



SETHU INSTITUTE OF TECHNOLOGY

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PULLOOR, KARIAPATTI - 626115



SMART FARMER-IoT ENABLED SMART FARMING APPLICATION

NALAIYATHIRAN PROJECT REPORT

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In partial fulfillment for the award of the degree

Of

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE AND ENGINEERING

SETHU INSTITUTE OF TECHNOLOGY

-

NOVEMBER 2022

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1. INTRODUCTION:

1.1 Project Overview

The Internet of Things is an emerging topic of technical, social, and economic significance. Consumer products, durable goods, cars and trucks, industrial and utility components, sensors, and other everyday objects are being combined with Internet connectivity and powerful data analytic capabilities that promise to transform the way we work, live, and play.

Internet of Things aim towards making life simpler by automating every small task around us. As much is IoT helping in automating tasks, the benefits of IoT can also be extended for Farming Applications.

Smart Farming based on IoT, this is an emerging system increases the quantity and quality of agricultural products. IoT devices provide information about nature of farming fields and then take action depending on the user's input. In this an IoT based advanced solution for monitoring the soil conditions and atmosphere for efficient crop growth is presented.

1.2 Purpose

The main aim of this project is to help farmers automate their farms by providing them with a Web App through which they can monitor the parameters of the field like Temperature, soil moisture, humidity and etc. and control the equipment like water motor and other devices remotely via internet without their actual presence in the field. . The developed system is capable of sending a notification to the user's phone about environmental conditions (parameters) of the field.

The purpose of this project is to monitor the parameters in the agricultural field. By making farming more connected and intelligent, precision

agriculture helps reduce overall costs and improve the quality and quantity of products, the sustainability of agriculture and the experience for the consumer.

2. LITERATURE SURVEY:

2.1 Existing Problem

Farmers need to deal with many problems, including how to:

- Cope with climate change, soil erosion and biodiversity loss
- Meet rising demand for more food of higher quality
- Invest in farm productivity
- Adopt and learn new technologies
- Stay resilient against global economic factors
- Inspire young people to stay in rural areas and become future farmers

2.2 References

1. Wheeler T, von Braun J (2013) Climate change impacts on global food security. *Science* 341(80):508–513. <https://doi.org/10.1126/science.1239402>
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6. Duckett T, Pearson S, Blackmore S, Grieve B, Chen W-H, Cielniak G, Cleaversmith J, Dai J, Davis S, Fox C, From P, Georgilas I, Gill R, Gould I, Hanheide M, Hunter A, Iida F, Mihalyova L, Nefti-Meziani S, Neumann G, Paoletti P, Pridmore T, Ross D, Smith M, Stoelen M, Swainson M, Wane S, Wilson P, Wright I, Yang G-Z (2018) Agricultural robotics: the future of robotic agriculture. [arXiv:1806.06762v2](https://arxiv.org/abs/1806.06762v2)
7. Autonomous technology is steering a new agricultural revolution|ASI [WWW Document] (n.d.). URL: <https://www.asirobots.com/autonomous-technology-steering-new-agricultural-revolution/>. Accessed 31 Jan 2019
8. Sahi MK, Wheelock C (2016) Driverless tractors and drones to be among the key applications for agricultural robots. Tractica

2.3 Problem Statement Definition

The Problem statement Comprises set of questions which the project seeks to address. It identifies the current state and future state and any gaps between the two.

Farmers are to be present at farm for its maintenance irrespective of the weather conditions. They have to ensure that the crops are well watered and the farm status is monitored by them physically. Farmer have to stay most of the time in field in order to get a good yield. In difficult times like in the presence of pandemic also they have to work hard in their fields risking their lives to provide food for the country.

The Problem arises here in this project is:

Problem-1:



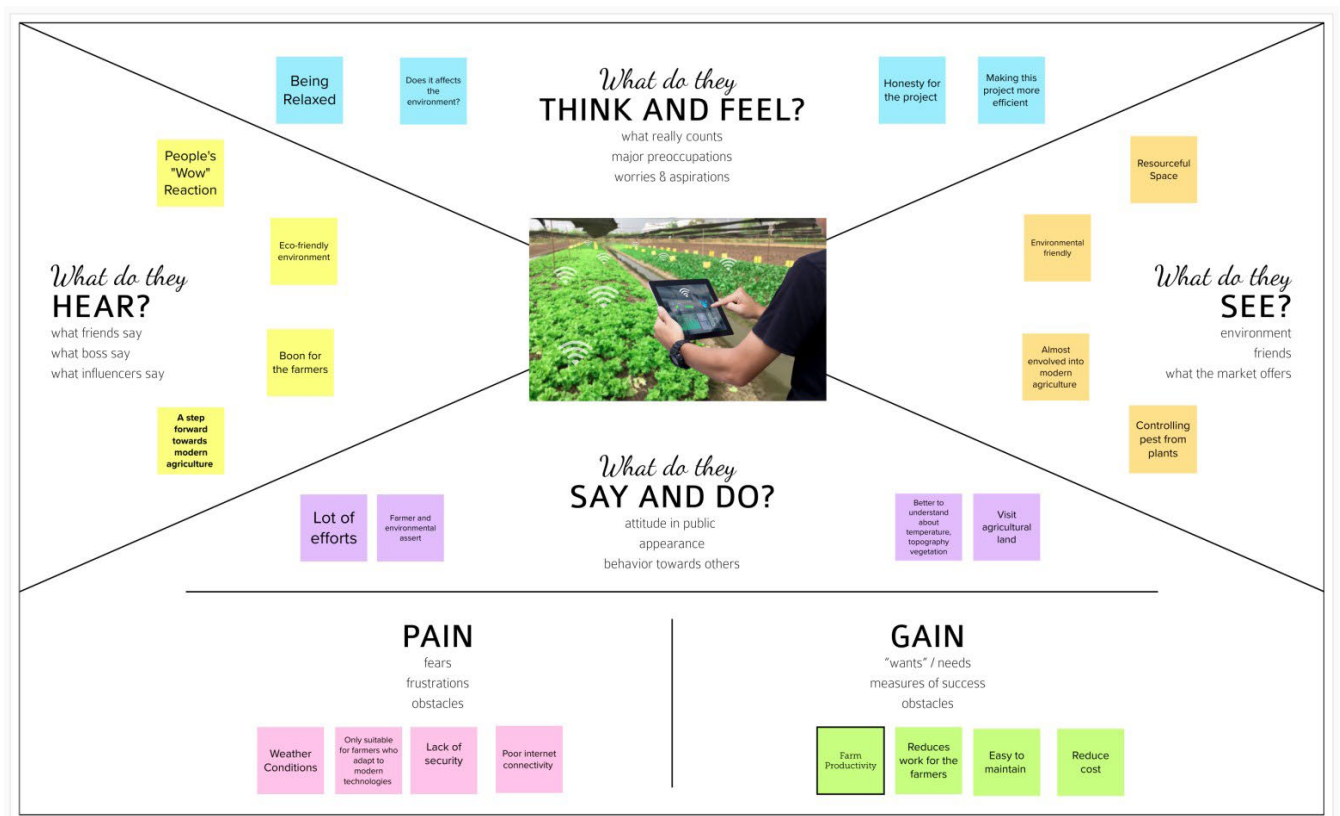
Problem-2:



3. IDEATION AND PROPOSED SOLUTION:

3.1 Empathy Map Canvas


An empathy map is a collaborative tool teams can use to gain a deeper insight into their customers.



3.2 Ideation and Brainstorming

Brainstorm & Idea Prioritization:

Step-1: Team Gathering, Collaboration and Select the Problem Statement:




Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

⌚ 10 minutes to prepare
🕒 1 hour to collaborate
👥 2-8 people recommended

[Share template feedback](#)




Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

⌚ 10 minutes

- 1 Team gathering
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.
- 2 Set the goal
Think about the problem you'll be focusing on solving in the brainstorming session.
- 3 Learn how to use the facilitation tools
Use the Facilitation Superpowers to run a happy and productive session.

[Open article](#)




Define your problem statement

What problem are you trying to solve? Frame your problem as a *How Might We* statement. This will be the focus of your brainstorm.

⌚ 5 minutes

PROBLEM

Farmer need to deal with many problems like crop with climate change, soil erosion and Biodiversity loss



Key rules of brainstorming

To run an smooth and productive session

1 Stay in topic.	2 Encourage wild ideas.
3 Defer judgment.	4 Listen to others.
5 Go for volume.	6 If possible, be visual.

Step-2: Brainstorm, Idea Listing and Grouping:

3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

Soil erosion

Make shelter beds to save plants from harming

Soil erosion has destroyed entire orchards

Manure/Pesticides

Improve soil quality by using natural manure

Smart pest management

Avoid using new pesticides

Encourage farmers to use manure properly

Climate

Frequent climate monitoring

Do farming in seasonal manner

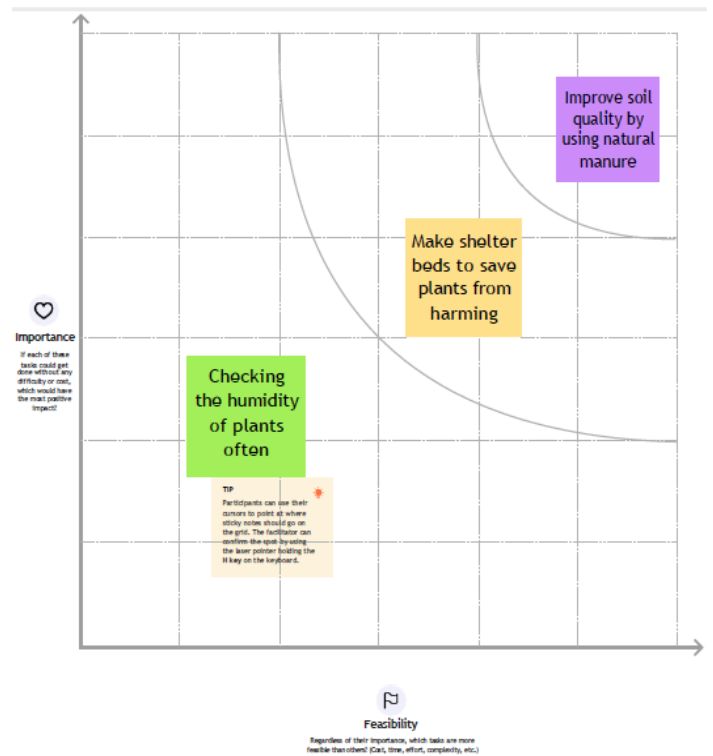
Turn off irrigation system when rain is in the forecast

4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes



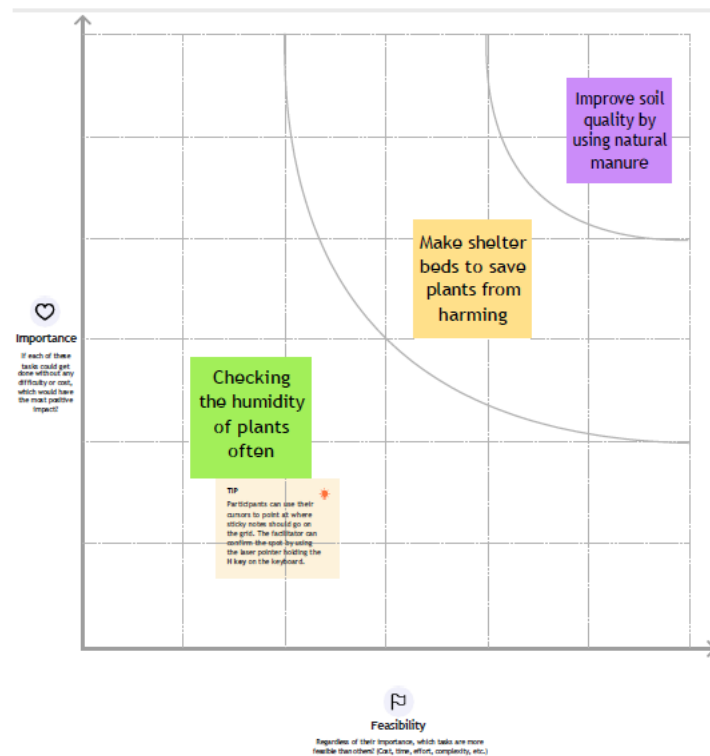
Step-3: Idea Prioritization:



Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

🕒 20 minutes



After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

Quick add-ons

- A Share the mural**
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.
- B Export the mural**
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

Keep moving forward

- Strategy blueprint**
Define the components of a new idea or strategy.
[Open the template](#)
- Customer experience journey map**
Understand customer needs, motivations, and obstacles for an experience.
[Open the template](#)
- Strengths, weaknesses, opportunities & threats**
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
[Open the template](#)

[Share template feedback](#)

3.3 Proposed Solution

The proposed solution should relate the current situation to a desired result and describe the benefits that will accrue when the desired result is achieved. So, begin your proposed solution by briefly describing this desired result.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To make farming easier by choosing several constraints in agriculture and to overcome those constraints, to increase production quality and quantity using IOT.
2.	Idea / Solution description	Using smart techniques like monitoring farms climate, smart irrigation and soil analysis.
3.	Novelty / Uniqueness	Solar power smart irrigation system which helps you to monitor temperature, moisture, humidity, using smart sensors.
4.	Social Impact / Customer Satisfaction	This will be better than the present modern irrigation and user friendly application. There will be better production yield.
5.	Business Model (Revenue Model)	As the productivity increases customer satisfaction also increases and hence need for the application also increases, which can raise the income of the business.
6.	Scalability of the Solution	It is definitely scalable we can increase the Constraints when the problem arises.

3.4 Problem Solution fit

Problem-Solution canvas is a tool for entrepreneurs, marketers and a corporate innovator, which helps them identify solutions with higher chances for solution adoption, reduce time spent on solution testing and get a better overview of current situation.

Journey steps Which step of the experience are you describing?	Discovery Why do they even start the journey?	Registration Why would they trust us?	On Boarding and first use How can they feel successful?	Sharing Why would they invite around?	Outcome What are they able to do now? What can they finally avoid doing? What changed in my environment?
Actions What does the customer want to achieve or avoid? What information do they look for? What is their context?	User can save their time.	Reduce their stress on losses.	Can stay updated instead of checking directly the field.	one device peroring multiple tasks and achieve 99% profit	To better understand the important factors like topography, vegetation, etc.
Needs and pains This is a toolbox... What does the customer want to achieve or avoid? Tip: Reduce ambiguity, eg. by using the first person narrator	cultivate using latest technology Larger yield than conventional farming	farming and manual labor were synonymous. dependency on manual labor has reduced significantly.	worry about the losses crop will not be affected from changing environment.	By utilizing IoT solutions, this is able to meet growing demand for crops while providing the highest quality standards.	Major obstacle in this technology adoption in india is medium land hldings followed b lack of education and support system
Touch point Which part of the service do they interact with?	Easier to make all sorts of management decisions. possible to optimise the monitoring of farm	thoughts difficult to adapt to the technology sceptical about benefits from smart farming technologies	User could understand detailed dependencies between the conditions and the quality of the crops. can recreate the best conditions	Economic Friendly	reduce use of fertilizers, herbicides, agricultural pollution
Customer Feeling What is the customer feeling? Tip: Use the emoji app to express more emotions	😊	😊	😊	😊	
Backstage					
Opportunity What could we improve or introduce?	Precise Farming	Increase the technology awarness among the process	Increase the dexterity and boost productivity	Increase quality prooduct and optimize human labour	

4. REQUIREMENT ANALYSIS

4.1 Functional requirement

Functional requirements may involve calculations, technical details, data manipulation and processing and other specific functionality that define what a system is supposed to accomplish. Behavioral requirements describe all the cases where the system uses the functional requirements; these are captured in use cases.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Username
FR-2	User Confirmation	Through password
FR-3	Login to system	Check credentials
FR-4	Check details	Temperature details Humidity details Soil Moisture details
FR-5	Log out	Exit

4.2 Non-Functional requirements

A Non-functional requirement (NFR) is a requirement that specifies criteria that can be used to judge the operation of a system, rather than specific behaviors.

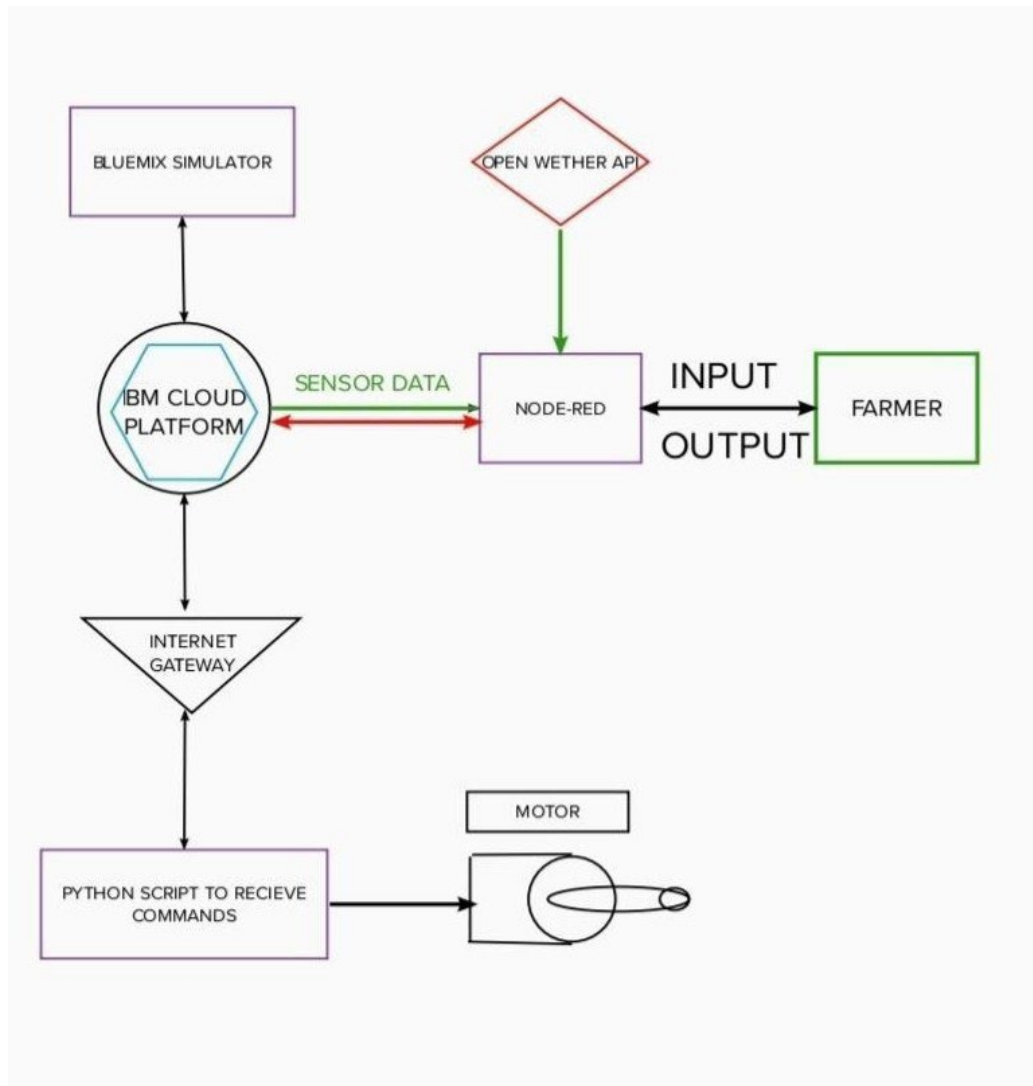
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	<ul style="list-style-type: none"> • High productivity • Less time consumption • Easy to learn
NFR-2	Security	Sensitive and private data must be protected from their production until the decision making and storage stages
NFR-3	Reliability	Accuracy of data and hence it is Reliable.
NFR-4	Performance	The idea of implementing the integrated sensors with sensing soil and environmental or ambient parameters in farming will be more eminent for overall monitoring

NFR-5	Availability	Automatic adjustment of farming equipment made possible by linking information like crops, weather and equipment to auto adjust temperature, humidity, watering crops, etc.
NFR-6	Scalability	Scalability is a major concern for IoT platforms. It has shown that different architectural choices of IoT platforms a system scalability and that automatic real time decision making is feasible in an environment composed of dozens of thousands.

5. PROJECT DESIGN

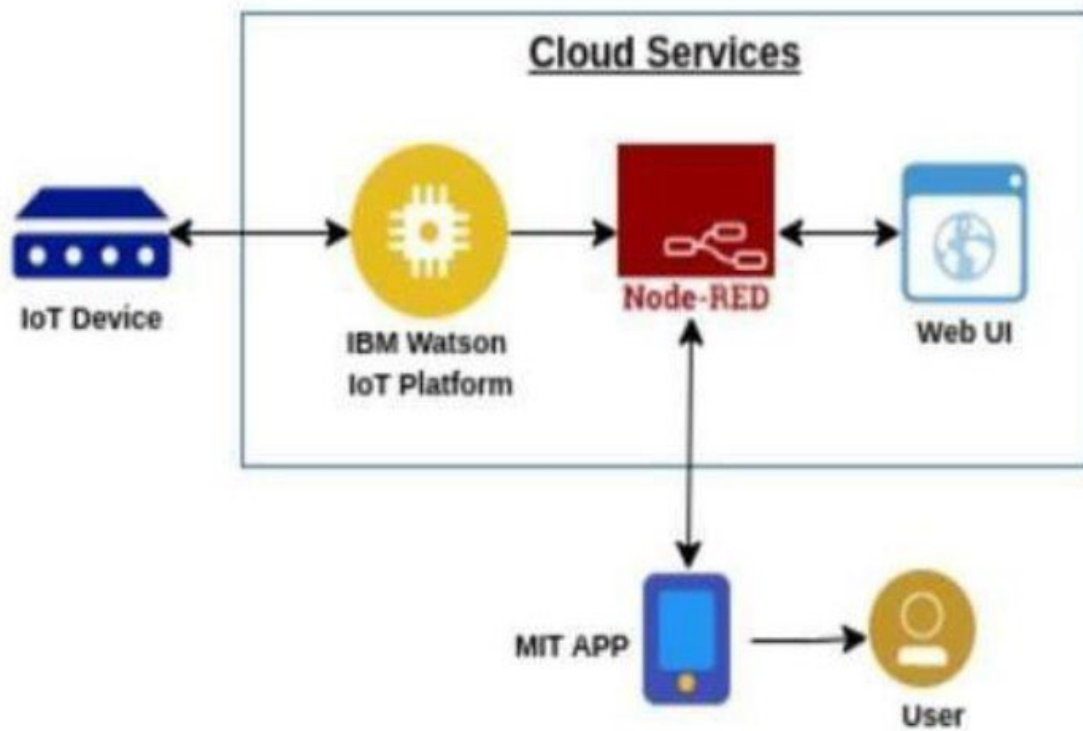
5.1 Data Flow Diagrams

A data flow diagram shows the way information flows through a process or system. It includes data inputs and outputs, data stores, and the various sub processes the data moves through. DFDs are built using standardized symbols and notation to describe various entities and their relationships.



5.2 Solution & Technical Architecture

Solution architecture (SA) is architectural description idea of a specific solution. SA's combine guidance from different enterprise architecture viewpoints (business, information and technical), as well as from the enterprise solution architecture (ESA).



5.3 User Stories

A user story is an informal, general explanation of a software feature written from the perspective of the end user or customer. The purpose of a user story is to articulate how a piece of work will deliver a particular value back to the customer.

6. PROJECT PLANNING & SCHEDULING:

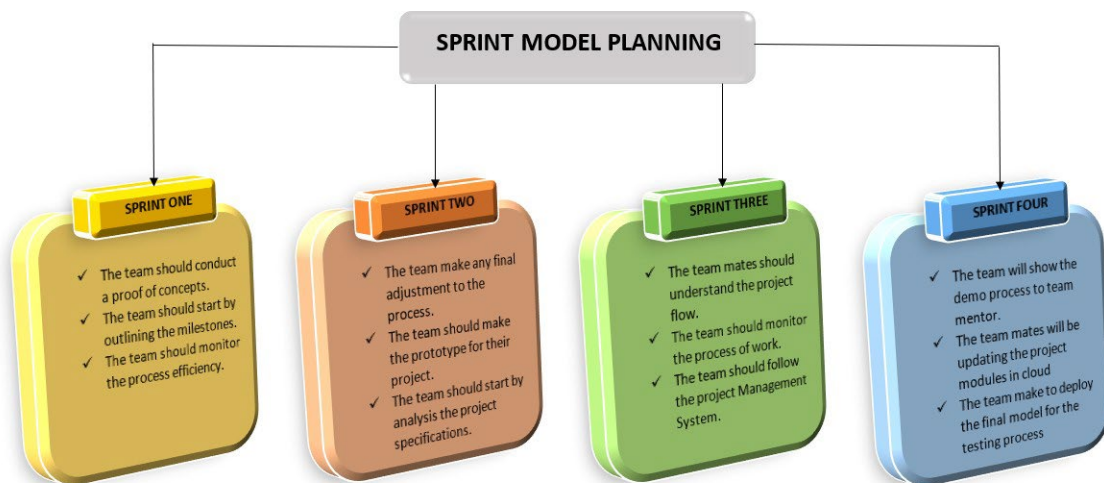
6.1 Sprint Planning & Estimation

The objective of the Estimation would be to consider the User Stories for the Sprint by Priority and by the Ability of the team to deliver during the Time Box of the Sprint.

Sprint	Functional Requirement (Epic)	User Story number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Software	USN-1	Sensors and Wi-Fi module with python code.	2	High	Lakshya, Dharshini, Boopathy Sneha
Sprint-2	Software	USN-2	IBM Watson IoT platform, Workflows for IoT scenarios using Node-red	2	High	Lakshya, Dharshini, Boopathy Sneha
Sprint-3	MIT app	USN-3	To develop an mobile application using MIT	2	High	Lakshya, Dharshini Boopathy Sneha
Sprint-4	Web UI	USN-4	To make the user to interact with software.	2	High	Lakshya, Dharshini Boopathy Sneha

6.2 Sprint Delivery Schedule

Delivery Plan



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	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	5 th NOV 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 th NOV 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	14 th NOV 2022

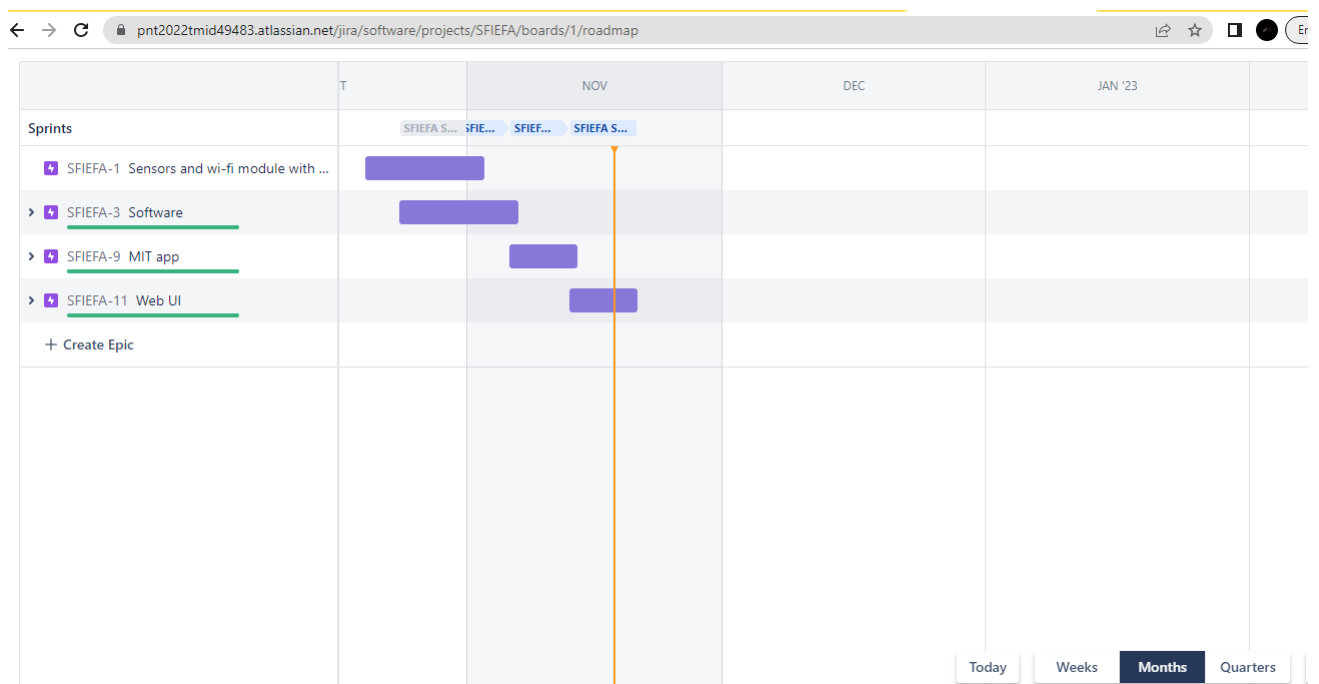
6.3 Reports from JIRA

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,

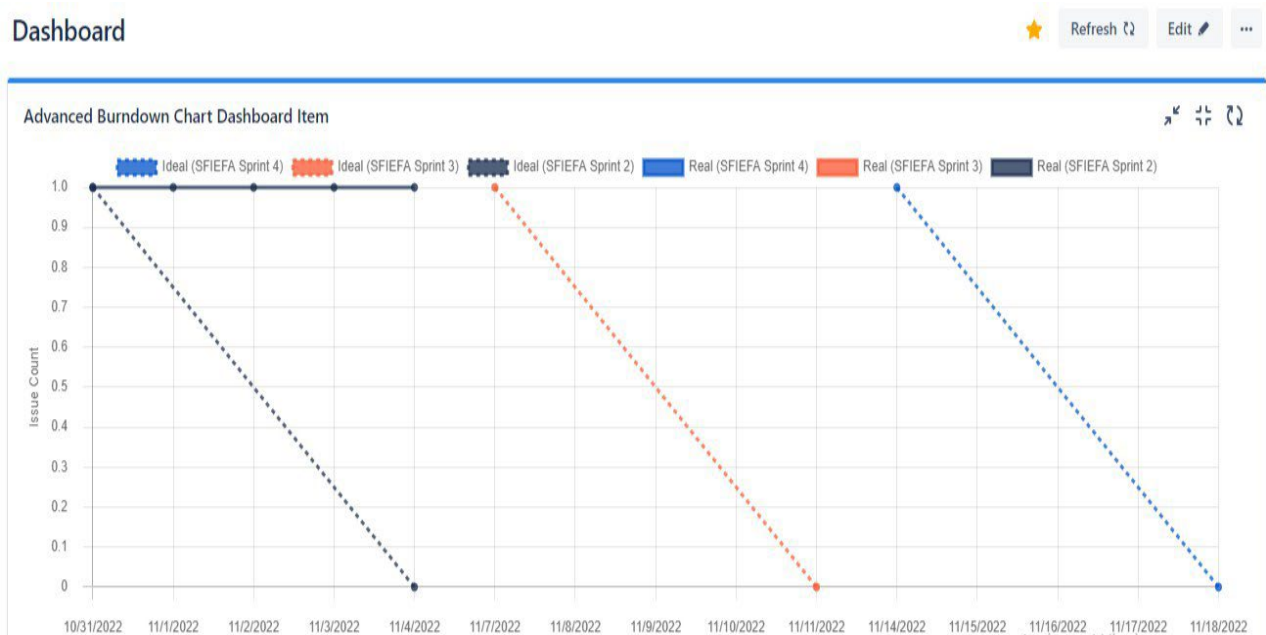
Jira has evolved into a powerful work management tool for all kinds of use cases, from requirements and test case management to agile software development.

Road Map:



Burndown Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.



7. CODING & SOLUTIONING:

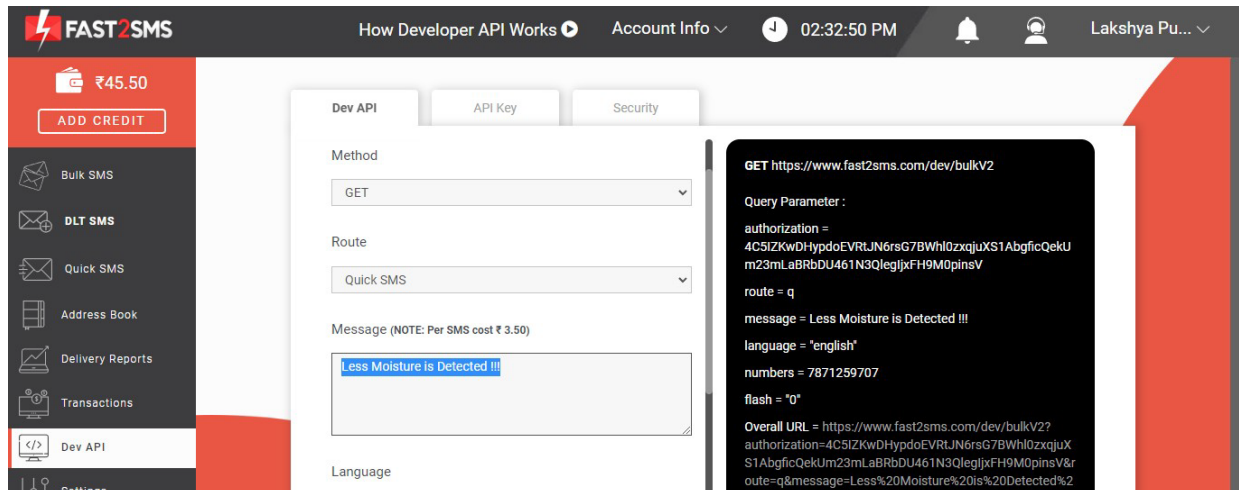
7.1 Feature-1

To indicate the less moisture level in the field, so that the user can switch on motor to reach the sufficient water level. We gave a condition using python:

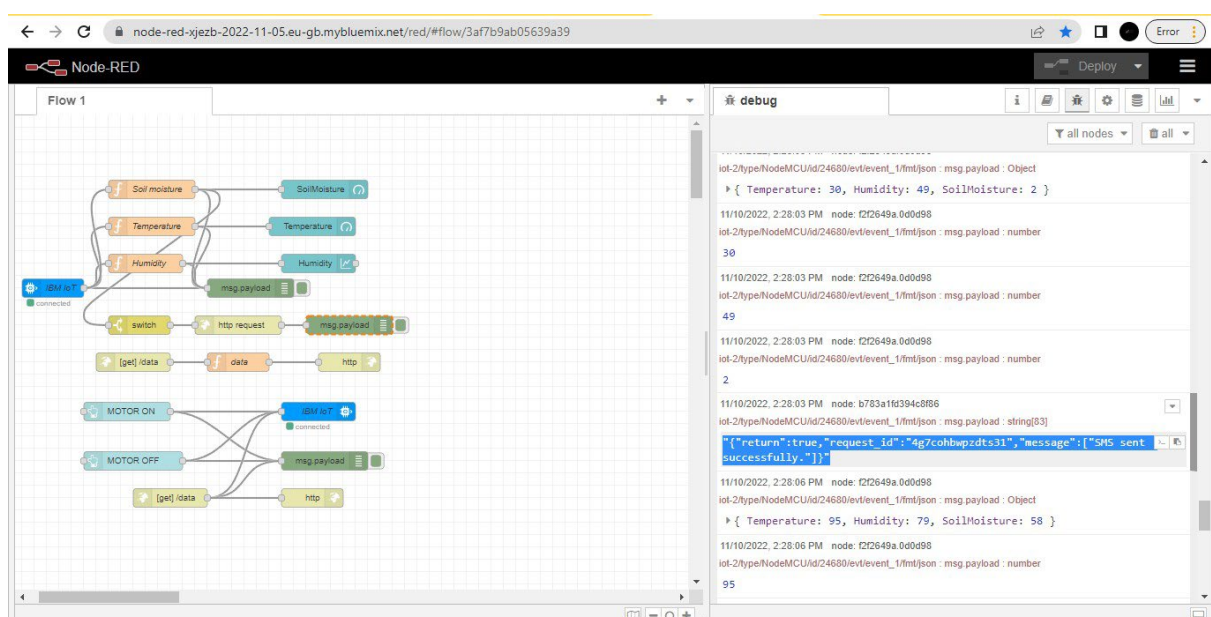
```
print("Published data Successfully: %s", myData)
if(soil<20):
    print("Less moisture is detected")
else:
    print("Moisture is sufficient")
```

7.2 Feature-2

We are using Fast2sms to send message to the user. Fast2SMS provides a very unique and useful feature which is not available in any other bulk SMS service provider. You can send SMS to DND and Non DND numbers even if you are not registered in the DLT portal.



After created the fast2sms service, copy the overall url and paste in the Node red flow to send SMS to whenever the moisture level went below the threshold limit.



8. TESTING

8.1 Test Cases

				Project Name	Smart Farmer-IoT enabled smart farming application								
				Maximum Marks	4 marks								
Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Comments	TC for Automation(Y/N)	BUG ID	Executed By
LoginPage_TC_01	Functional	Home Page	Verify user is able to see the Login/Signup popup when user clicked on Start button	MIT App Inventor	1.Open MIT application 2.Home page will appear. 3.Click on Start button.	http://ai2.appinventor.mit.edu/#6734083678666752	Login/Signup screen should display	Working as expected	Pass	Got the Exact Results	Yes	Nil	User
Database_TC_002	Functional	Firebase	Verify the Firebase	Firebase Account creation	1.Open Chrome 2. Search firebase 3.Create new form login project a.create account (if already not existed) and create realtime database. b.Create a program to store the credentials. 2.Publish the program to execute.	https://formlogi-n-283db-default-ndb.firebaseio.com/	To Store and Get the value of username and password	Working as expected	Pass	Got the exact results	Yes	Nil	Developer
LoginPage_TC_03	Functional	Login/Signup Buttons	Verify user is able to log into application with Valid credentials	MIT App Inventor	1.Enter UserName and Password in the respected boxes. 2.Click on sign up to store the values. 3.Now click login to view the parameters. 4.If invalid password entered in password text box	Username and Password Text boxes. Username: device password: 123	User should able to view the parameters	working as expected	Pass	got the exact results	Yes	Nil	User

Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Comments	TC for Automation(Y/N)	BUG ID	Executed By
LoginPage_TC_04	Functional	Login page	Verify user is able to log into application with Invalid credentials		1.Enter URL(https://shopenzer.com/) and click go 2.Click on My Account dropdown button 3.Enter Valid username/email in Email text box 4.Enter Invalid password in password text box	Username: dev password: 123	Application should show 'Incorrect email or password' validation message.	working as expected	pass	Got the exact results	yes	nil	User
TC-005	UI	Home Page	Verify whether the expected measurement sections are present and with default values	IBM cloud, Python IDLE, Node-Red, FastSMS	1.Navigate to the Soil Moisture UI 2.User should see the measurement fields for Temperature, Pressure, Humidity and Soil Moisture 3. All those fields should initially points to null value	Arduino board, ESP8266, Soil Moisture Sensor	Desired output.	Working as expected	Pass	Executed successfully	Yes	Nil	User
TC-006	Functional	Home Page	Verify the smoke sensor is detecting with good accuracy even with all	IBM cloud, Python IDLE, Node-Red, FastSMS	1.Navigate to the Soil Moisture UI 2. Check for the measurement accuracy	Arduino board, ESP8266, Soil Moisture Sensor	Desired output	Working as expected	Pass	Successful	No	Nil	User

8.2 User Acceptance Testing

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the Smart Farmer IoT enabled smart farming application 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 severity level, and how they were resolved.

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
Improper network connectivity	10	6	4	2	22
Humidity alone is detected.	12	10	6	4	32
Continuous Battery Consumption	20	9	5	2	36
Detection Coverage Area	14	6	2	2	24
Altering the Calibration Curve	20	9	7	6	42
Maintenance	11	3	2	1	17
Accuracy detection of parameters	17	9	6	3	35
Totals	104	52	32	20	208

3. Test Case Analysis

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

Section	Total Cases	Not Tested	Fail	Pas s
Improper network connectivity	6	2	1	1
Humidity alone is detected.	15	0	0	15
Continuous Battery Consumption	12	0	0	12
Detection Coverage Area	5	0	1	4
Altering the Calibration Curve	4	0	0	4
Maintenance	5	0	0	5
Accuracy detection of parameters	1	0	0	1

9. RESULTS:

9.1 Performance Metrics

Performance metrics are defined as figures and data representative of an organization's actions, abilities, and overall quality.

				Date	19-Nov-22				
				Team ID	PNT2022TMDI6898				
				Project Name	Smart Farmer IoT Enabled Smart Farming Application				
NFT - Risk Assessment									
No	Scenario Name	Scope/Feature	Functional Changes	Hardware Changes	Software Changes	Impact of Downtime	Load/Volume Changes		Risk Score
1	Detection accuracy - Response	New	New	Low	Moderate	Moderate	No Changes		Orange
2	Soil Moisture below threshold limit	New	Moderate	No	NO	Low	No Changes		Green
NFT - Detailed Test Plan									
	S.No	Project Overview	NFT Test approach	Assumptions/Dependencies/Risks	Approvals/SignOff				
	1	Detection Accuracy and response	Using python and Node Red	Dependency-Cloud client / Risk-Moderate					
	2	Soil Moisture below threshold limit	Using python and Node Red	Dependency-Cloud client / Risk-Low					
	3	User Mobile Application	Using MIT App Inventor	Dependency-Cloud client / Risk-					
End Of Test Report									
No	Project Overview	FT Test approach	NFR - Met	Test Outcome	GO/NO-GO decision	Identified Defects (Detected/Closed/Open)	Approvals/SignOff		
1	Detection accuracy - Response	Using Python and NodeRed	No	Expectations partially met	No-Go	Observed intermittent performance issue sometimes. Bug is open			
2	Soil Moisture below threshold limit	Using Python and NodeRed	Yes	Expectations met	Go	Observed response for the leakage detection in the UI and its accuracy is as expected.			

10. ADVANTAGES & DISADVANTAGES:

Advantages

- Farms can be monitored and controlled remotely.
- Increase in convenience to farmers.
- Less labour cost.
- Better standards of living.

Disadvantages:

- Lack of internet/connectivity issues.
- Added cost of internet and internet gateway infrastructure.
- Farmers wanted to adapt the use of WebApp.

11. Conclusion

Thus the objective of the project to implement an IoT system in order to help farmers to control and monitor their farms has been implemented successfully.

12. Future Scope:

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.

13. Appendix:

13.1 Source Code

```
#IBM Watson IOT Platform
```

```
#pip install wiotp-sdk
```

```
import wiotp.sdk.device
```

```
import time
```



```

import random

#Provide your IBM Watson Device Credentials

myConfig = {
    "identity": {
        "orgId": "0lz4tn",
        "typeId": "NodeMCU",
        "deviceId": "24680"
    },
    "auth": {
        "token": "1133557799"
    }
}

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()

#Conditions
while True:
    temp=random.randint(0,100)

```

```
hum=random.randint(0,100)
soil=random.randint(0,100)
myData={'Temperature':temp,
        'Humidity':hum,
        'SoilMoisture':soil}
    client.publishEvent(eventId="status", msgFormat="json", data=myData,
qos=0, onPublish=None)
print("Published data Successfully: %s", myData)
if(soil<20):
    print("Less moisture is detected")
else:
    print("Moisture is sufficient")
time.sleep(2)
client.commandCallback = myCommandCallback
client.disconnect()
```

14. Bibliography

Github link: <https://github.com/IBM-EPBL/IBM-Project-49483-1660820029>

Project Demolink:

https://drive.google.com/drive/folders/1tAnRgO7ZmH_nDLQptkTfXxP4ULZB93z3

MIT App Inventor: <http://ai2.appinventor.mit.edu/#6734083678666752>