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# Automatic Plant Moisture Detection and Watering System using Arduino

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**ABSTRACT:** The goal of the automatic plant sap detection and drainage system is to automatically improve the flow of plant sap quality. By placing various soil moisture indicators near plant roots, such as resistive, capacitive, or TDR sensors, the system sends readings to a microcontroller. This central unit compares and triggers data against predetermined demands for each plant the water system if the water level is insufficient. A snake pump or valve connected to a water source. The water system supplies water based on adjustable criteria such as plant species and environmental conditions. The system provides users with information and warnings through signals that using visual monitor, adjust settings, and report irregularities or repair needs. The methodology minimizes the risk of over-discharge or underwater, and improves plant growth while reducing water consumption. Used in a variety of environments, from the home garden to agriculture, the system increases the flexibility and efficiency of plant care.

**KEYWORDS:** Microcontroller, over discharge, under discharge, flexibility, and efficiency

## I. INTRODUCTION

Regarding the continuous growth in population, the call for water has been improved. Most of the country's economy pivotally dependent on irrigation. The irrigation systems we have today are inefficient in water management, so we came up with this project. We used soil moisture sensor [1] for this system. The benefit of the proposed system is it will reduce human interference and blunders in moisture levels. As per many researches excessive water supply makes plants growing in soil that is too wet suffer from a lack of oxygen which leads to the death of roots and a loss of vigor in the plant [2]. The main motto is to regulate the water flow so that no water is wasted. During monsoon and winter weather seasons, the water float may be optimized relying at the requirement, as a result saving precious water. As the era is enhancing day with the aid of using day, the primary concept is to develop a new automated irrigation system. The result is a scalable, implementable technology that we've got examined and confirmed numerically and within the field. By using this sensor, we will discover whether the soil is moist or dry. If it's far dry, the pumping motor will pump the water. Soil moisture is a very important element in the Atmospheric water cycle, each on a little agricultural scale and in largescale modelling of land/atmosphere interaction. Vegetation and crops invariably rely more on the moisture offered at root level than on precipitation prevalence. Water budgeting for irrigation planning, also because the actual programming of irrigation action, needs native soil moisture information. Even though we could use GSM module, used for domestic power consumption [3] we haven't used it.

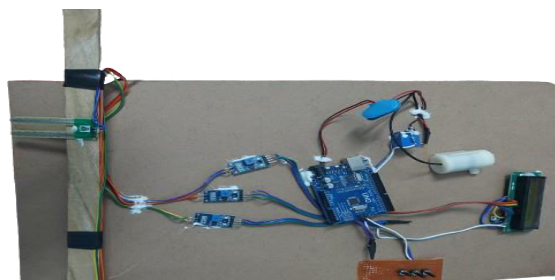


Fig 1. Hardware Used

## II. DESIGN AND METHODOLOGY

### 2.1 Arduino Microcontroller

Arduino is an open-source microcontroller which can be easily programmed, erased, and reprogrammed at any instant of time. Since Arduino is an open-source platform the software is not purchased and only the cost of buying the board or its parts is incurred, thus making it very cheap.

The hardware designs are also available online for free from its official website [4]. Arduino platform can be divided into two: Hardware and Software. Arduino uses hardware known as the Arduino development board. Arduino software for developing the code is known as the Arduino IDE (Integrated Development Environment). Built-up with the 8-bit Atmel AVR microcontrollers that are manufactured by Atmel or a 32-bit Atmel ARM, these microcontrollers can be programmed easily using the C or C++ language in the Arduino IDE.[5]

### 2.2 Relay (JQC-3FC(T73))

A relay is an electrically operated switch. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts [6].

A relay is an electrically activated switch. It consists of a coil internally which will create a magnetic field that attracts a movable lever and then changes switch contacts when a current is flowing through it. The typical usage of relay is to allow a low DC voltage circuit (circuit #1) to switch on or off a high voltage (DC or AC) circuit (circuit #2) without direct electrical connection between them. This means circuit #1 and circuit #2 are magnetically and mechanically linked but not electrically connected.[7]

### 2.3 Moisture Sensor (Tensiometer)

Integrated within the system, it detects soil moisture levels, enabling precise water supply regulation, conserving water, and optimizing plant growth in agricultural applications.

The sensor has an analogy output directly related to the soil resistance change due to the water content. The principle resides in the change of the resistance value due to the water content of the soil between the transistor-based circuits[8]. The probe electrode composed of a printed circuit board has two pin-type parallel structures and was electrically connected to the electronic circuit equipped with sensors and was highly integrated to form an integrated structure. The probe ends were designed to be triangular to be easily inserted into the soil to be tested. [9]

### 2.4 LCD Display

The term LCD stands for liquid crystal display. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc. An embedded system communicates directly to a human being by use of input and output devices. It should be noticed that in an embedded system, the interaction is instigated by the microcontrollers. The system uses input and output devices those generate direct communications with human being. LCD display can be considered as the most common devices that is connected to the microcontroller. Specifying the types of LCD displays, 16x2 and 20x4 are the most common ones connected to the microcontrollers. These digits indicate the numbers of the characters and the numbers of the lines. For example, a 16x2 LCD display contains 16 characters and 2 lines made available to use. Similarly, 20x4LCD display indicates 20 characters and 4 lines made accessible for use. [10]

### 2.5 12v Pump

Essential component in the system, it delivers water to plants based on moisture sensor readings. Efficiently powered by 12V, it ensures controlled irrigation, promoting agricultural productivity and water conservation. It is supported by the 9 volts battery and controlled by Arduino output and relay circuit.

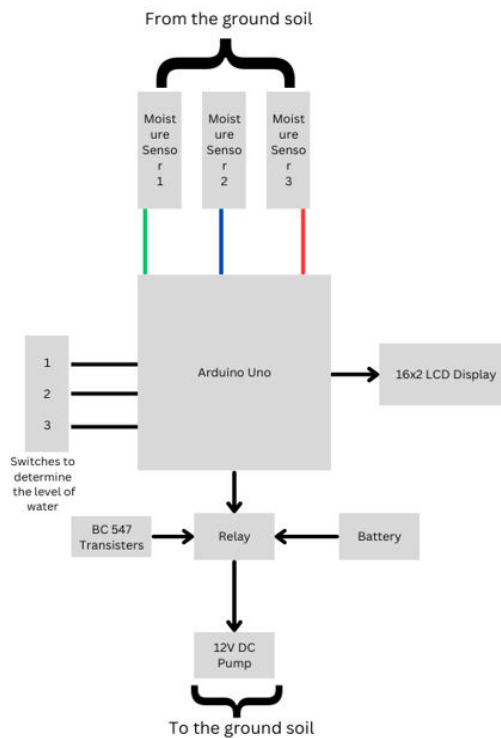


**2.6 Push button switches**

User interface elements allowing manual control over the system. Positioned for convenient access, they enable users to override automatic functions, such as activating or deactivating the water pump. Enhancing user interaction, these switches provide flexibility and customization options in managing irrigation processes.

Here it is used to select the levels for the moisture sensor namely L1 , L2 , L3.

**III. HARDWARE IMPLEMENTATION AND WORKING**



**Fig 2. Block Diagram**

In The proposed work can be explained in the form of block diagram as shown in figure. It comprises of following 6 blocks.

- Switches
- Moisture Sensor
- Arduino
- LCD Display
- Relay Circuit
- Water Pump

**3.1 Switching Circuit**

In the circuit, three switches are installed to define the desired moisture levels for soil maintenance. Each switch corresponds to a specific moisture level setting, which must be selected prior to activating the mechanism. These buttons enable users to specify their preferred moisture content for the soil, ensuring precise control over the irrigation process based on individual requirements or plant needs.

### 3.2 Sensing Methodology

Permanently embedded in the soil at varying depths, three sensors are strategically positioned with distinct intervals between them. Continuously monitoring soil moisture levels, these sensors provide real-time data to the microcontroller. Upon activation triggered by the designated switches, the microcontroller interprets the sensor readings in correspondence with the specified moisture levels. Based on this evaluation, the microcontroller orchestrates the irrigation process, adjusting water supply or other relevant parameters to meet the desired soil moisture conditions. This integrated system ensures efficient and responsive soil moisture management, optimizing agricultural productivity and resource utilization in the fields.

### 3.3 Micro controlling Unit

The Arduino UNO, acting as the circuit's core processor, is programmed through the Arduino IDE to orchestrate the mechanism. It receives inputs from switches and a moisture sensor, analyzing the data to determine the required action. Utilizing relays and pumps, it delivers water output to the soil accordingly. This iterative process continues until the desired moisture parameter is attained. By integrating sensor feedback with responsive output control, the system optimizes irrigation efficiency. This approach streamlines agricultural practices, ensuring precise water delivery tailored to soil moisture needs, thereby enhancing crop yield while conserving resources effectively.

### 3.4 Display Unit

The 16x2 LCD display serves as the interface for the mechanism, displaying initial messages and subsequent switch selections. It also indicates the status of the pump, whether it's activated or deactivated. Furthermore, the display provides a basic user interface for starting and initializing the system. With its visual feedback, users can easily interact with and monitor the operation of the mechanism, ensuring smooth functionality and effective management of soil moisture levels.

### 3.5 Relay Circuit Implementation

Incorporating a relay circuit within the overall system is essential for managing components controlled by the 5-volt output of the Arduino UNO microcontroller. Since this output isn't sufficient to drive a 12-volt pump directly, a relay is employed. Coupled with resistors and a diode, the relay enables seamless control of the pump. This setup facilitates the translation of the 5-volt signal into a suitable format for activating the 12-volt pump, ensuring effective operation of the mechanism.

### 3.6 Pumping Mechanism

Through the integrated mechanisms, the 12V pump is activated and supplies water to the fields until the predetermined condition is reevaluated and determined by the microcontroller, ensuring efficient irrigation management.

## IV. RESULT AND DISCUSSION

### Case 1.



Fig 3 Final Project with All Utilities

**Switch 1 is pressed.**

**MS1 MS2 MS3 = 'OFF'(NO MOISTURE )**

The LCD display shows the switch pressed.

The motor is turned on and the message is also displayed on the LCD screen.

MOTOR is turned 'ON' until the MS1 is turned ON

**RESULT**

**MS1 = 'ON'; PUMP = 'OFF'**

**Case 2.**

**Switch 2 is pressed.**

**MS1 = OFF (NO MOISTURE),**

**ON (MOISTURE DETECTED )**

: -as switch 2 is pressed MS1 have no role to play.

**MS2 = OFF (NO MOISTURE)**

**MS3 = OFF (NO MOISTURE)**

The LCD display shows the switch pressed.

The motor is turned on and the message is also displayed on the LCD screen.

MOTOR is turned 'ON' until the MS1 and MS2 is turned ON or detect moisture.

**RESULT**

**MS1 = 'ON', MS2='ON' ; PUMP = 'OFF'**

**Case 3.**

**Switch 3 is pressed.**

**MS1 = OFF (NO MOISTURE),**

**ON (MOISTURE DETECTED )**

**MS2 = OFF (NO MOISTURE),**

**ON (MOISTURE DETECTED )**

: -as switch 3 is pressed MS1 and MS2 has no role to play.

**MS3 = OFF (NO MOISTURE)**

The LCD display shows the switch pressed.

The motor is turned on and the message is also displayed on the LCD screen.

MOTOR is turned 'ON' until the MS1, MS2, MS3 is turned ON or detect moisture.

**RESULT**

**MS1 = 'ON',**

**MS2='ON',**

**MS3='ON'.**

**PUMP = 'OFF'.**

The system manages moisture levels efficiently by combining switches and sensors. For example, in Case 1, when Switch 1 is activated, motor operation is initiated until MS1 detects humidity. This ensures that the pump only runs when needed. In Case 2, Switch 2 is activated instead of MS1, demonstrating the system's flexibility and adaptability. Although there was a slight error in Case 3's result statement, the emphasis on switch inputs highlights its responsiveness.

All in all, the system provides accurate control over pump activation based on moisture detection. This optimizes energy consumption and ensures efficient moisture management. With clear communication via the LCD display, users can easily understand the status of the system, allowing for efficient monitoring and control. The system's versatility in responding to different inputs not only improves reliability, but also increases user confidence in maintaining the desired moisture levels.

With robust functionality and an easy-to-use interface, the system is an excellent choice for moisture management in a variety of environments.



## V. CONCLUSION

This paper proposes an automated plant watering system powered by the Arduino that can be used in a variety of agricultural farming applications, including green building concepts, roof farming, etc. The system works by using soil moisture sensors that detect the moisture level of the plants. The water pump will turn on or off according to the user's threshold. The goal of this technology is to provide farmers with simple farming solutions and to increase the efficiency of irrigation water usage.

The main objective of the proposed Automatic Plant Watering System is to provide an efficient and convenient solution for irrigation projects in agricultural farming. The system seeks to solve water supply problems in agriculture by utilizing Arduino UNO and using soil moisture sensors to detect the moisture level of the plants. It then automatically determines the amount of water to be supplied based on predetermined thresholds. By keeping an eye on the soil moisture level, the system makes sure that the plants get the right amount of water without wasting any water.

You can also monitor the moisture level remotely and receive real-time updates so that you can make the best water supply decisions. All in all, the Automatic Plant Watering system aims to make the irrigation process simpler and more efficient, making farming easier for farmers and making water usage more efficient in agricultural practices.

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