IoT based Smart Irrigation System

Mr. Muhammad Usama
Electrical Engineering Department
Namal University Mianwali
Mianwali, Pakistan
muhammad.usama@namal.edu.pk

Dr. Majid Ali
Electrical Engineering Department
Namal University Mianwali
Mianwali, Pakistan
majid.ali@namal.edu.pk

Mureed Qasim Shah
Electrical Engineering Department
Namal University Mianwali
Mianwali, Pakistan
mureed2018@namal.edu.pk

Muhammad Imran
Electrical Engierring Department
Namal University Mianwali
Mianwali, Pakistan
imran2018@namal.edu.pk

Abstract— **Agriculture of farming has started past 12000 many years straight back, Neolithic age gave the beginning of civilization, Farming and later becoming continued as traditional farming techniques. Agriculture has always been the backbone of Pakistan's economy. Pakistan is the fifth largest producer of sugarcane in the world, the seventh-largest producer of wheat, and the tenth-largest producer of rice. About 70 % of the populace in Pakistan is related to agriculture directly or indirectly. Its share of GDP is mostly about 25 percent which can be more than the share of any other sector. Various problems related to agriculture are constantly hampering the development of the nation. Agriculture in Pakistan uses 93 % of the water that's available while significantly 60 % of that water is wasted for the application and transport into the field. The reason that is significant application losings could be the lack of knowledge about irrigation scheduling and proper irrigation system. A possible option for these irritating dilemmas is to decide on an advanced agriculture system that consists of contemporary styles. So we can make farming smart using IoT. IoT is the fastest-growing technology in every domain of society, especially in agriculture. The leading characteristic of this project is that it will reduce the wastage of water during irrigation alongside many more advantages like maintaining proper moisture levels for the crops, reducing the farmer's effort, and increasing the productivity of crops. The sensor used in the system collects the data from the soil and sends it to the IoT web server where it can be further examined. We will design an android mobile application that will provide essay access to information to the farmer.**

Keywords— **IoT, Sensors, Precise Agriculture, Automatic Irrigation, Wifi Module, Crops production, Arduino**

I. Introduction

IoT is a system consisting of computing devices that can sense the data as well as convert data over the web without any human involvement. The project group shall recommend an IOT-based Irrigation and Weather Reporting System. This method will consist of two parts which can be crucial. The first part is linked to the irrigation monitoring and managing system plus the second is the weather reporting system. The project group can manage and monitor the way to obtain water coming from a place. The suggested system permits the people to directly look at the climate status online without the need for a weather forecasting company in this project. It will help to know about the current temperature, humidity, moisture, and rain by using a temperature sensor and humidity sensor respectively. The system will transfer the data to the microcontroller or process this data and the microcontroller will send this information to the web host over a WIFI Module.

In this project, sensors keep checking the values of humidity, temperature, soil moisture, and rain status and update the data on the website. A user can see the details of the sensor and according to the need of crops or plants he can supply the water just by a click on motor status. Farmers should work on the other parts of the field so that they will not care about the irrigation systems. The crops get damaged if the farmer does not supply the exact amount of water to crops or plants. So by using this system, farmers don't have to worry about the crops plants getting damaged as a result of drought waterlogging. So in this way, we will be able to save the wastage of water using proper irrigation systems.

II. Literature Survey

Archana and Priya published a paper to determine the value of moisture and temperature and humidity in the air. They did not propose the proper irrigation system for the watering of plants and crops. They only used soil moisture and temp and humidity sensors. [2] Karan Kansara builds an automatic irrigation system. It was not capable to determine the nutrient value of the plants and it will not provide any information about the temperature and humidity sensor and how we can control the motor pump when it's raining. [3] The published paper on "Automatic Irrigation System on Sensing Soil Moisture Content" only includes measuring the moisture in the soil. They also used only a single soil moisture sensor to measure the soil content in the soil. This system will not provide any remote monitoring of the field which could be via mobile app or website. Prof C.H.Chavan and P.V.Karnade proposed a system smart wireless sensor network for monitoring environmental parameters using Zigbee. The major drawback of this system was that it was not giving any information about weather forecasting. [4] So from the above projects, we see that many people in the world worked on the smart irrigation system. They recommended many ways to reduce the wastage of water during irrigation and increase the productivity of the crops. Some of the work you can find is given below in the references. One of the major drawbacks that we have found in their project is that they only use one soil moisture sensor to run the motor pump. Some of them also used rain sensors. So it's nearly impossible to irrigate the field using one soil moisture sensor. So here in our project, we have used four soil moisture sensors to control the motor pump and to start the irrigation. In case of excess amount of water, we also proposed a water drainage system. Our project will store the excess amount of rainwater and will use it for irrigation when needed. We also can change the soil moisture sensor limit according to temperature and humidity values

III. Methodology

The System is based on a micro-controller. Smart irrigation is used to save water. The soil, temperature and humidity, and rain sensor will give the live readings. These sensors will collect the data. These sensors are further connected with a Wi-Fi module to send the data on the ThingSpeak for easy monitoring.

This method includes the design of a prototype device that can be easily monitored via web or mobile app. For this purpose, the first step is drawing of timeline and reading the previous work after looking at the pros and cons of other projects that have been done before, we can start to implement and execute our plan. The complete guide for the methodology is given below in the chart.

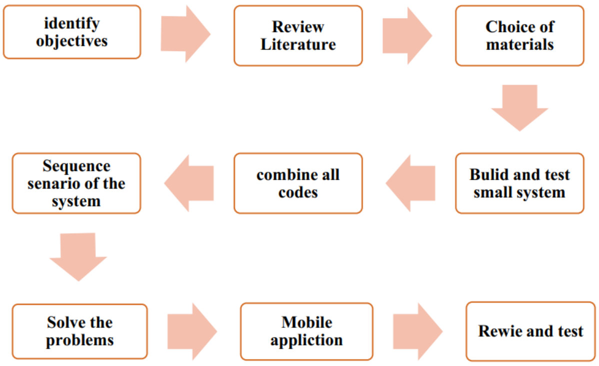

Fig. 1. Methodology

A. *Component Used*

1. Soil Moisture

Soil moisture sensor working is very simple. Resistance present in the soil is inversely proportional to the soil moisture. The fork-shaped probe acts just like a potentiometer whose resistance changes according to the water content present in the soil. An excess amount of water present in the soil means better conductivity. So the resistance will be low. If there is less water present in the soil means poor conductivity. So the resistance will be high.

Sensor output values will be according to the resistance. So by measuring these values we can measure the moisture level. It only has 4 pins to connect as shown below:

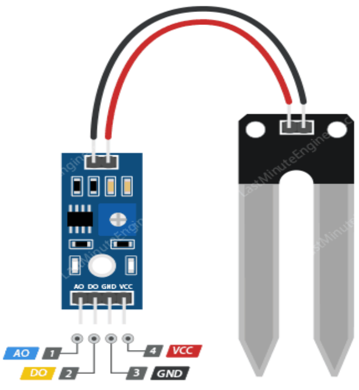

Fig 2: Soil Moisture

2. *Temperature and Humidity Sensor*

It is used to measure water vapor by measuring the electrical resistance between two electrodes. The relative humidity is proportional to the change in resistance between two electrodes.

Greater relative humidity means there is a decrease in the resistance between the electrodes, while lower relative humidity increases the resistance between the electrodes.

There is a thermistor built into the unit of DHT11 which is used to measure the temperature.

DHT11 is shown below:

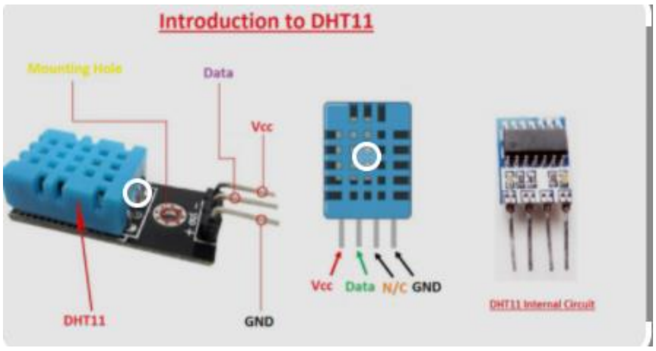

Fig 3: DHT11

3. *Rain Sensor*

In our smart irrigation project, we also included a rain sensor for the detection of rain. It uses a rain detection plate to detect the effect of rain. The rain sensor detects water that comes short-circuiting the tape of the printed circuits. It acts as a variable resistance that will change status. When the sensor is wet its means high resistance and when the sensor is dry it means low resistance.

Fig 4: Rain Sensor

4. Arduino Uno

The main heart of the project is Arduino. Given below is the figure of Arduino that we used in our project.

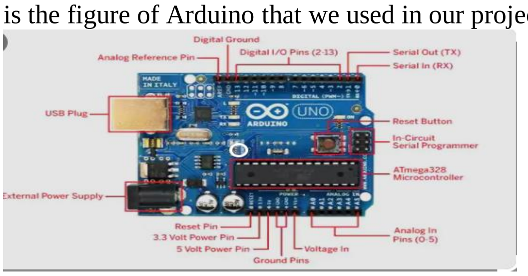

Fig 5: Arduino

5. ESP8266 Wifi Module

So in our project, we have also interface an ESP8266 WIFI module to our Arduino for sending the data on the webserver. It is a low-cost wireless transceiver that can be used for endpoint IoT developments. It uses UDP/TCP protocols to connect with the server.

So by using this WIFI module we are sending the values of Temperature, Humidity, and Soil Moisture Sensor on the webserver. We are also showing the status of Rain and Motor status on the web dashboard.

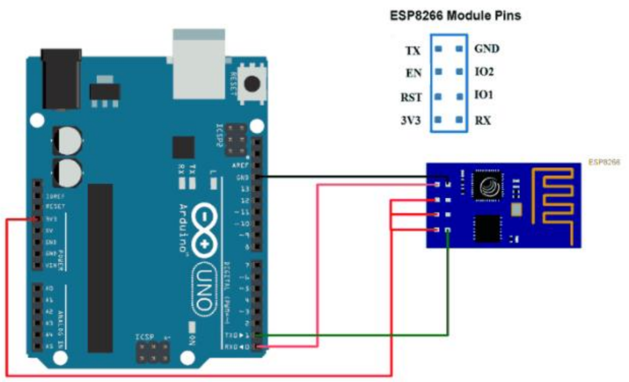

Fig 6: Arduino

B. *Simulation Diagram*

The complete simulation diagram of circuit is:

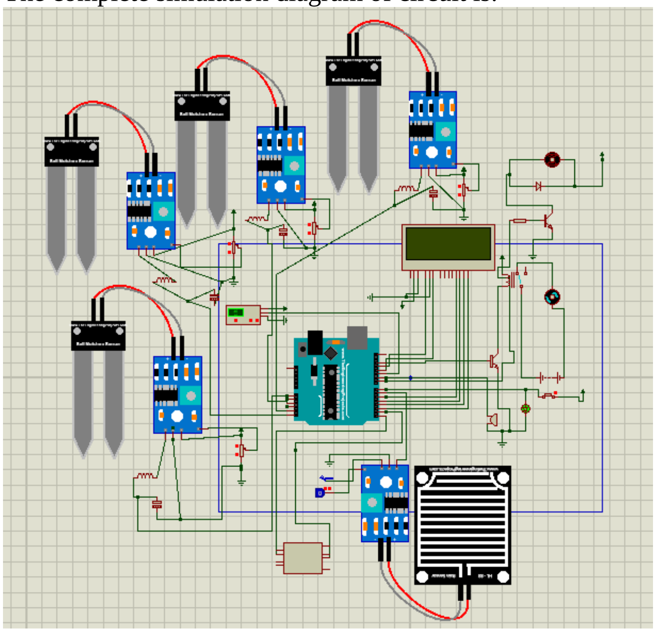

Fig 7: Simulation Diagram

C. *Block Diagram*

So the below block diagram we can see that we have a unit of sensors which includes Soil, Temp, Humidity, and Rain sensors, and our microcontroller which is Arduino Uno is constantly reading the values of these sensors. We have also connected a motor pump with Arduino which is further connected with the Relay module. This motor pump is controlled by soil moisture and rain sensor values which we have discussed above.

We have also connected a Wi-fi module with Arduino which will collect the data from the sensors and send it to the IoT web server.

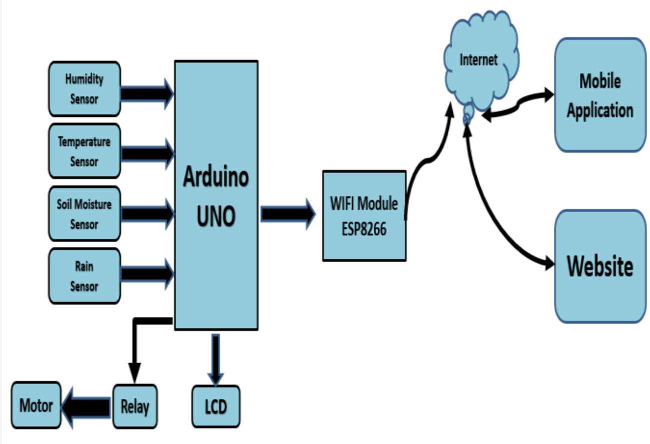

Fig 7: Block Diagram

D. *Flow Chart:*

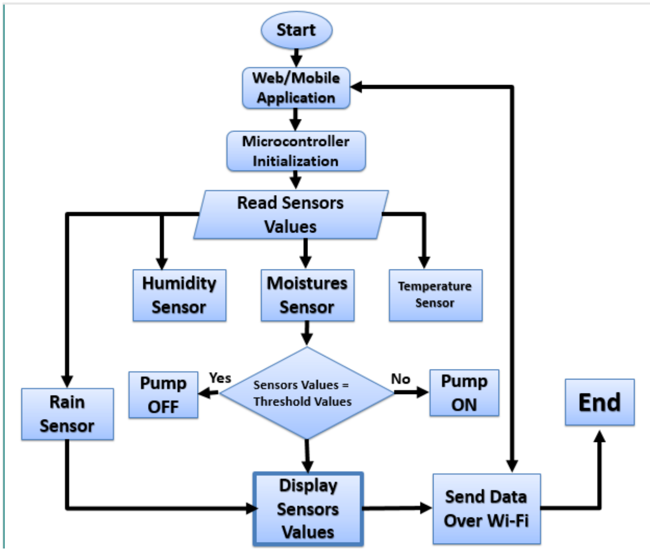

Fig 8: Flow Chart

E. *Hardware:*

We have connected all the components in the hardware and check out results.

Hardware connection are given below:

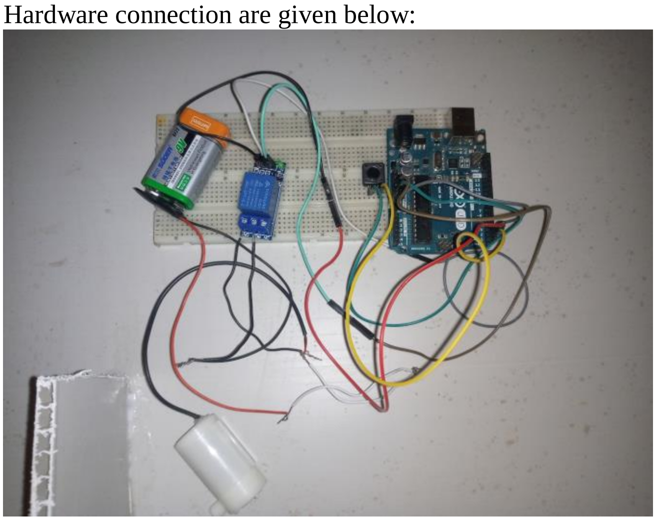

Fig 9: Motor Pump with Arduino

In the same manner we have conneted all the component and run our Arduino IDE. Resutls are given below.

IV. RESULT

A. Soil moisture and Rain sensor

1. Condition 1: (Soil Moisture Values > 700 && No Raining)

As we are continuously reading the values of all four soil moisture sensors. When all four sensor values are greater than 700 it means that our soil is dry and the motor Pump will be ON only if there is no rain.

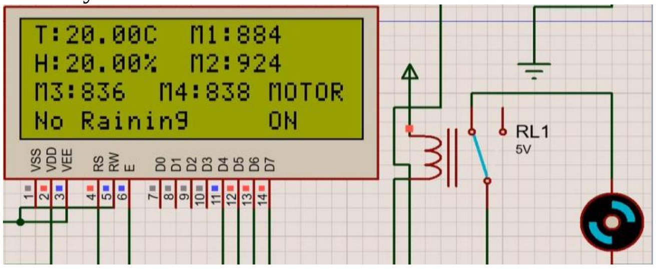

Fig 9: Condition 1

2. Condition 2: (Soil Moisture Values between 300 & 700 & No Raining)

As we are continuously reading the values of all four soil moisture sensors. When all four sensor values are less than 700 and greater than 300 it means that our soil is moist so the motor pump will be on and irrigation will start only if there is no rain.

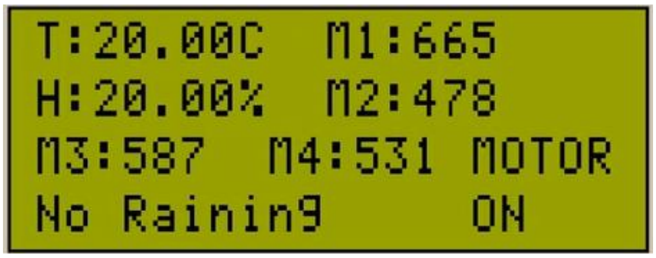

Fig 10: Condition 2

3. Condition 3: (Soil Moisture Values < 300 & No Raining)

As we are continuously reading the values of all four soil moisture sensors. When all four sensor values are less than 300 it means that our soil is completely wet so the motor pump will remain OFF.

Fig 11: Condition 3

4. Condition: (Soil Moisture Values > 700 && Raining)

As we are continuously reading the values of all four soil moisture sensors. When all four sensor values are greater than 700 it means that our soil is dry and there is a need for irrigation but the rain has started so our motor Pump will remain OFF and irrigation will stop.

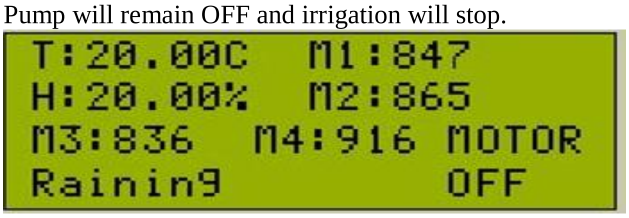

Fig 12: Condition 4

B. Temperature and Humidity Sensor

Given below is the value of the temperature and humidity sensor measured by the DHT11 Sensor

Fig 13: DHT11 Values

C. Web Dashboard Result

So as we discuss previously that our sensors are constantly sending the data on the webserver. Given below are the output result of sensor values that are displayed over the web dashboard. These values are sent by the ESP8266 Wi-Fi module on the ThingSpeak dashboard.

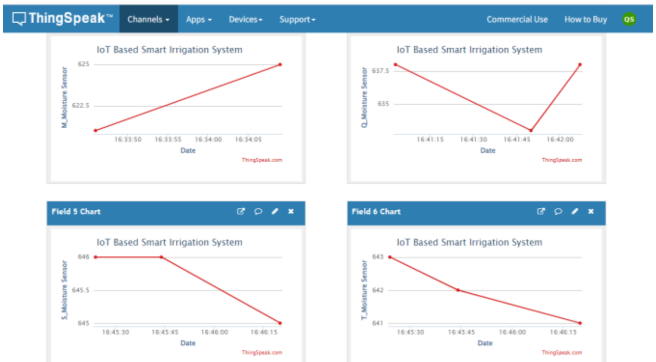

Fig 13: Results

V. DISCUSSION

After completing the software and hardware simulation and execution for the smart irrigation system, we achieved our goal. All the necessary and proposed requirements have been done smartly in this smart Irrigation system, that's why it is finalized now.

After this step, we tested the system on Proteus where its works properly. All the relevant results and their work can be seen in the previous section. We run our system on more than five conditions in the simulation part for its better working and also verified the results.

After that, we designed the hardware part of the project. First of all, we have tested and verified all the components including sensors and motor pump. Then based on our simulation circuit diagram we have started to design the hardware. We have connected four soil moisture sensors in the soil and connected them with Arduino. Now Arduino can get soil moisture sensor values to form the soil. This system is configured in this way that if there is rain then no irrigation should be done to reduce the wastage of water. For this purpose, we have used the rain sensor which will send the signal to Arduino if there is rainy or not. If it's raining, then our Arduino will send a signal and the motor pump will off automatically.

In our project, we are also measuring the values of temperature and humidity for two reasons. As we know Temperatures are high in summer and low in winter. Therefore, crops need less water in winter than in summer. So based on temperature and humidity sensor values in winter and summer, we can change the moisture limit of our project. Another reason for using this is that we can observe the weather condition without going to a weather forecasting agency or without opening Google.

So in our project, we have also interface an ESP8266 WIFI module to our Arduino for sending the data on the webserver.

VI. LIMITATIONS

Given below are the limitation of this project.

- The farmer must have an excess to the mobile phone or laptop.
- The farmer must have a strong internet connection.
- We were not able to retrieve the data from the ThingSpeak server into our designed mobile app. It is because we have used the free version of the ThingSpeak server and for retrieving the data from the server into MIT App inventor, it asks for the paid version so that's why we are unable to get data into the mobile app.

VII. CONCLUSION:

As IoT-based irrigation systems are making it workable for a farmer to gather important information which leads to better crop production. So if we shift from the old irrigation system to IoT based system then the need for the increasing population of Pakistan can be fulfilled. In this system, we have provided a new approach to the old used irrigation system where a huge amount of water is wasted. The soil moisture, temperature, humidity, and rain sensor values are measured and sent to the Arduino for further analysis. The farmers can monitor their farms from anywhere in the country via a mobile app or website dashboard.

VIII. FUTURE SCOPE:

To provide a predictive model so that the farmers can predict the future forecasting related to their field as he is constantly collecting the data from the sensors. It can be done by using machine learning models. To control the system via Zig Bee instead of wires which can provide very good results. We can also make this system workable using renewable energy which is solar power instead of using batteries. So by using solar energy we can reduce the future cost easily. Shifting towards the agri-business which focus on providing fresh product quality. Using the agriculture drones for the better monitoring and protection of the crops and fields. Adding the AI system to predict the production of crops.

REFERENCES:

[1] Moller, J. (2010). A Versatile Technology in automation of agriculture machinery. Computer virsion, 17.

[2] Design and Implementation of Automatic Plant Watering System "Archana and Priya" presented at International Journal of Advanced Engineering and Global technology, vol- 04, Issue-01, Jan-2016.

[3] Sensor Based Automated Irrigation System with IOT "Karan Kansara and Vishal Zaweri," presented at International Journal of Computer Science and Information Technologies, vol-06, 2015.

[4] C.H.Chavan and V.Karnade, " Wireless Monitoring of Soil oisture, Temperature and Humidity using Zigbee in Agriculture" presented at International Journal of Engineering Trends and Technology (IJETT), vol-11, May-2014.

[5] Asian Journal of Science and Technology Vol. 10,Issue 0 6, pp.9756-9768, June, 20.

[6] Measurement of Temperature and Humidity by using Arduino Tool and DHT11 "Deeksha Srivastava, Awanish Kessarwani, Shivani Dubey", International Research Journal of Engineering and Technology (IRJET), volume5, Issue 12, Dec 2018.

[7] The working principle of an Arduino "Yusuf Abdullahi Badmasai" published in 2014 11th International Conference on Electronics, Computer and Computation (ICECCO).

[8] Shen Jin, Song Jingling, Han Qiuyan, Wang Shengde, and YangYan, School of Electric and Electronic Engineering, A Remote Measurement and Control System for Greenhouse Based on GSM-SMS, IEEE 8th International Conference on Electronic Measurement and Instrument, 2007,pp. 45-82

[9] Webin Huang, Guanglong Wang, Research of Wireless Sensor Networks for an Intelligent Measurement System Based on ARM, pp.1074- 1079, 2011.

[10] Sezen SM, Yazar A, Irrigation Management on Yield And Quality Of Tomatoes Grown in different Soilless Media in Glasshouse, 41-48, 2010