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SUSTAINABLE FARMING WITH SMART IRRIGATION TECHNOLOGY

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Abstract: In a smart irrigation system, we read the soil moisture value and control the water pump using controllers like Arduino, raspberry Pico and etc. But it is quite costly and overwork. For reducing the troubles here we simply using the components Moisture sensor, Relay module, DC pump, Regulator and wires. In this method we simply power the moisture sensor and Relay using the 9V battery and 7805 Regulator. If the sensor properly worked then we connect the output of the moisture sensor to the Relay module input. Then the low moisture detected from soil the automatically switch on the Relay. Here the Dc pump is attached with relay module. Then pump will pump the water. In case the soil Moisture is get enough water then the relay will automatically off

***Index Terms* – Liquid limit, Plastic limit, Sand replacement, Core cutter, sensors.**

I. INTRODUCTION

Engineering has been around since the beginning of time, with civil engineering being one of the oldest. From the towering pyramids of Egypt to the modern marvels of skyscrapers and bridges, civil engineers have played a vital role in shaping the built environment and fostering human progress. Irrigation plays a vital role in agriculture by increasing production and reviving damaged soils. However, water scarcity is a growing global issue, especially in countries like India where agriculture is a significant contributor to the GDP. Traditional irrigation methods often result in water waste and low crop yields due to inaccurate water management. Smart irrigation, integrating sensors, weather data, and automation, is a solution to this problem. It minimizes water waste, maximizes efficiency, and promotes healthier plant growth. Soil moisture sensors are crucial in smart irrigation systems, helping determine soil moisture levels and optimizing watering schedules. These sensors measure water content using various techniques and are essential for sustainable water management in agriculture

II. MATERIALS USED

A. Moisture sensor

Measures soil water content, ensuring optimal conditions for plant growth. Cost-effective and easy to use, operating voltage 3.3V to 5V.

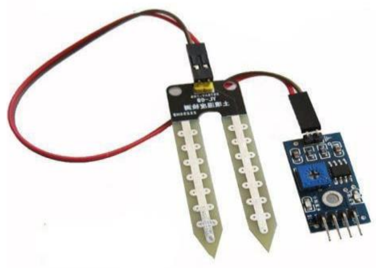

figure a

B. Relay module

Switches electrical devices on/off, isolating control circuits for safe operation. Chosen module operates at 5V with a single channel

figure b

C. Nine-volt battery

Supplies 9 volts, commonly used in various portable devices. Environmentally friendly, with a discharge time of 9 hours.

figure c

D. Regulator (RANVIKAR 7805)

Controls voltage, generating a regulated output from an unregulated input. Used in integrated circuits (ICs).

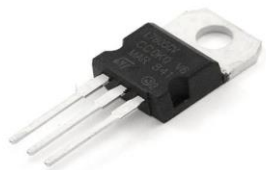

figure d

E. DC Motor pump(5v)

Small water pump motor powered by direct current. Maximum flow rate of 80 to 120 litres per hour, operating at 5V with low current consumption.

figure e

III. SOIL INVESTIGATION

Experiments conducted on soil based on moisture contents:

Liquid limit:

In the concept of liquid limit based on moisture content refers to the moisture content of soil at which it transitions from a semi-solid state to a more liquid-like consistency. Understanding this transition point is crucial for farmers and irrigation specialists to determine the optimal moisture levels for different types of crops. By knowing the liquid limit, they can adjust irrigation schedules to ensure that soil moisture remains within the ideal range for plant growth and development. This helps to prevent both waterlogging and drought stress, thereby maximizing crop yields.

figure 1

Plastic limit:

The plastic limit, similar to the liquid limit, is another important property of soil used in irrigation. It represents the moisture content at which the soil changes from a plastic, mouldable state to a semi-solid state. In irrigation, understanding the plastic limit helps determine the soil's ability to retain water and its susceptibility to compaction. Farmers and irrigation specialists use this information to optimize irrigation practices, ensuring that soil moisture levels remain within the desired range for healthy plant growth while minimizing water waste and soil erosion.

figure 2

Sand replacement:

Sand replacement is a method used to determine the in-place density of soil. In the context of irrigation, understanding the in-place density of soil is crucial for designing efficient irrigation systems and assessing soil compaction, which can affect water infiltration and root growth. By replacing a known volume of soil with sand of a known density and measuring the mass of soil excavated, engineers can calculate the in-place density.

figure 3

Core cutter:

The core cutter method is another technique used to determine the in-situ density of soil, particularly in irrigation applications. It involves driving a cylindrical steel cutter into the soil to extract a core sample, which is then weighed and measured to calculate its density. By measuring the volume and mass of the core sample, engineers can determine the soil's in-situ density, which is crucial for designing irrigation systems, assessing soil compaction, and understanding water

figure 4

IV. METHODOLOGY

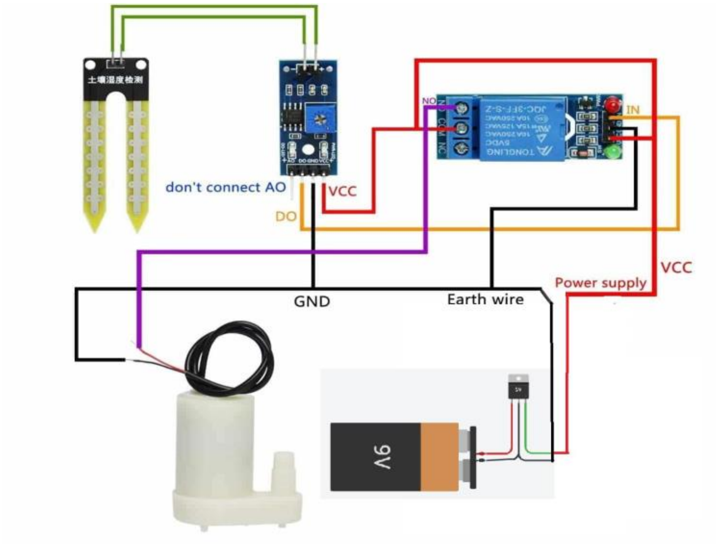

figure 4.1

Regulator, soil moisture sensor, relay, Dc motor and battery are all connected as shown in the circuit diagram connection is done using soldering method. After the connection insert soil moisture sensor into soil and connect the battery. Immerse the Dc motor into the water that required amount of pump to the plant. As required amount of water is pumped the motor stops automatically.

figure 4.2

V. RESULT AND CONCLUSIONS

- Soil moisture plays a crucial role in various soil properties and engineering tests. Liquid and plastic limits indicate the transition from solid to liquid and plastic states respectively.
- Increasing moisture content leads to greater fluidity and decreased resistance to deformation.
- Sand replacement and core cutter tests determine in-place density, influenced by moisture content.
- Irrigation affects soil density by altering moisture levels, impacting compaction and permeability.
- Higher moisture content generally results in lower soil density due to increased void volume filled with water, affecting soil strength and stability

Here is about the results and conclusions of soil investigation which we have done the following results are shown below Table 1 and graphs

1. **Liquid limit and plastic limit**

Villages	Liquid limit	Plastic limit
Gondiparla	40%	16.25%
Manugalapadu	56%	20.25%
Orvakal	64%	28.25%
Bastipadu	66%	19.05%

table 1

2. Sand replacement:

1. In situ bulk density of soil, p = 506.8 g/cm^3
2. In situ moisture content , W = 62.5%
3. In situ dry density of soil ,pd = 7.98 g/cc

3. Core cutter:

1. In situ bulk density of soil, p = 183 X 10^-3
2. In situ moisture content , W = 9.30%
3. In situ dry density of soil ,pd = 0.177

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