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An IoT Based Farm Irrigation System by Periodical Maintenance of Soil Moisture Value

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***Abstract:** India is the largest country and the main profession of our Indians is agriculture. There are many dry areas in India due to lacking of rainfall. So, irrigation becomes difficult. There is a need for water to grow the crops. The main objective is to minimize water consumption and water wastage. The objective of this work is to design a device for automated watering for a crop and was handled remotely by farmer. The system will help to identify whenever the soil goes dry, pump will automatically start watering. This process saves time and low electricity consumption for the device. The devise is designed by training moisture sensors with adequate power supply. The processor controls and makes decision whenever it receives signal from the transmitter. It setup a pump for water flow and to create a message system for communication purpose. An automatic maintenance of farm irrigation with soil moisture control was performed by Arduino. The soil moisture sensor and Relay circuit was used. This system senses the temperature of the land soil and moisture of the soil periodically. If the value is below threshold value, the pump will switch on. The irrigation system is necessary and useful for poor rain areas, unplanned water management, not proper storage facilities and more volume of water wastage. Hence, an IoT (Internet of Things) based farm irrigation system is developed. This system will be useful in all weather and climatic conditions.*

***Keywords:** IoT, Farm Irrigation, Soil Moisture and Arduino.*

1. INTRODUCTION

The consumption of food is increasing day by day due to population. To satisfy the demand, large production is necessary. The needs of food should be continuously monitored to maintain the level this is not easy without proper production and maintain with good quality.

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There is a need of human resource to carry out this work. It leads to increase the cost. So, automatic monitoring system is developed to handle this problem [12]. This reduces water wastage. The system will enable whenever the farm goes dry and disabled without manpower [18].

An intelligent automated irrigation [11] [13] [17] system was proposed to meet the needs of the farmer. This system plays a very important role in communication technology also. The sensors are used to monitor the dryness of farm. The computer server will collect the information regarding temperature of the farm, dryness of the farm and moisture of the farm to determine whether water irrigation is necessary or not. The microcontroller is attached with sensor network to regulates or controls the pump. The advantages are

- To determine the moisture of the soil
- To reduce Water wastage
- To increase Productivity
- To minimize manual work
- To automate the entire system

An IoT is a convergence of multiple system and multiple technologies. It consists of

- Required Devices to Compute
- hardware and
- Digital Devices
- Broadband high speed Networks
- Quality Sensors

There are various applications in agriculture. The parameters influence the productivity are

- Degree of Temperature
- Rate of Rainfall
- Measure of Humidity
- Speed of Wind
- Pest Infestation
- Contentof the Soil

The remaining paper is organized as follows. Chapter 2 describes literature survey. Chapter 3 describes methodology and chapter 4 discusses results. Chapter 5 presents conclusion and the future work.

2. RELATED WORKS

The water irrigation area in India is shown in Figure 1. In India, the traditional water irrigation method is followed in many locations. People from India feel that it is difficult to farm and get more production. The people need to face their basic needs. The harvesting, seeding, and tilling processes in the conventional manner require more labor. Rainfall is the

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main factor in irrigation.. Rainfall cannot be predicted. Therefore, if the farmer receives the water they require whenever they do, they will be satisfied and output will rise..

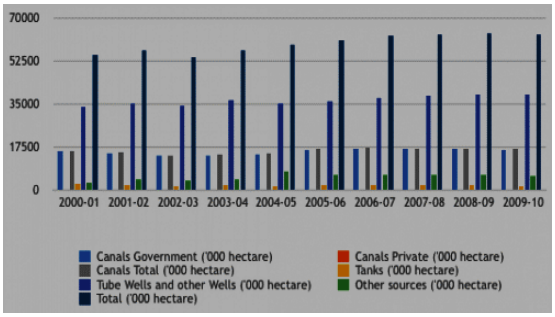

Figure 1. Area under irrigation in India

The literatures that are reviewed in relation to this identified issue and using our recently suggested methodology [1]. The use of solenoid valves in the intelligent agriculture model was suggested as a way to lower irrigation water use. It is a more effective system at a lower cost.[2]. The automatic watering system decreased water waste. To view the water conditions in the plant right now, real-time updates were made to the cloud. [3] The irrigation procedure in agriculture uses an Arduino board circuit with a gadget. Wireless sensors are used in the development and assembly of this irrigation system. Internet access is necessary for this operation.[4] The author suggested automating and securing mobile devices at home. [5] talked about the importance of irrigation and the difficulties in supplying the world's needs for food and fiber. In order to boost productivity, the author created an efficient and well thought-out agricultural water management system. [6] A number of sensors were suggested for this system in order to monitor temperature, scale humidity, and ascertain soil moisture. This detects different soil conditions, constraints, and limitations. The land's soil moisture content is preserved, and the motor will repeat it automatically whenever necessary. The user-based application will display the sensed values for the pump's condition and the state of the land. [7] created an intelligent irrigation system. It supplies water to the crop according to soil moisture content and climate conditions. Agriculture-related problems with conventional techniques are also covered, including water stage, power, time, money, human resources, etc. So, there is a need for smart system to develop agriculture sector for the growth of our country [14] [15]. [8] Offered plants with an automated system. The purpose of this irrigation system is to test the soil's levels of potassium, phosphorus, and nitrogen. The system will work according to the importance of macronutrients. There was a decrease in personnel. [9] The soil moisture content, surrounding air temperature, field humidity, field light intensity, and rain fall detection are all sensed by the author. It offers answers to issues with agriculture and health. [10] Using NodeMCU circuit boards, a clever and sophisticated irrigation alarm system was created. It also features a servo motor and a sensor for soil moisture.

A sensor detected the volumetric content of water in the soil, and the data was uploaded to the cloud. Large agricultural fields and culinary gardens were the intended applications for the star topology and multi-hop topology. A mechanism for email alerts was created.

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Tube wells are the main irrigation method used nowadays. Crop waste results from conventional methods of harvesting and storing water. Inappropriate water storage accounts for 7% of crop waste in India. This needs to be rectified, and strong mechanisms must be in place to carry out such initiatives successfully.

3. METHODOLOGY

In the past, agriculture was a common and traditional line of work for people. For their needs, the people turned to agriculture. People work on many platforms and in different countries these days. They were unable to provide for their own necessities. They therefore rely on farmers. Farmers are having difficulty at work. They are dealing with a lot of challenges.

In order to lessen the strain on humans, agriculture requires technology. However, there is a dearth of knowledge regarding the application of technology in this subject [16]. Farmers won't find using technology to be a hardship.

There is a moisture sensor on the sensor node. The ESP8266 board was responsible for gathering the sensor data. Using IoT, the gathered data is transmitted to the server over wifi internet. The ESP 8266 is made up of a wifi module. The sensor node can connect wirelessly thanks to this module. The circuit board and sensor node require a power source.

Current flows through liquids because of the motion of charged particles, or ions. When ionic substances dissolved in water are subjected to a voltage, these ions are created. They thus raise the conductivity of water. An increase in ions causes the soil's moisture content to rise, which raises the soil's electrical conductivity. Resistance drops with an increase in conductivity. Ohm's law (V=IR) states that resistance is directly correlated with voltage; wet soil has a higher conductivity when the voltage is lower than the conductivity of water. Consequently, the output voltage of dry soil is higher than that of wet soil. Figure 2 depicts the operational process.

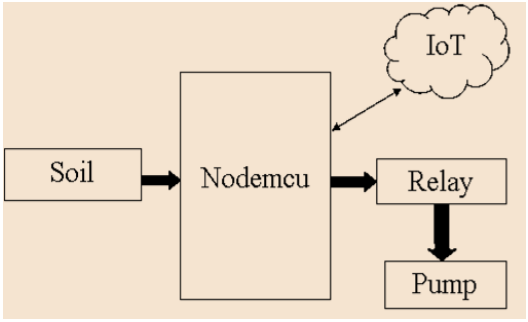

Figure 2. Architecture of proposed work

On the internet, NodeMCU is accessible as open source without charge. It is less expensive, easier to develop, more interactive, and equipped with a smart wifi-enabled firmware chip. A Lua flash storage is also included. It uses C programming to implement it. Serially connected

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communication protocols are supported by this package. Lua is the scripting language used by the firmware. Figure 3 shows the NODEMCU development board.

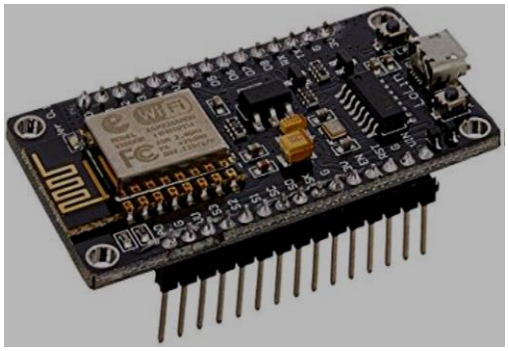

Figure 3. NodeMCU

The Arduino IDE provides a development environment for ESP8266 programming. It has a CPU with support for an operating system that runs in real time. The frequency of the operational clock ranges between 75 MHZ and 160 MHz. It can store data in its 4 MB of flash memory. Flash memory is erased and reprogrammed electronically. It can run programs thanks to its 128 KB of RAM. In Figure 4, the pin details are displayed.

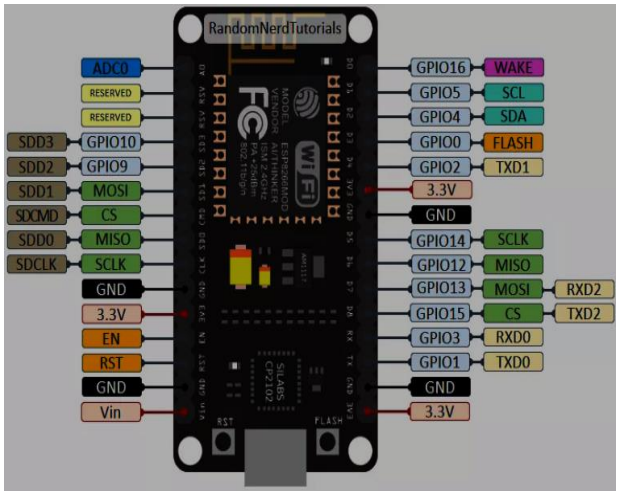

Figure 4. NodeMCu Pin details

Table 1 displays the details of the Soil Moisture Sensor. The following connections need to be made with the moisture sensor module: ground to ground, Vcc to 5Volts , analog output , digital output.

Table 1. Soil Moisture Sensor

Voltage required : 3.5V to 5.0V	Current required to Operation: 0.8ma
One Analog pin	Nine Digital pins

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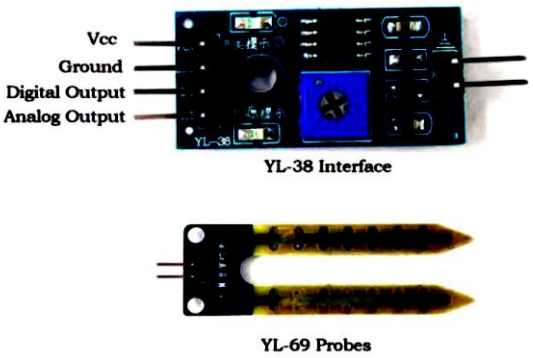

Figure 5. Soil Moisture Sensor

The temperature of the land or soil is measured by soil moisture sensors, as depicted in Figure 5. The earth contains an abundance of nutrients. The plant grows thanks to these nutrients. Plants need water to regulate their temperature..

4. RESULTS AND DISCUSSION

The fundamental component of the irrigation system is a sensor that has gateway access to the public internet. The primary goal of this effort is to enable an automated irrigation system, saving the farmer money, ground water, power, and time. The amount of human intervention in an automated system can be reduced.
This device finds moisture in the ground. Arduino will receive values when the soil dries out. After Arduino transfers these values to the cloud, the mobile user will receive a notification. When the soil moisture content falls below a predetermined level, the device will automatically provide plants with water for a certain amount of time, all without human intervention. A management server will have access to the data, which will be kept on the cloud, for the purposes of processing, monitoring, and feedback-control actions. When using 3-5V, the Mini Submersible Pump is used for watering. For this experiment, it is quite beneficial. It is also utilized in various contexts, such fountains and aquariums. It works well with all types of watering. Ground water, sea water, and city water are all excellent uses for this pump. In figure 6, the pump is displayed.

Figure 6. Micro Submersible Water Pump

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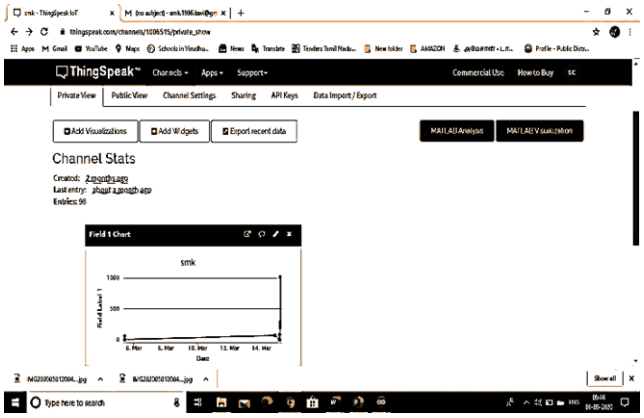

Figure 7.Channel status

The wetness is continuously monitored by the sensor. The pump will be in the on state if the level is low. A management server will have access to the data, which will be kept on the cloud, for the purposes of processing, monitoring, and feedback-control actions. In figure 7, the channel status is displayed. Figure 8 displays the work's suggested model.

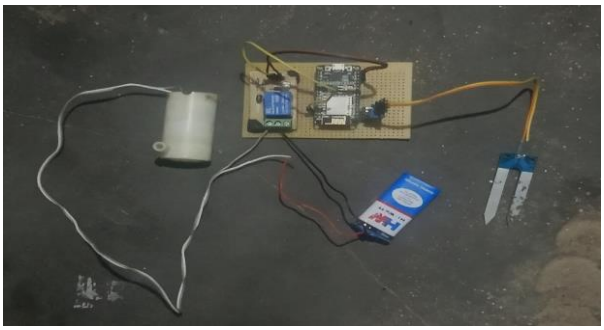

Figure 8. Proposed Model

To put the procedure into practice, the required libraries are downloaded. To communicate, an API key is generated via the server. After that, the Wi-Fi login and password are provided. The motor pin, sensor pin, and ESP8266 NODEMCU pin are all set. There is a time limit for data transmission. One variable stores the soil's moisture content. In order to read the values, the sensor is then connected to the ESP8266 NODEMCU. Subsequently, the moisture value obtained from the sensor is utilized to determine the on/off state of the pump. The pump will activate if the value falls below the threshold. The received message and alarm both show this.

Any farmer wants to end up with greater profit while putting in less money, labor, and stress. They will therefore benefit more from this arrangement. When given enough water and care, plants will undoubtedly yield positive outcomes. Figure 9 displays one of the favorable outcomes.

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Figure 9. Output of irrigation system

5. CONCLUSION

IoT- enabled modern agriculture benefited from the automation of the irrigation system. This was created through smart device experimentation. This will boost our nation's economic standing and raise productivity. Future research may take into account a wide range of other variables, including vast land areas, various soil types, and various climates. Every farmer in our nation lives by the mantra, "Reduce costs, increase production." Their needs will be promptly supported by this system.

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