SMART FARMER – IoT ENABLED SMART FARMING APPLICATION

A PROJECT REPORT

Submitted by

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Abstract

Internet of Things (IoT) play crucial role in smart agriculture. Smart farming is an emerging concept, because IoT sensors capable of providing information about their agriculture fields. The paper aims making use of evolving technology i. e. IoT and smart agriculture using automation. Monitoring environmental factors is the major factor to improve the yield of the efficient crops.

The feature of this paper includes monitoring temperature and humidity in agricultural field through sensors using CC3200 single chip. Camera is interfaced with CC3200 to capture images and send that pictures through MMS to farmers mobile using Wi-Fi. Agriculture is the primary occupation in our country for ages. But now due to migration of people from rural to urban there is hindrance in agriculture. So to overcome this problem we go for smart agriculture techniques using IoT.

This project includes various features like GPS based remote controlled monitoring, moisture & temperature sensing, intruders scaring, security, leaf wetness and proper irrigation facilities. It makes use of wireless sensor networks for nothing the soil properties, and environmental factors continuously.

It is a network of different devices which make a self-configuring network. The new developments of Smart Farming with use of IoT, by day turning the face of conventional agriculture methods by not only making it optimal but also making it cost efficient for farmers and reducing crop wastage.

The aim is to propose a technology which can generate messages on different platforms to notify farmers. The product will assist farmers by getting live data (Temperature, humidity, soil moisture, UV index, IR) from the farmland to take necessary steps to enable them to do smart farming by also increasing their crop yields and saving resources (water, fertilizers). The product proposed in this paper uses ESP32s Node MCU, breadboard, DHT11 Temperature and Humidity Sensor, Soil Moisture Sensor, SI1145 Digital UV Index / IR / Visible Light Sensor, Jumper wires, LEDs and live data feed can be monitored on serial monitor and Blynk mobile. This will allow farmer to manage their crop with new age in farming.

CHAPTER - 01

1. INTRODUCTION

1.1. Project Overview

IoT Based Smart Farming

Internet of Things Smart technology enables new digital agriculture. Today technology has become a necessity to meet current challenges and several sectors are using the latest technologies to automate their tasks. Advanced agriculture, based on Internet of Thinks technologies, is envisioned to enable producers and farmers to reduce waste and improve productivity by optimizing the usage of fertilizers to boost the efficiency of plants. It gives better control to the farmers for their livestock, growing crops, cutting costs, and resources.

The world's total population touched 6.60 billion in 2000 but is projected to grow to 9.32 billion by 2050. Hence, it is necessary to increase the yield on the limited farmland.

It is a high-tech system to grow crop cleanly and sustainably for the masses. It is the application of modern Information and Communication Technologies in agriculture.

Benefits of Smart Farming

1. Automatic adjustment of farming equipment made possible by linking information like crops/weather and equipment to auto-adjust temperature, humidity, etc.
2. In large farmland, Internet of Things equipped drone helps to receive the current state of crops and send the live pictures of farmland.
3. Analyzing farmland from the land using its Solutions you will know the current situation of fields and crops in.

According to studies:

1. 86% of the studied farmers use some kind of "precision farming".

2. 95% acknowledged that “precision farming” is very helpful to use.
3. 70% plan to expand their usage of "precision farming technologies".

Challenges for Building the Internet of Things Platform

1. A unified solution which can be integrated with different types of Internet of Things devices.
2. The most common challenge for the Internet of Things in agriculture is connectivity. Every area doesn’t have proper internet connectivity.
3. The second most common challenge for Internet of Things based Advanced Farming is the lack of awareness among consumers.
4. Due to various service providers, it becomes really difficult to maintain interoperability between different IoT systems.
5. A scalable solution that can be integrated with thousands of IoT devices for large farms.

Solutions for Building IoT based Intelligent Farming

Smart Farming has enabled farmers to reduce waste and enhance productivity with the help of sensors (light, humidity, temperature, soil moisture, etc.) and automation of irrigation systems. Further with the help of these sensors, farmers can monitor the field conditions from anywhere. Internet of Things based Advanced Farming is highly efficient when compared with the conventional approach. The applications of intelligent Agriculture solutions not only targets conventional, large farming. With operations, but could also be new levers to uplift other growing or common trends in agricultural like organic farming, family farming (complex or small spaces, particular cattle and/or cultures, preservation of specific or high-quality varieties, etc.), and enhance highly transparent Farming.

Applications of Internet of Things in Smart Farming

In Internet of Things based smart agriculture, a system is formed to monitor the farmland with the help of sensors, which senses components like temperature, light, humidity, soil moisture, etc. Then, automate the irrigation system and allow farmers to monitor their field conditions from anywhere through IoT Analytics Platform. To make the agricultural process even smarter and accurate, precision agriculture is used. This makes agricultural practice more controlled and precise in terms of raising livestock and farming. Internet of Things based Advanced Farming plays a vital role when it comes to the use of IT and other elements like sensors, agricultural drones, autonomous vehicles, control systems, automated hardware, robotics, variable speed technology, and others.

Weather Monitoring

Weather plays a very significant role when it comes to the Agriculture sector. In agriculture, there is almost everything dependable upon the climate condition. In smart Farming, temperature humidity, light intensity, and soil moisture can be monitored through various sensors.These are again used by the reactive system to trigger alerts or automate the process such as water and air control.

Smart Irrigation on Agriculture Land

In smart irrigation, automated sprinkler systems or intelligent pumps are used. Soil moistures sensors are used in different areas to get the moisture of the soil in agricultural land.

Based on the results from the soil moisture sensors, theintelligent pumps or intelligent sprinklers are turned On/Off.

Monitoring Soil Quality

Farmers usually use a sampling method to calculate soil fertility, moisture content. Fortunately, this sampling doesn't give accurate results as chemical decomposition varies from location to location. Meanwhile, this not much helpful. To resolve this thing, it plays an essential role in Farming. Sensors can be installed at a uniform distance across the length and breadth of the farmland to collect the accurate soil data.

Livestock Monitoring

Internet of Things devices can be used to collect data regarding the location, well-being, and the health of the cattle. This data can be further used for identification of the sick animals so that they can be separated from the others, thereby preventing the spread of diseases. This Live Stock Monitoring also lowers the labor costs with the help of Internet of Things based sensors.

Drone Monitoring

Drone monitoring is helping large farms to reduce the cost of monitoring, or the use of Geo-positioning sensors can set a stable path. Moreover, the data collected from these drones are sent back to the server where it can be used for analyzing and decision-making.

1.2. Purpose

Smart farming based on IoT technologies enables growers and farmers to reduce waste and enhance productivity ranging from the quantity of fertilizer utilized to the number of journeys the farm vehicles have made, and enabling efficient utilization of resources such as water, electricity, etc.

Smart farming is a management concept focused on providing the agricultural industry with the infrastructure to leverage advanced technology – including big data, the cloud and the internet of things (IoT) – for tracking, monitoring, automating and analyzing operations.

IoT in agriculture uses robots, drones, remote sensors, and computer imaging combined with continuously progressing machine learning and analytical tools for monitoring crops, surveying, and mapping the fields, and providing data to farmers for rational farm management plans to save both time and money.

When we talk about IoT-based smart farming, we are looking at a system built to monitor the crop field with the help of sensors. These sensors track every essential for crop production like soil moisture, humidity, light, temperature, etc., and automates the irrigation system. This system allows farmers to monitor the field conditions from anywhere. IoT-based farming is way too efficient when compared to conventional farming.

CHAPTER - 02

2. LITERATURE SURVEY

Smart Farming using IoT, a solution for optimally monitoring farming conditions

1. Introduction

The future of Smart Computing will be completely based on Internet of Things (IoT). It has a crucial role of transforming “Traditional Technology” from homes to offices to “Next Generation Everywhere Computing”. ‘Internet of Things’ is gaining an important place in research across the world and specially in area of advanced wireless communications. Today IoT has started touching people everywhere and from the point of normal user, IoT is laying the foundation of development of various products like smart health services, smart living, smart education in schools and automation.

The most researched are of IoT is agriculture. Because it is really crucial sector to ensure the food security as global population is increasing rapidly. Researchers first started applying ICT based technique in this sector, which were useful on some levels but definitely was not going to solve our problem in long run. So now, they are exploring IoT as an option to ICT in agriculture. Agriculture products need applications like soil moisture monitoring, environmental condition monitoring for temperature, moisture, supply chain management and infrastructure management.

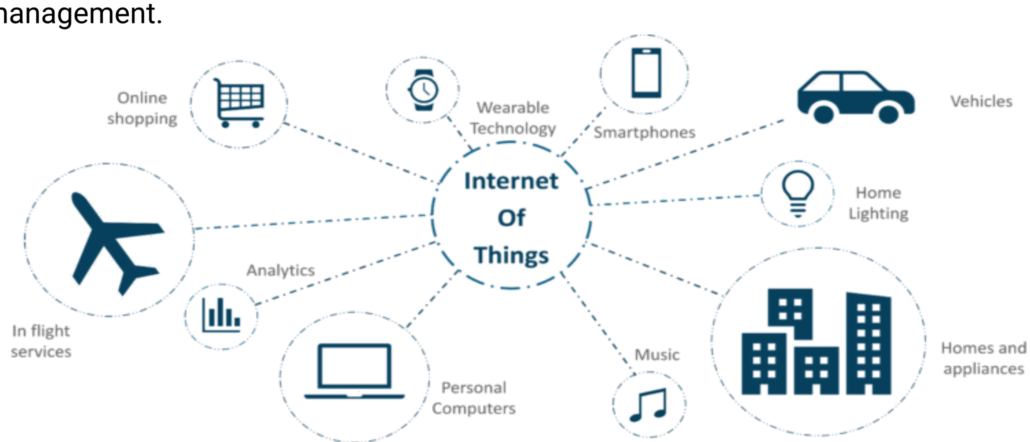


Fig 2.1. IoT application in every field

The future of agriculture is precision agriculture and it is expected to grow at 4 billion by 2020. Data generated from sensors on agriculture field can also be used for Data analytics, which will help farmers to improve crop yields. So, IoT based smart farming can solve many agricultures-based issues. The aim of this paper is to introduce a working product which will allow farmers to real time data.

The structure of the paper is as follows: Section 2 will have the significance of IoT based applications in Smart Farming and its benefits as well as short comings of the product based on IoT.
As this product is a working product, there will be pictures of the prototype model. Section 4 will give us the idea about the working of the product and the is test dataset which was measured during the testing of the prototype model. Section 5 will cover conclusion and future scope in the product with the advancements in IoT.

2. IoT in Smart Farming

Smart farming is a modern farming managemental concept with IoT technology to increase the productivity in agriculture. With the use of smart farming, farmers can effectively use fertilizers and other resources to increase the quality and quantity of their crops. Farmers cannot be physically present on the field 24 hours a day. Also, the farmers may not have the knowledge to use different tools to measure the ideal environmental conditions for their crops. IoT provides them with the automated system which can function without any human supervision and can notify them to make proper decision to deal with different kind of problems they may face during farming. It has the capability to reach and notify the farmer even if farmer is not on the field, which can allow farmer to manage more farmland, thus improving their production.

IoT applications in smart farming also includes farm vehicle tracking, livestock monitoring, storage monitoring and other farm options. There can be extensive use of Smart Organic Farming which is currently in trend across the world which shows that it is not only restricted to large farming operations.

2.1. Benefits of Smart Farming

People are still working on different Smart Farming technology using IoT, so the anticipated benefits of this technology are, Remote monitoring for farmers, water and other natural resource conservation, good management also allows improved livestock farming, the things which are not visible to necked eye can be seen resulting is accurate farmland and crop evaluation, good quality as well as improved quantity, the facility to get the real- time data for useful insights.

2.2. Shortfalls of Smart Farming

1. Agriculture being a natural phenomenon relies mostly on nature, and man predict or control nature let it be rain drought sunlight availability. pests control etc. So ever implementation IoT system agriculture.
2. The smart agriculture need availability on internet continuously. Rural part of the developing countries did not fulfil this requirement. Moreover, internet is slower.
3. Fault sensor or data processing engines can cause faulty l decisions which may lead to over use of water, fertilizers and other wastage of resources.
4. The smart farming-based equipment require farmer to understand and learn the use of technology. This is the major challenge in adopting smart agriculture framing at large scale across the continues.

3. Components used in proposed product

This device monitors the farm or greenhouse and based upon the readings of different kind of sensors like temperature, humidity, soil moisture, UV, IR, soil nutrients and gives different types of messages to the farmer about the present conditions so that the farmer can take quick action. The quick actions taken by the farmers will help them increase the productivity in their farming and proper use of natural resources will be done, which will make our product environment friendly also. Our product will increase the quantity and quality of the crops by properly monitoring the various present conditions. It is an IoT device with the concept of “Plug and Sense”. Live data for different parameters can be seen on Laptop and Smart Phones.

4. Implementation

Our aim was to create a prototype model, which can be easily installable in the field and is also easy to use as farmers might not have the technical knowledge. With the use of IoT system is the automated farmers in the smart farming agriculture.

Fig 2.2. (a) Circuit of the prototype, (b)Outside look, (c) Snapshot of Blynk mobile app with temp. and humidity

In Fig 2. (a), as you can see, it is the inside view of the prototype model where all the sensors and ESP32s are connected via breadboard and the power bank is used for power supply. (b), the outside view of the model with LEDs and in (c) we have put a snapshot of Blynk app window which is showing humidity and temperature. In the same way we can have different windows to monitor live feed from different sensors, create graphs for further analysis as well.

1) We used ESP32s node MCU, which is wireless and Wi-Fi enable.

2) On breadboard, we connected the ESP and DHT11 temperature and humidity sensor, soil moisture sensor, buzzer, LEDs and SI1145 Digital UV Index / IR / Visible Light Sensor with the help of jumper wires.

3) ESP32 goes to sleep after every 18 minutes, wakes up, takes the reading, upload it on the Blynk app cloud to feed the live data and goes to sleep mode again.

4) The LEDs retain the state so when the farmer passes through if he didn’t hear the sound or got the notification on phone can look the LEDs to take the necessary steps. Where turning red, blue or violet will give different indications. Same as one buzzer sound signals something, two means something else.

5) In the prototype model, bucket is used. Here the soil moisture sensor is fitted at the bottom and temperature humidity sensor, Digital UV Index sensor and the buzzer are placed at the top by putting a whole in the cover.

6) We give power with the help of a 6000 mAh power bank, so after uploading the code the system works on itself.

5.Future work

We had 3 mediums to notify the farmers, with the help of LEDs visual alert, with the help of Blynk mobile app that can track live feed as well and the different alert sound with help of small buzzer as well.

This product is used to notify farmers to take quick steps. But there is still scope, the future work can be focused on,

1. ESP32s node MCU has wireless Wi-Fi capabilities as well as Bluetooth capabilities. Due to limited budget we could not make more prototypes but in large farmlands and with different crops, farmers can install multiple prototypes like this which will be in some local network, connected with Bluetooth to each other and will have 1 main node which will collect data to upload it on the cloud.
2. In true IoT sense and with the help of artificial intelligence making this whole network of nodes which will be able to make the decisions on its own and trigger the necessary steps to nullify that situation.
3. A network where every component will be able to think individually, will retrieve data from cloud to also improve their decisions every time with the help of data mining algorithms. [5]
4. The research is going on in drone technology as well, connecting this system to the drones will provide 3D mapping of the farmlands, which will be able to monitor crop production and live conditions as well.

6. Conclusion

From our results and literature survey of other papers, we saw that the hardware and materials we used to develop our porotype allowed us to make an efficient and accurate, as well as cheap product for farmers. Which was economical and easily installable for farmers as well. Thus, we can conclude that this porotype will definitely help farmers in small farmland to effectively monitor their crops with the user-friendly app and other alert means.We can connect this whole system to Soracon Lagoon dashboard to get further in depth analysis with the of GSM module and IoT SIM card on our personal computers.

2.2. References

01. IoT in smart farmingg <https://www.iotforall.com/iot-applications-in-agriculture/amp/>
02.ESP32 Document
https://www.espressif.com/sites/default/files/documentation/esp32_datasheet_en.pdf
03.IoT application diagram <https://www.edureka.co/blog/iot-applications/>

2.3. Problem Statement Definition

The challenges of a smart agriculture system include the integration of these sensors and tying the sensor data to the analytics driving automation and response activities.

The help of the IoT devices, you can know the real-time status of the crops by capturing the data from sensors. Using predictive analytics, you can get an insight to make better decisions related to harvesting. The trend analysis helps the farmers to know upcoming weather conditions and harvesting of crops.

IoT in agriculture uses robots, drones, remote sensors, and computer imaging combined with continuously progressing machine learning and analytical tools for monitoring crops, surveying, and mapping the fields, and providing data to farmers for rational farm.

CHAPTER - 03

3. IDEATION & PROPOSED SOLUTION

3.1. Empathy Map Canves

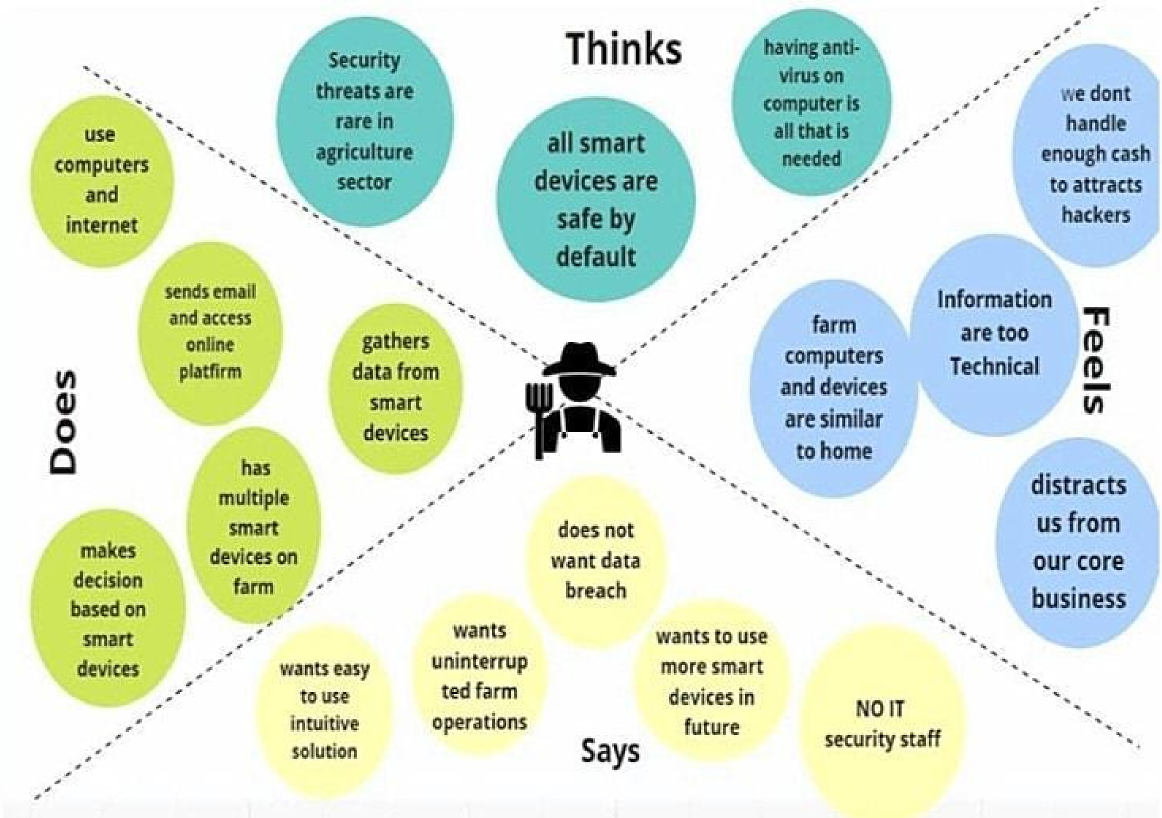


Fig 3.1 Empathy map for smart farming

3.2. Ideation & Brainstorming

Step1:Team Gathering,Collaboration and select the problem statement

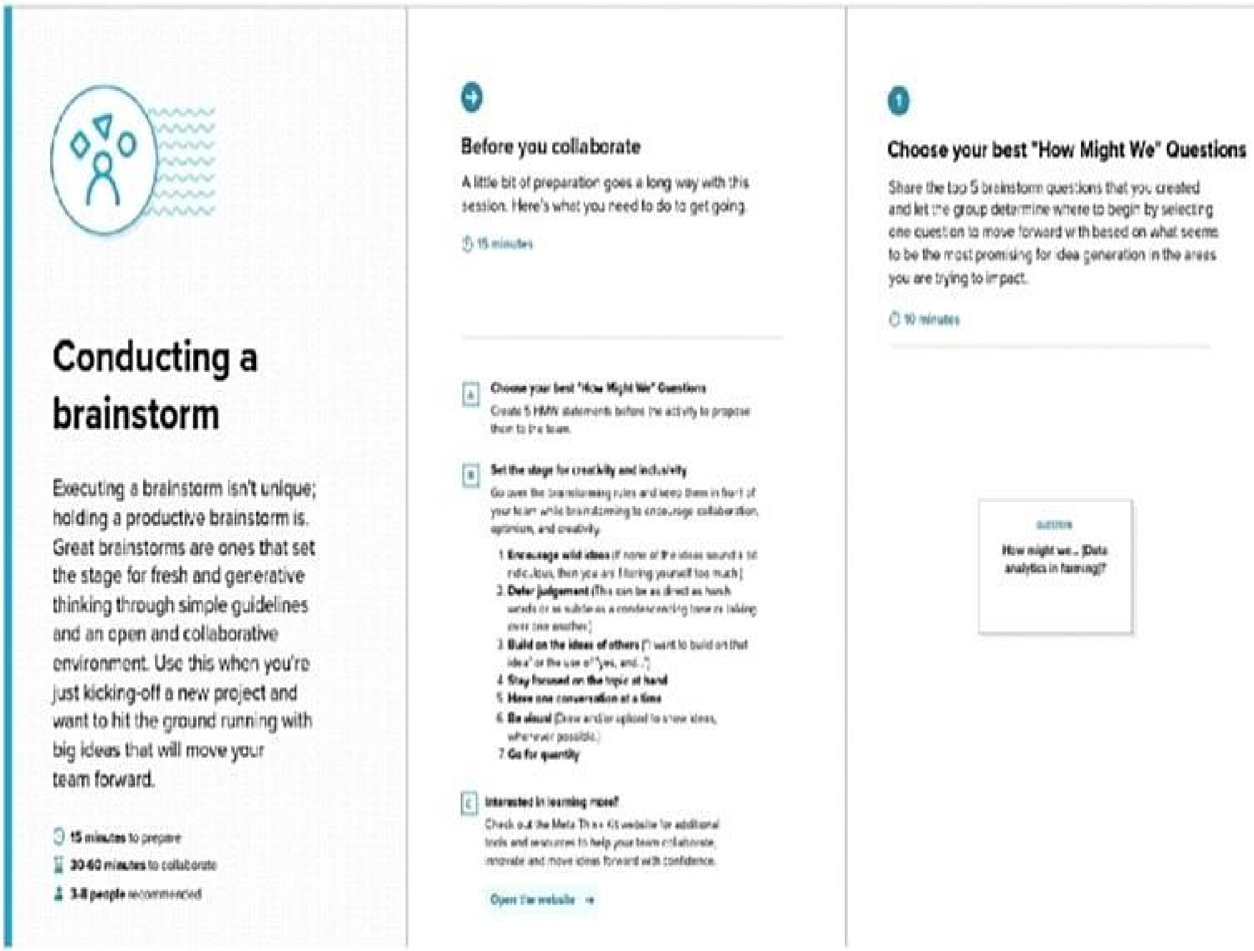


Fig 3.2 Ideation & Brainstorming

Step2:Brainstorm,Idea Listing and Grouping

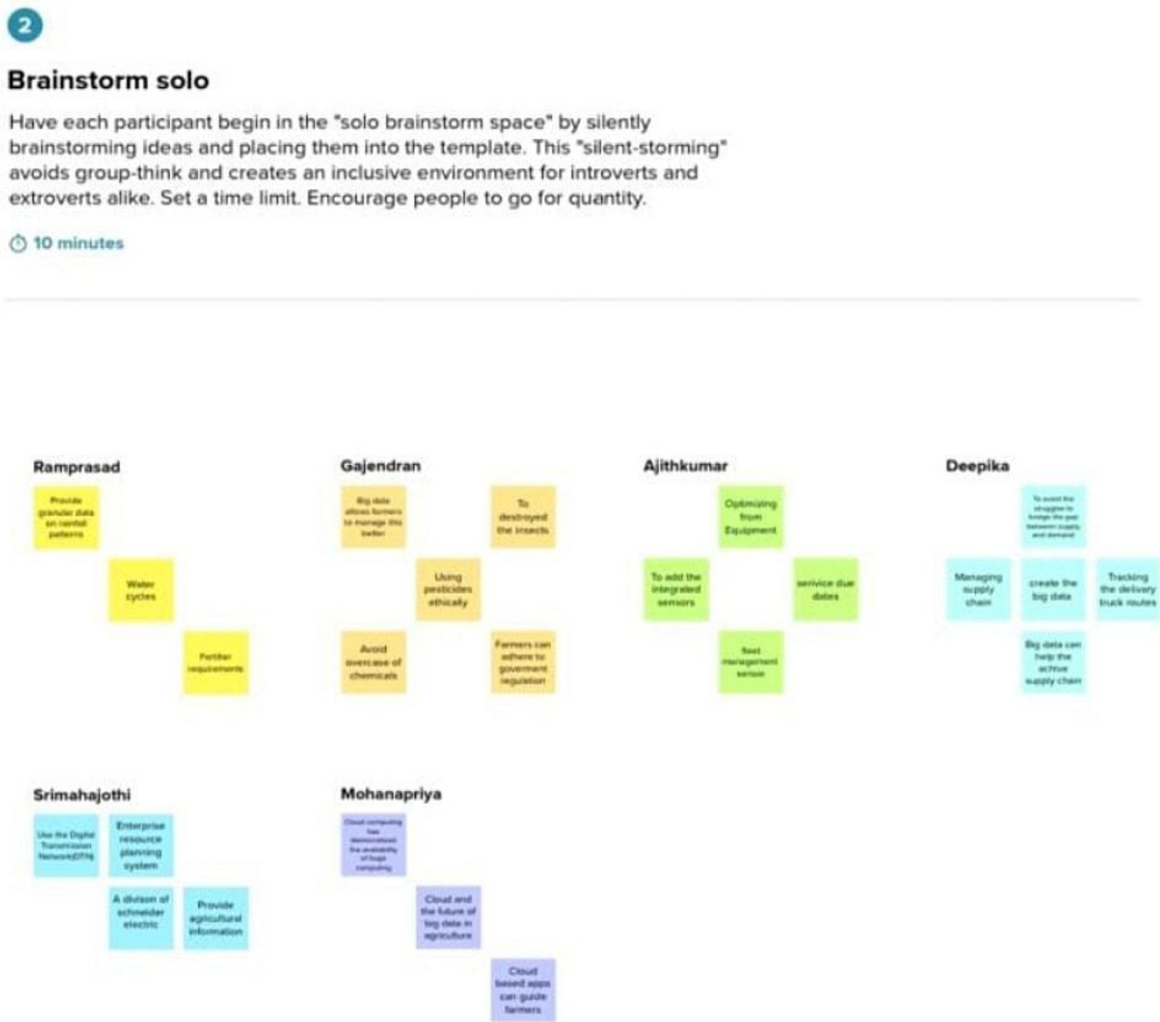


Fig 3.3 Brainstorm, Idea listing and grouping

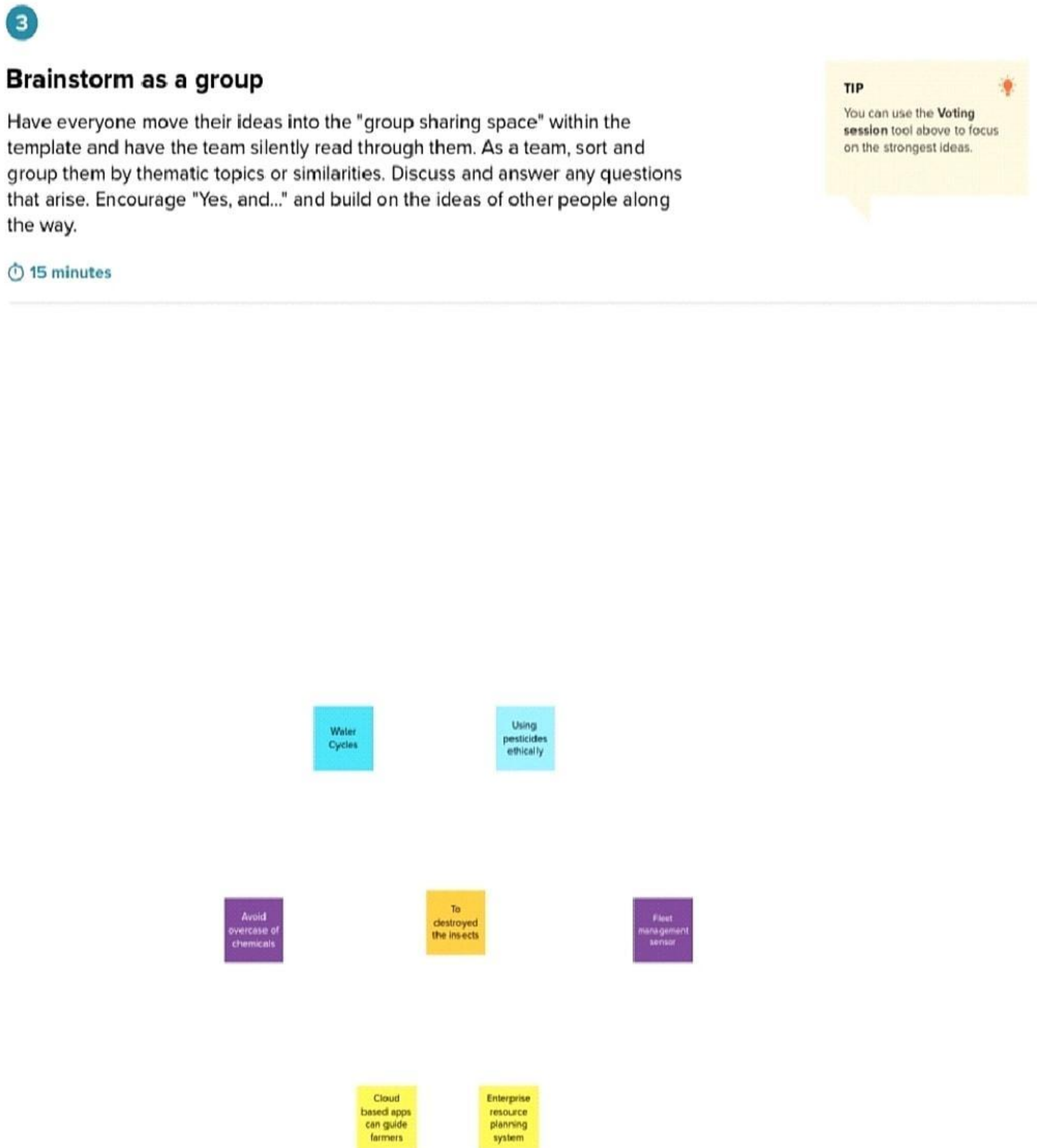


Fig 3.4 Brainstorm, Idea listing and grouping

Step3:Idea Prioritization

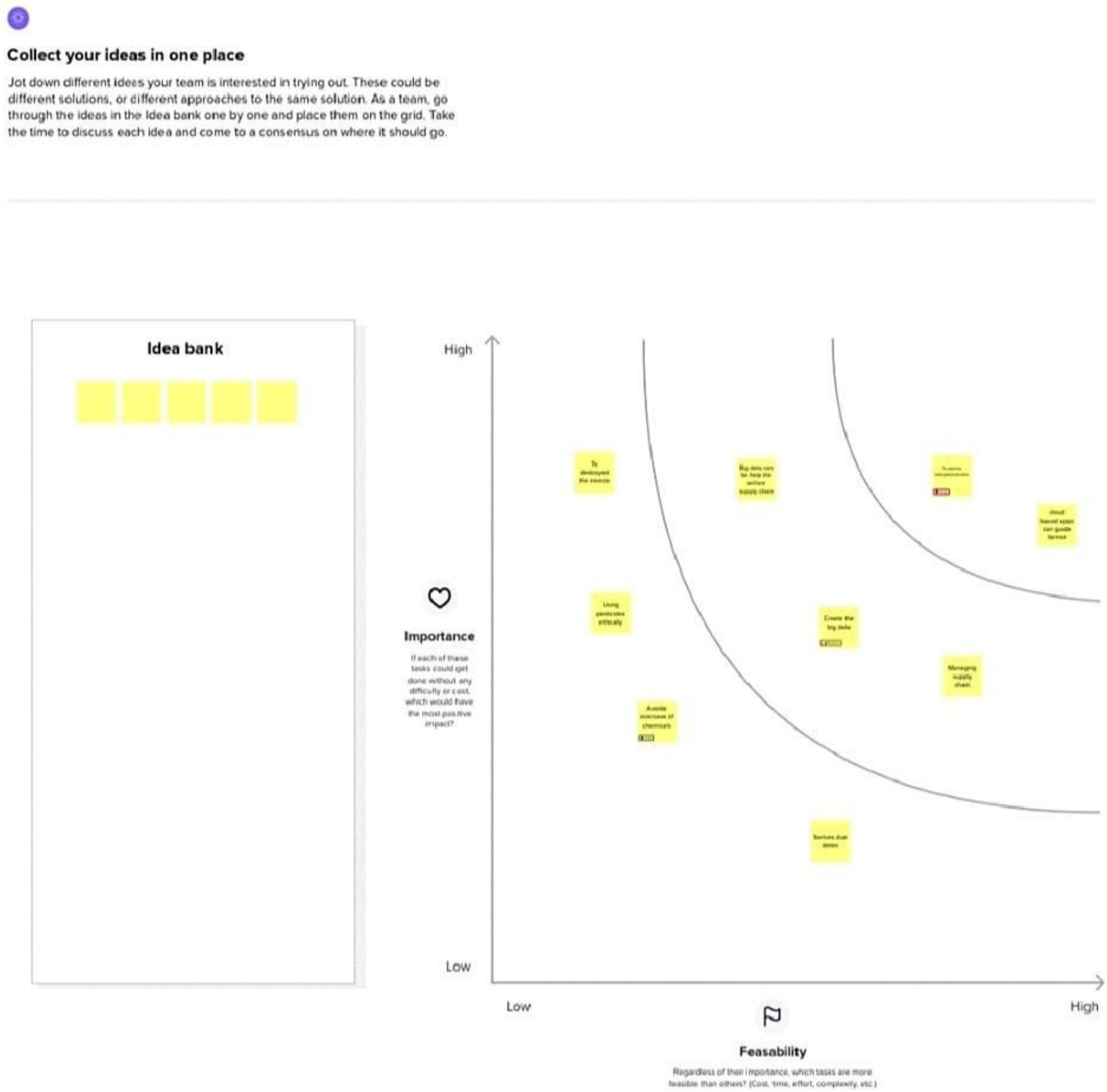


Fig 3.5. Idea Prioritization

3.3. Proposed Solution

Proposed Solution means the technical solution to be provided by the Implementation agency in response to the requirements and the objectives of the Project.

Sample 1Sample 2. Proposed Solution means the Proposed System with modifications that meet the Agency's requirements as set forth in this RFP.

S.No	Parameters	Description
1.	Problem statement (Problem to be solved)	Ideally ,each filed should get just the right amount of water at just the right time.Under watering causes crop stress and yield reduction.
2.	Idea /Solution description	Livestock tracking and Geo fencing.Smart logistics and warehousing.Smart pest managemment.
3.	Novity/Uniqueness	The novelty of the proposed approach lies in using the knowledge base and multi-agent technology to develop coordinated decisions on management of agricultural enterprises.
4.	Social impact/Customer satisfaction	Agriculture impacts society in many ways, including:supporting livelihoods through food,habitat, and jobs.
5.	Business model (Revenue model)	Model formers are used by extension agencies to serve as in-community representatives for new agriculture inputs or cultivation techniques.
6.	Scalability of the solution	Scalability in smart forming refers to the adptability of a system to increase the capacity.

Fig3.6. Proposed Solution

3.4. Problem Solution Fit

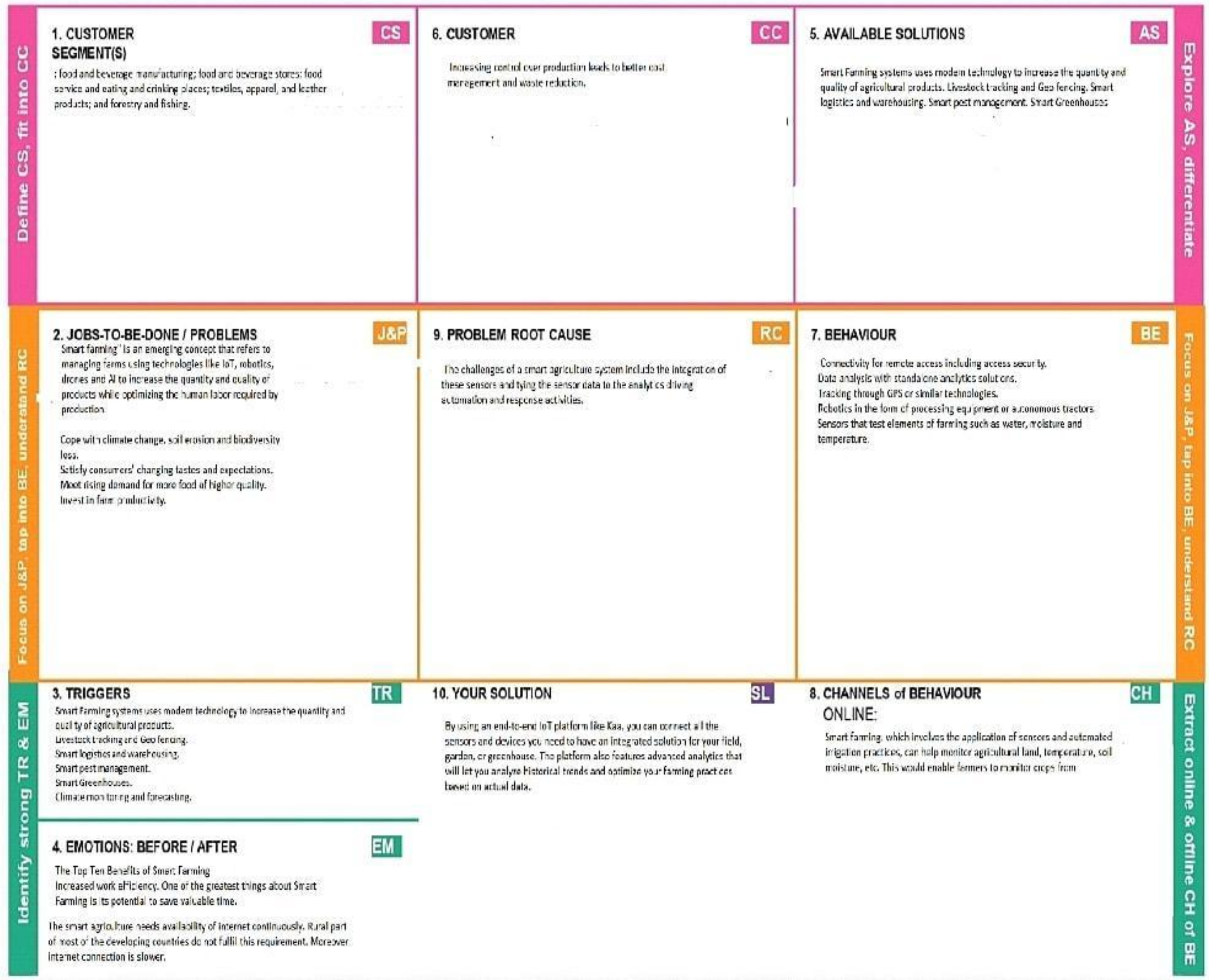


Fig 3.6. Problem Solution Fit

CHAPTER - 04

4. REQUIREMENT ANALYSIS

4.1. Functional Requirements

FR No.	Functional Requirements (Epic)	Sub Requirements (Story / Sub-Task)

FR-1	User Registration	Register to mail ID in application. User basic details register to application.
FR-2	User Configuration	Confirmation via EMAIL and to get the OTP in application . User to register in confirmation OTP for application and ready to access.
FR-3	The product essentially converts smart farmer -Io T enabled smart farming application	To measure a temperature of the land and humidity. Then planting, watering ,fertilizing to waiting for the plant growth.
FR-4	Harvesting the plant	Get the plant detail in our mobile for every day. To check the notification in oru mobile.

Fig4.1. Functional Requirements

4.2. Non-Functional Requirements

NFR No.	Non-Functional Requirements	Description
NFR-1	Usability	Indicates how effectively and easy users can learn and use a system.
NFR-2	Security	Assures all data inside the system or its part will be protected against malware attacks unauthorized access.
NFR-3	Reliability	Specifies the probability of the software performing without failure for a specific number of uses or amount of time.
NFR-4	Performance	Deals with the measure of the system's response time under different load conditions.
NFR-5	Availability	Describes hoe likely the system is accessible for a user at a given point in time.
NFR-6	Scalability	Assesses the highest work loads under which the system will still meet the performance requirements.

Fig4.2. Non-Functional Requirements

CHAPTER - 05

5. PROJECT DESIGN

5.1. Data Flow Diagrams

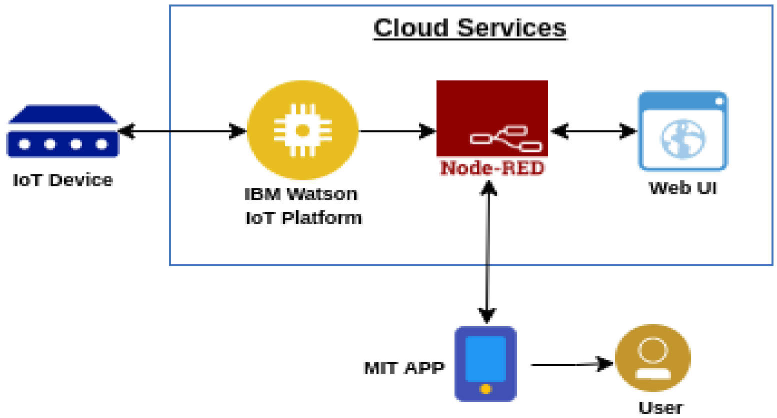


Fig5.1. Data Flow Diagram

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 subprocesses the data moves through. DFDs are built using standardized symbols and notation to describe various entities and their relationships.

A data flow diagram (DFD) maps out the flow of information for any process or system. It uses defined symbols like rectangles, circles and arrows, plus short text labels, to show data inputs, outputs, storage points and the routes between each destination.

Data flow diagram:

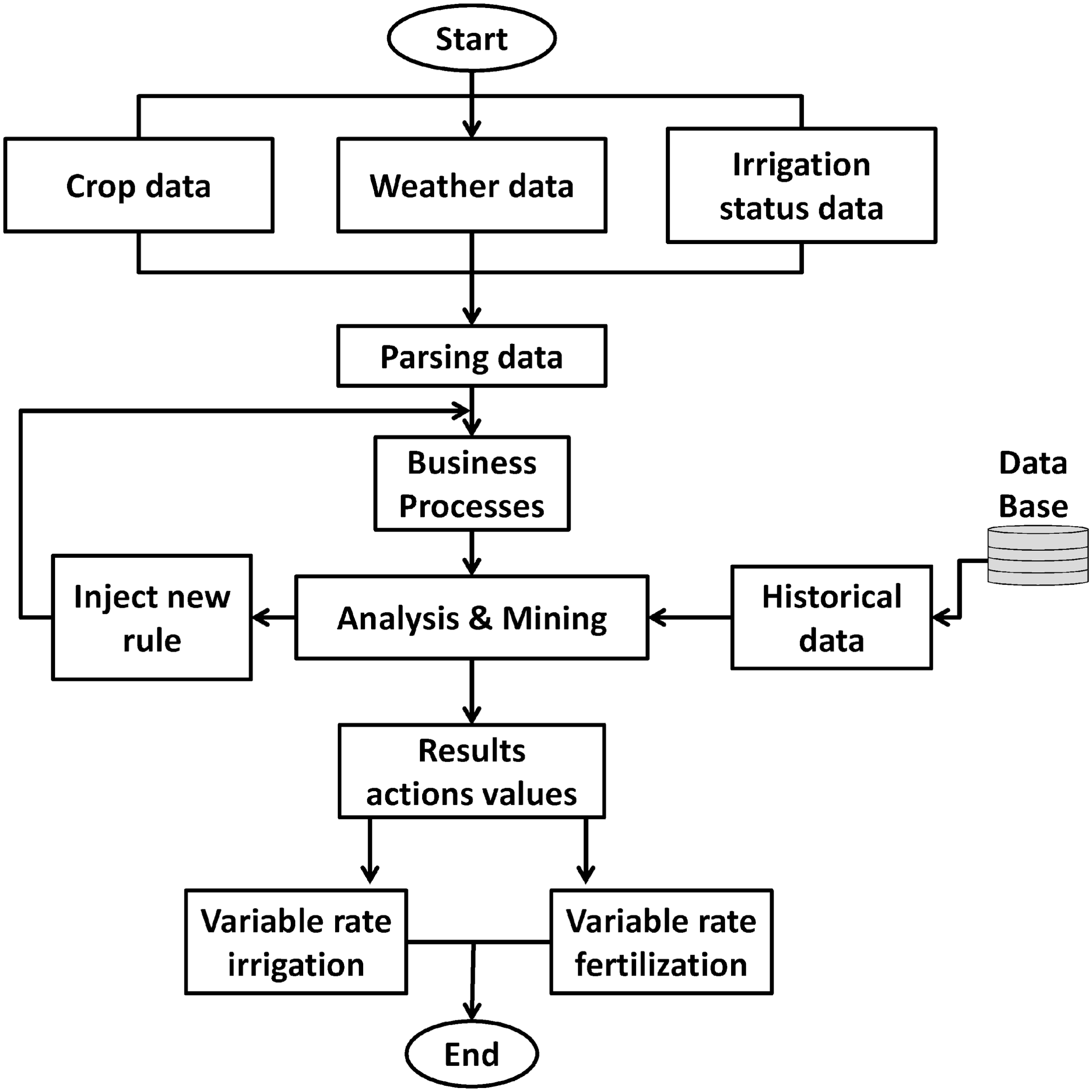


Fig5.2. Data Flow Diagram for Smart Farming

<u>5.2. Solution & Technical Architecture</u>

Solution Architecture Diagram:

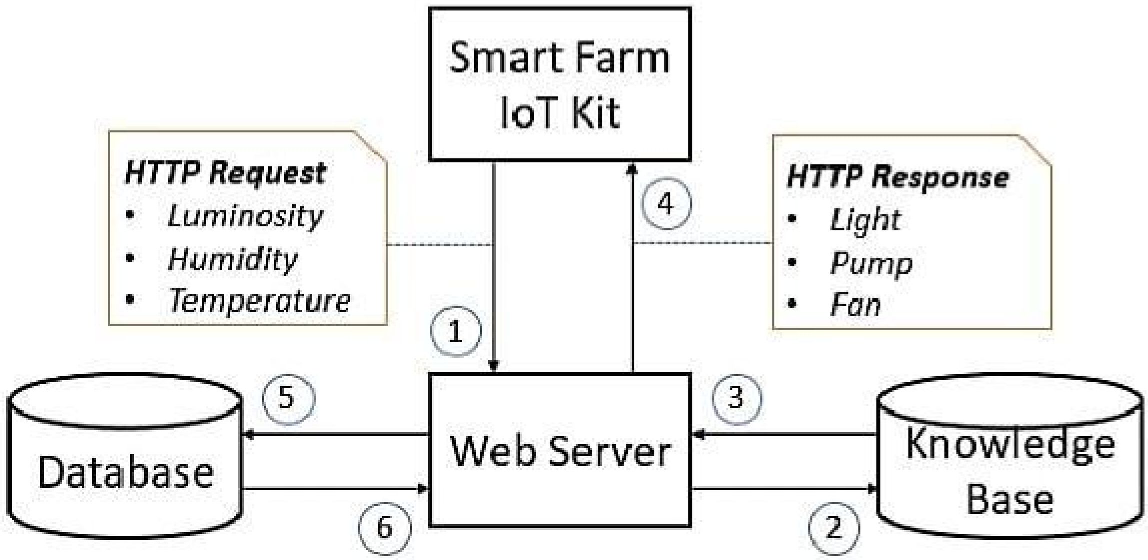


Fig5.3. Solution and Technical Architecture

Smart Farming systems uses modern technology to increase the quantity and quality of agricultural products. Livestock tracking and Geo fencing. Smart logistics and warehousing. Smart pest management.

In smart IoT farming, products have sensors and monitors that farmers use to monitor crops and take adequate actions based on the readings on the analytical dashboard. Various sensors monitor crops, weather conditions, and soil quality. It gives cohesive data of farm and field health to the farmers.

5.3. User Stories

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
		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
		USN-3	As a user, I can register for the application through smart farming	I can register & access the dashboard with smart farming Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail		Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password		High	Sprint-1
	Dashboard	USN-6	To use the application and know the temperature, climate, wind force and some etc.	I can access and know the information reletated to forming	High	Sprint-1
Customer (Web user)	Registration	USN-7	As user can browse the website by entering my email, password, and confirming my password	I can access my account / dashboard	High	Sprint-1
		USN-8	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
		USN-9	As a user, I can register for the application through smart farming	I can register & access the dashboard with smart farming Login	High	Sprint-2
Customer Care Executive	To help the user's		To help the farmer to 24/7. To explain the question from the farmer(user)	To help the user to critical situation	High	Sprint-1
Administrator	To maintain the server		The administrator have to maintain the server from the error and hackers	To maintain the server without busy	High	Sprint-1

Fig5.4.User Stories

CHAPTER - 06

6. PROJECT PLANNING & SCHEDULING

6.1. Sprint Planing & Estimation

Product Backlog, Sprint Schedule, and Estimation

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	Ramprasad
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	Ajithkumar
Sprint-2	Verification	USN-3	As a user, I can register for the application through smart farmer	2	Low	Mohanapriya
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	Deepika
Sprint-3	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	Srimahajothi
Sprint-4	Dashboard	USN-6	To use the application and know the temperature climate, weather, wind force	2	High	Gajendran

Fig6.1.Sprint Planing & Estimation

<u>6.2. Sprint Delivery Schedule</u>

Product Backlog, Sprint Schedule, and Estimation

Use the below template to create product backlog and sprint schedule

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	5	6 Days	24 Oct 2022	29 Oct 2022	5	29 Oct 2022
Sprint-2	2	6 Days	31 Oct 2022	05 Nov 2022	2	05 Nov 2022
Sprint-3	1	6 Days	07 Nov 2022	12 Nov 2022	1	12 Nov 2022
Sprint-4	2	6 Days	14 Nov 2022	19 Nov 2022	2	14 Nov 2022

Fig6.2.JIRA Sprint Delivery

<u>6.3. Report from JIRA</u>

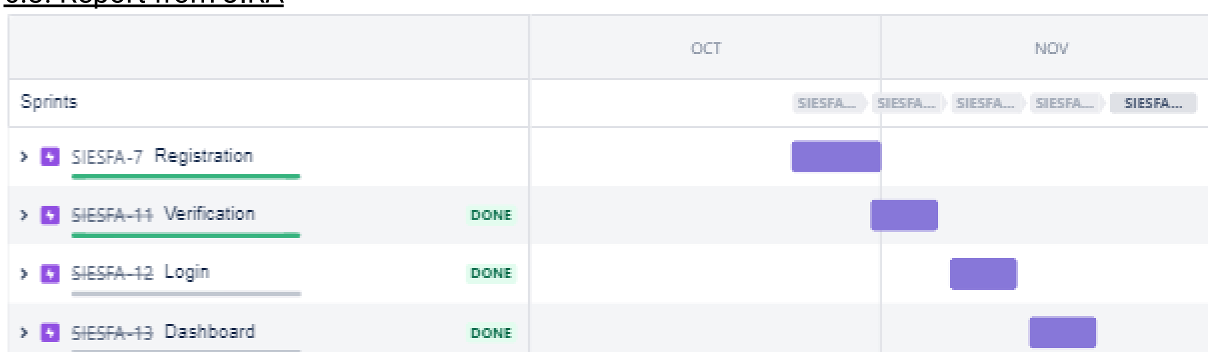


Fig6.3.JIRA Sprint

CHAPTER - 07

7. CODING & SOLUTION (Explain the features added in the project along with code)

<u>7.1.Code</u>

```
import wiotp.sdk.device
import time
import os
import datetime
```

```
import random
myConfig = {
&quot;identity&quot; :
{
&quot;orgId&quot; : &quot;dsjtjb&quot;,
&quot;typeId&quot;: &quot;new &quot;,
&quot;device Id&quot; : &quot;12345&quot;
},
&quot;auth&quot;:{
&quot;token&quot; : &quot;87654321&quot;
}
}
client = wiotp.sdk.device.DeviceClient (config=myConfig, logHandlers=None)
client.connect ()
def myCommandCallback(cmd) :
print (&quot;Message received from IBM IoT Plat form: %s&quot; cmd.data
[&#39;command&#39;])
m=cmd.data [&#39;command&#39;]
if(m==&quot;motoron&quot;):
print(&quot;motot is switched on&quot;)
ellif(m==&quot;motoroff&quot;):
print(&quot;motor is switched OFF&quot;)
print(&quot; &quot;)
while True:
soil=random.randint (0,100)
temp=random.randint (-20,125)
hum=random.randint (0,100)
myData={&#39;soil_moisture&#39;: soil,
&#39;temperature&#39;:temp,&#39;humidity&#39;:hum}

client.publishEvent(eventId=&quot;status &quot;, msgFormat=&quot;json&quot;, data=myData,
qos=0,
onPublish=None)
print (&quot;Published data Successfully: %s&quot;, myData)
time.sleep (2)
client.commandCallback = myCommandCallback
client.disconnect()
```

7.2. Output

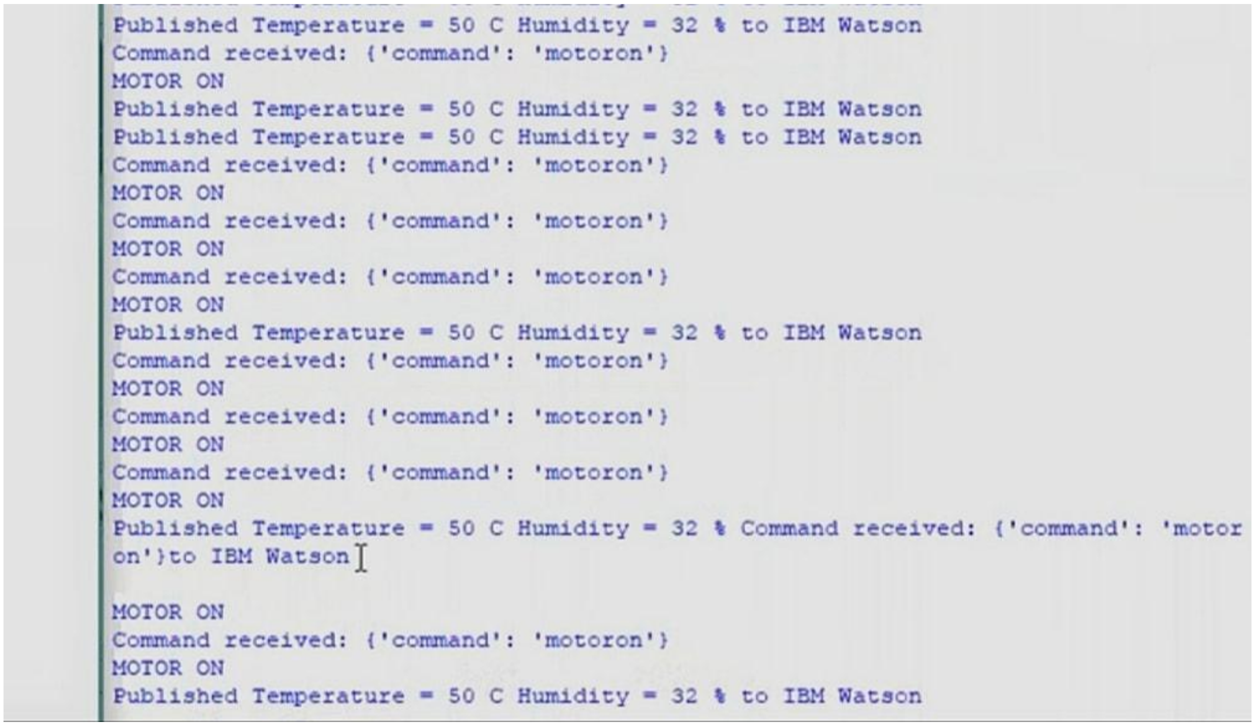


Fig7.1. Output for Python code

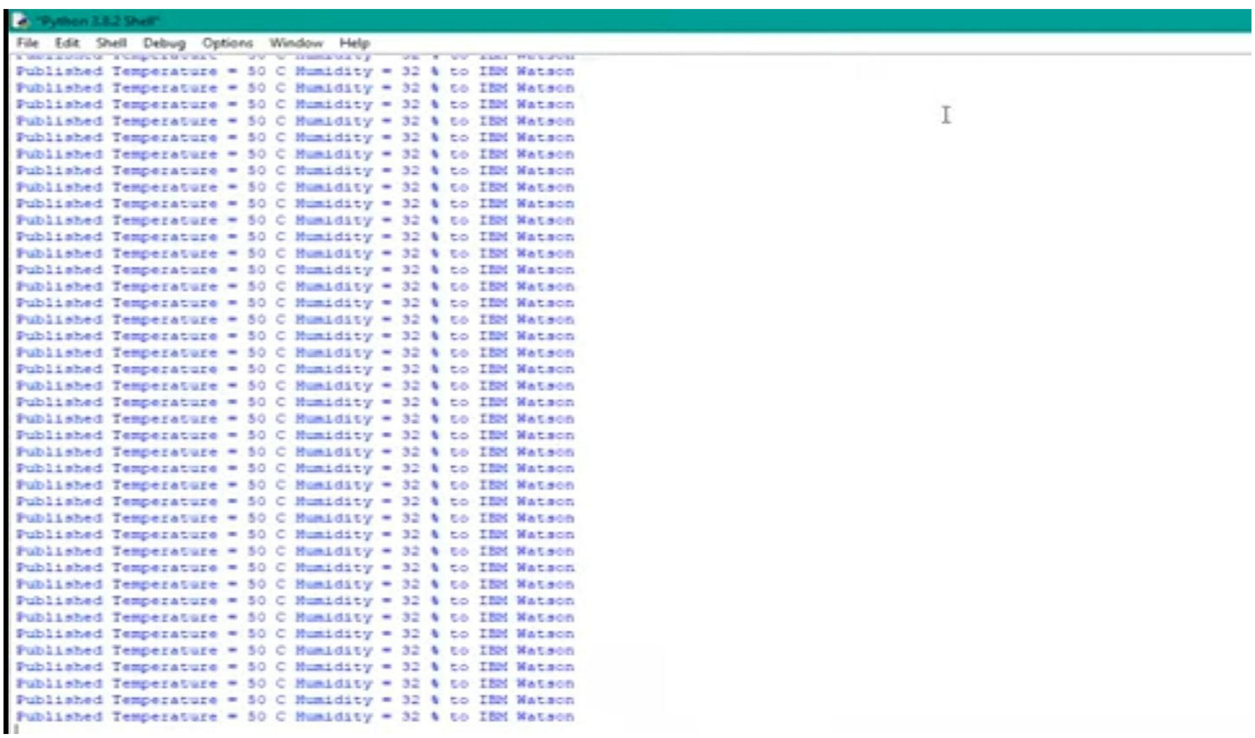


Fig7.2. Output for Python code

7.3. Database Schema

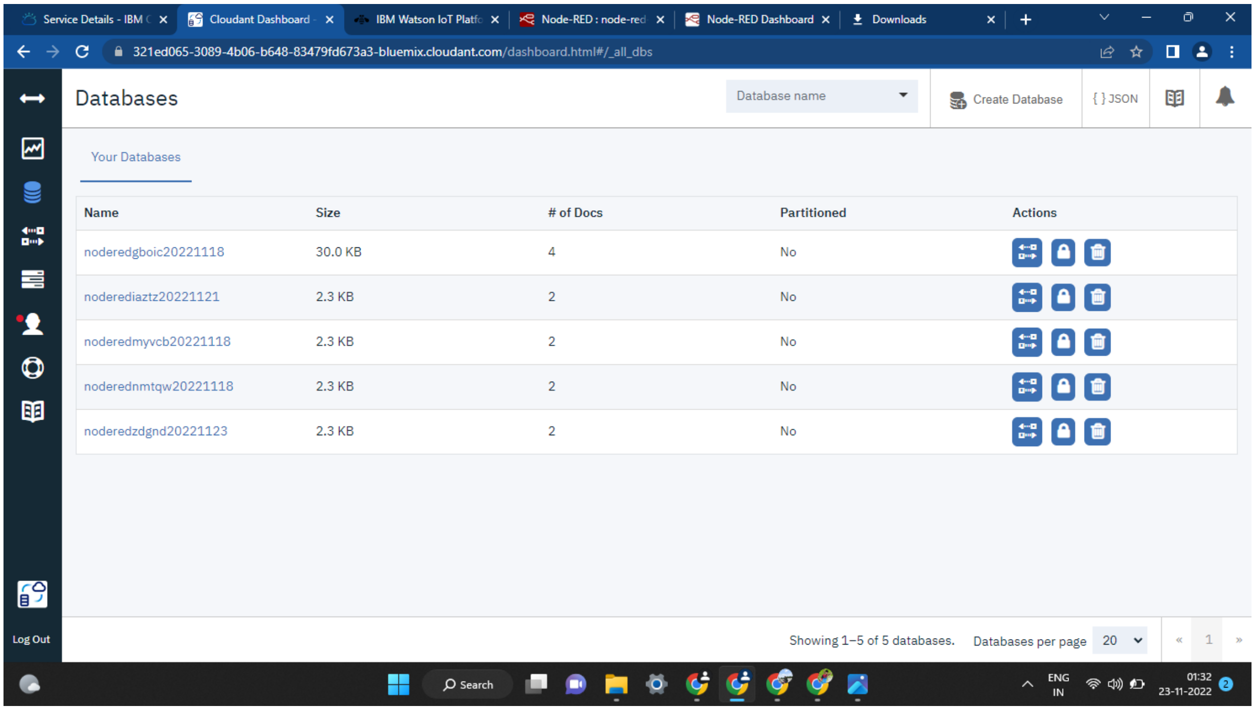
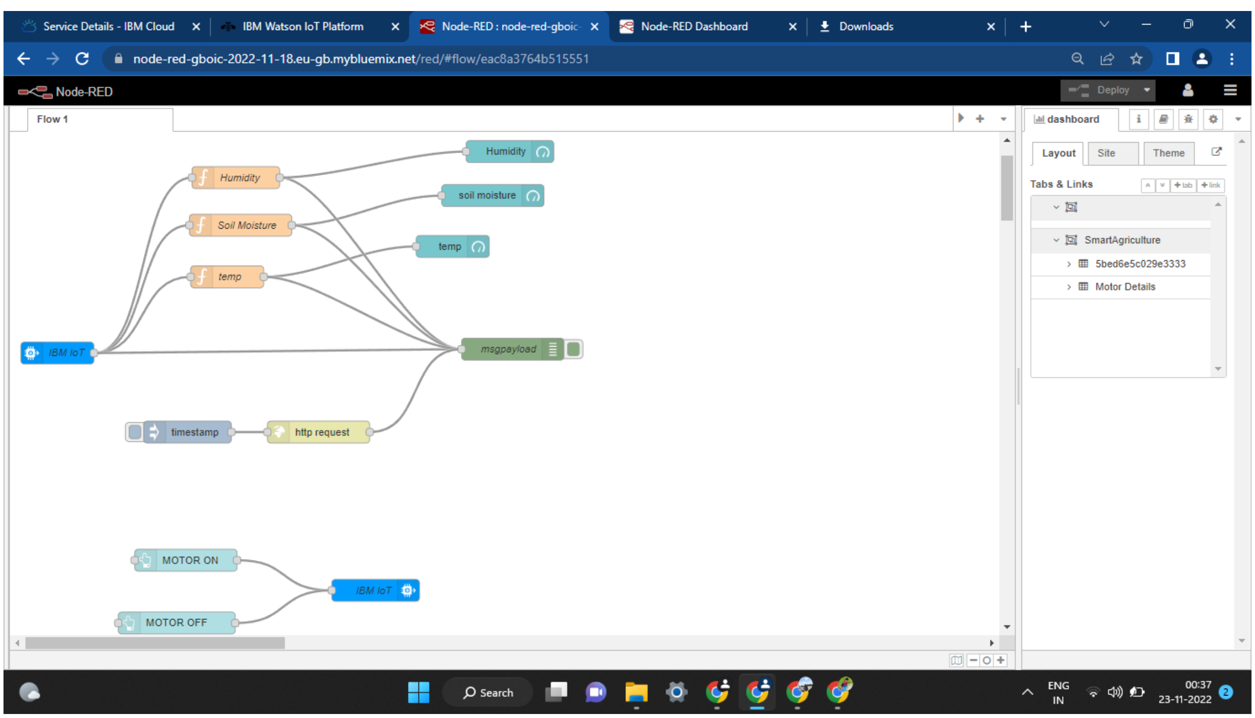


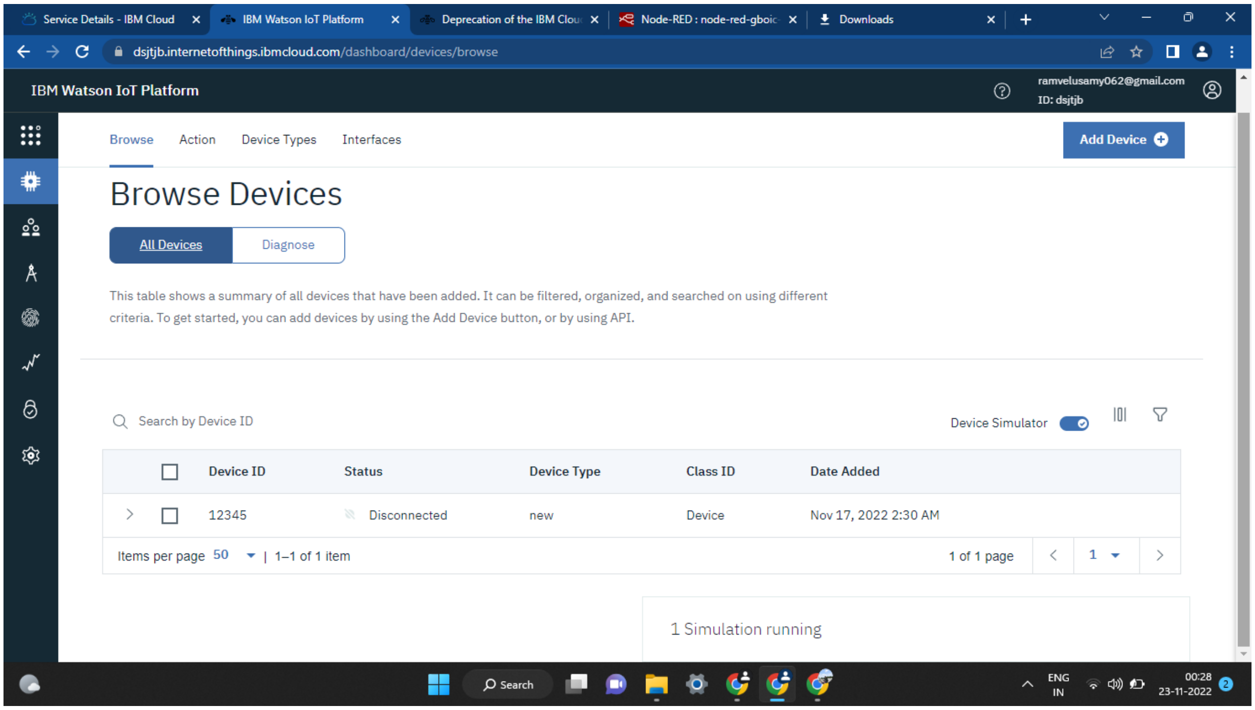
Fig7.3. Database Schema

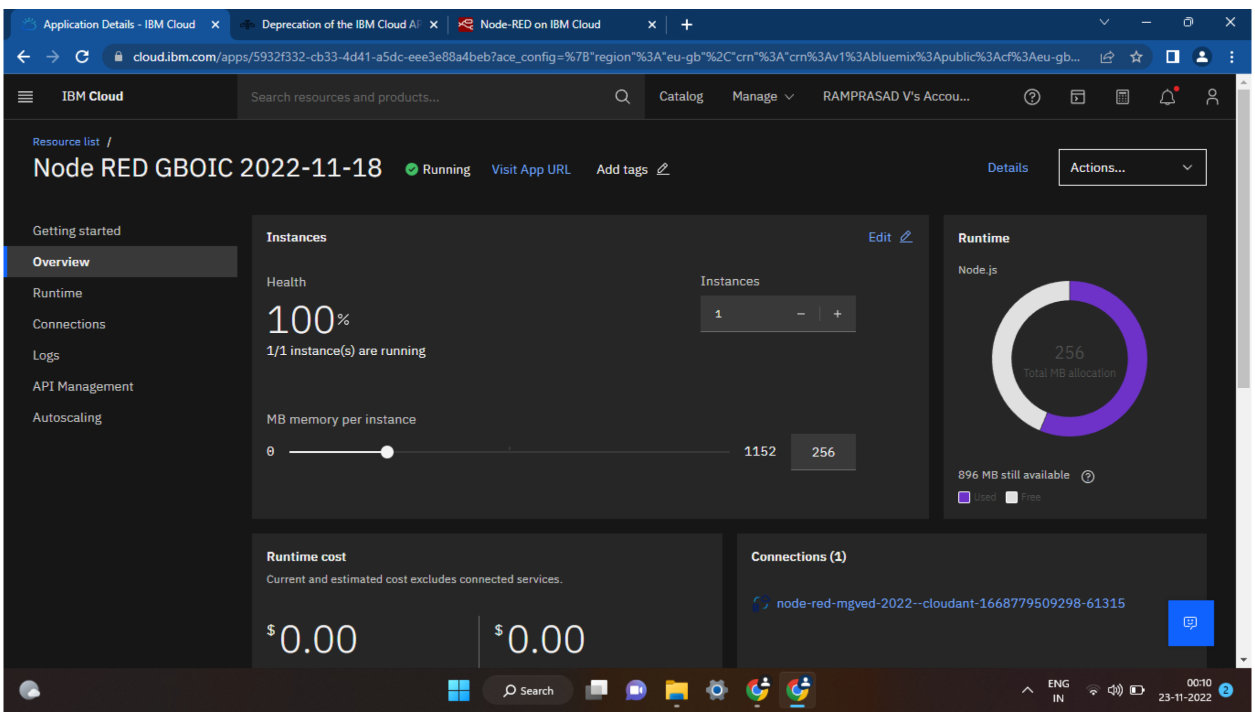
CHAPTER - 08

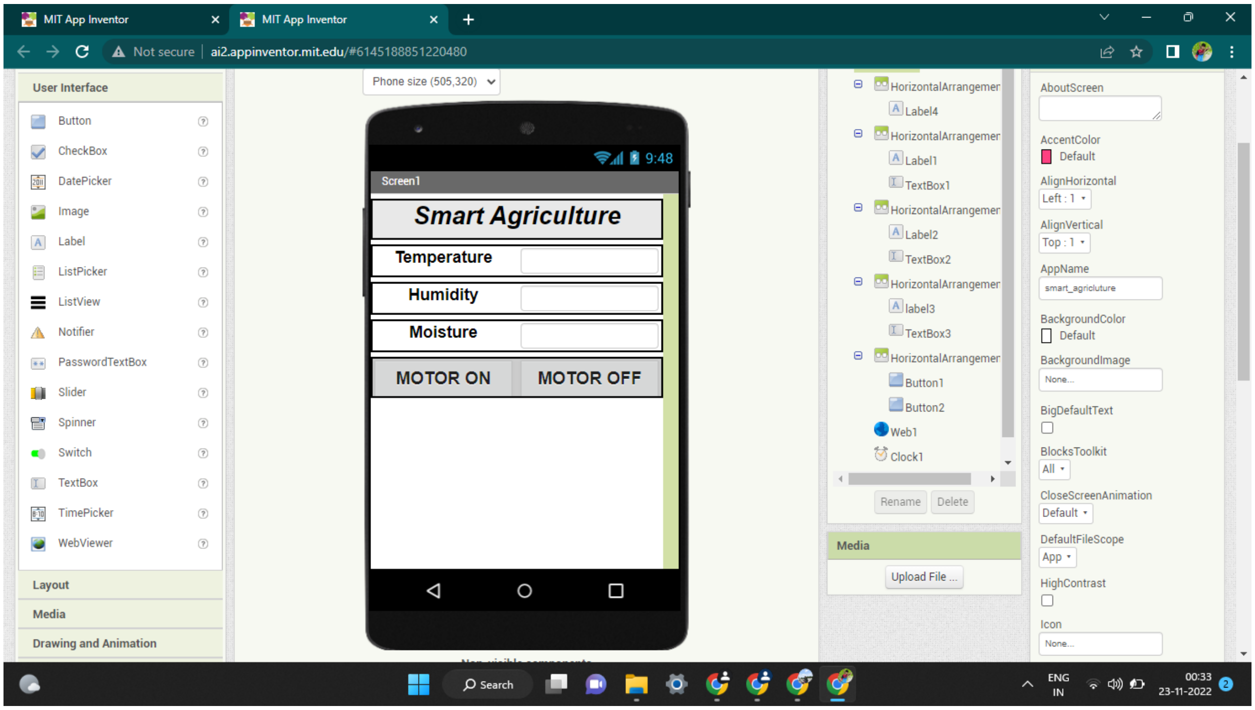
8. TESTING

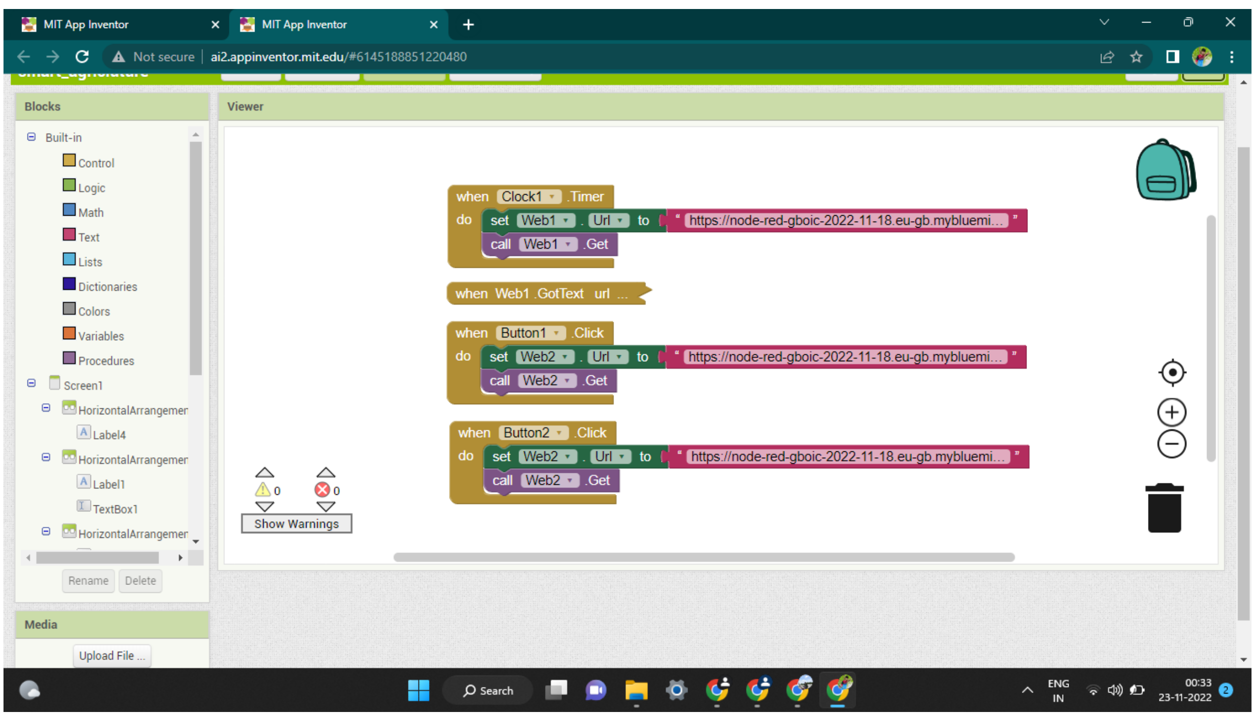
8.1. Test Cases

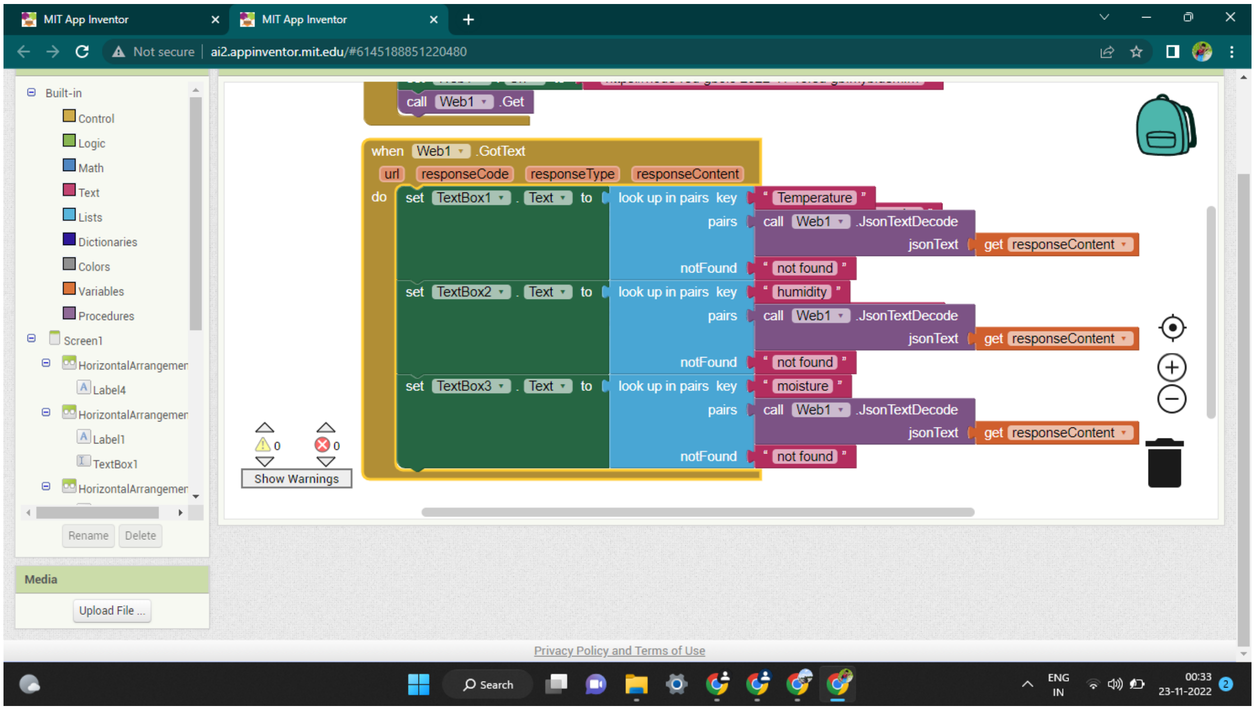



Service Details - IBM Cloud
IBM Watson IoT Platform
Deprecation of the IBM Clou
Node-RED : node-red-gboic
Downloads
dsjtjb.internetofthings.ibmcloud.com/dashboard/devices/browse
IBM Watson IoT Platform
ramvelusamy062@gmail.com
ID: dsjtjb
Browse
Action
Device Types
Interfaces
Add Device
Browse Devices
All Devices
Diagnose
This table shows a summary of all devices that have been added. It can be filtered, organized, and searched on using different criteria. To get started, you can add devices by using the Add Device button, or by using API.
Search by Device ID
Device Simulator
Device ID
Status
Device Type
Class ID
Date Added
12345
Disconnected
new
Device
Nov 17, 2022 2:30 AM
Items per page 50
1–1 of 1 item
1 of 1 page
1 Simulation running
Search
ENG
IN
00:28
23-11-2022


Application Details - IBM Cloud
Deprecation of the IBM Cloud AP
Node-RED on IBM Cloud
cloud.ibm.com/apps/5932f332-cb33-4d41-a5dc-eee3e88a4beb?ace_config=%7B"region"%3A"eu-gb"%2C"crn"%3A"crn%3Av1%3Abluemix%3Apublic%3Acf%3Aeu-gb...
IBM Cloud
Search resources and products...
Catalog
Manage
RAMPRASAD V's Accou...
Resource list /
Node RED GBOIC 2022-11-18
Running
Visit App URL
Add tags
Details
Actions...
Getting started
Overview
Runtime
Connections
Logs
API Management
Autoscaling
Instances
Edit
Health
100%
1/1 instance(s) are running
Instances
1
MB memory per instance
0
1152
256
Runtime
Node.js
256
Total MB allocation
896 MB still available
Used
Free
Runtime cost
Current and estimated cost excludes connected services.
$0.00
$0.00
Connections (1)
node-red-mgved-2022--cloudant-1668779509298-61315
Search
ENG
IN
00:10
23-11-2022


MIT App Inventor
ai2.appinventor.mit.edu/#6145188851220480
User Interface
Button
CheckBox
DatePicker
Image
Label
ListPicker
ListView
Notifier
PasswordTextBox
Slider
Spinner
Switch
TextBox
TimePicker
WebViewer
Layout
Media
Drawing and Animation
Phone size (505,320)
Screen1
Smart Agriculture
Temperature
Humidity
Moisture
MOTOR ON
MOTOR OFF
HorizontalArrangemer
Label4
Label1
TextBox1
Label2
TextBox2
label3
TextBox3
Button1
Button2
Web1
Clock1
Rename
Delete
Upload File ...
AboutScreen
AccentColor
AlignHorizontal
AlignVertical
AppName
smart_agriculture
BackgroundColor
BackgroundImage
BigDefaultText
BlocksToolkit
CloseScreenAnimation
DefaultFileScope
HighContrast
Icon
00:33
23-11-2022


MIT App Inventor
ai2.appinventor.mit.edu/#6145188851220480
Blocks
Viewer
Built-in
Control
Logic
Math
Text
Lists
Dictionaries
Colors
Variables
Procedures
Screen1
HorizontalArrangemer
Label4
Label1
TextBox1
Rename
Delete
Media
Upload File ...
when Clock1 .Timer
do set Web1 . Url to " https://node-red-gboic-2022-11-18.eu-gb.mybluemi... "
call Web1 .Get
when Web1 .GotText url ...
when Button1 .Click
do set Web2 . Url to " https://node-red-gboic-2022-11-18.eu-gb.mybluemi... "
call Web2 .Get
when Button2 .Click
do set Web2 . Url to " https://node-red-gboic-2022-11-18.eu-gb.mybluemi... "
call Web2 .Get
Show Warnings
00:33
23-11-2022

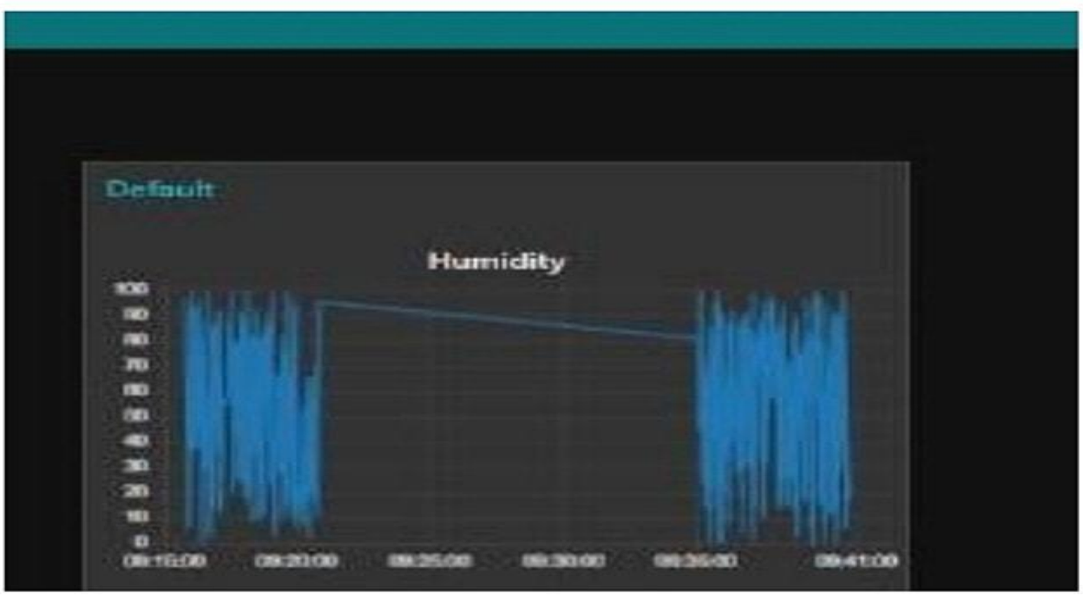


CHAPTER - 09

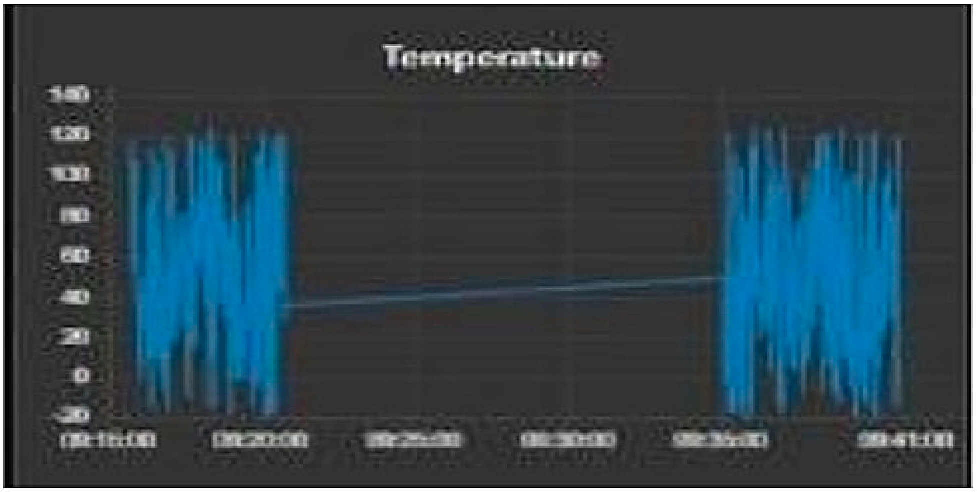
9. RESULTS

<u>9.1. Performance</u>

HUMIDITY

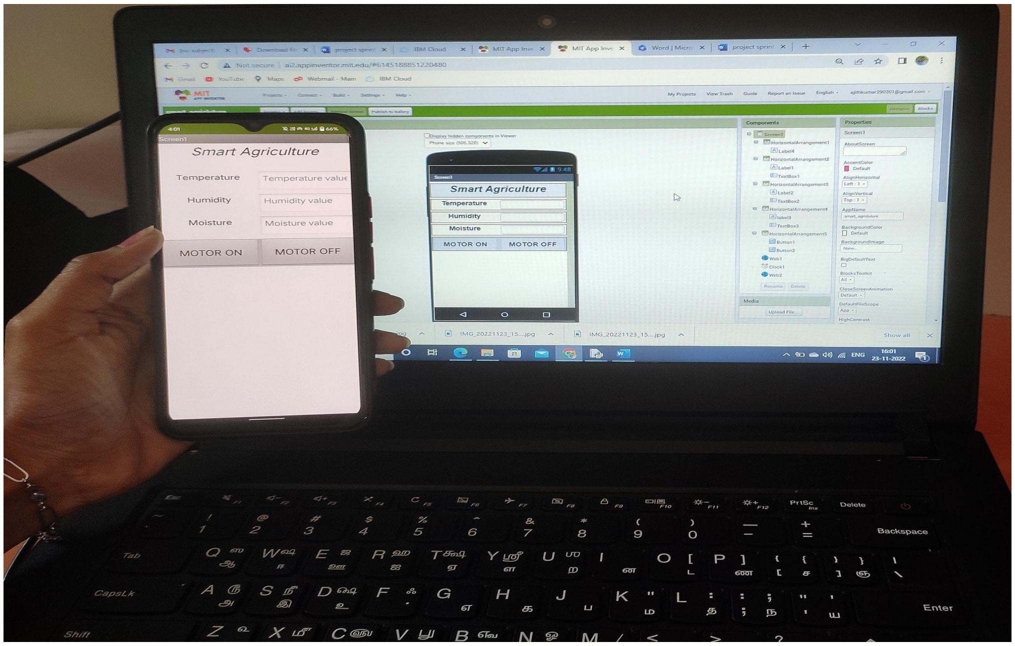


TEMPERATURE



SOIL MOISTURE

MITAPP INVENTOR



CHAPTER - 10

ADVANTAGES :

1. There are many ways that Smart Farming can improve sustainability.
2. From reducing spray wastage to improving fuel economy. By reducing the number of passes needed to complete tasks and reducing turning on the headland soil compaction is minimised.
3. Sensors installed on IoT devices are able to collect a large volume of useful information for farmers.
4. Modern technology has been able to catch up with a growing demand for food by world's population.
5. Farming creates opportunities to lift people out of poverty in developing nations. Over 60 percent of the world's working poor works in agriculture.
6. Intelligent data collection.
7. Waste reduction.
8. Process automation.
9. Animal monitoring.
10. Competitive advantage.

DISADVANTAGES:

1. The smart agriculture needs availability of internet continuously. Rural part of most of the developing countries do not fulfil this requirement. Moreover internet connection is slower.
2. Farms are located in remote areas and are far from access to the internet.
3. A farmer needs to have access to crop data reliably at any time from any location, so connection issues would cause an advanced monitoring system to be useless.
4. The main disadvantage is the time it can take to process the information.
5. Farmers are so busy with harvesting and caring for their crops that they may not have time to process data.
6. There are also issues with the water supply, as well as issues with the cost of the technology, which can be quite expensive.
7. Modern farming methods have overused the natural resource base.
8. Increased use of fertilizers has led to the loss of soil fertility.

CHAPTER 11

11. CONCLUSION

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.Thanks to remote access and basic access security, farmers can target their knowledge for a higher harvest. This closes the gap between quality and quantity. Faster action is possible through the use of advanced sensor technology and real-time data.

Sustainable agriculture is the way to maintain a parity between the increasing pressure of food demand and food production in the future. As population growth, change in income demographics, and food preference changes, there are changes in the demand of food of the future population.Further, changes in climate and increasing concern regarding the depletion of non-renewable sources of energy has forced policymakers and scientists to device another way to sustain the available resources as well as continue meeting the increased demand of food. Sustainable agriculture is the method through which these problems can be overlooked, bringing forth a new integrated form of agriculture that looks at food production in a holistic way.Sustainable agriculture is a process of farming using eco-friendly methods understanding and maintaining the relationship between the organisms and environment. In this process of agriculture and animal husbandry are combined to form a simultaneous process and practice. In other words, sustainable agriculture is an amalgamation of three main elements viz. ecological health, profitability, and propagating equality.

CHAPTER - 12

12. FUTURE SCOPE:

One specific type of IoT product that allows for precision farming are crop management devices. Similar to weather stations, they can be placed in the field to collect data specific to crop farming. Factors that can be tracked include temperature, precipitation, leaf water potential, and overall crop health.

The agricultural industry can reach an unprecedented level of productivity. No doubt the future belongs to intelligent farming approaches driven by big data, IoT devices, smart sensors, drones, and automated greenhouse management systems.

Smart farming is certainly a leading enabler in producing more food with less for an increasing world population. In particular, smart farming enables increased yield through more efficient use of natural resources and inputs, and improved land and environmental management.Precision farming, or precision agriculture, is an umbrella concept for IoT-based biggest difference from the classical approach is that precision farming allows decisions to be made per square meter or even per plant/animal rather than for a field.As is the case of precision agriculture, smart farming techniques enable farmers better to monitor the needs of individual animals and to adjust their nutrition accordingly, thereby preventing disease and enhancing herd health.Large farm owners can use wireless IoT applications to monitor the location, well-being, and health of their cattle. With this information, they can identify sick animals, so that they can be separated from the herd to prevent the spread of disease.

Agriculture is one of the major verticals to incorporate both ground-based and aerial drones for crop health assessment, irrigation, crop monitoring, crop spraying, planting, soil and field analysis, and other spheres.Since drones collect multispectral, thermal, and visual imagery while flying, the data they gather provide farmers with insights into a whole array of metrics: plant health indices, plant counting and yield prediction, plant height measurement, canopy cover mapping, field water pond mapping, scouting reports, stockpile measuring, chlorophyll measurement, nitrogen content in wheat, drainage mapping, weed pressure mapping, and so on.

Importantly, IoT-based smart farming doesn’t only target large-scale farming operations; it can add value to emerging trends in agriculture like organic farming, family farming, including breeding particular cattle and/or growing specific cultures, preservation of particular or high-quality varieties, and enhance highly transparent farming to consumers, society and market consciousness.

CHAPTER - 13

13. APPENDIX

Github Link:https://github.com/IBM-EPBL/IBM-Project-44444-1660724693

Demo Video Link:https://youtu.be/5dap-ck0Boo

IBM Link:https://workdrive.zohoexternal.com/writer/open/rl45idf9b144d3ea4409a8b2c9e9603943f23?authId=%7B%22linkId%22%3A%225k2wApabNEi-LYmlU%22%7D