NALAIYA THIRAN- IBM PROJECT REPORT

(19EC406T - Professional Readiness for Innovation, Employability and Entrepreneurship)

ON

SMARTFARMER- IoT ENABLED SMART FARMING APPLICATION

Submitted by

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IN

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VELAMMAL ENGINEERING COLLEGE
CHENNAI-66

BONAFIDE CERTIFICATE

Certified that this NALAIYA THIRAN – IBM PROJECT REPORT **"SMARTFARMER- IoT ENABLED SMART FARMING APPLICATION"** is the Bonafide work of **"ABDUL MOHAMED M (113219041001), GUNAL SANKAR K L (113219041032), KAVIRAMAN M (113219041048), MANJUNATH V (113219041064), PHELIM CHERRYL M R (113219041082)"** carried out in "PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP (NALAIYA THIRAN-IBM PROJECT)" during the Academic Year 2022-2023.

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ABSTRACT

Farming is an occupation which is playing the ultimate role for survive of this world. It supplies maximum needs for the human being to live in this world. Now we are in the state of automation where the up gradation of smarter technologies are improving day by day in maximum sectors starting from smart homes, garbage, vehicles, industries, Farming, health, grids and so on. In the field of Farming, the improvement with the implementation of Automation is also taking place with the invention of Internet of Things. The smart technology must assist farmers in providing water to crops at specific intervals and quantities as per requirement by the crops. The automated smart agriculture system monitors the moisture and temperature swings in the cultivated area, which provides a precise timing for the water pumping motor to switch on and off. The proposed approach regulates the use of water for agricultural fields and defends crop fields against animals and intruders, leading to higher agricultural yields. Agricultural sector is considered as the backbone of the Indian economy which is the most essential aspect of human life. Conventional irrigation systems, such as surface, sub-surface, drip and overhead sprinklers irrigation methods are being unproductive which gave way for the emergence of an optimized method to irrigate the agricultural fields. IoT is a growing paradigm that has infiltrated other sectors and rendered them increasingly efficient. It is advancing nowadays with the introduction of innovative sensors, sensor systems, and RF-based telecommunications.

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CHAPTER 1

INTRODUCTION

1.1 PROJECT OVERVIEW

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. As the world is trending into new technologies and implementations it is a necessary goal to trend up with agriculture also. IOT playsa very important role in smart agriculture. IOT sensors are capable of providing information about agriculture fields. we have proposed an IOT and smart 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. Thissmart agriculture using IOT system is powered by Arduino, it consists of Temperature sensor, Moisture sensor, water level sensor, DC motor. When the IOT based agriculture monitoring system starts it checks the water level, humidityand moisture level. It sends SMS alert on the phone about the levels. Sensors sense the level of water if it goes down, it automatically starts the water pump. Ifthe temperature goes above the level, fan starts. This all is also seen in IOT where it shows information of Humidity, Moisture and water level with date and time, based on per minute. Temperature can be set on a particular level, it is based on the type crops cultivated. If we want to close the water forcefully on IOT there is button given from where water pump can be forcefully stopped.

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 analyzing operations.

CHAPTER 2

LITERATURE SURVEY

2.1 EXISTING PROBLEMS

Farms are located in remote areas and are far from access to the internet. A farmer needs to have access to crop data reliably at any time from any location, so connection issues would cause an advanced monitoring system to be useless.

2.2 PROBLEM STATEMENT AND DEFINITION

1. Problem effect and issues

   Water management system Climate analysis.

   a) Water scarcity
   b) Crop failure
   c) Soil erosion

2. Impact of the issue

   The nutrients in the soil will be reduced and cause problems for the plant growth. when there is a sudden climate like heavy rain crops will get affected.

3. Result of not solving the problem

   a) Low crop yield
   b) Affect the growth
   c) Low nutrient product
   d) high cost

4. Result of fixing the problem and importance

   The growth of the crops is high. I will give nutritious product and the high crop yield. The maintenance cost will be reduced. The field is Safe and secured.We need to fix the problem to reduce the work of farmers. We need to upgrade the farming methods for the next generation.

CHAPTER 3

IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

An empathy map is a simple, easy-to-digest visual that captures knowledge abouta user's behaviors and attitudes. It is a useful tool to helps teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.

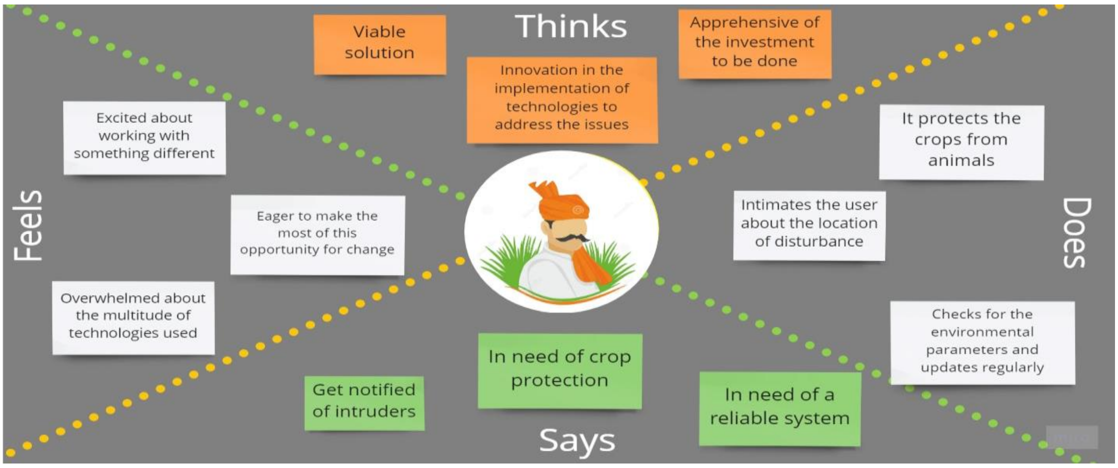

Fig 3.1 Empathy map

3.2 IDEATION & BRAINSTORMING

Brainstorming is a method of generating ideas and sharing knowledge to solve a particularcommercial or technical problem, in which participants are encouraged to think without interruption. Brainstorming is a group activity where each participant shares their ideas assoon as they come to mind.

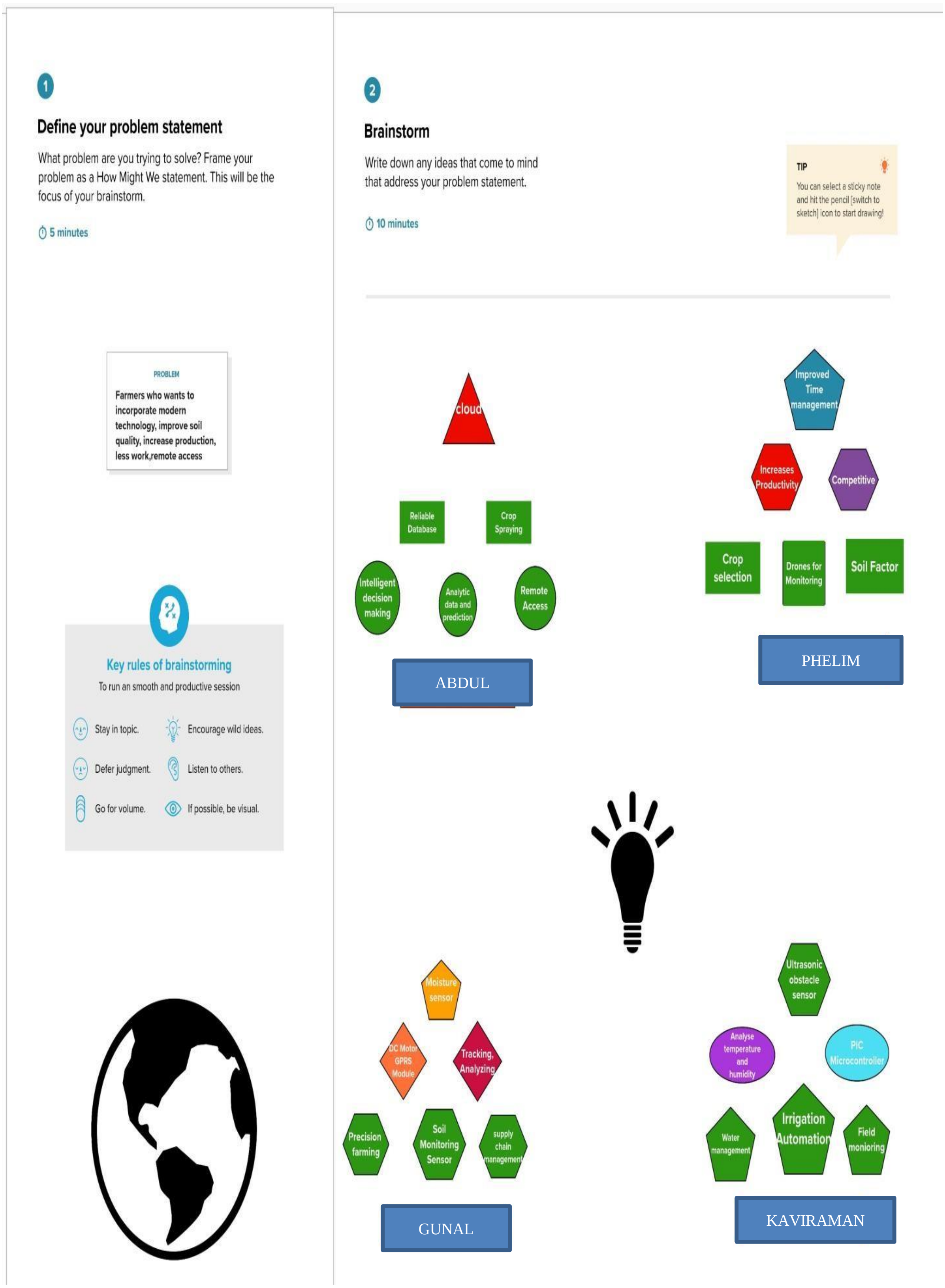

Fig 3.2 Brainstorming

Fig 3.3 Ideation

3.3 PROPOSED SOLUTION

Our proposed system concentrates on monitoring the farming conditions through sensors like Humidity, Temperature, and soil moisture; LDR is used to sense the light intensity for the farm, and also IR sensoris used to detect the pest, birds, and humans by their body temperature and alertsthe user through the message format to their mobile These sensors are the interface to process module Arduino-UNO. The LCD is used to display the status of different sensors. When there is a change in temperature condition, the sensordetects and turns ON the DC and cools down the condition. After the temperaturecomes to a normal state, the DC fan will turn OFF. LDR (Light Dependent Resistor) is used to detect the light intensity in the farm. When the light intensityis less on the farm, the LDR senses the condition and turns ON the bulb. When the required light intensity is back, the bulb will turn OFF. The soil moisture sensor is used to sense the moisture level in soil (water level) when the water levels are reached low in the ground. The ground gets dry, and the sensor detectsit, then turn ON the DC water pump. When floor gets moisturized, the DC waterpump will turn OFF. The user can monitor these conditions in mobile phone withthe help of Wifi module through IOT mobile app.

S. No	Parameter	Description
1.	Problem Statement (Problem to besolved)	To solve farmer issues like • Lack of Modernization and Mechanization • Invest in farm productivity and improving yield

		production. • Lack of accuracy in measuring the soli nutrients , temperature and the moisture content.
2.	Idea / Solution description	An application and device is introduced toknow about various data about their land remotely, where they can schedule some events for a month or a day. It also provides suggestions to users based on the crop they planted.
3.	Novelty / Uniqueness	Providing suggestions, Planning events
4.	Social Impact / CustomerSatisfaction	Farmers can track and control their land, suggestions of next plant crops andimproving yield gives satisfaction.
5.	Business Model (Revenue Model)	• It's a subscription model, where user have to pay for their internet. • Customer services are supported • It supports third party devices also • Reach customers via Referral, Agents, Third

		party applications
6.	Scalability of the Solution	Our product is scalable with our devices as well as third party devices also. Ability to provides various features in a application like reportsgeneration etc.

3.4 PROBLEM SOLUTION FIT

This is the project from the motivation of the farmers working in the farm lands are solely dependent on the rains and bore wells for irrigation of their land. In recent times, the farmers have been using irrigation technique through the manual control in which the farmers irrigate the land at regular intervals by turning the water-pump ON/OFF when required. Moreover, for the power indication they are glowing a single bulb between any one of phaseand neutral, meanwhile when there is any phase deduction occurs in other phases,the farmer cannot know their supply is low. If they Switch ON any of the motor, there will be the sudden defuse in motor circuit. They may have to travel so far for SWITCHING ON/OFF the motor. They may be suffering from hot Sun, rainand night time too. After reaching their farm, they found that there is no power, so they quietly disappointed to it. Even if power is there the proper supply of water and manure is not governed by which there will be many changes in the final crop produced. By which the quality of crops are differed due to the difference in the supply of water and nutrients. When there is no proper supply of water the soil temperature is also increased by which it results in the crop death.

Fig 3.4 Smart Farming Application

CHAPTER 4

REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via EmailConfirmation via OTP
FR-3	Login	Login via Username and PasswordLogin via Google
FR-4	Password reset	Reset password via Email Reset password via Phone Number
FR-5	Password Change	Change password via Email Change password via Phone Number
FR-6	Settings	Change settings for the convenience

4.2 NON-FUNCTIONAL REQUIREMENTS

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Application is easy to use with better user experience and the controls given with thatapplication.
NFR-2	Security	The user can register or login through their mailidand password. The security attacks could notbe done until the user share his/her login credentials to someone.
NFR-3	Reliability	The data are stored in the trusted cloud storageandit can be kept confidential. The user and the developer are able to access the data stored in cloud storage.
NFR-4	Performance	The user can control and analyse the data about their field or farm through application given with many features.
NFR-5	Availability	The user can easily access the analysed data fromthe sensors connected with IoT devices which placed in the farming land and the sensor analysed data are stored in a cloud storage for future references.
NFR-6	Scalability	The application features are upgraded randomlyfor easy access and better user experience.

CHAPTER 5

PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

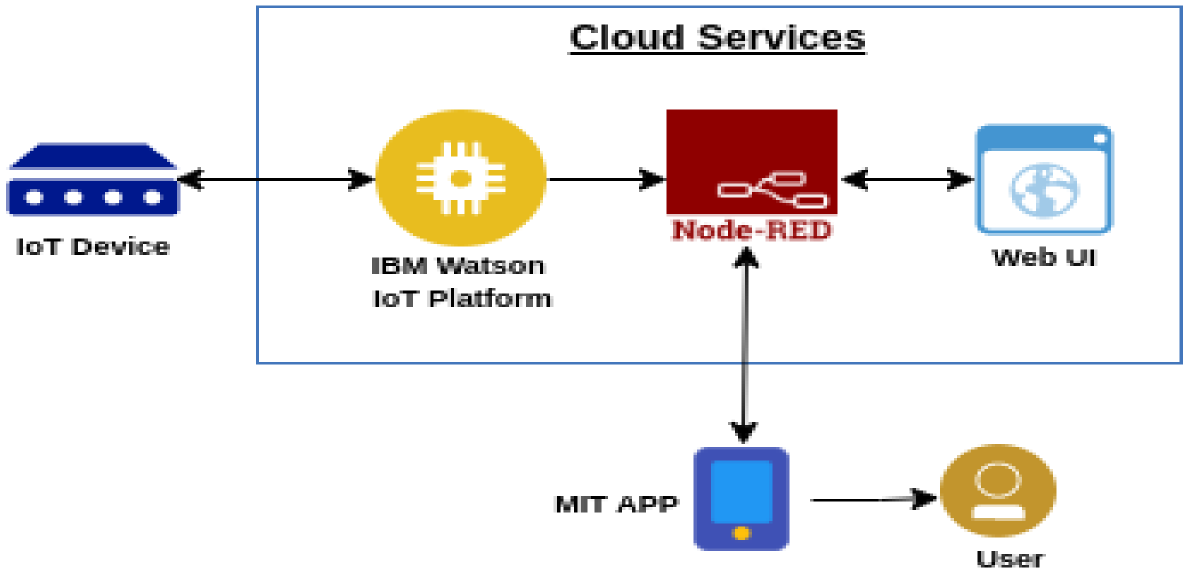

Fig 5.1 Data flow diagram

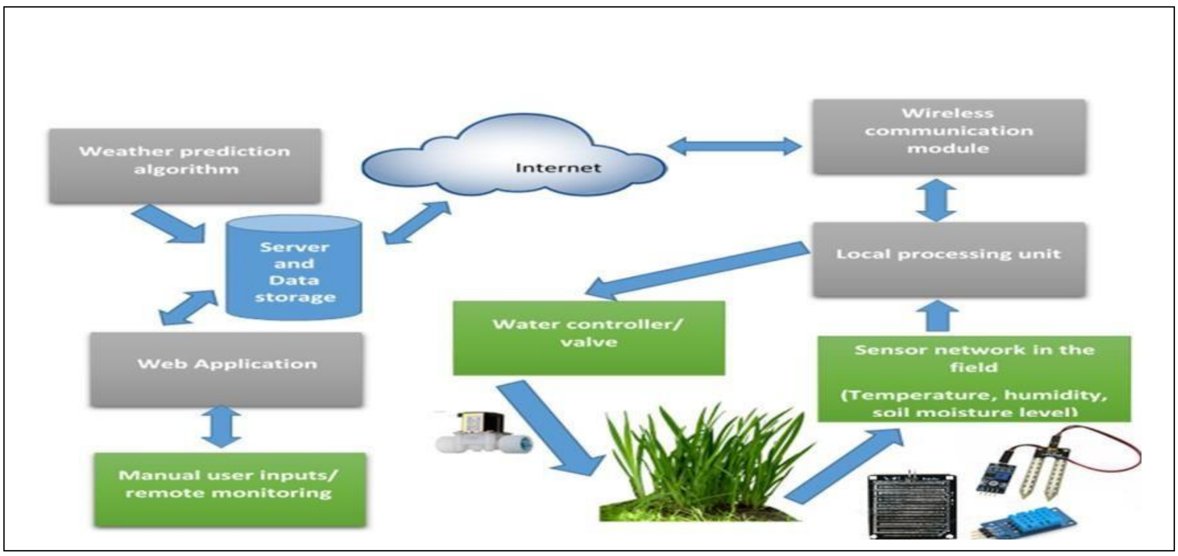

Fig 5.2 Work flow diagram

5.2 SOLUTION & TECHNICAL ARCHITECTURE

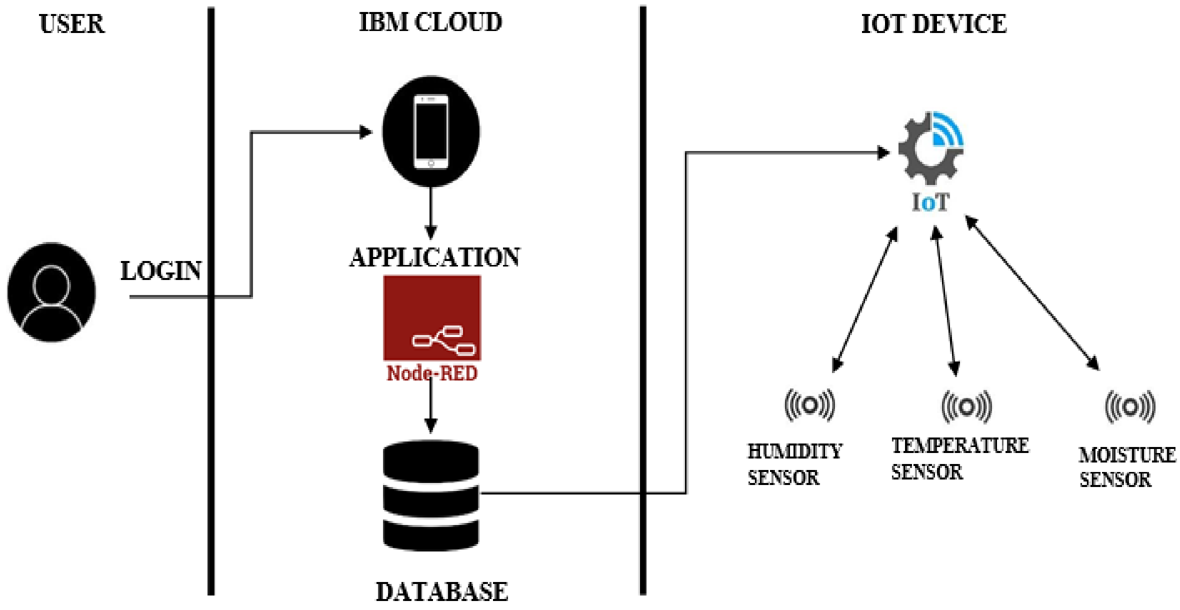

Fig 5.3 Architecture

S. No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g.Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	Logic for a process in the application	Java / Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.
6.	Cloud Database	Database to store the data fetch by sensors connected with IoT device.	IBM DB2, IBM Cloudant .
7.	File Storage	The user can store the data inany format	IBM Block Storage or Other Storage Service

			or Local Filesystem
8.	External API-1	Because of farming land it willbe need to monitoring weather, so the weather API are used.	IBM Weather API.
9.	Machine Learning Model	It is necessary to monitor andidentify the disease infection.	Object Recognition Model.
10.	Infrastructure (Server /Cloud)	Application Deployment onLocal System / Cloud Local Server Configuration: Cloud Server Configuration :	Local, Cloud Foundry,Kubernetes, etc.

5.3 USER STORIES

Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Release
Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access myaccount / dashboard	Sprint-1
	USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email& click confirm	Sprint-1
	USN-3	As a user, I can register for the application through Facebook	I can register &access the dashboard with Facebook Login	Sprint-2
	USN-4	As a user, I can register for the	I can register the application through	Sprint-1

		application through Gmail	gmail	
Login	USN-5	As a user, I can log into the application by entering email & password	I can log into the application by entering email and password	Sprint-3
Dashboard	USN-6	As a user, I can access the features of the application through dashboard	I can access the features of the application available in dashboard	Sprint-2
Registration	USN-7	As a user, I can register for the web application by entering my email, password.	I can register for the web application.	Sprint-3

CHAPTER 6

PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.
Sprint-1	Login	USN-2	As a user, I will receive confirmation email once I have registered for the application
Sprint-2	User Interface	USN-3	As a user, I can register for the application through Facebook
Sprint-1	Data Visualization	USN-4	As a user, I can register for the application through Gmail
Sprint-3	Registration (Web User)	USN-5	As a user, I can log into the application by entering email & password
Sprint-2	Dashboard	USN-6	As a user, I can access the features of the application in dashboard.

Sprint-4	Cloud Registration	USN-7	As a user, I can store the data in cloudstorage for future reference.
Sprint-4	Controls	USN-8	As a user, I can control the IoT devices via Mobile and also monitor the field with the helpof this IoT deivices.

6.2 SPRINT DELIVERY SCHEDULE

Sprint	Functional Requirment (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Hardware	USN-1	Sensors and wi-fi module with python code.	2	High	Abdul Mohamed M, Manjunath V, Phelim Cherryl M R, Gunal Sankar K L, Kaviraman M
Sprint-2	Software	USN-2	IBM Watson IoT platform, Workflows for IoT scenarios using Node-red	2	High	Abdul Mohamed M, Manjunath V, Phelim Cherryl M R, Gunal Sankar K L , Kaviraman M
Sprint-3	MIT app	USN-3	To develop an mobile application using MIT	2	High	Abdul Mohamed M, Manjunath V, Phelim Cherryl M R ,Gunal Sankar K L,

						Kaviraman M
Sprint-4	Web UI	USN-4	To make the user to interact with software.	2	High	Abdul Mohamed M, Manjunath V, Phelim Cherryl M R ,Gunal Sankar K L, Kaviraman M

Project Tracker, Velocity & Burndown Chart:

Sprint	**Total Story Poins**	**Duration**	**Sprint Start Date**	**Sprint End Date (Planned)**	**Sprint Release Date(Actual)**
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	5 NOV 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	12 NOV 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	14 NOV 2022

Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let’s calculate the team’s average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

6.3 REPORTS FROM JIRA

Jira Software is part of a family of products designed to help teams of all types manage work. Originally, Jira was designed as a bug and issue tracker. But today, Jira has evolved into a powerful work management tool for all kinds of use cases, from requirements and test case management to agile software development.

In this guide, you'll learn which features and functionalities of Jira can help your team with your unique needs. Explore how to start your project off right with pre-configured templates in Jira.

Fig 6.1 Timeline graph 1

Fig 6.2 Timeline graph 2

CHAPTER 7

CODING & SOLUTIONING

7.1 FEATURE 1

```
# MULTIPLE LINEAR REGRESSION
from sklearn.linear_model import LinearRegression regressor = LinearRegression()
regressor.fit(X_train, Y_train)
Y_pred = regressor.predict(X_test) np.set_printoptions(precision = 2)
print(np.concatenate((Y_pred.reshape(len(Y_pred), 1),
Y_test.reshape(len(Y_pred), 1)), axis = 1))
""
""

# BAYESIAN RIDGE REGRESSION
from sklearn.linear_model import BayesianRidge bay_ridge = BayesianRidge()
bay_ridge.fit(X_train, Y_train)
Y_pred = bay_ridge.predict(X_test)
np.set_printoptions(precision = 2)
print(np.concatenate((Y_pred.reshape(len(Y_pred), 1),
Y_test.reshape(len(Y_pred), 1)), axis = 1))
""
""
```

PLOYNOMIAL REGRESSION

from sklearn.preprocessing import PolynomialFeatures from sklearn.linear_model import LinearRegression

Go for a polynomial of degree 4 but 20 is good as well poly_reg = PolynomialFeatures(degree = 4) X_train_poly = poly_reg.fit_transform(X_train) poly_model = LinearRegression() poly_model.fit(X_train_poly, Y_train)

Y_pred = poly_model.predict(poly_reg.fit_transform(X_test)) for i in range(0, len(Y_pred)):

Y_pred[i] = round(Y_pred[i])

np.set_printoptions(precision = 2)

print(np.concatenate((Y_pred.reshape(len(Y_pred), 1),

Y_test.reshape(len(Y_pred), 1)), axis = 1))

""""

""""

import Fert_Dataset as fd import os

loc_Fert = os.getcwd() + r'/Datasets/FertPredictDataset.csv'

dataset = fd.get_fert_dataset(loc_Fert)

X = dataset.iloc[:, :3].values Y = dataset.iloc[:, 3].values

from sklearn.metrics import confusion_matrix

from sklearn.model_selection import train_test_split

X_train, X_test, Y_train, Y_test = train_test_split(X, Y,

test_size = 0.2,

random_state = 0)

from sklearn.tree import DecisionTreeClassifier

dtree_model = DecisionTreeClassifier(max_depth = 2).fit(X_train, Y_train)

dtree_pred = dtree_model.predict(X_test) """

7.2 FEATURE 2

```
import
Fert_Dataset as fd
import os

def Predict_Fertiliser(sensor_value):
    loc_Fert = os.getcwd() + r'/Datasets/FertPredictDataset.csv'

    dataset = fd.get_fert_dataset(loc_Fert)

    X = dataset.iloc[:,
    :3].valuesY =
    dataset.iloc[:,
    3].values

    from sklearn.model_selection import train_test_split

    X_train, X_test, Y_train, Y_test = train_test_split(X, Y,
                                                         test_size = 0.2,
                                                         random_state = 0)
    from sklearn.tree import DecisionTreeClassifier
    dtree_model = DecisionTreeClassifier(max_depth = 2).fit(X_train,
                                                         Y_train)
    dtree_pred = dtree_model.predict(sensor_value)
    return dtree_pred
```

CHAPTER 8

TESTING

8.1 TEST CASES

Fig 8.1 Python Script

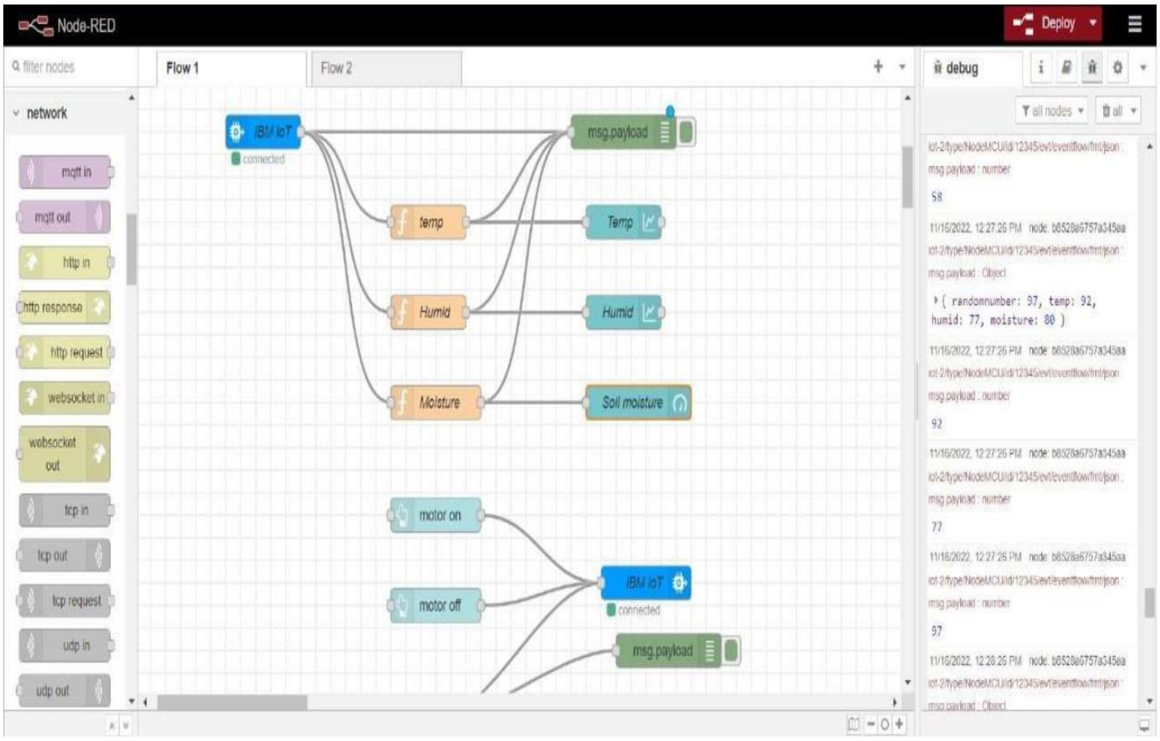

Fig 8.2 NodeRed workflow

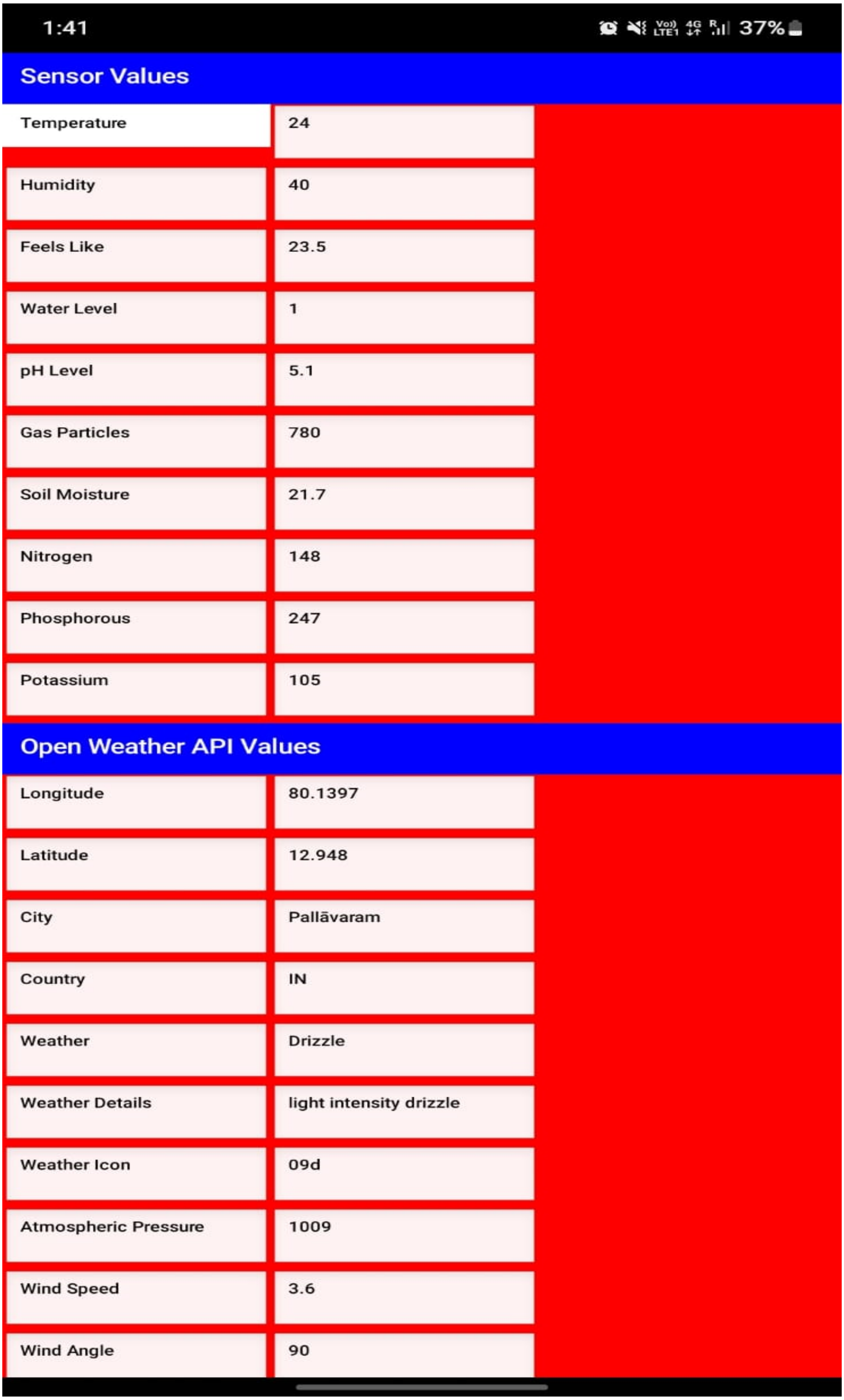

Fig 8.3 Android App interface

8.2 USER ACCEPTANCE TESTING

UAT Execution & Report Submission

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the SmartFarmer project at the time of the release to User Acceptance Testing (UAT).

2. **Defect Analysis**

This report shows the number of resolved or closed bugs at each severitylevel, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	5	2	0	0	7
Duplicate	1	0	0	0	1
External	0	1	0	1	2
Fixed	11	0	0	0	11
Not Reproduced	0	0	0	0	0
Skipped	0	0	0	0	0
Won't Fix	0	0	0	0	0
Totals	17	3	0	1	21

3. Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Authorization (MIT Based)	5	0	0	5
Home Page (MIT Based)	4	0	0	9

CHAPTER 9

RESULTS

9.1 PERFORMANCE METRICS

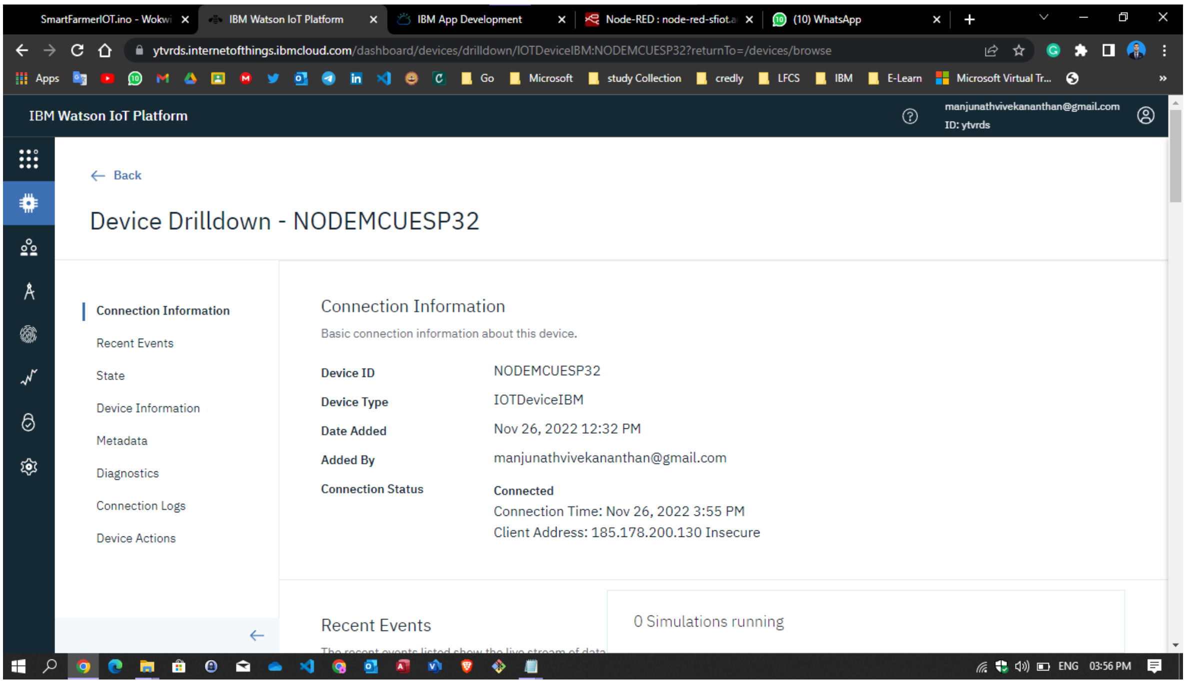

Fig 9.1 IBM Watson IoT Platform

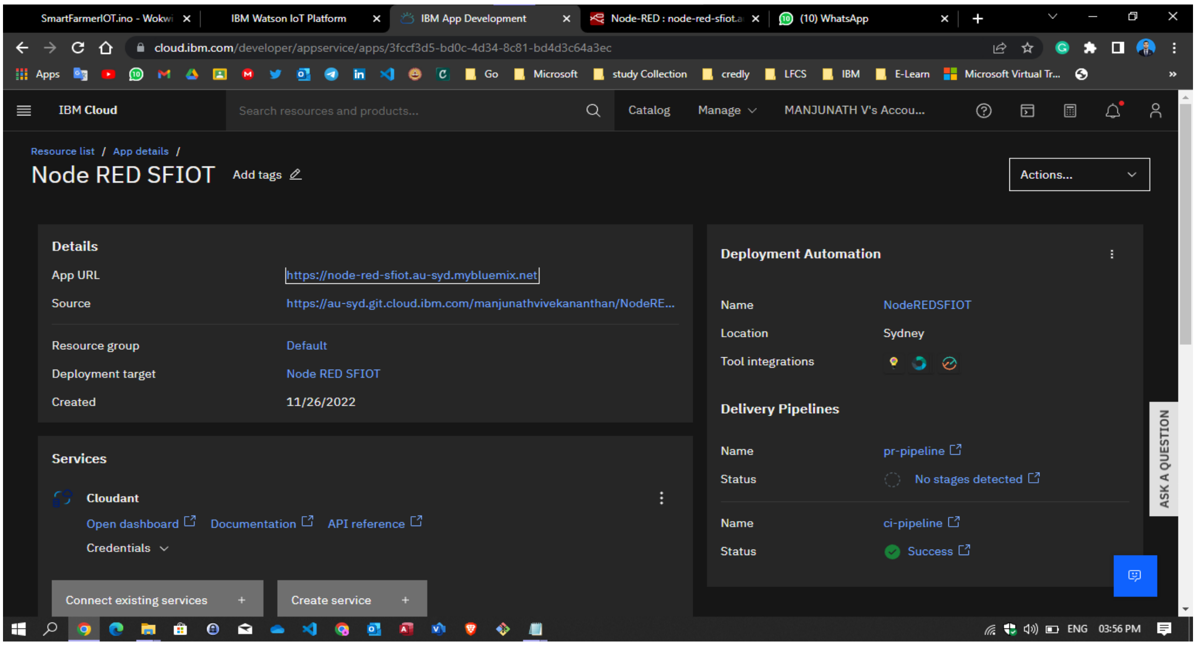

Fig 9.2 NodeRed Cloudant Service

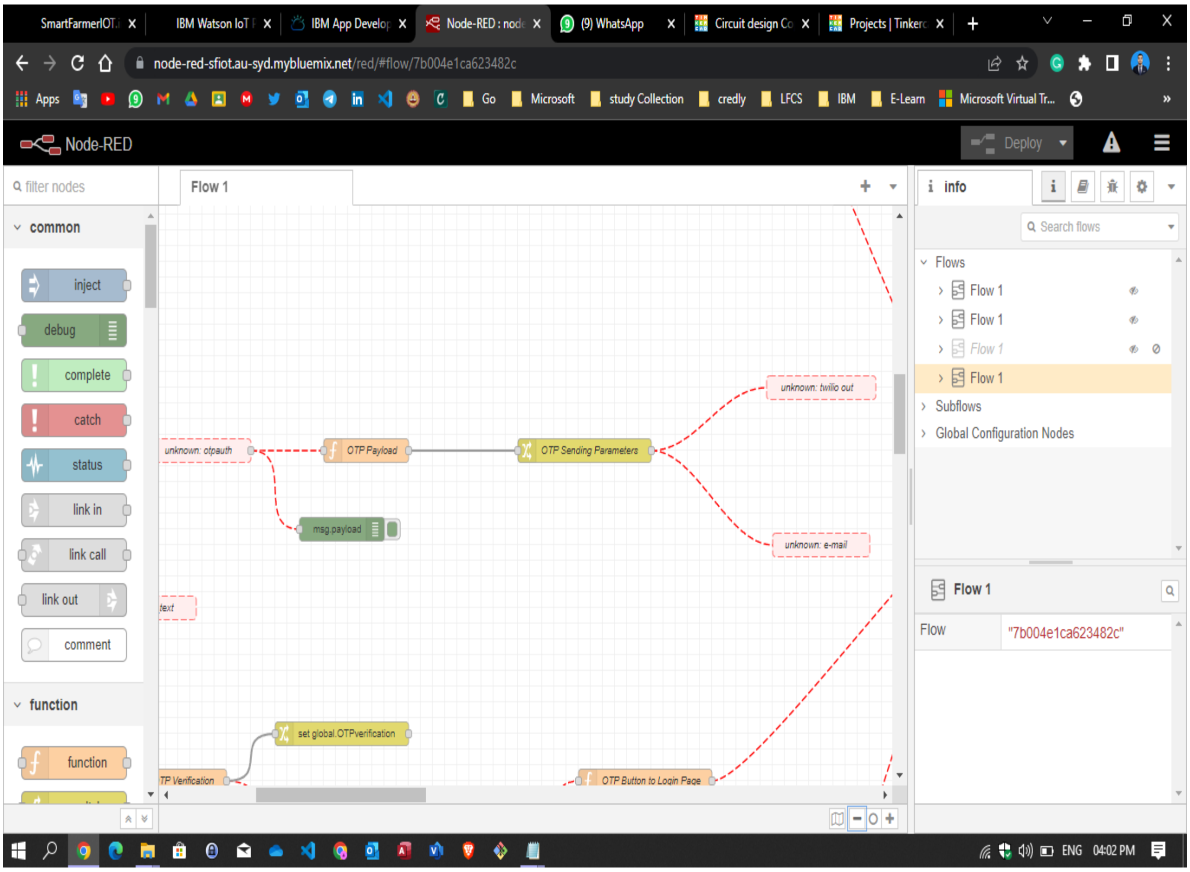

Fig 9.3 NodeRed workflow

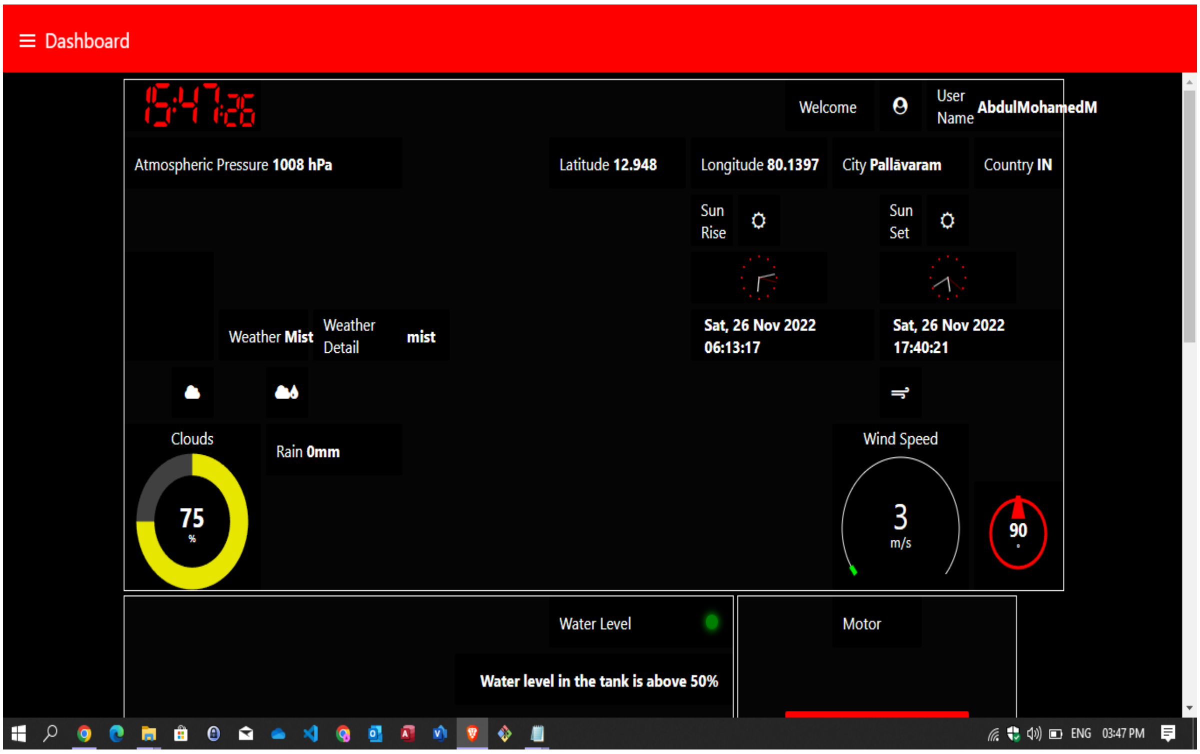

Fig 9.4 Web UI Dashboard

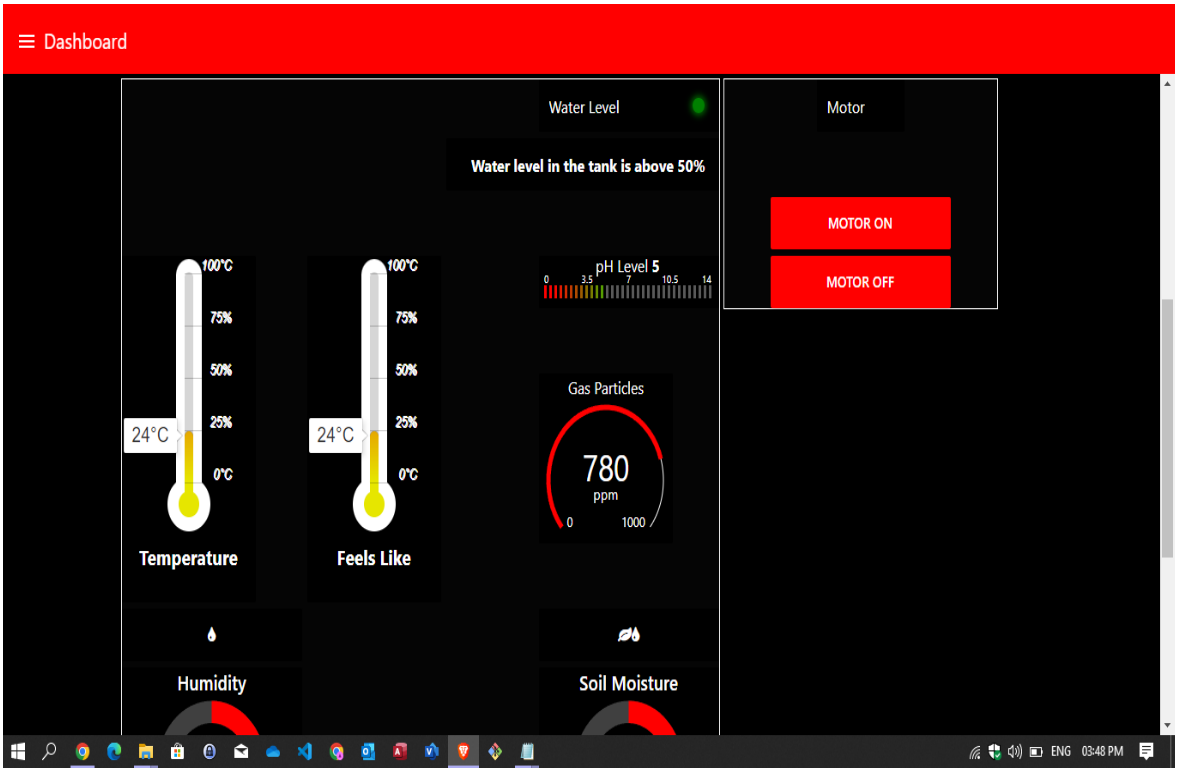

Fig 9.5 Temperature Monitor

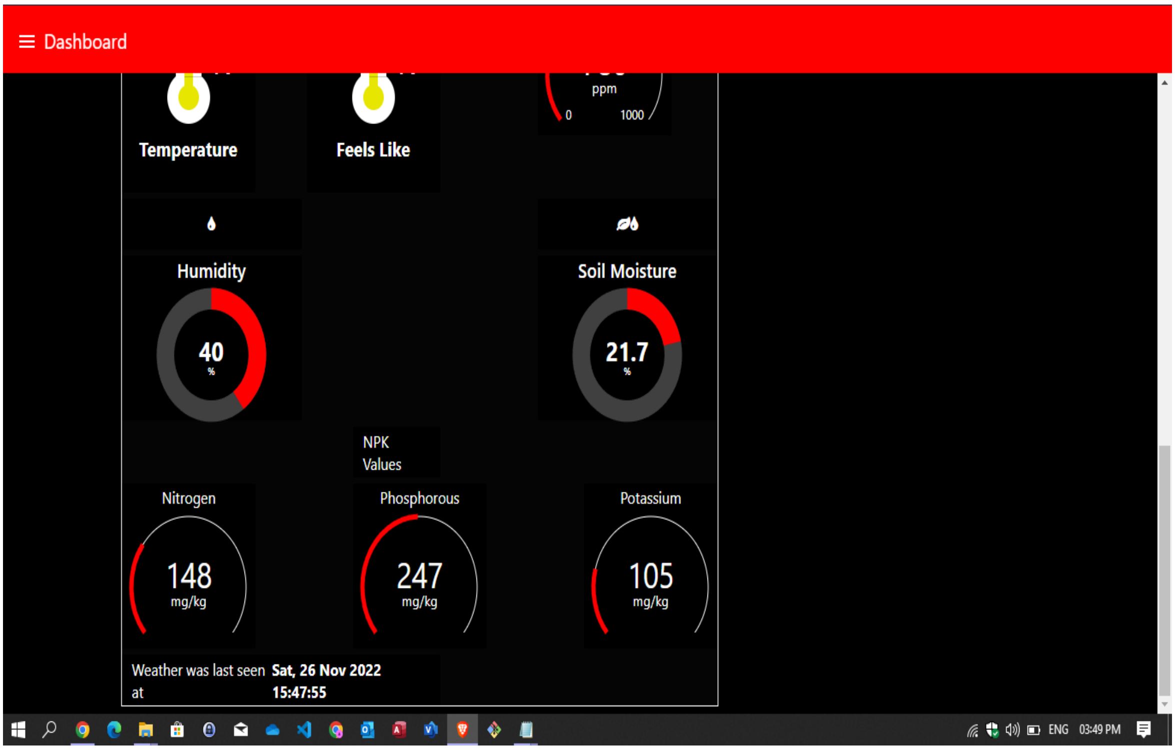

Fig 9.6 Humidity and NPK monitor

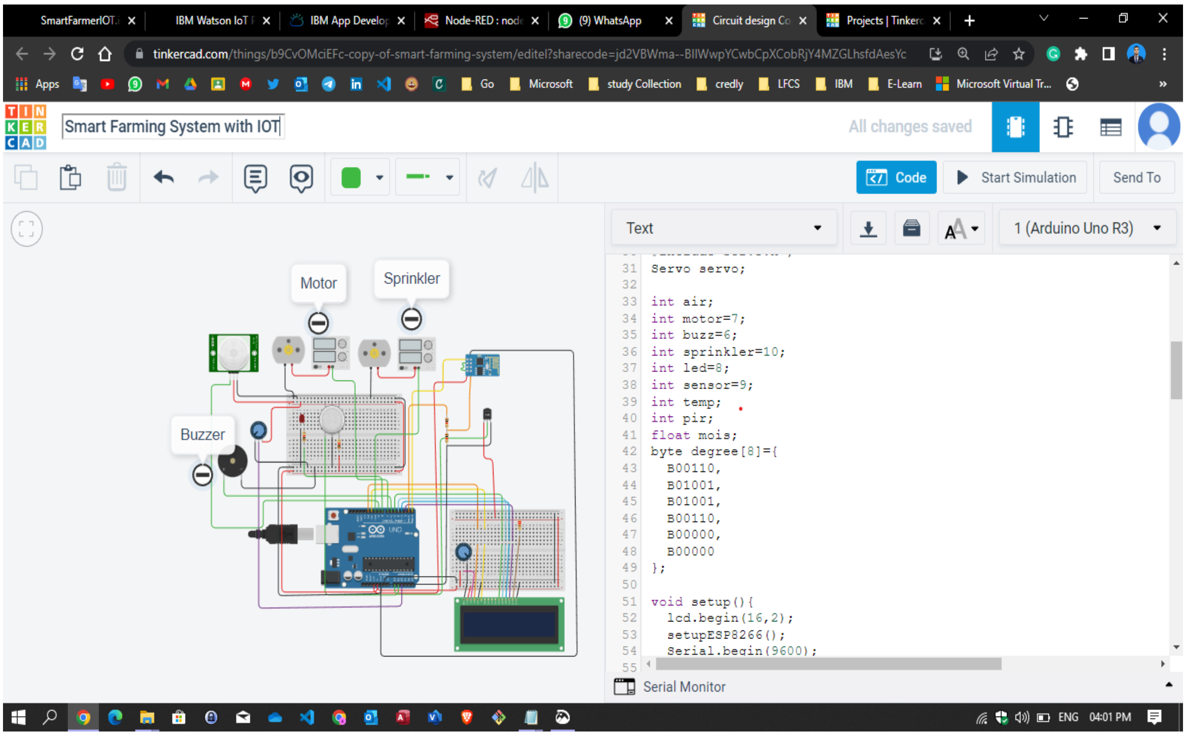

Fig 9.7 System Stimulation in Tinkercad

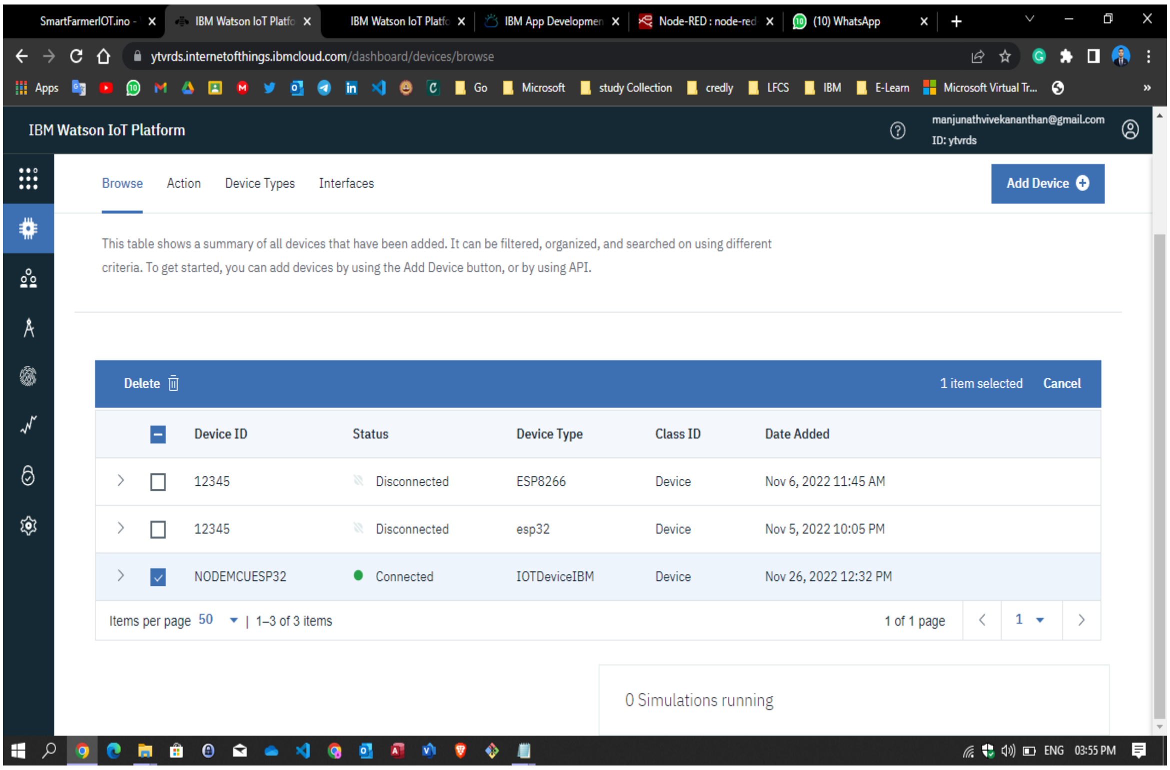

Fig 9.8 IoT device to IBM Watson connection

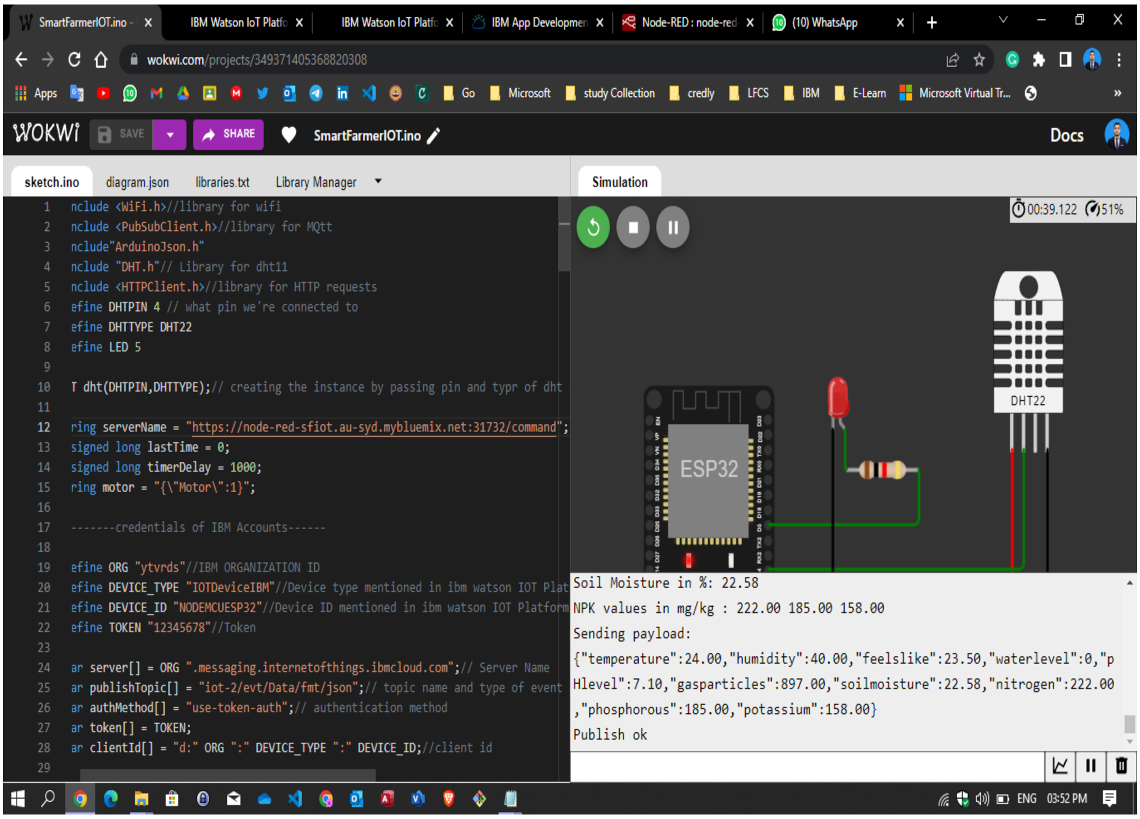

Fig 9.9 IoT Simulation in Wokwi

CHAPTER 10

ADVANTAGES & DISADVANTAGES

ADVANTAGES :

1. Sensors installed on IoT devices are able to collect a large volume of useful information for farmers. As we mentioned below, some examples are climatic conditions, soil quality and plantation progress.
2. Such data can be used to monitor the status of the farm, as well as the performance of workers and the efficiency of the appliances.
3. With greater production control, IoT in agriculture facilitates cost-efficient management. From smart devices, producers can more accurately identify any anomaly in the crop.
4. With IoT, farmers can monitor the health of farm animals closely, even if they are physically distant. Thus, one can reduce the search time of cowsand sheep in the pasture, for example, if they are part of the herd.
5. One more benefit is increased harvest —as we mentioned in the above topics—that yields a competitive advantage in business. To exemplify,we can mention preventive maintenance.
6. Once sensors are installed on a tractor, for example, the collected data can quickly notify whenever any technical failure arises.
7. In addition, one can also save in the process of irrigation and fertilization. After all, there are sensors installed in the agricultural machinery, which can generate a lot of information about the soil.
8. Another advantage is the possibility of programming the sensors to notify about the ideal harvest time. In this way, waste is avoided in the crop.
9. Such data can be used to monitor the status of the farm, as well as the performance of workers and the efficiency of the appliances.
10. Intelligent data collection. Sensors installed on IoT devices are able to collect a large volume of useful information for farmers.

DISADVANTAGES :

1. One huge disadvantage of smart farming is that it requires an unlimited or continuous internet connection to be successful.
2. This means that in rural communities, especially in the developing countries where we have mass crop production, it is completely impossible to operate this farming method.
3. In places where internet connections are frustratingly slow, smart farming will be an impossibility.
4. As pointed out earlier, smart farming makes use of high techs that require technical skill and precision to make it a success.
5. It requires an understanding of robotics and ICT. However, many farmers do not have these skills.
6. Even finding someone with this technical ability is difficult or even expensive to come by, at most.

CHAPTER 11

CONCLUSION

Smart farming is a modern farming management conceptwith IoT technology to increase the productivity in agriculture. With the use of smart farming, users can effectively monitor the crop field the quality, quantity of their crops and to irrigate the crops by using mobile application . Various parameters can be analyzed from the mobile application such as temperature, humidity and ph. Smart Farming helps the farmers to keep in touch with the field whenever and wherever they are, which helps in increase the crop production and also the flaws that are happening due to unforeseen reasons can be easily eliminated by continuous monitoring. This project apply combination of techniques to implement a solution to measures the the soil fertility, plants growth, humidity etc. This system should be required necessary in the agriculture. The system measures the animals invading problems, water scarcity, manure usage, collection of rain water in large number of tanks. This system works under smart technology, so the cost, time, man power can be reduced effectively. One of the biggest advantages of having an irrigation system is that while the design and installation may be expensive up front, it shouldn’t require much maintenance once it’s installed.

CHAPTER 12

FUTURE SCOPE

Smart farming refers to managing farms using modern Information andcommunication technologies to increase the quantity and quality of products while optimizing the human labor required. Among the technologies available for present-day farmers are: Sensors: soil, water, light, humidity, temperature management. Smart farming and IoT-driven agriculture are paving the way for what can be called a Third Green Revolution. Following the plant breeding and genetics revolutions, the Third Green Revolution is taking over agriculture. That revolution draws upon the combined application of data-driven analytics technologies, such as precision farming equipment, IoT, big data analytics, Unmanned Aerial Vehicles (UAVs or drones), robotics, *etc*. In the future, this smart farming revolution depicts, pesticide and fertilizer use will drop while overall efficiency will rise. IoT technologies will enable better food traceability, which in turn will lead to increased food safety. It will also be beneficial for the environment, through, for example, more efficient use of water, or optimization of treatments and inputs. Therefore, smart farming has a real potential to deliver a more productive and sustainable form of agricultural production, based on a more precise and resource-efficient approach. New farms will finally realize the eternal dream of mankind. It'll feed our population.

CHAPTER 13

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CHAPTER 14

APPENDIX

14.1 SOURCE CODE :

```
# -*- coding: utf-8 -*- """
"""
# PREPARE STRINGS FOR STATEMENT
low_potassium = "\nThe amount of potassium in your soil is low! We recommend using a class 1 fertiliser to improve your soil condition to grow the best crops for the season!"
low_nitrogen = "\nThe nitrogen content of your soil is low! We recommend using a class 2 fertiliser to improve your soil condition to make the most of your field!"
low_phosphorous = "\nThe phosphorous content in your soil is low! We recommend using a class 3 fertiliser to improve your soil quality to get the best out of your field!"
import Sensor_values as sv import Crop_Pred as cp
import Fertiliser_Prediction as fp import numpy as np
# GET THE SENSOR VALUES INTO THE CODE
sensor_values = sv.get_readings() user_location = sensor_values[0]

sensor_values = sensor_values[1]

# CROP AND FERTILISER PREDICTION
# KNP FOR FERTILISER PREDICTION
Fertiliser_Input = np.array(sensor_values[1 : 4])
```

```
# NPK & pH FOR CROP PREDICTION
crop_input = sensor_values[0:4] temp = crop_input[0]
for i in range(0, len(crop_input)-1): crop_input[i] = crop_input[i+1]

crop_input[len(crop_input)-1] = temp

# FINAL CROP PREDICTION
crop = cp.Predict_Crop(crop_input) keys = list(crop[1].keys())
values = list(crop[1].values())
for i in range(0, len(values)): if(int(crop[0]) == i):
crop_name = keys[i]
 print("\nThe crop you should grow to get the most out of your field is ",
 crop_name)
 fertiliser = int(fp.Predict_Fertiliser([Fertiliser_Input]))
if(fertiliser == 1): print(low_potassium)
elif(fertiliser == 2): print(low_nitrogen)
else:
print(low_phosphorous) #

# WEATHER STATION (HARDCODED)
temp = sensor_values[4] humidity = sensor_values[5] pressure =
sensor_values[6]
```

```
if(humidity > 70):

print("\nIt's likely to rain today!") elif(pressure < 100 and humidity > 70):

print("\nHigh chances of a thunderstorm! Stay safe!") elif(pressure < 99):

print("\nStrong winds headed your way!") else:

print("\nThe weather is clear today!")
```

14.2 OUTPUT

Fig 14.1


1:42
37%
Potassium
105
Open Weather API Values
Longitude
80.1397
Latitude
12.948
City
Pallāvaram
Country
IN
Weather
Drizzle
Weather Details
light intensity drizzle
Weather Icon
09d
Atmospheric Pressure
1009
Wind Speed
3.6
Wind Angle
90
Clouds
75
Sunrise
Sat, 26 Nov 2022 06:13:17
Sunset
Sat, 26 Nov 2022 17:40:21
Last Measured Time
Sat, 26 Nov 2022 13:37:55
Rain 1 hour
0
Rain 3 hour
0
Timezone
19800
Motor
Motor ON
Motor OFF

Fig 14.2

14.3 GITHUB & PROJECT DEMO LINK

1. GITHUB - https://github.com/IBM-EPBL/IBM-Project-22933-1659861458
2. APP LINK- https://node-red-sfiot.au-syd.mybluemix.net
3. VIDEO LINK - https://drive.google.com/file/d/1iOJEkGcPS-wU9WJJRB5t2sPj8YSQM68U/view?usp=sharing
4. wokwi link- https://wokwi.com/projects/349371405368820308
5. tinkercad link-https://www.tinkercad.com/things/b9CvOMciEFc-copy-of-smart-farming-system/editel?sharecode=jd2VBWma--BIIWwpYCwbCpXCobRjY4MZGLhsfdAesYc
6. NodeRed Link-https://node-red-sfiot.au-syd.mybluemix.net/red/#flow/7b004e1ca623482c