Smart Agriculture Monitoring System Using IoT

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Abstract—Agriculture is a major source of income for India's largest population and a major contributor to the Indian economy. The Internet of Things (IoT) is a technology that allows the use of mobile devices to control the operation of devices. The Internet of Things (IoT) is a kind of network technology that receives and exchanges information from various sensors and is best connected to the Internet. This is done by higher-level communication devices such as Wi-Fi modules. The data processed by the sensor is converted into meaningful data and sent to the user. Users can view data using portable devices such as mobile phones or tablets. The project helps farmers efficiently irrigate their fields with an automated soil moisture-based irrigation system. The proposed system is designed to overcome unnecessary water runoff to farmland. Temperature, Humidity, and Humidity readings are continuously monitored by the Temperature, Humidity, and Humidity Sensor and sent to a designated mobile phone. The Android app continuously collects data from assigned IP addresses. When the soil moisture value exceeds a certain limit, a relay connected to the Arduino microcontroller controls the automation of the irrigation system using the IoT 79 motor, and the state of the motor indicates the current state of the pump. Then the necessary water is supplied under the culture.

Index Terms— Drip irrigation Pump, ESP8266 Node MCU, Temperature and Humidity sensor, Relay, Soil-Moisture Sensor, Ultrasonic sensor.

I. INTRODUCTION

Agriculture is the basic source of livelihood for people in India. In the past decade, it is observed that there is not much crop development in the agriculture sector. Some of the factors which are responsible for this may be wastage of water, low soil fertility, fertilizer abuse, climate change, diseases, etc. It is very essential to make effective interventions in agriculture and the solution is better management and regular maintenance and checking of the crops which include the technologies-IOT in integration with Wireless sensor networks, sensing the parameters with sensors, and notifying the concerned people by SMS features. It has the potential to change the way of development in agriculture and gives a great contribution to making it smart agriculture. In IoT-based smart farming, a system is built for monitoring the crop field with the help of sensors like light, humidity, temperature, soil moisture, etc. The farmers can monitor the field conditions from anywhere. The proposed IoT-based Irrigation System uses ESP8266 NodeMCU Module and DHT11 Sensor. It will not only automatically irrigate the water based on the moisture level in the soil but also send the Data to Blynk Server to keep track of the land condition.

II. LITERATURE REVIEW

The research in the agriculture area is enhanced in various aspects to improve the quality and quantity of productivity of agriculture. Researchers have worked on many different projects on soil attributes and different weather conditions. A few review studies examined the implementation of Artificial Intelligence (AI) and the application of IoT for agricultural monitoring. The authors highlighted smart farming systems based on acquiring data and utilizing them to make optimized decisions, thereby reducing costs and enhancing environmentally friendly practices. A decision–making method was used for the identification and watering process, and they discussed the implementation of a fuzzy logic system. A system is developed by using sensors and according to the decision from a server based on sensed data, the irrigation system is automated. By using wireless

transmission, the sensed data is forwarded to the web server database. If the irrigation is automated, then that means the moisture and temperature fields fall below the potential range. The user can monitor and control the system remotely with the help of an application that provides a web interface to the user. A complete real-time and historical environment is expected to help achieve efficient management and use of resources. We can move to IoT Based Smart Agriculture Monitoring System develop with various features like GPS-based remote-controlled monitoring, moisture and temperature sensing, intruder scaring, security, leaf wetness, and proper irrigation facilities.

III. PROPOSED SYSTEM - BLOCK DIAGRAM

The suggested smart farming monitoring system seeks to transform conventional farming methods by utilizing cutting-edge technologies to improve crop irrigation and boost output. This solution delivers real-time monitoring and control capabilities by merging numerous components and integrating them into a coherent system, allowing farmers to make data-driven decisions and automate irrigation procedures.

Hardware elements including soil moisture sensors, PIR sensors, ultrasonic sensors, a relay, and a microcontroller board, an Arduino make up the majority of the system. These parts cooperate to collect necessary information and carry out irrigation management operations depending on predetermined thresholds or situations. In order to enable remote monitoring and alarm features and ensure that farmers receive timely updates on their mobile devices, the system also utilizes GSM connection.

The following diagram depicts the whole scenario of the Smart Agriculture Monitoring System using IoT. It consists of various modules, sensors, a microcontroller and a cloud server.

Whole system integrates to execute the tasks as per assigned manner on the basis of threshold values.

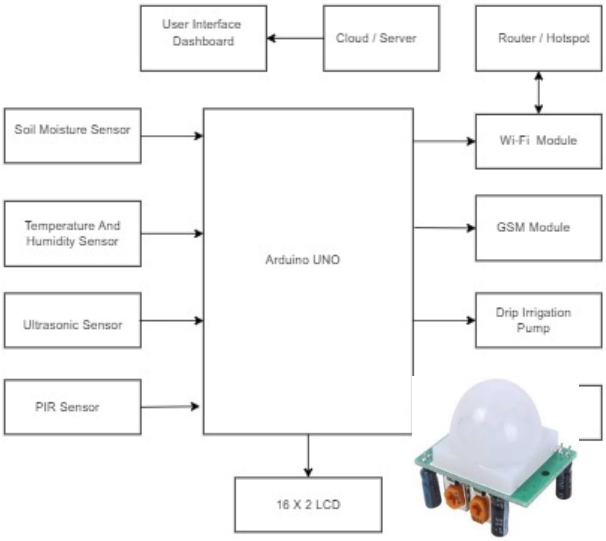


Fig. 1 – Proposed System Design

IV. COMPONENTS DESCRIPTION

Arduino UNO

An open-source microcontroller board called Arduino Uno is built around the ATmega328P microprocessor. It is a preferred option for professionals, academics and amateurs for prototyping and constructing various electronic projects. The Arduino Uno board is adaptable and simple to use because to its many built-in peripherals and variety of digital and analogue input/output ports. The Arduino Uno platform makes it simple to build interactive electronic systems and test out various sensors, actuators, and communication modules.

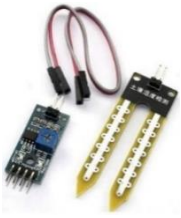
PIR Sensor

PIR Sensor is used to sense the motion, always used to detect whether a human or animals has moved in or out of the sensor range. They are small, inexpensive, low power, easy to use and don't wear out. It uses infrared rays to detect the motion within its range. Sensitivity ranges up to 7 meters. Power supply has 5V input voltage. Output is digital signal (3V output high when motion detected). So, it is called as Passive Infrared sensor or Pyro electric sensor.

Temperature and Humidity Sensor (DHT11)

Temperature Sensor is a precession integrated circuit temperature sensor, whose output voltage varies, based on the temperature around it. It is cheap IC which can be used to measure temperature between 0°C to 50°C. Its output voltage is linear proportional to the instantaneous temperature. It is an analog sensor.

Soil Moisture Sensor



Soil Moisture Sensor is used to detect the moisture of the soil. It is small, cheap and easily available. Its operating voltage is 3.3-5V DC. It consists of a moisture sensor, resistors, capacitors, comparator LM393, Moisture detect LED. Easy to use with microcontrollers. The sensor has both analog and digital output. When there is more water is present in the soil, it will conduct more electricity that means resistance will be low and moisture level is high. When there is less water is present in the soil, it will conduct less electricity that means resistance will be high and moisture level is low.

Ultrasonic Sensor

An ultrasonic sensor is used to measure the water level in the tank. An ultrasonic sensor is a device that measures the distance to an object using ultrasonic waves. Transducers are used to transmit and receive ultrasonic pulses. Easy to use, easy to interact with microcontrollers, safe operation, long service life and high accuracy. This is an analog sensor.

16*2 LCD

This is a type of electronic display. It's cheap and easy to program. Operating voltage 4.7-5.3V. It contains two lines, each of which can contain 16 characters. Alphanumeric and special characters can be displayed on the LCD.

Voltage Regulator

A voltage regulator is an electrical or electronic device that maintains the voltage of a power source within specified limits.

GSM Module (Global System for Mobile Communication)

It is cellular wireless telecommunications. It is used to send the output messages to the registered mobile of farmer. It allows for transmission, sending and receiving voice calls. Low-cost, long-range connectivity, small in size. Supported frequencies are 850/950/1800/1900MHz.

Relays

Relays is an electrical switch that is operated by an electromagnet. When activated the electromagnet pulls to either open or close an electrical circuit.

Power Supply Adaptor

Power Supply Adaptor is an external power supply is used to power small electronic or electrical devices. Output of power supply adaptor is 12V DC.

Tank Pump

It is used to pump the water into the tank if the tank level is low. It is interfaced with the relay from protection of high current. In this project we have used submersible pump.

Drip Irrigation Pump:

It is used to pump the water from tank to farm field whenever necessary. It is also interfaced with the relay from protection of high current.

V. IMPLEMENTATION

To implement this smart farming monitoring system using the mentioned components, here's a high-level outline of the implementation process:

Hardware Setup:
Connect the soil moisture sensor, PIR sensor, ultrasonic sensor, and relay to a microcontroller board (such as Arduino or Raspberry Pi) based on their specifications and interfaces.
Ensure the sensors and the relay are properly powered and connected to the microcontroller.

Sensor Data Acquisition:
Write code in the chosen programming language (e.g., Arduino IDE) to read data from each sensor connected to the microcontroller. Calibrate the sensors if necessary to obtain accurate measurements.

Control Logic:
Develop the logic to control the relay based on the data received from the sensors.
Determine the appropriate thresholds or conditions for activating the motor or pump connected to the relay for irrigation control

GSM Communication:
Integrate the GSM SIM900A module with the microcontroller.
Write code to establish communication with the GSM module, including initializing the module, configuring the necessary settings, and handling communication protocols.
Implement the code to send sensor data, alerts, or notifications to the farmer's mobile device via SMS or other communication channels supported by the module.

Power Management:
Ensure the system's power requirements are met, considering the power needs of the microcontroller, sensors, relay, and GSM module.
Implement power management techniques to optimize energy usage, such as sleep modes for the microcontroller or battery-powered solutions if necessary.

Testing and Deployment:
Test the system thoroughly, including sensor readings, control logic, GSM communication, and user interface functionality.
Conduct field tests to validate the system's performance in real-world farm conditions.
Once the system is deemed reliable and functional, deploy it on the farm and provide appropriate training to the farmer on system usage and maintenance.

VII. CONCLUSION

In conclusion, the integration of Internet of Things (IoT) technology in agriculture holds immense potential to enhance the efficiency and productivity of farming practices in India. By utilizing IoT devices such as sensors and mobile applications, farmers can monitor crucial parameters like temperature, moisture, and humidity in real-time. This enables them to make informed decisions regarding irrigation and water management, leading to optimal resource utilization and reduced water wastage. The proposed automated irrigation system based on soil moisture offers a practical solution to overcome the challenges of excessive water flow in agricultural lands. Through continuous monitoring and data collection, the system ensures that water is supplied to the crops only when needed, preventing both overwatering and underwatering.

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