PROJECT REPORT

SmartFarmer - IoT Enabled Smart Farming Application

TEAM ID:PNT2022TMID33042

1.INTRODUCTION

1.1.PROJECT OVERVIEW

Smart farming is a modern farming managemental concept with IoT technology to increase the productivity in agriculture. With the use of smart farming, farmers can effectively use fertilizers and other resources to increase the quality and quantity of their crops. Farmers cannot be physically present on the field 24 hours a day. Also, the farmers may not have the knowledge to use different tools to measure the ideal environmental conditions for their crops. IoT provides them with the automated system which can function without any human supervision and can notify them to make proper decision to deal with different kind of problems they may face during farming. It has the capability to reach and notify the farmer even if farmer is not on the field, which can allow farmer to manage more farmland, thus improving their production. It is estimated that the global population will reach 9 billion mark by 2050. IoT application is must for agriculture to feed such large population and effectively use the farmland and other resources as they are scarcely available in some places. Because of Global warming unpredictable weather conditions is affecting the crops and farmers are facing major losses so the IoT Smart Farming application will allow them to take quick measures to prevent that from happening.

1.2.PURPOSE

Smart Agriculture enhances the visibility, control and insight that you have concerning your farm. These factors translate into better time management, improved decision making and the more practical application of resources (i.e. Fertiliser, Irrigation) – producing healthier crops, higher yields and allows you to conserve resources. All of these factors translate to less work, higher revenues and reduced cost.

2.LITERATURE SURVEY

2.1.EXISTING PROBLEM

The biggest challenges faced by IoT in the agricultural sector are lack of information, high adoption costs, and security concerns, etc. Most of the farmers are not aware of the implementation of IoT in agriculture. The challenges of a smart agriculture system include the integration of these sensors and tying the sensor data to the analytics driving automation and response activities.

2.2.REFERENCES

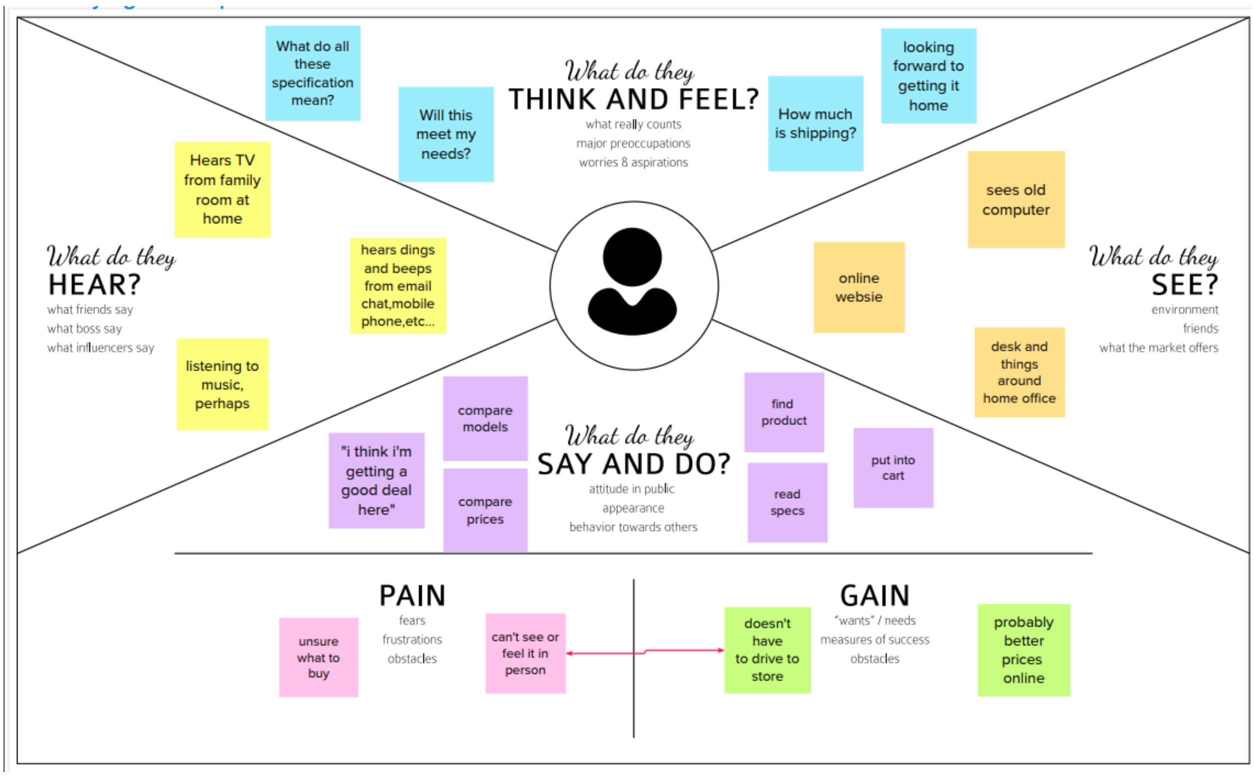
In the literature there are numerous examples of versatile IoT applicationoriented studies. In [4], an example of control networks and information networks integration with IoT technology has been studied based on an actual situation of agricultural production. A remote monitoring system with combining internet and wireless communications is proposed. Furthermore, taking into account the system, an additional information management sub-system is designed. The collected data is provided in a form suitable for agricultural research facilities. In their work Liu Dan et al. [5] take a CC2530 chip as the core and present the design and implementation of an Agriculture Greenhouse Environment monitoring system based on ZigBee connectivity. Additionally, the wireless sensor and control nodes take CC2530F256 as a core to control the environment data. This system comprises front-end data acquisition, data processing, data transmission and data reception. The ambient temperature is real-time processed by the temperature sensor of the terminal node and is send to the intermediate node through a wireless ZigBee based network. Intermediate node aggregates all data, and then sends the data to the PC through a serial port. At the same time, staff may view, and analyze the data, storage of the data on a PC is also provided. The realtime data is used to control the operation of fans and other temperature control equipment and achieve automatic temperature control in the greenhouse

2.3.PROBLEM STATEMENT DEFINITION

Create a problem statement to understand our farmer point of view.
Farmer problem statement template helps you focus on what matter to cultivate better crops.
Farmer problem statement allows you and your team to find solution for the issues or problems facing in agriculture. throughout the process you will able to cultivate good crops. this problem statement give idea for better farming.

3.IDEATION & PROPOSED SOLUTION

3.1.EMPATHY MAP CANVAS



3.2.IDEATION & BRAINSTORMING

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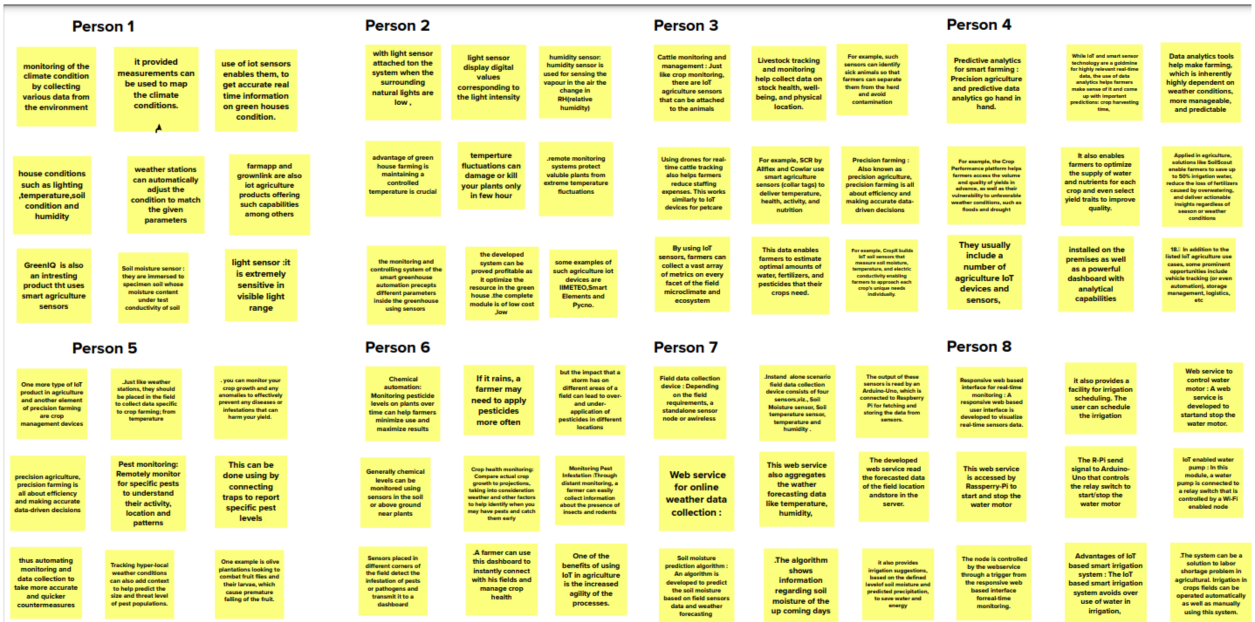
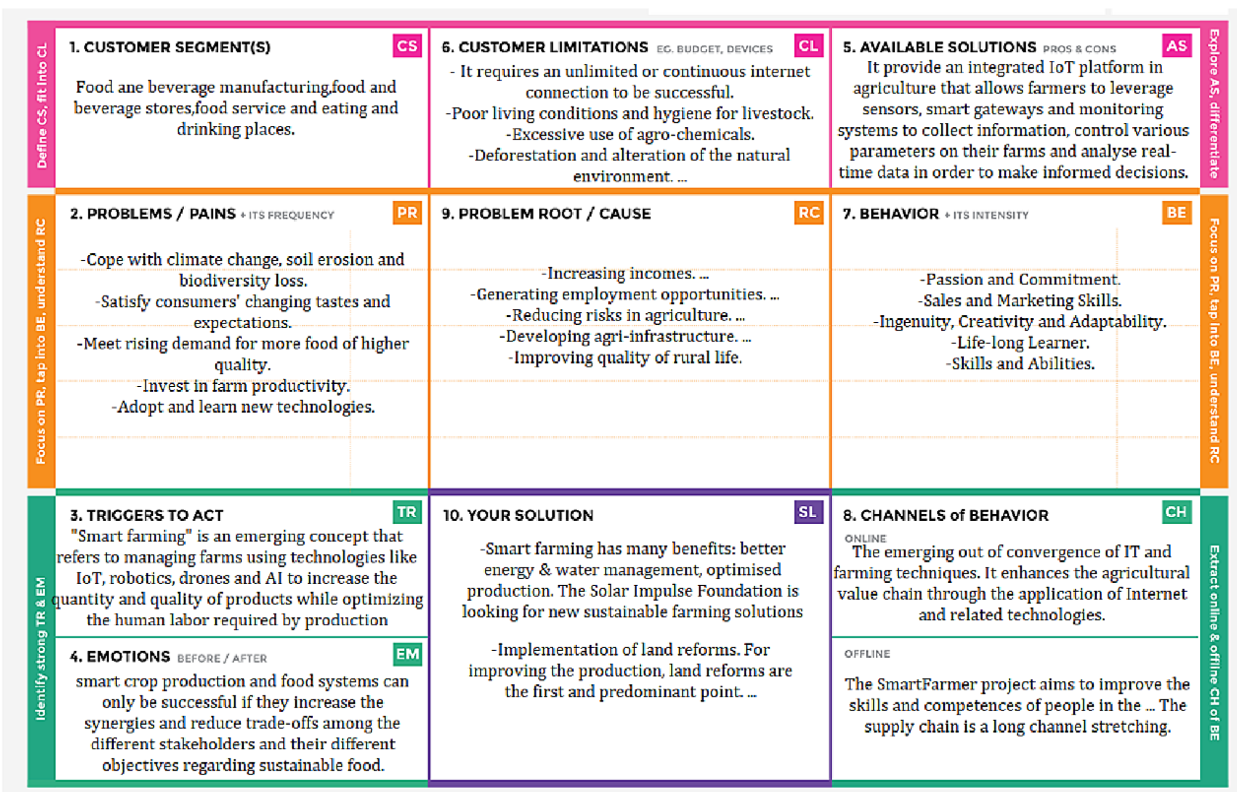


3.3.PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement(Problem to be solved)	To provide efficient decision support systemusing wireless sensor network whichhandle 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 levelincreasing Farmers get lot of distractions which is notgood for Agriculture. Performing agriculture is very much timeconsuming.
2.	Idea / Solution description	Water level is managed by farmers in both Automatic/Manual using that mobile application. It will make more comfortable to farmers
3.	Novelty / Uniqueness	collecting all the data from various sensor like temperature, humidity, lux,moisture and other environmental factorsand will do the analysison the same. During analysis if gets better resultof the combination of the data gathered from the varioussensor then those data to all collecting all the data fromvarious sensor like temperature, humidity, lux, moisture and other environmentalfactors and will do the analysis on the same.
4.	Social Impact/ Customer Satisfaction	People are still workingon different SmartFarming technology using IoT, so the anticipated benefitsof this technology are, Remote monitoring for farmers, water and other natural resourceconservation,good management also allows improved livestock farming, the things which are not visible to necked eye canbe seen resulting is accurate farmland and crop evaluation, good quality as well as improved quantity,the facilityto get the real- time data for usefulinsights.
5.	Business Model(Revenue Model)	The progress in the agriculture domain is linked to the recent technological advances.

		1. Modern agriculture systems integrate state- of-the-art technological solutions. 2. Data heterogeneity is thekey concept for big datain the agriculture domain. 3. Future agriculture systems shouldadopt a moreholistic approach
6.	Scalability of the Solution	this application promotessimplicity over complexity which helps the customersto use this application in effective mannar

3.4..PROBLEM SOLUTION FIT


Define CS, fit into CL

1. CUSTOMER SEGMENT(S) CS

Food ane beverage manufacturing,food and beverage stores,food service and eating and drinking places.

6. CUSTOMER LIMITATIONS EG. BUDGET, DEVICES CL

- It requires an unlimited or continuous internet connection to be successful.
-Poor living conditions and hygiene for livestock.
-Excessive use of agro-chemicals.
-Deforestation and alteration of the natural environment. ...

5. AVAILABLE SOLUTIONS PROS & CONS AS

It provide an integrated IoT platform in agriculture that allows farmers to leverage sensors, smart gateways and monitoring systems to collect information, control various parameters on their farms and analyse real-time data in order to make informed decisions.

Explore AS, differentiate

Focus on PR, tap into BE, understand RC

2. PROBLEMS / PAINS + ITS FREQUENCY PR

-Cope with climate change, soil erosion and biodiversity loss.
-Satisfy consumers' changing tastes and expectations.
-Meet rising demand for more food of higher quality.
-Invest in farm productivity.
-Adopt and learn new technologies.

9. PROBLEM ROOT / CAUSE RC

-Increasing incomes. ...
-Generating employment opportunities. ...
-Reducing risks in agriculture. ...
-Developing agri-infrastructure. ...
-Improving quality of rural life.

7. BEHAVIOR + ITS INTENSITY BE

-Passion and Commitment.
-Sales and Marketing Skills.
-Ingenuity, Creativity and Adaptability.
-Life-long Learner.
-Skills and Abilities.

Focus on PR, tap into BE, understand RC

Identify strong TR & EM

3. TRIGGERS TO ACT TR

"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 optimizing the human labor required by production

4. EMOTIONS BEFORE / AFTER EM

smart crop production and food systems can only be successful if they increase the synergies and reduce trade-offs among the different stakeholders and their different objectives regarding sustainable food.

10. YOUR SOLUTION SL

-Smart farming has many benefits: better energy & water management, optimised production. The Solar Impulse Foundation is looking for new sustainable farming solutions

-Implementation of land reforms. For improving the production, land reforms are the first and predominant point. ...

8. CHANNELS of BEHAVIOR CH

ONLINE

The emerging out of convergence of IT and farming techniques. It enhances the agricultural value chain through the application of Internet and related technologies.

OFFLINE

The SmartFarmer project aims to improve the skills and competences of people in the ... The supply chain is a long channel stretching.

Extract online & offline CH of BE

4.REQUIREMENT ANALYSIS

4.1.FUNCTIONAL REQUIREMENTS

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	-Registration through the app if customer wants to identify the water level -They can make use of this app
FR-2	User Confirmation	-Confirmation code for registration will send through ah email ID.for verification ,OTP will send through email
FR-3	Login	-Login through valid user id. -Login through valid password.
FR-4	Display water level	-In this system,temperature sensor detect the water level through climate changes and indicates required amount of water necessary to the field
FR-5	Review of indicating water level	-By using this app temperature sensor sends out the alert whenever the field requires water and indicates the level of water
FR-6	Logout	-After using this app,for indication of water level and detecting the required amount of water,customer will logout with satisfaction

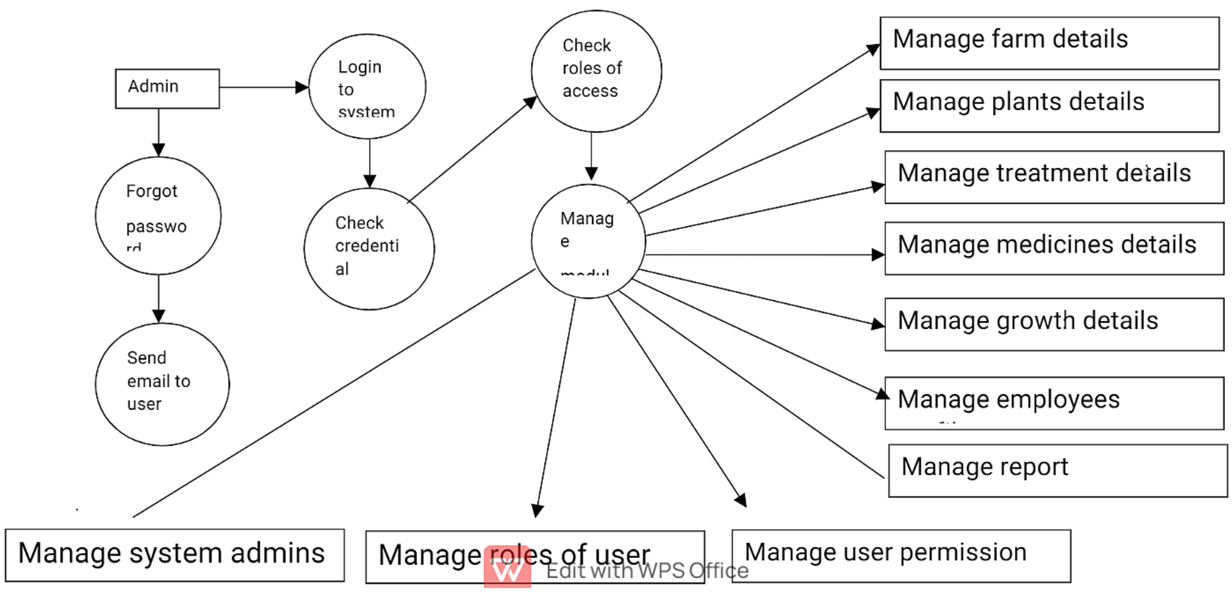
4.2.NON-FUNCTIONAL REQUIREMENT

FR No.	Non-Functional Requirement	Description
FR-1	Usability	-The software should be easily used by the customer
FR-2	Security	-This application is used for alerting the farmer whenever water level increase or decrease in the field
FR-3	Reliability	-The ability of the system to behave constantly in a user acceptable manner.when it is operated within the environment for which the system was intended

FR-4	Performance	-The app should be able to handled by the farmer for alerting the water level in the field
FR-5	Availability	-The system should be available all time.the user can access it using web browser when server becomes down
FR-6	Scalability	-It can be performed at software ,haedware,and database level

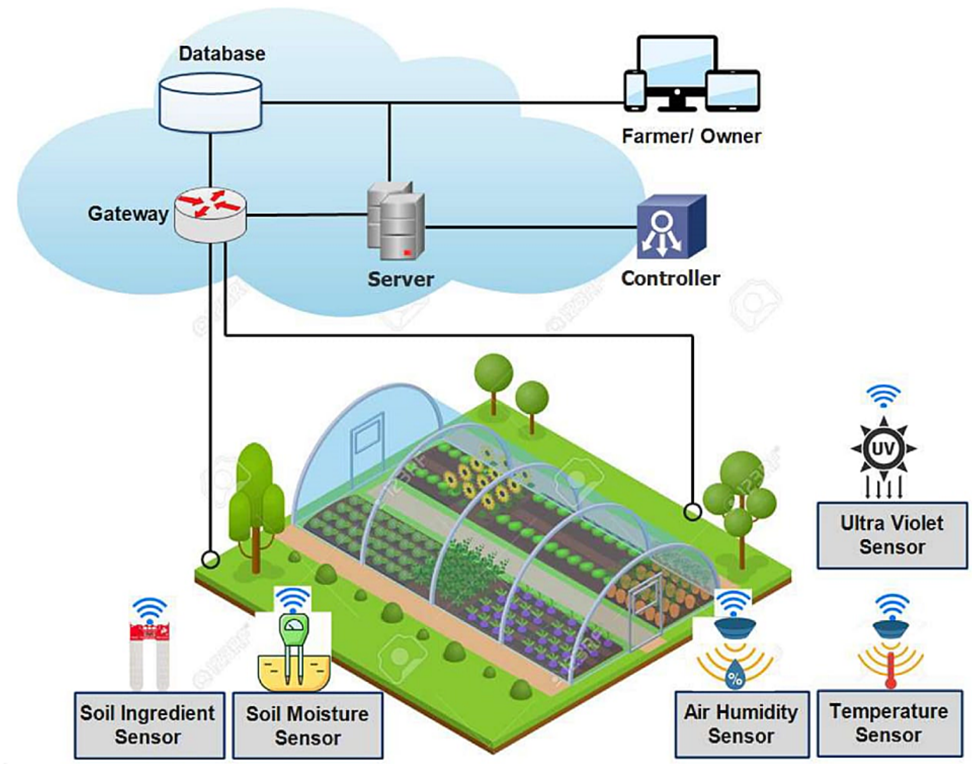
5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS

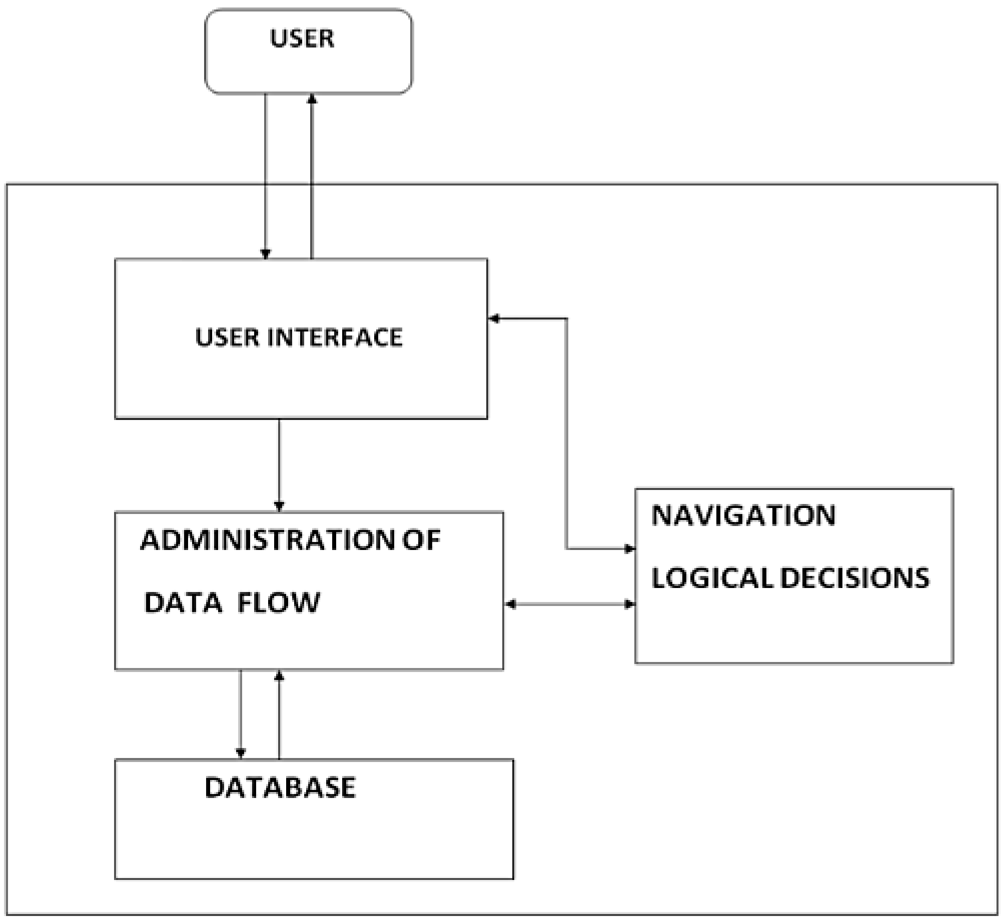


5.2 SOLUTION & TECHNICAL ARCHITECTURE

SOLUTION ARCHITECTURE



TECHNICAL ARCHITECTURE



5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Numbe	User Story / Task	Acceptance criteria	Priority	Release
Custom er (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	As a user once view the manage modules this describes the Manage system Admins and Manage Roles of User and etc.	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Gmail			Sprint-1
	Login	USN-4	As a user, I can log into the application by entering email & password		High	Sprint-1
Custom er (Web user)	Dashboard	USN-5	As a User can view the dashboard, and this dashboard include the check	I can view the dashboard in this smart farming application	High	Sprint-2

			roles of access and then move to the manage modules.	system.		
		USN-6	User can remotely access the motor switch	In the smart farming app	High	Sprint-3
Administ rator			As a user once view the manage modules this describes the Manage system Admins and Manage Roles of User and etc.			Sprint-2

6. PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

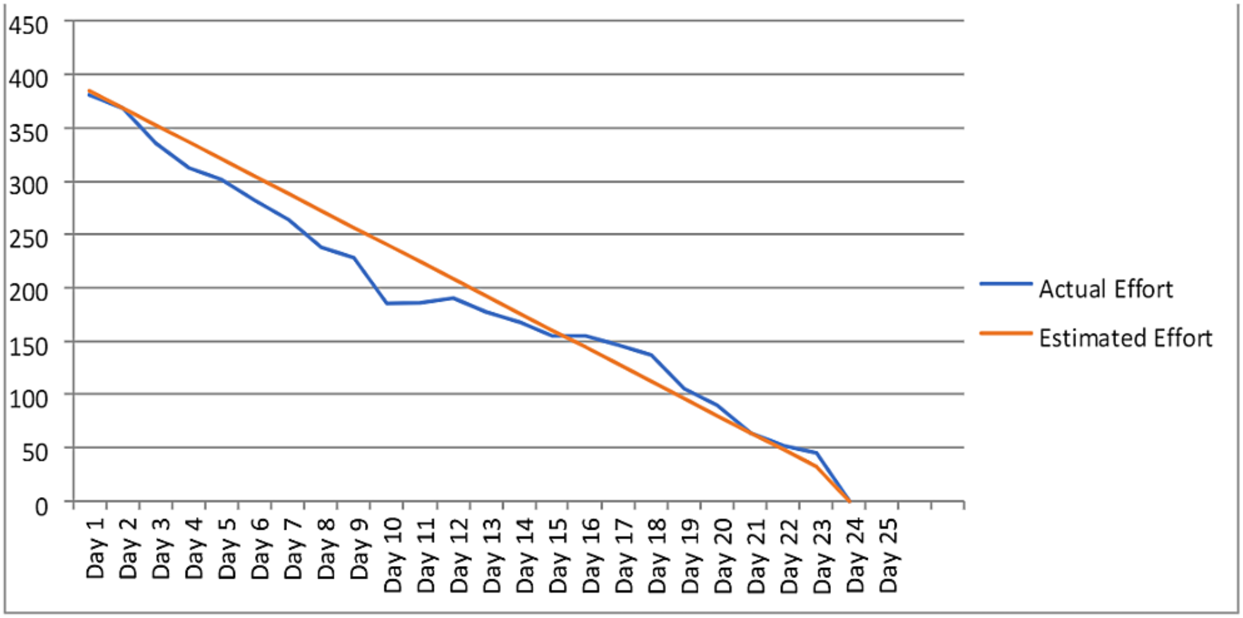
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Simulation creation	USN-1	Connect Sensors and Arduino with python code	2	High	S.Vimal Kumar,S.V enkatesh
Sprint-2	Software	USN-2	Creating device in the IBM Watson IoT platform, workflow for IoT scenarios using Node-Red	2	High	B.R.Srira m,M.R.Yu gendar, S.Venkate sh
Sprint-3	MIT App Inventor	USN-3	Develop an application for the Smart farmer project using MIT App Inventor	2	High	S.Venkate sh,B.R.Srir am
Sprint-3	Dashboard	USN-3	Design the Modules and test the app	2	High	S.Vimal Kumar,

						M.R.Yugendar,
Sprint-4	Web UI	USN-4	To make the user to interact with software.	2	High	M.R.Yugendar, S.Vimal Kumar, B.R.Sriram

6.2 SPRINT DELIVERY SCHEDULE

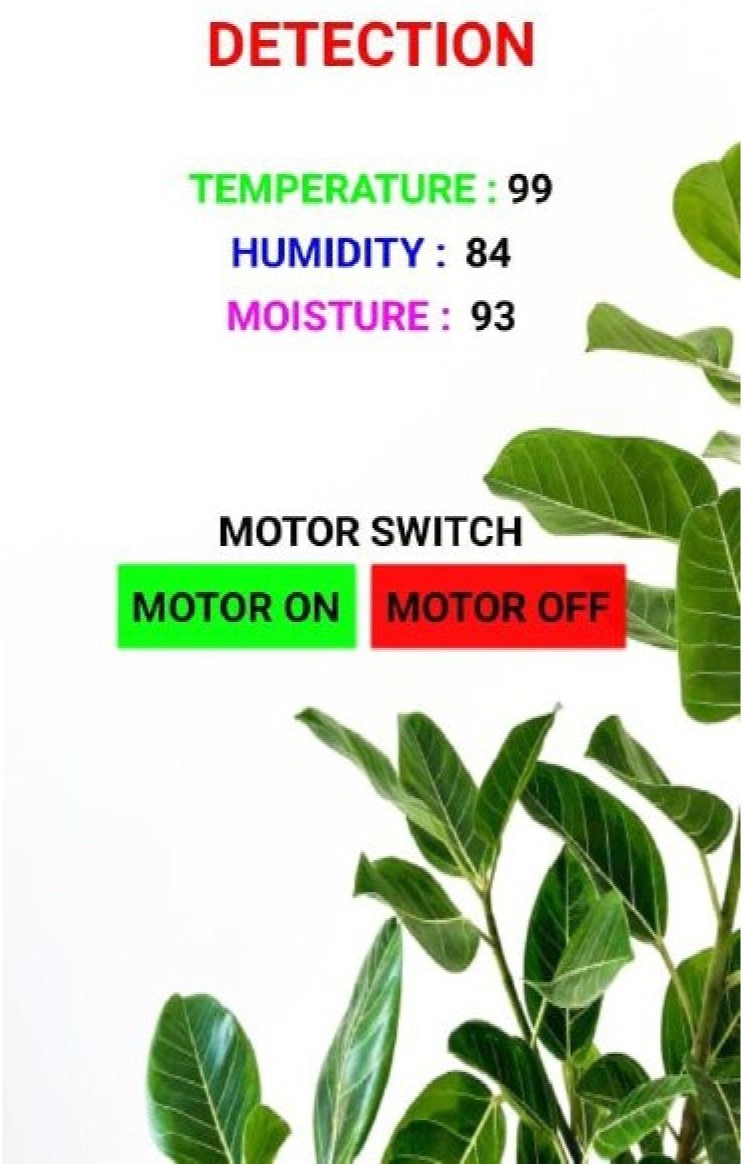
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022		05 Oct 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022		12 Oct 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022		15 Oct 2022

6.3 REPORTS FROM JIRA



7. CODING & SOLUTIONING

7.1 FEATURE 1


DETECTION
TEMPERATURE : 99
HUMIDITY : 84
MOISTURE : 93
MOTOR SWITCH
MOTOR ON
MOTOR OFF

8. TESTING

8.1 TEST CASES

Test Case ID	Feature Type	Component	Test Scenario	Pre-Requisite
Login page OO1	UI	Logo page	Verify user is able to see our logo page.	MIT App Inventor, App Script
Login page OO2	Functional	Login Page	Verify whether the user is able to login with their own username and password.	MIT App Inventor, App Script
Login page OO3	Functional	Login Page	Verify the user is able to login with incorrect login credentials.	MIT App Inventor, App Script
Login page OO4	Functional	Login Page	Verify the user is able to login with correct credentials.	MIT App Inventor, App Script

Steps to Execute	Test Data	Expected Result	Actual Result	Status
1.Click on the smart farmer app 2.Verify functional elements with our logo	http://ai2.appinventor.mit.edu/#4995769971900416	This page is must show the logo of application.	Working as expected	Pass
1.Verify with UI elements ● UserName box ● Password	http://ai2.appinventor.mit.edu/#4995769971900416	Application should show below UI elements: a.UserName text box b.password text box	Working as expected	Pass
1.If user enter the incorrect credential.	Username: smart password: former	Application will show 'plz verify your credential' to user.	Working as expected	Pass
1.Verify the user is able to login with correct credentials.	Username: smart password: farmer	Application should navigate to output page.	Working as expected	Pass

Comments	TC for Automation (Y/N)	BUG ID	Executed By
Result is Verified	NO	-	
Result is Verified	NO	-	
Result is Verified	NO	-	
Result is Verified	NO	-	

8.2 USER ACCEPTANCE TESTING

1.Purpose of Document

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).

2.Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity1	Severity2	Severity3	Severity4	Subtotal
By Design	7	5	4	4	17
Duplicate	2	1	2	0	3
External	1	2	0	2	5
Fixed	10	1	3	18	30
Not Reproduced	0	0	2	0	2

Skipped	1	0	0	0	3
Won't Fix	0	4	1	1	7
Totals	21	13	12	25	67

3.Test Case Analysis

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

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	51	0	0	51
Security	2	0	0	2
Outsource Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

9. RESULTS

9.1 PERFORMANCE METRICS

Date	**17-Nov-22**
Team ID	**PNT2022TMID33042**
Project Name	**Smart Farmer IoT Enabled Smart farming Application**

NFT - Risk Assessment

S.No	Scenario Name	Scope/feature	Functional Changes	Hardware Changes	Software Changes	Impact of Downtime	Load/Volume Changes	Risk Score
1	Detection accuracy - Response	New	New	Low	Moderate	Moderate	No Changes	Orange
2	Soil Moisture ,Temperature and Humidity below threshold limit	New	Moderate	No	NO	Low	No Changes	Green

NFT - Detailed Test Plan

S.No	Project Overview	NFT Test approach	Assumptions/Dependencies/Risks	Approvals/SignOff
1	Detection Accuracy and response	Using python and Node Red	Dependency- Cloud client / Risk- Moderate	
2	Soil Moisture Temperature and Humidity below threshold limit	Using python and Node Red	Dependency- Cloud client / Risk- Low	
3	User Mobile Application	Using MIT App Inventor	Dependency- Cloud client / Risk- Low	

End Of Test Report

S.No	Project Overview	FT Test approach	NFR - Met	Test Outcome	GO/NO-GO decision	Identified Defects (Detected/Closed/Open)	Approvals/SignOff
1	Detection accuracy - Response	Using Python and NodeRed	No	Expectaions partially met	No-Go	Observed intermittent performance issue sometimes . Bug is open	
2	Soil Moisture Temperature and Humidity below threshold limit	Using Python and NodeRed	Yes	Expectations partially met	Go	Oberved response for the leakage detection in the UI and its accuracy is as expected.	

10. ADVANTAGES & DISADVANTAGES

10.1 ADVANTAGES

Increased Production

Optimized crop treatment such as accurate planting, watering, pesticide application and harvesting directly affects production rates

Water Conservation

Weather predictions and soil moisture sensors allow for water use only when and where needed.

Real-Time Data and Production Insight

Farmers can visualize production levels, soil moisture, sunlight intensity and more in real time and remotely to accelerate decision making process.

Lowered Operation Costs

Automating processes in planting, treatment and harvesting can reduce resource consumption, human error and overall cost.

Increased Quality of Production

Analyzing production quality and results in correlation to treatment can teach farmers to adjust processes to increase quality of the product.

Accurate Farm and Field Evaluation

Accurately tracking production rates by field over time allows for detailed predicting of future crop yield and value of a farm.

Improved Livestock Farming

Sensors and machines can be used to detect reproduction and health events earlier in animals. Geofencing location tracking can also improve livestock monitoring and management.

Reduced Environmental Footprint

All conservation efforts such as water usage and increased production per land unit directly affect the environmental footprint positively.

Remote Monitoring

Local and commercial farmers can monitor multiple fields in multiple locations around the globe from an internet connection. Decisions can be made in real-time and from anywhere.

Equipment Monitoring

Farming equipment can be monitored and maintained according to production rates, labor effectiveness and failure prediction.

10.2 DISADVANTAGES

The smart agriculture needs availability of internet continuously. Rural part of most of the developing countries do not fulfil this requirement. Moreover internet connection is slower.

The smart farming based equipments require farmers to understand and learn the use of technology. This is major challange in adopting smart agriculture farming at large scale across the countries.

11. CONCLUSION

From our results , we saw that the hardware and materials we used to develop our porotype allowed us to make an efficient and accurate, as well as cheap product for farmers. Which was economical and easily installable for farmers as well. Thus, we can conclude that this porotype will definitely help farmers in small farmland to effectively monitor their crops with the user-friendly app and other alert means.

12. FUTURE SCOPE

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

•ESP32s node MCU has wireless Wi-Fi capabilities as well as Bluetooth capabilities. Due to limited budget we could not make more prototypes but in large farmlands and with different crops, farmers can install multiple prototypes like this which will be in some local network, connected with Bluetooth to each other and will have 1 main node which will collect data to upload it on the cloud.

• In true IoT sense and with the help of artificial intelligence making this whole network of nodes which will be able to make the decisions on its own and trigger the necessary steps to nullify that situation.

•A network where every component will be able to think individually, will retrieve data from cloud to also improve their decisions every time with the help of data mining algorithms.

•The research is going on in drone technology as well, connecting this system to the drones will provide 3D mapping of the farmlands, which will be able to monitor crop production and live conditions as well.

• We can connect this whole system to Soracon Lagoon dashboard to get further in depth analysis with the of GSM module and IoT SIM card on our personal computers. Thus, the future for smart farming is bright. With the help of proper technology and government subsidies this area can really take our world to the betterment.

13. APPENDIX

SOURCE CODE:

Python Code:

```
import time
import sys
```

```
import ibmiotf.application
import ibmiotf.device
import random


#Provide your IBM Watson Device Credentials
organization = "ofymg2"
deviceType = "Smartfarmer01"
deviceId = "123"
authMethod = "token"
authToken = "12345678"

# 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 ("send proper command")

   #print(cmd)




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

        temp=random.randint(90,100)
        Humid=random.randint(60,100)
        mois=random.randint(90,100)

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

        success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
        if not success:
            print("Not connected to IoTF")
        time.sleep(7)

        deviceCli.commandCallback = myCommandCallback

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

Wokwi-Code :

```
#include <WiFi.h>//library for wifi
#include <PubSubClient.h>//library for MQtt
#include "DHT.h"// Library for dht11
#define DHTPIN 15     // what pin we're connected to
#define DHTTYPE DHT22   // define type of sensor DHT 11
#define LED 2
```

```
DHT dht (DHTPIN, DHTTYPE);// creating the instance by passing pin and typr of dht connected

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength);

//-------credentials of IBM Accounts------

#define ORG "ofymg2"//IBM ORGANITION ID
#define DEVICE_TYPE "Smartfarmer01"//Device type mentioned in ibm watson IOT Platform
#define DEVICE_ID "123"//Device ID mentioned in ibm watson IOT Platform
#define TOKEN "12345678"     //Token
String data3;
float h, t;


//-------- Customise the above values --------
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";// Server Name
char publishTopic[] = "iot-2/evt/Data/fmt/json";// topic name and type of event perform and
format in which data to be send
char subscribetopic[] = "iot-2/cmd/command/fmt/String";// cmd  REPRESENT command type
AND COMMAND IS TEST OF FORMAT STRING
char authMethod[] = "use-token-auth";// authentication method
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;//client id


//-----------------------------------------
WiFiClient wifiClient; // creating the instance for wificlient
PubSubClient client(server, 1883, callback ,wifiClient); //calling the predefined client id by
passing parameter like server id,portand wificredential


void setup()// configureing the ESP32
{
  Serial.begin(115200);
  dht.begin();
  pinMode(LED,OUTPUT);
  delay(10);
  Serial.println();
  wificonnect();
  mqttconnect();
}
```

```
void loop()// Recursive Function
{

  h = dht.readHumidity();
  t = dht.readTemperature();
  Serial.print("temperature:");
  Serial.println(t);
  Serial.print("humidity:");
  Serial.println(h);

  PublishData(t, h);
  delay(2000);
  if (!client.loop()) {
    mqttconnect();
  }
}



/*.....................................retrieving to Cloud...............................*/

void PublishData(float temperature, float humidity) {
  mqttconnect();//function call for connecting to ibm
  /*
     creating the String in in form JSon to update the data to ibm cloud
  */
  String payload = "{\"temperature\":";
  payload += temperature;
  payload += "," "\"humidity\":";
  payload += humidity;
  payload += "}";


  Serial.print("Sending payload: ");
  Serial.println(payload);


  if (client.publish(publishTopic, (char*) payload.c_str())) {
    Serial.println("Publish ok");// if it sucessfully upload data on the cloud then it will print publish
ok in Serial monitor or else it will print publish failed
```

```
  } else {
    Serial.println("Publish failed");
  }

}


void mqttconnect() {
  if (!client.connected()) {
    Serial.print("Reconnecting client to ");
    Serial.println(server);
    while (!!!client.connect(clientId, authMethod, token)) {
      Serial.print(".");
      delay(500);
    }

     initManagedDevice();
     Serial.println();
  }
}
void wificonnect() //function defination for wificonnect
{
  Serial.println();
  Serial.print("Connecting to ");

  WiFi.begin("Wokwi-GUEST", "", 6);//passing the wifi credentials to establish the connection
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
}

void initManagedDevice() {
  if (client.subscribe(subscribetopic)) {
    Serial.println((subscribetopic));
    Serial.println("subscribe to cmd OK");
  } else {
```

```
    Serial.println("subscribe to cmd FAILED");
  }
}

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength)
{

  Serial.print("callback invoked for topic: ");
  Serial.println(subscribetopic);
  for (int i = 0; i < payloadLength; i++) {
    //Serial.print((char)payload[i]);
    data3 += (char)payload[i];
  }
  Serial.println("data: "+ data3);
  if(data3=="lighton")
  {
Serial.println(data3);
digitalWrite(LED,HIGH);
delay(2000);
  }
  else
  {
Serial.println(data3);
digitalWrite(LED,LOW);
  }
data3="";
}
```

GITHUB LINK & PROJECT DEMO LINK :

GITHUB LINK:

https://github.com/IBM-EPBL/IBM-Project-40980-1660638234

PROJECT DEMO LINK:

https://youtu.be/kmseNFwBlRY