TEAM ID: PNT2022TMID12810

SMART FARMER
IOT ENABLED - SMART FARMING APPLICATION

SUBMITTED BY:

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CHAPTER 1

INTRODUCTION

The objectives of this report is to proposed IoT based Smart Farming System which will enable farmers to have live data of soil moisture environment temperature at very low cost so that live monitoring can be done. Monitoring systems are used in the field to collect information on farming conditions (e.g., light intensity, humidity, and temperature) with the aim of enhancing crop productivity. Internet of things (IoT) technology is a recent trend in numerous fields, including monitoring systems for agriculture. In conventional farming, farmers need manual labour to handle crops and livestock, often leading to inefficient resource use. This downside can be addressed through the concept of smart farming, whereby farmers receive training in the use of IoT, access to the global positioning system (GPS), and data management capabilities to increase the quantity and quality of their products.

1.1 PROJECT OVERVIEW

IoT based SMART FARMING SYSTEM is regarded as IoT gadget focusing on Live Monitoring of Environmental data in terms of Temperature, Moisture and other types depending on the sensors integrated with it. The system provides the concept of “Plug & Sense” in which farmers can directly implement smart farming by as such putting the System on the field and getting Live Data feeds on various devices like Smart Phones, Tablets etc. and the datagenerated via sensors can be easily shared and viewed by agriculture consultants anywhere remotely via Cloud Computing technology integration. The system also enables analysis of various sorts of data via Big Data Analytics from time to time.

1.2 Purpose

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

CHAPTER 2

LITERATURE SURVEY

2.1 ABSTRACT

One of the important applications of Internet of Things is Smart agriculture. Smart agriculture reduces wastage of water, fertilizers and increases the crop yield. In the current agriculture system the specification such as temperature, moisture, humidity are detected manually which increases the labour cost, time and also monitoring cannot be done continuously. In this paper irrigation process is done automatically using different sensors which reduces the manual labour. Here a system is proposed to monitor crop-field using sensors for soil moisture, humidity and temperature. By monitoring all these parameters the irrigation can be automated.

2.2 ABSTRACT

Internet of Things (IoT), Agriculture, Agriculture Precision, ESP32, Temperature and Humidity Sensor, Smart Farming.

2.3INTRODUCTION

Most important factors for the quality and productivity of plant growth are temperature, humidity and light. Continuous monitoring of these environmental variables provides valuable information to the grower to betterunderstand, how each factor affects growth and how to maximize crop productiveness. The optimal greenhouse micro climate adjustment can enable us to improve productivity and to achieve remarkable energy savings especially during the winter in northern countries. WSN composed of hundreds of nodes which have ability of sensing, actuation and communicating, has great advantages in terms of high accuracy, fault tolerance, flexibility, cost, autonomy and robustness compared to wired ones. Moreover, with the onset of IoT and M2M communications, it is poised to

become a very significant enabling technology in many sectors, like military, environment, health, home and other commercial areas. IoT is a general term, covering a number of technologies that allows devices to communicate with each other, with or without human intervention. This paper presents a novel approach to implement wireless greenhouse automation and monitoringsystem which in a timely manner provides a possibility for screen monitoring of detailed data about the conditions of the greenhouse. Furthermore, the suggested setup can be incorporated with other internet and messaging services (i.e. Web, WAP, SMS) to provide communication for farmers. The wireless sensor network (WSN) is one of the most significant technologies inthe 21st century and they are very suitable for distributed data collecting and monitoring in tough environments such as greenhouses. The other most significant technologies in the 21st century is the Internet of Things (IoT)which has rapidly developed covering hundreds of applications in the civil, health, military and agriculture areas. In modern greenhouses, several measurement points are required to trace down the local climate parameters in different parts of a large-scale greenhouse in order to ensure properoperation of the greenhouse automation system. Cabling would make the measurement system expensive, vulnerable and also difficult to relocate once installed. This paper presents a WSN prototype consisting of MicaZ nodes which are used to measure greenhouses' temperature, light, pressure and humidity. Measurement data have been shared with the help of IoT. With thissystem farmers can control their greenhouse from their mobile phones or computers which have internet connection.

2.4IOT TECHNOLOGY AND AGRICULTURE

2.4.1 ESP32:

A feature-rich MCU with integrated Wi-Fi and Bluetooth connectivity for a wide-range of applications. ESP32 is capable of functioning reliably in industrial environments, with an operating temperature ranging from –40°C to +125°C. Powered by advanced calibration circuitries, ESP32 can dynamically remove external circuit imperfections and adapt to changes in external conditions. Engineered for mobile devices, wearable electronics and IoT applications, ESP32 achieves ultra-low power consumption with a combination of several types of proprietary software. ESP32 also includes state-of-the-art features, such as fine-grained clock gating, various power modes and dynamic power scaling. ESP32 is highly-integrated with in-built antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power management modules. ESP32 adds priceless functionality and versatility to your applications with minimal Printed Circuit Board (PCB) requirements. This DHT11 Temperature & Humidity Sensorfeatures a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability.

2.5 LITERATURE SURVEY

[1] Smart farm and monitoring system for measuring the Environmental condition using wireless sensor network – IOT Technology in farming

Authors: Tharindu Madushan Bandara, Wanninayaka Mudiyanselage, Mansoor RAZA

Published year: IEEE 2020

Description:

This study uses IoT technology to develop a smart farm. As a result, farming activities like managing crops and other resources become more affordable. They employed a wireless sensor network, allowing all sensor nodes to communicate with one another over long distances. The use of wireless sensor networks aids in data collection and decision-making through analysis of the data. It makes use of a variety of sensors, including moisture, temperature, and water volume sensors. The suggested system offers farmers a more reliable and adaptable smart concept, and it has a straightforward architecture that includes IoT sensors to gather data from the field and transfer it via wireless sensor network to a central server for decision-making and task allocation to appropriate devices.

[2] Smart Irrigation System for Precision Agriculture – The AREThOU5A IOT Platform

Authors: Achilles D. Boursianis, Maria S. Papadopoulou, Antonis Gotsis, Shaohua Wan, Panagiotis Sarigiannidis, Spyridon Nikolaidis, Sotirios K. Goudos

Published year: IEEE 2021

Description:

This paper provides a comprehensive explanation of the design and subsystems of an intelligent irrigation system (AREThOU5A IoT Platform). Modern precision agriculture is suggested as an alternative to conventional farming methods like irrigation with the use of cutting-edge technologies like IoT. In the described IoT platform, radiofrequency energy harvesting is used to power the IoT nodes, and an rectenna module has been fabricated and validated for this purpose. They presented experimental findings using fabricated rectenna with a satisfactory results.

[3] Security and Privacy in Smart Farming: Challenges and Opportunities

Authors: Maanak Gupta, Mahmoud Abdelsalam, Sajad Khorsandroo, Sudip Mittal

Published year: IEEE 2021

Description:

IoT and smart computing technologies are employed in many different applications, from monitoring the state of crops and soil moisture to using drones to help with activities like pesticide application. However, the usage of IoT and smart communication technologies exposes smart farming ecosystems to a wide range of cybersecurity risks and vulnerabilities. Such cyberattacks have the potential to destabilise the economies of nations with significant agricultural dependence. In this paper, they provided a comprehensive analysis of security and privacy in the ecosystem of smart farming. The study examines the security and privacy concerns in this dynamic and distributed cyber physical environment, as well as a multi-layered architecture that is pertinent to the precision agricultural area.

[4] IoT Enabled Smart Farming and Irrigation System:

Authors: M. Rohith, R Sainivedhana, N. Sabiyath Fatima

Published year: IEEE 2021

Description:

In order to automate the process of watering plants, the authors presented an IoT enabled smart irrigation and farming system . This technology makes it easier to measure the values of different parameters, including humidity, moisture, and temperature, and then water plants appropriately. Three sensors make up this system, which measures the humidity, moisture, and temperature of plants. The motor automatically turns on the water for plants if any of the sensor values fail. The paper's main contribution is that by using IoT-enabled devices to automate the watering process and reduce the amount of manual labour required, healthy plants may be cultivated.

[5] IoT Based Smart Plant Irrigation System with Enhanced learning

Authors: Kemal Cagri Serdaroglu, Cem Onel, Sebnem Baydere

Published year: IEEE 2020

Description:

An autonomous and flexible smart irrigation Internet of Things system is presented in this study. Decisions are typically based on static models that are built from plant properties. The most critical feature is that irrigation decisions can be adjusted based on varying environmental factors. The suggested solution includes Gradient Boosting Regression Trees (GBRT) as the final step after the irrigation model has been validated using four different supervised machine learning algorithms. To evaluate the total system performance, they have put up an environment with the sensor edge, mobile client, and decision service in the cloud. The preliminary findings from our prototype system, which was tested with Sardinia and Peace-lily indoor plants. The findings show that the suggested approach can successfully pick up on the various plants' irrigation preferences.

[6] IoT Based Intelligent Agriculture Field Monitoring System

Authors: Md Ashifuddin Mondal, Zeenat Rehena

Published year: IEEE 2018

Description:

The goal of this research project is to suggest a smart farming technique based on the Internet of Things (IoT) to handle the challenging circumstances in agriculture. The use of smart farming is attainable because it provides automated farming practises, high precision crop control, and information gathering. This paper describes an intelligent soil temperature and humidity monitoring system for agricultural fields. Without human interaction, the system acts in accordance with these values after analysing the sensed input. In this location, the soil's temperature and moisture are recorded, and the sensed values are recorded in the Thingspeak cloud for further data processing.

[7] A Revisit of Internet of Things Technologies for Monitoring and Control Strategies in Smart Agriculture

Authors: Amjad Rehman, Tanzila Saba, Muhammad Kashif, Suliman Mohamed Fati, Saeed Ali Bahaj, Huma Chaudhry

Published year: MDPI 2021

Description:

By automating human intervention, IoT can increase the effectiveness of agriculture and farming processes. Nearly every aspect of life has transformed as a result of the rapid development of Internet of Things (IoT)-based tools, including business, agriculture, surveillance, etc. In the face of diverse challenges, these radical breakthroughs are upending conventional farming techniques and offering new possibilities. This study aims to thoroughly assess smart agriculture utilising IoT methods. In smart agriculture, the study presents IoT applications, advantages, existing challenges, and future solutions. The goal of this intelligent agricultural system is to identify existing methods that can be used to increase crop yield and cut down on time, such as crop, pesticide, irrigation, and water management.

2.6 SYSTEM MODULE

ESP32 module: It is used to interface with temperature & humidity sensor. Sends wireless data to the user. Application server module: Receivesdata from ESP32 and records it into the database. Displays real time graph of the received data Android Module: Displays real time data (temperature, humidity) on the interface to the user remotely.

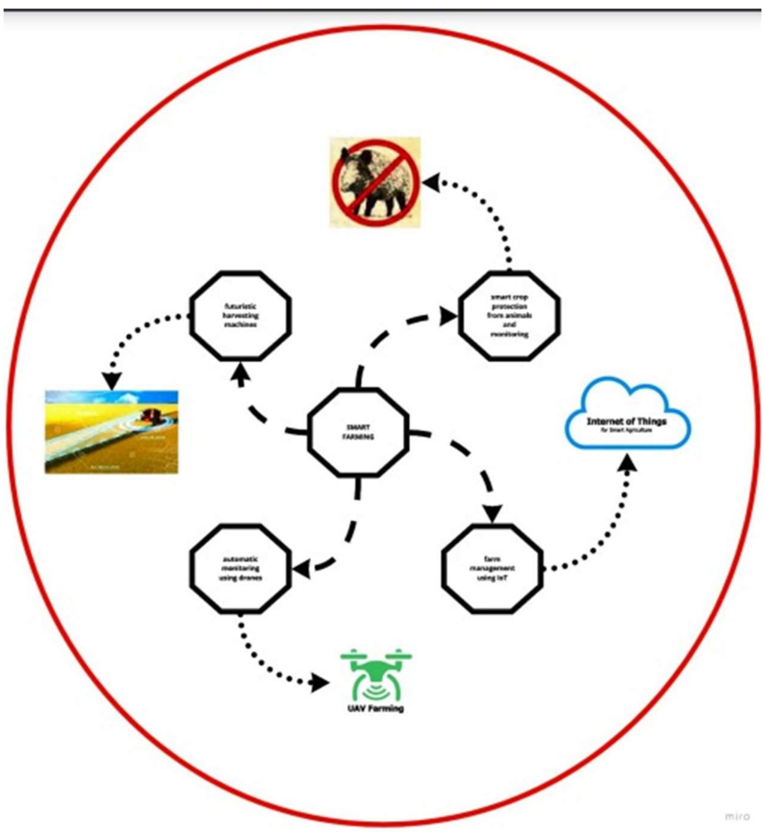
2.7 IMPLEMENTATION

This project can be implemented in a real greenhouse for growing good agricultural produce like ornamental flowers (Gerbera, Carnation, Anthurium etc.), which can be of export quality. The system will take care of automatic irrigation control and various parameters of the greenhouse can be monitored likeTemperature, Humidity. The Android Application will form the user interface and to record the parameter details we use an application servermodule. This recorded data can be used for analysis and help in taking decisions.Application Server.

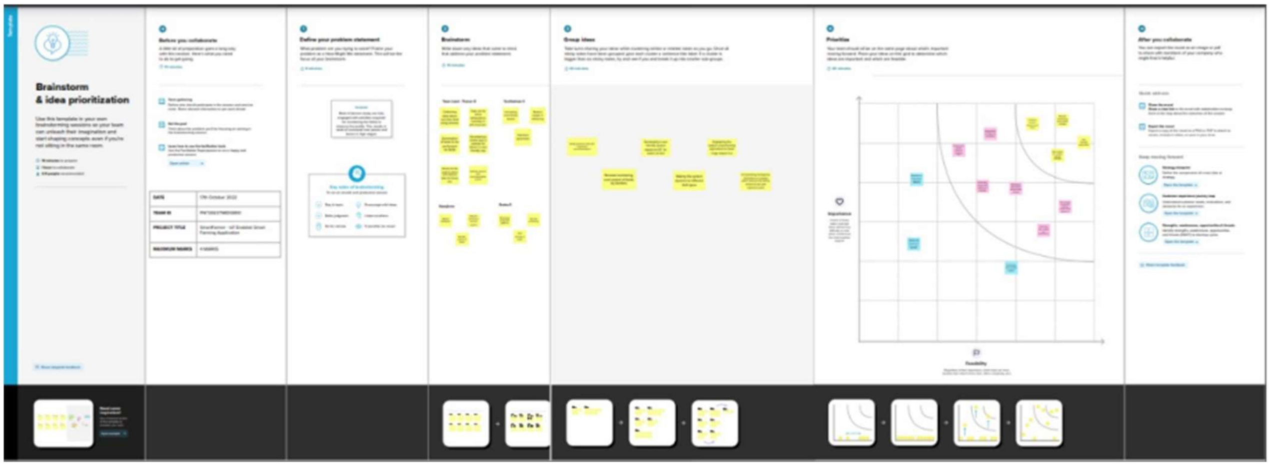
CHAPTER 3

IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming



3.3 Proposed Solution

Proposed Solution Template:

Project team shall fill the following information in proposed solution template.

S.No	Parameter	Description
1	Problem Statement (Problem to be solved)	In order to irrigate the field, farmers must wait in the field until the water covers the entire field. Another problem is the power supply. It may vary from village to village. Lack of information, high adoption, cost and security concerns are some of the biggest challenges associated with loT in agriculture.
2	Idea / Solution description	Farmers can better monitor their fields and maintain the humidity levels with the use of Smart Farming Techniques just as they do with precision agriculture. In Farms, the data collected by sensors can be used to determine the weather pattern based on humidity, temperature, moisture, and dew

		detections.
3	Novelty / Uniqueness	**NOTIFICATION** - Sensors in the Internet of Things collect data from the farming environment, including moisture in the soil, humidity in the air, temperature, soil nutrient content, pest images, and water quality. **REMOTE ACCESS** - It helps the farmer to operate the motor from anywhere.
4	Social Impact / Customer Satisfaction	Reduces the wages that is provided for labours working in the agricultural field. It saves a lot of time using remote access, Easily identify maintenance needs, build better products, send personalized communications, and a lot more. IoT can also help e-commerce businesses thrive and increase sales.
5	Business Model (Revenue Model)	Model representing the number of users per month can be used to enhance from business perspective.
6	Scalability of the Solution	· In smart farming, scalability refers to the ability of a system to adapt to changing conditions, such as an increase in the number of technologies, such as sensors and actuators.

3.4 Problem Solution fit

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

Farmers who raise crops are the targeted customers for this product. Our intention is to assist them by remotely monitoring field conditions. This product prevents the demise of agriculture.

6. CUSTOMER CONSTRAINTS CC

Using numerous sensors is challenging. For success, you must have limitless or constant internet access.

5. AVAILABLE SOLUTIONS AS

Using IoT technology, the irrigation process is automated. To automate the watering operation, field parameters and meteorological data were gathered and processed. Efficiency is limited over small distances, and data storage is challenging.

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

2. JOBS-TO-BE-DONE / PROBLEMS J&P

The purpose of this product is to use IoT sensors to collect environmental parameters, so that farmers can improve every aspect of their work from livestock to crop farming. The data collected from the sensor will be processed and updated in IoT Cloud. MQTT protocol is used to send shared data with the farmers via Mobile apps so that farmers can make decisions.

9. PROBLEM ROOT CAUSE RC

Farmers found it challenging to pursue agriculture because of the frequently changing and unpredictable weather and climate. Considering these elements is crucial when determining whether to water your plants. When a farmer is not there, it is difficult to supervise the fields, which results in crop damage.

7. BEHAVIOUR BE

To counteract the consequences of extra water from heavy rain, use a suitable drainage system. The use of pest-resistant hybrid plants.

Focus on J&P, tap into BE, understand RC

3. TRIGGERS TR

It is difficult for farmers to predict sufficient irrigation. Reduced yields and lower profits are consequences of inadequate water supplies for farmers. Weather forecasting is difficult to predict for farmers.

4. EMOTIONS: BEFORE / AFTER EM

BEFORE: Poor predicting skills, haphazard decisions, and low yield.

AFTER: Reliable data, a wise choice, and a great yield.

10. YOUR SOLUTION SL

Our product gathers information from several sensor kinds and transmits the values to our main server. The Weather API is also used to gather weather information. The farmer uses a smartphone application to make the final decision regarding irrigation of the crop.

8. CHANNELS of BEHAVIOUR CH

8.1 ONLINE

Giving the farmer access to information about the pH and moisture content of the soil by way of the internet. The user will receive online help for utilising the product.

8.2 OFFLINE

Education camps will be held to spread awareness of the value and benefits of automation and IoT in the advancement of agriculture.

CHAPTER – 4

REQUIREMENT ANALYSIS

4.1 Functional requirement

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Phone number Registration through Gmail
FR-2	User Confirmation	Confirmation via Phone numberConfirmation via OTP
FR-3	Observation	Sensors record observational data fromthe, soil, temperature, humidity and atmosphere.
FR-4	Diagnosis	The sensor values are fed to a cloud-hosted IoT platform that ascertain the condition of the examined object and identify the needs.
FR-5	Action	Shows the real time data and when the soil moisture content is reduced the water pump irrigate the field until the required moisture is achieved.
FR-6	Monitor	User can monitor the data online from anywhere.

4.2 Non-Functional requirements

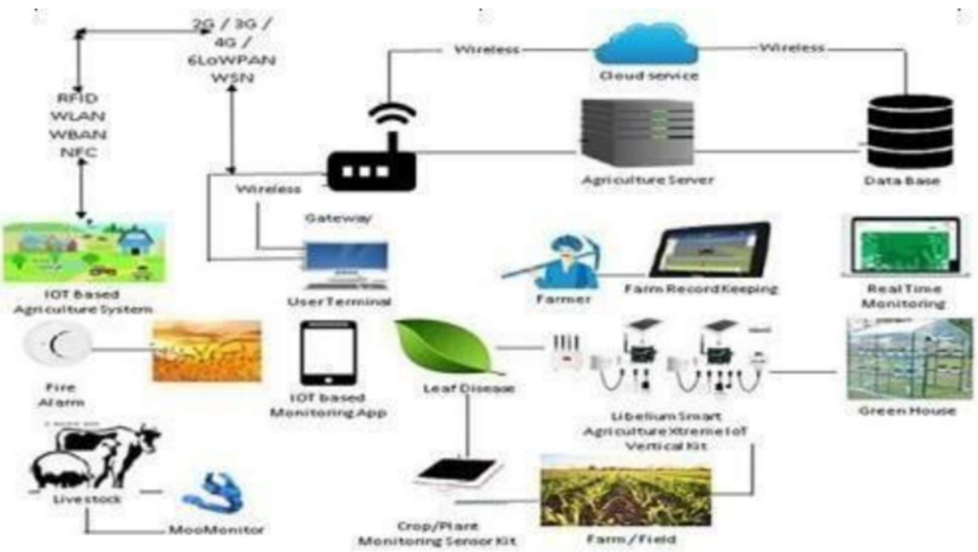
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Usability includes easy understandingand efficiency in use. With real-time monitoring and analytics systems,data collected by smart sensors allowsfarmers to better control processes.
NFR-2	Security	Device and data security includes authentication of devices and confidentiality.
NFR-3	Reliability	Smart farming platforms requirereliable and robust technologies suchas the physical safety of IOT devicesfor precision agricultural systemsshould be ensured in different environmental conditions to avoid communication failures.
NFR-4	Performance	High performance which includes the recurrent tasks on the field can be replaced by automatized modes of monitoring.
NFR-5	Availability	Automatic adjustment of farming equipment made possible by linking information like weather
NFR-6	Scalability	Automatic real time decision-making system is feasible in an environment composed of sensors continuously transmitting the real time data efficiently

CHAPTER – 5

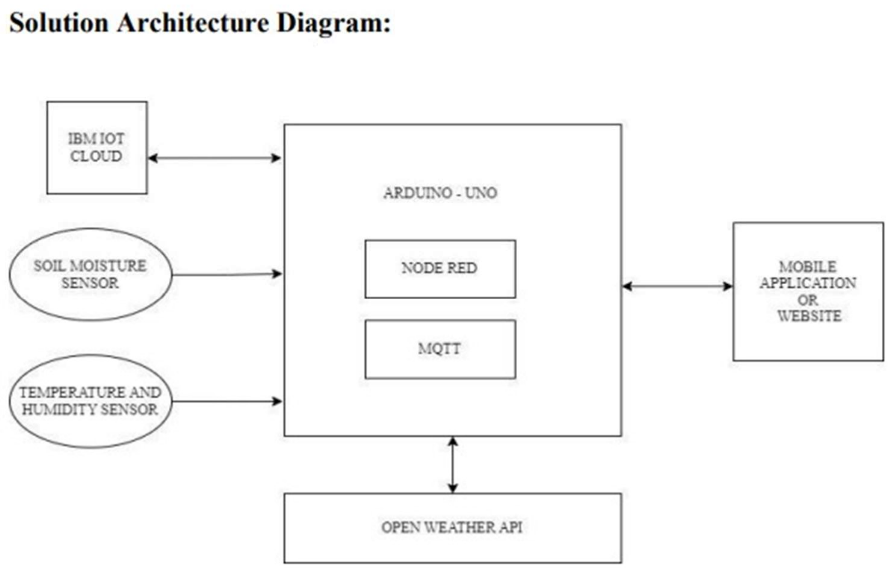
PROJECT DESIGN

5.1 Data Flow Diagrams

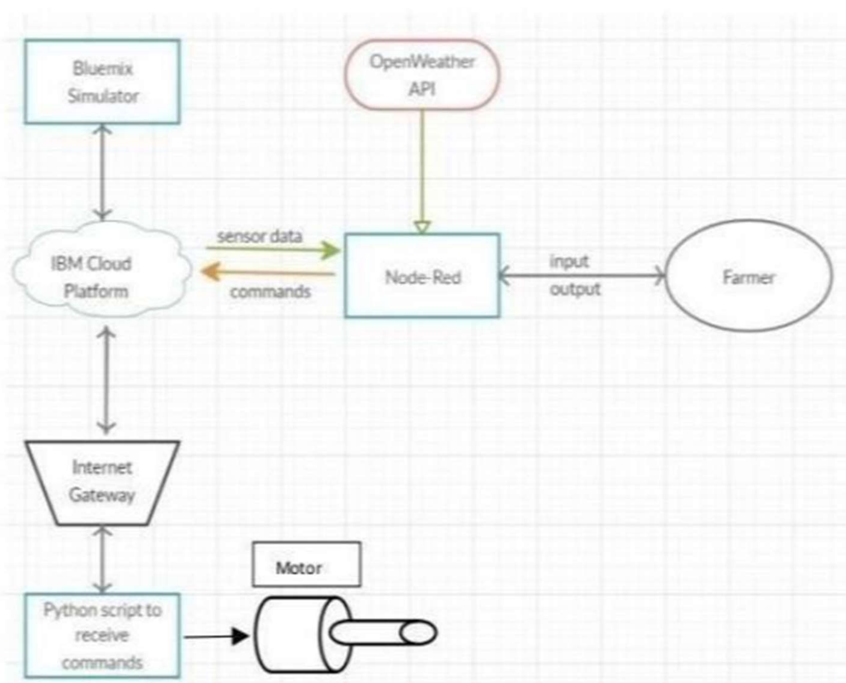


5.2 Solution & Technical Architecture

5.2.1 Solution Architecture



5.2.2 Technical Architecture



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 & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail	I can register & access the dashboard with Gmail Login	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password	I can access dashboard with email login	High	Sprint-1
	Dashboard	USN-6	As a user I can enter into dashboard by using navigation panel	I can access the dashboard by using navigation panel	High	Sprint-1
Customer (Web user)	Registration	USN-1	As a user, I can register for the web 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 web application	I can receive confirmation email & click confirm	High	Sprint-1
	Login	USN-3	As a user, I can log into the web application by entering email & password	I can access dashboard with email login	High	Sprint-1
	Dashboard	USN-4	As a user I can enter into web dashboard by using navigation panel	I can access into dashboard by using navigation panel	High	Sprint-1
Customer Care Executive	Registration	USN-1	As a user I can contact the customer care service through phone or mail medium	I can receive confirmation SMS or email	High	Sprint-1
		USN-2	As a user I want customer care to answer the questions related to product and services	I can get the problem solved within a day	High	Sprint-1
		USN-3	As a user I want customer care to register my complaints	I can receive a confirmation message stating my complaint is registered	High	Sprint-1
		USN-4	As a user I want customer care to collect and analyse consumer feedback	I can get the status of my feedback	High	Sprint-1
		USN-5	As a user I want customer care to troubleshoot technical problems	I can get the problem solved within a day	High	Sprint-1
Administrator		USN-1	As a user I want the administrator to use good working hardware	I can get a guarantee and warranty card	High	Sprint-1
		USN-2	As a user I want the administrator to sell the product in a reasonable rate	I can get the cost of bill of materials	High	Sprint-1
		USN-3	As a user I want the administrator to refund my amount if I am not satisfied with the product	I can get an assurance stating I will get my amount back	High	Sprint-1

CHAPTER-6

SPRINT DELIVERY PLAN

Product Backlog, Sprint Schedule, and Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High
Sprint-1		USN-3	As a user, I can register for the application through Facebook	2	Low
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High
Sprint-1	Dashboard	USN-6	As a user, I can log into the application by entering email & password and access all the resources and services available	2	High
Sprint-2	Login	USN-1	As a weather data controller, I log into my profile and start monitoring the weather	3	High

			updates		
Sprint-2	Dashboard	USN-2	I receive all the information about weather from web from weather API. Whenever thereis change in weather, corresponding updatesare made on sign boards.	2	Medium
Sprint-3	Login	USN-1	As a image controller, I keep note of all the images received from various areas and detect traffic in that particular area.	3	High
Sprint-3	Dashboard	USN-2	With the traffic, updates I change the status of sign board as “take diversion”.	2	Medium
Sprint-4	Login	USN-1	As a zonal officer, I ensure that boards near school display “slow down” and near hospitals display “no horn”.	3	High
Sprint-4	Login	USN-1	As an administrator, I ensure that all departments work co-ordinated and ensurethe accuracy and efficiency.	2	Medium

Project Tracker, Velocity & Burndown Chart:

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	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

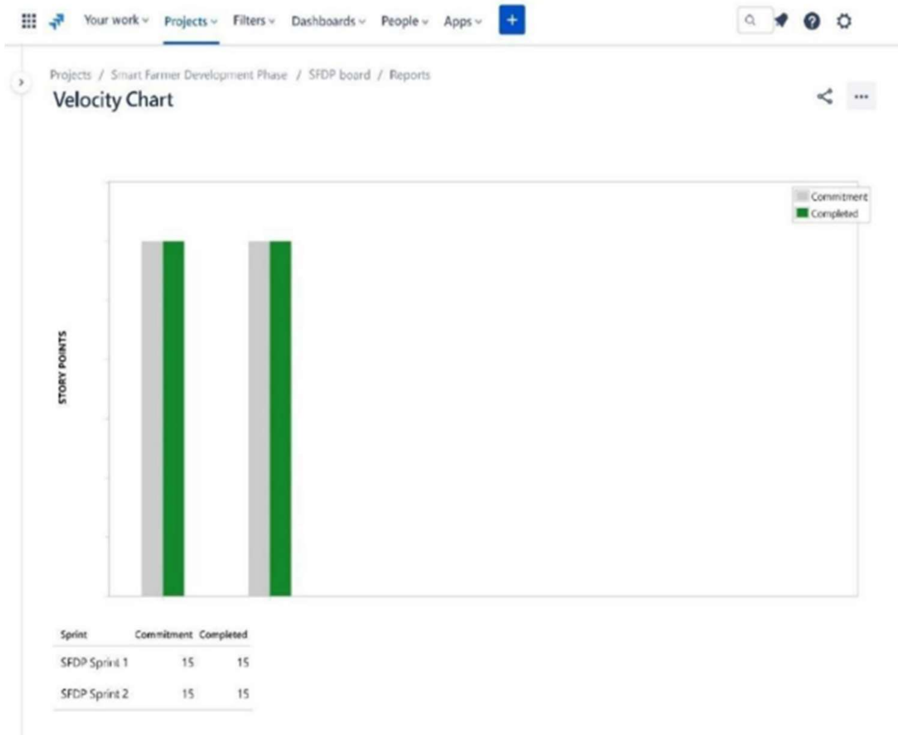
Velocity:

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

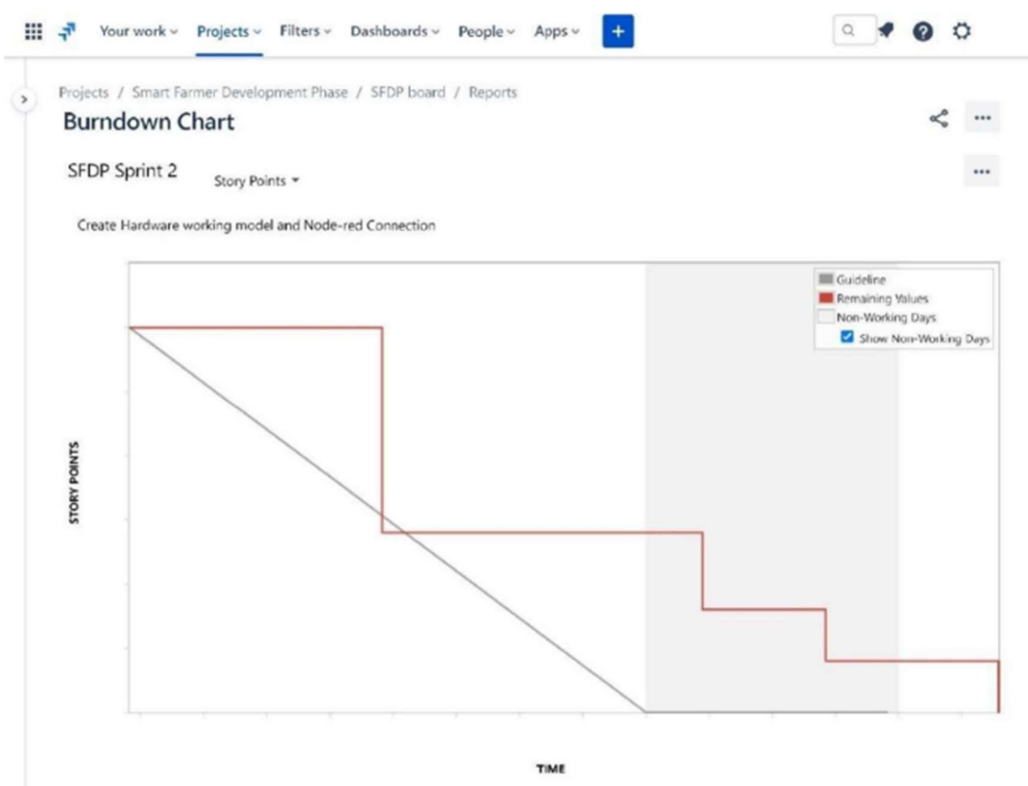
$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

JIRA REPORT

VELOCITY:



BURDOWN CHART:



CHAPTER-7

CODING & SOLUTIONING

CODING & SOLUTIONING

```
// SMART FARMING - IOT ENABLED APPLICATION
// PROJECT DONE BY THARUN G - 718019L144

// Importing the necessary libraries
#include <Adafruit_Sensor.h>
#include <DHT.h>
#include <DHT_U.h>
#include <WiFi.h>
#include <ESP32Servo.h>
#include "PubSubClient.h"
#define L LOW
#define H HIGH
#define DHTPIN 4
#define DHTTYPE DHT22
#define servoPin 2
#define violetPin 25
// Since motor is not available in wokwi platform,
// violet led is used instead of motor. However the connections
// remains same for motor if used.

// Cloud Credentials
#define ORG "c54g8s"
#define DEVICE_TYPE "ESP32"
#define DEVICE_ID "24_0A_C4_00_01_10"
#define TOKEN "projectDONEbyTharunTeam12345"

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

```
char server[] = ORG".messaging.internetofthings.ibmcloud.com";
char publishTopic[] = "iot-2/evt/Data/fmt/json";
char subscribeTopic[] = "iot-2/cmd/command/fmt/String";
char AUTH[] = "use-token-auth";
char token[] = TOKEN;
char CLIENTID[] = "d:"ORG":"DEVICE_TYPE":"DEVICE_ID;


DHT_Unified dht(DHTPIN, DHTTYPE);
uint32_t delayMS;

// Temperature and humidity variables
float temperature = 0;
float humidity = 0;
String data = "";

// SSID and Password for WiFi connection
char SSID[] = "Wokwi-GUEST";
char PASSWORD[] = "";

Servo servo;
// angle position of servo motor
int deg = 0;

WiFiClient wifiClient;
PubSubClient client(server, 1883, callback, wifiClient);

// Connecting to Cloud through MQTT Protocol
void mqttConnect()
{
 if (!client.connected())
 {
  Serial.print("Client trying to reconnect to ");
  Serial.println(server);
  while (!client.connect( CLIENTID, AUTH, TOKEN))
  {
   Serial.print(".");
```

```
    delay(500);
   }
   Serial.println();
   if (client.subscribe(subscribeTopic))
   {
    Serial.println("Subscription Success!");
   }
   else
   {
    Serial.println("Subscription 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]);
  data += (char)payload[i];
 }

 Serial.println("data: "+ data);
 if(data=="Motor OFF")
 {
  digitalWrite(violetPin, LOW);
  Serial.println("Now tap is closed and irrigation stopped!");
  Serial.println("Also MOTOR IS OFF (Shown by non-glowing voilet led)");
  for (; deg >= 0; deg -= 1)
  {
   servo.write(deg);
   delay(15);
  }
 }
 else if (data=="Motor ON")
```

```
 {
  digitalWrite(violetPin, HIGH);
  Serial.println("Now tap is open and irrigation occurs!");
  Serial.println("Also MOTOR IS ON (Shown by glowing voilet led)");
  for (; deg <= 90; deg += 1)
  {
   servo.write(deg);
   delay(15);
  }
 }
 data = "";
}

// Setup function - run only once
void setup() {
 Serial.begin(115200);
 WiFi.mode(WIFI_STA);
 WiFi.begin(SSID, PASSWORD);
 pinMode(violetPin, OUTPUT);
 digitalWrite(violetPin, LOW);

 // Connecting to WiFi
 Serial.print("Trying to connect to WiFi.");
 while (WiFi.status() != WL_CONNECTED) {
  delay(500);
  Serial.print(".");
 }
 Serial.println();

 Serial.print("Connected to ");
 Serial.print(SSID);
 Serial.print("(IP Address: ");
 Serial.print(WiFi.localIP());
 Serial.println(")");

 Serial.print("MAC Address: ");
 Serial.println(WiFi.macAddress());
```

```
  // DHT22 sensor and Servo motor configuration
  dht.begin();
  servo.attach(servoPin, 500, 2400);
  sensor_t sensor;
  dht.temperature().getSensor(&sensor);
  Serial.println("------------------------------------");
  Serial.print("Temperature Sensor - Resolution : ");
  Serial.print(sensor.resolution);
  Serial.println("°C");
  Serial.println("------------------------------------");
  dht.humidity().getSensor(&sensor);
  Serial.print("Humidity Sensor - Resolution : ");
  Serial.print(sensor.resolution);
  Serial.println("%");
  Serial.println("------------------------------------");
  delayMS = sensor.min_delay / 1000;

}

// Loop function - run continuously
void loop() {

  // Getting temperature and humidity values at the moment
  sensors_event_t event;
  dht.temperature().getEvent(&event);
  Serial.println("====================================");
  Serial.println("------------------------------------");
  if (isnan(event.temperature))
  {
    temperature = 0;
    Serial.println("Got error while reading temperature!");
  }
  else
  {
    temperature = event.temperature;
    Serial.print("Current Temperature: ");
```

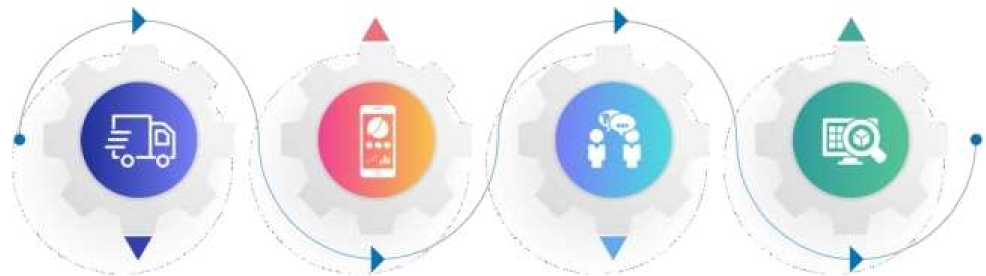
```
  Serial.print(event.temperature);
  Serial.println("°C");
}



dht.humidity().getEvent(&event);
if (isnan(event.relative_humidity))
{
  humidity = 0;
   Serial.println("Got error while reading humidity!");
}
else
{
  humidity = event.relative_humidity;
  Serial.print("Current Relative Humidity: ");
  Serial.print(event.relative_humidity);
  Serial.println("%");
}

Serial.println("------------------------------------");

if (temperature>0 && humidity>0)
{
  String payload = "{\"Temperature\":";
  payload += String(temperature,2);
  payload += ",\"Humidity\":";
  payload += String(humidity,2);
  payload += "}";
  Serial.print("Payload: ");
  Serial.println(payload);
  if (client.publish(publishTopic, (char *) payload.c_str()))
  {
    Serial.println("Published Successfully!");
  }
  else
  {
    Serial.println("Publish Failed!");
```

```
  }
 }
 Serial.println("-----------------------------------");

 // Controlling tap and motor based on certain conditions
 // if ( ((temperature < 27)||(temperature == 0)) && ((humidity > 30)||(humidity == 0)) )
 // {
 //   digitalWrite(violetPin, LOW);
 //   Serial.println("Now tap is closed and irrigation stopped!");
 //   Serial.println("Also MOTOR IS OFF (Shown by non-glowing voilet led)");
 //   for (; deg >= 0; deg -= 1)
 //   {
 //     servo.write(deg);
 //     delay(15);
 //   }
 // }
 // else
 // {
  // digitalWrite(violetPin, HIGH);
  // Serial.println("Now tap is open and irrigation occurs!");
  // Serial.println("Also MOTOR IS ON (Shown by glowing voilet led)");
  // for (; deg <= 90; deg += 1)
  // {
  //   servo.write(deg);
  //   delay(15);
  // }
 // }
 Serial.println("-----------------------------------");

 if (!client.loop())
 {
  mqttConnect();
 }

 delay(delayMS + 1000);
}
```

FEATURES:

- Scheduled automatic off times – diesel and electric pumps
- Rain gauge triggered automatic shutdowns
- Soil moisture level threshold automatic shutdowns
- “All Off” pump command feature
- based on standing water levels

Field operator specific automation scheduling access rights



Climate monitoring and forecasting

- Nature is a fickle friend of the farmers. Climate change, weather forecasts are now key features in in precision farming. They alert the farmer of the impending changes and help ensure preventive measures. With sensors in place to predict and analyze the weather, crops can be saves from being destroyed.

Predictive analytics for crops and livestock

IoT in smart farming is not restricted to a particular section. Smart farming sensors can be placed right in the ground. There, it shall read and analysis the derived data and help improve farming practices. Primarily, the leaf to soil ratio and soil humidity help increase quantity and quality of the produce. Wearables for cattle are the best bet against poaching and cattle napping.

Remote crop and soil monitoring

With the help of smart farming system, moisture and fertility of soil along with crops growth rate can be monitored remotely through real time animationand graphics via a smartphones. This helps the farmer make environmental variables and informed decisions for the farm.

Automated Sprinkler System

The weather, humidity in the air, analysis of the soil goes a long way in determining if there is a need for water dispersion. Precise and controlled water dispersion through IoT enabled water meter sensors helps in ensuring that there is no risk of damaging crops due to over watering.

Weather forecast:

Weather forecast is very crucial to agriculture activities and is a very important feature that farmers look for in the farming mobile app.

Theaccuracy of this data can help farmers be prepared for anything unforeseen.

CHAPTER-8

ADVANTAGES AND DISADVANTGES

Advantages:

- Increased production and its quality.
- Water is used effectively.
- Remote monitoring.
- Automatic controlling of irrigation.
- Cost Effective.
- IOT technologies enables growers and farmers to reduce waste and enhance productivity

Disadvantages:

Lack of Infrastructure: Even if the farmers adopt IoT technology they won't be able to take benefit of this technology due to poor communication infrastructure. Farms are located in remote areas and are far from access to the internet. A farmer needs to have access to crop data reliably at any time from any location, so connection issues would cause an advanced monitoring system to beuseless.

High Cost: Equipment needed to implement IoT in agriculture is expensive. However sensors are the least expensive component,yet outfitting all of the farmers' fields to be with them would cost more than a thousand dollars. Automated machinery cost more than manually operated machinery as they include cost for farm management software and cloud access to record data. To earn higher profits, it is significant for farmers to invest in these technologies however it would be difficult for them to make the initial investment to set up IoT technology at their farms.

Since IoT devices interact with older equipment they have access to the internet connection, there is no guarantee that they would be able to access drone mapping data or sensor readouts by taking benefit of public connection. Anenormous amount of data is collected by IoT agricultural systems which is difficult to protect. Someone can have unauthorized access IoT providers database and could steal and manipulate the data.

CHAPTER-9

CONCLUSION

IoT based SMART FARMING SYSTEM for Live Monitoring of Temperature and Soil Moisture has been proposed using Arduinoand Cloud Computing .The System has high efficiency and accuracy in fetching the live data of temperature and soil moisture.

The IoT based smart farming System being proposed via this report will assist farmers in increasing the agriculture yield and takeefficient care of food production as the System will always provide helping hand to farmers for getting accurate live feed of environmental temperature and soil moisture with more than 99% accurate results. The IoT agricultural applications are making it possible for ranchers and farmers to collect meaningful data. Large landowners and small farmers must understand the potential of IoT market for agriculture by installing smart technologiesto increase competitiveness and sustainability in their productions.

With the population growing rapidly, the demand can be successfully met if the ranchers, as well as small farmers, implement agricultural IoT solutions in a prosperous manner. Thus the smart agriculture using IoT will revolutionized the world of farming and it will increase the productivity as well as improvethe quality and can save lives of farmer. There is an urgent need for a system that makes the agricultural process easier and burden free from the farmer's side.

With the recent advancement of technology it has become necessary to increase the annual crop production output of our countryIndia, an entirely aro centric economy. The ability to conserve the natural resources as well as giving a splendid boost to the production of the crops is one of the main aims of incorporating such technology into the agricultural domain of the country.

To save farmer's effort, water and time has been the most important consideration.

CHAPTER-10

FUTURE SCOPE

Data collected by smart agriculture sensors, in this approach of farm management, a key component are sensors, control systems, robotics, autonomous vehicles, automated hardware, variable rate technology, motion detectors, button camera, and wearable devices. This data can be used to track the state of the business in general as well as staff performance, equipment efficiency. The ability to foresee the output of production allows to plan for better product distribution.

Agricultural Drones Ground-based and aerial-based drones are being used in agriculture in order to enhance various agricultural practices: crop health assessment, irrigation, crop monitoring, crop spraying, planting, and soil and field analysis.

Livestock tracking and geofencing Farm owners can utilize wireless IoT applications to collect data regarding the location, well-being, and health of their cattle. This information helps to prevent the spread of disease and also lowers labour costs.

Smart Greenhouses A smart greenhouse designed with the help of IoT intelligently monitors as well as controls the climate, eliminating the need for manual intervention.

Predictive analytics for smart farming Crop predication plays a key role, it helps the farmer to decide future plan regarding the production of the crop, its storage, marketing techniques and risk management. To predict production rate of the crop artificial network use information collected by sensors from the farm. This information includes parameters such as soil, temperature, pressure, rainfall, and humidity. The farmers can get an accurate soil data either by the dashboard or a customized mobile application.

Future work would be focused more on increasing sensors on this system to fetch more data especially 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.

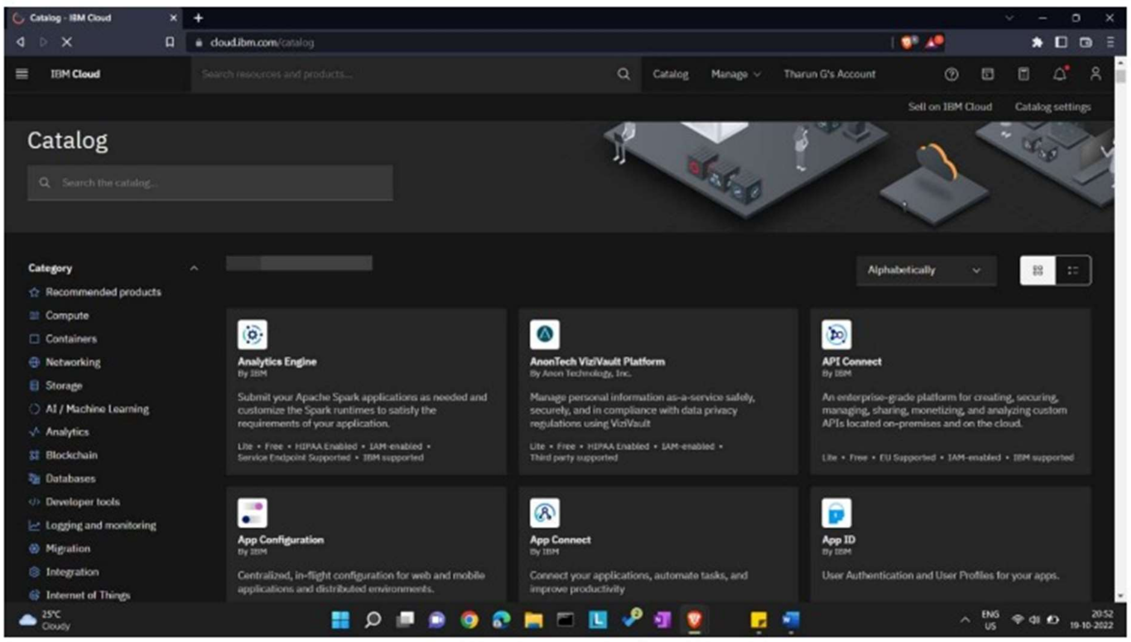
CHAPTER-11

APPENDIX

CREATION OF IBM CLOUD SERVICES:

SCREENSHOT OF CLOUD ACCOUNT CREATION:

Created an account in IBM Cloud Services



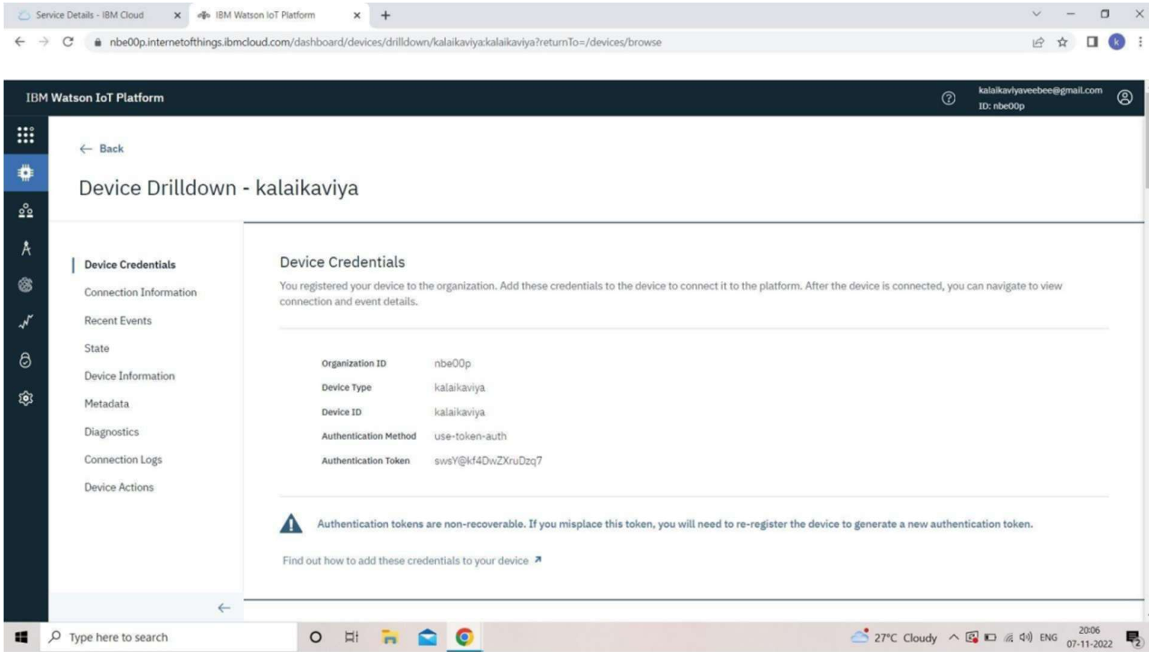
Create a IBM Watson IOT platform and device

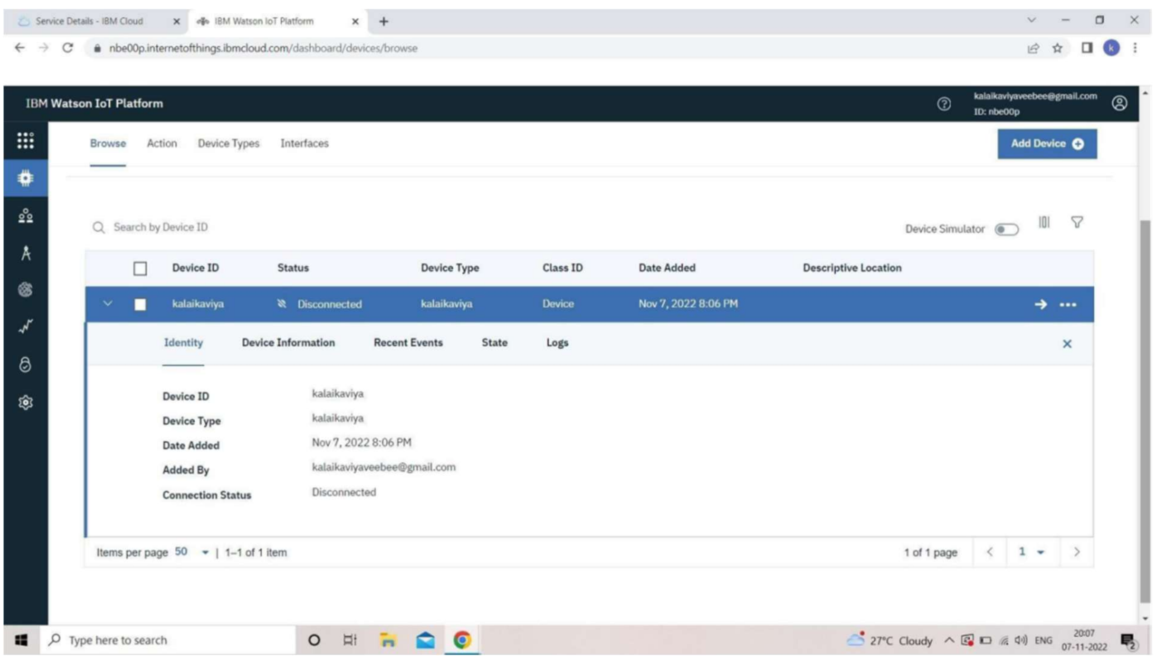
Step 1: login into IBM CLOUD account
Step2: click on catalog and search for IOT platform

Step 3: Then search for IOT Watson platform then click on create

Step 4: Then click on add device and give the device type and necessary details thenclick finish
Step 5: Finally, IOT Watson platform is successfully created

Screenshots of IBM Watson IOT platform and device:

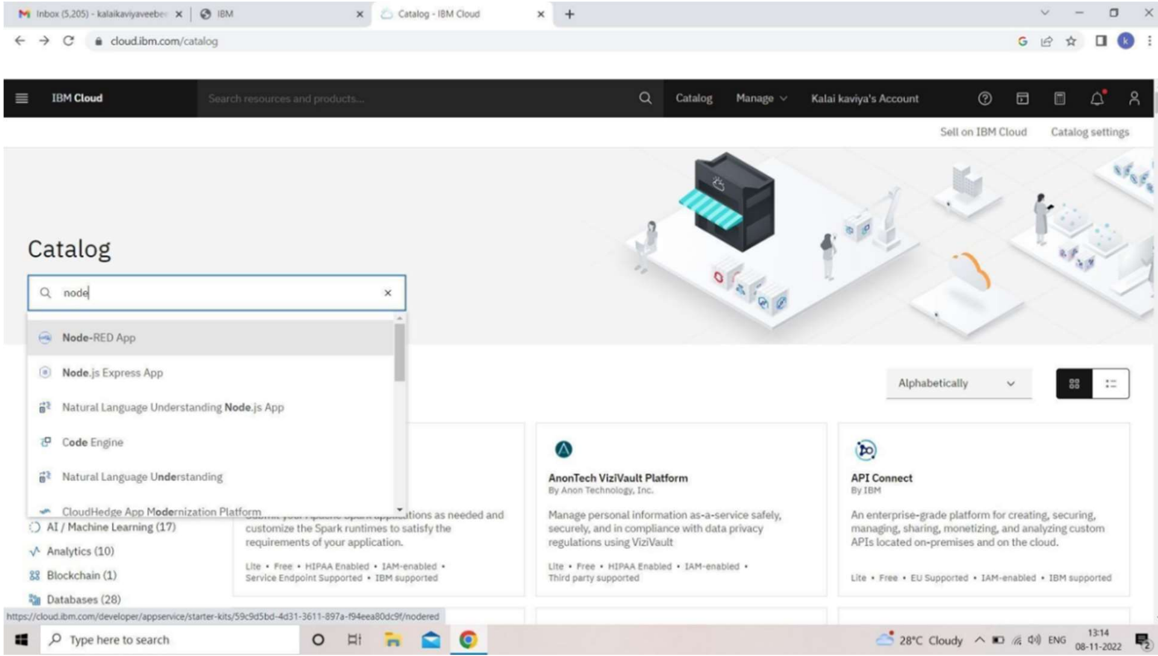




Create Node Red service

Step 1: Login into IBM CLOUD account

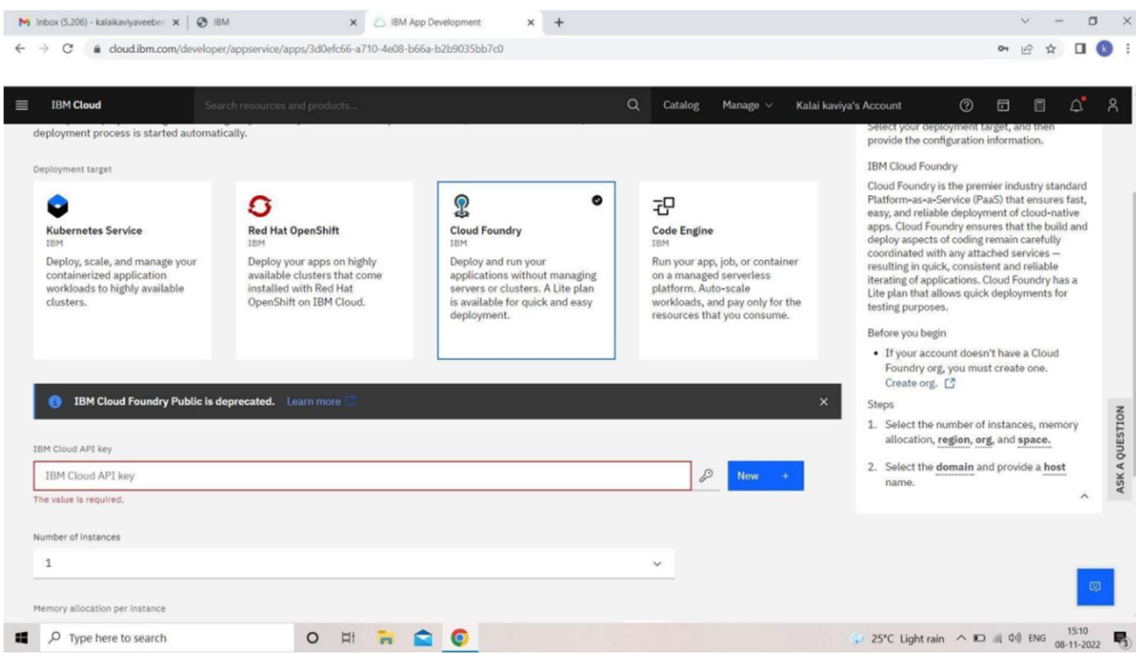
Step2: In catalog, search for node red application



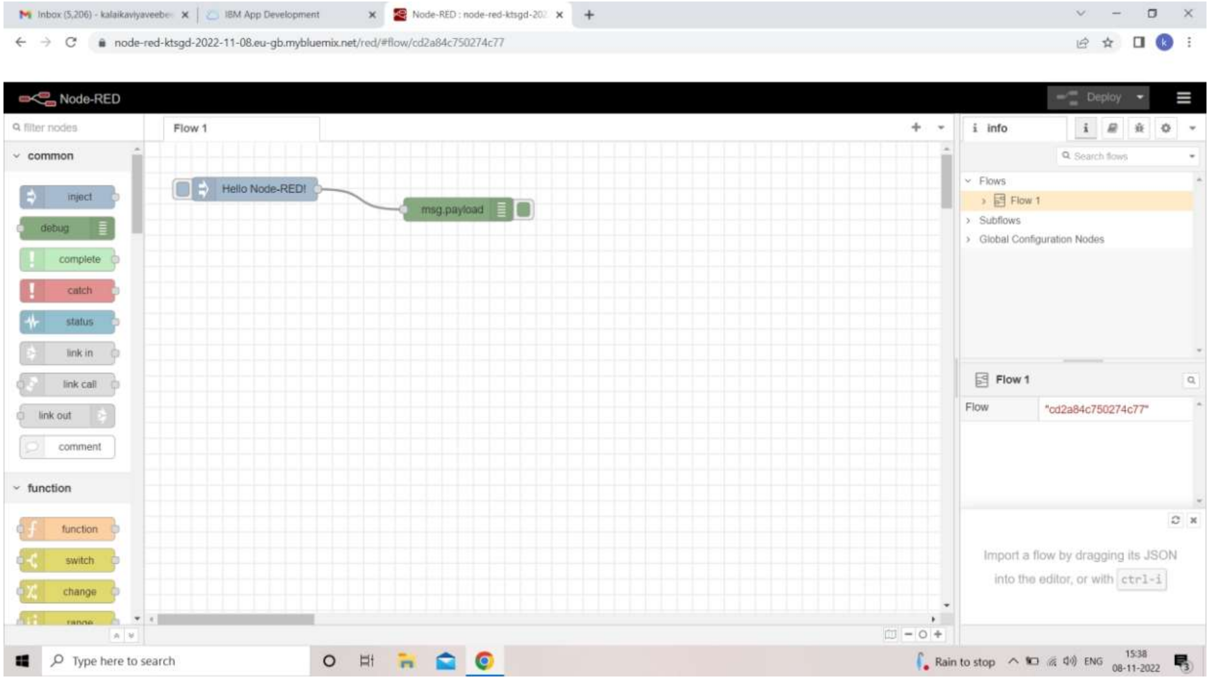
Step 3: Enter the project details and click on create

Step 4: click on deploy option and deploy

Step 5: Set up the environment for deploying and click on create



Step 6: Now drag and drop the nodes and connect nodes with IOT Watson platform

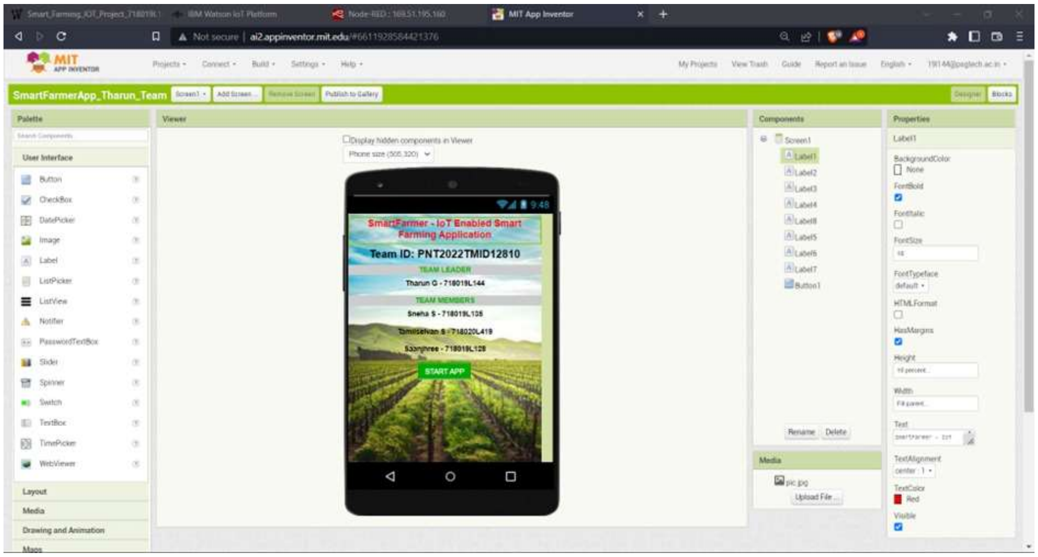


Step 7: setup the settings that connects node red service with Watson IOT

Step 8: Finally, output can be seen in node red service

Create a MIT APP INVENTOR

Screenshots of MIT APP INVENTOR:



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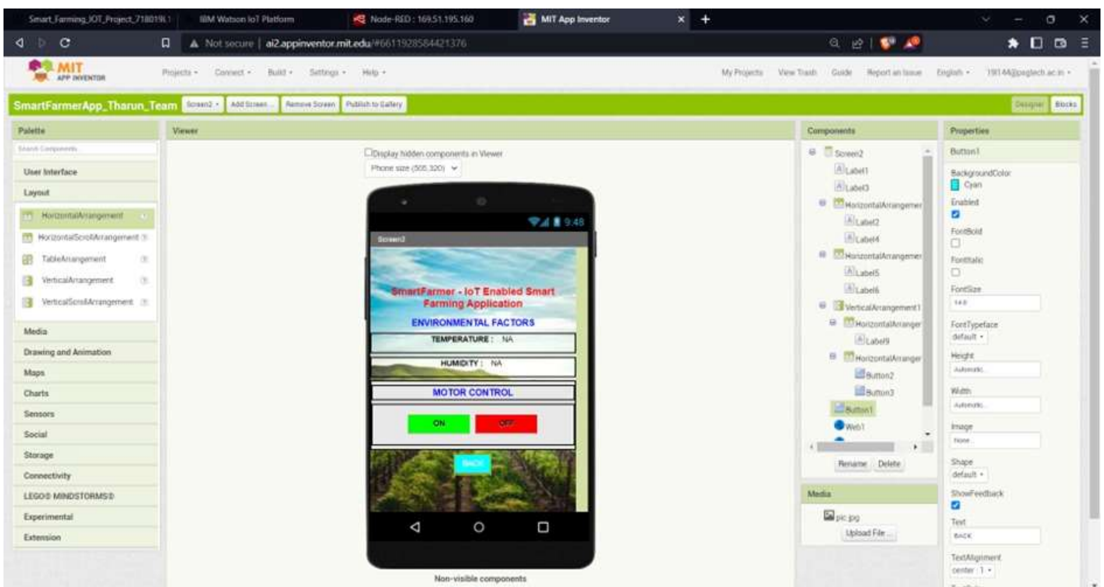
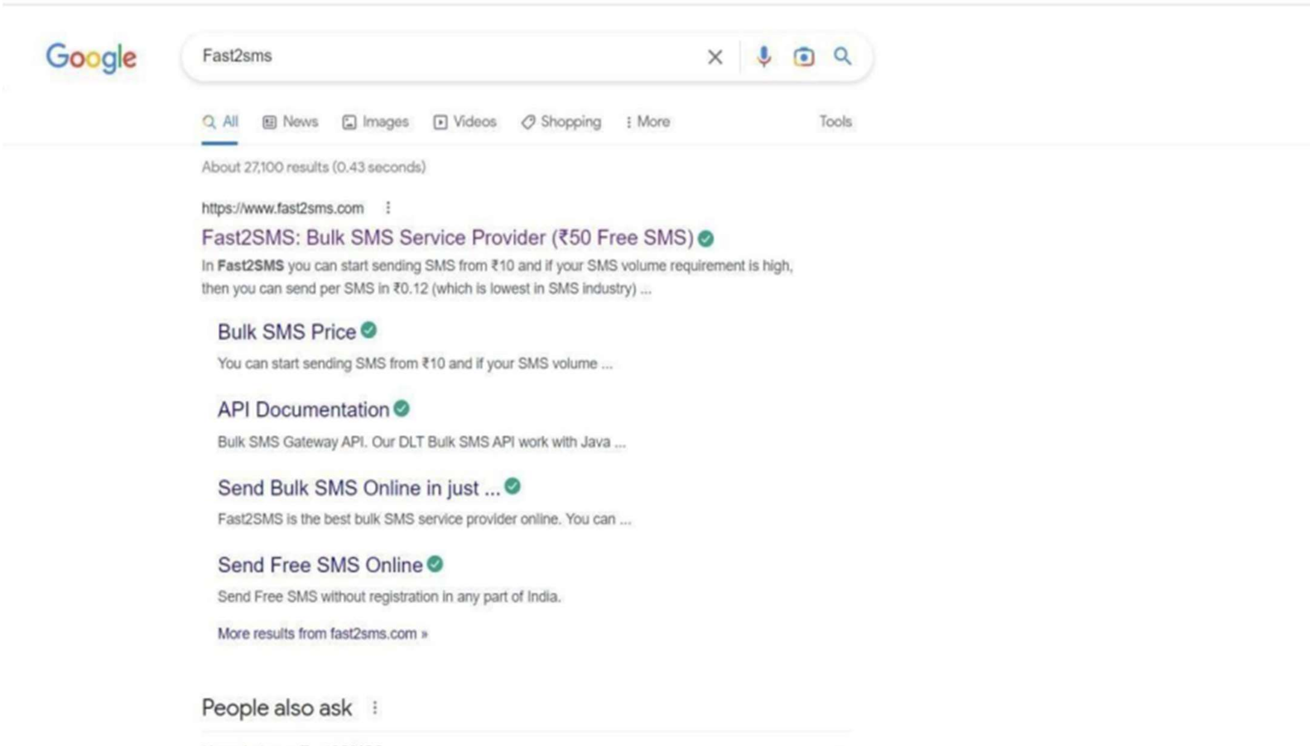


CREATE AN ACCOUNT IN FAST2SMS

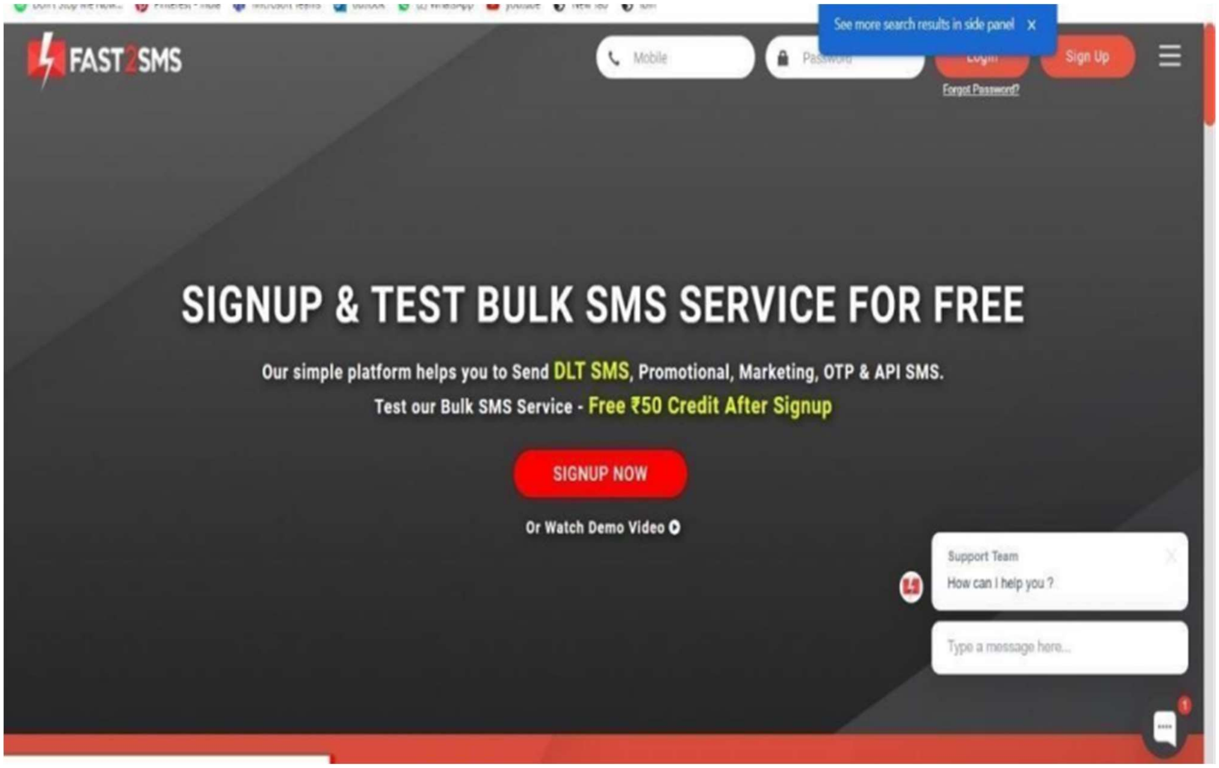
Step 1:

Type fast2sms in google and click on the fist link



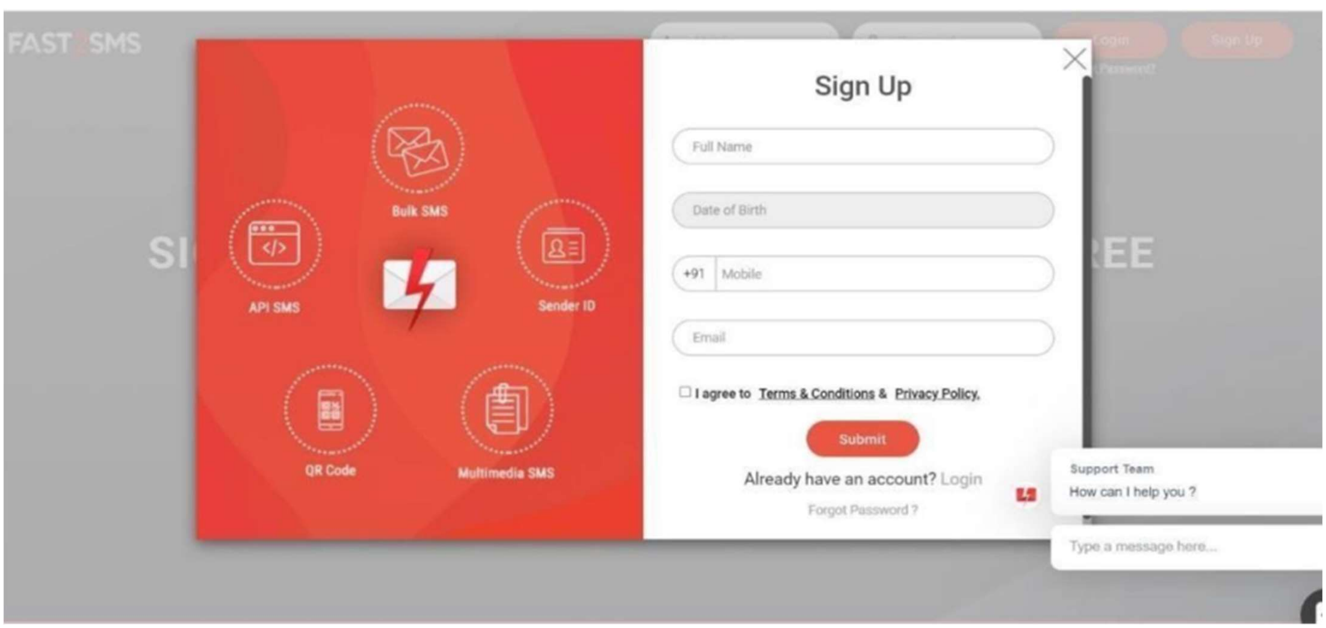
Step 2:

click on sign up now



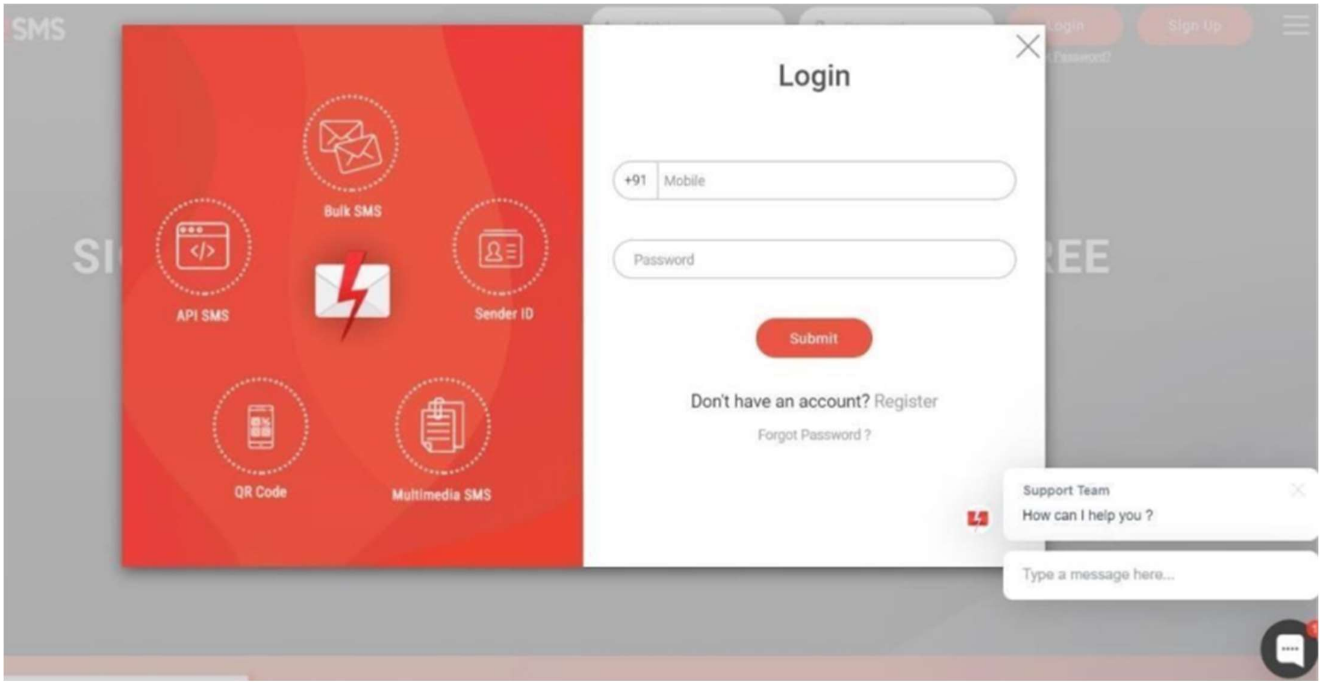
Step 3:

Give your details and click on the check box, then click the submit button.



Step 4:

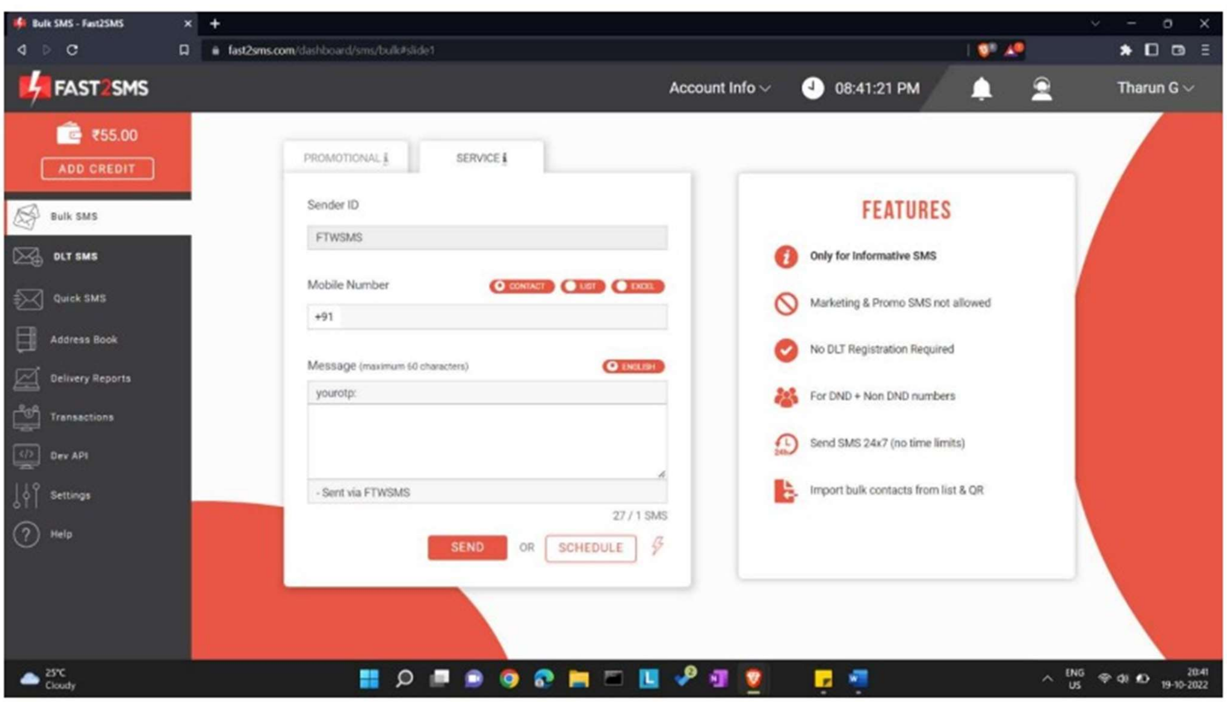
You will get the SMS with your password. Type your mobile number and the password then click on the submit button.



Step 5:

Click on the Dev API

Creation of An Account In Fast2sms Dashboard



Step 6:

Select the Route as Quick SMS and type the message in Message box. This can be used to send sms quickly to certain phone numbers.