PROJECT REPORT

IoT Application Development

"Smart Agriculture system based on IoT"

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Internship at SmartInternz

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1.Introduction

1.1 Overview:

This is a Smart Agriculture System project based on Internet Of Things (IoT), that can measure soil moisture, humidity and temperature conditions for agriculture using Watson IoT services.IoT aims to integrate the physical world with the virtual world by using the Internet as the medium to communicate and exchange information.

IoT has been defined as a system of interrelated computing devices, mechanical and digital machines, objects, animals, or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

In this project we have not used any hardware. Instead of real-time soil moisture, humdity, temperature conditions, sensors, IBM IoT Simulator is used which can transmit soil moisture, humidity, temperature as required. The Watson IoT Device Simulator is a solution that that enables customers to create and simulate hundreds of virtual connected devices, without having to configure and manage physical devices, or develop time-consuming scripts.

○ **Project requirements :** Node-RED, IBM Cloud, IBM Watson IoT, Node.js, IBM Device, IBM IoT Simulator, Python 3.8, Open Weather API platform.

○ **Project Deliverables :** Application for IoT based Smart Agriculture System

1.2 Purpose:

In IoT-based smart farming, a system is built for monitoring the crop field with the help of sensors and automating the irrigation system. The farmers can monitor the field conditions from anywhere. IoT-based smart farming is highly efficient when compared with the conventional approach.

In terms of environmental issues, IoT-based smart farming can provide great benefits including more efficient water usage, or optimization of inputs and treatments. The data collected by sensors in terms of humidity, temperature, moisture precipitation and dew detection helps in determining the weather pattern in farms so that cultivation is done for suitable crops.The analysis of quality of soil helps in determining the nutrient value and drier areas of farms, soil drainage capacity or acidity, which allows to adjust the amount of water needed for irrigation and the opt most beneficial type of cultivation.

2.Literarture Survey

2.1 Existing Problem:

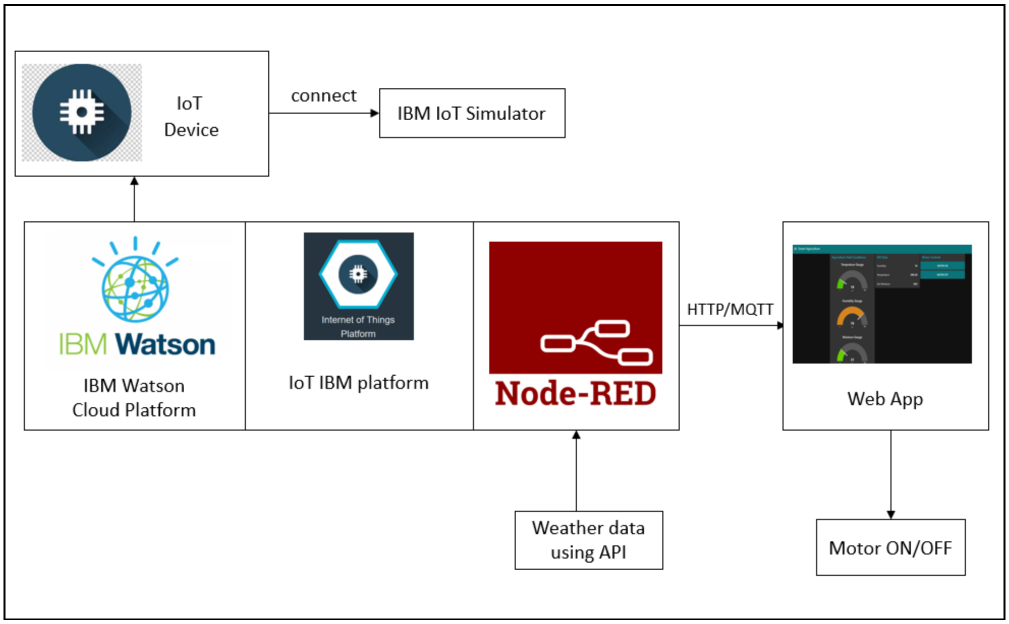
- Most of the agricultural operations in larger parts are carried on by human hand using simple and conventional tools.
- Little or no use of machines is made in ploughing, sowing, irrigating, thinning and pruning, weeding, harvesting threshing and transporting the crops.
- This is specially the case with small and marginal farmers. It results in huge wastage of human labour and in low yields per capita labour force.
- Water is the most crucial part in agriculture. More as well as less supply of water both have negative effects on the crops.Continuous observation is required for water supply depending on the weather conditions.
- During dry weather water requirement for crops is more, but it may happen that the farmer is not available on the field at that time. Hence there will not be proper supply of water. This may lead to damage of crops.
- Sometimes it may happen that the farmer would forget to switch off the pump, this would result in excessive supply of water especially in rainy season.
- When the climate changes, the rainfall cycle, magnitude and the timing of rainfall is altered leaving the farmers unprepared for the change.
- When the temperature is warm, the water is held in the form of moisture. In arid regions, soil moisture gets evaporated fast leaving less water for crop production.

2.2 Proposed Solution:

- In IoT based smart agriculture, a system is built for monitoring the crop field with the help of sensors.
- This affords the farmers the capability to monitor the field conditions from anywhere.
- IoT- based smart agriculture is highly efficient when compared with the conventional approach.
- In agriculture, irrigation is the important factor as the monsoon rainfalls are unpredictable and uncertain.
- Irrigation is the application of controlled amounts of water to plants at needed interval in order to grow crops.
- The goal of technology is to make the lives of human beings easier and simpler
- It is therefore an attempt to extend the chain of electronic life to the famers and provide a means of reducing the cost included during manual means of monitoring and irrigation, save time and energy, and to control the ever increasing problem of water.

3.Theoritical Analysis

3.1 Block Diagram



3.2 Hardware / Software Designing

- Create a device in IBM Cloud.
- Connect the device to IBM Simulator to get the weather conditions.
- Build Node-RED flow to build a web application to display the weather conditions and control the devices.
- Get the real time weather condition data from openweathermap and integrate it in the Node-RED.
- Control the working of the web application to the devices by python coding.

4.Experimental Investigations

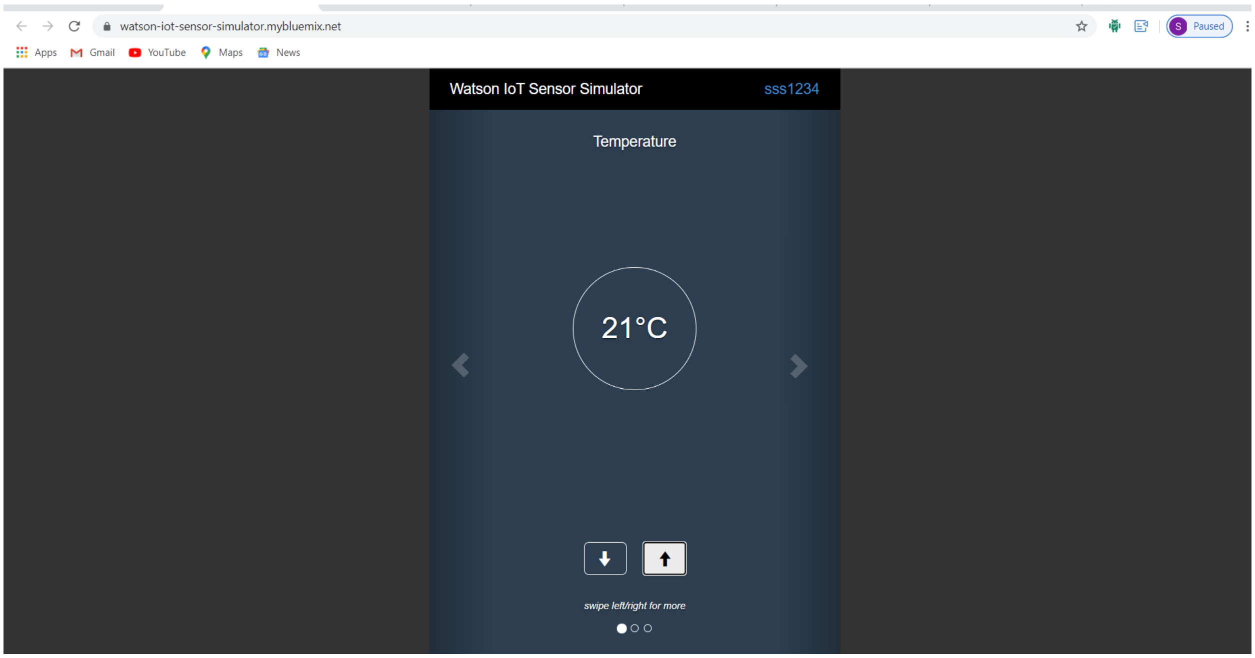


Fig (1)Watson Iot Simulator

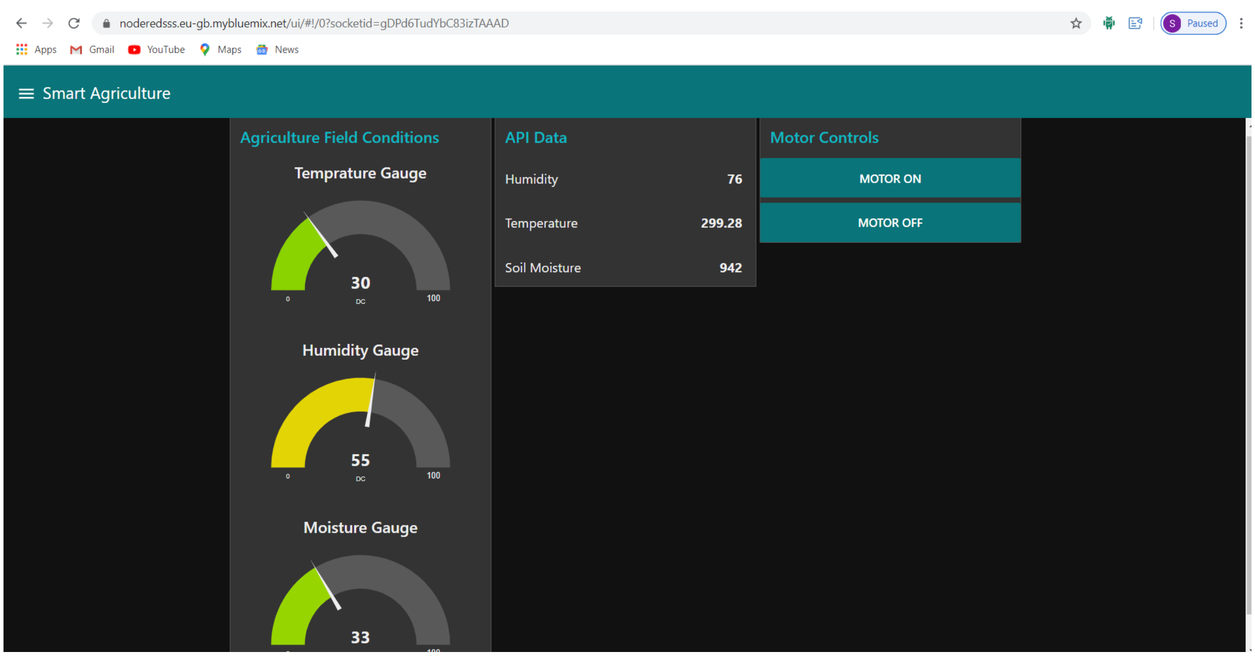


Fig (2)Web Application

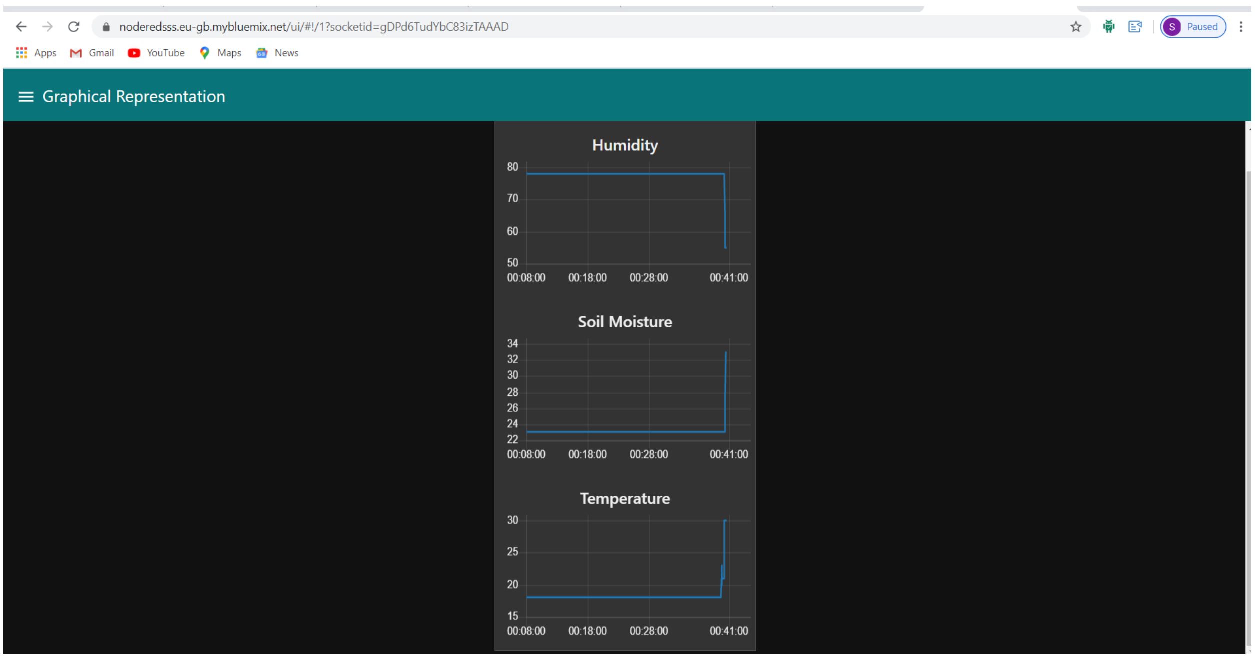
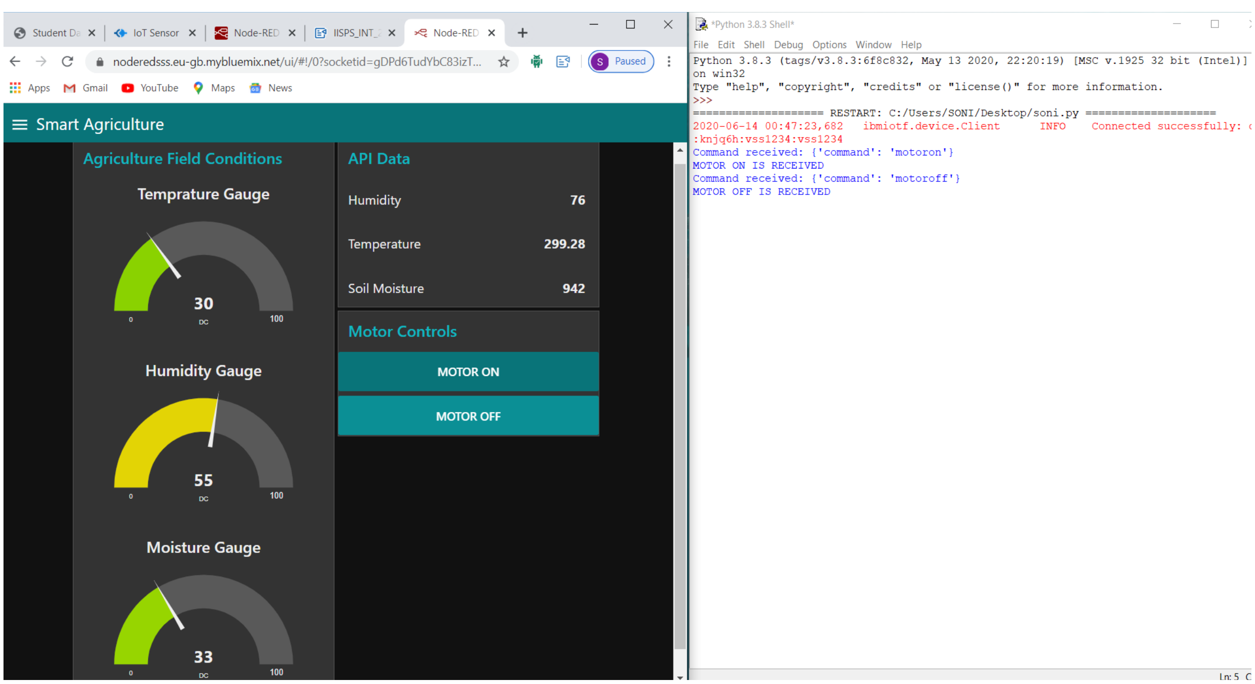


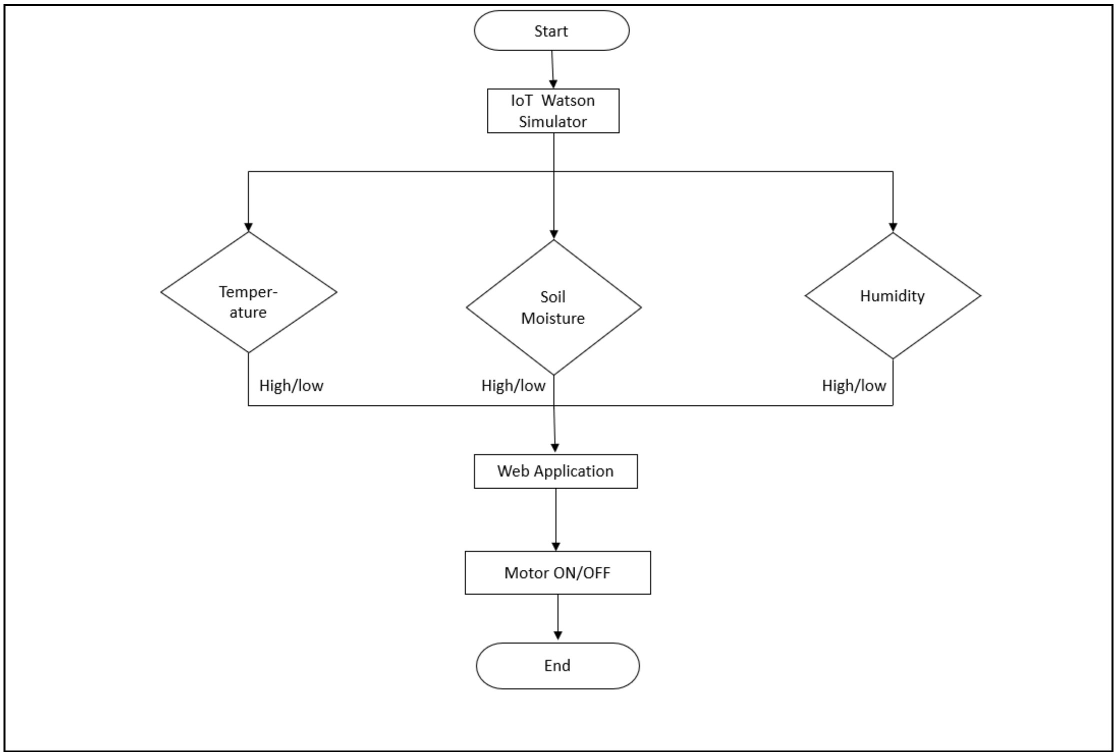
Fig (3) Graphical Representation

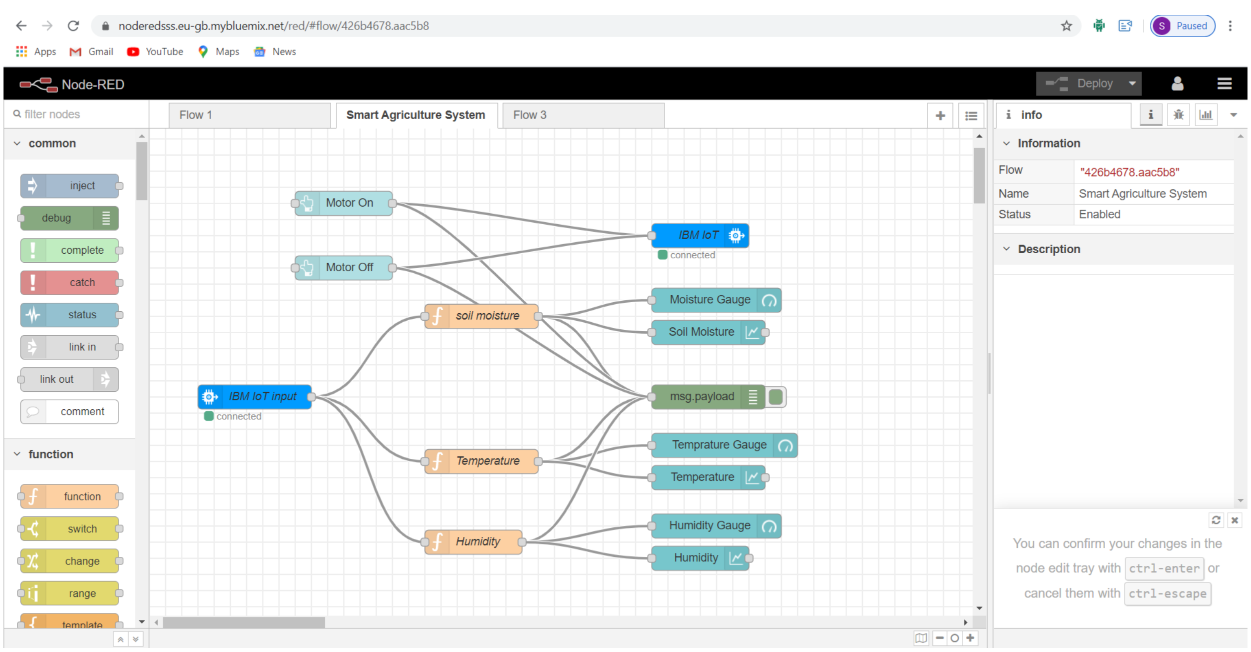


Fig(4) Device Control Action

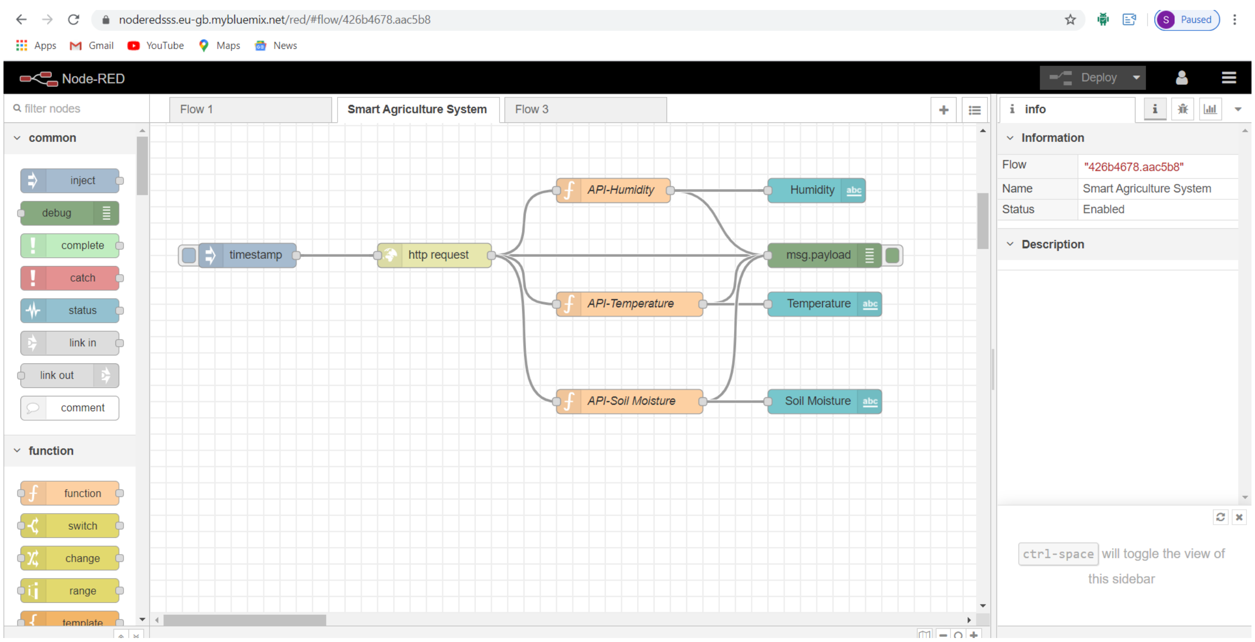
- In this project we send the weather data through IoT Simulator shown in Fig(1) instead of real-time soil and temperature conditions.
- Simulator passes the data through IBM Colud to the web application. The data is displayed on the dashboard show in Fig(2 & 3).
- Web Application is build using Node-RED.
- We have created 2 tabs:
  1. IoT Smart Agriculture.
  2. Graphical Representation.
- Web Application is also used to control the devices further like motor, pumps, lights, or any other devices in the agricultural field. In this project the output is passed using python code and the control action is displayed in python code console window in Fig(4).

5. Flowchart





(Fig5)Node-RED flow



(Fig 6) Node-RED flow

Following are the nodes used in the project in the Web Application:

1. IBM IoT : IN and OUT Nodes.
2. function Nodes.
3. Gauge Nodes.
4. Chart Nodes.
5. Debug Node.
6. Button Nodes.

Following are the nodes used for the weather condition from openweathermap:

1. Timestamp Node.
2. http request Node
3. Function Nodes.
4. Text Nodes.
5. Debug Node.

6. Result

We have successfully build a web based UI and integrated all the services using Node-RED.
Web Application :https://noderedsss.eu-gb.mybluemix.net/ui/

7. Advantages & Disadvantages

7.1 Advantages:

- Weather predictions and soil moisture sensors allow for water use only when and where needed
- .Farmers can visualize production levels, soil moisture, sunlight intensity and more in real time and remotely to accelerate decision making process.
- Automating processes in planting, treatment and harvesting can reduce resource consumption, human error and overall cost.
- All conservation efforts such as water usage and increased production per land unit directly affect the environmental positively
- .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.

The Internet of Things has truly enhanced many industries by providing data collection, real-time insight and process automation through low cost sensors and IoT platform implementation.

7.2 Disadvantages:

- Smart Agriculture requires internet connectivity continuously, but rural parts can not fulfill this requirement.
- Farmers are not used to these high-end technologies. They do not understand computer language or the artificial intelligence.
- The use of smart technology in agriculture is impressive, it does incur a lot of costs.Since the farming industry does not see higher profits, huge investments in this space are unlikely.
- Even after the altering of machines, there are chances where the farmers might tend to operate the machines wrongly causing it to damage or send it to repair.

- Since technology involves a lot of machines, there are chances where the data might get wrong at times.

8. Applications

- Climate plays a very critical role for farming.Sensors monitor the condition of the crops and the weather surrounding them.
- Precision Farming is one of the most famous applications of IoT in Agriculture. It makes the farming practice more precise and controlled by realizing smart farming applications such as livestock monitoring, vehicle tracking, field observation, and inventory monitoring. The goal of precision farming is to analyze the data, generated via sensors, to react accordingly
- .Cloud based data storage and an end-to-end IoT Platform plays an important role in the smart agriculture system.
- The Ground and Aerial drones are used for assessment of crop health, crop monitoring, planting, crop spraying, and field analysis.

9. Conclusion

Thus, the IoT agricultural applications are making it possible for farmers to collect meaningful data. 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 growing rapidly, the demand can be successfully met if the farmers, implement agricultural IoT solutions in a prosperous manner.

10. Future Scope

In future due to more demand of good and more farming in less time, for betterment of the crops and reducing the usage of extravagant resources like electricity and water IoT can be implemented in most of the places.

11. Bibliography:

- IBM Cloud :
  https://cloud.ibm.com/docs/overview?topic=overview-whatis-platform
- Watson IoT :
  https://www.iotone.com/software/ibm-watson-iot-platform/s62
- Node-RED :
  https://nodered.org/docs/getting-started/windows#3-run-node-red
  https://www.youtube.com/watch?v=cicTw4SEdxk
- Openweathermap :
  https://openweathermap.org/
- Git Hub :
  https://github.com/rachuriharish23/ibmsubscribe

12. Appendix

12.1 Source Code:

```
import time
import sys
import ibmiotf.application # to install pip install ibmiotf
import ibmiotf.device

#Provide your IBM Watson Device Credentials
organization = "knjq6h" #replace the ORG ID
deviceType = "sss1234"#replace the Device type wi
deviceId = "sss1234"#replace Device ID
authMethod = "token"
authToken = "Soni@2001" #Replace the authtoken


organization = "knjq6h" #replace the ORG ID
deviceType = "vss1234"#replace the Device type wi
deviceId = "vss1234"#replace Device ID
authMethod = "token"
authToken = "Varsha@2001" #Replace the authtoken

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

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

    if cmd.command == "setInterval":


        if 'interval' not in cmd.data:
            print("Error - command is missing required information: 'interval'")
```

```
            else:
                interval = cmd.data['interval']
        elif cmd.command == "print":
            if 'message' not in cmd.data:
                print("Error - command is missing required information: 'message'")
            else:
                output=cmd.data['message']
                print(output)

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:

        deviceCli.commandCallback = myCommandCallback

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

12.2 Node-RED flow code:

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            ]
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    "name": "API-Temperature",
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    "noerr": 0,
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"func": "msg.payload=msg.payload.main.grnd_level\nreturn msg;",
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"#ff7f0e",
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"#d62728",
"#ff9896",
"#9467bd",
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"#ff7f0e",
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"ymin": "",
"ymax": "",
"removeOlder": 1,
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"removeOlderUnit": "3600",
"cutout": 0,
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"#aec7e8",
"#ff7f0e",
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"#98df8a",
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