

PROJECT REPORT

Smart Farmer - IoT Enabled Smart Farming Application

1. INTRODUCTION:

1.1 Project Overview

- This project is based on Internet Of Things (IoT), that can measure soil moisture, Humidity and temperature conditions for agriculture using Watson IoT services. IoT is network that connects physical objects or things embedded with electronics, software and sensors through network connectivity that collects and transfers data using cloud for communication. Data is transferred through internet without human to human or human to computer interaction.
- In this project we have not used any hardware. Instead of real soil moisture, Humidity and Temperature data obtained from sensors we make use of IBM IoT Simulator which can transmit these parameters as required.

1.2 Purpose

- IoT-based agriculture system helps the farmer in monitoring different parameters of his field like soil moisture, temperature, and humidity using some sensors.
- Farmers can monitor all the sensor parameters by using a web or mobile application 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.

2. LITERATURE SURVEY:

2.1 Existing Problem

- Agriculture is a field which forms the basis of our economy. Yet it faces a lot of problems in terms of availability of resources, Irrigation, increasing rate of Pesticides, Climatic disasters, Insects which ruin the crops and makes a huge loss this sector.
- In agriculture water is needed for the crops for their growth. If the Soil gets dry it is necessary to supply water. But sometime if the farmer doesn't visit the field it is not possible to know the condition of soil.
- Sometimes over supply of water or less supply of water affects the growth of crops.
- Sometimes if the weather/temperature changes suddenly it is necessary to take certain actions.
- Specific crops grow better in specific conditions, they may get damaged due to bad weather.

2.2 References

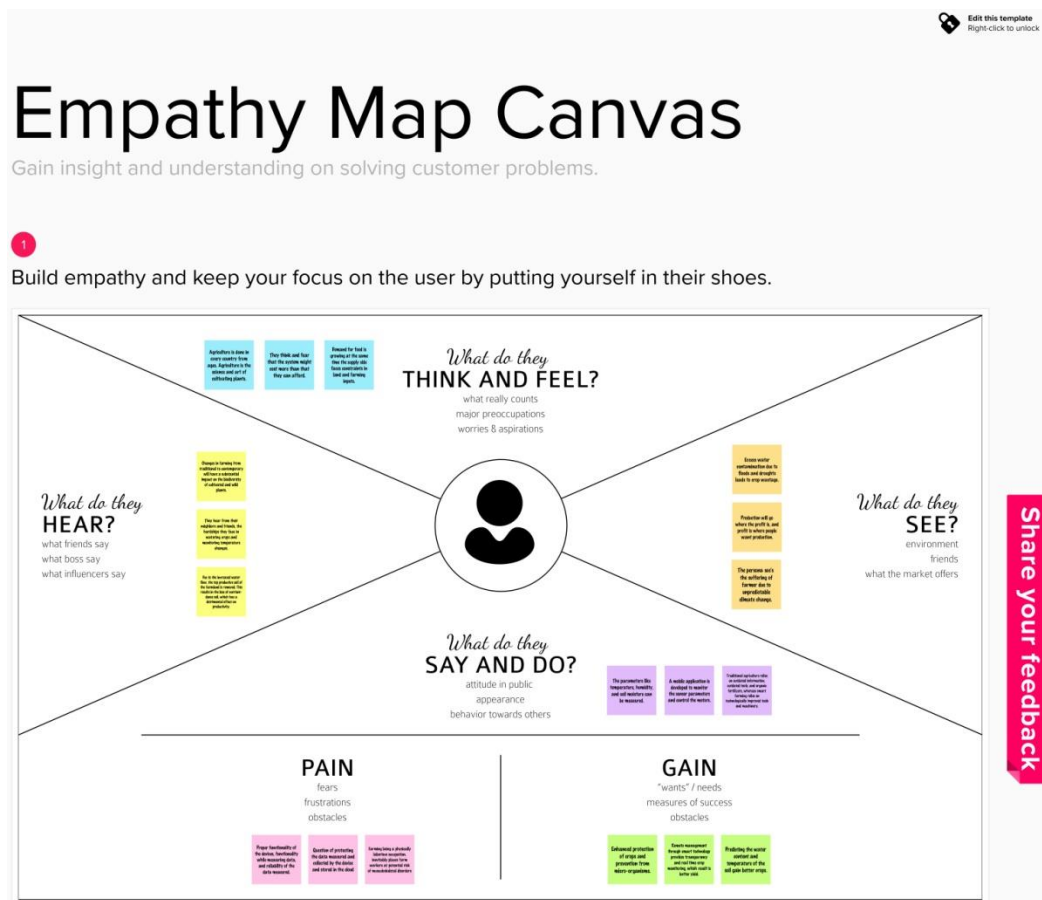
1. Mobile Integrated Smart Irrigation and Monitoring System Using IOT
Date of Conference: 06-08 April 2017
Publisher: IEEE
Date Added to IEEE Xplore: 08 February 2018
DOI:10.1109/ICCSP.2017.8286792
2. IoT Based Smart Irrigation Monitoring And Controlling System
Date Added to IEEE Xplore: 15 January 2018
ISBN Information: Electronic ISBN: 978-1-5090...
Date of Conference: 19-20 May 2017
INSPEC Accession Number: 17504411
3. Smart Waste Collection Monitoring and Alert System via IoT
Date Added to IEEE Xplore: 24 June 2019
DOI:10.1109/ISCAIE.2019.874376
Print on Demand(PoD) ISBN: 978-1-5386-854

2.3 Problem Statement Definition


- Smart Farmer System based on IoT can monitor soil moisture and climatic conditions to grow and yield a good crop.
- The farmer can also get the real time weather forecasting data by using external platforms like Open Weather API.
- Farmer is provided a mobile app using which he can monitor the temperature, humidity and soil parameters along with weather forecasting details.
- Based on all the parameters he can water his crop by controlling the motors using the mobile application.
- Even if the farmer is not present near his crop he can water his crop by controlling the motors using the mobile application from anywhere.
- Here we are using the Online IoT simulator for getting the Temperature, Humidity and Soil Moisture values.

3. IDEATION & PROPOSED SOLUTION:

3.1 Empathy Map Canvas



3.2 Ideation & Brain Storming



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
- 2-3 people recommended



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

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



PROBLEM STATEMENT

Farmers are under pressure to produce more food and use less energy and water in the process. A remote monitoring and control system will help farmers deal effectively with these pressures. Ideally, each field should get just the right amount of water at just the right time. Most of the rural area people can't implement the IoT devices because of they don't know about the device to use it.



WHO

WHO is having the problem?
WHO will benefit from our solution?
What do we know/assume about them?

1. Question: Research Background

What is the current state of the problem? What are the key stakeholders? What are the key challenges?

2. Question: In which way does the problem affect the user?

What are the key stakeholders? What are the key challenges? What are the key impacts?

3. Question: Research Background

What is the current state of the problem? What are the key stakeholders? What are the key challenges?

4. Question: In which way does the problem affect the user?

What are the key stakeholders? What are the key challenges? What are the key impacts?

WHAT

Is it easy to explain?
Is it an actual/real problem?
Have we got any evidence?

1. Question: Research Background

What is the current state of the problem? What are the key stakeholders? What are the key challenges?

2. Question: In which way does the problem affect the user?

What are the key stakeholders? What are the key challenges? What are the key impacts?

3. Question: Research Background

What is the current state of the problem? What are the key stakeholders? What are the key challenges?

4. Question: In which way does the problem affect the user?

What are the key stakeholders? What are the key challenges? What are the key impacts?

WHERE/WHEN

DOES IT OCCUR?

What is the context where the Persona is experiencing the problem?
Can we easily explain the context?
Have we got proof of the problem happening in a certain context or space?

1. Question: Research Background

What is the current state of the problem? What are the key stakeholders? What are the key challenges?

2. Question: In which way does the problem affect the user?

What are the key stakeholders? What are the key challenges? What are the key impacts?

3. Question: Research Background

What is the current state of the problem? What are the key stakeholders? What are the key challenges?

4. Question: In which way does the problem affect the user?

What are the key stakeholders? What are the key challenges? What are the key impacts?

WHY

CARE ABOUT IT?

What is the most important value for the user?
What pain points would a solution help get rid of?
Why is it worth our investment?
How does it meet our business goals? KPIs?

1. Question: Value for the User

What is the current state of the problem? What are the key stakeholders? What are the key challenges?

2. Question: Value for the Business

What is the current state of the problem? What are the key stakeholders? What are the key challenges?

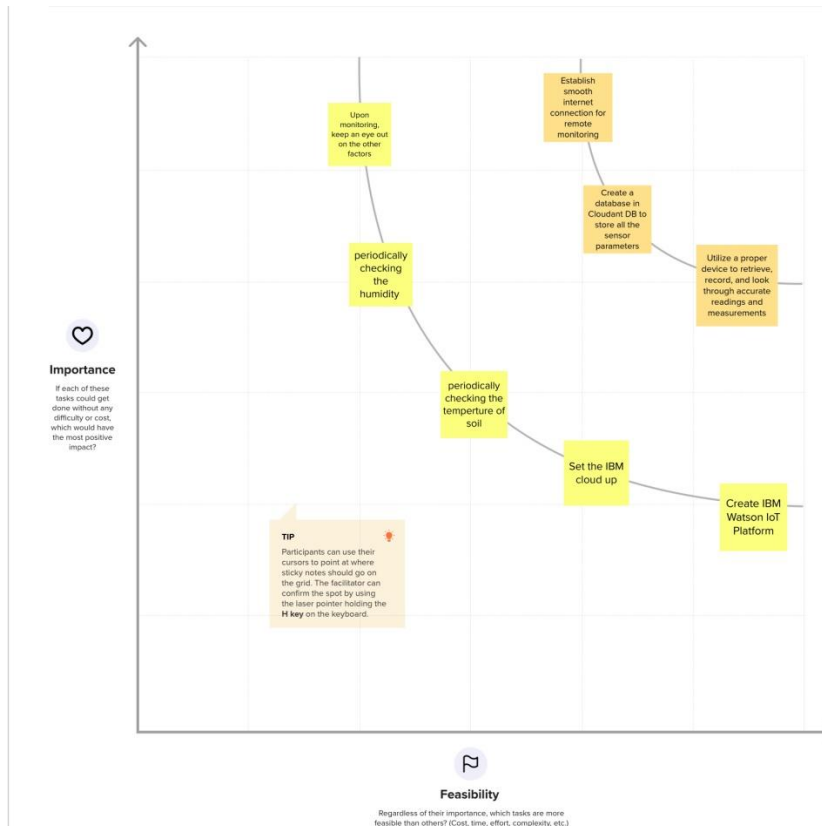
3. Question: Value for the User

What is the current state of the problem? What are the key stakeholders? What are the key challenges?

4. Question: Value for the Business

What is the current state of the problem? What are the key stakeholders? What are the key challenges?

Brainstorming:



3.3 Proposed Solution

S.No.	Parameter	Description
1	Problem Statement (Problem to be solved)	To provide efficient decision support system using wireless sensor network which handle different activities of farm and gives useful information related to farm. Information related to Soil moisture, Temperature and Humidity content. Due to the weather condition, water level increasing Farmers get lot of distractions which is not good for Agriculture.
2	Idea / Solution description	Smart Agricultural System solutions provide an integrated IoT platform in agriculture that allows farmers to leverage sensors, smart gateways and monitoring systems to collect information, control various parameters on their farms and analyse real-time data in order to make informed decisions.
3	Novelty / Uniqueness	Various eminent researchers have been making efforts for smart farming by using IoT concepts in agriculture. But, a bouquet of unfolded challenges is still in a queue for their effective solution. This study makes some efforts to discuss past research and open challenges in IoT based agriculture.
4	Social Impact / Customer Satisfaction	Reduces the wages for labors who work in the agricultural field. It saves a lot of time. IoT can help improve customer relationships by enhancing the customer's overall experience.
5	Business Model (Revenue Model)	A monthly subscription is charged to farmers for prediction and suggesting their irrigation timing based on sensors

3.4 Problem Solution Fit

Problem-Solution fit canvas 2.0

Purpose / Vision

<div>1. CUSTOMER SEGMENT(S)</div> <div>CS</div> <div>Define CS, fit into CC</div> <p>The customers of this product are the farmers who cultivate crops. Our aim is to assist, aid and help them to monitor the field parameters remotely and to keep track of the parameters. This product saves the agriculture from extinction.</p>	<div>6. CUSTOMER CONSTRAINTS</div> <div>CC</div> <p>Deployment of huge number of sensors is difficult. It requires an unlimited or continuous internet connection to be successful.</p>	<div>5. AVAILABLE SOLUTIONS</div> <div>AS</div> <div>Explore AS, differentiate</div> <p>The irrigation process is automated using IoT. weather data and field parameters were obtained and processed to automate the process of irrigation. The drawbacks are high cost of installation, efficient only for short distance, difficulty in storing the data.</p>
<div>2. JOBS-TO-BE-DONE / PROBLEMS</div> <div>J&P</div> <div>Focus on J&P, tap into BE, understand RC</div> <p>The objective of this product is to obtain the different field parameters using sensor and process it using a central processing system. Cloud is used to store and transmit the data by using IoT. Weather APIs are employed to assist the farmer in making decision. The farmer could take decision through a mobile application.</p>	<div>9. PROBLEM ROOT CAUSE</div> <div>RC</div> <p>The frequent change or unpredictable weather and climate, made it difficult for the farmers to do agriculture. These factors play a major role in making decision whether to water the plant or not. The monitoring of the field is hard when the farmer is out of station, thus leading to crop damage.</p>	<div>7. BEHAVIOUR</div> <div>BE</div> <div>Focus on J&P, tap into BE, understand RC</div> <p>Using proper drain system to overcome the effects of excess water due to heavy rain. Using hybrid varieties of crop that are resistant to pests.</p>
<div>3. TRIGGERS</div> <div>TR</div> <div>Identify strong TR & EM</div> <p>Farmers facing issues in providing proper irrigation. No proper supply of water leads to reduced production which affects the profit level of the farmer. Farmer's struggle to predict the weather.</p>	<div>10. YOUR SOLUTION</div> <div>SL</div> <p>Our product collects the data from different types of sensors and it sends the value to the main server. It also collects the weather data from the weather API. The ultimate decision, whether to water the crop or not is taken by the farmer using mobile application.</p>	<div>8. CHANNELS of BEHAVIOUR</div> <div>CH</div> <div>Extract online & offline CH of BE</div> <p>ONLINE: Providing online assistance to the farmer, in providing knowledge regarding the pH and moisture level of the soil. Online assistance to be provided to the user in using the product</p> <p>OFFLINE: Awareness camps to be organized to teach the importance and advantages of the automation and IoT in the development of agriculture.</p>
<div>4. EMOTIONS: BEFORE / AFTER</div> <div>EM</div> <p>BEFORE: Lack of knowledge in weather forecasting → Random decisions → low yield. AFTER: Data from reliable source → correct decision → high yield</p>		

Problem-Solution fit canvas is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 license. Created by Daria Nęprkowska / Amaltama.com

4. REQUIREMENT ANALYSIS:

4.1 Functional Requirements

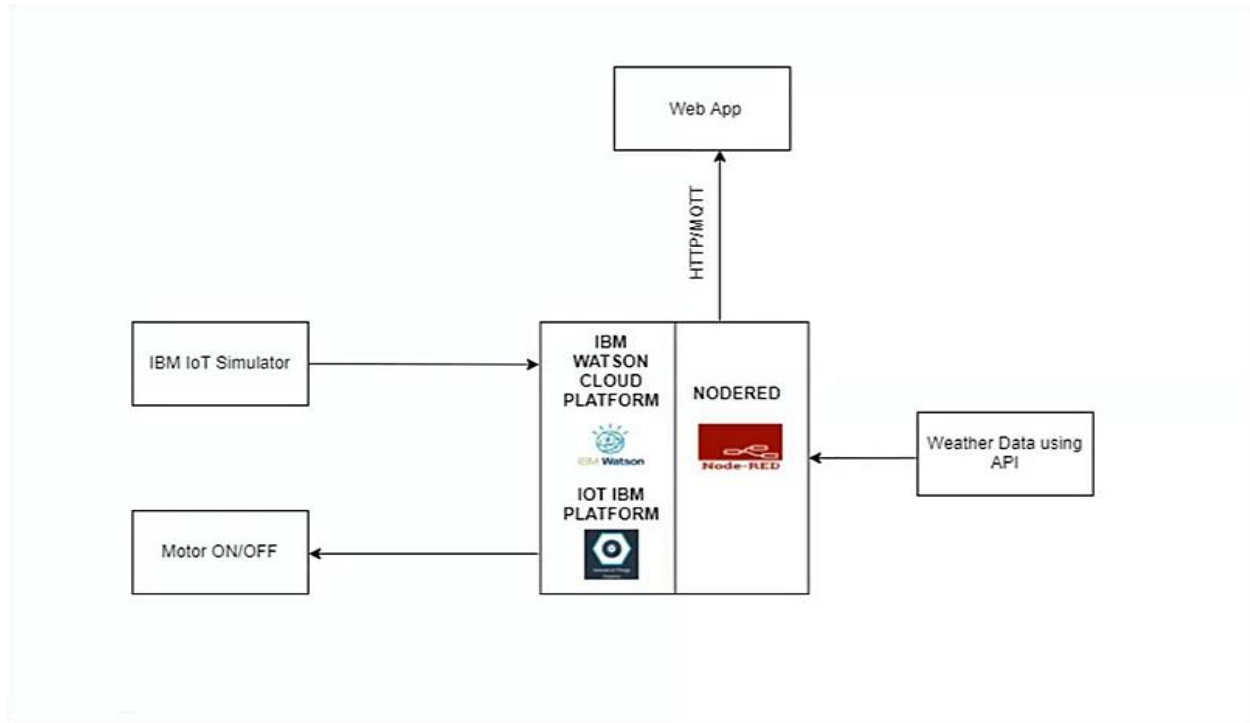
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Gmail
FR-2	User Confirmation	Confirmation via EmailConfirmation via OTP
FR-3	User sign in	Check Credentials Check Roles of Access.
FR-4	Monitoring	Monitor temperature, humidity and etc.,
FR-5	Analysis	Analysing different environment parameters.
FR-6	Processing	If environment parameters (temperature, humidity) exceeds its threshold value suggest the solutions like ifwater level is low means turn on the Water pump.

4.2 Non Functional Requirements

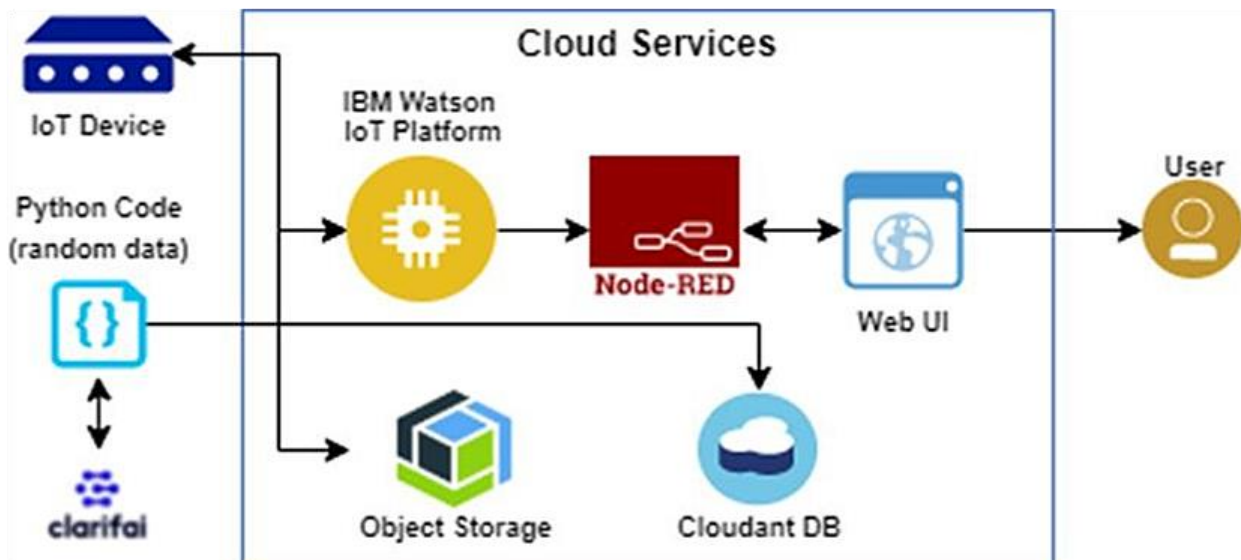
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Farmers can monitor their land even them not neartheir field.
NFR-2	Security	OTP verification while login their account for usersecurity.
NFR-3	Reliability	Environmental parameters are accurately monitored.
NFR-4	Performance	Improving yield compare to manual monitoring.
NFR-5	Availability	Can be accessed at anytime from anywhere withfeasible internet facility.
NFR-6	Scalability	Scalability in smart farming refers to the adaptability of a system to increase the capacity of yield.

5. PROJECT DESIGN:

5.1 Data Flow Diagram



5.2 Solution & Technical Architecture



5.3 User Stories

User Type	Function Requirement (EPIC)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	1	Can register for the application by entering my email, password, and confirming my password.	Can access my account/ dashboard	High	Sprint-1
		2	Will receive confirmation email once I have registered for the application	Receive confirmation email & click confirm	High	Sprint-1
		3	Can register for the application through Facebook	Can register & access the dashboard with Facebook Login	Low	Sprint-2
	Login	4	Can Register for the application through Gmail		Medium	Sprint-1
		5	Can Log into the application by entering email & password		High	Sprint-1
	Dashboard					
Customer (Web user)						
Customer Care Executive						
Administrator						

6. PROJECT PLANNING& SCHEDULING:

6.1 Sprint Planning & Estimation

S.NO	ACTIVITY TITLE	ACTIVITYDESCRIPTION	DURATION
1	Understanding the project	Assign the team members after thatcreate repository in the GitHub and then assign task to eachmember and guide them how to access the GitHub while submitting the assignments	1 week
2	Staring The Project	Team Members to Assign All the Tasks Based on Sprints and Work on it Accordingly.	1 week
3	Completing Every Task	Team Leader should ensure that whether every team member have completed the assigned task or not	1 week
4	Stand Up Meetings	Team Lead Must Have a Stand-Up Meeting with The Team and Work on The Updates and Requirement Session	1 week
5	Deadline	Ensure that team members are completing every task within the deadline	1 week
6	Budget and Scope of project	Analyze the overall budget which must be in certain limit it should be favorable to every person	1 week

6.2 Sprint Delivery Schedule

Product Backlog, Sprint Schedule, and Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Simulation Creation	USN-1	Connect Sensors and Arduino with python code	2	High	Pranav Thirekha Srivatsan
Sprint-2	Software	USN-2	Creating device in the IBM Watson IoT platform, workflow for IoT scenarios using Node-Red	2	High	Pranav Srivathsan Elakiya
Sprint-3	MIT App Inventor	USN-3	Develop an application for the Smart farmer project using MIT App Inventor	2	High	Pranav Thirekha Elakiya
Sprint-3	Dashboard	USN-3	Design the Modules and test the app	2	High	Pranav Thirekha Srivatsan
Sprint-4	Web UI	USN-4	To make the user to interact with software	2	High	Pranav Elakiya Srivathsan

Project Tracker, Velocity & Burndown Chart:

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	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

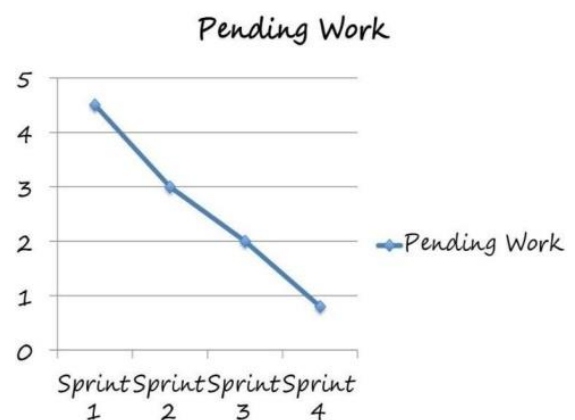
Velocity:

AV for sprint 1 = Sprint Duration / velocity = 12/6 = 2

AV for sprint 2 = Sprint Duration / Velocity = 6/6 = 1

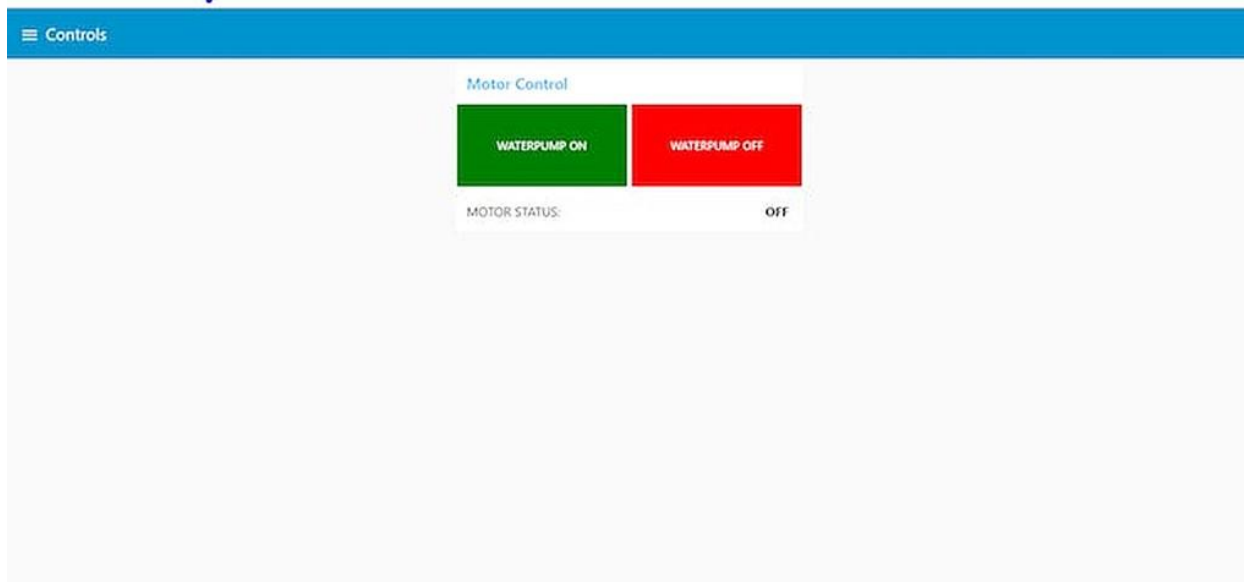
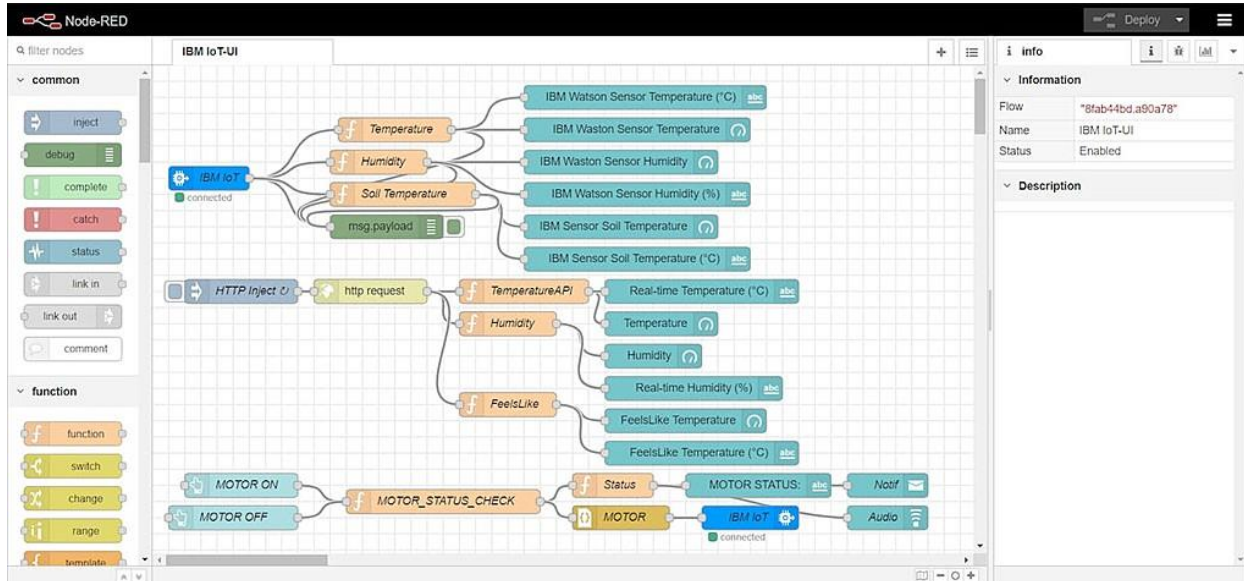
AV for Sprint 3 = Sprint Duration / Velocity = 6/6 = 1

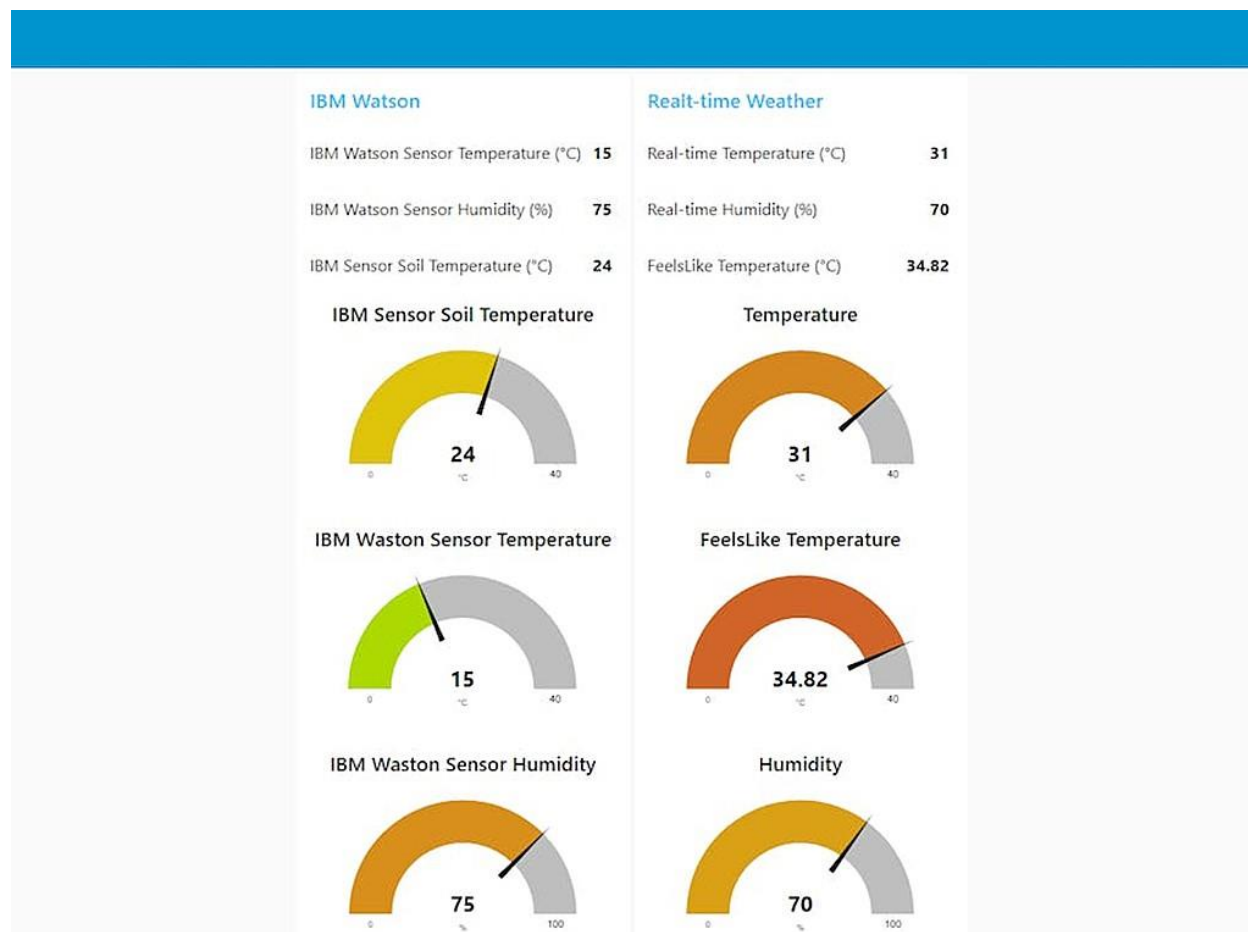
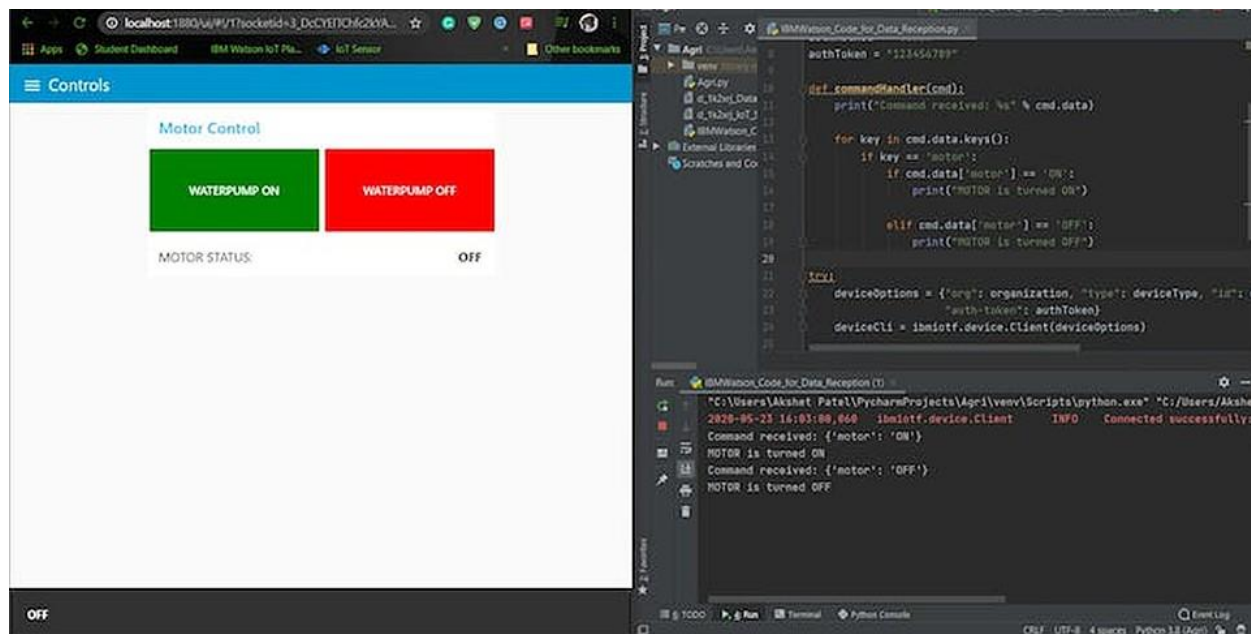
AV for Sprint 4 = Sprint Duration / Velocity = 6/6 = 1



7. CODING & SOLUTIONING:

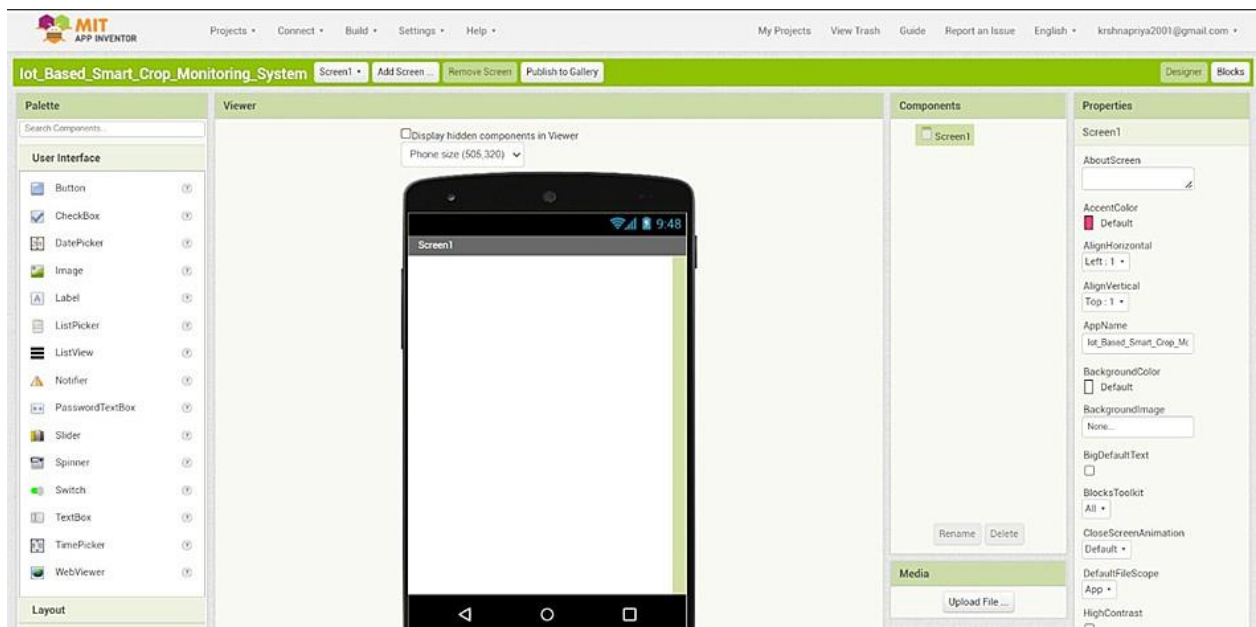
7.1 Feature 1



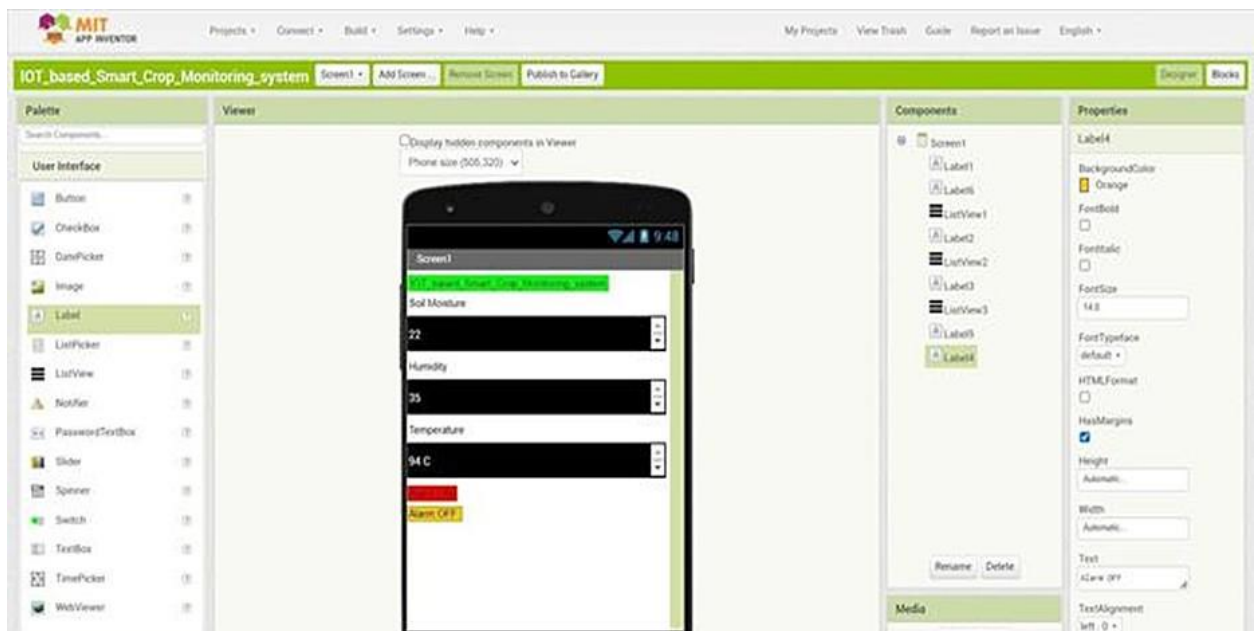


7.2 Feature 2

MIT APP inventor to design the APP



Customize the App interface to Display the Values



8. TESTING:

▲ 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
By Design	11	4	2	2	19
Duplicate	1	1	2	0	4
External	2	3	0	1	6
Fixed	10	2	3	20	35
Not Reproduced	0	0	2	0	2
Skipped	0	0	2	1	3
Won't Fix	0	5	2	1	8
Totals	24	15	13	25	77

Test Case Analysis

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

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	5	0	1	4
Client Application	47	0	2	45

Security	3	0	0	3
Outsource Shipping	2	0	0	2
Exception Reporting	11	0	2	9
Final Report Output	5	0	0	5
Version Control	3	0	1	2

9. RESULT:

We have successfully built an IOT Based Smart Farming System for Agriculture and integrated all the services using Node-RED.

10. ADVANTAGES & DISADVANTAGES:

10.1 Advantages

- All the data like climatic conditions and changes in them, soil or crop conditions everything can be easily monitored.
- Risk of crop damage can be lowered to a greater extent.
- Many difficult challenges can be avoided making the process automated and the quality of crops can be maintained.
- The process included in farming can be controlled using the web applications from anywhere, anytime.

10.2 Disadvantages

Smart Farmer system requires internet connectivity continuously, but rural parts can not fulfill this requirement.

- Any faults in the sensors can cause great loss in the agriculture, due to wrong records and the actions of automated processes.
- IoT devices need much money to implement.

11. CONCLUSION:

IoT based smart Farming System for Live Monitoring of Temperature and Soil Moisture and to control motor remotely has been proposed using Node Red and IBM Cloud Platform. The System has high efficiency and accuracy in fetching the live data of temperature and soil moisture. The IoT based smart farming System being proposed via this project will assist farmers in increasing the agriculture yield and take efficient care of food production as the System will always provide helping hand to farmers for getting accurate live feed of environmental temperature and soil moisture with more than 99% accurate results. Therefore, the project proposes a thought of consolidating the most recent innovation into the agrarian field to turn the customary techniques for water system to current strategies in this way making simple profitable and temperate trimming.

12. FUTURE SCOPE:

In future due to more demand of good and more farming in less time, for betterment of the crops and reducing the usage of extravagant resources like electricity and water IoT can be implemented in most of the places.

13. APPENDIX:

GITHUB LINK: <https://github.com/IBM-EPBL/IBM-Project-31033-1660194711>

SOURCE CODE: <https://github.com/IBM-EPBL/IBM-Project-31033-1660194711>

DONE BY:

Pranav Aadhithya.K.B

Thirekha.M

Srivathsan.V.M

Elakiya.G.J