Automatic Water Controlling System Based On Soil Moisture

Antor Mahamudul Hashan, Abdullah Haidari

Abstract: Nowadays, population growth has led to water scarcity in most parts of the world. A large amount of water is wasted in agriculture. This article proposes an automatic plant watering system that uses an Arduino UNO and Soil moisture sensor. It automatically detects soil moisture and decides if watering is needed. The automatic watering system, a soil moisture sensor, checks the moisture level in the soil, and if the moisture level is low, the Arduino turns on a water pump to provide the water. The water pump automatically shuts off when the system detects sufficient moisture in the soil. Whenever the system turns the pump on or off, the status of the water pump and soil moisture is updated. This system is fully automated and does not require human intervention. This system is useful for gardens, Farming, etc.

Index Terms: Watering System, Arduino UNO, Water Pump, Motor Driver Ic, Moisture Sensor, LCD Display, Power Supply.

1. INTRODUCTION

We use a lot of water for agriculture. In most cases, this water is used inefficiently, and a significant amount of water is wasted. Introduce modern irrigation methods that are simple, easy to use, and increase water use efficiency. The automatic Water Controlling System is the most efficient technique of supplying water into the land. The most significant advantage is that the water is supplied to the root zone in a drop-by-drop manner, thereby saving a huge amount of water. Farmers in India are now using manual irrigation techniques. This process sometimes requires more water, and sometimes the water is late, which causes the crops to dry out [1]. This problem can be solved with an automated watering irrigation system. The automated watering irrigation system uses soil moisture sensor that are installed in the root zone on undisturbed soil. The moisture sensor is connected to the irrigation system controller, which measures soil moisture, and the system valves automatically turn on and off at different times. It also saves time, eliminates human error in adjusting soil moisture levels, and maximizes yields through less water consumption [5]. When components are activated, all components will read and output to the controller and the information will be displayed. The sensor readings are analog in nature, so the ADC pin on the controller converts the analog signals to digital. The controller will then access the information and when the motors are turned on / off, it will be displayed on the LCD panel. There are many systems for saving water when growing different crops.

2 OBJECTIVE

The idea of this paper is to investigate the characteristics of the Irrigation and select an appropriate irrigation system. Increase yields through an efficient irrigation system and significantly reduce water demand.

3 RELATED WORKS

There are plant irrigation projects using 8051 microcontrollers. The disadvantage of the project is that it uses the 8051, whose signal processing ability and speed is not as good as the PIC 16F877 [2]. In addition, it has a memory limit, this controller only has one serial port, so connecting more sensors becomes difficult. There is another project called automatic watering of plants, it is very similar to our project, but it has some disadvantage that it does not display parameter values remotely, but simply controls the operation of the pump. One project then discusses an automation system for watering plants that used two wires to measure moisture. This arrangement does not provide accurate results compared to the hygrometer-defined soil moisture module. There are many other demo projects for indicating an automatic plant watering system, but they are not capable and not feasible for practical implementation, since they all have some minor problems, such as insufficient pump driver power, limited reservoir capacity [3]. Another researcher Yandog Zhao investigated irrigation management systems based on Internet articles. Another built-in automatic irrigation system for cardamom fields such as high, low, sloppy, and flat areas. This system uses a PIC16F877A microcontroller [4]. Temperature and humidity sensors detect field temperature and field humidity, humidity sensor detects soil moisture, these conditions are updated at their base station. In addition, the system is not reliable due to the microcontroller architectures used.

4 METHODOLOGY

There are two functional components in this system. These are Soil Moisture sensor and a water pump. A block diagram of an automatic watering system is shown below:

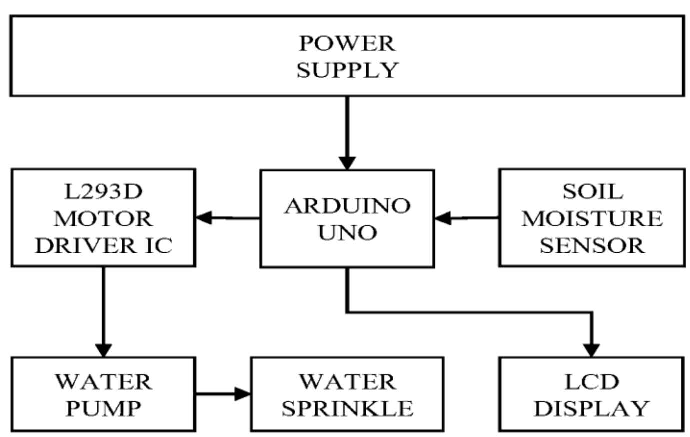

***Fig.** 1. System Block Diagram*

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This automatic water controlling system has been designed to continuously measure the moisture level of the soil. Here, if the soil moisture level is low, the Arduino turns on the water pump to provide the plant with water. When the system detects enough moisture in the soil, the water pump will automatically shut off.

5 EQUIPMENT'S

The hardware and software components are:

1. Arduino Uno
2. L293D Motor Driver Ic
3. Water Pump
4. Soil Moisture Sensor
5. LCD Display

5.1 ARDUINO UNO

Arduino Uno is a microcontroller board based. It has 14 digital I/O, of which 6 pins can be used as PWM outputs, 6 analog inputs, 16 MHz ceramic resonators, USB connection, power connector, ICSP header and reset button [9]. This is programmed using the Arduino Software (IDE).

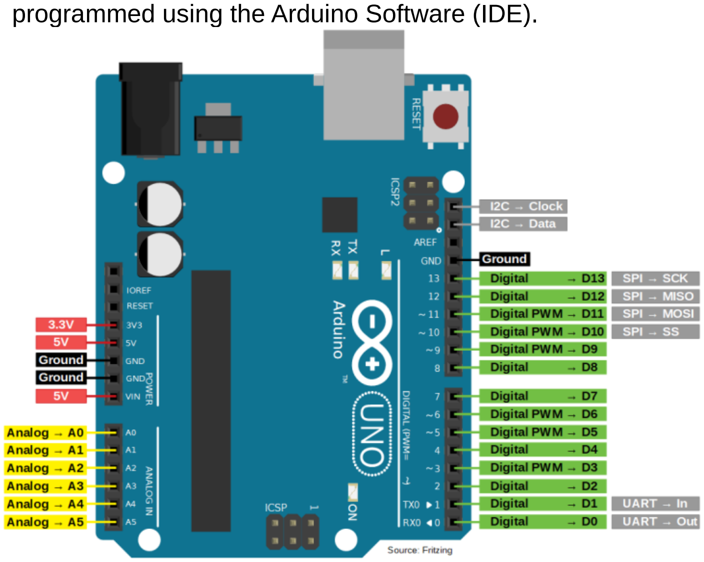

Fig. 2. Arduino Uno Pinout

5.2 MOISTURE SENSOR

It consists of two conductive metal probes that are used to measure the moisture content of the soil.

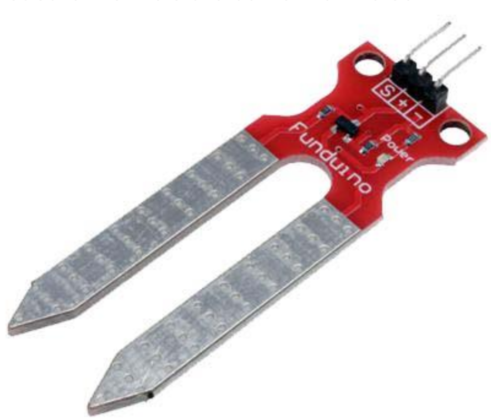

Fig. 3*. Soil Moisture Sensor*

This sensor can be used to check soil moisture when there is not enough water in the soil, the module output is high, otherwise it is low. It has two header pins that connect to the Arduino UNO. It has a detection length of 38 mm and an operating voltage of 2-5 V [8]. In analog mode, I used the analog output of the sensor instead of the digital one. The sensor gives values from 0 to 1023. This soil moisture is measured as a percentage, so we will compare these values from 0 to 100. When we took readings from dry soil, then the sensor value was 500, and in wet soil, the sensor value was 12.

5.3 MOTOR DRIVER IC

The L293D has four outputs that can draw 600mA, each of which can step up the voltage or step down to 0 V. This makes it ideal for driving motors back and forth as each side of the motor can be connected to an output [10]. Pin 0 and 1 will make it turn one way, and pin 1 and 0 will make it turn the other way.

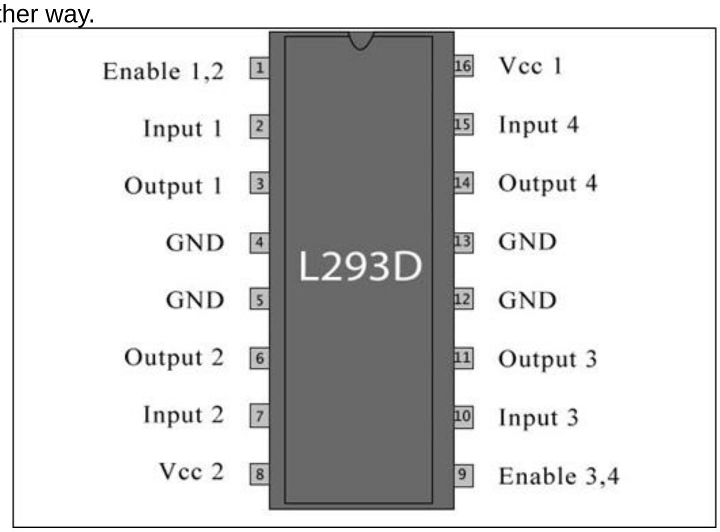

Fig. 4*. L293D Motor Driver IC*

L293D motor driver IC like as H-bridge IC. This IC has 16 pins and can drive two DC motors at the same time. It can drive DC motors both clockwise and counterclockwise.

TABLE 1

Logic Table for L293d

PIN 1	PIN 2	PIN 7	OUTPUT
High	High	Low	Reverse
High	Low	High	Forward
High	High	Low	Stop
High	Low	High	Stop
Low	X	X	Stop

5.4 WATER PUMP

The pump uses a 12V DC motor. The pump is turn on and off automatically by motor driver IC. The Arduino board reads the moisture values and compared with the reference value, thereby activating the motor driver circuit. It is a small pumping motor that can be powered by a 2.5 ~ 12V power supply. It has a low current consumption of 220mA.

***Fig. 5**. Water Pump (12 Volt)*

6 IMPLEMENTATION

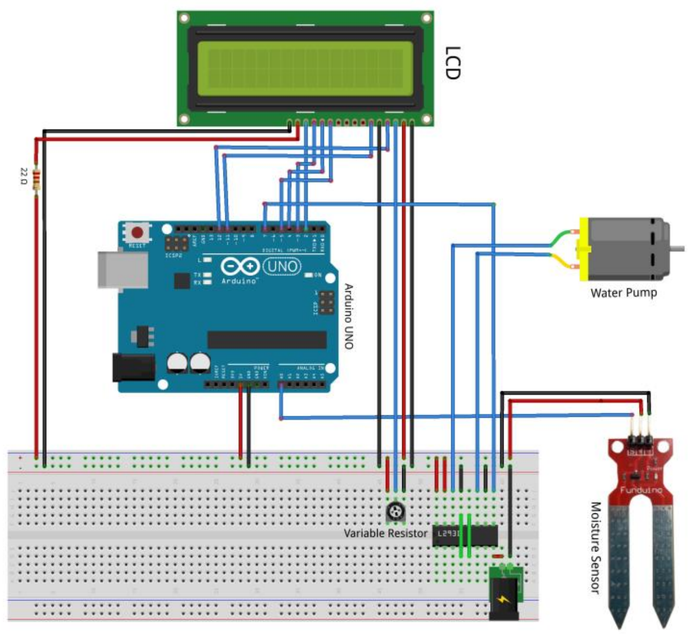

***Fig. 6**. System Connections*

Arduino is a platform used for building electronic and programming projects. Arduino consists of a microcontroller, which is a physical programmable circuit as a hardware part, and the software part has an IDE (Integrated Development Environment) that is used to write and upload computer code to the Arduino board. First, the Arduino UNO, power supply and soil moisture sensor connect with the breadboard. Then a soil moisture sensor is connected to the UNO board, which determines the water content of the plant. It is used to show if the system is working properly. Soil moisture sensors are connected to Arduino pin A0 for analog input, so we can get soil temperature data. The Vcc pin connects through the 5V pin of the Arduino; The GND pin is the ground for connecting all components. D7 is known as a digital pin, so it is connected to transistors for low power amplification. Motor driver IC connected with VCC pin through D13 of Arduino board, it sends current to the motor pump, D7 pin is used for ground. D7 is connected through 22Ω resistors.

7 WORKING PROCESS

In this project, there are two functional components. These are soil moisture sensors and a water pump. Therefore, the Arduino board is programmed using Arduino IDE software. A moisture sensor is designed to determine the soil moisture level. The water pump supplies water to the plants. This project uses Arduino Uno for controlling the water pump and soil moisture sensor. The motor can operate from 9 x 12 volts. The soil moisture sensor measures the level of moisture in the soil, turns on the alarm, and sends a signal to the Arduino if irrigation is needed. The water pump supplies the plants until they reach the desired moisture level.

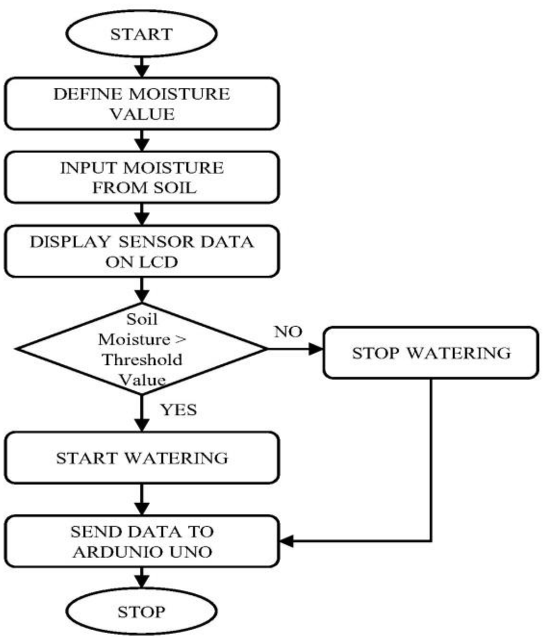

***Fig. 7**. Water Controlling Flowchart*

8 RESULT AND DISCUSSION

"Automatic Water Controlling System Based On Soil Moisture" worked successfully. The main advantages of the applied automatic sprinkler systems are labor and time efficiency, as well as cost savings. Once installed in the system, you can set a timer to water at regular intervals per day during growing. Two different soils are used to test the automatic plant watering system model. The moisture content of both soils is measured and compared with the reference values. In the first soil, the moisture content measured by the sensors is less, so the pump automatically supplies water to the crop until it reaches the limit. And the second soil, the soil is already wet. In this case, the pump was turned off. This system does not require the presence of farmers on the land, as it can be operated from anywhere. This reduces the need for labor and saves a lot of time. The proposed system has other advantages as well. It provides only portable amount of water for the crop, thus saving water which is otherwise wasted due to waterlogging.

TABLE 2
Difference in Water Consumed

Day	Normal Watering System (Liter/Day)	Automated Watering System (Liter/Day)
5	6	4
10	7.5	5
15	12	8
20	14	8.5
25	18	11.7
30	22	14
35	24	16
40	27	17.8

With automatic water control system, water consumption can be reduced by 50% compared to traditional irrigation system. Also, it can improve soil moisture and minimize soil erosion, weed control, and nutrient loss.

9 FUTURE IMPROVEMENT

- Mobile Application based waster controlling system.
- Solar energy can be used for power supply.
- Various functions can also be added depending on the scope of the task.

10 CONCLUSION

This project has developed an automatic watering system using Arduino. The prototype of the model worked properly when tested on different soils. The components we use in the system are readily available and easy to operate. Thus, this system acts as an efficient irrigation method. This is much better than the manual watering process, which is labor-intensive and time-consuming. This project is primarily intended for farmers and gardeners who do not have time to water their plants. It also applies to those farmers who wastewater during irrigation. The project can be extended to greenhouses, where manual supervision is practically non-existent. This principle can be elaborate to create fully automated gardens and farmland. Combined with the principle of rainwater harvesting, this can lead to huge water savings when used correctly. On agricultural land with severe rainfall shortages, this model can be successfully applied to achieve excellent results with most soil types.

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