IoT Based Smart Crop Protection System for Agriculture

NALAIYA THIRAN PROJECT

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1.INTRODUCTION

Internet of Things (IoT) technology has brought revolution to every field of common man’s life by making everything smart and intelligent. IoT refers to a network of things which make a self-configuring network. The development of Intelligent Smart Farming IoT based devices is day by day turning the face of agriculture production by not only enhancing it but also making it cost-effective and reducing wastage. The objective of this report is to propose IoT based Smart Farming System assisting farmers in getting Live Data (Temperature, Soil Moisture) for efficient environment monitoring which will enable them to increase their overall yield and quality of products. The IoT based Smart Farming System being proposed via this report is integrated with Arduino Technology mixed with different Sensors and a Wi-Fi module producing live data feed that can be obtained online from Thingsspeak.com. The product being proposed is tested on Live Agriculture Fields giving high accuracy over 98% in data feeds.

1.1 Project Overview

The objective of this report is to propose an IoT based Smart Farming System which will enable farmers to have live data of soil moisture environment temperature at very low cost so that live monitoring can be done. The structure of the report is as follows: chapter I will cover over of overview of IoT Technology and agriculture-concepts and definition, IOT enabling technologies, IOT application in agriculture, benefits of IOT in agriculture and IOT and agriculture current scenario and future forecasts. Chapter II will cover definition of IOT based smart farming system, the components and modules used in it and working principle of it. Chapter III will cover algorithm and flowchart of the overall process carried out in the system and its final graphical output. chapter IV consist of conclusion, future scope and references

1.2 Purpose

In recent times, the erratic weather and climatic changes have caused issues for farmers in predicting the perfect conditions to initiate farming. Though on a superficial scale it seems unpredictable, it can be determined with certain parameters with which crop planning can be done. Maintenance of farm fields during and after cultivation is also important. These can be performed by measuring soil moisture, humidity and temperature.

Measurement of these parameters is performed using physical sensors. This system is in turn connected to IoT system which can provide a easy to access interface for farmers to read, analyze and take action based on the presented condition. Taking it a step ahead, the system can also gain access to motors and other electrical equipment used in farming and automate their operation. This can help with unsupervised operation, ensuring accuracy and less response time.

2.LITERATURE SURVEY

TITLE: IOT Based Smart Crop Protection and Irrigation System

AUTHOR: Ipseeta Nanda

DESCRIPTION: This will be an integrative approach in the field of IIOT designed for perceptive Agriculture which are proceeding the arrangements in course of open source and on low powers devices This project work contains various sorts of sensors, controllers in addition to positioner on behalf of WSN and ARM Cortex-A board which consumes 700mA or 3W power is the main temperament of the classification. Different sensors like DHT 11 Humidity & Temperature Sensor, PIR Sensor, LDR sensor, HC SR04 Ultrasonic Sensor and cameras are interfaced with the board

PUBLISHED IN: 2020

TITLE: Smart Crop Protection System

AUTHOR: Mohit Korche

DESCRIPTION: Agriculture is the backbone of the economy but because of animal interference in agricultural lands, there will be huge loss of crops. This article provides a comprehensive review of various methods adopted by farmers to protect their crops. The article also discusses the use of modern technology in agriculture. Finally, this article reviews smart crop protection systems using sensors, microcontroller and GSM module.

PUBLISHED IN: 2021

TITLE: Smart Crop Protection System from Animals using PIC

AUTHOR: Mukesh Mahajan

DESCRIPTION: Crops on farms are many times ravaged by local animals like buffaloes, cows, goats, birds etc. This leads to huge losses for the farmers. It is not possible for farmers to barricade entire fields or stay on field 24 hours and guard it. So here we propose an automatic crop protection system from animals. This is a micro-controller-based system using PIC family microcontroller. This system uses a motion sensor to detect wild animals approaching near the field. In such a case the sensor signals the microcontroller to act.

PUBLISHED IN: 2020

TITLE: Smart Intrusion Detection System for Crop Protection by using Arduino

AUTHOR: Srushti Yadahalli

DESCRIPTION: Agriculture is still one of the most crucial sectors of the Indian economy. It is important for human survival as well as economic growth. Traditional systems like humanoid scarecrows are used even today in an agricultural field to stop birds and animals from disturbing and feeding on growing crops. There are many loopholes in such ideas and so enhancing agricultural security has become a major issue these days. Thus, this paper focuses on proposing a system which detects the intruders, monitors any malicious activity and then reports it to the owner of the system. It acts as an adaptable system which provides a practicable system to the farmers for ensuring complete safety of their farmlands from any attacks or trespassing activities.

PUBLISHED IN: 2020

TITLE: Smart Irrigation and Crop Protection Using Arduino

AUTHOR: RR Thirunavukkarasu

DESCRIPTION: This paper aims at designing and executing the advanced development in communication system for smart irrigation and crop protection from animals that invaded to farms like cows, goat, elephants, etc. and the famers can't protect the entire farm by staying in farm for all day. So, the PIR sensor is kept in the field to watch out for the animal motions. When it detects any movement recorded in the PIR sensor. it starts alarming. And therefore, soil moisture sensor detects moisture level in soil when it starts getting wet. it will be automatically starts water pump. However, a greater amount of water in farm will spoil the crops so, servo motor opens the canal when heavy rain flows detected by rain sensor. added upon gas sensor is used to detect the fire in farm.

PUBLISHED IN: 2021

2.1 Existing problem

The food shortage and the population growth are the most challenges facing sustainable development worldwide. Advanced technologies such as artificial intelligence (AI), the Internet of Things (IoT), and the mobile internet can provide realistic solutions to the challenges that are facing the world. Therefore, this work focuses on the new approaches regarding smart farming (SF) from 2019 to 2021, where the work illustrates the data gathering, transmission, storage, analysis, and suitable solutions. IoT is one of the essential pillars in smart systems, as it connects sensor devices to perform various basic tasks. The smart irrigation system included those sensors for monitoring water level, irrigation efficiency, climate, etc. Smart irrigation is based on smart controllers and sensors as well as some mathematical relations. In addition, this work illustrated the application of unmanned aerial vehicles (UAV) and robots, where they can be achieved several functions such as harvesting, seedling, weed detection, irrigation, spraying of agricultural pests, livestock applications, etc. real-time using IoT, artificial intelligence (AI), deep learning (DL), machine learning (ML) and wireless communications. Moreover, this work demonstrates the importance of using a 5G mobile network in developing smart systems, as it leads to high-speed data transfer, up to 20 Gbps, and can link many devices per square kilometer. Although the applications of smart farming in developing countries are facing several challenges, this work highlighted some approaches the smart farming. In addition, the implementation of Smart Decision Support Systems (SDSS) in developing countries supports the real time analysis, mapping of soil characteristics and helps to make proper decision management. Finally, smart agriculture in developing countries needs more support from governments at the small farms and the private sector.

2.2 References

[1] Nayyar, Anand & Puri, Vikram. (2016). Smart farming: IoT based smart sensors agriculture stick for live temperature and moisture monitoring using Arduino, cloud computing & solar technology, The international conference on communication and computing (ICCCS-2016)

[2] Gorli, Ravi & Yamini G. (2017). Future of Smart Farming with Internet of Things. Journal of Information technology and Its Applications.

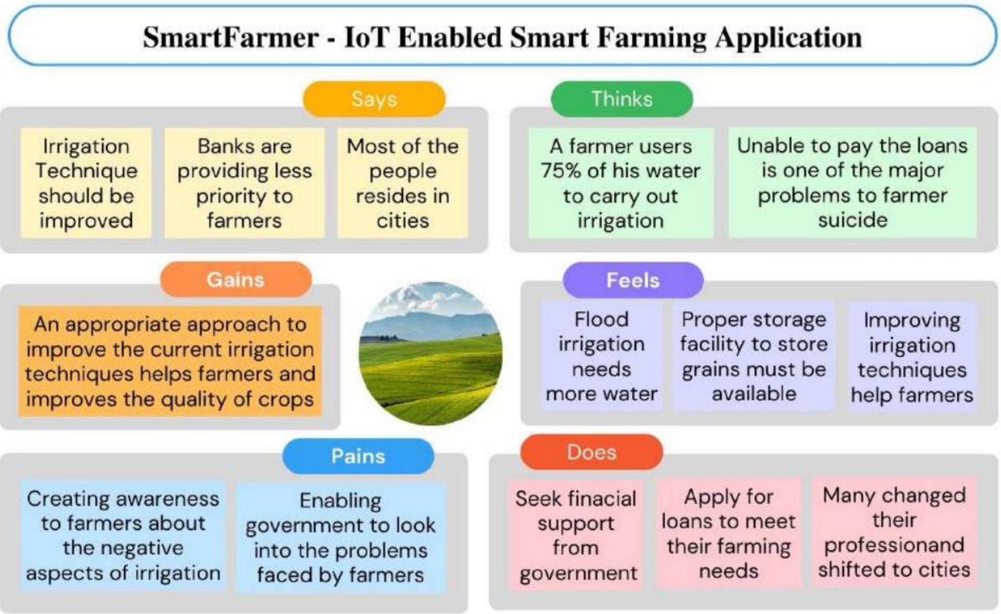
[3] S. jegadeesan, dr. g. k. d. Prasanna venkatesan Smart cow health monitoring, farm environmental monitoring and control system using wireless sensor networks, international journal of advanced engineering technology.

[4] IoT based agriculture monitoring and smart irrigation system using raspberry pi, International Research Journal of Engineering and Technology (IRJET).

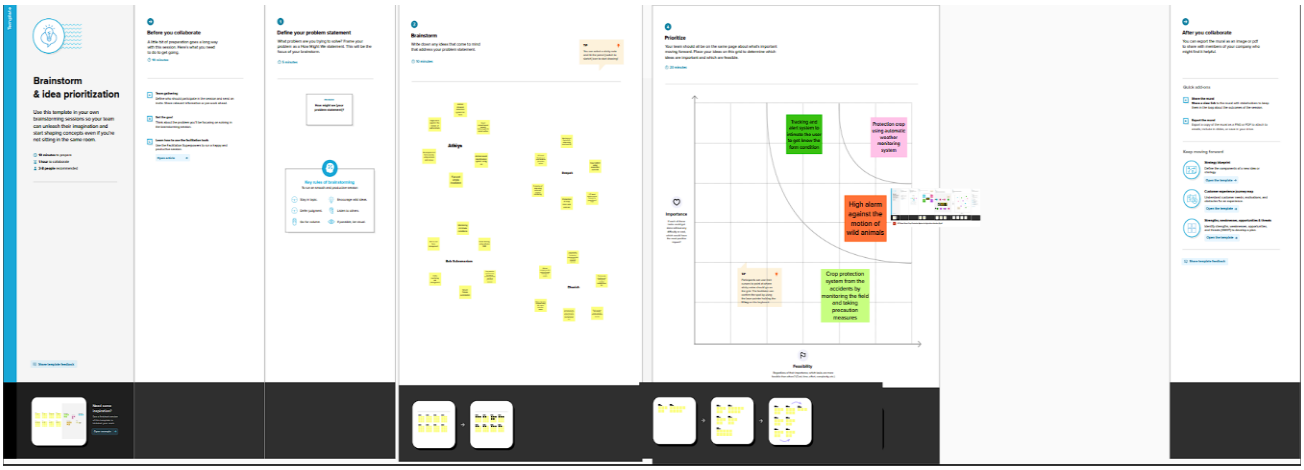
2.3 Problem Statement Definition

The problem statement in a nutshell covers all the possible technical aspects that can be included by farmers to convert farming in to smart and efficient farming. IoT enabled smart farming, on a wider perspective, concentrates on connecting all the independently operating sub-systems in farming automation into a single entity. IoT-based agriculture system helps the farmer in monitoring different parameters of his field like soil moisture, temperature, and humidity using some sensors. The idea of IoT is further extended with the help of mobile and web applications where farmers can monitor all the sensor parameters even if the farmer is not near his field. Watering the crop is one of the important tasks for the farmers. They can make the decision whether to water the crop or postpone it by monitoring the sensor parameters and controlling the motor pumps from the mobile application itself.

3.1 Empathy Map Canvas



3.2 IDEATION & BRAINSTROMING

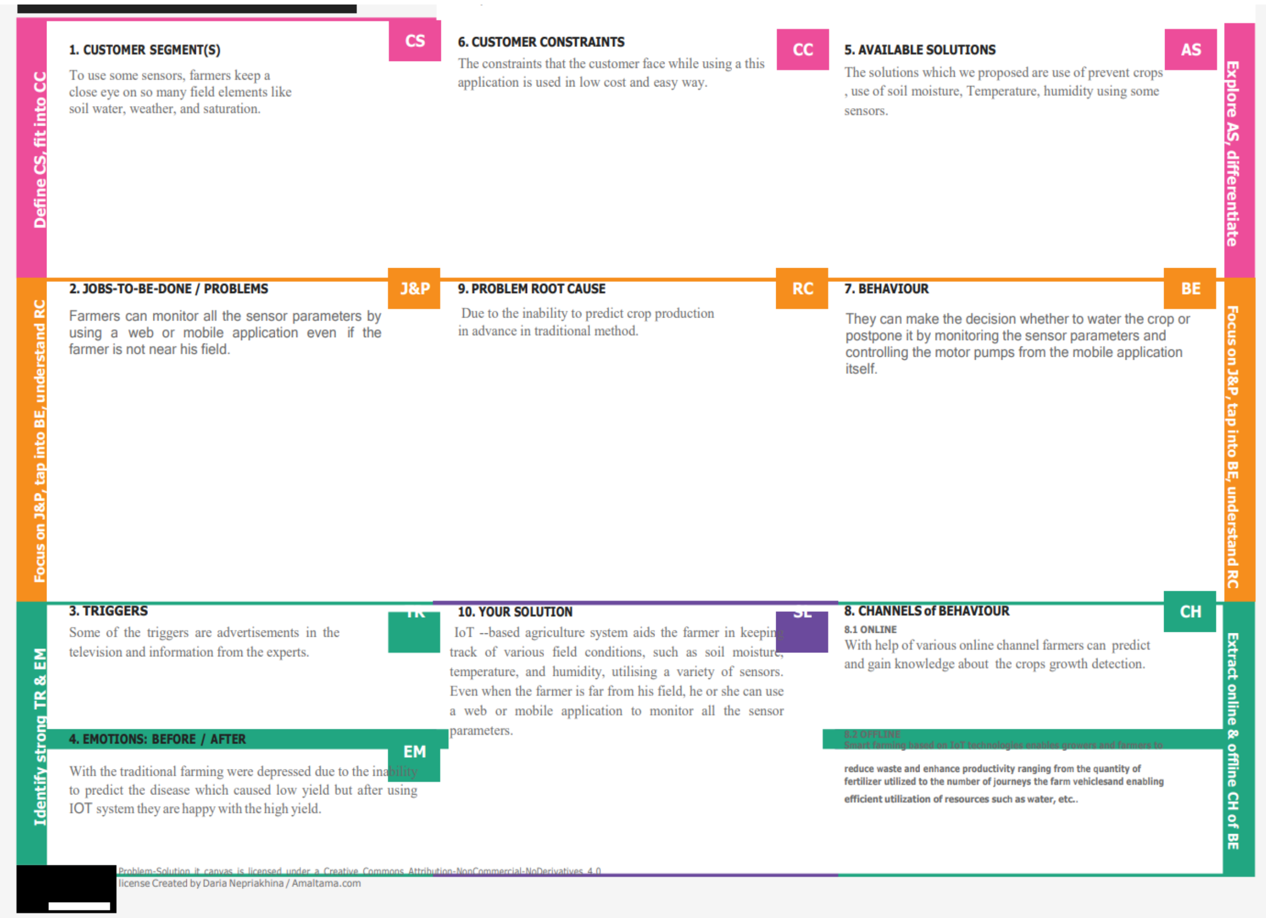


3.3 Proposed Solution Template:

Project team shall fill the following information in proposed solution on the template.

S. No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Over use of fertilizer and insecticides in agricultural fields damages crops and decreases field productivity, making the soil more susceptible to pest infestations.
2.	Idea / Solution description	We can offer a solution using the Smart Farming Application system, which was created for monitoring the irrigation system and using sensors to monitor the agricultural area.
3.	Novelty / Uniqueness	We can use IoT gadgets can be effectively used to offer answers to the issue. To determine the real moisture content of the soil, we employ a soil moisture level sensor.
4.	Social Impact / Customer Satisfaction	This Application will help to Customers andfarmers will benefit from this application's improved understanding of key farming components like water, vegetation, and soil kinds.
5.	Business Model (Revenue Model)	This application will give a revenue or profit about 40% of yearly expenditure.
6.	Scalability of the Solution	Our project is capable to grow in the marketas smart farming is an emerging technologynow a days.

3.4 PROBLEM SOLUTION FIT



REQUIREMENT ANALYSIS

4.1Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	**Reliability**	In the context of sustainable agriculture, this negates the purpose of precision smart farming, which relies on the most up-to-date data and real-me environmental Monitoring.

FR-2	**Seamless data storage and access**	The cloud allows farmers to sensor-monitor hundreds of different points and create an aggregated view of the data, which can then be analyzed by AI for insights. Without the cloud, data would be fragmented and stuck in silos. This will be particularly important for farmers who want to monitor hundreds of crops or ca le assets close together or run several autonomous machines at the same me
FR-3	**Low latency**	Lower latency and edge cloud, and where computation happens closer to the IoT device—can give farmers more authority over their systems, facilitating absolute control and monitoring of autonomous devices and near instantaneous field intelligence.
FR-4	**Security**	Farmers can opt for private networking, a wireless access point (WAP) solution that segregates traffic when connecting with mobile devices for a secure, scalable foundation for adopting new wireless platforms and technologies.

4.2 Non-functional Requirements:

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

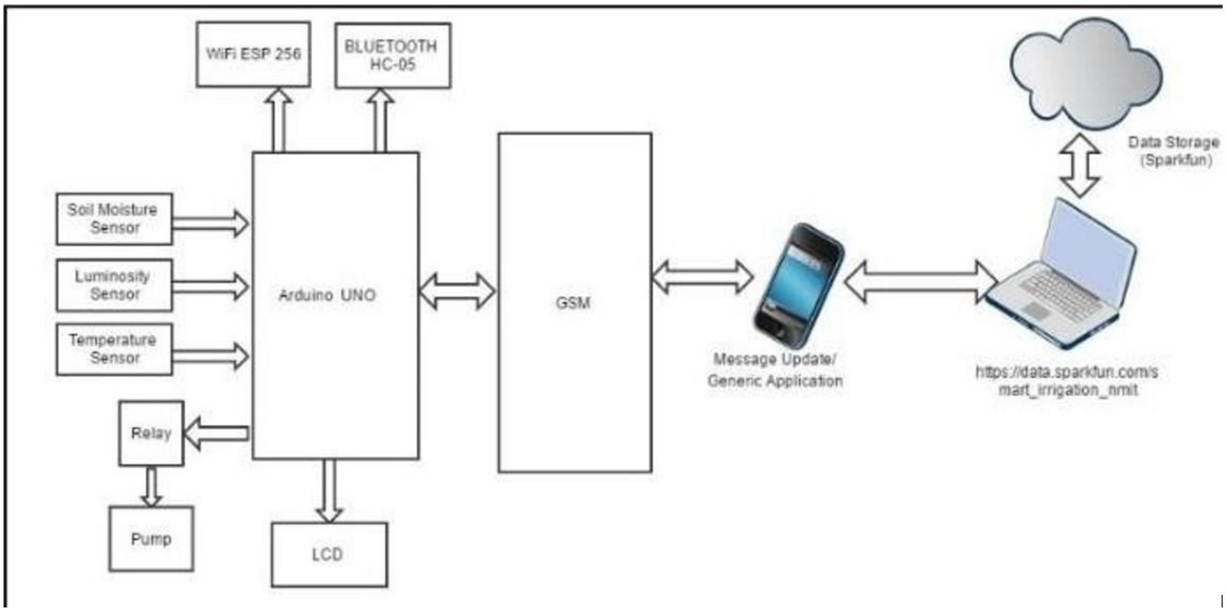
FR No.	**Non-Functional Requirement**	**Description**
NFR-1	**Observation**	Sensors record observational data from the crops, livestock, soil, or atmosphere.
NFR-2	**Diagnostics**	The sensor values are fed to a cloud-hosted IoT platform with predefined decision rules and models—also called “business logic”—that ascertain the condition of the examined object and identify any deficiencies or needs.
NFR-3	**Decisions**	A er issues are revealed, the user, and/or machine learning-driven components of the IoT platform determine whether location-specific treatment is necessary and if so, which.
NFR-4	**Ac on**	A er end-user evaluation and ac on, the cycle repeats from the beginning

PROJECT DESIGN

5.1 Data Flow Diagrams

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.



User Stories

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
Customer (higher authority)	confirmation	USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
Customer (fire service 101)	Safety measure register	USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
Customer (Mobile user)	Mobile application	USN-4	As a user, I can register for the application through Gmail	I can register & access the dashboard with Gmail Login	Medium	Sprint-1
Customer (credential)	Login	USN-5	As a user, I can log into the application by entering email & password	I can access my account / dashboard	High	Sprint-1
	Dashboard	USN-6	Uploading data	I can be able to upload my dataset	High	Sprint 2
Customer (Web user)	Notification	USN-7	when there is a emergency the alert notification will be received through GSM module	The alert message is sent to the owner's mobile as an SMS.	High	Sprint 2
Customer Care Executive	Network Connectivity	USN-8	When the maximum moisture level is detected in the field	The sensor detects the moisture and notifies the owner via message	High	Sprint 3
Administrator	Accessing	USN-9	When there is an issue in accessing the device	Admin/Device operator's advice should be undertaken	High	Sprint 3
		USN-10	Asking Help / feedback	I can be able to ask help if I can face any issues or problems while using the webpage	Medium	Sprint 4
		USN-11	Managing the database	I can assure that my data is in secure state	High	Sprint 4
		USN-12	Managing the overall process	I can assure that my data and process is going better	High	Sprint 4

6.1 SPRINT PLANNING AND ESTIMITION

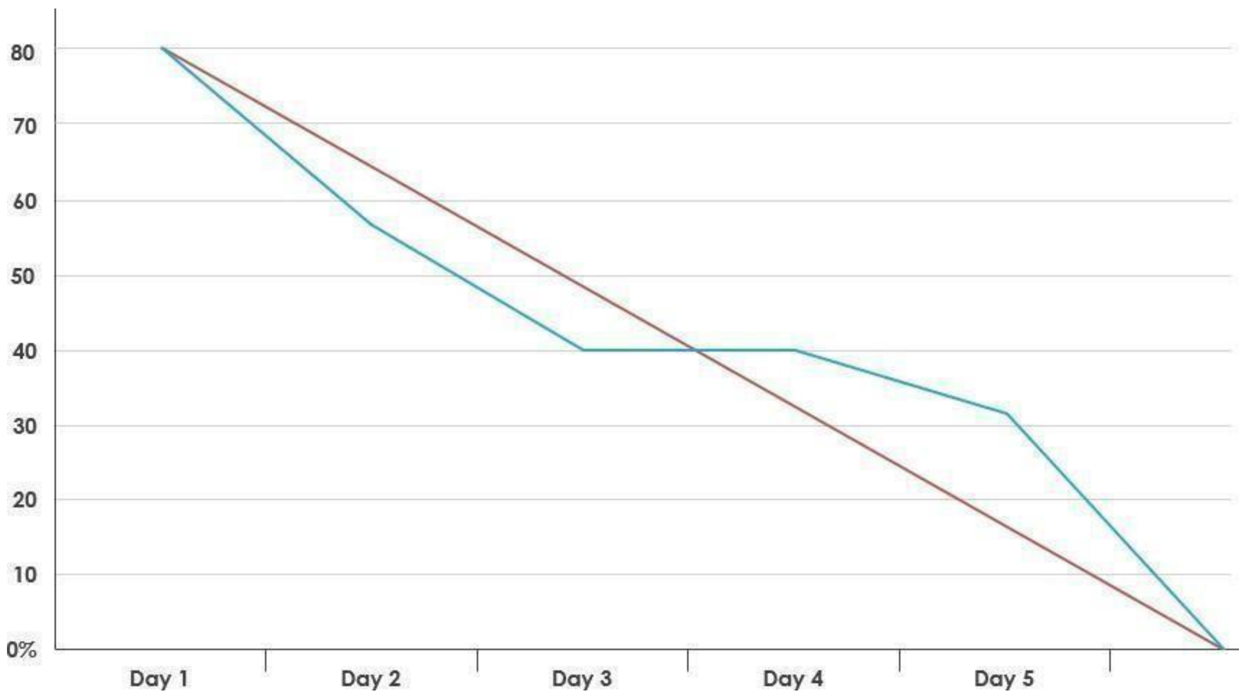
Sprint	Functional Requirement (Epic)	User Story Number	User Story /Task	Story Points	Priority	Team Member
Sprint-1	Registration (Farmer Mobile User)	UNS-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	HIGH	ATHIYA SULTHANA K
Sprint-1	Login	UNS-2	As a user, I will receive confirmation emailonce I have registered for the application	1	HIGH	DHANISH S
Sprint-2	User Interface	UNS-3	As a user, I can register for the application through Facebook	3	LOW	BALASUBRAMANIUM C S
Sprint-1	Data Visualization	UNS-4	As a user, I can register for the applicati onthrough GMAIL	2	MEDIUM	DEEPAK KUMAR S
Sprint-3	Registration (Farmer -Web User)	USN - 1	As a user, I can log into the application by entering email and password	3	HIGH	BALASUBRAMANIUM C S
Sprint - 2	Login	USN - 2	As a registered user, I need to easily login loginto my registered account via the web page in minimum time	3	HIGH	ATHIYA SULTHANA K

Sprint - 4	Web UI	USN - 3	As a user, I need to have a friendly user interface to easily viewand access the resources	3	MEDIUM	DHANISH S
Sprint - 1	Registration (Chemical Manufacturer - Web user)	USN - 1	As a new user, I want tofirst register using my organization email and create a password for the account.	2	HIGH	ATHIYA SULTHANA K
Sprint - 4	Login	USN - 2	As a registered user, Ineed to easily log in using the registered account via the web page.	3	HIGH	DEEPAK KUMAR S
Sprint - 3	Web UI	USN - 3	As a user, I need to have a user-friendly interface to easily view and access the resources.	3	MEDIUM	DHANISH S
Sprint - 1	Registration (Chemical Manufacturer - Mobile User)	USN - 1	As a user, I want to first register using my emailand create a password for the account.	1	HIGH	BALASUBRAMANIUM C S
Sprint - 1	Login	USN - 2	As a registered user, I need to easily log in tothe application.	2	LOW	DEEPAK KUMAR S

Project Tracker:

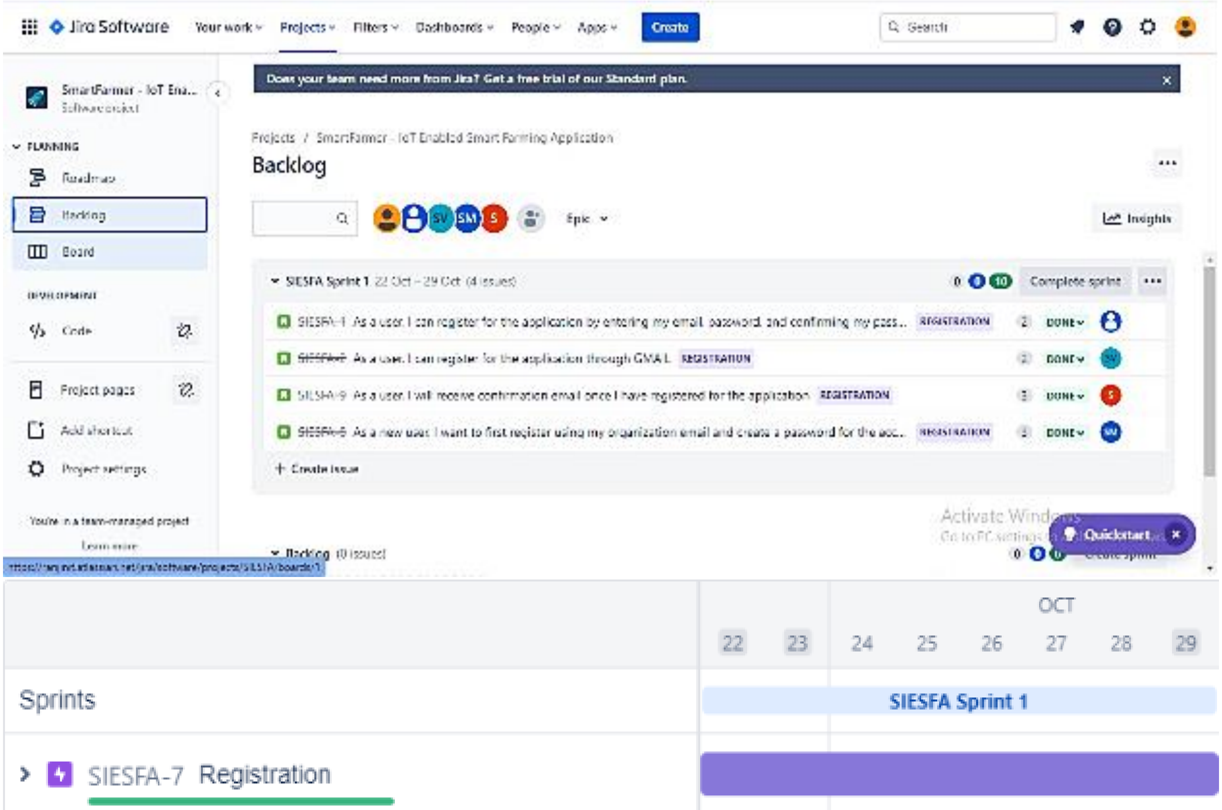
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	12	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	6	6 Days	31 Oct 2022	05 Nov 2022	20	30 OCT 2022
Sprint-3	6	6 Days	07 Nov 2022	12 Nov 2022	20	6 NOV 2022
Sprint-4	6	6 Days	14 Nov 2022	19 Nov 2022	20	7 NOV 2022

BURNDOWN CHART

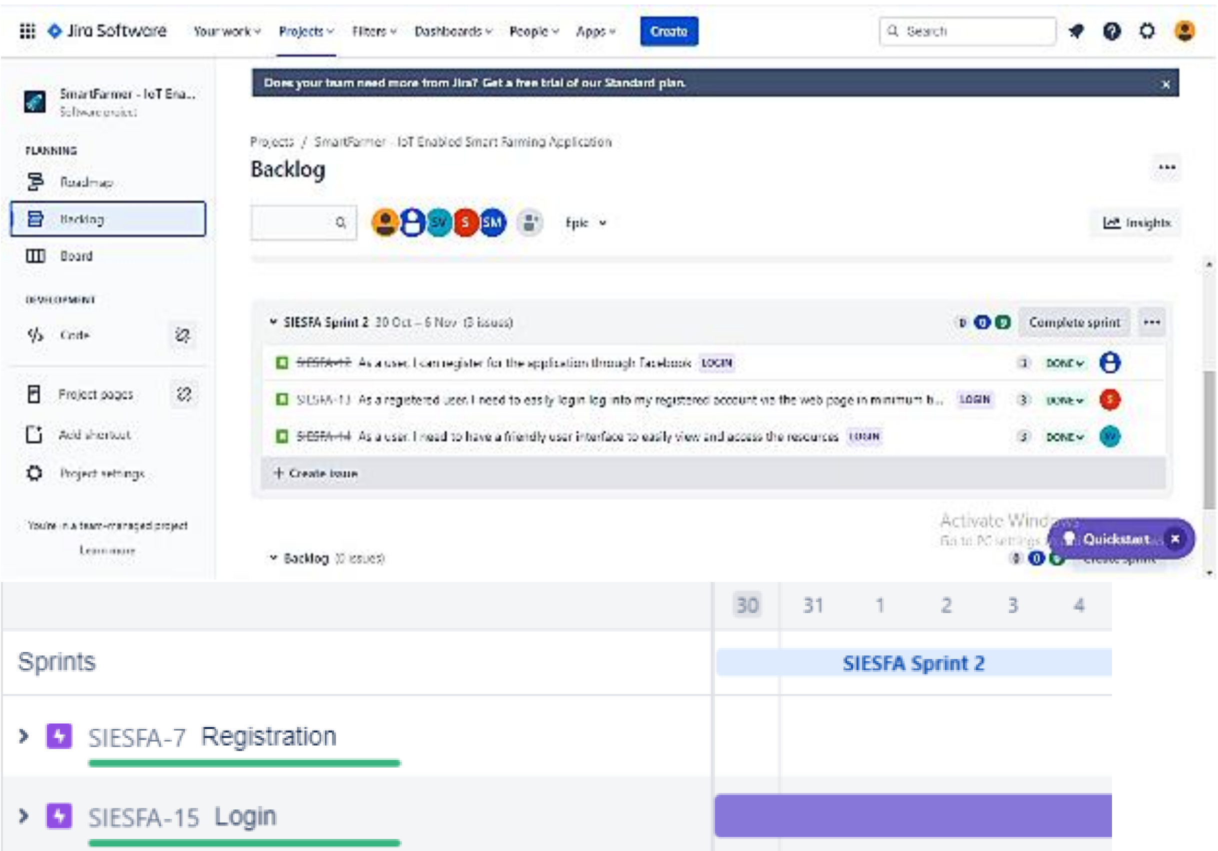


6.3 REPORTS FROM JIRA

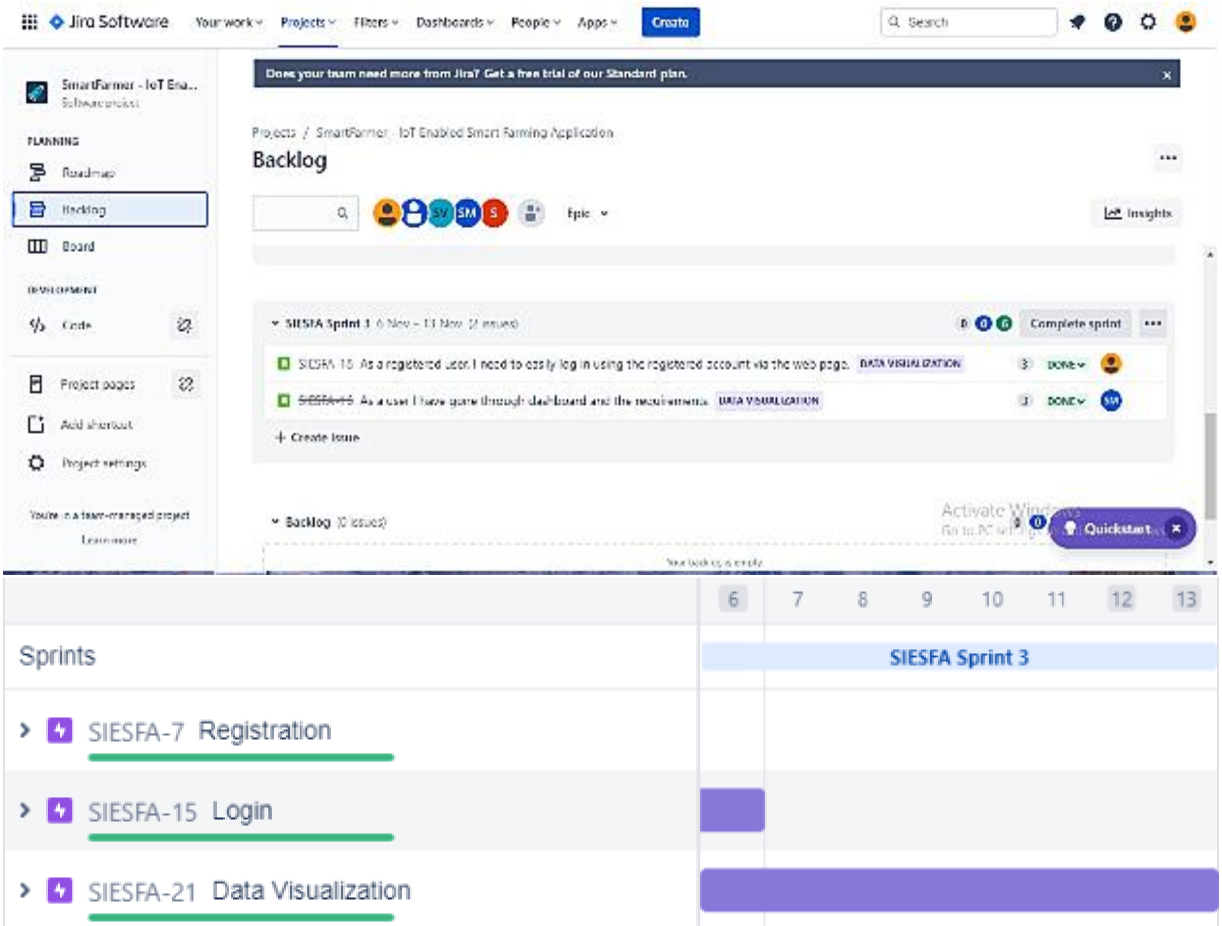
SPRINT 1:



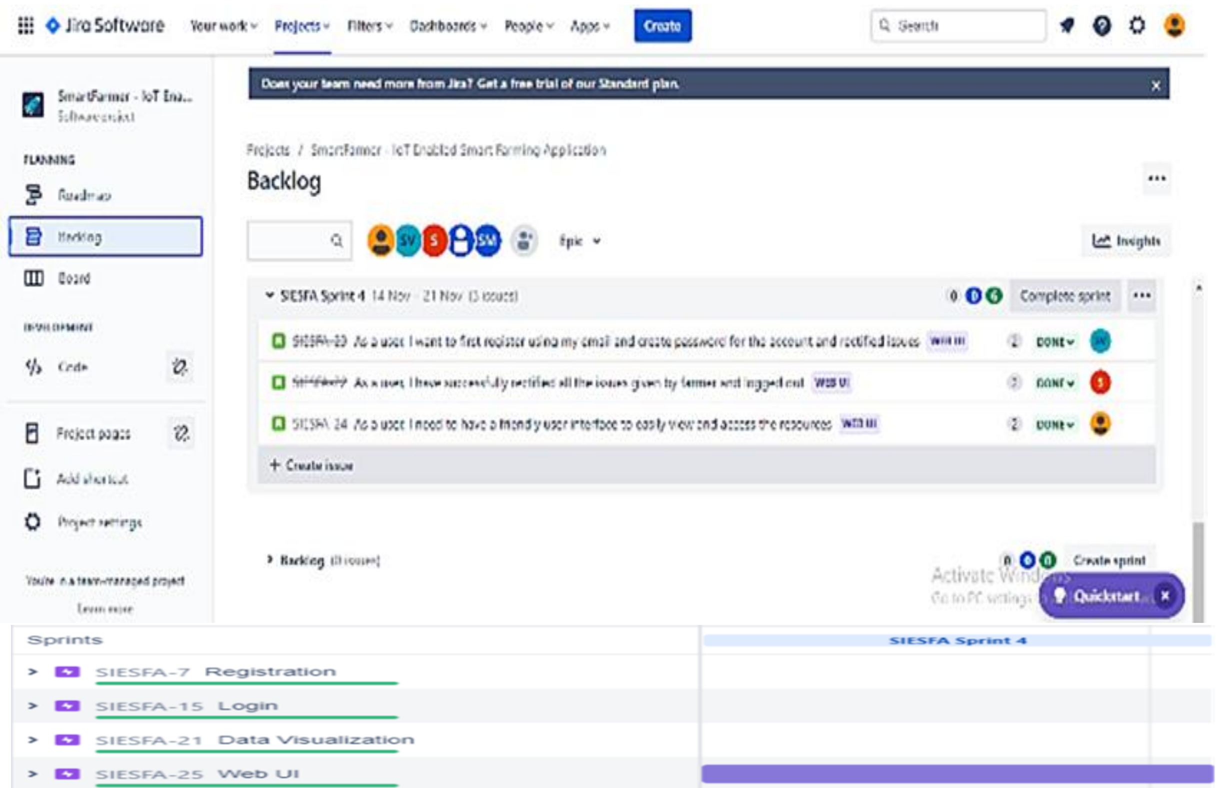
SPRINT 2:

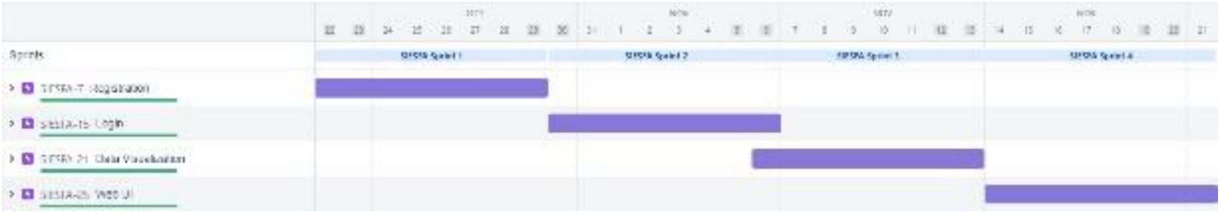


SPRINT 3:



SPRINT 4:





7: coding and solution

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": "41mir6",
        "typeId": "TestDeviceType",
        "deviceId":"12345"
    },
    "auth": {
        "token": "dxV@N9UtEhSp41c6*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()
```

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}
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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}
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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}
```

<u>8.TESTING:</u>

TEST CASES:

Although smart agriculture IoT, as well as industrial IoT in general, aren't as popular as consumer connected devices, the market is still very dynamic. The adoption of IoT solutions for agriculture is constantly growing. Namely, COVID-19 has had a positive impact 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:

1. 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 various data 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).

2. End-to-end farm management systems

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

3. Predictive analytics for smart farming

Precision agriculture and predictive data analytics go hand in hand. While IoT and smart sensor technology are a goldmine for highly relevant real-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 platform helps farmers access the volume and quality of yields in advance, as well as their vulnerability to unfavorable weather conditions, such as floods and drought.

4. 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, Farm app and Grow link are also IoT agriculture products offering such capabilities among others.

5. Crop management

One more type of IoT product in agriculture and another element of precision farming are 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 prevent any diseases or infestations that can harm your yield.

Arable and Semios can serve as good representations of how this use case can be applied

in real life.

6. Cattle monitoring and management

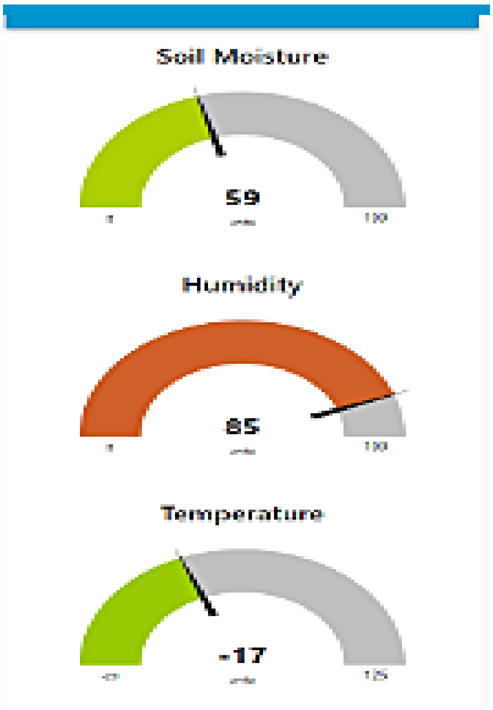
Just like crop monitoring, there are IoT agriculture sensors that can be attached to the animals on a farm to monitor their health and log performance. Livestock tracking and monitoring help collect data on stock health, well-being, and physical location.

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 staffing expenses. This works similarly to IoT devices for pet care.

7. Precision farming

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

.



8.1 USER ACCEPTANCE TESTING

RESOLUTION	SEVERITY 1	SEVERITY 2	SEVERITY 3	SEVERITY 4	SUB TOTAL
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 parameters in the Node RED	5	0	0	5
	3	0	0	3

CHAPTER 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.

Figure 9.1: Performance Metrics

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

Figure 9.2: NFT - DETAILED TEST PLAN

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.
- 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 a 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 about 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 have been used 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(0,100)
    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()
```

GitHub Link:

https://github.com/IBM-EPBL/IBM-Project-23769-1659928807

DEMO VIDEO LINK:

https://drive.google.com/file/d/1B1eWGzZ5hTwln15nt2VCYR4GoBzMhlcm/view?usp=drivesdk