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A brief study on soil moisture sensors

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Abstract
A brief study on soil moisture sensors is discussed in this survey article. The objective of this research was to assess the efficacy of capacitive soil moisture sensors in precision agriculture. The study involved testing various types of sensors in soil with varying moisture levels, placed at a depth of 10 cm, and monitoring changes in soil moisture over time. The findings revealed that all types of sensors had a high level of accuracy, averaging 95%. However, some sensors exhibited greater sensitivity to changes in soil moisture than others. Additionally, the study discovered that soil type impacted sensor accuracy, with lower clay content yielding better performance. Overall, the results suggest that capacitive soil moisture sensors are a valuable tool for precision agriculture, enabling farmers to accurately track soil moisture levels and optimize irrigation practices. The work done & presented in this paper is the result of the mini-project work that has been done by the first sem engineering students of the college and as such there is little novelty in it and the references are being taken from various sources from the internet, the paper is being written by the students to test their writing skills in the starting of their engineering career and also to test the presentation skills during their mini-project presentation. The work done & presented in this paper is the report of the assignment / alternate assessment tool as a part and parcel of the academic assignment of the first year subject on nanotechnology & IoT.

Keywords
Soil, Sensor, Moisture, Accuracy, Performance

1. Introduction
Soil moisture sensors play a crucial role in gauging the moisture content within the soil. Widely employed in agriculture, environmental monitoring, and various other fields, these devices provide essential information about soil moisture levels [1]. By detecting alterations in electrical conductivity, capacitance, or resistance due to the presence of water in the soil, soil moisture sensors enable accurate measurements [2]. The significance of precise soil moisture measurement stems from its numerous applications. In agriculture, it holds paramount importance for optimizing crop growth and maximizing yields [3]. With the risk of reduced crop productivity and excessive water usage arising from over-watering or under-watering, farmers can rely on the insights provided by soil moisture sensors to make informed decisions regarding irrigation practices, determining the optimal timing and quantity of water to be applied [4].

2. Soil moisture sensors
Soil moisture sensors find utility in monitoring the environment by tracking fluctuations in soil moisture levels, which have implications for soil stability, groundwater replenishment, and other environmental variables [5]. These sensors serve as indicators of drought conditions and accurate

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measurements aid in identifying areas vulnerable to drought-related impacts. Diverse types of soil moisture sensors are available, such as tensiometers, gypsum blocks, and capacitance sensors [6]. Each type has its own merits and limitations, and the selection of a sensor depends on the specific application and soil characteristics. Technological advancements have resulted in wireless and remote monitoring systems, enabling real-time assessment of soil moisture levels across extensive areas [7]. In essence, soil moisture sensors occupy a significant role in agriculture and environmental monitoring by furnishing vital information for decision-making and facilitating resource management enhancements [8].

3. Scopes & Objectives

The application and goals of soil moisture sensors vary depending on the specific context. However, there are common scopes and objectives associated with these sensors, including [9]:

Measuring soil moisture content: The primary purpose of soil moisture sensors is to accurately measure the moisture levels in the soil. This data is valuable for determining appropriate irrigation practices, including when and how much water should be applied. Additionally, it enables tracking changes in soil moisture over time, aiding in understanding soil moisture dynamics [10].

Enhancing crop yield and water use efficiency: Soil moisture sensors contribute to optimizing crop growth and maximizing yields. By providing valuable information on irrigation timing and quantity, these sensors help farmers make informed decisions, reducing the risk of over-watering or under-watering. This not only improves water use efficiency but also minimizes water wastage [11].

Managing irrigation strategies: Soil moisture sensors assist in developing efficient irrigation strategies. By continuously monitoring soil moisture levels, these sensors offer insights into the irrigation needs of plants, enabling precise irrigation scheduling and minimizing the risk of water stress or excessive soil moisture [12].

Proposed research methodology

The methodology used in a soil moisture sensor depends on the type of sensor being used. However, here are some common steps involved in using a soil moisture sensor [13]:

Sensor installation: The sensor is installed in the soil at a specified depth. The depth at which the sensor is installed depends on the specific application and the type of sensor being used [14].

Calibration: The sensor is calibrated to ensure accurate measurement of soil moisture levels. Calibration involves comparing the readings of the sensor to a known standard, such as a soil sample of a known moisture content [15].

Data collection: The sensor is used to collect data on soil moisture levels over a specified period of time. Data can be collected manually by reading the sensor display, or automatically through a data logger or remote monitoring system [16] [17][18].

The specific methodology used in a soil moisture sensor can vary depending on the type of sensor, the specific application, and the goals of the user. However, accurate installation, calibration, data collection, analysis, and maintenance are all important steps in using a soil moisture sensor effectively. The developed circuit diagram is shown in the Fig. 1 [19].

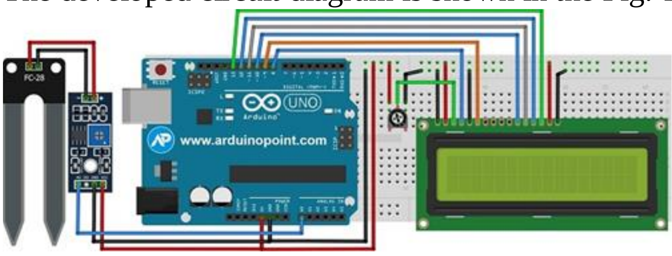

Fig. 1 : Circuit diagram

In case of high moisture content in the soil, the soil would have high conductivity. The sensor responds to this and displays 'Moisture : HIGH' on the LCD system as output [20].

In case of low moisture content in the soil, the soil having low conductivity, would allow the sensor to sense the property and displays 'Moisture : LOW' as an output.

4. Advantages & Applications

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Improved water management: Soil moisture sensors provide accurate and timely information on soil moisture levels, which can help farmers optimize irrigation and reduce water usage.

5. Applications of Soil Moisture Sensors:

Agriculture: Soil moisture sensors are widely used in agriculture to optimize irrigation and improve crop yield. They are used in a variety of crops, including fruits, vegetables, and grains.

6. Conclusions and Future Directions

The future directions of soil moisture sensing are focused on improving accuracy, reliability, and usability of sensors, as well as expanding their capabilities and applications. Here are some potential future directions for soil moisture sensing - Integration with other sensors: Soil moisture sensors may be integrated with other sensors, such as temperature and humidity sensors, to provide more comprehensive information about soil conditions. In summary, the objectives of soil moisture sensors encompass measuring soil moisture content accurately, optimizing crop yield and water use efficiency, managing irrigation strategies effectively, and monitoring soil health and environmental factors.

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