



## A Study on Automated Micro Irrigation Using Soil Moisture Sensors

K.Y. Raneesh <sup>a</sup>

<sup>a</sup> Department of Agriculture Engineering, Sri Shakti Institute of Engineering and Technology, Coimbatore-641062, Tamil Nadu, India.

\* Corresponding Author: [drraneesh@siet.ac.in](mailto:drraneesh@siet.ac.in)

Received: 25-08-2021; Revised: 02-10-2021; Accepted: 11-10-2021; Published: 30-10-2021

**Abstract:** Micro irrigation is the modern method of irrigation. By this method water is irrigated through drippers, sprinklers, foggers and by other emitters on surface and sub surface of the land. Micro irrigation can be given by tubes and drippers which deliver water directly to the base of each plant or crop. Drip irrigation, sprinkler irrigation, bubbler irrigation and sub-surface irrigation are the different types of irrigation. Soil moisture is the key variable in controlling the exchange of water and heat energy between the land surface and atmosphere. Soil moisture sensor measures the volumetric water content in the soil. Automation in micro irrigation is a system by which all the operations related to supply of irrigation water or fertilizer to the crop are carried out automatically with minimum manual interventions using soil moisture sensors.

**Keywords:** Micro Irrigation, Automation, Soil Moisture, Sensors.

### 1. Introduction

Agriculture is depending mainly on rain which is not a sufficient source of water for whole irrigation of agricultural crops. The irrigation system helps to supply water to the agricultural fields according to the moisture condition of the soil. In conventional system the farmer has to work properly and with full care of water supply for watering the crops, which also depends on crops types. Insufficient watering causes stress to plants. A systematic irrigation system is useful to reduce water use for agricultural crops which is a much-required process. The need of a balanced irrigation system is to succeed over irrigation and under irrigation. To overcome these problems related to over and under irrigation and to minimize the man power, the smart irrigation system has been introduced. The latest technique through which small amounts of water can be supplied to the parts of root of a plant is called drip system. The plant soil moisture stress is overcome by providing proper amount of water resources frequently by

which the moisture condition of the soil will retain better condition for plant growth. The full concept of the irrigation system is like traditional techniques of sprinkler or surface irrigation requires half of water sources. Even more specific amounts of water can be supplied for plants. The main objective of this project is to save water and reduce or minimize labour work in the agriculture fields and greenhouses. Continuously monitoring the status of sensors provide signal for taking necessary action to implementing the process and get the output of soil moisture sensor and provide water according to the need or required of crop.

Archana and Priya (2016) proposed a paper in which the humidity and soil moisture sensors are placed in the root zone of the plant. Based on the sensed values the microcontroller is used to control the supply of water to the field. Sonali D. Gainwar and Dinesh V. Rojatkar (2015) proposed a paper in which soil parameters such as pH, humidity, moisture and temperature are measured for getting high yield from soil. This system is fully automated which turns the motor pump ON/OFF as per the level of moisture in the soil. The current field status is not intimated to the farmer. V. R. Balaji and M. Sudha (2016) proposed a paper in which the system derives power from sunlight through photo-voltaic cells. This system does not depend on electricity. The soil moisture sensor has been used and based on the sensed values PIC microcontroller is used to ON/OFF the motor pump.

Weather forecasting is not included in this system. G. Parameswaran and K. Sivaprasath (2016) proposed a smart drip irrigation system using IOT in which humidity, temperature and pH sensors are used. Irrigation status is updated to the server or local host using personal computer. S. Reshma and B.A. Sarath (2016) proposed an IOT based automatic irrigation system using wireless sensor networks in which various sensors are used to measure the soil parameters. This system provides a web interface to the user to monitor and control the system remotely. Weather monitoring is not done in this system. Joaquin Gutierrez (2013) proposed a gateway unit which handles sensor information, triggers actuators, and transmits data to web application. It is powered by photovoltaic panels and has duplex communication link based on cellular internet interface that allows for data inspection and irrigation scheduling to be programmed through web page.

## Methodology

The main aim of this project was to provide water automatically to the crops in a greenhouse using microcontroller (Arduino Nino). There are timer-based devices available in India which waters the soil on set interval. They do not sense the soil moisture and the ambient temperature to know if the soil actually needs watering or not. The automated irrigation is used to assist in the growing of agricultural crops, maintenance of landscapes, and vegetation of disturbed soils in dry areas and during periods of inadequate rainfall. Drip and sprinkler irrigation are the most common methods used in automation. As the method of dripping will reduce huge water losses it became a popular method by reducing the labor cost and increasing the yields. When the components are activated, all the components will read and gives the

output signal to the controller, and the information will be displayed to the farmer. During operation, the controller will access information and when the motors are turned On/Off it will be displayed on the LCD Panel, and serial monitor windows.

### Arduino Micro-controller

Arduino is an open-source which provide prototyping platform based on easy-to-use software and hardware. Arduino boards are able to read inputs - a finger on a button, light on a sensor - and turn it into an output -turning on an LED, activating a motor, publishing acceptably online. We can tell board what to do by sending a set of instructions to the microcontroller board. To do so we use the Arduino Software (IDE), and the Arduino programming language (based on wiring), based on Processing. The Arduino Uno can be powered via with an external power supply or the USB connection. The power source is selected automatically External or non-USB power can come either from an AC-to-DC adapter or battery. The adapter are |will be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from electric battery are often, may be inserted within the Gnd and Vin pin headers of the power connector. The board will operate on, care for Associate in Nursing external provide of six to twenty volts. If provided with less than 7V, however, the 5V pin may provide less than 5 volts and therefore the board is also unstable. If exploitation over 12V, the voltage could overheat and harm the board. The suggested range is seven to twelve volts.

### Soil Moisture Sensor

Although soil water status will be determined by direct (soil sampling) and indirect (soil moisture sensing) ways, direct methods of observing soil moisture aren't usually used for irrigation planning because they're intrusive and labour intensive and can't offer immediate feedback. Soil wetness probes is may be for good put in at representative points in an agricultural field to supply continual wetness readings over time which will be used for irrigation management. Special care is required when exploitation soil moisture devices in coarse soils since most devices require close contact with the soil matrix that's generally troublesome to achieve in these soils. Most of the presently available volumetrically sensors appropriate for irrigation are insulator. This cluster of sensors estimate soil water content by measurement the soil bulk permittivity (or non-conductor constant) that determines the speed of an Associate in Nursing electromagnetic radiation, non-particulate radiation or pulse through the soil. During a material stuff just like the soil (i.e., created from totally different elements like minerals, air and water), the worth of the permittivity is formed up by the relative contribution of every of the elements. Since the insulator or non-conductor constant of liquid water is far larger than that of the opposite soil constituents, the entire permittivity of the soil or bulk permittivity is principally ruled by the presence of liquid water. The insulator or non-conductor ways use empirical (calibrated) relationships between volumetrical water content and therefore the detector output signal (time, frequency, impedance, wave phase). These techniques are getting wide adopted as

a result of they need sensible| reaction time (almost fast measurements), don't need maintenance, and may give continuous readings through automation. Though these sensors are supported the insulator principle the varied varieties out there or accessible (frequency domain reflectometry-FDR, capacitance, time domain transmission-TDT, amplitude domain reflectometry-ADR, time domain reflectometry-TDR, and section transmission) gift necessary variations in terms of standardization needs accuracy, installation and maintenance needs and value.



**Figure 1.** Soil Moisture Sensor

The steps involved in this automated irrigation process are as follows:

***Step 1:***

In this tutorial, we assume you're using an Arduino Uno You also need a standard USB cable (A plug to B plug): the kind you would connect to a USB printer, for example.

***Step 2: Download the Arduino environment***

Get the latest version from the download page. When the download finishes, unzip the downloaded file. Make sure to preserve the folder structure. Double- click the folder to open it. There should be a few files and sub-folders inside.



**Figure 2.** Audrino Board

### *Step 3 Connect the board*

The Arduino Uno, Mega, Duemilanove and Arduino Nano automatically draw power from either the USB connection to the computer or an external power supply. If you're using an Arduino Diecimila, you'll need to make sure that the board is configured to draw power from the USB connection. The power source is selected with a jumper, a small piece of plastic that fits onto two of the three pins between the USB and power jacks. Check that it's on the two pins closest to the USB port. Connect the Arduino board to your computer using the USB cable. The green power LED (labelled PWR) should go on.

### *Step 4 : Install the drivers*

Installing drivers For the Arduino Uno or Arduino Mega 2560 with Windows7, Vista, or XP

### *Step 5: Launch the Arduino application*

Double-click the Arduino application. (Note: if the Arduino software loads in the wrong language, you can change it in the preferences dialog. See the environment page for details.)

### *Step 6: Open the blink example*

Open the LED blink example sketch: File > Examples > 1.Basics > Blink.

### *Step 7: Select your board*

You'll need to select the entry in the Tools > Board menu that corresponds to your Arduino.

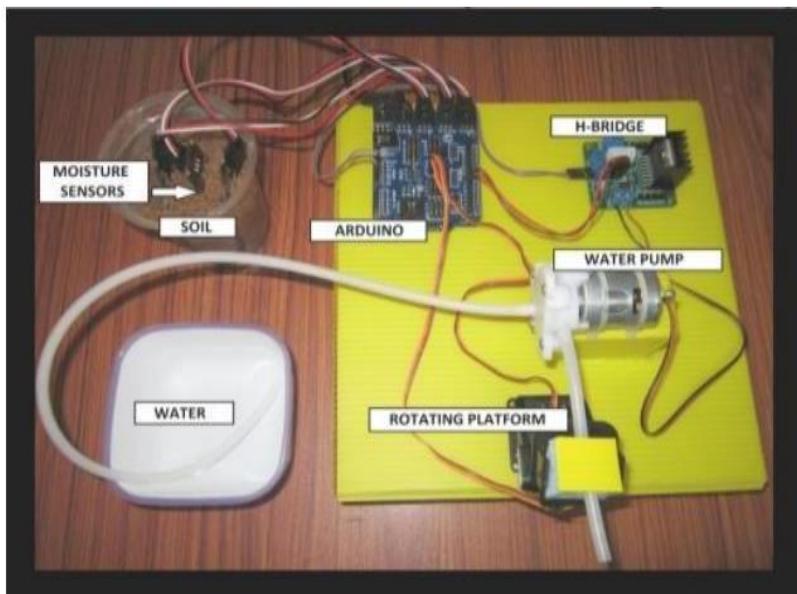
### *Step 8: Select your serial port*

Select the serial device of the Arduino board from the Tools | Serial Port menu. This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial

ports). To find out, you can disconnect your Arduino board and re-open the menu; the entry that disappears should be the Arduino board. Reconnect the board and select that serial port.

### *Step 9: Upload the program*

Now, simply click the "Upload" button in the environment. Wait a few seconds-you should see the RX and TX leds on the board flashing. If the upload is successful, the message "Done uploading." will appear in the status bar.



**Figure 3.** Circuit Board

Algorithm for Arduino nano board:

```
Int sensor pin=A0
Int output_value;
Void_steup()
{
Serial.begin(500);
Serial.println("Reading
Delay(1000);
}
Void_loop()
{
```

```
Output_value=analogRead(>500,<1000)
Output_value=map(ouypuy13)
Serial.print("Moisture :
Serial.print(output value)
Delay(1000)
}
```

## Results and Discussions

Continuous increasing demand of food requires the control in highly specialized greenhouse vegetable rapid improvement in food production technology. In a production and it is a simple, precise method for country like India, where the economy is mainly based on irrigation. It also helps in time saving, removal of human agriculture and the climatic conditions are isotropic, still error in adjusting available soil moisture levels and to we are not able to make full use of agricultural resources. At the present era, the farmers have been using the conventional irrigation methods like manual control sprinklers, flood irrigation, basins, etc. The entire soil in this process consumes more water or surface is saturated and often stays wet long after irrigation. Such condition promotes infections by pests. Water can be perfectly applied if we use automatic micro irrigation is implemented using sensors. This irrigation system will prevent moisture stress in the plants and irrigation will take place only when there will is need for acute use of water resources.

Soil moisture is an important factor considered for plant growth, both on a small agricultural scale and in large scale modelling of land and atmosphere interaction. Vegetation always depend more on the moisture available at root zone level than on precipitation occurrence. Water budgeting for irrigation planning, as well as the actual scheduling of irrigation action, requires local soil moisture information. Microcontroller based irrigation of water in the soil proves to be a real time feedback control system of the soil water energy status. The relation which monitors and controls all the activities of drip between content and potential is not universal and depends on irrigation system efficiency. The automated irrigation system based on soil moisture using Arduino nano has been designed. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. The soil moisture sensor measures the moisture level of the crops. If the moisture level goes below the desired and limited level, the moisture sensor sends the signal to the Arduino nano board which triggers the water pump to turn and supply the water to the desired level. When the desired moidture level is reached the pumps is turned off. The model developed for soil moisture sensing of irrigation reduces soil erosion and nutrient leaching. The water consumption is low and manpower is reduced.

## Conclusions

The project has been developed by integrated features of all the hardware components and software used. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Thus, the Arduino based automatic irrigation system has been designed and tested successfully. The system has been tested to function automatically. The moisture sensors measure the moisture level at the root zone level of the plants. If the moisture level is found to be below the desired level, the moisture sensor sends the signal to the Arduino board which triggers the Water Pump to turn ON and supply the water to respective plant using the drip system. When the desired moisture level is reached, the system halts on its own and the Water Pump is turned OFF. Thus, the functionality of the entire system has been tested thoroughly and it is said to function successfully. A proper algorithm approach and use of micro controllers will help in designing the automated irrigation system for measurement and control of several crucial parameters for growth of plants. The final results obtained from the evaluation after sensing of parametric values needs to be definitive and precise. The cost of hardware and software involved in the operation can be made less if profit is to be achieved higher. Improvements in the controllers can be made less expensive and more reliable sensors can be developed for use in agricultural production.

## References

- [1] J.G. Kolo, Design and Construction of an Automatic Power Changeover Switch, AU Journal of Technology, 11 (2007) 1-6.
- [2] P. Archana, R. Priya, Design and implementation of automatic plant watering system. International Journal of Advanced Engineering and Global Technology, 4 (2016) 1567-1570.
- [3] S.D. Gainwarm D. V. Rojatkar, Soil Parameters Monitoring with Automatic Irrigation System, International Journal of Science, Engineering and Technology Research(IJSETR), 4 (2015) 3817-3820.
- [4] V.R. Balaji M. Sudha , Solar Powered Auto Irrigation System, International Journal of Emerging Technology in Computer Science and Electronics (IJETCSE), 20 (2016) 203-206.
- [5] G. Parameswaran, K. Sivaprasath, Arduino Based Smart Drip Irrigation System Using IOT, presented at International Journal of Engineering Science and Computing
- [6] S.Reshma and B.A.Sarath Manohar Babu, Internet of things Based Automatic Irrigation System using Wireless Sensor Networks, presented at International Journal and Magazine of Engineering, Technology, Management and Research, vol-03, Issue-09, Sep-2016.
- [7] A.G. Smajstrla, R.C. Koo, (1986) Use of tensiometers for scheduling of citrus trickle irrigation, Proceedings of the Florida State Horticultural Society, 99 (1986) 51-56.

- [8] A.J. Clemens, (1990) Feedback Control for Surface Irrigation Management, American Society of Agricultural Engineers, USA.
- [9] J.B. Peatman, (1996) Design with micro controllers, Mc- Graw Hill, USA.

**Funding:** No funding was received for conducting this study.

**Conflict of interest:** The Author has no conflicts of interest to declare that they are relevant to the content of this article.

**About The License:** © The Author 2021. The text of this article is open access and licensed under a Creative Commons Attribution 4.0 International License