

## Application of Soil Moisture Sensor in Mixed Farming

Manoj H G<sup>1</sup>, Dr N G S Udupa<sup>2</sup>

<sup>1</sup> M.Tech, Department of Mechanical Engineering, Nagarjuna College of Engineering and Technology, Devanahalli, Bangalore, India

<sup>2</sup> Professor and Head of the Department, Post-Graduation, Department of Mechanical Engineering, Nagarjuna College of Engineering and Technology, Devanahalli, Bangalore, India

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**Abstract -** *The main objective of this project is that it detects the moisture level in the soil and help the farmer in multiple farming, as nowadays there is a scarce for the man power in the field of agriculture, so the farmers are looking for the technology that is easy to work on and which can substitute the work of a labor for the better. Taking all these problems into consideration we have developed a device that detects the moisture level in the soil when the devise is placed in the field it works under three conditions wet, normal and dry conditions. Wet and Normal Condition is when the devise is left on it checks the moisture level in the soil, if there is enough moisture in the soil the devise remains constant and does not function. The second condition is when the devise tries to detect the moisture in the soil and the sensors detect a dry condition then the devise which is interfaced with the water pump is turned on until it reaches the normal condition. In multiple farming three or more crops are grown at the same time where the land is divided into three different zones this device is placed in all the three different zones, sensor 1, solenoid valve1 is placed in zone 1, and similarly for zone 2 and zone 3. In zone 1 when the devise is switched on it verifies the conditions of the soil if its normal the sensor 2 is activated in the zone 2 where the sensor senses the condition dry thus the solenoid is triggered which in turn activates the water pump, it waits for the condition to go normal and automatically switches off and goes to the next zone to repeat the same procedure.*

**Key Words:** Soil moisture sensor, Arduino board, Relay, Solenoid valve

### 1. INTRODUCTION

Mixed farming is a system of farming in which a farmer conducts different types of agricultural practices together [1]. If a farmer cultivates 3 types of crops then there

occurs a difficult task in irrigation as individual crop contains different types of water level respectively. In current times, the farmers have been using irrigation system through the labor-intensive control in which the farmers irrigate the land at regular intervals by turning the water-pump on/off when essential. These procedures sometimes consume more water and sometimes the water supply to the land is delayed due to which the crops dry off [2, 3]. Water shortage deteriorates plants enlargement before visible wilting occurs. In addition to this slow development rate, lighter mass fruit follows water shortage [4]. So, to overcome this problem we have designed the project to ease the farmer. This project is based on mechatronics which is an interdisciplinary area of engineering that combines mechanical, electronic, electrical engineering and computer science. [5, 6]

Basically, the project consists of electrical, electronic and mechanical parts. The electrical part consists of adapter which is meant to convert ac into dc of required volts. The mechanical part consist of pump to pump out the water from a reservoir and solenoid valves to control the flow of water and the electronic part includes Arduino board acts like a brain to this project. It take the given input processes and gives out the necessary output. The system consists of hardware, software and finally the integration of the two parts to provide the results. The hardware system consists of sensor and drivers. A sensor is a device that detects and measures a physical property and records, indicates, or responds to it [7]. Sensor produces a continuous output signal or voltage which is generally proportional to the quantity being measured [8]. In this project we have used soil moisture sensor. Soil moisture sensor is a device which measures the moisture content in the soil. In hardware design, we need all the components that are necessary to accomplish the project, and these components are adapters, water pump, solenoid valves, sensors and some minor components sensor module like reservoir.

### 2. DESCRIPTION OF COMPONENTS

The main components of this project are Soil moisture sensor; Arduino board, Relay, Transistor, Solenoid valve, DC (Direct Current) motor and LCD (Liquid Crystal Display) are represented as shown in fig-1.

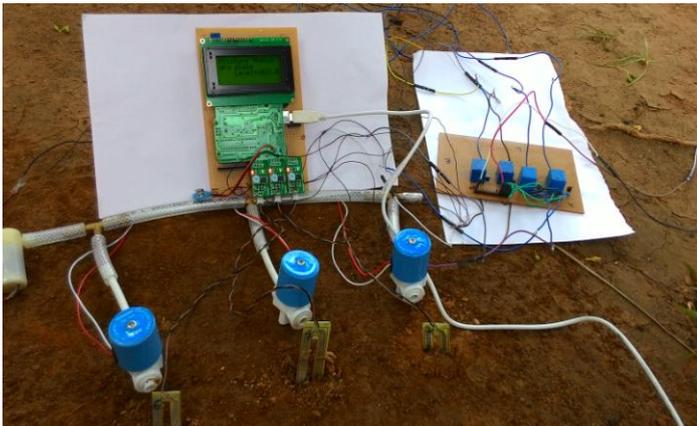


Fig -1: Soil moisture sensor

### 2.1 Soil Moisture Sensor

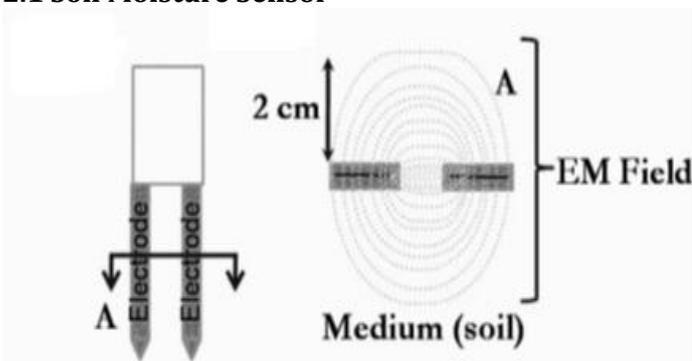


Fig -2: Working Principle of Soil moisture sensor

The Soil Moisture Sensor uses capacitance to measure dielectric permittivity of the surrounding medium. In soil, dielectric permittivity is a function of water content. The sensor creates a voltage proportional to the dielectric permittivity, and therefore the water content of the soil. The sensor averages the water content over the entire length of the sensor. There is a 2 cm zone of influence with respect to the flat surface of the sensor, but it has little or no sensitivity at the extreme edges. The fig-2 shows the electromagnetic field lines along a cross-section of the sensor, illustrating the 2 cm zone of influence [9].

### 2.2 Arduino Board

The Arduino board is a microcontroller board based on the ATmega328 which has 14 digital input/output pins, 6 analog inputs, a USB connection, a power jack and reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with USB cable and upload the program using Arduino Software. The operating voltage is 5v with a flash memory of 32kb of which 0.5kb used by boot loader. Its dimension consists of 68.6mm length and width of 53.4mm.

### 2.3 Relay

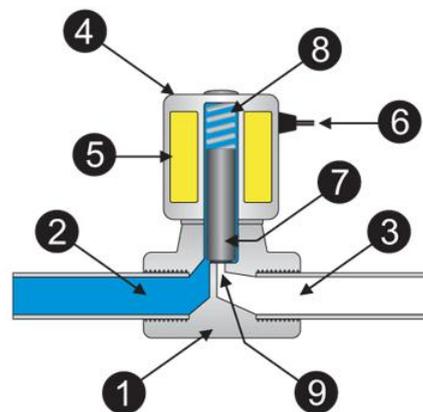
Relay is an electrical device, typically incorporating an

electromagnet, which is activated by a or signal in one circuit to open or close another circuit. A relay is a small machine consisting of an electromagnet, a switch and a spring. The spring holds the switch in one position, until current is passed through the coil. The coil generates a magnetic field which moves the switch. It uses a very small amount of current to activate a relay [10].

### 2.4 Transistor

Transistors are semiconductors used to amplify an electrical signal or switch an electrical signal on and off. Often there will be a need for more power to run a component than the Arduino can provide. A transistor allows controlling the higher power signal by breaking or closing a circuit to ground. Combining this higher power allows to amplify the electrical signal in your circuit. A transistor circuit has four parts; a signal power source (connects to transistor base), an affected power source (connects to transistor collector), voltage out (connects to transistor collector) and ground [11].

### 2.5 Solenoid Valve



- |                |                    |            |
|----------------|--------------------|------------|
| 1. Valve Body  | 4. Coil / Solenoid | 7. Plunger |
| 2. Inlet Port  | 5. Coil Windings   | 8. Spring  |
| 3. Outlet Port | 6. Lead Wires      | 9. Orifice |

Fig -3: Working Principle of Solenoid Valve

A solenoid valve is an electromechanical device used for controlling liquid or gas flow. The solenoid valve is controlled by electrical current, which is run through a coil. When the coil is energized, a magnetic field is created, causing a plunger inside the coil to move. Depending on the design of the valve, the plunger will either open or close the valve. When electrical current is removed from the coil, the valve will return to its de-energized state. The media controlled by the solenoid valve enters the valve through the inlet port. The media must flow through the orifice before continuing into the outlet port. The orifice is closed and opened by the plunger. The valve pictured above is a normally-closed solenoid valve. Normally-

closed valves use a spring which presses the plunger tip against the opening of the orifice. The sealing material at the tip of the plunger keeps the media from entering the orifice, until the plunger is lifted up by an electromagnetic field created by the coil. [12]

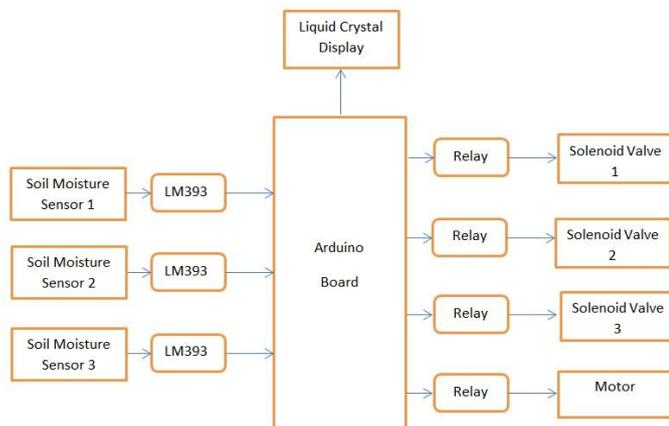
### 2.6 DC Motor

A DC motor is a class of electrical machines that converts direct current electrical power into mechanical power. When a current carrying conductor is placed in a magnetic field, it experiences a mechanical force. The direction of this force is given by Fleming’s left hand rule and its magnitude is given by  $F = \text{magnetic flux density (B)} * \text{current (I)} * \text{length (L)}$ .

### 2.7 Liquid Crystal Display (LCD)

LCD is an electro-optical device use to display digits or characters. It consists of two sheets of glass separated by a sealed in normally transparent, liquid crystal material; the outer surface of each glass sheet has a transparent conductive coating such as tin oxide or indium oxide , with the viewing side coating etched into character forming segments that have leads going to the edges of the display; a voltage applied between front and back electrode coatings disrupts the orderly arrangement of the molecules , darkening the liquid enough to form visible characters even though no light is generated.

## 3. METHODOLOGY



**Fig -4:** Block diagram of application of soil moisture sensor in mixed farming

### 3.1 Assembly

Initially coding is to be composed using C programming in Arduino software. The program includes the set of instructions in which the Arduino board processes it and gives right decisions to carry out. When programming is done it has to be verified in Arduino software thereby the software compiles the program and mentions if any errors are present in the program, if there is an error a proper corrections has to be done and repeat the verification till

the errors disappear, with the help of USB cable connect the Arduino board to the Computer and synchronise the software from Arduino software to Arduino board. Connect the three Soil moisture sensors to the Arduino Board analogue inputs A0, A1 and A2 with the help of LM393 module, is an instrument for measuring the potential (voltage) in a circuit. Three solenoid valves and a Motor are connected to digital output pins 9, 10, 11 and 10 respectively to the Arduino board with the help of relays, transducers. At last LCD is connected to digital output of the Arduino board to display instantaneous status of the project.

### 3.2 Working Principle

Soil moisture sensor 1 checks the level of moisture content in zone 1 and the sensor value is amplified by using LM393 module which will be the input for Arduino board which processes, if the level of zone 1 is dry then Arduino board triggers the solenoid valve 1 to open and turn the Motor ON and it waits for the condition to go normal and automatically switches off the solenoid valve 1 and motor. If normal condition is present in zone 1 then the Arduino board will shed the solenoid valve1 and motor. LCD will display the soil moisture sensor number and its reading correspondingly. After this Arduino board reads the moisture condition in level in zone2 from soil moisture sensor2 and if it detects normal or wet condition then the zone 2 is shed and moves on to the further zone3.If zone 3 is dry then the Arduino board triggers solenoid valve 3and motor until it comes to moral condition. Similarly the same way Arduino board reads conditions from zone1, zone 2 and zone 3 from corresponding soil moisture sensors1, 2 and 3, if dry condition is detected then the respective solenoid valves1, 2 and 3gets open with motor turned on automatically until it comes to normal condition. If normal or wet condition is detected then the Arduino board will shed the respective zone. In general the process is in such a way that it checks zone 1, 2 and 3 continuously and if it detects dry in any zone then it provides water to that respective zone and then only it will goes to the further zone.

## 4. CONCLUSIONS

The Arduino board and soil moisture sensor based irrigation system proves to be a real time response control system which monitors and wheel all the activities of irrigation system. The present system is a model to modernize the agriculture industries at a mass scale with optimum expenditure. In this paper, an automated irrigation model is designed and implemented this model considering low cost, reliability, and automatic control. As the proposed model is automatically controlled it will help the farmers to properly irrigate their fields. The model always ensures the sufficient level of water in different fields avoiding the under-irrigation and over-irrigation

they can provide irrigation to larger areas of plants with less water spending. Using this system, one can save manpower, water to get better manufacture and eventually income. Advanced soil moisture level sensor used here can measure different parameter such as pressure, temperature and humidity, of soil. Different amount of water requirements for different types of soil according to the type of crop, provide definite amount of water to the plant hence, we can save large amount of water.

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## BIOGRAPHIES



Manoj.H.G is Pursuing M-Tech in Mechanical Machine Design Department Nagarjuna College of Engineering & Technology.



Dr. N.G.S.Udupa is working as a Vice Principal in Nagarjuna College of Engineering & Technology. He received the B.E. from Mysore University, secured 1<sup>st</sup> rank in M-Tech from IIT Madras and Ph.D in IIT Madras.