

IOT-ENABLED SMART AGRICULTURE WITH CLOUD DATA STORAGE AND AI-BASED PREDICTION

Er.AGOWTHAM, Department of Computer Science and Engineering, Institute of Sri Ramanujar Engineering College, Chennai, India.

Abstract—Agriculture is a cornerstone of the global economy and food security, yet traditional farming methods face significant challenges such as inefficient resource usage, unpredictable climatic conditions, and vulnerability to pests and diseases. This project presents an IoT-enabled smart agriculture system designed to overcome these limitations by leveraging modern technologies. Our system utilizes a network of sensors to monitor critical environmental parameters such as soil moisture, temperature, humidity, and sunlight intensity in real time. Data collected is transmitted seamlessly to a cloud platform where it is stored securely and made accessible remotely. Advanced AI and machine learning algorithms process this data to predict irrigation needs, detect early signs of crop stress or disease, and optimize farming operations for higher productivity and sustainability. By automating irrigation control through relay modules and providing farmers with an interactive web dashboard, our system supports data-driven decision-making that conserves water, reduces labour, and increases crop yields. This project demonstrates how the integration of IoT, cloud computing, and AI can revolutionize agriculture, promote sustainable farming practices, and contribute to meeting global food demands efficiently.

Keywords—IoT, Smart Agriculture, Cloud Storage, AI Prediction, Sensor Monitoring, Crop Yield Forecasting

I. INTRODUCTION

The mainstay of the project is to develop an IoT-based smart agriculture system using ESP32 that automates irrigation based on real-time environmental data and detects plant diseases through AI-based image analysis.

SYNOPSIS

Agriculture remains the backbone of many developing economies, directly supporting livelihoods and food security. However, farmers continue to face major challenges such as unpredictable weather, improper irrigation practices, and the widespread occurrence of plant diseases. These factors significantly reduce productivity, increase water wastage, and affect crop quality. With climate change intensifying, the need for efficient and sustainable farming solutions has become more pressing than ever. Technology-driven agriculture, often referred to as “smart farming,” offers a

pathway to address these challenges by combining IoT, cloud computing, and artificial intelligence. Through connected sensors and intelligent data analysis, farmers can monitor their fields in real time, optimize water usage, and detect diseases early, thus preventing large-scale losses. Beyond increasing efficiency, such systems empower small and medium farmers by providing data-driven insights that were once limited to large-scale farms. By integrating affordable hardware with accessible cloud services, smart farming systems can enhance productivity while conserving natural resources. Ultimately, this approach promotes sustainable agriculture, supports economic stability for farmers, and contributes to global food security — aligning with the broader goal of using technology for social good and environmental resilience.

A.OBJECTIVES

The main objectives of the IoT-Enabled Smart Agriculture with Cloud Storage and AI-Based Prediction project are: Monitor soil and environmental conditions Measure soil moisture, temperature, and humidity in real time. Automate irrigation Turn ON/OFF the water pump automatically based on soil moisture levels. Cloud data storage & remote monitoring Upload sensor readings to the cloud (ThingSpeak / Firebase / Blynk) for live tracking.

AI-based prediction Use machine learning to predict irrigation needs and improve crop yield. Efficient resource usage Minimize water wastage and human labor by automating farming decisions. Smart decision support system for farmers Provide insights for better crop planning and field management.

B.INTRODUCTION OF DOMAIN

1. INTERNET OF THINGS (IoT)

The Internet of Things (IoT) plays a crucial role in modern agriculture by enabling real-time monitoring and automation. In this project, IoT devices such as soil moisture sensors and temperature-humidity sensors are connected to a microcontroller. These devices collect live data from the farm and transmit it over the internet. The system continuously monitors soil moisture and environmental

conditions and automatically controls the irrigation pump based on the sensor values.

IoT helps reduce manual effort, saves time, and ensures accurate control of farming processes. Farmers can view data remotely using cloud dashboards, making farm management easier, faster, and more efficient. This technology supports precision farming and improves crop productivity.

Sensors & Devices: IoT uses interconnected sensors (for soil moisture, pH, light, etc.) and devices (drones, robots) placed across the farm to gather vast amounts of data in real-time.

Data Collection: These sensors continuously monitor key environmental and crop health parameters.

Automation: IoT also enables remote control and automation of farm operations like irrigation and fertilization based on sensor data.

2. CLOUD COMPUTING

Cloud computing is used to store and access farming data online. In this project, sensor values are uploaded to cloud platforms like ThingSpeak or Blynk through Wi-Fi. The cloud system displays real-time graphs and dashboards, enabling farmers to monitor field conditions from anywhere at any time. Cloud storage provides historical data, which helps analyze trends such as soil moisture changes and climate variations. It eliminates the need for manual data recording and enables automation and remote control. With the cloud, farmers can receive alerts, track irrigation status, and make informed decisions using digital tools.

Data Storage: Acts as a central, scalable repository for the massive datasets generated by IoT devices, storing everything from soil conditions to crop images.

Processing Power: Provides the infrastructure to process and analyze this complex, large-scale data, which is too much for individual devices or local computers.

Accessibility: Allows farmers to access and manage their farm data and systems from anywhere with an internet connection through web-based interfaces.

3. ARTIFICIAL INTELLIGENCE (AI)

Artificial Intelligence (AI) enhances farming by analyzing sensor data and predicting irrigation needs. In this project, AI models are trained with soil moisture and climate data to estimate future water requirements. Based on past patterns and current conditions, the AI system helps determine the best time to water crops and avoid over-watering or under-watering.

AI supports smart decision-making, increases crop yield, and promotes efficient resource utilization. It transforms

traditional agriculture into data-driven smart farming, improving sustainability and productivity.

Data Analysis: AI algorithms, including machine learning and deep learning, analyze the historical and real-time data stored in the cloud to find patterns and predict outcomes.

Predictive Insights: AI can predict crop yields, identify potential pest outbreaks, and forecast optimal planting times.

Decision Support: Transforms raw data into actionable insights and recommendations, helping farmers make informed, site-specific decisions for resource management (water, fertilizer) and pest control.

4. MACHINE LEARNING

Machine Learning is a field of Computer Science, where new developments evolve at recent times, and also helps in automating the evaluation and processing done by the mankind, thus reducing the burden on the manual human power. According to tech target, Machine learning is a type of artificial intelligence (AI) that provides computers with the ability to learn without being explicitly programmed.

Machine learning is an important component of the growing field of data science. Through the use of statistical methods, algorithms are trained to make classifications or predictions, uncovering key insights within data mining projects.

Machine learning is a growing technology which enables computers to learn automatically from past data. Machine learning uses various algorithms for building mathematical models and making predictions using historical data or information. Machine learning programs can perform tasks without being explicitly programmed to do so. It involves computers learning from data provided so that they carry out certain tasks.

Machine learning and data mining often employ the same methods and overlap significantly, but while machine learning focuses on prediction, based on known properties learned from the training data, data mining focuses on the discovery of unknown properties in the data. Machine learning focuses on the development of computer programs that can change when exposed to new data. Finding out the suitable crops based on the soil's appearance becomes tedious for novice farmers. There also exists a need to prevent the agricultural decay.

Effective utilization of agricultural land is crucial for ensuring food security of a country. In this document, we propose a crop recommendation system using spectral spatial classification and Ada-boost meta-algorithm.

II. EASE OF USE

The proposed smart agriculture system is designed with a strong emphasis on ease of use to ensure accessibility for

farmers with varying levels of technical expertise. A user-friendly interface is provided through a web or mobile application that displays real-time sensor data, historical trends, and AI-based predictions in a simple and intuitive manner. Automated data collection and cloud-based processing eliminate the need for manual data handling, thereby reducing user effort and operational complexity. Alert notifications and recommendation messages further assist users in taking timely actions without requiring continuous system supervision. By minimizing technical intervention and simplifying system interaction, the proposed approach enhances usability and promotes the practical adoption of smart agriculture technologies.

ABBREVIATIONS AND ACRONYMS

In this paper, several abbreviations and acronyms are used for clarity and consistency. The term Internet of Things (IoT) refers to the network of interconnected sensors and devices used for real-time data collection in agricultural fields. Artificial Intelligence (AI) and Machine Learning (ML) denote computational techniques employed for predictive analysis and decision support. Wireless Sensor Network (WSN) represents the distributed sensor nodes deployed for environmental monitoring. Cloud computing indicates the use of remote servers for data storage and processing. Graphical User Interface (GUI) is used to describe the user-friendly application interface provided to farmers. Communication technologies such as Global System for Mobile communication (GSM) and Long Range communication (LoRa) are utilized for data transmission, while microcontroller units such as ESP modules manage sensor integration and communication.

III. PROBLEM DEFINITION

Agricultural productivity is significantly influenced by environmental conditions such as soil moisture, temperature, humidity, and weather variability. In conventional farming practices, these parameters are often monitored manually or estimated based on experience, leading to inaccurate decision making and inefficient use of resources. Fixed irrigation schedules and delayed responses to changing field conditions result in excessive water consumption, crop stress, and reduced yield quality.

Existing technology-based solutions mainly focus on basic monitoring or rule-based automation without intelligent analysis of data. Many systems lack real-time integration, scalable data storage, and predictive capabilities that can adapt to dynamic agricultural environments. Furthermore, the absence of user-friendly interfaces and actionable

recommendations limits the practical adoption of advanced agricultural technologies by farmers.

Therefore, there is a critical need for an intelligent, scalable, and easy-to-use smart agriculture system that can continuously monitor field conditions, securely store large volumes of data, and apply AI-based predictive models to support timely and accurate decision making. Addressing these challenges is essential to improve resource efficiency, enhance crop productivity, and promote sustainable farming practices.

IV. LITERATURE SURVEY

4.1 Precision Agriculture using Internet of thing with Artificial intelligence: A Systematic Literature Review

Authors: Noureen Fatima, Kainat Fareed Memon, Zahid Hussain Khand, Javed Ahmed, Zahid Hussain Shaikh, Sana Gul, Manisha Kumari ,and Ghulam Mujtaba Sukkur IBA University, Sindh, Pakistan

Machine learning with its high precision algorithms, Precision agriculture (PA) is a new emerging concept nowadays. Many researchers have worked on the quality and quantity of PA by using sensors, networking, machine learning (ML) techniques, and big data. However, there has been no attempt to work on trends of artificial intelligence (AI) techniques, datasets, and crop type on precision agriculture using the internet of things (IoT). This research aims to systematically analyze the domains of AI techniques and datasets that have been used in IoT-based prediction in the area of PA. A systematic literature review is performed on AI-based techniques and datasets for crop management, weather, irrigation, plant, soil, and pest prediction. We took the papers on precision agriculture published in the last six years (2013-2019). We considered 42 primary studies related to the research objectives. After critical analysis of the studies, we found that crop management; soil, and temperature areas of PA have been commonly used with the help of IoT devices and AI techniques. Moreover, different artificial intelligence techniques like ANN, CNN, SVM, Decision Tree, RF, etc. have been utilized in different fields of Precision agriculture. Image processing with supervised and unsupervised learning practice for prediction and monitoring the PA are also used. In addition, most of the studies are forfeiting sensory datasets to measure different properties of soil, weather, irrigation, and crop. To this end, in end, we provide future directions for researchers and guidelines for practitioners based on the findings of this review.

4.2 Vertical Farming Perspectives in Support of Precision Agriculture Using Artificial Intelligence.

Authors: RikiRuli A. Siregar 1 , KudangBoro Seminar 2,*, Sri Wahjuni 1 and Edi Santosa 3

Vertical farming is a new agricultural system which aims to utilize the limited access to land, especially in big cities. Vertical agriculture is the answer to meet the challenges posed by land and water shortages, including urban agriculture with limited access to land and water. This research study uses the Preferred Reporting for Systematic Review and Meta-analysis (PRISMA) item as one of the literary approaches. PRISMA is one way to check the validity of articles for a literature review or a systematic review resulting from this paper. One of the aims of this study is to review a survey of scientific literature related to vertical farming published in the last six years. Artificial intelligence with machine learning, deep learning, and the Internet of Things (IoT) in supporting precision agriculture has been optimally utilized, especially in its application to vertical farming. The results of this study provide information regarding all of the challenges and technological trends in the area of vertical agriculture, as well as exploring future opportunities.

4.3 Integrated-Smart Agriculture: Contexts and Assumptions for a Broader Concept.

Authors: Vitor João Pereira Domingues Martinho * and Raquel de Pinho Ferreira Guiné

The innovative technologies developed in the different fields of science (nanotechnology, artificial intelligence, genetic modification, etc.) opened new and infinite possibilities for the several stakeholders that carry out their activities in the different economic sectors. For agriculture, these new approaches are particularly relevant and may bring interesting contributions, considering the specificities of the sector, often dealing with contexts of land abandonment and narrow profit margins. Nonetheless, the question in these unstopped evolutions is about the interlinkages with sustainability. In this context, the objectives of this study are to highlight the main insights from the available scientific literature about the interrelationships between the new trends in the agriculture and the sustainability. To achieve these aims, a search on the Web of Science Core Collection (WoS) and Scopus databases was carried out, on 15 May 2021, for the topics 'smart agriculture' and 'sustainability'. A total of 231 documents (102 from WoS and 129 from Scopus) were obtained, remaining 155 documents after removing the duplicated, which were surveyed through systematic review

following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) approach. As main insights, the concerns of the researchers with the impacts on the sustainability from the transformations in the farming organization are highlighted. On the other hand, it was shown the relevance and the new opportunities, including in terms of food supply, arising from the precision agriculture, agricultural intelligence, vertical/urban farming, circular economy, internet of things, and crowdfarming. We suggest the new and wider concept of 'integrated-smart agriculture', better than 'climate-smart agriculture'.

4.4 Artificial Intelligence Techniques for Agriculture Revolution: A Survey

Authors: Anu Jose¹, S Nandagopalan², Chandra Mouli Venkata Srinivas Akana³

According to the data given by UN Food and Agriculture, there will be an increase of 2 billion human populations by 2050 and an increase in land for cultivation will be only 2% during this period. By bringing technological innovation into agriculture this situation can be domineered. AI-powered solutions can set an exemplar model in farming. The yield as well as the quality of the crop can be ameliorated through artificial intelligence (AI). This work presents a detailed review on different methods of artificial intelligence, machine learning and deep learning techniques adopted in agriculture to enable farmers to produce quality yield with limited resources in less time. This article discusses a systematic review on studies and describes its limitations and strengths. This article presents different applications of AI-Powered solutions and the products available in market for providing services to farmers. In addition, we discussed the future of AI-Powered agriculture, and the practical and technical challenges ahead. The survey results divulge that the technological advancement in farming is still in the beginning stage in most of the developing countries. This survey will give a clear idea about the existing AI-Powered agriculture system and will help researchers to develop a new ecosystem.

4.5 Global Navigation Satellite Systems as State-of-the-Art Solutions in Precision Agriculture: A Review of Studies Indexed in the Web of Science

Authors: Dorijan Radočaj * , Ivan Plaščak and Mladen Jurišić

Global Navigation Satellite Systems (GNSS) in precision agriculture (PA) represent a cornerstone for field mapping, machinery guidance, and variable rate technology. However, recent improvements in GNSS components (GPS, GLONASS, Galileo, and BeiDou) and novel remote sensing and computer processing-based solutions in PA have not

been comprehensively analyzed in scientific reviews. Therefore, this study aims to explore novelties in GNSS components with an interest in PA based on the analysis of scientific papers indexed in the Web of Science Core Collection (WoSCC). The novel solutions in PA using GNSS were determined and ranked based on the citation topic micro criteria in the WoSCC. The most represented citation topics micro based on remote sensing were “NDVI”, “LiDAR”, “Harvesting robot”, and “Unmanned aerial vehicles” while the computer processing-based novelties included “Geostatistics”, “Precise point positioning”, “Simultaneous localization and mapping”, “Internet of things”, and “Deep learning”. Precise point positioning, simultaneous localization and mapping, and geostatistics were the topics that most directly relied on GNSS in 93.6%, 60.0%, and 44.7% of the studies indexed in the WoSCC, respectively. Meanwhile, harvesting robot research has grown rapidly in the past few years and includes several state-of-the-art sensors, which can be expected to improve further in the near future.

V. SYSTEM ANALYSIS

A. EXISTING SYSTEM

Traditional irrigation and crop monitoring systems rely heavily on manual observation and human judgment. Farmers often decide watering schedules based on experience rather than accurate soil or environmental data, leading to over-irrigation or water scarcity. Similarly, plant disease identification is usually performed visually, which can be inaccurate and delayed until the infection spreads widely. These conventional methods result in resource wastage, reduced yield, and increased costs. Although some semi-automated systems exist, they lack intelligent decision-making, real-time monitoring, and remote accessibility. The absence of data-driven tools makes it difficult for farmers to achieve sustainable and efficient agricultural practices.

B. PROPOSED SYSTEM

The proposed system introduces an IoT-based smart agriculture solution that integrates automated irrigation control and plant disease detection using an ESP32 microcontroller and cloud-based analytics. The ESP32 acts as the central controller, collecting real-time data from various sensors such as a soil moisture sensor for measuring soil humidity, an LDR for detecting light intensity, a DHT11 for temperature and humidity readings, and a water level sensor to monitor water availability. All sensor data is transmitted to the Firebase cloud, where it is stored and accessed by a Python-based web application.

The web application hosts two machine learning models. The first model performs intelligent irrigation scheduling by analyzing the environmental and soil parameters stored in Firebase to decide whether the pump motor should be activated. This decision is sent back to the ESP32 via Firebase, which triggers a relay to start or stop the pump motor automatically. The second model identifies plant diseases by analyzing uploaded leaf images through the web interface. The results include the disease name and recommended treatments, displayed on a separate webpage.

This system promotes efficient water usage, reduces manual intervention, and empowers farmers with real-time insights, ultimately leading to healthier crops and more sustainable farming practices.

C. METHODOLOGY

The project follows a systematic methodology to design a smart irrigation system. First, sensors such as soil moisture and temperature-humidity sensors are installed in the field to collect environmental data. The microcontroller reads the sensor values and processes them in real time. If soil moisture falls below a predefined threshold, the relay automatically activates the water pump.

The data is simultaneously uploaded to the cloud platform through Wi-Fi for remote monitoring. Farmers can view live sensor readings on their mobile phones or computers. Stored data is used to train an AI model that predicts irrigation needs based on previous records. The system is tested in different soil conditions to ensure accuracy and reliability. This methodology makes irrigation smart, efficient, and automated.

VI. SYSTEM OVERVIEW

The proposed IoT-enabled smart agriculture system provides an integrated platform for real-time field monitoring, cloud-based data management, and AI-driven prediction. The system is designed to collect environmental data from agricultural fields, process and analyze the data using intelligent algorithms, and deliver actionable insights to farmers through an easy-to-use interface. The overall objective is to improve decision making, optimize resource utilization, and enhance crop productivity.

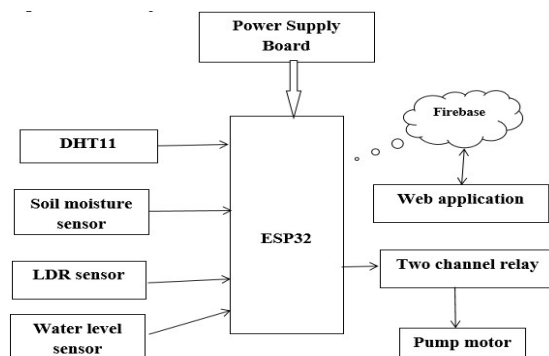
The system begins with the deployment of IoT sensors that continuously monitor critical parameters such as soil moisture, temperature, humidity, and light intensity. These sensors are connected to microcontroller units that perform initial data acquisition and transmit the information to the

cloud using wireless communication technologies. The cloud platform acts as a centralized repository, ensuring secure storage, data preprocessing, and scalability.

An AI-based prediction module operates within the cloud environment to analyze both real-time and historical sensor data. Machine learning models are used to identify patterns and forecast irrigation requirements and crop stress conditions. The results of the analysis are presented to users through a web or mobile application, which provides real-time visualization, predictive insights, and alert notifications. By seamlessly integrating sensing, communication, cloud computing, and artificial intelligence, the system delivers a comprehensive solution for precision and sustainable agriculture.

VII. SYSTEM ARCHITECTURE DIAGRAM

The system architecture of the IoT-enabled smart agriculture project consists of interconnected layers that work together to automate irrigation and monitor farming conditions. The bottom layer includes sensors such as soil moisture and temperature-humidity sensors, which continuously collect real-time field data. This data is sent to the microcontroller (Arduino/NodeMCU), which acts as the processing unit. The microcontroller analyzes the sensor values and automatically controls the water pump using a relay module based on soil moisture levels. The processed data is then transmitted to a cloud platform through Wi-Fi, enabling remote data storage and live monitoring on mobile or web dashboards. The cloud system also provides historical data that is later used by the AI model to predict irrigation requirements. This architecture ensures efficient water management, real-time monitoring, automation, and intelligent decision-making, making farming smarter and more productive.



VIII. SYSTEM IMPLEMENTATION

MODULE DESCRIPTION:

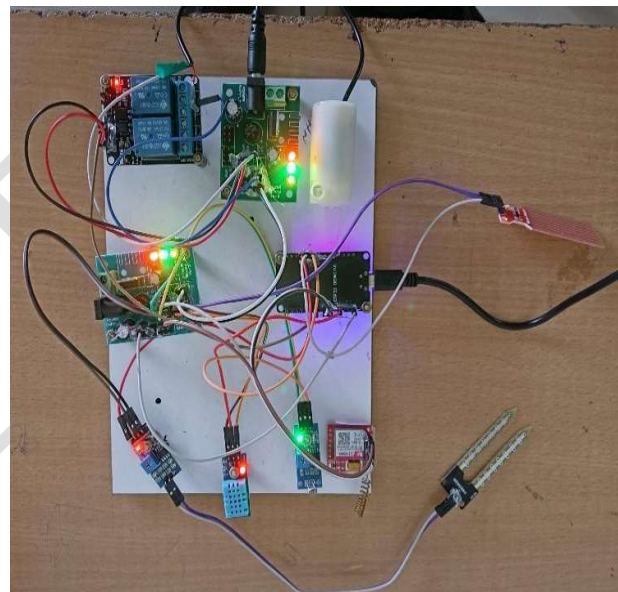
A. MODULE 1: SENSOR DATA COLLECTION

Collects real-time data from environmental sensors (moisture, humidity, temperature, light). Sends data to the microcontroller for processing. This module collects real-time environmental data from various sensors placed in the agricultural field.

Function: Monitors parameters like soil moisture, temperature, humidity, and light intensity.

Working: Sensors send the collected data to the microcontroller (like Arduino, ESP32, or Raspberry Pi) for processing.

Purpose: Provides accurate, real-time input data for decision-making and prediction.



B. MODULE 2: CLOUD DATA STORAGE

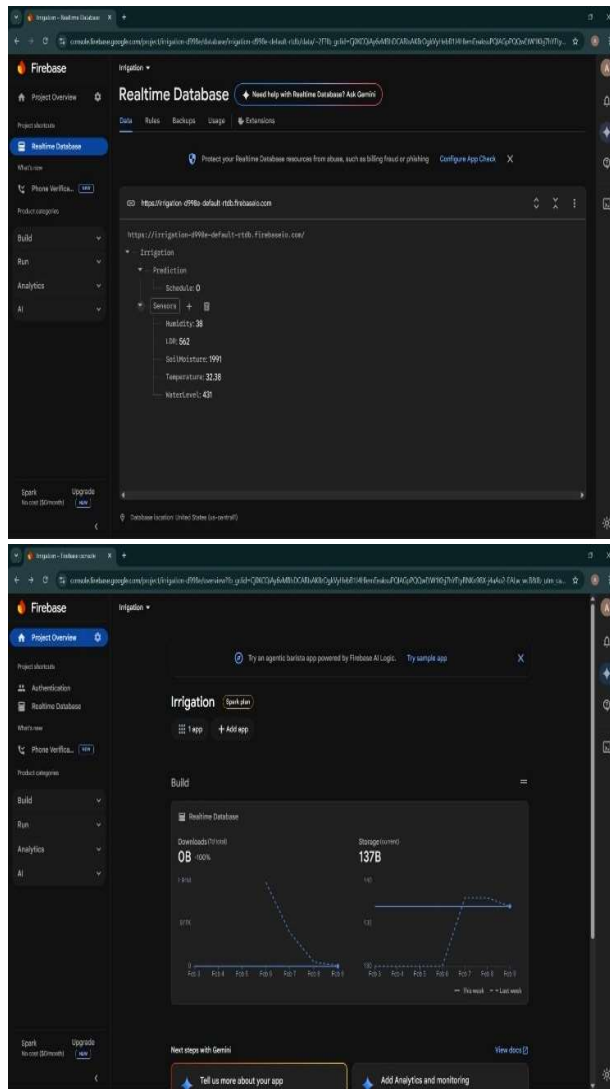
Transmits sensor data to cloud storage (ThingSpeak, Firebase, etc.) for logging and analysis.

Enables remote access to data via web or mobile application. This module handles the uploading and storing of sensor data on an online cloud platform.

Function: Stores all sensor readings for analysis and visualization.

Working: The microcontroller sends data to cloud services such as ThingSpeak, Firebase, or AWS IoT using Wi-Fi or GSM connectivity.

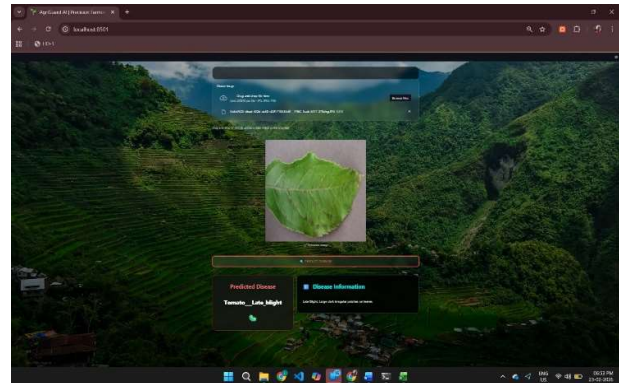
Purpose: Enables farmers or researchers to remotely monitor the field data anytime and anywhere.



C. MODULE 3: DATA ANALYSIS AND AI PREDICTION

AI/ML algorithms analyze stored data to predict.
Optimal irrigation time.
Crop yield estimation.
Early detection of disease conditions.
Model training is done using historical data.
This is the intelligent part of the system where artificial intelligence algorithms analyze the collected data.
Function: Uses machine learning models to predict irrigation schedules, estimate crop yield, and detect unfavorable conditions.
Working: Historical and real-time data are processed by AI algorithms (like Linear Regression, Decision Trees, or Neural Networks) to generate accurate predictions.

Purpose: Helps farmers make data-driven decisions, improving crop growth and reducing wastage.



D. MODULE 4: AUTOMATED IRRIGATION CONTROL

Based on soil moisture threshold and AI predictions, the system automatically activates or stops the water pump using relay control.

This module automatically controls the water supply based on sensor readings and AI predictions.

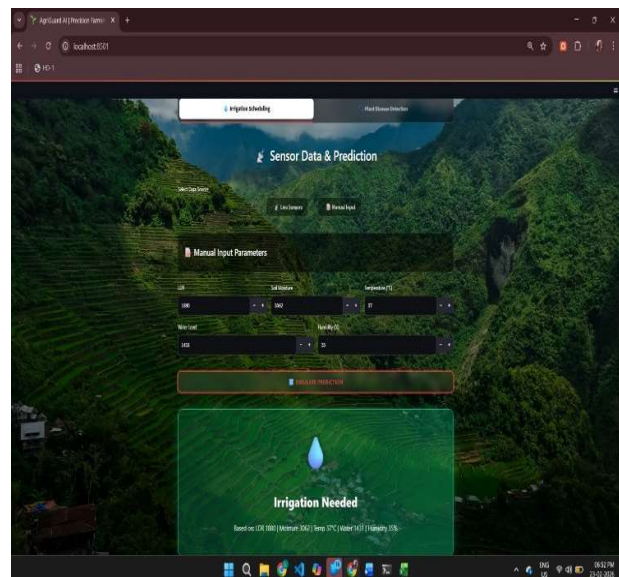
Function: Operates a relay-controlled water pump depending on soil moisture level.

Working:

If soil moisture < threshold → Pump turns ON

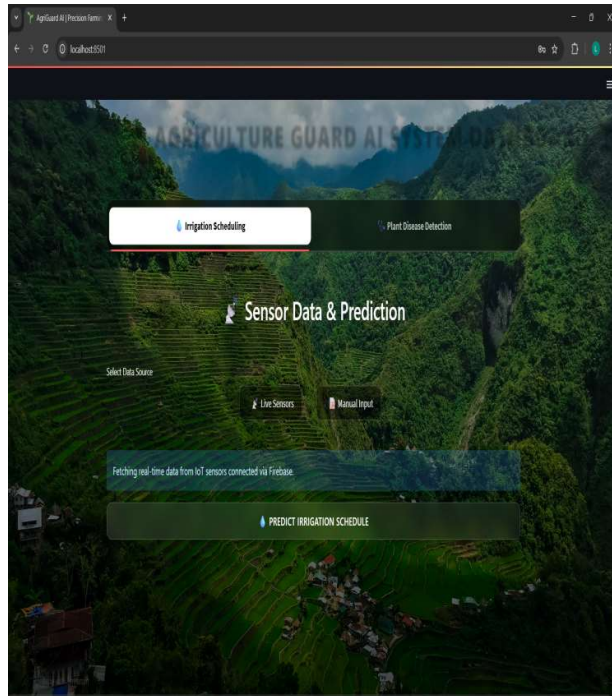
If soil moisture ≥ threshold → Pump turns OFF

Purpose: Saves water and ensures optimal irrigation automatically without manual effort.



E. MODULE 5: WEB/MOBILE DASHBOARD

Provides visualization of data (graphs, charts).
Displays notifications, alerts, and AI-based suggestions.
Allows manual override of irrigation control.
This module provides a user interface to visualize the data and system status.
Function: Displays graphs, sensor readings, alerts, and predictions on a website or mobile app.
Working: Cloud-stored data is fetched and shown to users with easy-to-understand visuals.
Purpose: Allows remote monitoring and manual control of irrigation through a user-friendly dashboard.



F. MODULE 6: ALERT AND NOTIFICATION SYSTEM

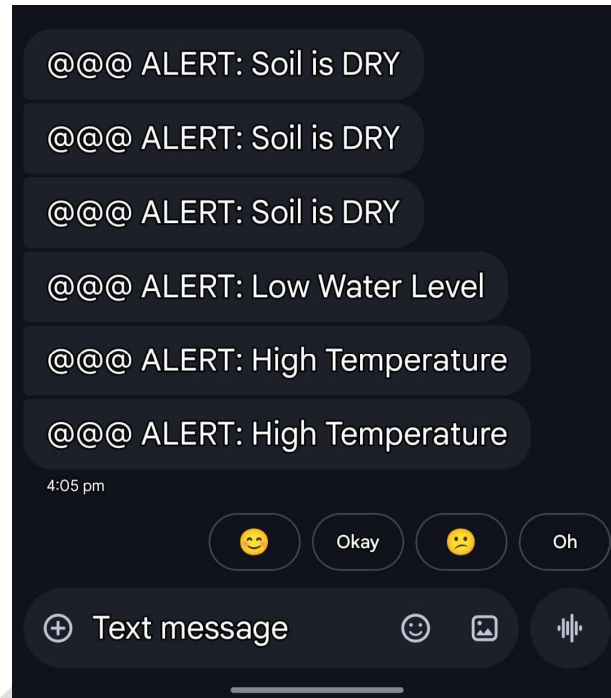
Sends alerts via SMS, email, or mobile app when critical parameters exceed limits (e.g., low soil moisture, high temperature).

This module sends notifications to the farmer about critical conditions or required actions.

Function: Sends alerts via SMS, email, or mobile notification when any parameter goes beyond safe limits (e.g., very low soil moisture, high temperature).

Working: The system continuously checks data values; if abnormal, it triggers an alert message.

Purpose: Ensures quick action to protect crops from environmental stress or failure.



CONCLUSION:

The IoT-enabled Smart Agriculture system successfully demonstrates how modern technologies like Internet of Things (IoT), Cloud Computing, and Artificial Intelligence (AI) can transform traditional farming into a more efficient, data-driven, and sustainable practice. By integrating smart sensors and IoT devices, the system continuously monitors key environmental parameters such as soil moisture, temperature, humidity, and light intensity in real time. This data is automatically uploaded to a cloud storage platform, ensuring secure and centralized data management that can be accessed from anywhere.

The use of AI-based prediction models further enhances the decision-making process. By analyzing the collected data, the system can predict important agricultural factors such as optimal irrigation schedules, crop yield estimation, and disease risks, allowing farmers to take preventive actions before problems occur. This reduces resource wastage and increases productivity.

Overall, the project provides a scalable and intelligent solution for modern agriculture, promoting precision farming and sustainable crop management. It demonstrates how IoT, cloud, and AI can work together to help farmers make smarter decisions, reduce manual effort, and achieve higher efficiency with lower costs. Future enhancements could include integrating drone-based monitoring, mobile

applications, and blockchain for improved traceability and automation in the agricultural supply chain.

ACKNOWLEDGMENT

The authors would like to express their sincere gratitude to the management of **Sri Ramanujar Engineering College** for providing the necessary facilities and support to carry out this work. We extend our heartfelt thanks to the Head of the Department and faculty members of the Department of Computer Science and Engineering for their continuous guidance, valuable suggestions, and encouragement throughout the course of this project. We also acknowledge the support received from peers and friends who contributed through constructive discussions and feedback. Finally, we are thankful to all individuals who directly or indirectly assisted in the successful completion of this work.

REFERENCES

1. Precision Agriculture using Internet of thing with Artificial intelligence: A Systematic Literature Review. Authors: Noureen Fatima, Kainat Fareed Memon, Zahid Hussain Khand, Javed Ahmed, Zahid Hussain Shaikh, Sana Gul, Manisha Kumari ,and Ghulam Mujtaba Sukkur IBA University, Sindh, Pakistan
2. Vertical Farming Perspectives in Support of Precision Agriculture Using Artificial Intelligence. Authors: RikiRuli A. Siregar 1 , KudangBoro Seminar 2,*, Sri Wahjuni 1 and Edi Santosa 3
3. Integrated-Smart Agriculture: Contexts and Assumptions for a Broader Concept. Authors: Vítor João Pereira Domingues Martinho * and Raquel de Pinho Ferreira Guiné
4. Artificial Intelligence Techniques for Agriculture Revolution: A Survey Authors: Anu Jose1, S Nandagopalan2 ,Chandra Mouli Venkata Srinivas Akana3
5. Global Navigation Satellite Systems as State-of-the-Art Solutions in Precision Agriculture: A Review of Studies Indexed in the Web of Science. Authors: DorijanRadočaj * , Ivan Plaščak and MladenJurišić
- 6.A study on various data mining techniques for crop yield prediction, Yogesh Gandge; Sandhya, 2020 International Conference on Electrical, Electronics, Communication, Computer, and Optimization Techniques (ICEECOT)
- 7.Use Of Deep Neural Networks for Crop Yield Prediction: A Case Study of Soybean Yield in Lauderdale County, Alabama, USA, Anıl Suat Terliksiz; D. TurgayAltýlar, 2019 8th International Conference on Agro-Geoinformatics (Agro-Geoinformatics)
- 8.Fuzzy Logic based Crop Yield Prediction using Temperature and Rainfall parameters predicted through ARMA, SARIMA, and ARMAX models, Shivam Bang; Rajat Bishnoi; Ankit Singh Chauhan; Akshay Kumar Dixit;

Indu Chawla, 2019 Twelfth International Conference on Contemporary Computing (IC3)

9.Maize crop yield estimation with remote sensing and empirical models, Yolanda. M. Fernandez-Ordoñez; J. Soria-Ruiz, 2021 IEEE International Geoscience and Remote Sensing Symposium (IGARSS)

10. Prediction of major crop yields of Tamilnadu using K-means and Modified KNN, A Suresh; P. Ganesh Kumar; M. Ramalatha, 2018 3rd International Conference on Communication and Electronics Systems (ICCES)