PROCEEDINGS

SRISHTI 2024

SAINTGITS COLLEGE OF ENGINEERING
(AUTONOMOUS)

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Glimpse on SRISHTI 2024

SRISHTI 2024 – the 10th National Level Project Exhibition and Competition was organized by Saintgits College of Engineering in association with Kerala Startup Mission, ANSYS, Entuple Technologies, Cadence, MathWorks, Conceptia Konnect, SOLIDWORKS, ARK Infosolutions Pvt. Ltd., Tvasta, Floormate Rubber Products Pvt. Ltd., SCIE, Saintgits IEDC, and Mega Solutions on 26th and 27th February 2024. SRISHTI offers a platform for talented engineering students to showcase innovative technology projects. Undergraduate engineering students from various branches, as well as M. Tech., MCA, Design, Medical students, and research scholars can participate in this competition. The theme for SRISHTI 2024 was 'AI for Sustainability'. The industry collaborators for SRISHTI 2024 were Dalmia Cement, Gapblue, UltraTech Cement, METCON, ICT Academy of Kerala, SMEC, V-Guard, Synthite, Raspberry Pi Foundation, Floormate Rubber Products Pvt. Ltd., Fabcon, Autogenbot LLP, and DCUBE Ai. SRISHTI 2024 received 835 registrations from 11 states out of which 373 projects were theme-based. Best 154 projects were shortlisted for the final round evaluation. The Best Innovation was awarded a cash prize of Rs. 1 Lakh. A total prize money of Rs. 4.13 Lakhs was distributed during SRISHTI 2024. The event was inaugurated on 26th February 2024 at 11:00 am by Shri. Thomas T. John, Director, Saintgits Group of Institutions. The Award Function was held on 27th February 2024 and the winners were honoured with cash awards and certificates.

Dr. Fossy Mary Chacko
Coordinator, SRISHTI 2024

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Stabilization of Expansive Soil Using Water Hyacinth Ash

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Abstract: Strength of soil is an important criterion while constructing a structure over it. Expansive soils are soils that have low strength and bearing capacity. This study focuses on stabilizing the expansive soil in Akkulam region. The soil in Akkulam is very weak so the structures constructed over it are very vulnerable to failure, also the bunds constructed in the agricultural fields of this regions is prone to breaching. In this project the stabilization is done using an easily available and cost-effective material, water hyacinth ash (WHA). Water hyacinth, being a threat to the water bodies, is made to ash and used to treat the soil to increase its stability. The soil is treated using WHA (0.25%,0.5%,0.75%,1%,1.25% & 1.5%). Optimum percentage of WHA is determined by comparing the results of UCC test. To determine the effect of curing the material tests were conducted on soil treated with optimum percentage of WHA after curing it for 3&7 days.

Introduction

The potential of water hyacinth ash in enhancing the soil stability is explored. Expansive soils pose significant challenges in construction and agriculture, and this sustainable solution offers promising results.

The work focusses on the following criteria:

- To increase the stability and strength of the soil.
- To understand the geotechnical behavior of the soil at different percentage of Water Hyacinth Ash
- To determine the optimum percentage of Water Hyacinth Ash to stabilize the soil sample.

Preparation of Testing soil: The collected soil sample is mixed with water hyacinth ash. Water hyacinth ash is made by burning the sun-dried water hyacinth plant collected from nearby water bodies. The percentages of WHA that is added to the soil are 0.25%, 0.5%,0.75%, 1%, 1.25% & 1.5%.

Tests Conducted: Specific Gravity test – IS 2720(Part III)-1980, Atterberg Limit test – IS 2720 (Part V)-1985, Standard proctor test – IS 2720 (Part VII)- 1974, Unconfined Compressive Strength test – IS 2720 (Part II)-1973, California Bearing Ratio test – IS:2720 (Part XVI):1987

Importance of the Project

As environmental sustainability is an important aspect these days it has also affected the method used for soil stabilization. As a part of it many recycled materials have been used for the purpose of stabilization. Reusing construction and demolition waste is a sustainable approach, so C&D waste, broken brick powder etc. are being used in soil stabilization. Also, plastic waste which is making a huge problem in the environment can be recycled and reused for stabilization purposes, it helps both in improving the properties of the soil as well as in reducing the problems caused by the plastic waste. Another material that can be considered is water hyacinth. It is a weed that is constantly creating problems in water bodies including transportation difficulties, it is being grown very aggressively in almost all water bodies and invading all other aquatic life. Making water hyacinth ash and using it for the stabilization is a new trend in stabilization as a part of sustainable approach.

Conclusion

- The maximum compressive strength was obtained as 1.8 kPa when 1% of water hyacinth ash was added.
- The percentage increase in compressive strength for 1% WHA was found out to be 50% compared to soil without WHA.
- The max value of OMC was obtained when cured for 3 days.
- Max CBR value is obtained for soil with 3 days of curing, which suggests that 3 days of curing is required for maximum subsoil strength.

Automatic Product Sorting Using Image Processing

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Abstract: The Automatic Product Sorting System Using Image Processing revolutionizes industrial sorting processes by integrating advanced image processing algorithms with real-time monitoring capabilities. Positioned above a conveyor belt, a Webcam w100 captures product images, which are processed by an ESP-32 Processor to identify defects. Upon detection, a servo motor redirects flawed products, while defect-free items continue along the belt. Real-time monitoring via an Arduino Webserver ensures proactive decision-making. This innovative system enhances efficiency, quality control, and cost-effectiveness in manufacturing, with implications for improved product quality and consumer satisfaction.

Introduction

The Automatic Product Sorting System Using Image Processing leverages cutting-edge technology to streamline the sorting process in industrial settings. By employing a Webcam w100 and ESP-32 Processor, product images are captured and analyzed in real-time to identify defects. Through sophisticated image processing algorithms, defects are compared against predefined quality criteria, ensuring only high-quality products continue along the conveyor belt. The system's DC motor speed controller switch module regulates product flow, while the ESP-32 Processor dynamically routes defective products to alternative sorting boxes. Additionally, real-time monitoring is facilitated via an Arduino Webserver, providing operators with instant access to critical data and statistics. With its efficient operation and precise defect detection capabilities, this system represents a significant advancement in automated product sorting technology.

Project Description

The Automatic Product Sorting System Using Image Processing revolutionizes industrial sorting processes through advanced automation and precise defect detection. At the heart of the system lies a sophisticated setup comprising a Webcam w100 positioned strategically above a conveyor belt. As products traverse the belt, the webcam captures high-resolution images, which are then processed in real-time using the powerful ESP-32 Processor. Through intricate image processing algorithms, each product's features are meticulously analyzed to identify defects, ensuring only items meeting predefined quality criteria progress along the conveyor. Central to the system's efficiency is the DC motor speed controller switch module, which maintains optimal conveyor belt speed for seamless product flow. When defects are detected, the ESP-32 Processor swiftly triggers the servo motor, diverting flawed products to designated sorting boxes for further inspection or disposal. Additionally, the system boasts real-time monitoring capabilities facilitated by an Arduino Webserver, enabling operators to track sorting performance and receive immediate notifications of any anomalies.

Working of Project

The Automatic Product Sorting System Using Image Processing operates seamlessly through a series of integrated steps. It begins with a Webcam w100 positioned strategically above a conveyor belt, capturing images of products as they move along. These images are then processed in real-time by the ESP-32 Processor, employing sophisticated image processing techniques to analyze each product's features and identify defects. The system's image processing algorithms compare the captured product images against

predefined quality criteria to detect any defects accurately. Meanwhile, the DC motor speed controller switch module regulates the speed of the conveyor belt, ensuring smooth and efficient product movement. Upon identifying a defect, the ESP-32 Processor swiftly triggers the servo motor, redirecting the flawed product to an alternate sorting box for further inspection or disposal. Conversely, if a product is deemed defect-free, it continues along the conveyor belt to its designated collection point. Real-time monitoring of the sorting process is facilitated through an Arduino Webserver, providing operators with immediate access to critical data and statistics. This enables proactive decision-making and ensures efficient management of the sorting system. In summary, the Automatic Product Sorting System Using Image Processing streamlines industrial sorting processes by seamlessly integrating advanced hardware and software components. Through precise defect detection and real-time monitoring, it maximizes productivity, enhances quality.

Technical description of the project

The technical description of the Automatic Product Sorting System Using Image Processing delves into the intricacies of its hardware and software components, as well as the underlying algorithms and mechanisms driving its functionality.

Hardware Components:

1. Webcam w100: Positioned above the conveyor belt, it captures high-resolution images of products in real-time.
2. ESP-32 Processor: Processes captured images using advanced image processing techniques for defect detection and product analysis.
3. DC Motor Speed Controller Switch Module: Regulates the speed of the conveyor belt to ensure smooth product movement.
4. Servo Motor: Actuates to redirect defective products to alternate sorting boxes based on the analysis results.

Software Components:

1. Image Processing Algorithms: Employed by the ESP-32 Processor to analyze product images, comparing them against predefined quality criteria to identify defects.
2. Arduino Webserver: Facilitates real-time monitoring by providing a web-based interface to track sorting performance and receive notifications.

Working Mechanism:

1. Image Capture and Processing: The Webcam w100 captures product images, which are processed by the ESP-32 Processor using image processing algorithms.
2. Defect Detection: Image processing algorithms compare product images against predefined quality criteria to detect defects.
3. Conveyor Belt Control: The DC motor speed controller switch module regulates the speed of the conveyor belt for efficient product movement.
4. Sorting: Upon defect detection, the servo motor redirects defective products to alternate sorting boxes, while defect-free products continue along the conveyor belt.
5. Real-Time Monitoring: The Arduino Webserver enables operators to monitor sorting performance and receive notifications in real-time via a web-based interface.

Importance of the Project

The Automatic Product Sorting System Using Image Processing stands out for its transformative impact on industrial sorting processes and its unique blend of innovation, efficiency, and precision. What sets it apart from other ideas is its seamless integration of cutting-edge technologies, including advanced image processing algorithms, microcontroller-based systems, and real-time monitoring capabilities. One of the key differentiators of this project lies in its ability to automate and streamline the product sorting process with unparalleled accuracy. By harnessing the power of image processing techniques, the system can identify defects with remarkable precision, ensuring that only high-quality products proceed along the production line. This level of accuracy and efficiency minimizes the need for manual intervention, reducing human error and optimizing resource utilization.

The beneficiaries of this project are multifaceted and include various stakeholders across different industries. Manufacturing companies stand to benefit significantly from the system's ability to enhance efficiency, quality control, and cost-effectiveness in their operations. By automating sorting processes and minimizing the occurrence of defective products, companies can streamline their production workflows, reduce waste, and improve overall product quality.

Furthermore, the project has implications for consumers, who ultimately benefit from the improved quality and reliability of products reaching the market. With fewer defective items making their way into circulation, consumers can have greater confidence in the products they purchase, leading to increased satisfaction and trust in the brand. Additionally, the project contributes to the advancement of technology and innovation in the field of automation and quality control. By pushing the boundaries of what is possible through the integration of advanced technologies, the project serves as a catalyst for progress, driving improvements in manufacturing processes and setting new standards for efficiency and precision.

In summary, the Automatic Product Sorting System Using Image Processing is distinguished by its innovative approach, efficiency, and precision in automating product sorting processes. Its beneficiaries include manufacturing companies seeking to optimize their operations, consumers looking for high-quality products, and the broader industry, which benefits from advancements in technology and innovation.

Conclusion

In conclusion, the Automatic Product Sorting System Using Image Processing represents a significant advancement in industrial automation and quality control. By seamlessly integrating cutting-edge technologies such as image processing algorithms and real-time monitoring capabilities, the system streamlines sorting processes with unparalleled efficiency and precision. Its ability to accurately detect defects, optimize resource utilization, and enhance overall product quality makes it a valuable asset for manufacturing companies across various industries. Moreover, the project contributes to technological innovation and progress, driving improvements in automation and setting new standards for efficiency and reliability in product sorting. With its transformative impact on industrial operations, the Automatic Product Sorting System promises to revolutionize manufacturing processes and deliver tangible benefits for both businesses and consumers alike.

Grey Water Treatment Using Microbial Fuel Cell

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Abstract: Microbial fuel cells are devices that convert organic substances into electrical energy with the help of microorganisms. The MFCs are advantageous in an industrial perspective as this can utilize a wide range of substrates. The MFC was constructed using two chambers (anode and cathode) separated by a proton exchange membrane (PEM). Anode is made of zinc and cathode is made of copper. Voltmeter, connecting wires, waste water containing organic matters (grey water) are used. Anode is inoculated with a microbial culture or mixture of bacteria (*Lactobacillus Plantarum*). Anode is fed with grey water. Cathode container is filled with water (electrolyte). Voltmeter measures the voltage across the circuit. The necessity of alternate and environmentally friendly energy sources is increasing as we are running out of non-renewable resources, such as oil. Microbes can make electricity from cheap and easy things like food waste or sewage. Thus, generation of electricity using microbial fuel cell is a better option.

Introduction

Microbial fuel cell (MFC) is a type of bio electrochemical fuel cell system that generates electric current by diverting electrons produced from the microbial oxidation of reduced compounds on the anode to oxidized compounds such as oxygen on the cathode through an external circuit. They are essential for bioremediation, renewable energy, and wastewater treatment. In the process of consuming organic matter, MFCs produce electricity. They can speed up the removal of pollutants from contaminated environments, are suited for independent or remote areas, and are environmentally beneficial. MFCs provide an adaptable and sustainable answer to a range of problems. Microbial fuel cells (MFCs) are a cutting-edge technique for treating water that can be used to both treat wastewater and produce energy. Utilizing the metabolic processes of microorganisms, they clean water and generate electricity as a byproduct, showcasing a significant advance in sustainable technology. Because MFCs use less energy, they have a smaller environmental impact and lower operating expenses. They are a potential substitute for traditional techniques since they can function in a variety of environments.

Project description

There are two containers of size 15cm×15cm×15cm. Anode container consists of zinc and cathode container consists of copper and electrical connections were established and MFC setup was made.

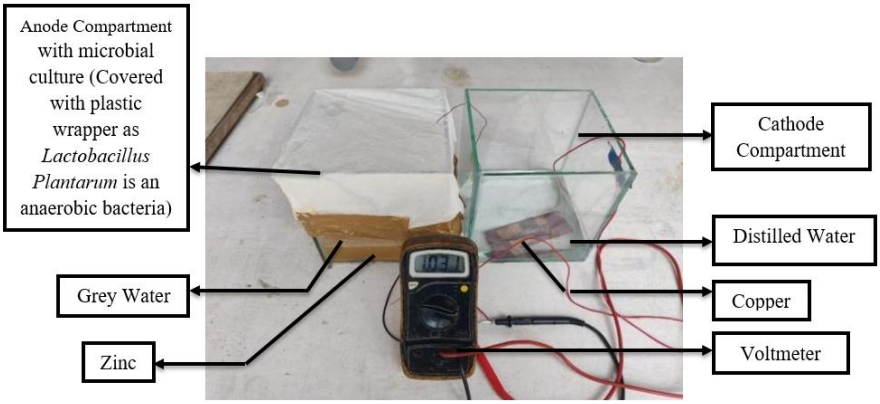

Fig. 1. Setup of MFC

Grey water samples were collected. One litre of grey water sample was poured into the anode container and 250ml of microbes were inoculated (1/4th of sample). Distilled water was used as an electrolyte in the anode container. BOD test was conducted before and after treatment of grey water. Results were analyzed. Microorganisms in the anode chamber oxidize organic compounds, releasing electrons. These electrons flow through an external circuit, creating electrical current. This process helps break down organic matter. A biofilm forms on the anode surface, enhancing microbial activity. The biofilm includes bacteria capable of degrading organic pollutants. The cathode chamber facilitates reduction reactions, consuming electrons. This indirectly promotes BOD reduction in the anode chamber. As a result, BOD levels decrease due to microbial activity and electrochemical processes.

Table 2. BOD removal efficiency and voltage generated after treatment using MFC

Sample No	Efficiency (%)	Voltage (mV)
1	61.9	0.2 to 0.46
2	68.4	0.2 to 0.46
3	73.6	0.2 to 0.47
4	80.0	0.2 to 0.93
5	83.3	0.2 to 1.06
6	88.89	0.2 to 1.08
7	80.95	0.2 to 0.8
8	82.35	0.2 to 0.96
9	85	0.2 to 0.99
10	89.47	0.2 to 1.09

$$\text{Average Efficiency} = \left(\frac{61.9 + 68.4 + 73.6 + 80 + 83.3 + 88.89 + 80.95 + 82.35 + 85 + 89.47}{10}\right)$$

$$= 79.38\%$$

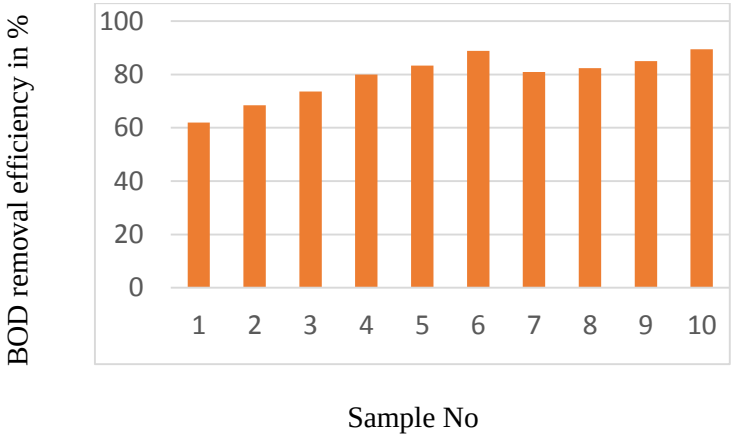

Fig. 2. BOD removal efficiency after treatment of grey water using MFC

Importance of the Project

MFCs offer an innovative approach to treating wastewater while simultaneously producing electricity. MFC-treated water can be reused for irrigation and toilet flushing. MFCs can be applied to various types of wastewater, from domestic to industrial, and can be scaled up or down depending on the specific needs. By developing sustainable energy and wastewater treatment solutions, MFC projects contribute to a cleaner, healthier planet for future generations.

Conclusion

It can be concluded that the use Lactobacillus plantarum in microbial fuel cells as a major innovation with the treatment using grey water has shown promising results. The grey water was collected from different households. Microorganisms that can oxidize organic compounds are kept in the anode chamber, and reduction reactions are facilitated by the cathode chamber. The microbes use the organic matter present in grey water where the organic matter gets oxidized and the BOD gets reduced. Electric current is produced when the microorganisms in the anode chamber oxidize organic compounds by releasing electrons which flow through the external circuit. The results show that the BOD of grey water gets reduced after treating it using MFC. From the results, it is observed that the removal of BOD using MFC has an average efficiency of 79.38% (out of the 10 samples used). It is suggested that the BOD of grey water samples after treatment using MFC can be further reduced by adding more active bacteria. This study highlights the potential of using grey water for irrigation after treating grey water using a microbial fuel cell. The use of greywater not only provides an eco-friendly solution but also offers a cutting-edge for producing a small amount of electrical energy to charge LED bulbs etc.

Effect of SBR Latex on Properties of Pervious Concrete

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Abstract: Pervious concrete, also known as permeable or porous concrete, is an eco-friendly construction material used in parking lots and sidewalks to manage stormwater and reduce surface runoff. However, it has low strength. A study has shown that adding styrene-butadiene rubber latex (SBR latex) to pervious concrete can improve its mechanical strength without compromising its permeability. The study used aggregates passing through 10mm sieves and retained on 6.3mm IS sieves, with PPC cement and aggregates tested for specific gravity. SBR latex was added in varying amounts to the mix design. Concrete cubes were tested for compressive strength after 28 days of curing. The proposed methodology contributes to sustainable pavement construction and offers a cost-effective approach to infrastructure development. The effect of SBR latex on previous concrete's compressive strength indicates improved bonding and increased hydration compounds, which are significant for all types of concrete used in construction.

Introduction

Pervious concrete is an eco-friendly construction material designed to address surface runoff and promote sustainable urban development. Its high porosity allows water to pass through, reducing stormwater runoff and facilitating groundwater recharge. Pervious concrete reduces demand for traditional stormwater management systems and contributes to preserving natural ecosystems. Pervious concrete is a popular choice for parking lots and sidewalks due to its ability to manage stormwater and reduce surface runoff. It's also used in residential settings as a porous surface for patios, driveways, pool decks, and walkways. This environmentally friendly alternative to traditional asphalt or concrete allows water to pass through, preventing runoff from entering the stormwater system. Pervious concrete is also a key component of green infrastructure initiatives, promoting water conservation and environmental sustainability. SBR latex is added in 0%,3%,6%,9%, and 12% according to the weight of the cement to increase strength.

Methodology

The study's goals were established through a thorough examination of the project's pertinent areas requiring additional investigation. An analysis of prior literature concerning the project's topic was conducted to grasp advancements in the field that could benefit the current study. Utilizing insights from this literature review, the necessary materials, and tests to be undertaken were determined. The methodology includes objectives, literature review, material collection, mix design for control mix, preparation and testing of pervious comcrete by adding SBR latex, and results analysis and conclusion.

Importance of the Project

Pervious concrete, a lower strength compared to conventional concrete, has been studied for its application as pavement construction material. Researchers have tried to improve its strength and durability by adding foreign materials and varying aggregate and cement ratios. However, these efforts have also affected the permeability of the concrete. The weakest link in the structure is the interfacial layer between the aggregate and cement paste. To develop sufficient strength in pervious concrete, researchers have tried adding foreign materials, increasing the cement-to-aggregate ratio, decreasing aggregate size, using cementitious materials, or decreasing the w/c ratio. SBR latex has been suggested as a convenient method to improve mechanical strength without compromising permeability. It improves mechanical properties, cohesion, and

strength by bridging microcracks and enhancing the bond between cement and aggregates. However, only a few studies have been conducted on SBR-modified pervious concrete, making further investigation necessary.

Conclusion

Pervious concrete is a crucial aspect of green infrastructure initiatives, promoting water conservation and environmental sustainability in urban planning. Its compressive strength is a key factor affecting its usage. Water content is crucial for compressive strength, and lower w/c ratios lead to higher compressive strengths in normal concrete. However, in pervious concrete, control of water content is essential for producing fresh cement paste with good workability and avoiding clogging of pores. Lower w/c ratios can reduce bonding between aggregate and cement paste, while higher values can lead to paste accumulation at the bottom of the sample. A study found that SBR latex enhances pervious concrete strength, but excessive proportions can cause binder seepage, affecting strength and permeability. The study recommends an optimum latex content of 9% for a mix with a w/c ratio of 0.32 and 6% for a mix with a w/c ratio of 0.35.

Content Creation and Artistic Style Injection: Revival of Kerala Mural Art Through Neural Networks

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Abstract: Kerala mural art, once a vibrant means of depicting Hindu mythology, has witnessed a decline in popularity over time. This project seeks to revive these paintings, using advancements in artificial intelligence, particularly neural networks. By employing artistic style transfer, the project can replicate the content of one image with the stylistic characteristics of another, creating captivating digital art inspired by styles such as cubism and surrealism. The application allows users to easily apply these styles to their photos, either generated by the system through prompts or uploaded, transforming them into digital canvases reminiscent of iconic artists like Picasso and van Gogh. The system prioritizes high-resolution results, using advanced neural network architectures to maintain the authenticity of chosen art styles while preserving original image details.

Introduction

Kerala mural art features a vibrant palette including orange, yellow, red, green, and black, used to depict Hindu mythological stories and deities like Vishnu, Krishna, and Shiva. However, the process, technique, and even the canvas have now changed. From the floor to the wall, onto thick cotton canvas, and now onto designer sarees, handcrafted beauty to low-quality digital prints, natural to artificial colors, and from handmade brushes to synthetic ones. Somewhere along the way, the original essence and reverence for this art form seem to have been diminished. This project aims to reignite interest in mural art and preserve its old techniques, cultural heritage, and traditional values by combining image generation using deep learning algorithms to translate textual descriptions into images, with neural style transfer. This technique involves extracting the stylistic features of a reference image, such as brushstrokes, color palettes, and textures, and applying them to a target image.

Project description

The primary objective of this project is to develop an image generator that responds to detailed user prompts, generating images tailored to the specified criteria. The user is allowed to either use the image generator tool or pick a content image of preference. In addition, the system offers a unique feature allowing users to select from a wide array of art styles, including both renowned and lesser-known styles. This feature aims to broaden users' artistic horizons beyond their current knowledge, fostering an appreciation for diverse art forms. The selected art style is applied to the generated image using the "Neural Style Transfer" technique, enabling users to visualize their input in different artistic styles.

The VGG-Network, a Convolutional Neural Network established and fully detailed, provides the foundation for the results reported in this paper. Its performance on a standard visual object identification benchmark challenge is comparable to that of humans. We made use of the feature space that the 19-layer VGG-Network's 16 convolutional and 5 pooling layers provided. The fully connected layers of the VGG19 architecture were discarded for this application since classification is not performed in this case. The VGG19 model was trained on the ImageNet dataset, consisting of over 14 million images belonging to over 21,000 classes. With its extensive ImageNet training, VGG19 functions as a potent feature extractor.

ImageNet's millions of annotated photos have "taught" VGG19 how to identify and distinguish between items in images.

Upon employing the trained VGG19 model, its performance revealed a deficiency in handling style transfer tasks for paintings boasting a plethora of vibrant hues and intricate patterns, notably exemplified in mural art. Due to this, the model underwent training on an eclectic array of artistic genres, ranging from various paintings and sculptures to engravings, iconography, and, notably, mural art. Impressively, this refined model achieved an outstanding accuracy rate of 97.46% in the classification of these diverse art forms. This enhanced model demonstrated a remarkable ability to discern intricate details such as multiple colors, rich patterns, and brushstrokes within the style images, leading to significantly improved accuracy in style transfer tasks.

Taking your own pictures or browsing stock photo libraries may not produce images that exactly match your ideal lighting, composition, or detail level. With detailed textual instructions, Stable Diffusion gives you complete control over every aspect of the content image, unlike searching for pre-existing photos. Stable Diffusion is a latent text-to-image diffusion model. A diffusion model that is trained in the autoencoder's latent space is combined with an autoencoder to create the latent diffusion model known as Stable Diffusion v2. U-Net, a text encoder, and the variational autoencoder (VAE) make up stable diffusion.

Diffusion models (DMs) hold immense potential for generating images based on additional information beyond simple categories or blurry starting points. This research explores a novel approach to unlock this potential by leveraging the power of cross-attention mechanisms. These likelihood-based models are capable of modelling conditional distributions of the form $p\ (z|y)$, where y denotes any type of input such as text, semantic maps etc. This can be done by using a conditional denoising autoencoder. By adding the cross-attention mechanism to the basic UNet backbone of DMs, we make them more versatile conditional image generators.

Fig. 1. Image generated using Stable Diffusion

Fig. 2. Style image used for this experiment

Fig. 3. The style of the content image is evidently changing with each iteration in the above case. Our model was able to replicate the mural art style onto the image of the rabbit excellently.

Importance of the Project

Comparison to existing models reveal that while the generation capabilities are similar, our model exhibits exceptional performance in style transfer of not only famous art and its styles but also those of a traditional field of lesser-known varieties, showcasing its effectiveness and competitiveness among existing solutions. Our model does a great job of reproducing detailed features, especially mural art. It recognizes the significance of crisp lines for motifs and figures, the harmony of earthy tones with colourful accents, and the distinctive use of perspective.

Conclusion

The main intention of our project is to target the ongoing challenges related to transferring art styles of comparatively higher creative efficiency. This method integrates modules such as background creation, background integration, and fast transfer, aiming to both preserve and innovate pattern elements. We have presented a novel approach for text-to-image generation, combining the stability and efficiency of diffusion models with the artistic rendering capabilities of neural style transfer. Our proposed model exhibits promising results, generating high-quality images that match the input text descriptions while integrating desired artistic styles. Since the model has been trained on mural art, and even other categories of art such as sculptures, engravings, and so on, along with tweaks in parameters, it shows great improvement and likeness in its style transfer capabilities compared to existing models. Further research could explore refining the model's performance and scalability, as well as investigating its applicability to other domains beyond image generation.

Multiple Disease Prediction System

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Abstract: The goal of this project is to create a multi-disease detection system with inputs from brain, lung, and kidney MRI/CT scan pictures. It uses deep learning models to forecast the likelihood of kidney and brain tumours, as well as lung pneumonia. To shed light on the model's decision-making process, the system also creates a saliency map, which highlights the areas of the input images that are most pertinent to the prediction.

Introduction

The initiative uses cutting-edge technology to identify different diseases from MRI/CT scan images, to revolutionize medical diagnosis. The system makes precise and timely predictions by using deep learning algorithms, with an emphasis on kidney, lung, and brain disorders.

Lung pneumonia, kidney tumours, and brain tumours are serious medical conditions that need prompt and accurate diagnosis. Medical image interpretation by hand is a common component of traditional diagnostic techniques, but it can be laborious and error-prone. This study aims to improve diagnostic efficiency and accuracy by incorporating deep learning models into medical imaging analysis.

Saliency maps are another addition that improves the system's readability and openness. These maps offer a visual representation of the areas of interest in the input photos that have the biggest influence on the predictions made by the model. To improve patient care and treatment outcomes, medical personnel must be able to comprehend and trust the diagnostic results.

MRI and CT scan images of the brain, lungs, and kidneys are collected from medical databases and hospitals. Preprocessing techniques including noise reduction, scaling, and normalisation are applied to images to standardise the input for the deep learning model.

Convolutional neural networks (CNNs) are used by the system to analyse images. PyTorch and TensorFlow are two deep learning frameworks that are used to create the CNN architecture. Convolutional, pooling and fully linked layers are among the layers that make up the CNN architecture. To enhance model performance, transfer learning approaches are used with pre-trained models like ResNet, VGG, and Inception. For best results, model hyperparameters like learning rate, batch size, and number of epochs are adjusted.

The deep learning model is trained using the previously processed photos. To assess model performance, the training dataset is divided into test, validation, and training sets. The model gains the ability to differentiate between patterns in the kidneys, lungs, and brain that are normal and pathological concerning tumours and pneumonia. During training, model parameters are optimised by the use of algorithms such as Adam optimiser or stochastic gradient descent (SGD).

New MRI/CT scan pictures are supplied into the training model for inference during prediction. Based on fresh MRI/CT scan data, the model may be trained to predict the existence of brain and kidney tumours as well as lung pneumonia. The system uses approaches such as integrated gradients and gradient-based methods to create saliency maps during prediction. Saliency maps make it easier to grasp the diagnostic

results by highlighting the parts of the input images that provide the biggest contributions to the model's predictions.

Together with confidence ratings for each prediction, the system generates output showing whether or not there are tumours in the brain, kidneys, or lungs, as well as pneumonia. Alongside the saliency maps, medical practitioners can examine the results to comprehend the logic of the model and make well-informed therapeutic judgements. By emphasising key areas in the input photos, these methods provide the decisions made by the model with a visual representation.

A user-friendly interface incorporates both the saliency map creation module and the deep learning model. Through the interface, medical practitioners can see diagnostic predictions, evaluate saliency maps, and submit pictures from MRIs and CT scans.

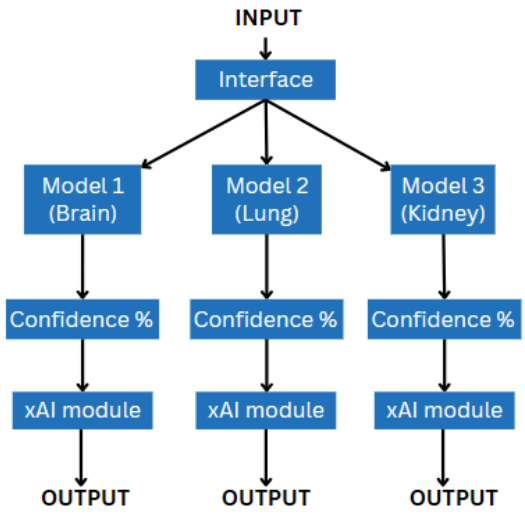

Fig. 1. Workflow of the System

Importance of the Project

This initiative is critical because it combines cutting-edge deep learning methods with medical imaging to diagnose lung pneumonia, kidney tumours, and brain tumours with precision and interpretability. The creation of saliency maps, which improve transparency and support medical professionals in making decisions, is its primary differentiator. Patients who receive accurate and timely diagnoses, medical professionals who acquire insightful diagnostic knowledge, and researchers who progress medical AI for better patient outcomes are all beneficiaries.

Conclusion

The multi-disease identification system, which combines deep learning algorithms with MRI/CT scan image analysis, marks a breakthrough in medical diagnostics. This study addresses important healthcare concerns by reliably predicting the existence of lung pneumonia, kidney and brain tumours, and by delivering clear insights via saliency maps. By highlighting pertinent areas in input photos, the technology improves diagnostic precision and helps medical practitioners make defensible conclusions.

Further study and development in this field will enhance the system's functionality and broaden its spectrum of medical issues to which it can be used. The initiative will ultimately assist patients by providing them with timely interventions, healthcare professionals by providing them with access to state-of-the-art diagnostic tools, and the medical community at large by advancing knowledge and technology for better patient care and results.

Formulating Flight Trajectory Using Topological Data Analysis and Machine Learning

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Abstract: This project is driven by the collaboration between Cochin International Airport Limited (CIAL) and the Centre for Topology and Applications (CETA), Rajagiri. It incorporates essential parameters like latitude, longitude and altitude, flight velocity, time instances, and other additional parameters from an aircraft's journey retrieved from its Flight Data Recorder. The novelty of this project is the integration of historical flight data with Topological Data Analysis and Machine Learning to find the best estimate for a flight path from source to destination. The result is a dynamic flight path adaptation that accounts for seasonal and climatic variations, leading to higher operational efficiency.

Introduction

Developing a dynamic flight trajectory prediction model involves integrating real-time flight data. By employing machine learning algorithms, the model recommends an optimized flight path to minimize fuel consumption, enhance safety, and ensure on-time arrivals. While developing an ML model that predicts a flight path or a flight trajectory between any given source and destination, our focus was to provide the best possible estimate from the historical flight trajectories. We observed that this technique will work if there is a single air traffic route between the source and the destination. However, when there are multiple air traffic routes, which is often the case, it's important to find out these different routes and determine the optimized trajectories for each of the routes individually. Else, the problem of getting a mere statistical mean of all the different optimized trajectories which may not make any sense as a potential flight path.

Project description

Using 3-D visualization, we observed the flight trajectories made by a specific flight from a particular source to a destination. These visualizations lead to two main observations:

(a) multiple flight paths are present between the source and destination, and,
(b) there is a seasonal effect on the pattern of the trajectories.

To reflect the seasonal aspect in the optimized trajectory estimation, we built the ML model for a particular day's optimized trajectory recommendation using the month-wise trajectory data. The main observation, which is the presence of multiple flight trajectories, is modeled in an unsupervised manner using a bottom-up hierarchical clustering technique. We were careful in developing this clustering technique from scratch since we had tailored an algorithm for clustering curves which is analogous to clustering flight trajectories. Each of the clusters produced from our algorithm is then optimized separately to find the best trajectory estimate in each cluster of trajectories. This approach also helped us to easily trace out the anomalous trajectories from the data which has a pattern that is statistically very different from the rest of the trajectories. The hierarchical clustering algorithm works on the principle that data pairs with proximal distances are merged to form the desired number of clusters based on the cut level defined on the dendrogram. The resultant clusters formed with the new data pairs are statistically averaged values of the previous data points.

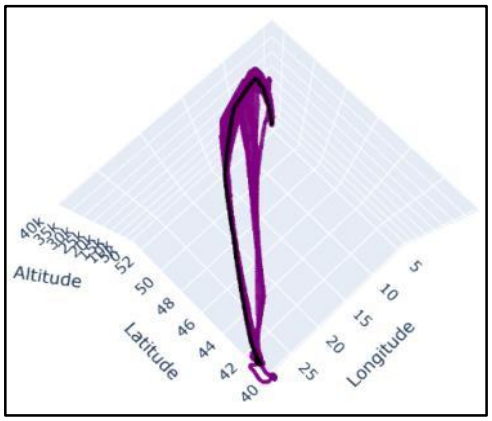

Fig. 1. Visualization of a month flight trajectory data

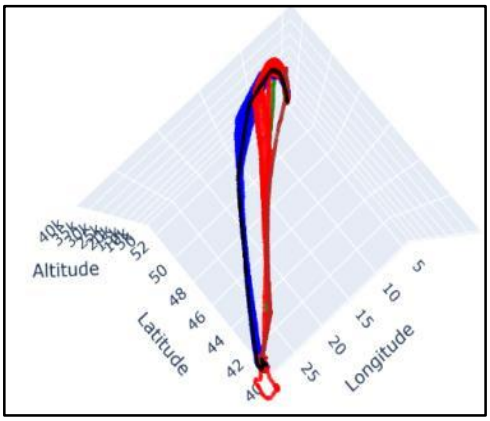

Fig. 2. Visualization of a Clustered Month Flight Trajectory Data

Statistical averaging of flight trajectories can cause a single resultant flight trajectory to pass through the median path of the given source to the destination route, which is unfeasible for a flight journey. This brings into the role, the importance of TDA where flight trajectories can be formulated while considering its feasibility. TDA brings benefits such as overcoming the limitations of initializing the parameters (through persistence diagrams) and reshaping the flight trajectory paths at optimal conditions (persistence landscapes). The data engineering part of this work deserves special focus. We performed the usual normalizing and cleansing of trajectory data in such a way that given a pair of trajectories, they can be compared for their similarities in a quantifiable manner. However, a one-to-one correspondence between the points of two different trajectories was not organically present in the data. This is primarily because of the discontinuity in the time gaps at which the flight location is sensed, and also because two different flights made by an airplane may have different velocities in a given time instance. We handled this problem by extrapolating new points in the trajectory data such that a theoretically sound one-to-one correspondence between the points of two different trajectories was created.

Importance of the Project

The project highlights the demerits of traditional flight planning methods employed by airports. Implementation of machine learning in the aviation industry using unsupervised learning methods to predict flight trajectory patterns is a simple and newly found method. Limitations of machine learning algorithms are overcome, by the integration of Topological Data Analysis which studies patterns of flights using spatial analysis and techniques. What makes the project significant, is the data-driven tailoring of data engineering methods, such that the ML and TDA algorithm functions properly with quality prediction.

Conclusion

This automated system recommends dynamic flight trajectories due to seasonal and climatic variations. In addition, it can recognize multiple flight routes between a given source and the destination. Such a process of automating flight travel can aid in substantial reductions of fuel consumption and operational efficiency improvements, contributing to the aviation industry and environmental sustainability. Hence it promises significant benefits for both airlines and the environment, with the potential for automated systems that can cater to a range.

Application of Natural Fibre in Flexible Pavement

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Abstract: This study investigates the challenges confronting flexible pavements in India, encompassing issues such as heavy traffic wear, inadequate drainage, and harsh climatic conditions. With limited resources and expertise exacerbating maintenance problems, and construction methods often contributing to environmental degradation, the research explores the viability of using coir fibre, derived from coconut husks, as an eco-friendly reinforcement for these pavements. By integrating coir fibres into pavement mixes, the study aims to mitigate environmental impact, enhance structural strength, improve drainage, and reduce construction costs. Marshall stability tests are conducted to determine the optimal fibre content, with variations tested at 0.2%, 0.4%, and 0.6% by total aggregate weight, while maintaining a consistent fibre length of 10 mm. Results indicate varying stability and flow values corresponding to different fibre percentages. By identifying the optimal fibre and binder contents, this research contributes to sustainable pavement construction and offers a cost-effective approach to infrastructure development. The insights gained into the comparative strength and stability of pavements reinforced with natural fibres provide valuable information for future environmentally conscious pavement design, ultimately aligning with India's aspirations for sustainable development and environmental stewardship in transportation infrastructure. The study finds that 0.2% coir fibre content and 5.32% bitumen content are optimal based on the Marshall stability test, underscoring the efficacy of coir fibre reinforcement in flexible pavement construction.

Introduction

Pavement structures are integral to maintaining efficient transportation networks, their selection between flexible and rigid types influences the overall performance and durability of road infrastructure. In India, the preference for flexible pavements prevails due to their inherent benefits over rigid alternatives and their cost-effectiveness. Flexible pavements demonstrate a flexible structural behaviour under applied loads, supported by layered construction comprising soil subgrade, sub-base, base, and surface courses. Each layer plays a distinct role in load distribution and bearing, efficiently transmitting vertical stresses downwards. Bituminous mixtures, widely used in flexible pavements, offer a smooth, dense surface crucial for vehicular comfort while enduring traffic-induced abrasion. Recognizing the importance of bituminous mixtures in flexible pavement construction is vital for designing resilient and sustainable transportation infrastructure capable of withstanding daily wear and tear. This understanding ensures the creation of robust pavements, essential for maintaining smooth and enduring travel routes.

Methodology

The laboratory specimens were prepared to determine the optimum fibre and binder content and test the bituminous mix's performance for its tensile strength. The mixes were prepared according to the IRC 111-2009 mix design procedure. To determine the optimum fibre content, optimum binder content, and quality of the bitumen mixture by using the Marshall Test method. The Marshall specimens were prepared with dimensions of 100 mm in diameter and 60 mm in height by using a gyratory compactor. After casting, the specimens were kept at ambient temperature for 24 hours. After that, the specimens were kept in the hot water for 20 minutes at a temperature of 60 °C. The BC samples were prepared by keeping the binder content at 5.5%, the coir length at 10 mm, and varying the coir fibre content as 0.2%, 0.4%, and 0.6% by weight of the total mix to identify the optimum fibre content.

Then the samples were prepared by keeping the optimum coir fibre constant and varying the bitumen content to 5%, 5.5%, and 6% to determine the optimum binder content. Volumetric analysis was done using the results obtained, and the optimum emulsion content was found. The Marshall Stability Test evaluated the performance of bituminous concrete mixes with and without coir fibre. Marshall Stability specimens were prepared with and without coir fibre.

Importance of the Project

The absence of coir fibres in flexible pavements can lead to diminished durability, increased cracking, reduced tensile strength, vulnerability to moisture damage, elevated maintenance needs, and potential environmental repercussions. Introducing coir fibres into asphalt mixtures offers a remedy, enhancing overall performance and extending pavement lifespan. Its blend of environmental sustainability, mechanical prowess, wide availability, and cost efficiency sets coir fibre apart from other reinforcement options. Socio-economically, its inclusion generates jobs, bolsters rural economies, cuts construction expenses, boosts pavement quality, fosters environmental responsibility, and propels innovation in the construction sector. Stakeholders including transportation authorities, road users, construction firms, the coir industry, environmentalists, and local communities reap benefits from enhanced performance, cost savings, and eco-friendliness. Coir fibre integration spans research, development, partnerships, capacity building, policy backing, and market growth, showcasing its potential to fortify sustainable and resilient infrastructure development.

Conclusion

The incorporation of coir fibre into bituminous mixes has demonstrated notable enhancements in performance characteristics. Through empirical analysis, it was observed that the addition of coir fibre led to a significant increase in Marshall Stability value by 29.45% compared to conventional CBM formulations. An extensive literature review supports the determination of the optimal coir fibre content at 0.2% by weight of aggregate, with a corresponding optimal fibre length of 10 mm. Furthermore, based on Marshall Stability testing, the ideal emulsion content for bituminous concrete mix was established at 5.32% by weight of the total mix, aligning with selected gradations. Coir fibre, as a readily available and eco-friendly material, emerges as a sustainable alternative for pavement construction, offering promising prospects for environmentally conscious infrastructure development. These findings underscore the efficacy and viability of coir fibre reinforcement, presenting a tangible pathway towards more resilient and environmentally sustainable pavement solutions.

Experimental Investigation on the Utilisation of Waste Plastic and Glass Bottles for Mosaic Tiles

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Abstract: Mosaic tiles are decorative tiles made of small ceramic, stone, or other materials. A study focused on using plastic and glass waste in making these tiles to reduce environmental impact. For backing-layer, a high-performance mortar was developed with silica-fumes, metakaolin, and steel-fibres, as well as waste plastic chips. The optimum mix included 20% waste plastic chips. The resulting tiles met requirements for flexural strength, water absorption, and flatness, perpendicularity, and straightness tests according to IS1237:2012. These mosaic tiles are considered a better alternative to normal tiles, promoting sustainable waste reduction and environmentally responsible construction practices.

Introduction

Plastic waste is a major global environmental issue that threatens ecosystems, wildlife, and human health. Glass bottle disposal is also a significant concern as it clutters landfills and harms ecosystems and wildlife. Mosaic tiles, made from small colourful tesserae pieces. This project aims to convert waste plastic and glass bottles to create decorative mosaic tiles. Glass bottles are converted into mosaic chips. These pieces are carefully placed to make tricky mosaic patterns and then they are firmly bound together with a cement-based grout filling. For backing layer, high-performance mortar was developed incooperating plastic. Mosaic tiles are made the use of IS 1237:2012 Cement Concreting flooring Tiles Specification. Tiles are cured for 28 days. Properties which include flexural strength, water absorption property, flatness of surface, perpendicularity and straightness of tile will be determined. Also cost estimation for the same shall be performed.

Methodology

Material collection- Material testing - Mix proportioning - Casting and testing tile with high performance mortar incorporating steel fibre (0, 1, 2, 4%) to find its optimum - Casting and testing of tile with high performance mortar incorporating optimum steel fibre to which plastic chips are added (10, 15, 20%) to find its optimum - Casting and testing of tile - Cost analysis

Feasibility test

The test was conducted to evaluate the feasibility of producing mosaic tiles using waste glass chips and plastic chips. Tile was made using the provisions in IS 1237:2012 Cement Concreting flooring Tiles Specification. The tile manufactured consists of a wearing layer and a backing layer, the details of which are given below. Wearing layer was made using PPC cement, marble powder in a ratio 1:1 and glass chips shredded on the mould covering more than 25% of the wearing surface. Backing layer was made using PPC cement, Fine aggregate and shredded plastic chips in the ratio 1: 3: 0.3. After casting the tile, it was demolded after 24 hours and then kept for 28 days of water curing. After curing, the tile was polished, and tested for its flexural strength and water absorption. Process of producing mosaic tiles using waste glass chips and plastic chips are shown in Fig 1.

Fig. 1. Process of producing mosaic tiles using waste glass chips and plastic chips

Flexural Strength Test

AS PER IS:1237 and 654, The Tile Flexure Testing Machine(Fig 2.)is used to determine the flexural strength of clay roofing tiles and cement concrete flooring tiles. The Tile Flexure Testing Machine is a double lever loading machine where load is placed by a flow of lead metal that automatically stops as the sample breaks. The sample is mounted between rollers which are 40mm or 12mm in dia. Bearing rollers can be placed at centre distances. Flexural Strength Test of sample tile is shown in Fig 3. Flexural strength is found out using Eq.(1)

$$F = \frac{3 \times P \times l}{2 \times b \times t^2} \qquad \textbf{Eq.(1)}$$

where, P - Breaking load, l - Effective length, b - Width and d – Depth

Fig. 2. Flexural Testing Apparatus
(source:https://5.imimg.com/data5/OB/YP/MY-753942/)

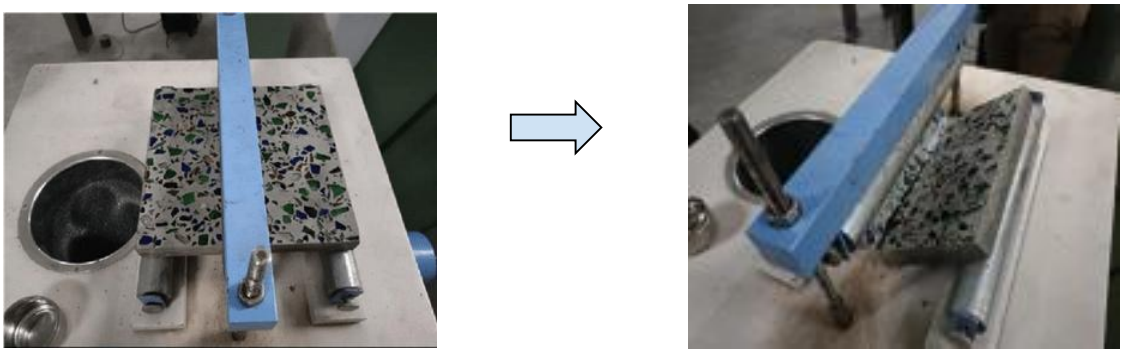

Fig. 3. Flexural strength test of tile sample for feasibility test

Water Absorption Test

The water absorption test for cement tiles is crucial to assess their porosity and durability. The tiles are immersed in water for 24h, then taken out and wiped dry. Tile shall be weighed immediately after saturation and wiping. The water absorption for tile is found out using the Flexural strength equation given as Eq.(2)

$$W = \frac{W_1 - W_2}{W_2} \qquad \textbf{Eq.(2)}$$

where, w_1 = mass of the saturated specimen in gram, w_2 = mass of the oven-dried specimen in gram.

Result and Inference

Obtained Flexural strength of tile sample is $1.18 N/mm^2$ and Water absorption of tile sample is 3.26 %. According to IS 1237:2012, minimum flexural strength of tile should be $3 N/mm^2$. The obtained value of the tile sample is 1.18 N/mm2 which is very low. Hence the strength of mortar has to be increased. According to IS 1237:2012, water absorption of cement tile should be less than 10% and the obtained water absorption of the sample is 3.26%. Hence it is within the limit. Results of Flexural Strength Test and Water absorption Test conducted indicate that the flexural strength is very low for which a high performance mortar is developed using silica fume, metakaolin and steel fibres.

Mix designation for high performance mortar

Mix designation for various mix proportions is given in Table 1.

Table 1. Mix designation

Mix ID	DESIGNATION
S10MK10SF0	1:2 Cement mortar with 10% Silica-fumes and 10% Metakaolin
S10MK10SF1	1:2 Cement mortar with 10% Silica-fumes, 10% Metakaolin and 1% Steel fibres
S10MK10SF2	1:2 Cement mortar with 10% Silica-fumes, 10% Metakaolin and 2% Steel fibres
S10MK10SF4	1:2 Cement mortar with 10% Silica-fumes, 10% Metakaolin and 4% Steel fibres
S10MK10SF2P10	1:2 Cement mortar with 10% Silica-fumes, 10% Metakaolin, 2% Steel fibres and 10% plastic
S10MK10SF2P15	1:2 Cement mortar with 10% Silica-fumes, 10% Metakaolin, 2% Steel fibres and 15% plastic
S10MK10SF2P20	1:2 Cement mortar with 10% Silica-fumes, 10% Metakaolin, 2% Steel fibres and 20% plastic

Mix details for high performance mortar

Mix details of high performance mortar are enlisted below Table 2.

Table 2. Mix details

Mix No.	Mix ID	Steel fibre (g)	Plastic chips (g)	OPC (g)	Metakaolin (g)	Silica Fumes (g)	FA (g)	W/C	Super plasticizer
1	S0MK0SF0	0	-	1270	0	0	2815	0.5	0%
2	S10MK10SF0	0	-	1016	127	127	2815	0.5	0.7%
3	S10MK10SF1	40	-	1016	127	127	2815	0.5	0.8%
4	S10MK10SF2	81	-	1016	127	127	2815	0.5	1%
5	S10MK10SF4	163	-	1016	127	127	2815	0.5	1.4%
6	S10MK10SF2P10	81	101.6	1016	127	127	2815	0.5	1.6%
7	S10MK10SF2P15	81	152.4	1016	127	127	2815	0.5	1.7%
8	S10MK10SF2P20	81	203.2	1016	127	127	2815	0.5	1.9%

Mix proportioning for 3 sample tiles

Mix proportion for 3 samples of mosaic tiles are given below in Table3.

Table 3. Mix proportion of mosaic tiles

Mix No.	Mix ID	Steel fiber (g)	Plastic chips (g)	OPC (g)	Marble powder (g)	Metakaolin (g)	Silica-fumes (g)	FA (g)	W/C	Super-plasticizer
1	For wearing layer	-	-	1484	1484	-	-	-	0.5	0.7%
2	For backing layer	79.68	247.31	988.80	-	123.60	123.60	2747.95	0.5	1.9%

Casting of high performance mortar with steel fibre

For the testing flexural strength of high performance mortar with steel fibres, 3 wooden moulds of dimension $400 \times 100 \times 16$ mm were manufactured as shown in Fig 4. For casting the ratio of fine aggregate, cement, and steel fibre are 1: 2 cement mortar and 10% silica fumes and 10% metakaolin with different proportions [1%, 2%, 4%] of steel fibres are used. And they are hand mixed in a mixing pan. The mortar is compacted as 3 layers and then transferred to the mould. It is demolded (Fig 5) after 24 hours and then kept for curing in the curing tank for 28 days. After 28 days, the flexural strength of the tile was tested in Universal testing machine (UTM) as shown in Fig 6.

Fig 4. Wooden moulds of dimension $400 \times 100 \times 16$ mm

Fig 5. Specimen before flexural test

Fig 6. Flexural strength test on UTM

Flexural strength test of high performance mortar with steel fibre

The flexural strength test were conducted on high performance mortar beams with steel fibre of mould size $400 \times 100 \times 16$ mm. The specimen is kept on Universal testing machine and load is gradually applied until the specimen is broken. The breaking load is taken and flexural strength is found out using the flexural strength equation. Flexural strength of 7th day and 28th day of high performance mortar with steel fibre in different percentages (1, 2, 4%) are given in Table 4. And bar chart representation is shown in Fig 7.

Table 4 Flexural strength result of high performance mortar with steel fibre

Mix ID	Avg Weight (g)	Avg. Load (KN)	Flexural strength (7day) N/mm^2	Avg. Load (KN)	Flexural strength (28 day) N/mm^2
S10MK10SF0	1395	15.05	308.64	15.25	312.53
S10MK10SF1	1395	14.81	303.72	15.383	315.35
S10MK10SF2	1443	15.25	312.74	15.483	317.40
S10MK10SF4	1501	15.75	322.99	15.90	325.95

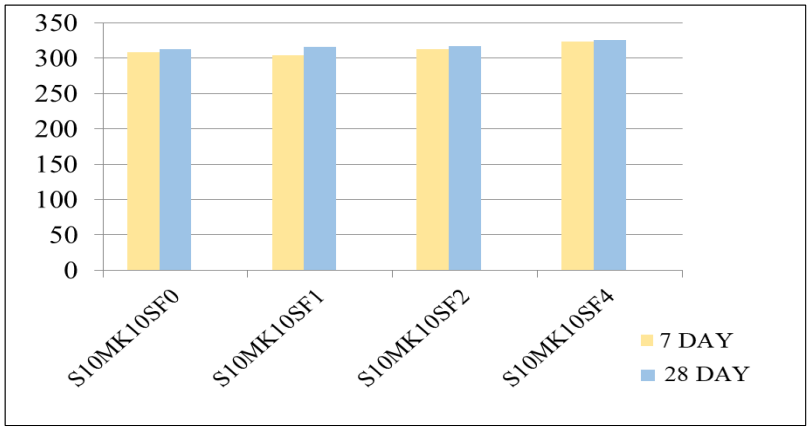

Fig 7 Bar chart of flexural strength of high-performance mortar beam with steel fibre

Inference

It is observed that as the percentage of steel fibre increases the flexural strength also increases. It is also observed that there is no considerable strength gain after 7th day when compared with 28th day strength, which shall be due to early strength gain due to presence of silica-fumes and metakaolin. Optimum percentage of steel fibre is taken as 2% considering workability aspect and as also its flexural strength is greater than the required strength for tiles.

Casting and testing of High performance mortar with optimum steel fibre and plastic chips

Casting of high performance mortar with obtained optimum percentage (2%) of steel fibre and incorporating different percentage (10, 15, 20%) of plastic chips.And to find optimum high performance mortar with plastic chips by flexural strength method.

Casting of High performance mortar with optimum steel fibre and plastic chips

Casting of high-performance mortar with optimum percentage of steel fibre and plastic chips are casted in the same mould of size $400 \times 100 \times 16$ mm (Fig 7a.). By adding steel fibre in the mortar, the flexural strength of the tile has increased and 2% of steel fibre of high performance mortar is taken as optimum according to our workability. The plastic that are considered for using were HDPE plastics from back covers of T.V. scrap. These plastics are converted to small chips.Plastic chips are added in different proportions (10%,15%,20%) with 2% of steel fibre.

Flexural strength test of High performance mortar with optimum steel fibre and plastic chips

Result of flexural strength of high performance mortar with different proportions of steel fibre is given in Table 5. Bar chart showing the flexural strength of the 7th day and 28th day of high performance mortar with 2% steel fibre and plastic chips in different percentages (10, 15, 20%) is given in Fig 8.

Table 5. Flexural Strength of high performance mortar with optimum steel fibre and plastic

Mix ID	Avg. Load (KN)	Flexural strength(7day) N/mm^2	Avg. Load (KN)	Flexural strength(28 day) N/mm^2
S10MK10SF2P10	15.05	308.525	15.25	312.62
S10MK10SF2P15	14.95	306.475	15.15	310.57
S10MK10SF2P20	14.80	303.400	15.05	308.52

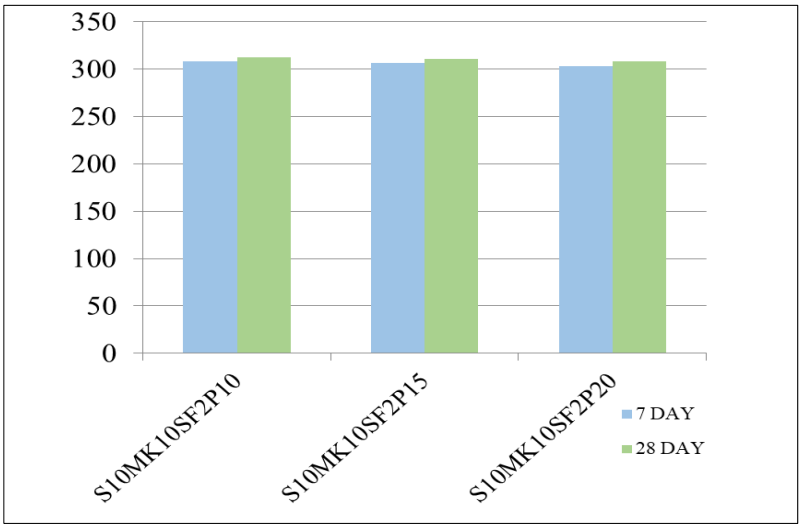

Fig 8. Bar chart of flexural strength of high-performance mortar with optimum steel fibre and plastic

Inference

As the percentage of plastic chips increases it is found that the flexural strength decreases. It is also observed that there is no considerable strength gain after 7 th day when compared with 28th day strength, which shall be due to early strength gain due to presence of silica-fumes and metakaolin. Silica-fumes and metakaolin are mineral admixtures with less particle size than cement, which occupies the void spaces in mortar mix and increases the strength of mortar. From the flexural test result, high performance mortar with 20% plastic is taken as optimum because it gives more strength than required for tile and also more amount of plastic waste can be effectively reused.

Casting and testing of Mosaic tile

Mosaic tile is casted with 2 layers, wearing layer and backing layer. The wearing layer consists of glass chips embedded in cement-marble grout and backing layer with developed high performance mortar with optimum plastic chips. Tests were conducted according to IS 1237: 2012.

Casting of mosaic tile

Casting of mosaic tile using high performance mortar with 2% steel fibre and 20% plastic chips as backing layer and cement marble grout mix with glass chips as wearing layer. Mosaic tile of size $250 \times 250 \times 18$mm is made. After 28 days of curing, the wearing layer is polished. 2 mm of wearing layer of tile is reduced after polishing making it to size $250 \times 250 \times 16$mm.(Fig 9)

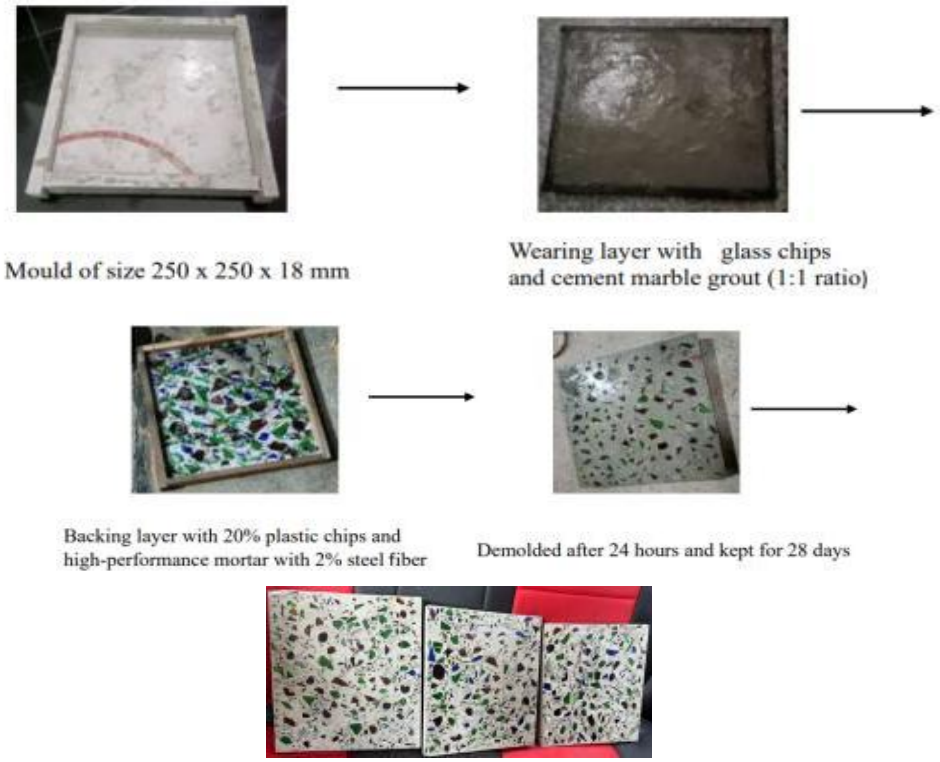

Fig 9. Casting process of mosaic tile

Tests on mosaic tile

Various tests conducted according to IS 1237: 2012 on tiles are explained below

Flexural strength test

Flexural strength, sometimes called bending strength, also known as modulus of rupture, shortly abbreviated as MOR, is a measure of the strength of samples just before the rupture. The sample of size $250 \times 250 \times 16mm$ tile was used for testing. Both ends of the beam strip are established and loaded at the midpoint of its length (for the Mid-point loading test) until failure. Flexural testing of tile is shown in Fig10. And tile after flexural test is shown in Fig 11.Flexural strength of mosaic tile were tested and the results are given in Table 9a. These mosaic tiles consist of a wearing layer (glass chips & cement marble grout) and backing layer (high performance mortar with steel fibre and plastic waste).

Fig10 Flexural Testing of tile

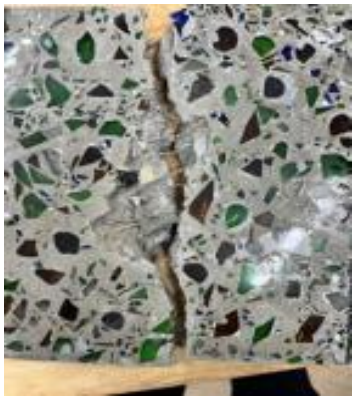

Fig 11. Tile after flexural testing

Table 6. Flexural Strength of mosaic tiles

Sample no.	Load (N)	Flexural strength (28 days) (N/mm^2)
Sample 1	1015.55	4.76
Sample 2	1021.64	4.78
Sample 3	1018.75	4.77

Result and Inference

Average flexural strength is 4.77 N/mm2. According to IS 1237:2012, flexural strength of cement tile shall not be less than 3 N/mm2 and the obtained flexural strength of the sample is 4.77 N/mm2 . Hence it is within the limit.

Water absorption test

They are immersed in water for 24 h, then taken out and wiped dry. Each tile shall be weighed immediately after saturation (W_1) after wiping.The tile shall then be oven-dried at a temperature of 65 ± 1°C for a period of 24h, cooled to room temperature and reweighed (W_2). Result shown in Table 7.

Fig 12 Tile immersed in water

Fig 13. Tile kept for oven drying for 24

Table 7. Water absorption test Result

Samples	M_1 g (mm)	M_2 g (mm)	Water absorption (%)
Sample 1	2338	2281	2.49
Sample 2	2356	2304	2.25
Sample 3	2345	2284	2.65

Result and Inference

Average percentage of water absorption is 2.46%. According to IS 1237:2012, water absorption of cement tile should be less than 10% and the obtained water absorption of the sample is 2.64%. Hence it is within the limit.

Flatness of tile surface

The flatness of the tile surface is tested by means of a metal ruler, whose length is not less than the tile diagonal. For testing surfaces that are concave, the ruler is placed on the surface of the tile along one of the diagonals so that the ruler touches the tile at not less than two points.(Fig 14).The largest gap is measured, and the test is repeated along the second diagonal. The larger gap is the amount of concavity. For testing surfaces that are convex, the ruler is placed on the surface of the tile along one of the diagonals so that the distances between the ruler and the tile, at the ends of the diagonal, are equal. The largest gap is measured between the ruler and the tile, and the test is repeated along the second diagonal. The larger gap is the amount of convexity. Result of flatness of tile surface as given in Table 8.

Fig 14. Flatness test of tile

Table 8. Flatness of tile surface

Sample no.	Concavity (mm)	Convexity (mm)
Sample 1	0	0
Sample 2	0	0
Sample 3	0	0

Result and Inference

According to IS 1237:2012, the concavity and convexity in the cement tile shall not exceed 1 mm. And the obtained Flatness of the tile surface is 0 mm which is within the limit. Hence the tile is neither concave nor convex.

Perpendicularity test

One arm of a square, the arms of which are longer than the sides of the tile, is placed along one of the edges of the tile, so that the corner of the square touches the corner of the tile. The distance between the other arm of the square and the other edge is measured at the end of the tile. The test is repeated such that two opposite edges shall be tested. The largest gap between the arm of the square and the edge of the tile shall be reported. As shown in Fig 15.

Fig 15. Perpendicularity test of tile

Table 9. Perpendicularity of tile

Sample no	Spacing (mm)			
	Side 1	Side 2	Side 3	Side 4
Sample 1	0	2	1	0
Sample 2	0	0	0	1
Sample 3	0	1	0	0

Result and Inference

According to IS 1237:2012, perpendicularity of the cement tile shall be less than 2% of the length of the edge of the tile. So as per the size of tile with edge 250 mm it should be less than 5 mm, the largest spacing obtained is 2mm and hence within the limit.

Straightness test

Two corners of the tile surface shall be connected with a fine thread alongside one of the tile edges and the largest gap between the thread and the plane is recorded. The test is repeated alongside each of the other edges. The gap between the thread and the plane of the tile shall not exceed 1 percent of the edge length. As shown in Fig 16.

Side 1

Side 2

Fig 16. Straightness test of tile

Table 10. Straightness of tile

Sample no	Spacing (mm)			
	Side 1	Side 2	Side 3	Side 4
Sample 1	1	0	0	0
Sample 2	0	0	1	1
Sample 3	0	1	0	0

Result and Inference

According to IS 1237:2012, The straightness of the cement tile shall be less than 1% of the length of the edge of the tile. So as per the size of tile with edge 250 mm it should be less than 2.5 mm, the largest spacing obtained is 1mm and hence within the limit.

Final inference

Results of flexural strength test, water absorption, flatness of surface test, perpendicularity test and straightness test shows that they are within the limit as prescribed by IS 1237: 2012. And therefore this tile proves to be a better alternative for the normal tiles.

Cost analysis

Cost analysis of one mosaic tile is done by taking the quantity of materials used for one mosaic tile and its market price. As shown in Table 10.

Table 11. Cost analysis for one tile

Sl No.	Item	Quantity (g)	Rate per kg	Cost (Rs.)
For wearing layer				
1	Cement	478	8/-	3.82/-
2	Marble powder	478	1/-	0.47/-
For backing layer				
3	Cement	319	8/-	2.55/-
4	Fine aggregate	886	1.14/-	1.01/-
5	Silica fumes	40	14/-	0.56/-
6	Metakaolin	40	15/-	0.60/-
7	Steel fibre	25	75	1.87/-
8	Super plasticizer	9.4	0.08/g	0.75/-
Total Cost for one tile				11.63/-

It is estimated that the cost of one tile is around Rs. 12/- which is less than the market price of a similar tile of approximate same size and hence the mosaic tile developed can be called as a cheaper alternative for normal tiles.

Conclusion

An innovative mosaic tile was developed with a wearing layer of glass chips in cement marble grout and a backing layer of high-performance mortar with steel fiber and plastic waste. The tile was manufactured according to IS 1237:2012 standards, but initial feasibility tests were not successful. Issues were resolved by creating a high-performance mortar mix with silica fume, metakaolin, and an optimal percentage of steel fibers for the backing layer. It was found that a 2% steel fiber content provided the best balance of strength and workability. The addition of plastic chips decreased flexural strength, but a mix with 20% plastic waste was chosen for its strength and sustainability benefits. Testing showed that the tiles exceeded requirements for flexural strength, water absorption, and other factors outlined in IS 1237:2012. The project aimed to promote sustainable waste reduction and environmentally responsible construction practices through the development of these innovative mosaic tiles.

Future scope of study

- Study can be done utilising plastic other than the HDPE category.
- Wearing property of tile can be investigated.
- Steel fibre in high performance mortar can be replaced with other fibres

LEDSRES - A Novel Load Estimation and Distribution System for RES

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Abstract: This project introduces a load estimation and distribution system for renewable energy, utilizing LSTM models and blockchain technology. It significantly enhances energy management efficiency, transparency, and reliability. The system combines predictive analytics with blockchain to accurately forecast energy demand and secure transactions, reducing operational costs and improving resource utilization. Its adaptable design seamlessly integrates with existing infrastructures, promoting scalability and environmental sustainability across various markets.

Introduction

Addressing global energy challenges and the need for sustainable solutions, this project integrates machine learning, neural networks and blockchain technology to revolutionize renewable energy management, particularly in underserved regions. By utilizing LSTM networks, the system accurately forecasts energy demands, enabling proactive adjustments. Blockchain ensures secure, transparent transactions, fostering trust among stakeholders. This innovative approach enhances the accessibility and efficiency of renewable energy, promoting environmental sustainability and economic stability. It sets a new standard for integrating renewable sources into existing grids and local microgrids, aiming for broader scalability and impact.

Project Description

The proposed system employs Long Short-Term Memory (LSTM) networks to accurately forecast energy demands, complemented by blockchain technology for secure and transparent management of energy trades. This combination enables real-time, adaptive energy distribution strategies that dynamically respond to fluctuations in energy supply and demand. Data collected from various renewable sources, such as solar, wind, and hydroelectric power, is processed by LSTM algorithms to effectively predict load demands. Smart contracts executed on the blockchain platform ensure that energy trading is both secure and efficient, enhancing reliability and trust among stakeholders.

Designed for seamless integration, the system collaborates with existing grid infrastructures. It utilizes smart meters and IoT devices to improve data accuracy and system responsiveness, augmenting rather than replacing current frameworks. The modular architecture of the system allows for scalability and adaptability, making it well-suited for diverse geographic locations and energy markets. This integration not only improves energy distribution efficiency but also supports broader goals of energy sustainability and accessibility.

Importance of the Project

This project stands out by combining LSTM and blockchain—technologies not typically integrated in the energy sector—to address issues like inefficiency and lack of transparency in energy distribution. It directly benefits energy providers by optimizing resource allocation, and consumers by stabilizing energy prices and supply. The project's innovative approach significantly contributes to the reliability and sustainability of energy markets.

Future Directions

Future enhancements will focus on empowering communities through direct neighbor-to-neighbor energy sharing, allowing households to efficiently trade surplus power. The system will integrate intuitive auditing tools to simplify energy monitoring and control, making energy management more accessible. Additionally, it will support seamless power trading for both individuals and businesses, fostering a dynamic energy market. Initiatives will promote renewable energy adoption at the grassroots level to ensure a sustainable future. Smart, time-based charging solutions will be developed to enable real-time energy trading, optimizing charging schedules to immediately take advantage of lower rates and the availability of renewable resources. This approach will significantly enhance energy affordability, sustainability, and system resilience, facilitating dynamic and efficient transactions in the energy market.

Conclusion

The implementation of this project has shown promising results in enhancing the efficiency and sustainability of energy distribution. It sets a precedent for future energy systems, emphasizing the importance of integrating advanced technologies to create robust, efficient, and transparent energy management systems. These advancements collectively contribute to a more resilient, efficient, and environmentally friendly energy ecosystem.

Integrated Vertical Farming Using Sensors and Lighting System

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Abstract: With global hunger rising due to population growth, industrialization, and climate change, innovative umm solutions are much needed. The escalating world population poses a significant concern for food security. Industrialization endangers arable lands, while reckless chemical fertilizer use threatens natural resources and life on Earth. Climate change aggravates crop management difficulties too. Integrated vertical farming, leveraging sensors and lighting systems alongside novel techniques, emerges as a potent response. This approach optimizes resource utilization, fosters sustainability, and ensures universal access to nutritious food. Aimed at a hunger-free world, it mitigates threats to food security and environmental sustainability using advanced technologies.

Introduction

Verti-fi stands at the forefront of the battle against hunger and the promotion of global food security through sustainable agriculture. This state-of-the-art vertical farming technology seamlessly integrates hydroponics, aeroponics, and aquaponics, empowered by cutting-edge tools like big data analytics, the Internet of Things, robotics, and artificial intelligence. By 2030, Verti-fi aims to eradicate hunger by minimizing resource consumption and addressing food insecurity with a steady supply of fresh produce. It champions sustainable farming practices, curtails waste, and enhances food productivity to fulfill Sustainable Development Goal 2: Zero Hunger. Additionally, Verti-fi contributes to poverty reduction, job creation, economic growth, and stabilization of food prices. Its eco-conscious approach minimizes the planet's carbon footprint and optimizes resource utilization, aligning with the imperative of supporting farmers through innovation and technology.

Project description

An innovative agricultural idea called "integrated vertical farming" was developed to overcome the difficulties caused by scarce land, especially in urban settings. The sustainable answer to land and water scarcity provided by vertical farming is the creative fusion of hydroponics, aeroponics, and aquaponics. This technology maximizes space efficiency by forgoing conventional soil-based technologies. Additionally, Internet of Things (IoT) technology is used in vertical farming, where sensor devices are used to track important parameters in real-time, including temperature, light exposure, soil moisture, and nutrient levels. The smooth wireless transmission of this data makes farm management procedures more accurate and responsive. Vertical farming can maximize the use of resources, boost crop yields, and guarantee year-round output through the combination of sophisticated gardening techniques and Internet of Things technology. Because integrated vertical farming minimizes its negative effects on the environment and lessens reliance on conventional farming techniques, it not only solves concerns about food security but also advances sustainability.

Working Principle

The working principle of vertical farming entails the integration of hydroponics, aeroponics, and aquaponics within a controlled environment, typically a greenhouse. This enclosed setting allows for precise control over environmental conditions, such as temperature, humidity, and light intensity, optimizing plant growth throughout the year.

Moreover, the use of artificial LED lighting ensures consistent illumination, tailored to the specific needs of various crops. Central to the operation of vertical farming are sensor devices distributed throughout the farming environment. These sensors continually monitor essential parameters, including temperature, humidity, light intensity, soil moisture, and nutrient levels.

The real-time data obtained from these sensors is transmitted wirelessly to a central control system. Farmers can access this data through a mobile application, providing them with insights into the status of their crops and environmental conditions within the greenhouse. Additionally, the application allows farmers to remotely control various aspects of the farming environment, such as adjusting temperature and humidity levels or activating irrigation systems, ensuring optimal growing conditions for the crops.

Furthermore, the central control system stores the collected data, leveraging big data analytics to identify trends, optimize crop management strategies, and predict potential issues before they arise. This data-driven approach enables farmers to make informed decisions, maximizing crop yield. By leveraging sensor data and mobile applications, farmers can remotely monitor and manage their crops, ensuring sustainable and efficient food production.

Technical Description

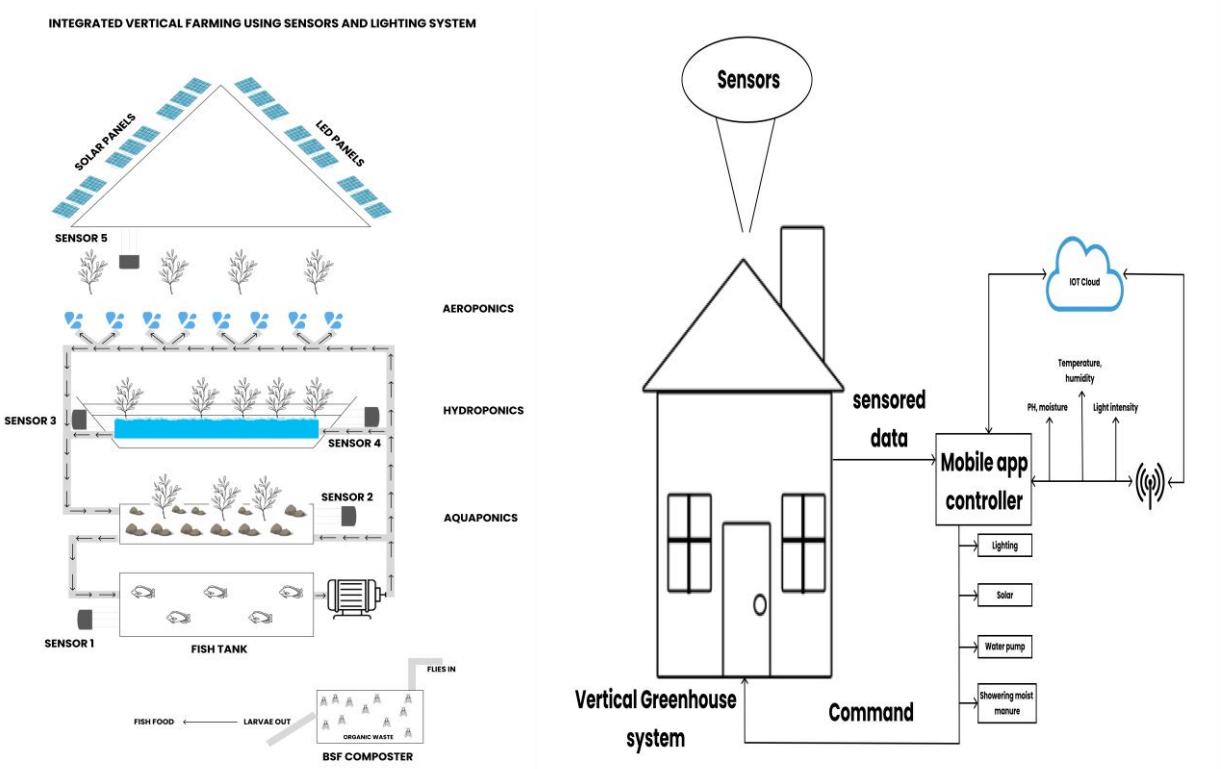
Vertical farming embodies a comprehensive integration of cutting-edge technologies to optimize crop cultivation within a controlled environment. The system encompasses hydroponics, aeroponics, and aquaponics cultivation methods, each offering distinct advantages in nutrient delivery and plant growth. Hydroponics facilitates soilless plant growth in a nutrient-rich water solution, while aeroponics suspends plant roots in the air, misting them with nutrients. Aquaponics combines fish farming with hydroponics, creating a symbiotic ecosystem where fish waste fertilizes plants and plants filter water for fish.

Critical to vertical farming's operation are sensor devices meticulously placed throughout the facility. These sensors continuously monitor essential parameters such as temperature, humidity, light intensity, soil moisture, and nutrient levels. Real-time data from these sensors are wirelessly transmitted to a central control system for analysis and action.

This central control system, often cloud-based, leverages big data analytics to process and store collected data. It identifies trends, optimizes crop management strategies, and provides insights to farmers via a user-friendly mobile application. Developed using Flutter and Firebase, the application ensures cross-platform compatibility, secure data synchronization, and efficient data storage and retrieval.

The integration of the BSF composter into the vertical farming system promotes sustainability by closing the nutrient loop and minimizing waste. It enables farmers to utilize organic waste generated within the farming operation to enhance soil fertility and crop productivity, contributing to a more environmentally friendly and resource-efficient cultivation process.

Furthermore, artificial LED lighting serves as the primary light source within the controlled environment. These lights provide customizable illumination tailored to specific crop needs, ensuring consistent growth year-round. Additionally, the entire system operates within a controlled environment, typically a greenhouse, allowing precise regulation of temperature, humidity, and other environmental factors to optimize plant growth and resource utilization.



Importance of the Project

Verti-Fi revolutionizes food production with its integrated vertical farming approach, addressing global hunger amidst land scarcity. Unlike traditional methods, it harnesses hydroponics, aeroponics, and aquaponics, amplified by IoT and solar power, maximizing yield and sustainability. Beneficiaries include all striving for food security, sustainable agriculture, and economic prosperity. Its uniqueness lies in holistic resource optimization, making it a beacon of innovation in agriculture. The project targets food producers, distributors, and health-conscious consumers, offering a transformative solution to food security challenges. Verti-Fi's impact extends far beyond immediate hunger, heralding a more resilient, sustainable future for generations to come.

Conclusion

To sum up, the Verti-Fi project is a novel attempt to address global food security issues using creative agricultural techniques. Through the integration of cutting-edge systems such as hydroponics, aeroponics, and aquaponics with vertical farming technologies, Verti-Fi provides an environmentally friendly and sustainable solution to end hunger. Its all-encompassing strategy, which makes use of data analytics, solar energy, and the Internet of Things, optimizes crop yields and resource efficiency to guarantee a stable food supply for coming generations. Verti-Fi promises a better, more sustainable future for everybody as we negotiate the challenges posed by urbanization and population expansion. We can make the dream of a world free from hunger a reality by working together and being dedicated to the cause.

Dynamic Tech Trace: Tactical Tracking Tool for Tactile Threat Detection

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Abstract: Public safety and security are increasingly threatened by the rising incidents of mass shooting and gun violence, necessitating effective weapon detection systems. This paper presents a state-of-the-art approach utilizing the YOLO V5 deep learning model for robust weapon detection. The proposed system demonstrates resilience against various challenges such as affine transformations, rotations, occlusions, and size variations, achieving an impressive F1-score of 95.43% on a publicly available dataset. In addition to YOLO V5, specifically Mask-RCNN, for firearm detection and segmentation, achieving a detection accuracy (DC) of 90.66% and a Mean Intersection over Union (mIoU) of 88.74%. To further enhance the accuracy of the system,various data augmentation and preprocessing techniques are combined, demonstrating the effectiveness of the proposed methodology.

Introduction

A weapon detection system is crucial for enhancing public safety and security. Modern security demands for advanced technological solutions . We introduce a groundbreaking tracking tool for threat detection . the important of such a system is to enhance the overall security . public safety and security are increasingly threatened by the rising incidents of mass shootings and gun violence necessitating effective weapon detection systems.

By implementing the weapon detection system public security can increased to a much better level. It involves developing systems or algorithms to automatically identify and recognize weapons in various environments, such as airports, public spaces, or surveillance footage. These systems often employ technologies like computer vision and machine learning to detect objects resembling firearms, knives, or other dangerous items, with the aim of enhancing security and public safety.

Currently,Convolutional Neural Network (CNN)-based deep learning approaches are proposed for real-time recognition and classification. The authors conducted a comparative analysis of two versions of the state-of-the-art model called YOLOV3and YOLOV4 for weapons detection. The weapons dataset was created, and images were collected from Google images and other assets.Annotations were manually annotated in different formats, as YOLOV3 requires annotation files in text format and some models require annotation files in XML format. Both models were trained on a large data set of weapons and tested for comparative analysis. YOLOV4 performed better in terms of processing time and sensitivity than YOLOV3 in terms of processing time and **s**ensitivity. However, they can compare these two in precision metrics.

System Architecture

1. Data collection: Collects input data from various sources such as surveillance cameras, images, or video feeds from public spaces, airports, etc.

2. Preprocessing module**:** Preprocess the annotated videos to extract frames and resize them to a standard resolution.Augment the dataset with techniques like rotation, flipping, or color adjustments to increase variability.

3. Model selection: Choose a suitable deep learning model for weapons detection, such as YOLOv3 or YOLOv4. Split the annotated dataset into training, validation, and testing sets. Train the selected model

on the training set using techniques like transfer learning or fine-tuning.Validate the trained model on the validation set to tune hyperparameters and ensure generalization.

4. Evaluation module: Evaluate the performance of the trained model on the testing set using metrics like precision, recall, and F1-score. Compare the performance of different models, such as YOLOv3 and YOLOv4, in terms of processing time, sensitivity, and precision metrics.

5. Deployment module: Deploy the trained model to a real-time surveillance system for weapons detection. Integrate the model with existing video surveillance infrastructure to analyze live video feeds. Implement alert mechanisms to notify security personnel in case of weapon detection.

6. Monitoring and maintenance module: Continuously monitor the performance of the deployed model in real-world scenarios. Fine-tune the model periodically using new data or updated techniques to adapt to changing conditions.

Literature survey

Zou, Z., Chen, K., Shi, Z., Guo, Y. and Ye, J proposed a model and it mainly focus on object detection, which is a fundamental task in computer vision involving identifying and localizing objects within images or video frames.they conucteda survey of the progress made in object detection techniques over the past 20 years, covering a wide range of methodologies, including traditional methods, deep learning approaches, and emerging trends. It traces on the evolution of object detection techniques, starting from traditional methods based on handcrafted features and moving towards more sophisticated deep learning approaches, particularly Convolutional Neural Networks (CNNs).

The paper also discuss the significant impact of deep learning on advancing the state-of-the-art in object detection, enabling the development of highly accurate and efficient models. The paper mainly highlights highlights the remaining challenges in object detection, such as handling occlusions, scale variations, and small object detection.

It also discusses promising research directions for future exploration, including multi-modal fusion, weakly supervised learning, and domain adaptation. The survey explores various applications of object detection across domains such as autonomous driving, surveillance, robotics, and healthcare, emphasizing the practical significance of ongoing research in this field.

Methodology

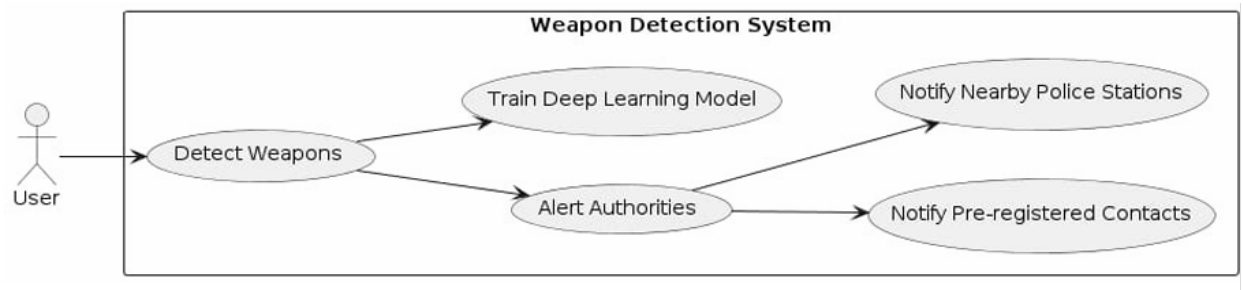
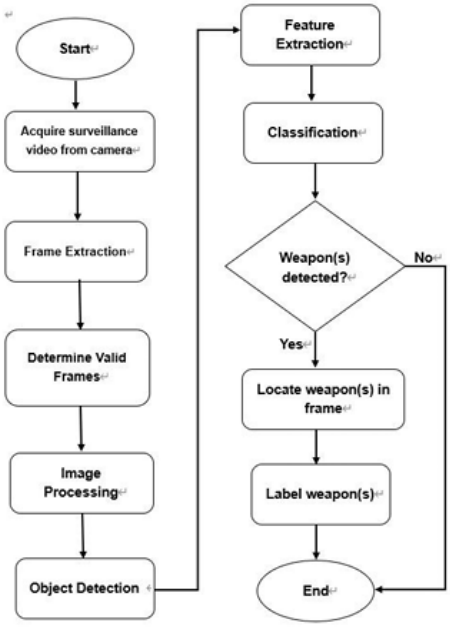


Fig. 1. Use-case diagram

Flowchart



Importance of the project

Weapon related murder rates in our country has been increasing rapidly . In India arms are illegal to own but there is a great amount of sully of illegal arms all around our country. So we can implement these weapon detection modules on to the CCTV cameras of railways airports etc. to enhance the security.

- **Public**

The primary beneficiaries are the general public. Implementing an effective weapon detection system can create safer environments in public spaces such as airports, train stations, schools, shopping malls, and entertainment venues. This contributes to a sense of security and peace of mind for individuals going about their daily lives.

- **Law enforcement and security agencies**

Law Enforcement and Security Agencies: Law enforcement agencies and security personnel benefit from weapon detection systems as they provide valuable support in their efforts to prevent crimes, respond to incidents, and maintain public order. These systems serve as force multipliers, enabling authorities to more effectively monitor and secure large areas.

Conclusion

Threat detection technologies play a vital role in enhancing public safety by leveraging AI, machine learning, and sensor advancements. They offer significant benefits, including reducing armed threats and enabling early threat detection. Collaborative efforts among governments, private sectors, and communities are crucial for advancing these technologies and creating a safer environment The implementation of an effective weapon detection system holds significant importance for a wide range of beneficiaries, including the general public, law enforcement agencies, governments, businesses, and communities at risk. Ultimately, the project's success lies in its potential to save lives, prevent harm, and foster a safer and more secure society for all.

Acknowledgements

We express our sincere thanks to our guide, Ms Neha Beegam PE, Assistant Professor, Department of Artificial Intelligence & Data Science, Ilahia College of Engineering and Technology and support which were instrumental in all the stages of the project work and without whom the project could not have been accomplished. We also wish to express our sincere appreciation to Ms Rosna Haroon, Head of the Department, Ilahia College of Engineering and Technology, who was willing to spend his precious time to give some ideas and suggestion towards the project. We would like to thank Dr. K A Navas., Principal, Ilahia College of Engineering and Technology.

Hybrid Energy Vehicle Powered by Solar and Wind

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Abstract: The scarcity of fossil fuel in the future and its negative impact on the environment, an alternative energy source has to be discovered. Wind power is a clean and sustainable natural resource that has not yet been fully exploited in the automotive sector. This project deals with the design of an electric vehicle battery that can be charged using a hybrid model of solar and wind power. The system gets maximum solar energy during the day and maximum wind power during the night because the wind blows more during the night than during the day. The hybrid system is designed and built to generate power by combining wind turbines and solar panels. Developing a new approach for the cost-effectiveness evaluation of the Hybrid Systems for electricity generation.

Introduction

Alternative energy sources are required due to the depletion of fossil fuels and their negative environmental effects. Potential energy sources include solar and wind power. When the demands of the load are not met by conventional sources, alternative sources of energy Sources are able to make up for the shortfall. Vehicle emissions are the principal factor affecting the quality of the air in cities. Using wind turbines to capture wind energy seems to be the most promising method of producing renewable energy. In a battery bank, the energy produced by solar and wind power is combined. A hybrid renewable energy system combines two or more energy-producing technologies, most commonly wind and solar energy. The system's increased reliability results from combining solar and wind power generation, which is another benefit of using a hybrid power system. Additionally, since there is less reliance on a single source of power, the size of the battery storage can be slightly decreased. When the sun isn't out, there's usually lots of wind. The wind and solar powered cars help to alleviate this issue because they have the ability to be charged on board, whereas the typical electric car finds it difficult to charge after a few kilometers.

Project description

The car that runs on solar and wind power is very efficient and has the least amount of . maintenance Figure 1 displays the proposed system's circuit diagram. The vehicle operates on the principle of charging and discharging its internal battery. When the car is operating, after a set number of kilometers, the motor needs to be recharged because it uses battery power. Wind turbines produce electricity for this vehicle, and solar panels modules are directed to battery for charging. The car doesn't need to be in standby mode in order to charge because the battery is recharged on board. A car that runs on a battery and is charged by free energy sources is designed to maximize energy efficiency and conserve it. After receiving the bits from the remote, the controller determines whether or not they are part of the needed signal. In the event that the bits match the necessary data, the controller will move the robot in one of the following directions: forward, backward, left, right, or stop. Driver IC L293D, which receives a signal from the controller and provides 12V or 0V to the motor terminals in accordance with the signal, is used to drive the vehicle's motors. Additionally, the motor rotates in forward, backward, or stop depending on the voltage on the motor terminals. In order to move the vehicle in the forwarding direction, the driver's indicator light (IC) sends a signal to both motors telling them to run in the same direction, which is forward. By employing the battery as a supply source, the car can be operated wirelessly using a remote.

Technical description

ESP32 is a single chip 2.4 GHz Wi-Fi and Bluetooth combo chip designed with TSMC ultra-low power 40 nm technology. It is designed and optimized for the best power performance, RF performance, robustness, versatility, features, and reliability, for a wide variety of applications, and different power profiles. Hitachi's HD44780 based character LCD are very cheap and widely available, and is an essential part for any project that displays information. By using I2C to LCD interface board controls the LCD using only 2 wires. This I2C LCD Interface board used an I2C communication interface. The HC-SR04 ultrasonic sensor uses SONAR to determine the distance of an object just like the bats do. L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.

L293D Logic Table.-Lets consider a Motor connected on left side output pins (pin 3,6). For rotating the motor inclockwise direction the input pins has to be provided with Logic 1 and Logic 0.Pin 2 = Logic 1 and Pin 7 = Logic 0 denotes Clockwise Direction, Pin 2 = Logic 0 and Pin 7 = Logic 1 indicates Anticlockwise Direction ,Pin 2 = Logic 0 and Pin 7 = Logic 0 shows Idle [No rotation] [Hi-Impedance state] and Pin 2 = Logic 1 and Pin 7 = Logic 1 | Idle [No rotation]

IOT WEB SERVER

The Internet of things (IoT) is the network of everyday objects physical things embedded with electronics, software, sensors, and connectivity enabling data exchange. The wind and solar energy availability indicated in IOT web browser.

Circuit diagram

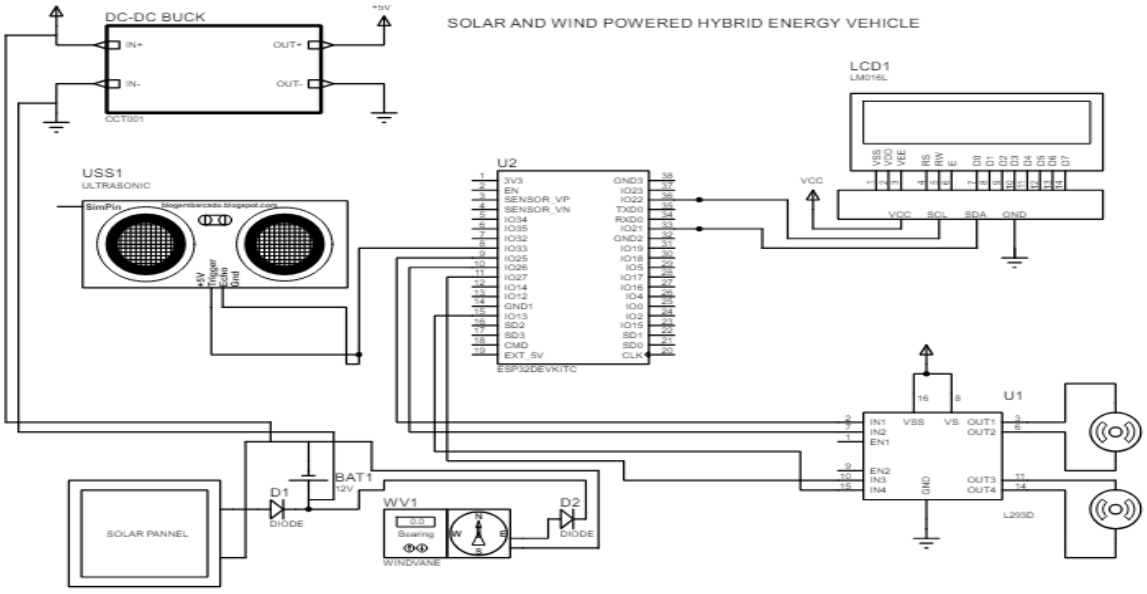

Fig. 1. Circuit diagram

Output

Fig. 2. Received data on IOT web server

Importance of the Project

The adoption of electric vehicles powered by solar and wind energy carries numerous benefits for the environment, economy, and society at large. By reducing reliance on fossil fuels, these vehicles mitigate air pollution and greenhouse gas emissions, contributing to improved air quality and mitigated climate change. Additionally, the decentralization of energy production through solar and wind power promotes energy independence and resilience, reducing dependency on centralized fossil fuel infrastructure. Furthermore, the proliferation of renewable energy-powered transportation creates opportunities for economic growth and job creation in the renewable energy sector.

Prototype

Fig.3 Designed prototype

Conclusion

There is huge potential for producing electricity from renewable sources. This project gives a clear idea that vehicle-powered with the help of solar energy and wind energy is more effective than fuel vehicle. By combining the two intermittent sources of the wind and solar energy to charge battery of electric vehicle. The system's power transfer efficiency and reliability can be improved significantly. By the use of hybrid vehicles, it is possible to eliminate the usage of fossil fuels. It has higher efficiency than using individual solar and wind system.

Medibot Autonomous Nursing Assistant

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Abstract: In modern healthcare settings, the demand for automation and robotics to enhance medical processes is rapidly increasing. This study presents ”MediBot”, an innovative robotic solution designed to enhance medical processes in modern healthcare settings. MediBot, a human-following nursing trolley, utilizes Raspberry Pi as its core controller. Specifically developed for medical environments, its primary objective is to autonomously trail doctors at an appropriate distance, serving as a reliable assistant in healthcare facilities. Employing advanced computer vision techniques, MediBot accurately detects and analyzes colorspecific tags worn by doctors, ensuring seamless tracking. By replacing manual approaches, such as nurses following doctors, MediBot optimizes workflow efficiency, allowing medical staff to concentrate on patient care. The research addresses technical challenges associated with real-time color detection, distance calculation, and precise robot movement control,contributing to the evolving landscape of automation and robotics in healthcare.

Introduction

In the rapidly evolving landscape of modern healthcare, the demand for automation and robotics is on the rise. This study introduces ”MediBot,” a revolutionary robotic assistant designed to optimize healthcare processes. With a Raspberry Pi core controller, MediBot is a human-following nursing trolley, autonomously accompanying doctors in medical settings. Its advanced computer vision technology detects QR code tags worn by doctors, replacing manual tracking by nurses. This innovation not only streamlines workflow but also allows medical staff to prioritize patient care. The research addresses technical challenges in real-time QR code detection, distance calculation, and precise robot control, aiming to contribute to the seamless integration of robotic assistance in healthcare.

Methodology

The developing for the Medibot Autonomous Nursing Assistant, a trolley designed to autonomously follow doctors using QR code identification, Raspberry Pi, and a camera module, involves several key steps. Firstly, a thorough requirement analysis is conducted to understand the specific functionalities required, such as QR code detection, doctor tracking, and obstacle avoidance. Following this, the hardware setup entails acquiring and connecting the necessary components, including the Raspberry Pi board, camera module, motor drivers, wheels, and power supply.

Software development involves installing required libraries and developing algorithms for QR code detection, doctor tracking, and obstacle avoidance using image processing techniques. Additionally, QR code mapping is executed by generating and placing unique QR codes strategically in the environment. Control logic is developed to interpret QR code information and control the trolley’s movement to follow the doctor while avoiding obstacles. Testing and validation are then performed to ensure proper functionality in both simulated and real-world environments. Finally, comprehensive documentation and maintenance plans are established to provide guidelines for operation, maintenance, and future updates of the Medibot Autonomous Nursing Assistant. Through this methodology, the autonomous nursing assistant trolley aims to effectively assist medical professionals in their tasks, enhancing efficiency and safety in healthcare settings.

A. QR code Detection and following

The QR code detection and following using a camera module and Raspberry Pi involves several steps:

- Firstly, set up the Raspberry Pi board and connect the camera module securely to it. Ensure that the camera has a clear view of the environment where QR codes will be placed.
- Next, develop software to capture images using the camera module. Utilize Python libraries such as picamera or OpenCV for image acquisition, allowing for real-time or periodic image capture.
- Implement image processing algorithms to detect QR code regions within the captured images. Use techniques like edge detection, thresholding, and contour detection to identify QR code patterns.
- Utilize a QR code detection library such as pyzbar to decode the information encoded in the detected QR code regions. Extract relevant data such as unique identifiers or coordinates embedded in the QR codes.
- Develop algorithms to interpret the decoded information and determine the identity or location of the doctor associated with each QR code. Calculate the direction and distance to the doctor based on their position relative to the trolley.
- Integrate motion control commands into the Raspberry Pi software to adjust the trolley's movement accordingly. Use PWM signals or motor control libraries to steer the trolley and adjust its speed to maintain a desired distance from the doctor.
- Optionally, incorporate obstacle detection algorithms using additional sensors or image processing techniques to identify obstacles in the trolley's path. Modify the trolley's trajectory or speed to avoid collisions while following the doctor.
- Test the QR code detection and following system on the Raspberry Pi in controlled environments with various scenarios. Validate the accuracy and reliability of the system through real-world testing, ensuring it can effectively track and follow the doctor in dynamic environments.
- Optimize and refine the software as needed, fine-tuning the QR code detection and following algorithms to improve performance and responsiveness. Address any identified issues or limitations through iterative optimization and refinement of the system.
- Through this , the Raspberry Pi-based system can effectively detect and follow QR codes to track and follow doctors, offering enhanced efficiency and convenience in medical settings.

B. Obstacle avoidance

Implementing obstacle avoidance using ultrasonic sensors and Raspberry Pi involves several steps:

- Hardware Setup: Connect ultrasonic sensors to the Raspberry Pi GPIO pins. Ensure each sensor has both a trigger and an echo pin connected to the appropriate GPIO pins for interfacing.
- Ultrasonic Sensor Operation: Write Python scripts to initialize the GPIO pins and read distance measurements from the ultrasonic sensors. Use the GPIO library (e.g., RPi.GPIO) to control the GPIO pins and handle sensor input/output.
- Distance Measurement: Implement code to send a trigger signal to the ultrasonic sensor, which emits ultrasonic waves. Measure the time taken for the ultrasonic waves to bounce off an obstacle and return to the sensor (echo time). Calculate the distance to the obstacle using the speed of sound and the echo time.
- Obstacle Detection: Set a threshold distance beyond which obstacles are considered imminent. If the measured distance is less than the threshold, an obstacle is detected in the path of the trolley.

- Trolley Control: Develop algorithms to respond to obstacle detection by adjusting the trolley's movement. For example, if an obstacle is detected in front of the trolley, stop or reverse the trolley to avoid collision. Use PWM signals or motor control libraries to control the trolley's speed and direction.
- Integration with QR Code Following: Integrate the obstacle avoidance functionality with the QR code detection and following system. Prioritize obstacle avoidance commands over QR code following commands when obstacles are detected to ensure the trolley's safety.
- Testing and Validation: Test the obstacle avoidance system in controlled environments with various obstacles and scenarios. Validate the effectiveness of the system in avoiding collisions and navigating around obstacles.
- Optimization and Refinement: Fine-tune the obstacle avoidance algorithms to improve performance and responsiveness. Consider factors such as sensor placement, sampling rate, and threshold distance to optimize obstacle detection and response.
- Real-world Deployment: Deploy the obstacle avoidance system on the Raspberry Pi-powered trolley in real-world environments. Continuously monitor and evaluate the system's performance, making adjustments as necessary to ensure reliable operation.

By following these steps, you can implement obstacle avoidance using ultrasonic sensors and Raspberry Pi, enhancing the safety and autonomy of the trolley in navigating its environment.

C. Block Diagram

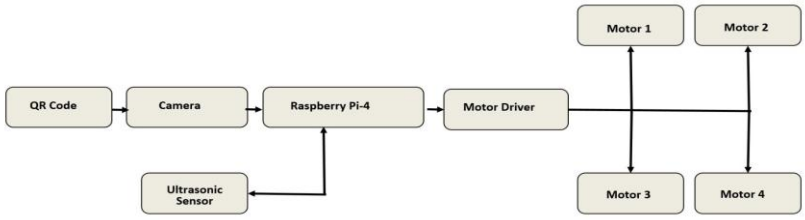

Fig. 1. Block diagram

D. Circuit Diagram

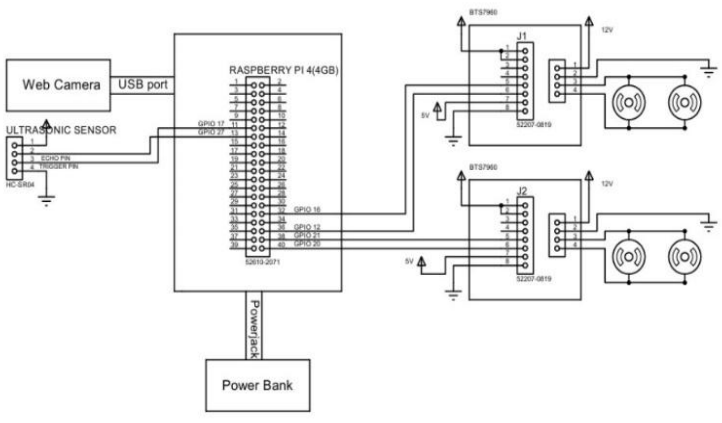

Fig. 2. Circuit Diagram

Fig. 3. MEDIBOT Model

E. Working

The obstacle avoidance system, integrated with QR code detection for the following, combines ultrasonic sensors, Raspberry Pi, and image processing techniques to ensure safe and accurate navigation of autonomous trolleys. Ultrasonic sensors detect obstacles, while Raspberry Pi processes this data alongside QR code information captured by a camera module. When navigating, the trolley utilizes ultrasonic sensors to detect nearby obstacles. Simultaneously, the camera module captures images to identify QR codes strategically placed in the environment.

Raspberry Pi processes these images, extracting QR code data to determine the trolley's designated path or target, such as a doctor in a hospital setting. If an obstacle is detected within a predefined range, indicating a potential collision, the system triggers appropriate responses to avoid it. Simultaneously, the Raspberry Pi interprets QR code data, ensuring the trolley stays on course while following the designated path or target. Continuous monitoring and optimization of both obstacle avoidance and QR code detection systems enhance the trolley's responsiveness and reliability. This integrated approach enables safe and accurate navigation in dynamic environments, facilitating the trolley's seamless integration into various industries and applications.

Fig. 4. QR code detection

Experimental Analysis

In practical tests, the integrated system demonstrated reliable obstacle avoidance and accurate QR code detection, ensuring safe navigation and precise following of designated paths or targets. Real-world scenarios confirmed the system's effectiveness, highlighting its potential for seamless integration into diverse environments. Continuous refinement promises further enhancement of performance and adaptability. Overall, the system's performance showcases its potential for enhancing safety and efficiency in autonomous navigation tasks. The successful integration of obstacle avoidance and QR code detection paves the way for broader applications across industries such as healthcare, logistics, and manufacturing. Further refinement and optimization hold promise for continued improvement and widespread adoption of the technology.

Acknowledgment

I would like to express my sincere gratitude Dr. Arunkant A Jose, Dr.Dhanya S our mentors, for their invaluable guidance, support, and encouragement throughout the development of MEDIBOT AUTONOMOUS NURSING ASSISTANT. I would also like to thank MITS for their contributions and support, without which this project would not have been possible

Safeguarding Coal Mine Workers

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Abstract: Ensuring the safety and well-being of coal mine workers is a paramount concern due to the inherent dangers associated with mining activities. This project introduces a comprehensive safety system that utilizes real-time monitoring, advanced sensors, and machine learning to enhance the protection of coal miners. The proposed solution integrates wearable technology into miners' jackets, incorporating GPS positioning, pulse monitoring, gas sensors, water level indicators, and accelerometers. Additionally, a GSM module enables instant communication and emergency response. The GPS module continuously tracks the miners' positions, providing crucial location data in case of emergencies. Real-time pulse monitoring ensures early detection of health issues related to exposure to hazardous conditions, while gas sensors and water level indicators offer immediate warnings against potential dangers such as gas leaks or flooding. The accelerometer measures the impact of falls, triggering emergency responses if miners fall from a certain height. Furthermore, Machine learning algorithms are employed to assess the occupational disease probability of emphysema and black lung disease based on historical health data. This predictive analysis allows for proactive measures to mitigate health risks and provides timely interventions. The integration of these technologies aims to revolutionize the safety standards in coal mining by creating a proactive and responsive system. The combination of real-time data monitoring, emergency response mechanisms, and predictive health analytics establishes a comprehensive framework to safeguard miners from both immediate dangers and long-term health risks. This project not only enhances the safety of coal mine workers but also sets a precedent for leveraging cutting-edge technologies in high-risk industries to prioritize the health and well-being of the workforce.

Introduction

Coal mining remains a vital industry worldwide, powering economies while presenting inherent risks to worker safety and health. This project endeavors to elevate safety standards within coal mines by integrating advanced sensor technologies such as MPU6050, GPS module and gas sensors. Real-time monitoring of workers' health and vision further enhances safety protocols. Moreover, the project pioneers an online platform employing Machine Learning algorithms for early Lung Cancer Detection, a prevalent concern among miners. By amalgamating sensor data and health analytics, the project aims to mitigate accidents, optimize emergency responses, and proactively address health risks. Emphasizing community engagement and user-friendly interfaces, this initiative aspires to cultivate a culture of safety consciousness and well-being in coal mining operations. Through innovation and collaboration, this project endeavors to redefine safety paradigms, ensuring the protection and longevity of coal mine workers globally.

Description

This project focuses on leveraging cutting-edge sensor technologies to enhance safety and well-being in coal mining environments. The deployment of MPU6050 sensor(accelerometer), GPS module sensor, real-time pulse monitoring sensors enables real-time monitoring of workers' movements, facilitating the detection of potential accidents. Gas sensors provide immediate alerts in case of hazardous gas emissions, ensuring swift response and evacuation protocols. Wearable devices equipped with health and vision monitoring capabilities continuously assess workers' vital signs and eye fatigue, enabling early identification of health issues. In parallel, the project introduces an online platform powered by machine learning algorithms for the early detection of lung cancer, a significant health concern in the coal mining industry.

This platform aggregates sensor data, health metrics, and environmental factors, offering actionable insights to workers and stakeholders. By integrating sensor data with health analytics, the project aims to reduce accidents, optimize emergency responses, and mitigate health risks associated with coal mining operations. Additionally, community engagement initiatives and user-friendly interfaces foster a culture of safety awareness and empowerment among coal mine workers.

Working

1. Sensor Integration:
   - MPU6050 sensors are strategically placed within the coal mine environment to monitor workers' movements in real-time. These sensors detect deviations from normal behavior, such as sudden falls or unusual motions, triggering immediate alerts.
   - Gas sensors are deployed throughout the mine to continuously monitor air quality. In the event of gas leaks or hazardous emissions, these sensors provide instant notifications to workers and supervisors, enabling swift evacuation procedures.

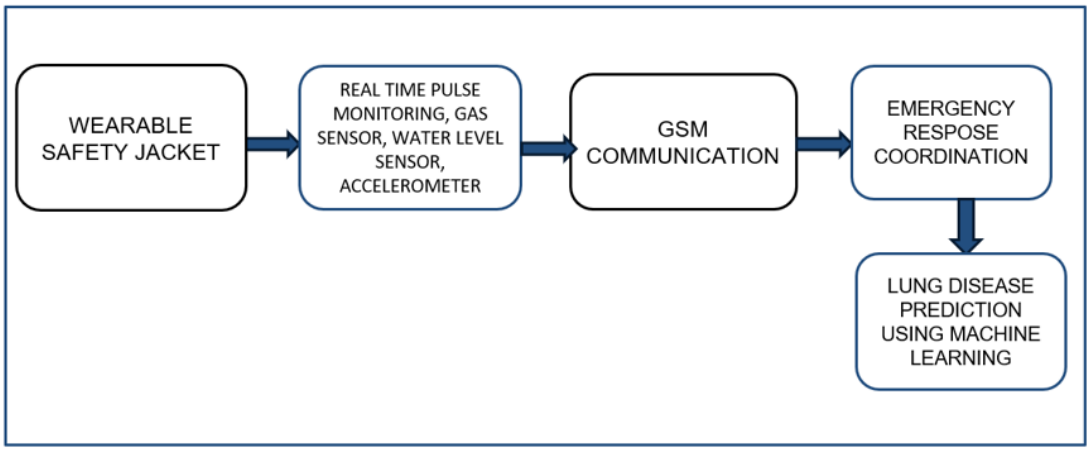
2. Real-time Health and Vision Monitoring:
   - Wearable devices equipped with health and vision monitoring capabilities are distributed to coal mine workers. These devices continuously track vital signs such as heart rate, blood pressure, and oxygen levels, providing real-time health insights.
   - Vision monitoring sensors assess workers' eye fatigue levels by tracking eye movement patterns and blink rates. This helps in identifying signs of fatigue or strain, prompting timely breaks and interventions to prevent accidents.

3. Online Platform for Data Analysis:
   - Sensor data, health metrics, and environmental parameters are collected and processed in real-time through an online platform.
   - Machine learning algorithms analyze this data to identify patterns indicative of potential safety hazards or health risks. For instance, anomalies in movement patterns detected by MPU6050 sensors may indicate an increased risk of accidents, while deviations in health metrics could signal underlying health issues.
   - The platform provides actionable insights to workers and supervisors, enabling informed decision-making and proactive interventions to mitigate risks.

4. Early Lung Cancer Detection:
   - The online platform also incorporates machine learning algorithms trained to detect early signs of lung cancer based on health data collected from workers.
   - By analyzing factors such as respiratory function, exposure to dust and pollutants, and other health indicators, the algorithm can identify individuals at higher risk of developing lung cancer.
   - Early detection alerts are generated, prompting further medical evaluation and intervention, potentially improving treatment outcomes and prognosis for affected individuals.

5. Continuous Improvement and Training:
   - The project emphasizes continuous evaluation and improvement based on feedback from sensor data and health analytics.
   - Regular training programs are conducted to educate workers on the use of sensors, safety protocols, and the importance of maintaining good health practices in the coal mine environment.

By integrating sensor technologies, real-time monitoring, and machine learning-driven analysis, this project aims to create a safer and healthier working environment for coal mine workers, reducing accidents, mitigating health risks, and enhancing overall well-being.



Importance of the Project

This project is crucial for safeguarding the lives and well-being of coal mine workers. By integrating advanced sensor technologies and real-time health monitoring, it enhances safety protocols and facilitates early detection of health risks such as lung cancer. The online platform's machine learning algorithms provide actionable insights, enabling proactive interventions to mitigate accidents and health hazards. Improved safety not only protects workers' lives but also ensures operational continuity and reduces financial losses associated with accidents and health-related downtime. Moreover, fostering a culture of safety awareness underscores the project's significance in promoting long-term sustainability and social responsibility in the coal mining industry.

Conclusion

In conclusion, this project represents a significant advancement in coal mine safety, leveraging technology to protect workers' lives and well-being. By integrating sensor technologies, real-time monitoring, and machine learning-driven analysis, it enhances safety protocols and enables early detection of health risks. The proactive approach facilitated by the online platform fosters a culture of safety awareness and empowers stakeholders to make informed decisions. Moving forward, continued collaboration, innovation, and investment in such initiatives are essential to sustainably improve safety standards in coal mining and ensure the health and longevity of workers worldwide.

Sports Analysis via Wearable Device

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Abstract: Accurately assessing athlete performance in sports analytics is challenging due to limited technical understanding, leading to misinterpretations. To overcome this, we integrate sensors and microcontrollers into athletic attire, capturing real-time data on movement patterns, biomechanics, and physiology. Decision tree algorithms extract meaningful patterns for unbiased evaluation. This objective assessment enhances performance, enables personalized training, and aids injury prevention through longitudinal tracking. Customization ensures applicability across sports and individual needs, promising to revolutionize sports analytics by optimizing performance and minimizing subjective biases.

Introduction

In sports analytics, evaluating athlete performance precisely poses a challenge, often due to limited technical understanding. To confront this, we've innovated by seamlessly integrating sensors and microcontrollers into athletic gear. These sensors capture real-time data on movement patterns, biomechanics, and physiology. Microcontrollers swiftly process this information, providing immediate, insightful feedback directly to athletes. Central to this approach is employing Decision Tree algorithms to extract meaningful insights, enabling unbiased evaluations. This method enhances performance and allows for personalized training, while its adaptability ensures applicability across various sports.

Project Description

Our project aims to redefine sports analytics by integrating cutting-edge technology into athletic attire, thereby enabling real-time performance assessment and optimization. Through the seamless integration of sensors and microcontrollers, athletes can receive immediate feedback on their movement patterns, biomechanics, and physiological responses, facilitating continuous improvement and injury prevention.

The project's technical framework leverages Decision Tree algorithms to extract meaningful insights from the gathered data, ensuring objective evaluations free from subjective biases. This holistic approach promises to revolutionize sports analytics by enhancing performance, personalizing training regimens, and minimizing the influence of human error.

Working of the Project:

1. **Data Acquisition:** Sensors embedded in the athletic attire continuously collect data on various aspects of athlete performance, including motion, muscle activity, and vital signs.
2. **Data Processing:** The collected data is transmitted to microcontrollers, where it undergoes real-time processing. Microcontrollers analyse the data to extract relevant features and patterns.
3. **Feedback Mechanism:** Utilizing Decision Tree algorithms, the microcontrollers provide immediate feedback to the athlete based on the analyzed data. This feedback includes insights into movement efficiency, biomechanical alignment, and physiological exertion.
4. **Performance Optimization:** Armed with this feedback, athletes can make on-the-fly adjustments to their technique, training intensity, and recovery strategies, optimizing their performance in real-time.

Technical Description of the Project:

- **Sensors:** The project utilizes a variety of sensors, including accelerometers, gyroscopes, electromyography (EMG) sensors, and heart rate monitors. These sensors are strategically placed within the athletic attire to capture comprehensive data on athlete movement and physiological responses.
- **Microcontrollers:** At the core of the project are microcontrollers responsible for data processing and feedback generation. These microcontrollers are equipped with Decision Tree algorithms, allowing for efficient analysis of the gathered data and generation of actionable insights.
- **Communication Protocol:** A robust communication protocol facilitates seamless data transfer between the sensors, microcontrollers, and athlete interface. This ensures low-latency feedback delivery, crucial for real-time performance optimization.
- **Athlete Interface:** The athlete interface, typically a wearable device or smartphone application, provides athletes with intuitive feedback visualizations and actionable recommendations. This interface enables athletes to interpret and act upon the insights generated by the system effectively.
- **Decision Tree Algorithms:** Decision Tree algorithms are employed to analyze the collected data and identify patterns indicative of optimal performance or potential areas for improvement. These algorithms enable objective evaluation of athlete performance, free from the biases inherent in subjective assessments.
- **Customization:** The project's architecture allows for customization to cater to the specific needs of different sports and individual athletes. This flexibility ensures the applicability and effectiveness of the system across diverse athletic disciplines.

Importance of our project:

1. Objective Evaluation: Our project integrates sensors and microcontrollers to provide data-driven assessments of athlete performance, eliminating subjective biases for accurate feedback.
2. Real-Time Feedback: Athletes receive immediate insights, enabling on-the-fly adjustments during training or competitions, fostering continuous improvement.
3. Personalized Training: Tailored training regimens based on individual performance insights optimize athletes' potential by targeting weaknesses.
4. Cross-Sport Applicability: Customizable for various sports, from running to golf, our project benefits athletes across disciplines.
5. Technological Innovation: Fusing sensor tech, microcontrollers, and data analytics, our project pioneers sports science, driving research and development in sports technology.

Conclusion:

In conclusion, our project pioneers a revolution in sports analytics by seamlessly integrating sensors, microcontrollers, and Decision Tree algorithms into athletic attire. This comprehensive system provides objective evaluations, real-time feedback, and personalized training regimens. Athletes leverage data-driven insights to refine technique, adjust training intensity, and prevent injuries. The system's customizability ensures applicability across sports and individual needs. It embodies the intersection of technology and athleticism, unlocking new possibilities for performance optimization. Looking ahead, we envision our project driving further innovation in sports analytics, empowering athletes, and reshaping the landscape of sports through continued research and development.

Smart Helmet for the Deaf

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Abstract: The assistive helmet for the deaf transform's safety for drivers with hearing impairments. It integrates LEDs for enhanced visibility, replacing traditional heads-up displays. The project prioritizes comprehensive assistance, empowering deaf drivers with intuitive visual cues for navigation and horn detection. Voice-to-text technology converts navigation cues into actionable commands, ensuring constant awareness. A sophisticated horn detection mechanism and automatic wiper system further bolster safety. Meticulously designed, this helmet seamlessly integrates advanced technologies to address unique challenges faced by deaf drivers, setting a new standard in assistive technology. It prioritizes visibility, usability, and effectiveness, empowering deaf drivers to navigate safely and independently on the road.

Introduction

The Smart Helmet for the Deaf revolutionizes motorcycle safety, integrating advanced technology for deaf riders' unique needs. Its intuitive navigation system uses LED indicators for clear visual cues, enhancing situational awareness. A sophisticated horn detection mechanism alerts riders to nearby vehicles in real-time, ensuring vigilance. Additionally, an automatic wiper system improves visibility in adverse weather. With a user-centric design, it empowers deaf riders to navigate with confidence. Bridging technology and accessibility, it sets a new standard in motorcycle safety gear, promising a safer future for deaf riders globally.

Project Description

Key features of the Assistive Helmet for the Deaf include:

1. Navigation Assistance: Visual cues provided by LED displays guide the driver through turn-by-turn directions, ensuring safe navigation even without auditory input.
2. Horn Detection: The microphone detects horn sounds from surrounding vehicles, allowing the system to alert the driver visually to potential hazards.
3. Adaptive Weather Mechanism: Environmental sensors detect adverse weather conditions such as rain, triggering an automatic wiper system to ensure clear visibility for the driver.

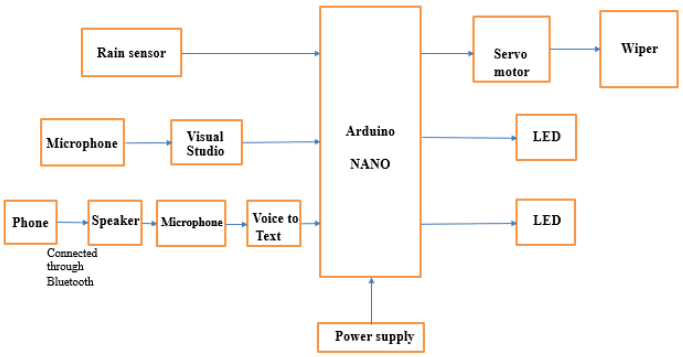

Fig. 1. Block diagram of proposed method

In this schematic diagram, the microphone captures ambient audio from the surroundings, which is then analyzed to identify vehicle horn sounds. Based on the side with the higher decibel value, the LED illuminates in that direction. In the absence of horn sounds, the LED remains inactive. When the mobile phone is connected to the speaker via Bluetooth, directional information is transmitted from the speaker through voice command to the microphone, convert it to text, and based on the information, instructing the LEDs output. If no connection is established between phone and speaker, the LED remains static. Additionally, an automatic wiper mechanism is activated upon rain detection, ensuring clear visibility. Conversely, if no rain is detected, the wiper mechanism remains idle.

Working

The system will interpret voice commands such as "turn right/left" within specific distance ranges and trigger corresponding LED patterns. For example, if the command is "turn right/left" without specifying distance, it indicates an immediate turn, prompting a LED chase pattern in the respective direction. Specific distance ranges (e.g., 0-100 meters, 100-200 meters, etc.) will each have their distinctive LED patterns to signal upcoming turns. Additionally, commands like "continue for 3km" will result in no LEDs being illuminated to indicate straight driving, while "continue for 1km" will cause all LEDs to glow red, signaling the driver to continue straight for that distance. Through testing and refinement, the system will provide clear visual cues to aid the driver's navigation.

In addition to navigation assistance, our project incorporates a sophisticated horn detection mechanism that analyzes auditory cues to identify which side the vehicle is approaching. The LED displays promptly indicate the direction of horn sounds. This feature significantly enhances situational awareness and safety, enabling deaf drivers to navigate busy traffic environments with confidence.

Furthermore, our project includes an automatic helmet wiper system that detects environmental conditions such as rain and activates the wiper mechanism accordingly. By ensuring clear visibility during adverse weather conditions, this feature enhances overall safety and comfort for deaf drivers.

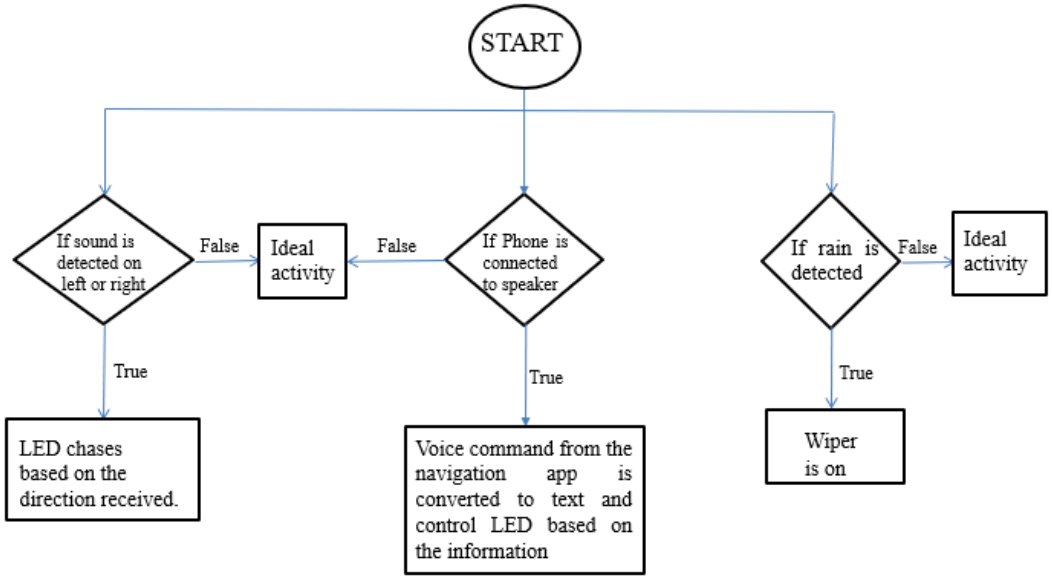

Fig. 2. Block diagram of workflow

Technical Description

The "Assistive Helmet for the Deaf" employs advanced hardware such as strategically positioned LEDs, a microphone, and environmental sensors, integrated with sophisticated software algorithms. These components offer real-time assistance to drivers with hearing impairments, providing visual cues for navigation and hazard detection. Speech-to-text conversion facilitates communication, while Bluetooth connectivity enables seamless integration with mobile devices. Python and Arduino IDE are utilized for algorithm development and microcontroller programming. This technical architecture ensures comprehensive support and safety enhancements for deaf drivers, marking a significant advancement in assistive technology for the road.

Importance of the Project

The "Smart Helmet for the Deaf" stands out for its tailored solution to address the safety needs of deaf drivers, integrating advanced technology seamlessly into motorcycle gear. Unlike traditional methods, it offers real-time visual cues and hazard detection, prioritizing safety, accessibility, and independence. Beneficiaries include deaf riders globally, empowering them to navigate roads confidently and safely, setting a new standard in inclusive motorcycle safety gear.

Conclusion

This project revolutionizes road safety and accessibility for drivers with hearing impairments. By integrating LED displays directly into the helmet, it offers essential visual cues for navigation assistance, optimizing routes and ensuring safe deliveries through partnerships with platforms like Swiggy and Zomato. Customization options for LED colours and brightness levels enhance user experience, while rigorous testing ensures reliability and compliance with safety regulations. This ambitious endeavour represents a significant step forward in enhancing road safety and inclusivity for all drivers.

Solar Powered Bus Station

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Abstract: The prevalent mode of public transportation in our country is buses, yet current bus stations lack essential features, such as adequate lighting and information displays, leading to discomfort and security concerns for passengers, especially at night. Introducing solar-powered bus stations addresses these issues sustainably, minimizing carbon emissions and dependency on traditional electricity sources. The proposed infrastructure integrates various components like solar panels, sensors, and Arduino-controlled systems to automate operations efficiently. Notably, a GPS module enables real-time tracking of buses via a dedicated app, enhancing passenger convenience. By enhancing user-friendliness and ensuring comfort and security, the project aims to modernize existing bus stations effectively.

Introduction

In today's world, the significance of solar power and renewable energy sources is widely recognized for their sustainability and non-polluting nature. Concurrently, existing bus stations fail to provide adequate facilities, security, and comfort to the public. Major drawbacks include insufficient lighting, manual operation leading to electricity wastage, and a lack of bus schedule information, causing inconvenience and uncertainty for commuters. Our project aims to address these issues effectively. By implementing Solar Powered Bus Stations, we harness solar energy through rooftop panels to power essential components like LED lights and fans, ensuring a sustainable energy source. Using a prototype with a 5V solar panel and a 12V battery for stability, we integrate various sensors, controllers, and modules managed by Arduino and NodeMCU to automate operations and enhance functionality. Additionally, a dedicated app, 'GPS Tracker Pro', developed using Flutter, provides real-time bus location updates and route information, improving passenger experience and promoting efficient, eco-friendly public transportation systems.

Project description

The Solar panel installed atop the bus station, angled as per the station's architecture, harnesses sunlight, converting it into electrical energy through photovoltaic cells. This process ensures a steady generation of direct current (DC) electricity, vital for powering station components. The panel's location, typically on rooftops or open fields, maximizes sunlight exposure, impacting the electricity output. However, due to voltage fluctuations inherent in solar panel output, maintaining a stable power supply poses a challenge. To ensure continuous operation, a 12V battery supplements the solar panel output, providing a consistent voltage source. Connecting the positive terminals of both the solar panel and battery to the breadboard, and linking their negative terminals to the Relay module facilitates electric flow within the system. The project encompasses two main modules: the Bus module and the Bus station module. The former, housed within buses, integrates a Node MCU and GPS module. Conversely, the latter, installed in bus stations, incorporates an Arduino UNO along with various sensors, LEDs, dual-channel relays, and a DC motor. Each module's components serve specific functions to enhance system performance and efficiency. In the Bus station module, the Arduino UNO serves as the central controller, orchestrating system automation. All sensors and components interface with the Arduino, facilitating seamless operation.

The Relay module, with five connections, regulates power distribution, enabling the Arduino to control high-power devices such as the DC motor. Connected to the Arduino's digital output pins, the relay acts as an electromagnetic switch, effectively managing power flow.

The PIR sensor detects motion within and around the bus station, transmitting data to the Arduino for further processing. Upon motion detection, the LDR sensor gauges ambient light levels, triggering LED illumination if light intensity falls below a certain threshold. Additionally, the DHT11 sensor monitors temperature and humidity levels, activating the DC motor when temperatures exceed a predefined threshold, aiding in ventilation.

Moving to the Bus module, the GPS module, connected to the Node MCU, receives signals from satellites, calculating the bus's position using trilateration or triangulation algorithms. These coordinates are then transmitted to a designated server for further processing. Leveraging software applications like GPS navigation or mapping software, the server interprets the received data, allowing real-time bus tracking and location display. Utilizing Flutter, we developed the 'GPS Tracker Pro' app, enabling users to access real-time bus locations and routes by scanning a QR code placed at the bus station. The app visualizes the bus's position on a digital map, along with its starting point and final destination, offering users an interactive experience including zooming, panning, and location searching.

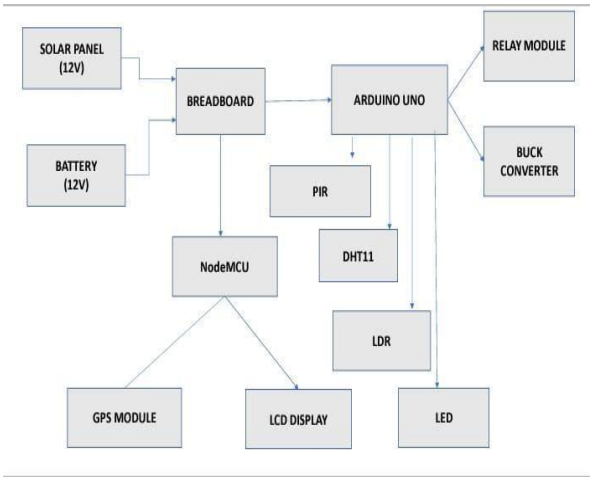

Fig. 1. Block Diagram

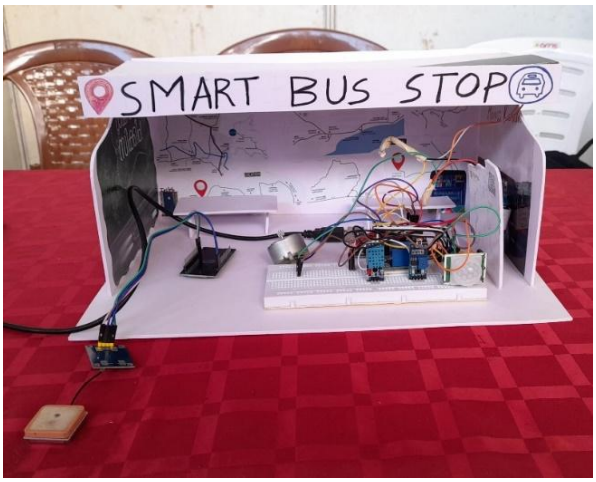

Fig. 2. Prototype

Importance of the Project

Existing bus stations suffer from manual operation of lights, leading to potential electricity wastage when unattended. Additionally, the absence of fans, bus route details, and live bus location updates at terminals poses significant limitations. Introducing Solar Powered Bus Stations offers a comprehensive solution, utilizing solar panels to generate electricity for operations.

The project design incorporates various sensors, modules, and controllers, dividing the system into Bus and Bus Station modules. Arduino governs the Bus Station module, managing sensors, LEDs, and motors, while NodeMCU oversees the Bus module, integrating the GPS module for app functionality. This integrated approach promises to address existing challenges effectively, providing an efficient and sustainable public transportation solution.

Conclusion

In this project, a comprehensive assessment of existing bus station's shortcomings were identified and the key issues are inadequate lighting, lack of route information, and poor maintenance. Addressing these challenges, we introduced the Solar Powered Bus Station concept, aligning with sustainable urban development goals. By harnessing solar energy, we reduce reliance on conventional power sources, minimizing greenhouse gas emissions and promoting environmental friendliness. Our design integrates a range of components, from sensors to GPS technology, enabling efficient operation and real-time bus tracking via the 'GPS Tracker Pro' app. The project's successful completion ensures enhanced passenger experience, with improved amenities and reduced energy consumption, achieving a 90% energy saving and an 80% decrease in maintenance needs. By embracing solar power and sensor technology, we pave the way for greener, more cost-effective public transportation infrastructure, meeting project objectives and surpassing performance expectations. Thus, our approach signifies a step forward in sustainable transportation solutions, offering both economic and environmental benefits to our community.

Acknowledgement

We would like to take this opportunity to express our profound gratitude towards many individuals, as without their kind support, it would not be possible for us to complete this project. We would like to extend our sincere thanks to our respected principal Dr. A G Mathew Sir for his immense support. We addressed many difficulties in coordinating the activities of the project, but we are highly indebted to Ms. Preethi Elizabeth Iype, our project guide for her continuous guidance and constant supervision as well for providing necessary information regarding this project and also for her support in completing the project. We would like to express my gratitude towards our project coordinator Mr. Rony K Thomas for her kind support and guidance. Also we express our sincere thanks to our HOD, Dr. Geenu Paul for helping as and for encouraging as. We also thank all our faculties for their valuable support throughout this project . We end up by thanking our dear parents, friends and all who helped us in finalizing the project with in the limited time frame. Last but not the least we thank Almighty, for letting us through all the difficulties we've experienced and for providing us with everything.

Automated Water Monitoring & Managing System for Aquaculture Using IOT

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Abstract: In recent years, the Internet of Things (IoT) has emerged as a transformative technology with profound implications for various sectors, including environmental monitoring and management. This paper presents an innovative IoT-based automated water quality monitoring and management system (AWQMS) designed to revolutionize the way we monitor and safeguard water resources.The AWQMS leverages a network of IoT-enabled sensors deployed at strategic locations throughout water bodies, continuously measuring crucial parameters such as pH, dissolved oxygen, turbidity, temperature, and conductivity. At the heart of the AWQMS lies advanced data analytics and machine learning algorithms, which analyze incoming data streams to detect anomalies and deviations from predefined water quality thresholds.

Introduction

In aquaculture, utilizing pond environments is crucial for successful fish farming, with water and soil serving as essential media for fish enlargement. However, the quality of pond environments degrades due to increased waste from feed remnants, feces, and fish excretion. Various water quality parameters, such as temperature, total dissolved solids (TDS), and pH, significantly influence fish growth and survival rates. Temperature and dissolved oxygen levels are particularly pivotal, impacting fish appetite, metabolism, and overall growth. Factors like sunlight radiation, air temperature, weather conditions, and geographical location contribute to fluctuations in water temperature. Sunlight, especially, warms the water surface faster than deeper layers, leading to temperature stratification and the formation of distinct layers like epilimnion, hypolimnion, and thermocline. Another critical parameter is pH, indicating the water's acidity or alkalinity.

Project Description

The AT Mega 328 microcontroller, commonly utilized in numerous projects requiring a simple, low-power, and cost-effective solution, is prominently featured in various Arduino development platforms such as the Arduino Uno, Arduino Pro Mini, and Arduino Nano models. Equipped with 14 digital input/output pins, 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, power jack, ICSP header, and reset button, it offers comprehensive support for microcontroller operations. Its integration with the Arduino IDE software facilitates programming ease and efficiency.In the context of the Automated Water Quality Monitoring & Managing System, the Arduino Uno board serves as the central processing unit, orchestrating sensor inputs and relay outputs. The system employs four inputs, with three connected to the microcontroller's analog pins and one to the digital input pin. While the microcontroller can accommodate up to six analog inputs, the current implementation utilizes only three, leaving room for expansion in advanced iterations of the system.Key sensor connections include the turbidity sensor to analog input pin A0, the temperature sensor to analog input pin A2, and the water level sensor to digital input pin D12. Threshold comparisons of sensor readings activate relays connected to pin D9, facilitating automated responses based on preset conditions. Internet connectivity for the microcontroller is facilitated through a WiFi module, which uploads sensor data to cloud storage. The WiFi module interfaces with the microcontroller via Rx and Tx pins, providing seamless communication between the two components. To accommodate the voltage disparity between the microcontroller (operating at 5 volts) and the solenoidal valves and relay (requiring 12 volts), optocouplers serve as isolation devices. Optocouplers, connected

between the microcontroller and the solenoidal valves/relay, prevent voltage feedback and potential damage to the microcontroller. This setup ensures reliable operation and protects against electrical disturbances. Threshold values, typically set between 7 and 8.5 for pH measurements, dictate the operation of solenoidal valves. Depending on whether the pH reading falls below 7 (acidic) or above 8.5 (basic), corresponding valves are activated to manage water quality parameters until neutralization is achieved.

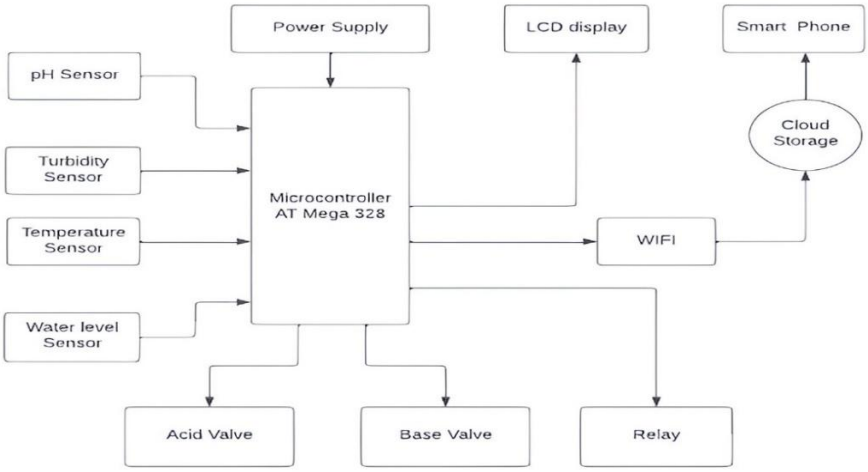

Fig. 1. Block diagram of the system

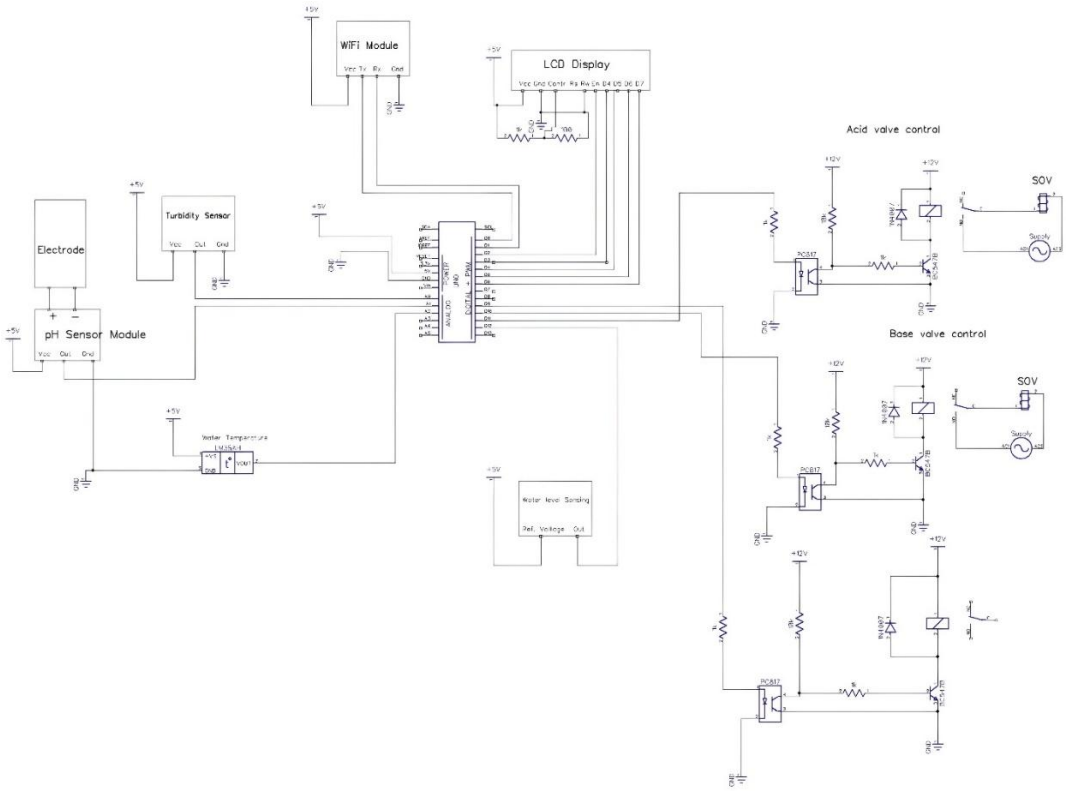

Fig. 2. Circuit diagram of the system

Importance of the Project

An automated water quality monitoring system employing IoT in aquaculture is pivotal for real-time surveillance, fostering optimal conditions for aquatic organisms, maximizing productivity, and reducing operational costs. Its beneficiaries include aquaculture farmers, who benefit from enhanced productivity and reduced risks, consumers enjoying high-quality seafood products, and regulatory agencies ensuring environmental compliance. Additionally, improved water quality supports ecosystem health, benefiting biodiversity and downstream habitats. This technology streamlines monitoring, enabling proactive responses to deviations, and contributes to sustainable aquaculture practices, safeguarding both industry interests and environmental integrity.

Conclusion

A water quality monitoring system, utilizing water detection sensors and leveraging an existing GSM network, offers automatic surveillance of turbidity, pH, and temperature. This setup ensures cost-effectiveness, eliminating the need for on-site personnel and enhancing the efficiency and convenience of water quality testing. Its adaptability allows for easy integration of additional parameters by simply swapping sensors and adjusting software programs. This versatility extends to monitoring various environmental factors like hydrology, air pollution, and industrial processes, highlighting its value in environmental monitoring and the concept of a smart environment. Sensor deployment enables real-time data collection and analysis, facilitating interaction with other objects via the network. With a total expenditure of approximately 83.79 USD, this research introduces a low-cost water quality monitoring system for aquaculture. Integrated sensors monitor temperature, pH, and total dissolved solids (TDS), enabling remote monitoring via an Android platform. Real-time smartphone monitoring provides fish farmers with crucial water parameter data for ensuring optimal water quality.

Acknowledgement

We extend our heartfelt gratitude to Almighty God for granting us the blessings to successful complete of this paper. We sincerely appreciate the inspiration, support, and guidance of all individuals who played a pivotal role in achieving this milestone and A.P.J. Abdul Kalam Technological University, Kerala. Special thanks to Er. Jose Thomas, Secretary of St Thomas Educational Society, for providing timely resources and invaluable insights that contributed to the successful completion of the preliminary work for this paper. We are deeply grateful to Dr. Shajan Kuriakose, Principal of St. Thomas College of Engineering and Technology, Chengannur, for generously providing all necessary facilities for conducting our research. Our sincere appreciation also goes to Dr. Asish B Mathews, Head of the Department of Electronics and Communication Engineering, and all the staffs of the Department of Electronics and Communication Engineering for their unwavering support, guidance, and encouragement throughout the process.

CultiNova: Solar Powered Innovation for Precision Agriculture and Disease Detection

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Abstract: CultinNova tackles tomato crop management through deep learning. It analyzes soil conditions, weather data, and tomato leaf images to identify diseases, optimize water usage with soil sensors, and empower informed decision-making. Early disease detection and efficient resource management contribute to sustainable agricultural practices, ultimately enhancing tomato crop yields. This agrobot merges advanced technologies to revolutionize tomato farming, promoting efficient food production and responsible resource utilization within the agricultural sector.

Introduction

Tomatoes, vital for both nutrition and agricultural economies, demand precise soil conditions and irrigation for optimal growth and yield. Factors like moisture, temperature, humidity, and rainfall play crucial roles. CultinNova addresses the necessity for efficient water management through its innovative agrobot solution. Utilizing deep learning and soil sensors, it analyzes tomato cultivation needs, facilitating optimized irrigation and early disease detection. Through promoting sustainable practices and informed decision-making, CultinNova stands poised to revolutionize tomato farming, making significant contributions to food security.

Project Description

This project aims to develop and deploy CultinNova, an advanced agrobot specialized in precise crop management, particularly focusing on tomatoes. Leveraging cutting-edge technologies like Convolutional Neural Networks (CNN) and EfficientNetV2, CultinNova will detect crucial parameters such as soil moisture levels, atmospheric conditions, and potential diseases affecting tomato plants. Beyond conventional irrigation methods, CultinNova will optimize water distribution using soil moisture sensors, enhancing resource efficiency. The motivation behind this endeavor arises from the urgent need to improve agricultural practices in response to escalating challenges such as food security and sustainability. Tomatoes, being a staple crop with substantial economic and nutritional significance, serve as a fitting focal point for this project. By addressing key issues like efficient irrigation and disease management in tomato cultivation, CultinNova endeavors to propel precision agriculture forward, thereby bolstering crop yields, resource management, and overall agricultural sustainability.

Working

The real-time tomato disease detection system utilizes a pre-trained machine learning model, EfficientNetV2B0, on a Raspberry Pi 5. The process as depicted in Fig 1 involves loading the trained TensorFlow model, which distinguishes between healthy and diseased tomato plants based on visual features. Video frames are read from a file or webcam, then preprocessed by resizing to the model's input size and normalizing pixel values. The preprocessed frame is fed into the model for disease prediction, generating probabilities for various tomato diseases like Bacterial Spot or Early Blight. The disease with the highest probability is identified. The predicted disease name is overlaid on the video frame, facilitating visual disease identification. Users can control the system with the 'q' key to quit the program and halt the

video processing loop. This integrated approach enables real-time monitoring and diagnosis of tomato plant health, aiding in timely intervention and crop management. A continuous feedback loop is present where the robot constantly monitors the black line using the IR sensors. Based on the detected line position, the motor speeds are adjusted to keep the robot centered on the line. If the line is lost momentarily, the robot stops briefly before resuming its search. This closed-loop control system enables the robot to autonomously follow the designated path. The ESP32 continuously reads sensor data (temperature, humidity, and soil moisture), calculates the likelihood of rain, and transmits this information to the Blynk App for remote monitoring as obtained in Fig 2.. Additionally, the Blynk App can be used to control the LED remotely, potentially for irrigation based on moisture levels.

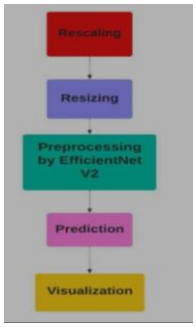

Fig. 1. Flow Chart for Disease Detection

Fig 2: Blynk App Display of Soil Parameters

Importance of the Project

CultiNova distinguishes itself by combining disease detection through image analysis for early intervention and reduced crop loss, with sensor-based precision irrigation that optimizes water usage and resource savings. Additionally, rainfall prediction allows farmers to adjust irrigation schedules, preventing overwatering. This multifaceted approach benefits farmers by minimizing losses, conserving water, and optimizing resource utilization through informed decision-making based on weather prediction, making CultiNova a comprehensive solution for improved tomato crop health and resource management.

Conclusion

CultiNova has successfully combined disease detection, precision irrigation, and rainfall prediction, offering a comprehensive solution for optimized tomato crop management. This unique system empowers farmers to minimize crop losses through early disease intervention, conserve water with sensor-based irrigation, and optimize resource utilization based on weather predictions. Further research can refine the system's accuracy, expand disease detection capabilities, and explore integration with other agricultural practices, paving the way for even greater impact on tomato crop health, resource management, and overall agricultural sustainability.

Acknowledgement

First of all to the Great Almighty, the author of knowledge and wisdom for his countless love. With great respect, we express our sincere thanks to our Head of the Department, Dr. Abhilash Antony for the proper guidance and support. We would like to sincerely thank our guides Ms. Binu Manohar and Dr. Dhanya S, for their support and valuable guidance.

Solar-Driven Hydrogen and Oxygen Production for Clean Cooking and Medical Applications

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Abstract: The novel project of solar-driven hydrogen and oxygen production is unique as it is energy-intensive processes. Involving solar power generation, the activity of separating and storing a gas mixture of hydrogen and oxygen, and cooking and other medical processes provides a more convenient and renewable alternative to such power generation facilities. Gases are released and stored through solar panels and electrolysis, while utilizing the gases as environmentally friendly alternative for the purposes of cooking and medical processes, also reduces carbon combustion. Throughout the years, this will allow households to become more ecologically friendly, thus contributing to the future.

Introduction

The solar-driven production of hydrogen and oxygen is a visionary and environmentally responsible project that targets revolutionizing cooking and medical applications. The initiative aims to eliminate the need for current cooking techniques, making solar power a directly usable and sustainable energy source. The project's primary objective is resolving household energy production while eliminating the high environmental costs of existing cooking practices. Focusing on sustainability and the environment, the innovation marries technological advancement and environmentalism to promote a future in which the energy demands are satisfied responsibly. The project's implications are massive, as it paves the way for a cleaner and more sustainable future in which the environment is conserved due to lowered energy usage.

Project description

The solar-driven project for hydrogen and oxygen production is a new sustainable initiative aimed at providing cooking and medical resources for areas without electricity or clean water. The many-sided scheme starts with solar panels which convert sunlight into electricity. This green power is then transmitted to an electrolysis system in which water is split into its constituent gases, hydrogen and oxygen. What sets this project apart is that it changes the gases produced into a supercritical fluid form; an advanced state combining liquid-like density with gas-like diffusivity thereby improving their storage efficiency and stability. In places where there might be no traditional infrastructure, such as those lacking reliable power supply systems or pipelines for transporting these separated gasses over long distances due to their inherent danger, this supercritical fluid state ensures availability of hydrogen and oxygen as separate entities but easily accessible from one another too.

The dual role played by separated hydrogen within this sustainable system cannot be overemphasized because on one hand it acts as clean fuel used for cooking purposes only mainly among communities relying heavily on old fashioned methods such as wood burning stoves while at the same time serving. At the same time, oxygen is made usable for emergency medicine. In particular, it may be used for respiratory therapy and to cater for health care needs in communities that lack electricity or clean medical supplies. Oxygen production driven by solar power is a dependable means of supplying medical facilities especially in regions where conventional sources may not be accessible due to infrastructure challenges. Essentially, this project shows a comprehensive strategy towards overcoming energy and healthcare bottlenecks in underserved areas.

The scheme does not only promote environmental conservation through utilization of solar energy but also improves general living standards among people who have no electricity or clean water because they use hydrogen gas for cooking while still getting oxygen which serves their health needs best.

Block Diagram

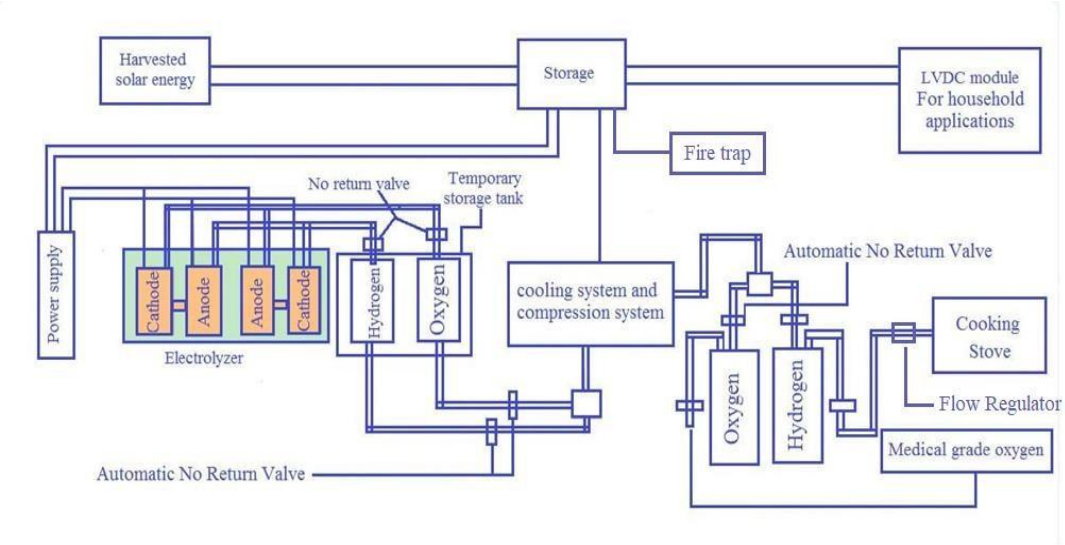

Fig. 1. Block Diagram

Designing a solar-driven system for hydrogen and oxygen production involves several key components and considerations. The first way is to use the sun's panels in converting sunlight into electric energy which acts as the main power supply for this system. This electricity produced then drives an electrolysis process at low voltage direct current (LVDC) which helps split water into hydrogen and oxygen. Some check valves that are automatic are included in order not to allow gas backflow. Besides, it is necessary to have a tank where both these elements can be stored before being used. Cooling and compression systems enable regulation of heat levels and pressures during production or storage respectively. For example, oxygen should meet medical standards since its application is mainly done within health-related fields while the rest of them may find use elsewhere including cooking stoves among others.A good design must put efficiency first hence effective utilization calls for proper management represented by "Power Buy." However, safety remains key throughout all phases so scalability along with integration forms part of our approach towards achieving such goals. Furthermore, compliance with environmental requirements ought not be ignored either because it contributes greatly towards sustainable development in terms of both energy provision and resource conservation during realization process.

Importance of the Project

The solar driven hydrogen and oxygen production combines renewable energy generation with cooking fuel production for medical purposes thereby solving two global problems at once. Such a program benefits areas without electricity or clean water since it ensures a dependable and green power supply for cooking as well as life-saving oxygen provision in hospitals. By filling the space between energy demand and health care service delivery among marginalized communities, this initiative promotes ecological consciousness while ensuring improved quality of life over long periods.

Conclusion

The solar-driven hydrogen and oxygen production project underscores its transformative potential in shaping a sustainable and resilient future. Through powering solar-driven hydrogen and oxygen production research project, the initiative not only sensitizes but also capacitates the transformation to a more sustainable and robust future. The project reiterates that clean energy technologies are not a one-time solution, but a process, thus continuing the regular research, innovation, and implementation. It also concretizes the reduction of the global transition to a world that is more sensitive to the environment, as it solves the energy crisis in marginalized areas in addition to healthcare. Due to the economies of scale and the improvement in technology, it goes into cost-effective proportions which necessitates public and private uptake. It ushers the globe into a more advanced and nature-friendly system.

Remotely Operated Underwater Robot

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Abstract: Robots that operate underwater that are remotely operated (ROVs) have become indispensable for a wide range of underwater tasks, from environmental monitoring to industrial applications to scientific research. An overview of the main ideas and developments in the field of ROVs is given in this abstract. These are remote-controlled, autonomous underwater vehicles that are operated by people on the surface. They are essential to deep-sea exploration because they let people go to places that would be dangerous or unreachable otherwise. With real-time data collection capabilities provided by ROVs that are outfitted with cameras, sensors, and manipulation tools, scientists can study marine ecosystems, geology, and biodiversity with previously unheard-of precision. Robotic underwater vehicles (ROVs) are utilized in industrial settings to perform tasks like underwater inspections, offshore structure maintenance, and underwater cable and pipeline installation. They are indispensable tools in situations where human intervention is unsafe or impractical due to their dexterity and adaptability.

Introduction

With human ingenuity, Remotely Operated Underwater Robots (ROVs) are a remarkable technological advancement that allows us to explore the vast and mysterious depths of our oceans. These extremely advanced devices are made to navigate and carry out tasks in underwater environments that are frequently too dangerous or inaccessible for human divers. With the help of their numerous sensors, cameras, and manipulator arms, remote control capabilities of ROVs enable their operators to direct their movements and actions from the surface.

ROVs are vital instruments that are used in many different fields, such as underwater inspections, marine research, and offshore oil and gas exploration. They are also essential in helping to discover the mysteries of the ocean's depths. Their capacity to endure high pressure, investigate complex underwater environments, and carry out accurate maneuvers renders them indispensable in furthering our comprehension of the ocean and its varied ecosystems. Remotely operated underwater robots will surely stay at the forefront of underwater exploration as technology advances; pushing the envelope of what is possible in the unexplored areas beneath the waves.

Project description

A block diagram of an underwater Remotely Operated Vehicle (ROV) typically includes various subsystems and components that work together to enable the vehicle to operate underwater. Keep in mind that the specific design and components may vary depending on the ROV's purpose and manufacturer. Designing a remotely operated underwater robot involves a comprehensive methodology to ensure its successful operation in challenging aquatic environments.

The process typically begins with a thorough analysis of mission requirements and environmental conditions, including water depth, temperature, and potential obstacles. The next step involves defining the robot's specifications, such as size, weight, and payload capacity, to meet the mission objectives effectively. Engineers then select appropriate materials and components that can withstand underwater pressures and corrosion. Here’s the generalized block diagram:

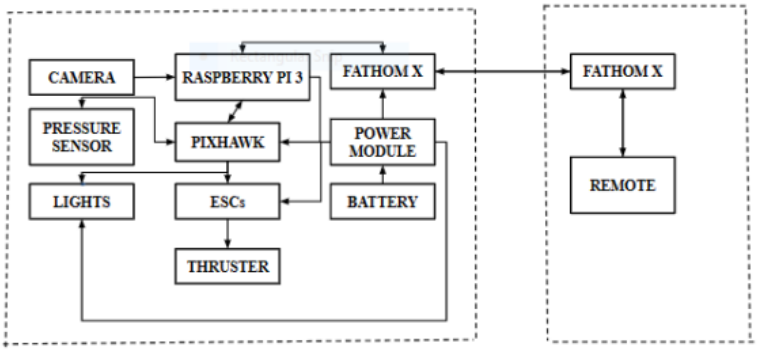

Fig.1. Block diagram of underwater ROV

The development phase includes the integration of sensors, cameras, and communication systems to enable remote operation and real-time data transmission. The robot's control system is designed to provide precise maneuverability and responsiveness to user commands. To ensure robust communication, a reliable underwater communication protocol is implemented, taking into account the challenges posed by water as a medium. Testing plays a crucial role in the methodology, involving both simulated and real-world underwater scenarios. This phase helps identify and address any issues related to the robot's functionality, performance, and durability. Additionally, safety measures are implemented to protect the robot from potential malfunctions and to prevent environmental damage. Throughout the entire process, collaboration between multidisciplinary teams, including mechanical engineers, electrical engineers, software developers, and marine scientists, is essential. Continuous feedback loops and iterative improvements are employed to refine the robot's design and functionality. The final robot is then ready for deployment in various underwater applications, such as exploration, inspection, and maintenance.

Fig.2 ROV Design

Importance of the Project

ROV equipped with 8 thrusters but devoid of cameras and sensors serves as a compelling exploration into alternative avenues of underwater technology. By prioritizing thruster development over conventional sensory feedback mechanisms, this project opens doors to novel applications and research domains. It underscores a strategic shift towards emphasizing propulsion efficiency, maneuverability, and stability in underwater environments where visual feedback may be limited or unnecessary. This approach not only fosters innovation in ROV design but also paves the way for cost-effective solutions tailored to specific tasks or environments.

Moreover, it provides a fertile ground for educational and research endeavors, offering insights into the intricate interplay between propulsion systems and underwater operations. In essence, this project represents a bold departure from traditional ROV paradigms, offering promise for unlocking new possibilities in underwater exploration and technology. The ROV, distinguished by its utilization of 8 thrusters while lacking cameras and sensors, presents a notable departure from conventional ROV designs. Unlike its counterparts, which heavily rely on sensory equipment for navigation and data gathering, this ROV places paramount importance on propulsion technology. With its sophisticated array of thrusters, it promises enhanced maneuverability and control, suggesting suitability for tasks demanding precise underwater movement. By eschewing cameras and sensors, it signals a strategic pivot towards applications where visual feedback is superfluous or impractical. This deliberate omission likely streamlines the design, enhancing reliability and reducing costs, making it an appealing choice for targeted tasks and environments. Moreover, this ROV project embodies a forward-looking approach to research and development, offering a platform to explore novel propulsion systems and advance the frontier of underwater robotics. In essence, it represents a compelling innovation in ROV technology, poised to address specific challenges and uncover new opportunities in underwater exploration and operation.

The ROV offers potential benefits to various stakeholders across different sectors. Industries involved in underwater construction, maintenance, and infrastructure projects could leverage its precise maneuverability and control for tasks such as pipeline inspection, offshore platform maintenance, and underwater welding. Research institutions and academia could utilize this ROV to study underwater locomotion, control algorithms, and marine biology, contributing to advancements in robotics and autonomous systems. Government agencies responsible for marine conservation and environmental monitoring could employ it for seabed mapping, habitat assessment, and oil spill cleanup operations. Commercial diving and salvage companies could find value in its agility and reliability for underwater salvage and commercial diving operations. Additionally, educational institutions could integrate this ROV into their curriculum to provide students with hands-on experience in ROV operation and engineering, preparing them for careers in underwater exploration and technology. In summary, the beneficiaries of this ROV span industries, research fields, and educational sectors, each finding utility in its unique capabilities and applications.

Conclusion

Underwater remotely operated vehicles (ROVs) play a crucial role in various industries and scientific endeavors, providing a versatile and efficient means of exploring the depths of the ocean. These submersible robots have proven invaluable in tasks such as deep-sea exploration, underwater archaeology, marine research, offshore industry support, and environmental monitoring. The advantages of ROVs include their ability to operate in extreme depths and harsh underwater environments without exposing humans to potential risks. They can be equipped with a variety of sensors, cameras, and tools to capture high-quality imagery, collect data, and perform intricate tasks. The real-time feedback and control offered by ROVs allow operators to navigate, manipulate objects, and conduct experiments with precision. While ROVs have significantly advanced our understanding of the underwater world and facilitated the execution of complex tasks, challenges still exist. Issues such as power limitations, communication latency, and the high cost of advanced ROV systems remain areas for improvement. Continued technological innovation and research are needed to enhance the efficiency, autonomy, and cost-effectiveness of underwater ROVs.

Enhancing Solar Energy Harvesting Through Flywheel Integration

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Abstract: Harnessing solar energy efficiently, our system integrates a pulley-driven DC motor connected to a flywheel, acting as a kinetic energy reservoir. This kinetic energy powers a dynamo, interfaced with an inverter circuit, augmenting and storing surplus energy. By optimizing energy production, our setup maximizes solar power utilization, reducing dependence on extensive solar panel arrays. This innovative approach addresses challenges such as installation costs and spatial limitations while mitigating environmental impacts. With a focus on sustainability, our system offers a promising avenue for accessing clean energy, minimizing reliance on fossil fuels.

Introduction

This project aims to enhance solar energy utilization by integrating mechanical components to store and augment energy output. Utilizing solar panels as the primary energy source, a system comprising a DC motor, pulley system, flywheel, dynamo, and inverter circuit will be designed and implemented. Solar energy will be converted into mechanical energy to drive the flywheel, store kinetic energy, and further amplify it through electrical conversion. Successful implementation could offer an innovative approach to maximize solar energy efficiency, reducing reliance on extensive solar panel installations and contributing to sustainable energy solutions.

Objective of the Project

The objectives for this project are: The system's goal is to produce more power with the least number of solar panels possible because it is expensive, requires more space, requires a complicated installation, requires maintenance, and so forth. By adding an additional component to the solar panel, such as a flywheel, alternator, inverter, and motor, we can generate more electricity while using fewer solar panels.

Overview

The escalating global demand for sustainable energy solutions in light of population growth and dwindling fossil fuel reserves has steered attention towards renewable sources, prominently, solar energy conservation. Renowned for its renewable and inexhaustible nature, solar energy has emerged as a pivotal alternative. However, the proliferation of solar panels introduces challenges such as heightened installation expenses, limited space availability, intricate maintenance demands, and potential environmental implications from manufacturing to disposal. Yet, solar panels epitomize a clean, enduring energy source, promising long-term cost savings and reducing reliance on conventional fossil fuels.

Seeking to curtail the number of solar panels utilized, a novel approach harnesses solar energy to power a DC motor through a pulley-driven mechanism, subsequently storing kinetic energy in a flywheel. This rotational energy is transformed via an alternator connected to an inverter circuit, yielding surplus energy beyond its consumption threshold. This innovative setup not only optimizes solar energy utilization but also integrates mechanisms for monitoring flywheel revolutions, employing a hall effect sensor to regulate motor activation, thereby presenting an intricate yet efficient means of sustainable energy utilization

Block diagram of proposed system

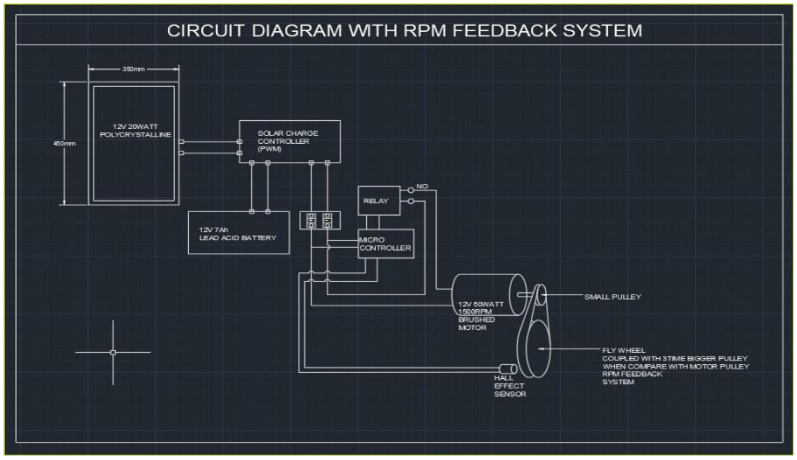

Fig. 1. Block diagram of Proposed system

Working

The solar panel, rated at 12 volts, yields an output between 16 to 18 volts, producing 20 watts of power. This power is directed to a 12-volt solar charge controller equipped with pulse-width modulation (PWM) technology. The controller integrates a buck converter that regulates voltages surpassing the setpoint limit and transfers the power to a lead-acid battery, supplying 12 volts at 10 amps. Though the battery is labeled as a 12-volt system, its rated voltage stands at 13.5 volts. Utilizing this battery, a 12-volt brushed motor, rated at 15 watts, operates at 1500 revolutions per minute (rpm). Simultaneously, a small pulley attached to the motor rotates at 1500 rpm, transmitting this motion to a flywheel. Consequently, the flywheel rotates at 800 rpm, generating additional energy. Initially, the solar panel produces 20 watts at 0.5 amps, and through the flywheel's output, this increases to 25 watts at 1 amp. The flywheel, coupled with a 12-volt dynamo, produces electrical output, which is then directed to an inverter circuit. This circuit converts the dynamo's output into a usable form and supplies it to the intended load. A hall effect sensor, positioned in proximity to the flywheel, monitors its revolutions. Upon reaching a predetermined threshold, the sensor triggers the controller to signal the relay, ceasing motor activation. Conversely, if the sensor detects a reduction in flywheel revolutions, it prompts motor re-energization, maintaining the system's operation. This feedback mechanism ensures efficient and controlled rotational speed, optimizing energy generation and distribution.

Importance of the Project

Integration of mechanical components allows for the conversion of solar energy into mechanical energy via the DC motor and pulley system. The mechanical energy is stored in a flywheel, further converted into electrical energy through an alternator and inverter circuit for amplification.

• The system's primary aim is to optimize solar energy utilization, potentially reducing the need for extensive solar panel installations while maintaining or increasing energy output.

• Assessment of the system's environmental implications throughout its lifecycle to ensure 4 sustainability and minimal ecological footprint compared to traditional energy generation methods.

Everyone who uses solar energy will find this useful.

Conclusion

In conclusion, the implementation of our solar energy system utilizing a combination of solar panels, charge controllers, batteries, and mechanical components such as brushed motors and flywheels has exhibited promising results. Through harnessing solar energy efficiently and storing it in batteries, we've successfully utilized kinetic energy generated by the flywheel to produce additional power via the dynamo and inverter circuit. This project highlights the potential for integrating various renewable energy technologies to optimize energy capture, storage, and utilization. The reliable operation of the system, coupled with the utilization of kinetic energy, demonstrates a feasible approach towards sustainable and efficient energy production.

Gravity Based Continuous Power Generation

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Abstract: Gravity-based continuous power generation is an innovative and sustainable approach to harnessing energy from the Earth's gravitational force. Elevated weights are used to store potential energy and transform it into electrical power when released due to gravity. Water from the reservoir is used to lift the weight back to the initial position by acting as a counter weight at the opposite side. The system offers an environmentally friendly and reliable energy source with the potential to enhance energy storage and grid stability. The key components of gravity-based power generation include kinetic energy conversion mechanisms and associated technologies. It also highlights the environmental benefits, scalability, and integration possibilities of this emerging field, making it a promising solution for the transition to cleaner and more sustainable energy sources. The applications of Gravity based power generation span from grid-level energy storage to micro grid systems, remote power installations, and beyond. These systems use gravitational potential energy to store excess energy during low demand and release it as needed. Contributing to a more reliable and resilient energy infrastructure.

Introduction

Electricity is an integral part of the modern economy and its importance is only increasing with the growing demand for electricity services. The rise in household incomes, electrification of transportation and heating, and increased use of digital devices and air conditioning are expected to drive up the demand even further. However, this increase in demand has led to record-breaking CO2 emissions in the global energy sector in 2018. The availability of low-emission power generation technologies has made it a priority for climate change pollution reduction efforts. Renewable energy can help ensure universal access to electricity. Experts predict that global electricity demand will increase by 2.1% per year until 2040, which is twice the rate of primary energy demand. As a result, electricity's share of total final energy consumption is expected to increase from 19% in 2018 to 24% by 2040. The electricity demand is expected to grow significantly in developing economies. However, we are still relying on conventional source of energy such as fossil fuels to generate electricity, which are non-renewable and have a short lifespan. Gravity-based continuous power generation capitalizes on the principles of potential energy and gravity to generate a consistent and renewable power supply. The concept is rooted in the fundamental physical relationship between the gravitational force exerted by the Earth and the potential energy stored in an elevated mass. This potential energy can be harnessed and converted into useful work, offering a sustainable solution for continuous power generation. The central idea involves the cyclic process of lifting a mass to a certain height, thereby storing potential energy in the gravitational field. As the mass descends under the influence of gravity, this potential energy is transformed into kinetic energy, setting the mass in motion. The mechanical motion generated during the descent is then captured and utilized to drive a generator, converting the kinetic energy into electrical energy.

Project description

The basic working principle of this Gravity based continuous power generation is Faraday's law of electromagnetic induction. The mechanical energy of gear is converted into electrical energy. The hard ware includes DC generator, freewheel, roller chain, voltage regulator, battery etc. Gravity based continuous power generation, works by storing and releasing potential energy created by raising heavy objects to a higher position and then allowing them to descend.

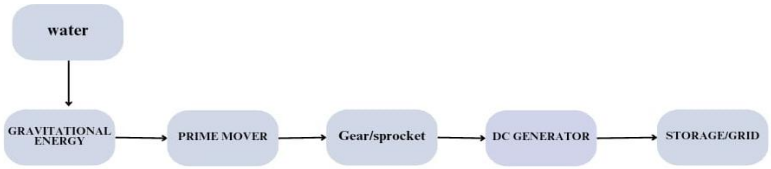

Fig.1. Block diagramof gravity based continuous power generation

Working

(i) **Charging Phase**: Initially, the system starts with heavy weights (usually filled containers or blocks) positioned at a higher elevation. The water from the reservoir is used to lift these weights to a higher level, converting electrical energy into potential energy.

(ii) **Discharging Phase**: When electricity is needed, the weights are allowed to descend under the influence of gravity. As they descend, they turn a generator or motor, converting the potential energy back into electrical energy.

(iii) **Energy Distribution**: The generated electricity can be fed into the electrical grid or used to power specific applications.

The shaft of the DC generator rotates while descend of weight. In a DC generator, field coils produce an electromagnetic field and the armature conductors are rotated into the field. Thus, an electromagnetically induced Electromotive Forces generated in the armature conductors. The direction of induced current is given by Fleming's right hand rule. Thus electricity can be obtained by exercising. This electricity can be regulated and stored in a battery.

Importance of the Project

Gravity-based power generation projects are a significant innovation in the field of renewable energy. They leverage the constant and omnipresent force of gravity to generate power, making them a renewable and continuous source of energy. These projects utilize a gravity energy conversion unit to convert potential energy into kinetic energy, which is then converted into electrical energy. The mechanisms involved in gravity power generation are simplified, efficient, and environmentally friendly. They require minimal starting energy for long-term energy conversion.

An added advantage is that gravity can be used for energy storage, filling batteries during peak conditions when energy from other renewable sources is plentiful. When demand for power exceeds supply, this stored energy can be released. Gravity-based power generation projects can overcome the limitations of other electricity production methods, which can only capture energy in specific quantities and to a certain extent. Thus, these projects play a crucial role in meeting our energy needs sustainably and efficiently. They represent an innovative approach to harnessing the power of one of nature’s fundamental forces.

Gravity-based power generation systems uniquely harness gravity, a consistent and ubiquitous force. They’re environmentally friendly, requiring no fuel combustion. Unlike traditional systems, they can store energy, converting potential energy into electrical energy as needed. Their longevity and low maintenance costs further distinguish them from conventional power generation systems.

Conclusion

Gravity-based power generation systems are a unique innovation in renewable energy technology. They utilize the constant force of gravity, making them a reliable and continuous source of power. Unlike other energy sources, gravity is not dependent on weather or time of day. These systems are environmentally friendly, emitting no pollutants and requiring no fuel. They also offer the advantage of energy storage, a feature not commonly found in traditional power systems. With their longevity and low maintenance costs, gravity-based power generation systems present a sustainable, efficient, and promising solution for our future energy needs.

Solar Powered Battery Charger Using Boost Converter for Agricultural Pre-Cooling System

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Abstract: The project develops a standalone agricultural precooling system powered by solar energy, employing Peltier modules for cooling. It optimizes solar energy harvesting via a boost converter and implements Maximum Power Point Tracking (MPPT). DC-powered components enhance efficiency, with a DC battery charged by solar power. Temperature monitoring and control are integrated using an ESP32 microcontroller. This approach ensures eco-friendly precooling, reducing reliance on conventional power sources. By efficiently precooling fruits and vegetables, it promotes sustainability in agriculture. The initiative represents a crucial step toward technologically advanced and sustainable precooling practices, aligning with eco-friendly agricultural principles.

Introduction

In response to the urgent need for sustainable agricultural practices, this project presents a pioneering solution: a standalone precooling system powered by solar energy. By significantly reducing reliance on traditional power sources, our system aims to revolutionize the sustainability of precooling methods for fruits and vegetables. Central to our innovation is the integration of a 36V, 200W photovoltaic array with a sophisticated boost converter and microcontroller-driven Maximum Power Point Tracking (MPPT) system. This setup optimizes energy transfer, ensuring efficient charging of a 48V battery pack. The stored energy powers an automated miniature precooling system, leveraging Peltier modules for effective cooling. Moreover, real-time monitoring and control functionalities provided by the ESP32 microcontroller ensure precise temperature and humidity regulation, thereby safeguarding produce quality. With scalability envisioned for larger agricultural operations, our project heralds a transformative shift towards sustainable precooling practices, promising heightened efficiency and broader environmental benefits.

Project description

The solar-powered agricultural precooling system operates through a carefully orchestrated series of steps, beginning with the harnessing of solar energy. A 36V, 200W photovoltaic (PV) array captures sunlight and converts it into electrical energy, serving as the primary power source for the system. This harvested energy undergoes optimization through a boost converter circuit, which boosts the voltage from 36V to 54V, ensuring efficient utilization of available solar power. Concurrently, a sophisticated Maximum Power Point Tracking (MPPT) system, integrated with a Texas Instruments (TI) LaunchPad featuring the F28004x C2000 real-time MCU. This microcontroller unit, dynamically adjusts the electrical load to match the maximum power output of the PV array, enhancing overall system efficiency. The boosted 54V output from the converter is directed towards charging a battery system. This battery serves as a crucial energy storage unit, capable of storing excess energy generated during periods of high solar irradiance for later use. As a result, the system maintains operational continuity even during periods of reduced solar input, ensuring uninterrupted functionality. The stored energy within the battery powers an automated miniature precooling system, a key component of the overall setup. Utilizing Peltier modules driven by the battery's stored energy, the precooling system effectively leverages the Peltier effect to provide efficient cooling. These modules play a vital role in maintaining optimal temperatures necessary for preserving the freshness and quality of fruits and vegetables, thereby mitigating post-harvest losses.

Our precooling system also incorporates an ESP32 microcontroller, facilitating real-time monitoring and control of essential parameters like temperature, humidity, and system performance. Through a dedicated application, farmers gain remote access to monitor the system's status, enabling proactive management for optimal produce preservation. Notably, the system's versatility and scalability enable seamless adaptation to diverse agricultural settings, from small-scale farms to larger operations. Its modular design ensures broad applicability, enhancing productivity and sustainability across the agricultural sector. Additionally, its scalability ensures that the benefits of solar-powered precooling can be leveraged across various contexts, meeting the unique needs of different farming communities.

Overall, the solar-powered agricultural precooling system represents a transformative solution that addresses key challenges in modern agriculture. By minimizing reliance on traditional power sources, reducing post-harvest losses, and promoting sustainable farming practices, this innovative system holds the potential to significantly enhance agricultural productivity, economic viability, and environmental sustainability.

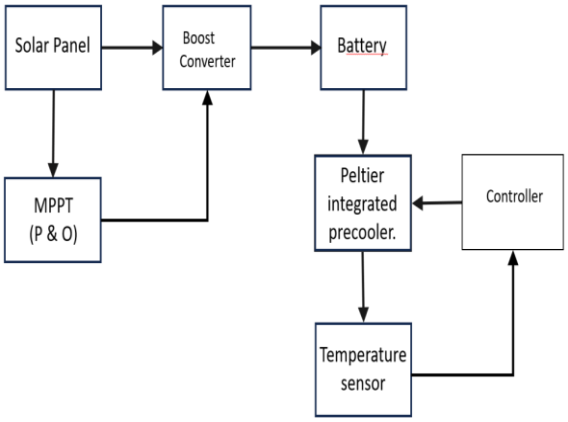

Fig. 1. Block Diagram

Fig. 2. 3D Model of Precooler

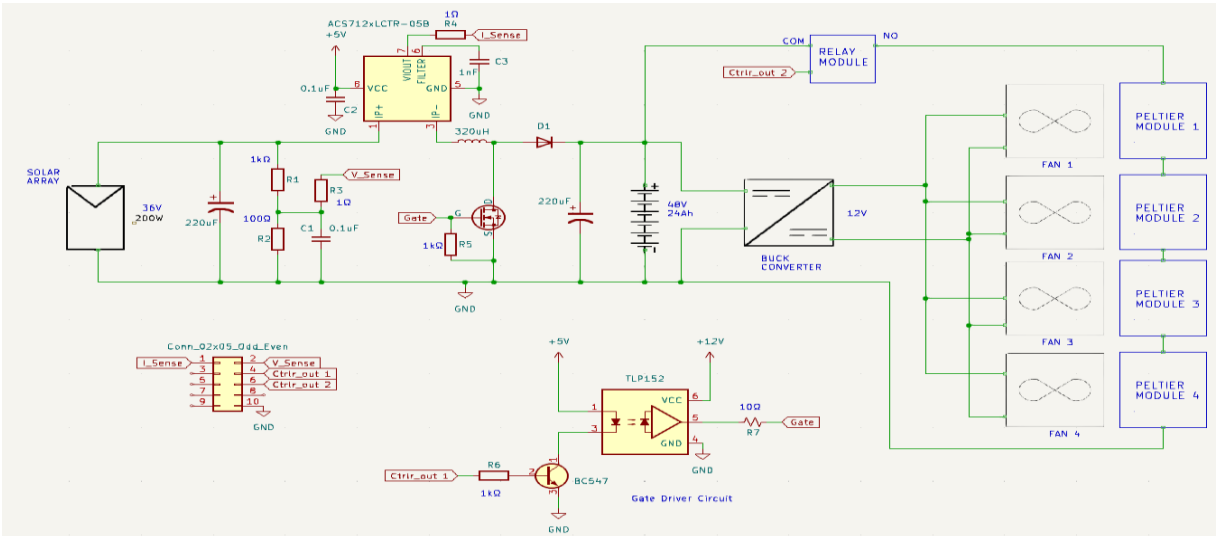

Fig. 3. Circuit Diagram

Importance of the Project

Our solar-powered agricultural precooling system offers multifaceted benefits, including enhanced productivity, reduced post-harvest losses, and increased economic returns for farmers. Its unique integration of solar-charged batteries ensures energy self-sufficiency, mitigating unpredictable energy expenses. Farmers benefit from remote monitoring and control, promoting ease of use and productivity. Cost savings, job creation, and eco-friendly practices further underscore its significance, attracting consumers and expanding market access. Versatile and adaptable, it caters to diverse agricultural settings, ensuring sustainability on both small and large scales.

Conclusion

In conclusion, our solar-powered agricultural precooling system represents a transformative leap towards sustainable and efficient farming practices. By addressing key challenges such as post-harvest losses, energy reliability, and environmental impact, this project offers a holistic solution that benefits farmers, consumers, and the environment alike. The integration of solar energy with advanced cooling technology and remote monitoring capabilities not only enhances agricultural productivity but also fosters economic growth in rural areas. Moreover, its scalability and adaptability ensure its relevance across diverse agricultural contexts, promising a brighter and more sustainable future for farming communities worldwide. As we move forward, continued innovation and adoption of such eco-friendly solutions will be crucial in meeting the growing demands of a changing world while preserving our precious natural resources.

Triple Fire Shield for EV Batteries: Prevention, Mitigation and Design Innovations

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Abstract: Concerns about fossil fuel scarcity and pollution are driving the world's transition from gasoline and diesel vehicles to electric vehicles (EVs), highlighting the importance of monitoring the safety of lithium-ion batteries (LIBs). Our proposal, called "Triple Fire Shield for EV Batteries", represents an overall concept designed to increase EV safety. Our program aims to solve and reduce the various risks associated with lithium-ion batteries through the use of preventive measures, remedial measures and new technologies. Our efforts contribute to the goal of sustainable mobility while increasing public confidence in electric vehicles by improving the safety of electric vehicles.

Introduction

Electric vehicles (EVs) stand at the forefront of modern transportation, heralding a paradigm shift towards sustainable mobility. With their seamless integration of cutting-edge technology, each journey in an EV offers a tantalizing glimpse into the future of transportation. The latest projections from the International Energy Agency's (IEA) Global Electric Vehicle Outlook indicate that worldwide sales of electric cars are poised to reach a staggering 17 million units by 2024, underscoring the accelerating pace of EV adoption on a global scale. Furthermore, reports on Electric Vehicle (EV) sales in India forecast exponential growth, with a Compound Annual Growth Rate (CAGR) of 35 percent, driving annual volumes to an estimated 27.2 million units by 2032. Such projections underscore the growing prominence of EVs as a sustainable alternative to traditional combustion engine vehicles.

Central to the rise of electric vehicles is the evolution of lithium-ion battery (LIB) technology. These batteries offer a host of advantages, including high energy density, extended lifespan, and consistent performance, making them an ideal power source for EVs. However, amidst the rapid advancement of electric transportation systems, the primary safety concern remains EV fires. Factors such as extreme weather conditions, overcharging, overheating, and physical damage to LIBs can trigger thermal runaway, the leading cause of most EV fires. Data from EV firesafe reveals a concerning trend, with an increase in EV fires and safety incidents reported globally in the first half of 2023, including over 500 battery fires, 138 injuries, and 36 fatalities. To address these safety challenges comprehensively, a multifaceted strategy is proposed, aimed at enhancing the safety of EV batteries through prevention, mitigation, and design innovations. This holistic approach not only improves EV protection but also fosters consumer confidence and supports the continued growth of the electric vehicle market.

The cornerstone of this strategy lies in prevention, achieved through the implementation of advanced methods such as the Battery Management System (BMS) and a liquid cooling system. The BMS serves as the nerve center of battery safety, equipped with temperature, voltage, and current sensors that continuously monitor key parameters. When the battery reaches full charge, the BMS employs intelligent algorithms to cut off power, preventing overcharging and safeguarding battery health. Furthermore, the BMS activates the liquid cooling system when temperatures surpass predefined thresholds, ensuring optimal operating conditions and mitigating the risk of overheating-induced thermal runaway.

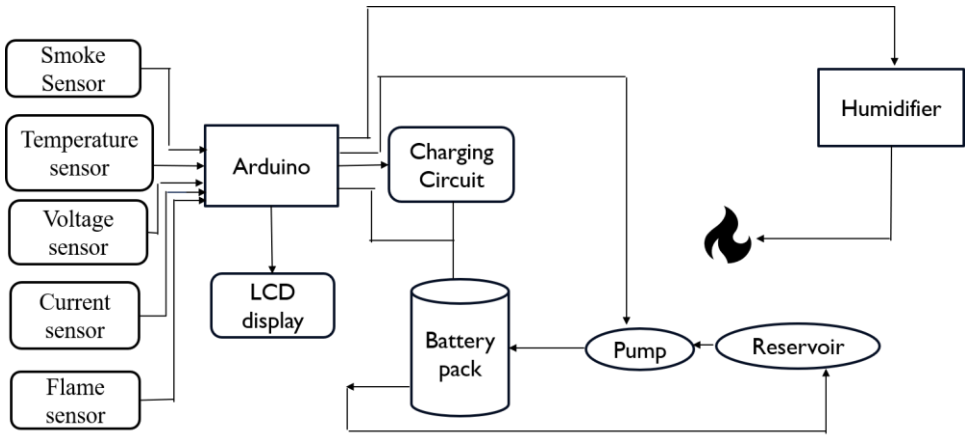

Fig 1. Block Diagram of the proposed system

Complementing these preventive measures is the incorporation of an automatic fire suppression system, poised to swiftly mitigate the impact of thermal runaway. In the event of a thermal runaway scenario, an automatic fire extinguishing system, simulated using a piezoelectric humidifier, is activated. This system delivers a rapid response, swiftly suppressing any potential fire outbreak and minimizing damage to the battery and surrounding components. By integrating preventive and mitigative measures, the proposed strategy provides a robust safety net, bolstering the resilience of EV batteries against potential risks.

Moreover, the strategy encompasses a proactive approach to innovation, focusing on the exploration of novel designs and technologies to further enhance battery safety. This involves rigorous research and development efforts aimed at identifying and implementing design innovations tailored to the unique challenges of EV batteries. From advanced thermal management solutions to innovative materials and Neural networks analyze historical data to predict optimal pulse timing for passive cell balancing, improving battery efficiency. They learn the relationship between input signals (gate pulses) and battery state of charge (SOC) before and after balancing. By training on data from Simulink models, they optimize the balancing process for better battery performance, enhancing longevity and management. construction techniques, the pursuit of cutting-edge design innovations holds the key to unlocking new frontiers in EV battery safety.

The integration of these components—BMS, liquid cooling, automatic fire suppression, and design innovations—constitutes a synergistic approach to enhancing the safety and performance of electric vehicles. By fortifying the protective measures surrounding EV batteries, this threefold strategy not only mitigates safety risks but also in stills confidence in consumers, driving continued adoption of electric vehicles.

Importance of the Project

Many electric vehicles (EVs) currently utilize basic Battery Management Systems (BMS) to monitor battery voltage and prevent overcharging or undercharging, while some employ air or liquid cooling systems to manage temperature. However, these systems often lack advanced monitoring and automated fire detection, relying on manual firefighting or external suppression systems in emergencies. To address these shortcomings, the project focuses on enhancing EV battery safety through a threefold strategy.

It aims to prevent thermal runaway by implementing advanced temperature management methods, including an improved BMS and external liquid cooling systems. Additionally, it seeks to mitigate the impact of thermal runaway by integrating an automatic fire suppression system. Lastly, through systematic research, the project explores innovative designs and technologies to protect EV batteries from physical damage, thereby enhancing overall safety and crashworthiness.

Conclusion

The project aims to improve the safety and reliability of electric vehicles (EVs) by expanding three sections. The approach includes preventive measures, mitigation strategies and new designs to prevent heat and fire. Directly addressing safety concerns, the program not only improves the electrical protection of the vehicle, but also increases consumers' trust and safety in them. Increasing consumers' confidence in electric vehicles is important as it plays a key role in the growth of the electric vehicle market. In addition, by improving the safety standards of electric vehicle batteries, the project does not directly affect the general use of transportation applications. In essence, the initiative not only plays an important role in safety, but also in developing the future traffic space into other sustainable and safer roads.

Acknowledgements

We hereby express our sincere gratitude to our guide Mr. Rahul Charles C M, Assistant Professor in Department of Electrical and Electronics Engineering, College of Engineering Perumon for his valuable guidance and suggestions. We also express our sincere thanks to Ms. Viji Chandran, Assistant Professor in Department of Electrical and Electronics Engineering for her valuable assistance and necessary directions which aided us in the completion of this venture. We would like to express our sincere gratitude to Dr. Rajeesh J, Principal of College of Engineering Perumon and and Dr. Mohanalin Raja Rathnam, HOD of Electrical and Electronics Engineering for providing all the required resources which helped us in the successful completion of this work. Finally we extend our gratitude to the entire faculty of the department and to all our friends for their help in carrying out this work successfully.

Nirmohi – A Seat Width Adjustable Wheelchair for the Differently Abled

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Abstract: "Nirmohi: A Seat Width Adjustable Wheelchair for the Differently Abled" integrates a scissor jack mechanism for precise seat width adjustments, accommodating diverse user geometries. This design minimizes frequent wheelchair replacements, reducing environmental waste. Nirmohi promotes manufacturing sustainability and economic growth through large-scale production. It aligns mobility assistance with fiscal prudence and ecological mindfulness, embodying engineering finesse and societal responsibility.

Introduction

In the domain of mobility solutions for individuals with disabilities, the demand for adaptable and sustainable wheelchair designs is critical. Addressing the challenges of diverse user geometries and the frequent need for wheelchair replacements due to evolving user needs, we introduce "Nirmohi"—an innovative seat width adjustable wheelchair. Nirmohi integrates a sophisticated scissor jack mechanism, allowing for precise and effortless adjustments to accommodate varying user sizes.

This revolutionary approach enhances user comfort and ergonomic alignment, while also aiming to reduce environmental impact by curbing the disposal of redundant wheelchairs. Beyond its immediate benefits, Nirmohi envisions broader implications, promoting manufacturing sustainability and aligning mobility assistance with economic and ecological mindfulness.

This project embodies a fusion of engineering ingenuity, societal responsibility, and inclusive design principles, settinga new standard in mobility augmentation for the differently abled. Through Nirmohi, we aim to reshape thelandscape of mobility solutions, fostering accessibility, sustainability, and dignity for individuals with diverse mobility needs

Project Description

The "Nirmohi" wheelchair represents an innovative approach to addressing the complex needs of individuals with mobility impairments through a seat width adjustable design utilizing a sophisticated scissor jack mechanism. This project aims to provide a detailed technical understanding of Nirmohi's working mechanism, material composition, adjustment capabilities, and the associated benefits in terms ofuser comfort, sustainability, and manufacturability.

Working Mechanism

The fundamental working principle of Nirmohi revolves around a scissor jack mechanism integrated into the wheelchair's frame. The scissor jack comprises interconnected metal bars arranged in a scissor-like configuration. Actuation of the scissor jack, either manually through a mechanical handle or electronicallyvia a motorized system, enables controlled expansion or contraction of the wheelchair's seat width. This mechanism allows users to adjust the seat width to accommodate different body sizes and preferences, ensuring optimal comfort and ergonomic support.

Technical Details

- Scissor Jack Construction: The scissor jack mechanism is constructed using high-strength steel oraluminum alloy bars, engineered to withstand varying loads and provide precise seat width adjustments. The geometry and dimensions of the scissor jack are carefully designed to achieve thedesired range of motion and load-bearing capacity while maintaining structural integrity.
- Material Composition: Nirmohi's frame is predominantly composed of lightweight yet durable materials such as aluminum alloys, selected for their excellent strength-to-weight ratio and corrosion resistance. The choice of materials not only contributes to the overall performance of thewheelchair but also facilitates ease of maneuverability and portability.
- Adjustment Mechanism: The seat width adjustment mechanism is designed for user-friendly operation, offering smooth and controlled adjustments to accommodate different body sizes. The mechanism may incorporate locking features to ensure stability and safety during use, preventing unintended seat width changes.
- Ergonomic Considerations: Nirmohi prioritizes ergonomic design principles to enhance user comfort and usability. Features such as padded seating, adjustable armrests, and customizable footrests are integrated to promote proper posture and reduce fatigue, addressing the specific needsof individuals with mobility impairments.

Benefits and Impact

- Customization and Adaptability: The adjustable seat width capability of Nirmohi enables customization to suit individual user preferences and varying clinical requirements, promoting inclusivity and user satisfaction.

- Longevity and Sustainability: By reducing the frequency of wheelchair replacements, Nirmohi contributes to sustainability efforts by minimizing waste generation and resource consumption. Thedurable construction and adjustable features extend the wheelchair's lifespan, making it a cost- effective and environmentally responsible mobility solution.

- Manufacturability and Scalability: The design of Nirmohi emphasizes manufacturability and scalability, leveraging advanced manufacturing techniques such as CNC machining for precision component fabrication and robotic welding for frame assembly. This approach ensures consistent quality and reliability in mass production, facilitating widespread adoption and accessibility.

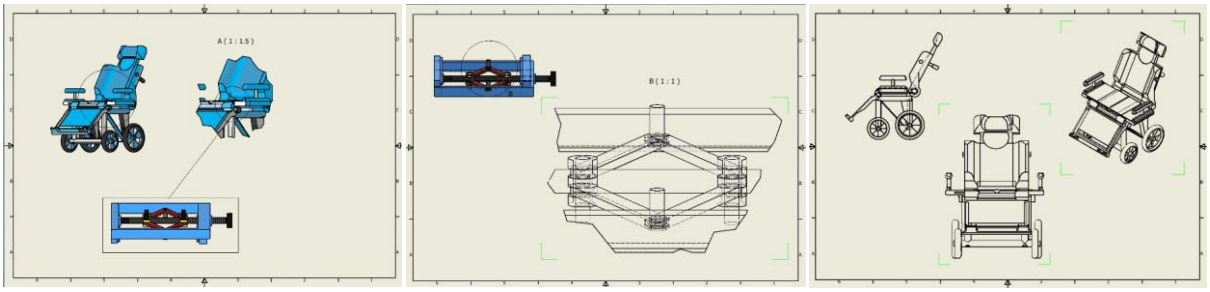

Fig 1. CAD models of the proposed system

Importance of the Project

The "Nirmohi" project is of profound importance in mobility assistive technology, addressing critical challenges for individuals with mobility impairments. Its innovative seat width adjustment, powered by a scissor jack mechanism, enhances user comfort and adaptability, promoting inclusivity and personalized care. By extending wheelchair lifespan and reducing environmental impact, Nirmohi contributes tosustainability efforts. This project exemplifies engineering excellence and societal impact, emphasizing accessibility, durability, and user-centric design. Ultimately, Nirmohi represents a transformative approachto mobility assistance, empowering individuals with disabilities and fostering a more equitable and sustainable future.

Conclusion

In conclusion, the "Nirmohi" project signifies a pivotal advancement in mobility assistive technology, integrating engineering innovation with user-centric design to enhance the quality of life for individuals with mobility impairments. Through meticulous technical analysis and continuous research, Nirmohi underscores the transformative capacity of adaptive design solutions in fostering accessibility, sustainability, and inclusivity within the mobility assistance landscape. This project heralds a new era of tailored solutions that prioritize user needs, reflecting a profound commitment to advancing equitable and sustainable support systems for individuals with disabilities.

Harnessing Wastewater E. coli as Protein Rich Food Source

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Abstract: The project presents a revolutionary approach to peanut butter production, eliminating the need of peanuts and incorporating Single-Cell Protein (SCP) derived from wastewater microbes. This eco-friendly innovation caters to individuals with peanut allergies while addressing sustainability concerns in food production. The project began with the process of harnessing wastewater microbes as a source of SCP, capitalizing on their rapid growth and high protein content. Careful selection and optimization yield an ideal product.

Introduction

The project actually aims to provide an alternative to traditional peanut butter by eliminating the use of peanuts in the production process. This process actually helps in the re-purposing of wastewater so that a circular economy is generated around the wastewater processing and selection of appropriate and safe *Escherichia coli* strains. The process begins by serially diluting the wastewater to appropriate concentrations. This is then transferred to Eosin Methylene Blue agar for selective growth of coliforms- particularly the strains of *Escherichia coli* for cell disruption and further protein isolation and purification. Further, the ingredients are processed to produce food substitute.

Project Description

This project utilizes *Escherichia coli* strains that appear as purple or black in appearance giving out a characteristic metallic-green sheen. This is indicative of the presence of *E. coli* in our culture medium. This colony is then inoculated onto freshly prepared nutrient medium for further growth and proliferation. After this, the sample is observed to have adequate growth seeing the extent of turbidity in the nutrient medium. The solution is then transferred to a buffer solution, preferably a phosphate buffer of neutral pH for cell disruption and protein extraction. The solution is centrifuged multiple times and underwent sonication at regular intervals of thirty seconds. Following this procedure, the solution is then centrifuged again to obtain the pellets. The process of salting-out of proteins using Ammonium Sulfate is done to preferentially precipitate out proteins from the solution. After this procedure, the sample underwent qualitative and quantitative analysis using SDS-PAGE and Lowry's test to determine the amount of protein released. The presence of endotoxins in a protein mixture is the cause for various health issues observed among customers who consume microbial-based foods. Hence, the treatment and removal of these toxins are of paramount importance. This is done by treating the protein with a non-ionic detergent such as Triton X-114 which has proven benefits for effective removal of endotoxins by preferentially adsorbing and acting on the endotoxin's lipid module thereby neutralizing its effects and destroying the molecule. On centrifugation, the protein- rich layer is obtained at the top while the endotoxin-detergent layer is at the bottom. This happens due to bi-layer separation caused by lowering the temperature of the solution under the cloud-point of the detergent. The presence of endotoxins is further studied by studying the treated samples under a magneto-elastic sensor reader that detects endotoxin presence due to variation of magnetic fields. The sample with the concentration of endotoxin which is acceptable for consumption according to global food laws is chosen. Further, dialysis of the solution is done to remove all the other impurities attached to the protein like salts, ions etc. Dialysis membranes are activated by boiling the tubes in a solution of sodium bicarbonate and EDTA followed by sequential cooling and storage in refrigerator under ethanol-EDTA solution.

The protein solution was entered to the activated tubes and tied to a rod/support to submerge in a buffer solution. The container containing this apparatus already has a stir-bar that helps in stirring of the solution with use of magnetic stirrer. This forceful induction of movement allows for simpler removal of impurities from the protein solution to outside the tubes. Further, the tube was submerged in a 30% sucrose solution for storage of protein solution and to prevent loss of protein. Further, concentration of the product was done by performing salting-out if necessary. This finished protein is then used for formulation of the peanut-butter substitute by identifying the amount required of each component, further analysis showed that the composition of 49.14% protein, 18.43% flavor additives, 12.29% sweeteners, 18.14% oils, and 1-2% stabilizers yielded the most favorable results by organoleptic analysis. Hence, the composition of the product was fixed.

Importance of the project

The importance of the project lies in its affordability as the beneficiaries of this project are under-nourished individuals. Harnessing wastewater *Escherichia coli* as protein-rich peanut butter substitute addresses critical issues of sustainability and resource management. It offers a sustainable solution by utilizing a waste product to produce a valuable food source, reducing environmental pollution and resource depletion. Moreover, it diversifies the food supply, providing an alternative protein source that could alleviate pressure on traditional agriculture systems. Additionally, it promotes innovation in biotechnology and food science, paving the way for future developments in sustainable food production.

Conclusion

In conclusion, this project holds immense significance I addressing pressing challenges of sustainability and food security. By transforming a waste product into a valuable food source, it not only mitigates environmental pollution but also reduces the strain on traditional agricultural resources. Furthermore, this innovative approach offers a sustainable solution to the growing demand for protein-rich foods, contributing to a more resilient and diversified food supply. This project demonstrates the potential for unconventional food sources to meet nutritional needs while minimizing environmental impact. By embracing novel approaches to food production, we can pave the way for a healthier, more sustainable global food system.

Memory Care: Empowering Alzheimer's Patients

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Abstract: MemoryCare integrates wearable glasses and a mobile app to assist Alzheimer's patients and caregivers. The glasses use facial recognition to identify individuals and provide audio cues, aiding recognition. They also deliver reminders for daily routines. The caregiver app enables location tracking with boundary alerts, customizable reminders, and direct patient communication. By leveraging advanced technologies like facial recognition, GPS, and reminders, MemoryCare promotes independence, safety, and improved quality of life for Alzheimer's patients while empowering caregivers with comprehensive support tools.

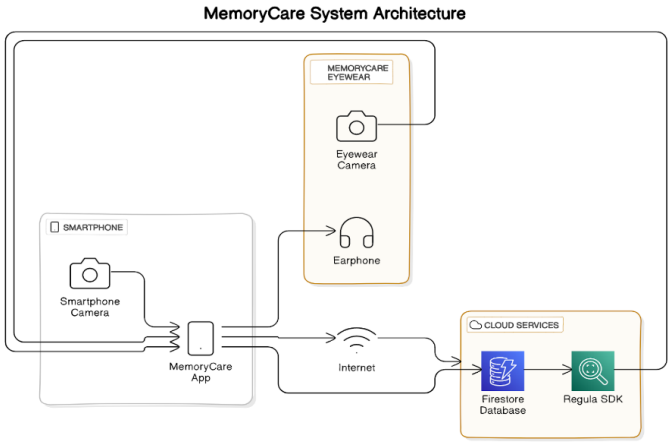
Introduction

Alzheimer's disease poses significant challenges for patients in recognizing loved ones and maintaining daily routines. The proposed MemoryCare system aims to address these issues by leveraging wearable technology and mobile applications. It combines wearable glasses with facial recognition capabilities to identify family members and provide audio cues, aiding in recognition. The glasses also deliver audio reminders for daily routines, medication schedules, and other essential tasks. The caregiver's mobile app facilitates location monitoring through GPS, routine management, and direct communication with the patient. MemoryCare utilizes cutting-edge technologies like facial recognition, GPS tracking, speech synthesis, and cloud computing to enhance the quality of life for Alzheimer's patients, promoting independence and safety while providing caregivers with tools for better support and monitoring.

Project Description, Working of the Project and Technical Description

MemoryCare aims to address the significant challenges faced by Alzheimer's patients, such as difficulties in recognizing loved ones and maintaining daily routines. The wearable glasses leverage advanced facial recognition technology to identify familiar faces and provide audio cues, assisting patients in recognizing their loved ones. Additionally, the glasses deliver audio reminders for daily tasks, medication schedules, and other essential routines, promoting independence and adherence. The caregiver's mobile application serves as a central hub for managing patient profiles, setting reminders, and tracking locations. Caregivers can input and schedule reminders, which are then delivered through the wearable glasses' audio system. The app also integrates GPS technology and Google Maps, enabling real-time location monitoring and geofencing capabilities to ensure patient safety.

Working of MemoryCare



The architectural diagram above illustrates the components and data flow of the MemoryCare system, designed to provide a comprehensive assistive solution for Alzheimer's patients and their caregivers. At the core of the system are the MemoryCare wearable glasses, a wearable device equipped with a camera, audio output, and embedded computing capabilities. These wearable glasses leverage the powerful RegulaForensics facial recognition SDK to enable real-time face detection and identification of loved ones. When a face is recognized, the integrated text-to-speech functionality powered by the Flutter_tts library provides audio naming through the wearable glasses' speakers or bone conduction transducers.

The wearable glasses communicate seamlessly with the MemoryCare mobile application, developed using Google's cross-platform Flutter framework. This app serves as a central hub for caregivers to manage patient profiles, update routines and schedules, and receive real-time alerts and notifications. The app also utilizes the device's built-in GPS and integrates with the Google Maps platform to enable location tracking and geofencing capabilities, ensuring the patient's safety and providing peace of mind for caregivers. Underpinning the entire system is a robust cloud infrastructure built on Google's Firebase platform. This includes the Firestore NoSQL database, which securely stores and synchronizes patient data, facial recognition profiles, location histories, and routine information across all connected devices in real-time. Firebase also provides secure user authentication, push notifications, and other critical services. The seamless integration of these components – the wearable glasses hardware, mobile application, and cloud backend – creates a holistic ecosystem that empowers both Alzheimer's patients and their caregivers. By leveraging cutting-edge technologies such as facial recognition, location tracking, and routine management, MemoryCare aims to restore a sense of familiarity, independence, and structure in the lives of those affected by this debilitating condition.

Technical Description

Wearable Glasses Hardware: The MemoryCare glasses are designed with a lightweight, comfortable, and ergonomic form factor. They incorporate an embedded camera, display, audio output (speakers or bone conduction transducers), and a low-power processor with wireless connectivity. The glasses act as an access point to avoid network issues.

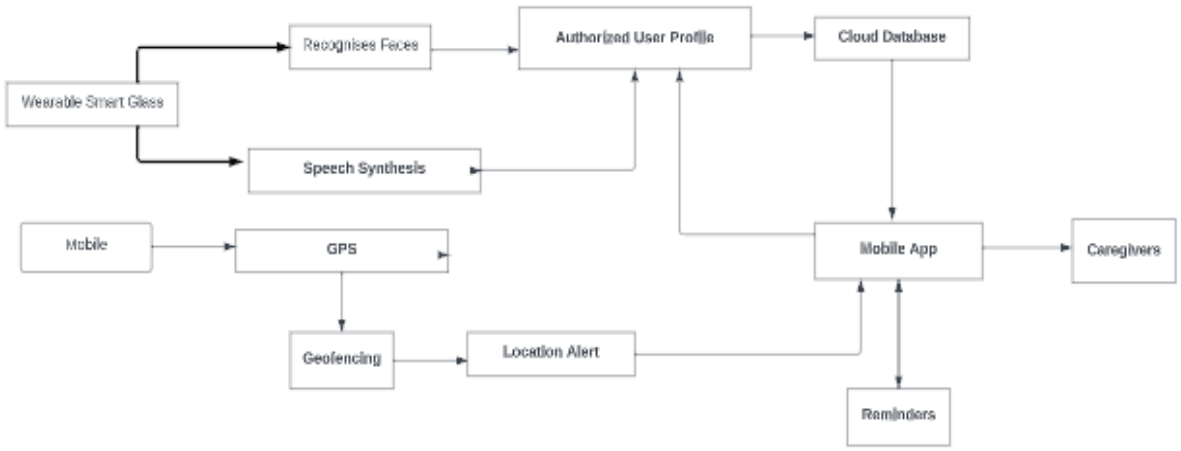
Mobile Application Development: The MemoryCare mobile app is developed using Google's Flutter framework, enabling cross-platform compatibility for both iOS and Android devices. The app features a user-friendly interface with large buttons, clear iconography, and minimalistic layouts for easy accessibility.

Facial Recognition: The facial recognition system utilizes the RegulaForensics SDK, which employs deep learning models such as convolutional neural networks trained on massive datasets of facial images. The SDK performs real-time face detection, feature extraction, and matching against enrolled facial profiles.

Text-to-Speech: The Flutter_tts library is integrated into the system for converting text (names, reminders, etc.) into audio output, which is then delivered through the wearable glasses' speakers or bone conduction transducers.

Cloud Infrastructure: Google Firebase serves as the cloud backend, offering a suite of services. The Firestore NoSQL database stores and synchronizes patient data, facial recognition profiles, routines, and location histories in real-time across all connected devices. Firebase Authentication ensures secure user access, while Cloud Messaging enables push notifications and alerts.

Location Tracking and Geofencing: The mobile app integrates with the device's built-in GPS and the Google Maps platform, enabling accurate location tracking and geofencing capabilities. Caregivers can define safe zones, and the app sends alerts if the patient breaches these boundaries.



Importance of the Project

MemoryCare is an innovative system that addresses the challenges faced by Alzheimer's patients and caregivers. It combines wearable smart glasses with facial recognition, location tracking, and routine management capabilities integrated with a secure cloud backend. The glasses provide audio cues for recognizing loved ones and delivering reminders, while the mobile app allows caregivers to manage patient profiles, set routines, and receive location alerts. By leveraging advanced technologies like deep learning and cloud computing, MemoryCare offers a comprehensive solution to enhance independence, safety, and care coordination for those affected by Alzheimer's disease.

Conclusion

In conclusion, MemoryCare offers a pioneering solution for Alzheimer's disease management, blending advanced technology with personalized care. By integrating facial recognition technology, a user-friendly mobile app, and secure cloud infrastructure, it addresses the challenges faced by patients and caregivers. Through extensive user research and iterative design, MemoryCare is tailored to meet specific needs, providing features like real-time facial recognition, routine management, and location tracking. Drawing from existing research, MemoryCare optimizes functionality, ensuring seamless operation and user satisfaction. Ultimately, MemoryCare represents a transformative approach to Alzheimer's care, empowering patients and relieving caregivers' burden. With its innovative features and commitment to user-centric design, MemoryCare promises to significantly enhance the quality of life for Alzheimer's patients worldwide.

Transcutaneous Electrical Nerve Stimulator

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Abstract: TENS provides a drug-free and side-effect-free method of treating patients experiencing various pain symptoms. The device offers a wide range of therapeutic applications through its ability to deliver modifiable multi-frequency stimulations. Devices for surface functional electrical stimulation applications must generate up to 150V with current pulse intensities of 10-100mA which is achieved with the help of a ferrite core transformer and suitable driver circuit. The device is powered by a Li-ion battery features wireless connectivity to smartphones. It is developed solely for experimental purposes and is tested using an R-R-C model of human skin.

Introduction

TENS is a method of electrical stimulation whose primary goal is to provide some degree of symptomatic pain relief by stimulating sensory nerves and thereby stimulating the pain gate mechanism. An electric current is needed to stimulate the nerve. The current is usually applied transcutaneous (i.e., through the skin), the selected nerve contains many nerve fibres all of which will need to be stimulated to produce maximal muscle contraction. Generation of an action potential in all nerve fibres in a motor nerve will require a current of sufficient magnitude and duration. Several aspects are considered when designing the stimulator drive stage for TENS. The type of output control, either voltage or current, required output waveform parameters such as frequency, pulse width, and inter-pulse intervals are calculated. The circuit is designed for the desired output waveform. The electrical impedance of the skin determines the power rating of the components used.

Project description

The overall device consists of Li-ion Battery, a Boost converter, linear voltage regulators, a low-side gate driver, a step-up transformer, an STM32F303K8T6 MCU, a HC-05 Bluetooth module and a potentiometer. The Boost converter is used to boost the nominal 3.7V DC output from a lithium-polymer battery to 12V DC, which serves as the input for the low-side gate driver and the high-frequency step-up transformer. The step-up transformer is constructed with a ferrite core and has a primary side chopper and the secondary winding is connected to the electrodes. It features a turns ratio of 1:24.33, which induces a sufficient voltage across the secondary winding to overcome skin impedance and allow the required amount of current to flow. The low-side MOSFET is driven by a UC2715 low-side gate driver, and the switching frequency is set at 100 kHz.

The STM32F303K8T6, a 32-bit ARM architecture-based microcontroller is employed to generate various PWM patterns, which serve as the input signal for the gate driver. Additionally, two ADCs and a DAC in combination with an in-built analog comparator is utilised to employ peak mode current control. The current in the primary winding of the transformer is measured using the ADC with the help of a Current-sense resistor. A second ADC will measure the voltage across a potentiometer terminal which act as the input to the DAC. The DAC output serves as the reference value for the analog comparator. When the primary current exceeds the reference value, the comparator triggers the fault interrupt and the PWM signal is disabled. A HC-05 Bluetooth module is utilized to enable wireless communication between the board and a smartphone. This allows for the frequency of stimulation to be changed depending on the data received by the Bluetooth module.

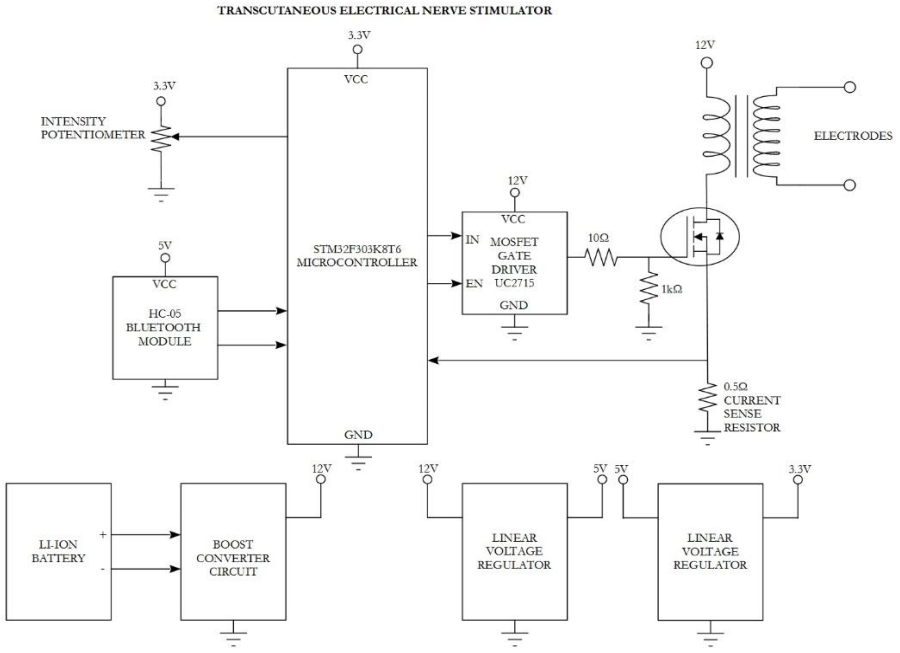

Fig. 1. Block Diagram

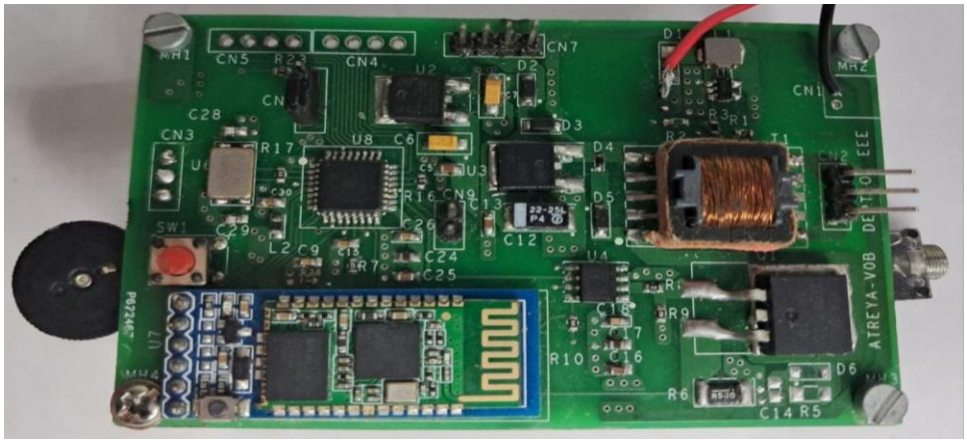

Fig. 2. TENS Device – Top view

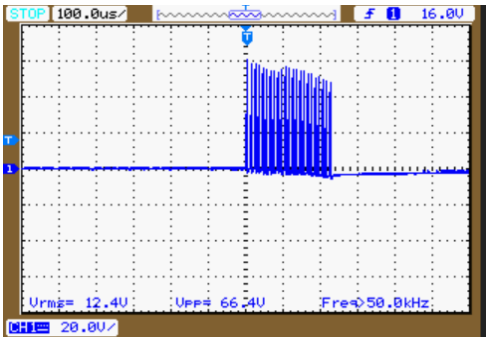

Fig. 3. Output Voltage waveform with R-R-C model of Skin as load and Vref set at max value

Importance of the Project

Unlike conventional TENS devices with onboard controls, this one incorporates Bluetooth connectivity for smartphone pairing, allowing for remote monitoring and control. Its compact and portable design is powered by a 3.7V Lithium-ion Battery, with convenient micro-USB charging. TENS device reduces the reliance on pain medication, resulting in reduction in medication expenses and medical interventions/procedures for pain management. The beneficiaries include individuals suffering from conditions such as arthritis, back pain and other chronic conditions. Patients recovering from injuries and surgeries use this device during rehabilitation. Athletes use it to manage pain and aid in injury recovery.

Conclusion

The proposed TENS device has been designed and developed with a focus on portability and ease of use. It can be powered using a 3.7V Li-ion battery and deliver currents up to 250mA with a pulse width of 200µS. The device features wireless connectivity to an Android-based smartphone for operation mode selection and current limit adjustment. Operation modes include various patterns such as single twitch (at 1Hz), TOF twitch stimulation (at 2Hz), 5Hz, and 10Hz stimulation. The output waveforms are observed on an R-R-C model of skin using a Digital Storage Oscilloscope (DSO) and verified based on literature.

Acknowledgement

We express our sincere gratitude to our principal, Dr. Niranjan N. Chiplunkar, for providing us with all the facilities in the college, as well as for his constant motivation and encouragement. We are grateful to Dr. Sudesh Bekal (Professor and Dean, R&D) for his constant support and encouragement. Additionally, we extend our heartfelt appreciation to Nitte (DU) for generously funding this project. We are extremely grateful to our Head of Department, Dr. Suryanarayana K, for his insightful advice and continuous support, as well as for providing us with an exceptional environment and access to specialized equipment in the Centre for Design of Power Electronics Systems at the Research and Innovation Centre, NMAMIT. We express our sincere gratitude to our project guide, Mr. Ravikiran Rao M, Dept. of EEE, for his invaluable guidance, unwavering support, and timely assistance throughout our project. We are very grateful to Mr. Anup Shetty, Dr. Dinesh Shetty, Ms. Swathi Hatwar H and Ms. Raksha Adappa for their advice and suggestions at various stages. We thank all the teaching and non-teaching staff, as well as those who have directly or indirectly supported us.

Advanced Real Time Bone Fracture Monitoring with Pain Control Mechanism

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Abstract: Bone fracture healing is vital for mobility, but traditional fixators lack real-time monitoring, requiring innovation. To clear up this trouble, a clever fixator design imbued with the transformative energy of Aware, Sensing, Smart, and Active (ASSA) technology has been developed. It continuously gathers and analyses facts from numerous incorporated sensors, supplying real-time insights into the tricky dance of fracture healing. Its analytics automate milestone identification, aiding timely interventions and informed decision-making in patient recovery. Furthermore, the fixator vigilantly monitors patient compliance. Beyond monitoring, the ASSA fixator integrates a pain manipulation mechanism powered by a thermoelectric generator, extending its innovation.

Introduction

The Internet of Things (IoT) aids in environmental and health concerns, crucial for remote healthcare. Real-time patient tracking enables accurate diagnosis and timely interventions. Fractures hinder mobility, requiring time for recovery. This paper proposes opportunity answers though implement a multi-sensor actual-time bone fracture tracking device. This device utilizes IoT for real-time treatment planning in healthcare. The article suggests a smart cast with sensors for monitoring orthopedic healing, enabling early complication detection and personalized treatment planning. The system integrates various sensors like GSR, stress, and ultrasonic sensors to gather specific data from the fracture site, highlighting the potential of IoT for fracture management. A microcontroller processes and analyzes this data, offering a more objective and data-driven assessment of healing progress compared to traditional methods. The system reduces patient radiation exposure by eliminating routine X-rays and enables early detection of issues like misalignment or excessive pressure through real-time monitoring. Finally, the system uses a thermoelectric generator (TEG) to be incorporated into the sensor design which offer localized heat therapy to treat pain brought on by typical healing patterns.

Project Working and Technical Description

The project proposes a method that can continuously monitor the fractured bone and notify immediately if there is any excess pressure applied or misalignment due to the patient's actions. MEMS and pressure sensors detect bone position and pressure changes, alerting patients and doctors if misalignment or excessive pressure occurs. Continuous monitoring optimizes recovery by ensuring proper pressure application, with data stored in the cloud for remote access. This facilitates understanding of the recovery process and enables remote treatment if needed. Upon power supply, the Arduino Uno initializes with programmed sensors: Pressure, Mems, GSR, and Ultrasound, all connected to a processing unit. A GPRS module facilitates data transfer from the device. Also, LCD displays processor-sent information based on patient actions. A temperature sensor tracks bone temperature, relayed to the microcontroller. A pressure sensor detects excess pressure, triggering alerts on the LCD if preset limits are surpassed, warning of potential harm to the fractured bone. GSR electrodes on fingers detect emotions for sleep monitors. MEMS sensors on each side of a fracture detect tilt, sending coordinates to a microcontroller. The bone is classified as aligned or misaligned based on sensor position.

GSR Sensor: Galvanic skin response (GSR) measures emotional arousal via sweat gland activity. Strong emotions stimulate the sympathetic nervous system, increasing sweat production. The Grove - GSR sensor attaches electrodes to fingers for easy measurement. This makes it a useful tool for creating emotion-related projects, such as a sleep quality monitor. The sensor operates on a voltage of 5V or 3.3V, has adjustable sensitivity, and can be used with external finger cots for better comfort.

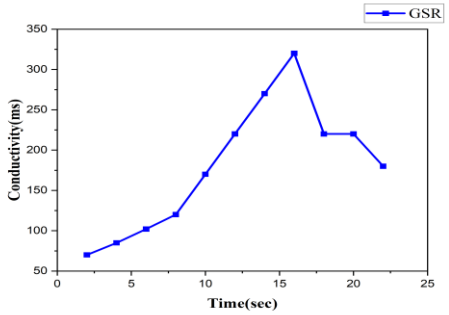

Fig.1. Measurements from a GSR sensor in fractured bones.

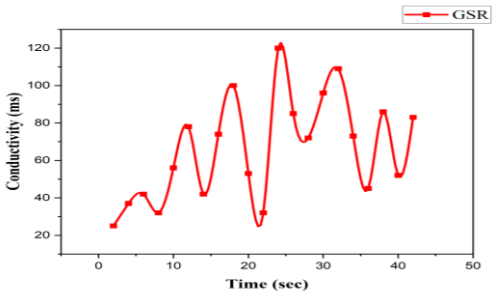

Fig.2. GSR sensor readings taken from a non-fractured bone

During initial evaluation, galvanic skin response detects bone and muscle stress. Electrodes on non-fractured muscles collect data up to 120 ms. For fractured bones, conductivity over 120 ms triggers a buzzer alert, recorded every 30 seconds.

MEMS Sensor: The LPY4150AL MEMS sensor offers temperature stability (-40°C to +85°C) and high resolution, with ±1500 dps full scale. It detects rates up to 140 Hz with a single sensing element, providing angular rate via analog output. ST has deployed millions for reliability. Embedded in casts, it monitors bone movement. Readings <8 m/s² indicate normal stress. The fixator alerts misalignment, aiding early detection.

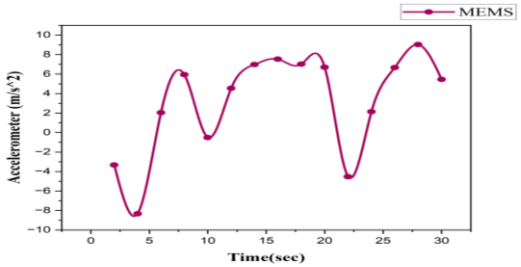

Fig. 3. MEMS sensor readings taken from a non-fractured bone

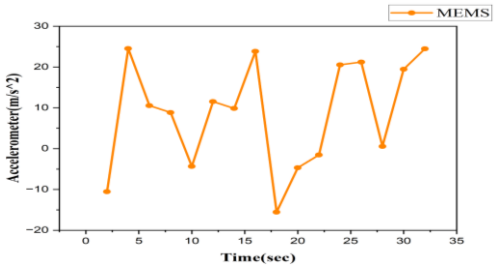

Fig. 4. Measurements from a MEMS sensor in fractured bones.

Post-evaluation of MEMS, Ultrasound, and GSR sensors in bone fracture rehabilitation reveals pain during the transition from limping to normal gait due to load-bearing pressure. To address this, a force sensor (350 kg/ms^2 capacity) monitors pressure, recording data every 5 minutes in seconds.

Pressure Sensor: The sensor offers a low actuation force of 0.1N and a sensitivity range up to 10N, customizable for various sizes. It ensures highly repeatable force readings with just a 2% variation, boasting a slim profile of 0.35mm and enduring up to 10 million actuations. Its straightforward integration process makes it cost-effective and ideal for various applications, including automotive, medical, industrial, and robotics. The standard 400 sensor, 7.62mm in diameter, utilizes FSR technology sensitive to force, with resistance decreasing as force increases.

Ultrasound Sensor: Ultrasound sensors operate at sound intensities that are considered safe for diagnostic purposes. The intensity is typically measured in watts per square meter (W/m^2) or milliwatts per square centimeter (mW/cm^2). Diagnostic ultrasound adheres to safety standards, with intensities under 100 mW/cm^2. It monitors bone fractures by analyzing consistent patterns of ultrasound waves passing through bone tissue, measuring reflected sound wave intensity to assess bone integrity. Normal sound intensity patterns range from 1,500 to 2,000 m/s. In contrast, those with bone fractures exhibit irregularities or different intensity ranges at fracture sites during ultrasound interactions.

Importance of the Project

The bone fracture monitoring project with pain control shows promise for revolutionizing care. Continuous monitoring and machine learning expedite intervention, potentially improving healing times. Integrated pain control enhances patient comfort. Remote monitoring could lower healthcare costs while promoting faster healing and well-being.

Conclusion

The ASSA orthopedic fixation device showcases the application of Internet of Things (IoT) technologies in achieving these goals. In this paper, we explore how the device enables continuous monitoring of a patient's recovery from a fractured tibia post-surgery. The capabilities of the device include:

- Emitting a buzzer alert to warn the patient about high-risk movements, such as leg misalignment at the injury site.
- Offering recommendations for adjusting prescribed activities or exercises, which might include modifying the weight borne by the fractured leg during walking or using crutches.
- Utilizing ultrasound technology to assess bone density at the injury site.
- Deploying a GSR sensor to detect stress or pain, which is then managed through a TEG mechanism that produces heat in the affected area.

Acknowledgement

The authors would like to extend their gratitude to T. Logasundari, Assistant Professor, Department of Biomedical Engineering, and Dr. A. Vijayalakshmi, Head of the Biomedical Department, Sri Manakula Vinayagar Engineering College for their generous support, unwavering encouragement, and constructive contribution to the project.

Kinetic Foot Fall

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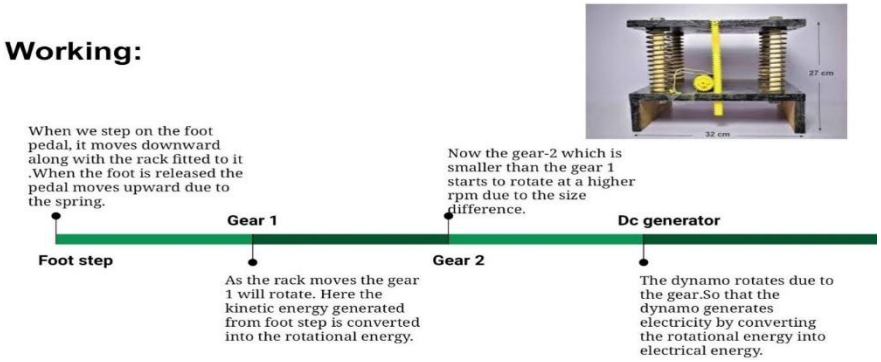
Abstract: The Footstep Power Generation project is devised to harness the kinetic energy produced by human footsteps during walking or running and convert it into electrical energy. With the escalating demand for electricity worldwide, conventional power generation methods are proving insufficient to meet the increasing needs. This system offers a non-conventional approach to electricity production, utilizing foot traffic in various public areas such as roads and bus stations. The core of the system involves the utilization of a DC Generator to convert mechanical energy from footsteps into electrical energy. Although initially perceived as intricate and costly, an innovative and economically viable enhancement has been introduced. This enhancement involves positioning a mechanical footstep power generator on the rear foot region, thereby improving performance and efficiency. By implementing this technology on a larger scale, significant contributions can be made towards augmenting the electrical power generation infrastructure of a country. This study presents the essence of the Footstep Power Generation project, highlighting its potential to address the growing demand for sustainable energy solutions.

Introduction

The development of several green (clean) energy systems is a major strategy to achieve environmental balance. During walking, human feet exert force on the ground, and this force can be used to generate electrical energy with the help of a footstep power generator. Several types of footstep power generation methods are available, and the majority of these devices use piezoelectric transducers to generate power. Major problem in designing with piezoelectric transducers is the selection of suitable ferroelectric material because it governs the efficiency of energy conversion. Walking is the most common activity in day-to-day life. When a person walks, he loses energy to the road surface in the form of impact, vibration, sound etc, due to the transfer of his weight onto the road surface, through foot falls on the ground during every step. This energy can be tapped and converted in the usable form such as in electrical form. In order to develop a technique to harmless foot step energy, a foot step electricity generating device was developed. This device, if embedded in the footpath, can convert foot impact energy into electrical form. The working principle is simple. When a pedestrian steps on the top plate of the device, the plate will dip down slightly due to the weight of the pedestrian. The downward movement of the plate results in rotation of the shaft of an electrical alternator, fitted in the device, to produce electrical energy. The top plate reverts back to its original position due to negating springs provided in the device. If such devices are embedded in places where there is continuous human traffic such as in city malls, railway platforms, city footpaths etc., the electricity generated from these devices can be used for street lights.



Importance of the project

The Footstep Power Generation project represents a crucial advancement in sustainable energy solutions by harnessing kinetic energy from human footsteps. Amidst escalating global electricity demands, conventional methods fall short. This innovative approach utilizes foot traffic in public areas to generate electricity, offering a non-conventional solution. By converting mechanical energy into electrical energy via DC Generators, it presents a viable means of augmenting power generation infrastructure. Cost-effective enhancements further enhance performance, making it a promising avenue for addressing the growing demand for sustainable energy sources worldwide.

Conclusion

In conclusion, the Footstep Power Generation project offers a promising solution to the increasing global demand for sustainable energy. By harnessing the kinetic energy from human footsteps, this innovative system presents a non-conventional approach to electricity production. Through the utilization of DC Generators and cost-effective enhancements, it demonstrates potential for significant contributions to augmenting a country's electrical power generation infrastructure. As we strive towards a more sustainable future, initiatives like this highlight the importance of leveraging unconventional sources of energy to meet growing needs while reducing environmental impact. Embracing such advancements will be crucial in addressing the challenges of energy sustainability in the years to come.

Nutraceuts from Discarded Vegetable Peels

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Abstract: With ever increased food processing in the new millennia, production of Agro waste has been increased tremendously. These wastes are rich sources of essential bioactive compounds. In developing countries, the waste materials from Agro industries can help to obtain valuable compounds. Fresh fruits and vegetables are highly utilized commodities by health-conscious consumers and represent a prominent segment on the functional and nutritional food sector. Due to the high market competition and increased demand for healthy natural and functional products, thus we made an attempt to increase antioxidant and dietary fiber content, it may significantly be increased by incorporating potato and orange peel powder. Foods containing fiber can provide health benefits as well, such as helping to maintain a healthy weight and lowering the risk of diabetes, heart disease and some types of cancer. Hence, it may open a new channel in food industry for developing value added products from vegetable peels.

Introduction

The baking industry is one of the largest sectors of the food processing industry in India. Since they are readily available, convenient for eating right away, and have a long shelf life, baked goods are the most popular. The most popular snack food for both children and adults is biscuit. Additionally, their rising demand opens up more opportunities for their production, fortification, and other nutritional advancements. The main goals of fortification are to maintain the nutritional quality of products, to maintain adequate nutrient levels in order to treat or prevent specific nutritional deficiencies in the population, to increase the added nutritional value of a product from a business perspective, and to provide specific technological functions in food processing. Now a days to improve the nutritional quality of bakery products, whole natural foods and their byproducts are becoming part of the bakery products which improve their quality and nutritional bioavailability in a cost-effective way.

Objectives

1. Improvement of dietary fiber content in biscuits with the incorporation of potato peel powder and orange peel powder.
2. Development of antioxidant rich biscuits with the incorporation of orange peel powder without compromising the sensory acceptance.

Methodology

Collection of raw materials

Potato peels and orange peels were collected from Venus restaurant, Irinjalakuda, Thrissur. Considering the nature of their work, restaurants are bound to generate considerable amount of food waste. This certainly becomes a major concern to the relevant authorities such as management and government. A large amount of peel waste is generated in restaurants which forms part of this waste and has led to a big nutritional and economic loss and environmental problems. Thus, discarded peels can be utilized to produce value-added product.

Peel Powder Production

1. Potato peels and orange peels were washed in distilled water. 2. They were weighed.

3. Peels were laid on aluminum foil, 4. They were then placed in hot air oven at 50° C for 24 hrs.

5. Dried peels were crushed into powder using mechanical blender, 6. The peel powder was stored in a refrigerator.

Preparation of Biscuits

Ingredients

1. Ragi flour, 2. Baking powder, 3. Butter, 4. Stevia powder, 5. Milk, 6. PPP, 7. OPP,

Procedure:

1. Preheat your oven at 180°C,

2. Mix the ingredients in a bowl. Do it until the mixture is light and fluffy.

3. Grease your cooking tray with butter and place the biscuits on top,

4. Bake the biscuits at 160°C for 20 minutes.

Potato peel

Orange Peel

Result and Disscussion

Produced Biscuts

Measurement of Sensory Evaluation

Sensory score of biscuits showed that with regard to taste, aroma and overall acceptability, the sensory characteristics of biscuit type 3 were found to be the best. The taste is the primary factor which etermines the acceptability of any product, which has the highest impact as far as market success of product is oncerned. Biscuit containing 100% ragi flour were rated the poorest in taste. Biscuit containing 20% potato and orange peel powder has the highest mean score**.** The mean scores for appearance of the biscuits didn't show considerable change. As increase in peel powder, mean score for texture was also increasing while that of aroma was decreasing.

Biscuits	Appearance	Aroma	Texture	Taste	Overall acceptability
Control	7.8	9	7.3	6	6.6
Type 1	7.9	8.5	7.3	6.5	7.09
Type 2	7.9	8.4	7.2	6.3	7.3
Type 3	7.5	8.9	7.8	7.5	8.2

Conclusion

In conclusion, with increased food processing in the new millennia, production of agro-industrial waste has increased tremendously. Development of sustainable solution for managing fruit and vegetable waste has become extremely important in present scenario. Hence, the utilization of the fruit as well as vegetable waste especially peels in developing value-added products will be an eco-friendly and sustainable way to create novel business opportunities. Foods containing fiber can provide health benefits as well, such as helping to maintain a healthy weight and lowering the risk of diabetes, heart disease and some types of cancer. Hence, it may open a new channel in food industry for developing value added products from vegetable peels.

Robotic Drug Dispenser with QR Code Integration

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Abstract: The "Robotic Drug Dispenser with QR Code Integration" project tackles challenges in medication dispensing by introducing advanced automation. Traditional methods face issues like interpretation errors and processing delays. To overcome these, we implement a QR code-based system for precise dispensing. Our setup includes a web app-generated QR code, Raspberry Pi camera for decoding, and Arduino-controlled robotic arm and conveyor belt. By embracing these advancements, we aim to enhance healthcare systems, prioritizing patient care and safety. This project underscores the fusion of technology and medicine for efficient and accurate medication delivery, promising significant contributions to healthcare progression.

Introduction

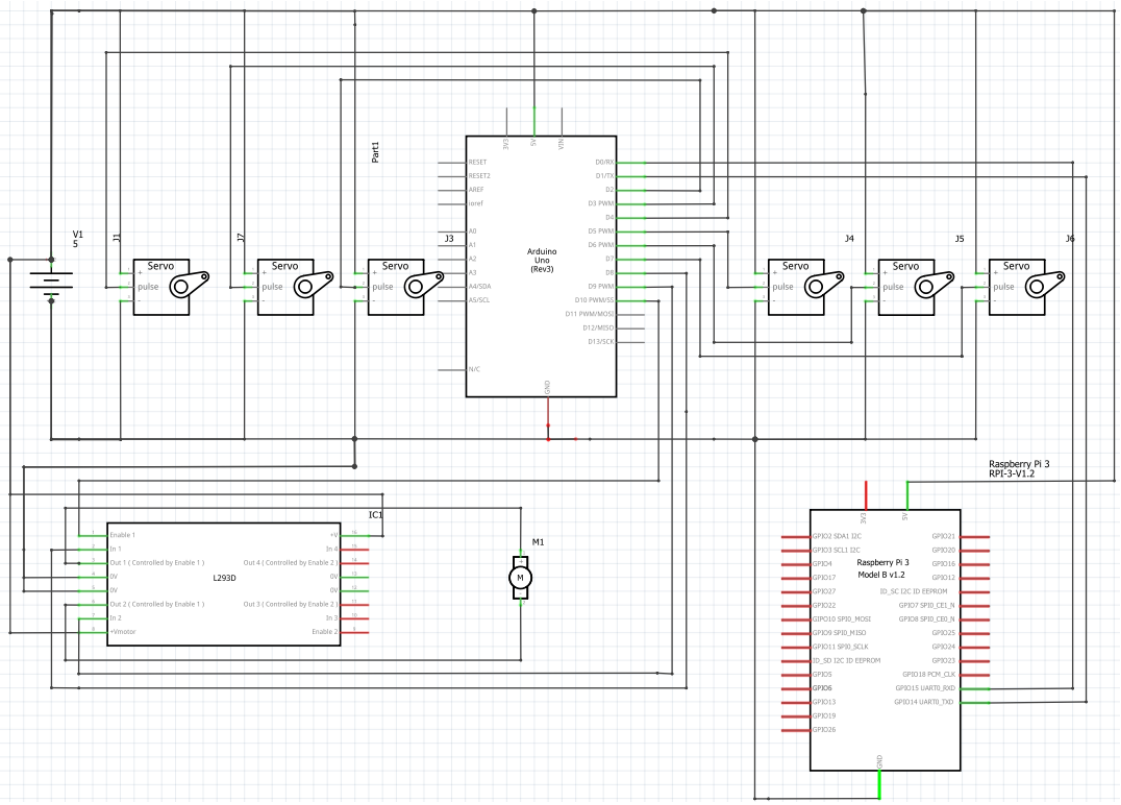
The background of this project stems from the need to enhance the efficiency and accuracy of medication dispensation in healthcare settings. Traditional methods of prescribing and delivering medications often face challenges such as errors in interpretation, delays in processing, and inefficiencies in distribution. These issues can lead to serious consequences for patients and healthcare providers. Handwriting-related errors by healthcare providers have been a persistent challenge in medication dispensation. Due to the fast-paced nature of medical practice, doctors often jot down prescriptions swiftly.

These hurriedly written prescriptions become susceptible to misinterpretation by pharmacists, nurses, or even the patients themselves, contributing significantly to medication errors. Introducing a system reliant on QR codes for prescription information aims to address these issues by digitally encoding medication details, this system eliminates the ambiguity associated with handwritten prescriptions. It ensures accurate capture and interpretation of information, reducing the likelihood of errors in medication dispensation due to misinterpretation. The utilization of QR codes in prescriptions represents an innovative leap from conventional handwritten methods. QR codes encode medication details in a digital format, offering a standardized and easily interpretable way to convey prescription information.

Methodology

The methodology adopted for this research project involves a multifaceted approach to address the challenges associated with unclear prescriptions in healthcare settings. The study comprises a comprehensive review and analysis of existing literature, encompassing studies focusing on medication errors, prescription systems, and technological interventions within the healthcare domain. The integration of system design and development involves creating a technological infrastructure centered around QR code technology, Raspberry Pi, and a robotic arm. This innovative system is engineered to decode and process prescription information encoded in QR codes swiftly and accurately. The iterative process of prototyping, testing, and refinement forms a crucial aspect of this methodology, ensuring the functionality, accuracy, and reliability of the proposed system. Ultimately, this multifaceted methodology aims to bridge the gap caused by illegible prescriptions by introducing a technological solution that streamlines the prescription processing and medication dispensation processes. By doing so, it aims to minimize errors, enhance accuracy, and improve patient safety within healthcare settings, thereby paving the way for more efficient and reliable healthcare practices.

Circuit Diagram



Importance of the Project

The utilization of QR codes in prescriptions marks a significant departure from conventional handwritten methods, offering a standardized way to encode medication details digitally. This shift eliminates ambiguity and potential errors stemming from fast-paced handwriting, ensuring precise medication dispensation. QR code adoption not only revolutionizes prescription practices but also aligns with ongoing digital transformation in healthcare, enhancing interoperability and communication among professionals. This project pioneers QR code integration in medical settings, ushering in accuracy and efficiency in medication dispensation while laying the groundwork for broader technological advancements in healthcare, benefiting patient outcomes and delivery processes.

Conclusion

The integration of QR codes in medical prescriptions signifies a ground breaking advancement in healthcare. This innovation enhances patient safety by streamlining medication dispensation and minimizing errors, marking a transformative step towards improved healthcare delivery globally. The addition of a robotic arm for medicine delivery boosts these advancements, increasing accuracy and standardizing healthcare quality. Moreover, as the conveyor belt transports medicine to the counter, it reduces human intervention, facilitating a fully automated system. Overall, the integration of the conveyor belt model represents a significant stride towards a seamlessly automated medication distribution system, redefining standards for accessibility, efficiency, and patient-centered care. This comprehensive approach optimizes pharmacy workflows and underscores our commitment to leveraging technology for better patient outcomes and healthcare delivery.

TROPOMI Powered Web App for NO2, SO2, CO Pollution Analysis

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Abstract: This report presents a pioneering project leveraging geospatial technologies—remote sensing, GIS, and GPS—to comprehensively monitor and mitigate escalating pollution levels. Integrating TROPOMI data, GIS analysis, and Google Earth Engine API, we visualize pollutant concentrations and their impacts on human health. Our findings underscore the critical role of geospatial technologies in informing evidence-based decisions and targeted interventions. By elucidating spatial-temporal pollution dynamics, this project offers insights crucial for fostering sustainable urban environments.

Introduction

In the face of rapid urbanization and industrialization, coupled with the pressing need for sustainable development, addressing environmental pollution has emerged as a paramount challenge. Recognizing the critical importance of monitoring and managing air quality, our project endeavors to harness the power of geospatial technologies, specifically Geographic Information Systems (GIS), remote sensing, and advanced tools like TROPOMI (Tropospheric Monitoring Instrument). Through a comprehensive approach, we aim to provide insights into air quality dynamics and spatial distribution, facilitating informed decision-making and effective pollution control measures.

Project Description

Our project integrates GIS, remote sensing, and TROPOMI data to analyze and monitor air pollution levels. Utilizing remote sensing satellites equipped with sensors capable of measuring atmospheric pollutants, we capture valuable data on pollutants such as carbon dioxide, nitrogen oxides, methane, and aerosols. This data aids in tracking pollution sources, understanding dispersion patterns, and assessing air quality on regional and global scales.

Working of the Project

The project workflow involves several key steps:

1. Data Acquisition: Remote sensing satellites collect data on atmospheric pollutants using onboard sensors. TROPOMI data is specifically utilized to visualize the concentration of pollutants such as NO2, SO2, and CO.

2. Data Processing: The collected data is processed using GIS techniques to generate spatial maps depicting air quality parameters. GIS software such as ArcGIS is employed for data analysis and visualization.

3. Web Application Development: The processed data is then integrated into a web application using Google Earth Engine API. This application provides users with interactive access to air quality information, facilitating real-time monitoring and analysis.

4. Verification and Validation: GPS technology is employed for the verification of data collected through satellite observations. Handheld GPS devices and Differential GPS (DGPS) systems ensure accuracy and reliability in data validation.

Technical Description

The technical aspects of our project encompass various components:

1. Remote Sensing: Remote sensing satellites equipped with sensors capture data on atmospheric pollutants. These sensors measure pollutant concentrations, particle size and shape, and air mass movement, providing valuable insights into air quality dynamics.

2. GIS Analysis: Geographic Information Systems (GIS) software, such as ArcGIS and ERDAS Imagine, are utilized for spatial analysis and visualization. GIS enables the integration of spatial and non-spatial data, facilitating comprehensive analysis of air quality parameters.

3. Web Application Development: The integration of processed data into a web application is achieved using Google Earth Engine API. This web application offers users interactive access to air quality information, enhancing data accessibility and usability.

4. Data Verification with GPS: GPS technology is employed for the verification of satellite-derived data. Handheld GPS devices and DGPS systems ensure accuracy and reliability in data validation, enhancing the credibility of air quality assessments.

In summary, our project represents a comprehensive approach to air quality monitoring and analysis, leveraging the synergistic capabilities of GIS, remote sensing, and advanced tools like TROPOMI. By providing valuable insights into air quality dynamics and spatial distribution, our project aims to support informed decision-making and effective pollution control measures in urban environments.

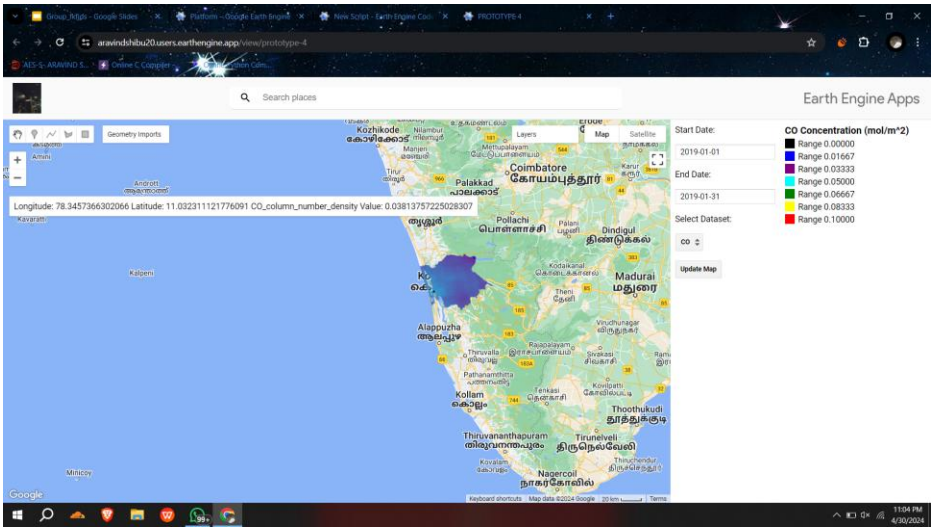

Fig.1 UI of the Web APP

Importance of the Project

Our project holds paramount importance in addressing the pressing issue of air pollution through the integration of GIS, remote sensing, and TROPOMI data. What sets us apart is our comprehensive approach, which not only analyzes air quality but also facilitates real-time monitoring and informed decision-making. Beneficiaries include policymakers, urban planners, researchers, and the general public, who can utilize our insights to implement targeted pollution control measures and safeguard public health and the environment.

Conclusion

In conclusion, our project exemplifies the transformative potential of integrating geospatial technologies to address the complex challenges posed by air pollution. By harnessing the power of GIS, remote sensing, and advanced tools like TROPOMI, we have provided comprehensive insights into air quality dynamics and spatial distribution. Through the development of a web application, we have democratized access to critical environmental data, empowering stakeholders to make informed decisions and implement effective pollution control measures. Moving forward, our project sets a precedent for leveraging technology to foster sustainable urban environments and mitigate the adverse impacts of pollution on public health and the environment. With continued collaboration and innovation, we are poised to make significant strides towards achieving cleaner, healthier communities for future generations.

Acknowledgement

Dr.Binu M Issac. HOD, Department of Civil Engineeirng, Mr.Ajai Thampy. Assistant Professor, Amal Jyothi College of Engineering (Project Guide), Mr.Bennet Jose Mathew. Assistant Professor, Amal Jyothi College of Engineering (Project Coordinator).

Network Intrusion Detection System (IDS) using Machine Learning

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Abstract: The project aims to develop an Intrusion Detection System (IDS) powered by Artificial Intelligence (AI) and Machine Learning (ML) to enhance network security against advanced cyber threats. The IDS will leverage AI to analyze patterns, anomalies, and behavioral deviations within the network, employing ML algorithms to learn from historical data and adapt to emerging threats.The key features of the AI/ML-based IDS include the ability to detect advanced threats that traditional security measures may miss, distinguish between normal and potentially malicious behavior with high accuracy, and reduce false positives by identifying novel attack patterns.The system will provide a comprehensive solution for both Local Area Networks (LAN) and Wi-Fi networks, seamlessly monitoring and analyzing network traffic across diverse communication channels. Continuous learning and adaptation are pivotal aspects, enabling the IDS to evolve its detection capabilities based on ongoing analysis and respond effectively to emerging threats.The project prioritizes user-friendly implementation, ensuring seamless integration into existing network infrastructures. Overall, the AI/ML-based IDS aims to safeguard critical digital assets and data, contributing to the advancement of cybersecurity by providing a forward-looking approach to counteract the evolving nature of cyber threats in an interconnected digital landscape.

Introduction

Enterprise networks are under constant assault from sophisticated cyber threats that can bypass traditional perimeter defenses like firewalls and antivirus solutions. Once inside the network, these advanced threats use evasive tactics like tunneling, encryption, and lateral movement to operate undetected for extended periods, escalating privileges and exfiltrating data. This lack of visibility into threats operating within network boundaries represents a critical gap that exposes organizations to potentially catastrophic breaches. Intrusion detection systems (IDS) have become essential for filling this visibility void. IDS provide continuous interior monitoring of network activities, endpoints, and cloud infrastructure to detect anomalous behaviors and traffic patterns indicative of compromise. By analyzing network flows and correlating events, IDS can spot threats missed by perimeter controls, like lateral movement, privilege escalation, and data staging by adversaries.

Modern IDS leverage machine learning to establish baselines of normal behavior and rapidly identify even subtle deviations that may signal an intrusion. Leveraging AI, IDS conduct round-the-clock threat hunting across globally distributed networks. As IT environments grow more complex with cloud, mobile, and interconnected supply chains, IDS deliver vital threat visibility and accelerate incident response capabilities before major damage occurs. The necessity for comprehensive IDS protection has never been higher given the volume and sophistication of cyber attacks pummeling enterprise defenses. The network security system is designed to provide comprehensive monitoring and protection against potential threats across both wireless (Wi-Fi) and wired (LAN) networks. The system architecture is built around two main components: traffic monitoring modules and a centralized analysis engine powered by machine learning. At the core of the system lie the traffic monitoring modules, which are dedicated components responsible for capturing and analyzing network traffic from their respective domains. The Wi-Fi monitor is specifically designed to observe and record all wireless network traffic, including data transmitted and received by connected devices, access points, and wireless routers. Similarly, the LAN monitor keeps a vigilant watch over the wired network infrastructure, scrutinizing the flow of data across switches, routers, and other network devices.

These monitoring modules act as the eyes and ears of the system, continuously gathering and relaying network traffic data to the centralized analysis engine. This engine is equipped with a powerful sniffer tool, which serves as the primary hub for traffic analysis and processing. The sniffer tool is a sophisticated network packet capture and analysis utility that dissects the incoming data streams from the Wi-Fi and LAN monitors. It meticulously examines each packet, extracting relevant features and metadata that can provide insights into the nature and intent of the network traffic. These features may include packet headers, payload contents, protocol information, source and destination addresses, and various other attributes that can aid in distinguishing benign traffic from potential threats.

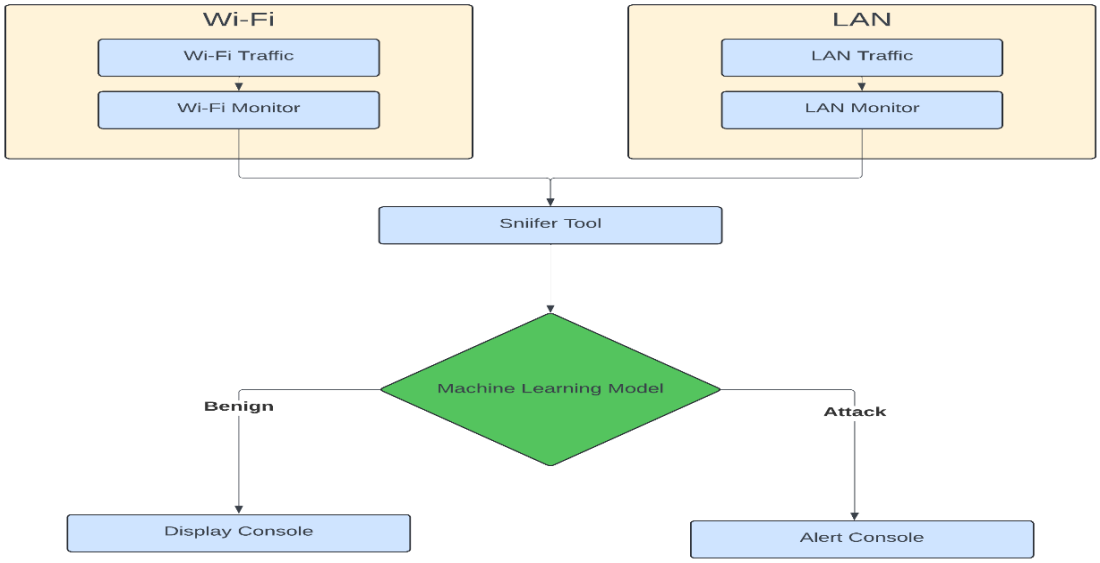

Fig. 5. Architecture

At the heart of the analysis engine lies a robust machine learning model, which has been rigorously trained on vast datasets of labeled network traffic. This training process involves exposing the model to a multitude of benign and malicious traffic samples, allowing it to learn the intricate patterns and characteristics that distinguish between the two categories.

When the sniffer tool feeds the extracted features into the machine learning model, the model applies its learned knowledge to classify the traffic as either benign or an attack. This classification process is driven by advanced algorithms and techniques, such as deep neural networks, ensemble methods, or supervised learning algorithms, depending on the specific requirements and characteristics of the network environment. The system's output is presented through two distinct consoles: the Display Console and the Alert Console. If the machine learning model classifies the network traffic as benign, the relevant information and statistics are displayed on the Display Console, providing administrators with real-time visibility into the network's operations and activity levels.

However, if the model detects any anomalous or potentially malicious traffic patterns, it triggers an alert on the Alert Console. This console is designed to grab the attention of security personnel and administrators, notifying them of the detected threat and providing detailed information about the nature of the attack, the affected network segments, and any additional contextual data that can aid in swift incident response and mitigation efforts.

The power of this network security system lies in its ability to continuously monitor and analyze network traffic in real-time, leveraging the predictive capabilities of machine learning to accurately identify potential threats. By combining the strengths of dedicated monitoring modules, advanced sniffer tools, and cutting-edge machine learning algorithms, the system provides a robust and adaptive defense against a wide range of cyber threats, ensuring the integrity and security of both wireless and wired network infrastructures.

Importance Of The Project

In the dynamic realm of cybersecurity, the introduction of an Artificial Intelligence (AI) and Machine Learning (ML) powered Intrusion Detection System (IDS) marks a pivotal advancement. Departing from conventional security measures, it arms organizations with an intelligent and adaptive shield against advanced cyber threats. This project's distinction lies in its capacity to employ AI and ML algorithms for analyzing network traffic patterns, anomalies, and behavioral deviations, enabling the detection of sophisticated threats that conventional defenses might miss. Unlike static signature-based approaches, this IDS learns continuously from historical data, remaining vigilant against emerging threats and evolving attack vectors.

Its comprehensive scope, encompassing monitoring and analysis of both Local Area Networks (LAN) and Wi-Fi networks, addresses the security requirements of modern interconnected environments. By leveraging advanced techniques like deep neural networks, the system accurately discerns between normal and malicious behavior, heightening security efficacy. Beneficiaries include enterprises, government agencies, and individuals facing mounting cyber complexities. With user-friendly implementation and seamless integration, this IDS offers proactive defense while minimizing disruptions. By advancing cybersecurity through innovation, this project plays a critical role in fortifying defenses against evolving cyber threats, fostering a more secure digital landscape.

Conclusion

The proposed network security system offers a comprehensive and intelligent approach to safeguarding both wireless (Wi-Fi) and wired (LAN) network infrastructures. By integrating dedicated traffic monitoring modules, a sophisticated sniffer tool, and a robust machine learning engine, this system provides real-time threat detection and mitigation capabilities. The seamless combination of hardware components like Wi-Fi and LAN monitors with advanced software algorithms enables continuous monitoring and analysis of network traffic. The sniffer tool's ability to extract relevant features from packets and the machine learning model's predictive power work in tandem to accurately classify traffic as benign or malicious.

This system's strength lies in its adaptability and continuous learning capabilities. As new threats emerge, the machine learning model can be retrained with updated datasets, allowing it to evolve and stay ahead of the ever-changing cyber threat landscape. This proactive approach ensures that the system remains effective and relevant, even in the face of sophisticated, novel attack vectors. Furthermore, the system's user-friendly interfaces, including the Display Console and Alert Console, provide administrators with real-time visibility into network operations and prompt notifications of potential threats. This streamlined communication enhances situational awareness and enables rapid incident response, minimizing the potential impact of cyber attacks. Overall, this network security system represents a significant advancement in the field of intrusion detection and prevention, leveraging the power of artificial intelligence and machine learning to fortify network defenses against a wide range of cyber threats, ensuring the integrity and resilience of critical digital infrastructures.

Vortex Generators for Passive Cooling of Rooftop Photovoltaic Systems Under Free Convection with Smart Concentric System

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Abstract: Decreasing the operating temperature of a photovoltaic (PV) module can increase its electrical output and longevity. This can be achieved by increasing the radiative and convective heat losses on the front or the rear module surface. In this report, we have proposed, a passive cooling method for the rooftop PV system, which enhances convection heat flux on the module's rear surface. As the vortex generators (VGs) are attached on the surface of the roof without physical contact to the module back sheet, this technique would not void the module warranty and can be easily retrofitted on an existing rooftop system. In the absence of wind (free convection), the module is subjected to the highest temperatures, and our VG design specifically targets this worst-case scenario. The previous results reveal a temperature reduction of more than 4 °C using VGs in the configuration studied. This can be translated to a significant increase in module lifespan by around 30% to 40%, thus reducing the levelized cost of electricity also by using a smart concentric system we can utilize the sunlight more efficiently.

Introduction

Reducing PV module operating temperature offers economic benefits and environmental advantages. Despite advancements in cell technologies, operating 30°C above standard conditions leads to an 8%–9% loss in electrical generation. Every 1°C decrease extends module lifespan by 7%, with 5°C cooling potentially doubling it. Cost-effective cooling methods are crucial. Passive air cooling with aluminum fins shows promise but faces challenges like high electrical insulation requirements and incompatibility with bifacial modules. Vortex generators have achieved 2°C to 3°C cooling but share some limitations. Focus shifts to residential or commercial rooftop setups for improved airflow, aiming to optimize cooling without compromising performance.

Project description

The project incorporates a smart concentric system, which consists of sensors, actuators, and an intelligent control algorithm. These components work together to dynamically adjust the configuration and orientation of the VGs based on real-time environmental conditions such as temperature, wind speed, and solar radiation. This adaptive approach ensures optimal cooling efficiency throughout the day and under varying climatic conditions, further maximizing energy output and system reliability. The project aims to enhance the efficiency and longevity of rooftop photovoltaic (PV) systems through the implementation of vortex generators (VGs) for passive cooling under free convection, coupled with a smart concentric system. With the increasing adoption of rooftop solar installations for both residential and commercial purposes, the need to mitigate temperature-related performance losses and material degradation becomes paramount. The data of the site where the PV system is going to place should be collected by various means.the geographical data can be collected through internet and also through physical means the data should contain availability of the sunlight, weather condition during various seasons, environmental conditions such as atmospheric humididty, temperature and moisture contents of the air etc. By physical means analyze the availabity of the sunlight and intensity of the sunlight through out the day. By this data we can obtain the duration for concentrating the light on PV for an optimum period. We need to design a frame to carry the lens used for concentrating the light on PV module. It should be designed in a manner of easily controllable i.e can be moved smoothly using a stepper or sevo motor.

Diagram

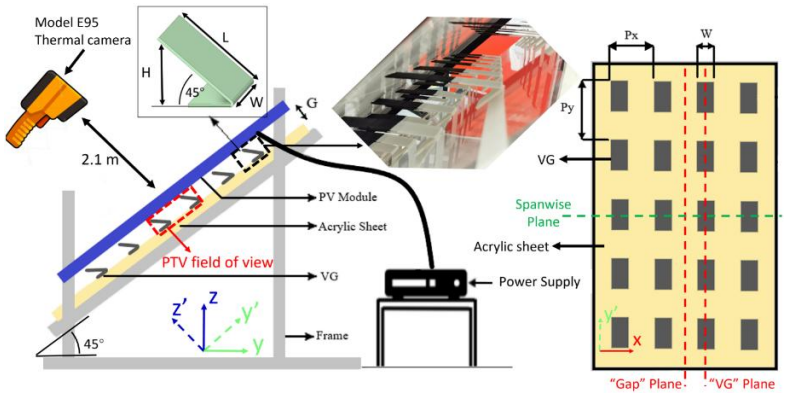

Fig. 1. Diagram

The frame should be designed in a manner to reduce the load on the motor as much as possible. It should also bring the lens to the position of concentration with least movement so that we can achieve the desired output. The load on the motor should be calculated using simulation software and also calculate the power consumption by the system using a simulation software and also through practical working and data collection.

Importance of the Project

The project addresses the critical need to enhance the efficiency and longevity of rooftop photovoltaic (PV) systems by utilizing vortex generators (VGs) for passive cooling under free convection, complemented by a smart concentric system. By optimizing cooling through VG-induced turbulence and dynamic control based on environmental factors, the project maximizes energy output and system reliability. This innovative approach holds significant promise for advancing sustainable energy generation, reducing operating costs, and mitigating the environmental impact of traditional energy sources.

Conclusion

The utilization of vortex generators in conjunction with a smart concentric system for passive cooling of rooftop photovoltaic (PV) systems under free convection offers a promising avenue for enhancing energy generation efficiency and prolonging the lifespan of PV installations. Through experimental and computational analyses, it has been demonstrated that the integration of vortex generators can effectively mitigate the thermal stresses experienced by rooftop PV panels by promoting airflow and heat dissipation. The vortex generators induce vortices that disrupt the boundary layer, thus enhancing convective heat transfer and reducing the temperature differentials across the PV surface. Moreover, the incorporation of a smart concentric system further optimizes the cooling process by dynamically adjusting airflow rates based on environmental conditions and system requirements. This intelligent control mechanism ensures efficient operation while minimizing energy consumption and maximizing the overall performance of the PV system. In conclusion, the combination of vortex generators and a smart concentric system presents a viable and cost-effective solution for passive cooling of rooftop PV systems, offering benefits such as improved energy output, increased durability, and reduced maintenance costs. As renewable energy technologies continue to evolve, integrating innovative cooling strategies like this will play a crucial role in maximizing the efficiency and sustainability of solar power generation.

Treatment of Processed Water from Coir Industry Using Coir Pith

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Abstract: Wastewater from the coir industry is a significant environmental concern due to its contamination with organic matter and dyes. Coir pith is an eco-friendly and cost-effective solution for the treatment of processed water. Coir pith, being a lignocellulosic material with a high surface area and porous structure, holds promise as a medium for pollutant removal. Furthermore, its abundance, renewability, and cost-effectiveness align with the principles of a circular economy. The wastewater treatment process involves the preparation and activation of coir pith to maximize its adsorption capacity, enabling the removal of organic contaminants, heavy metals, and dyes from coir industry wastewater. The effectiveness of coir pith and waste glass in removing a wide range of pollutants from processed water, highlighting the potential for sustainable water treatment in the coir industry. Furthermore, the economic feasibility and scalability of this approach, emphasizing its potential for implementation in small to large-scale coir processing units. The used coir pith can either be safely disposed of or repurposed for other applications, reducing waste generation and its associated environmental impact. This emphasizes the advantages of employing coir pith in coir industry wastewater treatment, including the reduction of environmental pollution, decreased operational costs, and the promotion of a sustainable approach that ensures the industry's long-term viability. This innovative solution has the potential to reduce the environmental impact of the coir industry.

Introduction

The removal and treatment of processed water from the coir industry, employing coir pith, constitute an essential aspect of sustainable wastewater management. This method proves effective in decreasing both Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), crucial parameters indicative of water quality. Traditional biological treatment techniques often encounter challenges in achieving optimal wastewater clearance in coir industry effluents.

To address this limitation, an innovative and efficient treatment approach has been developed, integrating coir pith alongside recycled glass and gravel.This comprehensive method not only enhances the efficiency of wastewater treatment but also aligns with eco-friendly practices by utilizing recycled materials in the process. Coir pith, also known as coir dust or coco peat, is a byproduct obtained during the extraction of coir fibers. Its unique properties make it an excellent candidate for water treatment applications. This introduction aims to explore the potential of coir pith in purifying and mitigating the environmental impact of wastewater generated by the coir industry. The introduction of glass as a complementary treatment component adds another layer of sophistication to the process.

Glass, known for its inert and non-reactive nature, serves as an excellent medium for filtration and separation processes. When combined with coir pith, the synergistic effects of these materials contribute to a comprehensive and efficient water treatment system, ensuring the removal of contaminants and promoting the sustainable reuse of water resources.

This innovative approach aligns with the principles of circular economy and sustainable development, as it transforms two distinct byproducts—coir pith and waste glass—into valuable resources for water purification. The combination of these materials not only enhances the treatment efficiency but also underscores a commitment to environmental stewardship and resource efficiency.

Working of the project

The quality analysis of the water sample collected from the coir industry will encompass a thorough examination of key parameters crucial for wastewater assessment. Chemical Oxygen Demand (COD) will be measured to quantify the amount of organic pollutants, providing insight into the water's contamination level.

Biological Oxygen Demand (BOD) analysis will evaluate the oxygen required by microorganisms to decompose organic matter, indicating the water's organic pollution. Chloride and sulphate levels will be assessed to gauge the presence of inorganic compounds, while Total Suspended Solids (TSS) analysis will measure the concentration of solid particles in the water. Designing an effective filter unit for water purification involves careful consideration of various parameters to ensure optimal performance. The appropriate size of the unit is based on factors such as water volume, flow rate, and the specific contaminants present. This initial planning is crucial to ensure that the filter can effectively remove the impurities.

Each layer within the filter unit plays a critical role in achieving efficient filtration. Typically, the top layer consists of a finer material like coir pith, which is effective in capturing smaller particles and organic substances. Below this, layers of recycled glass or sand provide secondary filtration, each contributing unique properties such as porosity or surface area for adsorption. The base layer of gravel ensures proper drainage and supports the layers above, preventing clogging and maintaining the structural integrity of the filter. In practical application, these filter units are configured and tested to evaluate their effectiveness in treating wastewater from industries like coir processing. By systematically comparing setups using untreated or treated coir pith alongside recycled materials, researchers assess filtration efficiency under controlled conditions. This research not only aims to improve water quality but also supports sustainable practices by utilizing natural and recycled materials effectively in wastewater treatment. Such innovative approaches are pivotal in addressing environmental concerns and enhancing industrial water management practices.

Importance of the project

It addresses the need to enhance the efficiency of the multi-barrier approach in pathogen removal. The presence of suspended solids and particulate matter in water can impede disinfection, and effective filtration becomes crucial in overcoming this challenge.The exploration of alternative media, such as glass media, allows for the evaluation of potential advancements in filtration performance. Understanding their advantages, including high filtration efficiency, minimal modification requirements, and slow head loss development, provides valuable insights for optimizing water treatment processes. Incorporating legislative and standard considerations in the study underscores the importance of aligning new treatment technologies with established guidelines for safe waste water treatment.

Additionally, conducting full-scale tests with variations in operating conditions ensures a comprehensive evaluation of the alternative media's performance, aiding in their potential implementation in industrial settings.The study addresses the critical need to enhance water treatment processes by evaluating alternative media, considering factors like efficiency, adaptability, and compliance with safety standards, ultimately contributing to advancements in the field of water technology and treatment minimizing environmental impact and fostering resource conservation within the coir industry.

Conclusion

The performance evaluation of different filter units reveals distinct outcomes in their effectiveness and suitability for wastewater treatment from the coir industry. The untreated coir pith, sand, and gravel filter emerges as a standout solution due to its ability to effectively reduce various pollutants such as BOD, turbidity, chloride, sulphate, zinc, and copper. This filter unit not only demonstrates simplicity and cost-effectiveness but also offers a viable method for treating wastewater with multiple contaminants. However, it is noted that this filter slightly increases turbidity and acidity, indicating some limitations that need consideration depending on specific water quality requirements.

In contrast, the treated coir pith (with HCl), glass, and gravel filter exhibits poor performance across several parameters. This setup not only fails to effectively reduce turbidity but also exacerbates water quality issues by increasing acidity and failing to adequately mitigate COD and chloride levels. This underlines the challenges and limitations associated with modifying natural materials like coir pith with chemical treatments for wastewater treatment purposes. As such, while these filter units show promise in reducing pollutant loads and promoting sustainability through the use of natural materials, careful consideration of their performance characteristics and limitations is essential when selecting appropriate treatment methods for industrial wastewater.

In summary, while the untreated coir pith, sand, and gravel filter offers a promising solution for wastewater treatment due to its effectiveness and economic viability, the performance variability among different filter setups underscores the importance of tailored solutions to meet specific water quality standards. Further research and optimization efforts are necessary to enhance the efficiency and reliability of these filter units, ensuring they can consistently meet regulatory requirements for safe discharge of treated wastewater.

Smart Traffic Signal Management Using AI

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Abstract: Traffic congestion in urban areas leads to long delays, increased fuel consumption, and air pollution. Advancements in adaptive traffic signals and intelligent transportation systems can alleviate these issues. By utilizing live camera images and AI for traffic density calculations, adaptive traffic light control algorithms can effectively reduce congestion and improve traffic flow. YOLO (You Only Look Once), a real-time object detection model, adjusts traffic signal timers based on vehicle density. This approach reduces congestion, minimizes waiting times, and lowers fuel consumption and pollution. A simulation and prototype demonstrate the system's efficacy compared to existing static systems.

Introduction

Our proposed system begins by taking an image captured by CCTV cameras at traffic junctions as input for real-time traffic density calculation through image processing and object detection. Image is fed into the vehicle detection algorithm, employing YOLO. The algorithm identifies the number of vehicles for each class, such as cars, bikes, buses, and trucks, enabling the calculation of traffic density. The signal switching algorithm utilizes this density, along with other relevant factors, to establish the green signal timer for each lane, subsequently updating the red signal times accordingly. To prevent the starvation of a specific lane, the green signal time is constrained within maximum and minimum values. A simulation and a prototype were developed to compare the efficiency with existing system.

Project description

In real time traffic signal, the process begins with cameras capturing real-time videos at intersections. The system employs image processing techniques to detect vehicles within the captured frames. Following vehicle detection, the next step involves calculating the traffic density based on the number of identified vehicles. Subsequently, the green signal time for traffic lights is determined, likely influenced by the calculated traffic density. Finally, the traffic signal timer is updated accordingly, reflecting the dynamically assessed conditions to optimize traffic flow at the intersection.

The chosen site for this study is S.H. Junction in Changanassery. The selection was based on the observation that certain vehicles experience delays in crossing the road, whereas wasted green time is observed on another road. To create simulation datasets, recorded videos spanning 10 minutes at various times were required to tabulate different values of waiting time and green time wastage. With the collected data from site, simulations were developed to showcase both the existing and proposed traffic systems at a specified intersection. Each simulation ran for a total duration of 25 minutes, 300 seconds each, capturing snapshot of traffic patterns. The simulated environment features a 4-way intersection equipped with four traffic signals. Each signal is accompanied by a timer, indicating the remaining time before the signal transitions from green to yellow, yellow to red, or red to green.

Fig. 1. Snapshot of simulation

Fig. 2. Proposed system – Case 1

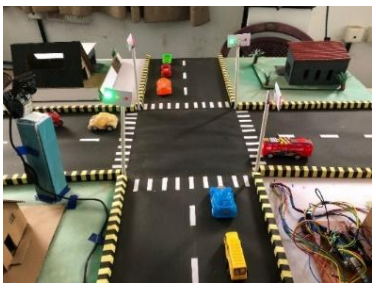

Fig. 3. Proposed system- Case 2

In prototype of proposed system, webcams are positioned on either side of the road alongside four traffic lights. An Arduino Microcontroller oversees the camera, tallying the vehicle count as they traverse the road. Signal adjustments occur when the camera detect traffic congestion. The system operates across three distinct cases, outlined as follows:

Case1: If there are no vehicles present on the road then light is (Red), until vehicles are arrived

Case 2: If there is varying number of the traffic density at signals, the system changes the priority of traffic light (Green) for the road that have the highest density as shown in Fig. 2.

Case 3: If all roads exhibit equal density, the system activates a sequential arrangement between them, allowing it to operate normally by controlling the signals one after the other.

Importance of the Project

The increase in urban vehicle numbers has created challenges like reduced road capacity and lower service levels. Fixed signal timers at intersections, which don't adjust to changing conditions, often cause traffic problems. As road use grows, innovative traffic control solutions are needed. Current methods include manual control by traffic police, static-timed traffic lights, and electronic sensors that adjust signals based on traffic data. However, these methods have downsides: manual control requires many officers, static timers can't adapt to real-time traffic, and advanced sensors are expensive and have limited range.

Conclusion

The proposed system adjusts green signal duration based on traffic density, giving longer green time to busier directions. This adaptive method aims to reduce delays, congestion, and waiting times, thus lowering fuel consumption and pollution. Simulations show significant improvements over current systems in vehicle throughput at intersections. Further calibration with real-life CCTV data could enhance performance.

Unlike existing systems using pressure mats or infrared sensors, this system leverages existing CCTV cameras, reducing deployment and maintenance costs. Integrating this system with CCTV cameras in major cities could greatly improve traffic management. By using YOLO for vehicle detection and analysis, the system can adapt signals based on traffic density, improving traffic flow and road safety. The successful prototype demonstrates the potential for future advancements in traffic management systems, offering a more efficient and cost-effective solution.

Acknowledgement

We express our sincere thanks and gratitude to our guide, Dr. Soosan George T., Professor and Dean, Department of Civil Engineering, SAINTGITS College of Engineering, for her valuable guidance that has been a source of inspiration throughout the project.

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We also acknowledge Dr.Susan Rose, Head of Civil Engineering Department, SAINTGITS College of Engineering for her help during the course of the project.

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We also thank all the Staff members, who helped us directly or indirectly and our friends and family for their great help and support during the course of the project.

Last but not the least; we thank God Almighty for his blessings throughout the endeavour, without which it would not have been possible.

Synthesis of Platinum Group Metal-Free Electrocatalyst for Polymer Electrolyte Membrane Water Electrolyser (PEMWE)

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Abstract: The major challenge in producing green hydrogen by water electrolysis is the development of low-cost, earth-abundant catalysts for Hydrogen Evolution Reaction (HER) and Oxygen Evolution Reaction (OER). The present work focused on the synthesis of cobalt-manganese spinel oxide (Co_2MnO_4) catalyst supported on Nitrogen-doped Carbon Nanotubes (NCNTs) by solvothermal reaction. The characterization of the material shows that the as-prepared catalyst is Co_2MnO_4. The OER performance was evaluated using cyclic voltammetry (CV) and linear sweep voltammetry (LSV). Co_2MnO_4 catalysts supported on NCNTs have higher current density and oxidation stability compared to other earth-abundant catalysts, which makes them a promising catalyst for PEMWE.

Introduction

Polymer Electrolyte Membrane Water Electrolyser (PEMWE) produces green hydrogen and has the advantage of high charge density, compact structure, and low-temperature range. However, it suffers from sluggish kinetics of Oxygen Evolution Reaction (OER) at the anode, which in turn slows down Hydrogen Evolution Reaction (HER) at the cathode. Currently, PEMWE uses platinum group metals such as carbon-supported platinum as HER catalyst and ruthenium and iridium-based oxides as OER catalysts. This necessitates the development of platinum group metal-free (PGM-free) earth-abundant catalysts that have high efficiency for both OER and HER. Cobalt-oxide-based material is identified as an attractive catalyst for HER and OER due to its high electrocatalytic activity and stability in an acid medium. The present work involved the synthesis of nitrogen-doped carbon nanotubes (NCNTs) supported by Cobalt-Manganese spinel oxide catalyst supported on nitrogen doped carbon nanotubes (Co_2MnO_4-NCNTs) by solvothermal reaction followed by its characterization and electrochemical analysis.

Technical Description of the Project

PEM water electrolyser consists of 2 half-cell reactions:
At the cathode, the hydrogen evolution reaction (HER) occurs by:

$$4H^+ (aq) + 4e^- \rightarrow 2H_2 (g)\ E^\circ = 0.0\ V\ (vs\ RHE) \quad (1)$$

At the anode, oxygen evolution reaction (OER) occurs by::

$$2H_2O (l) \rightarrow O_2 (g) + 4H^+ (aq) + 4e^-\ E^o = 1.23\ V\ (vs.\ RHE) \quad (2)$$

The overall water splitting reaction is given by:

$$2H_2O (l) \rightarrow 2H_2 (g) + O_2 (g)\ E^o = 1.23\ V\ (vs\ RHE) \quad (3)$$

The objective is to increase the OER kinetics for large-scale production of green hydrogen.

Methodology

- Preparation of Nitrogen-doped CNTs (NCNTs) by oxidizing in nitric acid and heating at reflux.
- Catalyst precursor solution preparation
- The aqueous solution of Co $(OAc)_2.4H_2O$ and Mn $(OAc)_2.4H_2O$ is prepared in a 2:1 molar ratio. It is then added to the suspension of NCNTs in Propanol.
- This reaction mixture is carried out for solvothermal reaction and it is centrifuged and dried to get.

Fig. 1. shows the step-by-step synthesis procedure

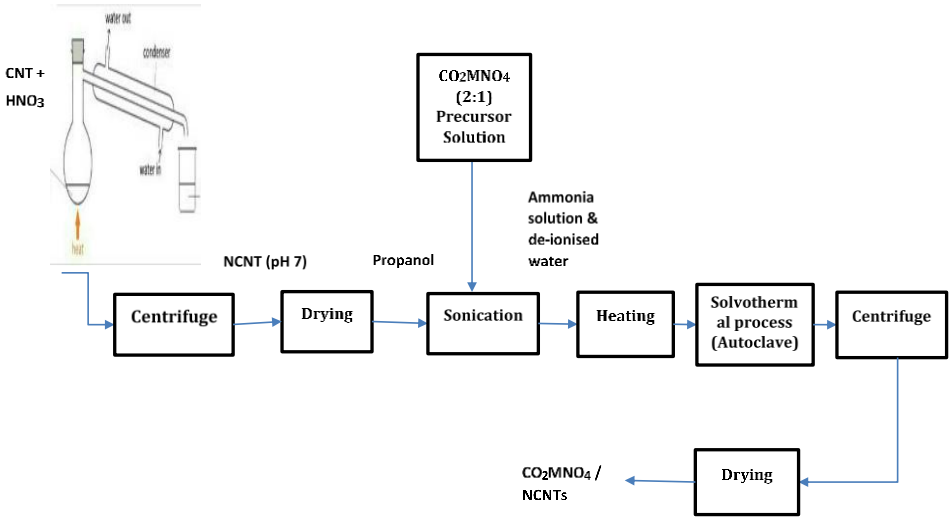

Figure 1. Step-by-step Synthesis Procedure of CO_2MNO_4 / NCNTs

Importance of the Project

Proton Exchange Membrane Water Electrolysis (PEMWE) holds significant potential for sustainable green hydrogen production, essential for the transportation sector, fertilizer production, and the gas processing industry. Despite its promise, cost-effective large-scale production remains a major hurdle. Electrocatalysts play a critical role in overcoming this challenge. This project provides valuable insights into developing earth-abundant and low-cost catalysts. By modifying these synthesized catalysts to enhance their activity and current density, the project aims to facilitate large-scale green hydrogen production using PEMWE technology.

Conclusion

The nitrogen-doped carbon nanotubes (NCNTs) supported Cobalt-Manganese spinel oxide catalyst (Co_2MnO_4-NCNTs) has been prepared by solvothermal reaction. The XRD analysis shows the presence of Co, Mn and Oxygen indicating there is no impurities present. The Energy-dispersive X-ray (EDX) analysis of the prepared electrocatalyst shows that the sample formed is Co_2MnO_4. The OER performance is determined by Cyclic Voltammetry and Linear Sweep Voltammetry (LSV). When compared to the existing electrocatalysts like IrO_2 and Pt, the activity is comparatively less but on the economical aspect cobalt compounds seems to be the feasible option. The activity of cobalt compounds can be improved by use of MOF structure and incorporation of other high-activity-showing metals into its structure. The project work showed that cobalt manganese oxide (Co_2MnO_4) proved to be an economical alternative to the current Platinum Group Metal electrocatalysts.

Adsorptive Removal of Methylene blue Dye from Water Using Modified Grape Stalk

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Abstract: This work focuses on the ability of grape stalk, a waste product of viticulture industry as an adsorbent for treating dye pigments from textile effluents. The study consists of chemical modification of grape stalk to enhance the properties such as surface area, porosity, and functional groups in adsorbent surface favoring adsorption. The removal efficiency is evaluated by batch and continuous operations. The effect of parameters pH, contact time, dye concentration, adsorbent dosage, and impact of bed height & flow rate is studied. The regeneration ability of the adsorbent is also performed to find the reusability of the adsorbent.

Introduction

Water is an important element in proper functioning of the earth's ecosystem but the quality of water resources is decreasing due to contamination. The major contributor to the contamination is the manufacturing sector with the textile industry in the top. It is estimated that an average textile mill that produces 8000kg/day of fabric consumes about 1.6 million liters of water, of which 8% is used in printing and 16% in dyeing process. Since the dyes used are highly soluble in water, it is carried away in effluents, which lead to contamination of water bodies as they are not easily degradable. This imparts the significance of treating these effluents before disposing in water bodies. Adsorption is one of the best treatment methods, but traditional adsorbents are expensive and non-ecofriendly. Thus in this work, the removal of methylene blue, a widely used colorant, using modified grape stalk, a bio adsorbent is studied.

Project Description

In this work, grape stalk (GS) is collected from juice factory, cleaned, dried and powdered. The powdered grape stalk is then modified by sol-gel method using HCl and TEOS. One gram grape stalk powder is treated with 5ml (2M) HCl and 10ml TEOS, stirred until gel formation, which is then dried in an oven at 45^{o}C for 3 hours to remove the residual moisture content. The solidified material is then powdered to form modified grape stalk (MGS) powder adsorbent. The modified grape stalk powder is then used for batch and continuous removal operations. The Batch removal experiment is conducted by taking a known concentration of 100ml sample in reagent bottle to which MGS is added and kept in rotary shaker at 250 rpm with a fixed time interval for each batch.

The treated sample is then collected and analyzed using UV-Visible spectrophotometer at 668nm wavelength and the final concentration is obtained. The continuous experiments are conducted in a packed bed column with packings of modified grape stalk filled between glass beads in order to ensure proper contact of effluent with the adsorbent. The effluent feed (methylene blue dye solution) is supplied from an overhead tank which passes through the packings and treated water is collected in a collecting tank as shown in Figure 1 which is then analyzed in a UV-Visible spectrophotometer. The spend adsorbent is then collected, weighed and dried inorder to study the reusability by desorption and regeneration. The regenerated MGS adsorbent is again utilized for the adsorption process.

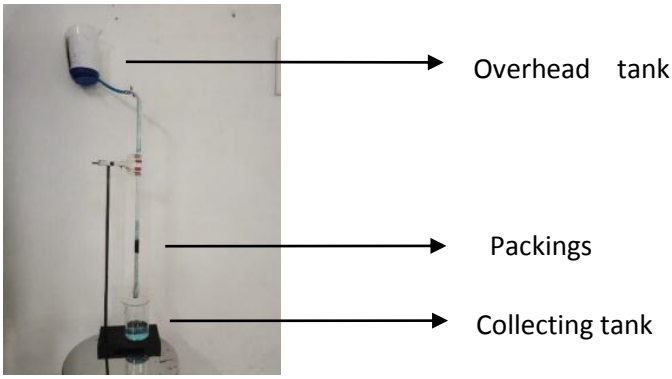

Fig.1. Experimental setup for continuous operation

The morphology and properties of GS and MGS are studied and compared using scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FT-IR), and X-ray diffraction studies (XRD) and observed the presence of more adsorption sites and functional groups in MGS.

Batch experiments were carried out to find adsorption capacity, percentage removal, the effect of different parameters, adsorption Isotherm models (to study the nature of the interaction between adsorbate and adsorbent), and adsorption kinetics models (to study the rate at which solute is adsorbed). The experiments to find the effect of parameters are carried out by varying pH (2.5, 5.5,7 & 8.5) keeping all other factors constant. Similarly, other parameters like contact time (15, 30, 45 & 60 minutes), adsorbent dosage (1, 2 &3 g), and dye concentration (5, 35 & 65ppm) are also studied. The Isotherms models are plotted for various concentrations using Langmuir and Freundlich models. The adsorption kinetics model is drawn for Pseudo first-order model (PFO), Pseudo second order (PSO) and Elovich model by observing variation in rate of adsorption with time.

Continuous experiment was carried out using packed column of glass beds with MGS sandwiched between them with different combinations of bed height, initial dye concentration, and flow rate as shown in table 1. Removal efficiencies and breakthrough plots for each system are obtained and compared to find the best system.

Table 1. Various combinations in column arrangement.

Bed height (cm)	Flow rate (ml/min)	Concentration (ppm)
1	2.05	50
3	2.05	50
3	2.05	70
3	5	50

The reusability of adsorbent is directly related to its regeneration which is studied by calculating the desorption rate. The desorption of system is conducted by thermal method in which the used adsorbent is subjected to 160^{o}c for 2 hours in a hot air oven and studying the change in weight of adsorbent before adsorption, after adsorption and after thermal treatment, by thermo-chemical method by dipping the adsorbent in HCl solvent at 30^{o}c-60^{o}c and calculating the presence of dye in the solvent after the process.

Importance of project

Adsorption is considered as the best method for water treatment as it is cost-effective, ecofriendly and easy to operate. The limitations associated with traditional adsorbents are their high cost, tedious synthesis methods and high energy needs. The use of grape stalk, a bio waste, as an adsorbent eliminates the issues associated with synthetic adsorbents, and enhance reusability. It also upholds values of energy saving, and sustainability, reduces the accumulation of waste products, and provides new life to waste supporting circular economy. This work is not only limited to the textile industry it can be extended to leather, printing sectors, etc.

Conclusion

It is found that the modified grape stalk (MGS) have an adsorption capacity of 25 mg/g and removal efficiency of 98.16%. Highest removal is obtained at pH range 3.5-5.5. The rate of removal increases with contact time and adsorbent dosage until saturation whereas rate of adsorption decreases as concentration of dye in effluent increases. Freundlich isotherm (R^2=1) and PSO kinetics (R^2=0.981) shows the best fitting indicating chemisorption in the system. Continuous experiments shows that higher adsorption is favored by low flowrate and larger bed height due to increased contact of adsorbent and adsorbate. On comparing the performance of batch and continuous systems for same adsorbent dosage of 3g, 95% removal with 100ml sample and 94% removal with 758.5ml is obtained respectively. 87% of pores is regenerated favoring reusability of adsorbent. From the findings it can be concluded that MGS is a potential adsorbent for treating large volumes of industrial effluents.

Empowering Mobility, Enhancing Lives: NaviGest - Gesture Control for Independence

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Abstract: NaviGest is an advanced gesture and voice-based home control system designed for individuals with paralysis or limited mobility. Utilizing Flutter's features including voice commands, manual control recognition, and ML Kit for machine learning, NaviGest enables autonomous operation of household appliances. This non-wearable solution merges speech, manual, and gesture-based controls, ensuring real-time monitoring and portability. With high accuracy in silent environments, NaviGest offers comprehensive control options through its user-friendly mobile application, making it a valuable tool for enhancing autonomy and quality of life for paralyzed individuals. Further noise reduction enhancements are suggested for optimal performance.

Introduction

The primary objective of humanitarian research is to assist the elderly and individuals with severe or total mobility impairments. Existing devices, such as eye-controlled interfaces, voice-activated home assistants, and Internet of Things (IoT) solutions, often fall short in accommodating the wide range of mobility impairments encountered in this population.

Mobility disabilities are highly individualized, necessitating customized accessibility solutions. For instance, individuals with upper body paralysis might rely on voice commands, while those with lower body paralysis might prefer physical controls. Completely paralyzed individuals may interact with home interfaces through eye blinks, facial expressions, or gaze direction.

Project Description

NaviGest is a novel system designed to empower individuals with severe mobility impairments by enabling them to control their environment using intuitive gestures and voice commands. The workflow of the entire system is depicted in Figure 1.

The system integrates with home automation technology, reducing dependency on assistance. It comprises several key components:

1. **Mobile Application**: The Flutter application captures user inputs through manual interactions, voice instructions, and gestures. Inputs are processed in real-time and communicated to a Firebase database, ensuring effective interaction with the backend system.

2. **ESP32 Development Board**: This board features dual-mode WiFi and Bluetooth capabilities, low power consumption, and supports various communication protocols. It controls a 4-channel relay module that interfaces with high-current devices.

3. **Gesture and Voice Recognition**: The system utilizes the Google ML Kit for gesture recognition and the speech-to-text Flutter plugin for voice commands. Eye blinks and gaze movements are detected and translated into control commands.

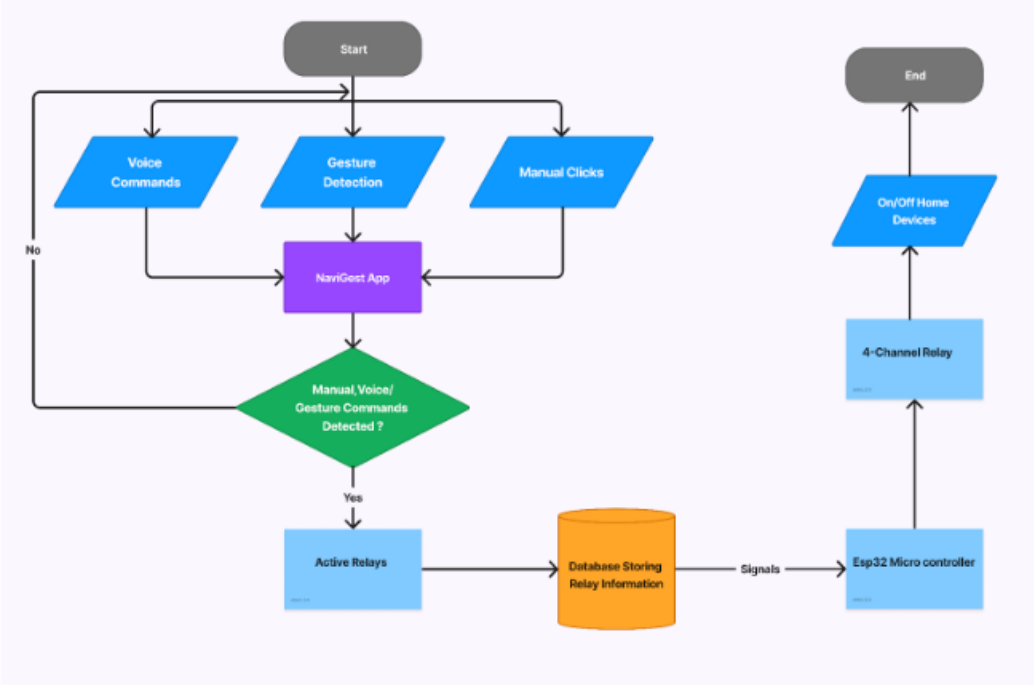

Figure 1: System Workflow

Importance of the Project

NaviGest stands out by offering a versatile and comprehensive approach to assistive technology. It combines multiple control methods, real-time processing capabilities, and compatibility with existing smart home devices, making it a practical and impactful solution. The system prioritizes user engagement and offers a potential breakthrough for individuals with mobility impairments, promoting independence and improving their quality of life.

Conclusion

The NaviGest project successfully developed an innovative gesture-based assistive system for individuals with paralysis, enabling them to control household appliances using intuitive gestures and voice commands, thereby enhancing their independence and quality of life. While the system showed high accuracy under various conditions, performance degradation under high noise levels suggests the need for further enhancements in noise reduction techniques. Overall, the user-friendly interface and multiple control options ensure accessibility and convenience, making NaviGest a valuable tool for improving the quality of life for paralyzed individuals.

Acknowledgement

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Smart Waste Segregation System

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Abstract: The proposed system integrates advanced technologies for waste management processes through automated segregation and monitoring.The system employs computer vision for real-time waste segregation into distinct categories.The segregation mechanism involves YOLO algorithm using a camera module for waste detection. Complementing the segregation mechanism, gas and level detection sensors are embedded within the waste bins. These sensors continuously monitor the fill-levels of the bins and the presence of methane gas emitted from accumulating waste. Upon detection of full bins or hazardous gas levels, the system automatically sends alerts to designated authorities or responsible personnel so the authorities can take necessary actions immediately.

Introduction

The system involves waste segregation unit with bin monitoring. The IR sensor detects the presence of waste. The camera module deployed at the top of the bin identifies the waste by capturing the image of the waste and comparing it with the trained images using the sorting algorithm. As the waste is successfully identified the waste is transported to the correct bin using a waste holder which has a motor attached to it which rotates and moves accordingly. There are totally 4 bins in the system which are classified as recyclable waste, metal waste, organic waste and non-detectable waste. Each bin is equipped with ultrasonic sensors and gas sensor. The system is also incorporated with an alerting mechanism. When the bin level reaches a threshold value an alert message is sent to the respective authorities.

Working

System operation:

1. The user is required to deposit waste into the waste tray through the front opening of the system.
2. The IR sensor kept at the opening detects the waste deposition.
3. The camera module captures an image for image identification purposes.
4. Upon processing the YOLO algorithm, the system determines the waste type, categorizing it as metal, degradable, non-degradable, or non-detectable. The system is divided into four sections for each waste type.
5. Following waste type identification, the motor attached to the waste tray rotates, facilitating the disposal of waste into the designated sections.
6. Unidentified waste is categorized as non-detectable and directed to the corresponding bin.

Alarm System Operation:

1. Four ultrasonic sensors, placed in each section of the bin, continuously monitor waste levels.
2. The gas sensor in the bio-degradable bin monitors methane levels.
3. Utilizing the Blynk app, authorities can remotely monitor waste levels.
4. An email alert is triggered and sent to respective authorities when the waste level reaches the threshold set by the ultrasonic sensors.

Importance of the Project

A key feature of the system is its ability to autonomously communicate. When it detects full bins or hazardous gas levels, it automatically notifies designated authorities or responsible personnel. These notifications provide detailed information about the specific bins needing immediate attention or the type of gas detected, enabling prompt response. Authorities can then quickly arrange for waste collection or implement measures to mitigate environmental risks from gas emissions. This integrated system greatly reduces the need for human intervention, improves waste segregation accuracy, and ensures timely disposal and risk management. By utilizing advanced technologies, the system enhances the efficiency and eco-friendliness of waste management. The use of computer vision for precise segregation and gas sensors for environmental safety streamlines waste handling and proactively addresses potential ecological hazards, offering a comprehensive and innovative solution to modern waste management challenges.

Conclusion

Our smart bin leverages advanced deep learning technology to accurately sort various types of waste, including recyclables, organic matter, disposables, and metals. This innovation reduces human error and effort in waste separation, enhancing efficiency and promoting responsible disposal habits. Our project highlights the potential of deep learning to improve everyday processes and infrastructure. By integrating AI into waste management, we illustrate how machine learning can address significant environmental challenges. By pursuing and implementing such innovative solutions, we can move towards a more efficient and environmentally friendly future.

AgroRover Crop Leaf Disease Detection Rover

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Abstract: The AgroRover-Crop Disease Detection Rover integrates robotics, computer vision, and precision farming via ROS. It autonomously navigates fields, using sensors and CNNs to assess crop health and soil conditions in real-time. By monitoring moisture, pH, and fertility, it optimizes irrigation and fertilization, enhancing yields and sustainability, and providing actionable insights for intelligent agriculture.

Introduction

AgroRover modernize agriculture by integrating robotics and automation, equipped with sophisticated sensors, cameras, and actuators. This versatile vehicle performs a wide range of tasks autonomously or under remote guidance, including soil analysis, planting, irrigation, weeding, and harvesting. A key component of precision agriculture is leaf disease detection, crucial for identifying and monitoring plant diseases early. Traditional methods involve manual inspections, which are time-consuming and error-prone. Integrating these capabilities into AgroRover allows real-time plant health monitoring. Specialized cameras and algorithms enable AgroRover to analyze leaf characteristics and identify diseases efficiently. This proactive approach helps farmers mitigate disease spread, minimize crop losses, and enhance productivity, sustainability, and resilience in farming systems.

AgroRover enhance modern agriculture by integrating robotics and automation for tasks like soil analysis, planting, and harvesting. Equipped with advanced sensors and cameras, they reduce manual labor and improve efficiency. Key features include real-time leaf disease detection using machine learning and computer vision, allowing early identification and intervention. This technology boosts productivity, sustainability, and resilience, offering farmers precise, actionable insights to manage crop health and optimize farming practices.

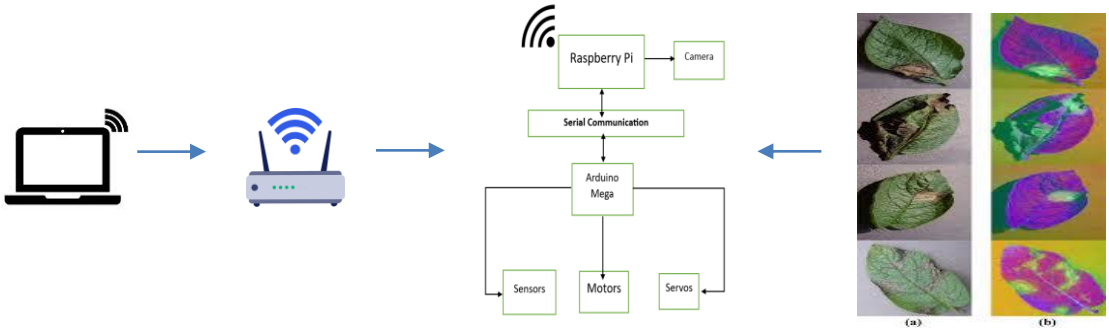

Fig. 1. Interfacing the hardware

AgroRover operates in Training and Autonomous modes. In Training mode, the rover is manually driven to perform tasks like crop leaf detection and soil moisture measurement. Joystick commands from a host PC are transmitted via WebSocket to the rover's Raspberry Pi and Arduino systems, which control motors and sensors. These commands are recorded in a CSV file, creating a log of movements and actions for future reference.

In Autonomous mode, the rover uses this data to replicate precise movements and perform tasks automatically. It measures soil moisture levels with specialized sensors, providing real-time insights for precise irrigation. Simultaneously, it conducts crop disease detection using high-resolution images analyzed by a pre-trained Convolutional Neural Network (CNN). This enables real-time disease identification and proactive intervention to protect crops.

Fig. 2. Input Image of a tomato leaf having mold

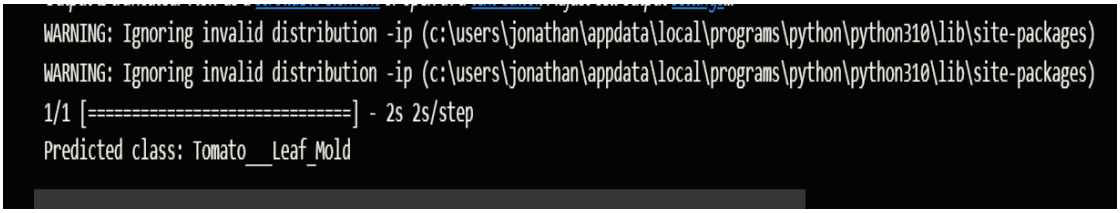

Fig. 3. Obtained result

ROS nodes manage the rover's functions, including sensor data collection, image processing, and motor control. This integration of robotics and automation enhances agricultural efficiency and sustainability, providing farmers with precise, actionable insights to optimize practices and boost productivity.

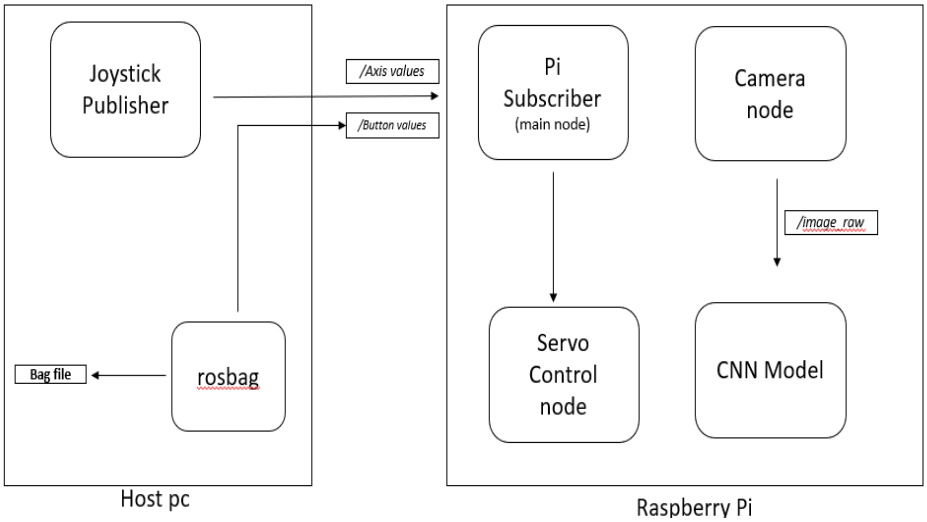

Fig. 4. ROS nodes control

Importance of the Project

The AgroRover project is crucial for modern agriculture as it enhances efficiency, productivity, and sustainability through the integration of robotics and advanced technologies. Unlike traditional methods, the AgroRover automates tasks such as soil moisture measurement and crop disease detection, reducing the reliance on manual labor and minimizing human error.

What sets the AgroRover apart is its dual operational mode—Training and Autonomous—allowing for precise data collection and adaptive learning. This ensures that the rover can effectively respond to varying agricultural conditions, making it versatile across different crops and environments.

Beneficiaries of this technology include farmers, agricultural businesses, and researchers. Farmers gain real-time insights into soil health and crop conditions, enabling them to make informed decisions that improve yields and reduce losses. Agricultural businesses can leverage this technology to enhance service offerings, while researchers can utilize the data collected for further studies on crop health and environmental impact. Overall, the AgroRover represents a transformative approach to precision agriculture, addressing the challenges of modern farming practices.

Conclusion

In conclusion, the Automated AgroRover for Crop Disease Detection marks a significant advancement in precision agriculture. By integrating artificial intelligence, machine learning, and advanced sensors, it streamlines monitoring and enhances agricultural efficiency. The rover autonomously analyzes plant health and identifies diseases in real-time, empowering farmers to make informed decisions swiftly. Its adaptability to changing conditions and targeted interventions reduces pesticide reliance, promoting sustainability. Ultimately, the AgroRover exemplifies the synergy between technology and agriculture, paving the way for sustainable food production and resilient farming ecosystems.

Acknowledgement

First and foremost, we offer our gratitude to God Almighty for his blessings and deliverance throughout the period of this project. We are truly grateful to our college management, academic advisors, parents and friends for their invaluable guidance and support throughout this journey.

Gyro-Stabilized Platform in Ambulance

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Abstract: Timely transportation of patients is very important. At the same time it is also important to transport them with utmost care inorder to reduce the severity. Ambulances are fast moving vehicles and are subjected to a large number of vibrations and jerks and the patients inside it will also experience the same effect. People having fractures or severe head injuries will have to undergo these problems and this can increase its severity. These platforms work against the motion of the vehicle and will help in the smooth transportation of patients. In this prototype, Arduino (AT mega 328) microcontroller is used to process the input from MPU-6050 inertial measurement unit. The code in Arduino uno controller analysis the input data, and when the C code receives the input from MPU and analyzes the angle and gives an output to the MG996R servo motor, it receives the signals and moves to the corresponding coordinates, so the movement of the vehicle will be nullified.

Introduction

Accidents encompass a broad range of unexpected events resulting in unintended harm, damage, or injury. These incidents can vary from vehicular collisions and workplace mishaps to slips and falls in everyday life. Platforms in ambulances encompass a range of integrated systems and technologies designed to enhance emergency medical services. These platforms contribute to improved patient care, communication, and operational efficiency. Stabilized platforms in ambulances play a crucial role in maintaining the stability of medical equipment, especially during patient transport. Here's a general background on stabilized platforms in ambulance .Overall, stabilized platforms in ambulances contribute to a safer and more effective medical environment during patient transport, ensuring that both the patients and the medical equipment receive the necessary stability for optimal care.

The project focusing on constructing a gyro-stabilized platform within ambulances is structured in two pivotal phases. The initial segment involves an extensive theoretical exploration, delving into the technical requirements and specifications of the equipment necessary for the development of the stabilized platform. This phase encompasses a comprehensive review of gyroscopic stabilization systems and sensor technologies tailored to suit the dynamic environment of ambulances. In the subsequent phase, the project transitions into an empirical investigation through a detailed survey of current scenarios in ambulances. This survey aims to meticulously analyze the existing challenges, nuances, and inefficiencies within ambulance settings, shedding light on the specific areas where the implementation of a gyro-stabilized platform could yield the most substantial impact. The synthesis of theoretical insights and empirical observations forms the foundation for a comprehensive and pragmatic approach toward realizing a gyro-stabilized platform that could revolutionize emergency medical transportation.

A motor (either DC or AC), a potentiometer, a gear assembly, and a control circuit make up a servo system, as shown in fig. 3.1.3. The gear assembly is first used to increase the torque of the motor while lowering its revolutions per minute (RPM). The potentiometer knob aligns itself such that no electrical signal is generated at the potentiometer's output port when the servo motor is in its starting position. The error detection amplifier's other input wire is then connected to an electrical signal. An error signal is produced as an output of the feedback mechanism, which analyzes the difference between these two signals—one from the potentiometer and the other from outside sources.

The motor receives this error signal as input, which causes it to start rotating. Meanwhile, the motor shaft is connected to the potentiometer, which rotates as a result, producing a signal. As a result, the potentiometer's feedback signal varies along with its angular position. The potentiometer eventually positions itself so that the signal applied outside matches its output. There is no output signal from the amplifier to the motor input at this point, indicating that there is no difference between the signal applied externally and the signal produced by the potentiometer. As a result, the motor stops rotating. This sensor is integral to the system, providing crucial data about the vehicle's orientation and movement. The MPU6050 combines both a gyroscope and an accelerometer, allowing it to detect angular velocity and linear acceleration, respectively. This dual capability ensures comprehensive monitoring of the vehicle's dynamics, capturing even the slightest deviations from the desired trajectory. Once the MPU6050 sensor collects the data, it is transmitted to a microcontroller, which acts as the central processing unit of the system. The microcontroller is programmed to interpret the incoming data from the sensor swiftly and accurately. It analyzes the gyroscopic and accelerometric inputs to determine the current state of the vehicle's balance and motion. Upon processing this data, the microcontroller executes a predefined algorithm designed to maintain stability. This algorithm considers the extent and direction of the tilt or deviation and calculates the necessary corrective measures. The result of this computation is a coded sequence that the microcontroller sends out as an output signal. This output signal travels through a network of connecting wires to reach a servo motor. The servo motor is a critical component in this system, known for its precision and responsiveness. It receives the signal and interprets the instructions to adjust its rotation. The servo motor's response is immediate and proportional to the detected deviation; it rotates in the opposite direction to counteract the tilt or imbalance. This counter-rotation is essential for real-time correction, ensuring that the vehicle remains stable and balanced.

Importance of the Project

The proposed system of incorporating gyrostabilized platforms into ambulances presents numerous industrial applications, especially within the emergency medical services and transportation sectors. Here are some key applications:

▪ Emergency Medical Services (EMS): Ambulance Manufacturing: To improve patient safety and comfort during transport, ambulance manufacturers might incorporate gyrostabilized platforms into their designs. This invention may set new industry norms for the production of ambulances. Ambulance Retrofit Services: Gyrostabilized platforms can be installed on existing ambulances to provide fleets with an upgrade path without having to replace the entire vehicle.

▪ Patient Transport Services: Non-Emergency Medical Transport (NEMT) services: NEMT services use gyrostabilized platforms to provide safer and more comfortable travels for patients requiring transport for regular medical appointments or transfers between medical facilities. Air Ambulance Services: Gyrostabilized platforms can be installed on helicopters and fixed-wing air ambulances to reduce vibration and turbulence impacts while in flight, improving patient safety in air transport situations.

▪ Medical Equipment Manufacturing: Creation of Stabilized Patient Transport Platforms: Medical equipment manufacturers are able to create and sell independent gyrostabilized platforms that can be fitted into a range of emergency and non-emergency vehicles. Portable Stabilization devices: Hospital beds or stretchers used for patient transfers inside hospital grounds are examples of situations in which portable gyrostabilized devices can be designed for use.

▪ Automotive Industry: Integration in Specialized Vehicles: This technology can be applied to other specialized vehicles, like military medical transport vehicles, mobile medical units, and vehicles used in disaster relief efforts, that need steady transport conditions

Conclusion

The development and successful simulation of a stabilized platform demonstrate promising implications for enhancing patient transportation in critical scenarios. Observing the swift and precise response of servo motors in nullifying tilt effects provides a strong basis for practical implementations. If similar components and mechanisms are integrated into real-world platforms, such as those installed in ambulances, they hold immense potential to significantly improve patient care during transit. By mirroring the prototype's capabilities, these platforms can actively counteract any potential tilting or instability, ensuring a smoother and more stable journey for patients. This stability is crucial as it minimizes the risk of exacerbating the condition of individuals being transported, particularly those in critical medical states. The utilization of such stabilized platforms in ambulances can substantially mitigate the impact of movements during transit, reducing the potential risks and discomfort experienced by patients. Ultimately, this advancement stands to positively impact the quality of care and outcomes for patients in transit, highlighting the valuable potential of integrating stability mechanisms into medical transportation system.

Acknowledgement

First and foremost, we offer our gratitude to God Almighty for his blessings and deliverance throughout the period of this project. We are truly grateful to our college management, academic advisors, parents and friends for their invaluable guidance and support throughout this journey

An Experimental Investigation of Epoxy Polymer Composite Reinforced with Areca Fiber and MWCNT for Automotive Suspension

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Introduction

This experimental study focuses on the development and assess a GFRP (Glass Fiber Reinforced Polymer) - epoxy composite reinforced with areca fiber and MWCNT (Multi-Walled Carbon Nanotubes) for use in automotive engineering's suspension system, specifically as a leaf spring. The study aims to enhance the mechanical properties of Glass Fiber Reinforced Polymer (GFRP) - epoxy composites by incorporating areca fibers and Multi-Walled Carbon Nanotubes (MWCNTs) in varying proportions. The research seeks to contribute to the design of sustainable, lightweight, and high-performance materials for vehicle suspension systems, thereby improving overall vehicle economy and reducing environmental impact.

Methodology

The methodology involved the fabrication of composite laminates using the hand layering technique to ensure a uniform distribution of GFRP, epoxy, areca fibers, and MWCNTs. Three distinct compositions were prepared and tested to investigate the influence of varying proportions of areca fibers and MWCNTs on the laminate properties. Tensile tests were conducted to assess the strength and deformation characteristics, and a Data Acquisition System was employed to gather precise mechanical behavior data.

Results

The experimental investigation revealed that the third composite composition, consisting of GFRP 50%-Epoxy 30%-Areca Fiber 15%-MWCNT 5%, exhibited superior tensile strength, flexural strength, and impact strength compared to the other two compositions. The findings suggest that this composition could potentially replace conventional metal leaf springs in automotive suspension systems, offering a promising solution for the development of more efficient and eco-friendly vehicles.

From Fields to Stars: Pectin Extraction and Millet Pudding Mix for Cosmic Explorers

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Abstract: This project aims to create an instant pudding mix for cosmic explorers using sustainable agricultural by-products like jackfruit rind, tamarind seed, and wild jack. Through microwave-assisted extraction, pectin is obtained from these by-products, with jackfruit rind identified as the highest yield. The pectin, along with foxtail millet and stevia, forms a nutritious pudding base, enhancing texture and nutritional value. Freeze-drying techniques ensure the pudding mix is lightweight, easy to transport, and has an extended shelf life, ideal for space missions. This eco-friendly, health-conscious alternative benefits both Earth-based consumers and space explorers.

Introduction

In the quest for sustainability and innovation, this project introduces an instant pudding mix designed to meet the unique needs of cosmic explorers. By utilizing underused agricultural by-products, specifically jackfruit rind, tamarind seed, and wild jack, this project addresses the intersection of waste management, nutrition, and economic viability. The core innovation lies in extracting high pectin content from these by-products to enhance the nutritional and textural properties of the pudding mix. Combined with foxtail millet and stevia, this mix not only offers a healthful, eco-friendly alternative to conventional pudding but also suits the stringent requirements of space missions. Freeze-drying techniques ensure the product is lightweight, easy to transport, and has a long shelf life, making it ideal for long-duration space missions.

Technical Description:

1. Raw Material Selection and Pectin Extraction:

The project begins with the selection of agricultural by-products: jackfruit rind, tamarind seed, and wild jackfruit. These materials are chosen for their high pectin content, a key component for the pudding's texture and nutritional profile. Comparative analysis reveals that jackfruit rind contains the highest pectin yield. The extraction process employs microwave-assisted extraction (MAE), an advanced technique that enhances pectin yield and reduces extraction time. The raw materials are dried, ground into a powder, and mixed with an acidified solvent. The mixture is then subjected to microwave irradiation, which accelerates the breakdown of plant cell walls and releases pectin into the solvent. The pectin is subsequently precipitated, purified, and dried for use in the pudding mix.

2. Pudding Base Formulation:

The extracted pectin is incorporated into a nutritious pudding base formulated with foxtail millet and stevia. Foxtail millet is selected for its high nutritional value, including protein, dietary fiber, and essential minerals. It is milled into a fine flour and combined with the purified pectin to create the base structure of the pudding.

Stevia, a natural sweetener, is added to the mix as a healthier alternative to sugar. It provides sweetness without the calories, making the pudding suitable for health-conscious consumers. The combination of foxtail millet and stevia results in a nutritious, low-calorie dessert option.

3. Freeze-Drying Process:
To ensure the pudding mix is convenient and long-lasting, freeze-drying techniques are employed. The formulated pudding mixture is first cooked and then freeze-dried. Freeze-drying involves freezing the pudding at a very low temperature, followed by sublimation, where ice is directly converted into vapor under reduced pressure. This process removes moisture while preserving the nutritional content and structural integrity of the pudding. The freeze-dried pudding is then ground into a fine powder, resulting in an instant pudding mix. This mix is lightweight, easy to transport, and has an extended shelf life, making it ideal for space missions where weight and longevity are critical factors.

4. Product Testing and Quality Assurance:
The instant pudding mix undergoes rigorous testing to ensure its nutritional value, taste, and texture meet the required standards. Sensory evaluations are conducted to assess the flavor, mouthfeel, and overall acceptability of the pudding. Nutritional and proximate analysis ensures the product meets dietary guidelines, providing essential nutrients and maintaining low-calorie content.

Importance of the Project

This project is pivotal due to its integration of sustainability, waste management, and nutrition, uniquely addressing the needs of cosmic explorers. Unlike traditional pudding mixes, it repurposes agricultural by-products like jackfruit rind, enhancing both environmental and economic viability. By using foxtail millet and stevia, it offers a healthier, low-calorie alternative. Beneficiaries include health-conscious consumers on Earth, particularly those in space missions, as the freeze-dried mix is lightweight and has a long shelf life. This innovative approach promotes health and environmental consciousness, setting it apart from other conventional dessert options.

Conclusion

This project combines sustainability, nutrition, and space mission requirements into an innovative instant pudding mix. Utilizing high pectin content from agricultural by-products like jackfruit rind, and incorporating nutritious foxtail millet and stevia, it offers a healthful, eco-friendly dessert option. Freeze-drying techniques ensure the mix is lightweight and has an extended shelf life, ideal for long-duration space missions. This innovative approach provides a sustainable alternative to conventional pudding mixes while supporting the health and well-being of cosmic explorers, promoting environmental consciousness and catering to the needs of health-conscious consumers on Earth.

Acknowledgement

First and foremost, I thankfully acknowledge our principal, **Dr. Sudha T**, for giving me the opportunity to present this project. I thank our Head of Department and my project guide, **Dr. Elsa Cherian**, Associate Professor and Head of the Department, Department of Food Technology, for her valuable guidance, support, and encouragement during the course of the project and in the preparation of the report. I express my sincere gratitude to the project coordinator, **Er. Ajna Alavudeen**, Assistant Professor, Department of Food Technology, Saintgits College of Engineering, for her valuable coordination, valuable advice, assistance, and help offered throughout this project. I express my heartfelt gratitude to the help extended by all other staff members of the department. I also remember all my friends and well-wishers with thanks for their encouragement and support. Above all, I would like to express my profound gratitude to **God Almighty** for the immense blessings upon me that led to the successful completion of this project.

IoT-based Customizable Instant Soup and Noodle Vending Machine

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Abstract: Our project introduces an innovative IoT-based soup and noodle vending machine designed to offer a customizable instant food option. With five separate containers for noodles, soup mix, vegetable masala, non-vegetable masala, and water, the ingredients are dispensed using spiral conveyor. The user interface, featuring an LCD screen, four touch sensors, and a regulator knob for Low, Medium, and High masala quantities, enables users to select vegetable or non-vegetable noodles and soups while adjusting flavour intensity. An integrated IoT mechanism continuously monitors performance and inventory level, ensuring uninterrupted service. Thus, our machine stands out with customizable ingredient quantities and promotes sustainability by optimizing resource usage.

Introduction

In today's fast-paced world, characterized by busy lifestyles and diverse dietary preferences, traditional food service models often struggle to meet the demands of modern consumers. The COVID-19 pandemic has highlighted the need for contactless dining options and personalized food choices. Traditional vending machines typically lack customization features, real-time inventory updates, and interactive interfaces, limiting their appeal and suitability for contemporary food service needs.

In response, the IoT-based instant soup and noodle vending machine emerges as a technologically advanced solution. It allows users to tailor their meals by adjusting spice levels according to their preferences. Equipped with Arduino microcontrollers, capacitive touch sensors, and IoT capabilities, the machine operates 24/7 in settings such as hospitals, offices, and schools. It ensures convenience, hygiene, and minimal food waste, supported by real-time monitoring and maintenance through IoT integration. This technological innovation redefines food vending by enhancing efficiency, sustainability, and customer satisfaction in contemporary urban environments.

Project description

This project unfolded in two distinct phases: the designing phase and the prototyping phase. During the design phase, the key considerations included designing the user interface to optimize interaction, selecting suitable components such as Arduino microcontrollers and capacitive touch sensors, and refining the dispensing mechanism for precise ingredient control. In the subsequent prototyping phase, these plans were implemented through the fabrication of structural components for the vending machine, integration of electronic systems such as DC geared motors for dispensing, and programming of the Arduino microcontroller to effectively manage machine operations. It included rigorous testing to validate performance, usability, and reliability under simulated and real-world conditions.

Technical Description of Project

The vending machine's external components are designed to enhance user interaction and customization. These include an LCD screen, touch sensors, and a regulator knob. The LCD screen provides real-time instructions and status updates, guiding users through the selection process with clarity and transparency. It displays menu options such as vegetable or non-vegetable soups and noodles, along with operational

messages like "Preparing Veg Noodles." Capacitive touch sensors enable a direct selection of food options. The regulator knob further enhances customization by enabling users to adjust spice levels with ease, ensuring each serving meets individual taste preferences accurately. Meanwhile, The internal components of the vending machine, features screw conveyor, relay, DC geared motor, and servo motor. The screw conveyor facilitates the movement of these ingredients to the dispensing point, while the DC geared motor and servo motor provide the necessary torque and control to ensure accurate portioning and dispensing. The relay plays a crucial role in managing electrical circuits and coordinating the timing and sequence of operations to maintain smooth functionality. Figure 1 depicts the circuit diagram of the equipment. Figures 2 and 3 show the front view and internal components of the developed prototype respectively. Central to the machine's operation is the Arduino UNO microcontroller, functions as the primary control unit. It integrates inputs from capacitive touch sensors, enabling users to select options such as vegetable or non-vegetable soups and noodles and to adjust spice levels according to personal preferences.

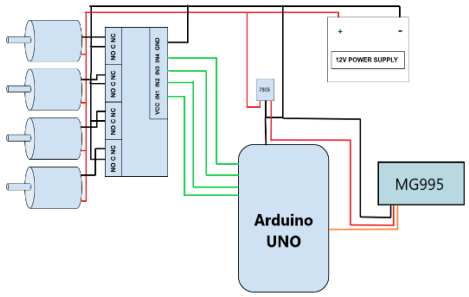

Fig. 1. Circuit Diagram of Vending Machine

Fig. 2. Front view of developed prototype

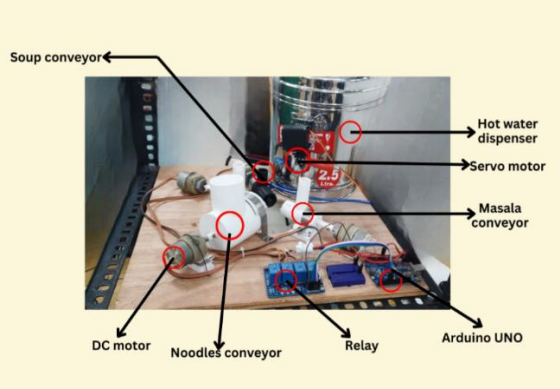

Fig. 3. Internal components of developed prototype

Working of Vending Machine

The vending machine is designed to dispense four main items: vegetarian soup, non-vegetarian soup, vegetarian noodles, and non-vegetarian noodles, offering users a highly interactive experience with customizable flavour profiles. Upon approaching the machine, users are greeted by an LCD screen that prompts them to place a cup near the designated opening. To enhance customization, the machine allows users to adjust the quantity of masala using a knob with settings for Low, Medium, and High. The touch

sensor interface enables the user to select their desired food item from the available options. Once a selection is made, the LCD display updates to show the status message corresponding to the chosen option, such as 'Veg noodles preparing', for example. The dispensing process begins with the noodles being dispensed into the cup, followed by the precise dispensation of masala based on the selected flavour intensity setting. Next, a predetermined amount of hot water is dispensed into the cup, initiating the cooking process for the noodles. This step ensures the noodles are properly cooked to perfection.

A DC motor drives the screw conveyor for dispensing noodles and masalas, while a servo motor controls the opening and closing of the hot water container. Users are then guided to take the lid, close the cup, gently shake it, and allow a few minutes for the noodles to cook thoroughly. In contrast, soup options do not require additional preparation steps and can be consumed immediately after dispensing.

Importance of the Project

The IoT-based instant soup and noodle vending machine project is significant due to its innovative approach to providing customizable, nutritious food options in public spaces. Unlike traditional vending machines, this project offers users the ability to select ingredient quantities, particularly the masala mix, enhancing user satisfaction and catering to individual dietary preferences. The primary beneficiaries are consumers in high-traffic areas such as hospitals, offices, and schools. The project stands out for its IoT-enabled features, including real-time performance monitoring and inventory management, promoting efficiency and sustainability by reducing food waste and optimizing resource usage.

Conclusion

In conclusion, the IoT-based instant soup and noodle vending machine represents a significant advancement in food vending technology, offering tailored, nutritious meals. By integrating IoT capabilities for real-time monitoring and maintenance, the machine ensures reliability and efficiency in diverse settings like hospitals, offices, and schools, while reducing the likelihood of technical issues. Furthermore, the collected data can be used to optimize inventory and enhance the user experience. This project not only meets the growing demand for convenient, customizable food options but also addresses concerns about hygiene and sustainability in public dining spaces. As a prototype, this project demonstrates significant potential for scalability. With successful initial deployment and positive user feedback, the vending machine can be expanded to various locations. Future enhancements could include adding a touchscreen display and payment options for easier use, along with built-in heating and mobile app functionality for greater convenience.

Acknowledgement

We would like to express our sincere gratitude to the teachers and students of the Food Technology Department and the Robotics Department at Saintgits College of Engineering for their invaluable support and contributions to this project. Their expertise and dedication were instrumental in the successful completion of our research on the IoT-based instant soup and noodle vending machine. We also appreciate the assistance provided by the lab technicians and administrative staff, whose efforts were crucial in facilitating our research activities.

IntelliGuide: Smart Walking Stick

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Abstract: IntelliGuide is a device created with the intention of assisting individuals with visual impairments by identifying objects and conveying the information to them through spoken words. This decreases the need for human assistance and enhances the comprehension of their surroundings. Additionally, it offers visually impaired individuals the opportunity to move independently without relying on others for assistance. The captured information can then be transmitted to the user through auditory means, such as sound or speech. It also has a GPS module to track the real time location of the visually impaired person.

Introduction

IntelliGuide is an IOT based project that combines modules such as real-time location tracking, object detection and text to speech to empower individuals with visual impairments to independently navigate their surroundings while gaining heightened awareness. By harnessing advanced technologies such as location tracking, object detection, and text-to-speech conversion, IntelliGuide functions as a comprehensive assistive aid for the visually impaired. The fundamental components of this ingenious system encompass the Raspberry Pi 4B, Pi Camera v1.3, HC-SR04 Ultrasonic Sensor, Neo 6m GPS module, Firebase, and a user interface built on React.

Project Description

By seamlessly integrating multiple sensors, IntelliGuide not only identifies objects near the user but also communicates pertinent information through auditory means, thus reducing their dependence on human assistance and cultivating a greater sense of independence. Moreover, the inclusion of a GPS module ensures continuous monitoring of the user's precise position in real-time, further enhancing safety and convenience during their daily traverses. By incorporating cutting-edge hardware and software, IntelliGuide surpasses conventional aids for the visually im-paired by presenting a versatile solution that tackles issues related to mobility. The seamless merging of Raspberry Pi and advanced sensors facilitates instant recognition of objects, while the Neo 6m GPS module ensures accurate tracking of one's location. The gathered data is effortlessly relayed to the user through auditory means, augmenting their understanding of the surroundings.

Working of The Project and Technologies Used

A. Internet of Things (IoT): The Internet of Things (IoT) is a technological paradigm shift that is ushering in a time when common things are smoothly conversing, sharing data, and becoming networked .
B. React: The Facebook-developed and maintained React.js toolkit has become a popular and effective JavaScript tool for UI development.
C. Firebase: The Firebase Realtime Database and Cloud Firestore, the two primary cloud-hosted NoSQL databases offered by Firebase, are intended to make it easier for developers to create scalable and real-time applications.
D. OpenStreetMap API: A powerful and open-source mapping platform called Open-StreetMap (OSM) API enables developers to access and use geographic data for a range of purposes.

E. Python: Python is a high-level, adaptable programming language that has a large and supportive community and is known for being easy to learn and understand

F. React Leaflet: React Leaflet combines the adaptability of React with the interactive mapping features of Leaflet, React Leaflet is a React wrapper for the Leaflet mapping toolkit

Hardware

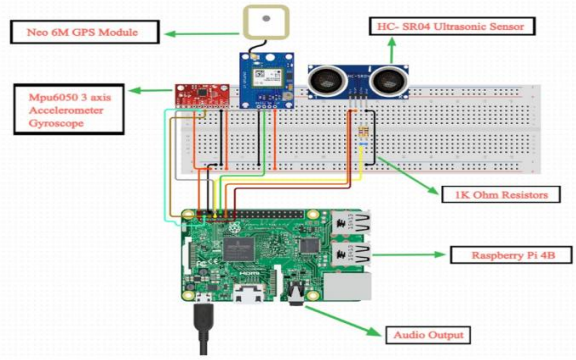

Fig. 1. Object Detection and Text to Speech

A. Hardware Integration and Working

Using a Raspberry Pi 4B as the central processing unit, the project makes use of its processing capability to perform text-to-speech and object detection functions. The incorporation ofhardware elements like GPS modules and ultrasonic sensors improves the device's ability to calculate distances and deliver location-based data.

B. TensorFlow Lite Object Detection

For real-time object detection, TensorFlow Lite, a scaled down variant of the well-known machine learning framework, is utilised.

C. Class Name Extraction

In addition to identifying objects, the TensorFlow Lite object detection model also extracts the names of their classes.

D. Google Text-to-Speech Integration

Google's Text-to-Speech engine is then utilised to translate the class names that were identified throughout the object recognition phase into spoken words in an effortless manner.

E. Location Tracking

A Neo 6M GPS module is integrated with Intelliguide to dynamically track the whereabouts of visually impaired people in real time.

Conclusion

With regard to assistive technology for the blind, the project marks a major advancement. Through the project's seamless integration of several sensors and modules, it not only tackles the particular difficulties experienced by the visually impaired but also highlights how developing technologies might enhance accessibility, autonomy, and safety in their day-to-day life. This creative approach fosters a stronger sense of independence and security for people with visual impairments, demonstrating the beneficial impact that technology can have on their life.

Design and Development of Single Serving Cooking Robot

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Abstract: Enter the realm of culinary innovation with our state-of-the-art single-serving cooking robot, designed to redefine the cooking experience. This groundbreaking robot prioritizes simplicity, user-friendliness, and safety, making cooking accessible to all. Explore diverse recipes and cuisines effortlessly while enjoying a secure cooking environment. The robot's customizable features allow you to tailor meals to your preferences, ensuring a personalized culinary experience. Additionally, its precision minimizes food waste, promoting sustainability. Embrace a new era of smart gastronomy with our cooking robot, where convenience meets the joy of creating and savoring delectable dishes. Welcome to the future of cooking.

Introduction

Welcome to the realm of culinary innovation with our state-of-the-art single-serving cooking robot, a groundbreaking kitchen companion designed to redefine the cooking experience. This innovative robot is engineered to save valuable time and effort, streamlining the cooking process and ensuring consistently delightful results with each preparation. User-friendliness takes precedence, providing an intuitive interface that not only simplifies tasks but also encourages culinary exploration. With a focus on safety and customization, our cooking robot transforms meal preparation into a personalized and sustainable culinary experience, making cooking accessible to all.

Project Description

The single-serving cooking robot revolutionizes the kitchen by automating meal preparation, focusing on simplicity, precision, and customization. This innovative device features an intuitive touch interface that allows users to select recipes, adjust portion sizes, and customize flavour profiles effortlessly. The robot’s core functionality revolves around an integrated system of sensors, actuators, and a microcontroller, ensuring accurate ingredient measurement, mixing, and cooking.

Working of the Project

The robot’s user-friendly interface displays a variety of recipes, categorized by cuisine and dietary preferences. Users select a recipe, and the robot calculates the necessary ingredients and steps. Precision dispensers and scales measure ingredients accurately, minimizing waste and ensuring consistency. The robot uses RFID tags on ingredient containers to identify and select the correct components. The robot’s mixing mechanism combines ingredients uniformly, while adjustable heating elements cook the food to perfection.

Temperature sensors and timers monitor the cooking process, ensuring optimal results. The robot is equipped with multiple safety mechanisms, including automatic shut-off, heat-resistant materials, and emergency stop buttons, providing a secure cooking environment. Users can tailor recipes to their preferences by adjusting portion sizes, spice levels, and ingredient substitutions. The robot adapts to these changes seamlessly, delivering personalized meals.

Technical Description

The robot is built around a microcontroller unit (MCU) that orchestrates all operations, including user input processing, ingredient dispensing, and cooking control. Key components include a capacitive touchscreen that enables intuitive navigation and recipe selection, interfacing with the MCU through an I2C communication protocol. Stepper motors control the dispensers, ensuring precise measurement of ingredients, while load cells provide feedback for accurate weight measurements. A servo motor-driven mixing arm combines ingredients in a mixing bowl, with the speed and duration of mixing controlled by the MCU based on the recipe requirements. Adjustable electric heating elements cook the food, with thermocouples providing real-time temperature feedback to the MCU for precise control. The robot includes multiple safety features such as thermal cutoffs, emergency stop buttons, and non-slip feet, with the MCU monitoring all safety inputs and shutting down the system if necessary. Figures and diagrams can illustrate the system architecture, ingredient dispensing mechanism, and safety features for better understanding. A flowchart of the cooking process and a block diagram of the MCU interfacing with various components can provide a clear technical overview.

Importance of the Project

This single-serving cooking robot stands out due to its focus on user-friendliness, safety, and customization. It democratizes cooking by making gourmet meal preparation accessible to individuals of all skill levels. Beneficiaries include busy professionals, elderly individuals, and anyone seeking a convenient and personalized cooking experience. Additionally, its precision reduces food waste, aligning with contemporary sustainability goals.

Conclusion

The single-serving cooking robot represents the future of cooking, combining innovation, convenience, and sustainability. It simplifies meal preparation, ensures consistent results, and offers personalized culinary experiences. With its advanced features and focus on safety, this robot transforms the kitchen into a space of exploration and enjoyment, making cooking accessible to everyone. Embrace the future of smart gastronomy with our innovative cooking companion.

Acknowledgement

We extend our gratitude to our mentors and the development team for their unwavering support and dedication.

Mobile Robot for Medical Assistance

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Abstract: Efficient solutions for healthcare staff are crucial. An advanced mobile robot in hospital wards and isolation units can reduce workload and improve services. Using SLAM for precise navigation and computer vision for obstacle detection and interaction, the robot performs tasks like medication delivery, waste disposal, remote patient monitoring, and data collection. In isolation wards, it minimizes infection risk by reducing human contact and handling hazardous materials. This project enhances healthcare efficiency, patient safety, and staff well-being, aiming to revolutionize the industry with advanced robotics.

Introduction

In today's healthcare landscape, innovative solutions are essential to support medical staff. Our project aims to develop an advanced mobile robot for hospital wards and isolation units. By utilizing Simultaneous Localization and Mapping (SLAM) technology, our robot navigates complex indoor environments with precision, even without GPS. The robot's applications include medication delivery, waste disposal, remote patient monitoring, and data collection. In isolation wards, it reduces infection risk by minimizing human contact and handling hazardous materials safely. Integrating SLAM with LIDAR, our project enhances healthcare operations, patient safety, and staff well-being, promising a transformative impact on medical robotics.

Working of the Project

In this project, we developed an advanced mobile robot designed for use in hospital wards and isolation units to support and streamline medical operations. The robot's primary functionalities include medicine delivery, food delivery, waste disposal, and remote patient monitoring, with an emphasis on minimizing human contact to reduce infection risks.The project started with the hardware development, which involved constructing a robust frame and integrating essential components. The frame, made of welded 3/4 inch square tubing, serves as the backbone of the robot, providing structural support and housing various parts. The base of the frame was designed to accommodate the motors and wheels. We used MY1016Z 250W e-bike motors securely attached to the base, driving 10-inch pneumatic wheels through a chain drive mechanism with a gear reduction of 4.888888:1, ensuring reliable propulsion and smooth movement. For steering, the robot employs a differential drive mechanism, which uses two motor chain drive and wheel systems to achieve precise control. An external encoder is fitted to obtain odometry data, an IMU (Inertial Measurement Unit) provides orientation data, and a LIDAR sensor measures distances. These sensors enable accurate navigation and mapping, allowing the robot to move seamlessly through hospital environments.

Technical Description

The hardware development began with the construction of the frame, which is made from sturdy steel, specifically welded 3/4 inch square tubing, ensuring durability and robustness. This frame provides the structural backbone and houses essential components such as motors, batteries, and sensors. A base was constructed and integrated into the frame to serve as the platform for attaching motors and wheels.

The MY1016Z 250W motors were securely screwed onto the base, crucial for providing the necessary propulsion for the robot's movement. The 10-inch pneumatic wheels were attached to the motors via a chain drive mechanism, ensuring a reliable and efficient transfer of power. The robot employs a chain drive system with a gear reduction of 4.888888:1, enhancing torque and control. Differential drive is used for steering, combining the two motor chain drive and wheel systems to achieve precise control.

A battery pack made from 14 Li-ion cells ensures optimal power supply, supporting the robot's operational needs. An external encoder is fitted to obtain odometry data, crucial for determining the robot's position and orientation. An IMU (Inertial Measurement Unit) provides orientation data, and a LIDAR sensor measures distances for accurate navigation and mapping. The software development involved creating a custom URDF (Unified Robot Description File) to describe the robot's physical and sensor configuration within the ROS (Robot Operating System) framework.

A custom package based on the Linorobot package was developed to process sensor data from the robot's computer, and the ROS 2 navigation stack (Nav2) was used to perform SLAM (Simultaneous Localization and Mapping) and autonomous navigation. The robot employs SLAM to generate accurate maps and navigate complex environments. Autonomous navigation algorithms, built into the Nav2 stack, enable the robot to perform tasks such as medicine and food delivery, and remote patient monitoring. Computer vision algorithms enable the robot to perceive its surroundings, detect obstacles, and interact intelligently with patients and healthcare professionals. After assembling the hardware components, rigorous testing was conducted to examine robustness, identify potential weaknesses, and ensure the robot meets standards of durability and functionality.

Simulations were conducted where the robot navigated through multiple environments using SLAM, generating accurate maps and demonstrating intelligent navigation and environmental perception. The integration of a 4-degrees-of-freedom (4-DOF) manipulator enhanced the robot's capabilities, allowing it to perform tasks such as pick and place operations with increased precision and versatility. Challenges arose in obtaining odometry data, crucial for determining the robot's position and orientation in real-time, which impacted the execution of planned integrations.

Despite these challenges, the successful simulation of SLAM and the integration of the 4-DOF manipulator in a virtual environment demonstrated significant progress. Future work will focus on addressing these challenges, refining the hardware and software integration, and expanding the robot's capabilities to ensure it can operate reliably in real-world hospital environments, thereby revolutionizing healthcare operations with advanced robotics.

Importance of the Project

Our project is pivotal in healthcare, integrating advanced robotics to automate tasks like medication delivery and waste disposal, thus easing the burden on medical staff. It uniquely minimizes infection risks in isolation wards and enhances operational efficiency through SLAM navigation.

By improving patient monitoring and cutting costs, it advances healthcare technology while prioritizing staff well-being. Beneficiaries include medical professionals freed from routine tasks and patients receiving enhanced care. Our scalable approach sets us apart, pioneering safer, more efficient healthcare systems with profound implications for patient outcomes and public health.

Conclusion

The successful deployment of our fully operational medical assistance mobile robot marks a significant milestone in transforming healthcare environments. By integrating advanced navigation and perception capabilities, especially SLAM, our robot demonstrates exceptional potential in healthcare settings. The inclusion of a 4 DOF manipulator enhances interaction and precision, allowing the robot to execute complex tasks with accuracy. Our ongoing efforts to optimize SLAM integration and refine manipulator functionality underscore our commitment to delivering a mobile robot capable of navigating intricate hospital environments and providing intelligent support. These advancements promise to establish a highly capable and adaptable solution for healthcare delivery, poised to improve efficiency, patient care, and overall healthcare outcomes. As we continue to innovate and refine our technology, we anticipate further enhancing the robot's versatility and impact in healthcare settings worldwide.

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Clique: The Virtual Study Group Mobile App

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Abstract: In today's fast-paced world, characterized by rapid technological advancements and a growing demand for flexible and accessible education, the Virtual Study Group Mobile App stands out as a transformative solution for learners. This digital platform is designed to enhance academic experiences by facilitating collaborative learning and knowledge sharing among students, irrespective of geographical boundaries. By leveraging the power of mobile technology, the app creates a dynamic and engaging virtual environment for study groups, offering features such as real-time communication, document sharing, synchronized schedules, and a user-friendly interface. This abstract explores the innovative features and benefits of the Virtual Study Group Mobile App, highlighting its comprehensive approach to fostering effective and personalized learning.

Comprehensive All-in-One Platform

The Virtual Study Group Mobile App combines a wide range of features into a single platform, reducing the need for users to switch between multiple apps for different purposes. This all-in-one approach includes:

- Real-Time Communication: Users can engage in text, voice, and video chats, enabling seamless interaction and collaboration within study groups.
- Collaboration Tools: Features like document sharing allow users to upload and exchange study materials, notes, and other resources.
- Task Management: Users can create, assign, and track study-related tasks, ensuring effective organization of group activities.
- Scheduling: The app helps coordinate study sessions, taking into account users' availability and different time zones.
- Notification Systems: Reminders and alerts keep users informed about upcoming study sessions, task deadlines, and incoming messages.
- Discussion Forums: Topic-specific forums enable broader knowledge exchange and community building.
- Study Material Recommendations: The app suggests relevant resources based on users' interests and needs.
- AI Assistant: An integrated AI assistant offers support by answering questions and assisting with various educational queries.

Tailored for Education

Unlike general-purpose communication tools, the Virtual Study Group Mobile App is explicitly designed for educational purposes. It focuses on creating a virtual study environment that is student-centric and academically focused. By offering features tailored to the needs of students, the app promotes active learning, critical thinking, and peer interaction.

Personalization and Flexibility

One of the standout features of the Virtual Study Group Mobile App is its flexibility, which allows for personalized study sessions. Users can select study group members based on academic interests and availability, resulting in more effective and tailored learning experiences. This personalization fosters a

sense of community and encourages the exchange of diverse perspectives and resources, enriching the overall learning experience.

Key Features and Modules

User Management Module: The User Management Module is essential for connecting users with similar academic interests and schedules. Users can create and maintain personal profiles, providing information such as names, profile pictures, academic interests, and availability. This data plays a vital role in matching users with peers who have similar goals, facilitating effective collaboration.

Study Group Module: The Module offers two main features: Study Group Creation and Study Group Search. Users can create their own study groups, defining the group's purpose, subject, and availability, and inviting others to join. This module also allows users to search for existing study groups based on criteria such as subject, study level, or time availability. These features streamline the process of forming and joining study groups, making it easier to connect with like-minded individuals and plan study sessions.

Communication Module: The Communication Module includes real-time text communication, voice and video calls. These features enable users to engage in interactive discussions and study sessions, fostering collaboration and enhancing the learning experience.

Collaboration Module: The Collaboration Module facilitates document sharing, allowing users to upload and exchange study materials, notes, and other resources. This functionality streamlines the exchange of essential resources and information, enhancing the collaborative learning experience.

Task Management Module: The Task Management Module helps in organizing group activities by allowing users to create, assign, and track study-related tasks. Assigning tasks to specific group members ensures effective distribution of responsibilities, while deadlines help with time management and keep everyone on track.

Scheduling Module: The Scheduling Module ensures that study sessions are scheduled at mutually convenient times. Users can set their availability and preferences, and the app coordinates study sessions to accommodate different time zones and schedules.

Notification Module: The Notification Module sends reminders and alerts about upcoming study sessions, task deadlines, and incoming messages. This feature helps keep users informed and on track, ensuring that they do not miss important events or deadlines.

Additional Features

Discussion Forums: Discussion forums allow users to engage in broader knowledge exchange and discussions beyond their study groups. These forums create a sense of community and encourage the sharing of diverse perspectives and resources, enhancing the overall learning experience.

Study Material Recommendations: The app recommends study materials and resources based on users' interests and needs. This feature facilitates access to relevant materials, helping users find the resources they need to succeed in their studies.

AI Assistant: The integration of an AI Assistant sets the Virtual Study Group Mobile App apart from other study group apps. The AI Assistant can answer questions and assist with various educational queries, providing an additional layer of support and guidance for students. This feature enhances the overall learning experience by offering personalized assistance.

Conclusion

The Virtual Study Group Mobile App offers a holistic approach to collaborative learning, combining a wide range of features into a single, user-friendly platform. By focusing on education and personalization, the app promotes active learning, critical thinking, and peer interaction. Its unique features, such as the AI Assistant and comprehensive communication and collaboration tools, set it apart from other study group apps. The Virtual Study Group Mobile App is a dedicated and student-centric tool that enhances the overall learning experience, fosters community, and offers personalized study opportunities, making it an invaluable resource for learners in the digital age.

AidOptics: Smart Spectacles for The Visually Impaired

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Abstract: AidOptics is a groundbreaking wearable technology designed to empower visually impaired individuals with a safer and more independent road-crossing experience. This innovative solution integrates a camera module into a pair of smart glasses, complemented by a mobile application, to provide real-time environmental analysis and text-to-speech capabilities. By utilizing the camera's advanced imaging capabilities, the device can detect road conditions, and relay this information to the user via the mobile app. The text-to-speech feature converts this data into audible instructions, enabling visually impaired individuals to confidently navigate road crossings with improved situational awareness and increased safety. Aid Optics represents a significant advancement in assistive technology, enhancing the mobility and quality of life for the visually impaired community. By combining the capabilities of a camera module and a mobile application, it offers real-time environmental analysis and text-to-speech guidance, enabling safer and more independent road crossings. This innovative solution aims to empower visually impaired individuals, improving their mobility and enhancing their overall quality of life.

Introduction

AidOptics is a wearable device that combines the power of a camera module integrated into a pair of smart glasses with an integrated mobile application. The camera captures visual data from the surroundings and leveraging Artificial Intelligence (AI) algorithms to interpret this data. These algorithms could identify objects, detect obstacles, and assess the environment in real-time, providing valuable information to the user. This solution will offer real-time environmental analysis and text-to-speech guidance, empowering visually impaired individuals to navigate road crossings more effectively.

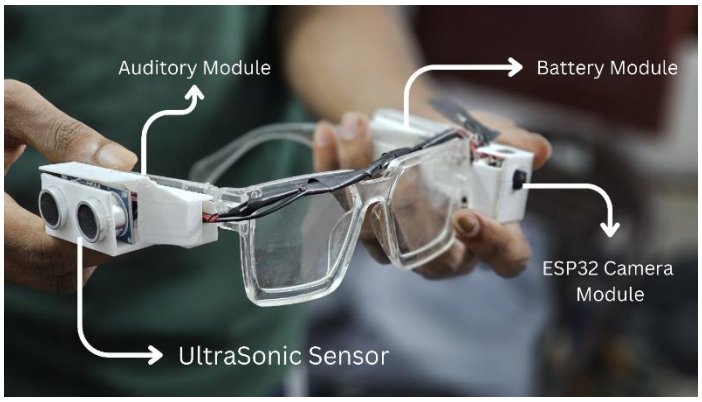
Its core, AidOptics is a ground-breaking initiative designed to bridge the accessibility gap for the visually impaired. By fusing a camera module within smart glasses and integrating sophisticated AI algorithms, this project aims to provide a comprehensive solution. The device's primary function revolves around capturing and interpreting visual data from the user's surroundings in real-time. Through this innovative technology, AidOptics will not only identify objects but also detect potential obstacles and assess environmental factors critical for safe navigation, particularly during road crossings. Coupled with a dedicated mobile application, this solution goes beyond traditional assistive devices by offering real-time environmental analysis and text-to-speech guidance. AidOptics aspires to be more than just a wearable device; it envisions becoming a lifeline, empowering visually impaired individuals to navigate the road crossings and daily routines with newfound confidence and independence. The scope of the AidOptics project extends far beyond a mere technological innovation; it's a pioneering venture aimed at revolutionizing the daily experiences of visually impaired individuals.

By seamlessly integrating cutting-edge camera technology within smart glasses and harnessing the power of Artificial Intelligence (AI), AidOptics ventures into uncharted territory. This project's scope encapsulates not just the development of a wearable device but the transformation of how visually impaired individuals navigate and interact with their surroundings.

AidOptics envisions a future where the visually impaired can gain real-time environmental insights, fostering a sense of independence and empowerment in their daily routines. The project's ambition is not solely confined to technological advancements but to create a societal shift, advocating for inclusivity and accessibility for all.

Importance of the Project

In a world that increasingly relies on visual cues for navigation and communication, the visually impaired face unique challenges in their daily lives, especially when it comes to crossing roads safely. According to a 2019 study published in the Journal of Transport Medicine, visually impaired people are four times more likely to be involved in a road accident than non-visually impaired people. This is evident as every year in India, nearly 15000 visually impaired people lose their lives due to road accidents; that is an average of 41 people per day. Visually impaired people face several challenges when crossing the street, including lack of accessibility, lack of awareness among drivers and pedestrians, and difficulty seeing approaching vehicles and other hazards. Recognizing the need for innovative solutions to enhance the mobility and independence of the visually impaired community, we introduce "AidOptics" – a wearable technology designed for individuals with visual impairments.



Conclusion

In conclusion, AidOptics represents a paradigm shift in assistive technology, seamlessly integrating advanced features to empower individuals with visual impairments. Through meticulous design and technological innovation, the system addresses key challenges faced by the visually impaired. The Object Detection feature, powered by Google ML Kit and the ESP32 camera module enhances users' awareness by providing real-time spoken feedback on their surroundings. Facilitating social interactions, the Face Recognition feature contributes to a sense of connection by identifying familiar faces. The incorporation of ultrasonic technology in Road Crossing Assistance prioritizes safety during mobility, offering crucial information for navigating streets and intersections. Simultaneously, Text-to-Speech Output fosters independence, converting visual information into audible feedback. The user-centric design allows feature selection via a Flutter mobile application or on-spectacle buttons, catering to individual preferences, while discreet information delivery through Bluetooth earbuds ensures a personalized user experience.

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