Engineering

E-ISSN No : 2581-6195 | Volume : 9 | Special Issue | May 2026

INTEGRATED AGRO MONITORING AND PROTECTION SYSTEM FOR FARMERS

Savita Soma[1], Rahul Nidode[2], Vaishnavi Mudbale[2], Akshata Janwadkar[2]

Access Online

Article DOI: 10.5281/zenodo.21371638

[1] Professor, Department of Electronics and Communication Engineering, Guru Nanak Dev Engineering College, Bidar, Karnataka, India

[2] UG Student, Department of Electronics and Communication Engineering, Guru Nanak Dev, Engineering College, Bidar, Karnataka, India

How to Cite: Savita Soma, Rahul Nidode, Vaishnavi Mudbale & Akshata Janwadkar (2026), Integrated Agro Monitoring and Protection System for Farmers, International Educational Journal of Science & Engineering (IEJSE),Vol: 9, Special Issue, May 2026 58-62

ABSTRACT

Agricultural productivity is often affected by animal interference and inefficient water usage. This work introduces a smart farming solution integrating Internet of Things (IoT) devices with data-driven techniques to enhance crop safety and irrigation efficiency. Sensors continuously monitor field conditions such as soil moisture, rainfall, and movement near crops. When unusual activity is detected, alert systems and deterrent mechanisms are activated automatically. Additionally, intelligent data analysis assists in optimizing irrigation schedules based on environmental conditions. The proposed system minimizes manual effort, improves water conservation, and increases overall farming efficiency.

KEYWORDS: Internet of Things (IoT), Machine Learning, Smart Agriculture, Crop Protection, Animal Intrusion Detection, Rainwater Management, Soil Moisture Monitoring

INTRODUCTION

Agriculture plays a crucial role in sustaining the economy and supporting the livelihood of millions of farmers. However, modern farming faces several challenges such as unpredictable weather conditions, improper irrigation, pest attacks, and lack of timely information about crop health. Traditional methods rely on manual monitoring, which is often inefficient, time-consuming, and prone to human error, resulting in reduced productivity.

The Integrated Agro Monitoring and Protection System for Farmers is designed to overcome these challenges by using smart technologies. The system utilizes sensors to monitor important parameters such as soil moisture, temperature, humidity, and rainfall in real time. This data is processed using a microcontroller and can be accessed remotely through IoT-based platforms.

MATERIALS AND METHODS

The Integrated Agro Monitoring and Protection System for Farmers is developed using a combination of hardware components and smart monitoring techniques to ensure efficient crop management.

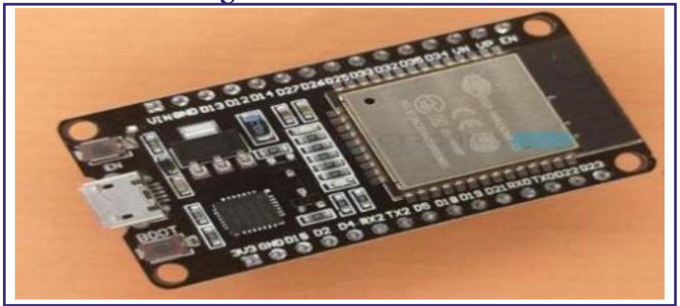
1. Materials Used:

The system includes a microcontroller (such as Arduino Uno), soil moisture sensor, temperature and humidity sensor (DHT11/DHT22), rain sensor, water pump, relay module, and a power supply unit. For communication and remote monitoring, IoT modules like Wi-Fi (ESP8266) are used. A mobile application or cloud platform is also integrated to display real-time data.

Research Paper

a) Microcontroller:

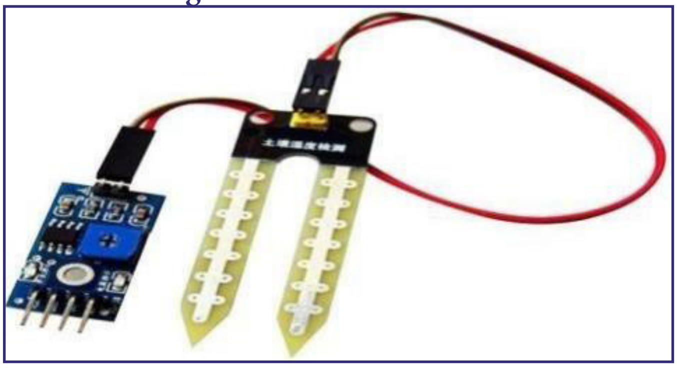
Fig.1: Microcontroller



The microcontroller acts as the central unit of the system, controlling and coordinating all operations. It receives data from sensors such as soil moisture and temperature sensors, processes the information, and makes decisions. Based on the data, it activates devices like water pumps and sends updates to the connected IoT platform.

b) Soil moisture Sensor:

Fig. 2: Soil moisture Sensor



The soil moisture sensor measures the water content present in the soil. It helps determine whether the soil is dry or wet. Based on the readings, the system decides when irrigation is needed. This ensures proper water usage, prevents overwatering, and supports healthy crop growth and efficient farming practices.

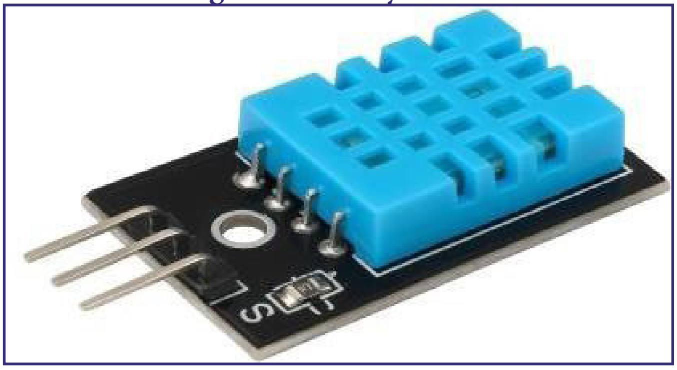
c) Rain sensor:

Fig. 3: Rain Sensor

The rain sensor detects the presence and intensity of rainfall in the field. It helps the system determine whether irrigation is required or should be stopped. By sensing rain conditions, it prevents unnecessary watering, conserves water resources, and protects crops from overwatering, improving overall efficiency of the farming system.

d) Humidity sensor:

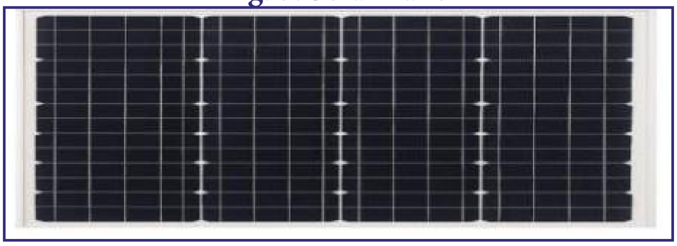
Fig. 4: Humidity Sensor



The humidity sensor measures the amount of moisture present in the air. It helps monitor environmental conditions that affect plant growth. The data is sent to the microcontroller for analysis, enabling better decision-making. Maintaining proper humidity levels supports healthy crops and improves overall agricultural productivity and system efficiency.

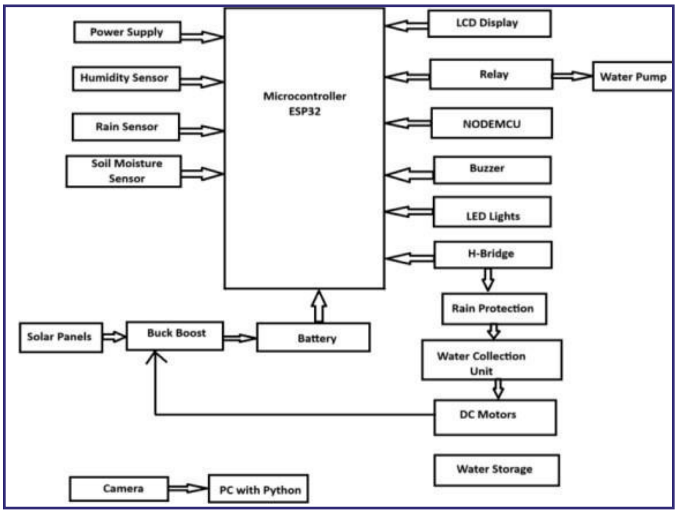
e) Solar panel:

Fig. 5: Solar Panel



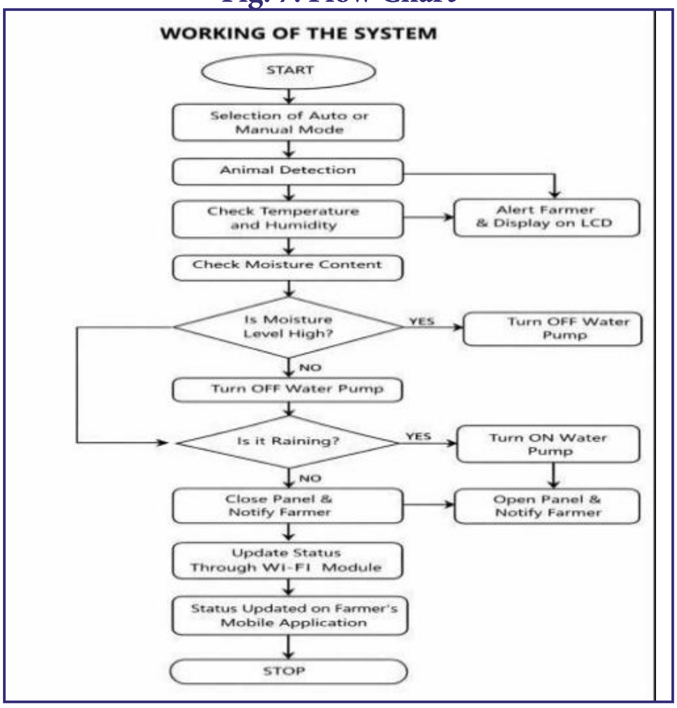
The solar panel is used as a renewable energy source to power the system. It converts sunlight into electrical energy, which is stored or used directly. This reduces dependency on conventional power sources, lowers costs, and ensures continuous operation of the system, especially in remote agricultural areas without electricity.

2. METHODOLOGY:



The diagram represents an Integrated Agro Monitoring and Protection System based on an ESP32 microcontroller. Various sensors like soil moisture, rain, and humidity sensors continuously collect environmental data and send it to the microcontroller for processing. Based on this data, the system controls devices such as water pumps through relays, LED indicators, and buzzers for alerts. Power is supplied using solar panels with a battery backup through a buck-boost converter. Additional modules like NodeMCU enable IoT communication for remote monitoring. The system also includes mechanisms for rain protection, water collection, and storage, ensuring efficient resource management and improved crop protection.

Fig. 7: Flow Chart

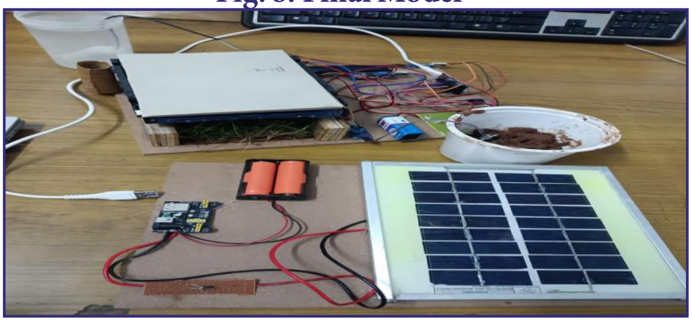


The flowchart describes the working of the Integrated Agro Monitoring and Protection System. The system starts by selecting either auto or manual mode. It detects animal intrusion and monitors temperature and humidity, alerting the farmer if needed. Soil moisture is checked to control irrigation—if moisture is high, the pump is turned off; otherwise, it is turned on. The system also detects rainfall and adjusts operations like opening or closing panels and notifying the farmer. Data is continuously updated through a Wi-Fi module, allowing real-time monitoring via a mobile application. This ensures efficient water usage and crop protection.

RESULTS

The Integrated Agro Monitoring and Protection System was successfully designed and implemented to monitor environmental conditions and automate farming operations. The system effectively collected real-time data such as soil moisture, temperature, humidity, and rainfall using various sensors. Based on these inputs, the microcontroller efficiently controlled the water pump, ensuring proper irrigation and preventing overwatering.

Fig. 8: Final Model



During testing, the system demonstrated reliable performance by responding accurately to changing field conditions. The automatic mode reduced manual intervention, while the alert system notified farmers about critical situations like high temperature or rain. Integration with IoT allowed real-time data updates and remote monitoring through a mobile application, improving accessibility and decision-making.

Overall, the system improved water management, reduced labor effort, and enhanced crop protection. It proved to be a cost-effective and efficient solution for modern agriculture, contributing to increased productivity and sustainable farming practices

DISCUSSION

The Integrated Agro Monitoring and Protection System demonstrates how smart technologies can improve traditional farming practices. The system effectively integrates sensors, a microcontroller, and IoT communication to monitor field conditions in real time. During implementation, it was observed that automated irrigation based on soil moisture levels significantly reduced water wastage and ensured optimal crop growth.

The use of temperature and humidity sensors helped in identifying environmental changes, allowing timely alerts to farmers. Rain detection further improved efficiency by preventing unnecessary irrigation. However, the system's performance depends on proper sensor placement and calibration. In some cases, environmental factors like dust or extreme weather may affect sensor accuracy.

The integration of solar power ensures continuous operation, especially in remote areas, making the system sustainable. IoT connectivity enhances usability by providing remote monitoring, though it requires stable internet access. Overall, the system offers a practical and efficient solution, but future improvements can focus on increasing accuracy, reliability, and scalability for large-scale farming.

CONCLUSIONS

The Integrated Agro Monitoring and Protection System for Farmers provides a smart and efficient approach to modern agriculture. By integrating sensors, a microcontroller, and IoT technology, the system enables real-time monitoring of important parameters such as soil moisture, temperature, humidity, and rainfall. This helps in automating irrigation and protecting crops from unfavorable conditions.

The system reduces manual effort, optimizes water usage, and improves decision-making through timely alerts and remote monitoring. The use of solar power further enhances its sustainability and suitability for rural areas. Overall, the system proves to be a cost-effective, reliable, and user-friendly solution that supports increased crop productivity and promotes sustainable farming practices.

ACKNOWLEDGMENTS

We would like to express our sincere gratitude to our project guide and faculty members for their continuous support, guidance, and valuable suggestions throughout the development of this project. Their encouragement helped us complete this work successfully.

We also thank our institution for providing the necessary facilities and resources required for the implementation of the project. Special thanks to our friends and classmates for their cooperation and helpful discussions during the development process.

Finally, we are grateful to our family members for their constant motivation and support, which played a vital role in completing this project successfully.

REFERENCES

1. Srushti Yadahalli, Aditi Parmar, Amol Deshpande "Smart Intrusion Detection System for Crop Protection by using Arduino" Second International Conference on Inventive Research in Computing Applications (ICIRCA), 2020.
2. Karthi keyan P, Paul Nishanth R, Valarmathi R "Crop Field Protection from Animals Using Convolutional Neural Networks" First International Conference on Computational Science and Technology (ICCST), 2022.
3. A.Sathesh, A.Yuvaneshwar, K.Vishnu, V.Vellaisamy, K.Gowthami "Image Processing based Protection of Crops from wild animals using Surveillance" Intelligent International Conference on Electronics and Renewable Systems (ICEARS), 2022.
4. Mahammad Firose Shaik, Ravi pati Mounika, A.Durga Prasad, Inakoti Ramesh Raja, B.Prajakatha Sekhar, D.Sampath "Intelligent Secure Smart Crop protection From Wild Animals" 8th International Conference on Advanced Computing Communication and Systems (ICACCS), 2022.
5. Priyanka Deotale, Prasad Lokulwar "Smart Crop Protection System from Wild Animals Using IoT" International Conference on Computational Intelligence and Applications, 2021.
6. Stefano Giordano, Ilias Seitanidis, Mike Ojo, Davide, Adami, Fabio Vignoli "IoT solutions for crop protection against wild animal attacks" IEEE International Conference on Environmental engineering (EE), 2018.
7. Dev smit Ranparia, Gunjeet Singh, Anmol Rattan, Harpreet Singh, Nitin Auluck" Machinelearning-based Acoustic Repellent System for Protecting Crops against Wild Animal Attacks" IEEE 15th International Conference on Industrial and Information Systems (ICIIS), 2020.
8. Damini Kalra, Praveen Kumar, K Singh, Apurva Soni" Sensor based Crop Protection System with IOT monitored Automatic Irrigation" International Advances Conference Computing, Communication Control and 2nd on in Networking (ICACCN), 2020.

9. GopikaNair, Mayuri Chawla, Narendra Bawane "Automatic Farming for Minimum Water Usage and Animal Protection Using Solar Fencing with GSM" International Conference on Innovative Trends in Information Technology", 2020.
10. M.SivaSahitya, L.Vinay, Bindeshwar Prasad Sah, P.Srilatha, B.S.Kiruthika Devi "An Investigation on Smart Crop Protection System Utilizing Internet of Things" 8th International Conference on Signal Processing and Communication (ICSC), 2022.