SMART FARMER – IOT ENABLED SMART FARMING APPLICATION

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INDEX

1. **INTRODUCTION**
   1.1 Project Overview
   1.2 Purpose
2. **LITERATURE SURVEY**
   2.1 Existing problem
   2.2 References
   2.3 Problem Statement Definition
3. **IDEATION & PROPOSED SOLUTION**
   3.1 Empathy Map Canvas
   3.2 Ideation & Brainstorming
   3.3 Proposed Solution
   3.4 Problem Solution fit
4. **REQUIREMENT ANALYSIS**
   4.1 Functional requirement
   4.2 Non-Functional requirements
5. **PROJECT DESIGN**
   5.1 Data Flow Diagrams
   5.2 Solution & Technical Architecture
   5.3 User Stories
6. **PROJECT PLANNING & SCHEDULING**
   6.1 Sprint Planning & Estimation
   6.2 Sprint Delivery Schedule
7. **CODING & SOLUTIONING (Explain the features added in the project along with code)**
   7.1 Feature 1
   7.2 Feature 2

8. **TESTING**

8.1 User Acceptance Testing

9. **RESULTS**

9.1 Performance Metrics

10. **ADVANTAGES & DISADVANTAGES**
11. **CONCLUSION**
12. **FUTURE SCOPE**

Source Code

GitHub & Project Demo Link

CHAPTER 1

INTRODUCTION

1.1 PROJECT OVERVIEW

The Internet of Things (IoT) is an innovative technology that offers practical and dependable answers for the modernization of numerous fields. Solutions built on the Internet of Things are being created to maintain and monitor agricultural farms with the least amount of human participation. The content covers a wide range of technological elements related to IoT in agriculture. The key elements of IoT-based smart farming are explained. Network architecture and layers, network topologies, and protocols have all been thoroughly discussed in relation to network technologies used in IoT-based agriculture. Additionally, it has been demonstrated how IoT-based farm systems may work with pertinent technologies like cloud computing, big data storage, and analytics.

1.2 PURPOSE

The idea of "smart agriculture" is relatively new. Most farmers and agricultural specialists are unfamiliar with this idea. In order to manage and operate agricultural lands and animals, smart agriculture makes use of smart technologies like automated machines, sensors, actuators, drones, and security cameras. The goal is to increase both the quality and output of agricultural products while taking energy and cost considerations into account. IoT-based smart farming enables growers and farmers to reduce waste and improve productivity across a range of metrics, including the amount of fertilizer used, the number of trips the farm vehicles have made, and the efficient use of resources like water, electricity, etc.

IoT smart farming solutions are a system designed for automating the irrigation system and monitoring the agricultural field with the aid of sensors (light, humidity, temperature, soil moisture, crop health, etc.). Farmers can keep an eye on the state of their fields from anywhere. On the basis of this data, they can choose between human and automatic solutions for taking the appropriate steps. The farmer can use sensors to start irrigation, for instance, if the soil moisture level drops. Comparing smart farming to traditional farming, the latter is significantly more efficient.

Precision agriculture lowers total costs by making farming more connected and intelligent while also enhancing product quality and quantity, agricultural sustainability, and consumer experience. Better cost control and waste elimination result from increased production control. It reduces the possibility of produce loss to be able to track anomalies in crop growth or livestock health, for example. Automation also increases effectiveness. Smart devices enable simultaneous activation of numerous processes, and automated services improve product quality and volume by more effectively managing production processes. In order to minimise waste, smart farming systems also enable careful monitoring of demand forecasting and timely delivery of goods to markets. In order to produce the proper crop that is in need, precision agriculture focuses on managing the supply of land and, depending on its state, concentrating on the right growing characteristics, such as moisture, fertilizer, or material content. The types of precision farming systems that are implemented depend on the business management software that is used. Control systems oversee sensor input, deliver remote data for supply and decision support, and automate machines and equipment for addressing new problems and assisting with production.

CHAPTER 2

LITERATURE SURVEY

2.1 EXISTING PROBLEMS

Wireless sensor networks (WSNs) are used by a variety of industries, including the military and agriculture. The power consumption of wireless sensor networks is a hot topic of study. They also looked at the life spans of WSNs and metaheuristics. They provide a transition, assessment, and determination process that aids in locating the best answer to the problem by using metaheuristic algorithms. Wireless Sensor Network and Cloud computing are employed to help farmers enhance the way of farming. Using sensors like temperature, humidity, moisture etc. are used to get information about the field and help farmers to take precise decisions on insights and recommendation based on the collected data. One of the limitations of this system is that continuous internet connectivity is required at user end which might prove to be costly for farmer. This can be overcome by extending the system to send suggestion via SMS to the farmer directly on his mobile using GSM module instead of mobile app.

An IoT based advanced solution for monitoring the soil conditions and atmosphere for efficient crop growth is presented. The developed system is capable of monitoring temperature, humidity, soil moisture level using Node MCU and several sensors connected to it. Also, a notification in the form of SMS will be sent to farmer and phone using Wi-Fi about environmental condition of the field. The project aims at making use of evolving technology i.e. IOT and smart agriculture using automation. Once hardware has been developed depending on the change in requirements and technology the software needs the updating. The updated hardware is called new version of the software. This new version is required to be tested in order to ensure changes that are made in the old version work correctly and it will not bring bugs in other part of the software. This is necessary because updating in one part of the hardware may bring some undesirable effects in other part of the hardware.

It is an efficient prediction method called WPART based on machine learning. Here five datasets are used for estimating the proposed method. The results indicated that the projected method is robust, accurate, and precise to classify and predict crop productivity and drought in comparison with the existing techniques. From the results, the proposed method proves to be most accurate in providing drought prediction as well as the productivity of crops like Soybean, Sugarcane, etc. The WPART method attains the maximum accuracy compared to the existing supreme standard algorithms. A crop irrigation management system with sensor data fetch, transfer and operate functionalities is proposed to meet the expectations. Finally, some unresolved problems and difficulties in the realm of IoT agriculture have been discussed.

2.2 REFERENCE

1. Akshay Atole, Amar Biradar, Apurva Asmar, Nikhil Kothawade and Sambhaji Sarode,"IoT based Smart Farming System", International Journal of Emerging Technologies and Innovative Research, ISSN:2349-5162, Vol.4, Issue 4, page no.29-31, April-2017.
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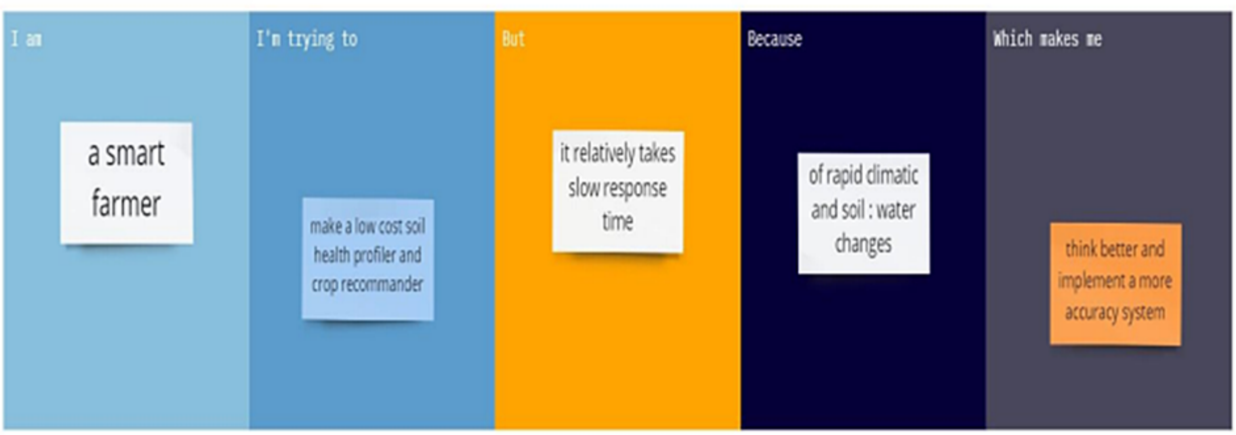
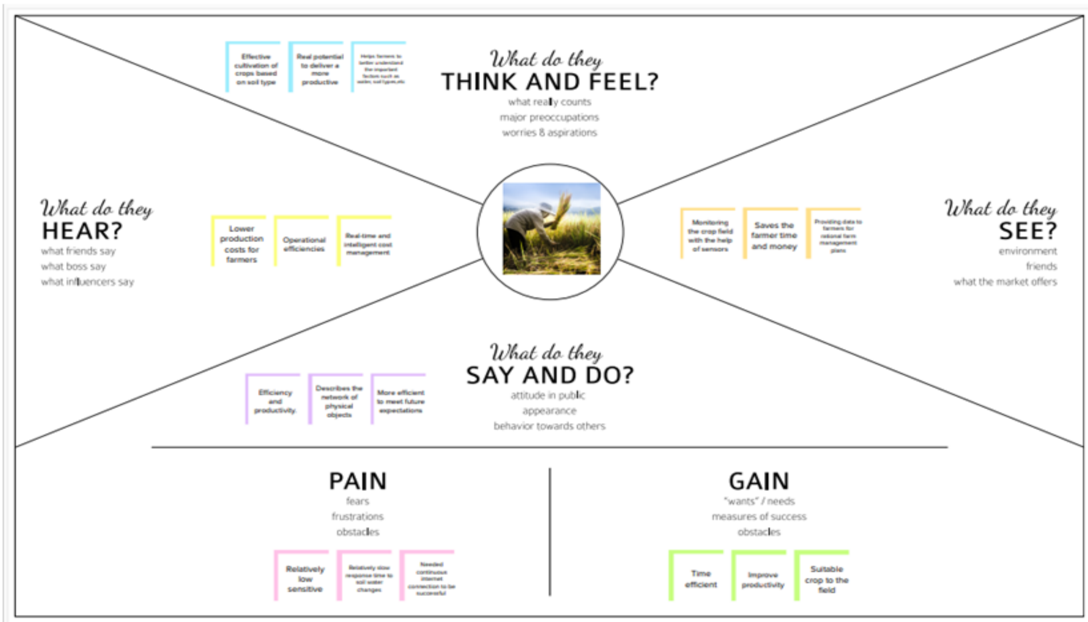
2.3 PROBLEM STATEMENT DEFINITION

Agriculture is representing an essential element in the developing countries. In the agriculture, there is problem for farmers to making a suitable crop for the soil to get the better yield. Soil analysis is a valuable tool for the problem. Our system providing a smart technology for soil analyzing. Therefore, it results in helps the farmers to making a suitable crop and improves the yield. A handheld Soil health profiler can solve these issues by giving the soil nutrient details and recommend suitable crops. This project involved an Node MCU which talk to the internet. Soil NPK sensor to measure level of the macro nutrients present in the soil. The sensor data is sent to the cloud server. Then the digitally generated soil fertility and crop prediction e-report is get in the specified link. It is very useful for farmers to cultivate suitable crop to the field. It improves soil quality and soil fertility. This gives more yields for the farmers. The designed system can be an easy alternative for the lengthy laboratory process. The designed system also takes the inputs like the geographical location, season of the year, etc to make the recommender system.



CHAPTER 3
IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

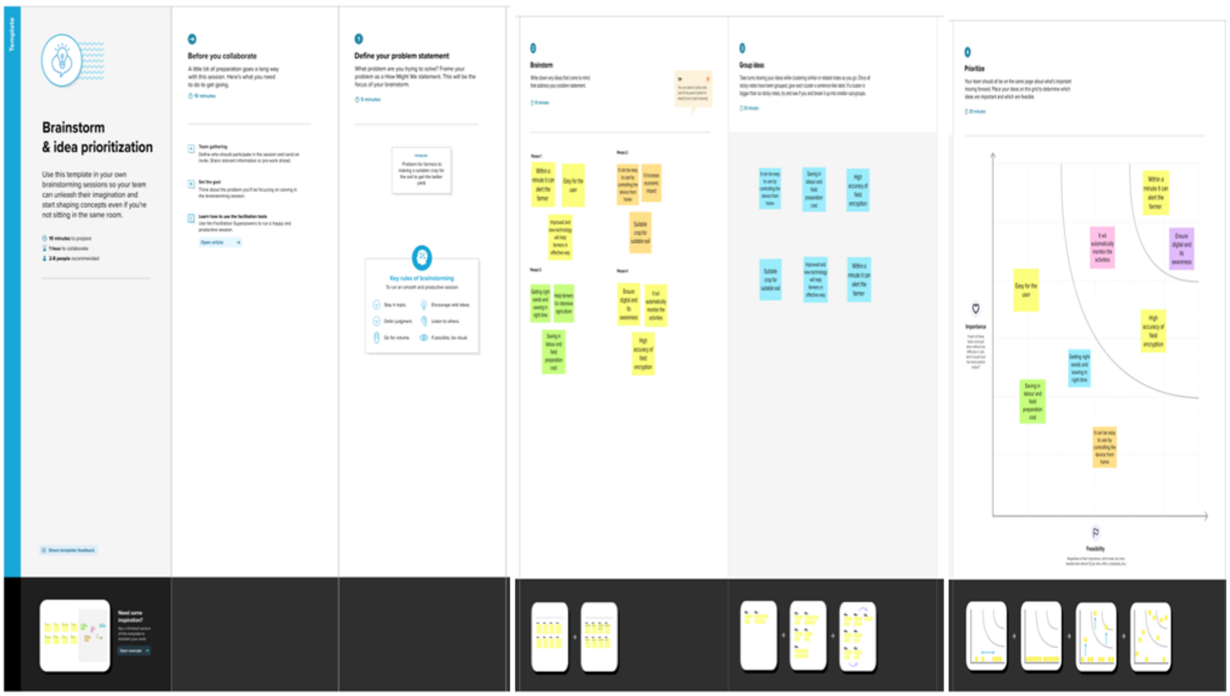


An empathy map is a collaborative tool teams can use to gain a deeper insight into their customers. Much like a user persona, an empathy map can represent a group of users, such as a customer segment. The major preoccupations worries and aspirations really counts the Effective cultivation of crops based on the soil type and it helps farmers in understanding factors such as water, soil types and so on. The ultimate main is to make production cost lower for farmers. By monitoring the crop field with the help of sensors that provide data plans for farm management. This saves farmer's time and money. This is more efficient to meet the future expectations by means of productivity.

The advantage is time efficient as it saves us time because it requires less human effort. The main resource that an IoT platform can save is time and efficient resource utilization. If we are aware of how each technology functions and how it monitors natural resources, we will be able to use resources more effectively.

Many farmers lack the skills of employing AI and IOT. Finding someone with this level of technical proficiency is at best challenging or expensive. A lot of talented farmers may be discouraged from adopting smart farming because of its advantages and disadvantages.

3.2 IDEATION AND BRAINSTROMING



One of the most talked-about benefits of Smart Farming is the increased level of precision and accuracy that can be achieved. There is no one simple answer as to how much more accurate Smart Farming is compared to traditional methods.Defining the problem of finding suitable crop for the soil. Of course, this technology must be simple to use if it is to truly lessen the cultivator's stress at work.

IoT-based sensors are installed underground to track soil condition and evaluate its suitability for various crops. This improves the efficiency of the agricultural industry by offering the greatest methods to provide flawless results. The development of technology offers farmers a full package to assess the condition of the soil and recommend farming solutions. These procedures are under the category of precision agriculture, which enables clever actions to increase farming efficiency in all respects.

3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Difficulty in selecting suitable crop for the soil.
2.	Idea / Solution description	A handheld Soil health profiler can solve these issues by giving the soil nutrient details and recommend suitable crops.
3.	Novelty / Uniqueness	It takes the inputs like the geographical location, season of the year to make the recommender system.
4.	Social Impact / Customer Satisfaction	It improves soil quality and soil fertility. It is also very time efficient process and gives more yields for the farmers.
5.	Business Model (Revenue Model)	The project involves an NodeMCU and soil NPK sensor which is cheaper than the existing ideas.
6.	Scalability of the Solution	Based on all the inputs from the system, it recommends the required crops and fertilizer to the soil.

The problem statement is finding difficult to select suitable crop for the soil. So here we have given a handheld Soil health profiler that can solve these issues by giving the soil nutrient details and recommend suitable crops. Taking the inputs like the geographical location, season of the year to make the recommender system is the unique feature. It improves soil quality and soil fertility. It is also very time efficient process and gives more yields for the farmers. The project involves a Node MCU and soil NPK sensor which is cheaper than the existing ideas. By giving all the inputs to the system it recommends the required crops and fertilizer to the soil.

3.4 PROBLEM SOLUTION FIT

Define CS, fit into CC				Explore AS, differentiate
	1. CUSTOMER SEGMENT(S) CS This product is for farmer who can cultivate the crops. Our main is to help farmer.	**6. CUSTOMER CONSTRAINTS** CC • May have confusions on deciding the crops. • Insufficient knowledge about the soil.	**5. AVAILABLE SOLUTIONS** AS • Carrying a guidebook to everywhere we go. • Accompanying an experienced people.	
Focus on J&P, tap into BE, understand RC	**2. JOBS-TO-BE-DONE / PROBLEMS** J&P • Difficulty in finding suitable crop for the soil. • No knowledge or experience about the soil nutrients as the user is just a learner.	**9. PROBLEM ROOT CAUSE** RC • Humans are incapable of memorising large number of datas. • Eventhough books are available, it is difficult to identify the species.	**7. BEHAVIOUR:** BE • Due to mismatch cropping, the field loses its fertility and heavy loss may occur.	Focus on J&P, tap into BE, understand RC
	3. TRIGGERS TR During an excursion or hiking or some trip to the forest, if a nearby person uses the app, then the person also will go for a try to know about the plants and animals what they are seeing through their eyes. **4. EMOTIONS: BEFORE / AFTER** EM • At first,farmers find it difficult to choose the crop that grows well with respect to the nutrients present in the particular soil. • After, it becomes easy task for them to identify suitable crop for the soil.	**10. YOUR SOLUTION** SL • The designed system can be an easy alternative for the lengthy laboratory process . • The designed system also takes the inputs like the geographical location, season of the year, etc to make the recommender system.	**8.CHANNELS of BEHAVIOUR** CH **8.1 ONLINE** • Searching through the internet to know about the soil specifications. **8.2 OFFLINE** • Get help from experienced people. • Carrying guide.	

Customer segments include famers who is the customer to cultivate the crops. The main aim is to help farmers as they find difficult to find suitable crop for the soil. They may have confusion on deciding the crops. It is not possible for humans to memorize large number of data. Even though books are available, it is difficult to identify the species. Also lack of knowledge and experience about the soil nutrients when the user is a beginner. When the cropping gets mismatched, the field loses its fertility and heavy loss may occur. During an excursion or hiking or some trip to the forest, if a nearby person uses the app, then the person also will go for a try to know about the plants what they are seeing through their eyes.

The designed system can be an easy alternative for the lengthy laboratory process. It also takes the inputs like the geographical location, season of the year, etc to make the recommender system.

CHAPTER 4

REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

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 weather details	Temperature details Humidity details
FR-6	Log out	Exit

The first step is registering through Gmail. After registration get the conformation via Email or OTP. Then check roles of access. Later manage the modules by managing system admins, user roles and user permission. Check the weather details like temperature and humidity details. Finally exit by logging out.

4.2 NON-FUNCTIONAL REQUIREMENT

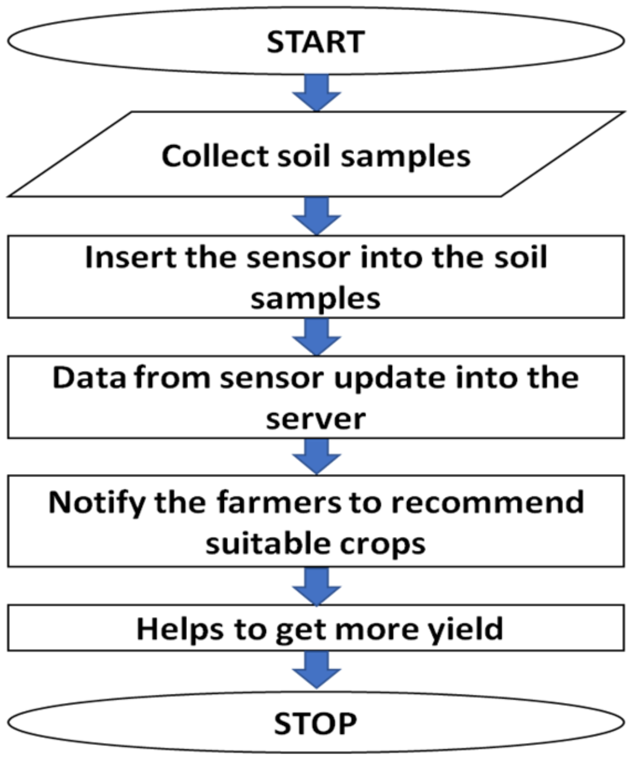
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Usability includes easy learn ability, efficiency in use, remember ability, lack of errors in operation and subjective pleasure.
NFR-2	Security	Sensitive and private data must be protected from their production until the decision making and 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.
NFR-4	Performance	The idea of implementing intergrated sensors with sensing soil and environmental or ambient parameters in farming will be more efficient for overall monitoring.
NFR-5	Availability	Automatic adjustment of farming equipment made possible by linking information like crops/weather and equipment to auto-adjust temperature, humidity, etc.
NFR-6	Scalability	Scalability is a major concern for IOT platforms. It has shown that different architectural choices of IOT platforms affect system scalability and that automatic real time decision-making is feasible in an environment composed of dozens of thousand.

Usability includes easy learn ability, efficiency in use, remember ability, lack of errors in operation and subjective pleasure. Sensitive and private data must be protected from their production until the decision making and storage stages. 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. The idea of implementing intregrated sensors with sensing soil and environmental or ambient parameters in farming will be more efficient for overall monitoring. Automatic adjustment of farming equipment made possible by linking information like crops/weather and equipment to auto-adjust temperature, humidity, etc. Scalability is a major concern for IOT platforms. It has shown that different architectural choices of IOT platforms affect system scalability and that automatic real time decision-making is feasible in an environment composed of dozens of thousand.

CHAPTER 5

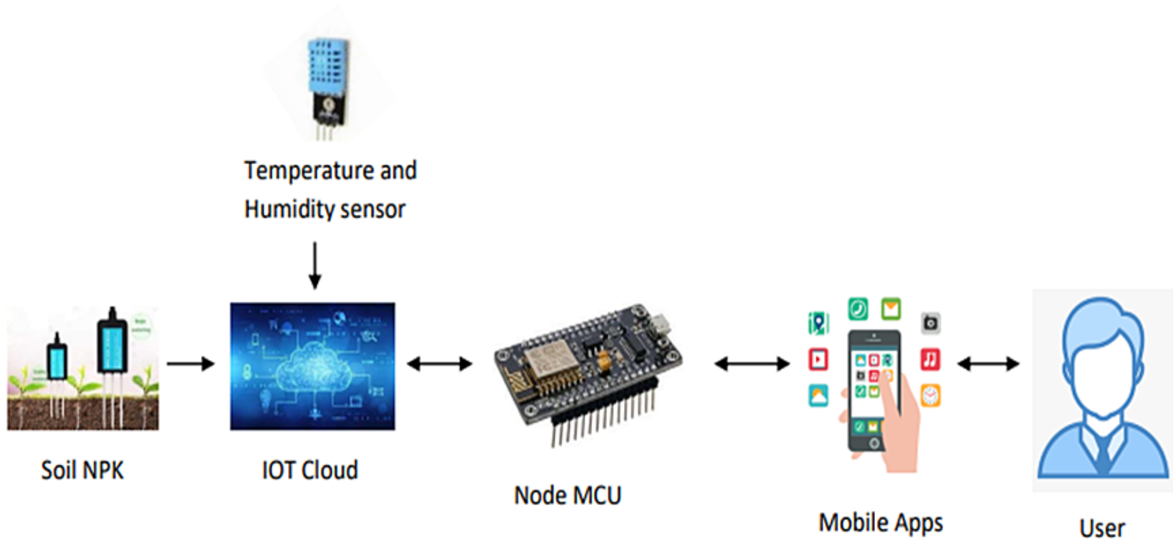
PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS



- The different soil parameters (temperature, humidity, soil moisture) are sensed using different sensors, and the obtained value is stored in the Cloud.
- Node MCU is an open source which can connect objects and let data transfer using the Wi-Fi protocol. In addition, by providing some of the most important features of microcontrollers such as GPIO.
- All the collected data are provided to the user through a mobile application that was developed using app inventor. The user could make a decision through an app, that what crop is suitable for the soil in the particular season by the humidity and temperature check. By using the app, they can be remotely operated by the user.

5.2 SOLUTION & TECHNICAL ARCHITECTURE



The suggested solution employs a microcontroller (Node MCU) with a Wi-Fi module on top of it. The interface is a smart phone. Sensors are used to monitor rain, humidity, temperature, and soil moisture. Node MCU determines whether or not to water the crop based on the amount of moisture present. The watering of the crop is started by Node MCU by employing the required functions and conditional statements in the code created for Node MCU to work. When the soil contains a enough amount of moisture. The atmosphere's humidity and temperature values are provided by the humidity and temperature sensor, which helps assess whether a crop is suited for growth.

Some crops can only grow in specific weather conditions, and others produce better only at a certain temperature range. Then the data moves to the smart phone application where the user can view the temperature, humidity, and soil moisture levels, and determine the notifications in the event of rain. The monitor shows the information provided by sensors, if the code includes serial operations, and serial exchange of data between the Node MCU and device is real.

5.3 USER STORIES

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 and click confirm.	High	Sprint-1
		USN-3	As a user, I can register for the application through Face book	I can register and access the dashboard with Face book 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 and password		High	Sprint-1
	Dashboard					
Customer (Web user)						
Customer Care executive						
Administrator						

CHAPTER 6

PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING AND ESTIMATION

S.NO	ACTIVITY TITLE	ACTIVITY DESCRIPTION	DATE
1	Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers, research publications etc.	19 Sept2022
2	Prepare Empathy map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements.	19 Sept 2022
3	Brainstorming ideas	List the ideas by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	19 Sept 2022
4	Proposed solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	19 Sept 2022
5	Problem solution fit	Prepare problem - solution Fit document.	19 Sept 2022
6	Solution Architecture	Prepare solution Architecture document.	19 Sept 2022
7	Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application.	03 Oct 2022
8	Data flow diagrams	Draw the data flow Diagrams and submit for review.	03 Oct 2022
9	Technology Architecture	Architecture diagram	03 Oct 2022

10	Solution requirement	Prepare the functional and non functional requirements.	03 Oct 2022
11	Sprint delivery	Prepare the Sprint delivery on Number of Sprint planning meetings organized, Minutes of meeting recorded.	20 Oct 2022
12	Milestone & Activity list	Prepare the milestones & Activity list of the project.	20 Oct 2022
13	Project Development Delivery of Sprint- 1,2,3&4	Develop & submit the developed code by testing it.	17 Nov 2022

6.2 SPRINT DELIVERY SCHEDULE

Sprint	Functional Requirement (Epic)	User Story Number	User Story/Task	Story Point	Priority	Team Members
Sprint-1	Simulation Creation	USN-1	Connect Sensors and Arduino with python code	12	High	RITHIKHAA D PRATHIKSHA T PRAVEEN B PRAVEEN KUMAR P
Sprint-2	Software	USN-2	Creating device in the IBM Watson IoT platform, workflow for IoT scenarios using Node-Red	12	High	RITHIKHAA D PRATHIKSHA T PRAVEEN B PRAVEEN KUMAR P
Sprint-3	Registration (Mobile User MIT APP INVENTER)	USN-3	As a user, I can register for the application by entering my email and password	4	High	RITHIKHAA D PRATHIKSHA T PRAVEEN B PRAVEEN KUMAR P

Sprint-3	Login	USN-4	As a user, I can log into the application by entering username & password.	4	High	RITHIKHAA D PRATHIKSHA T PRAVEEN B PRAVEEN KUMAR P
Sprint-3	Dashboard	USN-5	As a User can view the dashboard, and this dashboard includes temperature, Humidity and Soil moisture values	6	High	RITHIKHAA D PRATHIKSHA T PRAVEEN B PRAVEEN KUMAR P
Sprint-4	Logout	USN-7	Then check the Temperature, humidity and soil moisture after logout or exit the application	6	Medium	RITHIKHAA D PRATHIKSHA T PRAVEEN B PRAVEEN KUMAR P
Sprint-4	Web UI	USN-8	As a user, I need to have a friendly user interface to easily view and access the resources	6	Medium	RITHIKHAA D PRATHIKSHA T PRAVEEN B PRAVEEN KUMAR P

CHAPTER 7

CODING AND SOLUTIONING

7.1 FEATURE 1

PYTHON CODE:

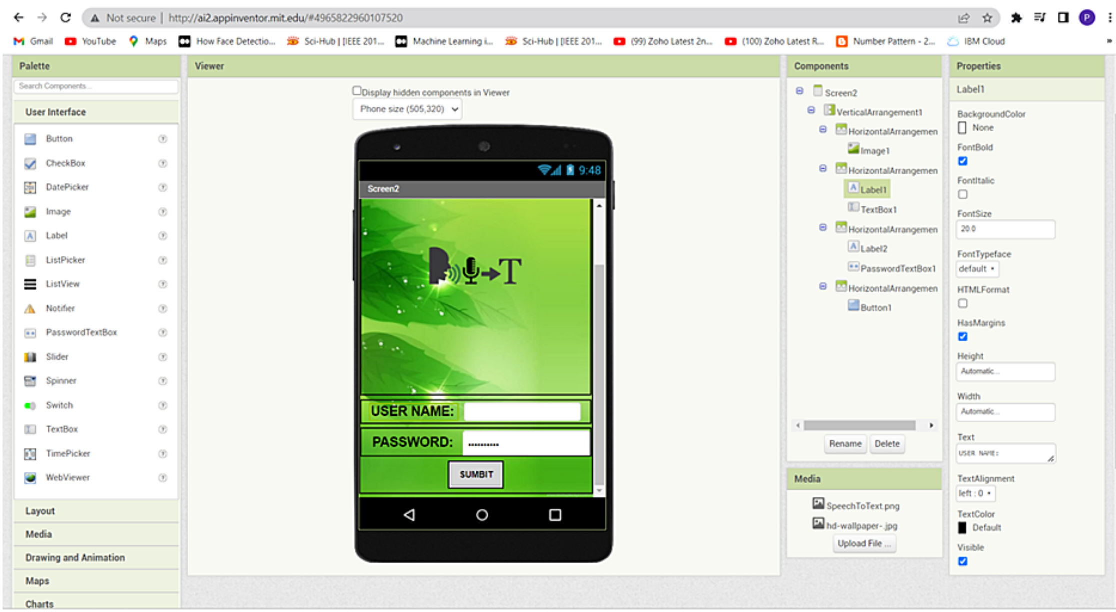
```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random

#Provide your IBM Watson Device Credentials
organization = "95a96q"
deviceType = "NodeMCu"
deviceId = "123456"
authMethod = "token"
authToken = "P123@456"

# Initialize GPIO
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="motoron":
        print ("Motor is on")
    elif+ status == "motoroff":
        print ("Motor is off")

try:
        deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method":
authMethod, "auth-token": authToken}
        deviceCli = ibmiotf.device.Client(deviceOptions)
        #.............................................
```

```
except Exception as e:
        print("Caught exception connecting device: %s" % str(e))
        sys.exit()

# Connect and send a datapoint "hello" with value "world" into the cloud as an event of type
"greeting" 10 times
deviceCli.connect()

while True:
      #Get Sensor Data from DHT11

      Temperature=random.randint(90,110)
      Humidity=random.randint(60,100)

      data = { 'Temperature' : Temperature, 'Humidity': Humidity }
      #print data
      def myOnPublishCallback():
        print ("Published Temperature = %s C" % Temperature, "Humidity = %s %%" %
Humidity, "to IBM Watson")

      success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
      if not success:
        print("Not connected to IoTF")
      time.sleep(10)

      deviceCli.commandCallback = myCommandCallback

# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

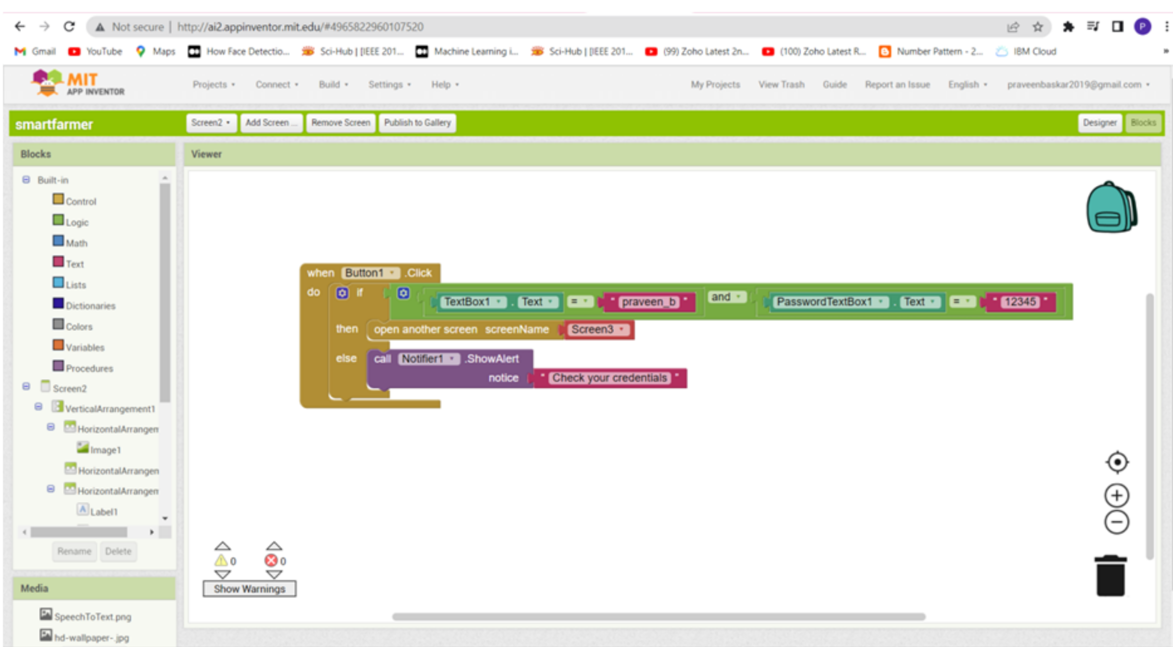
7.2 FEATURE 2

MOBILE APP (MIT APP INVENTOR)

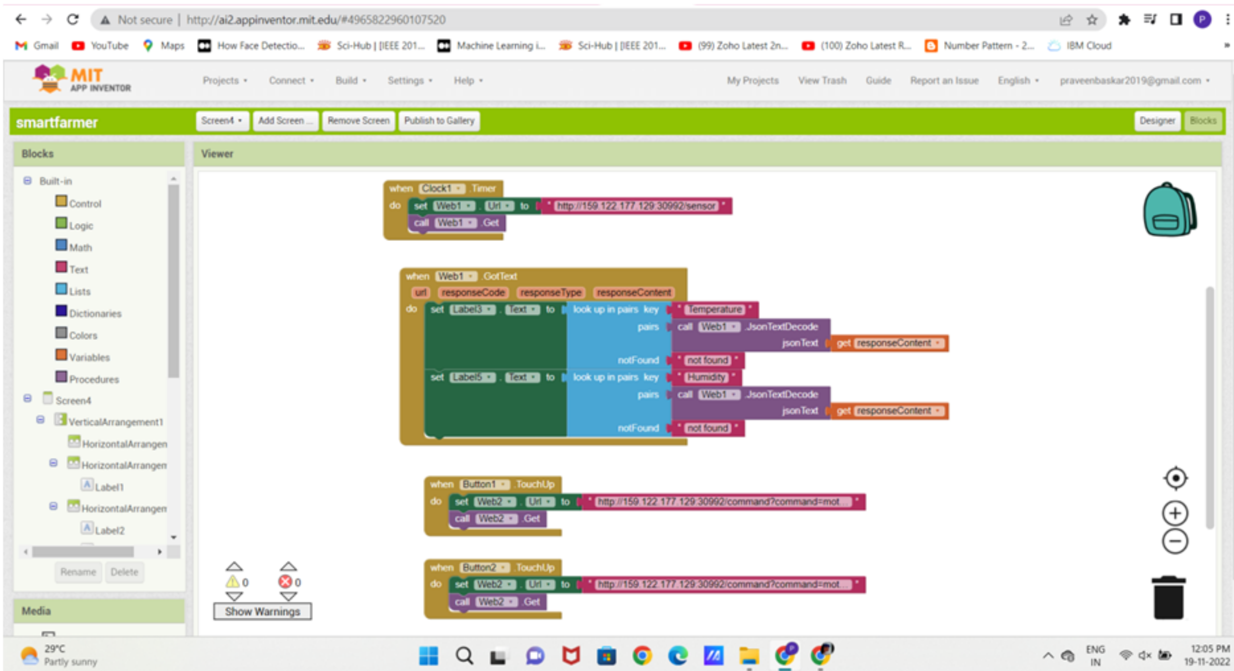
- DESIGNER PART



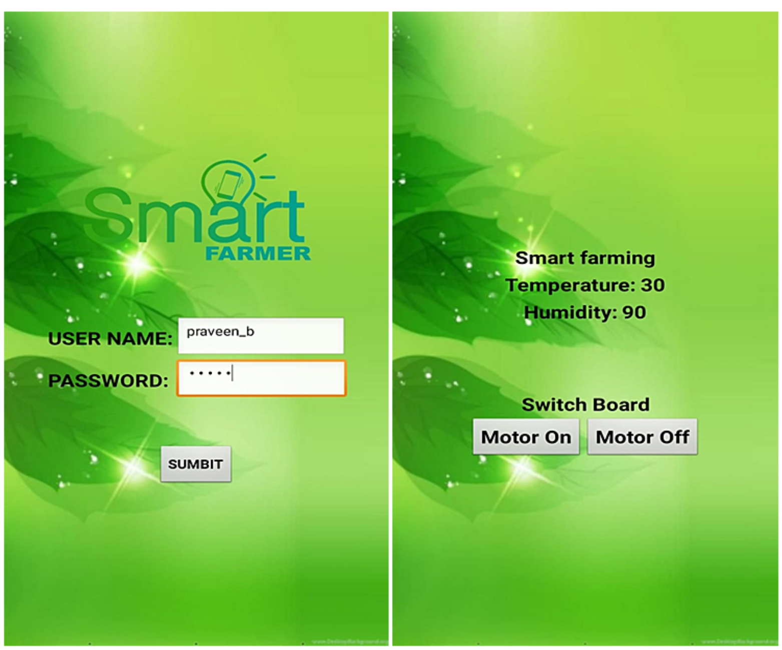
- BUTTON FUNCTION BLOCKS



- BLOCKS PART



- MOBILE APP



CHAPTER 8

TESTING

8.1 USER ACCEPTANCE TESTING

The purpose of this document is to briefly explain the test coverage and open issues of the “Smart Farmer - IoT Enabled Smart Farming Application” project at the time of the release to User Acceptance Testing (UAT). Increasing control over production leads to better cost management and waste reduction. The ability to trace anomalies in crop growth or livestock health, for instance, helps eliminate the risk of losing yields. Additionally, automation boosts efficiency. 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. This report shows the number of resolved or closed bugs at each severity level, and how they were resolved. This report shows the number of test cases that have passed, failed, and untested.

CHAPTER 9

RESULTS

9.1 PERFORMANCE METRICS

Hence a helpful and useful system is built for farmers to assist them in farming and also prevent them from natural calamities. It also saves farmers time to maintain all these things as this is working on cloud he can turn on/off motor from anywhere so basically it helps farmers and make them relived thus helping our economy to grow.

CHAPTER 10

ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- The ability to use soil sensing is one of the very great things about this area of farming. This component of intelligent farming allows you as a farmer to test your soil for information and measure it for a variety of significant and nutritious constituents required in ensuring the health of your farm products.

- In order to properly control the use of real-time variable rate equipment, soil sensing is also used. This enables you to comprehend the size of your property, enabling you to devise efficient methods of saving essential farming resources like water, fertilizer, and so forth. In order to avoid harming your plants, you only need to use fertilizers and insecticides where they are necessary. Additionally, you get to minimize waste of seeds, fertilizer, water, etc. while still achieving maximum harvests. Additionally, you get access to crucial information about the volume and intensity of the air in your environment as well as its levels of sound, humidity, and temperature.

- Minimize human effort : As IoT devices connect, communicate, and perform several tasks for us, they reduce the need for human work.

- Saves time : It saves us time because it requires less human effort. The main resource that an IoT platform can save is time.

- Efficient resource utilization : If we are aware of how each technology functions and how it monitors natural resources, we will be able to use resources more effectively.

DISADVANTAGES

- The fact that smart farming requires an unrestricted or ongoing internet connection for success is a major drawback. This means that using this agricultural method in rural areas, especially in developing nations where we produce large quantities of crops, is utterly unfeasible. Smart farming won't be possible in locations with excruciatingly slow internet connections.

- Many farmers lack the skills of employing AI and IOT. Finding someone with this level of technical proficiency is at best challenging or expensive. A lot of talented farmers may be discouraged from adopting smart farming because of its advantages and disadvantages.

- Complexity: The huge technology to IoT system is highly complex to design, build, manage, and enable.

CHAPTER 11
CONCLUSION

Since farmers provide food for everyone, agriculture is essential to the nation's economy. It links a wide range of businesses around the nation. Economically and socially, a nation with a sizable agricultural sector is seen as prosperous. The majority of nations depend heavily on agriculture as a source of employment. In a nation like India, irrigation makes up a considerable share of total water use. The temperature of the immediate environment, the temperature of the soil, and the relative humidity are a few of the variables that affect crop productivity. A direct correlation between agricultural irrigation and crop yield makes it essential for crop production. Successful field harvesting is heavily reliant on human supervision and expertise. The field's water source must be protected at all costs. A major problem in modern society, water shortage has a global impact and affects people on a daily basis. In light of this, we are concerned about the likelihood of a worsening of the situation in the upcoming years. Precision farming and smart irrigation are the solutions to the difficulties raised above. Intelligent irrigation in agriculture is only made possible by the implementation of the machine learning and the internet of things. The Internet of Things (IoT) has many advantages, including increased effectiveness, reduced costs, efficient energy use, forecasting, and public convenience.

CHAPTER 12

FUTURE SCOPE

For future improvement, we consider using time-series analysis to predict future values based on previously observed values. Also, we can broaden our scope by also adding other parameters such as soil quality, agricultural inputs, soil nutrients, irrigated area. These parameters should account for anomalies in the data, as well as improve the accuracy by multi-fold. Unsupervised clustering to label data for classifiers will also improve accuracy. Also, we planned to use IoT based computer vision system using deep learning models to improve the quality of production in the smart farming field.

APPENDIX

SOURCE

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random

#Provide your IBM Watson Device Credentials
organization = "95a96q"
deviceType = "NodeMCu"
deviceId = "123456"
authMethod = "token"
authToken = "P123@456"

# Initialize GPIO
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="motoron":
        print ("Motor is on")
    elif+ status == "motoroff":
        print ("Motor is off")

try:
        deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method": 
authMethod, "auth-token": authToken}
        deviceCli = ibmiotf.device.Client(deviceOptions)
        #..............................................

except Exception as e:
        print("Caught exception connecting device: %s" % str(e))
        sys.exit()
```

```
# Connect and send a datapoint "hello" with value "world" into the cloud as an event of type
"greeting" 10 times
deviceCli.connect()

while True:
        #Get Sensor Data from DHT11

        Temperature=random.randint(90,110)
        Humidity=random.randint(60,100)

        data = { 'Temperature' : Temperature, 'Humidity': Humidity }
        #print data
        def myOnPublishCallback():
            print ("Published Temperature = %s C" % Temperature, "Humidity = %s %%" %
Humidity, "to IBM Watson")

        success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
        if not success:
            print("Not connected to IoTF")
        time.sleep(10)

        deviceCli.commandCallback = myCommandCallback

# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

GITHUB LINK:https://github.com/IBM-EPBL/IBM-Project-22484-1659852831.git

PROJECT DEMO LINK: https://clipchamp.com/watch/ybxUNGWBga8