Project Scope

- Create a device in Watson IoT Platform.
- Connect your Device with Watson IoT Sensor Simulator.
- Collect data through Weather API.
- Make a work flow in Node-Red.
- Create a Web application with integration to all these services and run the Python code to deploy the application.

Schedule:- 16 Days

Project Team:- Pooja Patil

Project Deliverables:- Smart Agriculture System using IoT

Youtube Video Link:- https://youtu.be/LJFtSLB8oHU

PROJECT

REPORT

TOPIC NAME- Smart Agriculture System Based On Iot - SB18608

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CATEGORY- Internet of Things

CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

Agriculture is the process of producing food, feed, fiber and many other desired products by the cultivation of certain plants and the raising of domesticated animals (livestock). The practice of agriculture is also known as "farming", while scientists, inventors and others devoted to improving farming methods and implements are also said to be engaged in agriculture. Subsistence farming, who farms a small area with limited resource inputs, and produces only enough food to meet the needs of his/her family. At the other end is commercial intensive agriculture, including industrial agriculture. Such farming involves large fields and/or numbers of animals, large resource inputs (pesticides, fertilizers, etc.), and a high level of mechanization. These operations generally attempt to maximize financial income from grain, produce, or livestock. The 20th Century saw massive changes in agricultural practice, particularly in agricultural chemistry. Agricultural chemistry includes the application of chemical fertilizer, chemical insecticides, and chemical fungicides, soil makeup, analysis of agricultural products, and nutritional needs of farm animals. Beginning in the Western world, the green revolution spread many of these changes to farms throughout the world, with varying success. Other recent changes in agriculture include hydroponics, plant breeding, hybridization, gene manipulation, better management of soil nutrients, and improved weed control. Genetic engineering has yielded crops which have capabilities beyond those of naturally occurring plants, such as higher yields and disease resistance. Modified seeds germinate faster, and thus can be grown in an extended growing area. Genetic engineering of plants has proven controversial, particularly in the case of herbicide-resistant plants.

Fig.1.1.1 A Farm

As of 2006, an estimated 36 percent of the world's workers are employed in agriculture (down from 42% in 1996), making it by far the most common occupation. However, the relative significance of farming has dropped steadily since the beginning of industrialization, and in 2006 – for the first time in history – the services sector overtook agriculture as the economic sector employing the most people worldwide. Also, agricultural production accounts for less than five percent of the gross world product (an aggregate of all gross domestic products).

1.2 PURPOSE

Smart farming is a management concept focused on providing the agricultural industry with the infrastructure to leverage advanced technology – including big data, the cloud and the internet of things (IoT) – for tracking, monitoring, automating and analysing operations. Also known as precision agriculture, smart farming is software-managed and sensor-monitored. Smart farming is growing in importance due to the combination of the expanding global population, the increasing demand for higher crop yield, the need to use natural resources efficiently, the rising use and sophistication of information and communication technology and the increasing need for climate-smart agriculture.

Fig 1.2.1 IoT based Agriculture

1.3 SUMMARY

Smart farming and IoT-driven agriculture are laying the groundwork for a “third green revolution,” which refers to the combined application of information and communications technologies. This includes devices such as precision equipment, IoT sensors and actuators, geo-positioning systems, unmanned aerial vehicles (UAVs) and robots.

CHAPTER 2

LITERATURE SURVEY

2.1 EXISTING PROBLEM:

In the present scenario, we can observe that farmer have to face lot of struggle in farming. He has to make everything good, so that the yield will be good. He also has to stay near to his field. He has to make sure that watering of crop should be done properly, soil moisture and humidity should be perfect. Due to this farmer has to face a lot of problems.

There are several red flags in monitoring the agriculture, which farmers face in day to day basis. Like regular equipment maintenance, unpredicted environmental factors lead to many revenue loss.

1. Monitoring crop health is difficult when it comes to monitoring huge hectors of fields.

2. Unpredictable weather changes yield to a huge monetary loss where the temperature, humidity, wind speed, and heavy rain alerts are often missed or lack of awareness to prepare the field.

3. Detecting pests and controlling them is a herculean task especially in the tropical regions and other areas where it is difficult to monitor them consistently from recurrence.

2.2 PROPOSED SOLUTION

The only solution to his problem is automation of control unit of water motor. If farmer was able to control how much amount of water should be used for agriculture on the basis of soil moisture, temperature and humidity remotely then he can also utilize his me in other activity. Our solution to this problem is that to provide an application which is user interactive which retrieves data from the field through the IoT sensor and also changes is hardware of water motor, so that on a button click he will be able to make motor either ON or OFF. Also he can supply sufficient amount of water on the basis of live weather condition.

a. **Improved Agility of the Process**

IoT application into the agriculture sector helps to analyze the data and modify the farming methods with the results of the existing data. With advanced machine learning and data visualization tools, real-time data monitoring was made c.

b. **Get Better Control over Internal processes**

Now the site managers can get a better view of the farm field by providing data insights through iot based agriculture monitoring system about the crop health, soil strength, track the performance of the fleets and so much more. These will precisely provide detailed data and covers all the facets of agriculture from start to finish with IoT technologies.

c. **Increase in Productivity**

The main goal of smart agriculture system using IoT is to increase productivity on a large scale. Right from precision farming, autonomous tractors, extensive flood control methods through IoT sensors and forecast, the IoT based smart agriculture is the need of the hour. It helps to improve the irrigation facilities that increase crop productivity, offering end-end IoT agriculture monitoring.

d. **Higher Return on Investment**

Organic farming is the new trend in the agriculture sector owing to the health awareness of the Millenials and Gen X generations. With smart farming solutions, less crop wastage can be achieved easily and grow with more confidence to the biggest yield. Also, IoT solutions help the farmers to stay on top of the harvest season by performing various analysis based out of the real-time data.

e. **Predict Forecast for better decision making**

To create a calculated farm management decision, the smart agriculture monitoring system using IoT data visualization tools, provides an in-depth view of the asset health, soil health and a lot of factors involved around it. These predictive analysis helps a farmer or the landowner, to get a complete solution through a single dashboard using smart farming IoT solutions.

f. **Helps to produce the best quality**

Get a healthier and greener agriculture land that prevents the toxic environment of harmful pesticides. IoT helps to build a IoT based smart greenhouse with IoT microcontrollers, sensors that capture the plant growth, pest usage, lighting in a controlled environment. It helps to move towards eco-farming, avoiding the dangerous impacts of the chemicals that are a hazard to both humans and crops.

2.3 SUMMARY

According to the Food and Agriculture Organization, more than 60% of the world's population depends upon agriculture for their living. It implies the World's economy is heavily dependent upon this sector. But, Agriculture is the first industry to get affected by global warming and hazard environment challenges. IoT which has transformed several industries digitally has been a driving factor for building a Smart agriculture system.

CHAPTER 3

THEORETICAL ANALYSIS

3.1 INTRODUCTION

Hardware / Software designing Smart agriculture system implements on simulator, so there is no use of hardware designing and software designing includes:

● Creation of web application through node red

● Creation of device on IBM IoT platform available on IBM cloud

● Use of IBM simulator instead of data from hardware.

● Retrieving data from open weather API to get details about climatic condition of a region

● Use of node red dashboard nodes to create interactive control unit.

● Use of python language to make control on motor. In this project, web application is created by node red which also collapse with device created on IBM IoT platform through API and other authentication. IBM simulator is used to change data of IoT device instead of using any hardware sensor. Python language is used to depict the control over motor. Node-red's node also used to take data from open weather API.

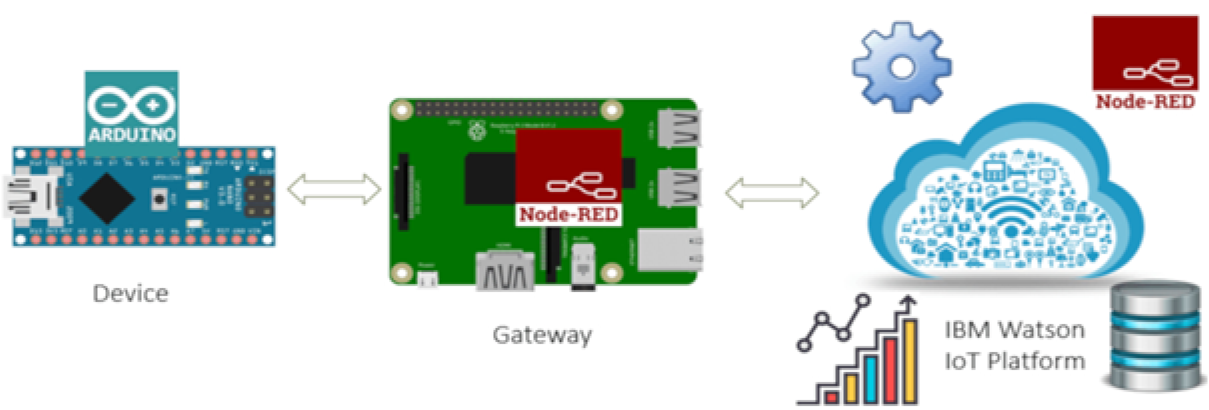

Fig.3.1.1 Block Diagram for Dashboard

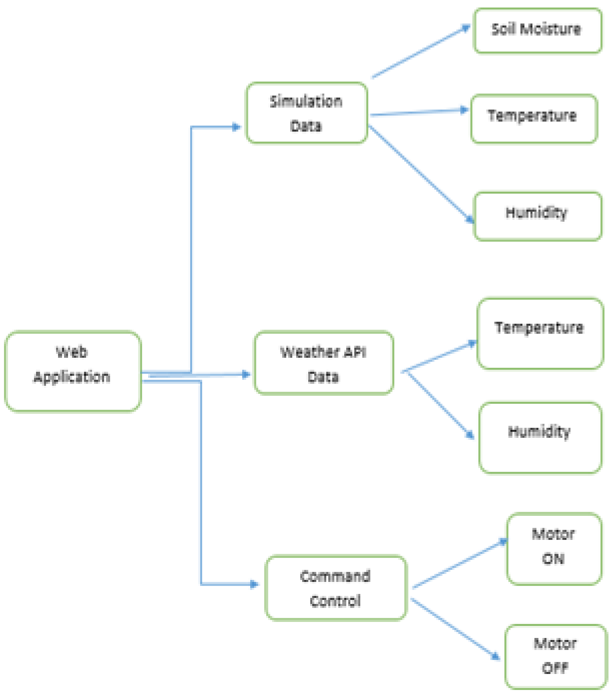

Fig. 3.1.1 Block Diagram

There are several types of IoT sensor devices, tools, and technologies used for building a smart agriculture system.

1. Sensors

a. Livestock monitoring is one of the important use cases of IoT based smart farming implementation.

b. For example, with IoT based smart farming system, they facilitate remote monitoring of the cattle through neck collar sensors to track the herd, detects and alerts any predators.

c. Along with the state-of-the-art IoT hardware like smart wearables, they provide valuable data like herd location, walking time, water intake, heat condition, and lot more detailed data.

2. **Protocols**

a. Communication protocols in smart farming systems, always remain as the backbone of any IoT based applications, whether they are required for a short-range or a long-range to cover a wide area of the land.

b. Intelligent farming uses protocols like LoRaWAN, Bluetooth, LR-WPAN in 5G mobile communication network.

c. ZigBee or Wifi is sufficient enough to cover a small field. Hence, all these protocols help to give the big picture of the farmers' needs and challenges, providing solutions to rectify them.

3.2 SUMMARY

Dedicated software platforms are used to monitor the different factors of farming. For instance, weather monitoring software like Open Weather on weather API gives granular details like humidity, precipitation, the temperature of the crop field. Also, data analytics software like Node-Red, IBM Watson Platform helps to provide an end-end farm management systems.

CHAPTER 4

EXPERIMENTAL INVESTIGATION

4.1 INTRODUCTION

A. **Node-Red Flow Diagram**. It has many nodes like:

   a. Function-Node for temperature, humidity and soil moisture.

   b. IBM IoT IN-Node for Input values.

   c. Gauges-Node for temperature, humidity and soil moisture.

   d. Inject-Node for timestamp.

   e. Debug-Node for output.

   f. Http request-Node for collecting data from Weather API.

   g. Button-Node for motor ON and motor OFF

   h. IBM IoT IN –Node for output values.

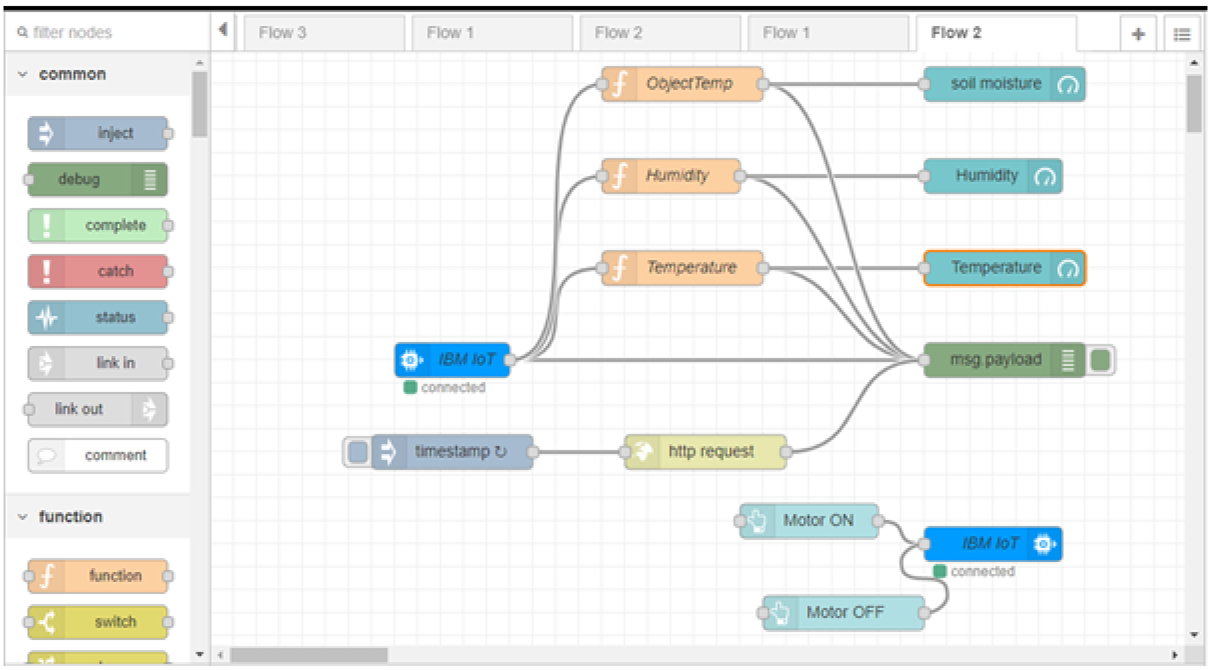

Fig. 4.1 Node-Red Flow diagram

B. Watson IoT Sensor Simulator Temperature for increase/decrease in temperature monitoring.

a. Humidity for increase/decrease in humidity.
b. Object Temperature is basically Soil moisture.

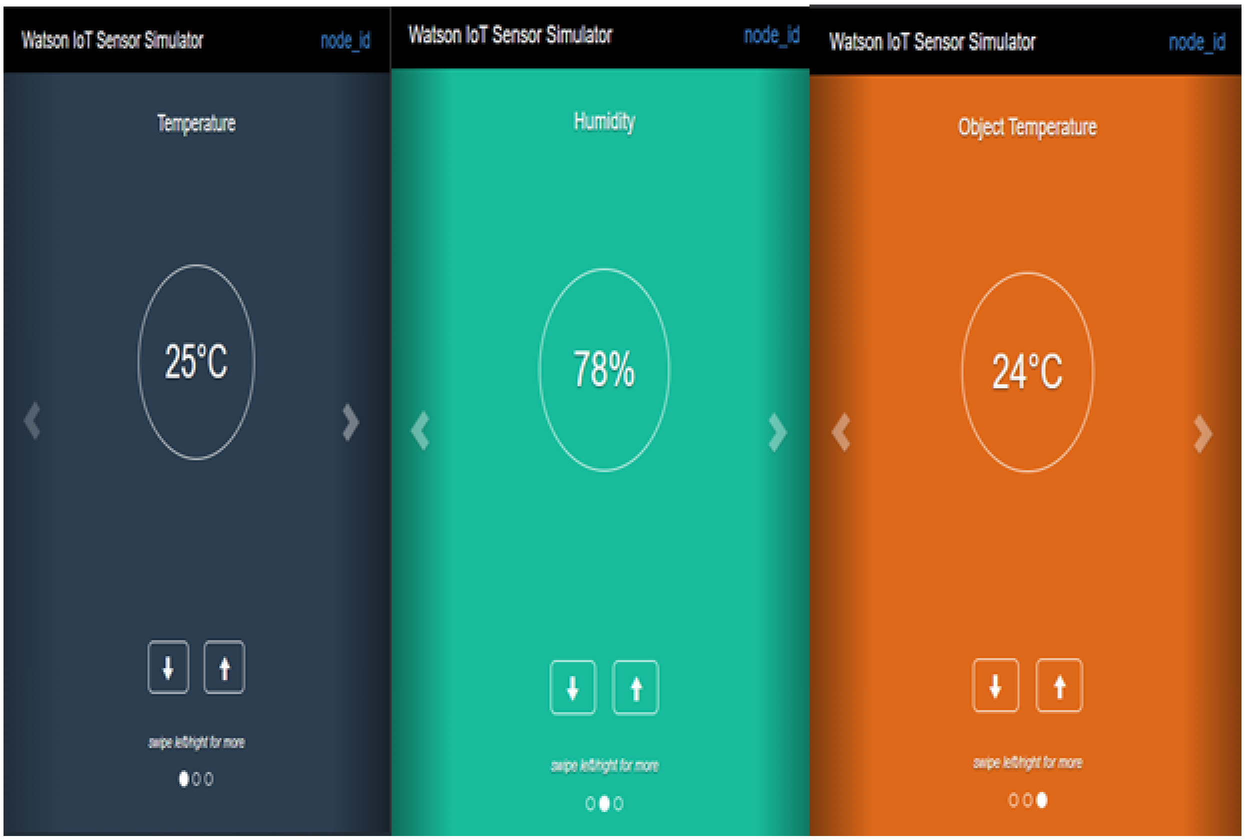

Fig. 4.2 Watson IoT Sensor Simulator

C. Dashboard- As we change the values in Watson IoT Sensor Simulator the values in Dashboard also changes. This is our final product. It has been developed by above Node-Red flow diagram.

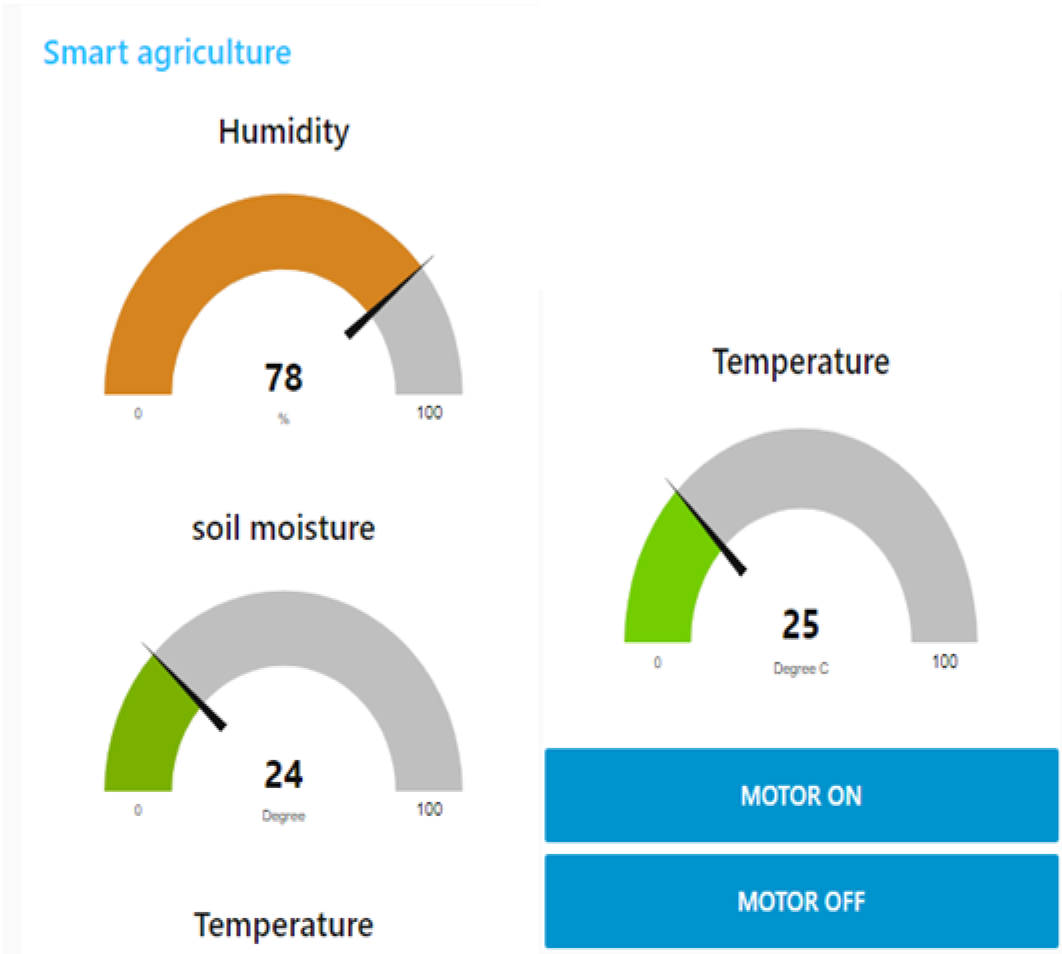

Fig. 4.3 Dashboard Application

D. Python Program-When button is clicked in dashboard application, it shows “light-on” / ”light-off” in output terminal.

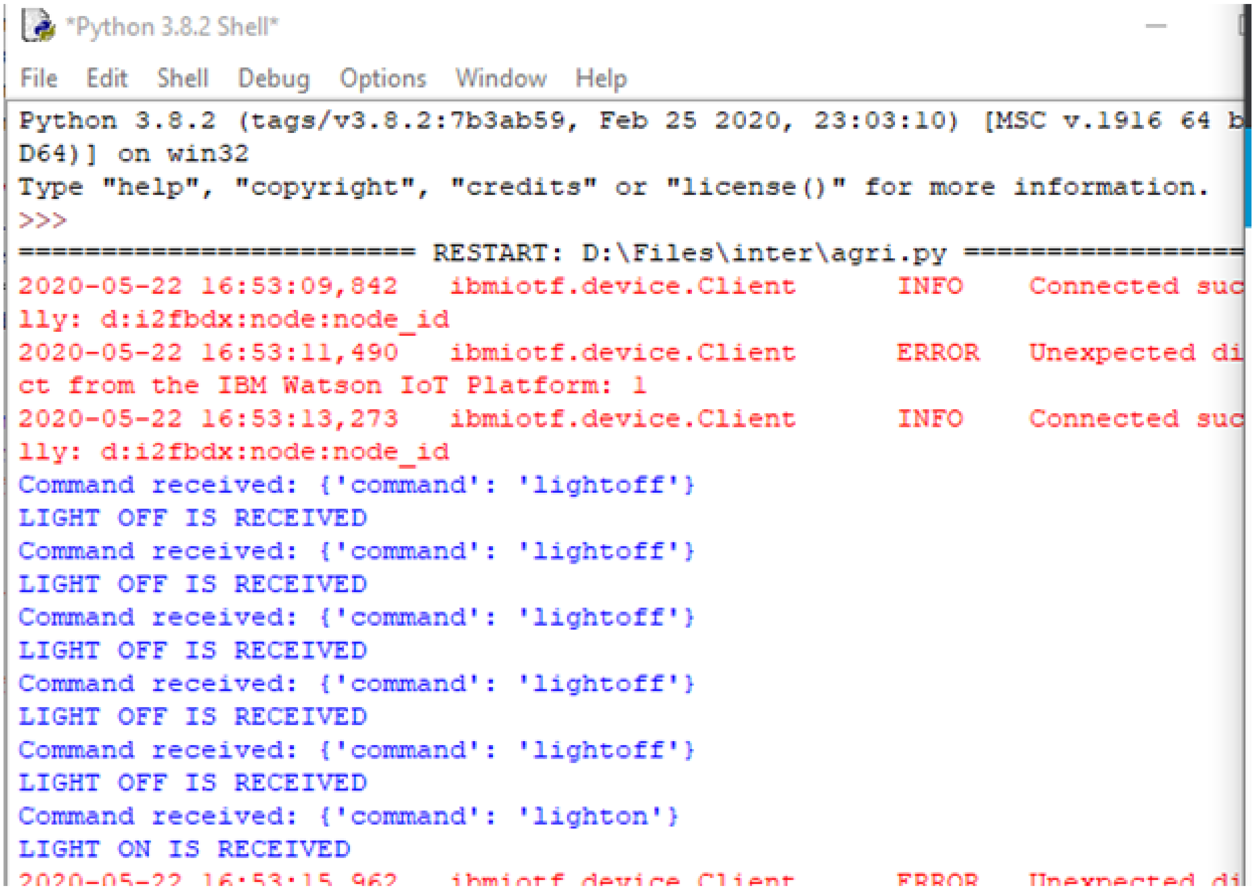

Fig.4.4 Python Program output

CHAPTER 5

FLOWCHART

5.1 INTRODUCTION

Flow diagram of Smart Agriculture IoT based System

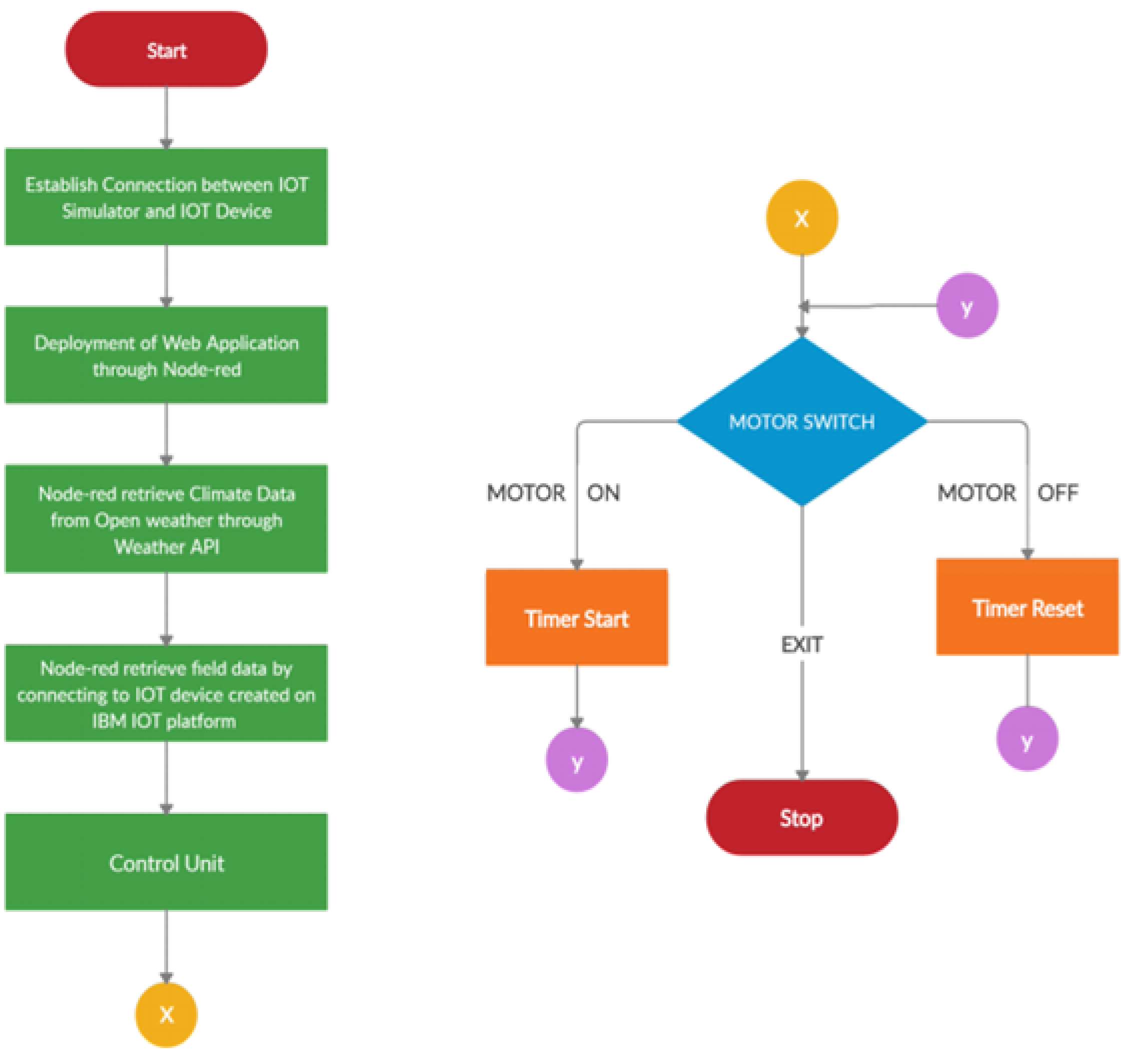

Fig.5.1 Flowchart of Application

CHAPTER 6

RESULT

6.1 INTRODUCTION

As smart agriculture solution matures, more and more farmers will emphasis on the data-driven technologies and AI technologies that are integrated with the IoT solutions. John Deere, one of the leading global heavy-duty automobile manufacturing companies, explained in a case study how effectively they utilized the data using smart IoT agriculture and increased their productivity to a significant level. Digital twin solutions for smart farming is also on the booming effectively by reducing the production downtime.

Benefits of smart farming

Advanatages

a. By making farming more connected and intelligent, precision agriculture helps reduce overall costs and improve the quality and quantity of products, the sustainability of agriculture and the experience for the consumer.

b. Increasing control over production leads to better cost management and waste reduction. The ability to trace anomalies in crop growth or livestock health, for instance, helps eliminate the risk of losing yields.

c. Additionally, automation boosts efficiency. With smart devices, multiple processes can be activated at the same time, and automated services enhance product quality and volume by better controlling production processes

d. Smart farming systems also enable careful management of the demand forecast and delivery of goods to market just in time to reduce waste. Precision agriculture is focused on managing the supply of land and, based on its condition, concentrating on the right growing parameters – for example, moisture, fertilizer or material content – to provide production for the right crop that is in demand.

e. The types of precision farming systems implemented depend on the use of software for the management of the business. Control systems manage sensor input, delivering remote information for supply and decision support, in addition to the automation of machines and equipment for responding to emerging issues and production support.

Disadvantages

a. Network error can cause device to disconnect.
b. Weather forecast may not be accurate.
c. The smart agriculture needs availability of internet continuously. Rural part of most of the developing countries does not full-fill this requirement. Moreover internet connection is slower.
d. The smart farming based equipments require farmers to understand and learn the use of technology. This is major challange in adopting smart agriculture farming at large scale across the countries.

CHAPTER 8

APPLICATIONS

8.1 APPLICATIONS OF IOT IN AGRICULTURE

a. Precision Farming

Also known as precision agriculture, precision farming can be thought of as anything that makes farming practice more controlled and accurate when it comes to raising livestock and growing crops. In this approach of farm management, a key component is the use of IT and various items like sensors, control systems, robotics, autonomous vehicles, automated hardware, variable rate technology, and so on.

The adoption of access to high-speed internet, mobile devices, and reliable, low-cost satellites (for imagery and positioning) by the manufacturer are a few key technologies characterizing the precision agriculture trend.

b. Agricultural Drones

Technology has changed over time and agricultural drones are a very good example of this. Today, agriculture is one of the major industries to incorporate drones. Drones are being used in agriculture in order to enhance various agricultural practices. The ways ground-based and aerial-based drones are being used in agriculture are crop health assessment, irrigation, crop monitoring, crop spraying, planting, and soil and field analysis.

The major benefits of using drones include crop health imaging, integrated GIS mapping, ease of use, saves time, and the potential to increase yields. With strategy and planning based on real-time data collection and processing, drone technology will give a high-tech makeover to the agriculture industry.

c. Livestock Monitoring

Large farm owners can utilize wireless IoT applications to collect data regarding the location, well-being, and health of their cattle. This information helps them in identifying animals that are sick so they can be separated from the herd, thereby preventing the spread of disease. It also lowers labor costs as ranchers can locate their cattle with the help of IoT based sensors.

JMB North America is an organization that offers cow monitoring solutions to cattle producers. One of the solutions helps the cattle owners observe cows that are pregnant and about to give birth. From the heifer, a sensor powered by a battery is expelled when its water breaks. This sends information to the herd manager or the rancher. In the time that is spent with heifers that are giving birth, the sensor enables farmers to be more focused.

d. Smart Greenhouses

Greenhouse farming is a methodology that helps in enhancing the yield of vegetables, fruits, crops, etc. Greenhouses control the environmental parameters through manual intervention or a proportional control mechanism. As manual intervention results in production loss, energy loss, and labor costs, these methods are less effective. A smart greenhouse can be designed with the help of IoT; this design intelligently monitors as well as controls the climate, eliminating the need for manual intervention.

CHAPTER 8

Conclusion

Thus, the IoT agricultural applications are making 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 growing rapidly, the demand can be successfully met if the ranchers, as well as small farmers, implement agricultural IoT solutions in a prosperous manner.

CHAPTER 9

FUTURE SCOPE

Of the many advantages IoT brings to the table, its ability to innovate the landscape of current farming methods is absolutely ground breaking. IoT sensors capable of providing farmers with information about crop yields, rainfall, pest infestation, and soil nutrition are invaluable to production and offer precise data which can be used to improve farming techniques over time. New hardware, like the corn-tending Rowbot, is making strides by pairing data-collecting software with robotics to fertilize the corn, apply seed cover-crops, and collect information in order to both maximize yields and minimize waste.

Another direction in which smart farming is headed involves intensively controlled indoor growing methods. The OpenAG Initiative at MIT Media Lab uses "personal food computers" (small indoor farming environments that monitor/administrate specific growing environments) and an open source platform to collect and share data. The collected data is termed a "climate recipe" which can be downloaded to other personal food computers and used to reproduce climate variables such as carbon dioxide, air temperature, humidity, dissolved oxygen, potential hydrogen, electrical conductivity, and root-zone temperature. This allows users very precise control to document, share, or recreate a specific environment for growing and removes the element of poor weather conditions and human error. It could also potentially allow farmers to induce drought or other abnormal conditions producing desirable traits in specific crops that wouldn't typically occur in nature.

CHAPTER 10

REFERENCES

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- http://api.openweathermap.org/data/2.5/weather?q=Chennai,%20IN&appid=94321001b3c1e3c2ec5513b9ceb8ca36
- https://node-red-vfkmu.mybluemix.net/red/#flow/7a5df8f4.c640c8
- https://node-red-vfkmu.mybluemix.net/ui/#!/0?socketid=d5tVApOIDw9o3HYAAAAA
- https://github.com/rachuriharish23/ibmsubscribe

CHAPTER 11

BIBLIOGRAPHY

11.1 PYTHON PROGRAM

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

#Provide your IBM Watson Device Credentials
organization = "i2fbdx" #replace the ORG ID
deviceType = "node"#replace the Device type wi
deviceId = "node_id"#replace Device ID
authMethod = "token"
authToken = "56-5?UKwGP+-EnUg1o" #Replace the authtoken

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

    elif cmd.data['command']=='lightoff':
        print("LIGHT 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()
```