Sanjivani Rural Education Society's

Sanjivani College of Engineering, Kopargaon

(An Autonomous Institute) Affiliated to Savitribai Phule Pune University, Pune

Approved by AICTE, Accredited 'A' Grade by NAAC

DEPARTMENT OF INFORMATION TECHNOLOGY

(NBA Accredited - UG Programme)

IT TECHNICAL

MAGAZINE

MARCH 2025

VISION OF DEPARTMENT

To develop world class IT professionals through quality education.

MISSION OF DEPARTMENT

To create Academic Excellence in the field of Information Technology through Education, Industry Interaction, Training and Innovation to improve quality of life of people. We are committed to develop industry competent technocrats with life-long learning capabilities and moral values.

PROGRAM EDUCATIONCAL OBJECTIVES (PEOs)

PEO 1:

Graduates of IT program should possess knowledge of fundamental concepts in mathematics, science, engineering and technology as well as skills in the field of Information Technology for providing solution to complex engineering problem of any domain by analyzing, designing and implementing.

PEO 2:

Graduates of IT program should possess better communication, presentation, time management and teamwork skills leading to responsible and competent research, entrepreneurship and professionals, will be able to address challenges in the field of Information Technology at global level.

PEO 3:

Graduates of IT program should have commitment to ethical practices, societal contributions through communities and life-long learning.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Engineering Graduates will be able to:

PSO 1:

Attain the ability to provide software solutions by applying knowledge of Data Structures & Algorithms, Databases, Web Technology, System Software, Soft Computing and Cloud Computing.

PSO 2:

Apply the knowledge of Computer Hardware & Networking, Cyber Security, Artificial Intelligence and Internet of Things to effectively integrate IT based solutions.

PSO 3:

Apply the knowledge of best practices and standards of Software Engineering for Project Management.

FROM HOD's DESK

It gives me immense pride and satisfaction to present this edition of the IT Technical Magazine, which showcases the innovative and research-driven final-year projects undertaken by our students. The projects featured in this volume reflect the department's strong commitment to academic excellence, technological advancement, and socially responsible innovation.

This year's project portfolio demonstrates a remarkable alignment with emerging domains such as Artificial Intelligence, Machine Learning, Internet of Things (IoT), Cybersecurity, Smart Agriculture, Environmental Sustainability, Healthcare Analytics, and Industrial Automation. From AI-driven crop disease prediction and water resource forecasting to predictive maintenance systems and intelligent healthcare applications, our students have addressed real-world challenges with technical depth and practical relevance.

Particularly noteworthy are the interdisciplinary approaches adopted in projects such as real-time environmental monitoring, smart irrigation systems, direct market access platforms for farmers, and AI-enabled student assistance systems. These initiatives not only strengthen technical competencies but also contribute meaningfully to societal development and sustainable progress.

The department has continuously encouraged students to integrate research methodology, data analytics, and system design principles into their project implementations. The use of advanced tools such as deep learning frameworks, IoT sensor networks, predictive models, and cloud platforms demonstrates the department's commitment to Industry 4.0 and digital transformation initiatives.

I wish all our students the very best in their academic and professional endeavors.

Dr. Madhuri Jawale,
Professor and Head

FROM EDITOR'S DESK

It is with great enthusiasm that we present this edition of the IT Technical Magazine, highlighting the innovative final-year projects undertaken by our students. This volume reflects not only technical competence but also a strong commitment to addressing real-world challenges through intelligent and sustainable solutions.

The projects featured in this issue demonstrate the dynamic capabilities of our students in emerging domains such as Artificial Intelligence, Machine Learning, Smart Agriculture, Environmental Monitoring, Industrial Automation, Cybersecurity, Healthcare Systems, and Digital Governance. From predictive maintenance of industrial equipment to AI-driven crop rate prediction, from water resource forecasting to inclusive communication technologies, each project embodies a blend of innovation, research orientation, and practical implementation.

What stands out this year is the interdisciplinary integration of technologies — AI combined with IoT, edge computing with real-time analytics, deep learning with environmental sustainability, and digital platforms empowering farmers and students alike. These projects reflect the department's emphasis on Industry 4.0 readiness and socially impactful technological development.

This magazine serves as a platform to document the technical rigor, analytical thinking, and creative problem-solving demonstrated by our students. It also showcases the collaborative efforts between faculty mentors and students in transforming ideas into deployable systems.

May this edition inspire future batches to continue pushing the boundaries of innovation and research excellence.

Mr. U.B. SANGULE
Editor, Department of IT

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AI-Driven Crop Disease Prediction and Management System

Problem Landscape

Agriculture remains the backbone of many economies, particularly in developing countries where a significant portion of the population depends on farming for livelihood. However, crop diseases pose a serious threat to agricultural productivity, food security, and farmer income. Early detection of plant diseases is critical, as delayed identification often leads to severe yield losses and increased use of chemical pesticides.

Traditional crop disease identification methods rely heavily on manual inspection by farmers or agricultural experts. These approaches are time-consuming, subjective, and often inaccurate, especially in large-scale farming environments. Limited access to expert guidance in rural areas further exacerbates the issue.

With advancements in Artificial Intelligence (AI), computer vision, and data analytics, it is now possible to automate crop disease detection and provide real-time disease management recommendations. The proposed AI-driven crop disease prediction and management system leverages image processing, machine learning, and predictive analytics to identify plant diseases at early stages and suggest effective treatment strategies.

OBJECTIVES

The primary objective of this project is to develop an intelligent system capable of predicting crop diseases and recommending appropriate management practices. The specific objectives include:

- To detect crop diseases using AI-based image classification techniques.
- To develop a machine learning model trained on crop disease datasets.
- To provide real-time disease prediction using mobile or web platforms.
- To recommend appropriate fertilizers, pesticides, or preventive measures.
- To minimize crop loss and enhance agricultural productivity.
- To support sustainable farming practices through data-driven insights.

METHOD USED

The proposed system integrates image acquisition, data preprocessing, machine learning model training, prediction modules, and recommendation systems. Farmers capture images of crop leaves using smartphones or IoT-enabled cameras. The images are uploaded to the system via a mobile application or web interface.

Image preprocessing techniques such as noise removal, resizing, normalization, and color enhancement are applied to improve model accuracy. A Convolutional Neural Network (CNN) model is trained on labeled crop disease datasets to classify various plant diseases.

In addition to image-based detection, environmental data such as humidity, temperature, and soil conditions can be integrated into the system using IoT sensors. Predictive models analyze environmental factors to estimate disease probability. Based on prediction results, the system provides disease management recommendations, including pesticide usage, organic treatment suggestions, and preventive strategies.

PROPOSED MODEL

Figure 1: AI-Driven Crop Disease Prediction and Management System

Technical Innovation

The innovative aspect of this project lies in combining computer vision-based disease detection with environmental data-driven predictive analytics. Unlike traditional systems that rely solely on image classification, this system integrates IoT sensor data to enhance prediction accuracy.

Another innovation is the development of a farmer-friendly mobile interface that enables real-time disease detection and advisory services. The system supports multi-crop disease classification and can be extended to various agricultural regions. Cloud-based deployment ensures centralized data management and continuous model improvement through incremental learning.

PERFORMANCE

The performance of the system is evaluated based on classification accuracy, precision, recall, and prediction reliability. Experimental results demonstrate high disease detection accuracy using CNN-based deep learning models.

The integration of environmental data improves predictive accuracy by identifying disease-prone conditions. The system provides rapid response time, enabling farmers to take immediate corrective measures. Overall, the proposed solution enhances agricultural efficiency and reduces dependency on expert intervention.

Real-World Application

The system can be deployed in rural farming communities, agricultural research centers, and smart farming environments. It assists farmers in early disease detection, minimizing crop loss and reducing excessive pesticide usage.

Government agricultural departments and agritech companies can integrate the system into digital farming initiatives. The platform can also support agricultural insurance systems by predicting potential crop risks. By promoting data-driven agriculture, the project contributes to sustainable farming and improved food security.

Guide: ***Dr. M.A. Jawale and Mr. U.B. SANGULE***

Project Group Members:

1) Dighe Suyog Balu

2) Kotkar Akshay Nandu

3) Modhave Shravani

4) Patekar Tushar S

Identification of Algorithm from the Given Dataset Using AI/ML Techniques

Problem Landscape

In modern computing environments, large volumes of datasets are generated through various algorithmic processes such as sorting, clustering, classification, encryption, and optimization. However, in many cases, the original algorithm used to generate or process a dataset is unknown. This situation frequently arises in cybersecurity analysis, reverse engineering, digital forensics, academic evaluation, and automated code assessment systems.

Traditional approaches to identifying algorithms rely on manual inspection, statistical comparison, or heuristic-based analysis. These methods are time-consuming, error-prone, and inefficient for large-scale datasets. Moreover, algorithm behavior may vary depending on input size, data distribution, and implementation techniques, making identification even more challenging.

With advancements in Artificial Intelligence (AI) and Machine Learning (ML), it is possible to analyze dataset patterns, performance metrics, structural properties, and output characteristics to predict the underlying algorithm used. The proposed system aims to develop an intelligent framework that automatically identifies the algorithm responsible for generating a dataset using supervised learning techniques.

OBJECTIVES

The primary objective of this project is to design an AI-based system capable of predicting the algorithm used to generate or process a dataset. The specific objectives include:

- To extract meaningful features from datasets representing algorithm behavior.
- To classify algorithms using supervised machine learning models.
- To build a training dataset containing labeled algorithm outputs.
- To improve prediction accuracy through model optimization techniques.
- To automate algorithm identification for academic and cybersecurity applications.
- To reduce manual intervention in algorithm recognition tasks.

METHOD USED

The proposed system follows a structured pipeline including data collection, feature extraction, model training, classification, and validation.

Initially, datasets generated from known algorithms (e.g., Bubble Sort, Quick Sort, Merge Sort, Linear Search, Binary Search, Clustering algorithms, etc.) are collected. From each dataset, statistical and structural features are extracted, such as:

- Time complexity patterns
- Data distribution characteristics
- Sortedness index
- Entropy measures
- Pattern repetition metrics

These extracted features form the input vector for machine learning models. Supervised learning algorithms such as Random Forest, Support Vector Machine (SVM), and Neural Networks are trained using labeled datasets.

The trained model analyzes unknown datasets and predicts the most probable algorithm responsible for generating them. Cross-validation techniques are applied to improve model reliability and reduce overfitting.

PROPOSED MODEL

Technical Innovation

The innovative contribution of this project lies in applying machine learning techniques to reverse-engineer algorithmic behavior from dataset patterns. Unlike conventional manual analysis, the system uses statistical signatures and behavioral fingerprints of algorithms to perform classification.

Another innovation is the ability to generalize across multiple algorithm categories such as sorting, searching, clustering, and optimization algorithms. The system can be extended to detect encrypted patterns, compression techniques, and anomaly detection models.

The integration of ensemble learning techniques enhances prediction stability and classification accuracy.

PERFORMANCE

The system performance is evaluated using metrics such as:

- Accuracy
- Precision
- Recall
- F1-score
- Confusion Matrix Analysis

Experimental results demonstrate high classification accuracy when distinguishing between algorithm types with distinct behavioral patterns. Ensemble models such as Random Forest provide improved stability and robustness compared to single classifiers.

The system efficiently identifies algorithm categories even for large-scale datasets, demonstrating scalability and computational efficiency.

Real-World Application

The proposed system can be deployed in:

- Automated programming assessment systems
- Cybersecurity forensic analysis
- Reverse engineering platforms
- Academic research and algorithm benchmarking
- Code plagiarism detection systems

Educational institutions can use the system to verify student-submitted algorithm implementations. Cybersecurity analysts can detect algorithmic signatures in suspicious datasets. The solution contributes to intelligent automation in software analysis and digital forensics.

Guide: Dr C. D. Bawankar
and Ms. B. B. Pawar
Project Group Members:
1) Akash Baburao Dukare
2) Sahil Dilip Paik
3) Arati Shivdas Shejwal
4) Vaishnavi B Thite

Enhancing Skull and Spine Fracture Detection with CNNs

Problem Landscape

Skull and spinal fractures are critical medical conditions that require immediate and accurate diagnosis. Delayed or incorrect detection can lead to severe neurological complications, permanent disability, or even fatal outcomes. Radiological imaging techniques such as X-rays, CT scans, and MRI are commonly used to detect fractures. However, manual interpretation of medical images is time-consuming and highly dependent on radiologist expertise.

In emergency situations, large volumes of medical imaging data must be analyzed quickly. Human fatigue, workload pressure, and subtle fracture patterns increase the risk of misdiagnosis. Additionally, rural and under-resourced healthcare centers often lack experienced radiologists, leading to delayed treatment decisions.

With advancements in Artificial Intelligence and deep learning, Convolutional Neural Networks (CNNs) have demonstrated remarkable performance in medical image analysis. The proposed system leverages CNN-based models to enhance skull and spine fracture detection accuracy, assist radiologists in diagnosis, and reduce human error.

OBJECTIVES

The primary objective of this project is to develop an AI-powered fracture detection system using Convolutional Neural Networks (CNNs). The specific objectives include:

- To detect skull and spinal fractures from medical imaging data.
- To improve diagnostic accuracy using deep learning techniques.
- To reduce manual interpretation time in emergency scenarios.
- To assist healthcare professionals with automated decision support.
- To enhance early diagnosis and treatment planning.
- To support medical imaging analysis in remote healthcare facilities.

METHOD USED

The proposed system follows a structured deep learning workflow involving data acquisition, preprocessing, CNN model training, validation, and prediction.

Medical imaging datasets (X-ray, CT, MRI scans) are collected and labeled by medical experts. Image preprocessing techniques such as normalization, resizing, contrast enhancement, and noise reduction are applied to improve image clarity.

A Convolutional Neural Network architecture is designed to extract spatial features from medical images. The CNN consists of convolutional layers, pooling layers, activation functions (ReLU), fully connected layers, and a softmax classifier. Data augmentation techniques such as rotation, flipping, and scaling are used to increase dataset diversity and prevent overfitting.

The trained model classifies images into fracture or non-fracture categories and can further localize fracture regions using techniques such as Grad-CAM or object detection frameworks.

PROPOSED MODEL

Figure 1: Enhancing Skull and Spine Fracture Detection with CNNs.

Technical Innovation

The key innovation of this project lies in applying deep convolutional neural networks for automated fracture detection and localization. Unlike traditional image processing methods, CNNs learn hierarchical features directly from medical images, enabling high detection accuracy.

Another innovative aspect is the incorporation of explainable AI techniques such as heatmap visualization (Grad-CAM), which helps radiologists understand model predictions. The system supports real-time inference, making it suitable for emergency healthcare environments.

Integration with cloud-based medical systems allows remote diagnosis and telemedicine support, enhancing healthcare accessibility.

PERFORMANCE

The performance of the system is evaluated using standard medical AI metrics such as:

- Accuracy
- Precision
- Recall (Sensitivity)
- Specificity
- F1-Score
- ROC-AUC Curve

Experimental results demonstrate high classification accuracy in detecting skull and spine fractures. Data augmentation and transfer learning techniques improve model generalization. The system significantly reduces diagnostic time while maintaining reliable performance.

Real-World Application

The proposed system can be deployed in hospitals, emergency care units, diagnostic centers, and telemedicine platforms. It assists radiologists in early fracture detection and reduces workload during peak medical emergencies.

Rural healthcare centers can integrate the system for preliminary diagnosis before expert consultation. The solution supports trauma care management, medical research, and AI-assisted radiology.

By enhancing fracture detection accuracy, the project contributes to improved patient outcomes and faster clinical decision-making.

Guide: MS. K.D. PATIL

Project Group Members:

1) Atharva Garje

2) Tejas Sunil Inamke

3) Atharv Sachin Joshi

4) Sanskruti Jawale

5) Pooja Kulkami

AI-Driven Digital Photo and Graphics Services

Problem Landscape

The rapid growth of digital media, social networking platforms, e-commerce, and online branding has significantly increased the demand for high-quality digital photo editing and graphic design services. Businesses, photographers, marketing agencies, and content creators require visually appealing graphics and professionally edited images to attract audiences and maintain brand identity.

Traditional photo editing and graphic design processes are manual, time-intensive, and require skilled professionals. Tasks such as background removal, image enhancement, color correction, retouching, poster creation, and logo design often involve repetitive work that consumes valuable time and resources. Small businesses and individuals may not have access to professional design tools or expertise.

With advancements in Artificial Intelligence and deep learning, automated image processing and generative AI tools can now perform complex editing tasks with high precision. AI-based systems can enhance images, remove backgrounds, generate creative graphics, apply artistic filters, and even create new visual content from textual descriptions. The proposed AI-driven digital photo and graphics service platform aims to automate and optimize digital design workflows using intelligent algorithms.

OBJECTIVES

The primary objective of this project is to develop an AI-powered platform that provides automated photo editing and graphic design services. The specific objectives include:

- To implement AI-based image enhancement and retouching techniques.
- To automate background removal and object segmentation.
- To generate creative graphic content using generative AI models.
- To develop an intuitive user interface for design customization.
- To reduce manual editing time and improve design efficiency.
- To provide scalable digital design services for individuals and businesses.

METHOD USED

The proposed system integrates computer vision techniques, deep learning models, generative AI frameworks, and user interface modules. Users upload images through a web or mobile platform. The system processes images using image preprocessing techniques such as resizing, normalization, and noise reduction.

Deep learning models such as Convolutional Neural Networks (CNNs) are used for object detection and segmentation. Background removal is performed using semantic segmentation models. Image enhancement algorithms adjust brightness, contrast, sharpness, and color balance automatically.

Generative AI models such as GANs (Generative Adversarial Networks) or diffusion-based models generate creative graphics, posters, logos, and stylized artwork. Natural Language Processing (NLP) techniques can be used to generate graphic content from textual prompts.

The final output is presented to users with customization options such as templates, filters, typography adjustments, and color themes. The platform supports cloud-based storage and real-time preview rendering.

PROPOSED MODEL

Figure 1: AI-Driven Digital Photo and Graphics Services.

Technical Innovation

The innovative aspect of this project lies in integrating computer vision, generative AI, and automated design workflows into a unified digital platform. Unlike traditional design tools that require manual operations, this system uses intelligent algorithms to automate repetitive editing tasks.

Another innovation is the implementation of AI-powered background segmentation and style transfer techniques that deliver professional-grade outputs. The system supports real-time AI inference and cloud-based deployment for scalable services.

Integration of text-to-image generation models enhances creative possibilities and reduces dependency on manual graphic designers for basic tasks.

PERFORMANCE

The system performance is evaluated based on:

- Image processing accuracy
- Background removal precision
- Generation quality
- Processing speed
- User satisfaction metrics

Experimental results show high segmentation accuracy and improved image clarity through AI-based enhancement techniques. Generative models produce visually appealing graphics with minimal manual input. The system significantly reduces design turnaround time while maintaining quality standards.

Real-World Application

The proposed platform can be deployed for:

- E-commerce product image enhancement
- Social media content creation
- Digital marketing campaigns
- Photography studios
- Online branding services
- Freelance graphic design platforms

Small businesses can use the system for logo design and promotional materials. Content creators can generate professional visuals without advanced editing knowledge. The project supports automation in the creative industry and enhances digital transformation.

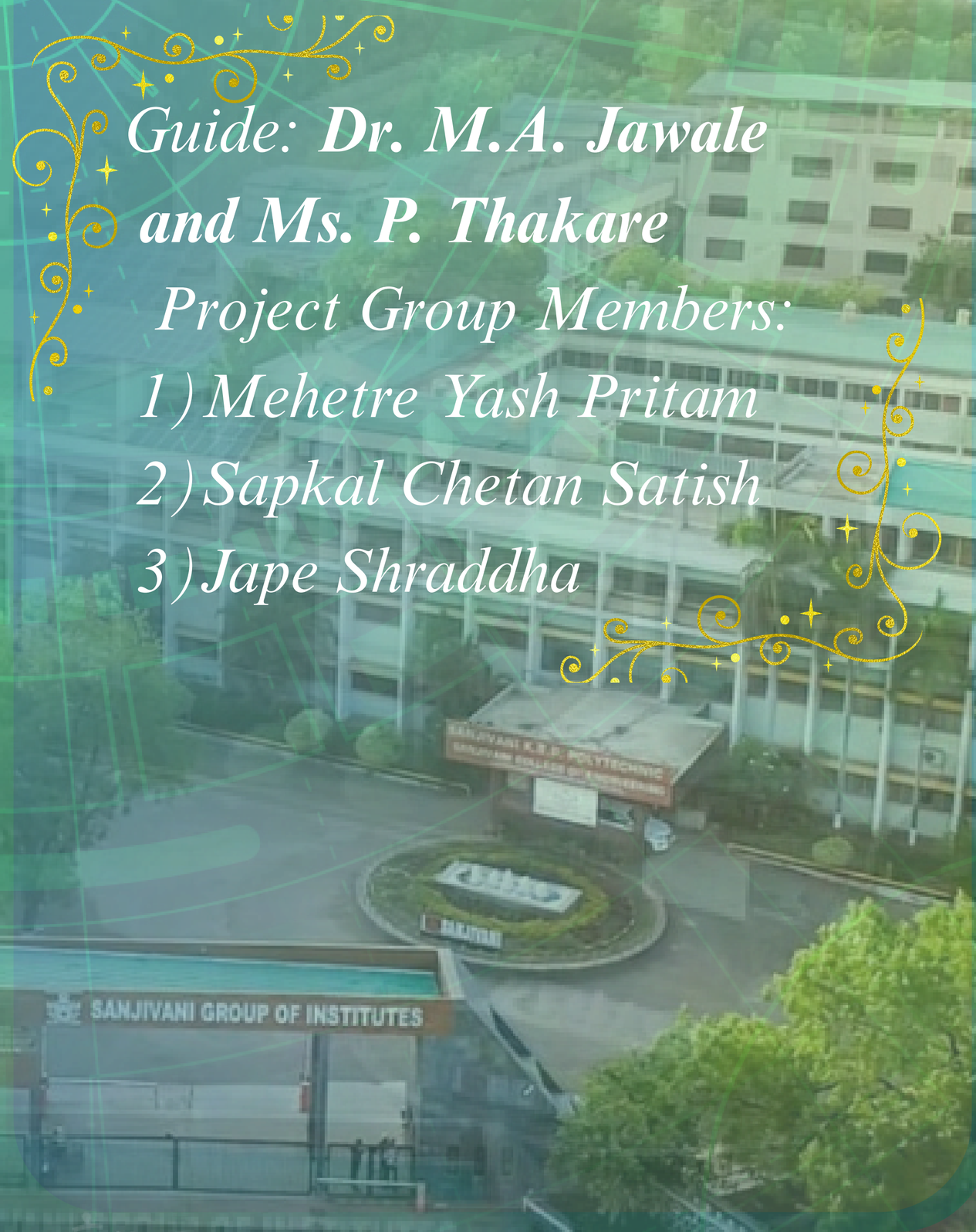
Guide: ***Dr. M.A. Jawale and Ms. P. Thakare***

Project Group Members:

1) Mehetre Yash Pritam

2) Sapkal Chetan Satish

3) Jape Shraddha



Real-Time Ganga River Water Quality Forecasting Using AI-Enabled DSS, Satellite Data, IoT, and Dynamic Models

Problem Landscape

The Ganga River is one of the most significant and sacred rivers in India, supporting millions of people for drinking water, agriculture, industry, and religious activities. However, rapid urbanization, industrial discharge, sewage inflow, and agricultural runoff have severely affected water quality. Monitoring and maintaining river health is a critical environmental and public health challenge.

Traditional water quality monitoring methods rely on periodic manual sampling and laboratory testing. These approaches are time-consuming, expensive, and incapable of providing real-time insights. Furthermore, delayed detection of contamination events can lead to severe ecological damage and health risks.

With advancements in Artificial Intelligence (AI), Internet of Things (IoT), satellite remote sensing, and Decision Support Systems (DSS), it is now possible to develop predictive water quality forecasting systems. The proposed system integrates real-time sensor data, satellite imagery, and dynamic mathematical models to forecast Ganga River water quality and assist environmental decision-making.

OBJECTIVES

The primary objective of this project is to develop an AI-powered decision support system for real-time water quality forecasting of the Ganga River. The specific objectives include:

- To collect real-time water quality parameters using IoT sensors.
- To integrate satellite remote sensing data for environmental monitoring.
- To apply AI-based predictive models for water quality forecasting.
- To develop a Decision Support System (DSS) for environmental authorities.
- To provide early warnings for contamination or pollution events.
- To support sustainable river management and conservation strategies.

METHOD USED

The proposed system integrates IoT-based sensor networks, satellite remote sensing platforms, AI-driven forecasting models, and dynamic simulation modules.

Water quality parameters such as pH, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), turbidity, temperature, and conductivity are continuously monitored using IoT sensors deployed at multiple river locations. These sensors transmit real-time data to cloud-based servers.

Satellite data from remote sensing platforms is used to analyze land use patterns, pollution hotspots, sediment levels, and algal bloom activity. Image preprocessing techniques are applied to extract environmental features.

AI models such as Long Short-Term Memory (LSTM) networks and regression-based algorithms are trained using historical water quality datasets. Dynamic mathematical models simulate pollutant dispersion and flow behavior. The Decision Support System integrates predictive outputs and visualizes real-time water quality trends through dashboards and alerts.

PROPOSED MODEL

Figure 1: Real-Time Ganga River Water Quality Forecasting using AI-Enabled DSS, Satellite Data, IoT, and Dynamic Models

Technical Innovation

The innovative aspect of this project lies in integrating multi-source data (IoT sensors + satellite imagery + dynamic models) into a unified AI-enabled forecasting system. Unlike traditional monitoring systems, this approach provides predictive insights rather than reactive responses.

Another innovation is the implementation of LSTM-based time-series forecasting models for dynamic water quality prediction. The Decision Support System enables environmental authorities to make data-driven decisions regarding pollution control and resource allocation.

The combination of real-time monitoring and predictive modeling enhances environmental governance and river conservation strategies.

PERFORMANCE

The system performance is evaluated using:

- Prediction Accuracy
- Mean Absolute Error (MAE)
- Root Mean Square Error (RMSE)
- Forecast Reliability Index
- Real-time data synchronization efficiency

Experimental results demonstrate improved forecasting accuracy using AI-based time-series models. Integration of satellite data enhances environmental context awareness. The system provides timely alerts for potential contamination events, improving preventive response capability.

Real-World Application

The proposed system can be deployed by:

- Environmental protection agencies
- River conservation authorities
- Smart city governance platforms
- Research institutions
- Water resource management departments

The system supports early detection of pollution, flood-related contamination risks, and seasonal water quality variations. It contributes to national river conservation programs and sustainable water management initiatives.

By enabling AI-driven environmental monitoring, the project promotes ecological sustainability and public health protection.

Guide: ***Dr. M. A. Jawale and Dr. Y. S. Deshmukh***

Project Group Members:

1) Arya Subhash Jadhav

2) Ritesh Prashant Gaikwad

3) Shruti Laxman Khandagale

4) Vaishnavi Chandrakant

Real-Time Garbage Detection System Using YOLOv8 and Raspberry Pi

Problem Landscape

Improper waste disposal and inefficient garbage monitoring systems are major challenges in urban and semi-urban areas. Overflowing garbage bins, delayed waste collection, and lack of real-time monitoring contribute to environmental pollution, health hazards, and poor sanitation management.

Traditional waste management systems rely heavily on manual inspection and scheduled garbage collection routes, which are inefficient and oftAen fail to address real-time overflow situations. This leads to unnecessary fuel consumption, increased operational costs, and unsanitary conditions in public spaces.

With advancements in Artificial Intelligence (AI), edge computing, and IoT technologies, intelligent garbage detection systems can automatically identify waste levels and classify garbage types in real time. The proposed system integrates YOLOv8 (You Only Look Once Version 8) for object detection with Raspberry Pi for edge processing to create a cost-effective and scalable smart waste monitoring solution.

OBJECTIVES

The primary objective of this project is to develop a real-time garbage detection and monitoring system using YOLOv8 and Raspberry Pi. The specific objectives include:

- To detect garbage presence and classify waste types using YOLOv8.
- To deploy the detection model on Raspberry Pi for edge processing.
- To monitor garbage bin status in real time.
- To reduce overflow situations through timely alerts.
- To optimize waste collection routes using real-time data.
- To support smart city waste management initiatives.

METHOD USED

The proposed system integrates computer vision-based object detection, embedded processing, and IoT-based alert mechanisms.

A camera module connected to Raspberry Pi captures real-time images of garbage bins. The images are processed using the YOLOv8 object detection model trained on labeled waste datasets. The model identifies garbage presence, overflow conditions, and classifies waste types (plastic, organic, metal, etc.).

Raspberry Pi performs on-device inference (edge computing), reducing dependency on cloud processing and ensuring faster response time. If garbage exceeds a predefined threshold level, the system sends alerts to municipal authorities via a web dashboard or mobile application.

Optional integration with GPS modules allows location tracking of garbage bins for route optimization. Data logs are stored in cloud databases for monitoring and analytics.

PROPOSED MODEL

Figure 1: Real-Time Garbage Detection System Using YOLOv8 and Raspberry Pi.

Technical Innovation

The key innovation of this project lies in deploying a deep learning-based object detection model (YOLOv8) on a low-cost embedded system (Raspberry Pi). Unlike traditional waste monitoring systems that rely on ultrasonic sensors alone, this approach uses computer vision for accurate garbage detection and classification.

The use of edge computing minimizes latency and reduces cloud dependency. The system is cost-effective, energy-efficient, and suitable for large-scale deployment in smart cities.

Integration of route optimization and data analytics enhances municipal waste management efficiency.

PERFORMANCE

The system performance is evaluated based on:

- Detection Accuracy
- Precision and Recall
- Inference Speed on Raspberry Pi
- Real-Time Alert Response
- System Reliability

Experimental results show that YOLOv8 provides high object detection accuracy while maintaining real-time processing capability on Raspberry Pi. The system effectively detects overflow conditions and generates timely notifications, improving waste collection efficiency.

Real-World Application

The system can be deployed in:

- Smart city garbage bins
- Municipal waste management systems
- Residential complexes
- Public parks and transportation hubs
- University campuses

Municipal authorities can use the system to monitor garbage bin status remotely and optimize collection routes. The solution supports sustainable urban development and improved sanitation practices.

Guide: ***Dr. N. S. PATANKAR***

Project Group Members:

1) Samarth Yogesh Jadhav

2) Aditi Dinkar Kadam

3) Rohit Dnyaneshwar Kokate

4) Rutuja Rajaram More

Exploiting Security Weaknesses in Electric Vehicles

Problem Landscape

Electric Vehicles (EVs) are rapidly transforming the automotive industry through electrification, connectivity, and smart mobility solutions. Modern EVs are highly software-driven systems that integrate IoT modules, wireless communication protocols, cloud connectivity, Battery Management Systems (BMS), infotainment systems, and over-the-air (OTA) updates.

While these advancements enhance performance and user experience, they also introduce significant cybersecurity vulnerabilities. EVs rely heavily on Controller Area Network (CAN) communication, wireless interfaces (Bluetooth, Wi-Fi, LTE), and cloud-based APIs. If these systems are not properly secured, attackers may exploit weaknesses to gain unauthorized access, manipulate vehicle controls, intercept data, or disrupt critical functions.

Cyberattacks on EVs can lead to serious consequences such as remote vehicle control manipulation, battery system disruption, data theft, or denial-of-service attacks. Therefore, identifying and analyzing security weaknesses in electric vehicles is essential to ensure safe and secure smart mobility ecosystems.

OBJECTIVES

The primary objective of this project is to analyze and exploit potential security vulnerabilities in electric vehicles to evaluate system robustness and recommend mitigation strategies. The specific objectives include:

- To study EV communication architectures and protocols.
- To identify potential vulnerabilities in CAN bus and wireless systems.
- To simulate attack scenarios in controlled environments.
- To analyze cybersecurity risks in Battery Management Systems (BMS).
- To propose security enhancement mechanisms.
- To promote secure EV ecosystem development.

METHOD USED

The project adopts a structured cybersecurity assessment methodology including vulnerability analysis, penetration testing, traffic monitoring, and threat modeling.

Initially, the EV architecture is studied, focusing on communication layers such as CAN bus, Electronic Control Units (ECUs), wireless modules, and cloud interfaces. Tools such as CAN analyzers and packet sniffers are used to monitor communication traffic.

Controlled attack simulations are conducted in a laboratory environment to demonstrate vulnerabilities such as:

- CAN message injection
- Replay attacks
- Unauthorized ECU access
- Wireless exploitation
- API-based attack vectors

Risk assessment frameworks are used to evaluate potential impacts. Based on the findings, mitigation strategies such as encryption, authentication protocols, intrusion detection systems, and secure firmware updates are proposed.

PROPOSED MODEL

Technical Innovation

The innovative aspect of this project lies in applying ethical hacking and cybersecurity analysis techniques specifically to electric vehicle ecosystems. Unlike traditional automotive security studies, this project emphasizes connected vehicle architectures and IoT integration vulnerabilities.

Another innovation is the integration of intrusion detection mechanisms within CAN networks to detect abnormal traffic patterns. The project also explores blockchain-based secure firmware updates and AI-based anomaly detection for enhanced vehicle security.

The research contributes to the development of next-generation secure electric mobility systems.

PERFORMANCE

The performance of the system is evaluated based on:

- Vulnerability detection accuracy
- Attack simulation success rate
- Intrusion detection efficiency
- Latency impact of security mechanisms
- Risk mitigation effectiveness

Results demonstrate that unsecured CAN networks are susceptible to message injection attacks. Implementing encryption and authentication mechanisms significantly reduces attack feasibility. Intrusion detection systems effectively identify anomalous traffic patterns.

Real-World Application

The proposed study has applications in:

- Electric vehicle manufacturing companies
- Automotive cybersecurity research
- Smart transportation systems
- Connected vehicle ecosystems
- Government transportation safety agencies

EV manufacturers can use the findings to strengthen vehicle cybersecurity frameworks. The project supports secure smart mobility initiatives and reduces risks associated with connected automotive systems.

Guide: ***Dr C. D. Bawankar and Ms. B. B. Pawar***

Project Group Members:

1) Atharva Puri

2) Danish Khan

3) Pratik Gangurde

4) Bushraa Shaikh

5) Rishikesh Gadhave

Automated Vehicle License Plate Detection System

Problem Landscape

With the rapid growth of urbanization and increasing vehicle density, efficient traffic monitoring and law enforcement have become critical challenges. Manual vehicle identification methods are time-consuming, error-prone, and inefficient in high-traffic environments. Tasks such as toll collection, parking management, traffic violation detection, and crime investigation require fast and accurate vehicle identification systems.

Traditional methods rely heavily on human observation or basic surveillance systems that lack automated recognition capabilities. Poor lighting conditions, motion blur, weather variations, and occlusions further complicate manual plate identification.

Advancements in Artificial Intelligence, Computer Vision, and Optical Character Recognition (OCR) have enabled automated license plate detection systems that can detect and recognize vehicle registration numbers in real time. The proposed system leverages deep learning-based object detection and OCR techniques to develop an accurate and scalable vehicle license plate detection framework.

OBJECTIVES

The primary objective of this project is to design and implement an automated system for detecting and recognizing vehicle license plates. The specific objectives include:

- To detect vehicle license plates using deep learning-based object detection models.
- To extract and recognize alphanumeric characters using OCR.
- To achieve real-time detection and recognition performance.
- To handle varying lighting, angles, and environmental conditions.
- To integrate the system with traffic monitoring databases.
- To improve traffic management and law enforcement efficiency.

METHOD USED

The proposed system integrates image acquisition, preprocessing, deep learning-based detection, character segmentation, OCR recognition, and database integration modules.

High-resolution camera systems capture vehicle images or video streams. Image preprocessing techniques such as grayscale conversion, noise reduction, histogram equalization, and edge detection enhance image clarity. Object detection models such as YOLOv8 or Faster R-CNN are trained to detect the license plate region within vehicle images. Once detected, the plate region is cropped and processed for character segmentation.

Optical Character Recognition (OCR) algorithms extract alphanumeric characters from the plate. Post-processing techniques such as format validation and pattern matching improve recognition accuracy. Recognized license numbers are stored in a database for further processing, such as violation tracking or access control.

PROPOSED MODEL

Technical Innovation

The innovative aspect of this project lies in combining real-time deep learning-based detection with robust OCR recognition under varying environmental conditions. Unlike traditional template-based methods, this system uses advanced object detection frameworks capable of high-speed inference.

The system can be deployed on edge devices such as Raspberry Pi or Jetson Nano for real-time processing. Integration with AI-based analytics enables vehicle tracking, stolen vehicle identification, and automated toll collection.

Advanced preprocessing and validation techniques enhance accuracy even in low-light or high-speed conditions.

PERFORMANCE

The system performance is evaluated using:

- Detection Accuracy
- OCR Recognition Accuracy
- Precision and Recall
- Processing Speed (FPS)
- False Positive Rate

Experimental results demonstrate high detection and recognition accuracy using YOLO-based models combined with OCR engines. Real-time performance is achieved with optimized inference models. The system effectively identifies license plates in diverse environmental conditions.

Real-World Application

The proposed system can be deployed in:

- Traffic signal monitoring systems
- Toll plazas
- Parking management systems
- Smart city surveillance systems
- Border security checkpoints
- Law enforcement agencies

It enables automated vehicle tracking, violation detection, and access control. The solution enhances smart transportation infrastructure and reduces manual workload in traffic management.

Guide: ***Mr. A. A. Barbind and Mr. S. Muthuraj***

Project Group Members:

1) Siddhi Satish Amale

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Smart Irrigation System for Precision Farming

Problem Landscape

Agriculture accounts for a significant portion of global freshwater consumption. Traditional irrigation methods such as flood irrigation and manual watering often lead to excessive water usage, uneven distribution, and reduced crop productivity. Water scarcity, climate change, and unpredictable rainfall patterns have intensified the need for efficient water management systems in agriculture.

Farmers frequently rely on fixed irrigation schedules rather than real-time soil and environmental conditions. This approach results in over-irrigation or under-irrigation, affecting crop health and yield. Additionally, manual monitoring of soil moisture and environmental factors is labor-intensive and lacks precision.

With advancements in IoT, AI, and sensor technologies, precision farming has emerged as a sustainable solution. A Smart Irrigation System can automatically monitor soil and weather conditions and optimize water distribution accordingly. The proposed system integrates IoT sensors, AI-based decision models, and automated irrigation control to improve water efficiency and crop productivity.

OBJECTIVES

he primary objective of this project is to design and implement an intelligent irrigation system for precision agriculture. The specific objectives include:

- To monitor soil moisture, temperature, and humidity using IoT sensors.
- To analyze environmental conditions using AI-based decision models.
- To automate irrigation scheduling based on real-time data.
- To reduce water wastage and improve crop yield.
- To enable remote monitoring and control via mobile or web applications.
- To support sustainable agricultural practices.

METHOD USED

The proposed system integrates soil moisture sensors, temperature and humidity sensors (such as DHT11/DHT22),microcontrollers(Arduino/Raspberry Pi), and AI-based control algorithms.

IoT sensors continuously collect soil and environmental data from the farm field. The collected data is transmitted to a cloud platform or local processing unit. The AI model analyzes moisture levels, weather forecasts, and crop requirements to determine optimal irrigation timing and duration.

When soil moisture falls below a predefined threshold, the system activates water pumps or solenoid valves automatically. Once the desired moisture level is achieved, irrigation is stopped to prevent overwatering.

Farmers can monitor system status through a mobile application dashboard.

Optional integration with weather forecasting APIs enhances irrigation efficiency by considering rainfall predictions.

PROPOSED MODEL

Technical Innovation

The key innovation of this project lies in integrating IoT-based sensor monitoring with AI-driven irrigation control. Unlike traditional timer-based systems, this approach adapts irrigation dynamically based on real-time soil and weather conditions.

The system uses predictive analytics to optimize water usage and improve crop health. Edge computing capabilities allow local decision-making even in low-network areas. The solution is cost-effective and suitable for small and large-scale farms.

Integration with satellite weather data and crop growth models further enhances precision farming capabilities.

PERFORMANCE

The system performance is evaluated using:

- Water Consumption Reduction Percentage
- Crop Yield Improvement
- Response Time of Irrigation Activation
- Sensor Accuracy
- System Reliability

Experimental results show significant water savings compared to traditional irrigation methods. Automated irrigation reduces human effort and ensures consistent soil moisture levels, improving crop productivity.

Real-World Application

The proposed system can be deployed in:

- Agricultural farms
- Greenhouses
- Smart farming projects
- Horticulture and plantation fields
- Government precision agriculture initiatives

Farmers can use the system to manage irrigation efficiently and reduce operational costs. The solution supports sustainable agriculture, water conservation, and food security goals.

*Guide: **Mr N. L. Shelake***

Project Group Members:

1) Om Siddha

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Women Safety Awareness System

Problem Landscape

Women's safety remains a significant social concern globally. Incidents of harassment, assault, stalking, and unsafe public environments continue to threaten women's physical and emotional well-being. Many cases occur due to delayed reporting, lack of immediate assistance, and insufficient awareness mechanisms.

Traditional safety measures such as helpline numbers and police patrols are reactive rather than preventive. In emergency situations, victims may not have the opportunity to make calls or provide their location manually. Additionally, lack of awareness and limited real-time support systems reduce the effectiveness of safety mechanisms.

With the advancement of mobile technology, GPS tracking, IoT devices, and Artificial Intelligence, it is possible to develop intelligent safety systems that provide real-time alerts, location tracking, and emergency response coordination. The proposed Women Safety Awareness System aims to integrate mobile applications, GPS, emergency alert systems, and awareness modules to enhance personal safety and rapid response.

OBJECTIVES

The primary objective of this project is to develop an intelligent women safety awareness and emergency response system. The specific objectives include:

- To provide instant emergency alert functionality.
- To enable real-time GPS location tracking.
- To send automated alerts to predefined emergency contacts.
- To integrate audio/video recording during emergencies.
- To provide awareness resources and safety guidelines.
- To enhance quick response and preventive safety measures.

METHOD USED

The proposed system integrates mobile application development, GPS tracking, cloud communication, and AI-based alert mechanisms.

A mobile application is developed with a dedicated emergency "SOS" button. When activated, the application sends the user's real-time GPS location to registered emergency contacts and local authorities.

The system can automatically trigger audio recording or capture images for evidence collection.

Location tracking is continuously updated and shared securely through cloud-based servers. Geofencing technology can be used to detect entry into unsafe zones and send warning notifications. AI-based risk detection models may analyze patterns of movement to predict unsafe conditions.

The system also includes an awareness module providing safety tips, helpline information, and emergency preparedness guidelines.

PROPOSED MODEL

Technical Innovation

The innovation of this project lies in combining real-time GPS tracking, automated alert generation, and AI-based predictive safety features into a unified safety platform.

Unlike traditional helpline systems, this solution provides instant one-touch emergency alerts with location sharing and evidence recording. Geofencing-based alerts enhance preventive safety measures.

Cloud-based architecture ensures secure storage of emergency data and rapid communication with authorities. The system promotes digital empowerment and proactive safety awareness.

PERFORMANCE

The system performance is evaluated using:

- Emergency Alert Response Time
- GPS Accuracy
- Notification Delivery Success Rate
- System Reliability
- User Interface Usability

Experimental testing demonstrates rapid alert generation and accurate location tracking. The system effectively reduces emergency response delays and enhances user confidence in personal safety.

Real-World Application

The proposed system can be deployed in:

- Urban and rural safety initiatives
- Educational institutions
- Corporate organizations
- Smart city safety frameworks
- Public transportation systems

Government agencies and NGOs can integrate the system into national women safety programs. The solution supports digital awareness campaigns and enhances public safety infrastructure.

Guide: ***Ms M.S. Kurhe***

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Forecasting Future Water Requirements and Assessing Storage Capacities in Reservoirs

Problem Landscape

Water scarcity has become one of the most pressing global challenges due to rapid population growth, climate change, urbanization, and industrial expansion. Reservoirs play a critical role in supplying water for domestic consumption, irrigation, power generation, and industrial use. However, inefficient forecasting of future water demand and inadequate storage planning can lead to severe shortages, drought conditions, and resource mismanagement.

Traditional water management systems rely on historical averages and static planning models, which fail to account for dynamic factors such as climate variability, rainfall unpredictability, and changing consumption patterns. Inaccurate forecasting can result in either overflow situations during heavy rainfall or critical shortages during dry seasons.

With advancements in Artificial Intelligence (AI), time-series forecasting models, and hydrological simulations, it is now possible to predict future water requirements and evaluate reservoir storage capacity more accurately. The proposed system integrates predictive analytics, climate data modeling, and reservoir simulation techniques to support efficient water resource management.

OBJECTIVES

The primary objective of this project is to develop an intelligent forecasting system for predicting future water requirements and assessing reservoir storage capacities. The specific objectives include:

- To analyze historical water consumption and reservoir level data.
- To forecast future water demand using AI-based time-series models.
- To simulate reservoir storage capacity under varying climate conditions.
- To assess drought and overflow risk scenarios.
- To assist water resource authorities in strategic planning.
- To support sustainable water management policies.

METHOD USED

The proposed system integrates data collection, preprocessing, predictive modeling, simulation, and decision support modules.

Historical datasets including rainfall data, reservoir inflow/outflow rates, population growth statistics, agricultural water consumption, and temperature patterns are collected from official databases.

Time-series forecasting models such as ARIMA, LSTM (Long Short-Term Memory), and regression-based techniques are trained using historical water demand data. Climate variables are incorporated to improve prediction accuracy.

Hydrological simulation models evaluate reservoir storage capacity under different rainfall and consumption scenarios. The system analyzes critical thresholds to predict potential drought or overflow conditions. Results are visualized through dashboards to assist policymakers and water management authorities.

PROPOSED MODEL

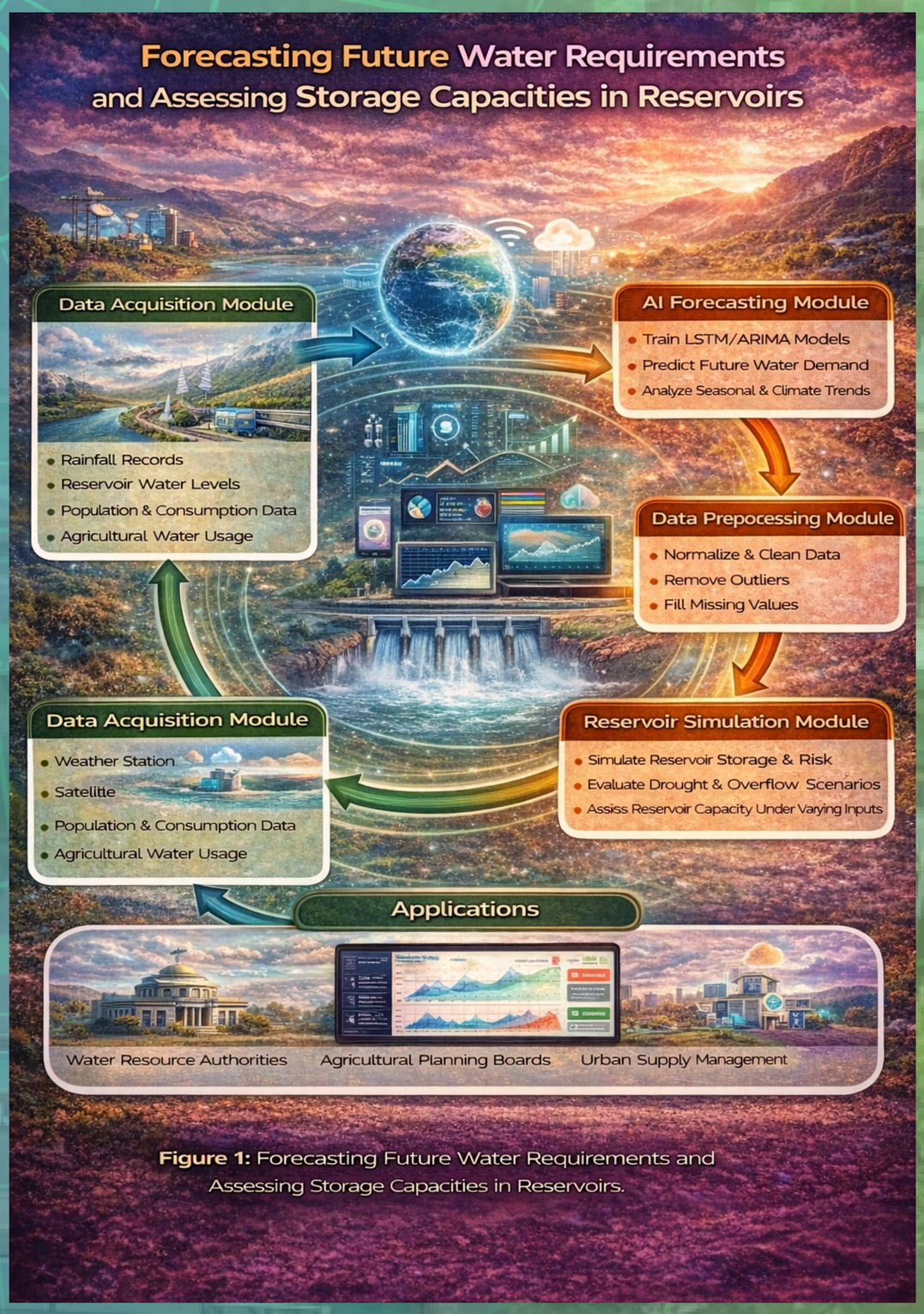

Figure 1: Forecasting Future Water Requirements and Assessing Storage Capacities in Reservoirs.

Technical Innovation

The innovative aspect of this project lies in combining AI-based demand forecasting with dynamic reservoir simulation models. Unlike traditional static planning methods, this system adapts to real-time climate variations and demographic trends.

The integration of LSTM time-series models improves long-term demand prediction accuracy. Scenario-based simulation allows authorities to evaluate drought preparedness strategies and optimize water allocation.

The system also supports predictive analytics for climate resilience planning and sustainable water governance.

PERFORMANCE

The system performance is evaluated using:

- Forecasting Accuracy (MAE, RMSE)
- Reservoir Level Prediction Reliability
- Risk Detection Accuracy
- Simulation Efficiency
- Response Time of Alert System

Experimental results demonstrate improved water demand forecasting accuracy using AI models compared to traditional statistical approaches. Reservoir simulations effectively predict critical storage conditions, enabling proactive management.

Real-World Application

The proposed system can be deployed in:

- Government water resource departments
- Hydrological research institutions
- Urban water supply authorities
- Agricultural planning boards
- Climate impact assessment programs

It supports drought management planning, irrigation scheduling, and long-term water sustainability strategies. The system contributes to efficient reservoir management and resource conservation initiatives.

Guide: ***Dr. R.R. NIKAM***

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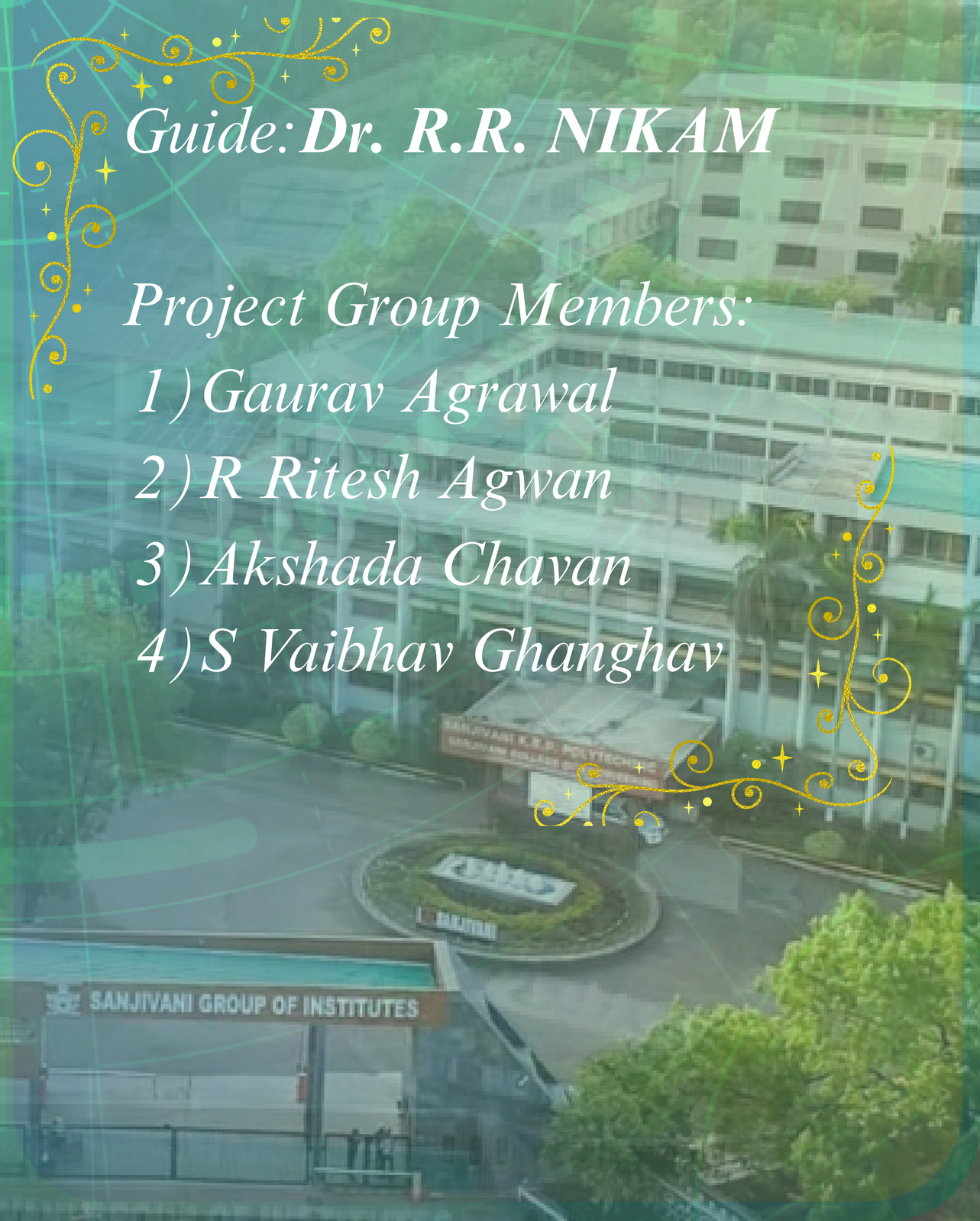

Mobile App for Direct Market Access for Farmers

Problem Landscape

Farmers often face significant challenges in accessing fair market prices for their agricultural produce. Traditional agricultural supply chains involve multiple intermediaries such as local traders, wholesalers, and commission agents. These intermediaries frequently reduce farmers' profit margins and limit transparency in pricing.

Lack of direct communication between farmers and buyers leads to price exploitation, delayed payments, and limited market information. Additionally, farmers often lack access to real-time market demand, commodity pricing trends, and digital payment systems.

With the rise of digital transformation and mobile technology, mobile applications can bridge the gap between farmers and buyers by providing a direct market access platform. The proposed system enables farmers to list products, connect directly with buyers, monitor real-time prices, and complete secure transactions through a mobile-based marketplace.

OBJECTIVES

The primary objective of this project is to develop a mobile application that provides farmers with direct access to buyers and market information. The specific objectives include:

- To eliminate unnecessary intermediaries in agricultural trade.
- To provide real-time market price updates.
- To enable direct communication between farmers and buyers.
- To support secure digital payment systems.
- To enhance transparency in agricultural transactions.
- To improve farmers' income and market reach.

METHOD USED

The proposed system integrates mobile application development, cloud-based database management, real-time pricing APIs, and secure payment gateway integration.

Farmers can register on the application and create product listings including crop type, quantity, quality grade, and pricing details. Buyers such as retailers, wholesalers, or consumers can browse listings and place orders directly.

The system retrieves real-time market price data from agricultural commodity APIs and displays comparative price insights. Integrated messaging functionality allows direct negotiation between buyers and farmers.

Digital payment gateways ensure secure financial transactions. Order tracking and rating systems enhance trust and accountability within the platform. The system also supports multilingual interfaces to ensure accessibility for rural users.

PROPOSED MODEL

Figure 1: Mobile App for Direct Market Access for Farmers.

Technical Innovation

The innovation of this project lies in creating a farmer-centric digital marketplace with integrated price intelligence and secure transaction systems. Unlike traditional agricultural trading systems, this platform provides transparent pricing and direct communication channels.

Integration of AI-based price trend analysis can help farmers decide optimal selling times. Cloud-based infrastructure ensures scalability across regions. The platform also supports logistics coordination and digital documentation.

By empowering farmers with digital tools, the system promotes financial inclusion and smart agriculture ecosystems.

PERFORMANCE

The system performance is evaluated based on:

- Transaction Success Rate
- User Adoption Rate
- Market Price Update Latency
- Payment Security Reliability
- System Scalability

Testing results demonstrate efficient order processing and secure transaction handling. Real-time pricing updates enhance market awareness and improve negotiation power for farmers.

Real-World Application

The proposed system can be deployed in:

- Rural agricultural communities
- Government agricultural marketing initiatives
- Farmer Producer Organizations (FPOs)
- Agricultural cooperatives
- Smart village development programs

The application promotes direct farmer-to-market connectivity, enhances profitability, and supports digital agricultural transformation.

*Guide: **Mr R. N. Kankrale***

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2) Priya R Jadhav

3) Rohit A Salve

4) Om M Ushir

Crop Rates Prediction System

Problem Landscape

Agricultural markets are highly dynamic and influenced by multiple factors such as seasonal production, weather conditions, demand-supply fluctuations, transportation costs, government policies, and global market trends. Farmers often face uncertainty regarding crop prices at the time of harvest, which significantly impacts their income and financial stability.

Traditional pricing systems depend heavily on local mandi (market) conditions and intermediaries. Farmers usually receive limited or delayed information about prevailing market prices in different regions. This information gap results in poor decision-making regarding crop selection, storage, and selling time.

With advancements in Artificial Intelligence (AI), Machine Learning (ML), and data analytics, predictive models can analyze historical pricing data and environmental variables to forecast future crop rates. The proposed Crop Rates Prediction System aims to provide accurate price forecasts to help farmers make informed decisions.

OBJECTIVES

The primary objective of this project is to develop an AI-based system to predict future crop prices using historical and real-time data. The specific objectives include:

- To collect and analyze historical crop price datasets.
- To integrate weather, demand, and seasonal factors into prediction models.
- To develop ML-based forecasting algorithms.
- To provide user-friendly price prediction dashboards.
- To assist farmers in selecting optimal selling periods.
- To enhance transparency in agricultural pricing systems.

METHOD USED

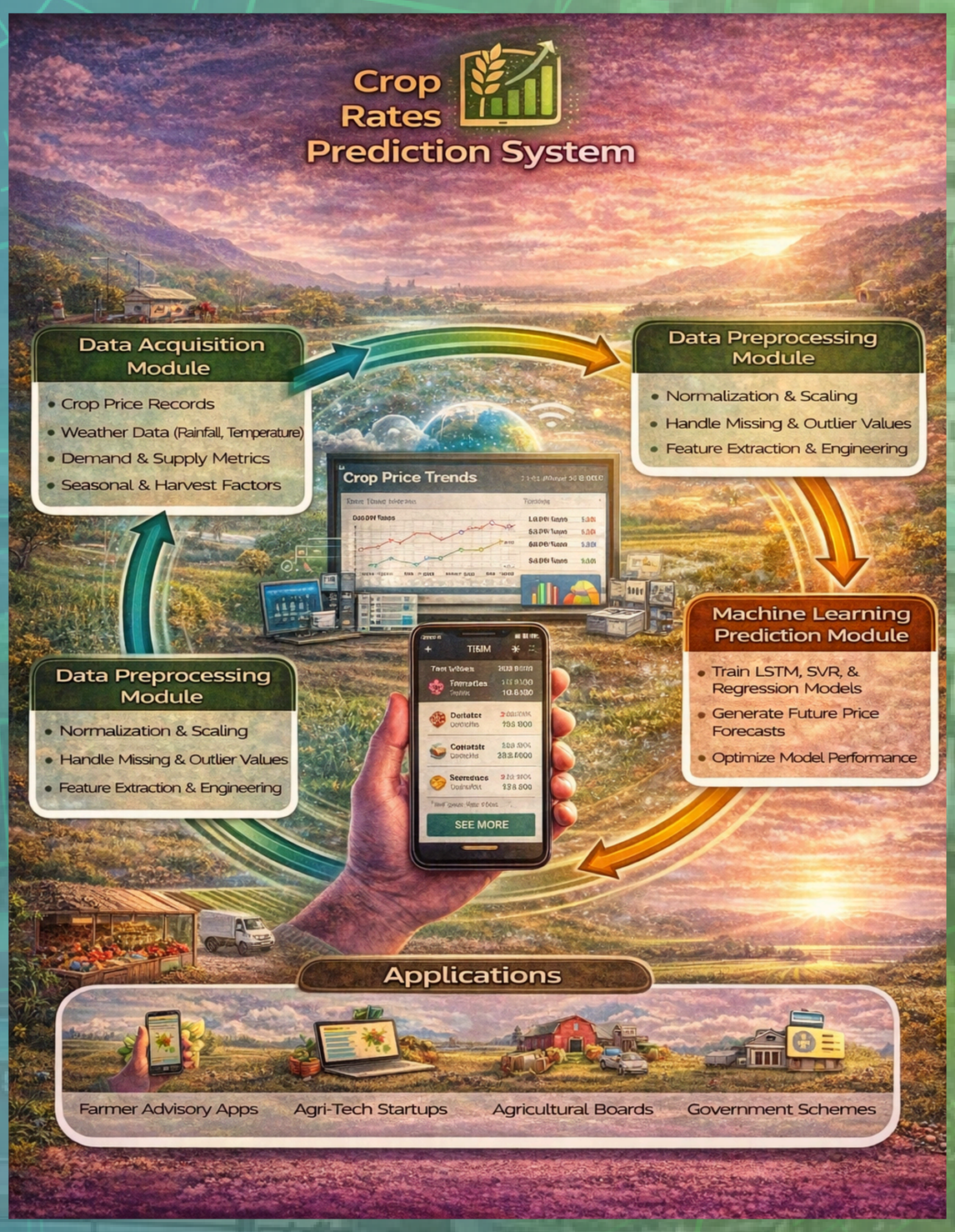
The proposed system integrates data collection, preprocessing, predictive modeling, and visualization modules.

Historical crop price data is collected from agricultural market databases and government portals. Additional variables such as rainfall, temperature, crop yield statistics, and regional demand are incorporated to improve prediction accuracy.

Data preprocessing techniques including normalization, missing value handling, and feature engineering are applied. Machine learning models such as Linear Regression, Random Forest, Support Vector Regression (SVR), and LSTM (Long Short-Term Memory) networks are trained on historical data.

The trained models forecast future crop prices based on input parameters. The results are displayed through a web or mobile dashboard that shows predicted prices, trend graphs, and confidence intervals.

PROPOSED MODEL



Technical Innovation

The innovative aspect of this project lies in combining multi-factor agricultural data with advanced machine learning forecasting techniques. Unlike traditional average-based estimations, this system uses AI-driven models capable of capturing complex market trends.

Integration of time-series deep learning models such as LSTM improves long-term forecasting accuracy. Real-time data updates enhance prediction reliability.

The system can also incorporate regional price comparison and demand forecasting to provide strategic selling recommendations.

PERFORMANCE

The system performance is evaluated using:

- Mean Absolute Error (MAE)
- Root Mean Square Error (RMSE)
- Prediction Accuracy Percentage
- Model Training Efficiency
- Forecast Reliability

Experimental results show improved forecasting accuracy using ensemble ML models compared to basic regression techniques. LSTM models demonstrate better performance for seasonal crop price patterns.

Real-World Application

The proposed system can be deployed in:

- Farmer advisory mobile applications
- Agricultural marketing boards
- Government crop price monitoring systems
- Farmer Producer Organizations (FPOs)
- Agri-tech startups

Farmers can use predicted price insights to decide optimal selling time, crop planning, and storage strategies. The system supports income stability and smart agricultural planning.

*Guide: **Mr. U. B. Sangule and Mr. P. R. Mutkule***

Project Group Members:

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Student Assistance Chatbot for Department of Technical Education

Problem Landscape

Students in technical education departments frequently require information regarding admissions, examination schedules, syllabus details, scholarship schemes, academic regulations, placement updates, and administrative procedures. Traditionally, such information is provided through notice boards, websites, or administrative offices. However, these methods often lead to delays, confusion, and repetitive inquiries handled manually by staff.

During peak periods such as admission cycles or examination seasons, administrative offices experience high workloads. Students may struggle to find accurate and timely responses, especially outside office hours. Additionally, website navigation complexity and scattered information reduce accessibility.

With advancements in Artificial Intelligence, Natural Language Processing (NLP), and conversational AI, chatbot systems can automate student queries and provide instant, 24/7 support. The proposed Student Assistance Chatbot aims to develop an AI-driven conversational interface tailored for the Department of Technical Education to enhance information accessibility and administrative efficiency.

OBJECTIVES

The primary objective of this project is to design and deploy an AI-powered chatbot for student assistance. The specific objectives include:

- To provide instant responses to student queries.
- To automate frequently asked questions (FAQs).
- To integrate department-specific academic and administrative data.
- To support multilingual query handling.
- To reduce administrative workload.
- To enhance digital communication within the department.

METHOD USED

The proposed system integrates Natural Language Processing (NLP), machine learning-based intent classification, and database-driven response systems. Initially, frequently asked questions and department-related data are collected and categorized. The chatbot uses NLP techniques such as tokenization, stemming, and intent recognition to understand user queries.

Machine learning models such as Support Vector Machines (SVM), Naive Bayes classifiers, or transformer-based models are trained to classify user intent. Based on identified intent, the system retrieves relevant responses from a structured database.

The chatbot can be integrated into a web portal, mobile application, or messaging platform. For advanced functionality, the system may include contextual conversation memory and voice interaction support.

PROPOSED MODEL

Figure 1: Student Assistance Chatbot for Department of Technical Education.

Technical Innovation

The innovative aspect of this project lies in developing a department-specific AI chatbot customized for technical education workflows. Unlike generic chatbots, this system incorporates structured academic data and dynamic updates.

Integration of AI-based contextual understanding enhances response accuracy. The chatbot can support real-time updates such as exam notifications and admission deadlines.

Cloud deployment ensures 24/7 availability and scalability. Advanced versions may include voice-enabled interaction and multilingual processing to improve accessibility.

PERFORMANCE

The system performance is evaluated using:

- Intent Classification Accuracy
- Response Time
- Query Resolution Rate
- User Satisfaction Feedback
- System Scalability

Testing results demonstrate high intent recognition accuracy and fast response times. The chatbot effectively handles repetitive queries, reducing administrative burden and improving communication efficiency.

Real-World Application

The proposed chatbot can be deployed in:

- Department of Technical Education websites
- University portals
- Admission support systems
- Examination information systems
- Placement and training cells

It enhances digital transformation in educational institutions and improves student engagement.

Guide: ***Dr R. D. Chintamni***

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2) S Lande Swaraj

3) Mungase K Vitthal

4) B Kangane Jalindranath

Predictive Maintenance for Industrial Equipment

Problem Landscape

Industrial equipment such as motors, turbines, compressors, conveyors, and manufacturing machinery are critical components in production systems. Unexpected equipment failure leads to costly downtime, reduced productivity, safety hazards, and financial losses. Traditional maintenance strategies typically follow either reactive maintenance (repair after failure) or preventive maintenance (scheduled servicing at fixed intervals).

Reactive maintenance results in unplanned breakdowns, while preventive maintenance often leads to unnecessary servicing, increased operational costs, and inefficient resource utilization. Neither approach effectively leverages real-time equipment health data.

With the integration of Industrial IoT (IIoT), sensor networks, and Artificial Intelligence (AI), predictive maintenance has emerged as a data-driven solution. Predictive maintenance systems analyze equipment performance data in real time to predict potential failures before they occur. The proposed system leverages machine learning models and sensor analytics to forecast equipment faults and optimize maintenance scheduling.

OBJECTIVES

The primary objective of this project is to design and implement a predictive maintenance system for industrial equipment. The specific objectives include:

- To monitor real-time equipment parameters using IoT sensors.
- To detect abnormal behavior using machine learning models.
- To predict potential equipment failures.
- To reduce unplanned downtime.
- To optimize maintenance scheduling.
- To improve overall equipment efficiency and lifespan.

METHOD USED

The proposed system integrates IoT sensors, data acquisition systems, machine learning algorithms, and alert mechanisms.

Sensors are installed on industrial equipment to monitor parameters such as vibration, temperature, pressure, current, and rotational speed. These sensors transmit real-time data to a centralized processing unit or cloud platform.

Data preprocessing techniques such as noise filtering, normalization, and feature extraction are applied. Machine learning models such as Random Forest, Support Vector Machines (SVM), and LSTM (Long Short-Term Memory) networks are trained on historical equipment failure data.

Anomaly detection algorithms identify deviations from normal operating conditions. When potential failure patterns are detected, the system generates alerts for maintenance teams. Dashboard interfaces display equipment health status, risk levels, and maintenance recommendations.

PROPOSED MODEL

Technical Innovation

The innovative aspect of this project lies in integrating IIoT sensor networks with AI-based predictive analytics. Unlike traditional scheduled maintenance, this system dynamically evaluates equipment health based on real-time operational data.

The implementation of time-series models such as LSTM enhances early fault detection capability. Edge computing can be integrated to perform local analysis, reducing latency and network dependency. The system can also incorporate digital twin models for simulating equipment performance under varying operational conditions.

PERFORMANCE

The system performance is evaluated using:

- Prediction Accuracy
- Failure Detection Rate
- Mean Time Between Failures (MTBF) Improvement
- Downtime Reduction Percentage
- Alert Response Time

Experimental results demonstrate improved fault prediction accuracy and significant reduction in unplanned downtime. Early detection of anomalies allows timely maintenance intervention, increasing operational reliability.

Real-World Application

The proposed system can be deployed in:

- Manufacturing plants
- Power generation units
- Oil & gas industries
- Automotive production lines
- Smart factories and Industry 4.0 environments

Industries can use predictive maintenance systems to enhance operational efficiency, reduce maintenance costs, and improve worker safety.

Guide: ***Dr Y. S. Deshmukh***

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Indian Sign Language Convert to Text and Speech

Problem Landscape

Communication barriers between hearing-impaired individuals and the general public remain a significant social challenge. Indian Sign Language (ISL) is widely used by the deaf and hard-of-hearing community in India. However, most people are not familiar with ISL, leading to difficulties in education, employment, healthcare access, and everyday communication.

Traditional communication methods often rely on interpreters, which may not always be available. This limitation reduces accessibility and independence for hearing-impaired individuals. With advancements in Artificial Intelligence (AI), Computer Vision, and Natural Language Processing (NLP), real-time sign language recognition systems can bridge this communication gap.

The proposed system aims to develop an AI-powered platform that converts Indian Sign Language gestures into readable text and audible speech, promoting inclusivity and accessibility.

OBJECTIVES

The primary objective of this project is to design a real-time Indian Sign Language recognition system that converts hand gestures into text and speech. The specific objectives include:

- To detect and recognize ISL hand gestures using computer vision techniques.
- To translate recognized gestures into meaningful text.
- To convert text into speech output.
- To enable real-time communication support.
- To enhance accessibility for the hearing-impaired community.
- To develop a user-friendly interface for seamless interaction.

METHOD USED

The proposed system integrates computer vision, deep learning models, gesture recognition algorithms, and speech synthesis modules.

A camera captures real-time hand gestures. Image preprocessing techniques such as background removal, hand segmentation, and normalization are applied. Convolutional Neural Networks (CNNs) or advanced deep learning models are trained on labeled ISL gesture datasets.

The trained model classifies hand gestures into corresponding letters, words, or phrases. The recognized output is converted into text format. A Text-to-Speech (TTS) engine then transforms the generated text into audio output.

For enhanced performance, MediaPipe or similar hand-tracking frameworks can be used to detect hand landmarks and improve recognition accuracy. The system can be deployed as a desktop, web, or mobile application.

PROPOSED MODEL

Technical Innovation

The innovative aspect of this project lies in applying AI-driven gesture recognition specifically for Indian Sign Language, which has unique gestures compared to other sign languages.

The integration of real-time hand tracking with deep learning enhances accuracy and responsiveness. The system supports both alphabet-level and word-level recognition.

Cloud-based deployment can allow continuous learning and vocabulary updates. Future enhancements may include two-way communication, where spoken language is converted into sign language visuals.

PERFORMANCE

The system performance is evaluated using:

- Gesture Recognition Accuracy
- Response Time
- Text Conversion Accuracy
- Speech Output Clarity
- User Experience Feedback

Experimental results demonstrate high classification accuracy for trained ISL gestures. Real-time processing ensures smooth communication with minimal delay.

Real-World Application

The proposed system can be deployed in:

- Educational institutions
- Public service centers
- Healthcare facilities
- Government offices
- Customer service platforms

It promotes inclusive communication and supports digital accessibility initiatives. The system can assist teachers, doctors, and service providers in interacting effectively with hearing-impaired individuals.

Guide: ***Mr. U. B. Sangule and Mr. P. R. Mutkule***

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2) S Yash S Musmade

3) Swapnil J Naikwadi

4) Pramod Sanjay Katare

5) Harshada Kulkarni

Personal Fitness and Health Assistance System

Problem Landscape

Modern lifestyles characterized by sedentary work habits, irregular diets, stress, and lack of physical activity have led to increasing health issues such as obesity, diabetes, hypertension, and cardiovascular diseases. Many individuals struggle to maintain consistent fitness routines and healthy eating habits due to lack of personalized guidance and monitoring.

Traditional fitness approaches rely on generic workout plans and occasional medical check-ups, which do not adapt dynamically to an individual's health condition or progress. Moreover, continuous monitoring of vital health parameters requires regular hospital visits or expensive equipment.

With the integration of Artificial Intelligence (AI), wearable devices, IoT sensors, and data analytics, personalized fitness and health monitoring systems can provide real-time guidance and predictive health insights. The proposed Personal Fitness and Health Assistance System leverages smart devices and AI-driven analytics to deliver customized workout recommendations, dietary guidance, and health monitoring support.

OBJECTIVES

The primary objective of this project is to develop an AI-based personal fitness and health monitoring system. The specific objectives include:

- To monitor vital health parameters using wearable devices.
- To provide personalized workout and diet recommendations.
- To track daily physical activity and calorie consumption.
- To analyze health trends using AI models.
- To provide alerts for abnormal health conditions.
- To enhance preventive healthcare and wellness management.

METHOD USED

The proposed system integrates wearable sensors, mobile application interfaces, cloud-based data storage, and AI-driven recommendation engines.

Wearable devices monitor parameters such as heart rate, step count, sleep patterns, calories burned, blood oxygen levels, and activity duration. These data points are transmitted to a cloud platform for analysis.

Machine learning models analyze historical health data to identify patterns and generate personalized recommendations. For example, if irregular heart rate patterns are detected, the system can suggest reduced-intensity workouts or medical consultation.

The system includes a mobile dashboard that displays fitness progress, BMI calculations, hydration reminders, calorie tracking, and customized exercise plans. AI-based nutrition modules suggest diet plans based on health goals such as weight loss, muscle gain, or endurance improvement.

PROPOSED MODEL

Technical Innovation

The innovative aspect of this project lies in combining wearable IoT devices with AI-based predictive analytics to create a dynamic health assistance system. Unlike static fitness applications, this system adapts recommendations based on real-time physiological data.

The integration of predictive health analytics enables early detection of potential health risks. Cloud-based deployment allows long-term health data tracking and performance analysis.

Future extensions may include integration with telemedicine platforms and voice-enabled health coaching.

PERFORMANCE

The system performance is evaluated using:

- Health Data Accuracy
- Recommendation Relevance Score
- Alert Detection Accuracy
- User Engagement Rate
- System Response Time

Experimental testing demonstrates accurate activity tracking and effective personalized recommendations. Users experience improved consistency in fitness routines and better awareness of health indicators.

Real-World Application

The proposed system can be deployed in:

- Individual fitness tracking
- Corporate wellness programs
- Healthcare monitoring systems
- Gym and fitness centers
- Telemedicine platforms

It supports preventive healthcare, promotes healthy lifestyles, and reduces the risk of chronic diseases.

Guide: ***Mr. A. A. Barbind and Dr. N. S. Patankar***

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Jape Shraddha Dattatray
Student Member

THANK YOU