PROJECT KICK OFF

- Project Summary :

  Smart Agriculture System is a commercially scalable model which is being built to reduce the efforts of Farmers. It intends to take care of one of the most important part of farming which is watering the crops. It needs to be done at the right time, in right amount and right conditions.

  There are many things to take care of, while considering the watering of crops. If the water is too much, the crops can get damaged by water logging. If we water on a rainy day, the extra rain water may tamper with the growth of crop. If the farmer forgets to turn on the pump for a day or two due to any reason, it can again make the soil too dry for the plants to get their daily nutrition level.

  Considering many facts, this project is chiefly focused on automating the process of water pump and providing the farmers with an application where they can see the status of pump, moisture of the soil, humidity, temperature as well ass weather forecasting.

  The ultimate goal of this project is to increase the quality of yield by taking care of irrigation process and start the revolutionary era of Farmers by bringing technology in this domain.

- Project Requirements

  ➤ Farming land is the primary requirement

  ➤ IoT devices and sensors for collecting the on field data and process the data to make decisions.

  ➤ Water pump at the field for irrigation.

- Technical Requirements

  ➤ Hardware at the field

  ➤ IoT devices - To collect data, and To complete the action decided to be taken after the data processing.

➤ Internet conection for the hardware device at the field and monitoring station.

- Software Requirements

  ➤ Node-Red for the UI designing of web-app.
  ➤ IBM Watson for data collection, storage and processing.
  ➤ IoT devices to take action on the processed data.
  ➤ Open weather map API keys and knowledge of http requests.

- Project Team

  ⭐ Mentor support from THE SMART BRIDGE team.
  ⭐ Colleagues

- Project Schedule

  To complete this project we are given approximately four weeks of time. My aim is to complete the tasks in:

  1. Project planning and kick off; explore the IBM cloud platform; connect the IOT simulator to Watson IOT platform in 1st week.
  2. Configure the node red to get the data from IBM IOT platform and open weather API in 2nd week.
  3. Building a web app in 3rd week.1
  4. Configure your device to receive the data from web application and control your motors and also complete final report in 4th week.

PROJECT REPORT

CHAPTER 1
INTRODUCTION

1.1 Overview

Plants and water have had and still have a key role in the history of life on earth. They are responsible for presence of oxygen needed for human survival on this planet. At the same time agriculture is also important to human beings because it forms the basis for food security. It helps human beings to grow appropriate crops with right nutrients and raise the animals in accordance to environmental factors.

Agriculture plays a crucial in country's development and any country's stand in the world can be determined by this sector. Agriculture plays a vital role in India's economy. Over 58% of the rural areas depend on agriculture as their main source of livelihood. Agricultural export constitutes 10% of the country's export. Yet farmers are using traditional techniques for agriculture and most of the farmers still depend on rain for irrigation. The farmer's and even the nation's economy will be ruined if there are no proper yields due to lack of knowledge of the soil nature, timely unavailability of water. Thus the government should take steps for a better and profitable irrigation.

It is a smart agriculture system based on IOT (Internet of Things) technology which brought revolution to each and every field of common man's life by making everything smart and intelligent. Aim of this project is to propose a novel smart IOT based agriculture system assisting farmers in getting live data (Temperature, soil moisture, soil temperature, weather condition, pressure) for efficient monitoring of the water content in the field by controlling the motor that enables them to provide smart irrigation system and reduce the unnecessary wastage of water in the fields, increase the overall productivity of the crops as adequate amount of water is provided and increase the quality of crops. We will use IBM Watson IOT platform to create devices and sensors that are required to control the water flow and connectivity and User Interface is provided by IBM Node red.

The live data of the environment of field is given by using Open Weather

1.2 Purpose

According to the World Wildlife Fund (WWF), 70% of our planet is covered by water. However, only 3% of it is fresh water, and only one-third of that is available for consumption. Many water systems are stressed due to the growing human population and over-consumption. Agriculture consumes more water than any other source. Much of the water used in agriculture is wasted due to inefficient irrigation systems. To alleviate this problem, many governments impose restrictions on water usage, especially in drought-stricken states.

To improve irrigation efficiency and properly enforce water usage restrictions we use Smart Agriculture system. This project enables us to provide the right amount of water needed by the plants. The present project proposes an IOT enabled smart soil moisture monitoring system that helps the government authorities to know the information about dry soil areas in the agricultural lands within a village, town or even a state, so that necessary precautionary steps can be taken to make such lands fertile. Besides, the project is also very much useful for the farmers, organizations or individuals running plant nurseries to automatically the pumping Motor ON and OFF on sensing the moisture content of the soil. The advantage of using this method is to reduce human intervention and still ensure proper irrigation.

CHAPTER 2

LITERATURE SURVEY

2.1 Existing problem

India's economy is highly dependent on agriculture sector especially in rural areas, almost 58% of rural population is dependent on agriculture as their primary source of livelihood. Due to the increase in population they have to increase their crop production rate but with traditional method they face so many problems to meet the needs of the country.

One of the major factor which causes decrease in agriculture yield is climate change. Agriculture is not only sensitive to climate change but also one of the major drivers for climate change. Understanding the weather changes over a period and adjusting the management practices towards achieving better harvest are challenges to the growth of agricultural sector as a whole.

Other problems faced by farmers include:

- Many trips have to be taken in order to check the soil humidity on a regular basis manually.
- It can be difficult to know the exact amount of water to be given to plants, thus causing stress for the crops by over or under watering.
- Overwatering leads to soil erosion.
- As world is only having 3% of freshwater, overwatering leads to scarcity of water.
- Manually measuring key data points about crops is often difficult, time-consuming, and more likely to be inaccurate.
- It is sometimes difficult to know the optimal time to plant without data.
- Overwatering crops could lead to higher water costs than the ideal cost.

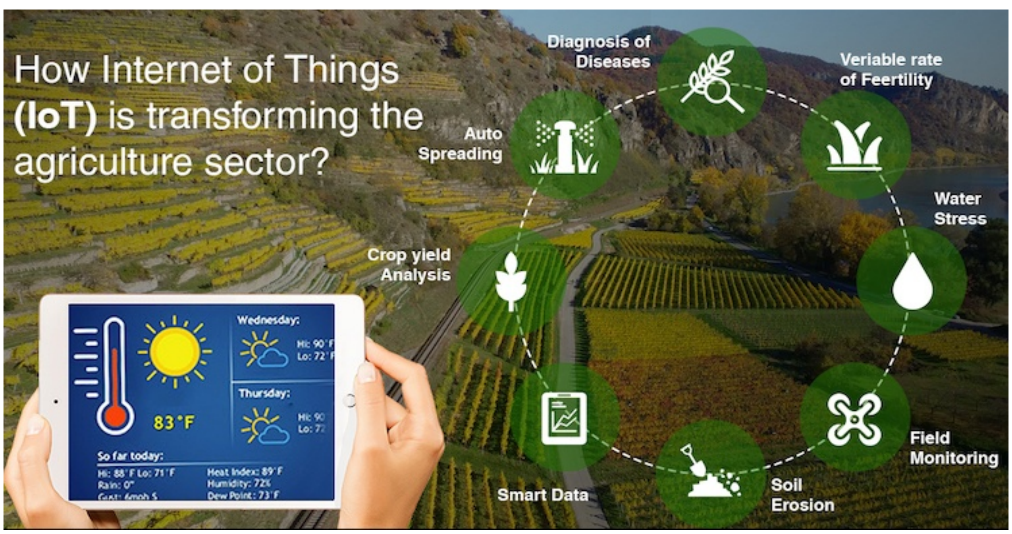
- It is highly possible that rains cause waterlogging.

2.2 Proposed Solution

To overcome the problems of traditional farming method, we proposed a solution by building a smart agriculture system that work on IoT (Internet of Things) and cloud computing.

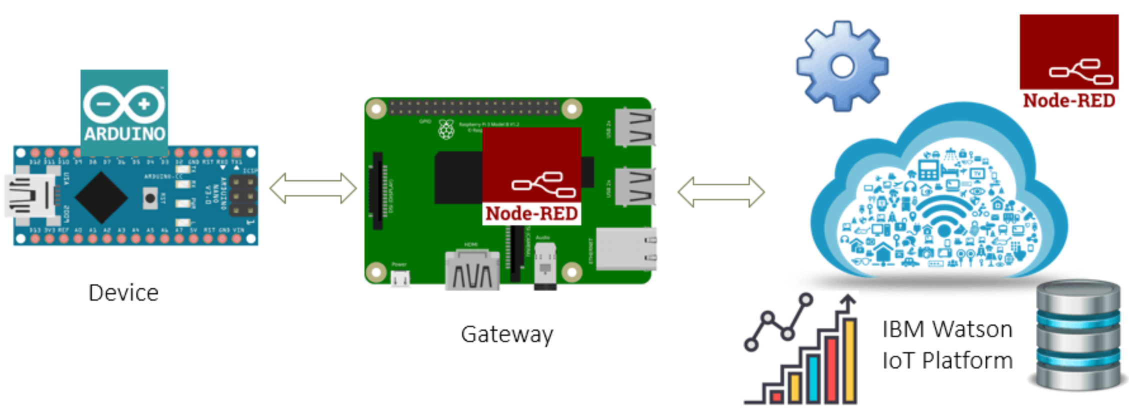
1. **Internet of things (IoT)**

   The *Internet of things (IoT)* is a system of interrelated computing devices, mechanical and digital machines provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. In this project we integrate this technology with agriculture to make a better world and solve our problems.



2. **Cloud Computing**

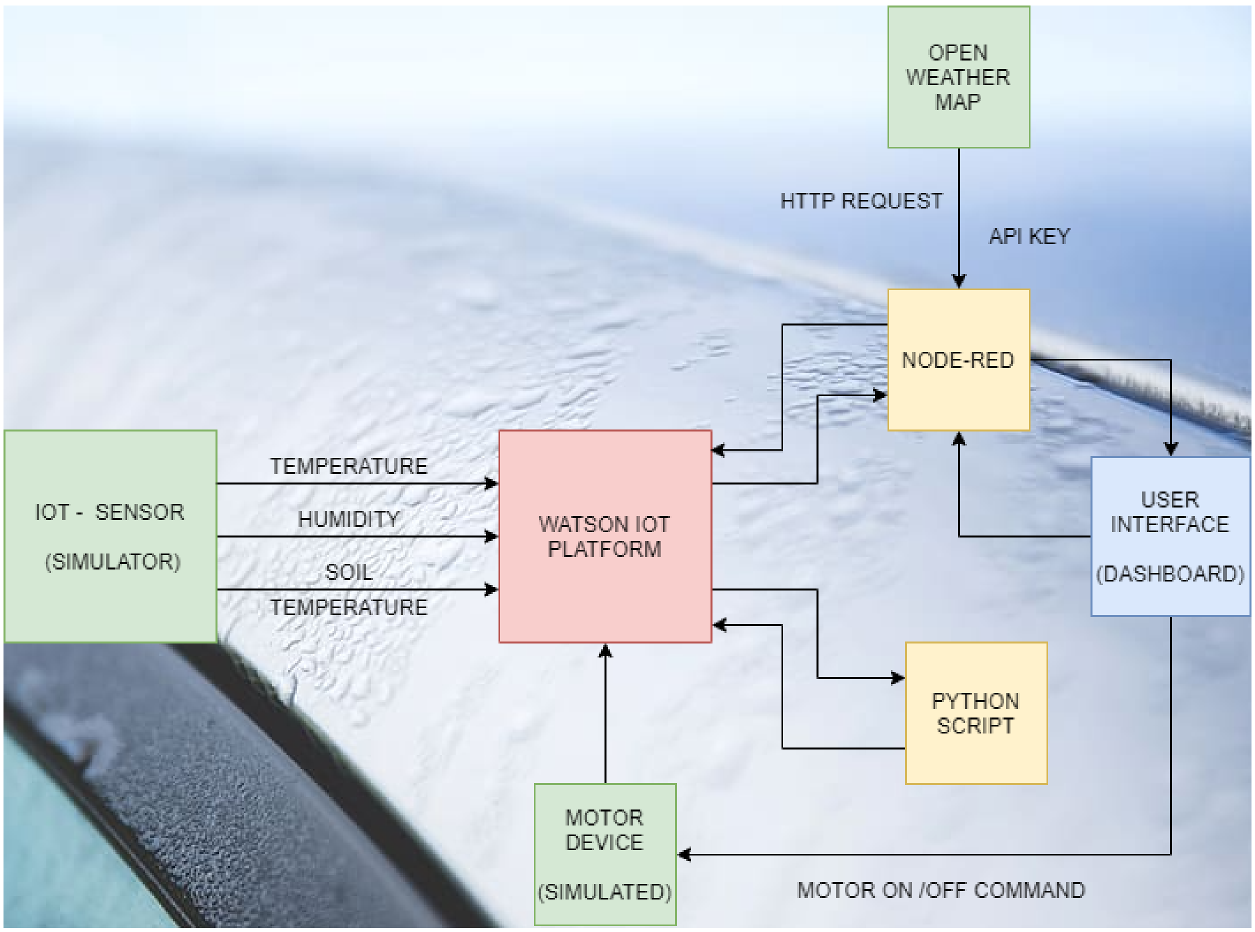
   Cloud computing metaphor: the group of networked elements providing services need not be individually addressed or managed by users; instead, the entire provider-managed suite of hardware and software can be thought of as an amorphous cloud. With the help of cloud computing technology, we can store the data collected by the sensors and also weather conditions in that particular area and use it for future analysis. This data are being used to provide predictive insights in farming operations, drive real-time operational decisions, and redesign business processes. This project is based on the idea to develop such a device which can monitor temperature of the surroundings, soil moisture and the temperature of the soil. This information can be get from the IOT Watson simulator .The simulator is used to retrieve the information from the sensor that we created using IBM Watson IOT Platform. This data is sent to the cloud and for weather condition details can be getting from the Open Weather API. Farmer can monitor the temperature, humidity and soil moisture parameters along with weather forecasting details through a web page. Based on all the parameters he can water his crop through the web page. Even if the farmer is not present near his crop he can water his crop remotely. The User Interface is developed using Node Red.



CHAPTER 3

THEORITICAL ANALYSIS

3.1 Block Diagram



3.2 Software Designing

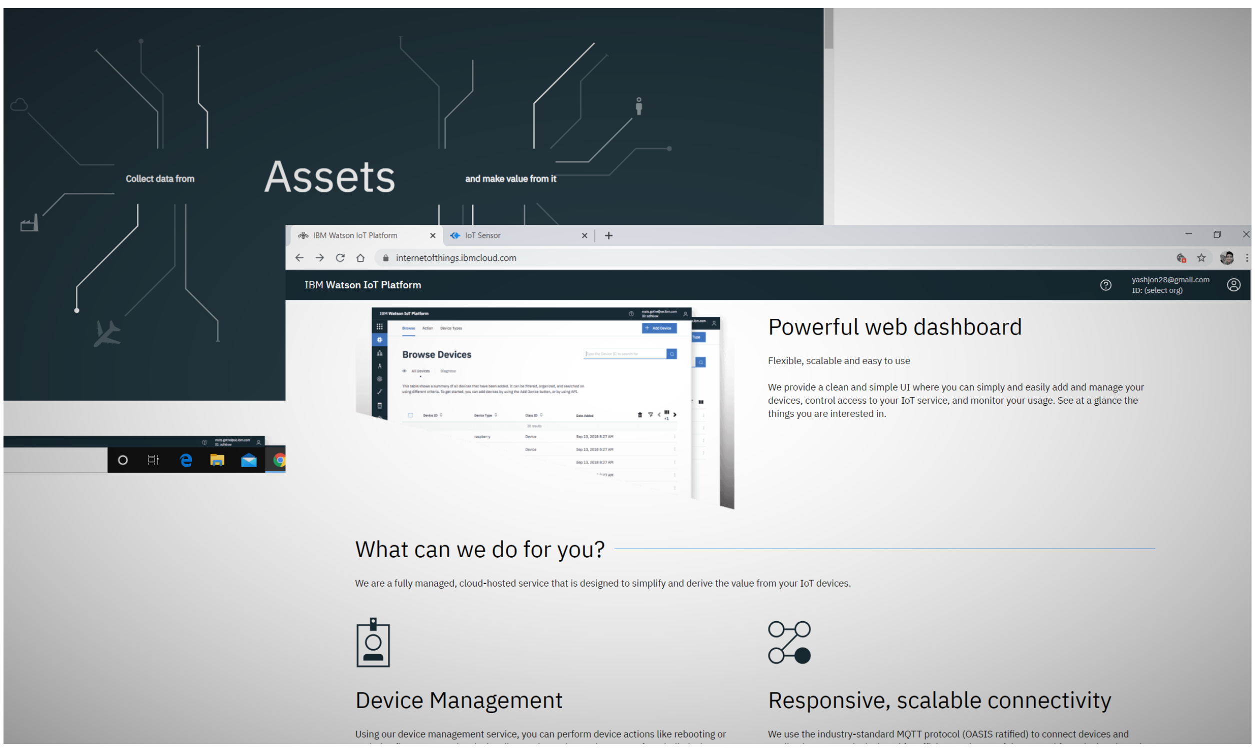
- IBM Watson IOT Platform
  Watson was created as a question answering (QA) computing system that IBM built to apply advanced natural language processing, information retrieval, knowledge representation, automated reasoning, and machine learning

technologies to the field of open domain question answering.

One Important tool of IBM Watson is IBM Watson IOT platform.

IBM Watson IoT Platform is a managed, cloud-hosted service designed to make it simple to derive value from your IoT devices. Watson IoT Platform and its additional add on services - Blockchain service and analytic service - enable organizations to capture and explore data for devices, equipment, and machines, and discover insights that can drive better decision-making.

Start by registering your device on IOT platform. Registering a device involves classifying the device as a device type, giving the device a name, and providing device information. Then you provide a connection token or accept a token that is generated by Watson IoT Platform.

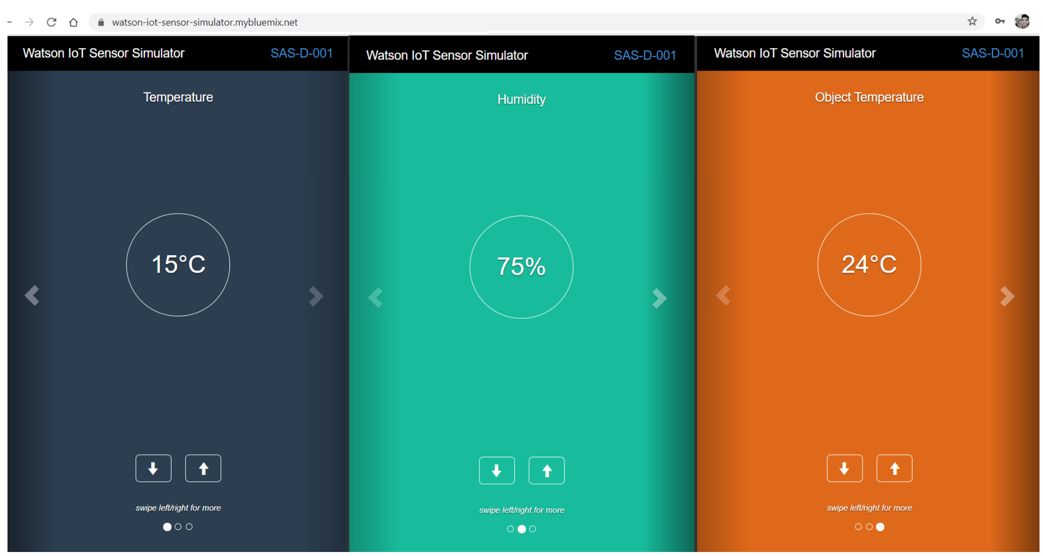


After you register a device with Watson IoT Platform, you can use the registration information to connect the device and start receiving device data. securely up to the cloud using the open, lightweight MQTT messaging protocol. You can set up

and manage your devices using your online dashboard or our secure APIs, so that your apps can access and use your live and historical data.
Before you can begin receiving data from your IoT devices, you must connect them to Watson IoT Platform. Connecting a device to Watson IoT Platform involves registering the device with Watson IoT Platform and then using the registration information to configure the device to connect to Watson IoT Platform.

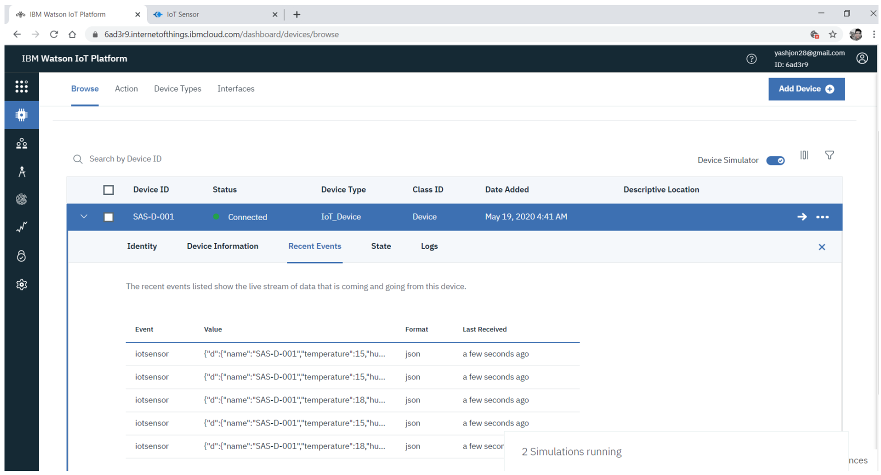
- Watson IOT Sensor Simulator
  It is used as online sensor simulator, to get the values of temperature, humidity, object temperature. The working is as follows:

  1. To view the simulated sensor, we must go to IoT Sensor , enter the saved details(i.e device id, device type, authentication token etc).The simulator connects automatically and starts publishing data. The simulator must remain connected to visualize the data.



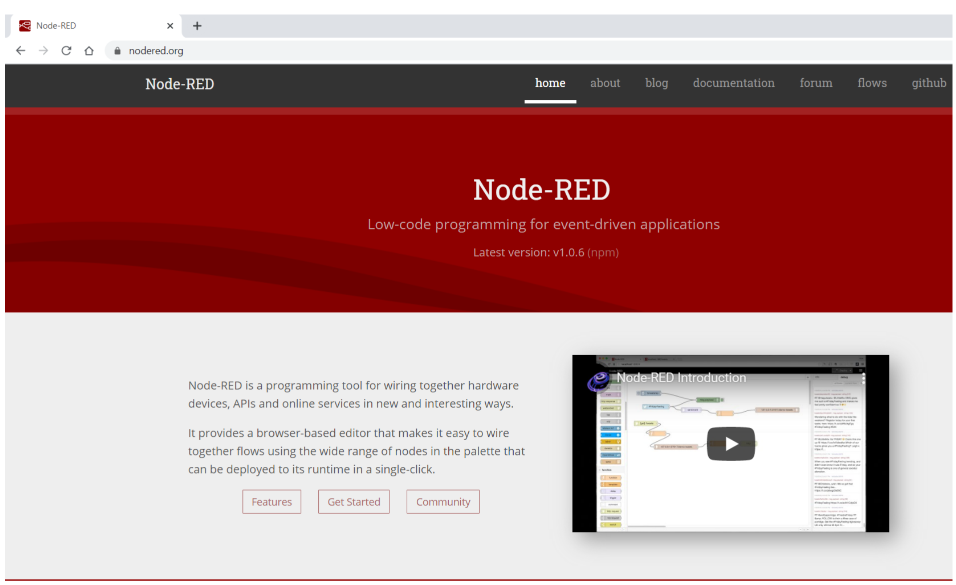
  2. We can use simulator buttons to change the simulated sensor readings. Data is published periodically.

3. We can view the simulated data in cloud platform by selecting the device type and then clicking recent activity to view the generated data.



- Node RED

  Node-RED is a flow-based programming tool, originally developed by IBM's Emerging Technology Services team and now a part of the JS Foundation. Node-RED is a flow-based development tool for visual programming developed originally by IBM for wiring together hardware devices, APIs and online services as part of the Internet of Things.



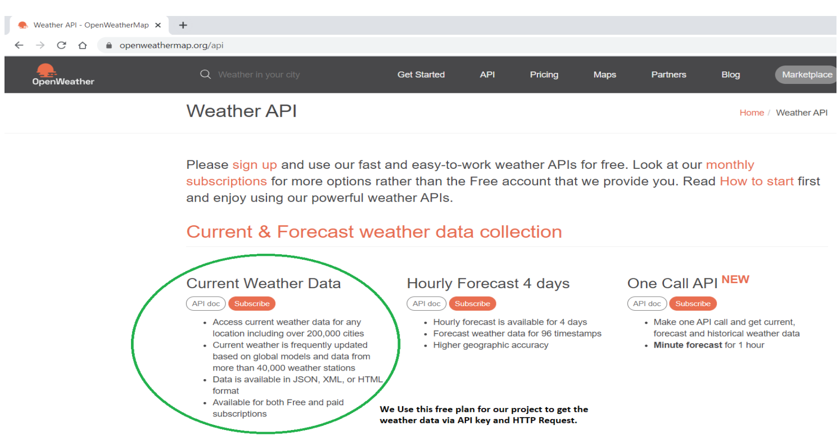
Node-RED provides a browser-based flow editor that makes it easy to wire together flows using the wide range of nodes in the palette. Flows can be then deployed to the runtime in a single-click. JavaScript functions can be created within the editor using a rich text editor. A built-in library allows you to save useful functions, templates or flows for re-use.

Node-RED provides a web browser-based flow editor, which can be used to create JavaScript functions. Elements of applications can be saved or shared for re-use. The runtime is built on Node.js. In 2016, IBM contributed Node-RED as an open source JS Foundation project. In our project we use node red to create UI for the farmer. The values from the sensor simulator and the weather details from Open Weather can be viewed the webpage.

With the help of data viewed in the webpage, if the farmer feels that there is a need to turn the motor on or off, he can do it remotely through the webpage.

- Open Weather API

OpenWeatherMap is an online service that provides weather data. It is owned by OpenWeather Ltd headquartered in London, United Kingdom. It provides current weather data, forecasts and historical data (starting from 1979) to more than 2 million customers, including Fortune 500 companies and thousands of other businesses globally. More than twenty weather APIs have been developed for getting different types of weather data.



They support multiple languages, units of measurement and data formats. Additionally, the OpenWeatherMap service allows any users to get basic weather data on the company’s website. With the help of Open Weather API, we can get the details like temperature, humidity, weather condition and even additional details like wind speed, pressure of the particular location.
These collected details are sent to webpage and can be viewed by the farmer.

- Python IDLE

Python is an interpreter, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python's design philosophy emphasizes code readability with its notable use of significant white space. Its language constructs and object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects.
IDLE is Python’s Integrated Development and Learning Environment.
IDLE has the following features:

- ➤ coded in 100% pure Python, using the tkinter GUI toolkit
- ➤ cross-platform: works mostly the same on Windows, Unix, and macOS
- ➤ Python shell window (interactive interpreter) with colorizing of code input, output, and error messages
- ➤ multi-window text editor with multiple undo, Python colorizing, smart indent, call tips, auto completion, and other features
- ➤ search within any window, replace within editor windows, and search through multiple files (grep)
- ➤ debugger with persistent breakpoints, stepping, and viewing of global and local namespaces
- ➤ configuration, browsers, and other dialogs

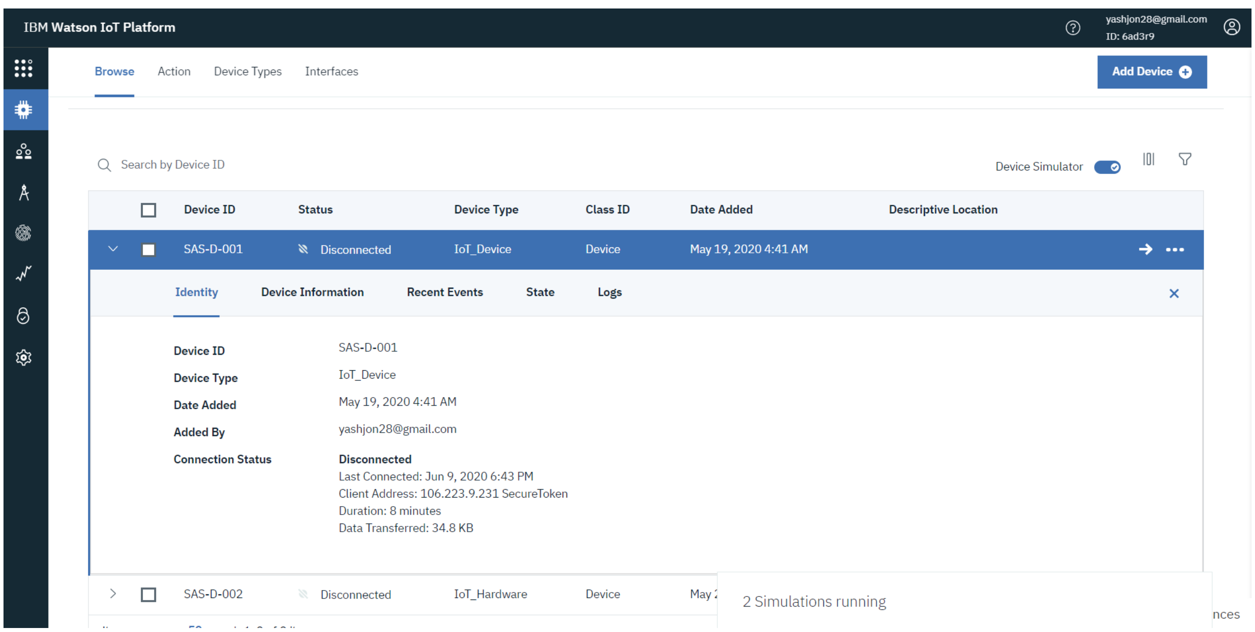
We use python programming to control the motor according to the data that we get through IBM Watson IOT Simulator.

CHAPTER 4

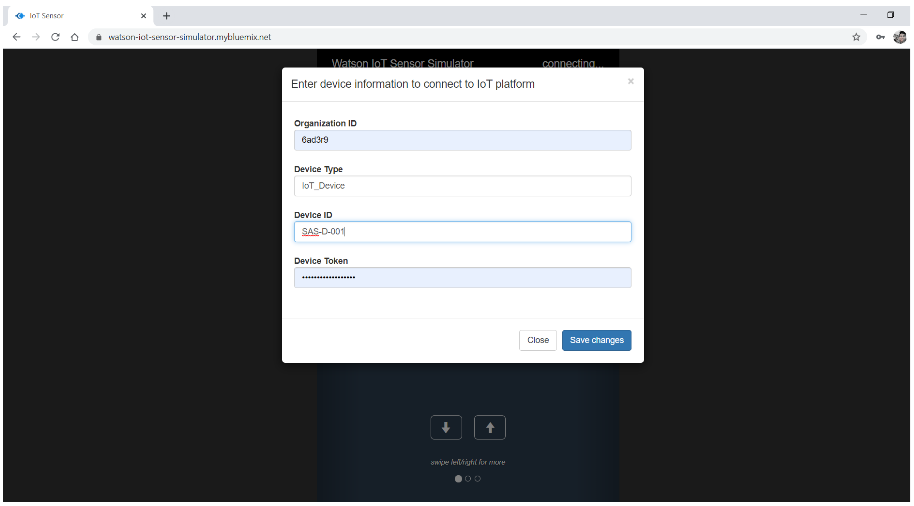
EXPERIMENTAL INVESTIGATIONS

The target of this project is to control the motor remotely by detecting the soil moisture, soil temperature and weather conditions of the particular area. The motor is operated using User Interface or a web application.
The procedure involved to achieve this are shown below.

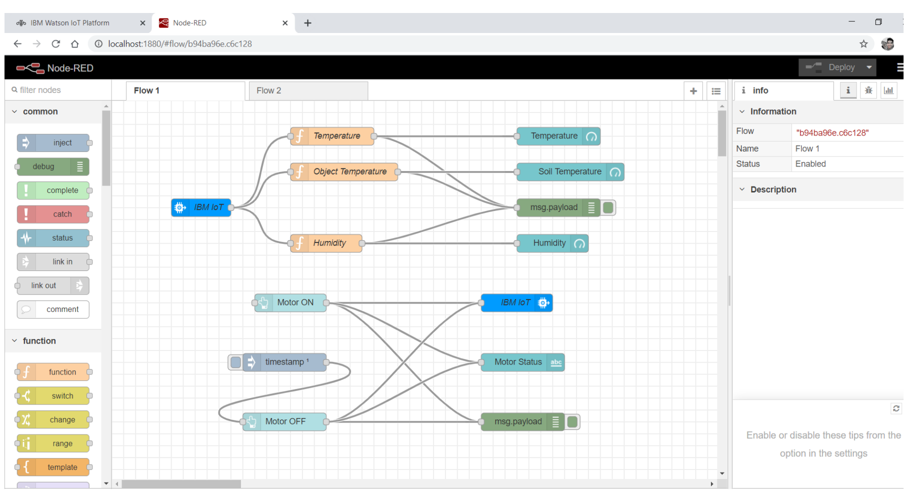
Step 1: Create a device in IBM Watson IOT platform, and save the details so that can we used further in project.



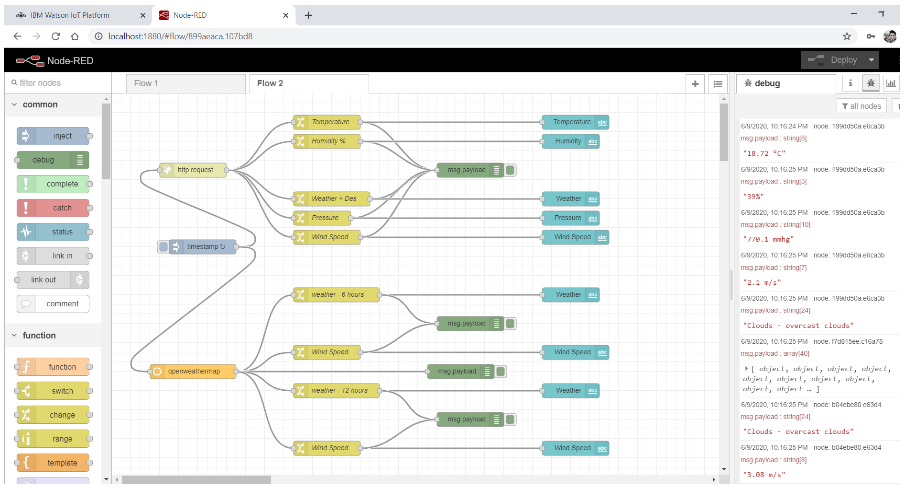
Step 2: After creating the device, enter the device details like device id, organisation id, device type authentication token in order to connect with IOT sensor simulator, so that we get the values like temperature, humidity and object temperature, which can be viewed and analysed in cloud.



Step 3: Configure the Nodered and install the required nodes to get the data from IBM IOT platform.

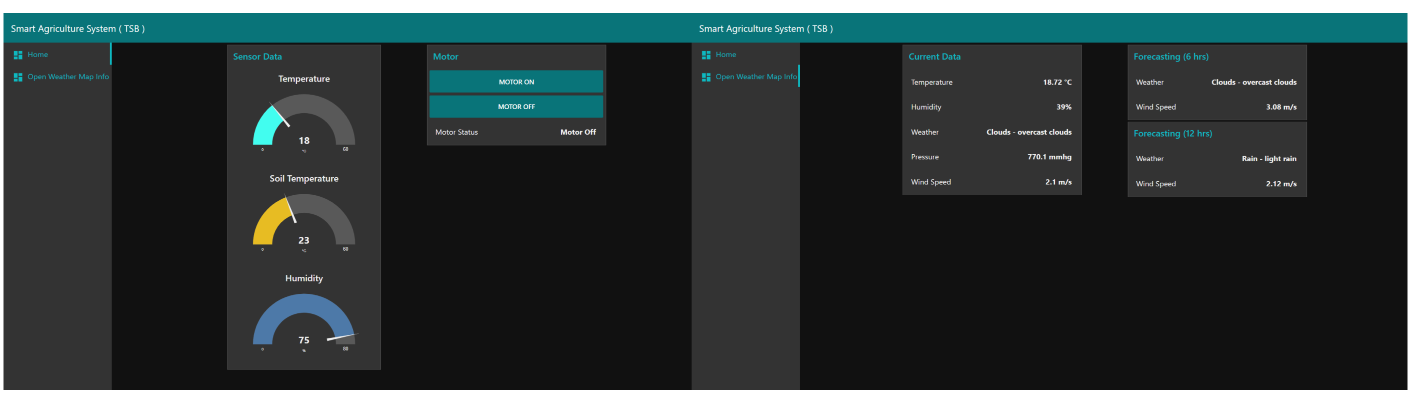


Step 4: Configure the Nodered and install the required nodes to get the weather details from Open Weather API using http requests.



Step 5: Configure the device to receive data from web application and control motors through we page. Here we write python code to subscribe to IBM IOT platform and get the commands. The details can be viewed in cloud and webpage.
(The code snippet is provided in the Appendix)

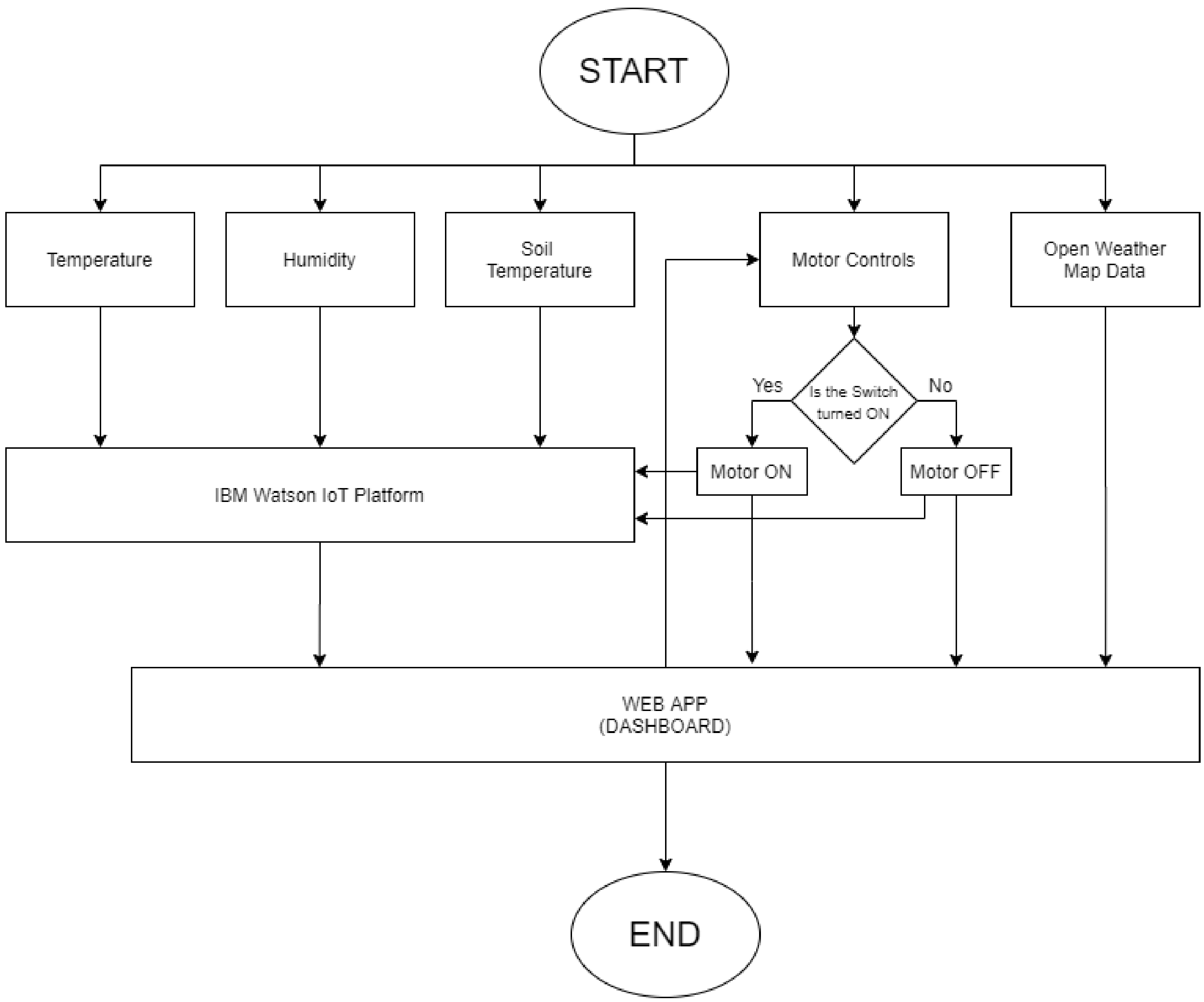
Step 6: After completing the above steps, we finally get a UI or webpage which can be used by farmer to monitor his crop growth and know the weather details.



(These are screenshots of two TABS viewed in Full Screen Mode)

CHAPTER 5

FLOW CHART



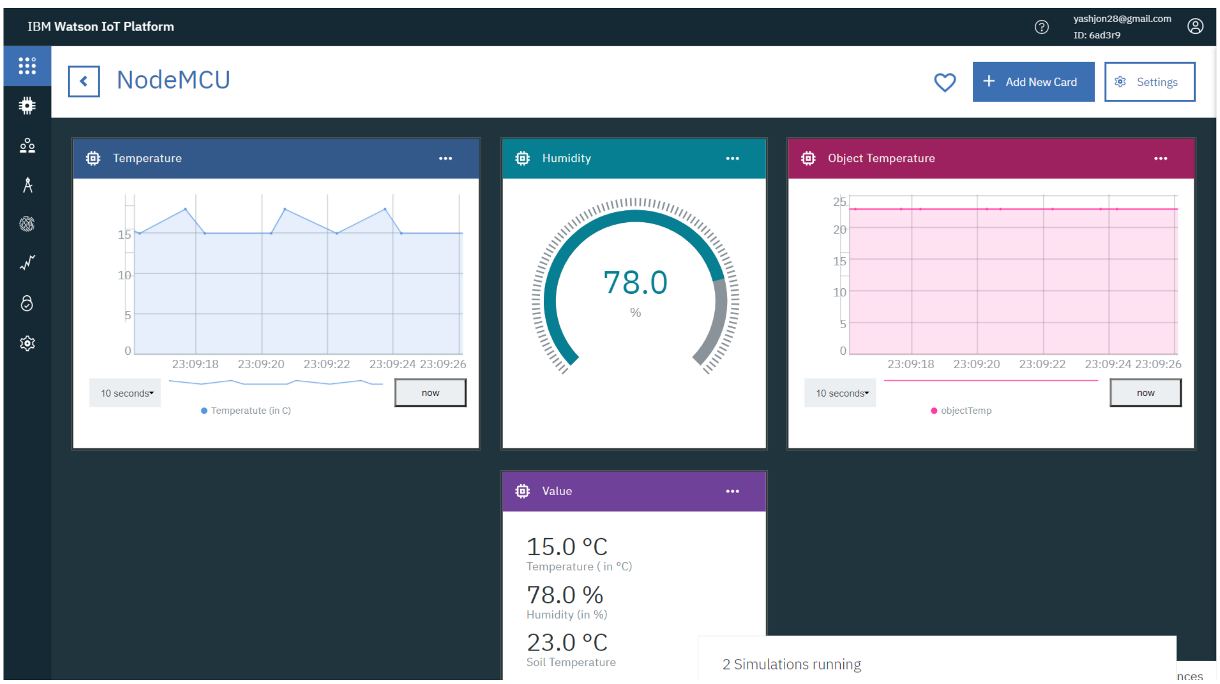
The flow represents the Flow of data at various levels, and shows the functioning of the motor via commands given from the Web App. Also, by default, the motor is kept off just like it should normally be.

CHAPTER 6

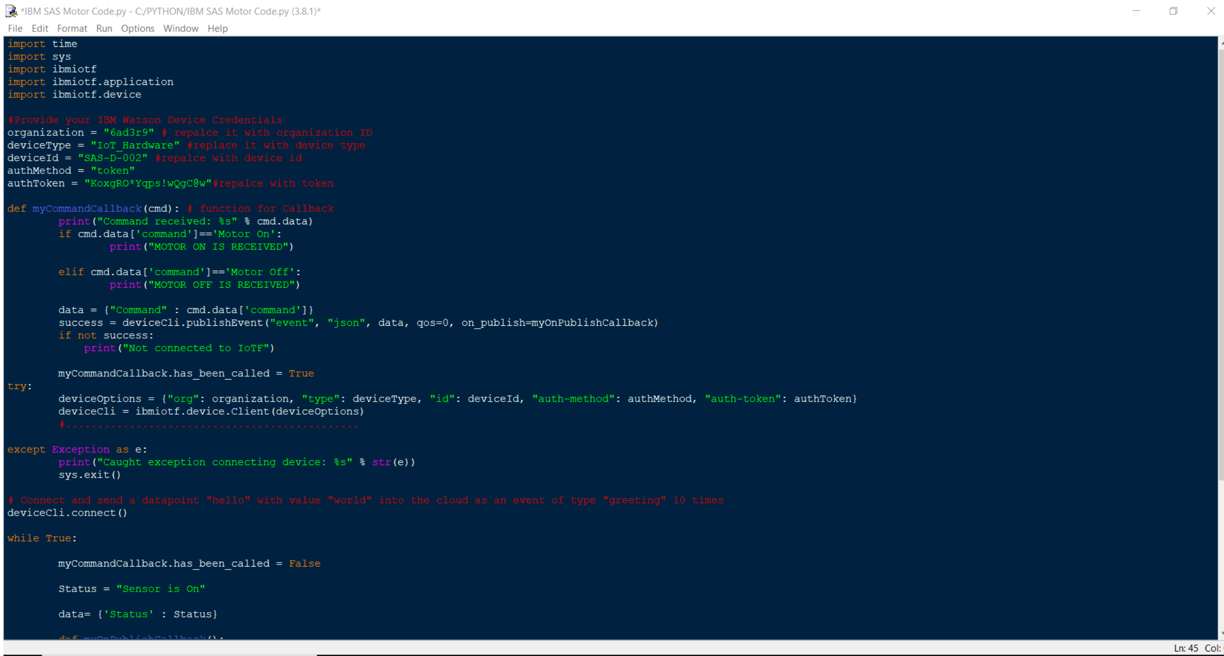
RESULTS

The results of this project are shown below.

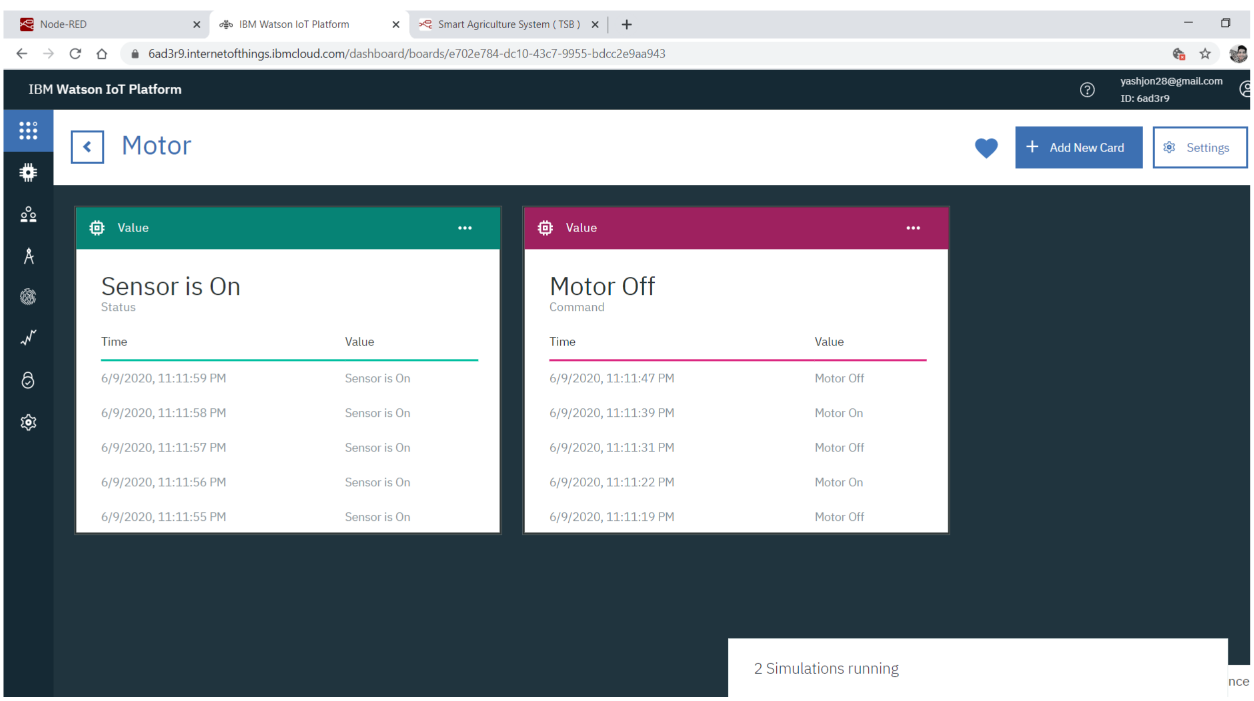
1) When we connect with IOT sensor simulator, we get the values like temperature, humidity and object temperature, which can be viewed and analysed in cloud.



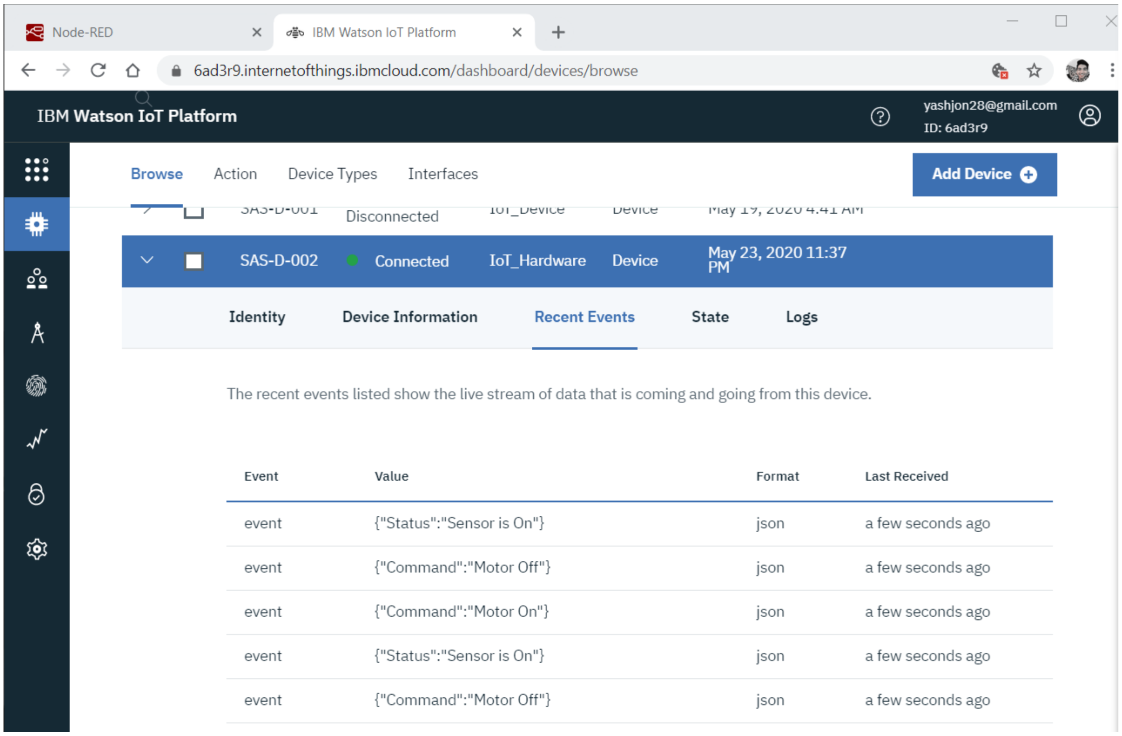
2) Python code to subscribe to IBM IOT platform and get the commands. The details can be viewed in cloud and webpage.



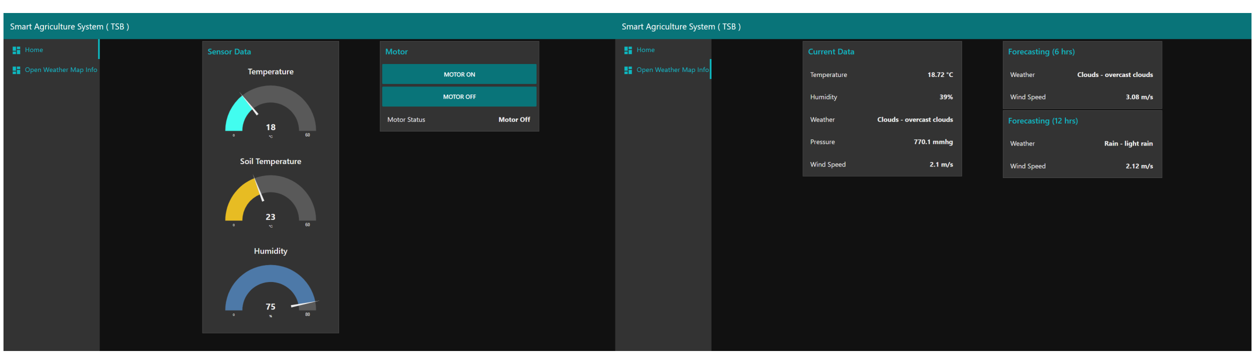
3) Status of Sensor and motor on IBM IOT Platform.



4) Events created due to the Motor On/off command sent by the webpage.



5) We finally get a UI or webpage which can be used by farmer to monitor his crop growth and know the weather details.



CHAPTER 7

ADVANTAGES AND DISADVANTAGES

Advantages:

- One of the greatest advantages of a smart irrigation system is its ability to save water. Generally speaking, traditional watering methods can waste as much as 50% of the water used due to inefficiencies in irrigation, evaporation and overwatering.

- Farmers can visualize production levels, soil moisture, sunlight intensity and more in real time and remotely to accelerate decision making process.

- They can also get to get important information about the amount of air and the levels of air, sound, humidity, and temperature of your environment.

- Weather predictions and soil moisture sensors allow for water use only when and where needed.

- Analysing production quality and results in correlation to treatment can teach farmers to adjust processes to increase quality of the product.

- Local and commercial farmers can monitor multiple fields in multiple locations around the globe from an internet connection. Decisions can be made in real-time and from anywhere.

- Optimized crop treatment such as accurate planting, watering, pesticide application and harvesting directly affects production rates.

Disadvantages:

- One huge disadvantage of smart agriculture is that it requires an uninterrupted or continuous internet connection to be successful. This means that in rural communities, especially in the developing countries where we have mass crop production, it is completely impossible to operate this agriculture method. In places where internet connections are frustratingly slow, smart farming will be very difficult to impliment.

- As pointed out earlier, smart agriculture uses high techs that require technical skill and precision to make it a success. However, many farmers do not have these skills. Even finding someone with this technical ability is difficult or even expensive to come by, at most. And, this can be a discouraging factor hindering a lot of promising farmers from adopting it.

- We need aftersales support for such devices which becomes very hard to provide as simple trouleshooting steps are very technial for normal farmers, thus making our devices very simple to use, with least chances of being corrupted or causing errors should be our first priority when we look to commerically scale this prototype.

CHAPTER 8

APPLICATIONS

There are quite a few and the ranking of best or not depends on the need of the farm land and the region or let's say typically need of local farmer.

- Monitoring quality of soil in real time
- Regulating water supply and controlling usage of water
- Monitoring and measuring core values for crop's growth and good yeild.
- Crop health which plays a very important in the yeild of crop produed.
- Remotely controllable motor for irrigation.

CHAPTER 9

CONCLUSION

Since IoT farming application are making it workable for farmer to gather important information leading to better decision for improvement in the quality of their crop. Many land owners must comprehend the capability of IoT usage for farming by introducing smart innovation to increase output. The need for increasing population can be fulfilled if the user can use IoT technology in a successful manner. In this report, the answer for analysing smart agriculture has been exhibited.

IoT based Smart agriculture improves the entire Agriculture system by monitoring the field in real-time. With the help of sensors and interconnectivity, the Internet of Things in Agriculture has not only saved the time of the farmers but has also reduced the extravagant use of resources such as Water and Electricity.

Thus, the smart agriculture based on IOT will it possible for ranchers and farmers to collect meaningful data. Large landowners and small farmers must understand the potential of IoT market for agriculture by installing smart technologies to increase competitiveness and sustainability in their productions. With the population proliferating, the demand can be successfully met if the ranchers, as well as small farmers, implement agricultural IoT solutions in a prosperous manner.

CHAPTER 10

FUTURE SCOPE

Future scope for this project is with the concept of IoT, given below are some of the main future scopes of IoT in field of agriculture :

- **Precision Farming**: Precision farming is a farming practice that are more accurate and controlled. It deals with production of crop along with raising livestock. In this farming techniques, we use component such as SN, system control, robots, autonomous vehicles, automated hardware. Such as crop metrics.
- **Smart Agri-Logistic:** It is all about smart fooding and agri-business. It focuses on servicing fresh quality product and natural production process with flexible chain-and compassing tracking and tracing system.
- **Smart Food Awareness:** It deals with customer profile, health and awareness and normal day's in the future super market. The demand for healthier but enjoyable diet is increasing, so we need to consider and serve it. Therefore we have to develop a system using iot which will aim for creating awareness in food quality.
- **Green Agriculture:** This technique uses control mechanism technique for environment parameters. To control environmental factors for a smart greenhouse, we use different sensors that contribute to environment parameters such as soil quality and soil type.

CHAPTER 11

BIBLIOGRAPHY

- IBM KNOWLEDGE CENTRE:
  https://www.ibm.com/support/knowledgecenter/SSQP8H/iot/kc_welcome.html

  IBM has been the core of the project since it's start. From virtual simulation, to full fledged controlled flow, it has all been possible via the support of documentation and our mentors.

- NODE RED :
  https://nodered.org/

  Used Node-Red as an integral part of our project for teh web based application extensively, and the documentation provided helped us very much in the process.

- OPEN WEATHER MAP :
  https://openweathermap.org/current

  For a laymann, Open weather map provides all the details from how to generate API and where can it be used. Following the documentation clears all our doubts as what all is the data about, what are the default units being used which helps a lot when you are using the data to represnt it to someone who might not know things unless told.

CHAPTER 12

APPENDIX

Source code

```
import time
import sys
import ibmiotf
import ibmiotf.application
import ibmiotf.device

#Provide your IBM Watson Device Credentials
organization = "6ad3r9" # Organization ID
deviceType = "IoT_Hardware" # Device type
deviceId = "SAS-D-002" # Device ID
authMethod = "token" # Authentication Method
authToken = "KoxgRO*Yqps!wQgC@w" # Repalce with token

def myCommandCallback(cmd): # function for Callback
        print("Command received: %s" % cmd.data)
        if cmd.data['command']=='Motor On':
                print("MOTOR ON IS RECEIVED")

        elif cmd.data['command']=='Motor Off':
                print("MOTOR OFF IS RECEIVED")

data = {"Command" : cmd.data['command']}
success = deviceCli.publishEvent("event", "json", data, qos=0, on_publish=myOnPublishCallback)
if not success:
         print("Not connected to IoTF")

#To check if our function has been called out or not
myCommandCallback.has_been_called = True

try:
         deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method": authMethod,
```

```
"auth-token": authToken}
    deviceCli = ibmiotf.device.Client(deviceOptions)
                                                        #.............................................

except Exception as e:
    print("Caught exception connecting device: %s" % str(e))
sys.exit()

#Connect and send a datapoint "hello" with value "world" into the cloud as an
#event of type "greeting" 10 times
deviceCli.connect()

while True:

    myCommandCallback.has_been_called = False

    Status = "Sensor is On"
    #Send Status to IBM Watson
    data= {'Status' : Status}

    def myOnPublishCallback():
      print (data, "to IBM Watson")
      #print (data2, "to IBM Watson")

    success = deviceCli.publishEvent("event", "json", data, qos=0, on_publish=myOnPublishCallback)
    if not success:
      print("Not connected to IoTF")
    time.sleep(1)

    deviceCli.commandCallback = myCommandCallback
    if myCommandCallback.has_been_called == True :
      print("call made")


# Disconnect the device and application from the cloud
# deviceCli.disconnect()
```