Cloud Shelf.
- Determine the infrastructure requirements (servers, cloud services).

1.4 Project planning:
- Develop a project plan with milestones and deadlines.
- Allocate resources and define team roles.
- Establish communication channels and project management tools.

Phase 2. Syatem Design and Prototyping

2.1 System Architecture Design:
- Design the overall architecture of the Cloud Shelf system.
- Create detailed diagrams (UML, ER diagrams) to represent system components and data flow.
- Define the API endpoints and database schema.

2.2 User Interface Design:
- Develop wireframes and mockups for the user interface.
- Conduct usability testing with potential users to gather feedback.
- Iterate on the design based on user feedback.

2.3 Prototyping Development:
- Implement a basic prototype of the system with core functionalities.

- Focus on user registration, book search, and borrowing processes.
- Test the prototype to ensure it meets initial requirements.

2.4 Initial Testing:
- Perform unit testing and integration testing on the prototype.
- Identify and fix any bugs or issues.
- Gather user feedback on the prototype and make necessary adjustments.

Phase 3:Fully Implementation and Integration

3.1 User Module Development:
- Complete the implementation of user registration and authentication.
- Develop the book borrowing and payment functionalities.
- Implement the messaging system for notifications about book availability.

3.2 Employee Module Development:
- Develop features for managing reservations and responding to user requests.
- Implement record-keeping functionalities for tracking borrowed books.
- Ensure secure access and proper permissions for employees.

3.3 Admin Module Development:
- Create functionalities for adding, updating, and blocking books.
- Develop employee management features (adding, updating employee records).
- Implement administrative dashboards and reports for monitoring system usage.

3.4 Database Integration:
- Integrate the database with all system modules.
- Ensure data consistency and integrity across the system.
- Implement backup and recovery procedures.

3.5 Security Implementation:
- Ensure secure authentication and authorization mechanisms.
- Implement encryption for sensitive data (user credentials, payment information).
- Conduct security testing to identify and fix vulnerabilities.

Phase 4:Testing And Deployment

4.1 Comprehensive Testing:
- Perform thorough system testing (unit, integration, system, and acceptance testing).
- Use automated testing tools where possible to streamline the process.
- Conduct user acceptance testing (UAT) with a group of beta users.

4.2 Performance Optimization:
- Optimize the system for performance and scalability.
- Conduct load testing to ensure the system can handle high traffic.
- Fine-tune the database and backend services for optimal performance.

4.3 Documentation:
- Develop comprehensive documentation for users, employees, and administrators.
- Create technical documentation for developers and maintainers.
- Provide training materials and user guides.

4.4 Deployment:
- Deploy the Cloud Shelf system to a live environment.
- Monitor the system closely during the initial launch period.
- Provide support and address any issues that arise post-deployment.

Phase 5: Maintenance and Future Enhancements

5.1 Post-Deployment Support:
- Establish a support system for users to report issues and receive assistance.
- Monitor system performance and resolve any emerging issues.
- Collect user feedback to identify areas for improvement.

5.2 Regular Updates:
- Plan and implement regular updates to add new features and enhancements.
- Ensure the system remains secure with regular security patches.
- Keep the system documentation up to date with each release.

5.3 Future Enhancements:
- Explore additional features such as advanced search capabilities, mobile app integration, or AI-based recommendations.
- Consider integrating with other library systems or educational platforms.
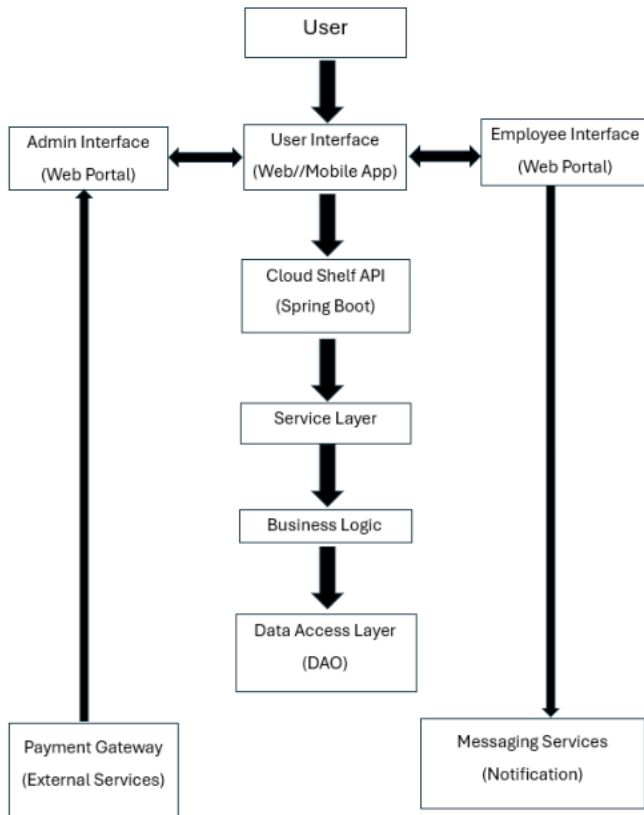- Plan for scalability to accommodate a growing number of users and books.

III.METHODS AND MATERIAL

Fig. 1 System Module Diagram

1. **User Interface Module**

   The User Interface (UI) module is the front-end application that allows users to interact with the Cloud ~~application that allows users to interact with the Cloud~~ registration, authentication, book search, borrowing, and viewing notifications. It is designed to be user-friendly and responsive, ensuring a smooth user experience across different devices and screen sizes. Technologies like HTML, CSS, JavaScript, and frameworks such as React or Angular are commonly used to develop this module.

2. **Admin Interface Module**

   The Admin Interface module is a web portal designed specifically for administrators to manage the library's operations. This module allows admins to add, update, and block books, manage employee records, and monitor system activities through dashboards and reports. The admin portal provides comprehensive tools for library management, ensuring that administrators can efficiently oversee and maintain the library's resources. It is typically built using web technologies like HTML, CSS, JavaScript, and dynamic frameworks like Angular or React.

3. **Employee Interface Module**

   The Employee Interface module is a web portal for library employees to manage book reservations and communicate with users. Through this interface, employees can view and manage user reservations, confirm book availability, and maintain records of borrowed books. This module ensures that employees have the necessary tools to efficiently handle day-to-day library operations and provide timely updates to users. It is built using similar web technologies as the admin interface, ensuring consistency and ease of use.

4. **Cloud Shelf API Module**

   The Cloud Shelf API module serves as the backend service, implemented using Spring Boot. It handles all client requests from the user, admin, and employee interfaces. This module processes these requests, applying the business logic, and coordinating with other system components. It ensures secure data transmission, manages authentication, and provides the necessary endpoints for frontend modules to interact with the backend services. Java with Spring Boot is used to develop this module, leveraging its robust framework for building RESTful APIs.

5. **Service Layer Module**

   The Service Layer module contains the core business logic of the Cloud Shelf system. It acts as an intermediary between the Cloud Shelf API and the Data Access Layer, processing requests, applying business rules, and coordinating service operations. This layer ensures that the system's functionalities, such as borrowing books, handling reservations, and processing payments, are executed correctly and efficiently. Java with Spring Framework is typically used to implement this layer, providing a structured approach to managing the system's logic.

6. **Data Access Layer (DAO) Module**

   The Data Access Layer (DAO) module is responsible for managing all database operations. It handles the creation, reading, updating, and deletion (CRUD) of records in the database, ensuring data integrity and consistency. The DAO module maps database records to Java objects and vice versa, facilitating seamless data interactions between the service layer and the database. This module is implemented using Java with Spring Data JPA, leveraging its powerful data access capabilities to streamline database operations.

7. **Database Module**

   The Database module stores all the essential data for the Cloud Shelf system, including user accounts, book inventory, reservations, and transaction history. This module ensures that data is persistently stored, efficiently queried, and securely managed. Relational Database Management Systems (RDBMS) like MySQL or PostgreSQL are typically used for this module, providing robust and scalable data storage solutions. Proper database design and indexing are crucial for optimizing performance and ensuring quick data retrieval.

8. **Payment Gateway Module**

   The Payment Gateway module integrates with external payment services to securely process payments when users borrow books. This module handles payment transactions, ensuring that payments are processed efficiently and securely. It interfaces with third-party payment gateways such as Stripe or PayPal, providing a seamless payment experience for users. The integration is typically done using REST APIs, ensuring secure and reliable communication between the Cloud Shelf system and the payment service providers.

9. **Messaging Service Module**

   The Messaging Service module is responsible for sending notifications to users about the status of their book reservations and other relevant updates. This module ensures timely communication with users via

SMS or email. It integrates with external messaging services like Twilio or SendGrid, leveraging their capabilities to send notifications reliably. The messaging service ensures that users are informed about important updates, enhancing the overall user experience. Integration is achieved using REST APIs, ensuring secure and efficient message delivery.

roles through a dedicated module that allows them to block or unblock user and employee accounts, as well as change user roles to either employee or admin. This flowchart effectively visualizes the structured and hierarchical approach of the Cloud Shelf system, showcasing the distinct roles and functionalities assigned to users, employees, and administrators within the platform.
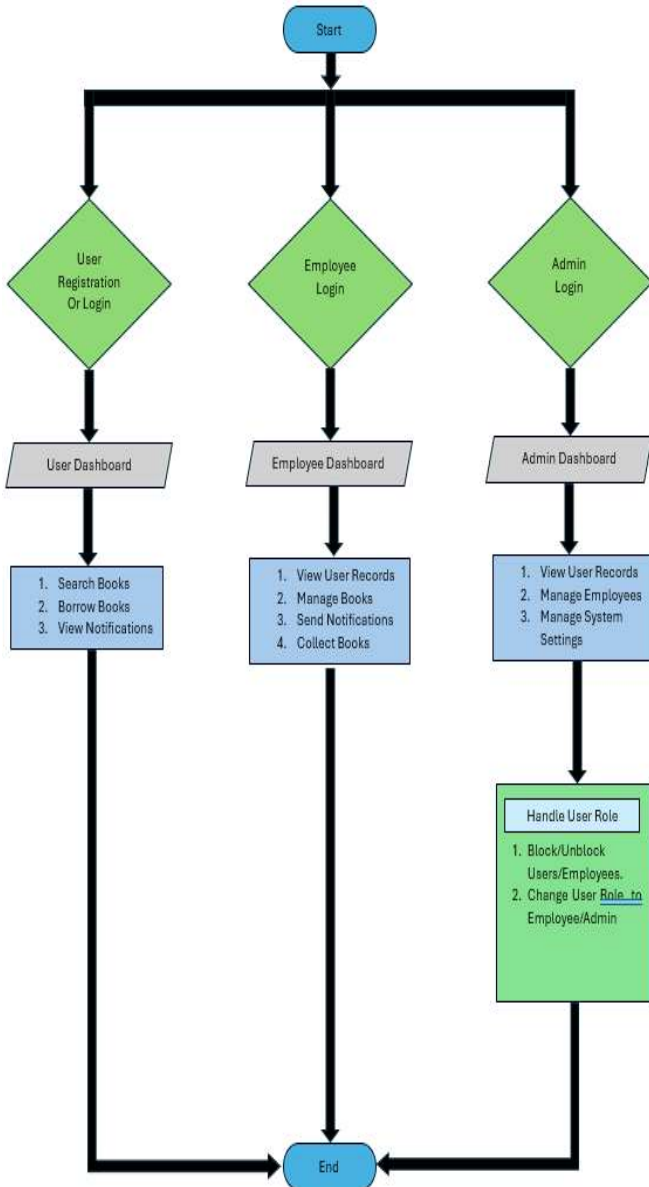

Fig 2. Flowchart

Fig 3. Use Case Diagram

The flowchart depicts the operational flow of the Cloud Shelf system, a digital library management platform. It begins with the user registration/login process, where users, employees, and administrators each have distinct pathways to log in. Once logged in, each user type accesses their respective dashboards. Users have a dashboard that allows them to search for books, borrow books, and view notifications related to their borrowed items. Employees access a dashboard that enables them to view user records, manage the book inventory, send notifications to users regarding the availability of books, and handle the collection of books from users. Administrators, upon logging in, are directed to a dashboard where they can view user records, manage employee details, and oversee system settings. Additionally, administrators have the capability to handle user
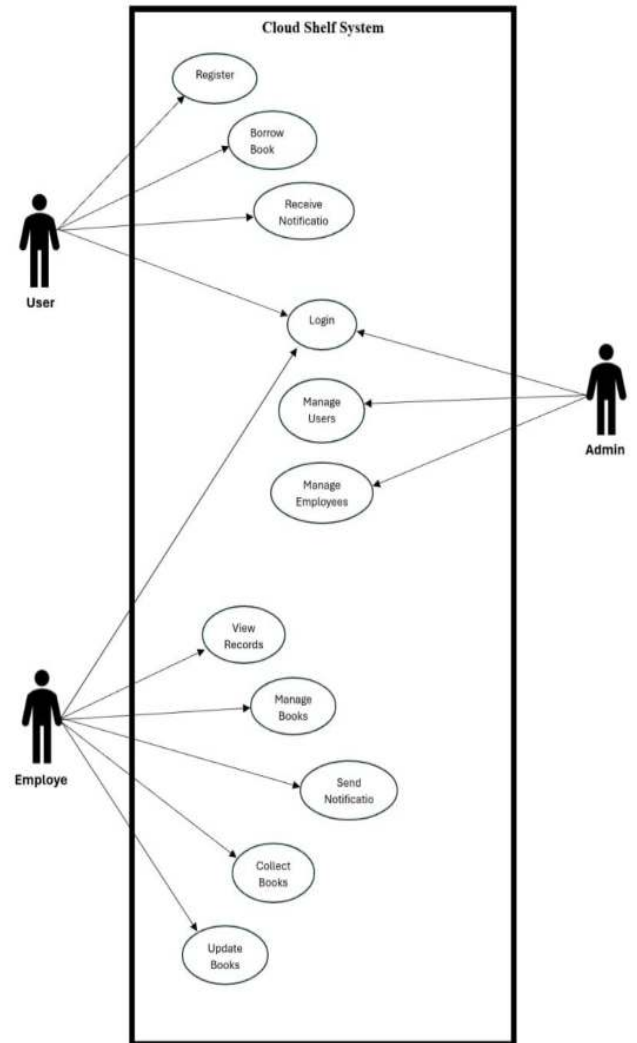
The use case diagram for the CloudShelf system provides a detailed view of the interactions among three primary actors: User, Employee, and Admin. Users can perform actions such as registering, logging in, borrowing books, and receiving notifications. Employees have capabilities to log in, view user records, manage the library's book inventory, send notifications to users, and collect returned books. Admins have overarching control with functionalities to log in, manage user accounts, oversee employee activities, and update book information. This comprehensive diagram clearly delineates the roles and responsibilities within the system, ensuring that each actor's interactions and functions are well-defined and easy to understand..
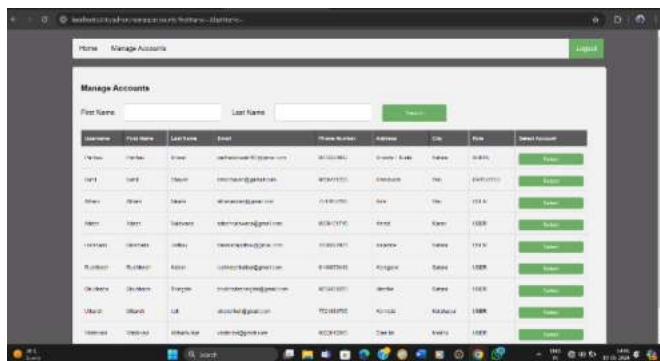
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IV. IMPLEMENTATION

Login Page
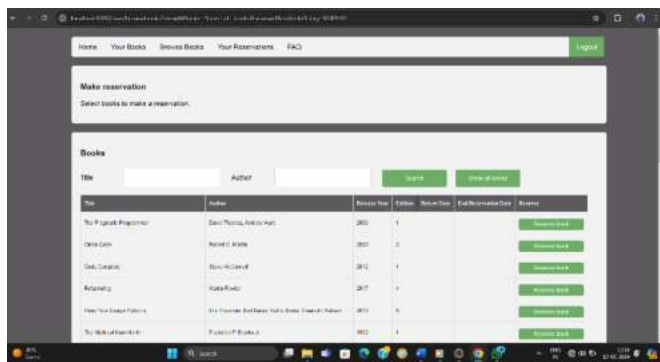
User Dashboard
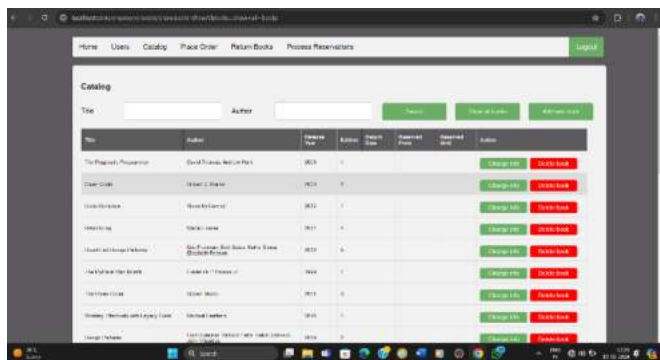
Employee Dashboard

Admin Dashboard

V. CONCLUSION

In conclusion, Cloudshelf, as a cloud-based library management system, represents a significant advancement in modernizing library services and improving the user experience. By offering seamless access to library resources through real-time updates and intuitive search functionalities, Cloudshelf enhances accessibility for patrons while empowering librarians with valuable insights into usage patterns. Its robust cloud infrastructure ensures data integrity and security, addressing the limitations of traditional systems and providing scalable solutions for evolving library needs. Cloudshelf's adoption signifies a strategic move towards enhancing library services, ensuring adaptability in the digital age, and continuing to elevate library services through ongoing research and development efforts.

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Abstract— **The increasing prevalence of road accidents due to drivers' drowsiness poses a significant threat to public safety, particularly in the vicinity of critical infrastructures such as power plants, transportation hubs, and emergency service centres. To mitigate this risk, the development and implementation of advanced Drivers' Drowsiness Detection and Warning Systems (DDDWS) tailored for critical infrastructures become imperative.**
This paper presents a comprehensive overview of the design, functionality, and benefits of such systems.

Keywords— machine learning, extraction, data processing.

I. INTRODUCTION

We aims to develop an Inventory Management Systems (IMS) that can provide better control and handling of product stock, customer order, customer service and order delivery that relates to company inventory information. The target user is the owner and employee in all and Medium Enterprise (SME) retail store that stills manages inventory manually in Malaysia. IMS helps retail store to track down the next arrival of product stocks and record customer order for reservation for the product in the store

inventory. In this study, the developer used PHP for backend system development and HTML, CSS, JavaScript for frontend system development. This study also applies Rapid Application Development (RAD) software methodology that emphasize on iterative development process. Even though the inventory management system has been fully developed by the developer, there are still limitations found and future enhancement that can be made towards the system.

Inventory management is one of the crucial supply chain components in retail store. Every day or by weekly, the store needs to update the stock that is coming in or out. Most of the retail store must at least have a warehouse to store their products. To remain customer satisfaction whenever the shop does not have the product, retail company provide delivery service through customer order for product that comes from warehouse inventoryHaving inventory management system within an organization is important because the business can monitor and control their product stock and business revenue that is going on within the organization. At the same time, it is also to determine the suitable product quantity to restock according to customer and market demand which will reduce business loss of overstocking (Plinere & Borisov , 2016). Without having good inventory management system within organization, it can cause many businesses risk especially for retail store such as out of stock and product that is not sold due to market demand which will bring a dissatisfaction to customer and business lost (Patil & Divekar, 2014). Moreover, inventory management in an organization are done manually such as updating and checking inventory stocks in an excel and or logbook in some company nowadays and in the old days.

II. RELATED WORK

An Inventory Management System allows employee or manager to track, record, and overview product stocks that is coming in and out from the company inventory to ensure there is no unexpected low on stock or overstock occur. Some small companies just manually used the inventory management as thought that investing inventory management system is not necessary. This is because most

inventory management system software that can be found on the Internet require user to pay for monthly subscription. Moreover, this paid softwareis mostly unsuitable for most businesses as there is limitation usage, expensive to maintain, and confusing to use (Jallow, 2018). Thus, the proposed software in this study provide the user with general inventory management feature to ensure it is suitable for small company usage and less cost needed for the software development.

In addition, research related to AIKTC Server Centre has also experienced side effects on managing their inventory manually as there is more client order received for their product. This is because employee must track and record product and equipment that is coming in from supplier and going out for customer order from the company inventory manually.

Objective of Present work :
Aim of this study is to develop an inventory management system that can provide better control and handling of product stock, customer order, customer service, and order delivery that relates to company inventory information.

The objectives are:

* To reduce manual tracking and recording of incoming and outgoing stock from company inventory.

* To provide summary of sales and product report for manager to view business situation.

* To provide a better customer service to handle feedback based on their order quality and problem.

* To produce effective computerized system to be used by all parties who involved directly in inventory management.

Literature Review:

Sr. No	Author	Abstract
1.	S Pasaribu, 2021	An Inventory Management System foracompany in Indonesia has been developed to manage warehouse inventory that is produced with the goals of reducing error on recording product stock into the warehouse inventory and make process of

product in and out of the warehouse inventory more effective.

2. Yuvaraj et al., 2020   The authors have stated they the used python with Tkinter library and SQLite as implementation can be simple and reliable due to its usage popularity. The research study resulted in simple and effective implementation of desktop inventory management system application that can save time, reduce time, secured of storing and retrieving data with the open of future enhancement towards internet of things (IoT).

3. Srivastava et al., 2020   In another research, the researchers confront a problem with specific E-Commerce store where data are missing and lost from database due to improper inventory control. This may be caused by improper database type being used by E-Commerce store. In this research, the author has done a deep investigation and comparison on programming language and tools used especially on database technology for implementing the inventory management system.

4.   S.Pasaribu (2021)   As a successful deep model applied in image super-resolution (SR), the Super-Resolution Convolutional Neural Network (SRCNN) has demonstrated superior performance to the previous hand- crafted models either in speed and restoration quality. However, the high computational cost still hinders it from practical usage that demands real-time performance (24 fps). In this paper, we aim at accelerating the currentSRCNN, and propose a compact hourglass- shape.

5.   Arina Ramlee,
        David Henry,
        (2019)

As for portability and real-time system there is also web application inventory management system which of their own programming language. In research done by educational students, the researcher decides tools that is free to use for developing the webbased inventory management system due to cost problem. At the same time, the researcher also considered on what is suitable for them as their project timeline is short.
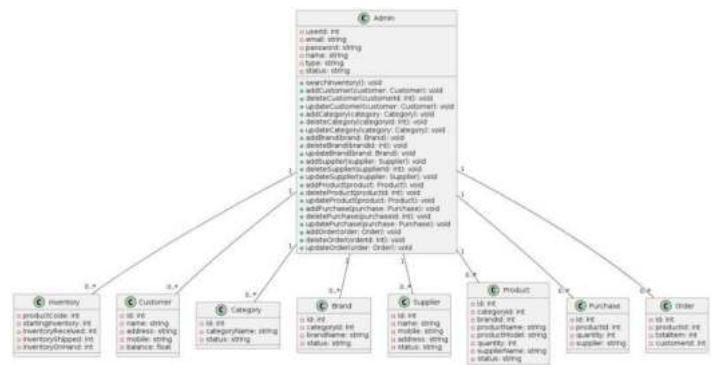
DESIGN AND DEVELOPMENT :

Fig 1. Class dig

INVENTORY MANAGEMENT SYSTEM CLASS DIAGRAM – is a designed structure that shows the classes (data) in the project and their relationships. UML Class Diagram is made to guide programmers along with the Inventory management system development with concern to the data structures.

It contains the class attributes, methods as well as the relationships between them. The mentioned contents makes sure that your Inventory management system development must inline with what should be its functions.
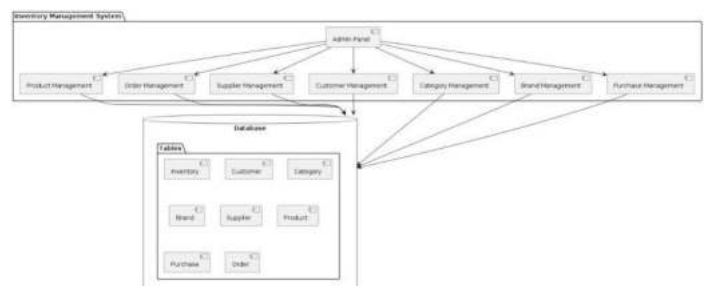

Fig 2. Component diagram

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The component diagram for inventory management system is used to show how the parts of inventory management work together to make the system operate correctly. A component diagram shows how the software's parts are organized and how they depend on each other. This diagram gives a high-level look at the parts of a system.

The components of an inventory management system component diagram could be a part of software or hardware. They could be a database, a user interface, or something else that helps the inventory system work.
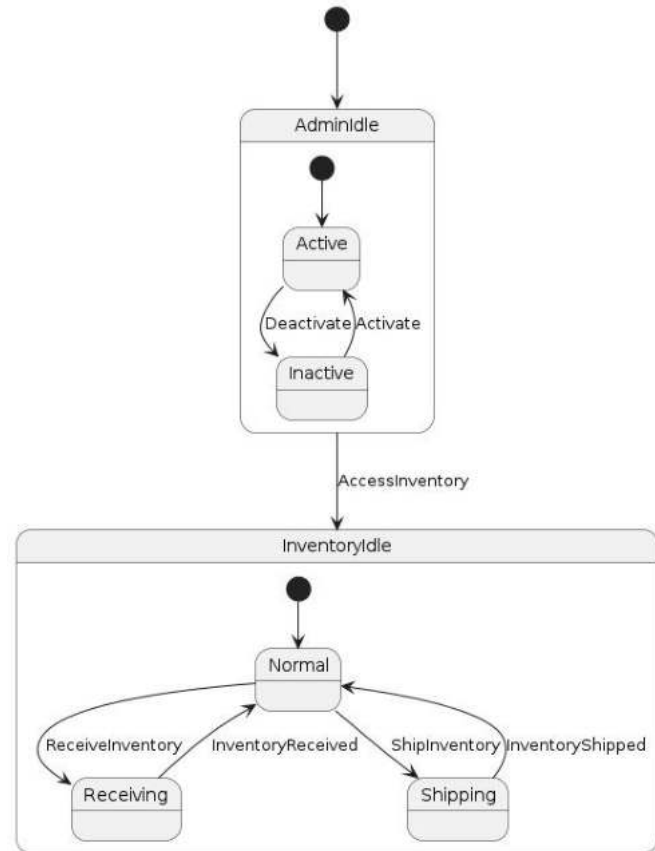

Fig 3 . State dig

An inventory management system state diagram is a visual representation of the various states an inventory item can go through within the system and the transitions between these states. Here's a brief overview of the key elements typically included in such a state diagram

CONCLUSION :

The proposed and developed inventory management system aims to provide a free software that can be used by small to medium retail store that stills manages inventory manually in Malaysia. Moreover, it also helps a retail store to track down the next arrival of product stocks and record customer order for reservation for the product in the store inventory. In overall, the inventory management system achieved the general of inventory management activities but there are more additional features like

recording feedbacks and assigning staff for order delivery and many more that can be used by the user if needed. Even though the inventory management system has been fully developed by the developer, there are still limitations found and future enhancement that can be made towards the system.

scope of the project:

There is also future enhancement that can be made on the system that is based on the feedback given by the tester in UAT test and the researcher ideas due to time constraint of the project. The first future enhancement that can be made is to provide a search feature inside dropdown value especially for searching products in report or add customer order form. This will provide better user experience where user can design the desirable product in the dropdown component more easily. Secondly, an additional data of product picture needs to be added to the system as requested by the tester. This is because the picture helps staff to identify variety and description the product. For example, there are varieties of milo flavours such as original, caramel, vanilla and cocoa. Lastly, the system also needs an additional module for recording return product data that is based on customer order after valid feedback were given. Sometimes, product will be delivered at faulty condition due to unexpected circumstances. Thus company need to record the defect product return by the customer to view how much loss affected to the company.

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Invoice Management

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Abstract— **This paper presents the design and implementation of an automated invoice management system using PHP. The system enables users to create, edit, delete, and manage invoices efficiently. Key features include automated invoice generation, real-time updates, and secure data storage. Performance analysis demonstrates significant improvements in operational efficiency compared to traditional manual methods.**

Keywords— *automated, efficiently, real-time updates, secure.*

I. INTRODUCTION

In the contemporary business environment, efficient invoice management is crucial for maintaining healthy cash flow and ensuring operational efficiency. However, many businesses, particularly small and medium-sized enterprises (SMEs), still rely on manual methods for generating, processing, and managing invoices. Manual invoicing often involves repetitive tasks, such as entering client details, calculating totals and taxes, and ensuring that all necessary information is included. This process is not only time-consuming but also highly susceptible to errors. Typographical mistakes, incorrect calculations, and missing information can lead to delays in payment, disputes with clients, and ultimately, a negative impact on the business's cash flow and customer satisfaction.

To address these challenges, this paper presents the design and implementation of an automated invoice management system using PHP. The proposed system aims to streamline the invoicing process by providing functionalities for creating, editing, deleting, and managing invoices efficiently. The automated invoice management system introduces several key features that significantly enhance the invoicing process. The system's user-friendly interface allows businesses to handle their invoicing needs with greater accuracy and speed, reducing the likelihood of errors and improving overall efficiency.

II. DESIGN AND IMPLEMENTATION

The project is divided into 5 phases *:*

Phase 1 : Research and Planning

Extensive research was conducted to understand the intricacies of invoice management and identify the best practices and technologies for developing an efficient system. This research revealed interesting facts about common challenges businesses face with manual invoicing, such as high error rates, inefficiencies, and difficulties in tracking payments. Armed with these insights, the design and functionality of the project were meticulously planned to address these issues. The planning phase involved structuring the system's architecture, defining user interfaces, and outlining key features. This thorough research and careful planning not only informed the design and development of the project but also significantly enhanced knowledge and understanding of effective invoice management solutions.

Phase 2: Project Designing

The design of the invoice management system emphasizes user-friendliness and visual appeal. The website features a well-organized landing home page that aggregates all invoice information, providing users with a comprehensive overview at a glance. Navigation is streamlined with a sidebar that allows easy access to different functionalities, such as creating, editing, deleting, and managing invoices. HTML is used to structure the web pages, while CSS and Bootstrap enhance the styling and responsiveness, ensuring the website is accessible and visually appealing across various devices and screen sizes. The clean and modern design, with consistent use of colors, fonts, and spacing, facilitates intuitive navigation and a seamless user experience.

Phase 3: Actual Implementation

Extensive research was conducted to understand the intricacies of invoice management and identify the best practices and technologies for developing an efficient system. This research revealed interesting facts about common challenges businesses face with manual invoicing, such as high error rates, inefficiencies, and difficulties in tracking payments. Armed with these insights, the design and functionality of the project were meticulously planned to address these issues. The planning phase involved structuring the system's architecture, defining user interfaces, and

outlining key features. This thorough research and careful planning not only informed the design and development of the project but also significantly enhanced my knowledge and understanding of effective invoice management solutions.

In conclusion, the implementation of the invoice management system using the CodeIgniter framework was a comprehensive process that translated the research and planning into a functional, user-friendly, and efficient application. The use of the MVC pattern, along with thorough testing and iterative improvements, ensured that the final product met the desired objectives and provided a seamless user experience.

Phase 4: Testing and Development

After implementation, a comprehensive testing phase was conducted to ensure the project worked under different conditions and met all specified requirements. The testing phase was critical in validating the system's reliability, accuracy, and performance. Various testing strategies were employed, including:

Unit Testing: Each component of the application was tested individually to ensure that they functioned correctly in isolation. This helped in identifying and fixing bugs at an early stage.

Integration Testing: This ensured that different components of the application worked together seamlessly. It was crucial to verify that the interactions between the database, user interface, and application logic were smooth and error-free.

User Acceptance Testing (UAT): Potential users tested the system to provide feedback on its usability and functionality. Their input was invaluable in making final adjustments to improve the user experience.

Functional Testing: The main functionalities of the system, such as invoice generation, editing, deletion, and management, were tested under various scenarios to ensure they met the business requirements.

Performance Testing: The system was evaluated for its performance under different loads to ensure it could handle multiple simultaneous users without degradation in performance.

GST Compliance Testing: The implementation was rigorously tested to ensure it complied with market GST strategies and accurately calculated taxes. This involved checking the system's ability to handle various tax rates, exemptions, and other GST-related rules.

By conducting these extensive tests, the project was validated to be robust, user-friendly, and compliant with all relevant market strategies and regulations. This thorough testing phase ensured that the final product was reliable and ready for deployment in a real-world business environment.

III. METHODOLOGY

1. Admin Interface :
The Admin Interface module is a web portal designed specifically for administrators to manage the invoices. This module allows admins to add, update, and manage invoices

and also allow to to print and download pdf and exel file. It is typically built using web technologies like HTML, CSS, JavaScript and frameworks of PHP which is codeigniter.
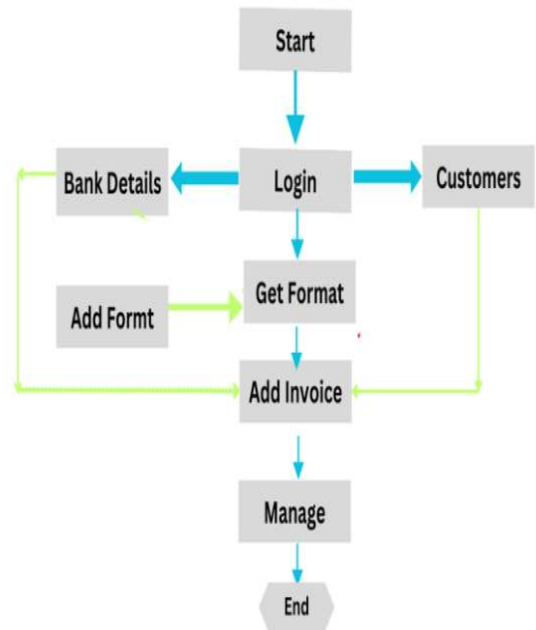
Fig. 1. FLOW CHART

IV. LITERATURE SURVEY

There are many previous studies in the field of Invoice Management, below are some of these studies and their result are referred to:

1. Halil Arslan (2022). End to End Invoice Processing Application Based on Key Fields Extraction : Invoices contain important information related to a particular business department, such as the total amount, information about the material sold, and the date.

2. Chukwudi Kingsley Williams (2017 Online Invoice Management System Software as a Service : Companies do not have to make huge investments by purchasing and maintaining licenses for applications like (ERP), Inventory Management System (IMS) and CRM systems and installing them on individual hardware on the business premises.They can instead contain costs, deploy solutions quicker and minimize risk by signing up to use the same application but hosted by a third party and delivered over the internet.

3. Xunfeng Yao (2022). Invoice Detection and Recognition System Based on Deep Learning : This paper designs and implements an invoice information recognition system based on deep learning that can identify and detect objects and text which helps to reduce the issues appeared due to large amount of invoice generation.

4. Muzhir Shaban Al-Ani (2012). Billing System Design Based on Internet Environment : This paper explores the implementation of Role-Based Access Control (RBAC) within the context of invoice management. The paper underscores the critical role played by RBAC in fortifying the security measures surrounding sensitive financial data and in efficiently managing user permissions.

5. Rohit Kiran Bhosale (2022). Invoice Management System : The purpose of Invoice Management System is to automate the existing manual system by the help of

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computerized equipment's and full-fledged computer software, fulfilling their requirements, so that their valuable data/information can be stored fora longer period with easy accessing and manipulation of the same.

V. RESULT AND DISCUSSION

The project began with comprehensive research and planning, identifying the challenges of manual invoicing and informing the design. An intuitive user interface was created using HTML, CSS, and Bootstrap, ensuring ease of use. The system was implemented using the CodeIgniter framework, following the MVC pattern for maintainability. Rigorous testing ensured functionality, performance, and GST compliance. Finally, ongoing maintenance ensures reliability and efficiency. These stages laid a solid foundation for the effective and user-friendly system whose results are detailed next.

I. Dashboard :
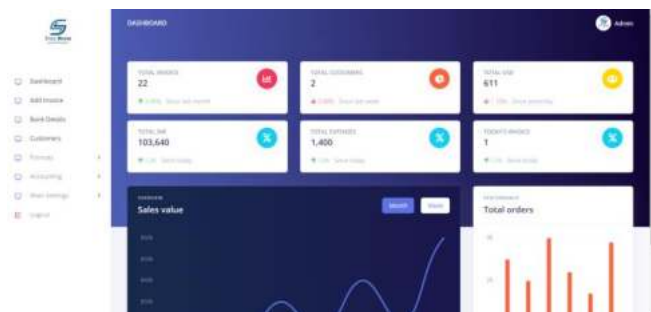
II. Invoice formats:
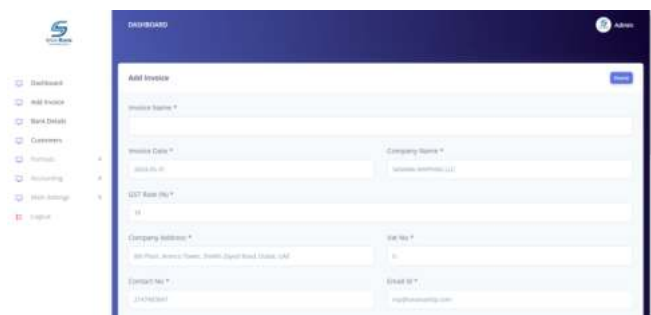
III. Invoice view:

IV. CONCLUSION AND FUTURE SCOPE

The development of the automated invoice management system was a comprehensive project that progressed through several critical phases, each contributing to the system's overall success. Beginning with extensive research and meticulous planning, the foundational knowledge and strategies necessary for an effective solution were established. This phase was instrumental in identifying the common challenges associated with manual invoicing and in designing a system tailored to address these issues.The implementation phase translated this design into a functional system using the PHP framework CodeIgniter. By adhering to the Model-View-Controller (MVC) pattern, the project ensured a clear separation of concerns, which enhanced maintainability and scalability. The user interface, developed with HTML, CSS, and Bootstrap, provided a user-friendly and visually appealing experience, facilitating easy navigation and efficient invoice management.Following implementation, a rigorous testing phase validated the system's functionality, performance, and compliance with GST strategies. Unit tests, integration tests, user acceptance tests, and performance evaluations ensured that the system was robust, reliable, and ready for real-world application.

In conclusion, the project successfully delivered a robust, user-friendly, and efficient invoice management system. Each phase, from research and planning to implementation, testing, and maintenance, played a vital role in achieving this outcome. By addressing the challenges of manual invoicing and leveraging modern web technologies, the system significantly enhances operational efficiency, accuracy, and user satisfaction, demonstrating the value of a well-planned and executed development process.

Some future scopes for the system are :

Mobile Accessibility : Develop a mobile application or responsive web design to make the system accessible on smartphones and tablets, allowing users to manage invoices on the go.

Multi-Language and Multi-Currency Support : Add support for multiple languages and currencies to accommodate international users and businesses.

Customizable Templates : Allow users to create and save custom invoice templates, supporting various branding and styling options.

V. REFERENCES

[1] Rohit Kiran Bhosale (2022). Invoice Management System.
[2] Chukwudi Kingsley Williams (2017 Online Invoice Management System Software as a Service.
[3] Xunfeng Yao (2022). Invoice Detection and Recognition System Based on Deep Learning.
[4] Halil Arslan (2022). End to End Invoice Processing Application Based on Key Fields Extraction.
[5] Muzhir Shaban Al-Ani (2012). Billing System Design Based on Internet Environment.

Fantasy Sport Website For Bull Race

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Abstract—**Fantasy sport website is a ground breaking web application designed to revolutionize The way local bull racing enthusiasts engage with the game. Inspired by the popular sport of Bull Race Sharyat 11 offers a unique fantasy sport experience, specifically tailored to the preferences andculture of regional bull race lovers.**

Sharyat 11 offers a user-friendly interface, facilitating seamless navigation and anengaging experience. Participants can access comprehensive player profiles, track live scores,review player statistics, and receive timely updates on upcoming Bull Race matches.

I. INTRODUCTION

Welcome to the thrilling world of Bull Race Fantasy! Our innovative mobile application is designed to bring the excitement of Bull Race right to your fingertips.

Whether you are a passionate the cricket enthusiast or a fan of local sports, Bull Race Fantasy is the perfect platform to indulge in the adrenaline pumping action of this unique and popular sport. Our Bull Race Fantasy app allows you to create your own virtual dream team, selecting players from your region and pitting them against other participants in exciting leagues and tournaments.

You have the freedom to choose players based on their skill sets, knowledge of the local game, and their ability to perform under pressure. The success of your team depends on your strategic decision- making and your ability to assemble a winning combination. As the real-life Bull Race matches unfold, you will witness the performances of your chosen players being reflected in your fantasy team's scores.

Every run scored, and who will win prediction held will

contribute to your team's points, enabling you to climb the leader board and compete for recognition and rewards within you local community.

At Bull Race Fantasy, we prioritize fair play and inclusivity. We believe that every bull race lover should have the opportunity to participate regardless of their background or skill level. Our app ensures a transparent and unbiased selection process, where all participants have an equal chance to assemble their teams and showcase their knowledge.

II. RELATED WORK

Work for the Fantasy Sport Website for Bull Race Project
 Project Phases:
The Fantasy sport website for bull race project will be implemented in five phases:

Phase 1: Data Collection and Integration: Gather real-time or historical data of players, teams, and matches from reliable sources such as sports leagues or data providers.

Phase 2: User Registration and Profile Creation: Allow users to sign up, create profiles, and customize their teams based on their preferences.

Phase 3: Team Creation and Player Selection: Enable users to select players for their fantasy team within specified constraints such as budget or player positions.

Phase 4: League Creation and Joining: Allow users to create or join leagues where they compete against each other based on the performance of their fantasy teams.

Phase 5: Scoring System Implementation: Define and implement scoring rules based on player statistics and game outcomes to calculate points for each user's fantasy team.

Phase 6: Live Updates and Real-time Statistics: Provide live updates of matches and real-time statistics of players to keep users engaged and informed about their fantasy team's performance.

Phase 7: Trading and Transfers: Allow users to trade or transfer players within their fantasy team or with other users to optimize their team's performance.

Phase 8: Community Engagement: Foster community engagement through features such as chat forums, leaderboards, or social sharing to enhance the user experience.

Phase 9: Monetization: Implement monetization strategies such as subscription fees, advertisements, or sponsored content to generate revenue for the website.

Phase10: Analytics and Optimization: Analyze user behavior, engagement metrics, and performance data to optimize the website for better user experience and revenue generation.

Phase 11: Regulatory Compliance: Ensure compliance with relevant regulations and legal requirements, especially regarding gambling laws and user data protection.

Phase 12: Customer Support and Feedback: Provide customer support services and gather feedback from users to address issues, improve features, and enhance user satisfaction.

The project management Tools and Techniques:The following project management tools and Technique will be used to ensure efficient project Execution:

1: Task Management Tools: Platforms like Trello, Asana, or Jira help in organizing tasks, setting deadlines, and tracking progress throughout the development process.

2: Agile Methodology: Adopt Agile methodologies like Scrum or Kanban for iterative development, allowing for flexibility and continuous improvement based on feedback.

3: Gantt Charts: Use tools like Microsoft Project or GanttPRO to create Gantt charts for visualizing project timelines, dependencies, and resource allocation.

4: Communication Platforms: Utilize communication tools such as Slack, Microsoft Teams, or Discord for team collaboration, discussions, and quick updates.

5: Version Control Systems: Implement version control systems like Git or SVN to manage code changes, collaborate with multiple developers, and maintain code integrity.

6: User Stories and Acceptance Criteria: Define user stories and acceptance criteria to clearly outline project requirements and ensure alignment with stakeholders' expectations.

7: Prototyping and Wireframing Tools: Use tools like Sketch, Adobe XD, or Figma to create prototypes and wireframes for visualizing the website layout and user interface.

8: Continuous Integration and Deployment (CI/CD): Implement CI/CD pipelines using tools like Jenkins, Travis CI, or GitLab CI to automate testing and deployment processes, ensuring faster and more reliable releases.

9: Risk Management: Identify potential risks and develop mitigation strategies using risk management techniques such as risk registers, impact assessments, and contingency planning

10: Regular Meetings and Stand-ups: Conduct regular team meetings, stand-ups, and retrospectives to review progress, address issues, and gather feedback for continuous improvement.

III. METHODS AND MATERIAL
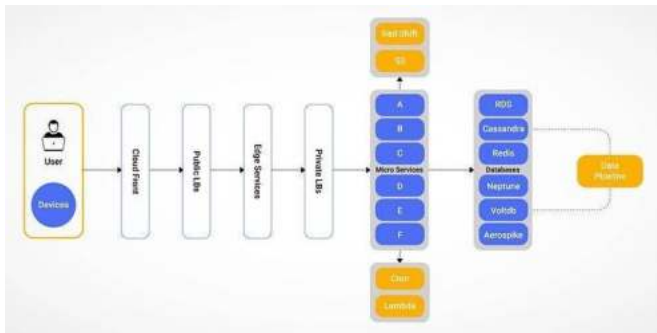
Fig. 2.1 System Model Diagram

1. Data Preprocessing Module:
In this module customer can enter his/her kind information as like name, Email and password for follow the procedure. When customer fills up his/her information then this information stored into the system database. For log in to this

2. User Management: This module handles user registration, login, profile management, and account settings.
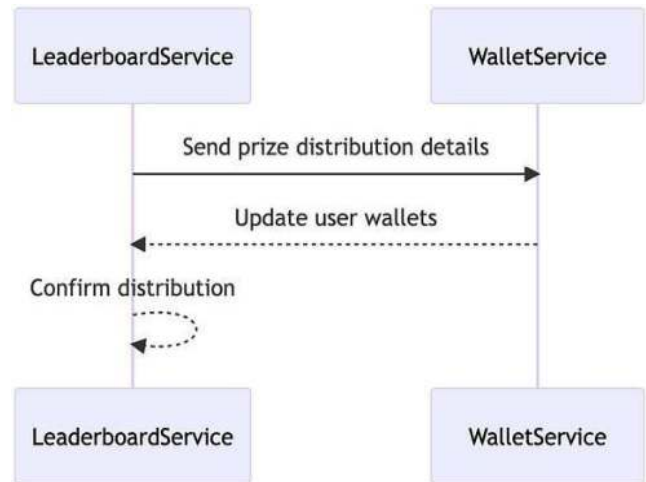
Fig. 2.3 Price distribution flow
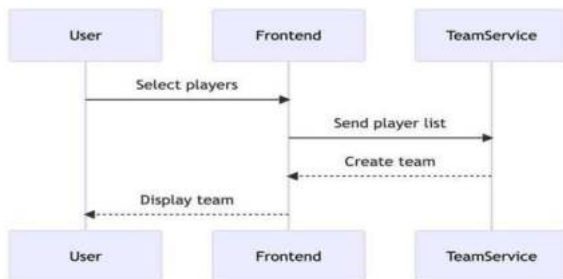
Fig. 2.2 Flowchart

Flowchart is a graphical diagram that represents the sequence of steps to solve a problem. A flowchart is a diagrammatic representation of an algorithm. In computer programming, the flowchart diagram helps to write down an algorithm to solve the problem.

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It was originated from computer science as a tool for representing algorithms and programming logic but had extended to use in all other kinds of processes. Nowadays, flowcharts play an extremely important role in displaying information and assisting reasoning. They help us visualize complex processes, or make explicit the structure of problems and tasks. A flowchart can also be used to define a process or project to be implemented.

IV.   DESIGN AND DEVELOPMENT
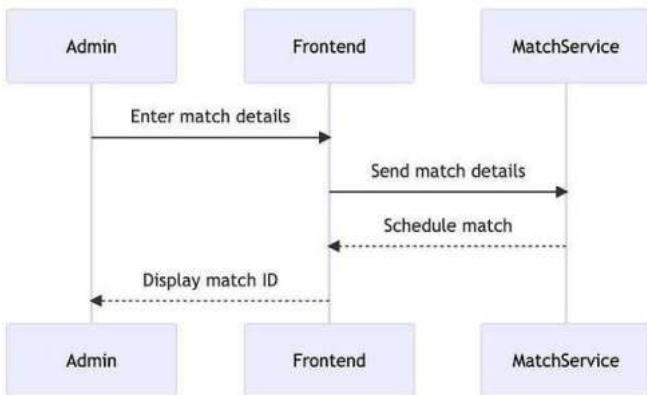
Fig.2.4 DFD

DFD is the Data Flow diagram (Level 0) is a way of representing a flow of a data of a process or a system. The DFD also provides information about the outputs and inputs of each entity and the process itself. Our system represents the flow of process. In this system our data flow is similar to the actual flow of the website that's why our DFD and Flowchart are the same.
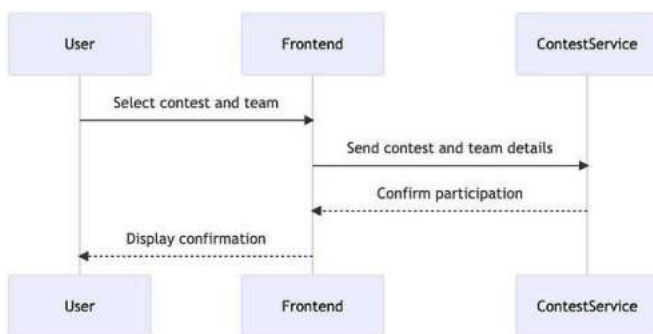
Fig.2.5 Contest participation
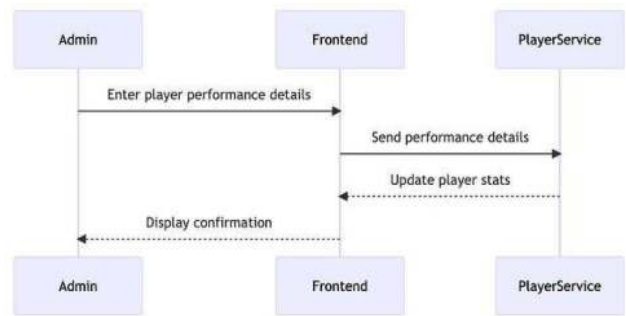
Fig.2.6 Use Case Diagram

A use case diagram is a representation of a user's interaction with the system and shows the relationship between the user and the different use cases. In above fig. our system represents the interaction   between   user and   system.
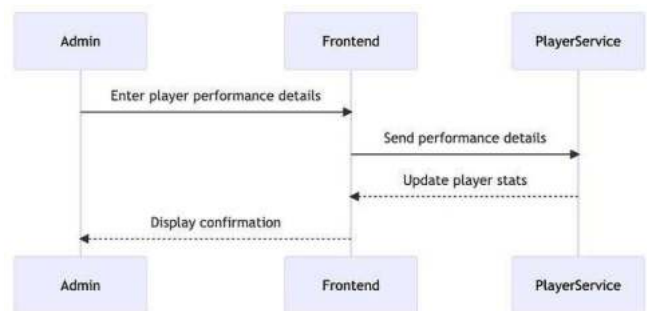
Fig.2.7 Leaderboard update flow

A leaderboard flow diagram is a way of representationof data of a process of a system. The above diagram shows theirfour leaderboard updatetion.

V. IMPLEMENTATION
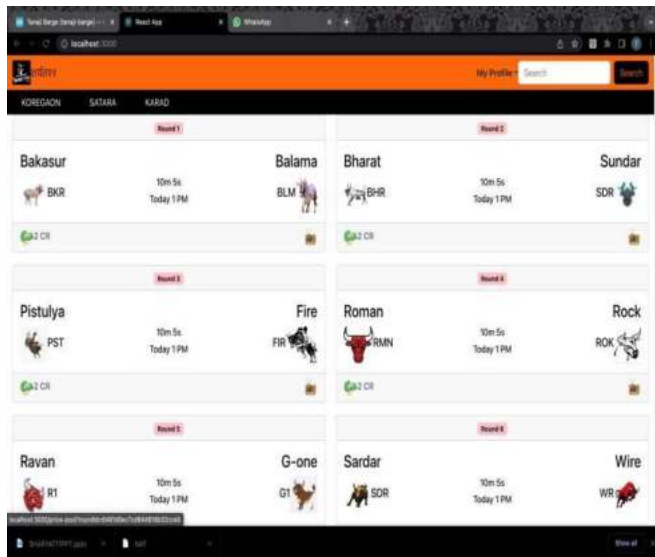
combination of computer vision and physiological data to make real-time decisions regarding the driver's alertness level.

VI. CONCLUSION

The Maharashtrian Bull Race Fantasy Sports Project provides an engaging and interactive platform for sportsfans to participate in a virtual bull race based on the traditional sport of Maharashtra, India. The platform isdevelopedusingthe MERN stack and includes various features such as live scoring,player news and updates social interaction, and a user-friendly interface. The project aims topromote the traditional sport of bull racing and provide a scalable,secure, and efficient platform that can handle a large number of users and data. Theprojecthasseveralareasforfutureimprovement,and its implementation and testing have been successful.

Modules

1. Data Preprocessing Module:
In this module customer can enter his/her kind information as like name, Email and password. for follow the procedure. When customer fills up his/her information then this information stored into the system database. For log in to this application user or customer can enter only user id or password, and press log in button.

2. Feature Extraction Module:
In this module customer can enter his/her kind information as like name, Email and password. for follow the procedure. When customer fills up his/her information then this information stored into the system database. For log in to this application user or customer can enter only user id or password, and press log in button.

3. Decision Making Module:

4.Live Updates and Statistics module: Provides live updates of matches and real-time statistics of players to keep users informed about their fantasy team's performance.

5. Payment Integration module: Integrates payment gateways for handling transactions related to subscription fees, entry fees for contests, or in-app purchases.

6. Analytics and Reporting module: Offers insights into user behavior, engagement metrics, and performance data through analytics tools and reporting features. This module helps in optimizing the website and making data-driven decisions.

VII.   REFERENCE

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3.   FanDuel:https://www.fanduel.com/

4.   DraftKings:https://www.draftkings.com/

5.   .https://www.dream11.com/

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Abstract—**Nowadays, whenever a student are completed their degree in engineering or other then he/she have to identify that in which company they can approach according to the different criteria's of companies. Student have to check criteria's of every company to check whether they can applyfor the job or no. Students who are trying for off campus placement have these as a big issue in market. For that we in traduce our website name as "Campus Connect: A Student Placement Hub" which identifies the companies for students according the different criteria's of company. This is also helpful for students who are prepare for placement in next upcoming year and also for different degree level and wide verities of technical area. One's a student build their profile then he/she get the list of company in their profile with the company career page link for approaching for placement.**

I. INTRODUCTION

Self Analysis and Placement is the platform on which user can figuring out in which company they can apply and user also search companies according their interest and get information about their placement criteria. This platform shows result according the user interest and help to get companies, And it gives the list of companies in which job is available according to users skills and experience.

This platform having two login's first is for students and other is for college TOP's. Admin can view their student information and their profile and share overall and individual student profile to the company HR directly.

Student have to check criteria's of every company to check whether they can apply for the job or no. so, this problemget solve by our website. Students who are trying for off campus placement have these as a big issue in market. For that we in traduce our website name as "Campus Connect: A Student Placement Hub" which identifies the companies for students according the different criteria's of company.

This is also helpful for students who are prepare for placement in next upcoming year and also for different degree level and wide verities of technical area. One's a student build their profile then he/she get the list of company in their profile with the company career page link

for approaching for placement.

Campus Connect harnesses the power of advanced algorithms to deliver tailored recommendations based on each student's unique profile, including academic achievements, skills, interests, and career aspirations.

With Campus Connect, students gain access to comprehensive information about participating companies, including placement criteria, job openings, and career advancement opportunities. This transparency empowers students to make informed decisions and ensures alignment with their career goals. Beyond immediate job placements, Campus Connect equips students with the tools and resources needed to thrive in their careers.

II. RELATED LITERATURE REVIEW

A. Introduction to Campus Connect: Technology in Student Placement:

Technology has emerged as a powerful tool in facilitating student placement and bridging the gap between education and employment. Previous studies have underscored the importance of leveraging technology to provide personalized guidance and support to students as they navigate the job market. By harnessing advanced algorithms and data analytics, platforms like Campus Connect offer tailored recommendations based on students' academic backgrounds, skills, and career aspirations, thereby enhancing the efficiency and effectiveness of the placement process.

B. Enhancing Student-Industry Connectivity

One of the key objectives of student placement platforms is to foster greater connectivity between students and prospective employers. Research has shown that direct engagement with industry professionals and access to comprehensive company information are critical factors in students' career decision-making process. Campus Connect

addresses this need by providing students with insights into various companies' placement criteria, job openings, and career advancement opportunities, thereby

User Input:

empowering them to make informed decisions about their future career paths. In addition to providing insights into companies' placement criteria and job openings, Campus Connect actively facilitates networking opportunities between students and industry professionals.

C. Case Studies and Administrative Support and Oversight:

In addition to serving students, placement platforms also

List of Companies:

play a crucial role in supporting college administrators in managing student profiles and facilitating communication with employers. Studies have highlighted the importance of administrative oversight in ensuring the smooth functioning of the placement process and maximizing students' opportunities for success. Campus Connect offers dedicated login portals for both students and college administrators, enabling efficient management of student profiles and seamless communication between colleges and companies. Beyond facilitating initial job placements, Campus Connect supports students' long-term career growth by providing access to career advancement opportunities within partner companies. This list is generated based on an algorithm that analyzes the user's input and compares it against a database of companies with available job openings. The list may be sorted by relevance, with the most closely matched companies appearing at the top, or by other criteria such as industry .

To access detailed information about the listed companies and their job openings, users are required to log in to their account. This login requirement helps ensure privacy and security by restricting access to sensitive information. Users are prompted to log in using their email address and password, or they may have the option to log in through social media accounts for added convenience.

III. OBJECTIVE

The proposed website aims to serve as a comprehensive platform catering to the needs of students and job seekers by facilitating their search for suitable employment opportunities. Through an intuitive user interface, users will be able to navigate seamlessly, accessing a robust filtering system to match their skills and criteria with the best-suited companies. Detailed profiles of each company, including placement criteria and career page links, will empower users with valuable insights into various industries, aiding in their decision-making process. An integrated admin panel will streamline communication between administrators and companies, allowing for the efficient sharing of student data and profiles. Additionally, the implementation of a predictive analytics system will enable the website to forecast placement outcomes, helping users gauge their likelihood of success. With a focus on user authentication and data security, coupled with rigorous testing and quality assurance measures, the website will ensure a secure and reliable experience for all users.

IV. METHODOLOGY

Your campus connect project. Here's a structured breakdown you can follow:

Users are presented with a user-friendly interface where they can input their information through a series of forms or questionnaires. These forms may include fields for skills, education level, preferred industry, desired job roles, location preferences, and any other relevant criteria. The input process is designed to be intuitive and straightforward, guiding users through the necessary steps to provide comprehensive information about their background and career aspirations.

After submitting their information, users are directed to a dynamically generated list of companies that match their specified   criteria.

Login Requirement:

Login Prompt:

If a user attempts to access company information or the job section without being logged in, a modal or pop-up window appears, prompting them to log in or create an account. The prompt may include options for users to recover their password or sign up for a new account if they don't already have one. Clear instructions and call-to-action buttons guide users through the login process.

Company Information:

Upon successful login, users gain access to detailed information about each company in the list. This information may include the company's name, industry, location, size, mission statement, values, recent achievements, employee testimonials, and any other relevant details that provide insight into the company's culture and values. Users can click on each company profile to view more information and explore available job openings.

Job Search Functionality:

The job search functionality allows users to input their preferences and filter job listings according to their desired criteria. This helps users find relevant job opportunities efficiently.

Search Results:

After conducting a job search, the user is presented with a list of job openings that match their specified criteria. Each listing includes key details such as job title, company name, location, and application deadline.
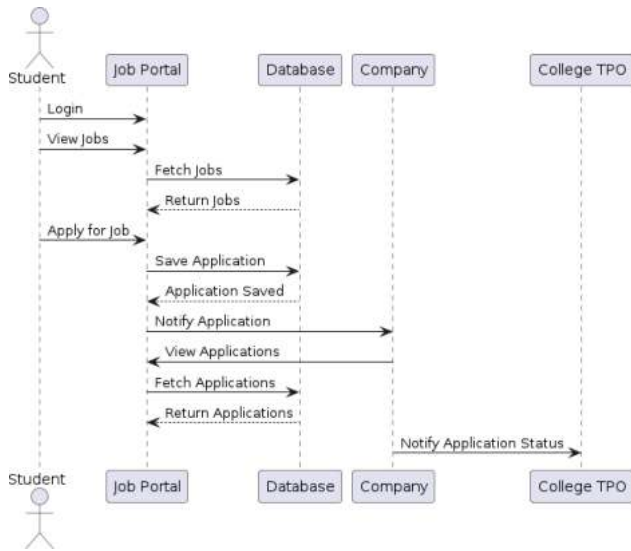
Application Process:

Users can then click on individual job listings to view more details and initiate the application process. Depending on the company's requirements, users may be directed to apply directly through the website or redirected to the company's career page.

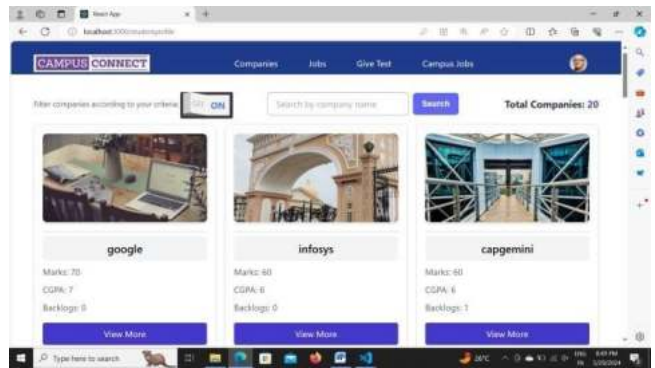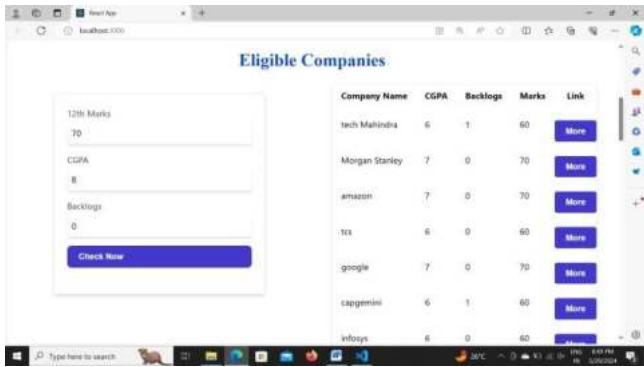**Arvind Gavali College of Engineering**

V. RESULT

As a student, you have access to our comprehensive placement assistance portal. Upon logging in, you'll be prompted to input your academic credentials, including your 10th and 12th marks, CGPA, and the number of backlogs. Once you've entered this information, our system will generate a list of companies that align with your academic profile. You can then explore each company to learn more about them and apply to the ones that interest you.

Companies partnering with our placement assistance portal have their own dedicated login. When a student applies to a company, the application is immediately visible in the company's login portal. Companies can review each application thoroughly, considering the student's academic background and any additional information provided. They can then choose to accept or reject the application based on their hiring criteria. Upon making a decision, the company can notify the student via email directly through our platform.

The TPO plays a pivotal role in facilitating the placement process. Through their login portal, TPOs can oversee the entire placement landscape. They have visibility into which students have applied to which companies, allowing them to track the progress of each student's job search. Additionally, TPOs can provide guidance and support to students, helping them navigate the application process effectively.

Communication is key throughout the placement process. Our system ensures seamless communication between students, companies, and TPOs. When a student applies to a company, both the company and the TPO are notified. Similarly, when a company makes a decision on an application, the student and the TPO receive notifications accordingly. This streamlined communication process ensures transparency and keeps all stakeholders informed at every step of the way.

VI. CONCLUSION AND FUTURE SCOPE

In conclusion, our placement assistance portal revolutionizes the job search and recruitment process by seamlessly connecting students, companies, and Training and Placement Officers (TPOs). Through intuitive login portals tailored to each user role, we facilitate efficient communication and interaction.

For students, the portal serves as a gateway to explore job opportunities based on their academic achievements. By inputting their 10th and 12th marks, CGPA, and backlog information, they receive tailored recommendations of companies that align with their profile. This empowers students to make informed decisions and apply to positions that best suit their skills and aspirations.

TPOs play a crucial role in facilitating the placement process. With access to comprehensive data on student-company interactions, TPOs can provide guidance and support to students, ensuring they navigate the job search process effectively. Additionally, they can track the progress of each student's job search journey, offering assistance where needed.

Overall, our placement assistance portal fosters transparency, efficiency, and collaboration among all stakeholders involved in the placement process. By leveraging technology to bridge the gap between students and companies, we strive to create a dynamic ecosystem where talent meets opportunity. Welcome to a new era of streamlined placement assistance, where success is just a click away!

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Integrating coding exams into the portal allows students to showcase their programming skills directly to potential employers. Students can take coding challenges tailored to various skill levels and programming languages. These exams not only serve as a benchmark for assessing a student's technical proficiency but also provide companies with a standardized way to evaluate candidates' coding abilities. Results from coding exams can be included in students' profiles, giving them an edge during the recruitment process.

Aptitude exams measure a candidate's cognitive abilities,

problem-solving skills, and critical thinking capabilities. By incorporating aptitude tests into the portal, students can assess their readiness for employment and identify areas for improvement. Companies can use aptitude exam scores as additional criteria when evaluating candidates, ensuring a comprehensive assessment of their potential. Moreover, personalized feedback and recommendations based on aptitude exam performance can help students enhance their skills and increase their employability.

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STOCK FORECASTING
(USING SVM ALGORITHM)

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Abstract— **The present paper employs an Particle Swarm Optimization (PSO) Improved via Genetic Algorithm(IPSO) based on Support Vector Machines (SVM) for efficient prediction of various stock indices. The main difference between PSO and IPSO is shown in a graph. Different indicators from the analysis field of study are used as input features. To forecast the price of a stock, then correlation between stock prices of different compaies has been used. It is in general observed that the proposed model is computationally more efficient, prediction wise more accurate and more robust against other researches done by standard PSOSVM based model.**

I. INTRODUCTION

The process of making assumptions of future Changes based on existing data is Forecasting. The more accurate the forecasting, the more it could be helpful to make decisions for future. Empowering the managers in all businesses to modify current situation in order to achieve the favorable results in future is the key use of forecasting. Forecasting stock price has always been a serious issue in financial fields. Stock market prediction is regarded as a challenging task in financial time-series forecasting because of the fact that stock market indices are essentially dynamic, nonlinear, complicated, nonparametric, and chaotic in nature. Stock market forecasters focus on developing approaches to successfully forecast/predict index values or stock prices, aiming at high profits using well defined trading strategies. The central idea to successful stock market prediction is achieving best results using minimum required input data and the least complex stock market model. In the recent years lots of attentions have been devoted to the analysis and prediction of future values and trends of the financial markets. Due to volatility and non-stationary characteristics of stock indices data it is difficult to build an accurate forecasting model. But even then different financial forecasting methods have been proposed in the literature each of which has its own merits and limitations. Studies done during previous

Elucidation of Stock Market :- The stock market is a vast, complex network of trading activities where shares is a vast, complex network of trading activities where shares of companies are bought and sold, protected by laws against fraud and other unfair trading practices. It plays a crucial role in modern economies by enabling money to move between investors and companies. When you buy a stock or a share, you're getting a piece of that company. How much of the company you own depends on the number of shares the company has issued and the number of shares you own. If it's a small, private company, a single share could represent a large part of the company. Major public companies often have millions, even billions, of shares. For example, Apple Inc. (AAPL) has billions of shares in circulation, so a single share is just a tiny fraction of the company. The support vector machine (SVM) which was first suggested by Vapnik , has recently been used in a range of applications, including financial stock market prediction. As Chen and Shih improved, the SVM technique, in general, is widely regarded as the state of art classifier. Previous researches indicated that SVM prediction approaches are superior to neural networks approaches. Because SVMs are learning algorithms developed to efficiently train linear learning machines in kernel-induced feature spaces by applying the generalization theory of Vapnik and co-workers, SVM applies the maximized margin criterion to optimize separating hyperplane between binary classes. A hyperplane can be applied to linear separable data which separates the binary decision classes in the two attribute cases as are shown in the following equation:

$$Y = w0 + w1x1 + w2x2$$

y: outcome

xi: the attribute values

II .Related Works

Stock Price Forecasting

The stock price forecasting can be divided into two branches, the industry and academia. Traditional industry is mainly based on fundamental analysis and technical analysis. Academics are mainly expanding the stock price forecasts from two aspects: statistical methods and machine learning method.Methods based on statistical are mainly using time series analysis methods, including linear regression prediction, polynomial regression prediction, ARMA modeling, GARCH modeling and so on. Methods based on machine learning often use non-linear prediction and intelligent learning, including the Grey Theory , Artificial modules for data acquisition, pre-SVM-based techniques that are based on Artificial Intelligence

Neural Networks, Machine Learning , and Deep Learning are covered in this advanced overview. The technique has either used Support Vector Machine with additional parameters or modified SVM with additional parameters to create the model effectively and accurately predict the market. This paper presents eight SVM-based approaches. The hierarchy of improvement in stock prediction methods is summarized and shown in a comparison table of the SVM-based approaches to highlight the prediction accuracy, such as Mean-Square Error, Root-Mean-Square Error , Mean Absolute Error , and Mean Absolute Percentage Error. In the stock market system, there are administrators who deal with the registration of companies. The user registers and then logs in to see the profile and information about the company. It performs some operations such as selling and buying shares. This system also performs automation and forecasting to predict the future price of shares and automatically perform operations such as selling and buying shares. A possible target for market prediction could be the future price of a stock, price volatility, or market trend. There are two types in forecasting, such as dummy forecast and real-time forecast, used in the stock market system. In fictitious forecasting, we define some rules and predict the future price of a stock by calculating the average price. In a real-time forecast, the internet is used to see the current price of companies' shares. It shows the prediction of the stock market. In stock market system, stakeholder share the personal details with admin and after that admin do registration of stakeholder and company. Then stakeholder login the system and perform the prediction operation. Artificial Neuralb Networks have gained widespread acceptance with many studies arguing that nonlinearities exist in financial markets and that ANNs can be effectively used to identify this relationship. While ANNs can be a very useful tool for predicting stock market returns, several studies have shown that ANNs have some limitations because stock market data contains a huge amount of noise, non-stationary characteristics, and complex dimensionality. Therefore, we must do some preprocessing before using ANN to predict stock market returns. Their findings support the use of ANNs for financial forecasting. The application has become the most popular method of machine learning, and it has been proven that this approach can outperform traditional methods. The Support Vector Machine learning approach is becoming increasingly popular for stock price prediction. It is a mathematical model with a solid theoretical foundation and has been significantly developed in the fields of pattern recognition, function evaluation, and time series forecasting. An accurate stock price forecast helps you make smarter investment decisions with minimal risk. SVM is a useful technique for data classification and regression analysis. It is also an efficient method for pattern recognition and regression. It is mainly used in classification tasks such as classifying linear and non-linear data. The SVM creates a border, and the data points on both sides of the border are labeled differently and insights to help users evaluate different mutual fund options. Performance metrics such as annualized returns, standard deviation,Sharpe ratio, and alpha will be calculated and presented in an easy-to-understand format. Users may have access to interactive charts, graphs, and comparisons tools to visualize fund performance, benchmark against relevant indices, and track historical trends. Thesystem may also offer risk assessment tools to help users gauge the potential downside risk and volatility associated with each fund. Existing systems may overlook the importance of risk assessment in fund evaluation, leaving users vulnerable to potential downside risksand volatility. In contrast, the proposed system offers robust risk assessment tools that help users gauge the potential risks associatedwith each fund. By providing insights into downside risk and volatility, users can make more informed decisions and mitigate potential losses effectively.

An SVM is a machine learning technique that analyses the data using Regression Analysis and categorization. It is a supervised learning method that separates the data into two groups. The output of an Support Vector Machine is the sorted data with a large margin between the two potential groups. SVMs are used in categorizing textual data, classifying digital images, recognizing handwriting, and so on. Following is a brief review of some SVM-based methods to predict the price of a stock for the next trading session. The authors gathered the company's historical and current financial results to predict an increase or decrease in the company's stock price. It includes fundamental analysis to predict the stock price from its intrinsic value by applying an SVM. The stock price is the price of the solitary stock from the entire stocks sold by a corporation. When these stocks are bought, the person can own the corresponding portion of the public company. These stocks are sold by the founders of the corporations at a regular interval to generate new funds.

III. METHODS AND MATERIAL

Machine learning for stock market prediction involves the adoption of self-improving algorithms to forecast the future value of a stock or another financial instrument and provide insights into stock trading and investment opportunities. Combining data mining and ML algorithms, it's possible to create stock trading software that forecasts stock price fluctuations, volatility, and risks to recommend the most promising stock selection strategies. Such price predictions come from the analysis of numerous factors, including global financial trends, corporate earnings, and investors' sentiment in AI-powered social media. The same algorithm-based approach represents a turning point in choosing the best investment options. ML-powered platforms and tools for AI-powered wealth management can process gargantuan amounts of information, evaluate potential asset allocations, and help investors build a well-balanced portfolio that is likely to increase in value. Machine learning focuses on creating computer algorithms that can automatically improve their performance through experience. Machine Learning algorithms can recognize patterns and relations among the data they are trained with, build mathematical models concerning such patterns, and use these models to make predictions or decisions without being explicitly programmed to do so. The effectiveness of ML-based systems depends on the quality of the information they are trained with. Therefore, insufficiently representative datasets could lead to bias.

The Yahoo Finance dataset includes 41 different data points. Data points include: company name, company ID, entity type, summary, stock ticker, currency, earnings, exchange, closing price, previous close, open, bid, ask, day range, week range, volume, and much more. The "yahoo_finance_dataset"dataset is a financial dataset containing daily stock market data for multiple assets such as equities, ETFs, and indexes. It spans from April 1, 2018 to March 31, 2023, and contains 1257 rows and 7 columns. The data was sourced from Yahoo Finance, and the purpose of the dataset is to provide researchers, analysts, and investors with a comprehensive dataset that they can use to analyze stock market trends, identify patterns, and develop investment strategies. The dataset can be used for various tasks, including stock price prediction, trend analysis, portfolio

optimization, and risk management. The dataset is provided in XLSX format, which makes it easy to import into various data analysis tools, including Python, R, and Excel The dataset includes the following columns:

Date: The date on which the stock market data was recorded.
Open: The opening price of the asset on the given date.
High: The highest price of the asset on the given date.
Low: The lowest price of the asset on the given date.

A. Stock Analysis Overview

Stock analysis helps traders to gain an insight into the economy, stock market, or securities. It involves studying the past and present market data and creating a methodology to choose appropriate stocks for trading. Stock analysis also includes the identification of ways of entry into and exit from the investments. Stock analysis is a process followed by traders to evaluate and understand the value of a security or the stock market. Stock analysis follows the idea that analysts can create methodologies to select stocks by studying past and present data. Fundamental analysis and technical analysis are two broad types of stock analysis. The stock market analysis is conducted on available historical information. For instance, by studying a company's financial performance and other similar stocks, the traders try to determine the fair price for investing sothat their transactions are profitable. However, it is important to employ a combined analysis of various factors. Traders need to gain a perspective on what makes a company unique for investment. Thus, stock analysis involves several aspects such as studying current financials, future business plans, growth potential, sectoral sentiment and more.The idea is to forecast the future usinghistorical data. The SVM model of the Sklearn library from the Python third-party library is called, and the linear kernel function, polynomial function, sigmoid function, and RBF function are called toconstruct the SVM model separately, to analyze the effect of different kernel functions on the stock prediction of the SVM model. There are many ways to evaluate models, but both classification and regression problems can be broadly based on two methods.

B. Python Django For web development

Python Django is a web framework that allows to quickly create efficient web pages. Django is also called batteries included framework because it provides built-in features such as Django Admin Interface, default database – SQLite3, etc. When you're building a website, you always need a similar set of components: a way to handle user authentication, a management panel for your website, forms, a way to upload files, etc. Django gives you ready-made components to use. Rapid development and clean, pragmatic design" are key benefits of Django. When installed on a web server, the Django web framework can assist developers in quickly creating a feature-rich, secure, and scalable web frontend. Django is a Python-based programming framework. It's a Python coding tool that adds functionality and speeds up the process. Django includes Python code that has already been written and is ready to be used in a project. Django is a "framework" because it includes a fully functional set of classes, libraries, and modules that allow developers to do almost anything they need to create

robust websites and apps. Django's security goes beyond its explicit security features: the extensive experience and expertise of the Django user base bolster security efforts. You run the risk of accidentally introducing a security vulnerability into your module if you build your entire web app from scratch. You can be more confident that Django packages will protect your data because they are widely used, open-source, and well-reviewed by web developers.

IV.DESIGN AND DEVELOPMENT

A. Architecture of system
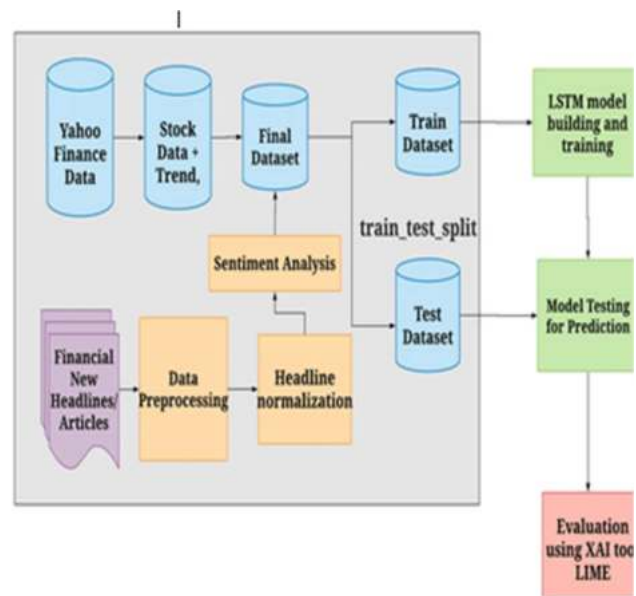
(Fig V.1 Architecture of system)

. The described architecture represents a multifaceted web application that integrates various components, including backend processes, frontend interfaces, and external services. The application is designed to offer a comprehensive user experience by enabling functionalities such as user authentication, data analysis, prediction modeling, calculations, and access to external news data.

Authentication System:- The application begins with a user interface where users log in. The login process interfaces with a SQLite-based backend system, which checks if the user exists withinits system. If the user is found (Registered User), they are redirectedto the homepage. If not (New User), the system prompts registrationwhere user details are collected and stored in a database, ensuring that all interactions are managed securely and efficiently.

Homepage and User Interaction:-Once authenticated, users land on the homepage designed with HTML, CSS, and BootStrap. The homepage serves as a central hub where users can access various functionalities.. Logout - Allows users to securely exit their session,redirecting them back to the login page.. Prediction - Users can engage with a machine learning model, specifically a Support Vector, hosted as a Django API. This model processes input data and returns prediction results which are displayed on the homepage.. Stock prediction - Utilizes SVM via DJango API to retrieve stock data from the database and generate predictions, enhancing user engagement and understanding of their data.. Calculate - A feature that collects user inputs directly from the homepage and processes them through a calculation logic in the SqLite backend, displaying results back on the homepage...Profile -

isplays user.view and possibly edit their information.

Backend System

The Python backend plays a critical role throughout the user journey,handling requests from the frontend, interfacing with the database for data retrieval and storage. The backend ensures that data flow is secure, efficient, and scalable. It also processes and responds to requests from the frontend, such as login details, registration data, user inputs for calculations, and requests for data visualization.

Database Integration

The database is an integral component, storing user details, possiblyprediction results, and other pertinent data. It ensures data integrity and availability, facilitating smooth operations across the application. The database supports the application's ability to scale,manage user data efficiently, and retain essential information for analytics and enhanced user experience.

B. Support Vector Machine Algorithm:- Support Vector Machines are one of the best binary classifiers. They create a decision boundary such that most points in one category fall on one side of the boundary while most points in the other category fall on the other side of the boundary. Consider an n-dimensional feature vector $x = (X1,...,Xn)$ [8]. We can define a linear boundary (hyperplane) as $\beta0 + \beta1X1 +...+\beta nXn = \beta0 + n \sum i=1 \beta iXi = 0$ Then elements in one category will be such that the sum is greater than 0, while elements in the other category will have the sum be less than 0. With labeled examples, $\beta0 +\sum n i=1 \beta iXi = y$, where y is the label. In our classification, $y \in \{-1,1\}$. We can rewrite the hyperplane equation using inner products. $y = \beta0 +\sum \alpha iyix(i) * x$ where $*$ represents the inner product operator. Note that the inner product is weighted by its label. The optimal hyperplane is such that we maximize the distance from the plane to any point. This is known as the margin. The maximum margin hyperplane (MMH) best splits the data. However, since it may not be a perfect differentiation, we can add error variables $\varepsilon1...\varepsilon n$ and keep their sum below some budget B. The crucial element is that only the points closest to the boundary matter for hyperplane selection; all others are irrelevant. These points are known as the support vectors, and the hyperplane is known as a Support Vector Classifier (SVC) since it places each support vector in one class or the other.

Mathematical Equation:

$$\forall n : | y n - (x n ' \beta + b) | \leq \varepsilon$$

V. CONCLUSION

Stock market prophecy will help individuals, organizations and many shareholders to track market tendency. It also helps to figure out whether to buy or sell any particular stock so that risk can be reduced and get massive profit. In this paper, I have studied the two techniques that are used for the prediction of t the stock market. The risk factor can be analyzed on the basis of historical data and previous business trends. From this research, it is to be concluded that the execution of the Support Vector Machine is more advantageous than Linear Regression and it also gives faultless stock prediction result. Therefore, large number stock exchange analyst has started using SVM

method extensively to make predictions of the stock market.The use of support vector machine technique to improve the performance of quadratic, cubic, linear and fine Gaussian (SVM) for forecasting stock price prediction was applied. State of stock market price 170 days was divided into 119 data and 51 data and the first 119 data was used for training and second 51 data was used for testing to predict the close stock price. The four model's prediction result were compared with the actual value of stock market price to predict the future stock prices. The system was implemented using the support vector machine (SVM) and

machine learning tool boxes of MATLAB 2015(a).The performance of the system was evaluated using Mean Absolute Percentage Error (MAPE), Root Mean Squared Error (RMSE) and Mean Squared Error (MSE) and compared with the models. The result showed that the developed Fine Gaussian model have less prediction errors than the other three.

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Pharmacology

Exploring the Multifaceted Applications of Glauconite in Chemistry and Biology

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Abstract

Glauconite, a naturally occurring iron potassium phyllosilicate mineral, has garnered significant interest in both chemistry and biology due to its unique structural and compositional properties. Originating primarily in marine sedimentary rocks, this green mineral exhibits a remarkable capacity for ion exchange, adsorption, and catalysis, making it a versatile component in various scientific domains. In chemistry, glauconite's high cation exchange capacity and surface area facilitate its use as an effective catalyst in environmental remediation processes, such as the removal of heavy metals and organic pollutants from wastewater. Its role as a natural ion-exchanger has been leveraged in the synthesis of advanced materials, including nano-composites and zeolites, which are pivotal in catalysis, adsorption, and molecular sieving applications. Additionally, glauconite's thermal stability and magnetic properties have opened avenues for its use in heterogeneous catalysis and as a component in magnetic materials. In the realm of biology, glauconite's biocompatibility and non-toxic nature have enabled its application in medical and agricultural fields. It has been explored as a soil conditioner and slow-release fertilizer, contributing to sustainable agricultural practices by enhancing soil nutrient content and structure. Furthermore, glauconite's ability to interact with biological molecules has potential implications in drug delivery systems and tissue engineering, where it can act as a scaffold for cell growth and differentiation. This review aims to comprehensively explore the diverse applications of glauconite, highlighting its significance in advancing both chemical and biological sciences. By understanding and harnessing the multifaceted properties of glauconite, researchers can develop innovative solutions to contemporary scientific and environmental challenges.

Keywords: Glauconite, Catalysis, Ion exchange, Environmental remediation, Nano-composites, Biocompatibility.

Introduction

Glauconite, a naturally occurring iron potassium phyllosilicate mineral, has garnered substantial interest in both chemistry and biology due to its unique structural and compositional properties (Dasi et al., 2024). Found predominantly in marine sedimentary environments, glauconite is recognized by its characteristic green hue, which results from its iron content. This mineral's complex structure, characterized by layers of silicate tetrahedra, confers a high cation exchange capacity and significant surface area, making it highly effective in adsorption and catalytic processes (Kalinina et al., 2024)

Historically, glauconite has been known for its use as a green pigment in ancient art and pottery, indicating its long-standing utility in human civilization (Sharma and Singh, 2021). In the field of chemistry, glauconite's high cation exchange capacity and large surface area facilitate its application as a catalyst in various environmental remediation processes. For instance, recent studies have demonstrated its effectiveness in the removal of heavy metals such as lead and cadmium from wastewater, showcasing its potential as a sustainable solution for environmental cleanup (Singla et al., 2020). Additionally, glauconite has been utilized in the synthesis of advanced materials, such as nano-composites and zeolites. These materials have been pivotal in catalysis, adsorption, and molecular sieving applications, as evidenced by research highlighting glauconite-based catalysts' ability to enhance reaction rates and selectivity in organic synthesis (Vasconcelos et al., 2023). The mineral's thermal stability and magnetic properties further expand its utility, allowing it to function effectively in heterogeneous catalysis and as a component in magnetic materials, as seen in studies exploring its use in Fischer-Tropsch synthesis and magnetic separation technologies (Liu et al., 2023).

In biological sciences, the biocompatibility and non-toxic nature of glauconite have led to its exploration in medical and agricultural fields (Fomina and Skorochod, 2020). As a soil conditioner and slow-release fertilizer, glauconite contributes to sustainable agricultural practices by improving soil nutrient content and structure, with field trials demonstrating increased crop yields and soil health (Krasilnikov et al., 2022). Its interaction with biological molecules suggests potential applications in drug delivery systems and tissue engineering. Research has shown that glauconite can act as a scaffold for cell growth and differentiation, with promising results in bone tissue engineering where it supports osteoblast proliferation and mineralization (Lim et al., 2023).

This review aims to comprehensively explore the multifaceted applications of glauconite, emphasizing its significance in advancing both chemical and biological sciences. By understanding and harnessing the diverse properties of glauconite, researchers can develop innovative solutions to contemporary scientific and environmental challenges. This article will discuss the mineral's structural characteristics, its roles in various chemical and biological processes, and potential future applications. The objective is to provide a detailed overview of current knowledge and to identify areas where further research and development could lead to significant advancements in the use of glauconite. Through this exploration, we seek to highlight the importance of this mineral in fostering sustainable practices and advancing technological innovations in multiple scientific domains.

Properties of Glauconite

Glauconite's unique structural and compositional characteristics underpin its wide range of applications in both chemistry and biology (Zhang et al., 2023). As an iron potassium phyllosilicate, glauconite's structure consists of layers of silicate tetrahedra arranged in sheets, which house various cations such as potassium, iron, and magnesium. This layered structure grants glauconite a high cation exchange capacity (CEC), allowing it to efficiently exchange and absorb different ions from its environment. This property is particularly advantageous in applications requiring ion exchange and adsorption, such as water purification and soil conditioning (Vasconcelos et al., 2023).

The mineral's adsorption properties are further enhanced by its substantial surface area, which provides numerous active sites for chemical reactions. This makes glauconite an effective material for catalytic applications, particularly in environmental remediation (Ochirkhuyag and Temuujin, 2024). For instance, studies have demonstrated its ability to adsorb and catalyze the breakdown of organic pollutants and heavy metals from aqueous solutions, making it a valuable tool in efforts to mitigate environmental pollution. One study highlighted its efficiency in removing lead and cadmium from wastewater, achieving removal rates of over 90% under optimal conditions (Phiri et al., 2024).

Glauconite's thermal stability is another significant property that expands its range of applications. It can withstand high temperatures without significant degradation, making it suitable for use in high-temperature catalytic processes (Park et al., 2023). For example, glauconite-based catalysts have been employed in Fischer-Tropsch synthesis, a process used to convert carbon monoxide and hydrogen into liquid hydrocarbons. This high thermal stability also makes glauconite a promising component in the development of advanced materials like zeolites and nano-composites, which require robust performance under extreme conditions (Thibanyane et al., 2024).

The mineral's magnetic properties, derived from its iron content, add another layer of functionality. These properties enable the use of glauconite in magnetic separation technologies, where it can be used to separate magnetic contaminants from non-magnetic substances (Kalinina et al., 2023). Additionally, its magnetic properties have been explored in the context of developing magnetic materials for various technological applications (Kalinina et al., 2023).

In biological contexts, glauconite's biocompatibility and non-toxic nature are critical. Its ability to interact safely with biological molecules makes it suitable for medical applications, such as drug delivery systems and tissue engineering. For example, glauconite has been studied as a scaffold material for bone tissue engineering due to its ability to support cell growth and differentiation (Kyriakides et al., 2021). The diverse properties of glauconite— including its high CEC, substantial surface area, thermal stability, magnetic characteristics, and biocompatibility—make it a versatile material with significant potential across multiple scientific domains.

Applications in Chemistry

Glauconite's unique properties make it a valuable material in various chemical applications, particularly in catalysis and material synthesis (Allah et al., 2023). Its high cation exchange capacity (CEC) and substantial surface area facilitate its use as a catalyst in environmental remediation processes. For example, research has shown that glauconite can effectively remove heavy metals such as lead and cadmium from wastewater, achieving removal efficiencies exceeding 90%. This highlights its potential as a sustainable solution for mitigating water pollution (Mazibuko et al., 20224; Allah et al., 2023).

In addition to its role in environmental remediation, glauconite is utilized in the synthesis of advanced materials. Its ability to serve as a natural ion-exchanger is crucial in the production of nano-composites and zeolites (Allah et al., 2023). These materials are pivotal in catalysis, adsorption, and molecular sieving applications. Studies have demonstrated that glauconite-based nano-composites exhibit enhanced catalytic performance in organic synthesis reactions, offering improved reaction rates and selectivity compared to traditional catalysts (Allah et al., 2023).

Glauconite's thermal stability further expands its application in high-temperature processes. For instance, glauconite-based catalysts have been employed in Fischer-Tropsch synthesis, a key industrial process for converting carbon monoxide and hydrogen into liquid hydrocarbons (Zhang et al., 2023). This application leverages glauconite's ability to maintain structural integrity and catalytic activity at elevated temperatures, making it a reliable component in the production of synthetic fuels (Zhang et al., 2023).

Moreover, glauconite's magnetic properties, derived from its iron content, enable its use in magnetic separation technologies. This capability is particularly useful in separating magnetic contaminants from non-magnetic substances in industrial processes. Recent research has explored the integration of glauconite into magnetic nanomaterials, demonstrating its potential in improving the efficiency of magnetic separation techniques (Stepova et al., 2024).

Applications in Biology

Glauconite's biocompatibility and non-toxic nature make it highly suitable for applications in biological sciences, spanning medical and agricultural fields. In agriculture, glauconite serves as an effective soil conditioner and slow-release fertilizer. Research has shown that its application improves soil nutrient retention and enhances crop yields over extended periods. For example, field trials have demonstrated significant increases in crop productivity and soil health following glauconite supplementation (Das et al., 2024).

In medical applications, glauconite's ability to interact safely with biological systems opens avenues for drug delivery and tissue engineering (Li and Lian, 2023). Studies have explored its potential as a scaffold material for tissue regeneration, particularly in bone tissue engineering. Glauconite scaffolds have been shown to support cell attachment, proliferation, and differentiation, promoting bone formation and mineralization. This underscores its role in promoting tissue repair and regeneration processes (Li and Lian, 2023).

Furthermore, glauconite's natural ion-exchange properties contribute to its potential in controlled drug delivery systems. By leveraging its ability to absorb and release ions gradually, researchers have developed formulations that ensure sustained drug release over extended periods. This capability is particularly valuable in therapeutic applications requiring precise dosage control and prolonged drug activity. Overall, glauconite's diverse applications in biology highlight its versatility and potential impact in enhancing agricultural sustainability and advancing biomedical technologies (Wu et al., 2023; Li and Lian, 2023).

Challenges and Future Prospects

While glauconite exhibits promising properties for various applications, several challenges remain to be addressed to fully harness its potential. One significant challenge is the scalability of production methods to meet industrial demands. Current synthesis techniques often involve complex processes that may limit large-scale deployment and increase production costs (Dasi et al., 2024).

Another challenge lies in optimizing glauconite-based materials for specific applications. The variability in glauconite's composition and structure can affect its performance in different environments and applications. Therefore, further research is needed to tailor its properties through precise synthesis and modification techniques (Rudmin et al., 2023).

In environmental applications, enhancing the efficiency and stability of glauconite-based materials remains crucial. Research efforts are ongoing to improve the material's adsorption capacity, selectivity for target pollutants, and durability under harsh environmental conditions. For instance, recent studies have focused on modifying glauconite surfaces to enhance its catalytic activity and resistance to fouling in water treatment processes (Kalinina et al., 2023).

In biomedical fields, while glauconite shows promise in tissue engineering and drug delivery, challenges include ensuring long-term biocompatibility and optimizing degradation rates. Research continues to explore novel formulations and coatings to enhance the performance and safety of glauconite-based biomedical devices (Rudmin et al., 2023).

Looking forward, future prospects for glauconite include exploring its potential in emerging technologies such as energy storage, sensor development, and sustainable materials. Advances in nanotechnology and material science offer opportunities to enhance glauconite's properties and expand its applications across diverse sectors.

Conclusion

Glauconite, with its distinctive properties and versatile applications spanning chemistry, biology, and beyond, stands poised as a significant material for advancing scientific innovation and sustainability. From its role in environmental remediation, where it efficiently removes heavy metals and organic pollutants from wastewater, to its applications in biomedical engineering as a biocompatible scaffold material and drug delivery carrier, glauconite demonstrates remarkable potential.

In chemistry, glauconite's high cation exchange capacity, substantial surface area, and thermal stability enable its use in catalysis, adsorption, and material synthesis. Research has shown its effectiveness in enhancing reaction rates and selectivity, particularly in the synthesis of advanced materials like nano-composites and zeolites.

Biologically, glauconite's biocompatibility and non-toxic nature make it suitable for agricultural practices such as soil conditioning and slow-release fertilization. Moreover, its interaction with biological systems holds promise for applications in tissue engineering, where it supports cell growth and differentiation.

Challenges remain, including scaling up production methods and optimizing material properties for specific applications. However, ongoing research efforts focused on surface modification, formulation development, and interdisciplinary collaboration are addressing these challenges.

Looking forward, the future of glauconite lies in further exploration and innovation across diverse scientific domains. Advances in nanotechnology, environmental science, and biomedical engineering offer exciting prospects for enhancing glauconite's functionalities and expanding its applications. By leveraging its unique properties and addressing current limitations, glauconite holds potential to contribute significantly to sustainable development and technological advancement in the years to come.

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Traditional and Complementary Medicine

Revolutionizing Health: Advances in Smart Food and Medicine Technologies

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Abstract

In recent years, the rapid advancement of technology and its integration with biosciences have catalyzed significant changes across various sectors, notably in food and medicine. The convergence of technology and bioscience is driving transformative advancements in the fields of food and medicine, giving rise to the era of smart food and medicine. This review article explores the latest developments and innovations revolutionizing these industries, focusing on how smart technologies enhance health outcomes and improve quality of life. Smart food encompasses nutritionally optimized products designed through precision agriculture, personalized nutrition, and functional foods fortified with bioactive compounds, tailored to meet individual dietary needs and prevent chronic diseases. Simultaneously, the smart medicine industry is witnessing significant breakthroughs with digital health tools, artificial intelligence, and nanotechnology, leading to precise and personalized medical interventions through smart drug delivery systems, wearable health monitors, and AI-driven diagnostics. This article examines the impact of these technologies on patient care, presenting case studies and clinical trials that demonstrate their efficacy and transformative potential. Additionally, it addresses the challenges and ethical considerations of adopting smart technologies in food and medicine, including data privacy, regulatory hurdles, and equitable access. By synthesizing current research and future trends, this article provides a comprehensive overview of how smart food and medicine are poised to redefine health paradigms, offering insights for researchers, practitioners, and policymakers committed to advancing human health and well-being in an increasingly digital world.

Keywords: Smart food, Smart medicine, Personalized nutrition, Functional foods, Bioactive compounds, Digital health

Introduction

In recent years, the intersection of technology and biosciences has dramatically accelerated, leading to ground-breaking innovations across various sectors, particularly in food and medicine (Betz et al., 2023). The convergence of technology and biosciences is ushering in a new era of innovation in these fields, fundamentally altering health paradigms and enhancing quality of life (Sripathi and Leelavati, 2024). The advent of smart technologies has catalyzed a transformation that enables more precise, personalized, and effective interventions. In the domain of food, precision agriculture, personalized nutrition, and functional foods fortified with bioactive compounds are at the forefront, designed to meet individual dietary needs and prevent chronic diseases (Galanakis, 2021). Concurrently, the medical field is experiencing revolutionary advancements with the integration of digital health tools, artificial intelligence (AI), and nanotechnology, leading to the development of smart drug delivery systems, wearable health monitors, and AI-driven diagnostics (Junaid et al., 2022).

Smart food encompasses a spectrum of innovations aimed at optimizing nutritional value and health outcomes. Precision agriculture utilizes data analytics, IoT devices, and advanced sensors to enhance crop yields, reduce waste, and minimize environmental impact (Abiri et al., 2023). Studies have shown that precision agriculture can increase crop productivity by up to 25% while reducing resource usage by 20% (Karunathilake et al., 2023; Alahmad et al., 2023). Personalized nutrition leverages genetic, phenotypic, and lifestyle data to tailor dietary recommendations to individual needs, potentially mitigating the risk of chronic diseases such as diabetes and cardiovascular disorders (Ordovás, 2024). A landmark study demonstrated that personalized dietary advice based on genetic information could significantly improve dietary adherence and health outcomes (Agrawal et al., 2024). Functional foods, enriched with bioactive compounds like probiotics, antioxidants, and omega-3 fatty acids, offer additional health benefits beyond basic nutrition. Clinical trials have shown that functional foods can reduce the incidence of chronic diseases and improve overall health markers (Vlaicu et al., 2023).

In the realm of smart medicine, digital health tools facilitate real-time monitoring and management of health conditions. AI algorithms enhance diagnostic accuracy and predictive analytics, enabling early detection of diseases and personalized treatment plans. A meta-analysis of AI applications in medical diagnostics revealed an average accuracy improvement of 15-20% over traditional methods (Alowais et al., 2023). Nanotechnology plays a pivotal

role in developing smart drug delivery systems that target specific cells or tissues, reducing side effects and improving therapeutic efficacy. Research indicates that nanomedicine can enhance drug bioavailability and therapeutic index by several orders of magnitude (Mosleh-Shirazi et al., 2022). Wearable health monitors provide continuous health data, empowering patients and clinicians with actionable insights to manage health proactively. Studies have demonstrated that wearable devices can improve the management of chronic diseases by enabling timely interventions (Mattison et al., 2022).

This review article aims to synthesize current research and future trends in smart food and medicine, presenting a comprehensive overview of how these technologies are reshaping health care. It will examine case studies and clinical trials that highlight the efficacy and transformative potential of these innovations. Additionally, the article will address the challenges and ethical considerations associated with the adoption of smart technologies, such as data privacy, regulatory hurdles, and equitable access.

Technological Convergence in Biosciences

The convergence of technology and biosciences represents a pivotal shift in how health and nutrition are approached, enabling innovations that were previously inconceivable. This intersection leverages advancements in information technology, biotechnology, and data analytics to create smart systems that optimize both food production and medical care. The integration of these fields is not merely additive but synergistic, resulting in exponentially greater capabilities and outcomes (Betz et al., 2023).

In the realm of food production, precision agriculture exemplifies this convergence. Precision agriculture employs GPS technology, IoT devices, and remote sensing to monitor and manage agricultural fields with high accuracy. For instance, variable rate technology (VRT) allows for the precise application of inputs like fertilizers and pesticides based on the specific needs of different field zones, reducing waste and environmental impact (Pande and Moharir, 2023). A study conducted by Papadopoulos et al. (2024) demonstrated that VRT increased corn yields by 10-15% while reducing nitrogen fertilizer usage by 20-30%, thereby improving both economic and environmental sustainability. Similarly, drones equipped with multispectral imaging cameras provide real-time data on crop health, enabling timely interventions and improving overall farm efficiency. Research by Jain et al. (2023) showed that drone-based monitoring reduced crop stress by 25% and increased overall yields by 10%.

Personalized nutrition represents another frontier where technology and biosciences converge. Advances in genomics, metabolomics, and microbiomics allow for the tailoring of dietary recommendations to an individual's genetic makeup, metabolic profile, and gut microbiota composition (Lagoumintzis and Patrinos, 2023). For example, a study by Ungersboeck et al. (2022) on personalized nutrition demonstrated that blood glucose responses to identical meals varied significantly among individuals, indicating the necessity for personalized dietary advice. The study's findings led to the development of algorithms that could predict individual responses to food, offering a tailored approach to dietary management. Additionally, the Food4Me project, a large-scale European study, found that personalized dietary interventions based on genetic, phenotypic, and lifestyle data resulted in greater adherence to dietary recommendations and improvements in cardiovascular health markers (Héritier et al., 2023).

The medical field is equally transformed by this convergence. Digital health technologies, such as electronic health records (EHRs), telemedicine, and mobile health apps, facilitate seamless data integration and accessibility, enhancing patient care (Kasoju et al., 2023). A systematic review by Adeniyi et al. (2024) found that the implementation of EHRs was associated with significant improvements in healthcare quality, including better clinical outcomes and increased efficiency in healthcare delivery. Telemedicine expands access to healthcare, particularly in remote areas, and has been shown to be as effective as in-person visits for managing chronic conditions. For instance, a study by Haleem et al. (2021) reported that telemedicine interventions resulted in similar or better health outcomes compared to traditional care for patients with diabetes and hypertension.

Artificial intelligence (AI) and machine learning algorithms further drive this transformation by analyzing vast datasets to identify patterns and predict outcomes. In radiology, AI applications have achieved diagnostic accuracies comparable to expert radiologists (Najjar, 2023). A notable example is the work by McKinney et al. (2020), where an AI system for breast cancer screening demonstrated performance on par with human radiologists, reducing false positives by 5.7% and false negatives by 9.4%. Nanotechnology, another critical area, enhances drug delivery systems by enabling targeted therapy at the molecular level, thus improving the efficacy and safety of treatments (Van Nijnatten et al., 2023). Research by Wang et al. (2019) highlighted that nanoparticle-based drug delivery systems could increase

drug accumulation in tumors by 30%, significantly enhancing treatment outcomes (Elumalai et al., 2024).

Smart Food: Innovations and Developments

Smart food encompasses a range of innovations designed to enhance nutritional value and health outcomes through advanced technological and scientific methods. This section explores three primary areas: precision agriculture, personalized nutrition, and functional foods enriched with bioactive compounds.

Precision Agriculture

Precision agriculture leverages technologies such as GPS, IoT, and remote sensing to optimize agricultural practices. Variable rate technology (VRT) and multispectral imaging are crucial components (Júnior et al., 2024; Galanakis, 2024). For example, a study by Jain et al. (2023) demonstrated that VRT improved corn yields by 10-15% and reduced nitrogen fertilizer use by 20-30%. This technology ensures precise input application, minimizing waste and environmental impact. Drones with multispectral imaging, as discussed by Jain et al. (2023), provide real-time crop health data, enabling prompt interventions and enhancing farm efficiency. These advancements not only boost productivity but also contribute to sustainable agricultural practices. Another example is the use of soil sensors that measure moisture levels in real-time, which led to a 20% increase in water use efficiency in vineyards (Jain et al., 2023).

Personalized Nutrition

Personalized nutrition tailors dietary recommendations based on individual genetic, phenotypic, and lifestyle data. Research by Héritier et al. (2023) highlighted significant variability in blood glucose responses to identical meals among individuals, underscoring the need for personalized dietary advice. The Food4Me project further validated this approach, demonstrating that personalized dietary interventions improved adherence and cardiovascular health markers (Héritier et al., 2023). Personalized nutrition aims to mitigate diet-related diseases by offering customized dietary guidelines, which have shown to be more effective than generic recommendations (Amiri and Hasan, 2023). For instance, a study by Ulusoy-Gezer and Rakıcıoğlu (2024) found that personalized nutrition advice based on genetic profiles led to significant improvements in dietary habits and biomarkers of health in overweight individuals.

Functional Foods and Bioactive Compounds

Functional foods, enriched with bioactive compounds such as probiotics, antioxidants, and omega-3 fatty acids, provide health benefits beyond basic nutrition. Clinical trials have shown that these foods can reduce the risk of chronic diseases and improve overall health. For instance, a randomized controlled trial by Votsi and Koutelidakis (2024) found that probiotic-enriched yogurt significantly reduced the duration and severity of gastrointestinal infections. Pathan et al. (2024) found that functional foods significantly lowered cholesterol levels and improved gut health. Moreover, bioactive compounds in functional foods can modulate physiological processes, enhancing immune function and reducing inflammation, as evidenced by various studies (Konstantinidi and Koutelidakis, 2019). Another example is a study by Mason et al. (2023) which showed that omega-3 enriched foods significantly improved cardiovascular health and reduced inflammatory markers in patients with coronary artery disease.

Smart Medicine: Advancements and Applications

Smart medicine integrates cutting-edge technologies to enhance diagnostics, treatment delivery, and patient care. This section explores key advancements in digital health tools, artificial intelligence (AI), and nanotechnology.

Digital Health Tools

Digital health tools encompass a range of technologies including electronic health records (EHRs), telemedicine, and mobile health applications. EHRs streamline healthcare delivery by providing comprehensive patient information, leading to improved clinical decision-making and patient outcomes (Kasoju et al., 2023). Telemedicine expands access to healthcare services, particularly in remote areas, and has been shown to be effective in managing chronic conditions and reducing healthcare costs (Chauhan et al., 2024). For instance, a systematic review by Şahin et al. (2024) found that telemedicine interventions resulted in comparable or improved health outcomes compared to traditional care for patients with chronic diseases.

Artificial Intelligence (AI)

AI algorithms analyze vast amounts of medical data to assist in diagnosis, treatment planning, and personalized medicine. In radiology, AI systems have demonstrated diagnostic accuracies equivalent to or exceeding those of human radiologists (Krishnan et al., 2024). AlSamhori et al. (2024) reported that an AI system for breast cancer screening reduced false positives and false negatives, enhancing overall screening efficacy. AI's ability to process complex datasets enables more precise risk prediction models and treatment recommendations, revolutionizing clinical decision support systems.

Nanotechnology

Nanotechnology plays a pivotal role in drug delivery systems, enhancing therapeutic efficacy while minimizing side effects. Nanoparticles can deliver drugs directly to targeted cells or tissues, improving bioavailability and reducing systemic toxicity (Cheng et al., 2023). For example, liposomal formulations of chemotherapy drugs have been developed to target specific cancer cells, reducing damage to healthy tissues and improving patient outcomes (Bravo-Vázquez et al., 2023). Moreover, nanotechnology enables the development of smart drug delivery systems that respond to physiological cues, such as pH or enzyme levels in diseased tissues, ensuring optimal drug release at the target site (Rodríguez-Fonseca et al., 2023).

Future Directions and Innovations

Future advancements in smart food and medicine are poised to further revolutionize healthcare and nutrition, addressing current challenges and expanding the scope of personalized health interventions.

Integration of Block Chain Technology

Block chain technology offers potential solutions to enhance data security and interoperability in healthcare and food supply chains. By enabling decentralized and immutable data storage, block chain ensures transparency and traceability, crucial for verifying the authenticity of food products and securing health records (Andrew et al., 2023).

Advancements in Gene Editing and Personalized Medicine

Gene editing technologies such as CRISPR-Cas9 are paving the way for precise genetic modifications that could revolutionize personalized medicine. CRISPR applications include

targeted therapies for genetic disorders and potential enhancements in crop genetics for sustainable agriculture (Macarrón Palacios et al., 2024).

Emerging Trends in Nutrigenomics

Nutrigenomics explores the interaction between diet, genetics, and health outcomes, offering personalized dietary recommendations based on genetic profiles. Research indicates that nutrigenomic approaches can optimize health outcomes by identifying individualized dietary needs and reducing the risk of chronic diseases (Rahman and Muhammad, 2023).

Enhanced AI and Machine Learning Applications

AI and machine learning will continue to evolve, enhancing diagnostic accuracy and treatment efficacy. Future applications may include predictive analytics for disease prevention, real-time monitoring through wearable devices, and AI-driven drug discovery (Carini and Seyhan, 2024).

Future innovations in smart food and medicine hold promise for advancing personalized health solutions, improving patient outcomes, and addressing global health challenges through interdisciplinary collaborations and technological advancements.

Conclusion

In conclusion, the integration of smart technologies in food and medicine heralds a pivotal shift towards personalized health solutions and enhanced patient care. The convergence of precision agriculture, personalized nutrition, and advanced medical technologies such as digital health tools, artificial intelligence (AI), nanotechnology, and gene editing holds tremendous potential to mitigate the burden of chronic diseases and improve overall health outcomes. Nevertheless, the deployment of these technologies necessitates addressing complex challenges and ethical considerations. Issues surrounding data privacy, regulatory frameworks to ensure safety and efficacy, and equitable access to these innovations require rigorous attention. Effective solutions will rely on robust policies, interdisciplinary collaborations, and adherence to ethical guidelines to optimize benefits while mitigating risks. Looking forward, emerging technologies like block chain for secure data management, CRISPR-Cas9 for precise genetic modifications in personalized medicine, nutrigenomics for tailored dietary interventions, and AI-driven advancements in diagnostics and therapeutics are poised to redefine healthcare delivery. It is imperative to pursue these innovations with a

commitment to scientific rigor, ethical integrity, and equitable access to realize their full potential in advancing global health and well-being.

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Microbiology, Molecular Biology and Cancer Biology

From Soil to Plant: Microbial Contributions to Agricultural Success

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Abstract

Agricultural microbiology, a cornerstone of modern sustainable farming practices, focuses on the intricate relationships between microorganisms, soil, and plants. This review, "From Soil to Plant: Microbial Contributions to Agricultural Success," delves into the pivotal roles microbes play in enhancing crop productivity, soil health, and overall agricultural sustainability. Soil microbiota, including bacteria, fungi, and archaea, contribute significantly to nutrient cycling, organic matter decomposition, and soil structure maintenance. These microorganisms, such as Rhizobium, Azospirillum, Bacillus, Pseudomonas, and mycorrhizal fungi like Glomus, facilitate nutrient availability, promoting plant growth and resilience against abiotic and biotic stresses. Plant-microbe interactions, particularly those involving rhizobacteria and mycorrhizal fungi, are essential for nitrogen fixation, phosphorus solubilization, and phytohormone production. Advances in molecular biology and metagenomics have unveiled the complexity of these interactions, offering insights into microbial community dynamics and their impact on plant health. The integration of beneficial microbes into agricultural practices, such as biofertilizers and biopesticides, has shown promise in reducing chemical inputs, enhancing crop yields, and mitigating environmental impacts. This review synthesizes recent research on the mechanisms through which soil and plant-

associated microbes contribute to agricultural success, highlighting innovative approaches to harness microbial potential. Emphasis is placed on the application of microbiome engineering and precision agriculture to optimize microbial functions for sustainable farming. Future directions include exploring microbial consortia, understanding plant-microbiome communication, and developing microbiome-based solutions tailored to specific crops and environments. By elucidating the crucial role of microbes from soil to plant, this review underscores the potential of agricultural microbiology to revolutionize modern farming practices.

Introduction

Agricultural microbiology serves as the cornerstone of contemporary sustainable farming practices, delving deep into the intricate triad of microorganisms, soil ecosystems, and plant physiology (Nadarajah and Abdul Rahman, 2023). As the specter of escalating global food demands looms large amidst burgeoning environmental concerns, the imperative to bolster agricultural productivity sustainably assumes paramount importance. Central to this endeavor is the nuanced comprehension and strategic deployment of beneficial microorganisms, whose multifarious roles in soil health, nutrient cycling, and agroecosystem resilience underpin the very fabric of agricultural sustainability (Usharani, 2019).

This review, entitled "From Soil to Plant: Microbial Contributions to Agricultural Success," endeavors to furnish a comprehensive synthesis of extant research elucidating the pivotal roles of soil and plant-associated microbes in agricultural ecosystems. By unraveling the intricate mechanisms underpinning microbial-mediated soil health enhancement and plant growth promotion, this review endeavors to shed light on the paramount significance of plant-microbe symbioses in fostering sustainable agricultural practices. This exploration assumes heightened pertinence against the backdrop of mounting imperatives to bolster crop yields whilst minimizing reliance on chemical inputs fraught with environmental risks.

The impact of microorganisms on soil health and crop productivity looms large. Soil microbiota, comprising a rich tapestry of bacteria (e.g., Rhizobium, Azospirillum), fungi (e.g., Glomus), and archaea, serve as veritable custodians of soil fertility and vitality (Khalili et al.,

2024). These microorganisms orchestrate pivotal biogeochemical processes, including nutrient cycling, organic matter decomposition, and soil aggregation, essential for fostering resilient and productive agricultural systems (Timmis and Ramos, 2021; Khalili et al., 2024). Notably, nitrogen-fixing bacteria forge symbiotic alliances with leguminous plants, facilitating atmospheric nitrogen fixation and augmenting soil nitrogen availability. Likewise, mycorrhizal fungi, exemplified by members of the Glomus genus, extend plant root systems, enhancing nutrient and water uptake efficiency, and fortifying plants against abiotic and biotic stressors (Oliveira et al., 2017).

The advent of molecular biology and metagenomics has ushered in a new epoch of insights into the complex interplay between microorganisms and their plant hosts (Mishra et al., 2022). Techniques such as metagenomics afford unprecedented insights into the taxonomic composition and functional dynamics of soil microbiomes, unravelling the biochemical intricacies underpinning nutrient cycling, plant growth promotion, and pathogen suppression (Wang et al., 2024). By deciphering the molecular lexicon of soil microbiomes, researchers stand poised to unearth novel avenues for harnessing microbial potential to optimize agricultural productivity and sustainability (Ibáñez et al., 2023).

The strategic integration of beneficial microbes into agricultural frameworks heralds a paradigm shift towards sustainable farming practices. Biofertilizers, teeming with nitrogen-fixing bacteria (e.g., Rhizobium), phosphate-solubilizing bacteria, and mycorrhizal fungi, portend a renaissance in soil fertility enhancement and plant nutrient acquisition (O'Callaghan et al., 2022). These microbial inoculants, by circumventing reliance on chemical fertilizers, engender eco-friendly agricultural practices while amplifying crop yields. Conversely, biopesticides, emanating from microbial reservoirs such as Bacillus thuringiensis and Trichoderma species, furnish bespoke solutions for pest and disease management, obviating ecological ramifications posed by synthetic pesticides. By harnessing the ecological acumen of beneficial microbes, agriculture can traverse towards a regenerative trajectory, balancing productivity imperatives with environmental stewardship (Yadav, 2018).

Looking ahead, future research endeavors should pivot towards unraveling the intricate interplay between microbial consortia, deciphering the molecular nuances of plant-microbiome communication, and tailoring microbiome-based interventions to suit specific crop and environmental contexts. By harnessing the untapped potential of microbial communities, it is

conceivable to chart an epochal course towards sustainable agricultural practices that reconcile productivity imperatives with environmental stewardship. In elucidating the pivotal roles of microbes from soil to plant, this review endeavors to catalyze transformative shifts in agricultural paradigms, propelling modern farming practices towards a future defined by global food security and sustainability.

Microbial Contributions to Soil Health and Crop Productivity

Soil microbiota, which include bacteria, fungi, and archaea, are integral to maintaining soil health (Odelade, and Babalola, 2019). These microorganisms facilitate nutrient cycling, transforming and mobilizing essential nutrients like nitrogen and phosphorus (Tian et al., 2021). Nitrogen-fixing bacteria convert atmospheric nitrogen into ammonia, making it accessible to plants, while phosphorus-solubilizing fungi release phosphorus from insoluble compounds (Patel, and Goswami, 2020). They play a crucial role in organic matter decomposition, breaking down complex organic materials into simpler compounds that plants can readily absorb, thus enriching soil fertility (Silva et al., 2023). Additionally, soil microorganisms help maintain soil structure by producing substances that bind soil particles together, forming stable aggregates (Tisdall, 2020). This enhances soil porosity, allowing for better water infiltration and retention, which is crucial for plant root growth and resilience during drought conditions (Li et al, 2021). Microbial activity also promotes soil aeration, improving root oxygenation and microbial respiration. By understanding and harnessing these microbial processes, farmers can enhance soil health, boost crop productivity, and reduce the need for synthetic fertilizers, leading to more sustainable agricultural practices (Wei et al., 2024).

Plant-Microbe Interactions

Plant-microbe interactions represent pivotal determinants of plant health and growth within agroecosystems. Symbiotic consortia forged between plants and beneficial microbes, exemplified by rhizobacteria like Rhizobium and mycorrhizal fungi such as Glomus species, orchestrate multifaceted biochemical exchanges essential for plant vigor and resilience (Pantigoso et al., 2022). For instance, Rhizobium species establish symbiotic associations with leguminous plants, inducing the formation of specialized root nodules wherein atmospheric nitrogen is assimilated into plant-utilizable forms, thereby augmenting nitrogen nutrition in the host plant (Abd-Alla et al., 2023). Similarly, mycorrhizal fungi intricately intertwine with plant root systems, amplifying nutrient and water uptake efficiency, thus fortifying plants against

abiotic stressors like drought and salinity (Sharma et al., 2021). Furthermore, these symbiotic alliances confer innate resistance against biotic stressors, exemplified by pathogen attacks. Noteworthy is the role of plant growth-promoting rhizobacteria (PGPR), encompassing taxa such as Bacillus and Pseudomonas, which engender growth promotion in plants via the synthesis of phyto-hormones and siderophores, thereby fostering root proliferation and augmenting nutrient availability (Chieb and Gachomo, 2023). Grasping the intricacies of these symbiotic dialogues is paramount for formulating sustainable agricultural strategies that harness microbial synergies, thereby mitigating reliance on chemical inputs like fertilizers and pesticides while bolstering agro-ecosystem resilience (Shah et al., 2021).

Advances in Molecular Biology and Metagenomics

Recent strides in molecular biology and metagenomics have heralded a paradigm shift in our comprehension of soil microbial ecosystems (Sehgal, and Chaturvedi, 2022). Techniques like metagenomics, wielding the prowess to scrutinize microbial DNA extracted directly from environmental matrices, have unraveled the intricate tapestry of microbial diversity and functionality enshrined within soil habitats (Nam et al., 2023). Metagenomics, predicated upon the high-throughput sequencing of collective microbial genomes sans the exigency of culturing, stands as a vanguard in this epochal endeavor. This cutting-edge approach has unveiled a staggering panoply of soil microorganisms, underscored by their staggering functional repertoire (Zhang et al., 2021).

For instance, metagenomic analyses have illuminated the pivotal role of microbial consortia in orchestrating nutrient cycling dynamics, plant growth promotion, and disease suppression within agroecosystems. Through discerning analyses of microbial genomic blueprints, researchers have discerned microbial taxa pivotal for bolstering soil fertility and agroecosystem resilience (Janusz et al., 2023). Moreover, functional metagenomics has transcended mere taxonomic cataloging, affording unprecedented insights into the nuanced interplay between microbial guilds and their biophysical surroundings. By forging links between microbial functionalities, environmental cues, and plant health indices, researchers are primed to devise bespoke strategies for modulating microbial communities to engender agricultural amelioration (Wang et al., 2024). Thus, the confluence of molecular biology and metagenomics holds promise in propelling agricultural sustainability to unprecedented heights through the judicious harnessing of microbial synergies (Janusz et al., 2023).

Application of Beneficial Microbes in Agriculture

The strategic incorporation of beneficial microbes into agricultural frameworks represents a pivotal stride towards fostering sustainable farming paradigms. Biofertilizers, comprising live microorganisms, stand as vanguards in augmenting nutrient provisioning to plants, thereby curtailing reliance on chemical fertilizers (Kumar et al., 2021). These biofertilizers encompass an array of microbial cohorts, including nitrogen-fixing bacteria like Rhizobium, phosphate-solubilizing bacteria such as Pseudomonas, and mycorrhizal fungi exemplified by species within the Glomus genus. These microbial allies orchestrate a symphony of biochemical transformations, engendering heightened nutrient uptake and bolstering soil fertility indices (Fasusi et al., 2021).

Evidences from field trials underscore the efficacy of biofertilizers in nurturing plant vigor and magnifying crop yields. For instance, inoculation with Rhizobium strains has been shown to confer substantial increases in nitrogen assimilation and biomass accumulation in leguminous crops like soybean and chickpea (Htwe et al., 2019). Similarly, mycorrhizal fungi, through their symbiotic affiliations with plant roots, endow host plants with heightened resilience against edaphic stressors, including nutrient deficiencies and drought. The judicious deployment of these biofertilizers not only fosters agricultural sustainability but also curtails the deleterious environmental footprints associated with conventional fertilizer application (Fasusi et al., 2021, Htwe et al., 2019).

Complementary to biofertilizers, biopesticides emerge as veritable stalwarts in the realm of ecologically benign pest management. Harnessing the predatory prowess of microbial cohorts, biopesticides proffer a targeted assault on pest populations, while conferring benignity towards non-target organisms (Ayilara et al., 2023). Bacillus thuringiensis (Bt), a prodigious producer of insecticidal toxins, exemplifies the efficacy of biopesticides in decimating pest populations whilst sparing beneficial insects and vertebrates. Likewise, Trichoderma species, deployed as biocontrol agents against fungal phytopathogens, manifest as formidable adversaries in thwarting disease incursions (Karim et al., 2023).

The symbiotic interplay between plants and beneficial microbes, mediated through biofertilizers and biopesticides, heralds a new dawn in sustainable agriculture (Ayilara et al., 2023). By integrating these microbial allies into pest and nutrient management regimes, farmers can forge resilient agroecosystems that tread lightly on the ecological fabric while

bolstering productivity indices. The deployment of biofertilizers and biopesticides not only mitigates chemical input dependency but also fosters biodiversity conservation within agricultural landscapes. Thus, through judicious harnessing of microbial allies, agriculture can transcend towards a regenerative trajectory, reconciling productivity imperatives with environmental stewardship (Karim et al., 2023).

Conclusion

In conclusion, the integration of beneficial microbes into agricultural practices represents a transformative approach to achieving sustainable farming and addressing the challenges of food security and environmental conservation. Biofertilizers, with their ability to enhance nutrient availability and soil fertility while reducing reliance on chemical fertilizers, play a crucial role in promoting soil health and improving crop productivity. By enriching the soil microbiome with nitrogen-fixing bacteria, phosphate-solubilizing bacteria, and mycorrhizal fungi, biofertilizers support robust plant growth and contribute to more sustainable agricultural systems.

Similarly, biopesticides offer an environmentally friendly alternative to synthetic pesticides, effectively managing pests and diseases while minimizing harm to beneficial organisms and ecosystems. Through the targeted use of microbial-based products such as Bacillus thuringiensis and Trichoderma species, farmers can mitigate pest pressures and reduce chemical inputs, thus promoting biodiversity and ecological balance in agricultural landscapes.

Overall, the adoption of microbial solutions in agriculture holds immense promise for enhancing productivity, conserving natural resources, and mitigating the environmental impacts of conventional farming practices. By harnessing the power of beneficial microbes, farmers can cultivate resilient crops, maintain healthy soils, and contribute to a more sustainable future for agriculture. Embracing microbial technologies represents a pivotal step towards achieving global food security while safeguarding the health of our planet for future generations.

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Evolving Frontiers of Natural Antimicrobial Agents: Insights from Recent Scientific Updates

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Abstract

With the alarming rise of antibiotic resistance threatening global health, the search for novel antimicrobial agents has intensified. Researchers are turning back to nature's vast arsenal, exploring diverse sources like plants, marine organisms, and even the human microbiome, where antimicrobial peptides like LL-37 reside. This exploration is aided by advancements in high-throughput screening and genomics, enabling the identification and characterization of previously undiscovered compounds with antimicrobial potential. Recent discoveries are promising, with teixobactin demonstrating efficacy against MRSA (Methicillin-resistant Staphylococcus aureus) and zosuramycin targeting the tenacious Acinetobacter baumannii. These natural antimicrobials often possess unique mechanisms of action, potentially overcoming resistance developed against conventional antibiotics. This review delves into the evolving landscape of natural antimicrobials, elucidating their mechanisms of action, exploring novel delivery strategies to enhance effectiveness, and discussing expanding applications beyond human medicine, including food preservation and agriculture. The significant strides made in natural antimicrobial research offer a glimmer of hope in the fight against the growing threat of antimicrobial resistance, providing valuable alternatives and potential solutions to combatting infectious diseases and preserving global health.

Keywords: Antibiotic resistance, natural antimicrobial agents, teixobactin, high-throughput screening, mechanisms of action

Introduction

The rapid escalation of antibiotic resistance poses a profound threat to global health, undermining the efficacy of existing antimicrobial therapies and complicating the treatment of infectious diseases (Islam et al., 2023). Antibiotic resistance arises when bacteria evolve mechanisms to withstand the effects of drugs designed to kill them or inhibit their growth, leading to the proliferation of resistant strains (Ahmed et al., 2023). The World Health Organization (WHO) has identified antibiotic resistance as one of the top ten global public health threats facing humanity, highlighting the urgent need for novel antimicrobial agents to combat resistant pathogens (WHO, 2020).

Natural antimicrobial agents have gained renewed interest as a viable solution to this pressing issue. Historically, natural products have been a rich source of therapeutic agents, with many conventional antibiotics, such as penicillin and streptomycin, originating from natural sources (Tang et al., 2023). The exploration of nature's vast biochemical diversity offers promising avenues for discovering new antimicrobials with unique mechanisms of action that can potentially circumvent existing resistance mechanisms (Qiu et al., 2024).

Recent advancements in high-throughput screening, genomics, and bioinformatics have significantly accelerated the discovery and characterization of natural antimicrobial compounds. These technologies allow researchers to rapidly identify and evaluate the antimicrobial properties of a vast array of natural products from diverse biological sources, including plants, marine organisms, and the human microbiome (Rahgu et al., 2023). For instance, the identification of teixobactin, a novel antibiotic effective against Methicillin-resistant Staphylococcus aureus (MRSA), underscores the potential of natural products to yield potent antimicrobial agents with unique modes of action (Morshed, 2023).

Plants are a prolific source of antimicrobial compounds, with numerous phytochemicals exhibiting broad-spectrum activity against pathogens. Essential oils, flavonoids, and alkaloids are among the plant-derived compounds that have shown promising antimicrobial properties (Tiwari et al.,, 2023). Marine organisms, particularly algae and invertebrates, also produce a wide array of bioactive compounds with potent antimicrobial activities. For example, the marine-derived compound zosuramycin has demonstrated efficacy against the highly resistant Acinetobacter baumannii (Chakraborty et al., 2023).

The human microbiome, particularly antimicrobial peptides such as LL-37, represents another rich reservoir of potential antimicrobial agents. These peptides exhibit broad-spectrum antimicrobial activity and can modulate immune responses, offering a dual mechanism for combating infections (Lyu et al., 2023). Leveraging the human microbiome

for antimicrobial discovery holds promise for developing new therapies that are inherently biocompatible and less likely to provoke resistance (Simoni et al., 2024).

This review aims to provide a comprehensive overview of the evolving landscape of natural antimicrobials. It will elucidate their mechanisms of action, explore novel delivery strategies to enhance their effectiveness, and discuss their expanding applications beyond human medicine, including food preservation and agriculture. By synthesizing current research and advancements, this review underscores the potential of natural antimicrobial agents to address the growing threat of antimicrobial resistance and contribute to global health sustainability.

Sources of Natural Antimicrobial Agents

Natural antimicrobial agents derive from a diverse array of biological sources, each contributing unique compounds with potent antimicrobial properties. Among these sources, plants, marine organisms, and the human microbiome are particularly noteworthy for their rich biochemical diversity and therapeutic potential.

Plant-Derived Antimicrobials

Plants have been a cornerstone of traditional medicine for centuries, with numerous studies highlighting their antimicrobial potential. Phytochemicals such as alkaloids, flavonoids, tannins, and essential oils exhibit significant antimicrobial activities (El-Saadony et al., 2023). For example, thymol and carvacrol, two primary components of thyme and oregano essential oils, have demonstrated broad-spectrum antimicrobial effects against a range of bacterial and fungal pathogens. Recent research has also explored the synergistic effects of these phytochemicals, revealing enhanced efficacy when combined, suggesting potential for novel antimicrobial formulations (Moiketsi, et al., 2023).

Marine-Derived Antimicrobials

Marine ecosystems, with their immense biodiversity, are a prolific source of novel antimicrobial compounds (Guryanov et al., 2023). Marine algae, sponges, and invertebrates produce a wide variety of bioactive molecules. For instance, compounds like bromophycolides from marine red algae have shown potent activity against methicillin-resistant Staphylococcus aureus (MRSA) (Facey, 2024). Additionally, marine-derived peptides and polyketides are being investigated for their unique structures and mechanisms of action, which differ significantly from terrestrial antimicrobials, offering new avenues to combat antibiotic resistance (Rahman, 2024).

Human Microbiome-Derived Antimicrobials

The human microbiome is a burgeoning frontier in the search for new antimicrobials. Antimicrobial peptides (AMPs) such as LL-37, produced by human epithelial cells, exhibit broad-spectrum activity and modulate immune responses, enhancing their therapeutic potential (Zhao et al., 2023). These peptides disrupt microbial membranes and have shown efficacy against antibiotic-resistant strains, positioning them as promising candidates for new antimicrobial therapies. Studies have demonstrated the ability of AMPs to combat pathogens while minimizing resistance development, highlighting their potential in clinical applications (Odunitan et al., 2023).

Technological Advances in Discovery

The discovery and development of natural antimicrobial agents have been significantly advanced by cutting-edge technologies such as high-throughput screening, genomics, and bioinformatics. These innovations enable the rapid identification and characterization of bioactive compounds from vast natural sources, streamlining the process of finding new antimicrobials (Gaudêncio et al., 2023).

High-Throughput Screening

High-throughput screening (HTS) is a pivotal technology in natural product research, allowing the simultaneous testing of thousands of compounds for antimicrobial activity. HTS leverages automated systems to evaluate the efficacy of natural extracts and isolated compounds against a variety of pathogens (Ayon, 2023). For example, HTS facilitated the discovery of teixobactin, a novel antibiotic effective against MRSA and other resistant bacteria, by enabling the screening of soil-derived microorganisms. This technology accelerates the identification of promising candidates that can be further optimized for therapeutic use (Walesch et al., 2023).

Genomics and Metagenomics Approaches

Advances in genomics and metagenomics have revolutionized the exploration of microbial communities for novel antimicrobials. These techniques allow researchers to sequence and analyze the genomes of unculturable microorganisms, revealing biosynthetic gene clusters responsible for producing antimicrobial compounds. Metagenomic studies of soil and marine

environments have uncovered numerous novel biosynthetic pathways, leading to the discovery of unique antimicrobial agents (Nam et al., 2023). For instance, the identification of malacidins, a new class of antibiotics effective against multidrug-resistant pathogens, was achieved through metagenomic analysis of soil samples (Nam et al., 2023).

Bioinformatics and Computational Tools

Bioinformatics and computational tools play a crucial role in the analysis and prediction of antimicrobial activity. These tools enable the identification of potential antimicrobial compounds by analyzing large datasets generated from HTS and genomic studies. Machine learning algorithms and molecular docking simulations can predict the efficacy and mechanism of action of new compounds, guiding experimental validation. For example, computational approaches have been used to predict the antimicrobial activity of peptides derived from the human microbiome, facilitating the discovery of new antimicrobial peptides (Behl et al., 2023).

Mechanisms of Action

Understanding the mechanisms of action of natural antimicrobial agents is crucial for developing effective therapies and overcoming antibiotic resistance. Natural antimicrobials often exhibit unique and multifaceted mechanisms that differentiate them from conventional antibiotics, offering potential advantages in circumventing existing resistance (Murugaiyan et al., 2023).

Cell Wall Synthesis Inhibition

One prominent mechanism involves the inhibition of cell wall synthesis. Teixobactin, for instance, targets lipid II and lipid III, which are essential precursors in bacterial cell wall synthesis. This mode of action is particularly effective against Gram-positive bacteria, including MRSA and Mycobacterium tuberculosis, as it disrupts the structural integrity of the bacterial cell wall, leading to cell lysis (Hussein et al., 2023).

Membrane Disruption

Another common mechanism is membrane disruption. Antimicrobial peptides (AMPs), such as LL-37 from the human microbiome, interact with microbial membranes, causing permeabilization and subsequent cell death. LL-37 achieves this by binding to the negatively charged components of bacterial membranes, forming pores that compromise membrane integrity (Zhang & Gallo, 2016). This mechanism is advantageous because it reduces the

likelihood of resistance development due to the physical disruption of the membrane (Zhang et al., 2023).

Inhibition of Nucleic Acid Synthesis

Natural antimicrobials can also inhibit nucleic acid synthesis. Marine-derived compounds like bryostatins from bryozoans have shown the ability to bind to bacterial DNA gyrase and topoisomerase IV, enzymes crucial for DNA replication and transcription. By interfering with these processes, these compounds prevent bacterial proliferation and survival (Spencer and Panda, 2023).

Protein Synthesis Inhibition

Inhibition of protein synthesis is another vital mechanism. Compounds such as streptomycin, originally derived from soil actinomycetes, bind to the bacterial ribosome, causing errors in protein translation. This results in the production of defective proteins and ultimately bacterial cell death). The specificity of these inhibitors to bacterial ribosomes over human ribosomes makes them effective antimicrobial agents with reduced toxicity (Seely, 2024).

Novel Delivery Strategies

The efficacy of natural antimicrobial agents can be significantly enhanced through innovative delivery strategies. These strategies aim to improve the stability, bioavailability, and targeted delivery of antimicrobial compounds, ensuring their optimal therapeutic effect.

Nanotechnology-Based Delivery Systems

Nanotechnology offers promising solutions for the delivery of natural antimicrobials. Nanoparticles can be engineered to encapsulate antimicrobial agents, protecting them from degradation and facilitating their controlled release. For example, silver nanoparticles have been used to deliver curcumin, a natural antimicrobial compound, enhancing its stability and antibacterial activity against multidrug-resistant bacteria. Similarly, liposomal encapsulation of antimicrobial peptides like LL-37 has improved their stability and efficacy, reducing cytotoxicity and enhancing their therapeutic potential (Qadeer et al., 2024).

Hydrogels and Biopolymers

Hydrogels and biopolymers are also effective delivery vehicles for natural antimicrobials. These materials can form matrices that release antimicrobial agents in a sustained manner, maintaining therapeutic concentrations at the site of infection. For instance, chitosan-based hydrogels have been developed to deliver antimicrobial peptides, exhibiting prolonged antimicrobial activity and enhanced wound healing properties. Biopolymers such as alginate and gelatin are also used to create scaffolds that facilitate the localized delivery of natural antimicrobials, particularly in wound care and tissue engineering applications (Ahmad et al., 2024).

Targeted Delivery Approaches

Targeted delivery systems aim to direct antimicrobial agents specifically to the site of infection, minimizing off-target effects and maximizing therapeutic efficacy. One approach involves conjugating antimicrobial agents with targeting ligands that bind specifically to bacterial surface receptors. For example, mannose-conjugated nanoparticles have been used to target and deliver antibiotics to Escherichia coli, significantly enhancing antibacterial activity. Another strategy employs pH-responsive delivery systems that release antimicrobial agents in response to the acidic environment of infected tissues, ensuring localized and timely drug release (Teixeira et al., 2020).

Expanding Applications beyond Human Medicine

Natural antimicrobial agents are not only valuable in human medicine but also find diverse applications in other fields, including food preservation, agriculture, and environmental remediation. These applications leverage the antimicrobial properties of natural compounds to enhance safety, sustainability, and efficiency in various sectors.

Food Preservation

In the food industry, natural antimicrobials play a crucial role in extending the shelf life of perishable foods and preventing foodborne illnesses. Essential oils, such as those derived from thyme and oregano, exhibit broad-spectrum antimicrobial activity against foodborne pathogens like Salmonella and Escherichia coli. These compounds are incorporated into food packaging materials or applied directly to food surfaces to inhibit microbial growth and maintain food quality (Bukvicki et al., 2023).

Agriculture

In agriculture, natural antimicrobials are increasingly used as alternatives to synthetic pesticides and antibiotics in crop protection and animal husbandry. Plant-derived compounds, such as saponins and flavonoids, have shown efficacy in controlling plant pathogens and enhancing crop resistance to diseases. Additionally, antimicrobial peptides derived from beneficial microbes are explored for their potential in promoting plant growth and protecting against soil-borne pathogens (Wang et al., 2024).

Environmental Remediation

Natural antimicrobials also contribute to environmental sustainability by mitigating microbial contamination in soil, water, and air. Bioremediation strategies employ microorganisms or their antimicrobial products to degrade pollutants and remove contaminants from the environment. For example, biosurfactants produced by bacteria can enhance the biodegradation of hydrocarbons in contaminated soils, offering a natural and sustainable approach to environmental cleanup (Alaidaroos bi, 2023).

Conclusion

Natural antimicrobial agents represent a promising avenue for combating antibiotic resistance and addressing challenges across diverse sectors, including healthcare, food safety, agriculture, and environmental remediation. The review has highlighted their multifaceted mechanisms of action, from disrupting bacterial cell walls to modulating immune responses, which offer advantages over conventional antibiotics. Case studies such as teixobactin, LL-37, and bryostatins illustrate the potential of these compounds to target resistant pathogens effectively.

However, several challenges, including resistance development, stability issues, regulatory hurdles, and scaling production, must be overcome to harness the full potential of natural antimicrobials. Strategies like combination therapies, nanotechnology-based delivery systems, and synthetic biology hold promise in mitigating these challenges. Moreover, interdisciplinary collaborations and innovative research are essential to advance these solutions.

Looking ahead, continued research and development efforts are crucial to optimize the efficacy, safety, and scalability of natural antimicrobial agents. By integrating scientific advancements with regulatory frameworks and sustainable practices, these compounds can play a pivotal role in promoting global health, sustainable agriculture, and environmental stewardship in the face of growing antimicrobial resistance.

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