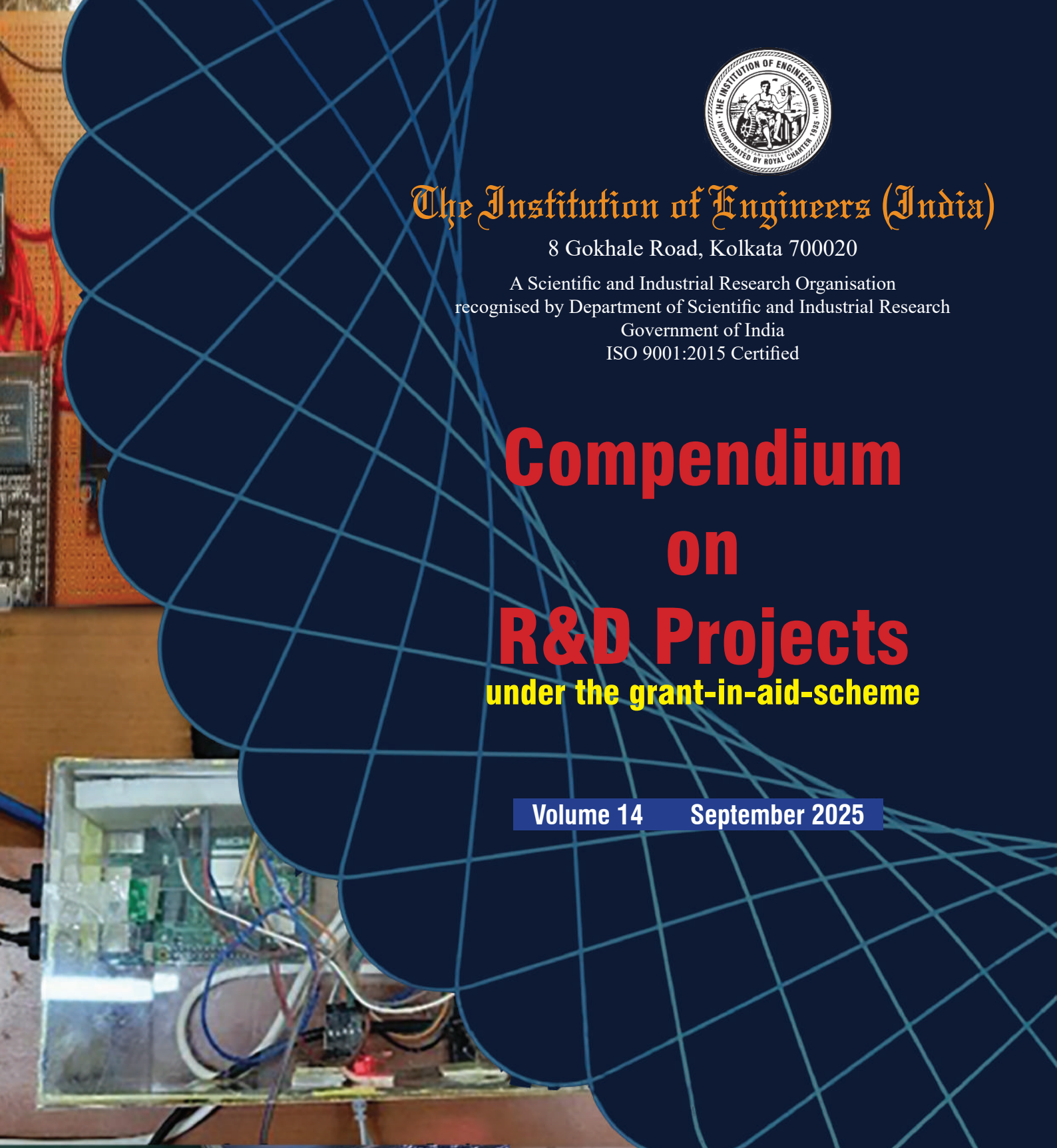
The Institution of Engineers (India)
8 Gokhale Road, Kolkata 700020
A Scientific and Industrial Research Organisation
recognised by Department of Scientific and Industrial Research
Government of India
ISO 9001:2015 Certified

Compendium on R&D Projects

under the grant-in-aid-scheme

Volume 14 September 2025



The Institution of Engineers (India)

Notification for

R&D Grant-in-Aid

To promote appropriate technology, assist in building up design & research talents and, most importantly, to help in nurturing potential R&D venture amongst engineering students pursuing Diploma/UG/PG/PhD courses, The Institution of Engineers (India) had instituted the R&D Grant-in-Aid program way back in 2001.

Like every year, the Institution invites applications for the session 2025-26 for funding industry-oriented R&D projects and research initiatives aimed at improving the life-style of common people from engineering students pursuing full time Diploma/UG/PG/PhD engineering program in AICTE/UGC/NAAC approved Institutions/Colleges/Universities. The application form and guidelines are available in our website https://www.ieindia.org. The projects should be carried out under the guidance of faculty members who are Corporate Members of IEI. Membership criteria for student investigator(s), guide(s) and Institution(s) are as follows:

Project Category	Student/Applicant Membership	Guide(s) Membership	Institutional Membership	Quantum of Grant (INR)
1. Diploma	Exempted [Membership of Student Chapter is desirable]	AMIE/MIE/FIE	Not Mandatory	Not exceeding ₹15,000/- for a single project
2. UG (BE/BTech/ AMIE/Equivalent)	SMIE	AMIE/MIE/FIE	Applicant's Institute should preferably be an Institutional Member with NBA / NAAC Accreditation	Not exceeding ₹50,000/- for a single project
3. PG (ME/ MTech/ Equivalent)	AMIE/MIE/FIE	MIE/FIE	Applicant's Institute should preferably be an Institutional Member with NBA / NAAC Accreditation	Not exceeding ₹1,00,000/- for a single project
4. PhD	AMIE/MIE/FIE	MIE/FIE	Applicant's Institute should preferably be an Institutional Member with NBA / NAAC Accreditation	Not exceeding ₹1,50,000/- for a single project

The soft copy of the duly filled-up applications (in editable format), as per the pro-forma available in our website www.ieindia.org, should be sent through email to research@ieindia.org and one printed copy of the same should reach the following address:

Deputy Director (Technical)

The Institution of Engineers (India), 8 Gokhale Road, Kolkata 700 020

Applications received in format other than that available on our website will not be accepted. Application should be forwarded through the Guide, Head of the Department or Head of the Institution. Please note that preference will be given to project proposals received from Institutions who are Members of The Institution of Engineers (India) and with NBA / NAAC Accreditation. Kindly go through the guidelines **(visit link https://shorturl.at/BiAOQ)** carefully before filling up the application.

The grant is not intended for the faculty members / working individuals who have access to other avenues of research funding. Proposals received will be scrutinized and the recipients of R&D Grant will be informed accordingly.

Message from the

President

With great pride and satisfaction The Institution of Engineers (India) unveils the Compendium on R&D Projects 2025 that encapsulates the outcomes of research projects completed under the support of The Institution of Engineers (India). This Compendium is more than a report—it is a testament to the power of engineering research in addressing societal, industrial, and environmental challenges of our time.

The Institution of Engineers (India), as the largest multidisciplinary professional body of engineers in the country, has always believed in the transformative potential of research and development. By funding and promoting innovative projects across diverse engineering domains, IEI continues to play a pivotal role in advancing the nation's technological capabilities.

I congratulate all the project investigators and research teams for their dedicated efforts, and I sincerely hope that this Compendium serves as a valuable reference and inspiration for the broader engineering community. Let us remain committed to fostering innovation, knowledge sharing, and excellence for the betterment of society.

Warm regards

Er VB Singh, FIE
President
The Institution of Engineers (India)

Message from Chairperson
Committee for Advancement of Technology and Engineering

The *Compendium on R&D Projects 2025* is a significant initiative that showcases the outcomes of projects nurtured through IEI's commitment to advancing technology and applied engineering research. This publication not only documents completed research but also highlights the potential of engineering solutions to respond to complex, real-world problems.

As Chairperson of the Committee for Advancement of Technology and Engineering (CATE), I am proud of IEI's continued efforts to bridge the gap between research and practical application. Through strategic funding and expert guidance, IEI empowers researchers, academicians, and professionals to contribute meaningfully to the engineering landscape.

I extend my heartfelt appreciation to all the project investigators, collaborators, and evaluators who made this Compendium possible. May it serve as a foundation for deeper inquiry, cross-disciplinary collaboration, and innovation in years to come.

Sincerely,

Prof (Dr) Shilpa Tripathi, FIE
Chairperson, CATE, IEI

Message from Chairman
Research & Development Committee

I am honored to present the Compendium on R&D Projects 2025, which showcases the outcomes of 24 R&D projects completed during 2024-25, with a total sanctioned cost of approximately Rs. 10.00 lakhs. This publication not only serves as a record of achievements but also highlights the potential of India's engineering ecosystem for national welfare.

As Chairman of the IEI Research and Development Committee, I take pride in our role in fostering innovation through the R&D Grant-in-Aid program, which has earned IEI recognition as a Scientific and Industrial Research Organization (SIRO) by the Government of India.

I commend the dedication of all research teams and encourage future projects that are both visionary and socially impactful. I hope this Compendium inspires further innovation and excellence in engineering research.

Lastly, I would like to acknowledge the excellent work of the Technical Department of IEI in bringing this publication to life.

Dr I Satyanarayana Raju, FIE
Chairman, RDC, IEI

From the Editor's Desk

It gives me immense pleasure to present this Compendium on R&D Projects, which encapsulates the outcomes of R&D projects sponsored by The Institution of Engineers (India). IEI has always been at the forefront of nurturing innovation, encouraging young minds, and supporting applied research that addresses societal challenges while advancing engineering science and technology.

Recognized as a Scientific & Industrial Research Organization (SIRO) by the Ministry of Science & Technology, Government of India, IEI actively administers a Grant-in-Aid scheme to support projects undertaken by undergraduate, postgraduate, and doctoral students across engineering institutions. This initiative fosters a strong research culture among budding engineers and positions IEI as a leader in undergraduate-level R&D funding.

In this edition, the outcomes of twenty-four projects have been documented, showcasing the diversity of engineering research. The projects span across healthcare and biomedical innovations, artificial intelligence, machine learning, the Internet of Things, robotics, and smart monitoring. They also cover civil and structural engineering solutions for sustainable infrastructure, environmental engineering initiatives addressing waste management and water quality, and defense-oriented projects on secure communication and blockchain-enabled governance. Research in mechanical and materials engineering highlights advanced manufacturing, thermal management, and corrosion-resistant composites, while socially relevant technologies such as assistive devices and robotic aids reflect the humane dimension of engineering.

Each project addresses pressing needs—be it healthcare accessibility, sustainability, security, or inclusivity—and collectively they illustrate the transformative potential of engineering innovation in nation-building.

I congratulate all investigators and their institutions for their valuable contributions and trust that this Compendium will serve as a reference and inspiration for researchers, industry professionals, policy-makers, and students alike.

Maj Gen (Dr) MJS Syali, VSM (Retd), FIE
Secretary and Director General
The Institution of Engineers (India)

सूचना का अधिकार
RIGHT TO INFORMATION

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(An ISO 9001:2008 CERTIFIED DEPARTMENT)

सत्यमेव जयते

भारत सरकार
विज्ञान और प्रौद्योगिकी मंत्रालय
वैज्ञानिक और औद्योगिक अनुसंधान विभाग
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F.No. 11/97/1988-TU-V

Date: 2nd June 2025

The Secretary & Director General
The Institution of Engineers (India)
8, Ghokhale Road,
Kolkata – 700020, West Bengal

Subject: **Renewal of Recognition of Scientific and Industrial Research Organisations (SIROs).**

Dear Sir,

This has reference to your application for renewal of recognition of **The Institution of Engineers (India), Kolkata, West Bengal** as a Scientific and Industrial Research Organisation (SIRO) by the Department of Scientific and Industrial Research under the Scheme on Recognition of Scientific and Industrial Research Organisations (SIROs), 1988.

2. This is to inform you that it has been decided to accord renewal of recognition to **The Institution of Engineers (India), Kolkata, West Bengal from 01.04.2025 to 31.03.2028.** The recognition is subject to terms and conditions mentioned overleaf.

3. Receipt of this letter may kindly be acknowledged.

Yours faithfully,

(Vinay Kumar)
Scientist - 'F'

The Institution of Engineers (India)

Volume 14, September 2025

Contents

Compendium on R&D Projects under IEI Grant-in-Aid Scheme

Publication Office

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Publisher

Maj Gen (Dr) MJS Syali, VSM (Retd.)

Secretary and Director General

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The Institution of Engineers (India)

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(Established in 1920, Incorporated by Royal Charter 1935)

A Scientific and Industrial Research Organisation
Recognised by
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A Century of Service to the Nation

Secure Wireless Communication for Defence Application

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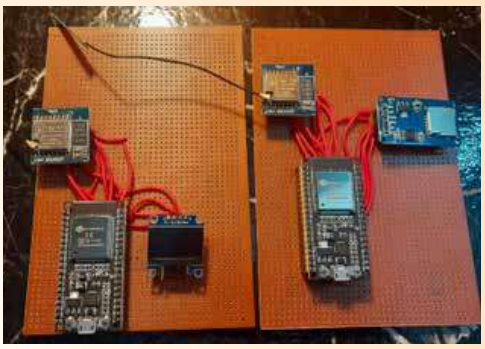
Final Project Output



Hardware of the Project

OBJECTIVES

- Develop a Secure Communication Protocol using LoRa technology to enable long-range wireless data transmission with AES-256 encryption, ensuring data confidentiality and integrity during defense operations.
- Create a user-friendly Mobile Application to facilitate seamless interaction with the communication system, enabling users to upload and download encrypted documents securely from a Network Attached Storage (NAS) server.
- Integrate LoRa modules with ESP32 microcontrollers to establish stable and reliable wireless communication between the ground station and remote satellite modules, enabling encrypted data transfer over long distances without traditional internet infrastructure.
- Ensure the scalability and cost-effectiveness of the system, making it suitable for deployment in remote or high-risk zones, particularly in defense or disaster response scenarios where conventional communication methods are unavailable or compromised.
- Adopt AES-256 encryption for all data transmissions, combined with robust user authentication and data integrity checks to prevent unauthorized access, tampering, or data leakage.
- Implement an SD card storage mechanism in the satellite node for offline data logging and delayed secure retrieval of encrypted files.
- Integrate a NAS system to support secure file backup and remote access, improving the system's operational efficiency and reliability.

- Design the architecture to operate in low-power conditions, optimizing the system for portable and field-ready defense-grade deployment.
- Successfully achieve bidirectional, encrypted data transfer over a range exceeding 2 km in open environments, demonstrating the system's reliability, security, and operational feasibility.
- Establish the project as a proof-of-concept for a low-cost, resilient communication infrastructure adaptable for military, disaster recovery, and border surveillance operations.

ACHIEVEMENTS

- Successfully designed and developed a fully functional prototype of a secure wireless communication system using LoRa and ESP32, tailored for defense applications.
- Achieved bidirectional transmission of encrypted files (AES-256 standard) between a ground station and a simulated satellite module with over long km communication range in open-field conditions.
- Developed an intuitive user interface for uploading, receiving, and managing classified files via a secure mobile/web platform with proper authentication protocols.
- Integrated SD card storage at the satellite node for secure, offline data logging and delayed retrieval capabilities.
- Implemented a Network Attached Storage (NAS) system for secure backup and remote access to classified documents, ensuring system scalability and reliability.
- Demonstrated resilience to signal jamming and data interception, validating the system's security and robustness in real-world scenarios.
- Achieved low-power operation suitable for field deployment in remote or high-risk environments without dependency on internet infrastructure.
- Recognized for its innovation in military-grade communication technology, showcasing potential use in border surveillance, disaster recovery zones, and strategic field operations.
- Positioned as a cost-effective alternative to existing military communication systems by leveraging open-source hardware and protocols.

Engineers participate in the activities which make the resources of nature available in a form beneficial to man and provide systems which will perform optimally and economically."

L. M. K. Boelter

Application of Friction Stir Channeling (FSC) to Manufacture Cold Plate for Power Electronics Cooling

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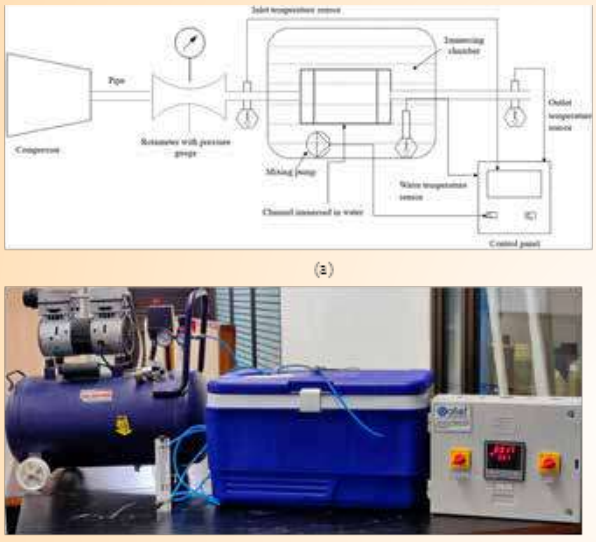
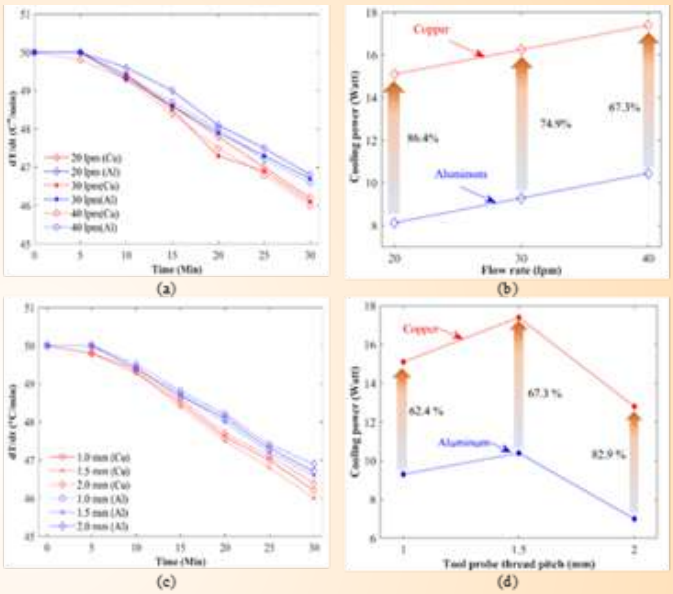


(a) Line diagram of the setup (b) actual setup for measurement of thermal performance



(a-d) Results of temperature drop and cooling power under different flow rate and tool design

OBJECTIVES

1. To develop an FSC process for manufacturing the cold plate for power electronics cooling.
2. To design and develop the unique purpose tool for the FSC process for above stated application.
3. To establish the optimum process parameters for manufacturing the cold plate using FSC.
4. To analyze the study on the effect of process parameters on surface roughness, channel dimension, and mechanical properties of processed zones.
5. Experimental investigation of critical features of cold plate, such as cooling power and temperature drop w.r.t. time.

ACHIEVEMENTS

1. Efficient Cold Plate Design for Electronics Cooling: The project successfully developed advanced cold plates using the Friction Stir Channeling (FSC) process, demonstrating the feasibility and effectiveness of copper and aluminum channels in enhancing thermal performance for power electronics applications.

2. Optimized Process Parameters: The experimental trials led to the identification of optimal process parameters (tool rotation speed, feed rate, and shoulder-workpiece clearance) that significantly improved the formation of defect-free channels in both copper and aluminum, thus enabling higher cooling power and temperature drop efficiency.
3. Advanced Tool Design: A specialized FSC tool was designed and developed, allowing the precise formation of channels with various probe thread pitches. This tool significantly contributed to improving material flow, surface finish, and thermal performance in the fabricated cold plates.
4. Enhanced Thermal Performance: The FSC copper channels demonstrated superior thermal properties compared to aluminum channels, with significantly higher cooling power and heat dissipation capacities. This outcome is particularly important for applications in high-capacity thermal management in power electronics.
5. Comprehensive Material Characterization: Detailed analyses using advanced techniques such as Electron Backscatter Diffraction (EBSD), surface roughness measurement, and microhardness testing were performed, offering insights into the microstructural evolution and mechanical behavior of the FSC-fabricated channels.
6. Contribution to Research and Industry: This project contributed to the body of knowledge on FSC for copper and aluminum, paving the way for its application in electronics cooling systems. The research outcomes also have the potential for industrial implementation, providing an innovative solution for thermal management in power electronics.

PUBLICATIONS

1. Pandya, M., Patel, N. P., & Mehta, K. P. (2024). Channel formation characteristics under the influence of tool design and comparative analysis on friction stir channeling between copper and aluminum materials. CIRP Journal of Manufacturing Science and Technology, 49, 128-149. (Q1 Journal, Impact factor 4.6, Cite score 9.1)
2. Pandya, M., Patel, N. P., & Mehta, K. P. (2024). Numerical simulation of friction stir channeling using coupled Eulerian-Lagrangian modeling. Journal of Manufacturing Process, 131, 1740-1757 (Q1 Journal, Impact factor 6.1, Cite score 10.2)
3. Pandya, M., Patel, N. P., & Mehta, K. P. (2024).Characterization of Copper Channels Produced by Friction Stir Channeling: Influence of Process Parameters, Journal of Materials Engineering and Performance, (Q2 Journal, Impact factor 2.2, cite score 3.9)
4. Pandya, M., Patel, N. P. (2024). Characterization of Copper Channels Produced by Friction Stir Channeling: Influence of Process Parameters, 5th international conference on Conference on Advances in Mechanical Engineering, SRM University, Chennai, India
5. Pandya, M., Patel, N. P. (2024).Investigating the effect of Preheating on friction stir channeling (FSC) performance in ETP Copper, 6th International Conference on Manufacturing, Material Science and Engineering, Vignan institute of Technology and Science, Hyderabad, India.

Fortification of Eggshell Waste and Vitamin D Source in Early Meal to Stimulate Women's Bone Health

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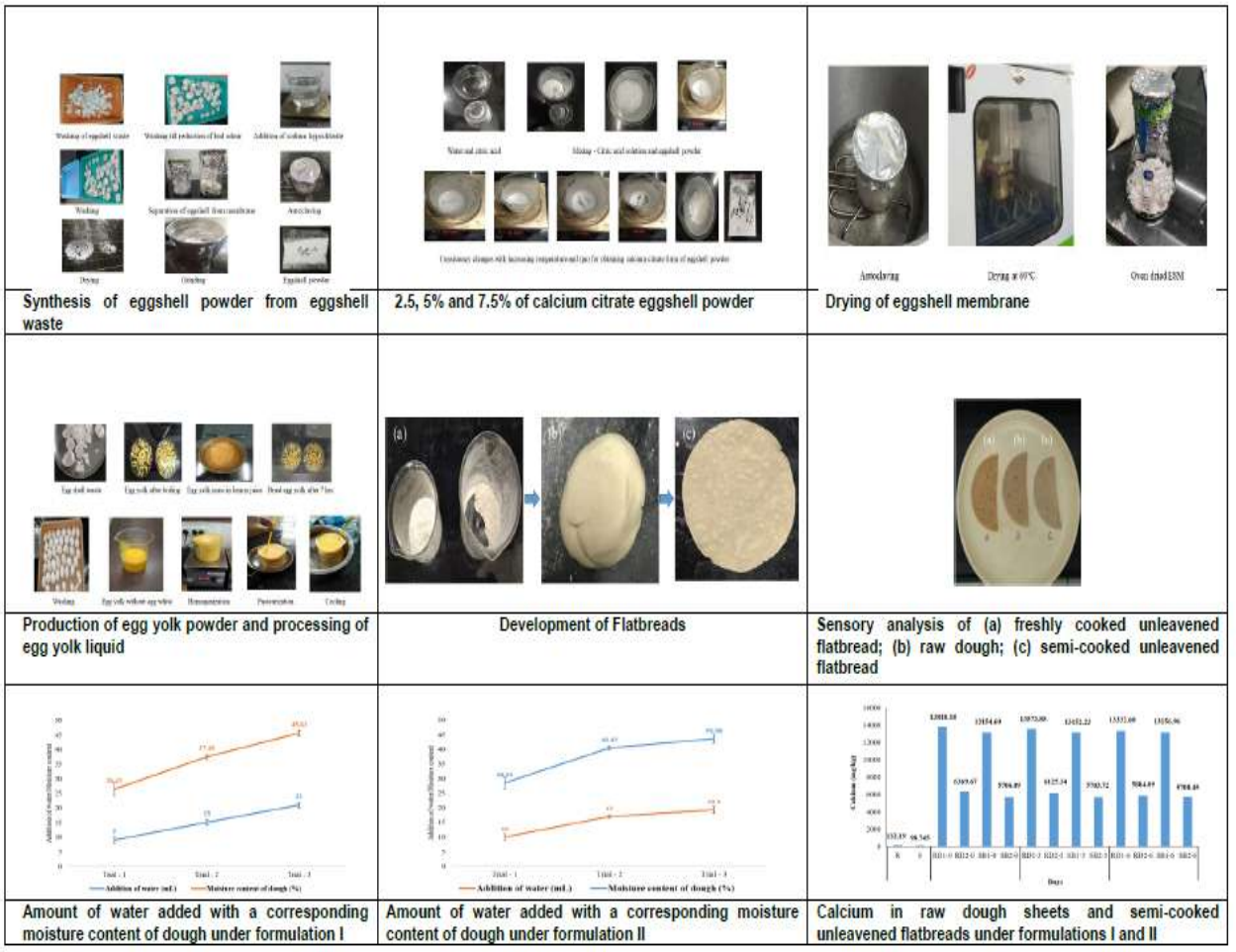


Synthesis of eggshell powder from eggshell waste

2.5, 5% and 7.5% of calcium citrate eggshell powder

Drying of eggshell membrane

Production of egg yolk powder and processing of egg yolk liquid

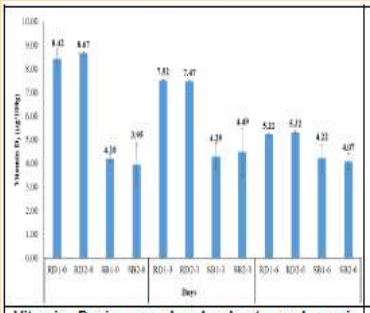
Development of Flatbreads

Sensory analysis of (a) freshly cooked unleavened flatbread; (b) raw dough; (c) semi-cooked unleavened flatbread

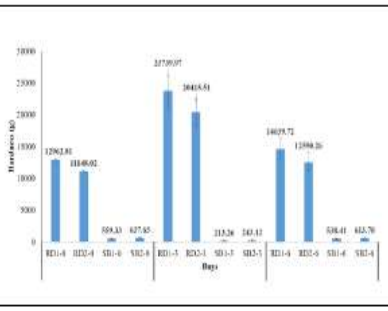
Amount of water added with a corresponding moisture content of dough under formulation I

Amount of water added with a corresponding moisture content of dough under formulation II

Calcium in raw dough sheets and semi-cooked unleavened flatbreads under formulations I and II

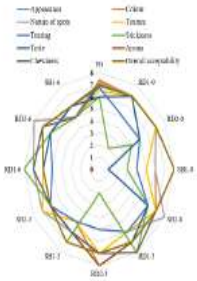


Vitamin D_3 in raw dough sheets and semi-cooked unleavened flatbreads under formulations I and II

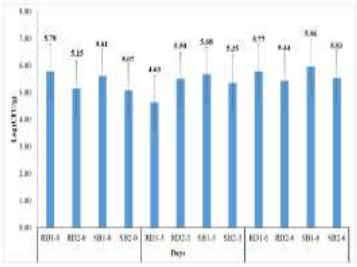


Hardness values in raw dough sheets and semi-cooked unleavened flatbreads under formulations I and II

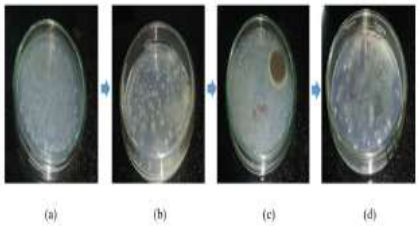
Texture Profile Analysis for raw dough sheets and semi-cooked unleavened flatbreads under formulations I and II



Sensory profiling in raw dough sheets and semi-cooked unleavened flatbreads under formulations I and II



Log(CFU/g)values for raw dough sheet and semi-cooked chapatti under formulations I and II



Microbial growth of raw dough sheet and semi-cooked unleavened flatbread under Formulation I and II (a) Raw dough sheet on 3rd day analysis under F1 (b) Raw dough sheet on 3rd day analysis under F2 (c) Semi-cooked unleavened flatbread on 6th day analysis under F1 (d) Semi-cooked unleavened flatbread on 6th day analysis under F2

OBJECTIVES

1. To obtain calcium from eggshell waste, collagen from eggshell membrane, and egg yolk powder from egg yolk liquid.
2. To analyse sensorial, proximate, and physico-chemical characteristics of the developed meal for consumer perception (Chapatti).

ACHIEVEMENTS

CC-ESP had a moisture content of 0.74% to 0.81%, reflecting minimal retention during drying. Calcium yield in CC-ESP (97.76%) was slightly higher than ESP (96.42%), with the final CC-ESP weight (108.22 g) surpassing ESP (106.40 g). The 5% citric acid concentration yielded the highest calcium content (58,379.68 mg/kg), while 2.5% and 7.5% produced 48,650.13 mg/kg and 35,955.51 mg/kg, respectively. The egg yolk powder contained 3.51 µg/100 g of vitamin D3. Formulation F1 required more water (87.3 mL) compared to F2 (78.93 mL). However, F2 exhibited lower moisture content—26.16% in raw dough sheets and 20.91% in semi-cooked unleavened flatbreads. Calcium content in F2 decreased from 6,369.67 mg/kg (RD-0) to 5,884.09 mg/kg (RD-6), but remained stable in semi-cooked samples. Vitamin D3 in F2 slightly declined from 8.67 µg/100 g to 5.32 µg/100 g over six days. Sensory evaluation rated F2 highly for texture and overall acceptability, with better shelf-life stability compared to F1. Yeast and mold counts were stable, indicating enhanced microbial control in F2.

Design And Development of Face Recognition Techniques from Surgical Face Database

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OBJECTIVES

The objective of this project is mainly concerned with the upcoming challenge in face biometric i.e. recognizing faces altered due to plastic surgery. Recently, the ability of varied algorithm expresses intricacy in recognizing face invariant to plastic surgery since it has the characteristic of texture deviations of the skin. Even though plastic surgery is looked to be an inspiring concern in the domain of surgical face recognition, the theme needs further theoretical and experimental investigation. Further, this recognition procedure is extremely exploited for the persistence of authentication and security via analysis of image and computerization. The basic mode of face recognition comprises two stages include verification phase and identification phase. The earlier is used for matching two faces however the latter is utilized for matching the database with hundreds or thousands of face images and the demand face image. Moreover, as per the researches and scientists, plastic surgery-based facial recognition is a challenging area; this work proposes three recognition models to address it.

We propose plastic surgery face recognition approach with Textural pattern (LBP, LTP) based features with PCA variation and Support Vector Machine (SVM). The model includes various phases like pre-processing, feature extraction and classification phase. Here, textural feature which are highly correlated with the surgical face recognition changes and thereby trains a SVM classifier is for classification purpose for accurate feature extraction. SVM is planned to adopt as the recognition system since it has certain unique characteristics over other systems like misclassify.

We proposed performance evaluation of Textural surgical image and PCA methods for surgical face recognition to solve the major concerns of face recognition under changing environment. In Surgical face recognition complications arise due to the fact that the object undergoes global and local surgery, changes in pose relative to the viewing camera, and changes in illumination relative to light sources. In this project, efficient feature extraction techniques using PCA and 2DPCA from textural face image for surgical face recognition are presented. This approach is established to reduce the computation periods required by these SVM.Tests conducted on a plastic surgery database demonstrate the suggested approach's LTP+2DPCA competitiveness in comparison to certain subspaces-based techniques currently in use.Fig. 1 describes the schematic diagram of proposed method.

ACHIEVEMENTS

In computer vision, surgical face recognition is an attractive and challenging research field for machines to recognize people based on their digital face images, has been fuelled by many academic scientists and industrial developers for over twenty years. In several security applications surgical face recognition is used such as, access control to authorized areas, computer, airports, identity verification/management for criminal justice system, disaster victim identification, etc. The other applications where the face recognition can be used are as follows: querying person's identity in still/ video databases, human machine interaction

applications, smart card solutions (enhanced ATM's security, ePassport), and targeted advertising. The surgical face recognition problem still has many challenges that need to be redressed with more powerful methods even though numerous systems have been proposed for the last decades. The research work presented in this thesis is mainly concerned with the upcoming challenge in face biometric i.e. recognizing faces altered due to plastic surgery like Blepharoplasty, Brow lift, Liposhaving, Malar augmentation, Mentoplasty, Otoplasty, Rhinoplasty, Rhytidectomy and skin peeling, and the superiority of the developed models are proved.

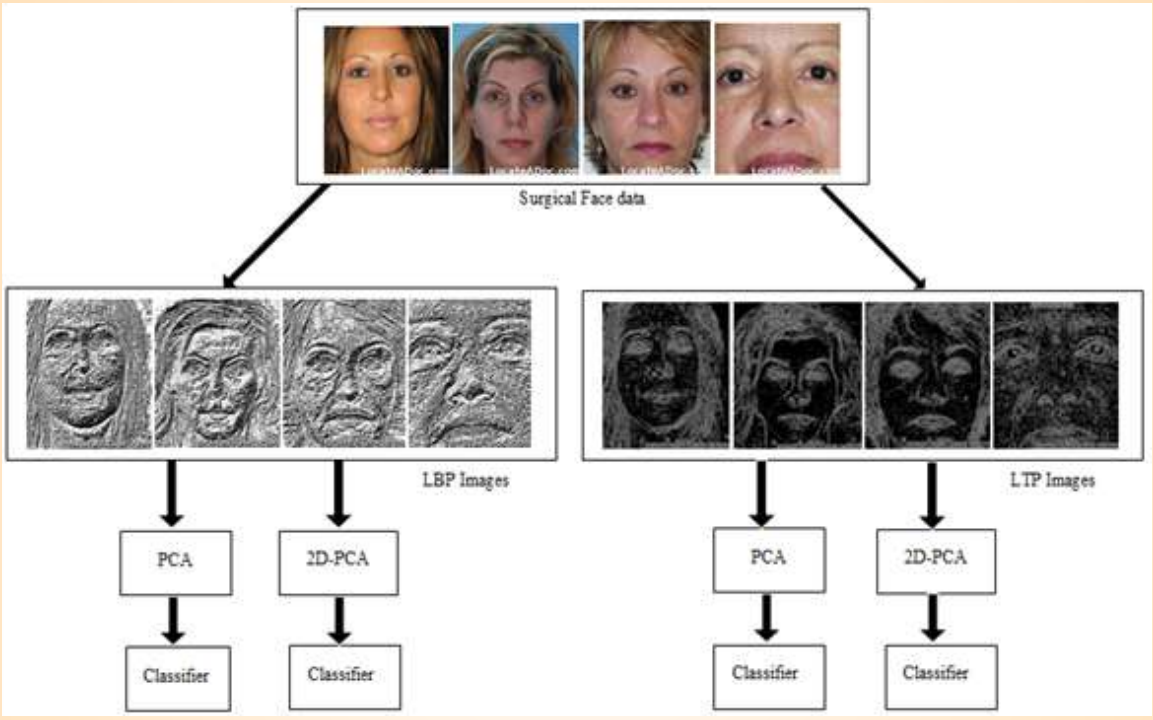

Fig.1: Schematic diagram of proposed method

PUBLICATIONS

M.Tech Thesis

Surgicalface recognition using Textural pattern and Machine learning Techniques -submitted by Tridib Maiti

Papers presented in Conference/Seminars

T. Maiti, A. Chakraborty, D. Das, S. P. Nath, S. Biswas & A. Dey, "Applications of Textural Features and PCA on Facial Recognition after Medical Alterations", 39th INDIAN ENGINEERING CONGRESS, 20-22 DECEMBER 2024, KOLKATA.

Papers communicated in journal

T. Maiti, A. Chakraborty, S. P. Nath, & A. Dey, "Analysis of Textural Features and PCA for surgical face recognition", Multimedia Tools and Applications (Communicated).

Investigation on the Effectiveness of Bubble Deck Slabs Utilising Agro Waste Infused Plastic Bottles

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Preparation of Specimens

During testing process

OBJECTIVES

The primary objective of the project is to investigate and compare the structural performance under load by undertaking flexural tests on the bubble deck slab specimens. The study aims to observe the crack pattern and mode of failure of bubble deck slabs. The investigation also aims to study the structural behaviour of bubble deck slabs by using numerical analysis with ANSYS software. The scope of the project includes material selection, mix design modification, experimental casting of slab specimens, and laboratory testing under static loading conditions. Finite element modelling is also undertaken to simulate the structural response and validate the experimental data. Furthermore, the study evaluates the feasibility, cost-efficiency, and environmental impact of using such modified bubble deck slabs in real-world applications. This research opens up new avenues for sustainable construction, providing engineers and builders with a viable alternative to traditional concrete slabs while contributing to circular economy goals and resource optimization.

ACHIEVEMENTS

The primary achievement was the successful integration of agro-waste materials with recycled plastic bottles to create a lightweight voided slab system that reduces the overall consumption of concrete. By incorporating agricultural by-product, palm kernel shell and infusing it into non-biodegradable plastic bottles, the project not only utilized waste materials effectively but also addressed key environmental concerns related to plastic disposal and agricultural residue management. Experimental investigations, including flexural and load-bearing tests, indicated that the bubble deck slabs retained sufficient structural integrity and stiffness while achieving a substantial reduction in dead load. This makes them a viable alternative to conventional solid slabs, particularly in multi-story construction where weight reduction translates to cost savings in foundations and structural supports. Finite element analysis (FEA) further validated these findings, offering insight into stress distribution and deflection behavior under load. Overall, the project represents a successful merger of structural engineering and sustainable practices, offering a pathway toward eco-friendly construction solutions that do not compromise performance. It also opens up opportunities for further research and industrial application.

Performance Evaluation of Limestone Calcined Clay Cement (LC^3) in Marine Bridge Column Corrosion

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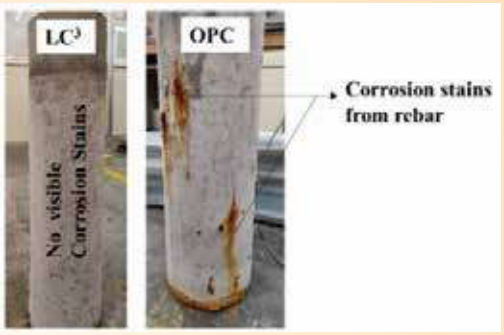
Test Setup of Accelerated CorrosionTechnique



Corroded Columns of LC^3 and OPC column specimens

OBJECTIVES

Performance Evaluation

1. Feasibility and Sustainability of LC^3:

   This study examines whether Limestone Calcined Clay Cement (LC3) is a practical and eco-friendly alternative to traditional Portland cement. It focuses on the availability of raw materials (limestone and clay), the energy efficiency of LC^3 production, and overall cost. A key benefit is LC^3's ability to reduce CO_2 emissions by up to 40%, making it a promising sustainable construction material.

2. Mechanical and Durability Performance:

   This part evaluates LC^3's strength and durability in concrete applications. Mechanical tests includecompressive, tensile, and flexural strength. Durability tests assess resistance to chloride penetration and chemical attacks. These results are compared with OPC to determine whether LC^3 meets structural performance requirements in various environments.

Suitability Criteria

3. Corrosion Resistance of LC3 Concrete:

   This objective focuses on how LC3 affects the corrosion rate of steel reinforcement, especially in chloride-rich areas like marine structures. Electrochemical tests help assess LC3's effectiveness in protecting steel and extending the service life of structures compared to conventional cement.

Structural Applications

4. Stability of Corroded Columns:

   This involves evaluating how corrosion impacts the strength and stability of reinforced concrete columns. The study includes visual inspection and load testing to determine if LC3concrete can better maintain structural performance in deteriorated conditions, ensuring long-term safety.

ACHIEVEMENTS

This project has been a significant step in advancing the understanding and application of sustainable cement alternatives in aggressive marine environments. The primary objective —evaluating the corrosion performance of Limestone Calcined Clay Cement (LC^3) in marine bridge columns —has been successfully achieved through systematic experimentation and analysis.

A notable achievement of this work is its application to full-scale structural elements. While most research on LC^3 is limited to laboratory-scale cubes or prisms, this study explored its performance in circular concrete columns (600 mm height), simulating real-world marine bridge conditions. This adds practical value and relevance to the study, especially for coastal infrastructure development.

The project also involved comprehensive testing to assess both mechanical and durability performance. Advanced material characterization techniques such as Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), X-ray Fluorescence (XRF), and Particle Size Analysis (PSA) were employed, along with durability assessments like Rapid Chloride Penetration Test (RCPT), water absorption, sorptivity, and surface resistivity. Corrosion-related tests such as Accelerated Corrosion Performance Test (ACPT), Linear Polarization Resistance (LPR), Electrochemical Impedance Spectroscopy (EIS), and Half-Cell Potential measurements were also conducted. These results were compared with Ordinary Portland Cement (OPC)-based concrete, helping to establish the viability of LC^3 as a durable and sustainable alternative.

The outcomes of this research are expected to benefit coastal and marine infrastructure projects, offering insights into material selection for structures exposed to chloride-induced corrosion. Engineers, researchers, and decision-makers in the construction industry can use this data to adopt LC^3 in environments where durability and sustainability are critical.

> Engineering is an activity other than purely manual and physical work which brings about the utilization of the materials and laws of nature for the good of humanity.
>
> R. E. Hellmund

Hansa 1: Unmanned Surface Vehicle for Water Top Pollution Navigation

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Fig. 1 Front view of Hansa 1: Unmanned Surface Vehicle made for water surface pollution monitoring

Fig. 2 Top view and propeller driver unit of Hansa 1

OBJECTIVES

This project aims to develop an unmanned surface vehicle (USV) to monitor pollution at the water surface. Pollution has become an important concern for the sustainable development and growth of the country. Researchers are facing challenges to deal with different kinds of pollutions that are coming out as a result of multi-dimensional activities. It may occur in different areas like soil, air, sound, water etc. This work focuses on monitoring pollution that may occur on top of the water surfaces as well as at the top layer of water. This has been achieved in four major steps: (a) designing an Unmanned Surface Vehicle (USV) (b) moving around the water surface, (c) Capturing different images and (d) analyzing them by advanced image processing tools to detect pollution. The USV is remotely operated and the analysis has also been carried out at remote location. Captured data are processed through multi-level wavelet decomposition. The analysis has been done by monitoring statistical nature of the coefficients obtained from decompositions and extracting features. These features are then utilized to distinguish different pollution levels.

ACHIEVEMENTS

This work developed a scheme for monitoring pollution that may occur on top of the water surfaces and at the top layer of water. This has been by developing an Unmanned Surface Vehicle (USV) that can move

around the water surface. Different image-capturing devices have been installed to capture the image of different objects. The captured images have been analyzed and compared by some advanced image processing tools to discriminate pure and polluted water. The monitoring system has been tested in tapped water bed (pond) at different wave conditions. The hardware monitoring unit has been built on USV. The proposed method has shown the satisfactory outcome for discrimination of pollution levels.

Specific Features

Different features extracted from this project work are as follows:

Design Features:

- High data storage
- Remote control system
- Remote monitoring unit
- Communication and image capturing towers

Compatibility:

- 360° detection
- Nano grid power supply
- Under water surveillance

Application:

- Water surface pollution detection
- Underwater monitoring
- Obstacle monitoring

This work has the opportunity to be utilized in different other future applications like underwater monitoring, obstacle monitoring, collection of water samples from remote locations, etc. Thus, the research findings / developed equipment may be used in the following areas: for water surface monitoring, underwater (top layer) monitoring, water surface pollution monitoring, underwater monitoring, obstacle monitoring, etc.

PUBLICATIONS

1. Surajit Chottapadhyay, Bhaskar Roy, Mrinmoy Nayek, Subhojit Ghosh, "Unmanned surface vehicle for remote water top pollution monitoring", 1st International Conference on Intelligent Computation and Analytics on Sustainable Energy and Environment, Paper ID – 111, September 21-23, 2023.
2. Unmanned Surface Vehicle based Water Surface Monitor (USV-WSM), Design, IP India, October, 2023 (applied).

"If we knew what it was we were doing, it would not be called research, would it?"

Albert Einstein

Non-Invasive Glucose Measurement – Diabetes Diagnosis and Management

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OBJECTIVES

The main objectives of the present work are formulated as follows:

1. Develop a Non-Invasive Glucose Measurement Device: Design and implement an innovative optical system for blood glucose estimation.
2. Ensure Standardization and Accuracy: Calibrate and validate the system to achieve clinical accuracy and reliability.
3. Explore Multi-Sensor Integration: Combine glucose monitoring with blood pressure and SpO2 measurements in a single device.

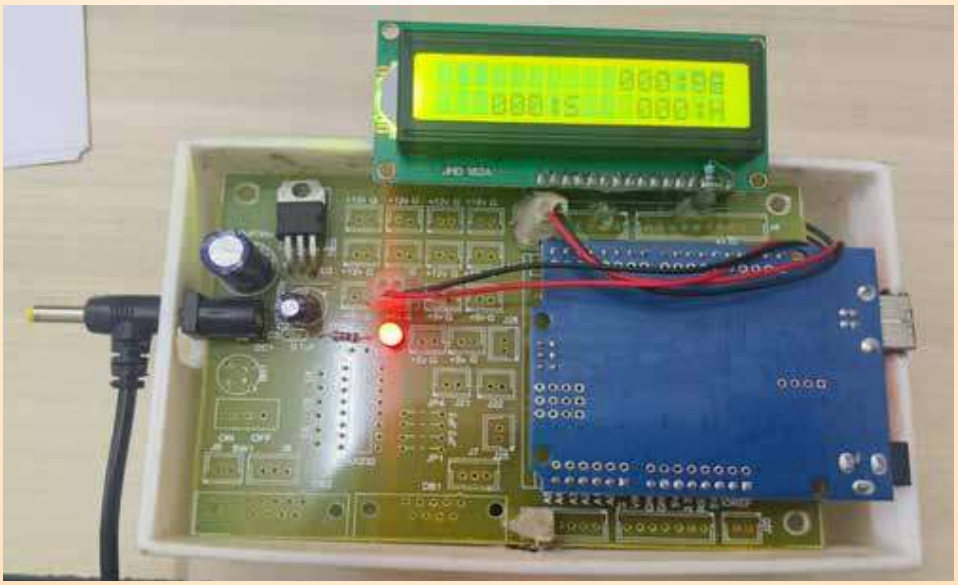

Figure: Non-Invasive Glucose Measurement – Diabetes Diagnosis and Management

ACHIEVEMENTS

This project work presents a groundbreaking advancement in healthcare technology: a non-invasive system for glucose measurement, diabetes diagnosis, and management. Unlike conventional methods, this innovative approach enables the measurement of glucose levels, blood oxygen saturation (SpO2), and blood pressure without the need for finger pricking.

1. Development of a Non-Invasive Glucose Monitoring System – Successfully designed and implemented an optical spectroscopy-based glucose measurement system, eliminating the need for finger pricking.
2. Accurate and Real-Time Monitoring – Achieved reliable glucose level detection using near-infrared spectroscopy, ensuring real-time and precise measurements comparable to standard biochemical methods.
3. Multi-Parameter Health Monitoring – Integrated blood oxygen saturation (SpO2) and blood pressure measurement, making it a comprehensive health monitoring solution for diabetes management.
4. Enhanced User Convenience and Compliance – Provided a painless, non-invasive alternative that encourages frequent glucose monitoring, improving adherence to diabetes management protocols.
5. Reduced Risk of Infection and Discomfort – Eliminated skin puncturing and blood sample collection, reducing pain, discomfort, and infection risks associated with traditional glucose monitoring methods.
6. Improved Calibration and Validation – Successfully calibrated the system against standard glucometers and invasive biochemical instruments, ensuring high accuracy and reliability.
7. Potential for Continuous Monitoring and Smart Integration – Established the foundation for future integration with wearable health devices and AI-driven analytics for continuous glucose tracking and personalized diabetes management.
8. Breakthrough in Diabetes Care Technology – Contributed to advancing non-invasive medical diagnostics, paving the way for innovative solutions in diabetes management and broader healthcare applications.

Lord Irwin, Viceroy and Governor General of India, laying the Foundation Stone of the First Institution Building in 1930

Design and Development of Customized 3D Printed Health Care Products

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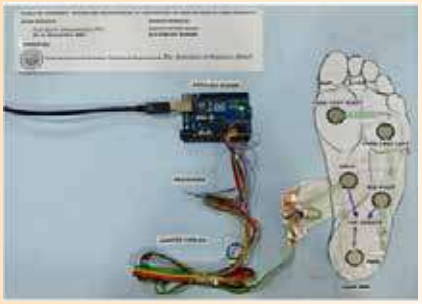
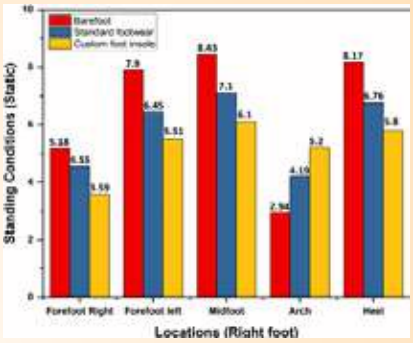


Experimental setup of the foot pressure measuring system



Experimental results of the standing Conditions for foot pressure measurement

OBJECTIVES

The primary objective of this study was to develop a static foot pressure measurement system utilizing Force-Sensitive Resistor (FSR) sensors and an Arduino Uno board, and to design and fabricate custom insoles using 3D printing technology. This research aimed to explore the effectiveness of these custom insoles in redistributing foot pressure,with the ultimate goal of improving foot health. Specifically, the study sought to measure and map the pressure distribution across different regions of the foot—Forefoot Right, Forefoot Left, Mid foot, Arch, and Heel—under three distinct conditions: barefoot standing, wearing standard footwear, and using the customized insoles. The intent was to identify the differences in pressure distribution under these conditions to assess the level of support and cushioning provided by each. In addition to developing themeasurement system, the research aimed to determine whether custom insoles, tailored to an individual's unique foot anatomy, could offer superior support compared to standard footwear.This was particularly focused on enhancing support in areas where natural arch support might be insufficient, thereby reducing pressure in other areas of the foot, such as the heel and forefoot. The study also intended to demonstrate the practical application of 3D printing technology in creating personalized foot care solutions and to highlight the potential benefits of integrating advanced sensor technology with modern fabrication techniques. Through this research, the objective was not only to advance the understanding of foot pressure distribution but also to contribute to the development of more effective and accessible solutions for managing foot-related conditions, such as plantar fasciitis, and improving overall foot health, especially in contexts requiring prolonged standing or high-impact activities.

ACHIEVEMENTS

This project successfully developed a new system to measure foot pressure and create custom insoles using advanced technologies like Force-Sensitive Resistor (FSR) sensors, Arduino Uno microcontrollers, and 3D printing. The system was carefully designed to capturestatic foot pressure data, which was then used to design insoles tailored to the specific shape and pressure points of an individual's foot. This

approach showcased the potential of combining modern sensing technologies with 3D printing to create personalized solutions for foot care.

A key achievement was the successful development and implementation of the foot pressure measurement system.FSR sensors were strategically placed at important points on the participant's right foot—such as the Forefoot Right, Forefoot Left, Midfoot, Arch, and Heel—to capture detailed pressure data. The data was collected in real-time using an Arduino Uno board, which allowed for data acquisition and analysis. This setup proved to be effective in measuring foot pressure under different conditions, providing a strong basis for future developments in foot health diagnostics.

The data collection and analysis phase of the project was another major accomplishment. By comparing pressure distributions under three conditions—barefoot standing, wearing standard footwear, and using custom insoles—thestudy identified significant differences in how pressure was distributed across the foot. Barefoot standing resulted in concentrated pressure in the midfoot and heel areas, indicating a lack of natural arch support. Standard footwear provided some redistribution of pressure, but the custom insoles offered the most balanced pressure distribution, especially by enhancing support inthearch area. This finding highlighted the importanceof tailoredsupport inmanaging foot health, particularly for those at risk of conditions like plantar fasciitis and diabetic foot ulcers.

The design and creation of the custom insoles were also important achievements. The project used digital scans of the participant's foot to design insoles that fit precisely, improving comfort and support. These insoles were made using FusedDepositionModeling(FDM) with ThermoplasticPolyurethane(TPU) materials,whichareknownfortheirdurability and flexibility. The result was a set of insoles that performed significantly better than standard footwear in terms of pressure distribution, reducing discomfort and providing a more stable and supportive base for the foot.

Evaluating the effectiveness of the custom insoles was a crucial part of the project's success. The custom insoles not only improved pressure distribution but also showed the potential to reduce discomfort and prevent injuries by providing targeted support where it was most needed. This achievement has important implications for the future of foot care, particularly in developing personalized orthotic solutions that can be tailored to meet the specific needs of different individuals.

The broader impact of this project lies in the exploration of advanced sensing and manufacturing technologies for foot care. By integrating FSR sensors with Arduino for pressure measurement and using 3D printing to create custominsoles, the project has set the stage for more accurate diagnostics and effective interventions. This approach could greatly improve the quality of life for individuals with foot-related conditions and enhance athletic performance by optimizing foot support.

Furthermore, the project identified important areas for future research, such as exploring foot pressure measurements during movement, using more advanced sensors and materials, and studying the long-term benefits of custom insolesfor different groups of people. Although the study focused on just one participant's foot, it highlighted the significant potentialof combining accurate pressuremeasurement with advanced fabrication techniques tocreate personalizedfoot care solutions. This research not only improves our understanding of foot pressure distribution but also opens up new possibilities for future innovations in orthotics and foot health management.

PUBLICATION

P. Udhayakumar, A. Hemalatha, M.S. Sanjay Kumar, A. Nivethitha Mary, S. Sabarish, (2024) — "Design and Development of Customized 3D Printed Health Care Products",Proceedings of 39th IE(I) National Convention of Mechanical Engineers and the National Seminar on Innovations in Mechanical Engineering, Sustainable Manufacturing Technologies, Design, and Energy Systems (IMESMTDES-2024), 13-14 September 2024, Punjab & Chandigarh State Centre, p.no.52-56, ISBN 978-81-966131-5-0

Evaluation of Anticorrosion Properties of Mild Steel Coated with Waste Foundry Sand Fines-reinforced Epoxy-based Polymer Matrix Composite

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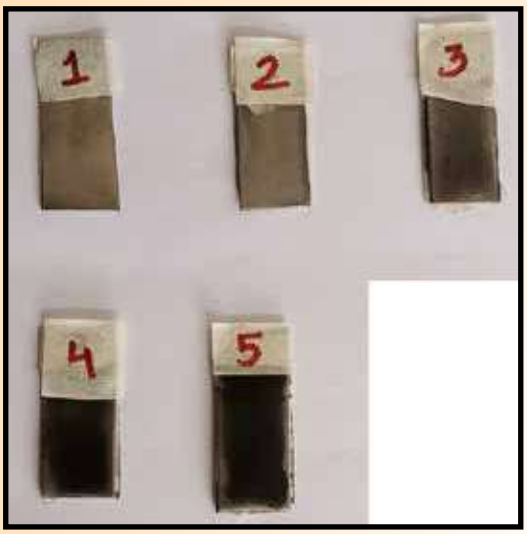
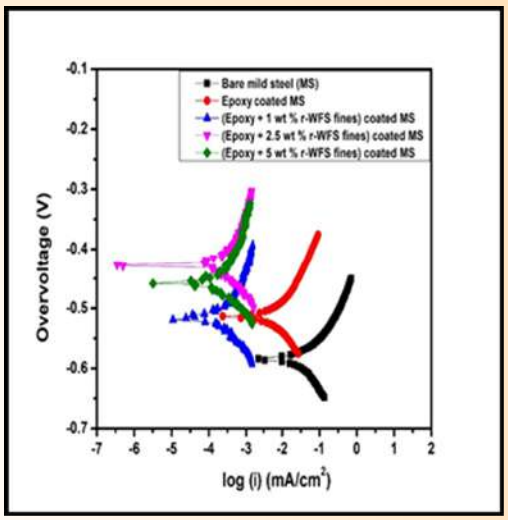


1: Bare mild steel, 2: Mild steel coated with epoxy only and reclaimed waste foundry sand fines- reinforced (3: 1 wt %, 4: 2.5 wt %, and 5: 5 wt %) epoxy-based polymer matrix composite coated mild steel substrate



Tafel plots showing best corrosion resistance performance for mild steel coated with 2.5 wt % reclaimed waste foundry sand fines- reinforced epoxy-based polymer matrix composite

Due to the economic considerations and limited natural resources, corrosion and solid waste generated from the foundry industry are few of the major concerns the industry is facing worldwide. Various ways have been employed and continue to be explored to combat metallic corrosion, while reclamation of used foundry sand is a way of industrial significance, which makes the used foundry sand reusable. Despite this, studies have discovered that, due to its low binding capacity, roughly 15-20% of the WFS in the form of fines must be disposed of following the mechanical reclamation process, rendering it unfit for reuse in casting.

Therefore, this work aimed at using such discarded/ reclaimed waste foundry sand fines (r-WFS fines), generated after the reclamation process, as reinforcement in epoxy-based polymer matrix composite and studying the effect of its coating on the anticorrosion properties of mild steel. Various properties of fresh sand used in the foundry were compared with those of r-WFS fines so as to understand the probable reasons why the r-WFS fines can't be re-used in the mould-making process. The r-WFS fines were then reinforced in the epoxy matrix in various amounts (1, 2.5 and 5 wt %) and brush-coated on mild steel (MS) substrates. Their corrosion resistance performance was evaluated using electrochemical methods along with morphological studies by scanning electron microscopy.

It was observed that the ball milling has hardly any effect on the size reduction of r-WFS fines. Low compressive strength and permeability and higher hardness number of r-WFS fines as compared to the fresh sand make it unsuitable for its reuse in the moulding process. Mild steel (MS) substrate coated with 2.5 wt % r-WFS fines reinforced epoxy showed maximum corrosion resistance while the corrosion resistance started decreasing with increasing amount of reinforcement. EIS also closely agrees with the results of cyclic voltammetry measurements. SEM studies show that above 2.5 wt % reinforcement amount, r-WFS fines particles started emerging from the matrix which might be responsible for the relatively higher diffusion of corrosive fluid leading to increased corrosion of the substrate.

OBJECTIVES

1. To compare waste foundry sand fines, obtained after the reclamation process, with that of green foundry sand in terms of various properties
2. To characterize waste foundry sand fines, obtained after the reclamation process, to determine its composition and particle size distribution
3. To reinforce various pre-determined proportions of waste foundry sand fines, of appropriate particle size, into epoxy so as to coat the composite onto the mild steel
4. To evaluate anticorrosion properties of mild steel coated with waste foundry sand fines-reinforced epoxy-based polymer matrix composite by using potentiodynamic polarization test and electrochemical impedance spectroscopy.

ACHIEVEMENTS

i. 1st Prize at ResCon 2024, held at IIT Bombay with a prize comprising of a memento, a certificate, and INR 65,000 /- cash

ii. A patent application is filed titled ‘Corrosion protective coating composition comprising reclaimed waste foundry sand fines and method of preparation thereof’, Application No.: 202411037901, Dt.14-05-2024 at the patent office, India.

> “Technology innovation is starting to explode and having open-source material out there really helps this explosion. You get students and researchers involved and you get people coming through and building start ups based on open source products.”
>
> Tim Berners-Lee

Optimization of NPK Analysis using Deep Learning

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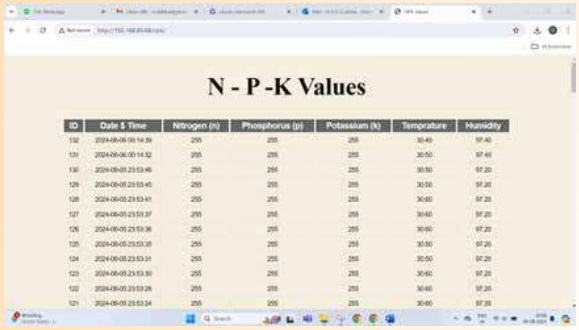
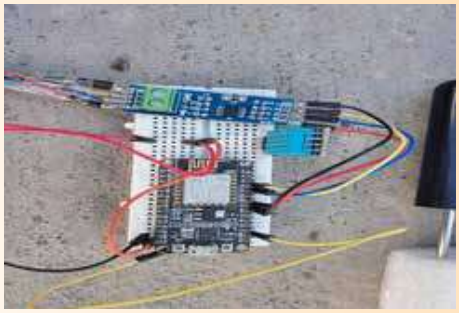


NPK detection using NPK sensor



NPK circuitry

OBJECTIVES

The primary objective of this project is to develop predictive models for NPK (Nitrogen, Phosphorus, and Potassium) values in soil by utilizing data collected from IoT devices. The image patterns of the soil are evaluated using Convolutional Neural Network (CNN). Also the time series data is evaluated using Recurrent Neural Network (RNN). Finally the specific input values are analyzed using Random Forest Regressor.

ACHIEVEMENTS

The model predicts best crops among a number of crops available after analyzing the prediction parameters. There is an enhancement in the accuracy of this research work when compared to the existing work that used another technique for prediction of crops. The accuracy is calculated as 98.47%. Results show that the combined model accuracy: 84.54545454545455 for recommended crop pomegranate. After incorporating real time data sensed, Bagging, XGBM and GBM are implemented and compared the accuracy levels. The accuracy arrived with Bagging classifier is found to be 97.52% and justified. The results show that Advanced ensemble averaging algorithm out performs well.

PUBLICATION

Lalitha, R.V.S., Srinivas, R., Raghavendran, C., Kavitha, K., Kumar, P.S.V.V.S.R., Sravanthi, P.S.L. (2022). Real Time Nitrogen, Phosphorus, Potassium (NPK) Detection in Soil Using IoT. In: Mandal, J.K., De, D. (eds) Advanced Techniques for IoT Applications. EAIT 2021. Lecture Notes in Networks and Systems, vol 292. Springer, Singapore. Feb 25-27, 2021 Kalyani University, Kalyani, West Bengal, India in association with CSI Kolkata chapter. https://doi.org/10.1007/978-981-16-4435-1_39

Low Cost Solar Powered Drain Cleaning and Sanitization Machine

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The above Fig shows the Low cost Solar Powered Drain Cleaning and Sanitization Machine. Solar panel is used to charge the batteries. The frame will be kept in the drain to be cleaned. As the batteries supply power to the motor it rotates the blades (buckets) using a chain drive. The sledge collected through blades will be dumped in the collecting tray and due to its slope the sledge will fall on the ground due to gravity. The machine is a portable one.

Working Principle of the Model

OBJECTIVES

- To develop low cost solar powered drain cleaning and sanitizing system that can be useful for Municipal corporations.
- To attempt avoiding usage of human workers for drains cleaning.
- To reduce the risk and human effort of municipal workers/Safai Karamcharis and hence enhancing their effective utilization.
- To reduce financial burden on municipal corporations for addressing drain cleaning and sanitization problems.
- To cover more length of drains cleaning in the stipulated time, as the number of drains is increasing and their length is also increasing at regular intervals.
- To integrate sanitizing process effectively with drain cleaning process.
- To utilize battery power rather than petrol/diesel for running the drain cleaning machine.
- To utilize solar power to charge the batteries and hence avoid / reduce the usage of electric power

ACHIEVEMENTS

- The project got wide publicity in academic circles. Project viva-voce examiner from affiliating university appreciated the idea of helping the municipal workers and also appreciated the working of the project. As part of the project, students interacted with safai karamchari to know the difficulties faced by them. During interaction, municipal workers appreciated the idea of the project. Students got very good exposure to the real time problems faced by the municipal workers and they also got rich practical experience while doing the project.

Dynamic Health Monitoring - Pioneering Early Disease Detection through Motion Analysis

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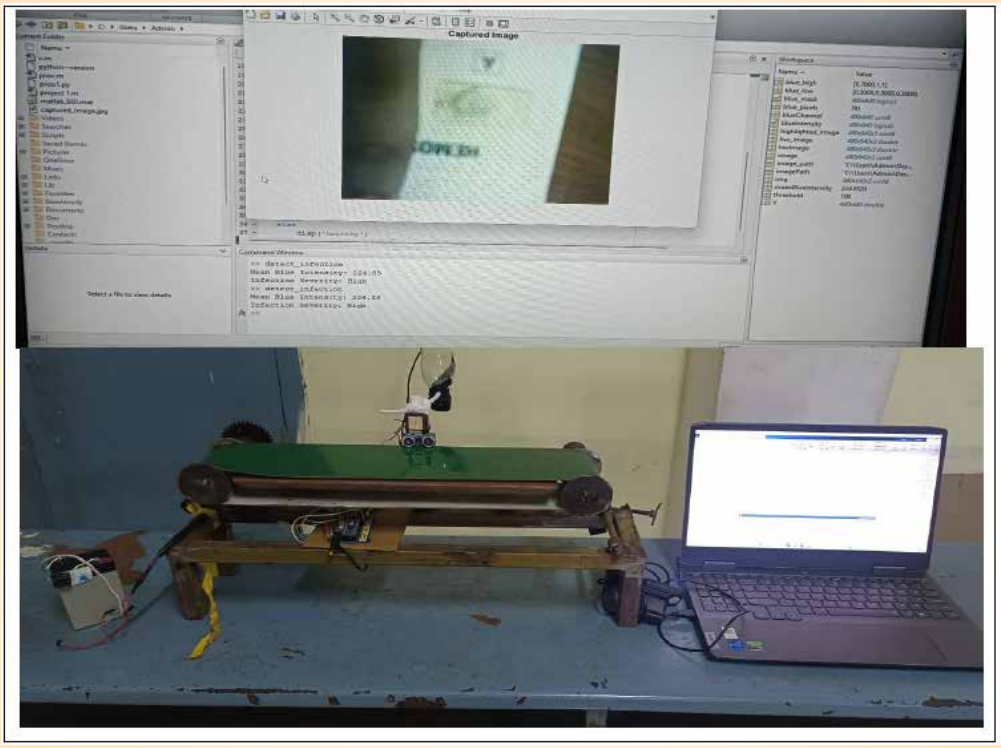

Overall Setup and Result

OBJECTIVES

A cost-effective, automated diagnostic system using a testing card and image processing can revolutionize infection detection by providing an efficient, accurate, and accessible solution. This system is designed to enhance early diagnosis, particularly in resource-limited areas, by leveraging colour-based analysis to detect infections swiftly. The diagnostic process begins with a stool sample applied to the testing card, followed by the addition of reagent solutions that trigger a colour reaction. A webcam or smartphone camera then captures the image of the sample, which is processed using image analysis techniques in MATLAB or OpenCV. The algorithm specifically detects the presence of blue coloration, which indicates infection, while its absence signifies a healthy result. To enhance precision, an optional microscope integration can be used for higher image clarity. The automated system ensures rapid diagnosis within minutes, eliminating the need for traditional, time-consuming laboratory tests. By employing advanced image processing techniques, including

thresholding and colour calibration, the system minimizes errors and ensures reliable results. Furthermore, it can be integrated with a mobile application for remote monitoring, allowing healthcare professionals to receive instant reports. This not only improves patient convenience but also enhances early intervention strategies. The affordability and portability of this solution make it suitable for use in clinics, rural healthcare centers, and even home-based testing. By eliminating the reliance on expensive lab infrastructure, the system significantly reduces diagnostic costs, making healthcare more accessible. Additionally, its real-time analysis capabilities enable quicker decision-making for medical professionals, reducing infection-related complications. With its AI-driven approach and automated functionality, this system bridges the gap between early disease detection and timely medical intervention, ultimately improving public health outcomes and reducing mortality rates.

ACHIEVEMENTS

The development of the testing card-based diagnostic system represents a remarkable breakthrough in simplifying infection detection through automation and image processing. By integrating a webcam and MATLAB, this system eliminates the need for manual analysis, ensuring a fast, reliable, and cost-effective solution for early infection diagnosis. Traditional diagnostic methods often involve complex laboratory procedures, trained personnel, and time-consuming tests, making them less accessible, especially in rural or resource-limited settings. In contrast, this innovative system offers a streamlined, user-friendly approach by automating the analysis of stool samples, reducing human intervention, and minimizing the chances of errors in interpretation.

At the core of the system lies a simple yet effective methodology—a stool sample is placed on the Hemospot testing card, followed by the addition of reagent solutions. These solutions react with the sample, producing a color change that serves as a key indicator of infection. The presence of blue coloration is detected using a webcam or smartphone camera, which captures the image and feeds it into a MATLAB-based image processing algorithm. This software meticulously analyzes the image, identifies the color intensity, and determines whether the sample is infected or healthy based on predefined thresholds. This automated detection process significantly enhances efficiency, allowing results to be obtained in just a few minutes, in contrast to hours or days required for conventional laboratory tests.

One of the most notable aspects of this system is its ability to ensure real-time infection detection, addressing the urgent need for fast medical decision-making. Infections, if left undiagnosed or untreated, can lead to severe health complications. The rapid diagnostic capability of this system enables early intervention, reducing the risk of disease progression and improving patient outcomes. The user-friendly design of the system ensures that even individuals with minimal technical expertise can operate and interpret the results with ease, making it suitable for point-of-care testing, rural healthcare centers, and even home-based diagnostics. A key achievement of this project lies in its focus on automation and accuracy, two essential factors that define the effectiveness of any diagnostic system. Manual diagnostic methods are often prone to human error, leading to misinterpretations or inconsistent results. By leveraging computer vision and image processing, this system minimizes variability in results, ensuring a higher level of reliability and consistency. Additionally, the integration of MATLAB's advanced computational techniques further enhances precision, making the system a robust alternative to traditional testing methods.

Design and Implementation of Smart Sensors-Based Solar-Powered Intelligent Monitoring System for Agricultural Environment in IoT & AI

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Project Module

Implementation of the project by the students in the college

OBJECTIVES

- Reducing input cost and wastage by employing digital agriculture and precision farming techniques and technologies
- Soil and water survey, planning and management.
- Identification of ideal locations for creation of ponds for water harvesting as well as pisciculture
- Geo fenced database of every farm linked with its owner/tiller
- Quarterly UAV based inventory of farms in project area
- Platform for planning of farm link roads, MSME cluster roads, storage infrastructure etc.
- Increasing productivity and better price with real time information exchange and access to market prices across the countryand for export markets as well
- Creation of an Online GIS Enabled ERP Platform with a robust Database, wherein the relevant data of every farmer and farm will be available so as to create a robust decision support system and address issues related to crop insurance, yield estimation and productivity enhancement activities. Decision making for farm roads for better access, can be done usingthis GIS platform.

- Development of Mobile Application for all farmers as well as administrator level app for village councils and officers in
- Tamil language and English which will not only provide useful techniques and access to market prices but also to receive weather information and pest advisories without the need for SMSs
- Development of Machine Learning Algorithms for crop varieties indigenous to the State using AI and Machine Learning.

ACHIEVEMENTS

- Dr. B. Paulchamy, Dr. A. Purushothaman, V. Thulasimani, S. Varsha, S. K. Nithya Priya, M. Sakthivel., "Design and Implementation of Smart Sensors Based Solar-Powered Intelligent Monitoring System for Agricultural Environment in IoT & AI", International Journal of Research and Analytical Reviews (IJRAR), Volume 11, Issue 3, E-ISSN 2348-1269, P- ISSN 2349-5138, September 2024.

Legacy of IEI

Hon'ble President of India, Shri Ram Nath Kovind and Shri Banwarilal Purohit, Hon'ble Governor of Tamilnadu at the Valedictory Session of the 32nd Indian Engineering Congress, Chennai, December 2017

Design and Implementation of Blockchain enabled Open Source Virtual Ballot Box

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Working Prototyp

Finger Print Verification Process

OBJECTIVES

Blockchain has the potential to revolutionize our elections. The use of blockchain technology for elections offers numerous advantages, including increased security, transparency, audibility, and accessibility, while also reducing the potential for fraud and enhancing trust in the electoral process. The objective of this project is to design and implement a voting platform which is an open-source virtual blockchain ballot box. The proposed platform will incorporate biometric security and various parameters for ballot data such as election information, candidate information and voter information. Smart contracts will be developed to automate various aspects of the voting process, such as candidate registration, voter eligibility verification, and vote counting. This smart contract can serve as the backbone of a blockchain-based voting platform, providing security, transparency, and incorruptibility through the use of blockchain technology while incorporating biometric security for voter authentication.

ACHIEVEMENTS

- The system architecture for the blockchain-enabled open-source virtual ballot box was comprehensively designed, encompassing all critical phases of the electoral process such as pre-voting, on-voting, and post-voting.
- Use case and class diagrams were developed to systematically model the voting management system. These diagrams clearly defined the system's actors, interactions, and structural components necessary for secure and transparent electronic voting.
- The pre-voting phase was effectively implemented on open blockchain networks, including key components such as voter registration, biometric enrollment, and candidate registration. These processes ensured secure and verifiable identity and candidate data.
- The on-voting phase was designed and executed using blockchain to support secure voter authentication and casting & recording of votes ensuring the integrity and immutability of the voting process.
- The post-voting phase was successfully implemented, incorporating vote counting, result publication, and auditability. These processes utilized blockchain transparency to guarantee accurate tallying and verifiable election outcomes.
- The complete virtual ballot system was tested across all phases such as pre-voting, on-voting, and post-voting through the integration of Smart Contracts, Arduino-based hardware, and Decentralized Application (DApp) coding, confirming the functional reliability and transparency of the system.

PUBLICATION

- U.Priya Dharshini, S.Kirthana, S.Akshaya, S.Dheenathayalan & K.Mohaideen Pitchai, "Next-Gen E-Voting: A Blockchain-Powered Virtual Ballot Box" submitted in the International Conference on Modern Sustainable Systems CMSS 2025, RVS College of Engineering and Technology, Coimbatore, India and Universiti Teknologi MARA, Malaysia, 12-14, August 2025.

Legacy of IEI

Smt Pratibha Devisingh Patil, President of India, lighting the lamp to mark the General Assembly 2007 of the World Federation of Engineering Organizations (WFEO), hosted by The Institution of Engineers (India) at New Delhi

A Smart Personalized Medical Dispensing System

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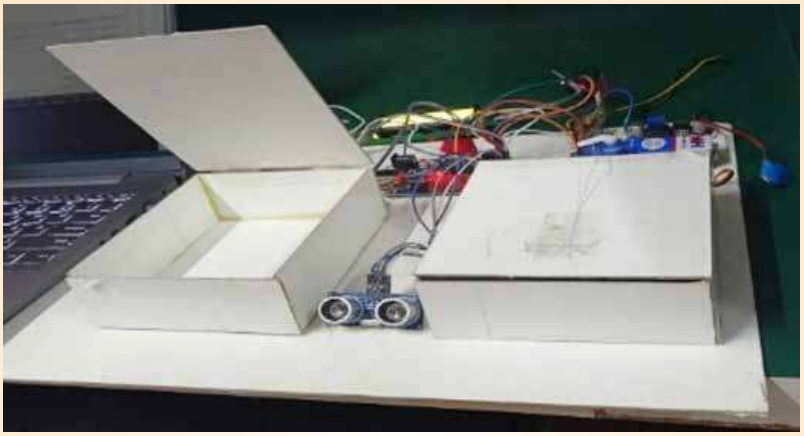

Automated Dispenser images

Complete set up

OBJECTIVES

To develop an automated pill dispenser using IoT technology to assist Dementia patient to make medication simple and easier.

ACHIEVEMENTS

Adopted Procedure and Results

The development of the Smart Personalized Medical Dispensing System followed a structured design and implementation process to address the growing need for accurate and timely medication delivery, particularly for elderly and chronically ill patients. The project began with requirement analysis, focusing on user safety, personalization, real-time monitoring, and ease of use. Based on this, a modular hardware design was selected comprising a microcontroller (Arduino) and integrates real-time alert mechanisms (RTC Module) and advanced IoT technology to enhance medication adherence for patients. At the scheduled dosage time, an alert is triggered through a speaker, prompting the patient to take their medication. The system utilizes an ultrasonic sensor to detect the user's hand gesture, initiating a signal transmission to an Arduino UNO. This Arduino UNO controls a servo motor responsible for dispensing the prescribed medicine. Simultaneously, the Arduino UNO communicates with an LCD display, provides real-time information on the dosage schedule and indicates the status of the servo motor (open or close).

The design of the Automated Pill Dispenser is user-friendly and intuitive, making it accessible for dementia patients. The device is equipped with voice prompts through speaker and visual cues (LCD) to guide the Dementia patient in proper medication administration. This will minimize confusion and reduces the likelihood of errors, as patients do not have to rely solely on memory to manage their medication regimen.

Initially when the system establishes the dispensing time (T) using a Real-Time Clock (RTC) module and conveys the timing information to an Arduino and GSM module through embedded C, the RTC module activates the alert system if the present time (T) aligns with the set time (t), delivers its output through a voice alert.

The results demonstrated high accuracy in timed dispensing (within ±30 seconds), 100% compliance in successful integration with alerts The system sets the dispensing time (T) using a Real-Time Clock (RTC) module. The timing information is then fed into an Arduino, along with a GSM module, using Embedded C. If the present time (T) is equal to set time(t) in RTC module t, the RTC module actuate the alert system to deliver its output through voice alert when RTC module is activated, it triggers the LCD and speaker to deliver their outputs.

This project successfully delivered a functional prototype of a smart, user-centric medical dispenser, laying the groundwork for further integration with telemedicine platforms and electronic health records in future iterations.

Smart Brief

Since the 1990s, new areas of tribology have emerged, including the nano tribology, bio tribology and green tribology. These areas study the friction, wear and lubrication properties at nano-scale, in bio medical applications (human joint prosthetics, dental implants) and ecological aspects involved in study of tribology of clean energy sources, green lubricants and biomimetic tribology.

IoT Enabled Smart Patient Health Monitoring System using Machine Learning Approach

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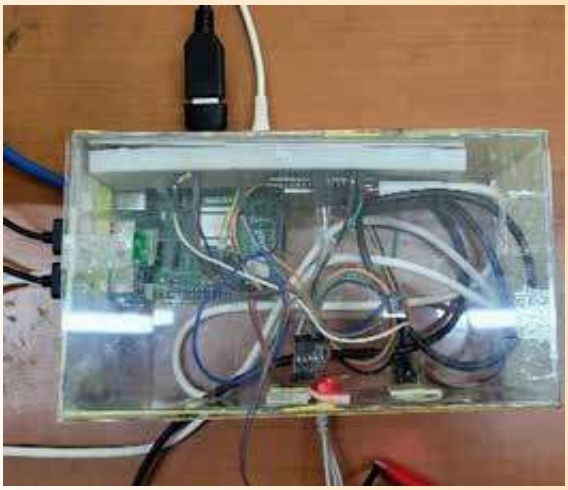
Front view of the final prototype



Top view of the final prototype

OBJECTIVES

This research aims to develop an IoT-enabled smart health monitoring system that continuously tracks key physiological parameters like body temperature, pulse rate, SpO_2 levels, and ECG signals in real-time. The system is designed for use in both hospitals and homes to provide quality healthcare. The system aims to analyse and classify health data with high accuracy with advanced technologies such as machine learning techniques specifically Extreme Gradient Boosting and Convolutional Neural Network models. Predictive models are developed to identify abnormalities in vital signs and provide timely alerts for potential health issues, including heart-related diseases like arrhythmia. Cloud-based data management using platforms like Thingspeak ensures real-time data accessibility and analysis. The system enhances personalized healthcare by offering data-driven insights and recommendations based on individual health parameters, thereby improving remote health monitoring efficiency and quality of service. The ultimate goal is to systematically monitor a person's health condition, detect anomalies, and provide timely medical interventions to reduce untimely deaths caused by a lack of knowledge and delayed medical treatment. By achieving these objectives, the proposed IoT-based smart health monitoring system aims to enhance medical diagnostics, improve public health management, and ultimately save lives through advanced technological integration.

ACHIEVEMENTS

The IoT-based smart health monitoring system utilizing machine learning has achieved remarkable milestones in enhancing medical diagnostics, improving remote and personalized healthcare, and ultimately saving lives.

- The integration of advanced machine learning techniques, such as Extreme Gradient Boosting (XGBoost) and Convolutional Neural Network (CNN) models, has significantly improved the accuracy of health data analysis and classification.

- By continuously tracking and analyzing key physiological parameters like body temperature, pulse rate, SpO2 levels, and ECG signals, the system ensures precise monitoring of a patient's health status.
- One of the most notable achievements of the system is its ability to detect anomalies in vital signs at an early stage. The predictive models can identify abnormalities and provide timely alerts for potential health issues.
- Specifically, the system's capability to predict heart-related diseases, such as arrhythmia, through real-time analysis of ECG reports, has been instrumental in preventing severe health complications and saving lives.
- The utilization of IoT cloud platforms like Thingspeak ensures that health data collected by sensors is transmitted, stored, and managed efficiently.
- Real-time data accessibility allows healthcare providers and patients to access and monitor health information promptly, leading to informed decision-making and timely medical interventions.
- The system's ability to provide personalized healthcare solutions based on individual health parameters has enhanced the efficiency of remote health monitoring.
- Data-driven insights and recommendations tailored to each patient's unique health status have improved the quality of care, ensuring that patients receive the most relevant and effective treatments.
- The deployment of sensors like MAX30102, DS18B20, and AD8232 in the health monitoring system has enabled continuous tracking of vital parameters.
- Wearable devices equipped with these sensors provide patients with an easy and convenient way to monitor their health, promoting proactive healthcare management.
- The system has demonstrated significant improvements in the quality of service (QoS) for health monitoring. By ensuring continuous and reliable data collection, transmission, and analysis, the system has provided consistent and high-quality healthcare support.
- The integration of advanced technologies and real-time monitoring capabilities has contributed to better patient outcomes and overall satisfaction.
- The IoT-based health monitoring system is designed to be scalable and flexible, making it suitable for various healthcare settings, including hospitals and homes.
- The system's adaptability allows it to cater to different patient needs and health conditions, ensuring comprehensive healthcare coverage.
- The health monitoring system features a user-friendly interface that makes it easy for patients and healthcare providers to interact with and utilize the system.
- The accessibility of real-time health data through IoT cloud platforms and wearable devices has empowered patients to take control of their health and well-being.
- The system's ability to systematically monitor and analyze health data has made valuable contributions to public health management.
- By providing insights into population health trends and potential outbreaks, the system has supported public health initiatives and policies aimed at improving overall community health.

The integration of advanced technologies, real-time monitoring capabilities, and predictive insights has revolutionized healthcare, ensuring that patients receive timely and effective medical interventions. The system's achievements highlight the potential of IoT and machine learning to transform healthcare and promote better health outcomes for individuals and communities.

PUBLICATION

1. Research paper published in the International Conference on Sustainable AI and its Applications (ICSAA-2025) (21-22 January 2025)organized by GNIT, titled "IoT Enabled Smart Health Monitoring System UsingMachine Learning Approach", ISBN : 978-93-341-6437-4.

Deep Learning Based Real-Time Scrap Inspection using Jetson Nano

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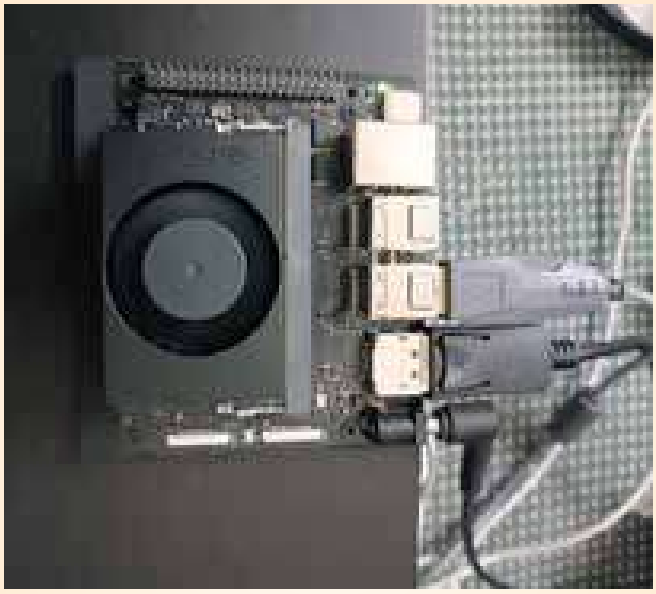

Jetson Nano setup

Real-Time Scrap Inspection setup

OBJECTIVES

In the steel industry, efficient and sustainable scrap handling is vital to reducing waste and supporting eco-friendly manufacturing. However, conventional methods like manual sorting or early automated systems using basic machine learning (ML) or convolutional neural networks (CNNs) struggle to keep up. These traditional approaches often suffer from inconsistent accuracy, slow processing, and high operational costs especially in the chaotic, variable environments of scrapyards with changing lighting and diverse material types.

This project aims to develop a real-time, reliable scrap inspection system using deep learning on edge devices, specifically the NVIDIA Jetson Orin Nano Super. By fine-tuning a Vision Transformer (ViT) model using Low-Rank Adaptation (LoRA), we deliver a robust solution for accurately classifying six different scrap categories from the Dataset of European Scrap Classes (DOES). LoRA enables efficient fine-tuning, reducing computational load without compromising accuracy.

The system is trained on high-quality, diverse images that reflect real-world scrapyard conditions. By leveraging the attention mechanism in ViTs, the model can capture complex visual patterns, leading to high precision in identifying different types of scrap. The entire solution is deployed on the Jetson Orin Nano Super for real-time performance, ensuring fast, on-site inspection without dependency on cloud infrastructure. This project blends sustainability, AI, and edge computing into a practical solution for the steel industry, boosting recycling efficiency, cutting costs, and reducing environmental impact.

ACHIEVEMENTS

This project successfully achieved a powerful integration of deep learning, edge deployment, and sustainability-driven innovation in the steel industry. The central achievement lies in the development and deployment of a fine-tuned Vision Transformer (ViT) model using Low-Rank Adaptation (LoRA), which achieved 99.56% classification accuracy on a curated dataset (DOES) covering six diverse categories of steel scrap. The use of LoRA significantly reduced training time and memory overhead, making the model lightweight enough for edge deployment without sacrificing performance.

Unlike traditional CNN or ML models that struggled with visual variability in scrapyard environments, the ViT model demonstrated robust performance across varying lighting conditions, complex textures, and overlapping scrap types. Precision and recall scores were also high, confirming the model's reliability for industrial use.

To make this system deployable in real-world conditions, we ported the PyTorch-trained model into ONNX format, then optimized and deployed it using TensorRT on the Jetson Orin Nano Super Developer Kit. This conversion drastically reduced latency, allowing for real-time inference with smooth and low-power processing, crucial for on-site, offline inspections.Hardware integration included a camera module for continuous image capture, along with accessories like an NVMe SSD for fast storage and DP to HDMI adapters for display output—creating a compact and fully self-sufficient inspection unit.

> The ideal engineer is a composite ... He is not a scientist, he is not a mathematician, he is not a sociologist or a writer; but he may use the knowledge and techniques of any or all of these disciplines in solving engineering problems.
>
> N. W. Dougherty

Eco Aware Railway System

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Infrastructure of the Rolling stock

Obstacle detection ,Classification and the calculation of Braking Distance

OBJECTIVES

The main objective of this project is to pioneer innovative approaches leveraging LiDAR technology to detect obstacles upfront in the rail tracks and prevent accidents due to catastrophic collisions in high speed train services. This project endeavors to implement proactive measures to prevent railway accidents. It seeks to address the pressing challenge of wildlife collisions along railway corridors by harnessing the capabilities of LiDAR sensors to detect and track wildlife movements in real-time around the corridors and in the rail tracks. The potential of LiDAR technology in enhancing railway safety by preventing collisions involving various living entities such as wildlife, livestock, and humans. The project seeks to address the essential safety concern posed by railway collisions with living entities, which have historically resulted in significant risks to both human life and animal welfare. By leveraging LiDAR technology, the objective is to provide real-time, high-resolution 3D mapping of railway environments, enabling precise detection and tracking of living entities near railway tracks. Through an in-depth analysis of existing literature and case studies, the project aims to evaluate the effectiveness of LiDAR-assisted solutions in preventing collisions with living entities on railway tracks. Furthermore, the project aims to highlight the potential benefits of adopting LiDAR-assisted solutions for railway safety, including improved collision avoidance, reduced risk of accidents, and enhanced protection for both human occupants and non-human inhabitants. Ultimately, the goal is to advocate for the integration of LiDAR technology as an integral component of comprehensive railway safety strategies, with the aim of mitigating collisions with living entities and safeguarding lives and ecosystems along railway corridors.

ACHIEVEMENTS

The LiDAR-based Obstacle Detection and Prevention System is revolutionizing railway safety by integrating real-time sensing, tracking, and decision-making to prevent accidents. One of the key achievements of this

project is its high detection accuracy, averaging 92.5%, ensuring precise identification of obstacles with minimal false positives. Additionally, the system boasts 90% classification accuracy, effectively distinguishing between wildlife, humans, and inanimate objects, allowing for appropriate safety responses. This capability is particularly beneficial in railway corridors where wildlife crossings and human encroachments are frequent, reducing the risk of severe accidents and disruptions in train operations.

A major accomplishment of this project is the adaptive braking system, which adjusts train speed based on the distance of the obstacle. The system follows a multi-stage braking mechanism to prevent sudden stops or derailments. If an object is detected beyond 100 cm, no change in speed is required. However, when an obstacle is within 100-50 cm, the motor speed is reduced to 11V, triggering two seconds of braking, with a stopping distance of 1.8 meters. If the obstacle is closer than 50 cm, the motor speed is further reduced to 9V, extending the braking duration to four seconds with a stopping distance of 3.5 meters. In the case of an immediate collision risk, emergency brakes instantly cut the motor voltage to 0V, stopping the train within 0.5 meters. This intelligent braking mechanism ensures that trains stop safely and effectively, mitigating accidents caused by sudden obstacles.

The LiDAR system's precision in distance measurement and object tracking is another significant achievement. It achieves high reliability in obstacle detection. The tracking update time is 100 ms for objects 50 cm or farther, and 50 ms for immediate obstacles, enabling quicker reaction times. These high levels of accuracy and responsiveness allow the system to track moving obstacles such as animals or vehicles stuck at level crossings, ensuring timely and appropriate actions.

By reducing wildlife collisions, human accidents, and track obstructions, this system offers a proactive safety mechanism for railway networks. Unlike traditional railway safety measures that rely on manual surveillance or delayed braking, this automated detection system operates independently, minimizing human error. It also expected to be ideal for high-speed trains, where even a fraction of a second can determine whether an accident occurs.

From an implementation perspective, this project provides a practical solution for modern railway safety. The system can be integrated into high-speed trains, offering an automated safety layer for operators. Its ability to combine LiDAR,Camera GPS, and INS technologies makes it a comprehensive railway monitoring system that enhances collision avoidance measures. Additionally, the system can be further optimized using machine learning algorithms to improve obstacle recognition and decision-making over time. The potential to retrofit existing railway infrastructure highlights its scalability and long-term impact in preventing railway accidents.

The overall impact of this project is substantial, proving that sensor fusion technology can transform railway safety by providing real-time obstacle detection, tracking, and adaptive braking mechanisms. By reducing accidents, protecting passengers and wildlife, and ensuring uninterrupted train operations, this project plays a crucial role in making railway travel safer and more reliable. The integration of advanced sensor technologies and intelligent decision-making modules allows trains to react autonomously, improving safety without requiring human intervention. The project lays the groundwork for future advancements in autonomous railway systems, demonstrating the potential of AI-powered railway monitoring solutions.

In conclusion, this project marks a major breakthrough in railway safety technology. The combination of high detection accuracy, real-time processing, adaptive braking, and precise LiDAR tracking ensures that trains can detect, analyze, and respond to obstacles before they become a threat. With its potential for large-scale deployment, this system can significantly reduce railway accidents, save lives, and enhance operational efficiency. Its success in detecting obstacles, tracking movement, and implementing intelligent braking decisions paves the way for smarter, safer, and more resilient railway networks worldwide.

Aditya Route Rover: Low-Cost and Efficient Monitoring System with IoT Integration

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Student Dashboard


Hardware setup

OBJECTIVES

- Implement real-time tracking and monitoring to enhance student safety during transit. Use face detection for student identification and attendance verification.
- Provide real-time bus location updates to parents via a web-based interface and notify parents when their child boards or exits the bus.
- Implement face detection to automate student identification and attendance marking as they board or exit the bus.
- Measure and control the Speed and Counting Sequence of the students/passengers.
- Integrate automatic counting to track the number of students on board and prevent under- or over-occupancy.
- Use GPS technology to provide accurate location tracking and reduce delays by optimizing bus routes based on real-time data.
- Implement automatic passenger counting to maintain an accurate record of students on board and integrate IoT sensors, GPS, and cameras to automate the bus monitoring process
- Integrate IoT sensors, GPS modules, and surveillance cameras to fully automate the student transit monitoring process for improved reliability and efficiency.
- Maintain historical data of trips, attendance, speed, and route logs for administrative analysis and audits.

- Support eco-friendly goals by reducing idle time and fuel consumption through smart routing and automation.
- Provide a simple and secure web portal for school administrators, parents, and transport managers to monitor activities in real time.
- Offer a centralized dashboard for school authorities to analyze student attendance, bus usage, and route efficiency.

PROCEDURE

System Workflow

- The GPS module collects real-time location data, which is processed by the Raspberry Pi.
- The USB camera captures live visual feeds for monitoring and analysis.
- Processed data is transmitted and displayed on a webpage, enabling easy access for users and operators.
- Network connectivity ensures smooth data transfer to a central server for continuous tracking and updates.

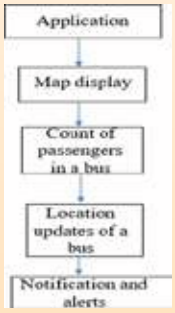
Back-End Process

- Bus monitoring system using face recognition and GPS tracking.
- The back-end system combines face detection with GPS tracking to enable real-time monitoring of both bus movement and passengers.

Backend Process Flow

Crowd Face Detection and Analytics

- The camera captures video inside the bus to monitor passenger activity.
- Face detection and recognition algorithms identify and count individuals.
- Data is analysed to understand passenger flow and occupancy trends.
- This information aids in security, attendance, and crowd management.



Frontend Process Flow

Application Interface

- Provides a user-friendly platform for passengers and operators.
- Displays essential real-time data including bus status.

Map Display

- Shows the live bus location and route on a digital map.
- Enables visual tracking of movement and direction.

Count of Passengers in a Bus

- Uses face recognition to monitor passenger count.
- Assists in managing bus occupancy efficiently.

Location Updates of a Bus

- GPS data is used to update bus position continuously.
- Displays ETA for different stops.

otifications and Alerts

- Sends updates on delays, speed, and route changes.
- Helps passengers plan their journey better.

ACHIEVEMENTS

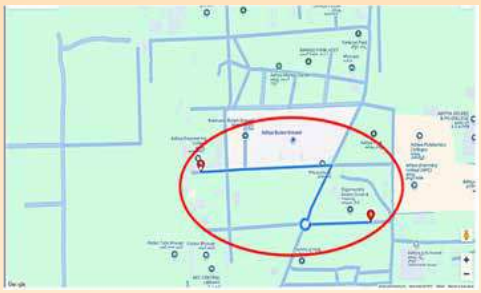
- A smart, web-based transportation management system built using React and Vite.
- Designed for educational institutions, integrating face recognition, GPS tracking, and live dashboards.
- Itimproves student/employee safety, route optimization, and fleet management efficiently.

Student Dashboard

- Personalized view after login
- Left Panel: Personal Details (photo, name, roll number, campus, year, dept., gender).
- Right Panel: Bus Details (original/current bus number, driver info, registration, area, condition, routes).
- Features are a live bus tracking map showing real-time movement, “Start Journey” and “Logout” buttons for user control, routes marked with key points (Point A to Point B), showing student travel through the campus (e.g., library, canteen, college).

Login Page

Student Dashboard



Map View

Employee Dashboard

- Web-based interface for managing faculty/staff data.
- Sidebar includes dashboards, busstatus, details of the bus, student, and employee data, and a logout button at the bottom.
- The main panel displays employee records in a table.
- Database integration (likely MongoDB) for efficient data storage.

Employee Dashboard Details

Student Registration Form

- Simple layout for easy data entry by administrators.
- Links student info with transportation details.

The Bus Management Interface displays bus information,including bus number, driver name, contact number, and town.

Face Recognition System

- Implemented on Raspberry Pi with a camera and a 7-inch crystal display with touchscreen.
- Face detected and marked with bounding box and roll number.
- Used for automated student attendance during travel.
- USB connectivity indicates real-time data transfer.
- Control icons allow user settings and management.

FaceRecognition Window

GPS Tracking and Integration

- Developed using Python in Visual Studio Code.
- Libraries used: OpenCV, NumPy, face recognition, pandas, pymeanz, serial, requests.
- Logs and sends real-time GPS coordinates (latitude & longitude).
- Serial communication with GPS hardware for continuous tracking.
- Location-based attendance and security alerts.

GPS Coordinates

System Benefits

- Real-time monitoring of student and employee transportation.
- Facial recognition improves authentication and attendance.
- GPS tracking provides live updates for students, parents, and administrators.
- Web-based dashboard centralizes all operations – students, employees, and buses.
- Enhances user experience, security, and transparency.

PUBLICATIONS

- A paper was communicated to the "Journal of Mechanics of Continua and Mathematical Sciences" for publication.
- This project was presented at the Technical Project Expo which was conducted by Jawaharlal Nehru Technological University Kakinada, on 15 & 16 March 2025.

Third Eye: Design and Implementation of Electronic Narrator Cum Writer Assistant Robot for Visually Impaired People

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Project Module

OBJECTIVES

- Develop a robot that reads aloud text from books, documents, and screens while also converting spoken words into written text to help visually impaired individuals with reading and writing tasks.
- Implement voice recognition and text-to-speech technology to facilitate hands-free interaction, enabling users to easily control the robot and receive verbal feedback for navigation and task execution.
- Equip the robot with sensors and machine learning algorithms to support visually impaired individuals in daily activities, enhancing their independence by assisting in tasks such as navigating unfamiliar environments and identifying objects.
- Design an intuitive and accessible user interface with personalized settings, ensuring that the robot can be easily customized to meet the unique needs and preferences of each user.

ACHIEVEMENTS

- Participated in National Conference on Innovations in Electronics,Communication Systems and Information Technology (NCIECIT 25) held on 27th March 2025 at HindusthanInstitute of Technology, Coimbatore, India.

PUBLICATION

- Dr. K. Kalpana, Dr. K. Mahendrakan, Deepika Gavini Lakshmi, Machavarapu Dileep Kumar, Siddartha Gundlapalli, Madhu Mohan SaiMalyavantham, “Third Eye: Design and Implementation of Electronic Narrator cum Writer Assistant Robot for Visually Impaired People” in International Journal of Research and Analytical Reviews (IJRAR), March 2025, Volume 12, Issue 1,PP:389-397, E-ISSN 2348-1269, P-ISSN 2349-5138.

Customized Tricycle Assistive Technology for People with Disabilities

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Assembled Prototype

Infotainment System which shows back camera images

OBJECTIVES

The primary objective of developing a Customized tricycle assistive technology for people with disabilities is

- To design a detachable handlebar for individuals with disabilities to operate, making it easy accessible for them.
- To create the model which is inexpensive based on the suggested system.
- To avoid the usage of outside assistance for disabled individuals to drive the vehicle.

ACHIEVEMENTS

The project was successful in creating a customized tricycle that was both economical and ergonomically constructed to meet the unique requirements of people with physical limitations. Improved user movement and freedom, increased safety due to stable structural design, and terrain adaptation are some of the major accomplishments. To accommodate a variety of body types and disabilities, the tricycle features a modular frame and user-friendly controls. Field testing showed that users were more comfortable and confident, which greatly enhanced their daily travel and involvement in community events. The user can detach the handlebar of the wheelchair once he or she reaches the destination.

PUBLICATION

M. Suryaparakash, S.Kannan, G.Sivapriya “Customized Tricycle Assistive Technology For People With Disabilities”, International Conference on Sustainable Energy and innovation Technology(ICSEIT-2K25), dated 12th April 2025.

AI Based Solid Waste Management using SORTBOT for Turning Trash in Treasure

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OBJECTIVES

- To develop an intelligent waste management system using AI for automatic waste segregation.
- To design and implement a robotic system (SORTBOT) that classifies waste into biodegradable, non-biodegradable, and metallic categories.
- To integrate deep learning algorithms (AlexNet CNN) for accurate image-based waste classification.
- To create a cost-effective and scalable solution suitable for smart cities and urban waste management.
- To reduce manual effort and human contact with waste, thereby improving hygiene and efficiency.

AI Based Solid Waste Management Using SORTBOT

ACHIEVEMENTS

A cost-effective and intelligent solid waste management system named SORTBOT has been developed to address the growing challenges of waste segregation in urban environments. The system is designed to operate autonomously with minimal human intervention, ensuring safer and more efficient waste handling. It is equipped with an ultrasonic sensor that detects the presence of waste items on a conveyor, triggering a camera module to capture images for classification. Using a deep learning algorithm (AlexNet CNN), the system identifies and categorizes waste into biodegradable, non-biodegradable, and metallic types with high accuracy. The system is managed by an embedded controller (Arduino/Raspberry Pi), which processes inputs from various components and coordinates the sorting mechanism. The robot is capable of operating in both automatic and semi-manual modes based on the desired application area and waste type, ensuring maximal sorting accuracy and environmental benefit. Based, on the results obtained from the developed system, the paper has been presented in conference during April 2025.

PUBLICATION

Dr. V. Jamuna, Ms.S.Sivajothi Kavitha , T. Dhanalakshmi, S.Divya Lakshmi have presented a paper titled “AI Based Solid Waste Management using SORTBOT” in the Second International Conference on Advancements in Science, Technology & Management, (ICASTM-II 2025) held on 11th and 12th April 2025 and efforts are made to publish the work in reputed journal.

Development of Electronic Tongue Based Sensing System for Water Toxicity Monitoring

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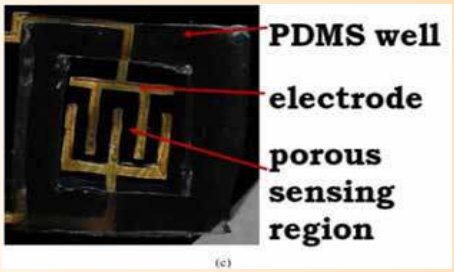
OBJECTIVES

1. Design and development of optimized nanoporous silicon oxide impedance sensor array for detection of aflatoxin B2, ochratoxin and mycotoxin-LR in water
2. Estimation of peak frequency from the steady state impedance sensitivity characteristics and cut-off frequency from the noise spectroscopy characteristics for different toxin concentration in pure buffer, complex mixture and spiked water samples.
3. Development of signal processing unit with embedded intelligent algorithm for quantification of the aforesaid toxins in real water samples, leading to a complete E-tongue system.
4. Testing of the developed prototypes in the laboratory with collected water samples
5. Development of multiple prototypes in collaboration with industry
6. Field testing of the prototypes and fine tuning of the system after testing water amples of different lotions
7. Transfer of technology to suitable industries through IEI Kolkata.

Picture of the sensing system



Final view of the developed sensor

ACHIEVEMENTS

Nanocrystalline silicon oxide (nc-SiO2) immunosensor array-based electronic tongue (E-tongue) has been developed to simultaneously detect multiple toxins with sub-femtomolar sensitivity with appreciable precision using classification algorithms. The quantification accuracy of multiple toxin detection in the subfemtomolar range has been improved by more than 90% through upgraded design of the E-tongue system by incorporating two major modifications. First, the pore geometry of the nc-SiO2 immunosensors has been optimized to obtain the best combination of sensitivity, selectivity, and reproducibility through the evaluation of a figure of merit. Second, in the multivariate data processing using partial least squares discriminateanalysis, additional input parameters corresponding to selectivity and standard deviations of the experimentally measured data have been incorporated. The final set of input parameters include peak frequency corresponding to maximum impedance sensitivity, bandwidth of the impedance sensitivity characteristics, cutoff frequency from noise spectroscopy, and their standard deviations. The optimized E-tongue system is capable of quantifying 0.1 fg/ml Aflatoxin B1 and Ochratoxin A with an error of only 10% and 20%, respectively, which is a remarkable achievement in the domain of toxin detection in piked water samples. The proposed E-tongue system is low cost with minimal operator dependence and hence has immense potential for commercial deployment.

PUBLICATION

Optimized Nanocrystalline Silicon Oxide Impedance Immunosensor Electronic Tongue for Sub-femtomolar Estimation of Multiple Food Toxins., H. Ghosh, R. Das, C. Roy Chaudhuri, IEEE Transactions on Instrumentation and Measurement., vol.66, pp.964-973, 2017.

The Institution of Engineers (India)

Recognized as Scientific & Industrial Research Organization by
Ministry of Science & Technology, Govt. of India

IEI R&D Grant-in-Aid Scheme

INSTRUCTIONS TO AVOID REJECTION OF PROJECT PROPOSALS DURING INITIAL SCRUTINY

(I) MUST FURNISH THE FOLLOWING GENERAL INFORMATION PRECISELY

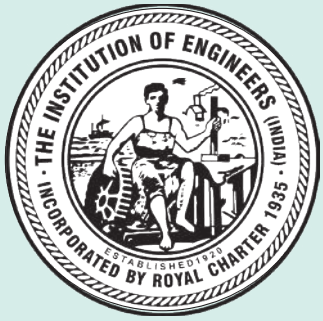
1. The project title should have clarity and must be relevant to the proposal.
2. Attach supporting documents for NBA / NAAC Accreditation.
3. Applications should be from Institutional Members [IMs].
4. Do not include names of more than two guides for a single project proposal .
5. Both the guides should be Corporate Members (AMIE/MIE/FIE- for UG Project Proposals and MIE/FIE- for PG & PhD Project Proposals). In case they are not, they must send the membership form with requisite fees along with project proposal.
6. Guide(s) should be from the same Institution as that of the Applicant(s).
7. A guide will not be allowed to supervise more than one project simultaneously.
8. Maximum number of students/applicants that can apply for a single UG Project Proposal must be limited to five. In case of PG & PhD only one student per project is allowed.
9. UG Applicants should be Student Members (SMIEs) of the Institution, whereas, PG & PhD students must be Corporate Member. In case they are not, they must send the membership form with requisite fees along with project proposal.
10. The 'Completion Date of Study' (Item D) should not be earlier than 'Project Completion Date' (Item H) or should not exceed the maximum duration prescribed for each category.
11. Inclusion of different category of applicants (UG/PG/PhD) in a single project proposal is not permitted.
12. Only full time students pursuing a course in engineering at UG/PG/PhD is eligible for funding. Faculty Members or those who are pursuing part-time course in engineering will not be considered as students.
13. PG applicant must enclose 'Enrolment Certificate' whereas PhD applicant must enclose 'Enrolment Certificate' as well as 'Registration Certificate' along with project proposal.
14. Project proposal will be considered for scrutiny only when the soft copy sent via email is followed with a hard copy of the proposal which must be signed and sealed by all concerned in required places.

(II) MUST ESTABLISH NOVELTY & FINANCIAL FEASIBILITY OF THE PROPOSAL

1. 'Review of R&D in the proposed area' (Item G) should be well documented and must establish novelty/uniqueness of the proposal.
2. Under item 'G', a list of 'References' should be provided for the earlier works carried out in the area.
3. The Applicant's Institute must extend its infrastructural facilities or provide partial funding for carrying out the project.
4. Proposals receiving Industry Support in cash/kind will be given preference.
5. It is expected that the proposal must provide complete information about items being procured. Procurement under non-permissible heads will not be considered for funding. In order to avail maximum grant 'Details of Financial Requirements' [Item-O] must be filled up with reference to upper ceiling of funding available under various Heads.

(III) INFORMATION SHEET & PAYEE DETAILS MUST BE COMPREHENSIVE

1. The 'Information Sheet' must be completely filled along with Membership Numbers for Guides, Students & Institute. Contact Numbers and E-mail of Guide(s) and Students must be furnished.
2. Payee Details should include all requisite details along with the GST number of the Institution.
3. Project proposal should be accompanied by hard copy of cancelled cheque. The cancelled cheque should be from the same account against which payee details have been provided and should bear the name of signatory authority.
4. Request of transfer of grant to account other than Principal/Director/Registrar/Dean (R&D) will not be entertained.



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