Research Trends International Journal of Technology and Innovation
An International Peer-Reviewed, Refereed & Open-Access Journal
ISSN : 3144-3273
Available Online at : https://rtijti.com/
doi : https://doi.org/10.5281/zenodo.23624711

Smart Farming Protection and Advisory System: An Integrated IoT and Web-Based Platform for Crop Monitoring, Weather Updates and Market Advisory

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A R T I C L E I N F O

Article History:
Received : 21-10-2026
Accepted : 23-10-2026
Published : 25-10-2026

Publication Issue
Volume 1, Issue 4
October – December 2026

Page Number
20-23

A B S T R A C T

Farmers face changing weather, soil-moisture problems, crop damage and volatile market prices, yet the information needed to respond to these problems is scattered across separate sources. This paper presents the Smart Farming Protection and Advisory System, a proposed web-based platform that brings crop monitoring, weather updates, crop protection advisory, market price analysis and selling advisory into a single farmer dashboard. An ESP32 microcontroller reads a soil moisture sensor, a rainfall sensor and a DHT11 temperature and humidity sensor and sends the readings over Wi-Fi to a Python Flask backend. The backend stores farmer, crop and sensor data in an SQLite database, combines it with weather API data, and produces crop-specific protection, irrigation and selling advice shown through an HTML5/CSS3/JavaScript interface. The paper describes the system architecture, its five functional modules, the hardware and software requirements, the planned evaluation metrics and a feasibility study. Based on the reviewed literature, the system is expected to improve real-time monitoring, reduce resource wastage and support timely, data-based farming and selling decisions at low cost.

Index Terms - Smart farming, Internet of Things (IoT), ESP32, Flask, SQLite, soil moisture sensor, rainfall sensor, DHT11, weather API, crop protection advisory, irrigation advisory, market price analysis, selling advisory, decision support system, precision agriculture, web-based dashboard.

I. INTRODUCTION

Agriculture plays a central role in the economic development of India. Farmers, however, must deal with unpredictable weather, soil moisture problems, crop damage and fluctuating market prices. Traditional methods rely on manual observation, which makes it hard to monitor crop conditions continuously and to obtain timely information for decisions on irrigation, crop protection and selling [1], [9].

Recent work shows that Internet of Things (IoT) sensing, wireless communication and data analytics can make farming more data-driven [1], [2], [10]. Most existing systems, however, address one concern at a time, such as monitoring, irrigation or crop protection. A farmer who wants sensor readings, a weather forecast, protection guidance and market prices must still consult several different sources.

This paper presents the Smart Farming Protection and Advisory System, which brings these services together in one web-based dashboard. The main contributions are: (i) a low-cost sensing layer built from an ESP32 and three commonly available sensors; (ii) a Flask/SQLite backend that stores and processes field, crop, weather and market data; (iii) crop protection and irrigation advisory that uses crop, sensor and weather data together; and (iv) market price comparison with selling advisory in the same interface.

The rest of the paper is organized as follows. Section II reviews related work. Section III states the problem and objectives. Section IV describes the system architecture

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and modules. Section V lists the requirements. Section VI presents the evaluation plan and expected outcomes. Section VII gives the feasibility study, and Section VIII concludes the paper.

II. LITERATURE REVIEW

Ayaz *et al.* [1] reviewed IoT and wireless sensor technologies in agriculture. They described sensors for soil, crop, irrigation, pest and environmental monitoring, together with IoT architectures, communication technologies and the use of UAVs, and they identified open challenges. Their findings support the choice of soil moisture, rainfall and temperature/humidity sensing in the proposed system.

Wolfert *et al.* [2] reviewed Big Data in smart farming. They showed how IoT and cloud computing support real-time monitoring and decision-making, and they pointed out problems with data sharing, privacy, governance and infrastructure. These concerns motivate the secure handling of farmer data in this work.

Nanda *et al.* [3] proposed an IIoT-based crop protection and irrigation system that uses DHT11, PIR, LDR and HC-SR04 sensors with a camera and an ARM Cortex-A board. Sensor data is stored in an IoT cloud, and alerts are sent through a website or mobile device when abnormal conditions occur. Vaish *et al.* [4] reviewed IoT and WSN-based automated crop protection. They covered continuous soil moisture monitoring, plant health management, protection from animals, and EWMA-based event detection.

Sivagami *et al.* [5] built an IoT-based monitoring and decision support system that collects soil moisture, temperature, humidity and NPK readings. Data analytics and machine learning then produce crop recommendations. Zhai *et al.* [6] surveyed decision support systems for Agriculture 4.0 and found that integrating data from different sources is difficult. Mahbub [7] proposed a smart farming concept based on embedded electronics, IoT and WSN, and Qazi *et al.* [8] reviewed IoT- and AI-enabled agriculture, noting problems of system complexity, data management, adoption and cost.

The existing studies cover monitoring, protection and crop recommendation well. They rarely combine sensor-based crop protection advisory with weather updates, market price comparison and selling advice in one low-cost platform. The proposed system addresses this gap.

III. PROBLEM STATEMENT AND OBJECTIVES

3.1 Problem Analysis

The reviewed literature points to the following problems: (a) the lack of real-time field monitoring [1], [3]; (b) the lack of continuous crop protection, especially over large areas [4]; (c) the lack of data-based crop decisions [5]; (d) difficulty in managing and sharing agricultural data [2]; (e) the lack of integrated decision support, because crop, weather, soil and market information sit in separate sources [6]; (f) limited remote monitoring infrastructure [7]; and (g) the complexity and cost of IoT/AI adoption [8].

3.2 Objectives

The overall objective is to develop an integrated IoT and web-based platform that collects agricultural data, monitors field conditions, provides weather updates and crop protection advisory, analyzes market information, and supports farmers in making timely, informed, data-based farming and selling decisions. The specific objectives are to:

- monitor soil moisture, rainfall, temperature and humidity using an ESP32 and sensors;
- transmit sensor data over Wi-Fi to a Flask backend and store it in an SQLite database;
- integrate a weather API for current and forecast information;
- generate crop protection and irrigation advice from crop, sensor and weather data;
- compare market prices and suggest a suitable market and selling option; and
- present all of this on one dashboard with secure registration and login.

IV. SYSTEM ARCHITECTURE AND METHODOLOGY

Figure 1 shows the overall architecture. A farmer registers, logs in, manages a profile and selects a crop. The ESP32 reads the sensors and sends the readings to the Flask backend. The backend validates the data and stores it in SQLite. An advisory engine combines the stored data with weather API data to produce the weather, crop protection and market modules. The dashboard presents the results together.

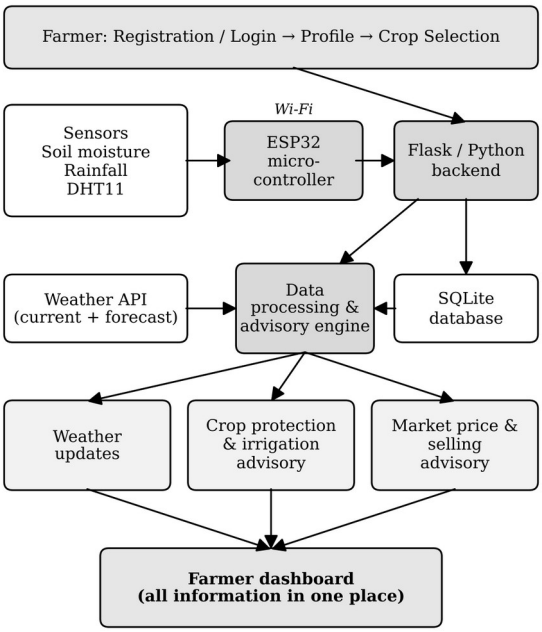


Figure 1. Architecture of the proposed Smart Farming Protection and Advisory System.

4.1 Module 1: Farmer and Crop Management

This module covers registration (name, mobile number, email, address and password), login, farmer profile, crop selection and crop information. The crop information includes season, soil type, water requirement, sowing period and harvesting period. All of it is kept in SQLite, and the selected crop drives the advisory services for that farmer.

4.2 Module 2: IoT Sensor and ESP32

The ESP32 reads a soil moisture sensor, a rainfall sensor and a DHT11 temperature and humidity sensor. It sends the readings over its built-in Wi-Fi to the Flask backend. The backend checks that the readings are valid, stores them, and flags a sensor or communication fault if the readings are missing or implausible. The sensor readings feed the weather, advisory and dashboard modules.

4.3 Module 3: Weather Updates

Temperature and humidity from the DHT11 and rainfall from the rainfall sensor describe local field conditions. A weather API adds current conditions (for example clear, cloudy or rainy) and the forecast, including expected rainfall. The dashboard shows the sensor and API values together so that farmers can plan field activities.

4.4 Module 4: Crop Protection Advisory

The advisory engine takes the selected crop, the latest soil moisture, rainfall, temperature and humidity readings, and the weather forecast. From these it gives guidance on protecting the crop from unfavorable conditions and on irrigation. For example, dry soil with no rain in the forecast points to irrigation, while recent or forecast rain points to delaying it. The advice is written in simple language and stored for later reference.

4.5 Module 5: Market Price and Selling Advisory

The module collects the available prices of the selected crop in different markets, from a database or a suitable data source, and compares them. It suggests a suitable market and gives selling guidance on where and when to sell. Prices, comparisons and recommendations appear on the dashboard.

V. REQUIREMENTS

The proposed system uses commonly available hardware and open-source software, as listed in Table 1. It also needs a stable internet connection for ESP32 communication and weather API access, and a small field or outdoor area for sensor testing.

Table 1. Main hardware and software components

Component	Role in the system
ESP32	Reads the sensors; sends data over Wi-Fi
Soil moisture sensor	Measures soil moisture
Rainfall sensor	Detects rainfall in the field
DHT11	Measures temperature and humidity
Python + Flask	Backend, data processing, APIs
SQLite	Stores farmer, crop, sensor, market and advisory data
HTML5, CSS3, JavaScript	Responsive farmer dashboard
Weather API	Current weather and forecast
Arduino IDE, VS Code	ESP32 programming and web development

VI. EVALUATION PLAN AND EXPECTED OUTCOMES

The system is at the proposal stage, so this paper gives no measured results. The planned evaluation covers the performance and quality measures in Table 2. Testing will use the college laboratories first and then a small field setup.

Table 2. Planned evaluation metrics

Metric	How it will be assessed
Sensor accuracy	Compare sensor readings for consistency
Transmission time	Time from ESP32 to Flask backend
Dashboard response	Load time for sensor, weather and advisory data
Weather API response	Response time and successful retrieval
Database performance	Efficiency of storing and retrieving records
Advisory relevance	Check advice against crop, sensor and weather data
Market comparison	Correct collection and display of prices
Error rate and availability	Log sensor, API, database and web errors
Security	Login, data access and basic unauthorized-access checks

Metric	How it will be assessed
Usability	Feedback from farmers, students and teachers

Based on the literature, the following outcomes are expected: (i) real-time visibility of soil moisture, rainfall, temperature and humidity; (ii) better weather awareness and irrigation decisions; (iii) timely crop protection advice; (iv) reduced manual monitoring and lower resource wastage; (v) better market awareness and selling decisions; and (vi) access to all information in one place.

VII. FEASIBILITY STUDY

Technical: every component (ESP32, the sensors, Python, Flask, SQLite and a weather API) is mature and well documented. *Economic:* the ESP32 and the sensors are inexpensive, and the software tools are open source. *Operational:* farmers can use a simple dashboard without technical knowledge. *Legal and data:* farmer details must be protected and used only for the intended functions [2]. *Environmental:* moisture- and weather-based advice supports efficient use of water and other resources. *Scalability:* more crops, sensors and languages can be added later. Overall, the system is feasible as a student-level IoT and web project and gives a practical base for future smart agriculture applications.

VIII. CONCLUSION AND FUTURE SCOPE

This paper presented the Smart Farming Protection and Advisory System, an IoT and web-based platform that brings sensor monitoring, weather updates, crop protection advisory, market price analysis and selling advisory into one farmer dashboard. The design uses an ESP32, Flask and SQLite, and the reviewed literature and the feasibility study indicate that it is technically, economically and operationally practical. Future work will implement and test the prototype in the field and report measured results. Planned enhancements include a mobile application, real-time market prices, fertilizer recommendations, more crops, multilingual support and automated irrigation.

ACKNOWLEDGMENT

The authors thank their project guide, Ms. N. R. Bhokare, and the Department of Computer Engineering, Sanjay Bhokare Group of Institute, Miraj, for their guidance and support.

REFERENCES

[1] M. Ayaz, M. Ammad-Uddin, Z. Sharif, A. Mansour, and E.-H. M. Aggoune, "Internet-of-Things (IoT)-based smart agriculture: Toward making the fields talk," *IEEE Access*, vol. 7, pp. 129551–129583, 2019.

[2] S. Wolfert, L. Ge, C. Verdouw, and M.-J. Bogaardt, "Big data in smart farming – A review," *Agric. Syst.*, vol. 153, pp. 69–80, May 2017.

[3] I. Nanda, S. Chadalavada, M. Swathi, and L. Khatua, "Implementation of IIoT based smart crop protection and irrigation system," *J. Phys.: Conf. Ser.*, vol. 1804, no. 1, Art. no. 012206, 2021, doi: 10.1088/1742-6596/1804/1/012206.

[4] R. Vaish, S. M. Al-Shaikh, S. K. Shah, Gayathri C, D. Dhabliya, and R. Vimala Devi, "Automated smart crop protection utilising IoT: A comprehensive review," *E3S Web Conf.*, vol. 540, Art. no. 13012, Jun. 2024, doi: 10.1051/e3sconf/202454013012.

[5] S. Sivagami, R. Selvakumari, S. Senthilvadivu, J. Shakila, B. Sree Dedeepya, and R. Vijaya Lakshmi, "IoT based smart agriculture monitoring and decision support system for crop recommendation and crop requirements," in *Proc. 1st Int. Conf. Intelligent Methods and Advanced Computer Scientific Innovations (IMACSI)*, vol. 3, 2025, pp. 540–548, doi: 10.5220/0014191000004932.

[6] Z. Zhai, J. F. Martínez, V. Beltran, and N. L. Martínez, "Decision support systems for agriculture 4.0: Survey and challenges," *Comput. Electron. Agric.*, vol. 170, Art. no. 105256, Mar. 2020.

[7] M. Mahbub, "A smart farming concept based on smart embedded electronics, internet of things and wireless sensor network," *Internet of Things*, vol. 9, Art. no. 100161, Mar. 2020.

[8] S. Qazi, B. A. Khawaja, and Q. U. Farooq, "IoT-equipped and AI-enabled next generation smart agriculture: A critical review, current challenges and future trends," *IEEE Access*, vol. 10, pp. 21219–21235, 2022.

[9] A. Khanna and S. Kaur, "Evolution of Internet of Things (IoT) and its significant impact in the field of precision agriculture," *Comput. Electron. Agric.*, vol. 157, pp. 218–231, Feb. 2019.

[10] A. Tzounis, N. Katsoulas, T. Bartzanas, and C. Kittas, "Internet of things in agriculture, recent advances and future challenges," *Biosyst. Eng.*, vol. 164, pp. 31–48, Dec. 2017.