NALAIYA THIRAN PROJECT

Smart Farmer-IoT Enabled Smart Farming Application

A PROJECT REPORT

Submitted By

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ABSTRACT

Agriculture is the source of life for the majority of Indians and it also has a huge influence on the economy of the country. The goal of our project is to reduce this manual involvement of farmers by using an automated irrigation system whose goal is to improve water use for agricultural crops. This paper presents the design and implementation of a wireless sensor network that can monitor air temperature, humidity, and light intensity in crop fields and also from remote locations. The system consists of nodes, equipped with small application-specific sensors, and a radio frequency module. The inspiration for this project came from countries with agricultural-based economies and favourable climatic conditions for the lack of rain and water scarcity. The farmers who work in the fields depend only on the rains and the wells to irrigate the land. Even if the farmland has a water pump, the farmer needs manual intervention to turn the pump on/off as needed. The goal of the project is to build an automatic irrigation system that controls the pump motor ON/OFF when it detects soil moisture. In agriculture, the use of appropriate irrigation techniques is essential. The advantage of using this technique is to reduce human intervention while certifying good irrigation. A software application is developed by predefining threshold values for soil moisture, temperature and water level programmed in the arm controller. This paper introduces water level control and monitoring and soil moisture detection.

Smart Farming agricultural system that supports IoT helps farmers to monitor various parameters in their fields such as soil moisture, temperature, humidity by several sensors. The farmer can monitor all sensor parameters using web or mobile application, even if he is not near his field. Watering crops is one of the important tasks of a farmer. They can make decisions to water or postpone watering crops by monitoring sensor parameters and controlling the pump motor from the mobile app itself. All sensor parameters are stored in the IBM Watson database

IoT is a network that connects physical objects or embedded items with electronics, software, and sensors through a cloud connection that collects and transmits data using the cloud for communication. Data is transmitted over the Internet without human-to-human or human-to-computer interaction. In this project we did not use any materials. Instead of actual soil conditions and temperatures, the IBM IoT Simulator sensors used can transmit soil moisture temperature as needed.

Project requirements: Node-RED, IBM Cloud, IBM Watson IoT, Node.js, IBM device, IBM IoT Simulator, Python 3.7, MIT App Inventor.

Project Deliverables: Application for IoT based Smart Agriculture System

1. INRODUCTION

1.1 Project Overview

As we all know, the Indian economy is one of the largest developing economies in the world. Agriculture is the largest contributor to the Indian economy. To achieve maximum employment and maximum profit in any given condition, it is necessary to upgrade the various engineering techniques used today. Therefore, maintaining an appropriate amount of water in the soil is one of the necessary conditions for harvesting a bountiful crop, which can be a source of a variety of nutrients, whether micro or macro, to they grow well. If we talk about Indian farmers, they are most affected by famine due to crop failure based on different drought factors. Annual rainfall plays a key role in determining the future of these crops as well as the farmers. The overuse of groundwater has dramatically reduced the groundwater table over the past 15 years. Therefore, it takes an hour to put every drop of water to good use so that our future generations can also use it. We should also develop new methods of using renewable energy sources. The development of these new techniques will help us achieve our sustainable development goals as well as reduce greenhouse gas emissions. As the name suggests, the solar-powered AUTO Irrigation SYSTEM project is one step. to use new techniques. This technique will be a very good choice for small and medium farmers who suffer year after year just because crop failure has happened every year. The implementation of this technology is wide-ranging in the near future.

1.2 Purpose:

The main objective of this project was to design a small-scale irrigated system that would use water in more well-organized way in order to prevent excess water loss and minimize the cost of labor. The following aspects were considered in the choice of design solution

- Installation cost
- Water saving
- Human intervention
- Reliability
- Power consumption
- Maintenance
- Expandability

A critical Consideration in the segment costs, since cost define the viability and feasibility of a project. The water saving was also an important feature, since there is demand to decrease.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM:

1. **Remote Monitoring of Crop Field Using Wireless Sensor Network**

This paper presents the design and implementation of wireless sensor network that can monitor the air temperature, Humidity, light intensity in a crop field and from remote places also. The system consists of nodes, which are equipped with small size application specific sensors and radio frequency modules. The sensor data is transmitted via radio frequency link to the centrally localized computer terminal for data logging and analysis. This data can be monitor from the remote places by uploading the data into the internet, also the sensor nodes can additionally be programmed from the computer terminal itself according to the changing needs of farmers thus preventing the need for redeployment of the wireless sensor network every time some changes are to be made. Since the energy is the main operating constraint sleep mode of the core component is utilized.

2. **Automatic irrigation control system for efficient use of water resources by using android mobile**

Agriculture is a source of livelihood of majority Indians and has great impact on the economy of the country. In dry lands or in case of insufficient rainfall, irrigation becomes difficult. So, it needs to be automation required for proper yield and handled remotely for farmer usage and safety. In this paper we suggest a Wireless sensor network and Embedded based technique to control water flow level for sectored, sprinkler or drip method section irrigation system. This system will be very economical in terms of the hardware cost, man power, and power consumption. In places such as agriculture land areas must be a continuous need for monitoring the water level at particular field. In places such as drip irrigation for coconuts, bananas and some vegetable plants, the water is let out through pipes directly to each field. A person has to carefully watch the water level at regular intervals. His job becomes difficult at night times and for frequent power cut. Sometimes there is wastage of water and electricity due to negligence and other times there is a hard job for the formers. This is highly helpful in places such as drip irrigation system where there are many flows.

Pipes but does not require any change in the agricultural fields. When the motor is switched on the sensors are activated and the fields are irrigated automatically without man power. Once the water reaches a particular level which may take several hours, this system takes appropriate steps to regulate or even stop the water flow.

3. **GSM based Automated Irrigation Control using Rain gun Irrigation System**

The green house based modern agriculture industries are the recent requirement in every part of agriculture in India. In this technology, the humidity and temperature of plants are precisely controlled. Due to the variable atmospheric conditions sometimes may vary from place to place in large farmhouse, which makes very difficult to maintain the uniformity at all the places in the farmhouse manually. The proposed system implemented GSM is used to report the detailed about irrigation. The report from the GSM is send through the android mobile. The keil software is used for simulated the result

4. **Automated Irrigation System using zigbee – GSM**

In recent years, Distributed Wireless sensor technology becomes very popular and extensively used in the scientific world. The WSN helps in the advancement of the current developing and rapidly changing technology. Power management, cost-saving and labor saving is always a major issue in the research field of wireless sensor networks. This paper gives a review of some existing or proposed systems based on the different technologies and also focuses on generic automated irrigation system based on WSN with GSM-zigbee for remote monitoring and controlling devices. The objective is to make use of wireless sensor network and communication technology such as zigbee and GSM in industrial field to make low-cost automated irrigation system to monitor the condition of the soil and to lower the energy consumption. The system helps the farmer to monitor and control the parameters of the soil such as air temperature, humidity, soil moisture. At any abnormal condition, the farmer is informed and will be able to take actions remotely by using GSM. Due to its lower energy consumption and low cost, the system has the potential to be useful in semiarid or arid areas.

5. Microcontroller based Controlled Irrigation System for Plantation

The population of India has reached beyond 1.2 billion. If the population goes on increasing with the present rate then after 25-30 years there will be a serious problem of food, so in order to meet the demand of food one has to give more emphasis on the development of agriculture. Today, man has occupied all the suitable land but the land located far away from the human settlement is not developed properly and not utilized fully because it requires more manpower, time and expenditure. But now a day it is possible to pay more attention with the help of modern available controlled devices like computer, microprocessor, sensor, integrated circuits and microcontroller. In the present work a Microcontroller based

Controlled remote irrigation system is developed for the agricultural plantation. The developed system is placed at the remote location and required water provides for plantation whenever the humidity of the soil goes below the set-point value. Humidity sensor provides proportional amount of output with exchange in humidity, which is compared, to the set-point and the data is taken through the channel. If the set-point data is high, then after motor is turned ON, which provides water to the plant till the humidity goes above set- point value. After reaching The humidity above set-point value motor is turned OFF and scans the next channel. This provides right amount of water at right time. The required software program is developed in assembly level language.

6. Remote Sensing and Control of an Irrigation System Using a Distributed Wireless Sensor Network

Efficient water management is a major concern in many cropping systems in semiarid and arid areas. Distributed in-field sensor-based irrigation systems offer a potential solution to support site- specific irrigation management that allows producers to maximize their productivity while saving water. This paper describes details of the design and instrumentation of variable rate irrigation, a wireless sensor network, and software for real-time in-field sensing and control of a site-specific precision linear-move irrigation system. Field conditions were site-specifically monitored by six in-field sensor stations distributed across the field based on a soil property map, and periodically.

Sampled and wirelessly transmitted to a base station. An irrigation machine was converted to be electronically controlled by a programming logic controller that updates georeferenced location of sprinklers from a differential Global Positioning System (GPS) and wirelessly communicates with a computer at the base station. Communication signals from
The sensor network and irrigation controller to the base station were successfully interfaced using low-cost Bluetooth wireless radio communication. Graphic user interface-based software developed in this paper offered stable remote access to field conditions and real-time control and

monitoring of the variable-rate irrigation Controller.

7. A wireless application of drip irrigation automation supported by soil moisture sensors

Highly increasing demand for freshwater, optimal usage of water resources has been provided with greater extent by automation technology and its apparatus such as solar power, drip irrigation, sensors and remote control. Traditional instrumentation based on discrete and wired solutions, presents many difficulties on measuring and control systems especially over the large geographical areas. This paper describes an application of a wireless sensor network for low-cost wireless controlled irrigation solution and real time monitoring of water content of soil. Data acquisition is performed by using solar powered nwireless acquisition stations for the purpose of control of valves for irrigation. The designed system has 3 units namely: base station unit (BSU), valve unit (VU) and sensor unit (SU).The obtained irrigation system not only prevents the moisture stress of trees and calcification, but also provides an efficient use of fresh water resource. In addition, the developed irrigation method removes the need for workmanship for flooding irrigation. The designed system was applied to an area of 8 de cares in a venue located in central Anatolia for controlling drip irrigation of dwarf cherry trees.

2.2 REFERENCES:

[1] S.Gopinath, K.Govindaraju, T.Devika, N.SuthanthiraVanitha, “GSM based Automated Irrigation Control using Raingun Irrigation System”, International Journal of Advanced Research in Computer and Communication Engineering Vol. 3, Issue 2, February 2014.

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[5] S. R. Kumbhar, Arjun P. Ghatule, “Microcontroller based Controlled Irrigation System for Plantation”, Proceedings of the International MultiConference of Engineers and Computer Scientists 2013Volume II, March 2013.

[6] Yunseop (James) Kim, Member, IEEE, Robert G. Evans, and William M. Iversen, “Remote Sensing and Control of an Irrigation System Using a Distributed Wireless Sensor Network”, IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, Volume 57, Number 7, JULY 2008.

[7] Venkata Naga RohitGunturi, “Micro Controller Based Automatic Plant Irrigation System”, International Journal of Advancements in Research & Technology, Volume 2, Issue4, April-2013.

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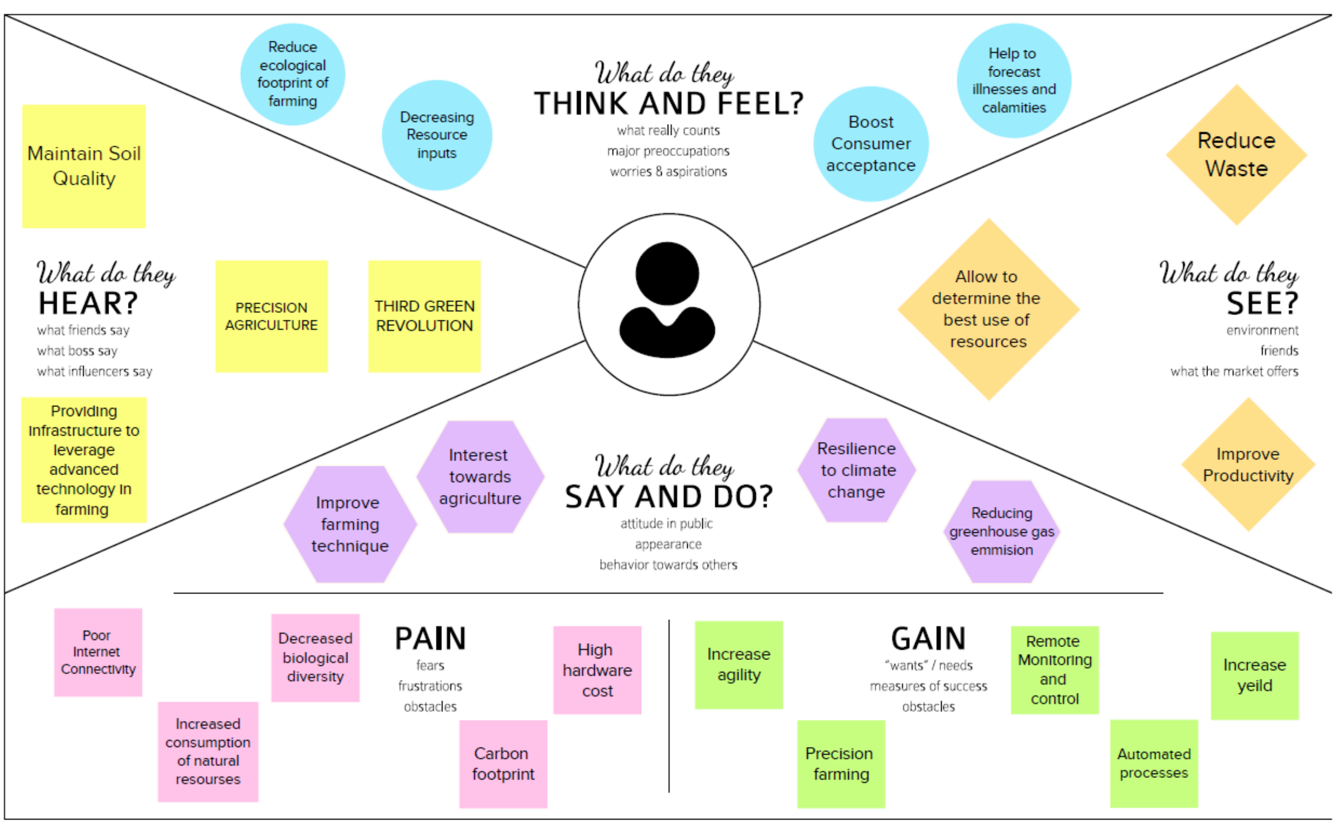
2.3 PROBLEM STATEMENT DEFINITION:

Most of the crop maintenance systems in our country are done manually. Farmers stay in the agricultural lands for longer duration for crops irrigation and field maintenance. The accurate value of the soil moisture level, crop wetness, Water level and growth level are not known. Present there is emerging global water crisis where managing scarcity of water has become a tedious job and there are conflicts between users of water. This is an era where human use and pollution of water resource have crossed the levels which lead to limit food production and low down the ecosystem. The major reason for these limitations is the growth of population which is increasing at a faster rate than the production of food and after a few years this population will sum up to 3-4 billion. Thos growth can be seen in countries which have shortage of uniform crop maintenance and are economically poor. Because of growth in population there is a huge demand to raise food production by 50% in the next half century to maintain the capita, based on an assumption that productivity of existing farm land does not decline. The crop water stress index called as CWSI existed around 30 years ago. This crop water stress index was then integrated using measurements of infrared canopy temperatures, ambient air temperatures, and atmospheric vapor pressure values to determine when to irrigate using drip irrigation. The management of these farms which are in greenhouses will require a data acquisition to be located in each greenhouse and the control room where a control unit is located. These are separated from the production area. At present, the data is transferred using wired communication called field bus. This data is transferred between greenhouses and control room. All the problems related here is presented using CAN and ZigBee protocols.

3. IDEATION &PROPOSED SOLUTION:

3.1 Empathy Map Canvas:



3.2 IDEATION & BRAINSTORMING:

All new business endeavors should start with a good brainstorming session. By working withthe people who know your existing farm or business, you can create exciting new means of incomeand production!

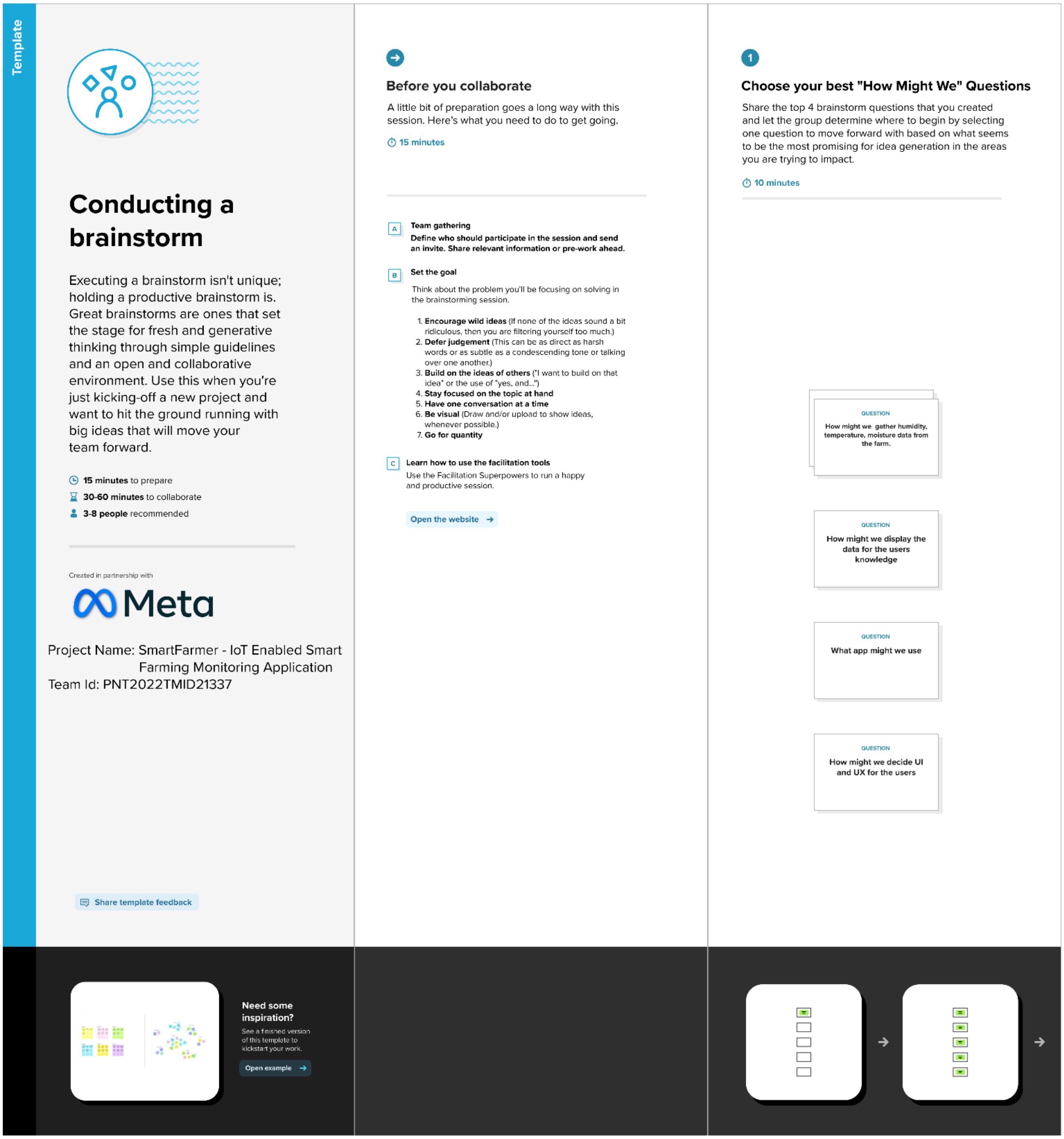
You should start by sitting down (along with your spouse and any partners, financiers or managers) and assessing your situation. Have a brainstorming session; write down your thoughts or record the session. Don't be afraid to dream, to imagine some pretty wild ideas. Think big. Imagine you could do anything; don't be limited by practicality at this stage. Think of goals. Try to fill needs or supply possible markets. Think of new ways to use a resource you already have—like corn cobs. Can corn cobs be made into toys—or paper—or alcohol? Combine elements fromwidely different sources.

Get additional ideas from what others are doing and from published resources, such as Acres U.S.A. and Mother Earth News. Watch for new and developing trends, such as public concerns about saturated fats, or growing biofuels.

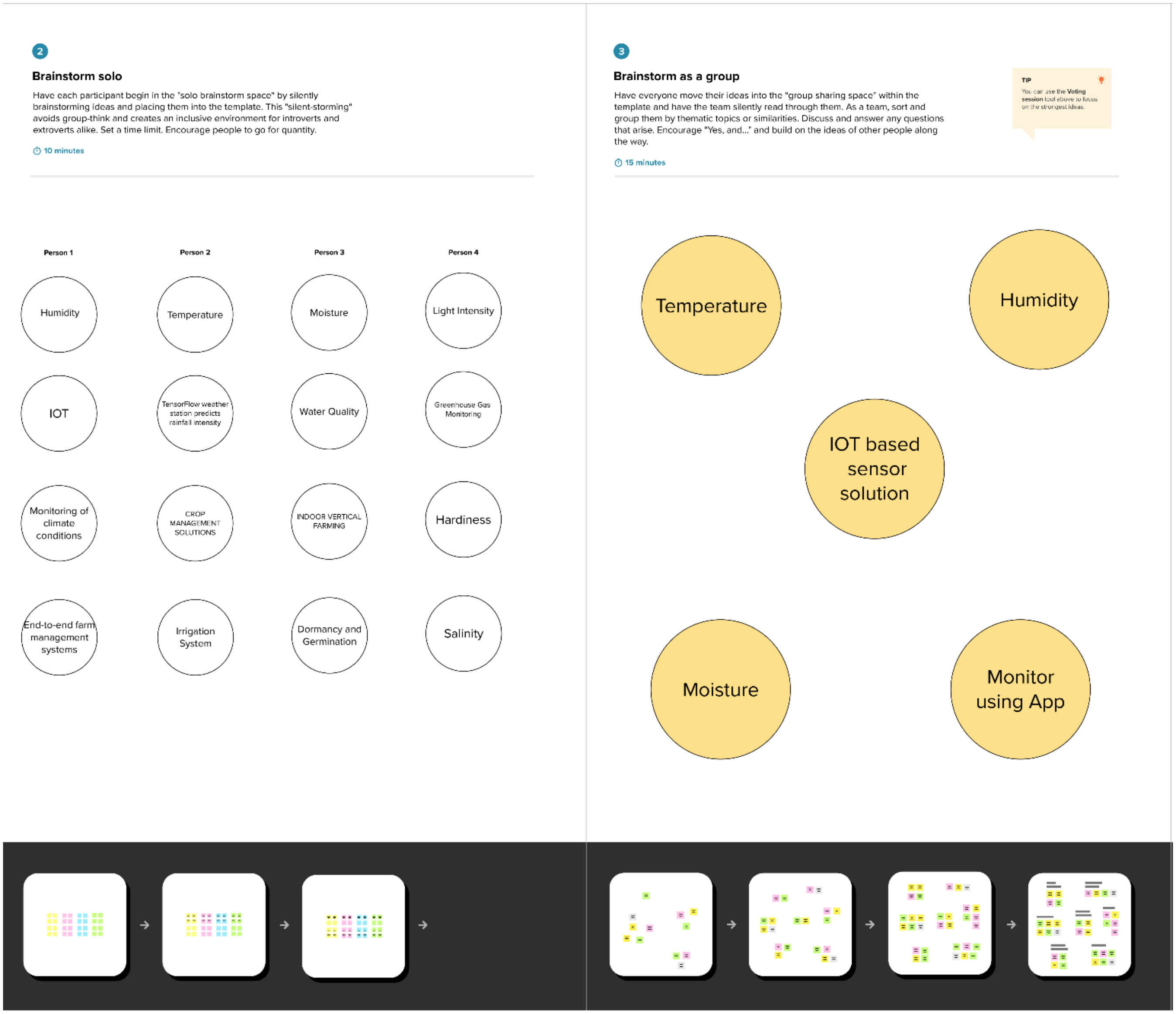
Reference:

https://app.mural.co/t/thiagarajarcollegeofengineer8387/m/thiagarajarcollegeofengineer8387/1665942305589/3f0e7ae9dd8d4a8e137aed0ecc653e6b3f576de0?sender=u8f191aa5246dc87e28511855

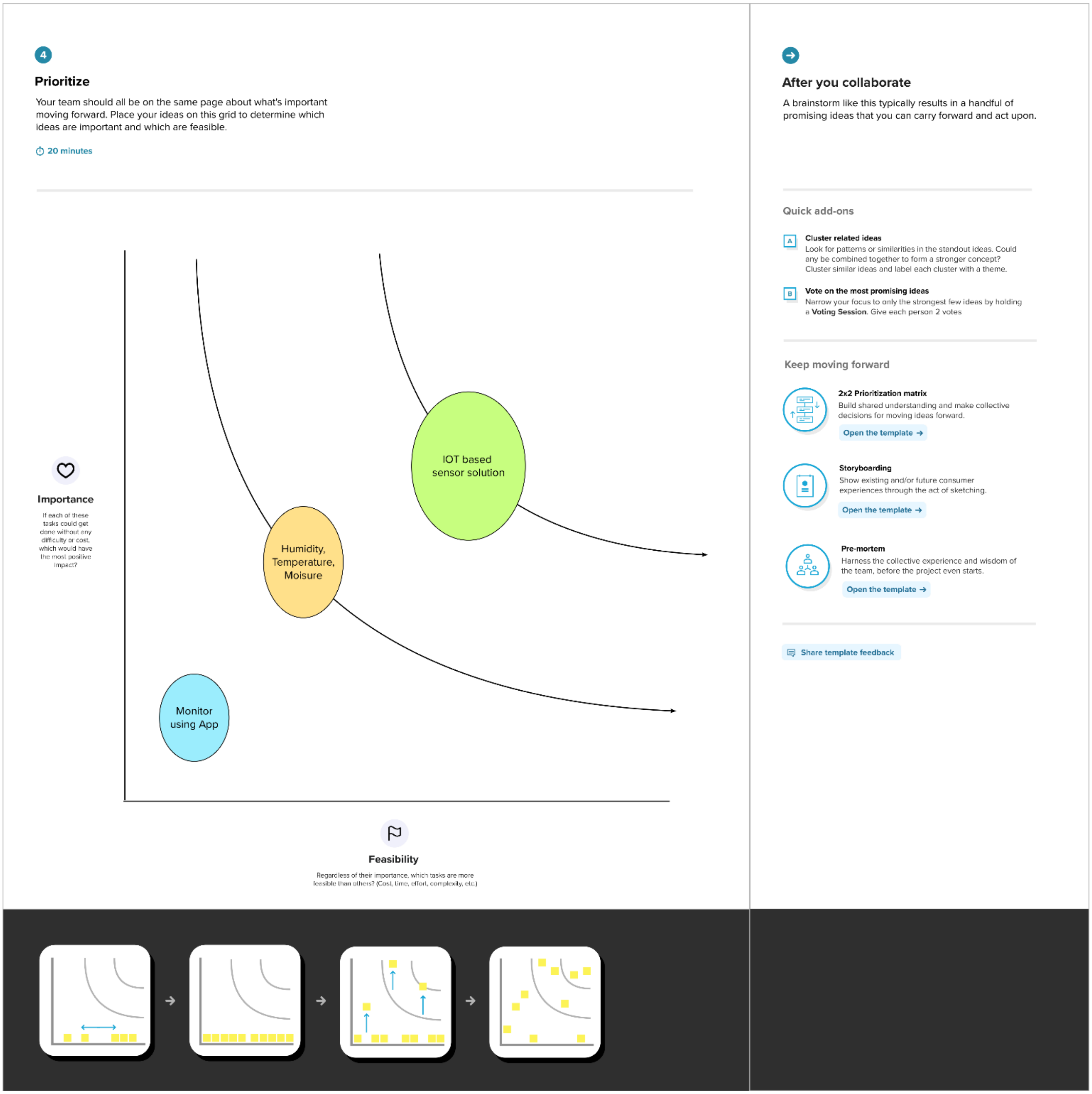
Step-1: Team Gathering, Collaboration and Select the Problem Statements:



Step-2: Brainstorm, Idea Listing and Grouping



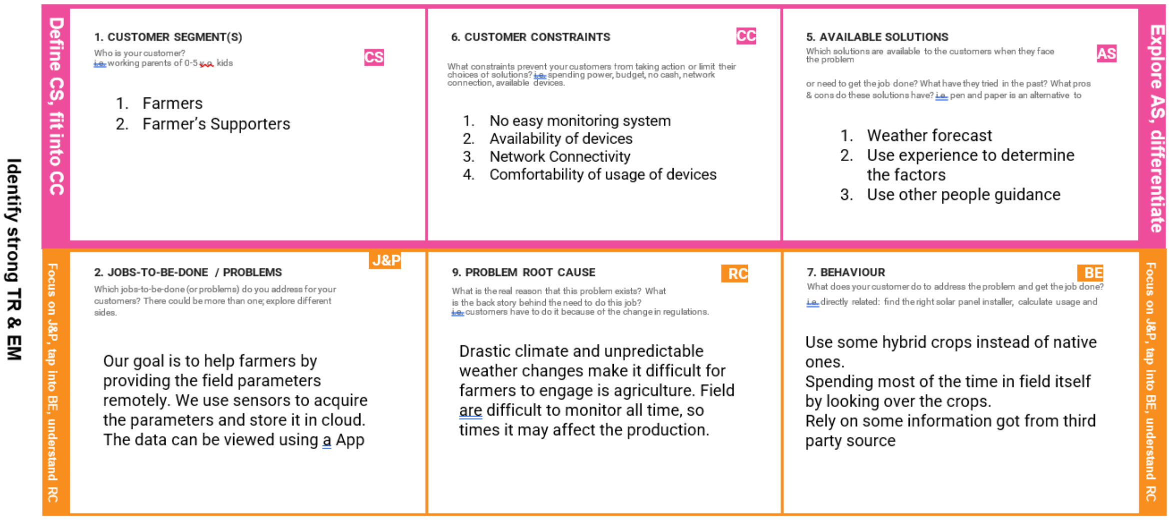
Step-3: Idea Prioritization

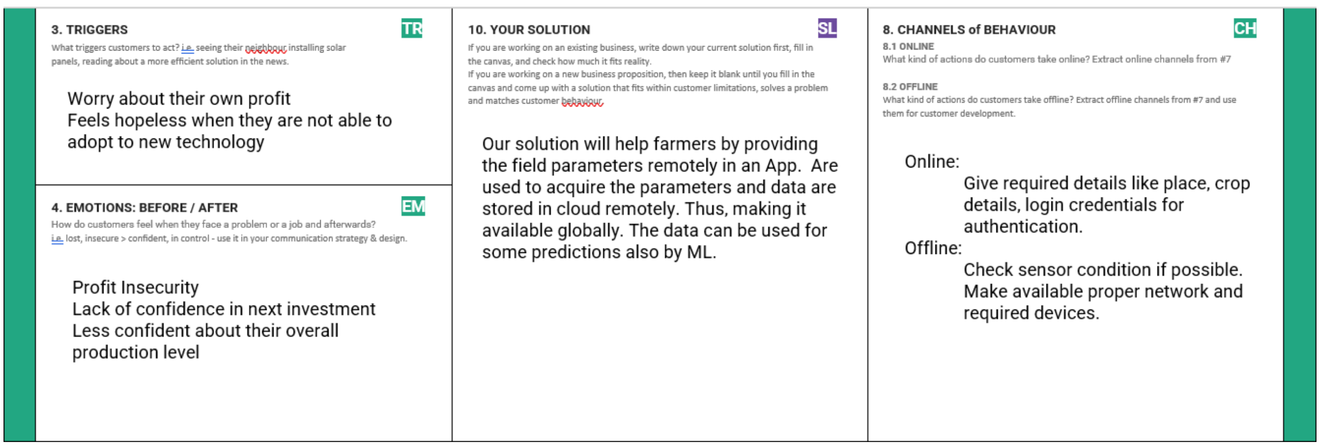


3.3 Proposed Solution:

S. No	Parameter	Description
1.	Problem Statement (Problem to be solved)	• Watering the field is a difficult process, Farmers must wait in the field until the water covers the whole farm field. • Power Supply is also one of the problems. In Village Side, the power supply may vary. • The Biggest Challenges Faced by IoT in the Agricultural Sector are Lack of Information, High Adoption, Cost and Security Concerns, etc
2.	Idea / Solution description	• As is the case of precision Agriculture Smart Farming Technique Enables Farmers better to monitor the fields and maintain the humidity level accordingly. • The Data collected by sensors, in terms of humidity, temperature, moisture, and dew detections help in determining the weather pattern in Farms. So, cultivation is done for suitable crops.
3.	Novelty / Uniqueness	**ALERT MESSAGE** – IoT sensor nodes collect information from the farming environment, such as soil moisture, air humidity, temperature, nutrient ingredients of soil, pest images, and water quality, then transmit collected data to IoT backhaul devices. **REMOTE ACCESS –** It helps the farmer to operate the motor from anywhere.
4.	Social Impact / Customer Satisfaction	• Reduces the wages for labours who work in the agricultural field. • It saves a lot of time. • IoT can help improve customer relationships by enhancing the customer's overall experience. • Easily identify maintenance needs, build better products, send personalized communications, and more. • IoT can also help e-commerce businesses thrive and increase sales. • It makes a wealthy society

3.4 PROBLEM SOLUTION FIT:





3.4.1 Costumer Problem Statement:

4. REQUIREMENT ANALYSIS:

4.1 FUNCTIONAL REQUIREMENT:

By automatic crop monitoring process, farmers would be able to know the right amountof water and Nutritionists at the right time thus to maintain the growth of crop. The farmer canmeasure the water level, Water level and crop growth at any place. These values in agriculturalland are measured by using sensors. It also assists the farmer to maintain the crop. The WSN forremote monitoring of crop field consists of set of wireless sensor nodes distributed in an area calledend devices or sensor nodes. They have a stronger battery, a larger memory and more computationpower, the sensor nodes collect the data from the field by using sensors and this data is send to the path between end devices. The collected data is sent to the internet and pc through WSN. Here in this paper an experimental scale within rural areas where there is an enormous dispositionof irrigation system which is executed using arm controller and wireless communication. The mainof this implementation was to demonstrate that the automatic irrigation system can be used tooptimize /reduce water usage. The system has a water level sensor which will indicate the presenceof water level in tank. A software application was advanced by programming the verge values ofsoil moisture water level that was automated into a microcontroller.

The proposed hardware of this system includes arduino, Temperature, humidity, Water level and soil moisture sensors, LCD. The system is low cost & low power consuming so that anybody canafford it. The data monitored is collected at the server. It can be used in precision farming. The system should be designed in such a way that even illiterate villagers can operate it. They themselves can check different parameters of the soil like salinity, acidity, moisture etc. from timeto time. During irrigation period they have to monitor their distant pump house throughout the night as the electricity supply is not consistent.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
Online		
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIn
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Cloud Account	Creating an IBM cloud account Sign in and confirmation via OTP/Mail
FR-4	MIT App Account	Download MIT App Sign up/Sign in MIT App Confirmation via OTP/Mail
Offline		
FR-1	Sensor Setup	Setting up of required sensors in required places Connecting the main controller to the IBM cloud platform

4.2 NON-FUNCTIONAL REQUIREMENTS

4.2.1 Usability

The system shall allow the users to access the system with pc using web application. Thesystem uses a web application as an interface. The system is user friendly which makes the system easy

4.2.2 Availability

The system is available 100% for the user and is used 24 hrs a day and 365 days a year. Thesystem shall be operational 24 hours a day and 7 days a week.

4.2.3 Scalability

Scalability is the measure of a system & its ability to increase or decrease in performance and cost in response to changes in application and system processing demands.

4.2.4 Security

A security requirement is a statement of needed security functionality that ensures one of many different security properties of software is being satisfied.

4.2.5 Performance

The information is refreshed depending upon whether some updates have occurred or not inthe application. The system shall respond to the member in not less than two seconds from the time of the request submittal. The system shall be allowed to take more time when doinglarge processing jobs. Responses to view information shall take no longer than 5 seconds to appear on the screen.

4.2.6 Reliability

The system has to be 100% reliable due to the importance of data and the damages that canbe caused by incorrect or incomplete data. The system will run 7 days a week. 24 hours a day.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Usability includes easy learnability, efficiency in use, remembering, and subjective pleasure.
NFR-2	**Security**	Data will be protected from their production until the decision-making and storage stages.
NFR-3	**Reliability**	By using a share protection scheme we can provide better security at optimal cost
NFR-4	**Performance**	The idea of implementing integrated sensors in the field will be more efficient for overall monitoring.
NFR-5	**Availability**	Data is will stored in the cloud and so will be available globally.
dNFR-6	**Scalability**	Since cloud technology has a variety of scalability options we can scale based on the needs in real-time

5. PROJECT DESIGN

5.1 Data Flow Diagrams:

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.

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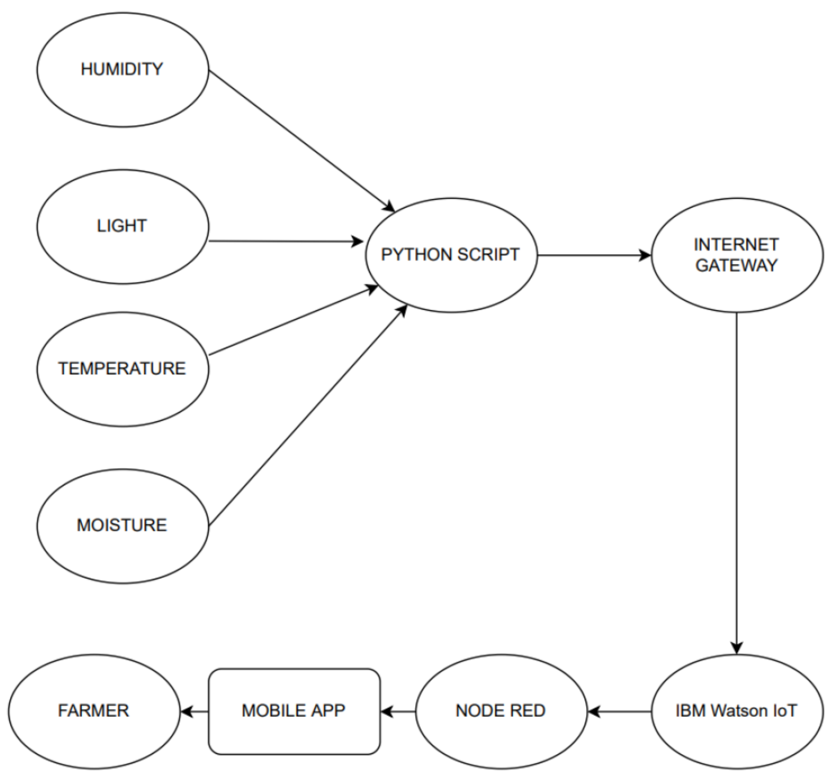


5.2 Technical Architecture:

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

Table-1: Components & Technologies:

S.No	Component	Description	Technology
1.	GUI	XML file in MIT APP helps to act as front-end	XML
2.	Temperature Sensor	The App will process data from sensors in Arduino then it will show it to the user and the user can control it manually	Python
3.	Humidity Sensor	Python helps us to backend work with the help of Django flask	IBM Watson STT service
4.	Moisture Sensor	Logic for a process in the application	IBM Watson Assistant
5.	Database	VARCHAR and Int	MySQL
6.	Cloud Database	Database Service on Cloud	IBM
7.	File Storage	System Storage	IBM Block Storage or Other Storage Service or Local Filesystem
8.	External API-1	External API s help us to send and receive data from one place to another	REST API, etc.
9.	External API-1	External APIs help us to send and receive data from one place to another	Arduino API, etc.
10.	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition
11.	Mobile Installation	Application Deployment on Mobile System	MIT App inventor

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Python, Arduino.	Backend works
2.	Security Implementations	penetration testing using owasp zap	OWASP
3.	Scalable Architecture	Scale is Tier 2	Java
4.	Availability	There is good availability of all these because most of them are open-source	Cloud
5.	Performance	Performance is purely based on efficiency and it is 70 %	Arduino UNO

5.3 Solution Architecture:

5.3.1 IOT based smart farming

The best tech solution to solve existing business problems is to first find the temperature, humidity, and moisture level from sensors. Then sending thru python Django as the python then using API sending data to MIT app. So from App, we can control the sensors. The characteristics are to extra care of plants improve growth and save water with a minimal amount of investment Structure includes MIT App then python then Arduino with sensors from cultivation and other aspects of the software to project stakeholders helps them to understand how much they save it.

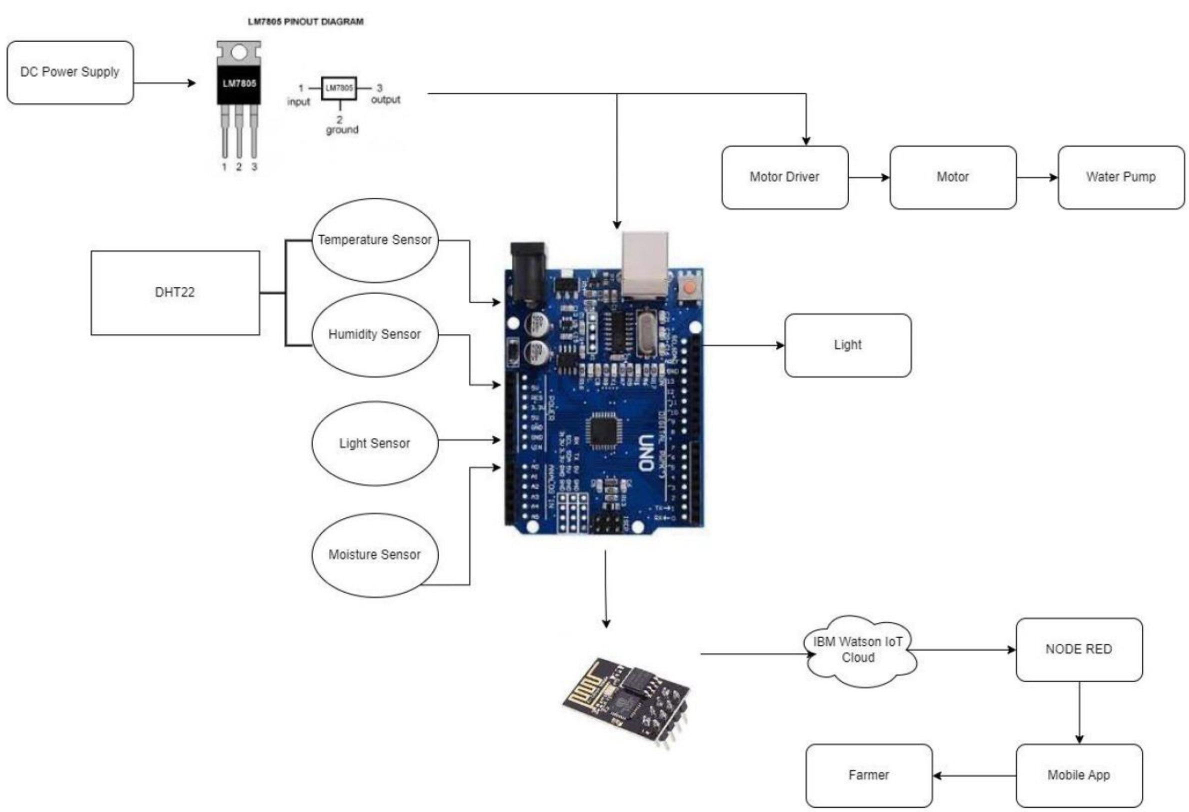
5.3.2 Features, development phases, and solution requirements:

Humidity measurements indicate the concentration of water vapor present in the air. They provide their measurements in the form of a proper electronic signal. Moreover, they also report relative humidity i.e., the ratio of moisture in the air to the maximum moisture at a given temperature. The relative humidity is useful for many applications, like HVAC (Heating Ventilation Air Conditioning) and comfort optimization applications in Smart Buildings and Facilities Management.

State-of-the-art humidity sensors provide support for internet connectivity and can be flexibly deployed in Internet of Things (iot) applications. This facilitates the integration of humidity measurements with the output of other sensors (e.g., temperature sensors) and boosts iot applications intelligence in various industry applications. The quality of a humidity sensor is reflected in its accuracy, reliability, response time, longevity, security, robustness, and ease of deployment. These characteristics also determine the sensor's cost. Furthermore, they drive the selection of humidity sensors for different applications. MIT App Inventor is an intuitive, visual programming environment that allows everyone even children, to build fully functional apps for smartphones and Those tablets. New to MIT App Inventor can have a simple first app up and running in less than 30 minutes.

5.3.3 Specifications:

Extra care for plants improves growth and saves water with a minimal amount of investment.



5.4 User Stories

FR No	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Visibility	Sensor nearing the crop field and to check the soil moisture and temperature with the help of humidity sensor
FR-2	User Reception	The Data like values of Temperature, Humidity, Soil moisture sensors are received via SMS
FR-3	User Understanding	Based on the sensor data value to get the information about present of farming land
FR-4	User Action	The user needs take action like destruction of crop residues, deep plowing, crop rotation, fertilizers, strip cropping, scheduled planting operations.

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint planning & Estimation

Title	Description	Duration
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers, research publications etc.	29 August-3rd September 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements.	5-10 th September 2022
Brainstorming ideas	List the ideas by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	12-17 September 2022

Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	19-24 September 2022
Problem Solution Fit	Prepare problem - solution Fit document.	26 September-01 October 2022
Solution Architecture	Prepare solution Architecture document.	26 September-01 October 2022
Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application	03-08 October 2022
Data Flow Diagrams	Draw the data flow Diagrams and submit for review.	10-15 October 2022
Technology Architecture	Architecture diagram.	10-15 October 2022
Milestone & Activity List	Prepare the milestones & Activity list of the project.	17-22 October 2022
Sprint Delivery	Prepare the Sprint delivery on Number of Sprint planning meetings organized, Minutes of meeting recorded.	17-22 October 2022
Project Development Delivery of Sprint- 1,2,3&4	Develop & submit the developed code by testing it.	22 October t0 19 November 2022

6.2 Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint StartDate	Sprint End Date (Planned)	Story Points Completed(ason Planned End Date)	Sprint Release Date(Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	28 Oct 2022
Sprint-2	20	5 Days	31 Oct 2022	04 Nov 2022	20	03 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	4 Days	14 Nov 2022	17 Nov 2022	20	16 Nov 2022

7. CODING & SOLUTIONING

The data is collected through a hardware circuit which will be present in the farm. With the help of sensors, we will be able to get the necessary data from the field. But in this case, we are using a python code which will generate random values for the respective parameter and it's sent to IBM Watson for further steps.

7.1 Feature 1

CONFIGURATION OF NODE-RED TO SEND COMMANDS TO IBM CLOUD

Here we add two buttons in UI

1 -> for motor on

2 -> for motor off

We used a function node to analyses the data received and assign command to each number.
The python code for the analyses is:

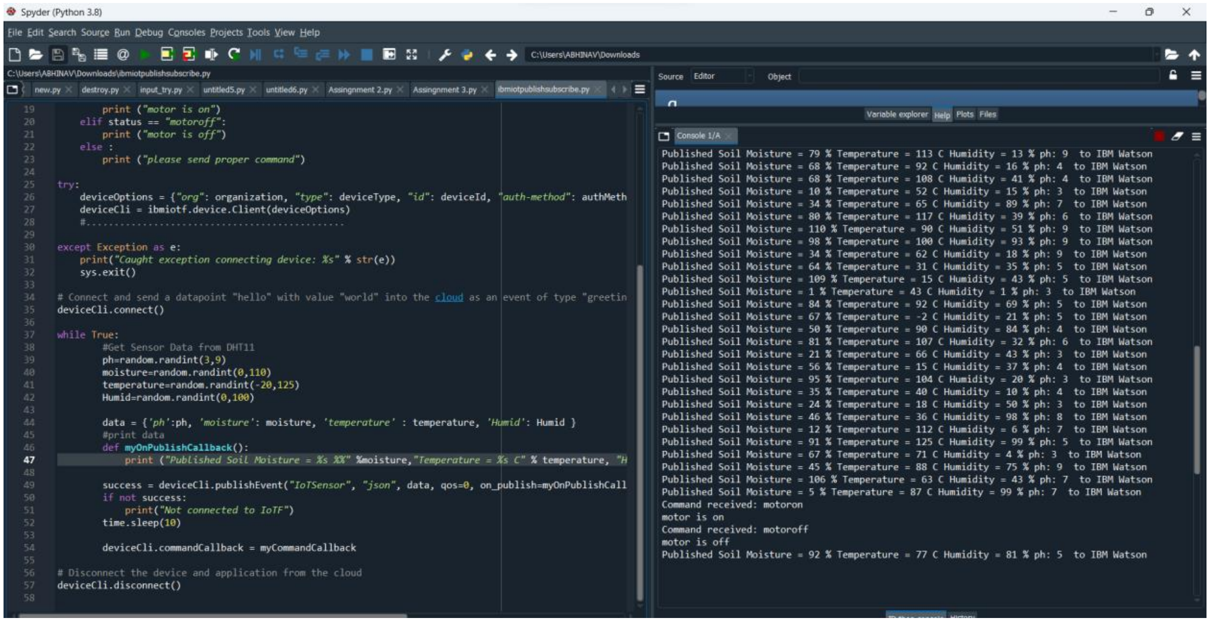
```
if status == "motoron":
      print ("motor is on")
   elif status == "motoroff":
      print ("motor is off")
   else :
      print ("please send proper command")
```

Code:

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

#Provide your IBM Watson Device Credentials
organization = "obbnyv"
deviceType = "raspberrypi"
deviceId = "123456789"
authMethod = "token"
authToken = "12345678910"

# 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")
   else :
      print ("please send proper command")



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
     ph=random.randint(3,9)
     moisture=random.randint(0,110)
     temperature=random.randint(-20,125)
     Humid=random.randint(0,100)

     data = {'ph':ph, 'moisture': moisture, 'temperature' : temperature, 'Humid': Humid }
     #print data
     def myOnPublishCallback():
        print ("Published Soil Moisture = %s %%" %moisture,"Temperature = %s C" %
temperature, "Humidity = %s %%" % Humid, "ph: %s "%ph, "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()
```

Output:

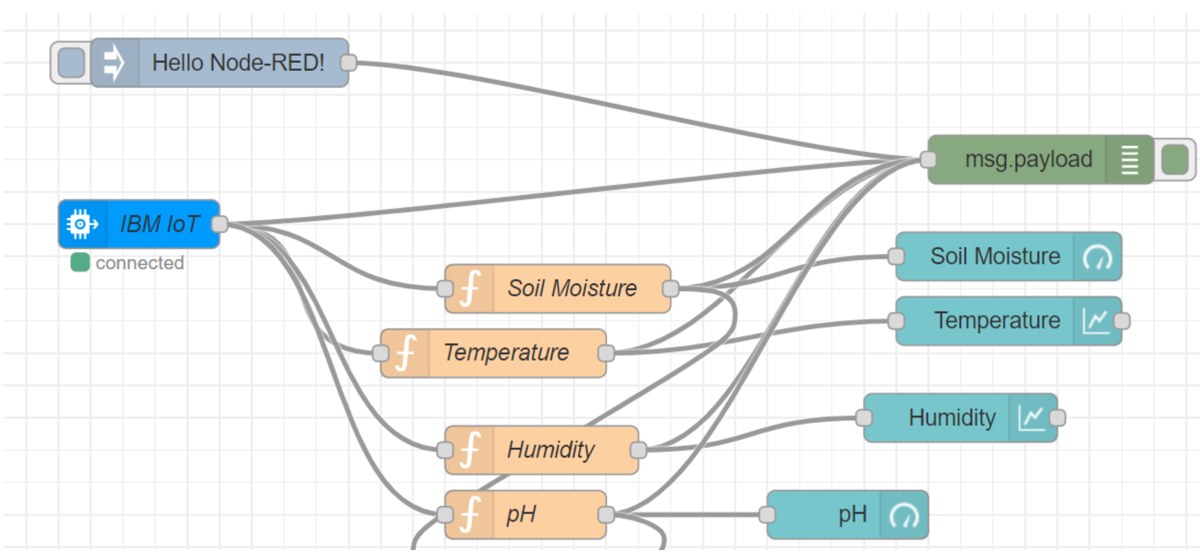


7.2 Feature 2

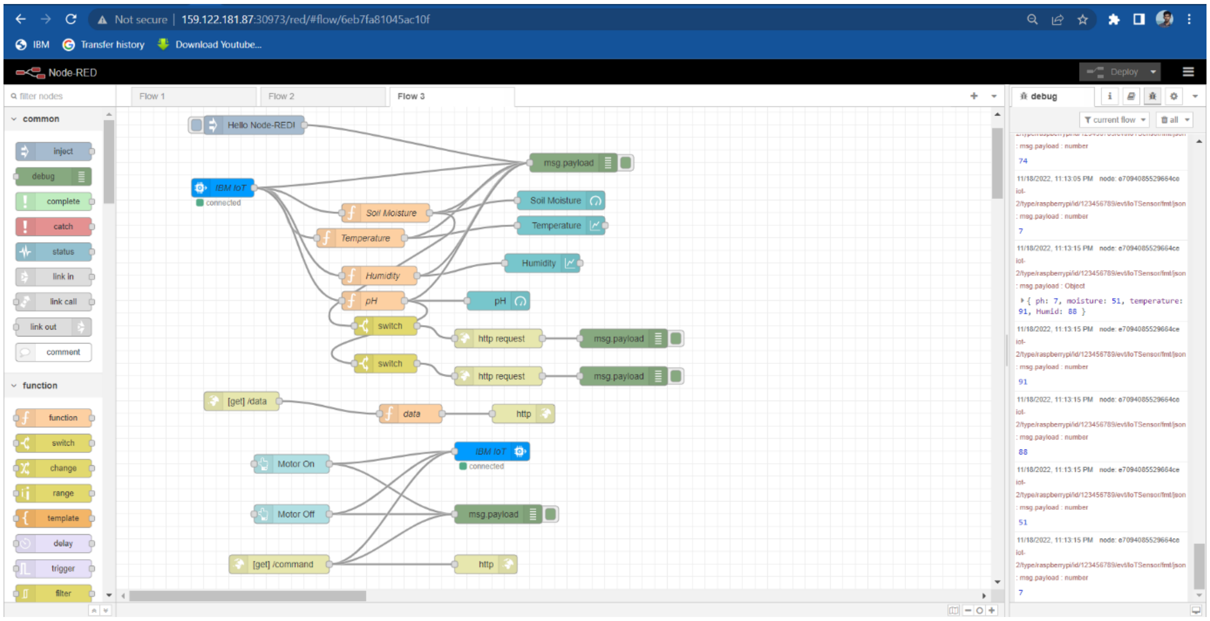
Adjusting user interface

In order to display the parsed JSON data a Node-Red dashboard is created.Here we are using Gauges, text and button nodes to display in the UI and helps tomonitor the parameters and control the farm equipment.

Below images we started to create the flow 1



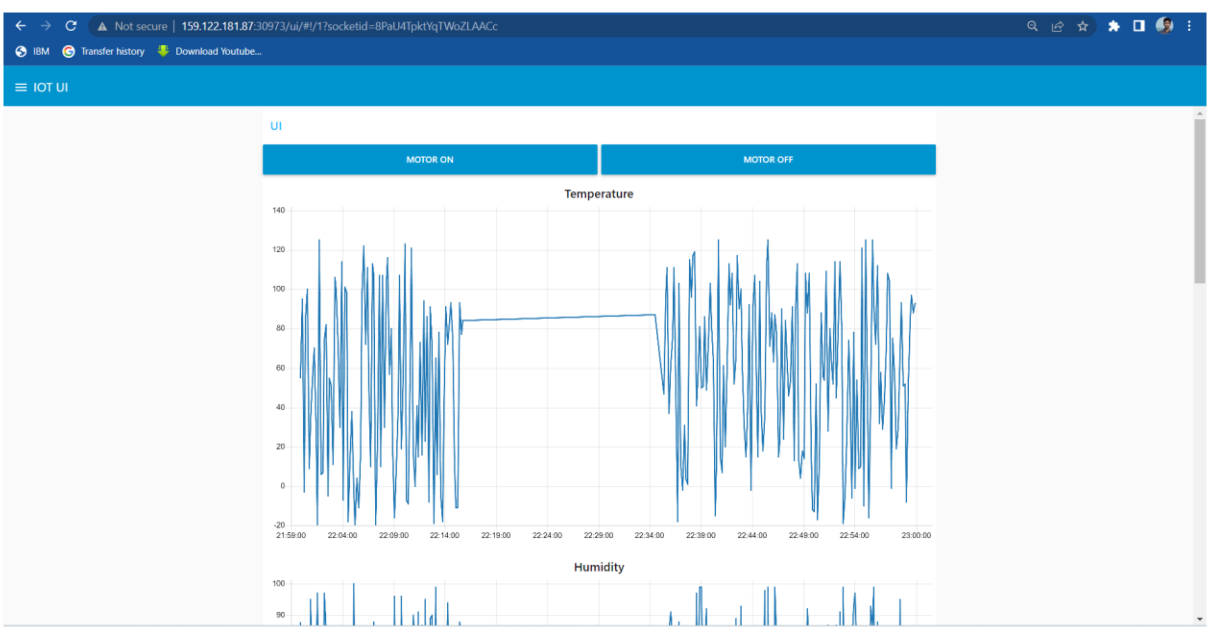
COMPLETE PROGRAM FLOW:

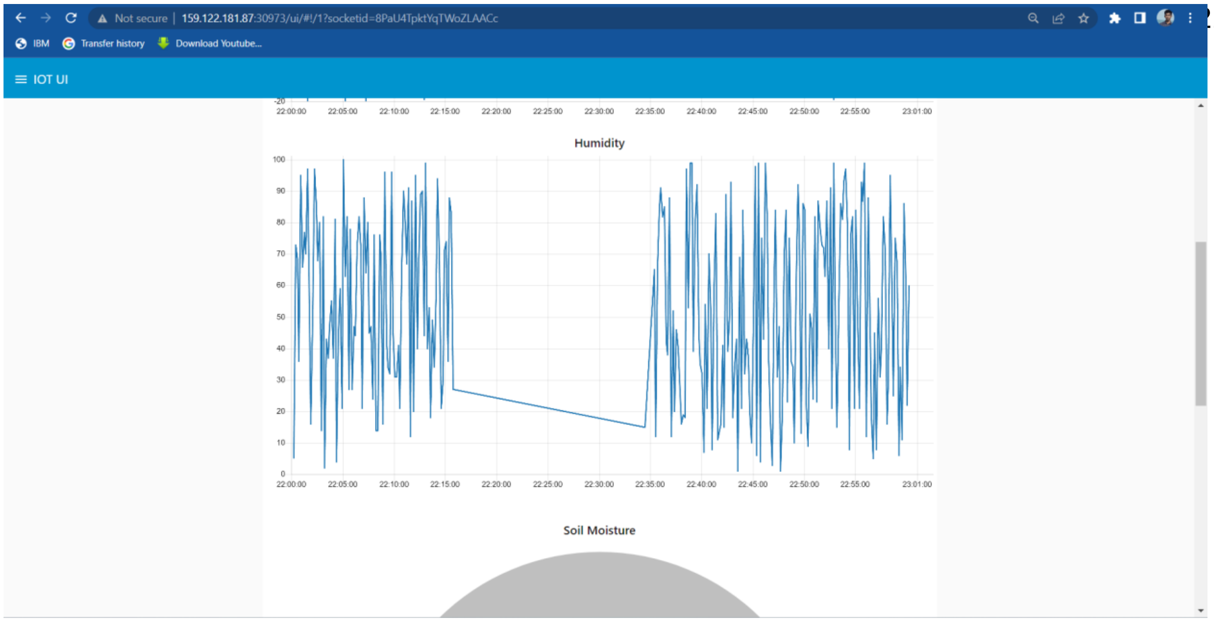


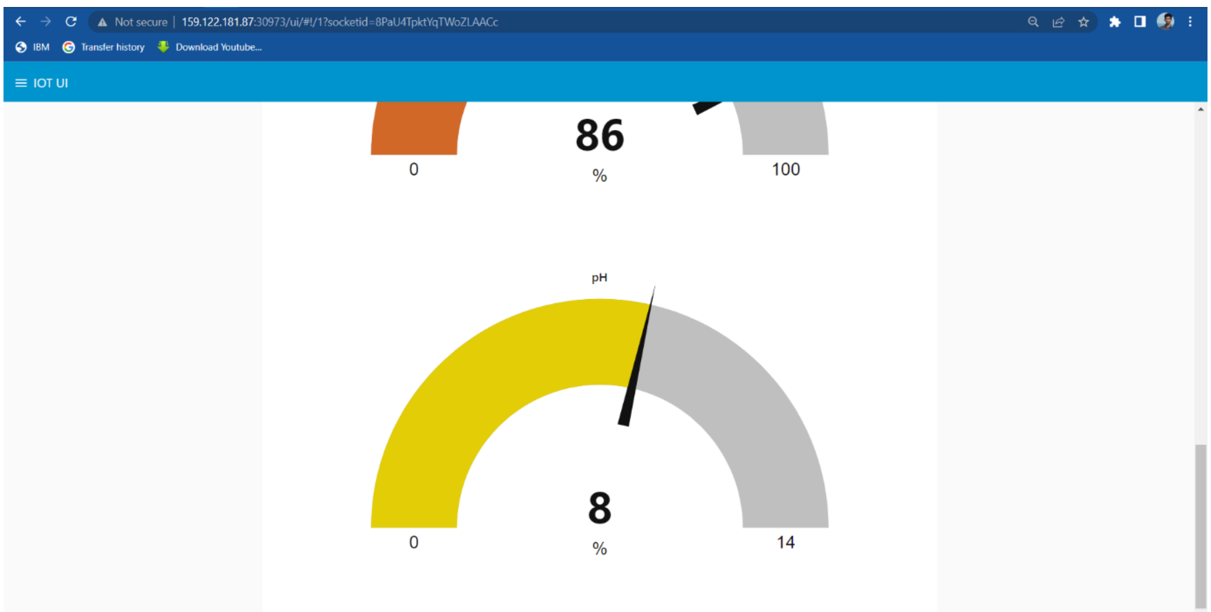
HTML Response:

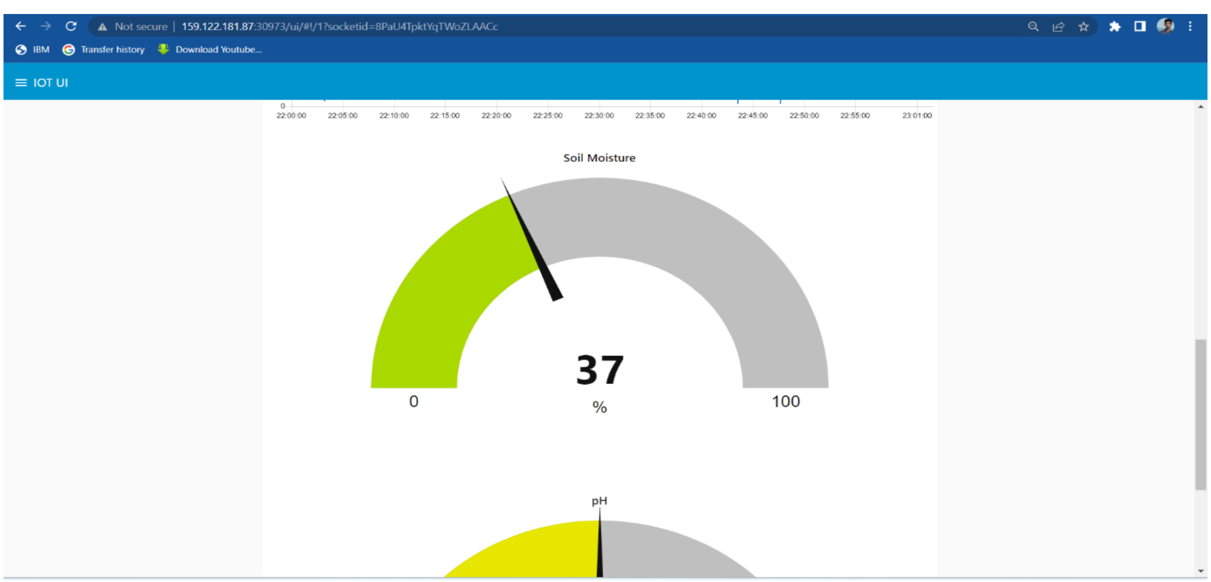
{"pH":5,"Soil":109,"Temperature":15,"Humid":43}

UI Dashboard:




Not secure | 159.122.181.87:30973/ui/#!/1?socketid=8PaU4TpktYqTWoZLAACc
IBM
Transfer history
Download Youtube...
IOT UI
Humidity
Soil Moisture

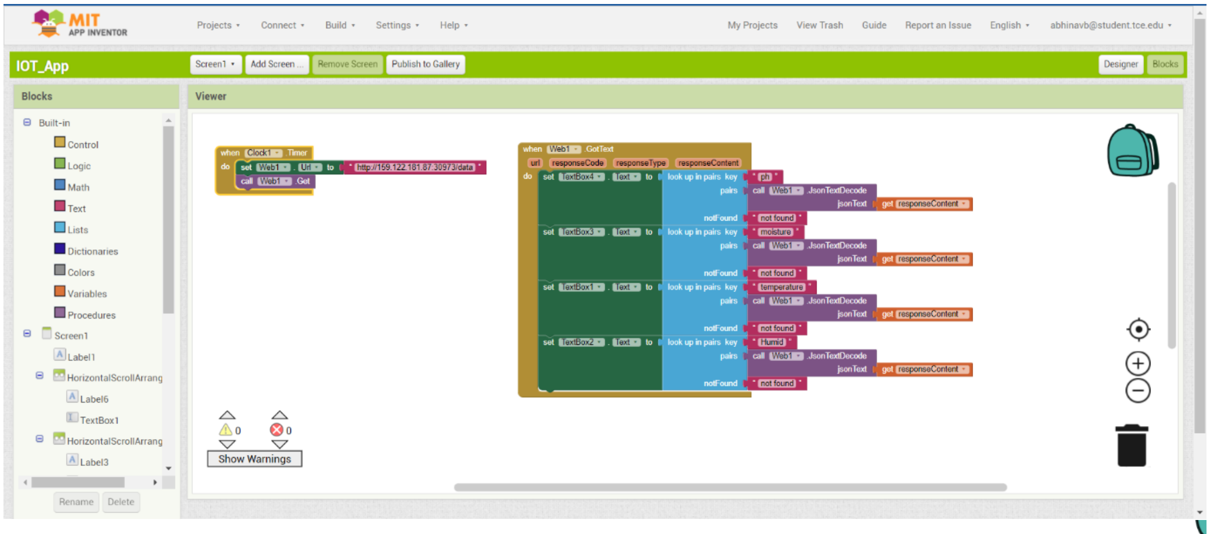

Not secure | 159.122.181.87:30973/ui/#!/1?socketid=8PaU4TpktYqTWoZLAACc
IBM
Transfer history
Download Youtube...
IOT UI
86
%
0
100
pH
8
%
0
14

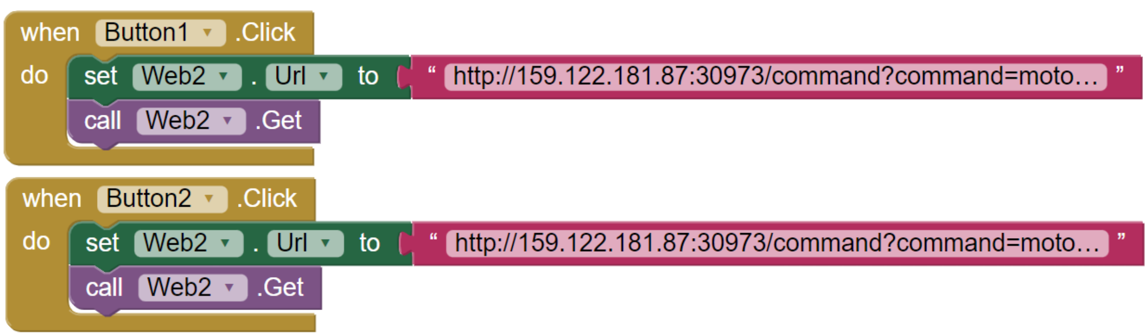

Not secure | 159.122.181.87:30973/ui/#!/1?socketid=8PaU4TpktYqTWoZLAACc
IBM
Transfer history
Download Youtube...
IOT UI
Soil Moisture
37
%
0
100
pH

MIT App Inventor:

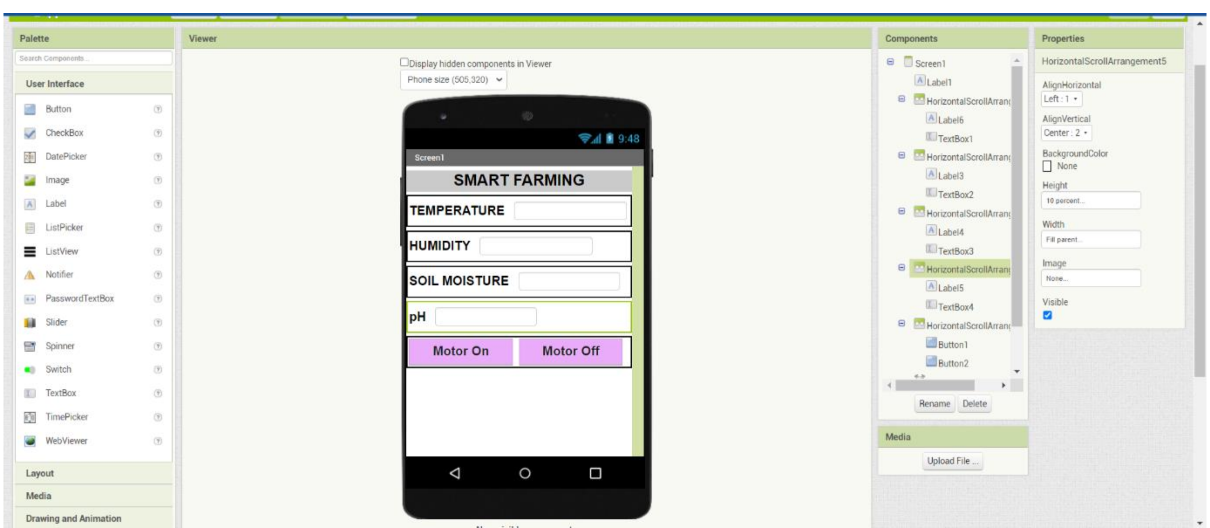
MIT App Inventor is an intuitive, visual programming environment that allows everyone even children to build fully functional apps for smartphones and tablets. Those new to MIT App Inventor can have a simple first app up and running in less than 30 minutes. And what's more, our blocks-based tool facilitates the creation of complex, high-impact apps in significantly less time than traditional programming environments.

Blocks:

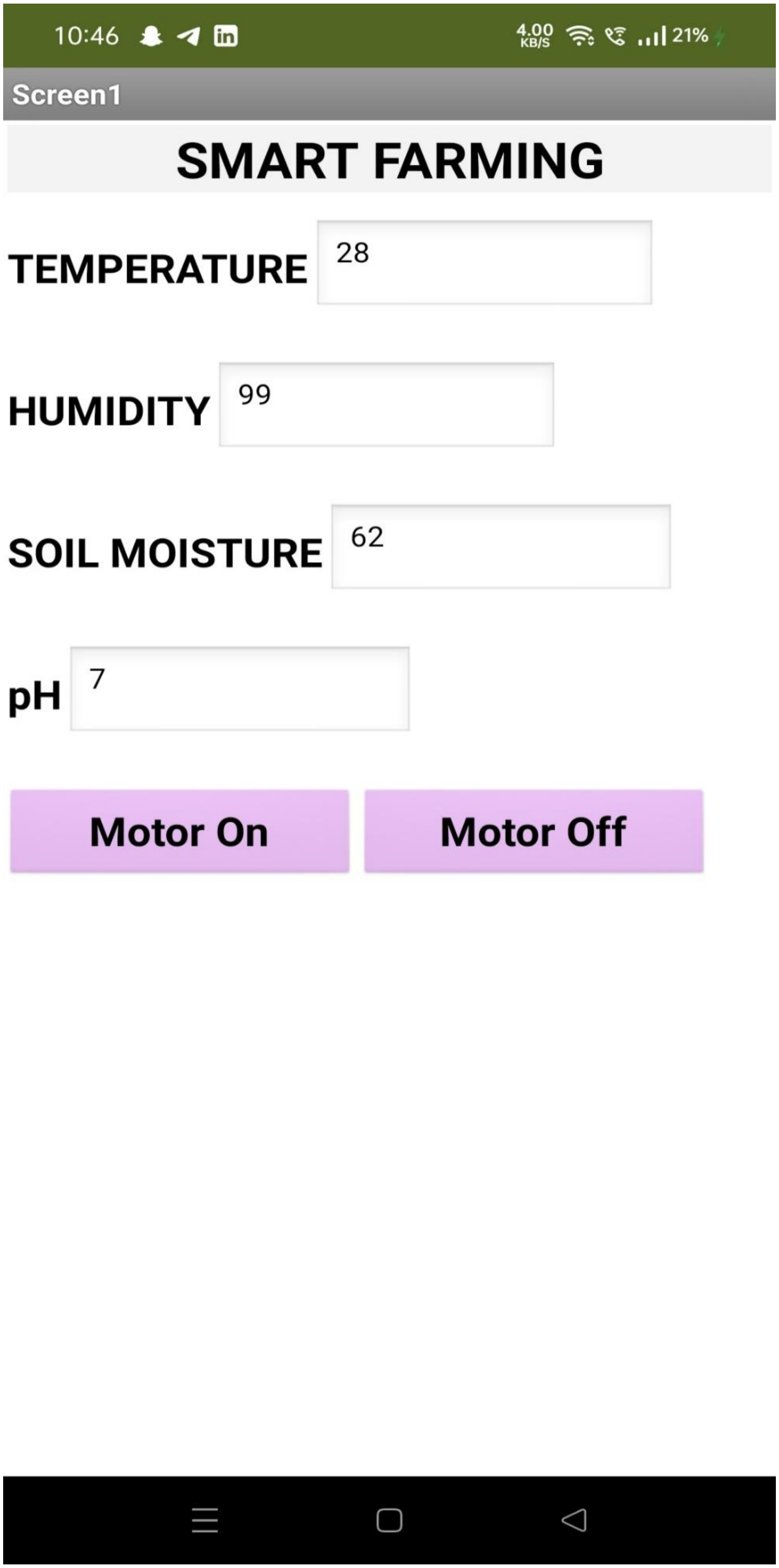




Designer:



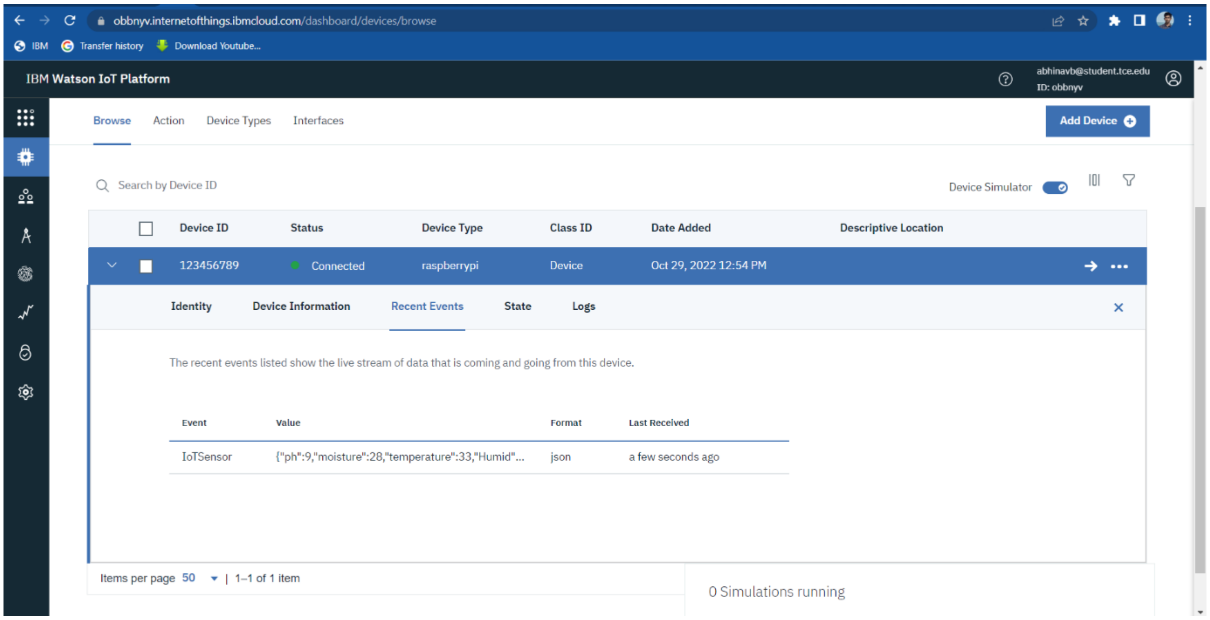
Mobile Application:



7.3 Feature 3

IBM Watson:

It is a fully managed, cloud-hosted service designed to make it simple to derive value from your Internet of Things devices. It provides capabilities such as device registration, connectivity, control, rapid visualization and storage of Internet of Things data.



8. TESTING

Software Testing is a method to check whether the actual software product matches expected requirements and to ensure that software product is Defect free. It involves execution of software/system components using manual or automated tools to evaluate one or more properties of interest. The purpose of software testing is to identify errors, gaps or missing requirements in contrast to actual requirements. Some prefer saying Software testing definition as a White Box and Black Box Testing. In simple terms, Software Testing means the Verification of Application Under Test (AUT). This Software Testing course introduces testing software to the audience and justifies the importance of software

8.1 TEST CASES

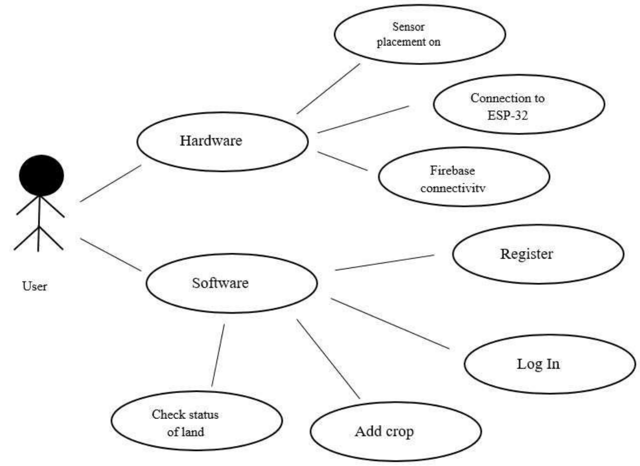
A Use Case Diagram in the Unified Modeling Language (UML) is a type of behavioral diagram defined by and created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. The main purpose of a use case diagram is to show what system functions are performed for which roles of the

Server Module

Sr. No	Test Case	I/P Procedure	Expected Result	Result Obtained	Status
1	Application open	Click on the application	Application open without any error	Application opens successfully	Pass
2	Application does not open	Click on the application	Application open without any error	Application failure to open	Fail
3	Sign Up	User click on Sign up button	Profile should be created successfully	Profile created Successfully	Pass
4	Log In with Username	User click on Log in button	Logged in Successfully	Logged in Successfully	Pass
5	Not logged in	User click on Log in button	System Failed to Log In	System is not Capable to log in	Fail
6	Click Add Crop	User click on the add button	Shows details to fill crop information	Give details to fil crop information	Pass
7	Click on Added Crop	User click on added crop profile	Shows values of the soil constraints	Displaying o/p successfully	Pass
8	Logout	Click On logout	Logged Out from System	Logged Out from System	Pass

actors in the system can be depicted. A use case diagram is a type of behavioral diagram created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases.

A strategy for system testing integrates system test cases and design techniques into a well-planned series of steps that results in the successful construction of software. The testing strategymust cooperate test planning test case design, test execution, and the resultant data collection and evaluation. A strategy for is testing must accommodate low-level tests that are necessary to verify that a small source segment has been correctly implemented as well as high level tests that validate major system functions against user requirements.

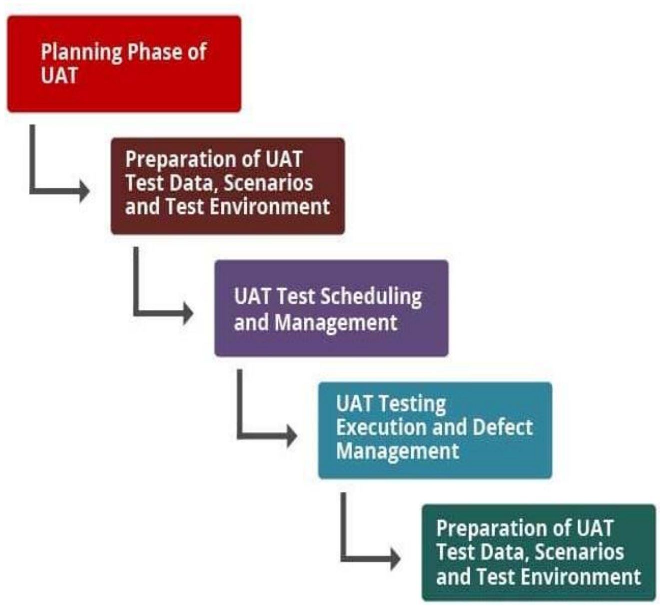


Software testing is a critical element of software quality assurance and represents the ultimate review of cation design and coding. Testing represents an interesting anomaly for the software. Thus, a series testing is performed for the proposed system before the system is readyfor user acceptance testing.

8.2 User Acceptance Testing:

User Acceptance Testing (UAT) is a type of testing performed by the end user or the client to verify/accept the software system before moving the software application to the production environment. UAT is done in the final phase of testing after functional, integration and system testing are done.

Phases of UAT Testing:



1. **Planning Phase of UAT**:

   Assigning a UAT Test Manager to oversee the entire process of UAT is essentially done in this stage. Proper planning and execution strategy are outlined here. Identification of critical resources is done and preparation of a critical resource plan is done.

2. **Preparation of UAT Test Data, Scenarios and Test Environment**:

   UAT readiness is ensured in this phase as the UAT test environment is set up, preparation of test management plan along with test data, interfaces, data, authorization along with scenario readiness is done here.

3. **UAT Test Scheduling and Management**:

   Proper action plans with UAT priorities are done in this phase. A triage process is kept in place to prioritize the assessments of defects blocking if any. An effective mechanism to track test scenarios and test scripts based on the requirements defined is taken up.

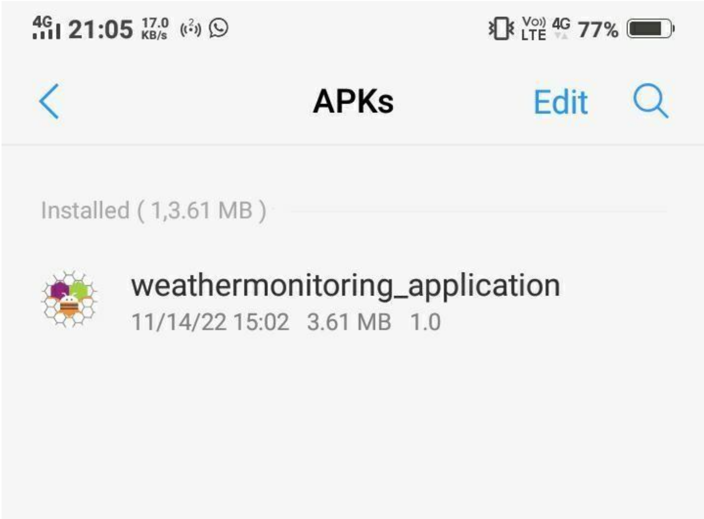
4. **UAT Testing Execution and Defect Management**:

   This is an important phase and proper identification of priority defects is taken up and more focus is placed on performing root cause analysis assessments. A trial run of UAT processes is done to validate execution and defects assignment and assessment is taken up for proper and quick resolution.

5. **UAT, Sign-off, and Reporting**:

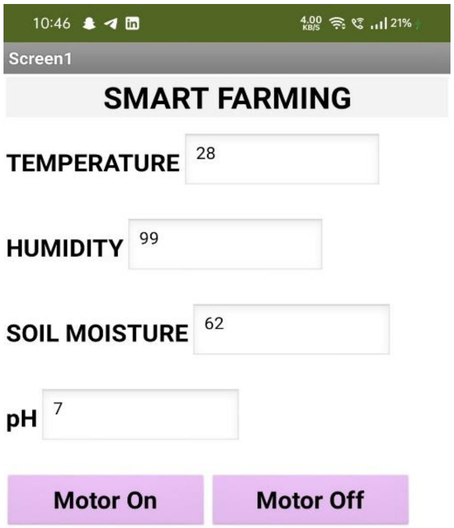
   In this final phase of UAT, accurate defect and testing status reports and defect reporting is generated from the test management system. Finally, a sign-off when all bugs have been fixed indicates the acceptance of the software. This final phase ensures and validates that the application developed meets the user requirements and is ready to be moved to production.

Step-1: First user needs to download the android APK file from MIT app inventor where we developed our mobile application and install in their mobiles.



Step-2: After successful installation we can find app icon in our mobile as shown below.

Step-3: By clicking on the app, the next page will be open. In that page we can see the real time temperature, humidity and soil moisture reading as shown below.



We are successfully created the IOT enabled smart farming application.

9. ADVANTAGES & DISADVANTAGES

Advantages	Disadvantages
Saves water, time, electricity and human energy.	The human energy is wasted.
Discourage weeds.	Uniform maintenance is difficult to the formers.
Farmer income is increased.	Farmer to verify the growth of the crop is not easy.
Crop growth, Water level, water level is intimated alternatively.	

10. CONCLUSION:

IOT based crop field monitoring system serves as a reliable and efficient system for monitoring agricultural parameters. The corrective action can be taken. Wireless monitoring of field not only allows user to reduce the human power, but it also allows user to see accurate changes in it. It is cheaper in cost and consumes less power. The GDP per capita in agro sector canbe increased. Agriculture is a backbone of human civilization since man has started agriculture. Asthe generation evolved, man developed many methods of crop monitoring to provide growth to the crop. In the present scenario on conservation of water is of high importance. Present work is attempts to save the natural resources available for human kind. By continuously monitoring the status of the soil, we can control the flow of water and thereby reduce the wastage. This review is proposed to supports aggressive water management for the agricultural land. Microcontroller in the system promises about increase in systems life by reducing the power consumption resulting in lower power consumption.

After completing this project, it can be concluded that the system works perfectly as planned. It fulfills the two objectives stated at the beginning of this project which is to develop a smart farming application that can monitor the parameters such as temperature, humidity, soil moisture, and pH value, to optimize the use of water by using the controlling system and to analyze vegetative traits of plants using the suitable value of temperature, humidity, soil moisture and pH using Thing Speak. Furthermore, the smart farming system is an efficient method of applying nutrient solutions in which the irrigation system is used as the carrier and the distributor for the plants. In a nutshell, the smart farming system using IoT is well suited for commercial agriculture to maximize profits and yields.

11. FUTURE SCOPE:

- Future work would be focused more on increasing sensors on this system to fetch more dataespecially with regard to Pest Control and by also integrating GPS module in this system to enhance this Agriculture IoT Technology to full-fledged Agriculture Precision ready product.

- 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.

- Among the technologies available for present-day farmers are: Sensors: soil, water, light, humidity, temperature management.

- Agriculture graduates can explore the sea of opportunities in both the public and private sectors.

- They can start their career as Agriculture Officer, Assistant Plantation Manager, Agricultural Research Scientist, Marketing Executive, Business development executive, and manymore.

- 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.

- "Smart farming" is an emerging concept that refers to managing farms using technologies like IoT, robotics, drones and AI to increase the quantity and quality of products while optimizingthe human labor required by production.

12. APPENDIX:

12.1 Source Code

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

#Provide your IBM Watson Device Credentials
organization = "obbnyv"
deviceType = "raspberrypi"
deviceId = "123456789"
authMethod = "token"
authToken = "12345678910"

# 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")
   else :
      print ("please send proper command")

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
      ph=random.randint(3,9)
      moisture=random.randint(0,110)
      temperature=random.randint(-20,125)
      Humid=random.randint(0,100)

      data = {'ph':ph, 'moisture': moisture, 'temperature' : temperature, 'Humid': Humid }
      #print data
      def myOnPublishCallback():
         print ("Published Soil Moisture = %s %%" %moisture,"Temperature = %s C" %
temperature, "Humidity = %s %%" % Humid, "ph: %s "%ph, "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()
```

12.2 GitHub & Project Demo link

GitHub Link	https://github.com/IBM-EPBL/IBM-Project-10239-1659119804
Project Demo Link	https://youtu.be/0Es55YToi9A