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An IoT Based Interface for the Smart Watering of Plants using Soil Moisture Sensor

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Abstract

Water plays a significant role in the growth of plants. Under watering and Over watering of plants may slow down the transpiration and photosynthesis processes. Hence proper watering is essential for the better growth of the plant. Internet of Things (IoT) provides the solution to the proper watering of plants. Hence, this study has developed an interface using soil moisture sensor and Ardunio for the monitoring of soil moisture of the plants, which help to water the plants properly. Based on the moisture data captured from the soil moisture sensor watering suggestions can be provided for the better growth of the plants. This interface helps to water the plant when it needs water and also it will be helpful for the optimum water utilization.

Keywords: Soil moisture sensor, Ardunio, IOT, Watering plants, Humidity

1. Introduction

Water is essential for the adequate growth of a plant. It serves as a solvent of substances and allows metabolic reactions in the plants [1]. It helps to solve plant nutrients from soils. It acts as a transporter of food materials produced in plants. Adequate supply of water is necessary for the proper transpiration process in plants [2]. In addition to that, the shortage of water may slow down the process of photosynthesis or even stop it. As a result, the internal food supply will be reduced. This reflects with the yellowing of leaves.

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Excess water cuts off the supply of oxygen which can affect the roots working. Over-watering can lead to root spoiling and the irreversible rotting of roots. Hence, smart irrigation system is necessary to water the plants [3]. In the smart irrigation system You can water the plants as needed to prevent the negative effects of overwatering and underwatering. To build the smart irrigation system IOT is the better choice [4]. Using soil mosisture senser with Arduino support we can desgina a smart irrigation system effectively [5].

In this study an interface is built to measure moisture in soil using sensors that are used to sense the moisture in the soil and Arduino board. The developed system will monitor the level of moisture in the soil and if it is low then the water will be supplied to the plant automatically[6][7]. In addition, this system is useful for the optimum water usage.

2. Materials and Methods

In this study an interface with soil moisture and Ardunio is developed to monitor the level of moisture in the soil. The diagram of interface connection is depicted below in the figure 1.

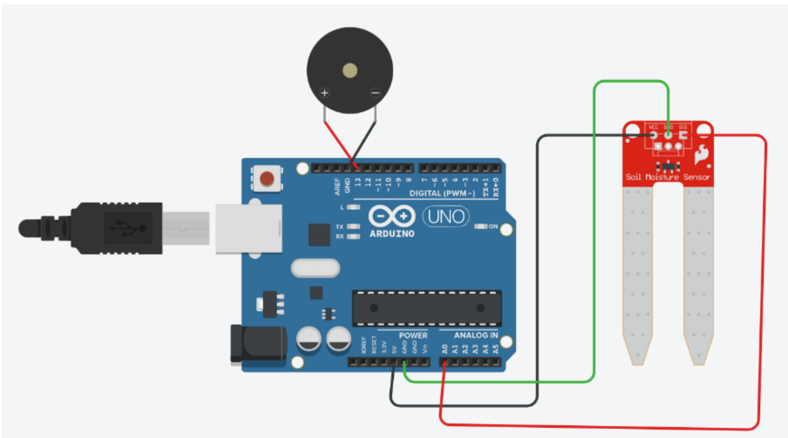


Figure 1. Connection Diagram of the Developed Interface.

2.1 Soil Moisture Sensor

These sensors are equipped with four pins: VCC, GND, Aout, and Dout. These pins play a crucial role in obtaining moisture data from the soil. The pinout configuration of the sensors to sense the moisture level of the soil is illustrated below in figure.2

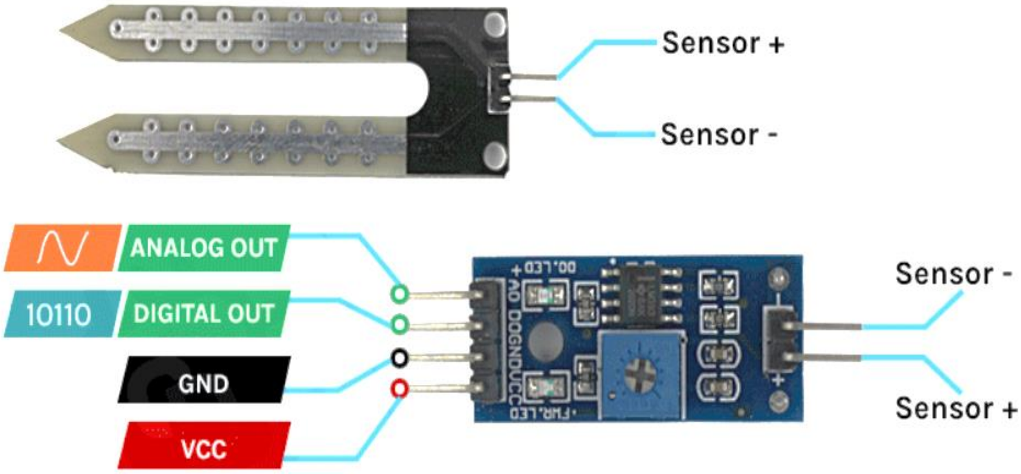


Figure 2. Pinout of the Soil Moisture Sensor [3]

The VCC pin is responsible for supplying power to the soil moisture sensor and can be connected to either 3.3V or 5V of the power supply and the GND is connected to the Ground of the Arduino board for proper functioning. The Digital output pin of the board produces a low signal when the soil moisture is at an appropriate level, while a high signal indicates low soil moisture. The Analog output pin, labeled AOUT, returns an analog signal within the range of VCC and ground [8][9].

There are two exposed conductive plates that function as a variable resistor in the sensor that are used for sensing the moisture level of the soil. The resistance value is influenced by the level of water present in the soil, with the probe's resistance being inversely proportional to the soil moisture. When the level of the water in soil is high, the resistance of the sensor is low, while it is high the soil is dry. The output voltage of the sensor is generated based on the probe resistance, allowing us to calculate the moisture level of the soil [10][11].

2.2 Finding the Threshold Values

To estimate the soil moisture level, the soil moisture sensor probe should be inserted in the soil. After that a sketch should be run in the Arduino editor. The sketch is mentioned below.

```
int buzzer=13;
int sensor=A0;
int val;
void setup()
{
pinMode(13,OUTPUT);
pinMode(A0,INPUT);
Serial.begin(9600);
}
void loop()
{
val=analogRead(A0);

Serial.println(val);
if(val>=1012)
{
digitalWrite(13,HIGH);
}
else
{
digitalWrite(13,LOW);
}
delay(1000);
}
```

Figure 3. Arduino Sketch

In setup() function the serial is initialized with 9600 baud. The sensor pin A0 is declared as the input and the buzzer pin 13 is declared as the output. In loop() function the analog reading from the sensor is initialized to the variable *val*. The value stored in val variable is displayed using Serial.println(Val) statement. If the condition val>=1012 is statisfied the buzzer connected to the pin 13 will be activated and the sound will produce [12][13]. Otherwise the buzzer will not be activated. After the many iterations of trail and error, the threshold value of the soil moisture is fixed as 1012.

When you run the sketch, the following readings can be observed:

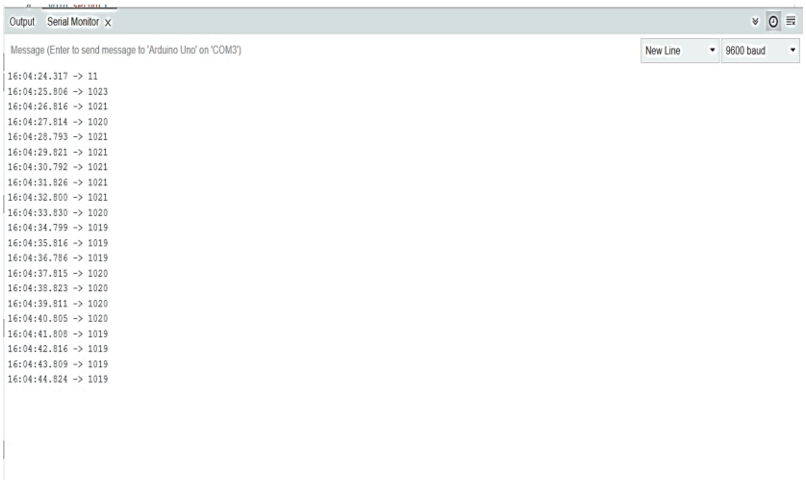
- When the soil is dry the reading is more than or equal to the value 1012.
- When the soil is wet if the reading is less than 1012.

3. Experimental Results

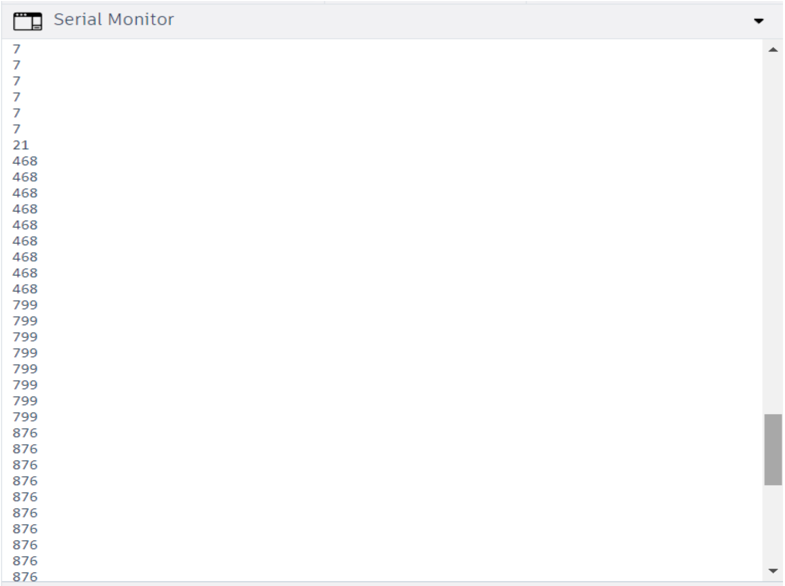
The code mentioned in the section 2 is excecuted in the Ardunio IDE 2.03. Once code executed without any errors the code is uploaded to the ardunio board connected to the computer with a wire. After uploadin the code now the interface is ready to use. The working of the interface is shown in the below figure 4.

Figure 4. Working of Developed Interface

The sensor is inserted in the soil. Once the probes of the soil moisture is inserted in the soil, the sensor provides the moisture value that can be seen in the serial monitor of the ardunio IDE 2.03. The sample readings in various situations are represented in figure 5.



(a)



(b)

Figure 5 (a), (b). Sample Readings of The Soil Moisture Sensor

If the reading in the serial monitor is greater than or equal to 1012 then the buzzer rings indicating the necessity of the water to the plants.

The interface proposed in this work comprises a straightforward circuit that enables users to easily monitor the water levels of their plants [14][15]. This works leads to optimal usage of water. By optimizing water usage, this approach can enhance plant growth rate as well.

4. Conclusion

The development of agriculture depends on the real-time monitoring and measurement of agricultural parameters. In this study, system for measuring and monitoring soil moisture using an Ardunio soil moisture sensor is created. The technology was put to the test in a lab setting. This method monitors soil quality and forecasts how it will affect plant growth, but if the typical pattern for productive crop growth cab be identified, then artificial farm fields may one day be constructed. Possibly, the plant development and demand quick creation of the best-nutritious crops could be automated.

References

[1] Taiz, L., Zeiger, E., Moller, I. M., & Murphy, A. , Plant Physiology and Development. Sinauer Associates., 2018.

[2] Smith, A. M., & Zeeman, S. C. Starch degradation. Annual Review of Plant Biology, 68, 211-237, 2017.

[3] Marschner, H. Marschner's Mineral Nutrition of Higher Plants (3rd ed.). Academic Press, 2012.

[4] H. Saini, A. Thakur, S. Ahuja, N. Sabharwal, and N.Kumar, “Arduino based automatic wireless weather station with remote graphical application and alerts”, in 2016 3rd International Conference on Signal Processing and Integrated Networks (SPIN), Feb 2016, pp. 605–609.

[5] Kalaimani, S. A., & Maruthavanan, M. IoT based irrigation system using Arduino and Raspberry Pi. In 2018 International Conference on Emerging Trends and Innovations in Engineering and Technological Research (ICETIETR) (pp. 1-6). IEEE, 2018

[6] J. Liang, X. Liu, and K. Liao. Soil Moisture Retrieval using UWB Echoes via Fuzzy Logic andMachine Learning, IEEE Internet Things J., 1, 99, 2017

[7] R. Elsheikh, A. R. B. Mohamed Shariff, F. Amiri, N. B. Ahmad, S. K. Balasundram, and M. A.M. Soom, Agriculture Land Suitability Evaluator (ALSE): A decision and planning support toolfor tropical and subtropical crops, Comput. Electron. Agric. 2013, 93, (98–110), 2013.

[8] Wei, H., Huang, Y., & Gao, H. Design of a Soil Moisture Monitoring System based on the Capacitive Sensor. Journal of Electrical Engineering and Automation, 3(1), 37-40, 2016.

[9] Mishra, A., Yadav, P., Singh, N., & Kumar, A. IoT based smart irrigation system using soil moisture sensor and ZigBee technology. 2019 International Conference on Sustainable Energy Technologies and Systems (SETS), 1-6,2019.

[10] Srbinovska, M., & Gavrilovska, L.Soil moisture measurement using Arduino and soil moisture sensor. 2017 40th International Convention on Information and

Communication Technology, Electronics and Microelectronics (MIPRO), 1199-1203, 2017.

[11] Schaefer, L. V., & Lopes, M. J. Design and development of a soil moisture sensor based on the capacity measurement. Sensors & Transducers, 232(1), 31-39, 2019.

[12] Patel, D., & Patel, N, Automatic Plant Watering System using Arduino. 2020 7th International Conference on Computing for Sustainable Global Development (INDIACom), 276-280, 2020.

[13] Dr. S. Velmurugan, V. Balaji, T. Manoj Bharathi, K. Saravanan, 2020, An IOT based Smart Irrigation System using Soil Moisture and Weather Prediction, International Journal Of Engineering Research & Technology (Ijert) Eclectic – 2020 (Volume 8 – Issue 07)

[14] K.S.S. Prasad, Nitesh Kumar, Nitish Kumar Sinha and Palash Kumar Saha. Water-SavingIrrigation System Based on Automatic Control by Using GSM Technology. Middle-East Journalof Scientific Research ,2012, 12, (1824-1827)

[15] Jirapond, M.; Nathaphon, B.; Siriwan, K.; Narongsak, L.; Apirat, W.; Pichetwut, N. IoT and agriculture data analysis for smart farm. Comput. Electron. Agric. 2019, 156, 467–474, 2019.