AUTOMATIC PLANT WATERING SYSTEM USING ARDUINO AND MOISTURE SENSOR

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ABSTRACT

Every crop has its unique level of water absorption. Some crops absorb more water and some imbibe less. The absorption of the soil differs substantially. Owing to seasonal changes, the water absorption of the soil also differs. Dry clay and wet clay absorption are discrete. The former imbibes more water and the latter imbibe less. Over irrigation affects the soil characteristics. Shallow irrigation affects plant growth. To eliminate the concern over optimally watering the field, this automatic watering system is designed using Arduino. The system comprises a soil moisture sensor (contact soil sensor), an Arduino UNO, and a servo motor. The moisture readings of different types of soils are fed to the design. Estimating and comparing the readings the plants are watered effectively.

KEYWORDS

Arduino UNO, automatic system, soil moisture sensor, dc motor

1. INTRODUCTION

Water is a basic requirement for all creatures in this world. Water shortage is a major problem in this period. Irrigation consumes a high quantity of water. Overdosing of water results in water logging, salinity, ill aeration of soil that cause pollution of underground water which leads to malaria. The absorbed water refers to the water that fills the voids of the soils. The soil particles hold the water on its surface. In general, the water content of a soil refers to a wet basis and the moisture content defines for a dry basis.

The sandy soil comprising extremely small-sized rocks is suitable for aeration and is less suited for water retention. Clay soils having colloidal particles can hold the water and are less suitable for aeration. The third type is the rock particles of large size and the particles hold no water. Therefore, the soil with the rock particles is not desired for the planting as it affects the root system. The holding capacity of the soil is deplorable. The loam soil is the best soil that retains the water and is desirable for plant growth. The type of soil provides perfect aeration and proper capillary spaces to retain the water are loam soil. It comprises sand; silt, decomposed humus, and clay together provide preferable characteristics.

The moisture of the soil ranges from 10% to 50% and the moisture value can vary before and after the watering is done. The moisture content in the soil is affected by many factors like heat, rain, wind. Fig.1. illustrated estimates the field capacity i.e., the soil capability to hold the excess water on its surface after it has drained and the wilting point is the level of moisture, below which the soil is unable to hold the excess water, and the plants will wilt and die. The field capacity and wilting point depend on soil type. The texture and structure of the soil estimate the speed of the soil filtration. The sandy soil has large pores and water is absorbed easily and eventually; but it

K.S.Babai,P.K.Suresh,K.UmaRani et al. (Eds): ICARTEC-2021
pp. 53 - 59, 2021.IJCI – 2021 DOI:10.5121/ijci.2021.100307

has a very low field. Clay has small pores and the speed of absorbing water is less and which increases the field capacity.

Therefore, good information about the ideal case situations is analyzed. Practically it is impossible to water manually with these set points. An automatic plant watering system that comprises modern electronic components can accurately estimate and water the plants efficiently. Water delivery systems are of two types which are used nowadays drip surface and sprinklers which can be automated. To water the crops efficiently, an automated plant watering system can be designed. An automatic crop watering system can be designed using an Arduino. Soil Moisture is observed and the absorption level is reckoned. The predetermined level of water is fed to the plants. Arduino is programmed to read the moisture value from the moisture sensor every 20 seconds. The value obtained is compared with the threshold value. The estimated value is managed by the controller instantly and starts motor that supplies the water to the plants for a fixed period or until gets the threshold moisture then switch off's the motor.

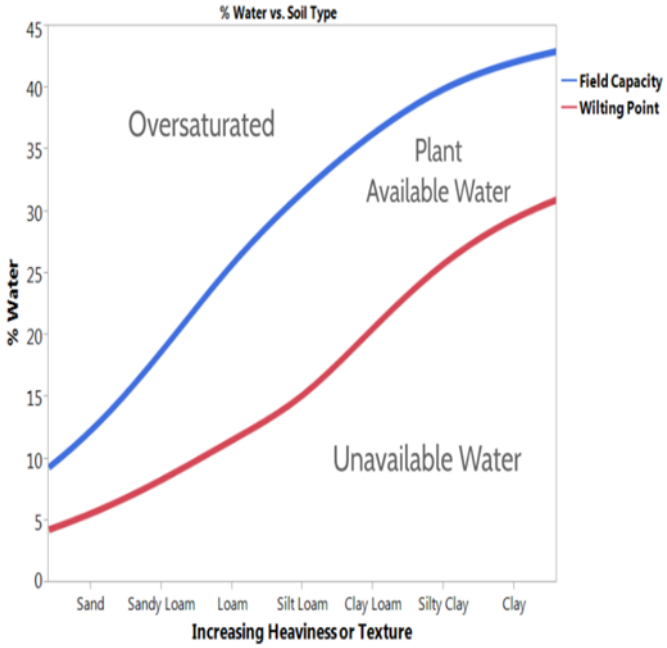

Figure 1. the soil texture vs. the Field Capacity, Wilting Point, Available and Unavailable water

2. LITERATURE REVIEW

Divani et al., [1] elucidates that the major problem facing in modern society is the water resource shortage; agriculture is one of the demanding job which consumes large quantity of water. So we must utilize maximum water in an efficient way. The components are moisture sensor; motor/pump and Arduino board is programmed using software. The predetermined range of soil moisture and temperature is set according to plant requirement. If soil moisture value is less than threshold system automatically triggers water pump on till sensor meets threshold and then sets off automatically. The value is passed on to the user network through an application.

Ishak et al., [2] performs the controlling action using SMS (Short Message Services) of cell phones.Moisture sensor signifies detection and warning level. As the moisture sensor is triggered, instantly the moisture level in soil and the output signal will be relayed to Arduino which serves as a switch that triggers the connected GSM modem to send a text message to the user that the

soil is dry. The water pump/motor starts working effectively by the code programmed to the module. The water pump waters the plant until the sensor reading reaches below than 500 (programmable) reading. The process repeats as the moisture level triggers value more than 500. Mayuree et al., [3] proposes that the soil moisture sensor is connected to Arduino and inserted into roots. L293d motor is connected to pump. The motor shield allows us to control the motor rotation and the motor speed by using an Arduino. An added motor with an external power supply up to 12V is a part of the setup. As the moisture value reaches its peak or the readings of the sensor reach more than moisture content as coded it starts to irrigate the field. As the moisture value decreases, it stops irrigating the field automatically.

Kotni et al., [4] elucidates that the water content in the soil controls the action done by the Arduino. The soil moisture sensor will detect the water content in the soil and feed it to the data pin of the sensor and send the data to Arduino for further processing. The code used in this project focuses on the threshold moisture of the soil. If the data (moisture content) collected by sensor is greater than the threshold moisture required for the respective soil, then the Arduino gives blank feed to the motor enabling it to give blank output or none output. When the data (moisture content) is less than the threshold moisture required by the soil, the Arduino feeds the motor to pump the water from the sprinklers to the soil.

Syed Musthak Ahmed et al.,[5] proposes to make the farmers stay away from the field for the whole day, prototype that senses soil moisture and based on the data, the designed system instinctively turns ON the water pump to the field. As the soil reaches an optimum moisture level, then the water pump automatically gets turned OFF. It is shortly can termed as maintenance free agriculture where farmers can be prevented from breathing harmful chemicals by staying on the field for the whole day and also estimates the ambient temperature and humidity in the field and senses the daylight and rainfall intensity on the agricultural field. Their prototype is implemented by incorporating IoT platform where farmers can monitor the parameters over internet on their mobile phone application.

The watering of plants is not possible [6] and so this plant watering system by using some simple components and method. In this prototype, soil moisture sensor senses the moisture level of the soil according to the threshold. If soil gets dry, the moisture level is sensed by the sensor. If it is low, it automatically switches the water pump on and the water is supplied to the plant. As plant is sufficiently watered and when it reaches the threshold, then sensor senses enough moisture in soil and the water pump will automatically get stopped.

Abhishek Gupta et al., [7] performs the project is implemented with sensors that detect the humidity in the soil and supply water to the crops. The prototype is composed with PIC16F877A micro-controller and it controls the water supply. The sensors are not activated till water is present on the field. When field gets dry, the sensors send a signal to the micro-controller. Micro controller then supply water to that particular field that needs water until the sensors is deactivated again. If there are more signal it will prioritize the former received signal and it waters it. PIC16F877A micro controller is used to perform it accurately. The micro controller is designed to detect the moisture level and supply the required water.

3. METHODOLOGY

3.1. Designing Components

Arduino is an open-source platform utilized for developing projects. It comprises of both a software, or Integrated Development Environment which is used to write a code and circuit board

onto which the code is uploaded from the computer. Figure 2. shows the pins on the Arduino UNO board are used to connect wires to construct a circuit. Arduino UNO board is fit to notice the surroundings by getting input from various sensors and can impact its condition by overseeing actuators like lights, engines, servo's and so forth [8]. The UNO board is the primary in a measure of USB Arduino sheets and the reference exhibit for the Arduino form.

Figure 2. Arduino UNO

The board will be programmed such that it measures the soil moisture content as well as the water level in the water tank and apprise the user with analysis. Figure 3. shows the soil moisture sensor, it measures the water content present in the soil by using dielectric constant, electrical resistance, or interaction with neutrons, as a substitute for the moisture content. The soil moisture sensor comes in a need to check the volumetric moisture level of the soil. The Soil Moisture Sensor makes use of capacitance to find the moisture content of soil. To evaluate the soil moisture content, simply place this sensor inside the soil, the moisture content is be determined and the moisture content of the soil.

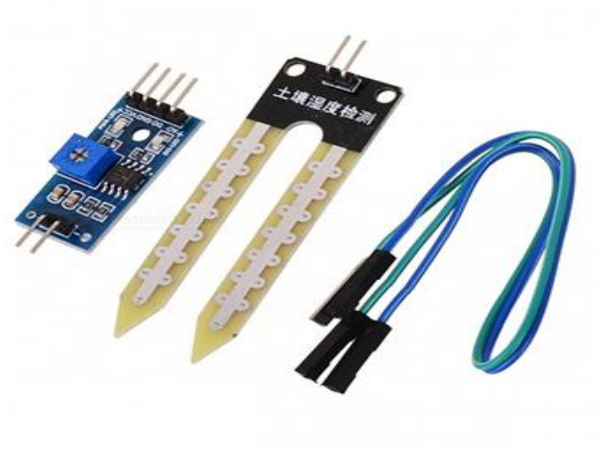

Figure 3. Soil moisture sensor

The two probes allow current to pass through the soil through which it evaluates the resistance value and thus wind ups to the moisture value. Wet soil is a good conductor of electricity, i.e., less resistance. Thus, a high moisture level is detected. Dry soil is a bad conductor of electricity, the more resistance, the moisture level will be low.

Figure 4. 6V DC motor pump

A DC motor allows us to direct the motor rotation direction and speed by using the Arduino UNO. 6V DC motor allows an added external power supply range to 12V. By the code, the water pumps out or are in off state. Figure 4. Shows the 6V DC motor pump. The pump cannot be connected directly to Arduino, to overcome this; a transistor is used to control the switching of the motor with the code. The block diagram of the system is illustrated in Figure 5. The water pump can be started ON/OFF by transmitting signals. The demonstration of pumping water is a basic and sensible strategy, significantly more reasonable than uncovering it utilizing manually or picking it in one's grasp held basin. The strategies are valid in every one of the cases whether the water is exchanged to a particular area, like water system, washing or cleaning, manure treatment, or for purging water from an unwanted territory. Regardless of the outcome, the vitality is expected to draw water out and is one of the immensely required modules of water use. Rest the various systems depend or benefit each from water sliding from high elevations or some harried water plumbing method. A 12V DC engine is utilized with the pump and turn it on or off automatically.

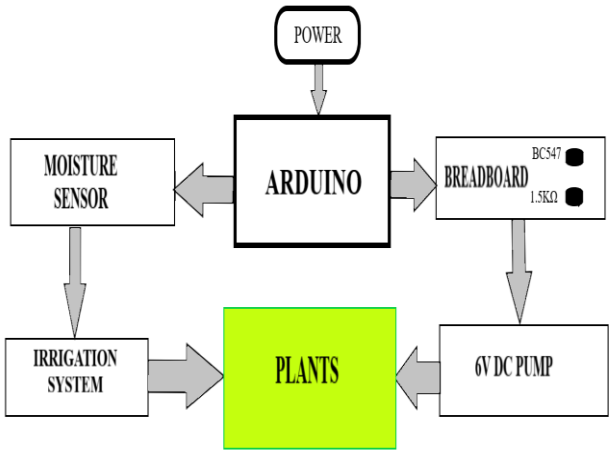

Figure 5. Block diagram of the system designed

3.2. System Design and Method

The Arduino is programmed initially and then compiled. The code is uploaded to the Arduino. Figure 6. shows the command in the serial monitor. The ground, Vcc, and digital pins of the soil moisture sensor are connected to the respective Arduino pins. The digital pin of the sensor is fed to the 11th digital pin of Arduino. By fixing the transistor (BC547) then, a resistor of value 1.5kohm in the breadboard and are connected to the Arduino. The positive terminal of the DC 6V pump to the Vin pin of the Arduino UNO and the output (negative terminal) of the pump is connected to the breadboard.

Figure 6. Serial monitor command output

4. EXPERIMENTAL RESULT

The Moisture-less soil is taken as a sample. The soil moisture sensor connected to the 6V DC motor pump and to the Arduino is placed on the surface of the soil firmly. The 12V external power supply is supplied to Arduino and 6V DC pump is placed submerged on a pool of water. The Arduino setup is mounted to Arduino case separately. The switch is turned ON, the moisture sensor instantly detects the moisture of the soil and compares with the pre-defined values. The estimated value of the moisture allows watering the plant ideally considering the soil type. The moisture content of the soil is checked continuously and this makes it an ideal plant watering prototype. The Figure 7. Illustrates the experimental setup of the system.

Figure 7. Experimental setup of the prototype

5. CONCLUSION

Water and soil are two essential elements for plant growth. Manual irrigation leads to huge effects on the soil and it affects the characteristics of the soil. Water is conserved by ideally irrigating the plants. Moisture content is monitored properly for healthy plant growth. The prototype proposed is an automatic system and can avoid the problems of over-irrigation or no irrigation. The prototype is cost-effective, non-complex. The design is portable. The system is suitable for domestic and large-scale irrigation.

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