Project Synopsis

on

AGRO CARE

Submitted as a part of course curriculum for

Bachelor of Technology

in

Computer Science

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ABSTRACT

With growing challenges in agriculture, such as unpredictable climate patterns and resource scarcity, smart farming solutions are essential for sustainable crop production. This project presents an IoT-based device that integrates soil detection, crop recommendation, and automated water regulation. The system employs various sensors to monitor soil properties like moisture, pH, temperature, and nutrient levels. These real-time data inputs are analysed using machine learning algorithms to recommend suitable crops based on soil conditions and environmental factors. Additionally, the device is equipped with a smart irrigation system that regulates water distribution based on the moisture content and specific crop requirements, ensuring efficient water usage. Farmers can access crop recommendations and control irrigation through a user-friendly mobile or web application. This innovative approach optimizes resource use, boosts crop yields, and promotes sustainability in farming practices by conserving water and maximizing soil potential.

INTRODUCTION

In today's world, maintaining agricultural productivity, guaranteeing food security, and fostering socioeconomic development all depend on effective water management. Since 70% of the freshwater on Earth is used for agriculture, it is crucial to use water resources efficiently, especially as population growth and climate change worsen the already severe water shortage. With 38% of the world's population living in drylands, which make up 41% of the planet's surface, unpredictable rainfall and high temperatures pose serious problems. Traditional irrigation techniques are ineffective in these areas, wasting water and producing little crop yields.

Smart irrigation systems provide a viable solution to these problems. These systems continuously monitor soil moisture levels and meteorological data to maximize irrigation, increase crop yields, and improve water use efficiency. Precision irrigation, a key element of smart farming, delivers water precisely where and when it's needed, reducing waste and enhancing agricultural productivity.

In addition to efficient water management, this project integrates crop prediction, using real-time soil and climate data to recommend optimal crops based on soil health and environmental conditions. By combining smart irrigation with crop prediction, the system not only minimizes water consumption but also helps farmers make informed decisions, improving crop yields and profitability while promoting sustainable agriculture, especially in water-scarce regions.

LITERATURE REVIEW

1. **Paper Title:** Smart irrigation system techniques using AI and IoT.
Author Name: Prashant Dharashive
Journal Name: International Journal of INTELLIGENT SYSTEMS AND APPLICATION IN ENGINEERING.
Learning Year of Publishing: 2021
Summary: The research paper "Smart Irrigation System Technique Using AI and IoT" explores optimizing water usage in agriculture. By integrating AI/ML to analyse plant conditions and IoT devices for real-time soil data, the system automatically waters crops when needed. Technologies like Raspberry Pi, MQTT, and sensors manage and monitor irrigation efficiency and soil nutrient levels.

2. **Paper Title:** Automated Irrigation System Using AL.
Author Name: Prof. Anand Tilagul
Journal Name: International Journal of INNOVATIVE REASERCH IN SCIENCE, ENGINEERING AND TECHNOLOGY.
Learning Year of Publishing: 2024
Summary: The research paper "Automated Irrigation System Using AI" focuses on improving water efficiency in agriculture. It uses IoT to collect real-time soil and weather data and analyse this data with the PLSR algorithm to determine the optimal water levels. The system then automatically controls.

3. **Paper Title:** Crop Recommendation Using IOT and ML.
Journal Name: International Journal of SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT
Author Name: Meet Senjaliya
Learning Year of Publishing: 2024
Summary: The research paper "Crop Recommendation Using IoT and ML" presents an efficient system for recommending crops based on specific locations and seasons. By leveraging IoT and ML, real-time data on soil, weather, and crop conditions are gathered and analyzed using algorithms like Random Forest and LSTM, providing farmers with optimized crop choices for improved productivity.

4. **Paper Title:** Water Management in Agriculture.
Journal Name: CENTURION UNIVERSITY OF TECHNOLOGY AND MANAGEMENT
Author Name: Sumit Ray
Learning Year of Publishing: 2024
Summary: Innovation for Efficient Irrigation. The research paper "Water Management in Agriculture: Innovation for Efficient Irrigation" focuses on optimizing water usage and improving crop yield. It integrates IoT for real-time monitoring, automated valves and pumps, and cloud-based platforms for remote irrigation management. ML predict and adjust water delivery using

crop growth patterns, weather, and historical data, enhancing site-specific irrigation with VRI techniques.

5. Paper Title: Enhancing Water use Efficiency, Crop Yield, and Environment Footprints
Journal Name: JIANGSU UNIVERSITY
Author Name: Imran Ali Lakhiar
Learning Year of Publishing: 2024
Summary: The research paper "A Review of Precision Irrigation Water Saving Technology Under Changing Climate" highlights methods to enhance water efficiency, improve crop yield, and reduce environmental impact. It examines modernizing traditional irrigation using AI for scheduling, IoT for real-time monitoring, WNS for data collection, and a decision support system to automate water management, addressing climate change challenges.

PROBLEM STATEMENT

With the challenges of water scarcity, climate variability, and unpredictable weather patterns, farmers need accurate and efficient tools for managing crop growth and ensuring optimal yields. Traditional irrigation and crop management methods are often inefficient, leading to water wastage, crop failure, or suboptimal yields.

Key Problems:

1. **Inefficient Water Use:** Conventional irrigation systems do not adjust water delivery based on real-time soil moisture, resulting in over or under-irrigation.

2. **Lack of Real-Time Monitoring:** Farmers lack access to real-time data about soil conditions like moisture levels, temperature, and nutrient content.

3. **Poor Crop Management:** Due to unpredictable environmental factors, farmers are often unable to predict optimal planting, watering, and harvesting times.

4. **Uncertainty in Crop Yield:** Farmers lack accurate tools for crop prediction, resulting in uncertainty around yield potential and resource allocation.

OBJECTIVE

The objective of this project is to develop a smart agricultural system that utilizes IoT sensors to monitor soil conditions in real-time and applies machine learning algorithms to predict crop yield and recommend optimized irrigation schedules, resulting in resource-efficient farming practices and improved crop productivity.

1. Real-Time Monitoring: Farmers will be able to monitor soil health and weather conditions remotely through a mobile or web interface.

2. Predictive Analysis: The system will predict when the next irrigation is needed and suggest the amount of water based on historical patterns and current conditions.

3. Crop Yield Forecasting: Machine learning models will provide farmers with yield predictions based on soil health, weather patterns, and crop variety.

4. Resource Optimization: By using real-time data, farmers can optimize their use of water and fertilizers, reducing waste and improving crop yields.

PROPOSED METHODLOGY

FLOWCHART:

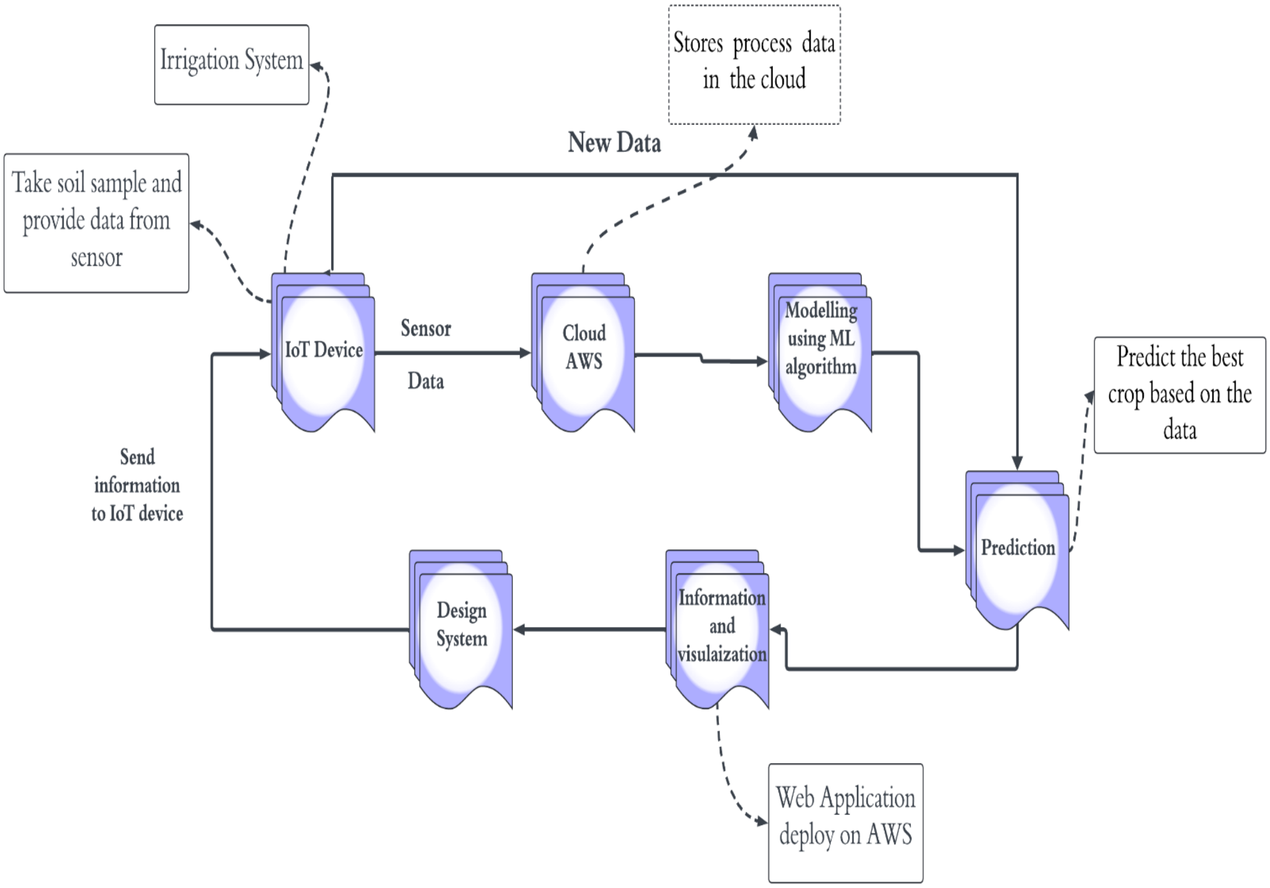

Fig 1 The complete flow of project.

This system provides an end-to-end solution for smart farming, where data from sensors is analyzed in the cloud using machine learning, and predictions are made to help farmers make better decisions about crop management and irrigation.

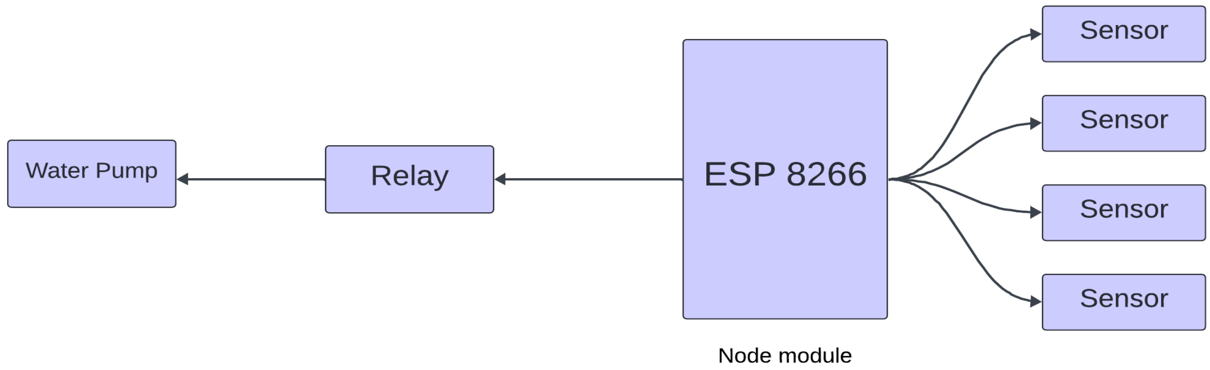

Fig 2 This figure shows the connection of sensors with microcontroller (ESP 8266).

The ESP8266 collects data from sensors and uses a relay to control the water pump, automating the irrigation process.

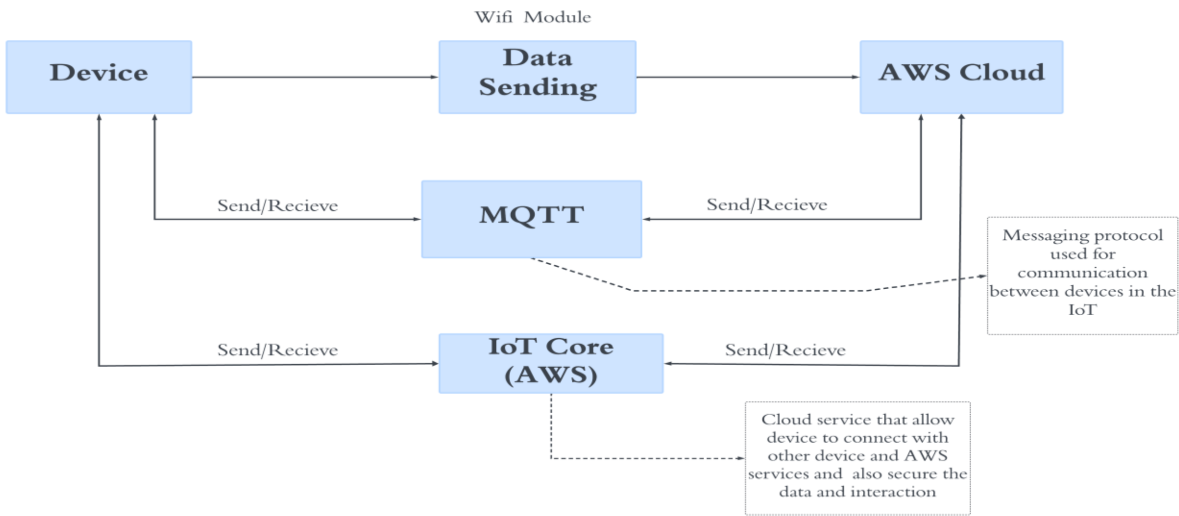

Fig 3 This figure shows how IoT device communicate with web application.

The device collects data and sends it via a Wi-Fi module using the MQTT protocol to AWS Cloud. AWS IoT Core ensures the secure connection and interaction between devices and cloud services, enabling real-time monitoring, data processing, and control of IoT system.

ALGORITHM:

Input:

- Soil moisture level from sensor.
- Predefined moisture threshold.
- Data from various sensors (moisture, pH, temperature, nutrients)

Algorithm:

- Start.
- Initialize the soil moisture sensor.
- Collect real-time soil moisture data.
- Compare the current moisture level to the predefined threshold:
  If moisture < threshold:
  Activate the water pump.
- If moisture ≥ threshold:
  Turn off the water pump.
- Continuously monitor the moisture level.
- Initialize soil sensors (moisture, pH, temperature, nutrient sensors).
- Collect real-time data from each sensor.
- Store the sensor data in a cloud database for analysis.
- Analyze the data to identify soil health (e.g., moisture condition, nutrient levels).
- If necessary, trigger alerts or recommendations based on soil deficiencies.
- Pre-process the data (normalize, remove missing values, etc.).
- Input data into a trained machine learning model (e.g., Random Forest or LSTM):
- Train the model on historical soil and crop yield data.
- Display crop recommendations through the web interface.
- End.

Output:

- Recommended crops based on real-time and historical data.

TECHNOLOGY USED

1. **Internet of Things (IoT):** The project integrates sensors to collect real-time data on soil moisture, temperature, and nutrient levels. These sensors are connected to the internet through an ESP8266 module, allowing remote monitoring and control.

2. **Embedded System:** This involves using the ESP8266 microcontroller to interface with the sensors and control actuators (like a water pump) based on the sensor data.

3. **Machine Learning:** Machine learning algorithms analyze the collected sensor data and recommend the most suitable crops for planting and the optimal irrigation schedules. This helps in making predictive decisions to enhance crop yield and resource use efficiency.

4. **Cloud Computing (AWS):** The data from sensors is transmitted to AWS Cloud, where it is stored and processed. The cloud infrastructure also runs machine learning models and provides crop recommendations, making the system scalable and accessible remotely.

5. **Frontend Web Development (ReactJS):** A user-friendly web application, developed using ReactJS, allows farmers to interact with the system, view crop recommendations, and control the irrigation process.

6. **Backend Web Development (MongoDB):** MongoDB is used to manage and store data related to soil conditions, weather patterns, and machine learning predictions.

Expected Outcomes

1. Real-Time Monitoring: Farmers can monitor soil health and environmental conditions through a user-friendly mobile or web application.

2. Predictive Analysis: Predict irrigation schedules and water needs based on historical and real-time data.

3. Crop Yield Forecasting: Provide accurate yield predictions based on soil, weather, and crop data using machine learning models.

4. Automated Irrigation: Implement a smart irrigation system that automatically adjusts water distribution based on soil moisture levels and crop requirements.

5. Crop Recommendation: Suggest suitable crops based on soil properties, climate conditions, and historical patterns.

6. Resource Optimization: Minimize water and fertilizer waste, leading to more efficient resource use and reduced environmental impact.

7. Enhanced Productivity and Sustainability: Improve crop yields, reduce water usage, and promote sustainable farming practices.

8. Farmer Empowerment: Equip farmers with actionable insights and tools to make informed decisions, increasing profitability and resilience to climate challenges.

CONCLUSION

Together, these technologies empower farmers to adopt precision agriculture, a data-driven approach that maximizes productivity while minimizing waste and environmental impact. The integration of smart irrigation, soil detection, and crop prediction systems not only improves crop yield and resource efficiency but also contributes to food security in the face of a growing global population. By optimizing the use of natural resources and enhancing decision-making processes, these innovations pave the way for a more sustainable and resilient agricultural future.

This smart irrigation and soil monitoring system will empower farmers with real-time insights and predictive analytics to optimize irrigation, reduce resource usage, and maximize crop yields through the combined power of IoT and ML

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