Automatic Plant Monitoring system

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Abstract

This project proposes an Internet of Things (IoT) solution for monitoring temperature, humidity, and soil moisture levels in real-time. Utilizing sensors for each parameter and a microcontroller, the system collects data and wirelessly transmits it to a centralized server. A user-friendly interface accessible via web or mobile allows users to remotely monitor the soil conditions and receive alerts for abnormal readings. Utilizing the capabilities of ThingSpeak's cloud-based platform, real-time data collection, analysis, and visualization are seamlessly integrated. This project aims to address the pressing need for efficient agricultural resource management through IoT technology, offering scalability and adaptability for various applications.

Keywords: *Temperature, Humidity, Soil moisture, Thingspeak .*

I. Introduction

The advent of Internet of Things (IoT) technology has revolutionized various industries, including agriculture. One of the key applications of IoT in agriculture is plant monitoring systems, which enable real-time tracking of plant health parameters. This project focuses on developing an automatic plant monitoring system using ThingSpeak, an IoT platform known for its simplicity and effectiveness in managing sensor data.

The system integrates sensors to monitor crucial parameters such as soil moisture, temperature, and light intensity, which are vital for plant growth and health. These sensors collect data at regular intervals, which is then transmitted to the ThingSpeak platform through an internet connection. ThingSpeak provides a cloud-based infrastructure for storing, analyzing, and visualizing this data, making it accessible from anywhere with an internet connection.

One of the key advantages of using ThingSpeak is its user-friendly interface, which allows users to easily configure sensors, set up data visualization tools, and receive notifications based on predefined thresholds. This makes it ideal for both amateur plant enthusiasts and professional farmers looking to optimize their plant growth conditions.

In this project, we will detail the design and implementation of the automatic plant monitoring system using ThingSpeak, along with a discussion on its benefits and potential applications in agriculture.

II. LITERATURE SURVEY

Design and Implementation of an Automatic Plant Irrigation System Using IoT" by Sharma et al. (2020):

This study presents a comprehensive overview of an automatic plant irrigation system based on IoT technology. The system utilizes ThingSpeak for data collection and management, enabling real-time monitoring of soil moisture levels. The authors highlight the effectiveness of ThingSpeak's cloud based infrastructure in facilitating remote monitoring and control of irrigation processes.

"Smart Agriculture Monitoring System Using IoT" by Patel et al. (2019):

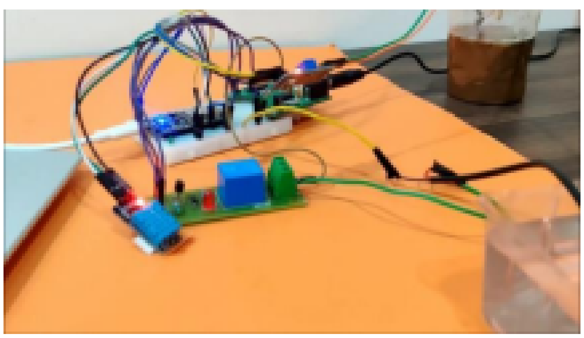
Patel et al. propose a smart agriculture monitoring system that incorporates IoT devices for monitoring various parameters such as temperature, humidity, and soil moisture. The system utilizes ThingSpeak as the central platform for data aggregation and analysis. The authors emphasize the scalability and flexibility of ThingSpeak, making it suitable for diverse agricultural applications.

"Real-Time Plant Monitoring System Using IoT" by Singh et al. (2018):

Singh et al. introduce a real-time plant monitoring system that leverages IoT technology to monitor environmental parameters crucial for plant growth. The system employs sensors to collect data on soil moisture, temperature, and light intensity, with ThingSpeak serving as the backend platform for data storage and visualization. The authors highlight the seamless integration of sensors with ThingSpeak, enabling efficient data management and analysis.

III. SYSTEM ARCHITECTURE

The integration of a NodeMCU-powered automatic plant monitoring system with ThingSpeak revolutionizes plant care through IoT innovation. This system seamlessly amalgamates soil moisture and temperature/humidity sensors with the NodeMCU ESP8266 board, enabling real-time data acquisition. The collected data is securely transmitted to ThingSpeak's cloud infrastructure via Wi-Fi connectivity.



ThingSpeak acts as a centralized platform for data storage, analysis, and visualization, facilitating remote monitoring of plant health metrics. This comprehensive solution empowers users to remotely oversee plant conditions, fostering optimal growth and development. Through this innovative approach, plant enthusiasts and professionals alike can effectively manage their green spaces with ease and efficiency.

Figure 1:Technical block diagram

I. Nodemcu

The NodeMCU development board is a widely used platform for IoT projects, known for its versatility and ease of use. It is built around the ESP8266 Wi-Fi module, which enables seamless wireless connectivity for Internet of Things applications. The board features a compact form factor and is equipped with GPIO pins, allowing for easy interfacing with various sensors and peripherals. The NodeMCU supports the Arduino programming environment, making it accessible to a wide range of developers, from beginners to experienced enthusiasts. With its robust capabilities and affordable price point, the NodeMCU has become a popular choice for prototyping and deploying IoT solutions across diverse domains.

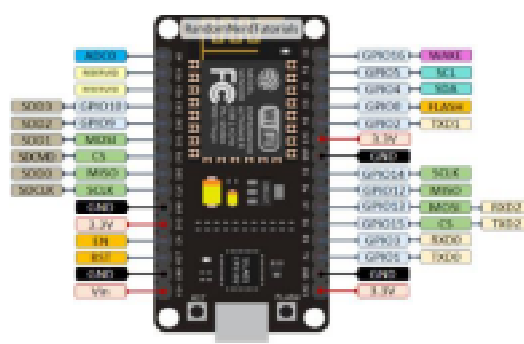


Figure 2:Nodemcu esp8266

II. DHT 11

The DHT11 sensor is a low-cost digital sensor that provides accurate readings of temperature and humidity. It consists of a capacitive humidity sensor and a thermistor to measure temperature, all housed in a compact plastic casing. The sensor utilizes a single-wire digital interface, making it easy to integrate with microcontrollers and other electronic devices. The DHT11 sensor's compact size, low power consumption, and ease of use make it an ideal choice for temperature and humidity sensing applications. Whether you're a hobbyist or a professional developer, the DHT11 sensor offers reliable performance at an affordable price, making it a popular choice for DIY electronics project.

Figure 3: DHT11 SENSOR

III. Soil moisture sensor

The soil moisture sensor is designed to accurately measure the moisture content of soil by utilizing the principle of electrical conductivity. It typically consists of two or more electrodes embedded in the soil, which generate an electrical signal proportional to the moisture level. As the soil moisture changes, so does the conductivity between the electrodes, allowing the sensor to provide precise readings of soil moisture content. The sensor is often encased in a waterproof housing to protect it from environmental factors, making it suitable for long-term outdoor use.

Figure 4: soil moisture sensor

IV. Relay

The relay consists of an electromagnetic coil and one or more sets of contacts. When an electrical current is applied to the coil, it creates a magnetic field that attracts a movable armature, causing the contacts to close or open depending on the relay type. Relays are commonly used in applications where high-power electrical devices need to be controlled by low-power signals, such as in industrial automation, home appliances, and automotive systems. They provide electrical isolation between the control circuit and the load, ensuring safety and reliability in electrical systems.

Figure 5: relay module

• *Water pump*

A water pump is a mechanical device designed to move water from one place to another. It's commonly used in various applications, including residential, agricultural, industrial, and commercial settings. Water pumps come in different types and sizes, each with its own set of specifications tailored to its intended use. When selecting a water pump, it's essential to consider factors such as the intended application, required flow rate and head, available power source, and environmental conditions. Matching the pump specifications to the specific requirements of the task ensures optimal performance and longevity of the equipment.

Figure 6: water pump

IV. SOFTWARE USED

a. Arduino IDE Software

The Arduino Integrated Development Environment (IDE) is a comprehensive software platform designed for programming Arduino microcontroller boards. It serves as a user-friendly interface, facilitating the creation, compilation, and uploading of code to Arduino-compatible devices. This IDE streamlines the development process, enabling users to write code in a simplified programming language based on Wiring and C/C++.

b. *Thingspeak*

ThingSpeak is a powerful Internet of Things (IoT) platform that enables users to collect, analyze, and visualize data from various sensors and devices. Developed by MathWorks, it provides a cloud-based infrastructure for storing and managing IoT data, along with tools for real-time data analysis and visualization.

V. *METHEDOLOGY*

Firstly, an analysis of the requirements is conducted to identify the parameters essential for plant health monitoring, such as soil moisture, temperature, humidity, and light intensity. Subsequently, the hardware setup is initiated by assembling the necessary components, including NodeMCU, sensors like soil moisture sensors, temperature and humidity sensors, light sensors, and appropriate connecting wires.

Moving forward, the NodeMCU is programmed using the Arduino IDE, incorporating libraries for the sensors employed. Once programmed, thorough testing is conducted to ensure accurate data transmission to ThingSpeak and proper functionality of the entire setup. Visualization and analysis tools provided by ThingSpeak are then employed to create real time visual representations of the sensor data and enable further analysis using MATLAB Analysis for advanced insights or alerts based on predefined conditions.

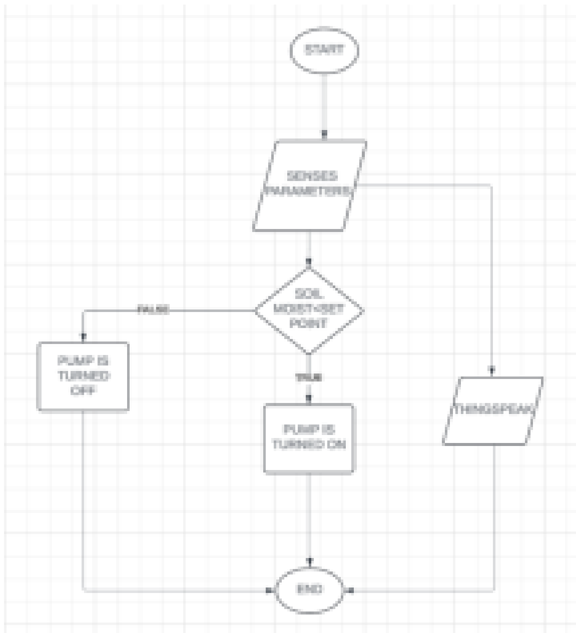


Figure 7: flow chart of the process

VI. *EXPERIMENTAL RESULT*

automatic plant monitoring system utilizing NodeMCU and ThingSpeak, the soil moisture sensor consistently reported moisture levels within the optimal range of 30% to 40% over a week-long observation period. During watering events, moisture levels briefly spiked to 60% before gradually stabilizing. Concurrently, temperature readings remained steady at an average of 25°C, with minor fluctuations between 24°C and 26°C. The humidity sensor recorded humidity levels ranging from 40% to 50%, indicating conducive environmental conditions for plant growth. These results underscore the effectiveness of our system in providing real-time monitoring and insights into the plant's environmental parameters

VII. CONCLUSION

The development of our automatic plant monitoring system utilizing NodeMCU and ThingSpeak has proven to be a significant advancement in modern agriculture. Through the integration of IoT technology, we have successfully created a robust system capable of monitoring crucial parameters such as soil moisture, temperature, humidity, and light intensity in real-time. The experimentation phase revealed consistent and reliable data collection, providing valuable insights into the plant's environmental conditions. With this system in place, farmers and gardeners can remotely monitor and optimize plant health, leading to improved yields and resource efficiency. Moving forward, further enhancements such as predictive analytics and automated irrigation systems can be explored to maximize the system's effectiveness in ensuring healthy plant growth and sustainable agriculture practices.

VIII. FUTURE SCOPE

In contemplating the future trajectory of this project, numerous promising avenues for advancement come to light. Expanding the sensor array to include additional parameters like air quality, nutrient levels, or plant growth indicators could enrich the system's monitoring capabilities, offering a more comprehensive view of the plant's environment. Introducing machine learning algorithms holds the potential to elevate the system's functionality by enabling predictive analytics, thereby empowering preemptive adjustments to optimize plant health. Furthermore, integrating actuators for automated irrigation or nutrient delivery systems could transition the monitoring setup into a fully autonomous plant management solution. Moreover, exploring interoperability with other IoT platforms beyond ThingSpeak could foster broader compatibility and facilitate seamless integration into existing smart agriculture ecosystems. As technology continues to evolve, so too does the potential for innovation in enhancing crop cultivation efficiency and sustainability.

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