Smart Farmer – IOT Enabled Smart Farming Application

NALAIYA THIRAN PROJECT BASED LEARNING

ON

PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP

A PROJECT REPORT

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INTRODUCTION

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1.1 PROJECT OVERVIEW

1. Smart farming, also known as e-agriculture, refers to agricultural equipment that digitally gather, store, analyse, and distribute electronic data and information. Smart agriculture is a wide term that encompasses agricultural and food production practices that are enabled by Internet of Things, big data, and sophisticated analytics technologies. When we talk about the Internet of Things, we usually mean the addition of sensing, automation, and analytics technologies to modern agricultural processes. Using these technologies, we achieve more efficiency, higher quality, and lower resource use than traditional agriculture.
2. Smart Husbandry is a strategic approach that focuses on furnishing the husbandry assiduity with the structure to use sophisticated technologies for shadowing, monitoring, automating, and assaying conditioning, similar as big data, the pall, and the internet of effects(IoT). Smart husbandry, frequently known as perfection husbandry, is software- managed and detector- covered. The combination of the expanding global population, the adding demand for advanced crop yield, the need to use natural coffers efficiently, the rising use and complication of information and communication technology, and the adding need for climate-smart husbandry is adding the significance of smart husbandry.

1.2 PURPOSE

1. Essentially, "smart farming" is the use of information and data technology to optimize diverse farming processes. The emphasis is on data availability and how farmers may use the information obtained sensibly. The objective is to boost product quality and quantity while optimizing human labor productivity. Or, to put it another way, producing more food with less investment and the same amount of land. The technology utilized in smart farming mainly comprises IoT and robotics. Farmers may use these instruments to monitor agricultural conditions without having to visit the field. This enables them to make judgments for the entire farm, a lot, or even a single plant. Smart farming is not just for huge agricultural enterprises. It can also help family farms, organic farms, and other small businesses. The entire smart farming process is softwaremanaged and sensor-monitored, lowering overall prices, boosting overall yield, improving availability quality, and, ultimately, improving customer experience. Automation has provided significant gains in production efficiency, quality, and sustainability.

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LIERATURE SURVEY

2.1 EXISTING PROBLEM

[**1**]. In this report held in 25 mar 2022-Smart farming technology innovations **–** Insights and reflections from the German Smart-AKIS hub .This paper explores farmers' and other stakeholders' perceptions and attitudes towards SFT in Germany with a multi-actor approach. Quantitative and qualitative data show that while there are generally positive attitudes, farmers are less enthusiastic with regard to expected positive effects of SFT for the environment. Also, there is still a number of adoption barriers on the technology level as well as due to an unfavorable institutional and infrastructural environment. Although a multi-actor approach was practiced, close cooperation of practitioners with developers were not frequently observed nor could they be easily supported through actionresearch. Notwithstanding, through the multi-actor approach, a comprehensive situational picture of SFT appraisal was composed and, a general raise of awareness among the respective AKIS actors generated.

[**2].** Report Published in February 2021-Unmanned Aerial Vehicle (UAV) Based Sustainable Smart Farming. To reach the goal of sustainable agriculture, smart farming is taking advantage of the Unmanned Aerial Vehicles (UAVs) and Internet of Things (IoT) paradigm. These smart farms are designed to be run by interconnected devices and vehicles. Some enormous potentials can be achieved by the integration of different IoT technologies to achieve automated operations with minimum supervision. This paper outlines some major applications of IoT and UAV in smart farming, explores the communication technologies, network functionalities and connectivity requirements for Smart farming.

[**3**]. Report held in June 2021- smart Farming using AI and IoT.To survive in this world the occupation of farming plays an important role as it provides maximum needs for human beings to live in this world. But in the advancement of the technologies with the invention of the Internet of Things, Automation (Smarter technologies) is replacing the traditional methodologies which in cause resulting in wide range improvement of the Fields. Now we are in the state of automation where the upgradation of smarter technologies is improving day by day in maximum sectors starting from smart homes, waste management, 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 the Internet of Things, Artificial Intelligence, Machine Learning, etc. Applications related to precision agriculture and technologies related to farm management and robotic automation etc. will benefit the environment a lot and will increase the overall efficiency.

[**4].** In this report held in February 2022."Analysis of barriers to circularity for agricultural cooperatives in the digitalization era". This study aims to propose a novel framework for barriers to circularity within cooperative supply chains. The barriers in the adoption and implementation of circular economy principles are examined within a framework.

[**5].** This report published in January 2019.Smart farming IoT platform based on edge and cloud computing. Biosystems Engineering .Precision Agriculture (PA), as the integration of information, communication and control technologies in agriculture, is growing day by day. The Internet of Things (IoT) and cloud computing paradigms offer advances to enhance PA connectivity.

Nevertheless, their usage in this field is usually limited to specific scenarios of high cost, and they are not adapted to semiarid conditions, or do not cover all PA management in an efficient way. It is based on exchangeable low-cost hardware and supported by a three-tier open source software platform at local, edge and cloud planes. At the local plane, Cyber-Physical Systems (CPS) interact with crop devices to gather data and perform real-time atomic control actions. The edge plane of the platform is in charge of monitoring and managing main PA tasks near the access network to increase system reliability against network access failures. Finally, the cloud platform collects current and past records and hosts data analytics modules in a FIWARE deployment. IoT protocols like Message Queue Telemetry Transport (MQTT) or Constrained Application Protocol (CoAP) are used to communicate with CPS, while Next Generation Service Interface (NGSI) is employed for southbound and northbound access to the cloud. The system has been completely instantiated in a real prototype in frames of the EU Drain Use project, allowing the controlof a real hydroponic closed system through managing software for final farmers connected to the platform.

2.2 REFERENCE

1. AndreaKnierim,MariaKernecker,KlausErdle,TeresaKraus,FriederikeBorges&AngelikaWurbs(2019) Smart farming technology innovations – Insights and reflections from the German Smart-AKIS hub

URL:https://doi.org/10.1016/j.njas.2019.100314

2. Nahina Islam, Md Mamunur Rashid, Faezeh Pasandideh ,Biplob Ray, Steven Moore and Rajan Kadel (2021) A Review of Applications and Communication Technologies for Internet of Things (IoT) and Unmanned Aerial Vehicle (UAV) Based Sustainable Smart Farming.

URL:https://doi.org/10.3390/su13041821

3. Nagraj Vallakati, Tomal Ghosh, Shatayu Thakur, Mansing Rathod (2021) Smart Farming using AI and IoT

URL:http://dx.doi.org/10.2139/ssrn.3866432

4. Ada, E., Sagnak, M., Uzel, R.A. and Balcıoğlu, İ. (2022), "Analysis of barriers to circularity for agricultural cooperatives in the digitalization era"URL:

https://doi.org/10.1108/IJPPM-12-2020-0689

5. Miguel A.Zamora-Izquierdo, JoséSantaa, Juan .Martínez, VicenteMartínez, Antonio F.Skarmeta (2019) Smart farming IoT platform based on edge and cloud computing URL:

https://doi.org/10.1016/j.biosystemseng.2018.10.014

2.3 PROBLEM STATEMENT DEFINITION

Problem Statement (PS):	An intelligent crop protection system helps the farmers in protecting the crop from the animals and birds which destroy the crop. This system also helps farmers to monitor the soil moisture levels in the field and also the temperature and humidity values near the field. The motors and sprinklers in the field can be controlled using the mobile application.
Iam	A Farmer
I'm trying to	frequently monitor the crops and make sure to prevent them from getting destroyed. Analyze data from various sensors.
But	requires a lot of man power for surveillance and monitoring.
Because	It's really hard to cover large boundaries and monitor them 24 hours a day.
Which makes me feel	Frustrated and fearful about the crops getting destroyed frequently.

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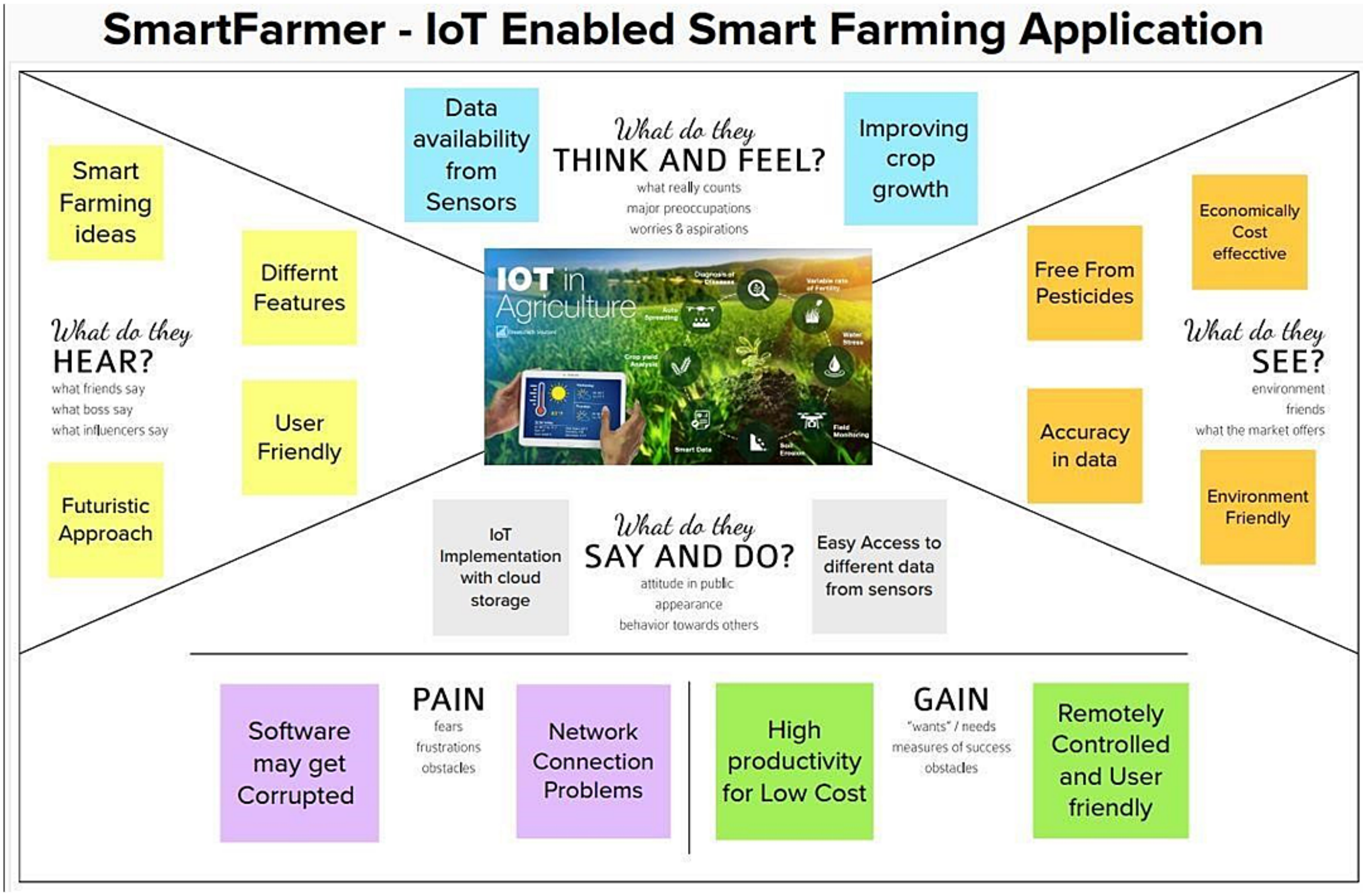
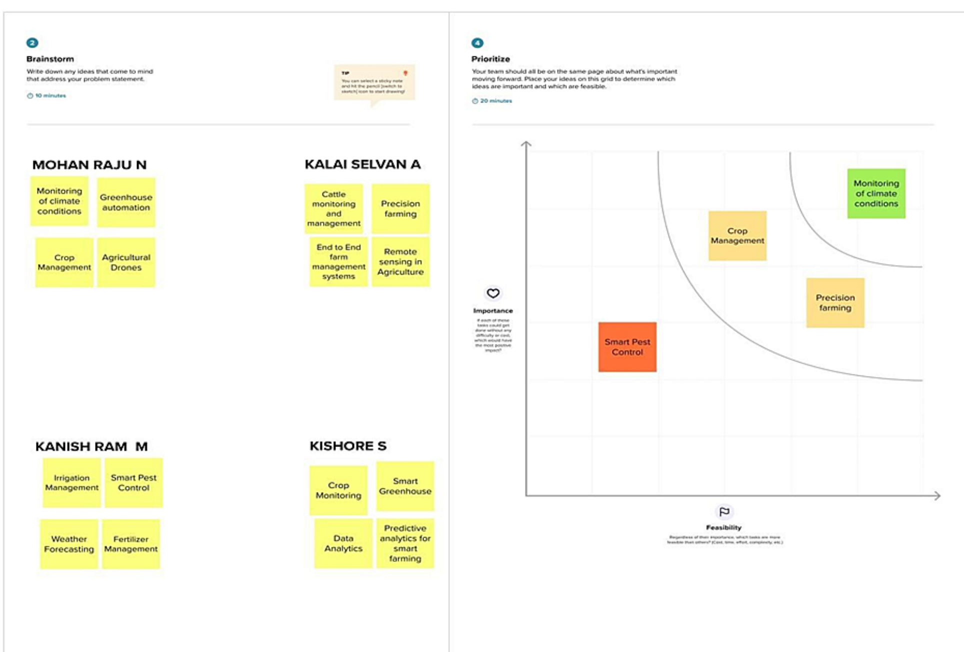
IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP



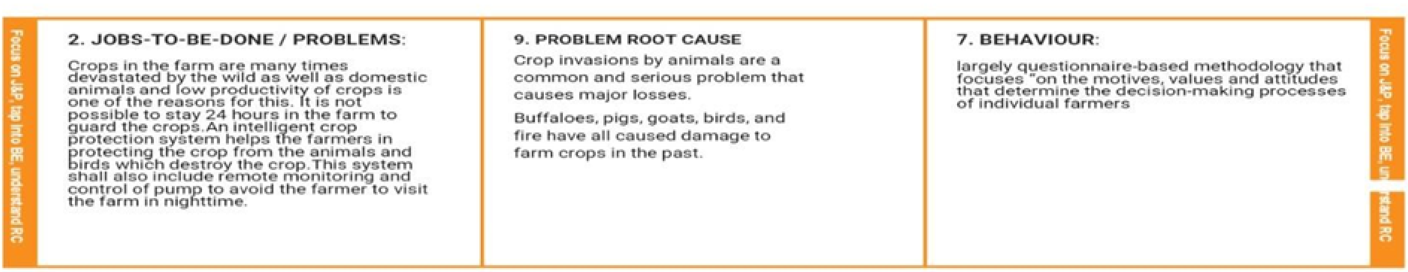
3.2 IDEATION & BRAINSTORMING



3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Proposed Statement (Problem to be solved)	To create a mobile application for monitoring temperature in the fields using IOT
2.	Idea / Solution Description	We will be developing a mobile application using IOT, so that the we can monitor the soil moisture and humidity in the fields, also the temperature near the field
3.	Novelty / Uniqueness	Easily predict the temperature present in the field which is highly useful for farmers
4.	Social Impact / Customer Satisfaction	It helps the farmers to protect the crops and provides the information of the environment
5.	Business Model (Revenue Model)	This application helps the farmers to harvest the crops on time and prevent from wastage of corps which cause economically beneficial
6.	Scalability of the solution	This use of application will reach all the farmers globally and have a positive impact

3.4 PROBLEM SOLUTION FIT



4.REQUIREMENT ANALYSIS

4.1 Functional requirement

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	IoT devices	Sensors and Wifi module.
FR-2	Software	Web UI, Node-red, IBM Watson, MIT app

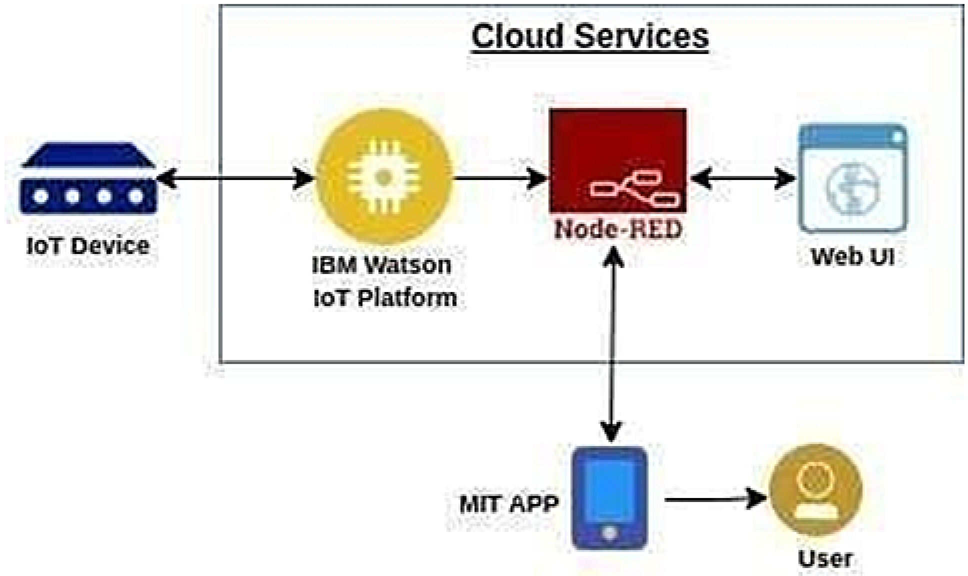
4.2 NON-FUNCTIONAL REQUIREMENTS

Following are the non-functional requirements of the proposed solution.

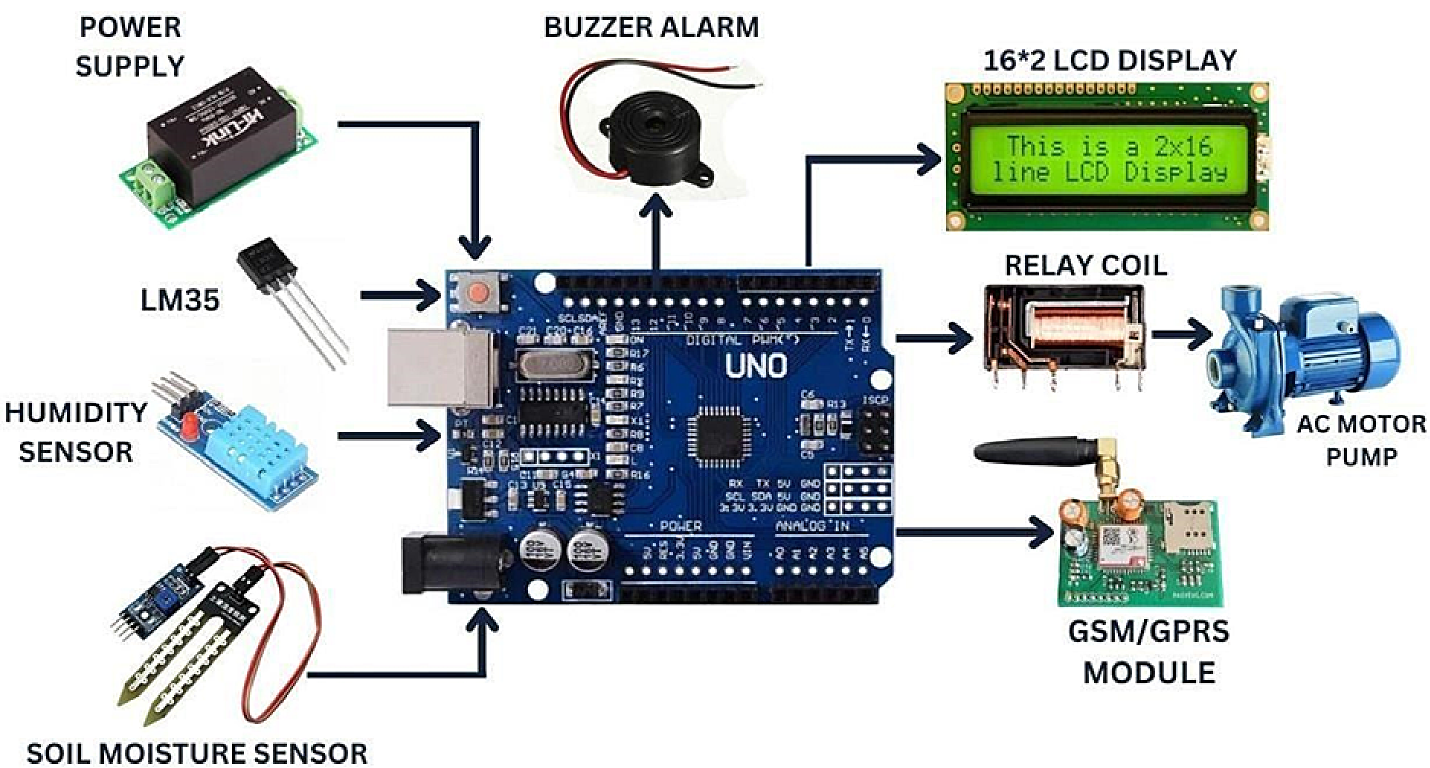
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Time consumability is less, Productivity is high.
NFR-2	**Security**	It has low level of security features due to integration of sensor data.
NFR-3	**Reliability**	Accuracy of data and hence it is Reliable.
NFR-4	**Performance**	Performance is high and highly productive.
NFR-5	**Availability**	With permitted network connectivity the application is accessible
NFR-6	**Scalability**	It is perfectly scalable many new constraints can be added

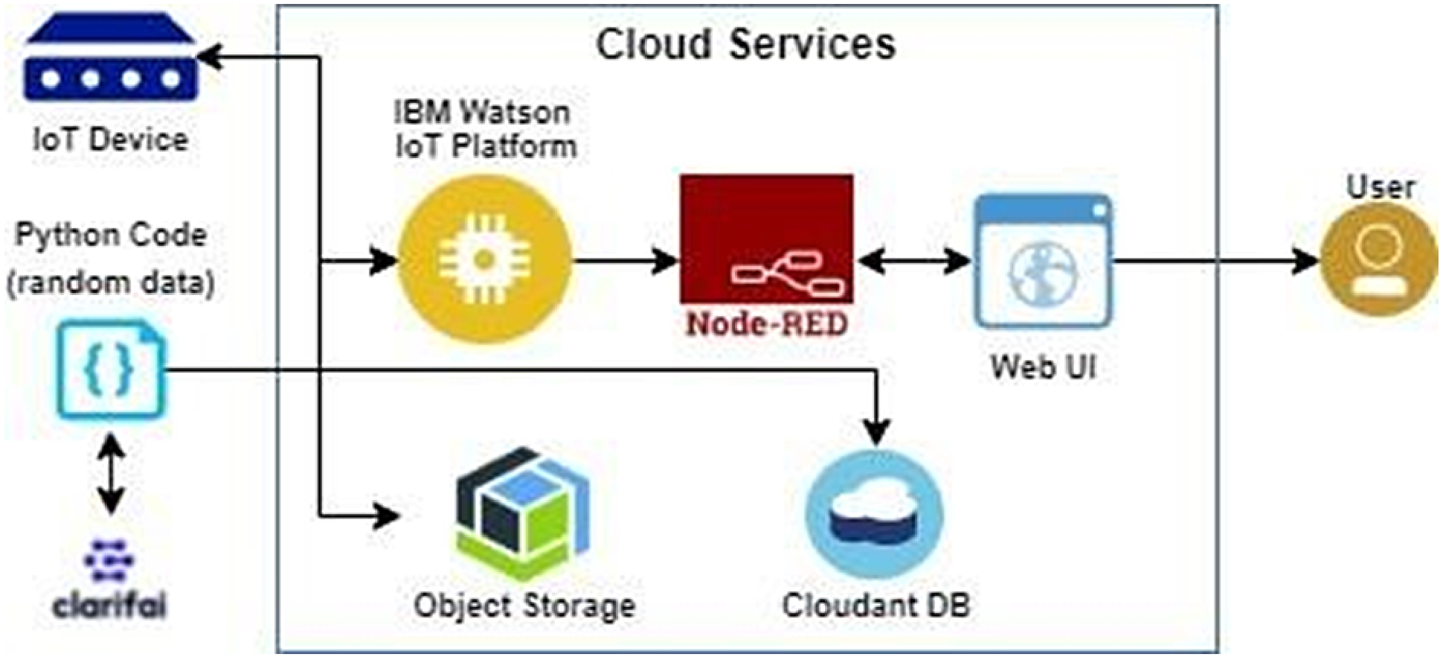
5.PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS



5.2 SOLUTION ARCHITECTURE& TECHNICAL ARCHITECTURE





5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story	User Story / Task	Acceptance criteria	Priority	Release
Customer	IoT devices	USN-1	Sensors and wi-fi module		High	Sprint-1
Customer	Software	USN-2	IBM Watson IoT platform, Workflows for IoT scenarios using Nodered		High	Sprint-2
Customer	MIT app	USN-3	To develop an application using MIT		High	Sprint-3
Customer	Web UI	USN-4	To make the user to interact with the software.	User can access the app for the services.	High	Sprint-4

6.PROJECT PLANNING & SCHEDULE

6.1 SPRINT PLANNING &ESTIMATION

Title	**Description**	**Date**
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers, research publications etc.	09 OCTOBER 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements.	09 SEPTEMBER 2022
Brainstorming ideas	List the ideas by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	09 SEPTEMBER 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	09 OCTOBER 2022
Problem Solution Fit	Prepare problem - solution Fit document.	09 0CTOBER 2022
Solution Architecture	Prepare solution Architecture document.	09 OCTOBER 2022
Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application	20 OCTOBER 2022
Data Flow Diagrams	Draw the data flow Diagrams and submit for review.	20 OCTOBER 2022
Technology Architecture	Architecture diagram.	20 OCTOBER 2022
Sprint Delivery	Prepare the Sprint delivery on Number of Sprint planning meetings organized, Minutes of meeting recorded.	04 NOVEMBER 2022
Milestone & Activity List	Prepare the milestones & Activity list of the project.	04 NOVEMBER 2022
Project Development Delivery of Sprint- 1,2,3&4	Develop & submit the developed code by testing it.	IN PROGRESS…

6.2 Sprint Delivery plan

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Simulation creation	USN-1	Connect Arduino and Sensors with python code	2	High	Mohan Raju Kalai Selvan
Sprint-2	Software	USN-2	Creating device in the IBM Watson IOT platform, workflow for IOT scenarios using Node-Red	1	High	Kanishram Kishore
Sprint-3	MIT App Inventor	USN-3	Develop an application for the Smart farmer project using MIT App Inventor	2	Low	Kishore Kanishram
Sprint-3	Dashboard	USN-3	Design the Modules and test the app	2	Medium	Kalai Selvan Mohan Raju
Sprint-4	Web UI	USN-4	To make the user to interact with software.	1	High	Mohan Raju Kalai Selvan

PROJECT TRACKER:

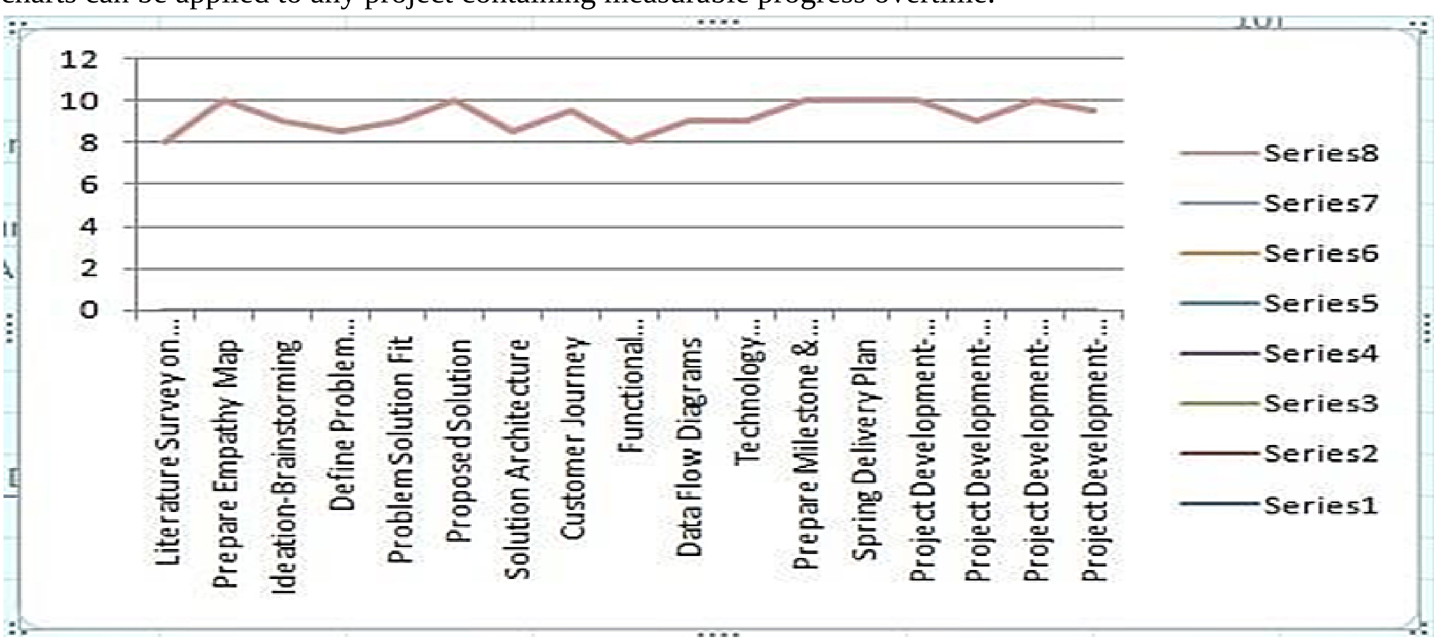
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	7 Days	30 Oct 2022	06 Oct 2022	20	29 Oct 2022
Sprint-2	20	9 Days	31 Oct 2022	09 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	06 Nov 2022	13 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	11 Nov 2022	17 Nov 2022	20	15 Nov 2022

Velocity:

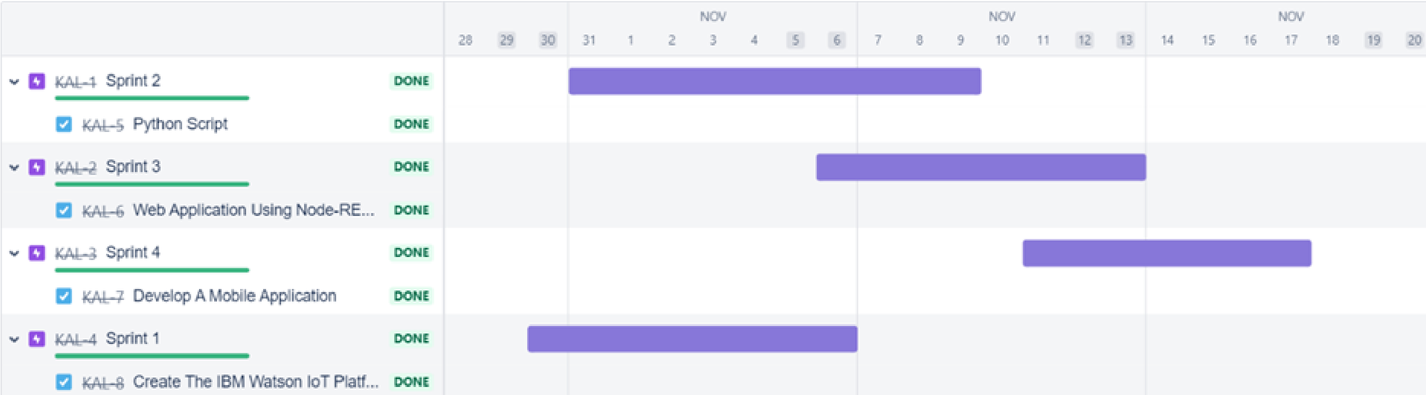
Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

Burndown Chart:

A burndown chart is a graphical representation of work left to do versus time However, burndown charts can be applied to any project containing measurable progress overtime.



6.3 Report from JIRA



7. CODING & SOLUTIONING

7.1 Feature 1

new_code.py - C:\Users\vaio\Documents\new_code.py (3.7.0)

File Edit Format Run Options Window Help

```python
#IBM Watson IOT Platform
#pip install wiotp-sdk
import wiotp.sdk.device
import time
import random
myConfig = {
    "identity": {
        "orgId": "4lmir6",
        "typeId": "TestDeviceType",
        "deviceId":"12345"
    },
    "auth": {
        "token": "dxV@N9UtEhSp4lc6*u"
    }
}

def myCommandCallback(cmd):
    print("Message received from IBM IoT Platform: %s" % cmd.data['command'])
    m=cmd.data['command']
    if(m=="motoron"):
        print("Motor is switched on")
    elif(m=="motoroff"):
        print("Motor is switched OFF")
    print(" ")

client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
client.connect()

while True:
    soil=random.randint(0,100)
    temp=random.randint(-20,125)
    hum=random.randint(0,100)
    myData={'soil_moisture':soil,'temperature':temp, 'humidity':hum}
    client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0, onPublish=None)
    print("Published data Successfully: %s", myData)
    client.commandCallback = myCommandCallback
    time.sleep(2)
client.disconnect()
```

7.2 Feature 2

Python 3.7.0 Shell

File Edit Shell Debug Options Window Help

```
Published data Successfully: %s {'soil_moisture': 58, 'temperature': 52, 'humidity': 17}
Published data Successfully: %s {'soil_moisture': 6, 'temperature': 101, 'humidity': 54}
Published data Successfully: %s {'soil_moisture': 73, 'temperature': 24, 'humidity': 7}
Published data Successfully: %s {'soil_moisture': 93, 'temperature': 65, 'humidity': 16}
Published data Successfully: %s {'soil_moisture': 37, 'temperature': 1, 'humidity': 52}
Published data Successfully: %s {'soil_moisture': 44, 'temperature': -14, 'humidity': 72}
Published data Successfully: %s {'soil_moisture': 90, 'temperature': 109, 'humidity': 55}
Published data Successfully: %s {'soil_moisture': 54, 'temperature': 19, 'humidity': 27}
Published data Successfully: %s {'soil_moisture': 14, 'temperature': 17, 'humidity': 57}
Published data Successfully: %s {'soil_moisture': 79, 'temperature': 42, 'humidity': 90}
Published data Successfully: %s {'soil_moisture': 29, 'temperature': 70, 'humidity': 21}
Published data Successfully: %s {'soil_moisture': 21, 'temperature': 27, 'humidity': 88}
Published data Successfully: %s {'soil_moisture': 80, 'temperature': 73, 'humidity': 35}
Published data Successfully: %s {'soil_moisture': 4, 'temperature': 72, 'humidity': 51}
Published data Successfully: %s {'soil_moisture': 80, 'temperature': 15, 'humidity': 50}
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Published data Successfully: %s {'soil_moisture': 89, 'temperature': 77, 'humidity': 65}
Published data Successfully: %s {'soil_moisture': 34, 'temperature': 21, 'humidity': 53}
Published data Successfully: %s {'soil_moisture': 45, 'temperature': 33, 'humidity': 63}
Published data Successfully: %s {'soil_moisture': 97, 'temperature': 1, 'humidity': 33}
Published data Successfully: %s {'soil_moisture': 73, 'temperature': 90, 'humidity': 18}
Published data Successfully: %s {'soil_moisture': 0, 'temperature': 31, 'humidity': 98}
Published data Successfully: %s {'soil_moisture': 28, 'temperature': 95, 'humidity': 57}
Published data Successfully: %s {'soil_moisture': 70, 'temperature': 30, 'humidity': 77}
Published data Successfully: %s {'soil_moisture': 34, 'temperature': 2, 'humidity': 35}
Published data Successfully: %s {'soil_moisture': 61, 'temperature': 11, 'humidity': 4}
Published data Successfully: %s {'soil_moisture': 71, 'temperature': 93, 'humidity': 95}
Published data Successfully: %s {'soil_moisture': 32, 'temperature': 114, 'humidity': 19}
Published data Successfully: %s {'soil_moisture': 27, 'temperature': 78, 'humidity': 55}
Published data Successfully: %s {'soil_moisture': 87, 'temperature': 89, 'humidity': 91}
Published data Successfully: %s {'soil_moisture': 87, 'temperature': 118, 'humidity': 76}
Published data Successfully: %s {'soil_moisture': 7, 'temperature': -13, 'humidity': 59}
Published data Successfully: %s {'soil_moisture': 53, 'temperature': 3, 'humidity': 85}
Published data Successfully: %s {'soil_moisture': 40, 'temperature': 124, 'humidity': 31}
Published data Successfully: %s {'soil_moisture': 29, 'temperature': 56, 'humidity': 91}
Published data Successfully: %s {'soil_moisture': 28, 'temperature': 6, 'humidity': 86}
Published data Successfully: %s {'soil_moisture': 78, 'temperature': 21, 'humidity': 30}
Published data Successfully: %s {'soil_moisture': 25, 'temperature': 90, 'humidity': 99}
Published data Successfully: %s {'soil_moisture': 6, 'temperature': 18, 'humidity': 59}
Published data Successfully: %s {'soil_moisture': 66, 'temperature': -2, 'humidity': 96}
Published data Successfully: %s {'soil_moisture': 78, 'temperature': 63, 'humidity': 0}
Published data Successfully: %s {'soil_moisture': 45, 'temperature': 30, 'humidity': 11}
Published data Successfully: %s {'soil_moisture': 30, 'temperature': 31, 'humidity': 65}
Published data Successfully: %s {'soil_moisture': 71, 'temperature': 30, 'humidity': 93}
Published data Successfully: %s {'soil_moisture': 14, 'temperature': 20, 'humidity': 0}
```

8. TESTING

8.1 Test Cases

TESTCASES:

Although smart agriculture IoT, as well as industrial IoT in general, aren't as popular as consumerconnected devices; yet the marketis still very dynamic. The adoption of IoT solutions for agriculture is constantly growing. Namely, COVID-19 has had a positiveimpact on IoT in the agriculture market share. There are many types of IoT sensors for agriculture as well as IoT applications in agriculture in general:
Monitoring of climate conditions

Probably the most popular smart agriculture gadgets are weather stations, combining various smart farming sensors.Located across the field, they collect variousdata from the environment and send it to the cloud. The provided measurements can be used to map the climate conditions, choose the appropriate crops, and take the required measures to improve their capacity(i.e. precision farming).
End-to-end farm managementsystems

This offers remote farm monitoring capabilities and allows you to streamline most of the business operations. Similar solutions are represented by FarmLogs and Cropio. In addition to the listed IoT agriculture use cases, some prominent opportunities include vehicle tracking(or even automation), storage management, logistics, etc.
Predictive analytics for smart farming

Precision agriculture and predictive data analytics go hand in hand. While IoT and smart sensortechnology are a goldmine for highly relevantreal-time data, the use of data

analytics helps farmers make sense of it and come up with important predictions: crop harvesting time, the risks of diseases and infestations, yield volume, etc. Data analytics tools help make farming, which is inherently highly dependent on weather conditions,more manageable, and predictable. For example, the Crop Performance platformhelps farmers accessthe volumeand qualityof yields in advance, as well as their vulnerability to unfavorable weatherconditions, such as floods and drought.
Greenhouse automation

Typically, farmers use manual intervention to control the greenhouse environment. The use of IoT sensors enables them to get accurate real-time information on greenhouse conditions such as lighting, temperature, soil condition, and humidity.For instance, Farmapp and Growlinkare also IoT agriculture productsoffering such capabilities among others.
Crop management

Onemore type of IoT productin agriculture and another elementof precision farmingare crop management devices. Just like weather stations,they should be placed in the field to collect data

specific to crop farming; from temperature and precipitation to leaf water potential and overall crop health.Thus, you can monitor your crop growth and any anomalies to effectively preventany diseases or infestations that can harm your yield.
Arable and Semioscan serve as good representations of how this use case can be applied in real life.

Cattle monitoring and management
Just like crop monitoring, there are IoT agriculture sensors that can be attached to the animals on a farm to monitortheir health and log performance. Livestock tracking and monitoring help collect data on stockhealth, well-being, and physical location.

For example, such sensors can identify sick animals so that farmers can separate them from the herd and avoid contamination. Using drones for real-time cattle tracking also helps farmers reduce staffingexpenses.This works similarlyto IoT devices for petcare.
Precision farming

Precision farming is all about efficiency and making accurate data-driven decisions. It's also oneof the most widespread and effective applications of IoT in agriculture. By using IoT sensors, farmers can collect a vast array of metricson every facet of the field microclimate and ecosystem: lighting, temperature, soil condition, humidity, CO_2 levels, and pest infections. This data enables farmersto estimate optimalamounts of water,fertilizers, and pesticides.

8.2 User Acceptance Testing

RESOLUTION	SEVERITY 1 TOTAL	SEVERITY 2	SEVERITY 3	SEVERITY 4	SUB
BY DESIGNING	5	1	0	0	6
DUPLICATE	0	0	0	0	0
EXTERNAL	8	0	4	1	12
FIXED	13	2	4	1	18
NOT REPRODUCED	7	2	0	0	9
SKIPPED	1	0	0	0	1
WON'T FIX	0	0	0	0	0

Section	Total	Not	Fai	Pas
Temperature	3	0	0	3
Ultrasonic	4	0	0	4
Soil	2	0	0	2
Wi-Fi	2	0	0	2
Transmission of data to IBM Cloud	3	0	1	2
Data Transmission	5	0	2	3
User login in Mobile Application	1	0	0	1
Accessing the Parameters in Mobile App	1	0	2	1
Controlling the Motor from the Mobile App	5	0	0	5
Viewing the	5	0	0	5
parameters in the Node RED	3	0	0	3

9. RESULTS

9.1 Performance Metrics

			NFT - Risk Assessment						
S.No	Project Name	Scope/feature	Functional Changes	Hardware Changes	Software Changes	Impact of Downtime	Load/Volume Changes	Risk Score	Justification
1.	Smart Farmer	Existing- Simulating the project through the Tinkercad with Temperature and humidity sensors, soil moisture, ultrasonic distance sensors, and DC and servo motors.	Moderate	High	High	No data transmission to Cloud	>80 to 90%	ORANGE	There is no Wi-Fi module in the Tinkercad simulator so data can't be sent to IBM Cloud.
2.	Smart Farmer	New- Simulating the project through the Wokwi simulator with Temperature and humidity sensor, ultrasonic distance sensors, servo motor, and LCD.	High	High	Moderate	The non-availability of certain sensors in Wokwi.	>30 to 40%	YELLOW	The random function is used for the Soil Moisture sensor to generate some random value.
3.	Smart Farmer	Existing – Visualizing the weather parameters in the Watson IoT platform.	Moderate	No Changes	Low	Delayed Visualization of Data.	>50 to 60%	GREEN	The stable internet connection is enough for a constant data transmission.
4.	Smart Farmer	Existing- Visualizing the weather parameters in the Watson IoT platform.	No Changes	No Changes	Moderate	Delayed Visualization of Data.	>40 to 50%	GREEN	The data can be easily transferred to other applications and also can be visualized in the dashboard.
5.	Smart Farmer	New- Login to the Smart Farmer mobile application and viewing the parameters.	Moderate	No Changes	High	Latency of data will be high.	>20 to 10%	GREEN	The parameter send by the module will be stored in the cloud and then sent to the mobile app, so there will be less latency.
6.	Smart Farmer	New – Controlling the motor from the mobile application and its indication in the simulator.	Low	Low	Low	Motor control will be delayed.	>30 to 20%	YELLOW	The motor control can be controlled by sending a response from the mobile app to the module.

NFT - Detailed Test Plan				
S.No	Project Overview	NFT Test approach	Assumptions/Dependencies/Risks	Approvals/Sign Off
1.	Smart Farmer	Spike Testing – For the sensors in the module.	1. For the temperature and humidity sensor, the values should be tested at extreme high, moderate, and extreme low levels to know that the indication is going on correctly. 2. For the Ultrasonic distance sensor, the distance will be increased and decreased to simulate the water level in the field. 3. For soil moisture, the random function should generate the values within the limit. 4. The ESP32 module should process and transmit data to IBM cloud.	Approved
2.	Smart Farmer	Endurance Testing – For Watson IoT visualization boards.	1. The parameter data should be accessed through the IBM Watson IoT Platform. 2. The visualization data should be continuously stored for a specified long duration.	Approved
3.	Smart Farmer	Resilience Testing – For Node-Red Dashboard Visualization.	1. The Node-Red should be able to perform well with different datasets or payloads coming from the module. 2. The Node-Red should display the correct parameter data and both the IBM and Node-Red data should match.	Approved
4.	Smart Farmer	Load Testing – For accessing the parameter data and controlling the motor from the mobile application.	1. The parameter data can be viewed and the motor should be controlled from the mobile application itself. 2. The data should be precise even if multiple user data for visualization.	Approved

End Of Test Report							
S. No	Project Overview	NFT Test approach	NFR - Met	Test Outcome	GO/NO-GO decision	Identified Defects (Detected/Closed/Open)	Approvals /Sign Off
1	Smart Farmer	Performance Testing	No delay in logging in to the application.Controlling motor like ON or OFF should not take more than 5 seconds. Live update of parameters through IBM Watson IoT platform to mobile application should not take more than 10 to 15 seconds.	POSITIVE	GO	Closed	Approved
2	Smart Farmer	Stress Testing	Unexpected load given to the application does not cause any error to the system.	POSITIVE	GO	Closed	Approved
3	Smart Farmer	Load Testing	Expected load given to the system to make sure that system works fine. Like large number of user installing application to view the parameters.	POSITIVE	GO	Closed	Approved
4	Smart Farmer	Compatibility Testing	Application developed can be installed in all versions of android smart phone.	POSITIVE	GO	Closed	Approved
5	Smart Farmer	Recovery Testing	If the application crashes, it can be uninstalled and can reinstall. Data that are passed to the mobile application are stored in IBM Watson IoT platform for future use.	POSITIVE	GO	Closed	Approved

10:ADVANTAGES AND DISADVANTAGES:

ADVANTAGES:

- Smart farming is a term that describes an innovative approach to agriculture that uses information and communication technologies to improve agriculture production , profitability , sustainability and food quality.
- Smart farming is a new energy –efficient agriculture technology that is being developed to help farmers , who often struggle with a lack of water and other resources ,to produce more food with fewer resources .
- It users sensors , analytics and other technologies to improve the efficiency of the agriculture process .This enables producers to increase production,reduce costs and protect the environment.
- IoT-enabled agriculture allows farmers to monitor their product and conditions in real-time. They get insights fast, can predict issues before they happen and make informed decisions on how to avoid them. Additionally, IoT solutions in agriculture introduce automation, for example, demand-based irrigation, fertilizing and robot harvesting.
- One of the benefits of using IoT in agriculture is the increased agility of the processes. Thanks to real-time monitoring and prediction systems, farmers can quickly respond to any significant change in weather, humidity, air quality as well as the health of each crop or soil

  in the field. In the conditions of extreme weather changes, new capabilities help agriculture professionals save the crops.

DISADVANTAGES:

- Smart agriculture needs the availability of the internet continuously. Rural parts of most of the developing countries do not fulfill this requirement. Moreover, internet connection is slower.
- The smart farming based equipment requires farmers to understand and learn the use of technology. This is a major challenge in adopting smart agriculture farming at large scale across the countries.
- Smart farming has its disadvantages in the following areas : increased use of chemicals ,uneven water distribution ,reliance on organic fertilizers, and increased food miles.
- Smart farming can also have negative impacts and it is not smart when it comes to environmental impact.

11:CONCLUSION:

- The development of the agriculture sector will always be a priority especially given the dynamics of the world today. Therefore, using IoT in agriculture has a big promising future as a driving force of efficiency, sustainability, and scalability in this industry.
- Smart farming **reduces the ecological footprint of farming**. Minimized or site- specific application of inputs, such as fertilizers and pesticides, in precision agriculture systems will mitigate leaching problems as well as the emission of greenhouse gases

12: FUTURE SCOPE:

Future work would be focused more on increasing sensor on this system to fetch more data especially with regard to Pest Control and by also integrating GPS modules in this system to enhance this Agriculture IoT Technology to full-fledged Agriculture

Precision ready product

- IoT helps us meet our food needs by reducing environmental hazards, such as extreme weather and climatic transitions.
- The harvesters and tractors were both mechanical inventions that work in agriculture since the 20th century. The agriculture industry is heavily dependent on

innovative ideas because of the increasing demand for food.

- The Industrial IoT has aided increased agricultural productivity with a lower cost, so, over the next few years, smart systems based on IoT will be more common in agricultural operations.
- A recent estimate shows that the agricultural industry will experience a compound annual growth rate (CAGR) of 20% due to IoT system installations.
- In addition, the number of linked agricultural devices will increase from 13 million in 2014 to 225 million by 2024

13: APPENDIX

SOURCE CODE:

```
import

wiotp.sdk.device

import time

import random

myConfig = {
"identity": {

   "orgId":

   "4lmir6",

      "typeId":

      "TestDeviceType",

      "deviceId":"12345"

   },

   "auth": {

      "token": "dxV@N9UtEhSp4lc6*u"

   }

}


def myCommandCallback(cmd):
   print("Message received from IBM IoT Platform: %s" % cmd.data['command'])

   m=cmd.data['command']

   if(m=="motoron"):
```

```
        print("Motor is
    switched on")
    elif(m=="motoroff"):
        print("Motor is switched OFF")
    print(" ")

  client = wiotp.sdk.device.DeviceClient(config=myConfig,
  logHandlers=None) client.connect()

while True:
  soil=random.randint(0,10
  0) temp=random.randint(-
  20,125)
  hum=random.randint(0,10
  0)
    myData={'soil_moisture':soil,'temperature':temp, 'humidity':hum}
    client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,
  onPublish=None)
    print("Published data Successfully: %s", myData)
    client.commandCallback = myCommandCallback
    time.sleep(2)
 client.disconnect()
```

GITHUB LINK: https://github.com/IBM-EPBL/IBM-Project-35009-1660280581

VIDEO DEMO LINK: https://youtu.be/LGdFkdT0U28