UNIVERSITY OF CAPE COAST

COLLAGE OF AGRICULTURE AND NATURAL SCIENCES

SCHOOL OF PHYSICAL SCIENCE

DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

CSC 499 PROJECT WORK

IoT IRRIGATION SYSTEM

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1 BACKGROUND:

Agriculture is done in every country from ages. Agriculture is the science and art of cultivating plants. Agriculture was the key development in the rise of sedentary human civilization. Agriculture is done manually from ages. As the world is trending into new technologies and implementations, it is a necessary goal to trend up with agriculture also. IoT plays a very important role in smart agriculture. IoT sensors are capable of providing information about agriculture fields. We have proposed an IoT irrigation agriculture system using automation. This IoT based Agriculture monitoring system makes use of wireless sensor networks that collects data from different sensors deployed at various nodes and sends it through the wireless protocol. This smart agriculture using IOT system is powered by ESP 32. It consists of Water Proof Temperature sensor, Moisture sensor, PH sensor, flow rate senor, relay and mini water pump or solenoid valve. When the IOT based irrigation agriculture monitoring system starts, it check soil moisture, temperature and PH value of the soil. Base on these sensor readings, it automatically pump the water to moist the irrigation farm. It also updates a web interface with the various readings and sends an email alert about the levels whenever abnormalities occur. Sensors sense the level of moisture if it goes down, it automatically starts the water pump. The PH level is to know when to applied fertilizer or not and the flow rate sensor is to calculate the amount of water that is been used for the irrigation farming as time goes on. The LCD is to display the reading as well. The water pump can also be start manually using the web interface as well as stopping it.

1.1 Soil Moisture:

Soil moisture is the water stored in the soil. It affected by precipitation, temperature, soil characteristics, and many more factors. These same factors help determine the type of biome present, and the suitability of land for growing crops. The health of our crops relies upon an adequate supply of moisture and soil nutrients, among other things. As moisture availability declines, the normal function and growth of plants are disrupted, and crop yields are reduced. And, as our climate changes, moisture availability is becoming more variable.

1.2 Soil Temperature:

Soil temperature is the factor that drives germination, blooming, composting, and a variety of other processes. Learning how to check soil temperature will help the home gardener know when to start sowing seeds. Knowledge of what is soil temperature also helps define when to transplant and how to begin a compost bin. Determining current soil temperatures is easy and will help you grow a more bountiful and beautiful garden. So what is soil temperature? Soil temperature is simply the measurement of the warmth in the soil. Ideal soil temperatures for planting most plants are 65 to 75 F. (18 to 24 C.). Nighttime and daytime soil temperatures are both important.

1.3 Soil PH:

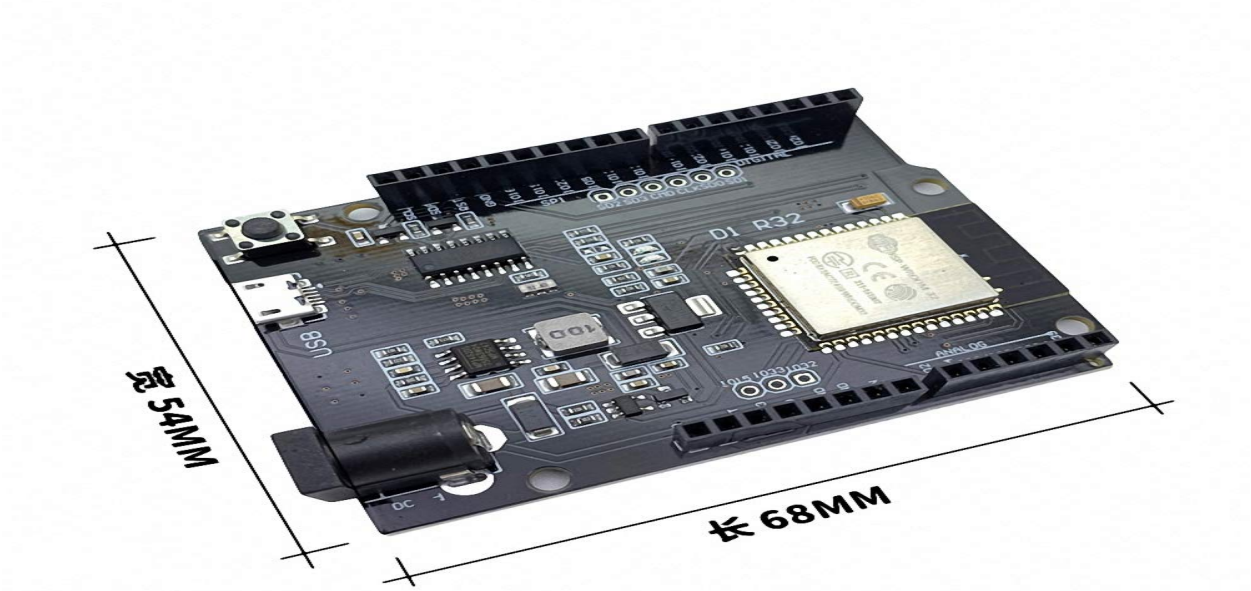
Soil PH is a measure of the acidity and alkalinity in soils. pH levels range from 0 to 14, with 7 being neutral, below 7 acidic and above 7 alkaline. The optimal pH range for most plants is between 5.5 and 7.0; however, many plants have adapted to thrive at pH values outside this range. Because pH levels control many chemical processes that take place in the soil – specifically, plant nutrient availability – it is vital to maintain proper levels for your plants to reach their full yield potential.

1.4 Amount of Water Used

It is necessary for a farmer to know the amount of water he used in his irrigation farming. With this he can calculate cost he spend in the process of the irrigation farming which can help know and make projections whether is going to make profit or lost at the farming system.

2 SENSOR LIST:

2.1 ESP 32 Wemos D1 R3



The ESP 32 wemos D1 R3 is a 5V power micro controller. It is capability with all the sensors need for the project and because of its WiFi capability, it makes it easy to send or receive data and commands from a remote web interface. it has a memory of 4MB which can hold all the codes needed for the project

2.2 Icstation Resistive Soil Moisture Sensor

The probe uses analog resistance to detect the moisture content of the soil. It has digital value out which outputs a low level from the DO port when the detecting humidity reaches the threshold value and analog

value out which can acquire the real-time data via the AD port of your single-chip microcomputer(MCU). It also has adjustable threshold which Clockwise/counter-clockwise rotate the blue potentiometer to increase/reduce the detection threshold. On-board power and signal indicator make you know the working status of the board at a glance at any time and a waterproof sensor probe with high corrosion resistance ensures a long lifetime at least 6 months in the soil.

2.3 Direct Waterproof DS18B20 Digital Temperature Sensor

The Direct waterproof DS18B20 digital temperature sensor will be used to detect the soil temperature of the soil. It has high quality stainless steel tube waterproof moisture-proof rust Stainless steel shell (6*50mm), lead length 100cm. and also operates on a 3.3v to 5V power supply which makes it easy to interface with the micro controller and a temperature range of -55 to +125 which is unique for the project. it needs not external components, the single bus interface unique.

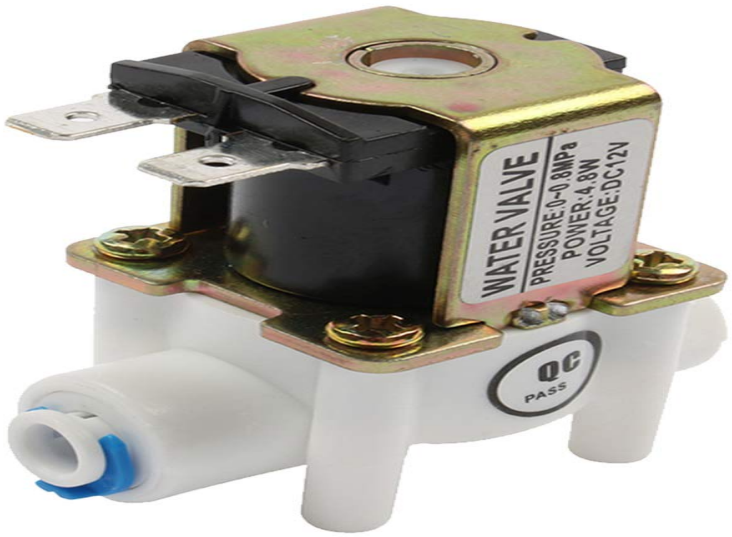
2.4 PH sensor

The PH sensor will be used to measure PH value of the soil in real time. The PH sensor operates on a 5V power supply and temperature between 0 degrees to 60 degree which PH values ranges from 0 to 14. The PH electrode probe is accurate and reliable that can gives almost instantaneous readings.

2.5 Submersible Water Pump

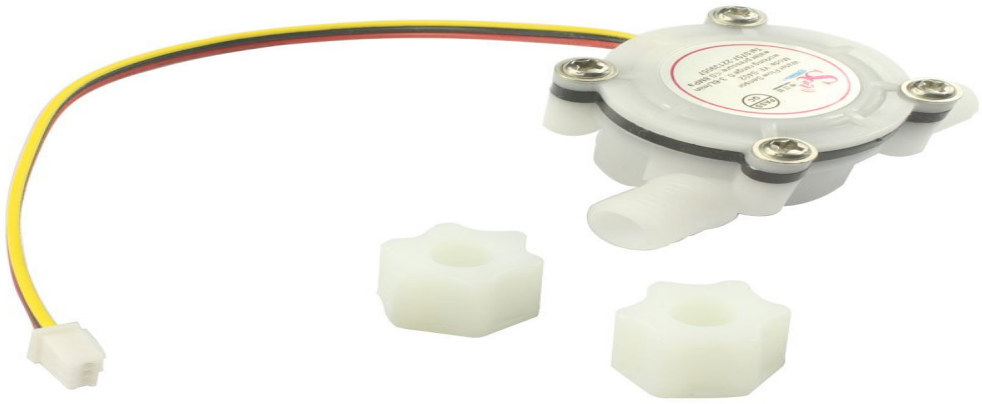
The Submersible water pump will be used to pump water to the irrigation farm. It operate on a 12 DV power supply which can be interface with relay in it operation. it can pump 260L/H at maximum which is the best for the project though we are planing to replace it with a value depending on the source of water available at the farm.

2.6 Solenoid Valve



The Solenoid valve operates like the water pump which can also be used to pump the water but in its case it can be tap to an exiting pipe which when start with a relay can start the pumping of the water. it operates on a 12V power supply and operates with a temperature range of 0 degrees to 60 degrees. It is alternative to the water pump depending on the source of water available at the farm.

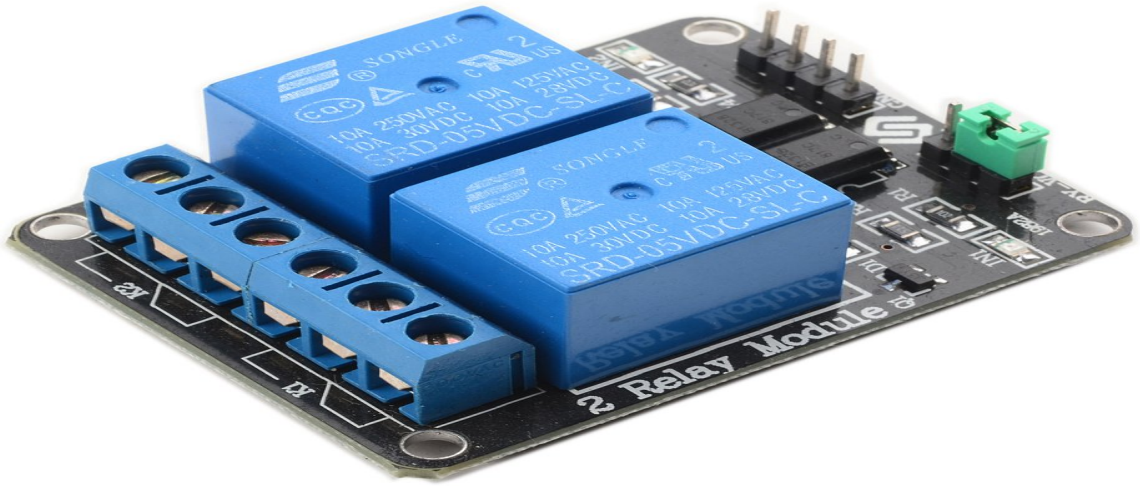
2.7 Water Flow Sensor



The water Flow sensor will be used to measure the amount of water that is used in the irrigation system. The Generic YF-S402 High Precision Flow Meter Water Flow Sensor operates on 5V to 18V power supply which can be tab to 12V power supply from the water pump or the solenoid valve. It operates within a

temperature of -25 degree to 80 degrees which is suitable for the project.

2.8 Relay



The relay will be used to operate the water pump and the water flow. It will operates both the water pump and the control when pumping water and reading the amount of water pump. It operates on 5V power supply which can be interface with the micro controller.

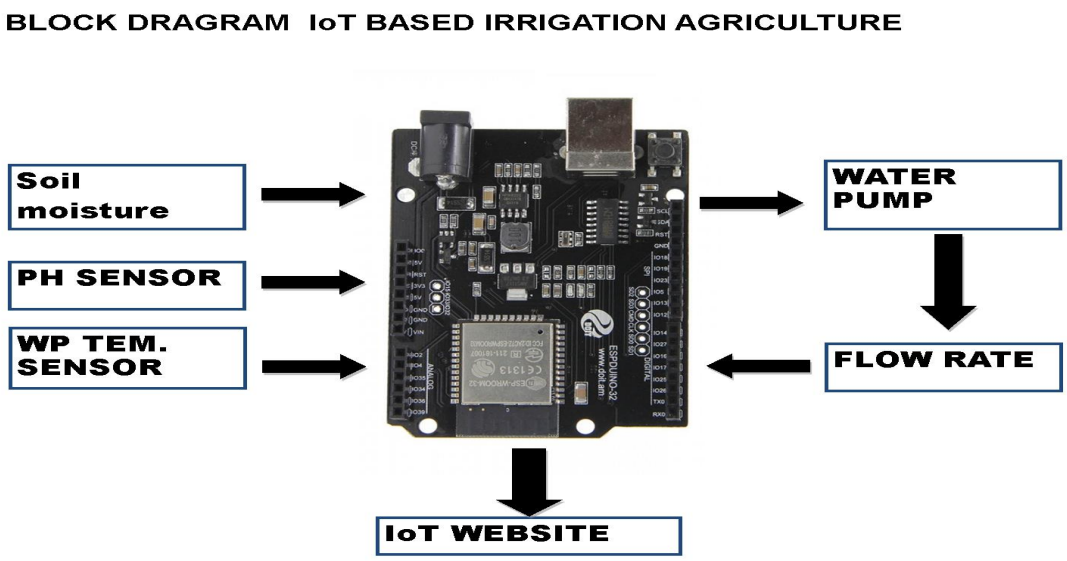
2.9 158 X 90 X 65mm Black Junction Box

The 158 X 90 X65mm Black Junction Box will be used to house the micro controller and the discrete parts

of the project. This will give protection to the micro controller against weather conditions including water and heat.

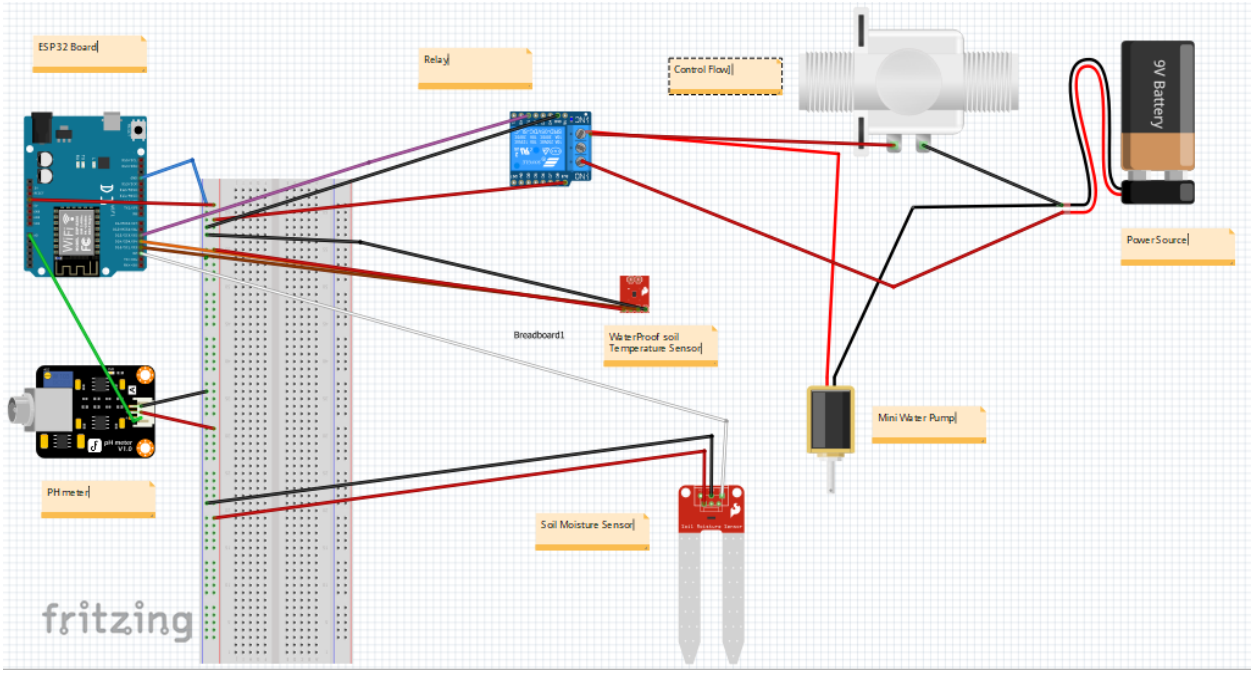
3 ARCHITECTURE:

3.1 Block Diagram



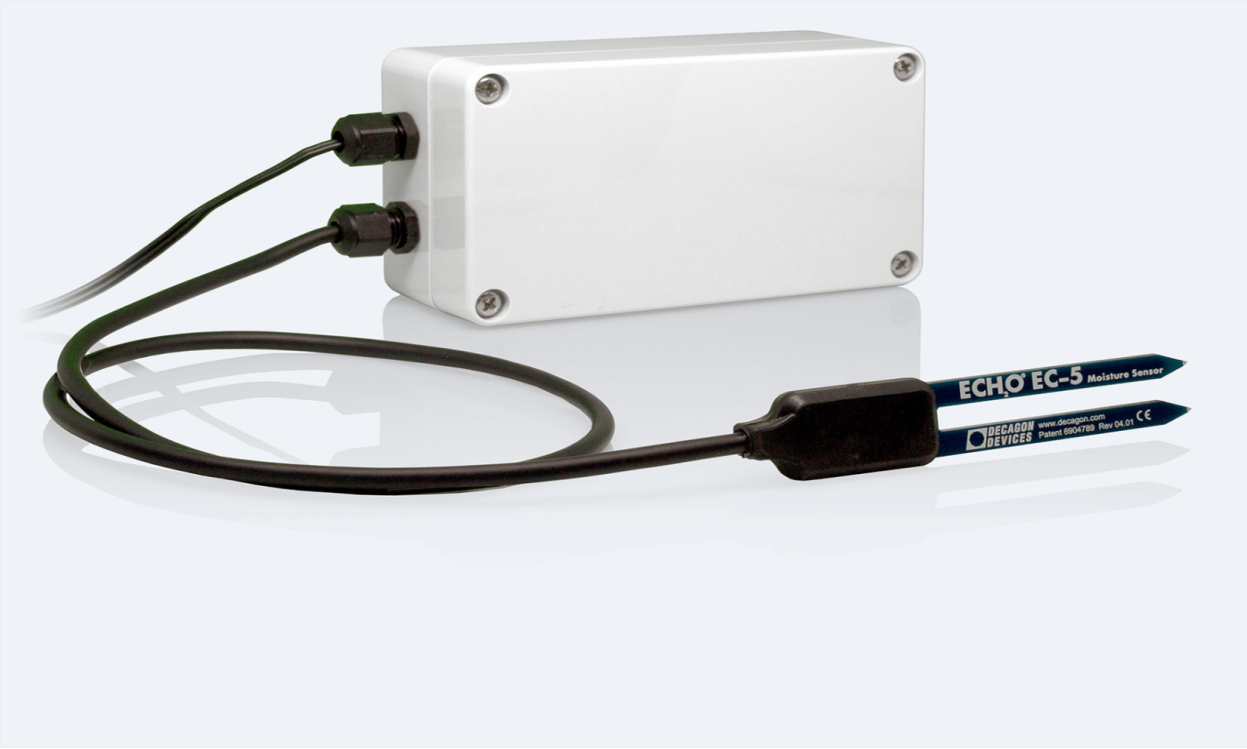
The block diagram of the project is displayed above:

3.2 Fritzing Diagram



The fritzing diagram of the project is displayed above:

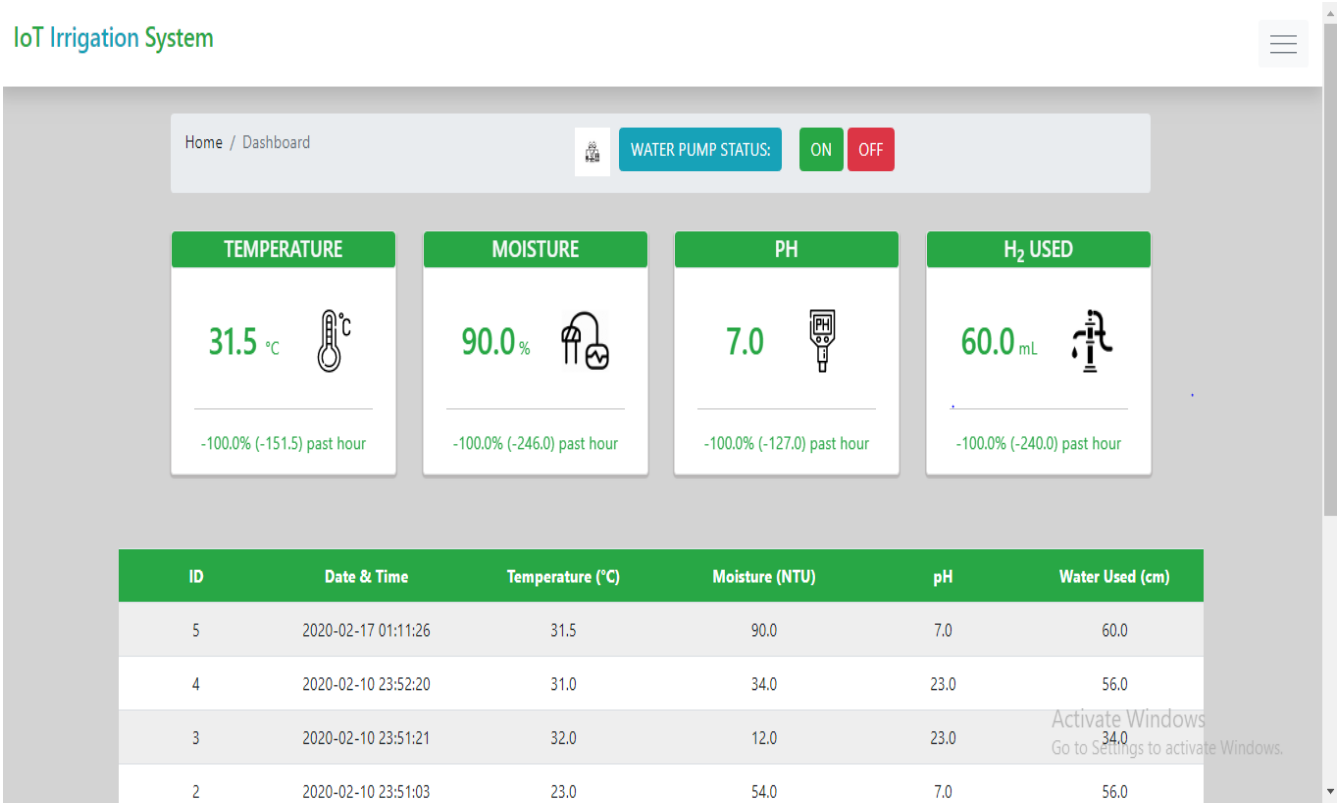
3.3 Prototype

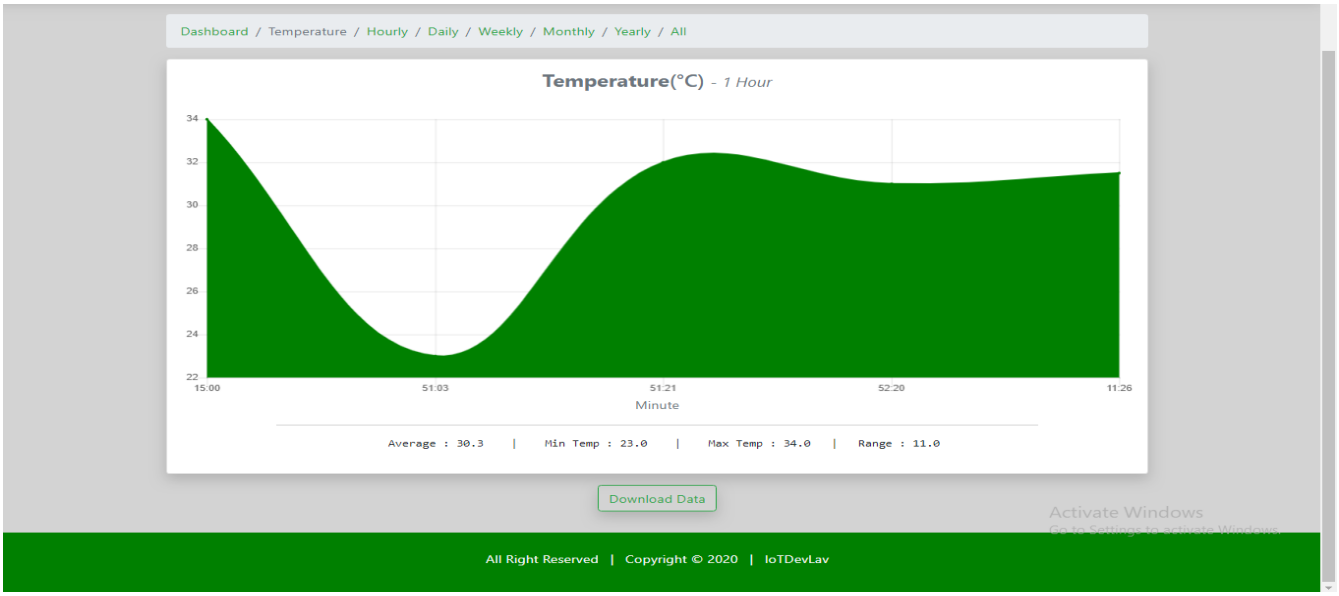


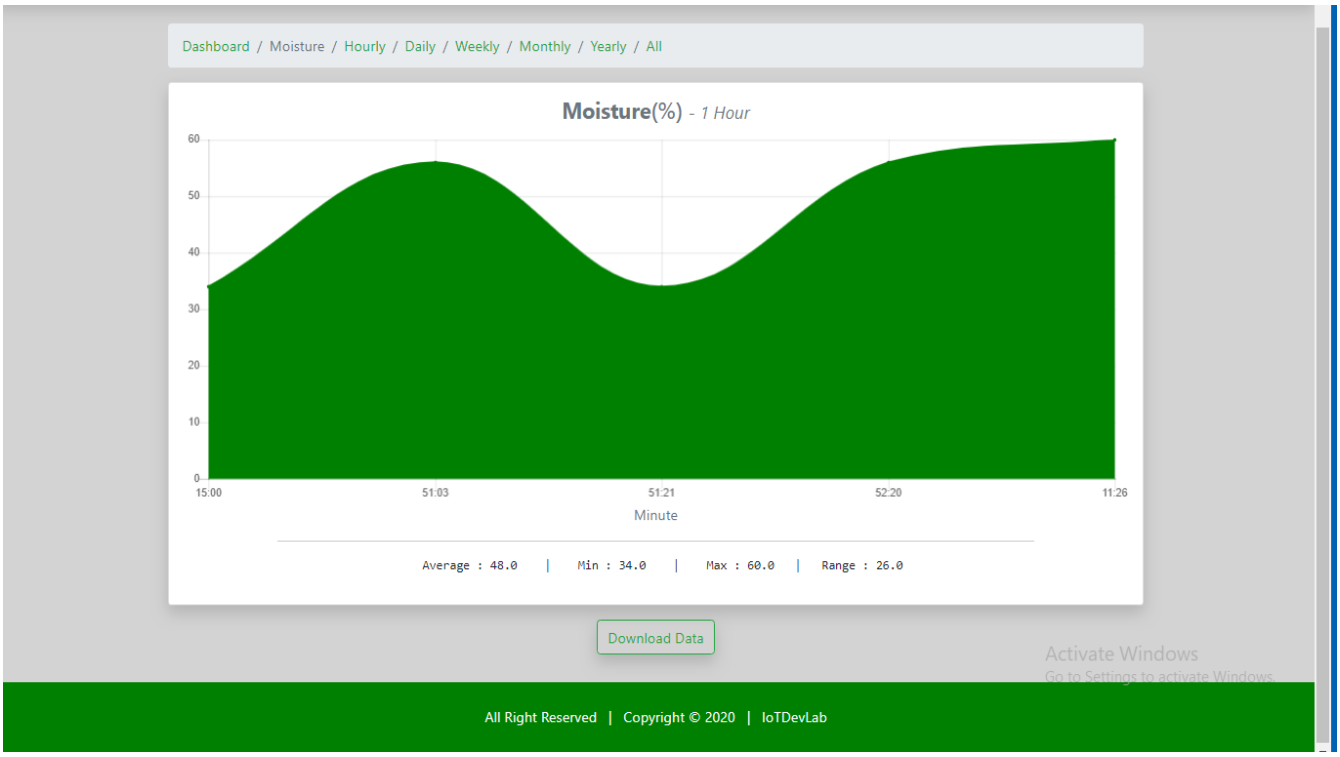
We are expecting the project when complete to look like the one in the diagram above which we will be install at UCC farm for testing and usage.

3.4 Web and Mobile Interface

The project is expected to have the following web and mobile interface for the end user for smooth operation and usage






Dashboard / Moisture / Hourly / Daily / Weekly / Monthly / Yearly / All
Moisture(%) - 1 Hour
60
50
40
30
20
10
0
15:00
51:03
51:21
52:20
11:26
Minute
Average : 48.0 | Min : 34.0 | Max : 60.0 | Range : 26.0
Download Data
Activate Windows
Go to Settings to activate Windows.
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Dashboard / pH / Hourly / Daily / Weekly / Monthly / Yearly / All
pH - 1 Hour
70
60
50
40
30
20
10
0
15:00
51:03
51:21
52:20
11:26
Minute
Average : 25.4 | Min : 7.0 | Max : 67.0 | Range : 60.0
Download Data
Activate Windows
Go to Settings to activate Windows.
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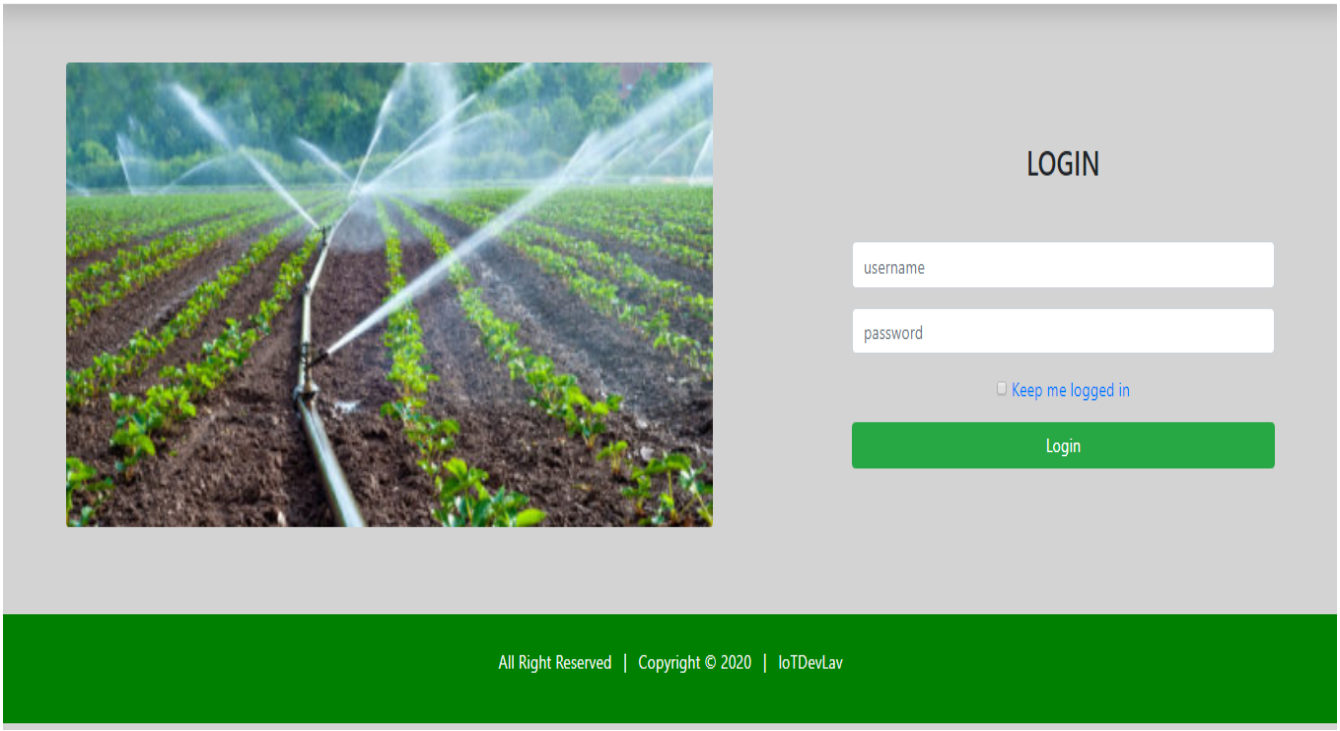

We will used flutter webview to build the mobile app which will control the web interface hosted on Heroku giving the end user both the web interface and the mobile app.

4 USED OF PROJECT

The project when completed will be used at the farm. The Farmer have to have get a power source at his farm. First of all , he need to pug the moisture probe, the PH probe and the temperature sensor probe. He will also need to connect his water supply the end of the solenoid valve or the water pump, then plug the micro controller to power source. The system will automatically start and start taking the readings. The water pump or the solenoid valve will start and the water will begin to flow through the gutter as show in the image above.

We are planning to used this system in nursing tomatoes seedlings as a way of testing it for two weeks which will be done at UCC farm. This will help us to know errors and faults that may occurs.

For tomato, the soil temperature should be within a mild range of 50 to 80 degrees Fahrenheit, its soil PH should be around 6.0 to 6.8 whiles its soil moisture should be around 70-80 percent. This parameters will used as the base parameters for pumping the water as well indication to when the farmer have to apply fertilizer or not.