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DEPARTMENT OF ELECTRONICS AND COMMUNICATION TECHONOLOGY

SMART SENSORS AND AGRICULTURAL DEVICES [21ECE203J]

MINI PROJECT REPORT

FINIDING SOIL MOISTURE USING IOT

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CONTENTS

ABSTRACT:

The utilization of Internet of Things (IoT) technology for soil moisture monitoring has gained significant attention in agricultural practices due to its potential to enhance crop yield and conserve water resources. This paper presents a comprehensive review of existing IoT-based soil moisture monitoring systems, focusing on their methodologies, technologies, and applications. Various sensing techniques, including capacitance, resistance, and dielectric methods, are analysed for their effectiveness in measuring soil moisture content. Furthermore, communication protocols such as Wi-Fi, LoRa, and NB-IoT are evaluated for their suitability in transmitting sensor data to the cloud for real-time monitoring and analysis.

Moreover, this paper discusses the challenges and opportunities associated with implementing IoT-based soil moisture monitoring systems, including sensor calibration, power management, data security, and scalability. Additionally, it explores the integration of machine learning algorithms for data analytics, enabling predictive insights and automated decision-making in agriculture. In conclusion, the review highlights the potential benefits of IoT-based soil moisture monitoring systems in optimizing irrigation strategies, improving resource efficiency, and enhancing agricultural productivity. Future research directions are proposed, emphasizing the need for interdisciplinary collaboration to address technical, environmental, and socioeconomic aspects for sustainable agriculture.

INTRODUCTION:

The advent of Internet of Things (IoT) technology presents a promising solution to these challenges. By integrating IoT devices with soil moisture sensors, farmers can access real-time data on soil moisture levels remotely, allowing for timely and informed irrigation decisions. This introduction serves as a primer on the paradigm shift brought about by IoT-based soil moisture monitoring systems.

Firstly, we delve into the principles of soil moisture measurement and its significance in agricultural productivity. Understanding the complex interplay between soil moisture, plant growth, and environmental factors is fundamental to appreciating the value of IoT-enabled monitoring systems. Next, we explore the components and functionality of IoT-based soil moisture monitoring systems. From the selection of appropriate sensors to the integration of communication protocols for data transmission, each aspect contributes to the system's effectiveness in providing actionable insights to farmers. Furthermore, we discuss the potential benefits of adopting IoT technology in agriculture, ranging from water conservation and improved crop yield to labour savings and environmental sustainability. By harnessing the power of IoT, farmers can optimize irrigation practices, mitigate risks associated with water scarcity, and enhance overall farm efficiency.

However, alongside the opportunities come challenges that must be addressed. Sensor calibration, data security, and interoperability issues pose significant hurdles in the widespread adoption of IoT-based soil moisture monitoring systems. Overcoming these challenges requires collaborative efforts from researchers, technologists, policymakers, and agricultural stake holders. In conclusion, this introduction sets the stage for exploring the innovative landscape of IoT-based soil moisture monitoring in agriculture. By embracing technology-driven solutions, farmers can navigate the complexities of modern farming practices with greater precision, resilience, and sustainability.

COMPONENTS USED:

- Soil Sensor
- LCD Panel
- Power Supply [DC FAN]
- Rectifiers
- 7805 Regulator
- Wi-Fi Module
- Transistors
- Diodes

COMPONENTS DISCRIPTION:

Soil sensor:

A soil sensor is a device used to measure various parameters of soil, such as moisture content, temperature, pH level, and nutrient levels. These sensors are essential tools in agriculture, environmental monitoring, and gardening, providing valuable data for optimizing irrigation schedules, fertilization practices, and overall soil health management. By continuously monitoring soil conditions, farmers and gardeners can make informed decisions to maximize crop yield, conserve water, and promote sustainable land use practices.

LCD Panel:

A 16x2 LCD panel consists of 16 characters arranged in 2 rows, making it capable of displaying up to 32 characters at once.16x2 LCD panels often use parallel or serial communication interfaces to connect to microcontrollers or other devices. Common protocols include HD44780-compatible parallel interface or I2C/SPI serial interfaces. Many 16x2 LCD panels feature backlighting, which enhances visibility in low-light conditions. Backlights are often LED-based and can be either white or coloured. These displays find applications in a wide range of devices, including DIY electronics projects, instrumentation panels, industrial control systems, and consumer electronics for displaying information such as text, numerical data, and simple graphics.

Rectifiers:

Rectifiers play a crucial role in modern electronics by converting AC power from mains or other sources into DC power suitable for powering electronic circuits. They are widely used in power supplies for electronic devices, ranging from small appliances to industrial machinery. The basic function of a rectifier is to allow current to flow in one direction while blocking it in the opposite direction. This process is achieved through semiconductor diodes, which form the heart of most rectifier circuits. Depending on the application, rectifiers can be half-wave, full-wave, or bridge rectifiers. Half-wave rectifiers pass only one half of the AC waveform, resulting in pulsating DC output. Full-wave rectifiers, such as the bridge rectifier, utilize both halves of the AC waveform to produce smoother DC output with less ripple. Bridge rectifiers are especially common due to their efficiency and simplicity. Rectifiers are essential components in power supply circuits for electronic devices, ensuring a steady and reliable source of DC power for proper operation. Their efficiency, reliability, and versatility make rectifiers indispensable in countless applications across various industries.

7805 Regulator:

The 7805 regulator is designed to provide a fixed output voltage of +5 volts DC. It can typically accept an input voltage range of 7 volts to 35 volts DC, making it suitable for regulating power from a wide range of sources, including batteries, rectified AC mains, or external power supplies. The maximum output current of the 7805 regulator is around 1 ampere, although this may vary slightly depending on the manufacturer and specific model. Many variants of the 7805 regulator include built-in thermal shutdown protection to prevent the device from overheating under excessive load conditions. The 7805 regulator is widely used in electronic circuits to provide a stable +5V power supply for microcontrollers, sensors, logic ICs, and other digital and analog components.

Wi-Fi Module:

Wi-Fi modules allow devices to establish connections to Wi-Fi networks, enabling them to communicate with other devices on the network and access the internet. Wi-Fi modules often come with embedded software stacks that handle network protocols, encryption, and other communication tasks, simplifying development and integration for device manufacturers. Wi-Fi modules can be configured to operate in various modes, such as client mode for connecting to existing Wi-Fi networks, access point mode for creating Wi-Fi hotspots, or both simultaneously. Wi-Fi modules support various security protocols, including WPA2-PSK, WPA3, and enterprise-level authentication methods, to ensure secure communication over Wi-Fi networks. Wi-Fi modules find widespread use in consumer electronics, IoT devices, industrial automation, smart home systems, and other applications requiring wireless connectivity and internet access.

Transistors:

Transistors are commonly used as switches to control the flow of current in IoT devices. They can turn components on or off based on digital signals from microcontrollers or sensors. This functionality is essential for managing power consumption and enabling energy-efficient operation in IoT systems. Transistors amplify weak signals from sensors or other input devices, allowing IoT devices to detect and process environmental data more accurately. By boosting signal strength, transistors help improve the sensitivity and reliability of sensor measurements in IoT applications. Transistors are integral to power management circuits in IoT devices, regulating voltage levels and controlling power distribution to various components. They help optimize power consumption, extend battery life, and ensure efficient operation of IoT devices in diverse environments. Transistors are essential components in the control logic of IoT devices, implementing functions such as logic gates, timers, and state machines. They enable decision-making and logic operations based on input signals, allowing IoT devices to perform complex tasks and respond dynamically to changing conditions.

Diodes:

Diodes are commonly used for rectification, converting alternating current (AC) to direct current (DC) in power supplies for IoT devices. This ensures a steady and reliable source of power for the device's operation. Diodes can be employed to protect IoT devices from damage due to reverse polarity connections. By allowing current to flow only in one direction, diodes prevent damage to sensitive components in the event of incorrect power supply polarity. Zener diodes are frequently used for voltage regulation in IoT devices, maintaining a stable output voltage even when input voltage fluctuates. This is crucial for ensuring consistent performance and protection against overvoltage conditions. Light-emitting diodes (LEDs) are widely used as indicators in IoT devices, providing visual feedback on device status, connectivity, or operational modes. LEDs are energy-efficient and can be easily controlled by microcontrollers or other circuitry.

PROPOSED METHODOLOGY:

This is used to find soil moisture and humidity while either urea or fertiliser are supplied to agriculture field from tank. New technique used here is that once when the urea or fertilisers get supplied, at that time using internet connection we can on off the sensor using mobile phone. So this type of prototype can be used worldwide using internet connectivity. Main aim of the project is to reduce the man labour and all details can be monitored using mobile applications. Ultrasonic sensor used to maintain the level of urea. Previous projects based on this topic are just done using Arduino and using DC motors and many no connecting wires. This may lead to the malfunctions when wired gets lose or may get disconnected and that can be run only through push button after coding's get inserted. But now coding's gets reduced and a temporary web link has been created and that can be accessible through mobile applications all over the world just by using the internet connections. Further we can develop permanent web page using HTM CSS JAVA and that can be linked through Arduino IDE and it can be used permanently.

Sensor Selection: Choose appropriate sensors for measuring soil moisture and humidity. Capacitive soil moisture sensors and DHT series sensors (such as DHT11 or DHT22) are commonly used for this purpose.

Alerting System: Implement an alerting system to notify users when soil moisture or humidity levels deviate from predefined thresholds. You can use email notifications, SMS alerts, or push notifications through a mobile app.

Data Transmission: Use an IoT module (like ESP8266 or ESP32) to transmit the sensor data to the cloud. You can use protocols like MQTT or HTTP to send the data.

Data Interpretation and Action: Based on the analyzed data, take appropriate actions such as adjusting irrigation schedules, activating sprinkler systems, or notifying farmers to take corrective measures.

Integration with Other Systems: Optionally, integrate the soil moisture and humidity data with other agricultural systems, such as weather forecasts or crop management software, to enhance decision-making processes.

EXSISTING METHODOLOGY:

Previous projects based on this topics are just done using Arduino and using DC motors and many no connecting wires. This may lead to the malfunctions when wired gets lose or may get disconnected and that can be run only through push button after coding's get inserted. But now coding's gets reduced and a temporary web link has been created and that can be accessible through mobile applications all over the world just by using the internet connections. Further we can develop permanent web page using HTM CSS JAVA and that can be linked through Arduino IDE and it can be used permanently.

NEW INNOVATION ON THIS PROJECT:

There have been several innovative developments in using IoT (Internet of Things) for soil moisture monitoring and management. Here are some notable ones:

Wireless Soil Moisture Sensors: Traditional soil moisture sensors required manual readings or wired connections, limiting their practicality for widespread deployment. IoT-enabled sensors, however, can transmit data wirelessly, allowing real-time monitoring across large areas. These sensors often use technologies like LoRa WAN or NB-IoT for long-range communication.

Low-Power Design: IoT devices optimized for low power consumption can operate for extended periods on battery power or even harvest energy from the environment, making them suitable for remote and off-grid locations.

Data Analytics and Predictive Modelling: Advanced analytics techniques, including machine learning algorithms, can process the data collected from IoT sensors to provide insights into soil moisture trends, predict future conditions, and optimize irrigation schedules. These predictive models can help farmers make data-driven decisions to improve crop yields and water efficiency.

Integration with Weather Forecasting: Combining soil moisture data with weather forecasts allows for more accurate predictions of irrigation requirements. By analysing weather patterns and soil moisture levels in real-time, farmers can adjust their irrigation schedules to match changing environmental conditions and optimize water usage.

Mobile Applications and Remote Monitoring: Mobile apps connected to IoT soil moisture monitoring systems enable farmers to remotely access real-time data and receive alerts or notifications about critical moisture levels. This capability allows for timely interventions and reduces the need for physical inspections.

Cloud-Based Platforms: Cloud-based IoT platforms offer scalability and accessibility, allowing users to store, analyse, and visualize large volumes of soil moisture data from anywhere with an internet connection. These platforms often provide customizable dashboards and reporting tools for easier data interpretation.

Sensor Fusion: Integrating soil moisture data with other environmental parameters such as temperature, humidity, and rainfall can provide a more comprehensive understanding of soil conditions and plant water needs. Sensor fusion techniques enhance the accuracy of soil moisture monitoring systems and enable more precise irrigation management.

Automated Irrigation Systems: IoT-enabled irrigation systems can automatically adjust watering schedules based on real-time soil moisture data, weather forecasts, and crop requirements. These systems optimize water usage, minimize waste, and reduce the manual effort required for irrigation management.

These innovations in IoT soil moisture monitoring offer significant benefits for agriculture, including improved water efficiency, increased crop yields, and more sustainable farming practices.

PICTURE REPRESENTATION:

OUTPUT:

CONCLUSION:

In conclusion, leveraging IoT technology for soil moisture monitoring presents a transformative approach to agricultural management. By integrating wireless sensors, advanced analytics, and remote monitoring capabilities, IoT solutions offer real-time insights into soil conditions, enabling farmers to optimize irrigation practices, conserve water resources, and enhance crop yields. The adoption of IoT in soil moisture monitoring brings several advantages, including:

Precision Irrigation: Real-time data from IoT sensors allows for precise irrigation scheduling, ensuring that crops receive the right amount of water at the right time. This optimization minimizes water waste and reduces the risk of over or under-watering.

Data-Driven Decision Making: IoT-enabled analytics provide farmers with actionable insights into soil moisture trends, enabling informed decisions about irrigation management, crop selection, and resource allocation.

Resource Efficiency: By accurately monitoring soil moisture levels and integrating data with weather forecasts, IoT systems help farmers optimize water usage, energy consumption, and fertilizer application, leading to more efficient farming practices.

Remote Monitoring and Control: Mobile applications and cloud-based platforms enable farmers to remotely access soil moisture data, receive alerts about critical conditions, and adjust irrigation settings from anywhere, improving operational efficiency and reducing manual labour.

Sustainability: IoT-based soil moisture monitoring promotes sustainable agriculture by reducing water waste, minimizing environmental impact, and supporting conservation efforts. By optimizing irrigation practices, farmers can mitigate the effects of drought, improve soil health, and preserve natural resources for future generations.

Overall, the integration of IoT technology in soil moisture monitoring represents a significant advancement in precision agriculture, offering scalable and cost-effective solutions for optimizing crop production while promoting environmental sustainability. As technology continues to evolve, further innovations in IoT-enabled soil moisture management are expected to drive increased efficiency, productivity, and resilience in agricultural systems.

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