Vivekanand Education Society's Institute of Technology

Department of Computer Engineering

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Project Synopsis Template (2024-25) - Sem V

Agribot

Sanjay Mirchandani
Assistant Professor, CMPN

Kedaar Kate
V.E.S.I.T
2022.kedaar.kate@ves.ac.in

Vansh Nenwani
V.E.S.I.T
2022.vansh.nenwani@ves.ac.in

Jenny Lalwani
V.E.S.I.T
2022.jenny.lalwani@ves.ac.in

Darshan Kakad
V.E.S.I.T
2022.darshan.kakad@ves.ac.in

ABSTRACT

The project aims to develop an IoT-based system to automate ploughing, sowing, farm irrigation and detection of plant diseases using Raspberry Pi and Arduino Mega. The system will employ sensors to monitor soil moisture, humidity and temperature; also a GPS module will be implemented for navigation, and a camera module for capturing plant images. These images will be sent to a server for classification using machine learning models. This integrated approach aims to optimize water usage and early detection of plant diseases, thereby enhancing crop yield and sustainability. Additionally, the system's design ensures its applicability and efficiency in controlled indoor farming environments, making it versatile and adaptable.

INTRODUCTION

Agriculture is a critical sector that faces numerous challenges, including water scarcity and crop diseases, which significantly impact crop yield and sustainability. This project aims to address these challenges by developing an Internet of Things (IoT)-based system to automate farm practices like ploughing, sowing and irrigation and detect plant diseases using Raspberry Pi and Arduino Mega.

This project leverages IoT technology to address these issues by automating irrigation based on soil moisture, humidity, temperature and providing real-time disease detection through image processing and machine learning. The Agribot will utilize three sensors to determine the optimal needs for crops [1]. By integrating the irrigation system, the bot can deliver precise amounts of water, promoting healthy plant growth while conserving water resources. The system is also designed to identify plant diseases through advanced image recognition techniques using machine learning algorithms that analyze images captured by onboard cameras. By comparing these images against a comprehensive database of plant diseases, the Agribot will accurately detect infections early, enabling timely intervention and reducing the risk of crop loss. This project demonstrates the potential of advanced technologies in transforming traditional agricultural methods, contributing to food security and environmental sustainability.

PROBLEM STATEMENT

Manual detection of plant diseases is a demanding task for farmers, requiring continuous observation and expertise. Additionally, inefficient farming practices can lead to overwatering or underwatering, affecting crop health and resource usage. Additionally, climate variability and unpredictable weather patterns further complicate irrigation scheduling and disease management. Therefore, there is an urgent need for an automated system that can continuously monitor soil moisture, environmental conditions, and plant health. The problem statement for Agribot is to develop an accurate and efficient system that can identify and classify diseases affecting various types of crops and also an automated irrigation system that adjusts water distribution based on real-time soil moisture levels and the specific needs of the crops.

PROPOSED SOLUTION

The proposed solution integrates IoT technology with agricultural practices to create an automated system for farm irrigation and plant disease detection. A combination of Raspberry Pi, Arduino Mega, sensors, and a camera module will be used to monitor soil moisture levels, environmental conditions, and capture plant images [5]. These images will be processed and classified using a machine learning model hosted on a Flask server. The core components and their functionalities are detailed as follows:

1. Raspberry Pi:

- Acts as the central processing unit of the system, coordinating data collection, processing, and communication.
- Interfaces with the camera module to capture high-resolution images of plants.
- Communicates with the Arduino Mega and the server to ensure seamless operation and data flow.

2. Arduino Mega:

- Manages sensor data acquisition and controls the irrigation system based on real-time soil related data[8].
- Interfaces with various sensors, including soil moisture sensors, temperature and humidity sensors, and a GPS module for precise farm navigation.

3. Sensors:

- **Soil Moisture Sensors:** Monitor the moisture levels in the soil, providing real-time data to optimize irrigation.
- **GPS Module:** Ensures accurate navigation and mapping of the farm, allowing targeted irrigation and monitoring.
- **Temperature Sensors:** Measure ambient temperature, aiding in climate monitoring and adjustments for optimal plant growth.
- **Humidity Sensors:** Track the humidity levels in the environment, providing data to help maintain ideal growing conditions and prevent diseases.

METHODOLOGY:

1. **System Design:**
    - **Architecture Development:** Develop an architecture combining Raspberry Pi and Arduino Mega with necessary sensors and actuators, ensuring seamless communication.

- **Component Selection:** Select and integrate soil moisture sensors, temperature and humidity sensors, a GPS module, and a camera module for comprehensive monitoring and control.
- **Integration and Testing:** Ensure all components are compatible and perform extensive testing to validate system functionality.

2. **Data Collection:**
    - **Data using Sensors:** Sensors measure the moisture, humidity and temperature in the soil to assess irrigation needs.
    - **Camera Images:** Cameras capture images of the plants to monitor their health and detect diseases.

3. **Data Transmission:**
    - **Sensor Data:** Collected soil data is transmitted to a central server for analysis [4].
    - **Images:** Captured images are sent to the server for processing.
    - **Send to Server:** Both sensor data and images are transmitted to a central server for further processing.

4. **Data Processing:**
    - **Process Sensor Data:** Analyze soil data to determine irrigation requirements.
    - **Analyze Images:** Use image processing techniques to detect signs of plant diseases from the captured images.
    - **Model for Disease Detection:** Apply a trained machine learning model to identify and classify plant diseases from the analyzed images.

5. **Decision Making:**
    - **Irrigation Needs:** Based on the processed sensor data, decide on the irrigation requirements and schedule.
    - **Disease Alerts:** Generate alerts if any plant diseases are detected, informing the necessary actions to be taken.

6. **Actuation:**
    - **Water Pump Control:** Control the water pumps to manage irrigation based on the decision-making stage.
    - **Disease Control Actions:** Initiate appropriate actions for disease control as per the alerts generated.

7. **Navigation:**
    - Using the GPS module, the Agribot follows routes or waypoints for tasks like crop monitoring or irrigation [9].

BLOCK DIAGRAM:

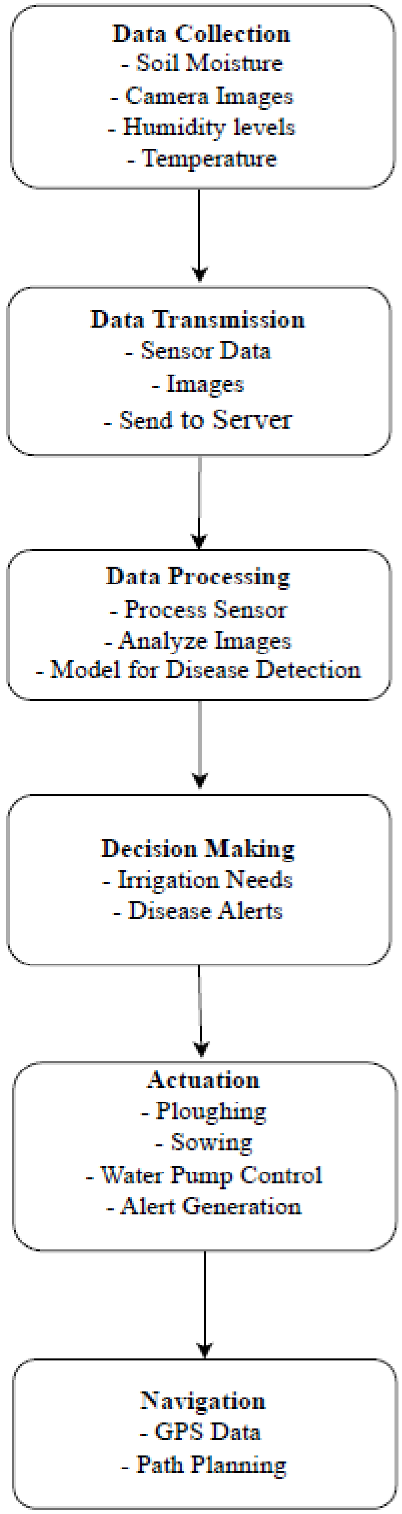

Fig. 1 Block Diagram for methodology.

HARDWARE, SOFTWARE AND TOOLS REQUIREMENT

Hardware:

1. Raspberry Pi (with camera module)
2. Arduino Mega
3. Soil moisture, humidity and temperature sensors
4. GPS module
5. Relay module
6. Water pump
7. Power supply (battery pack or solar panel)
8. Wi-Fi/4G dongle
9. Temperature/humidity sensors.
10. Mounting hardware and waterproof enclosures.

Software:

1. Raspbian OS for Raspberry Pi
2. Arduino IDE for programming Arduino Mega
3. Python for scripting on Raspberry Pi
4. Flask for server-side API and web interface
5. TensorFlow/Keras for machine learning model
6. OpenCV for image processing

Tools:

1. Breadboard and jumper wires
2. Soldering iron (if permanent connections are needed)
3. Multimeter for testing connections

PROPOSED EVALUATION MEASURES

1. **Image Classification Accuracy**: Evaluate the performance of the machine learning model using a labeled dataset.
2. **System Reliability**: Test the system's performance in different environmental conditions to ensure robustness.
3. **Response Time**: Measure the time taken from image capture to disease classification and response.

CONCLUSION

This project aims to integrate IoT technology into agriculture to automate irrigation and provide early plant disease detection. By leveraging the capabilities of Raspberry Pi, Arduino Mega, sensors, the system can optimize water usage and enhance crop health. The machine learning model hosted on a server will enable accurate disease classification, facilitating timely interventions. The proposed system holds promise for improving agricultural productivity and sustainability.

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