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Terra Hydro Sense for Soil Dryness Estimation

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Abstract - Soil moisture is the water content of the soil tends to be communicated by concerning volume or weight. Examination of dampness or moisture content of soil is exceptionally fundamental in every one of the fields including agriculture, hydrology, and so on. In this paper, soil moisture level (dryness %) of various kinds of soils namely, red soil, black soil, clay soil and sand was experimented. Here soil moisture sensor, LCD with I2C, power supply were connected to Arduino UNO. The experiment was done by pouring the water in terms of 0ml, 4ml, 8ml, 10ml, 14ml, 18ml, 22ml, 24ml, 30ml, 34ml, 38ml, 42ml and 48ml and showed that different soil types produced different level of moisture content.

***Key Words*:** Soil moisture, Microcontroller, Arduino UNO, Moisture Level, Soil types

1. INTRODUCTION

Soil moisture is a critical key aspects in farming, hydrology and ecological science, influencing plant well bung, water protection and soil structure, moisture content Is ratio of mass of water Contained in the pore spaces of soil to the strong mass of particles in that material expressed as a percentage. This Project focuses on determining soil moisture Levels using a soil moisture sensor integrated with an Arduino microcontroller, this system can be applied in agricultural, gardening and environmental monitoring to maintain optima so conditions for plant growth, reducing water waste, and preventing overwatering.

Usually the design and plan a basic, practical framework to quantify screen soil moisture levels, giving continuous information to assist with keeping up with usual soil hydration. Soil moisture is decent indicated of a future harvest yield but on the other hand is a critical supported of agricultural water security.

The different types of soil was showed in Fig-1 and the most basic part of soil moisture is the profundity of the soil water storage. Soil moisture is good predictors of a future crop yield but is also a significant contributes to agricultural water security, and most critical aspect of soil moisture is the depth of the soil water storage. The current trend of decreasing soil moisture is concerning.

The 8051 microcontroller to control both the water supply and the irrigation system for the field. Each field has sensors, but they do not start working until there is water on the field [1].

Fig-1: Different type of Soil

By using a low cost more efficient programmable module to detect the climatic behavior inside the greenhouse and controlling the parameters according to their crop production need, through various techniques with the use of atmega328 MCU module and sensors [2]. The smart irrigation framework using solenoid valves and Arduino microcontroller with timing allocation was proposed [3].

The humidity sensors interfaced with 8051 microcontrollers to measure the environmental conditions [4]. A novel Automatic irrigation system using Arduino Uno was proposed to supply water [5]. The automatic irrigation feedback control system based on monitoring of soil moisture using microcontroller was implemented [6].

The soil moisture sensor and temperature sensor was connected with microcontroller AT89552 for implementing smart irrigation system [7]. The automatic plant irrigation system using microcontroller was proposed [8]. IOT based capacitive sensor system to measure soil moisture was proposed [9].

The Programed water system framework (ADIS) to identify soil moisture by using a dirt adhesive sensor was presented [10]. Flood alert monitoring system using microcontroller 8051 based on IoT was proposed [11]. The real-time automatic irrigation system using raspberry PI 2 and 8051 along with GSM and web application was proposed [12].

Different type of soil required different soil moisture level to grow various crops such that, for Red Soil, Rice (40-60%), Maize (30-50%), Ragi (30-50%), Jowar (30-50 %), Groundnut (20-40%), Sunflower (20-40%), Turmeric (30-50%), Chili (30-50%), for Black Soil, Sugarcane (50-70%), Cotton (40-60%), Wheat (30-50%), Soybean (30-50%),

Safflower (20-40%), Sunflower (20-40%), Grapes (30-50%), Pomegranate (30-50%), for Clay Soil, Rice (60-80%), Sugarcane (60-80%), Wheat (50-70%), Potato (50-70%), Cabbage (50-70%), Cauliflower (50-70 %), for sand soil Crop, Maize (20-40%), Wheat (20-40%),| Ragi (20-40%), Jowar (20-40%), Groundnut (15-30%), Watermelon (15-30%), Muskmelon (15-30%). Based on the survey, here Red Soil, Black soil, and clay Soil and Sand were taken for the experiment to determine the moisture of content of various kinds of soils. These study audits the standards, and uses of soil sensor moisture examination, featuring its significance in agriculture business, hydrology, and ecological observing.

2. METHODOLOGY

The internal connection diagram Terra Hydro sense was shown in Fig-2 below. Components are used is as follows**:**

1. POWER SUPPLY: Power Supply required is 5v to 7v for Arduino UNO. Arduino Uno can be powered via USB cable connected to a computer. External Power Adapter: Arduino Uno can be powered using an external power adapter (7-12V DC). Battery: Arduino Uno can be powered using a battery (7-12V DC).
2. ARDUINO UNO: Arduino Uno is one of the most popular microcontroller board in the Arduino family. Widely used for prototyping.
3. LCD DISPLAY: LCD display Displays soil moisture levels in percentage and it Shows sensor readings in real-time. And also provides alerts or warnings for low soil moisture levels.
4. I2C Module: The I2C module converts the signal from the Arduino into command for the LCD. The LCD has 16*2 cells that can display characters or symbols.
5. Soil Moisture sensor: This sensor help to monitor the moisture level of soil based on voltage level from 0 to 1023.

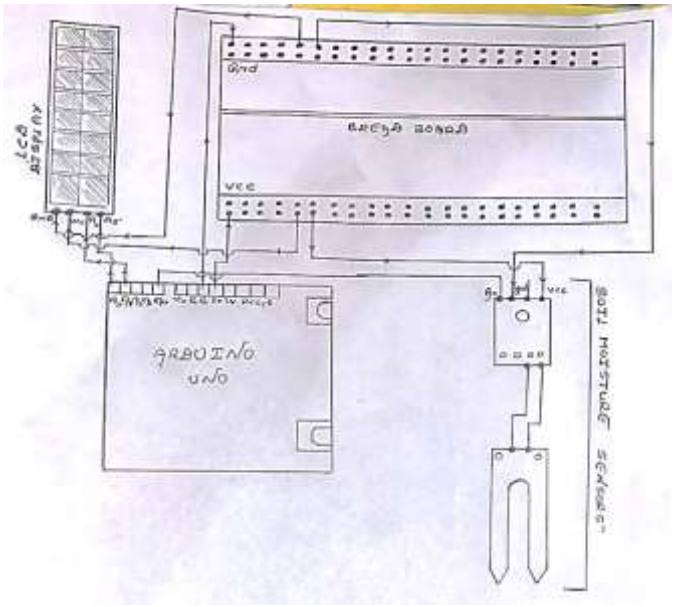

Fig- 2: Internal Connection Diagram of Terra Hydro sense

3. RESULTS AND DISCUSSION

The results from sensor data demonstrate the effectiveness of TDR and FDR sensors in providing precise, real-time soil moisture readings across various soil types. Capacitive sensors, while less accurate, are useful for general moisture monitoring where high precision is not critical. The Experimental results of Terra Hydro Sense Connection was showed in Fig-3 and the result analysis of Soil Moisture level (dryness%) of various types of soil was showed in Table-1. The sensor data correlates well with traditional methods showing that sensor-based measurements can effectively replace labour-intensive methods for continuous monitoring applications and in this work dryness, percentage was calculated effectively.

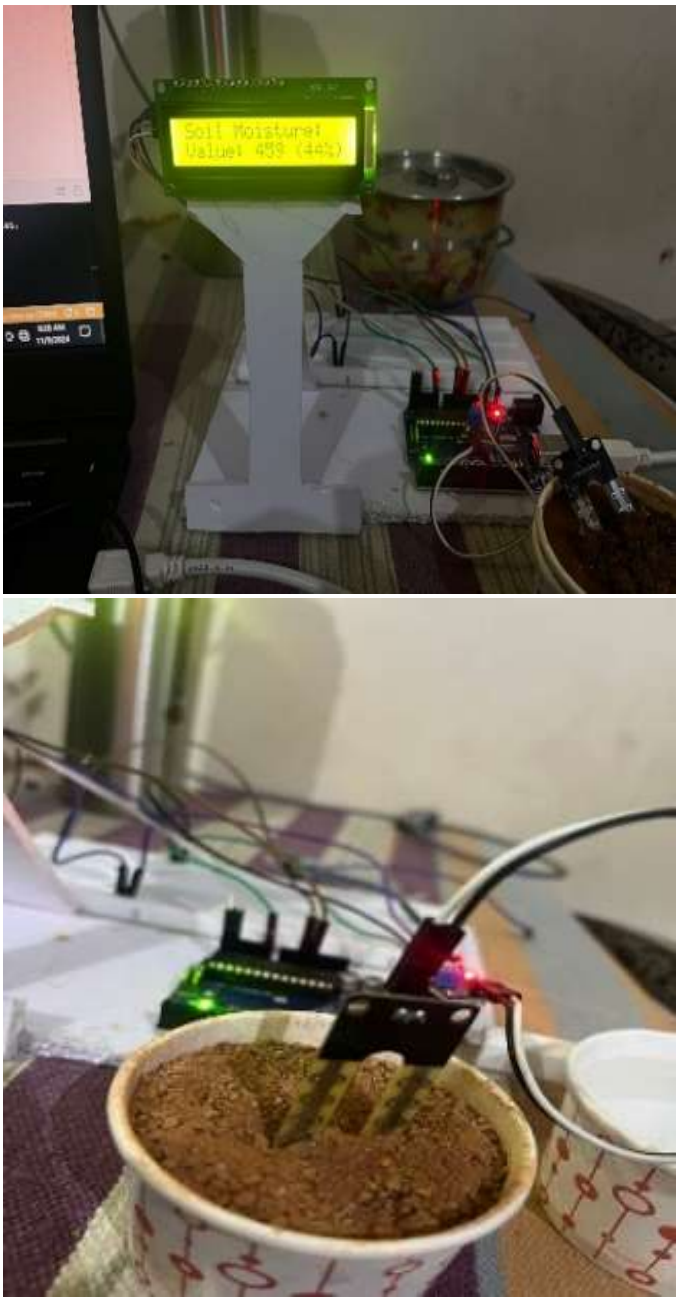

Fig-3: Experimental results of Terra Hydro Sense Connection

Table -1: Result analysis of Soil Moisture level of various types of soil

RED SOIL		BLACKSOIL		SAND		CLAY SOIL	
Water Added [ml]	Percentage of dryness	Water Added [ml]	Percentage of dryness	Water Added [ml]	Percentage of dryness	Water Added [ml]	Percent Age of Dryness
0	99%	0	99%	0	99%	0	99%
4	91%	4	84%	4	82%	4	53%
8	51%	8	78%	8	76%	8	50%
10	49%	10	75%	10	73%	10	47%
14	46%	14	68%	14	66%	14	43%
18	43%	18	62%	18	60%	18	37%
22	43%	22	61%	22	59%	22	35%
24	41%	24	60%	24	58%	24	33%
30	40%	30	56%	30	54%	30	31%
34	34%	34	52%	34	50%	34	30%
38	29%	38	47%	38	45%	38	28%
42	23%	42	42%	42	40%	42	24%
48	0%	48	38%	48	36%	48	20%

4. CONCLUSIONS

The determination of soil moisture is crucial for optimal crop growth, water resource management, and environmental sustainability. In this paper, various types of soil namely, red, black, clay and sand were reviewed by considering different types of crops along with moisture level requirements. The experiment was tested using soil moisture sensor that are connected to Arduino Uno, LCD I2C module. From the results analysis it can viewed that for various level of water (0ml, 4ml, 8ml, 10ml, 14ml, 18ml, 22ml, 24ml, 30ml, 34ml, 38ml, 42ml and 48ml) gives different values of dryness of the soil. From the results it concluding that the data value will helpful to farmers for suitable growing crops in future it is necessary to adopt cloud based methodology and Image processing technique in export the data values.

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