Automatic Soil Moisturizing System

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ABSTRACT:-
Soil moisture is directly related to the amount of irrigation in agriculture and affects crop yields. Therefore, a soil moisture sensor is an important tool for measuring soil moisture content. In this study, the previous the research done in the last 2-3 decades on soil moisture sensors and the principles of commonly used soil was reviewed humidity sensors and their various applications were summarized. Further advantages, disadvantages and influence the factors of the different measurement methods used were compared and analysed. Improvements introduced several researchers have established the main applications and performance levels of soil moisture sensors by establishing course for future development. These studies suggested that soil moisture sensors should be developed in the future to achieve this goal highly accurate, low-cost, non-destructive, automated and highly integrated systems. It was also stated that future studies should include the development of specialized sensors for different applications and scenarios. This review research aimed to provide some reference for the application department and scientific researchers in the selection process of soil moisture sensor products and measuring soil moisture.
Although many researches on soil sensors have been completed soil sensor users still face many problems due to differences in principle, type and design, along with the advantages of moisture sensors .Therefore, this study covers research studies since 2000 exceeds. These studies, together with the development history of soil sensors, were collected and analysed and the principles, methods and applications of were examined from different perspectives. The development of the soil moisture sensor was then discussed, and the departments using soil sensor products in the implementation process should provide a reference value for users and researchers and encourage further research. Soil moisture sensor.

I. INTRODUCTION:

Fresh water is a renewable but variable natural resource. Fresh water is usable by humans 0.01% of the total amount of water on Earth. Because of the population Growth and increase in water consumption per capita, some this area is currently facing a water shortage. It is agriculture consumes the sweetest water in the world, it supplies up to 80% of the water needed by the community. That It is estimated that 70% of the world's water is used for irrigation. Between 15 and 35 percent of the water taken from irrigation Unstable. In traditional upland agriculture, The amount of water and the possibility of inefficient use of water in farms .Farming causes overwatering, which can lead to plant washoutNutrients and fertilizers of the root system and finally reductionreturns.

Although several studies have already been done on soil sensors soil sensor users still face numerous challenges due to different principles, types and production standards, as well as different qualities of soil moisture sensors. Consequently, this study outperformed relevant works studies since 2000. Studies were retrieved and analysed, combined with the history of soil sensor development, analysis principles, methods and applications of various perspectives. Next, the development trend of soil moisture sensors were discussed with the expectation that applications departments, users and scientific researchers who use the soil sensor. Soil moisture sensor location and optimal number of sensorsare also important factors that significantly affect the sensor surfaceirrigation automation, performance and economy. This is still aresearch question to be evaluated. Therefore, an experiment was planned to develop a wireless watershed automatic irrigation

system based on an IOT-based soil moisture sensor to improve field application. Efficiency. An attempt was also made to find a suitable place, depth and number of soil moisture sensors in connection with the automaton control gate in the watershed layout field. This vital information can help in the up scaling of the automation distribution network of water in canals irrigation systems.Products provide some reference value in the process and promote further research on soil moisture sensors.
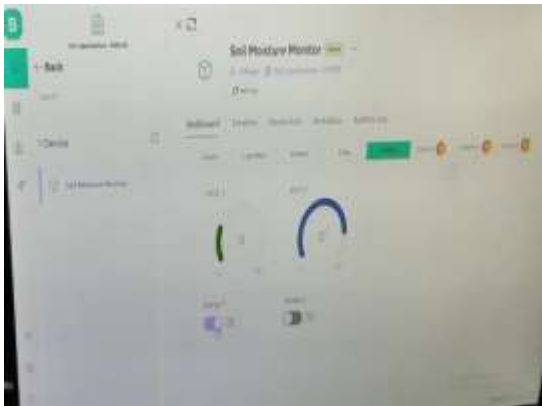
Component:
Hardware Component-

- ESP-32:

The ESP32 can be used in soil moisture sensing projects to measure soil moisture and automatically water plants based on their specific needs. Here are some ways in which the ESP32 can be used in a soil moisture sensing project. The ESP32 can be connected to a soil moisture sensor to measure soil moisture near plant roots. The ESP32 can be used to create a control circuit that regulates the watering of plants based on soil moisture readings. It can use the humidity data to turn water pumps connected to the system on and off. Data logging and analytics: The ESP32 can be used to periodically log and analyse soil moisture

data, allowing for the optimization of watering schedules and the development of more precise watering algorithms. Wireless Connectivity: The ESP32 can be equipped with Wi-Fi or Bluetooth connectivity to enable remote monitoring and control of the system via smartphone or computer. This feature is particularly useful for agricultural and environmental monitoring applications. Overall, the ESP32's integrated Wi-Fi and Bluetooth connectivity, along with its dual-core processor and range of peripheral interfaces, make it a versatile and powerful microcontroller for soil moisture-sensing projects. It can be used to automate plant watering, optimize water use, and improve plant health and growth.Adriano and ESP32 are popular microcontroller platforms used for building electronic projects, but there are some key differences between them. Here are some comparisons between the two platforms:

Processor: Adriano boards are usually based on Atmel AVR microcontrollers, while ESP32 is based on ten silica Xtensa LX6 microcontroller. The ESP32 has a higher clock speed and more memory than most Adriano boards. Wireless connectivity: The Adriano platform does not have built-in Wi-Fi or Bluetooth connectivity, while the ESP32 has an integrated Wi-Fi and Bluetooth module, making it a better choice for IOT applications that require wireless communication.
Price: Adriano boards are generally cheaper than ESP32 boards, but the price depends on the specific board and its features.

Power consumption: The ESP32 has a low power mode, which makes it more suitable for battery-powered applications that require long battery life. Development Environment: The Adriano platform has a well-established and user-friendly integrated development environment (IDE) that makes it easy to write, compile, and upload code. ESP32 has several development environments available, including Adriano IDE, Micro Python and ESP-IDF (Expressive IOT Development Framework).

I/O Pins: Adriano boards have a larger number of digital and analog input/output (I/O) pins than most ESP32 boards, making them more suitable for complex projects that require a large number of sensors or actuators.

Overall, Adriano and ESP32 are powerful and popular microcontroller platforms, but they have different features and capabilities that make them more suitable for different types of projects. Adriano is a good choice for beginners and projects that do not require wireless connectivity, while ESP32 is a better choice for more advanced

projects that require wireless communication or low power operation.

- **Soil Sensor:**
A soil moisture sensor is a device that measures the amount of moisture in the soil. Soil moisture sensors are important tools for farmers, ecologists, and environmental scientists as they provide vital information about the water content of soil, which can have significant impacts on plant growth, soil health, and the environment.

There are various types of soil moisture sensors, each with their own working principles and applications. Some of the most commonly used types of soil moisture sensors include:

Tensiometers:Tensiometers measure the amount of tension or suction required to extract water from the soil. The water tension is directly related to the soil moisture content, and tensiometers are commonly used for agricultural applications.

Capacitance sensors: Capacitance sensors measure the dielectric constant of the soil, which is related to the soil's moisture content. These sensors work by transmitting a high-frequency signal into the soil, and the capacitance of the soil changes based on the water content.

Time domain reflectometry (TDR) sensors: TDR sensors measure the time taken for an electromagnetic pulse to travel through the soil, which is related to the soil's dielectric constant and moisture content.

Electrical resistance sensors: Electrical resistance sensors measure the electrical resistance of the soil, which changes based on the soil's moisture content.

Gypsum block sensors: Gypsum block sensors use a porous ceramic block coated with gypsum, which absorbs water from the soil. As the block absorbs water, it expands and changes the electrical resistance of the sensor, which is related to the soil's moisture content.In recent years, microcontrollers such as the ESP32 have been used to create low-cost and effective soil moisture sensors. These sensors can be programmed to transmit data wirelessly, making them ideal for remote monitoring and data collection. The ESP32-based soil moisture sensorsare becoming popular due to their affordability, portability, and ease of use. In conclusion, soil moisture sensors are important tools for monitoring soil moisture content in agriculture, ecology, and environmental science. By providing real-time data on soil moisture content, these sensors can help farmers make informed decisions about irrigation and crop management, and provide valuable information for environmental research and management.

- **Jumper wire:**
Jumper wires are often used to connect different components in electronics and prototyping projects. There are different types of jumper wires, such as male to male, female to female, and male to female. This content describes the types of male and female jumper wires.

A male to female jumper wire has a male pin on one end and a female socket on the other end. Male pins are usually straight or angled header pins that can be inserted into breadboards or other female sockets. Female sockets are usually standard 0.1 inch header sockets that can accept male pins or other female sockets.

Male to female jumper wires are useful for connecting components with different pin configurations. For example, Adriano boards may have male pins and sensors, and LEDs may have female sockets. In such cases, a male to female jumper wire can be used to connect the two components. Male to female jumper wires are produced in different lengths, colours and gauges. The length of the wire varies from a few centimetres to a few meters depending on the needs of the project. Wire colour helps identify different connections and reduce confusion in complex projects. Wire gauge refers to the thickness of the wire, with lower gauge numbers indicating thicker wires. Thicker wires can carry more current and are better suited for high power applications. Male to female jumper wires are also available in insulation types such as PVC and silicone. The insulation material affects the flexibility and durability of the wires. PVC insulation is rigid and inflexible, while silicone insulation is soft and flexible. Silicone insulated wire is also very resistant to high temperatures and can be used in hot applications.

In short, male to female jumper wires are versatile and useful components for electronics and prototyping projects. They can be used to connect components with different pin configurations, come in different lengths, colours, gauges and types of insulation, and are essential for building and testing circuits.

- **PCB Board:**
PCB (Printed Circuit Board) A board made of non-conductive material (usually fiberglass or plastic) on which electronic components and circuits are mounted. It is used to create a safe and stable platform for electrical connections between components in scientific experiments and electronic projects.

A PCB board consists of layers of copper foil that are separated to form a circuit board. The chain pattern is created using computer-aided

design (CAD) software and printed on the board using a special printer. After the pattern is printed, the copper layer is chemically removed to leave the required circuit.

- **USB Cable:**
A USB Data cable is a type of USB cable used to transfer data between electronic devices such as smartphones, tablets, cameras, and computers. These cables usually have a USB Type-A connector on one end and a Micro-USB, USB Type-C, or Lightning connector on the other, depending on how the device is connected.USB data cables come in different versions, including USB 1.0, USB 2.0, USB 3.0 and USB 4.0, each with specifications for data transfer speeds. USB 2.0 is the most widely used version for data transfer as it offers fast data transfer speeds ofup to 480 Mbit/s, while USB 3.0 and USB 4.0 offer faster data transfer speeds.

Software Component:
Microcontroller Programming: The ESP32 must be programmed using an appropriate programming language (such as C++) to perform the functions required for the soil moisture system. These programs typically involve reading, processing, and transmitting sensor data wirelessly.

Sensor Data Processing: After the sensor data is read by the ESP32, it must be processed to determine soil moisture. This may include converting sensor readings to a meaningful scale, applying calibration factors, and applying any necessary filtering or smoothing.

Wireless Communication: If the soil moisture system is designed to be wireless (e.g. via Wi-Fi or Bluetooth), the ESP32 must be programmed to establish a wireless connection, format the data, and send it to the receiver. Devices (such as smartphones or computers).

User Interface: A user interface is usually required to allow the user to view soil moisture data and configure system settings. This may involve developing a mobile app or web interface that communicates with the ESP32 over a wireless network.

Data Storage and Analysis: If the soil moisture system is designed to record data over time, the ESP32 must be programmed to store the data in an appropriate format (file or database) for later analysis. It may involve developing software to perform data analysis, generate reports, or present data in a meaningful way.

using a breadboard and jumper wires. The ESP32 microcontroller is connected to your computer using a USB cable.

II. METHODOLOGY:
Soil moisture sensors are widely used in agriculture, environmental monitoring and research. They help farmers optimize irrigation and fertilization and enable researchers to study plant growth and ecosystem dynamics. However, conventional soil moisture sensors are expensive and require extensive wiring, making them inaccessible for small research projects. The ESP32 microcontroller is an affordable and powerful device that can be used to create soil moisture sensors. This paper presents a detailed method to create a soil moisture sensor using ESP32 microcontroller.

Materials for this project you will need the following materials:
- ESP32 microcontroller
- Soil moisture sensor
- bread board
- jumper
- USB cable
- Circuit setup

The first step in creating a soil moisture sensor using an ESP32 microcontroller is to set up the circuit. Soil moisture sensors usually have two probes that must be connected to the microcontroller. A probe is inserted into the soil to measure soil moisture. The circuit can be set up

Programming:
The next step is to program the ESP32 microcontroller using the Adriano Integrated Development Environment (IDE). The program must read the analog input from the soil moisture sensor and convert it into a digital signal. A digital signal must be sent to a computer for analysis. The following steps provide an overview of the programming process.

- Step 1: Install the Adriano IDE and ESP32 board package.
- Step 2: Open the Adriano IDE and select the appropriate board and port.
- Step 3: Create a new design and define a soil moisture sensor and a pin for data transfer.
- Step 4: Define variables for sensor reading and data transfer.
- Step 5: Write an initialization function to initialize the serial communication and the soil moisture sensor.
- Step 6: Write a loop function to continuously read the soil moisture level and send the data to your computer.

Data Collection:

Once the program is loaded into the microcontroller, the soil moisture sensor can be placed in the soil and data collection can begin. The microcontroller will continuously read the soil moisture level and send the data to the computer for analysis. The following steps describe the data collection process:

- Step 1: Place the soil moisture sensor in the soil.
- Step 2: Open the serial monitor in the Adriano IDE.
- Step 3: Record the readings over a period of time.
- Step 4: Save the data to a file for analysis.

Data analysis

The collected data can be analysed using software such as MATLAB or Python. The data can be graphed to show soil moisture levels over time. Statistical analysis can be performed to determine the significance of the data. The following steps describe the data analysis process:

- Step 1: Import the data into the analysis software.
- Step 2: Graph the data to show soil moisture levels over time.
- Step 3: Perform statistical analysis such as calculating the mean and standard deviation.
- Step 4: Interpret the data to draw conclusions.

Calibration

It is important to calibrate the soil moisture sensor before use. This involves measuring the soil moisture level using a standard method and adjusting the sensor values accordingly. The following steps describe the calibration process:

- Step 1: Measure the soil moisture level using a standard method such as gravimetric analysis or a commercial soil moisture sensor.
- Step 2: Record the readings from the soil moisture sensor.
- Step 3: Calculate the calibration factor by dividing the standard humidity level by the sensor reading.
- Step 4: Apply the calibration factor to future sensor values.

Experimentation:

Once the soil moisture sensor is calibrated, it can be used to conduct experiments. For example, the sensor can be used to determine the optimum moisture level for plant growth or to compare the soil moisture levels of different soil types.

In conclusion, using an ESP32 microcontroller to create a soil moisture sensor is a cost-effective and efficient way to measure soil moisture levels. The collected data can be analysed using various software tools and used for experimentation and research. Sensor calibration is critical to obtaining accurate data, and experiments can be designed to answer specific research questions.

Flowchart:
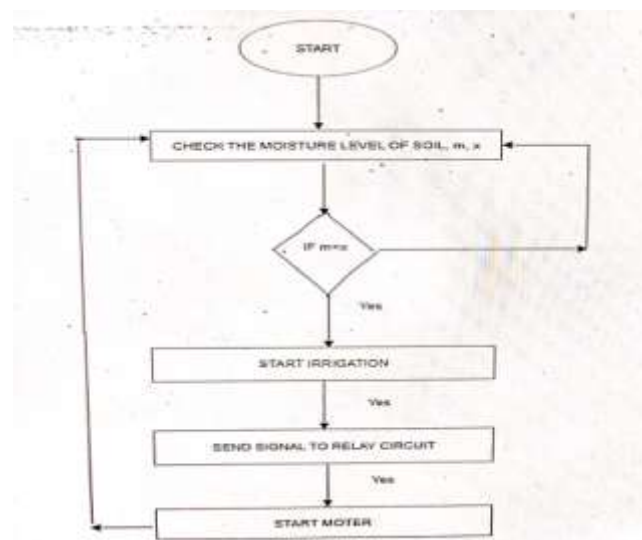
Circuit Diagram:
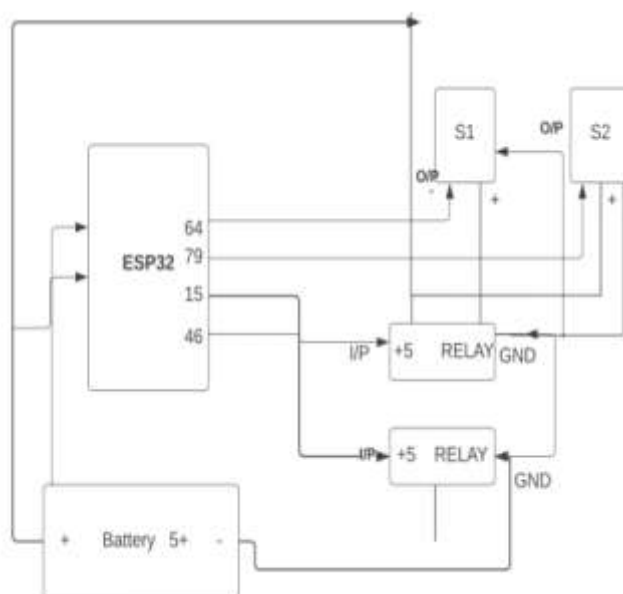
III.   CONCLUSION:

In conclusion, this research paper presents a detailed method to create soil moisture sensors using ESP32 microcontrollers. This method includes circuit setup, programming, data collection and analysis, calibration and testing. Using an ESP32 microcontroller makes building a soil moisture sensor affordable and easy, making it a great tool for small research projects. Soil moisture sensors can be used in agricultural, ecological and environmental applications to monitor soil moisture levels. Collected data can be analysed to determine soil moisture levels and make informed decisions about water management. In addition, sensors can be used to investigate the influence of environmental factors on soil moisture levels such as temperature, rainfall and irrigation.

Overall, the ESP32-based soil moisture sensor provides a cost-effective and easy solution for monitoring soil moisture levels. By following the methodology outlined in this research paper, researchers can build their own soil moisture sensors and collect data for their research projects. This technology can have a significant impact not only in the fields of soil science and agriculture, but also in other fields such as environmental monitoring and protection.

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