# AUTHOMATIC SOIL MOISTURE SENSING WATER IRRIGATION SYSTEM WITH WATERLEVEL INDICATOR

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## ABSTRACT

*This paper involves the development and formation of automatic irrigation system that uses sensor that determines soil moisture (by soil moisture sensor), water level indicator also its pumping system that aims to deliver the needed water based on the assigned soil moisture value. This paper also discusses the prototype design of microcontroller based on water irrigation which detects a soil if watering is required then the water will be maintained at the constant level. If the specific area is irrigated too much with water, there are possibilities that the plant may die due to excessive irrigation. The proposed system uses a microcontroller basically a platform device called ARDUINO where sensors are connected in its internal and external ports. Whenever there is a variation in moisture content of the soil these sensors will determine the change and will give an interrupt signal to the microcontroller and eventually will send signal to the relay driver and thus the water pump is now activated. This irrigation system also includes a water level indicator in the water tank which will indicate the water capacity of the reservoir itself whether it is low level or high level. This thesis paper will allow garden owners and other household areas or certain facilities in the efficient, convenient and effective method of water irrigation and may direct future research on the development of more advanced water irrigation system.*

***Keywords:*** *Soil Moisture Sensor, Microcontroller, Moisture Content, Automatic Irrigation.*

## INTRODUCTION

### *Background of the Study*

In our day to day life, water is very essential. It is considered to be basic need of human beings, animals, plants etc. But now days, water shortage is becoming one of the biggest problem in the world and there should be a solution in this kind of problem, it is no other than water conservation. We have different methods developed for the conservation of water.

Plants are also essential to human life. The food we eat, medicine, fiber which can be manufactured to fabric and clothing can also be provided by plants. It also acts as settling chambers for particulate pollutions. Like us, plants also need water in order to make their food. Water is considered one of the basic needs for plant growth. But we must consider such potential situations in watering our plants such as watering too much, too little and of course, just enough for us to sustain and maintain the plant growth. Because keeping your plant properly watered is important to its health.

In accordance to the stated facts about water, the researchers thought of an idea of an automatic water irrigation system, conservation project which can also be useful and be able to

contribute to the environment. This project design study to focus on soil condition of a certain grass/plantation area and determine when the plants need to acquire adequate water.

Soil moisture is an important parameter in monitoring of plant growth. Since soil moisture determines the amount of liquid or water content of the soil, the researchers will develop a device that will determine the moisture level of the soil that will trigger a water irrigation system to release and gives sufficient water for the plants to reach their full growth.

***Statement of the Problem***

Manual irrigation system is simple and cheap but is more labor intensive and wastes water. As water is brought into the system manually, this requires high labor input, moreover it is important to check the systems regularly to improve the production and avoid water loss on the plantation. Due to water costs and increasing water demands, gardeners need to be concerned about conservation.

***Objectives of the Study***

The main objective is to develop an automated irrigation system by implementing a controlled technique to meet soil moisture requirement that will contribute to water conservation and minimize the labor in the field of gardening.

Specifically, the study aims to:

1. Develop a program using a microcontroller that will process the data from the sensor and control the whole irrigation system;
2. Identify the suitable amount of water to be delivered that will assist in maintaining the level of soil moisture monitor the level of water tank which stores the water that will aid in the irrigation system; and,
3. Test the effect of varying moisture content of the soil to the plants with the following indications, at lower than optimized level, at optimized level, and at higher than optimized level.

***Scope and Limitation***

The project focused solely in constructing a water irrigation system with a device that will determine the moisture condition of the soil and will trigger the water irrigation system to operate. The drip hose will automatically release adequate amount of water if the moisture sensor detects that the soil is already dry and lacks water.

The project can automatically determine if the soil-moisture is below the minimum allowable limit, ensures plants are not affected by moisture stress at critical growing times, decreases human intervention, will be using a microcontroller to control the right amount of water to release based on the moisture content of the soil, uses a solar panel as the power source of the system**,** can simply determine the water level condition of the water tank by water level indicator.

The project is limited to be used for small area garden design, focuses primarily on soil-moisture content as the basis for the irrigation system, no other sensor will be implemented, maintenance of the system still requires human intervention to keep irrigation on course, sensitive to weather condition which may interrupt the effectiveness of the soil moisture sensor, manual refill of the water tank to store and establish adequate amount of water enough for irrigation also study will not cover about Fluid Mechanics.

## METHODOLOGY

### *2.1a Arduino Uno Microcontroller (short description)*

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform [1]

### 2.2. Block Diagram

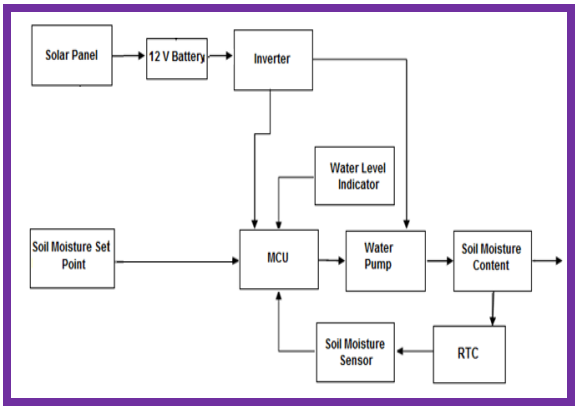


**Figure 2.1 Block Diagram of Automatic Irrigation System**

Figure 2.1 is the block diagram of the Automatic Irrigation System. In here, the power source provided by the Solar panel is being stored in a 12 V battery, and then it is converted to DC –to-AC by the inverter. The value of the conditions for soil moisture (if it is Wet, Dry and Soggy Wet), is encoded in the MCU which is a platform device called Arduino Uno. When the soil moisture sensor detects the conditions of the soil, the MCU will power up the water pump and delivers the right amount of water to the plants. It also has RTC (Real Time Clock) that is responsible for the scheduling process of the irrigation system. For the water source, there is a water level indicator installed and indicates if the water is in high or already in low level.

### 2.3. System Flowchart

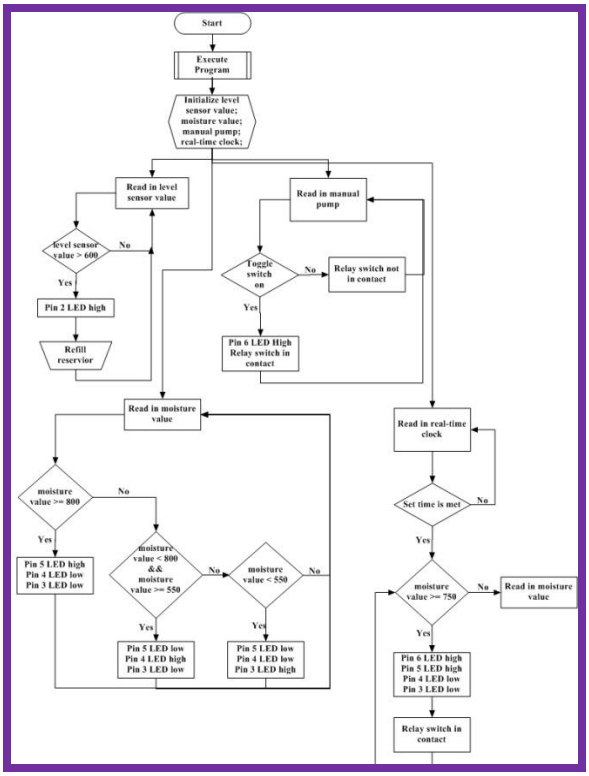


**Figure 2.2 *System Flowchart***

Figure 2.2 illustrates the flowchart of the automatic irrigation system. As the Arduino detects the soil condition of the soil given its designated ranges, it will send an interrupt signal to the relay drivers to switch On/OFF the water pump and deliver the water to the plants. The water level indicator is also programmed in the microcontroller where it will detect if it is in low level or high level condition.

## RESULTS AND DISCUSSIONS

### *Project Design*

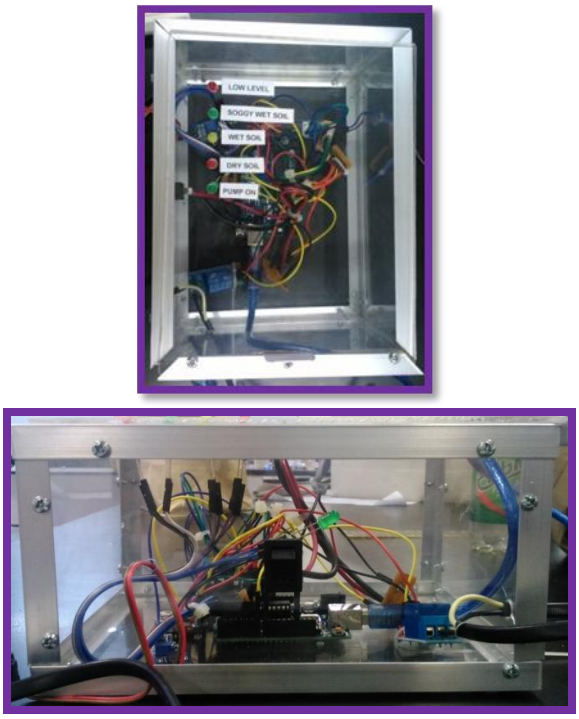


**Figure 3.1 The Prototype**

### *Project Description*

The project composes of Arduino Board, Driver Module, Relay Module, Real Time Clock Module, Hygrometer (Soil Moisture Sensor), Water Level Sensor and Power Supply.

The plantation area has 3 plots with dimension of 10m x 1m. Each plot has individual drip hose and water valve which delivers water to the plants once the hygrometer detects the dryness of the soil and triggers the relay. The hygrometer is located at the center of the single plot and is able to sense the soil moisture level of that whole single plot.

The system uses a single channel relay driver. This relay driver serves as the automatic switch of the system to trigger or turns On and Off the water pump which is connected to the water valve and drip hose. It will be using Real Time Clock (RTC) that is responsible for turning on and off the water pump based on the given time of schedule. The RTC provides real time function which enables the system to cope up with the actual earth time upon shutting down.

The power supply unit (PSU) is an integrated 10-W, 12Vdc output solar panel and 300-W, 12Vdc input and 220Vac output inverter backed up with a solar battery. The PSU serves as source of the entire system, including the exterior components like water pump and also the Arduino Board

***Properties of the Project***

The project is most applicable to garden owners where this enhanced irrigation system will help to conveniently utilize their crops without monitoring the soil condition most of the time. If installed and programmed properly, this will also help and can be an important instrument in conservation of water consumption which can reduce the excessive use of water in gardening purposes.

**Project Capabilities and Functions**

The system is capable of sensing the moisture present in the soil, the level of water in the water tank and supplying water by means of water pump into the soil. The sensors are being controlled by the microcontroller unit which is the arduinouno r3. There are set-points associated to the system wherein LED indicator will be triggered on and off according to the readings of the soil moisture sensor. The set-point is based on the converted digital inputs that are processed by the microcontroller unit.

The system has a timing system by the use of the real-time clock module. Once it meets the right time and when the moisture of soil is low, it will trigger the relay switch that will turn on the water pump and the water will be supply to the plant by means of dripping method.

Manual switching of the water pump is also included to the system wherein the user can switch on and switch off the pump without meeting any conditions. Manual switching uses a toggle switch to turn on and off the pump.

***Tools and Methodologies of the System***

**Table 1. Soil Moisture Sensor Readings for the Conditions of the Soil**

| **Soil Moisture Sensor Readings** | |
|---|---|
| **Conditions** | Range |
| **Wet** | Less than 550 |
| **Soggy** | 550-800 |
| **Dry** | 800 and up |

Table 1 shows the readings of the soil moisture sensor relative to the conditions of the soil. The soil moisture sensor is responsible for indicating the condition of the soil if it is Wet,

Soggy Wet and dry in order to know its water requirement which is programmed in the microcontroller.

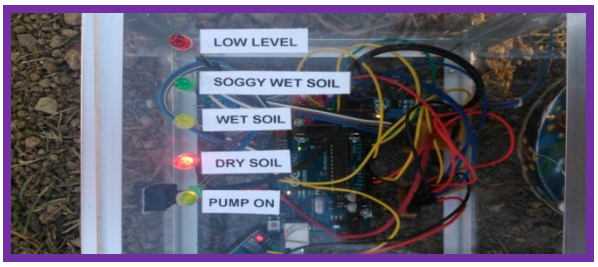


**Figure 3.5.1 The soil condition is dry**

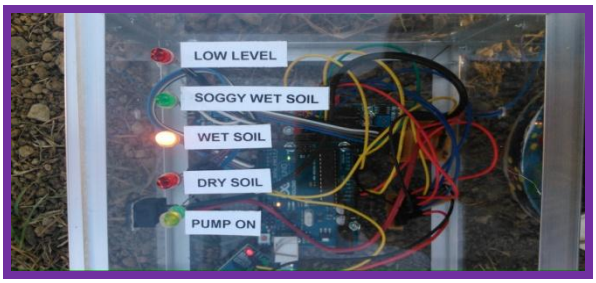


**Figure 3.5.2 The soil condition is wet**


**Figure 3.5.3 *The soil condition is soggy***

**Table 2.Non – Scheduling Irrigation for 3 plots (Manual)**

| | Trial 1 | Trial 2 | Trial 3 |
|---|---|---|---|
| **Cycles Per Day** | 2 | 2 | 2 |
| **Maximum Runtime per Cycle (min/plot)** | 5 | 10 | 15 |
| **Maximum Runtime per Day (min/plot)** | 10 | 20 | 30 |
| **Amount of Water Released (liters/plot)** | 4.25 | 8.5 | 12.75 |

**Table 3.Scheduling Irrigation for 3 plots**

| | Trial 1 | Trial 2 | Trial 3 | Trial 4 | Trial 5 |
|---|---|---|---|---|---|
| **Cycles Per Day** | 1 | 1 | 1 | 1 | 1 |
| **Maximum Runtime per Cycle (min/plot)** | 6.116 | 7.467 | 7.2 | 6.067 | 7.517 |
| **Maximum Runtime per Day (min/plot)** | 6.116 | 7.467 | 7.2 | 6.067 | 7.517 |
| **Amount of Water Released (liters/plot)** | 5.199 | 6.347 | 6.120 | 5.157 | 6.389 |

Table 2 and 3 shows the daily runtime period and amount of water released every cycle of irrigation. It determines the condition of the soil moisture level depending on the time it takes to irrigate the whole plot. During each trial, the proponents were able to test the runtime period of each cycle of each condition of the soil moisture. According to the table shown above, the initial condition of the soil moisture in every trial is below optimized level, meaning, the soil is dry. After several minutes, the soil moisture varies and obtains the three conditions of the soil moisture after irrigation which is below optimized level, at optimized level, and above optimized level.

## CONCLUSION

The development of our project which is the Automatic Soil moisture Sensing Water Irrigation System with water level indicator is the device that will provide the needed water when the soil moisture sensor detects if the soil is dry.

The development of program is obtained to operate the automatic irrigation system, given the scheduling process that is provided by the RTC, the amount of suitable water(based on range of its soil moisture) needed to deliver for the plants is being controlled so there is no excess water , which mainly contributes to conservation of water.

## RECOMMENDATION

Based on the gathered results and obtained data, the following recommendations were drawn: The researchers recommend that this research may be used as reference for further development of new methods and devices for watering and protection system of the plantation, such as : adding a CCTV camera to monitor the daily watering of plants and animal disturbances, adding a light post within the vicinity or corners of the plantation area, adding and mixing of fertilizer to water which may flow in every plot that can help the plants grow faster and lastly ,it can expanding the system and study the implementation of the system in a large scale plantation.

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