Smart Farmer-IOT Enabled Smart Farming Application

TITLE	Smart Farmer-IOT Enabled Smart Farming Application
DOMAIN NAME	INTERNET OF THINGS
TEAM ID	PNT2022TMID19661
LEADER NAME	BHOOPESH R K
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GITHUB LINK	https://github.com/IBM-EPBL/IBM-Project-31738-1660204612

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INTRODUCTION

1.1. PROJECT OVERVIEW:

- Agriculture plays vital role to build country economy as it provides food for the whole population. In this way, it connects and communicates with all of the country's important businesses. If a country's agricultural foundation is quite vast, it is considered socially and economically wealthy. As a result, the agri-industry must implement IoT in order to feed this huge population. Major problems, such as rising food demand, climate change, extreme weather conditions, and environmental effects, must be overcome.
- The main objective of this project is to increase production quantity and quality, by making maximum use of resources and minimizing the environmental impact. IoT smart farming solutions is a system that is built for monitoring the crop field with the help of sensors (light, humidity, temperature, soil moisture, crop health, etc.) and automating the irrigation system.

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.
- IoT based Smart Farming improves the entire Agriculture system by monitoring the field in real-time.
- With the help of sensors and interconnectivity, the Internet of Things in Agriculture has not only saved the time of the farmers.
- IoT-enabled agricultural solutions allow farmers to monitor the conditions. The quick collection of data allows farmers to get insights fast and predict issues even before they happen.

2. LITERATURE SURVEY

Paper 1: Agricultural Production System Using IoT as Inclusive Technology

Publication year: December – January 2016

Author name: **CHANDHINI. K.** Bangalore, Karnataka.

Summary: The IoT (Internet of Things) based agricultural convergence technology is a technology to create a high value such as improvement of production efficiency, quality increase of agricultural products in the whole process of agricultural production. In addition, implementing precision agriculture, which is an alternative to the future agriculture, through the convergence technology allows prediction of supply and demand, real-time management and quality maintenance during the entire life cycle of agricultural products. We make a literature study on the cited title and present it in the form of this note.

Methodology used: Sensor/Information Collection Layer, Transport/Network Layer, Application Layer, Sensors, Cloud-Computing, Mobile-Computing &Big-Data Analysis.

Conclusion: The IoT-based agricultural production system has built on the long-standing desire of farmers to ensure their land remains productive into the future. It also addresses the community's expectations and concerns for safe food and for environmental protection. An agricultural production system for the agricultural production using IoT technology and implemented it as GUI visualization software was designed. The IoT based agricultural production system through correlation analysis between the crop statistical information and agricultural environment information has enhanced the ability of farmers, researchers, and government officials to analyze current conditions and predict future harvest. Additionally, agricultural products quality can be improved because farmers observe whole cycle from seeding to selling using this IoT based agricultural production system. The production system can be improved to support more types of products and provide more services. By taking advantage of IoT technology, the efficiency of agricultural production can get a significant improvement. With constantly improving, agriculture IoT must be able to lead agriculture production to a new era.

Paper 2: An Approach Based on Fog Computing for Providing Reliability in IoT Data Collection: A Case Study in a Colombian Coffee Smart Farm

Publication year: 14 December 2020

Author name: Ana Isabel Montoya-Munoz

Summary: The reliability in data collection is essential in Smart Farming supported by the Internet of Things (IoT). Several IoT and Fog-based works consider the reliability concept, but they fall short in providing a network's edge mechanisms for detecting and replacing outliers. Making decisions based on inaccurate data can diminish the quality of crops and, consequently, lose money. This paper proposes an approach for providing reliable data collection, which focuses on outlier detection and treatment in IoT-based Smart Farming. Our proposal includes an architecture based on the continuum IoT-Fog-Cloud, which incorporates a mechanism based on Machine Learning to detect outliers and another based on interpolation for inferring data intended to replace outliers. We located the data cleaning at the Fog to Smart Farming applications functioning in the farm operate with reliable data.

Methodology used: Motivation, Reliable Fog Computing-Based Architecture, Failure Detection and Recovery Mechanism, Coffee Smart Farming Datasets, Test Environment, Failure Detection Evaluation—Results and Analysis.

Conclusions: This paper introduced an FC-based architecture approach that incorporates a mechanism for detecting outliers and another for inferring data intended to replace them. The evaluation demonstrated our approach's effectiveness in a real network deployed in a Colombian Smart Coffee Farm. For the failure detection mechanism, we selected the DBSCAN algorithm due to it presenting an excellent performance for marking outliers over all the tests with a FAR lower than 6%, a perfect Recall as well as an Accuracy, Precision, and F-Score greater than 99% for the most extensive dataset. We selected the linear interpolation for the failure recovery mechanism because it infers data with low RMSE allowing for replacing the detected outliers properly. Considering the obtained results, we concluded that the proposed approach is suitable for providing reliability in the IoT-based Smart Farming data collection process and supports the correct decision-making. Apart from that, our proposal falls behind in terms of power consumption analysis, architectures validation, or comparison, and optimal location of nodes per layer in the Fog Tier.

Paper 3: A Low-Cost Platform for Environmental Smart Farming Monitoring System Based on IoT

Published year: 24 May 2021

Author name: Ben Othman Soufiene, Faris A. Almalki

Summary: When integrating the Internet of Things (IoT) with Unmanned Aerial Vehicles (UAVs) occurred, tens of applications including smart agriculture have emerged to offer innovative solutions to modernize the farming sector. This paper aims to present a low-cost platform for comprehensive environmental parameter monitoring using flying IoT. This platform is deployed and tested in a real scenario on a farm in Medenine, Tunisia, in the period of March 2020 to March 2021. The experimental work fulfills the requirements of automated and real-time monitoring of the environmental parameters using both under- and aboveground sensors. These IoT sensors are on a farm collecting vast amounts of environmental data, where it is sent to ground gateways every 1 h, after which the obtained data is collected and transmitted by a drone to the cloud for storage and analysis every 12 h. This low-cost platform can help farmers, governmental, or manufacturers to predict environmental data over the geographically large farm field, which leads to enhancement in crop productivity and farm management in a cost-effective, and timely manner.

Conclusion: Smart farming involves the integration of advanced technologies into existing farming practices to increase production efficiency and quality of agricultural products. The evolution of IoT and UAVs has enabled the vision of sustainable smart farming, where these smart technologies have proven to increase the quality of crop yield and reduce the environmental footprint from the agricultural sector. This paper shows a low-cost platform for comprehensive environmental parameter monitoring using flying IoT. The proposal is based on experimental work to fulfill the requirements of automated and real-time monitoring of the environmental parameters using both under- and aboveground sensors. These IoT sensors devices on a farm collect vast amounts of environmental data.

Paper 4: Smart farmer system

Publication year: 04, April 2020

Author name: Athrva Dalvi, Shefali Kulkarni, Utsavi Kulkarni, Shweta Todkar

Summary: Agriculture is considered as the backbone of India, is the major contributor to the country's economy. However, technology involvements and their usage have still not been incorporated in this sector. Some initiatives have been incorporated by the governments by providing mobile messaging and calling services to farmer's queries relating sowing, harvesting and selling of crops, it provides static data related to quantity of soil in each region. The paper takes care of all major factors of agriculture i.e., monitoring, irrigation and security.

Methodology used: In this system can monitor the humidity, moisture level and can even detect motions. In, the authors have identified current and future trends of IoT in agriculture and highlight potential research challenges. In, the authors have introduced the latest technologies such as sensors, IoT to radically revise approaches to agriculture by collecting the data about various parameters of soil, analyzing the data and performed the computations.

Conclusion: The described system uses supervised machine learning algorithm to classify the crops into the various months in which they should be yielded based on their ideal requirements. The system uses information from soil moisture sensors to irrigate the soil to avoid the damage of crops due to over irrigation or under irrigation. The project provided us with an opportunity to study the existing systems, along with their features and drawbacks.

Paper 5 : Smart Agriculture using IoT

Publication year:23, March 2018

Author name: Dr V.Nagaveni

Summary: In the literature there are numerous examples of versatile IoT application-oriented studies. In, an example of control networks and information networks integration with IoT technology has been studied based on an actual situation of agricultural production. A remote monitoring system with combining internet and wireless communications is proposed. Furthermore, taking into account the system, an additional information management sub-system is designed.

Conclusion: The main advantage of this paper is that, all the functions to be performed by the Fan and Sprinkler to control the climatic conditions like temperature, relative humidity and soil moisture levels in the Greenhouse environment are all automated and it does not require any human intervention. This is particularly an important factor because the presence and availability of the human cannot always be trusted on. For important structures like the greenhouses, we need a more dependable and reliable way for its management which is easily achieved by this project. Greenhouses are very important as they are responsible for the efficient growth of crops that are either necessary to feed the population or necessary for the economic growth of any country.

Paper 6: IoT and agriculture data analysis for smart farm

Publication year: 2018

Author name: Jirapond Muangprathub, Nathaphon Boonnam, Siriwan Kajornkasirat, Narongsak Lekbangpong, Apirat Wanichsombat, Pichetwut Nillaor.

Journal name: Elsevier B.V

Summary: In this paper, we propose developing a system optimally watering agricultural crops based on a wireless sensor network. This work aimed to design and develop a control system using node sensors in the crop field with data management via smartphone and a web application. The three components are hardware, web application, and mobile application. The first component was designed and implemented in control box hardware connected to collect data on the crops. Soil moisture sensors are used to monitor the field, connecting to the control box. The second component is a web-based application that was designed and implemented to manipulate the details of crop data and field information. This component applied data mining to analyze the data for predicting suitable temperature, humidity, and soil moisture for optimal future management of crops growth. The final component is mainly used to control crop watering through a mobile application in a smartphone. This allows either automatic or manual control by the user. The automatic control uses data from soil moisture sensors for watering. However, the user can opt for manual control of watering the crops in the functional control mode. The system can send notifications through LINE API for the LINE application. The system was implemented and tested in Makhamtia District, Suratthani Province, Thailand. The results showed the implementation to be useful in agriculture. The moisture content of the soil was maintained appropriately for vegetable growth, reducing costs and increasing agricultural productivity. Moreover, this work represents driving agriculture through digital innovation

Paper 7: Scientific development of smart farming technologies

Publication year: 2018

Author name: Dieisson Pivoto, Paulo Dabdab Waquil, Edson Talamini, Caroline Pauletto Spanhol Finocchio, Vitor Francisco Dalla Corte, Giana de Vargas Mores.

Journal name: Elsevier B.V

Summary: Smart farming (SF) involves the incorporation of information and communication technologies into machinery, equipment, and sensors for use in agricultural production systems. New technologies such as the internet of things and cloud computing are expected to advance this development, introducing more robots and artificial intelligence into farming. Therefore, the aims of this paper are twofold: (i) to characterize the scientific knowledge about SF that is available in the worldwide scientific literature based on the main factors of development by country and over time and (ii) to describe current SF prospects in Brazil from the perspective of experts in this field. The research involved conducting semi-structured interviews with market and researcher experts in Brazil and using a bibliometric survey by means of data mining software. Integration between the different available systems on the market was identified as one of the main limiting factors to SF evolution. Another limiting factor is the education, ability, and skills of farmers to understand and handle SF tools. These limitations revealed a market opportunity for enterprises to explore and help solve these problems, and science can contribute to this process. China, the United States, South

Korea, Germany, and Japan contribute the largest number of scientific studies to the field. Countries that invest more in R&D generate the most publications; this could indicate which countries will be leaders in smart farming. The use both research methods in a complementary manner allowed to understand how science frame the SF and the mains barriers to adopt it in Brazil.

Paper 8: Smart Farming using IoT, a solution for optimally monitoring farming conditions

Publication year: 2019

Author name: Jash Doshi, Tirthkumar Patel, Santosh kumar Bharti. Journal name: Elsevier B.V

Summary: 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.

Paper 9: Literature study on Agricultural production system using IoT

Publication year: Dec-Jan 2016

Author name: Chandhini.K

Summary: The complexity of smart farming is also reflected into the ecosystem of players. They can be classified in the following way: Technology providers-these include providers of wireless connectivity, sensors, M2M solutions, decision support systems at geomapping applications. Providers of agricultural equipment and machinery. Precision agriculture makes use of a range of technologies that include GPS services, sensors and big data to optimize crop yields. Rather than replace farmer expertise and gut feeling, ICT-based decision support systems, backed up by real time data, can additionally provide information concerning all aspects of farming at a level of granularity not previously possible.

Conclusion: The IoT-based agricultural production system has built on the long-standing desire of farmers to ensure their land remains productive into the future. It also addresses the community's expectations and concerns for safe food and for environmental protection. The IoT based agricultural production system through correlation analysis between the crop statistical information and agricultural environment information has enhanced the ability of farmers, researches, and government officials to analyze current conditions and predict future harvest.

Paper 10: IoT Based Smart Agriculture Monitoring System

Publication year: July 2021

Author name: Harika Pendyala, Ganesh Kumar Rodda,Anooja Mamidi,Madhavi Vangala,Sathyam Bonala,Keerti Kumar Korlapati

Journal name: International Journal of Scientific Engineering and Research (IJSER)

Summary: In every country agriculture is done from ages which are considered to be science and also art of cultivating plants. In day today life, technology is updating and it is also necessary to trend up agriculture too. IoT plays a key role in smart agriculture. Internets of Things (IoT) sensors are used to provide necessary information about agriculture fields. The main advantage of IoT is to monitor the agriculture by using the wireless sensor networks and collect the data and send by wireless protocol.

Methodology used: A system is developed by using sensors and according to the decision from a server based on sensed data. Through wireless transmission the sensed data is forwarded to web server database. If the irrigation is automated then the moisture and temperature fields are

decreased below the potential range. The user can monitor and control the system remotely with the help of application which provides a web interface to user.

Paper 11: IoT based SMART FARMING SYSTEM

Publication year: December 2018

Author name: YASIR FAHIM

Journal name: CENTRAL INSTITUTE OF TECHNOLOGY, KOKRAJHAR

Summary: The aim / objective of this report is to propose IoT based Smart Farming System assisting farmers in getting Live Data (Temperature, Soil Moisture) for efficient environment monitoring which will enable them to increase their overall yield and quality of products. The IoT based Smart Farming System being proposed via this report is integrated with Arduino Technology mixed with different Sensors and a WIFI module producing live data feed that can be obtained online from Thingsspeak.com. The product being proposed is tested on Live Agriculture Fields giving high accuracy over 98% in data feeds**.**

Methodology used: Internet of Things has a strong backbone of various enabling technologies- Wireless Sensor Networks, Cloud Computing, Big Data, Embedded Systems, Security Protocols and Architectures, Protocols enabling communication, web services, Internet and Search Engines.

Conclusion: IoT based SMART FARMING SYSTEM for Live Monitoring of Temperature and Soil Moisture has been proposed using Arduino and Cloud Computing. 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 report 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.

Paper 12: IoT-Enabled Smart Agriculture: Architecture, Applications, and Challenges

Publication year:27 March 2022 **Author name: Licensee** MDPI **Journal name:** applied sciences

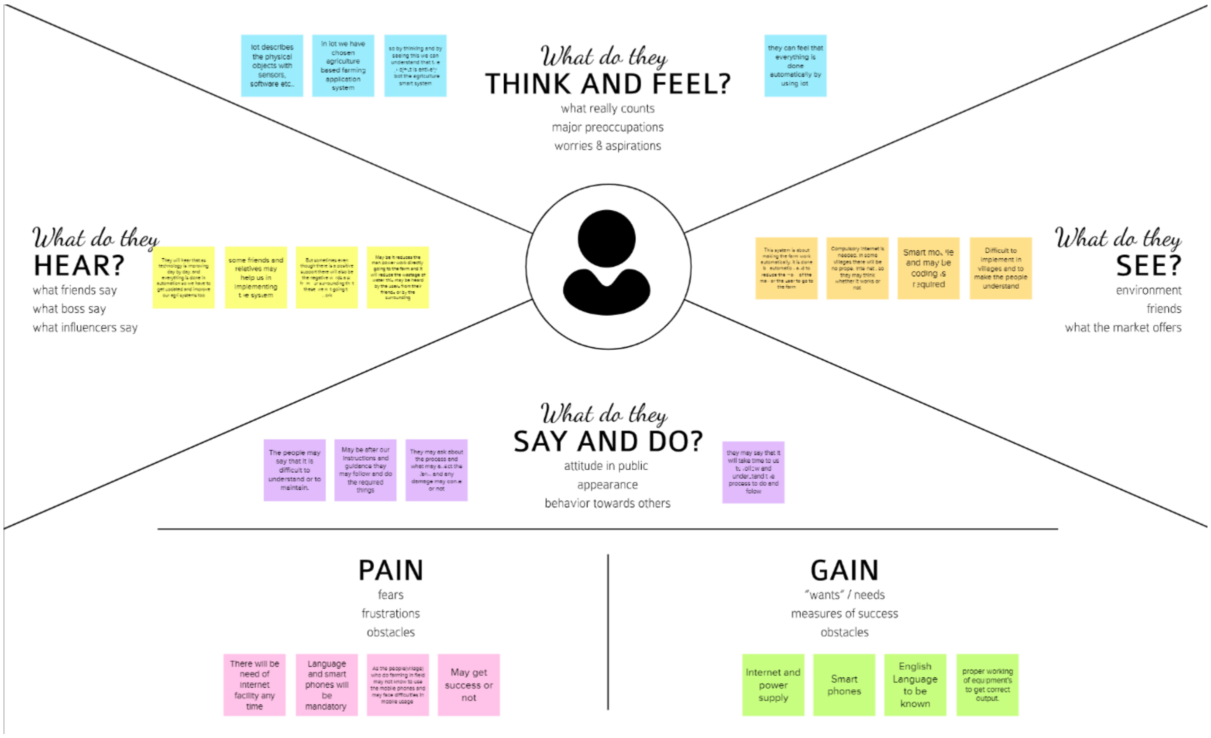
Summary: The growth of the global population coupled with a decline in natural resources, farmland, and the increase in unpredictable environmental conditions leads to food security is becoming a major concern for all nations worldwide. These problems are motivators that are driving the agricultural industry to transition to smart agriculture with the application of the Internet of Things (IoT) and big data solutions to improve operational efficiency and productivity. The IoT integrates a series of existing state-of-the-art solutions and technologies, such as wireless sensor networks, cognitive radio ad hoc networks, cloud computing, big data, and end-user applications.

Methodology used: IoT ecosystem for smart agriculture based on three main components, including IoT devices, communication technologies, and data process and storage solutions. An illustration of the IoT ecosystem for smart agriculture is presented

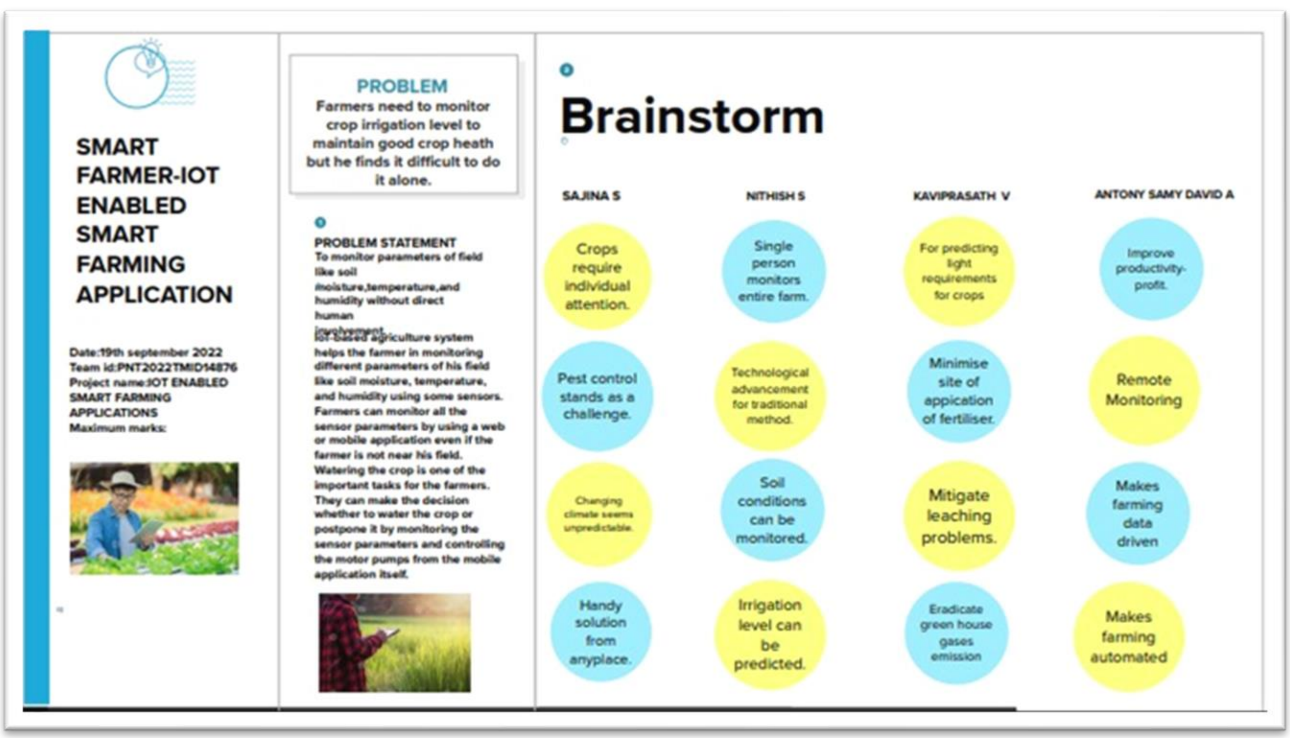
Conclusion: In this study, we presented an overview of IoT and big data for the smart agriculture sector. In addition, security, technologies need to be continuously improved, but in our opinion, the application of IoT solutions for smart agriculture is inevitable and will enhance productivity, provide clean and green foods, support food traceability, reduce human labor, and improve production efficiency

3. IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS:



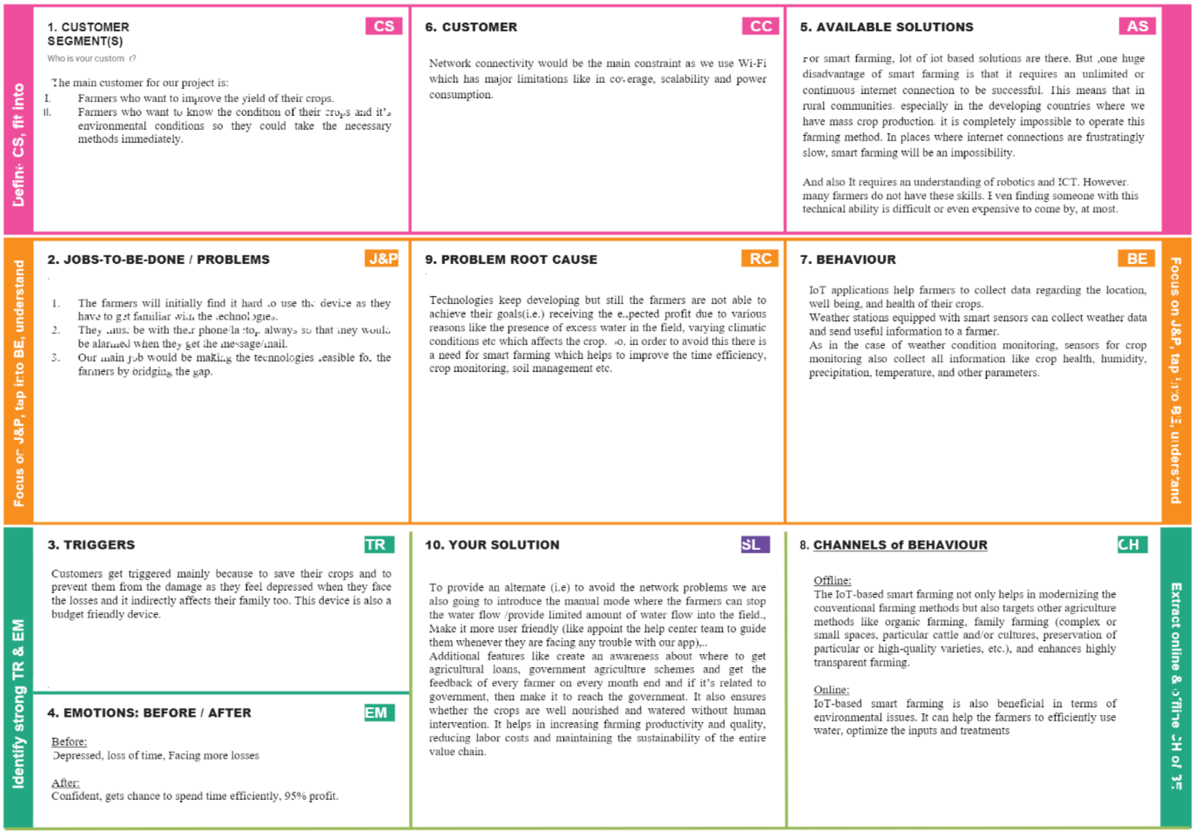
3.2 IDEATION AND BRAINSTORMING:



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 analyze 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.

3.4 PROBLEM SOLUTION FIT:



4. REQUIREMENT ANALYSIS

4.1 FUNTIONAL REQUIREMNTS:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Log in to system	Check Credentials Check Roles of Access.
FR-4	Manage Modules	Manage System Admins Manage Roles of User Manage User permission
FR-5	Check whether details	Temperature details Humidity details
FR-6	Log out	Exit

4.2 NON-FUNTIONAL REQUIREMNTS:

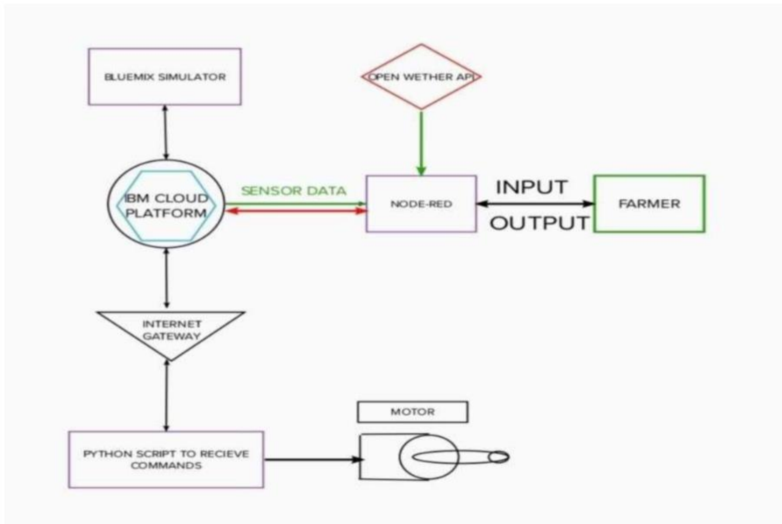
Following are the non-functional requirements of the proposed solution.

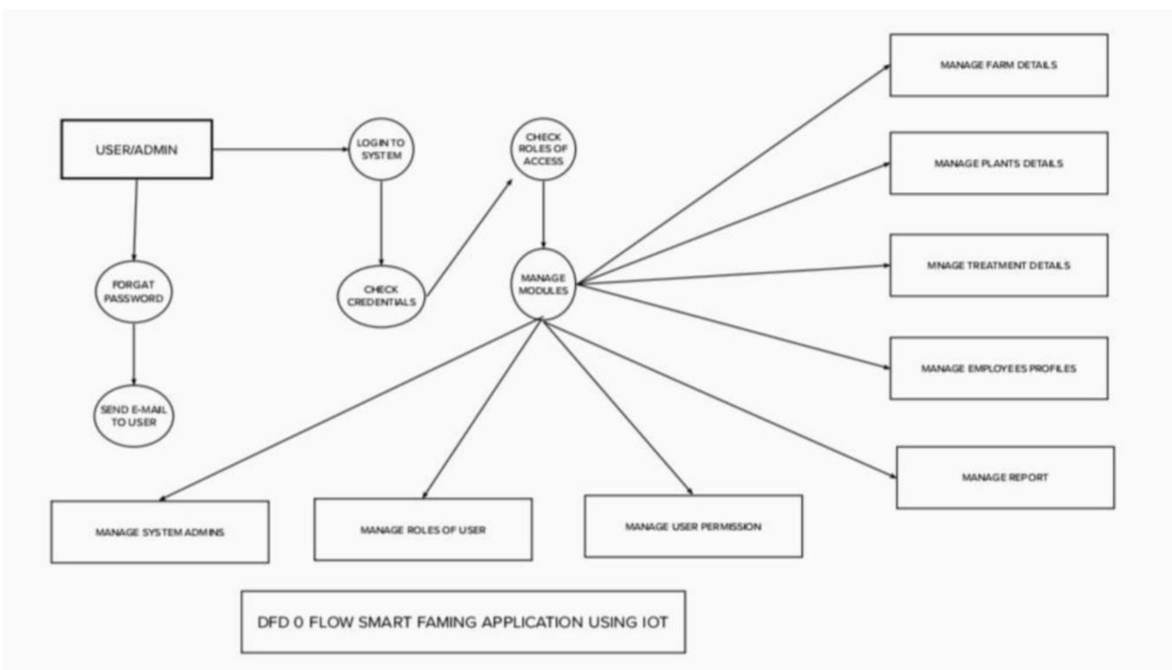
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Usability includes easy learn ability, efficiency in use, remember ability, lack of errors in operation and subjective pleasure.
NFR-2	**Security**	Sensitive and private data must be protected from their production until the decision-making and storage stages.
NFR-3	**Reliability**	The shared protection achieves a better trade-off between costs and reliability. The model uses dedicated and shared protection schemes to avoid farm service outages.
NF-4	**Performance**	the idea of implementing integrated sensors with sensing soil and environmental or ambient parameters in farming will be more efficient for overall monitoring
NF-5	**Availability**	Automatic adjustment of farming equipment made possible by linking information like crops/weather and equipment to auto-adjust temperature, humidity, etc.
NF-6	**Scalability**	Scalability is a major concern for IoT platforms. It has shown that different architectural choices of IoT platforms affect system scalability and thatautomatic real time decision-making is feasible in an environment composed of dozens of thousand.

5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAM:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

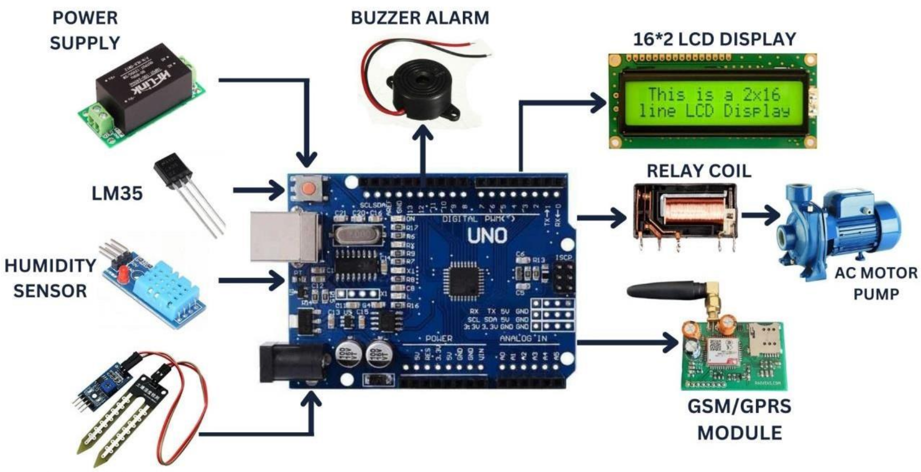




5.2 SOLUTION AND TECHNICAL ARCHITECTURE:

SOLUTION ARCHITECTURE:

The proposed solution will assist farmers by getting live data (Temperature, humidity, soil moisture) 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 architecture of proposed system consists of various blocks:

SENSORS

The soil moisture sensor senses the moisture level in the soil. The humidity and temperature sensor gives the humidity and temperature values of the atmosphere which determine whether the crop is suitable for growth. The soil moisture sensor, humidity and temperature sensor continuously monitors the soil and environmental conditions, sends the live data to mobile.

ARDUINO UNO

Arduino Uno is the heart of the system. The facts gathered with the aid of the sensors is sent to the Arduino UNO.The gathered information may be displayed in a Arduino IDE.

SOIL MOISTURE SENSOR

A soil moisture sensor empowers agriculturalists to estimate the water levels without the need to be physically present in the field.

TEMPERATURE SENSOR

The temperature sensor senses the surrounding temperature of the farm in different farm conditions.

HUMIDITY SENSOR

Humidity sensors are electronic devices that measure and report the moisture and air temperature of the surrounding environment.

GSM/GPRS MODULE
A GSM module is hooked up with the Arduino to facilitate messaging service which updates the farmer present climatic conditions of the subject. GSM module is used to sending a message to the owner of farm after comparison output is positive or negative. If output is positive then wild animal detected then message send to the owner of farm using GSM.

BUZZER ALARM

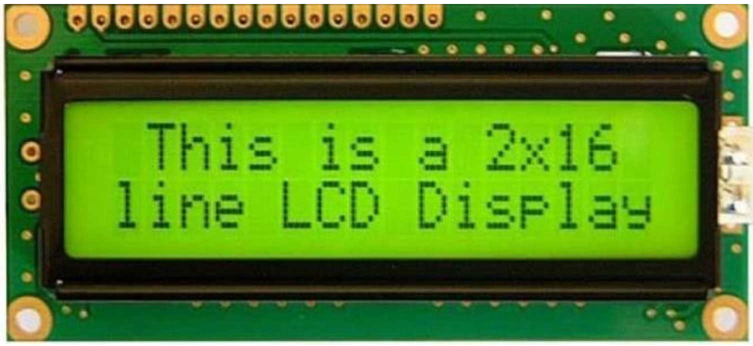
The project system can capture the image. This is to ward off the animals from fields. An buzzer is introduced, Its loudly audible to animals. The buzzer switched on automatically only after animals are detected in the farm.

AC MOTOR PUMP

This pump will pump water from well and water is sent to the farmland.

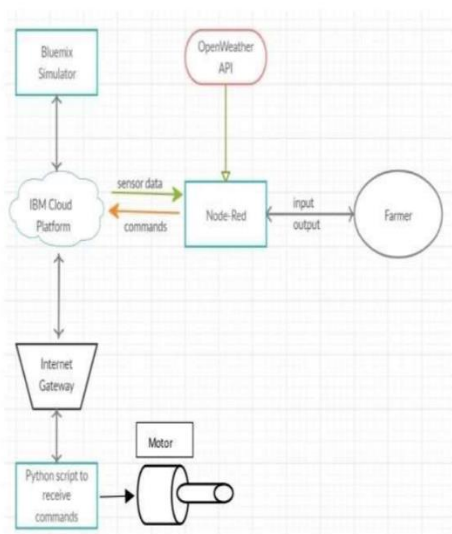
16*2 LCD DISPLAY

A LCD display is used to display the functioning of the project at any given time.



TECHNICAL ARCHITECTURE:

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2



Guidelines:

1. Include all the processes (As an application logic / Technology Block)
2. Provide infrastructural demarcation (Local / Cloud)
3. Indicate external interfaces (third party API's etc.)
4. Indicate Data Storage components / services
5. Indicate interface to machine learning models (if applicable)

- The different soil parameters temperature, soil moistures and then humidity are sensed using different sensors and obtained value is stored in the IBM cloud.
- Arduino UNO is used as a processing Unit that process the data obtained from the sensorsand whether data from the weather API.
- NODE-RED is used as a programming tool to write the hardware, software, and APIs. The MQTT protocol is followed for the communication.
- All the collected data are provided to the user through a mobile application that was developed using the MIT app inventor. The user could decide through an app, weather to water the crop or not depending upon the sensor values. By using the app, theycan remotely operate the motor switch.

Table – 1: Components & Technologies:

S. No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g.WebUI, Mobile App.	HTML, CSS, JavaScript / Angular Js /React Js etc.
2.	Application Logic-1	Logic for a process in the application	Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson IOT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.
6.	Cloud Database	Database Service on Cloud	IBM Cloud
7.	File Storage	File storage requirements	IBM Block Storage or Other StorageService or Local Filesystem
8.	External API-1	Purpose of External API used in the application	IBM Weather API, etc.
9.	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model, etc.
10.	Infrastructure (Server / Cloud)	Application Deployment on Local System / CloudLocal Server Configuration: Cloud Server Configuration:	Local, Cloud Foundry, Kubernetes, etc.

Table-2: Application Characteristics:

S. No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	Technology of Opensourceframework
2.	Security Implementations	Sensitive and private data must be protected fromtheirproduction until the decision-making and storage stages.	e.g. Node-Red, Open weather AppAPI,MIT App Inventor, etc.
3.	Scalable Architecture	scalability is a major concern for IoT platforms. ItI shown that different architectural choices ofIoT platforms affect system scalability and that automatic real time decision-making is feasible in an environment composed of dozens of thousand.	Technology used
4.	Availability	Automatic adjustment of farming equipment madepossible by linking information like crops/weather andequipment to auto-adjust temperature, humidity, etc.	Technology used
5.	Performance	The idea of implementing integrated sensors withsensing soil and environmental or ambient parameters in farming will be more efficient for overallmonitoring.	Technology used

5.3 USER STORIES:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Farmer -Mobile user	End User- Mobile app	USN-1	I have to check the temperature value of my field.	Click on the buttonto view the temperature.	High	Sprint-1
		USN-2 I	I have to monitor the soil moisture content near my crops.	Click on the buttonto view the moisture content	High	Sprint-1
		USN-3 I	I have to measure the humidity conditions for crop storage.	Click on the buttonto view the crop storage..	Low	Sprint-2
		USN-4 I	I have to measure the current temperature and compare it with previous temperature.	Click on the optionto compare results.	Medium	Sprint-1
		USN-5	I have to visualize the graph of crop production.	Click on the graphbutton to visualize the results.	High	Sprint-1

6. PROJECT PLANNING AND SCHEDULING

6.1. SPRINT PLANNING AND ESTIMATION

Sprint	Functional Requirement(Epic)	User Story Number	User Story /Task	Story Points	Priority	Team Members
Sprint-1	Simulation creation	USN-1	Connect Sensorsand Arduino with python code	2	High	Bhoopesh R K, Amitkumar Sharma R, Gautam KumarRai D, Kamali K
Sprint-2	Software	USN-2	Creating devicein the IBM Watson IoT platform, workflow for IoT scenarios usingNode-Red	2	High	Bhoopesh R K, Amitkumar Sharma R, Gautam KumarRai D, Kamali K
Sprint-3	MIT App Inventor	USN-3	Develop an application for the Smart farmerproject using MIT App Inventor	2	High	Bhoopesh R K, Amitkumar Sharma R, Gautam KumarRai D, Kamali K
Sprint-3	Dashboard	USN-3	Design the Modules andtest the app	2	High	Bhoopesh R K, Amitkumar Sharma R, Gautam KumarRai D, Kamali K
Sprint-4	Web UI	USN-4	To make the user to interactwith software	2	High	Bhoopesh R K, Amitkumar Sharma R, Gautam KumarRai D, Kamali K

Project Tracker, Velocity & Burndown Chart: (4 Marks)

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

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

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

6.2 MILESTONE AND ACTIVITY LIST

Title	Description	Date
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers, research publications etc.	09 OCTOBER 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements.	09 SEPTEMBER 2022
Brainstorming ideas	List the ideas by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	09 SEPTEMBER 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	09 OCTOBER 2022

Problem Solution Fit	Prepare problem - solution Fit document.	09 0CTOBER 2022
Solution Architecture	Prepare solution Architecture document.	09 OCTOBER 2022
Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application	20 OCTOBER 2022
Data Flow Diagrams	Draw the data flow Diagrams and submit for review.	20 OCTOBER 2022
Technology Architecture	Architecture diagram.	20 OCTOBER 2022
Sprint Delivery	Prepare the Sprint delivery on Number of Sprint planning meetings organized, Minutes of meeting recorded.	04 NOVEMBER 2022
Milestone & Activity List	Prepare the milestones & Activity list of the project.	04 NOVEMBER 2022
Project Development Delivery of Sprint- 1,2,3&4	Develop & submit the developed code by testing it.	19 NOVEMBER 2022

7. CODING AND SOLUTIONING

7.1. FEATURE -1 SOIL MOISTURE DETECTION

7.2. FEATURE-2 HUMIDITY DETECTION

7.3. FEATURE -3 TEMPERATURE DETECTION

7.4. FEATURE-4 MOTOR ON AND OFF

PYTHON CODE:

Goal:

To develop the python code to publish and subscribe to the commands from the IBM cloud.

PROGRAM:

```
import wiotp.sdk.device
import time
import OS import datetime
import random
myConfig = {"identity": {"orgId": " 023f97" "typeId": "NodeMCU" "deviceId":"12345"}, "auth":{
"token": " CT8N7Sz?giHVFxk-V?" } }
client = wiotp.sdk.device.DeviceClient {config =myConfig, logHandlers=None}
client.connect ()
def myCommandCallhack (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 ("")
while True:
soil=random.randint (0,100)
temp=random.randint (-20,125)
hum=random.randint (0,100)
```

```
myData={'soil_moisture': soil, 'temperature':temp, 'humidity' :hum}
client.publishEvent (eventId="status", msgFormat="json", data=myData, gos=0,
onPublish=None)
print ("Published data Successfully: %s", myData) time.sleep (2)
client.commandCallback = myCommandCallback
client.disconnect ()
```

8. TESTING

8.1. TEST CASES

I. IBM Watson IOT service:

Goal:

To create an IBM Watson IOT service and create a device using it.

Steps to create an IBM Watson IOT service:

- Click on catalog in IBM cloud account.
- Click on services.
- Enter as Internet of thing platform.
- Enter region and pricing plan.
- Enter service name and click create.
- Click on launch.
- Then IBM Watson OT platform opens.
- Click on sign in.
- Enter IBM Id.
- Enter Password.
- Then you can access IBM

Watson IOT platform**.**

Steps to create a device:

- Click on devices in IBM Watson IOT platform.
- Choose to create a device.
- Enter the device type as Node MCU.
- Enter the device ID as 12345.
- Click next.
- Enter device credentials (optional).
- Click next.
- Enter the authentication token (optional).
- Click on continue.
- Click on next.

Click finish

Device is created successfully, and we can see device credentials

Organization ID	023f97
Device Type	Node MCU
Device ID	12345
Authentication Method	Use- token- auth
Authentication Token	CT8N7Sz?giHVFxk-V?

Creation of Node – Red Service:

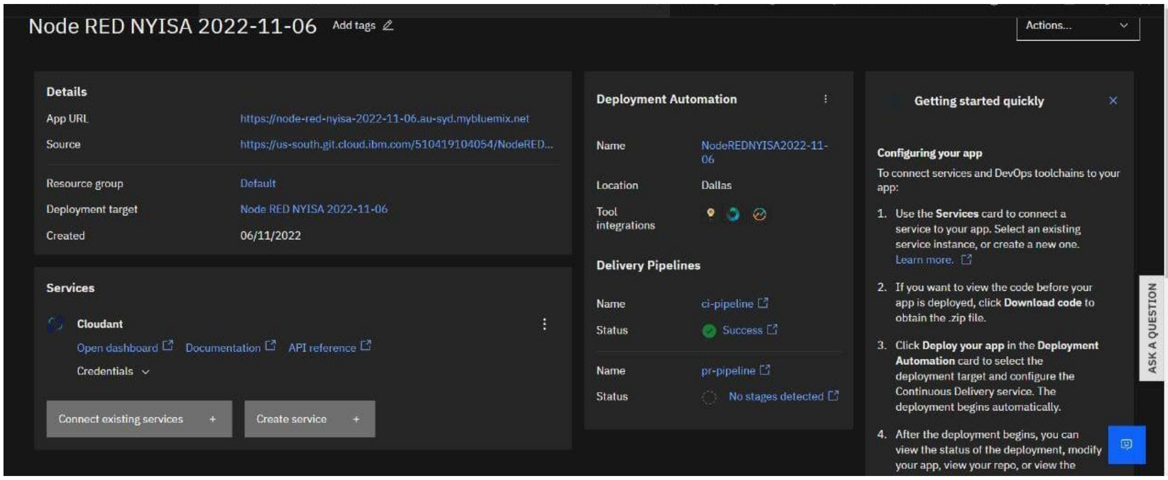
Goal:

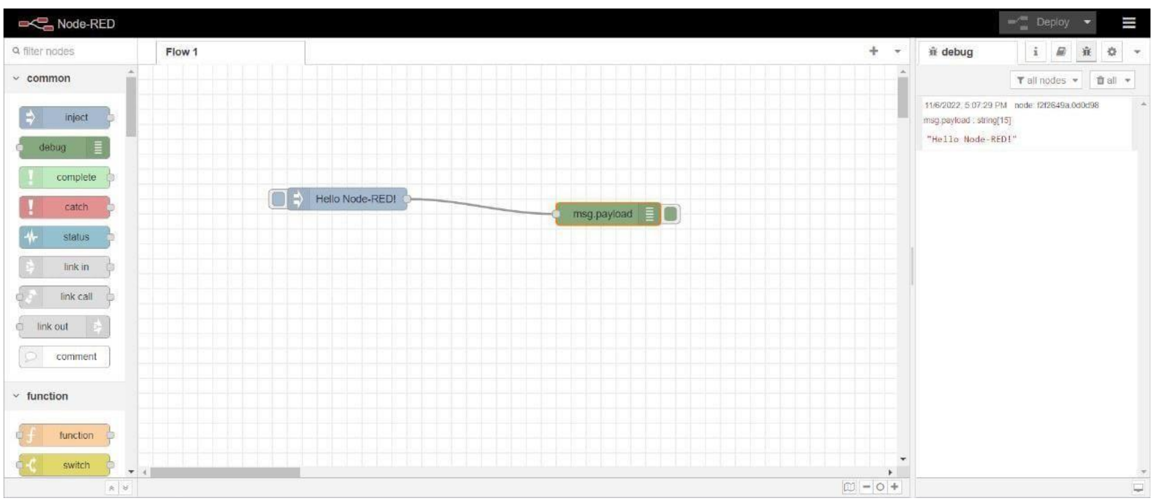
To create a Node Red service.

Steps to create a Node-Red service:

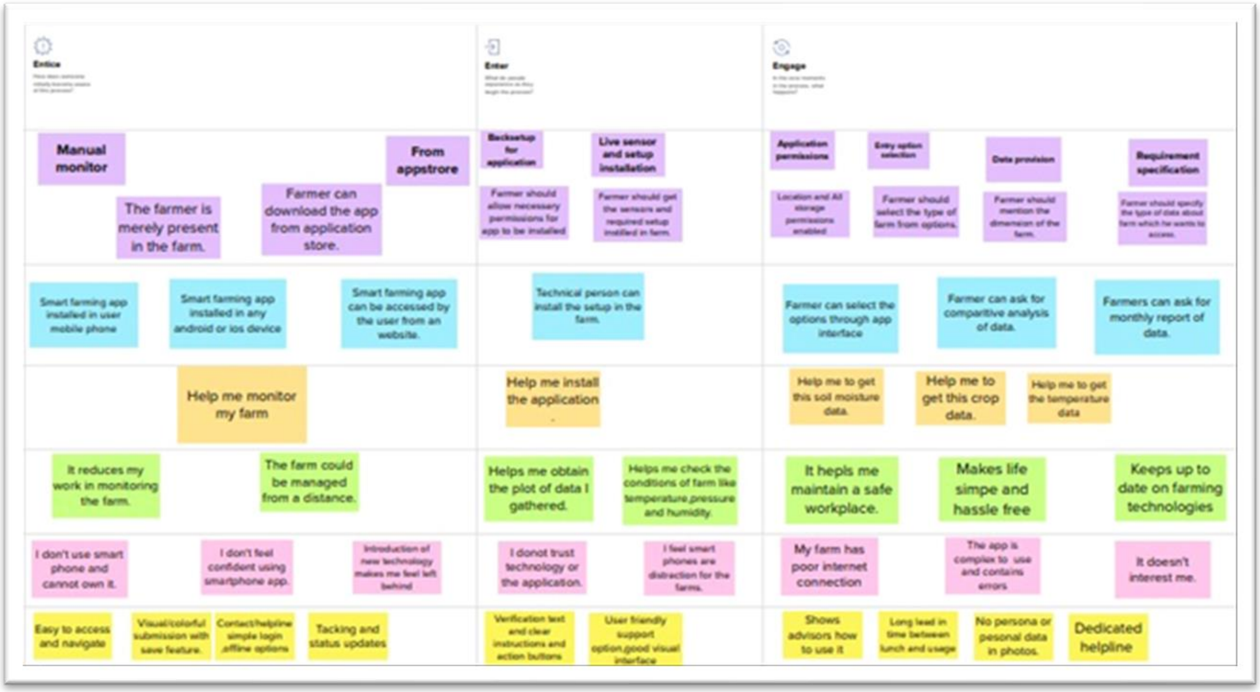
- Click on catalog in IBM cloud account.
- Click on services.
- Enter as Node red service.
- Node red app opens click on get started.
- Enter app name as default.
- Enter region as London.
- Choose pricing plan as lite.
- Click create.
- You will be redirected to a new page.
- Click on deploy your app.
- Choose cloud foundry.
- Enter IBM API key (by clicking new+).
- Choose memory size as default.
- Enter region as London.
- Click next.
- Click create.
- Status will be updated after creation.
- Click on App URL.
- Click next.
- Choose not recommended.
- Click next.
- You will see Node red page.
- Go to your node red flow editor.
- In the left panel choose nodes.
- In the right panel choose context mode
- In hello node red inject node enter the data as string and choose to repeat as none.
- Click done.
- Click debug node.
- Choose to deploy.
- When you click button on inject node you can see the message in debug console**.**

ACCOUNT CREATION:



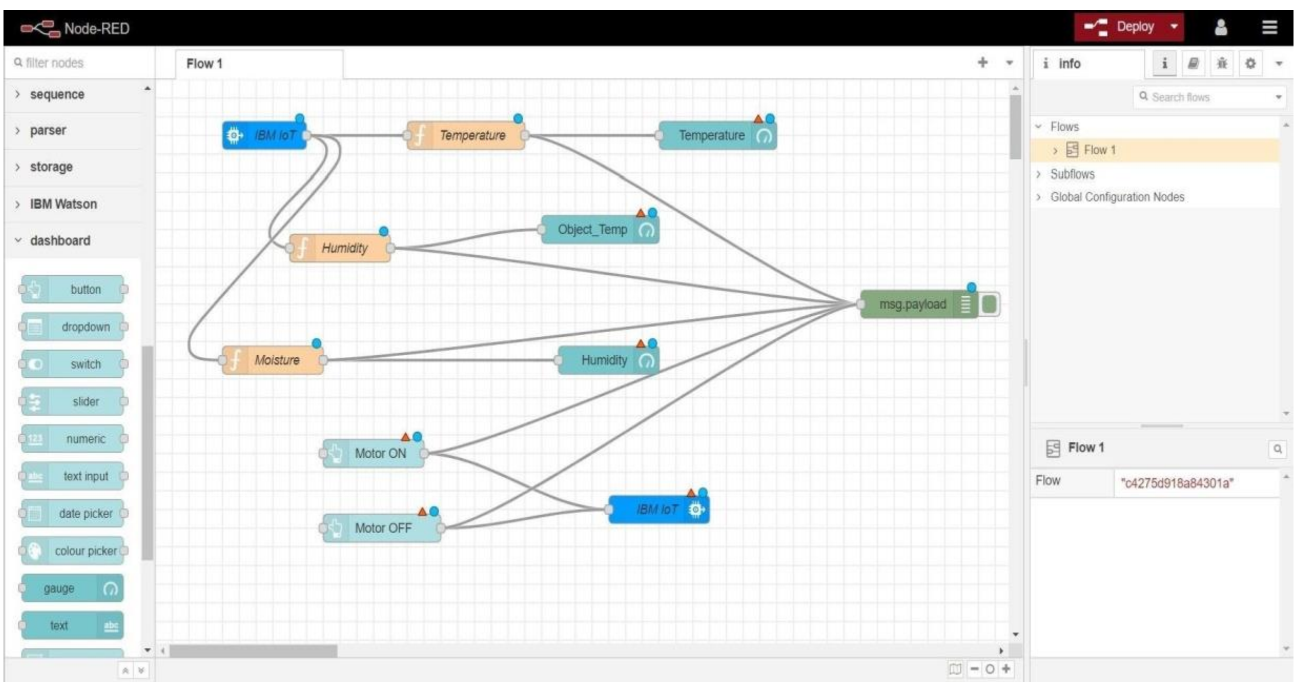


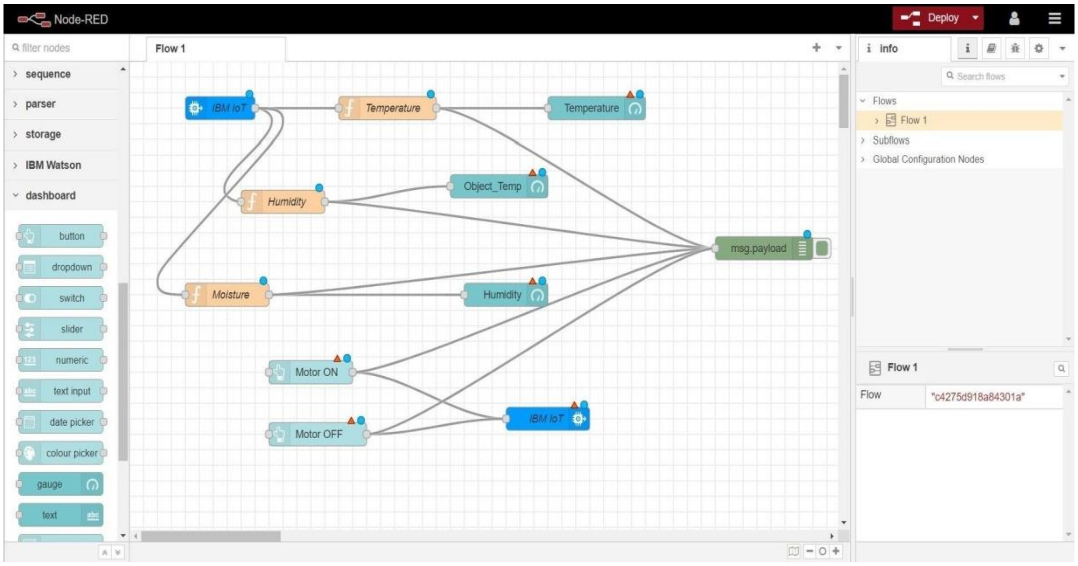
8.2 USER ACCEPTANCE TESTING:



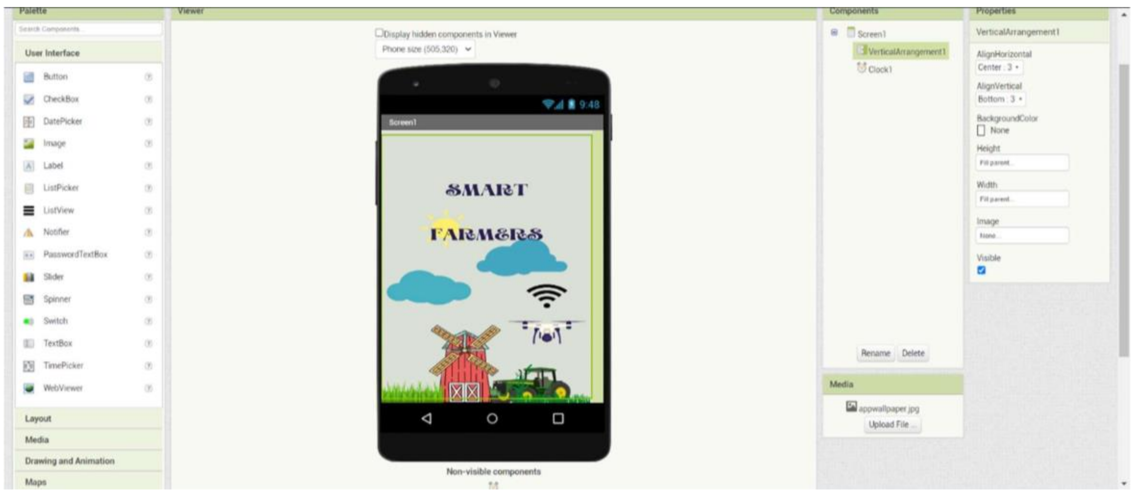
9. RESULTS

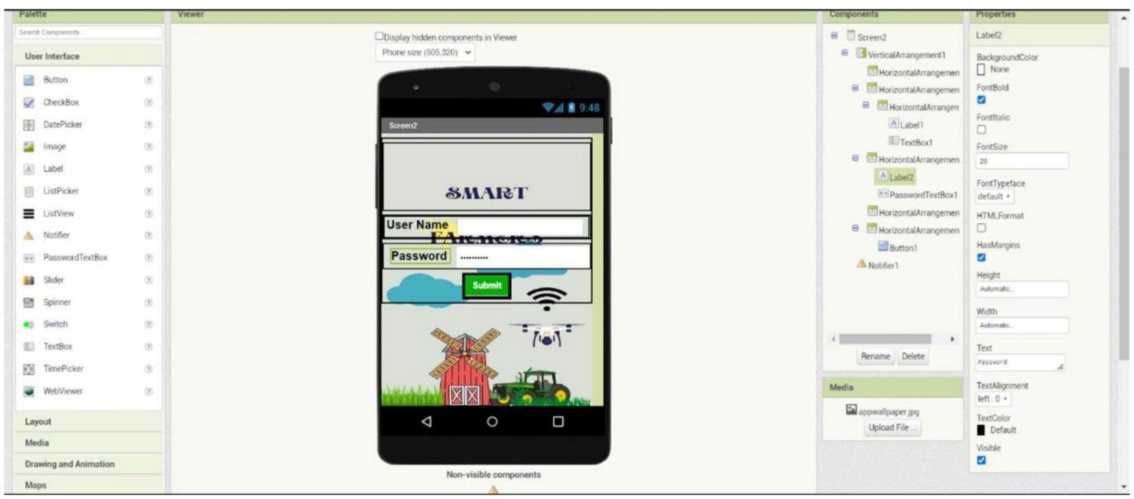
9.1. WEB APPLICATION:

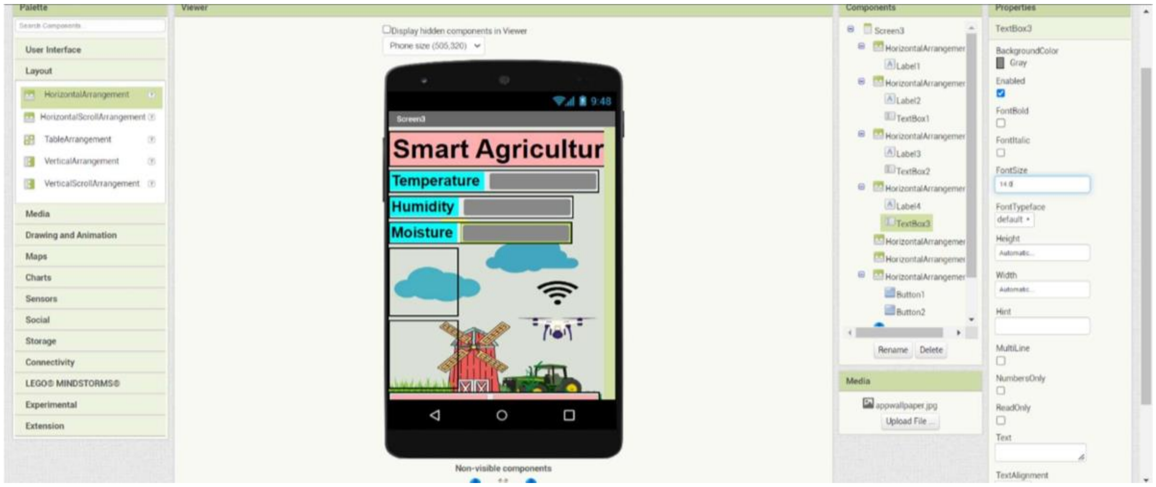


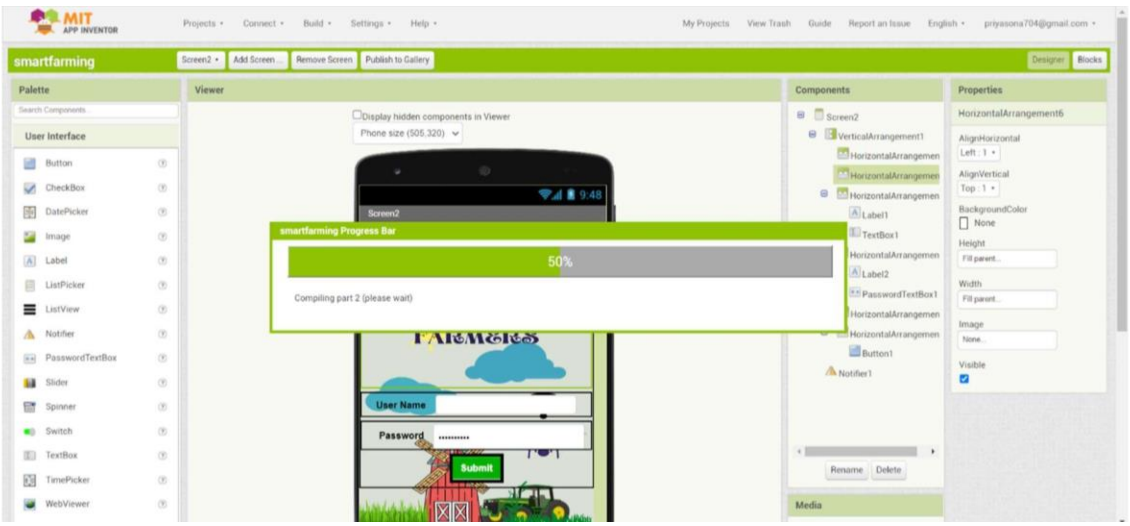


9.2. MOBILE APPLICATION









10. ADVANTAGES AND DISADVANTAGES

Advantages of IoT in Agriculture

- Intelligent data collection. Sensors installed on IoT devices are able to collect a large volume of useful information for farmers.
- Waste reduction.
- Process automation.
- Animal monitoring.
- Competitive advantage.

Disadvantages:

- The main disadvantage is the time it can take to process the information.
- Farmers are so busy with harvesting and caring for their crops that they may not have time to process data.
- There are also issues with the water supply, as well as issues with the cost of the technology, which can be quite expensive.
- The risk to the farming industry when using precision agriculture solutions could include: Business and customer information data theft. Stealing resources controlled by sensors and devices.

11. FUTURE SCOPE:

- Smart farming is certainly a leading enabler in producing more food with less for an increasing world population.
- Smart farming refers to managing farms using modern Information and communication technologies to increase the quantity and quality of products while optimizing the human labor required

12. 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