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# Development of Sensor Based Automatic Irrigation in Agriculture Using IOT

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***ABSTRACT:*** *The inducement behind the work is that we find in developing states of India like Bihar, Rajasthan, Orissa etc... the major thrift is mostly reliant on agriculture and climate conditions. An appropriate farming is done only when the productivity of the agriculture is maximized by meticulously adopting the crop and soil, meeting specific requirements in the agriculture and perpetuating environmental quality. This paper proposes a technical solution for automatic irrigation for agriculture and farms. This technique is used in agriculture where periodic irrigation is regulated in mass farmers find difficulty in feeding the plants in their hectic and febrile situation and in their absence for few days. The proposed solution will address this problem by automatically watering the plants based on the soil moisture. Using this feedback method, the over feeding and under feeding of plants shall be avoided, this will promote healthy growth of the plant and will produce good harvest. Also, efficient water utilization is made to conserve water.*

***KEYWORDS: automatic irrigation, automatic watering, soil moisture***

## I. INTRODUCTION

Freshwater is needed for crop and energy production, industrial fabrication as well as human and ecosystem needs. According to AQUASTAT database (AQUASTAT, 2016), 69% of the total extracted freshwater is used by agriculture sector, whereas 19% is used by industrial sector and the rest is used by the domesticsegment. Therefore, water can be considered as a critical need in agriculture sector for future global food security However, continued increase in demand for water by domestic and industrial sectors and greater concerns for environmental quality have create a challenge to every country to reduce the farm water consumption and sustain the fresh food requirement [1-5]. Consequently, there is an urgent need to create strategies based on science and technology for sustainable use of water. Industrialists and researchers are working to build efficient and economic automatic systems to control water usage in order to reduce much of the wastage. Irrigation is an artificial application of watering the land for agricultural production. The requirement of water to the soil depends on soil properties such as soil moistureand soil temperature. Effective irrigation can influence the entire growth process andautomation in irrigation systems using modern technology can be used to provide better irrigation management. In general, most of the irrigation systems are manually operated. These traditional techniques can be replaced with automated techniques of irrigation in order to use the time effectively.

Different automated watering techniques from previous works are, it can be found that the Arduino based sensors have been utilized for the plant watering system (Devika et al., 2014) and automated irrigation systems (Agrawal & Singhal, 2015; Kumar Sahu & Behera, 2015; Singh & Saikia, 2017). An Arduino Based Automatic Plant Watering System is proposed in (Devika et al., 2014) where the authors developed the Arduino microcontroller used to control two functional components which are the moisture sensors and the motor/water pump to automatically water the plant. The moisture sensor's function is to sense the level ofmoisture in the soil whereas the water pump supplies water to the plants. In (Agrawal& Singhal, 2015), a smart drip irrigation system using Raspberry Pi and Arduino is proposed for home automation An Automated Irrigation System Using Arduino Microcontroller system. A drip irrigation system makes the efficient use of water where the water is slowly dripped to the roots of the plants through narrow tubes and valves. Conventionally, farmers will present in their fields to do the irrigation process. Nevertheless, nowadays farmers need to manage their agricultural activity along with other occupations [6-12]. A sensor based automated irrigation system provides promising solutions to farmers where the presence of a farmer in the field is not compulsory during the irrigation process.

This paper aims:

- To detect the dryness in soil using sensors and provide water to theplants appropriately.
- To maintain the plants quite easily.
- To minimize this manual intervention by the farmer.
- To save a lot of water from being wasted.

- To irrigate when there is not enough moisture in the soil and the sensors decide when the pump should be turned on/off. This saves a lottime for the farmers. This also gives much needed rest to the farmers, as they don't have to go and turn the pump on/off manually.

## II. HARDWARE IMPLEMENTATIONS

The functional units of this project include,

1. Controller Unit
2. Sensor Unit
3. Actuator Unit
4. User Interface Unit
5. Wifi Communication Unit
6. Drip Irrigation Unit
7. Power Supply Unit

**Controller Unit:** Arduino UNO will be used as the controller

1) To receive the user threshold settings through 4x1 keypad
2) Read data from the sensors
3) Display the data/user input in the 16x2 LCD
4) Activate the relay/valve based on the sensor value and user threshold.

**Sensor Unit:** It consists of three soil moisture sensors and a temperature sensor. Thesoil moisture sensors will be placed in three different locations of the irrigation system. The controller reads the three sensors and based on its value the actuator is enabled/dis-abled. The temperature red by the controller and is uploaded in the IoT server.

**Actuator Unit:** The system will control a solenoid valve if the irrigation system has a overhead tank with sufficient water pressure. Else if the irrigation system has a motor-pump, then a 30A relay module will be used to turn it ON/OFF.

**User Interface Unit:** The system will have a 16x2 LCD display to display User input while the user inputs the threshold limits and display the sensor values otherwise. It also has a 4x1 keypad to accept user settings.

**WIFI Communication Unit:** An ESP8266 module is used to connect the system tothe internet via the home WIFI network. The user shall monitor the working of the system.

**Drip Irrigation Unit:** The drip kit will be installed in the garden to be irrigated using the automated system. The drip irrigation kit will contain drip emitters, emitterstakes, filter, connectors, line pipes and all accessories required for irrigating fifty number of plants. The controller will enable the actuator to open/close the solenoid valve or ON/OFF the motor-pump to irrigate the garden using this drip irrigation kit.

**Power Supply Unit:** A 12V, 2A SMPS will be used to powerup the system. The SMPS shall be plugged in to the AC mains.

**Soil Moisture Sensor:** Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. The relation between the measured property and soilmoisture must be calibrated and may vary depending on environmental factors suchas soil type, temperature, or electric conductivity. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be used by farmers or garden.

**Relay Board:** A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid state relays. Relays are used where it is necessary to controla circuit by a separate low power signal, or where several circuits must be controlledby one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations. Electromagnetic relays are those relays which are operated by electromagnetic action. Modern electrical protection relays are mainly micro-processor based, but still electromagnetic relay holds its place. It will take much longer time to be replaced the all electromagnetic relays by micro- processor based static relays.

**LCD Display:** A liquid crystal display or LCD draws its definition from its name itself. It is a combination of two states of matter, the solid and the liquid. LCD uses a liquid crystal to produce a visible image. Liquid crystal displays are super-thin technology display screens that are generally used in laptop computer screens, TVs, cell phones, and portable video games. LCD's technologies allow displays to be much thinner when compared to a cathode ray tube (CRT) technology. Liquid crystal display is composed of several layers which include two polarized panel filters and electrodes. LCD technology is used for displaying the image in a notebook or some other electronic devices like mini computers. Light is projected from a lens on a layer of liquid crystal. This combination of colored light with the grayscale image of the crystal (formed as electric current flows through the crystal) forms the colored image. This image is then displayed on the screen. The functional diagram and the pin diagram of the sensor is shown in figure 1 & figure 2.

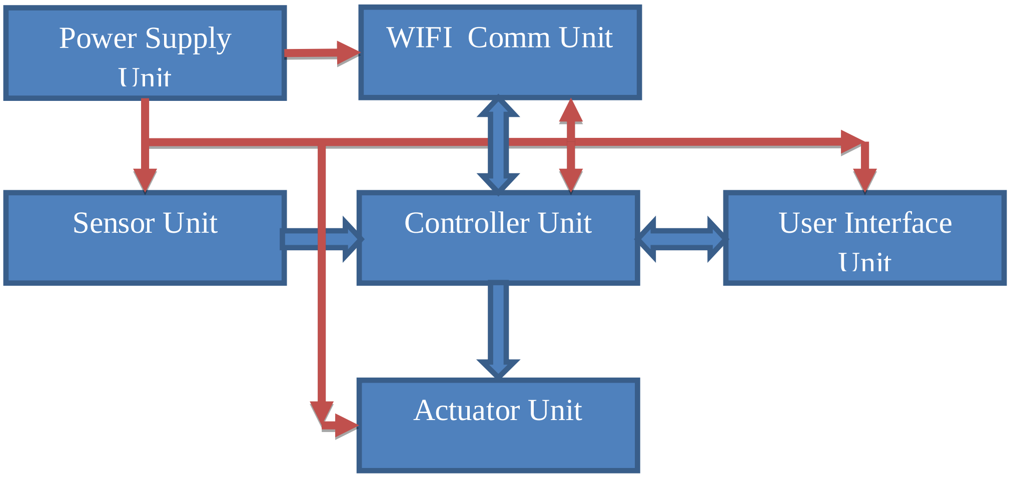


***Figure 1: Functional Block diagram***

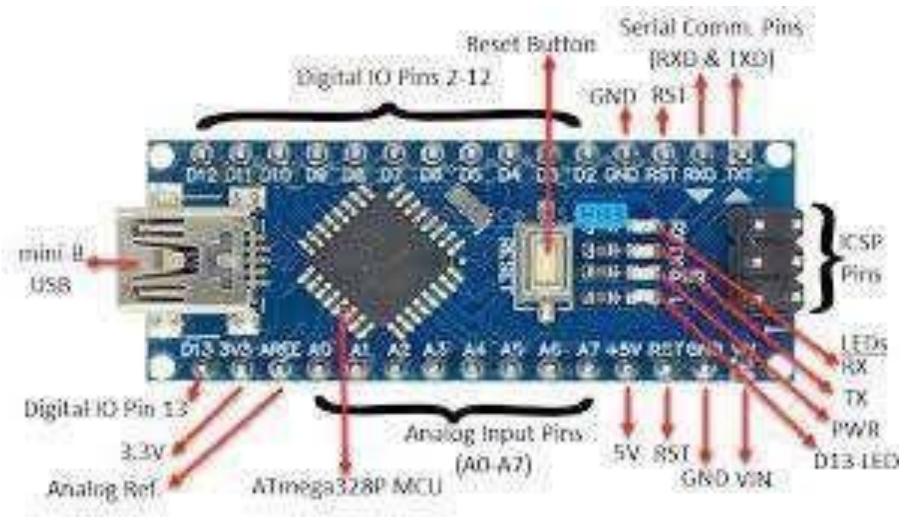


***Figure 2: Pin Diagram of Controller Unit (Aurdino Nano version 3)***

## III. HARDWARE MODEL OF THE SENSOR

The hardware model of the sensor has two sections: the external sensor unit, and the inbuilt processing unit. In the external sensor unit, the basic requirement of sensing the moistness of the sand or soil through resistance is performed, the arms of the sensorare able to detect resistance and provide input to the IC. When the soil becomes dry, it produces large voltage drop due to high resistance, and this is sensed by the soil moisture sensor, and this resistance causes the amplifierto produce an output that is above the threshold value required. This causes the relayto change from normally open to closed condition – The relay becomes on. When the relay is turned on, the valve opens and water through the pipes rushesto the crops. When the water content in the soil increases, the soil resistance gets decreases and the transmission of the probes gets starts to make the operational amplifier stop the triggering of the relay. Finally, the valve which is connected to the relay is stopped.

The comparator monitors the sensors and when sensors sense the dry condition then the project will switch on the motor and it will switch off the motor when the sensors are in wet. The comparator does the above job it receives the signals from the sensors.

A transistor is used to drive the relay during the soil wet condition. 5V double pole – double through relay is used to control the water pump. LED indication is provided for visual identification of the relay / load status. A switching diode is connected across the relay to neutralize the reverse EMF. The sensor has 5V regulated power supply for the internal blocks and uses regulated 12V power supply for the relay board. Power on LED is connected for visual identification of power status.

First, the sensor probes are inserted in the soil at specific locations in the field, at a depth of 5cm from the soil surface at regular intervals in the field. The wiring is made with protective covering so that it is not harmed by any unexpectedfactors like rocks in the field. Since wet soil is more conductive than dry soil, the soil moisture sensor module has a comparator in it. The voltage from the prongs and the predefined voltage are compared and the output of the comparator is high only when the soil condition is dry. When the moisture in the soil is above the threshold, the relay will be turned on. The relay coil gets energized and turns on the motor. The LED is also turned on as an indicator. The soil begins to get supplied with water, and the water content of the soil increases. When the moisture content of the soil increases and reaches the threshold value, the output of the soil moisture sensor is low and the motor is turned off. This prevents a case of over-watering.


***Figure 3: Working model of Controller unit***

***Figure 4: Working model of the Automated irrigation system***

Fig: 5 shows the correlation between the time and humidity. The sand, water level and temperature plays a major role in the development of this smart irrigation system. The soil is affected by diverse factors like air temperature, soil temperature, air humidity, ultra violet rays etc.. The soil moisture level is recorded by the soil moister sensors. These data are then purported in the thingspeak cloud for the visualization and the correlation between the temperature and humidity is calculated. So based on the correlation we can start the irrigation system or switch off. The experiment was carried out by taking the input from the DHT11 sensor. The moisture sensor gives analog output which can be read through the ESP8266 NodeMCU analog pin A0. Since the NodeMCU cannot give output voltage greater than 3.3V from its GPIO so we are using a relay module to drive the 5V motor pump. Also, the Moisture sensor and DHT11 sensor is powered from external 5V power supply and the data is collected from various sensors. This paper proposed an IoT based smart irrigation system uses sensors to record the data and store it in the cloud storage.

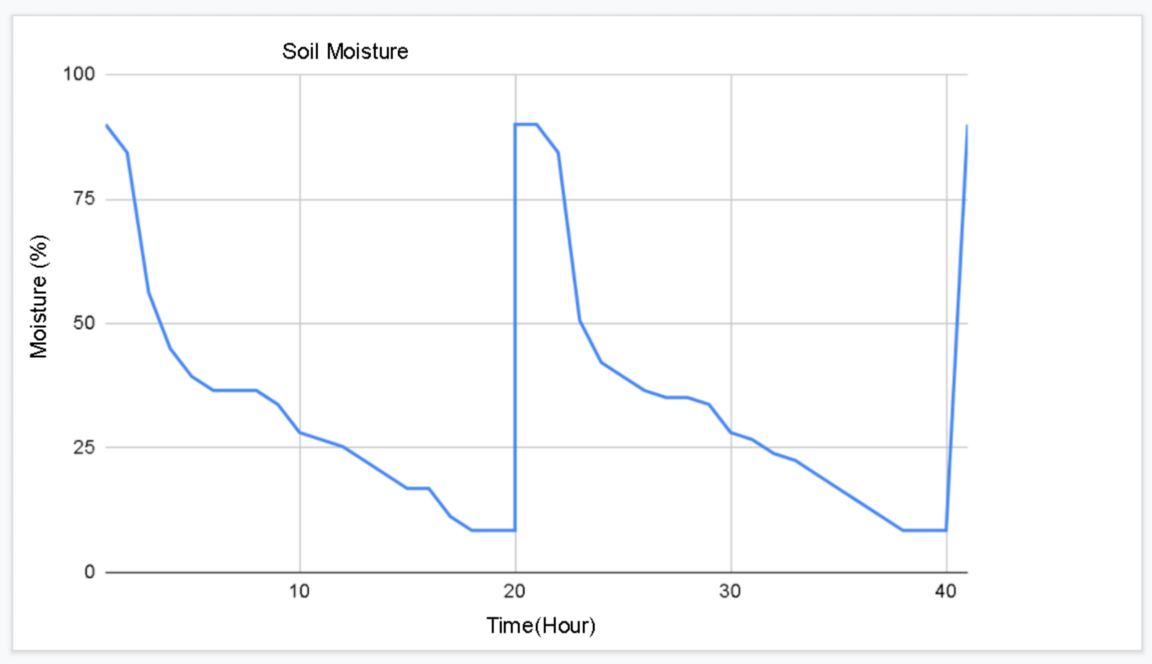


***Fig 5: Moisture vs time graph from IoT***

## IV. FUTURE SCOPE

- The application certainly is much more advantageous than the manual system. There will be no bias in the regions being covered and the delay is kept as minimal as it can be.
- The operator does not require any previous training because of its user friendliness.
- The operator is free from any technical issues. Extremely simple design makes the circuit easy to implement and maintain.
- Alterations in the system can be done easily if the process of the working changes in future.
- In future according to the user's requirement it can be updated to meet the user requirements.
- Smart WIFI Irrigation Controllers are next generation controllers that adjust your irrigation system automatically using real-time weather information. Moreover, you can control it from anywhere, anytime.

## V. CONCLUSION

Thus, the sensor (AIS) has been designed and tested successfully. It has been developed by integrating all the features of all the hardware components used. Presence of every module has been reasoned above and placed carefully in order to contribute to the best working of the unit. The system has been tested to function automatically, and to the best of its ability. The moisture sensors measure the moisture level (water content) of the different plants. If the moisture level is found to be below the desired level, the moisture sensor sends the signal to the comparator which triggers the DC Motor pump to turn ON and supply the water to respective field area. When the desired moisture level is reached, the system halts on its own and the DC Motor pump is turned OFF. Thus, the functionality of the entire system has been tested thoroughly and it is said to function successfully. Irrigation becomes easy, accurate and practical with the idea above shared and can be implemented inagricultural fields in future to promote agriculture to next level.

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