Smart Farmer-IOT Enabled Smart Farming Application

The Project Report

Submitted by

Team ID : PNT2022TMID38592
Team Members : Narasimhan .D
Ezhilarasan .K
Karthik .P
Senthilkumar .V

GitHub Link: https://github.com/IBM-EPBL/IBM-Project-17576-1659673609

PROJECT REPORT

Introduction:

1.1 overview:

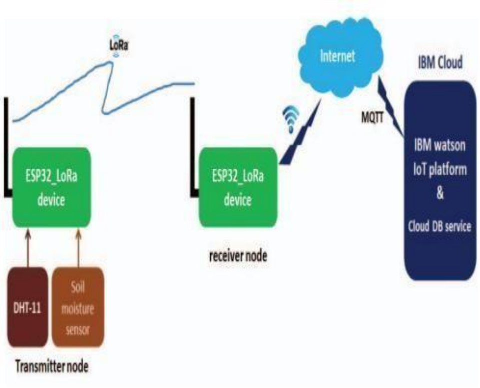
In this project we have developed a mobile application using which a farmer can monitor the temperature, humidity, pressure and soil moisture parameters along with weather forecasting details.Based on these details he can water the crops by controlling the motors through the app and the app gives an alert message if temperature or humidity goes beyond a threshold value.

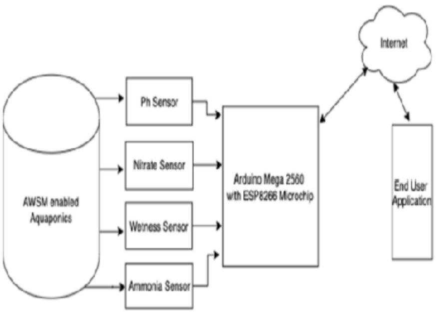
1.2 Purpose:

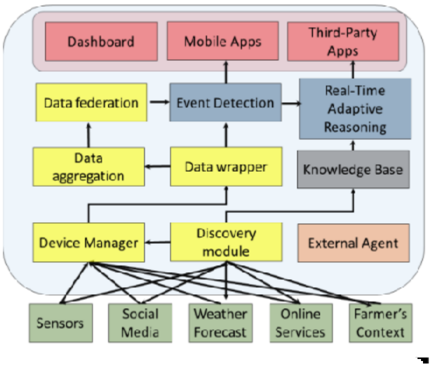
Agriculture plays a crucial role in the life of an economy. It is the backbone of our economic system, so improving the quality and way of production is crucial. Here comes the Smart Farmer. Smart Farmer helps in automated farming, collection of data from the field and then analyses it so that the farmer can make accurate decisions to grow high quality crops.

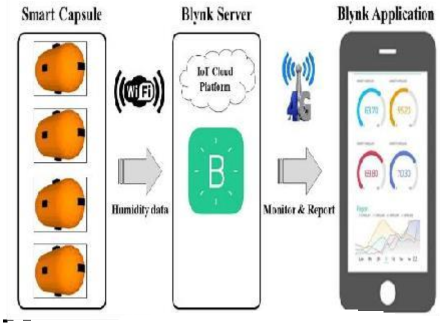
IoT based Smart Farming improves the entire Agriculture system by monitoring the field in real-time. With the help of sensors and interconnectivity, the Internet of Things in Agriculture has not only saved the time of the farmers but has also reduced the extravagant use of resources such as Water. and Electricity.

2 LITERATURE SURVEY

S.NO	JOURNAL PAPER	BLOCK DIAGRAM	ALGORITHM/ METHODOLOGY/ SOLUTION	FEATURES	DRAWBACK
1.	**Smart Farm Monitoring Using LoRa Enabled IOT**		1. Agricultural practices need to be transformed in order to overcome future food scarcity due to overpopulation across the globe. By employing emerging, disruptive technologies like IoT in the agricultural sector, it is possible to monitor farm fields using low-cost and low-power consuming devices, to automate irrigationsystems for efficient usage of water resources. 2. LPWAN technologies serve IOT applications in a better possible way so that LoRa WAN protocol or LoRa in LPWAN space gives additional advantageslike scalability, security and robustness in designing IoT applications	1. Scalable bandwidth 2. High Robustness 3. Doppler resistance 4. Fading resistance 5. Long range link 6. Low power 7. Low cost	1. This system has Gateway infrastructure barriers such aspublic network coverage scarce. 2. It takes skill and commitment todeploy and maintain own gateways. 3. It has integration complexity (Gaps in the standardization)

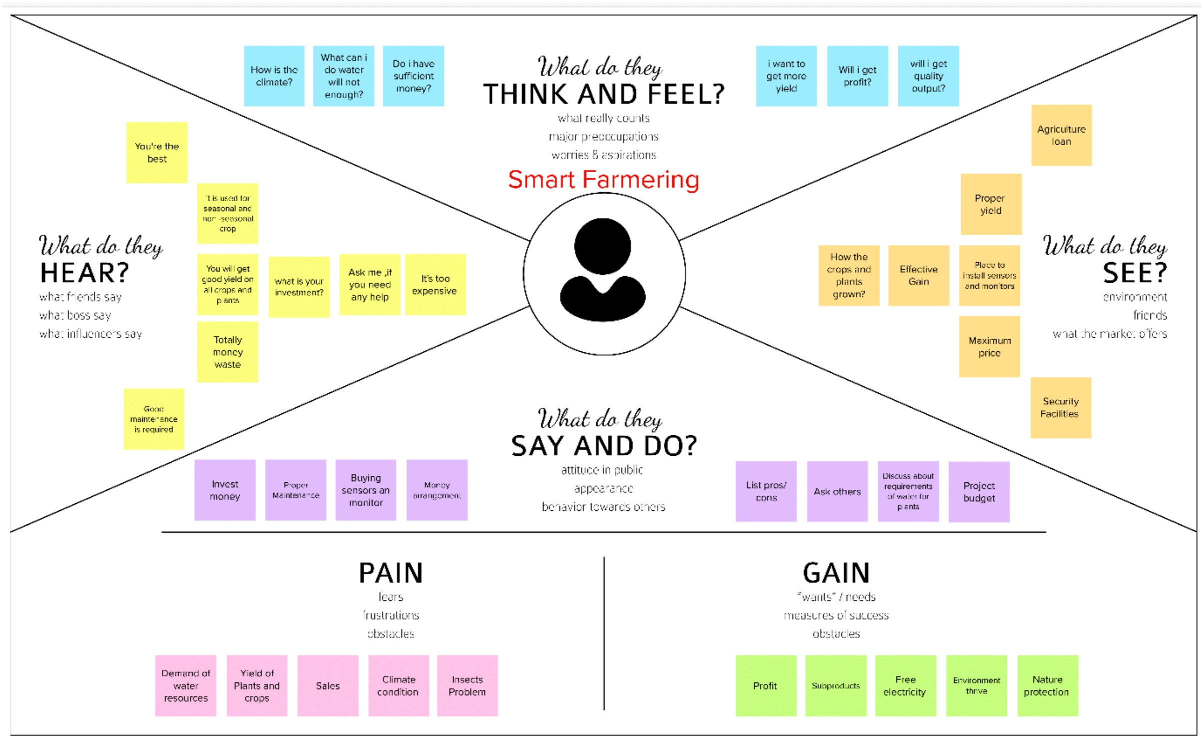
S.NO	JOURNAL PAPER	BLOCK DIAGRAM	ALGORITHM/ METHODOLOGY/ SOLUTION	FEATURES	DRAWBACKS
2.	**IOT enabled aquaponics with wireless Sensor smart monitoring**	 	1.Aquaponics is an advanced and emerging farming style in which fish farming and vegetable farming turned out to be more professional and precise. 2.AWSM enabled aquaponics system which was placed under the same Controlled environment. Sensorreadings will go to the Arduino Mega 2560 for processing and the data will be processed with AWSM algorithm. The results are sent to farmers and response from the farmer is executed through Arduino Mega 2650 which will reflect in the farm. 3.The presence of Chlorine and nitrate is detected quickly and will be intimated so that farmer can stop filling water through online instruction which will be implemented through Arduino Mega 2650 in the farm.	1. User friendly 2. A mobile application is developed in the Android platform to support the farmers. 3. It proposes an effective way to monitorand improve farming and will help farmers track the progress of the growth of the farm from anywhere inthe globe. 4.It is an efficient way of precision farming	1.AWSM is a notification based app and less control overthe devices and pieces of equipment connected to thesystem. 2.It requires an unlimited or continuous internet connection to besuccessful.

S.NO	JOURNAL PAPER	BLOCK DIAGRAM	ALGORITHM/ METHODOLOGY/ SOLUTION	FEATURES	DRAWBACKS
3.	**Agri-IoT: A Semantic Framework for Internet of Things -enabled Smart Farming Applications**		1. Agri-IoT,focused on the feasibility of using RSP in agricultural Applications 2. This system uses a machine running Debian GNU/Linux 6.0.10, with 8-cores of 2.13 GHz processor 64 GB RAM 3. Two realistic scenarios were considered: **Scenario A:** Fertility management of dairyCows. **Scenario B:** Soil fertility for crop cultivation.	1. Agri-IoT, a semantic framework for IoT based smartfarming applications, which supports reasoning over various heterogeneou ssensor data streams in real-time. 2. It can integrate multiple cross-domain data streams, providing a complete semantic processing pipeline offering common framework for smart farming applications. 3. Agri-IoT has the capabilitiesof combining and analyzing data streams	Some limitations of Agri-IoT include 1. Dynamicity 2. dutonomy 3. Full adaptability to heterogeneity.

S.NO	JOURNAL PAPER	BLOCK DIAGRAM	ALGORITHM/ METHODOLOGY/ SOLUTION	FEATURES	DRAWBACKS
4.	**Smart Farm Monitoring via the Blynk IoT Platform**		1. Blynk is an IoT platform that support both iOS and Android 2. Blynk application, which is used to control a device and display data. 3. Blynk server, which is a cloud service responsible for all communications between smartphones and things. 4. This system Composed of **A.** Smart Farm Monitoring **B.** Super Chart Widget **C.** Database **D.** Smart Capsule System Status **E.** Blynk Notification 5. This indicated that the developed systemwas suitable for monitoring the humidity of paddy in order to prevent excessive humidity, is the main cause of paddy rotting.	1. This smart system can be used to improve the productivity and quality of modern farming. 2. The prototypeof smart capsule developed to measure the humidity. 3. The Blynk Mobile application was used to monitor and display real-time humidity data through the digital dashboard.	1. Leakage monitoring technologies areexpensive, limited in their application 2. Space for paddy storageis less. 3. Dificult to Installation andRemoval.

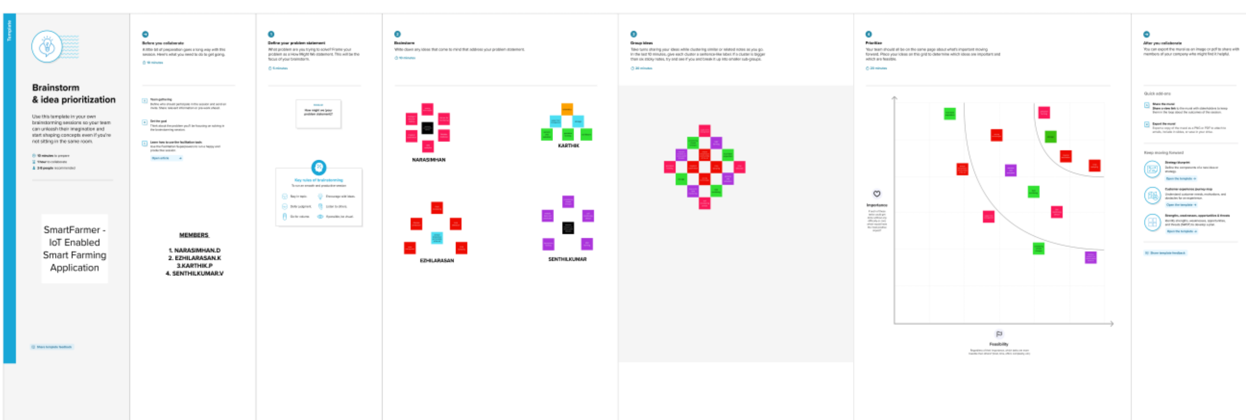
3 IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP



3.2 IDEATION AND BRAINSTORMING

4

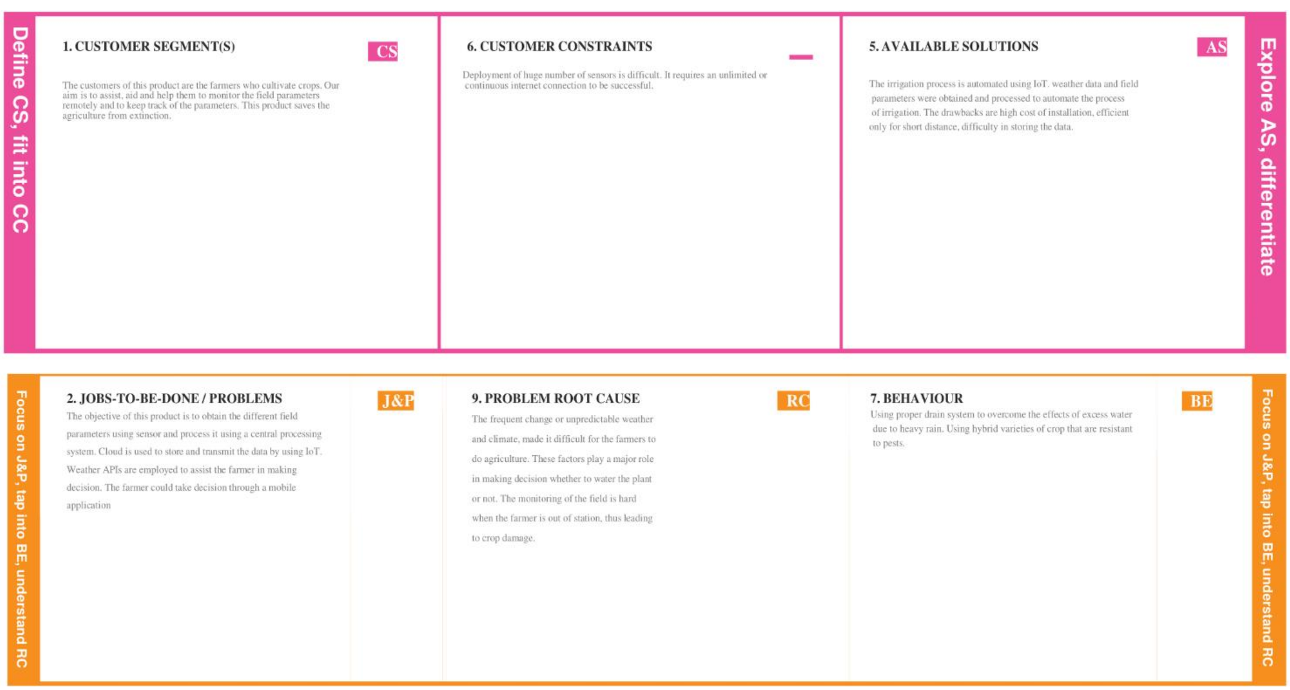


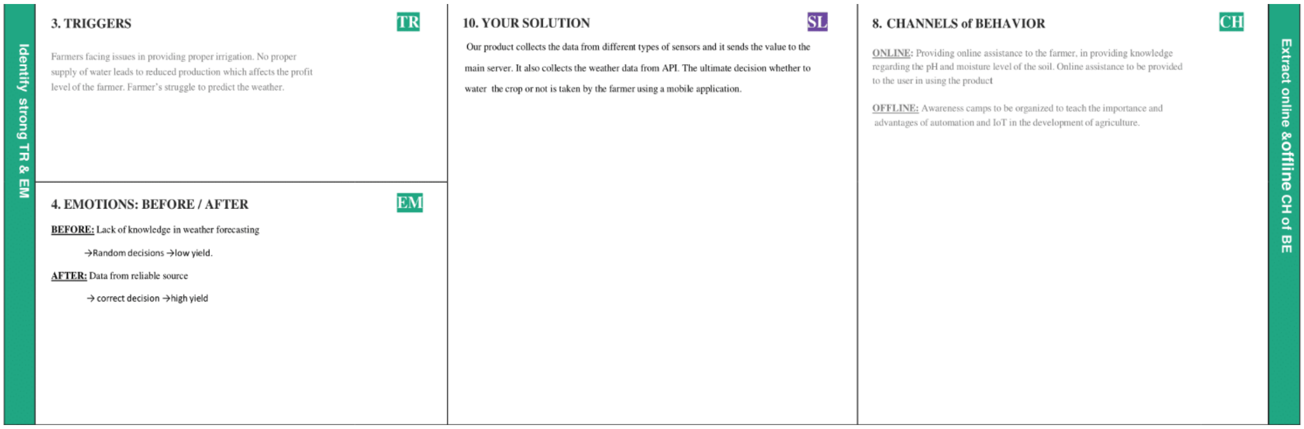
3.3 PROPOSED SOLUTION

As the climates are changing rapidly and weather is unpredictable, so farmers are facing difficulties so they need a system to tackle this, here we use “open weather API” to get weather information such as temperature, pressure, humidity and weather description at their current location.

Based on which they can decide whether to turn on the motors or turn off the motor if needed temperature and moisture sensors from IBM simulator is displayed on UI for monitoring the weather. An algorithm developed with threshold values of temperature, pressure, humidity is programmed to intimate the farmer if weather conditions go bad. He can control motors remotely from any place through IoT. Internet interface that allow data inspection and irrigation scheduling to be programmed through mobile application or Node-RED UI. The technological development in software and hardware make it easy to develop this which can make better monitoring and wireless network made it possible to use in monitoring and control of greenhouse parameter in precision agriculture.

3.4 PROBLEM SOLUTION FIT





4 REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIRMENT

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

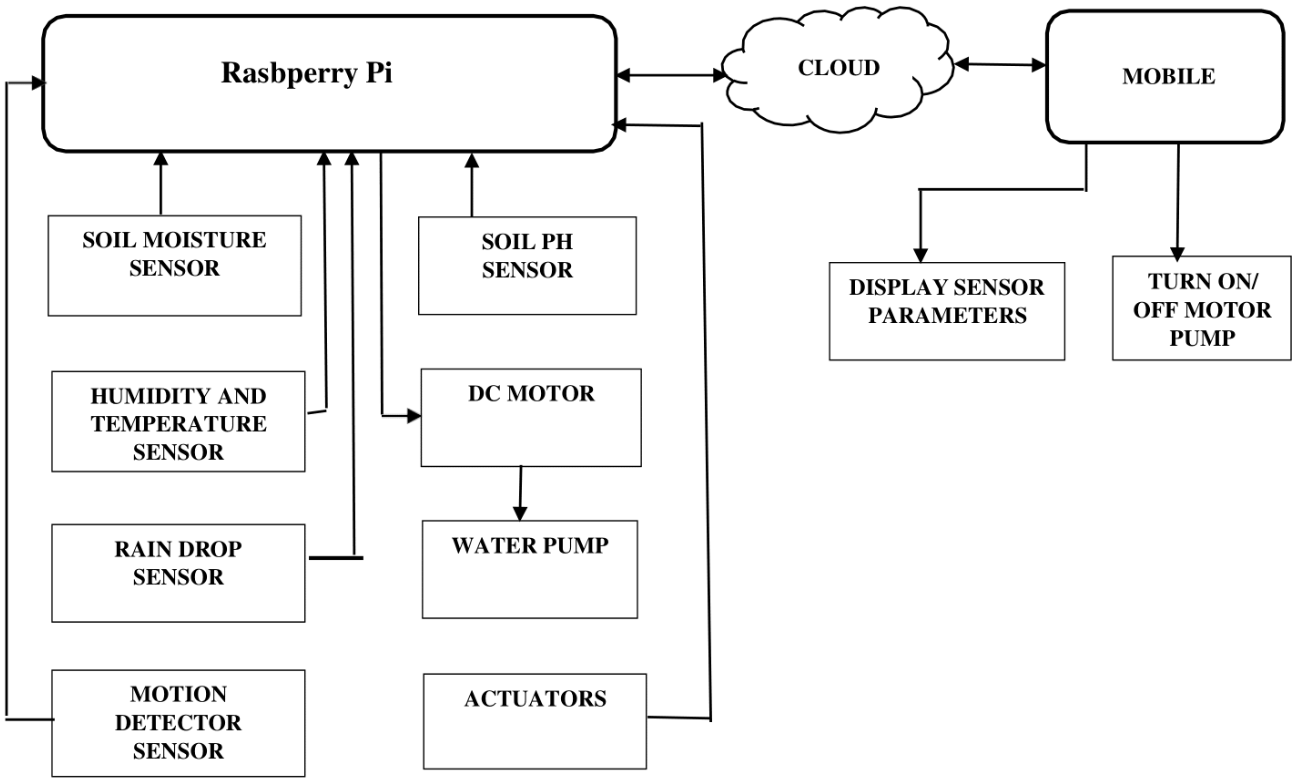
4.2 NON FUNCTIONAL REQURIMENT

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Usability includes easy learnability, efficiency inuse, 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 inthe field will be more efficient for overall monitoring.
NFR-5	**Availability**	Data will store 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

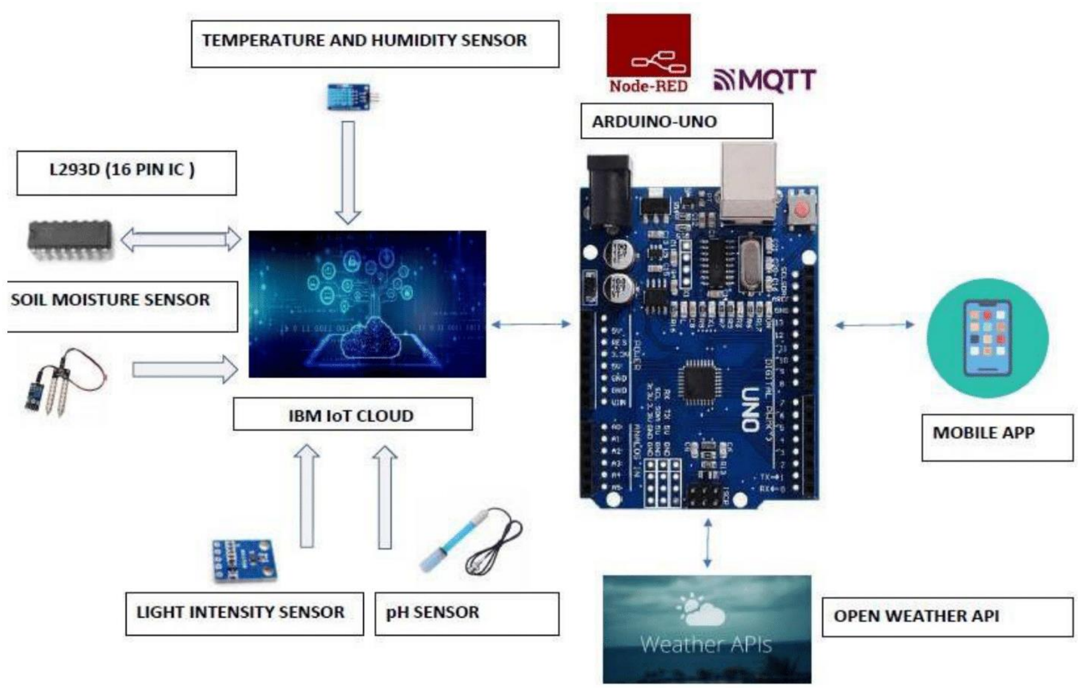
5.PROJECT DESIGN

5.1 DATA FLOW DIAGRAM

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



5.2 SOLUTION AND TECHNICAL ARCHITECTURE



- The different soil parameters (temperature, humidity, light intensity, pHlevel) are sensed using different sensors and the obtained value is storedin IBM cloud.

- The L293D is a 16-pin Motor Driver IC which can control a set of two DC motors simultaneously in any direction. The L293D is designed to provide bidirectional drive currents of up to 600 mA (per channel) at voltages from 4.5 V to 36 V (at pin 8!).

- Arduino UNO is used as a processing unit which processes the dataobtained from sensors and weather data from weather API.

- Node-RED is a programming tool for wiring together hardware devices,APIs and online services in new and interesting ways. It provides a browser-based editor.

- The MQTT protocol is followed for communication.

- All the collected data is provided to the user through a mobileapplication which was developed using MIT app inventor.

- Open Weather provides hyperlocal minute forecast, historical data, current state and from short-term to annual and forecasted weather data.All data is available via industry standard APIs.

- The user could make decision through an app, whether to water the cropor not, depending upon the sensor values.

5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story/ Task	Acceptance Criteria	Priority	Release
Farmer (Mobile App)	Display the sensor parameters fixed in the field	USN- 1	The farmer can view the parameters values like soil moisture, humidity, motion detection, soil alkalinity	Display the parameters	High	Sprint- 1
Farmer (Mobile App)	Turn on/ off the motor	USN- 2	Can turn on/ off the Dc motor if the moisture level and rain the reaches a threshold	Turn on/ off the dc motor for water pump	High	Sprint- 1
Rasbperry Pi	Microcontroller setup in the fields	USN- 3	The soil moisture sensor, humidity and temperature sensor, rain drop sensor, motion detection sensor, soil Ph sensor and DC motor connected with the water pump are interfaced with the micro- controller	Measures the parameters by the sensors interfaced with the micro-controller in the fields	High	Sprint- 1
IBM Cloud	Data transfer	USN- 4	The micro-controller in the field is connected to the IBM cloud and transfers data from and to the remote user	Transfers data between the fields and the user through internet	Medium	Sprint- 2

6 PROJECT PLANNING & SCHEDULING SPRINT DELIVERY AND SCHEDULE

6.1.SPRINT PLANNING AND ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Mobile/web user Registration	USN-1	As a user I can register the application by entering my email and password so that feels good	10	High	Narasimhan.D
Sprint-1		USN-2	As a user I want confirmation mail for registration	10	Medium	Senthilkumar.V
Sprint-2	Mobile/web user Login	USN-3	As a user I can login to the application by entering my email and password so that I can enter the application	10	High	Ezhilarasan.K
Sprint-2		USN-4	As a user I can login to the application by enter my phone number so can easily enter the dashboard	10	Low	Karthik.P
Sprint-3	Monitoring and controlling	USN-5	As a user I want smart application so that monitor the fields	2	High	Narasimhan.D
Sprint-3		USN-6	As a user I want to know the temperature level so that easily know irrigation timing	5	High	Karthik.P
Sprint-3		USN-7	As a user I want to check the humidity sothat it is helpful to put water	5	Low	Ezhliarasan.K
Sprint-3		USN-8	As a user I want a smart application so that I can monitor anywhere at anytime	3	Low	Senthilkumar.v
Sprint-3		USN-9	As a user I want motor control so that water wastage stops.	5	High	Narasimhan.D

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-4	Software connection	USN-10	As an admin I want to satisfy their users sothat connect & store in Ibm iot	5	Medium	Ezhilarasan.K
Sprint-4		USN-11	As an admin I want to make software (node red,IBM Watson) connection so that simulate the values	5	Medium	Karthik.P
Sprint-4		USN-12	As an admin I want to test the application sothat I know if it's working or not	10	High	Narasimhan.D

6.2 SPRINT DELIVERY SCHEDULE

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

Sprint	Tota 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 06-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) periteration unit (story points per day)

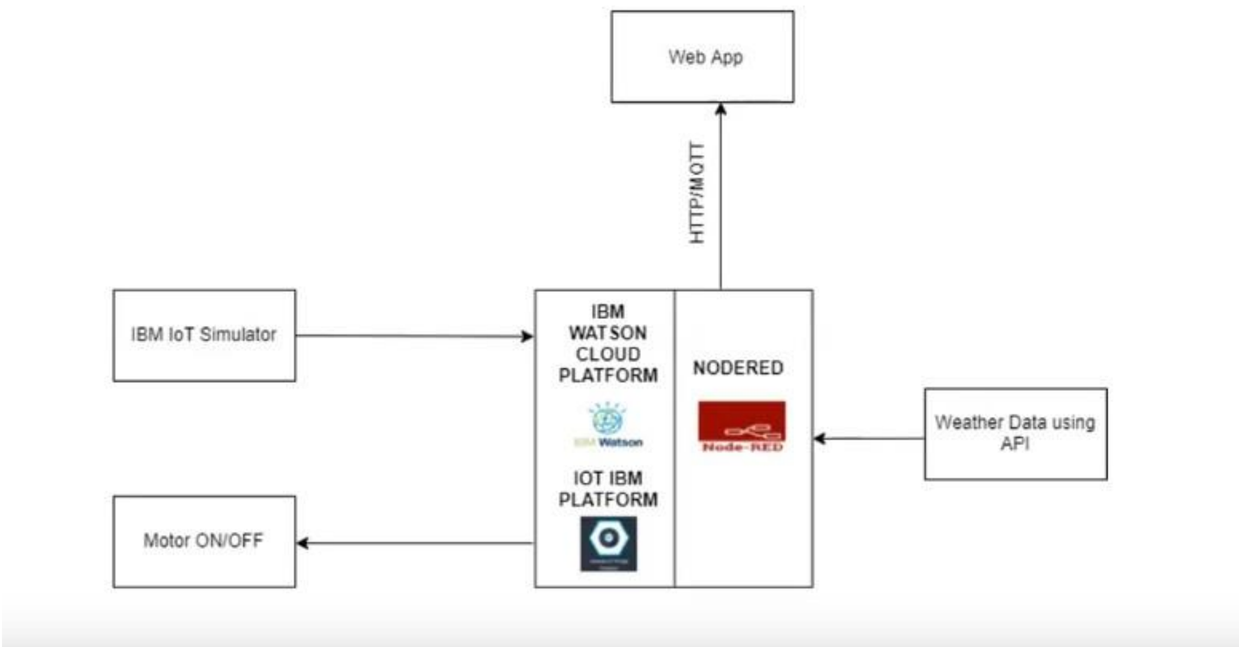
Average Velocity = Sprint Duration / Velocity = 20/6=3.33

6.3 REPORTS FROM JIRA

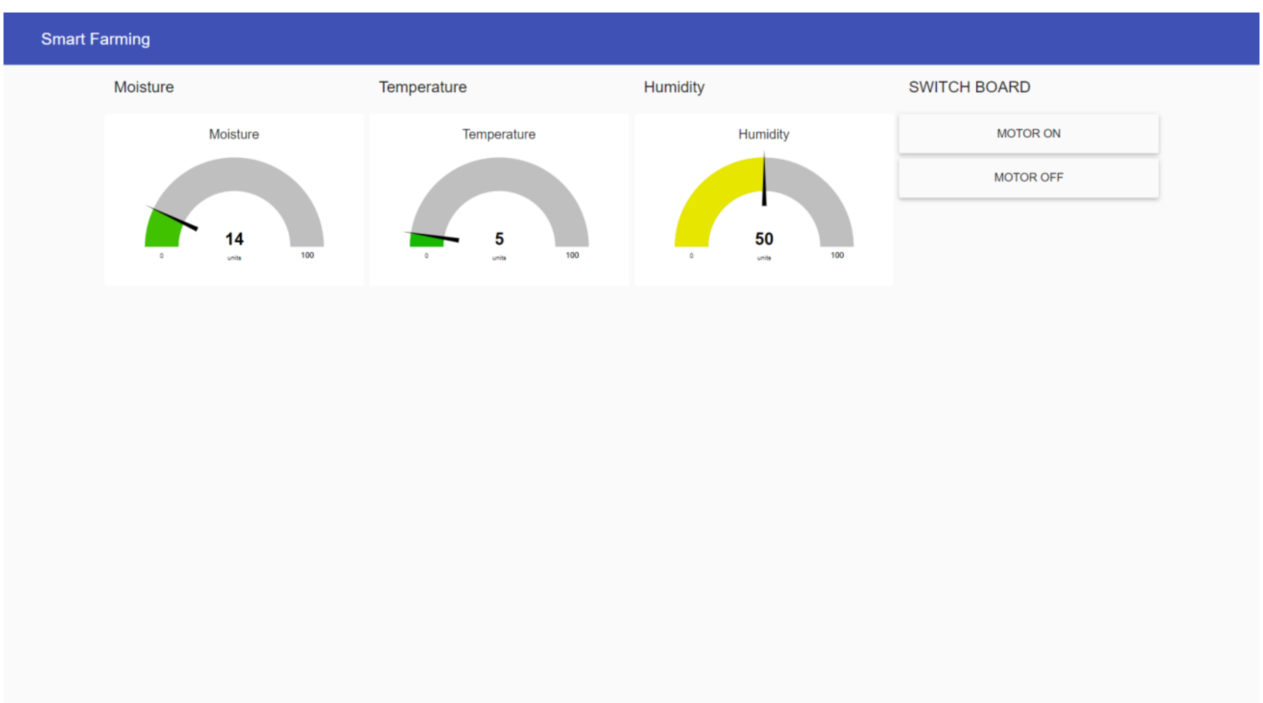
7 CODING AND SOLUTION

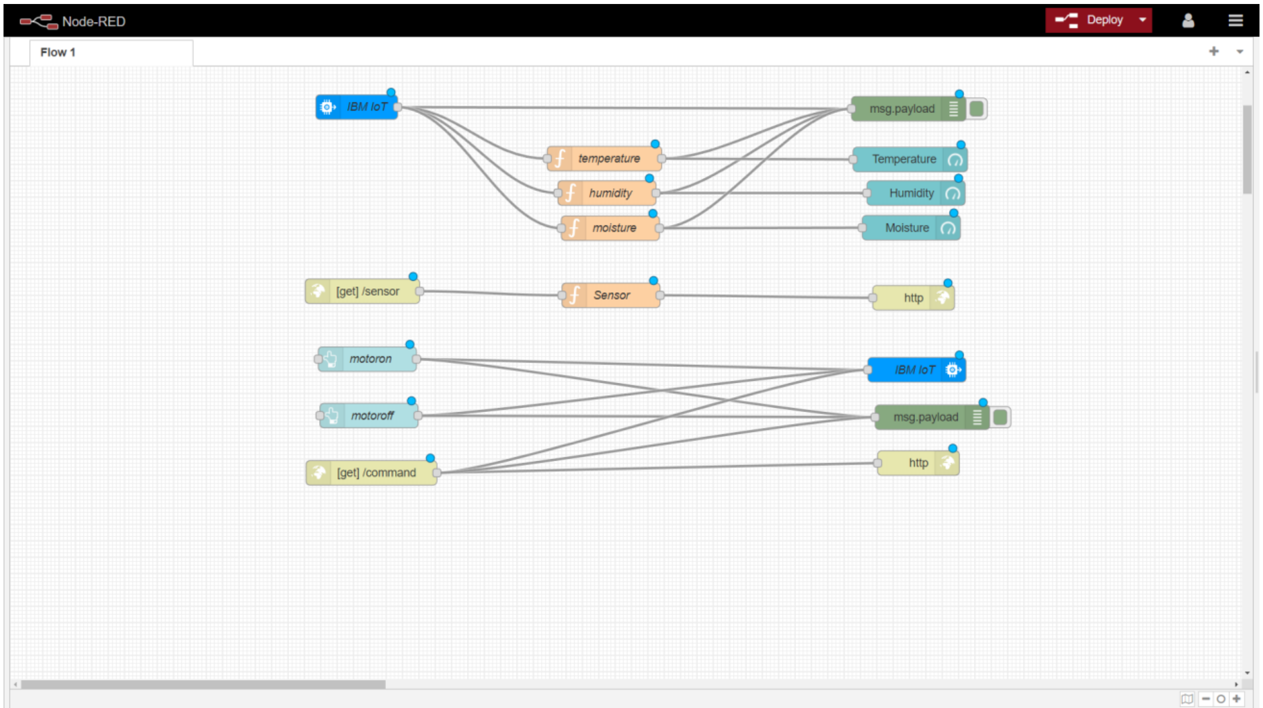
Theoritical Analysis:

3.1 Block diagram

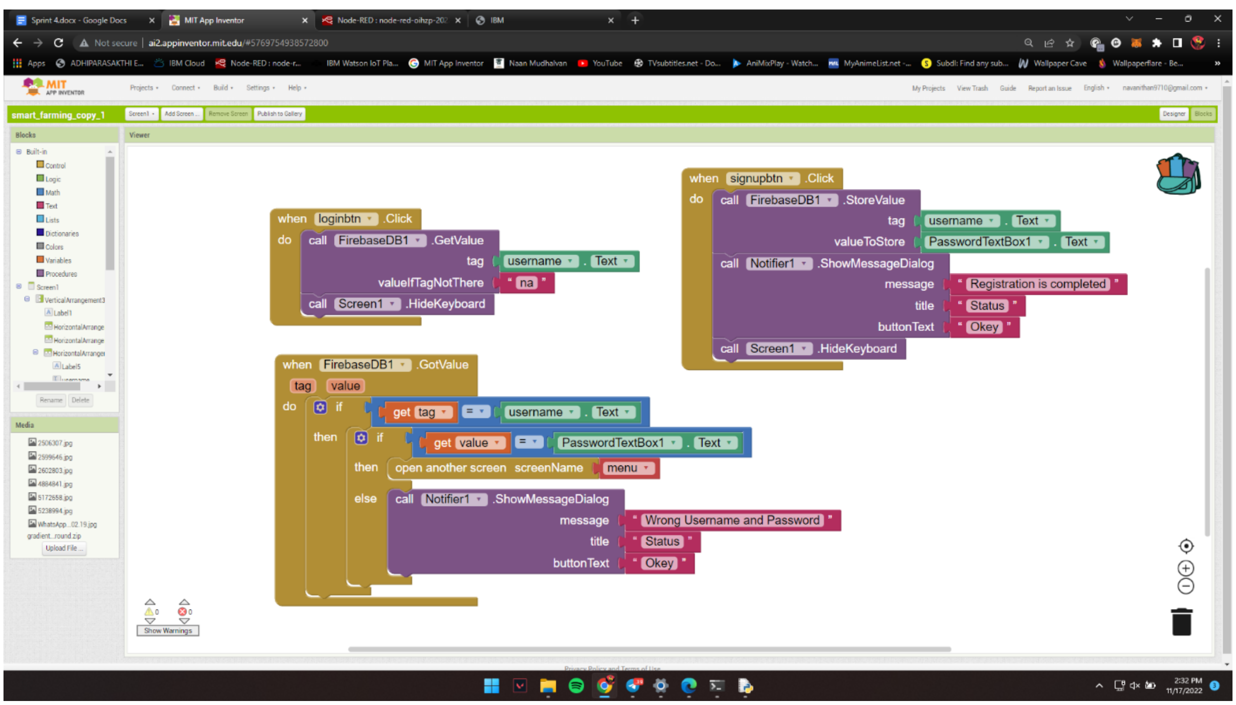


3.2 Software designing

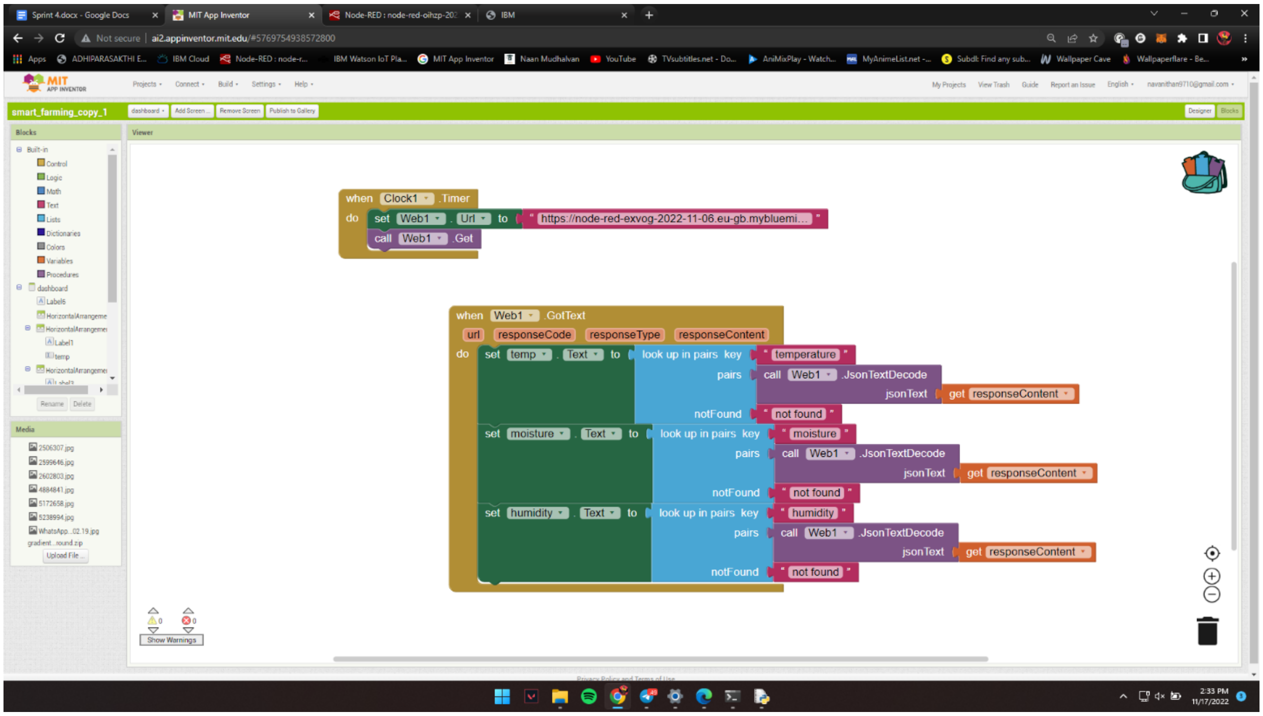




Node-RED
Deploy
Flow 1
IBM IoT
msg.payload
temperature
humidity
moisture
Temperature
Humidity
Moisture
[get] /sensor
Sensor
http
motoron
motoroff
[get] /command
IBM IoT
msg.payload
http

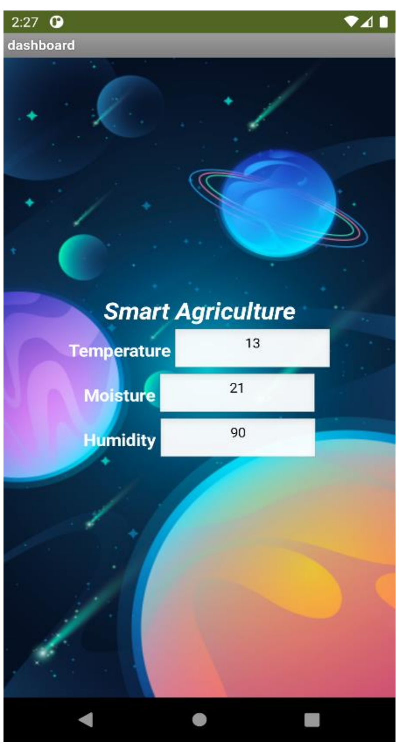


MIT App Inventor
smart_farming_copy_1
Blocks
Viewer
when loginbtn .Click
do call FirebaseDB1 .GetValue
tag username . Text
valueIfTagNotThere " na "
call Screen1 .HideKeyboard
when signupbtn .Click
do call FirebaseDB1 .StoreValue
tag username . Text
valueToStore PasswordTextBox1 . Text
call Notifier1 .ShowMessageDialog
message " Registration is completed "
title " Status "
buttonText " Okey "
call Screen1 .HideKeyboard
when FirebaseDB1 .GotValue
tag value
do if get tag = username . Text
then if get value = PasswordTextBox1 . Text
then open another screen screenName " menu "
else call Notifier1 .ShowMessageDialog
message " Wrong Username and Password "
title " Status "
buttonText " Okey "
Show Warnings



Final UI’s:

APP:

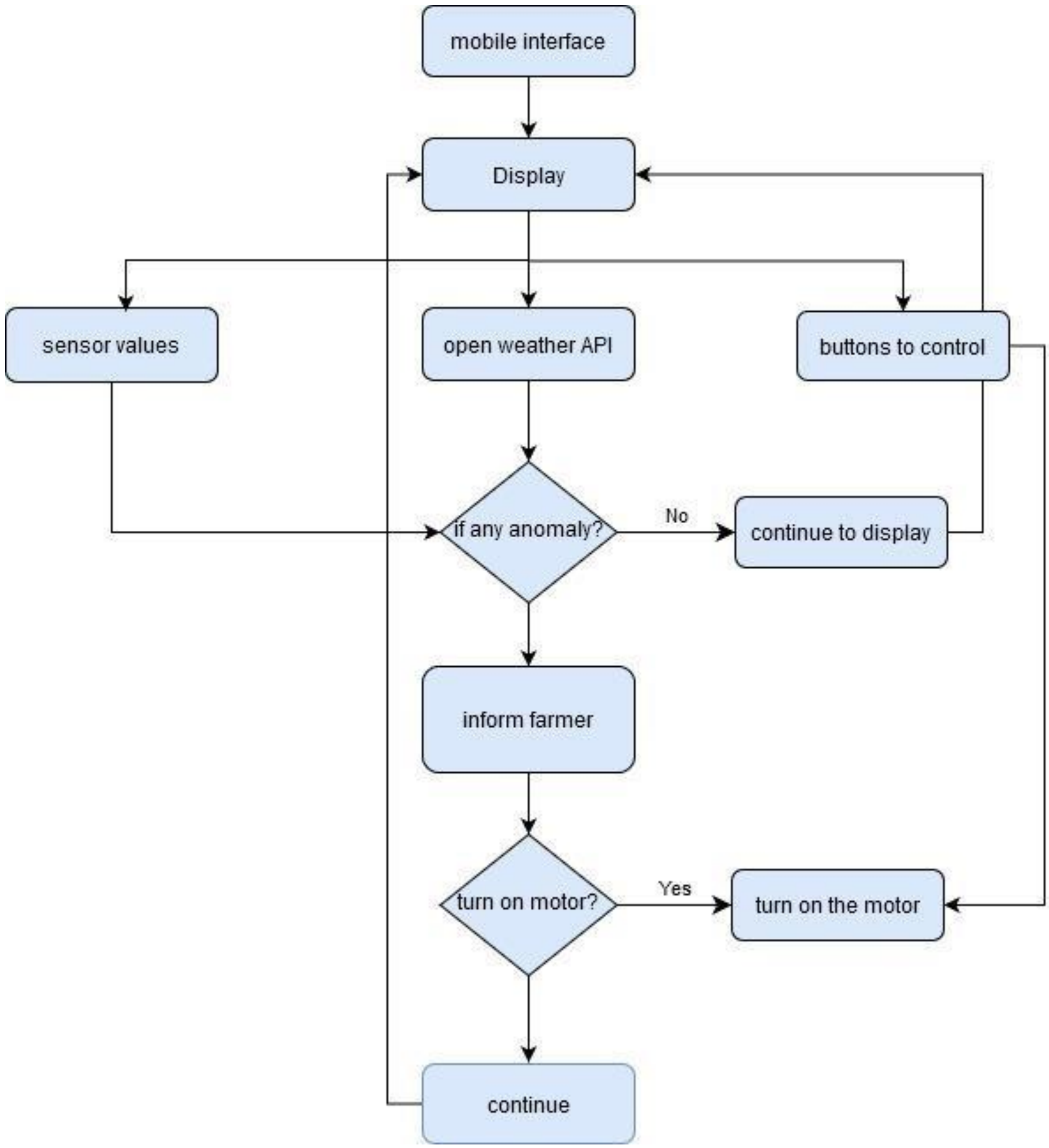


Node-Red UI:

Experimental Investigations:

The weather forecast is obtained from the Open weather API and is displayed in the node-red UI to the farmer and a threshold is set, if temperature, pressure, humidity and soil moisture goes beyond certain value the farmer get intimated and he can turn on/off the motor accordingly.

Flowchart:



mobile interface
Display
sensor values
open weather API
buttons to control
if any anomaly?
No
continue to display
inform farmer
turn on motor?
Yes
turn on the motor
continue

8 TESTING

8.1. TESTCASES

DATE: 23 NOVEMBER 2022

TEAM ID : PNT2022TMID38592

NFT RISK ASSESSMENT

SNO	Project Name	Scope/Feature	Functional Changes	Hardware Changes	Software Changes	Impact of downtime	Load/Volume Changes	Risk Score	Justification
1	smart farming - IoT Enabled Smart Farming application	New	Low	Moderate	Moderate	Low	>15 to 30%	RED	No changes seen

NFT DETAILED TEST PLAN

S.NO	Project overview	NFT Test Approach	Assumptions/Dependencies/Risk	Approval/SignOff
1	Smart farming	Stress	App crash/ Developer Team/SiteDown	Approved
2	Smart farming	Load	Server crash/ Developer Team/Server Down	Approved

S.no	Project overview	NFT Test Approach	NFR MET	Test outcome	GO/NO-GO Decision	Recommendations	Identified Defects (Detected/Closed/Opened)	Approval/SignOff
1	Smart farming	Stress	Performance	CPU-01	GO	High Performance	closed	Approved
2	Smart farming	Load	Stability	Dtabase Storage-01	NO-GO	One MongoDB instance for free	closed	Approved

8.2 USER ACCEPTANCE TESTING

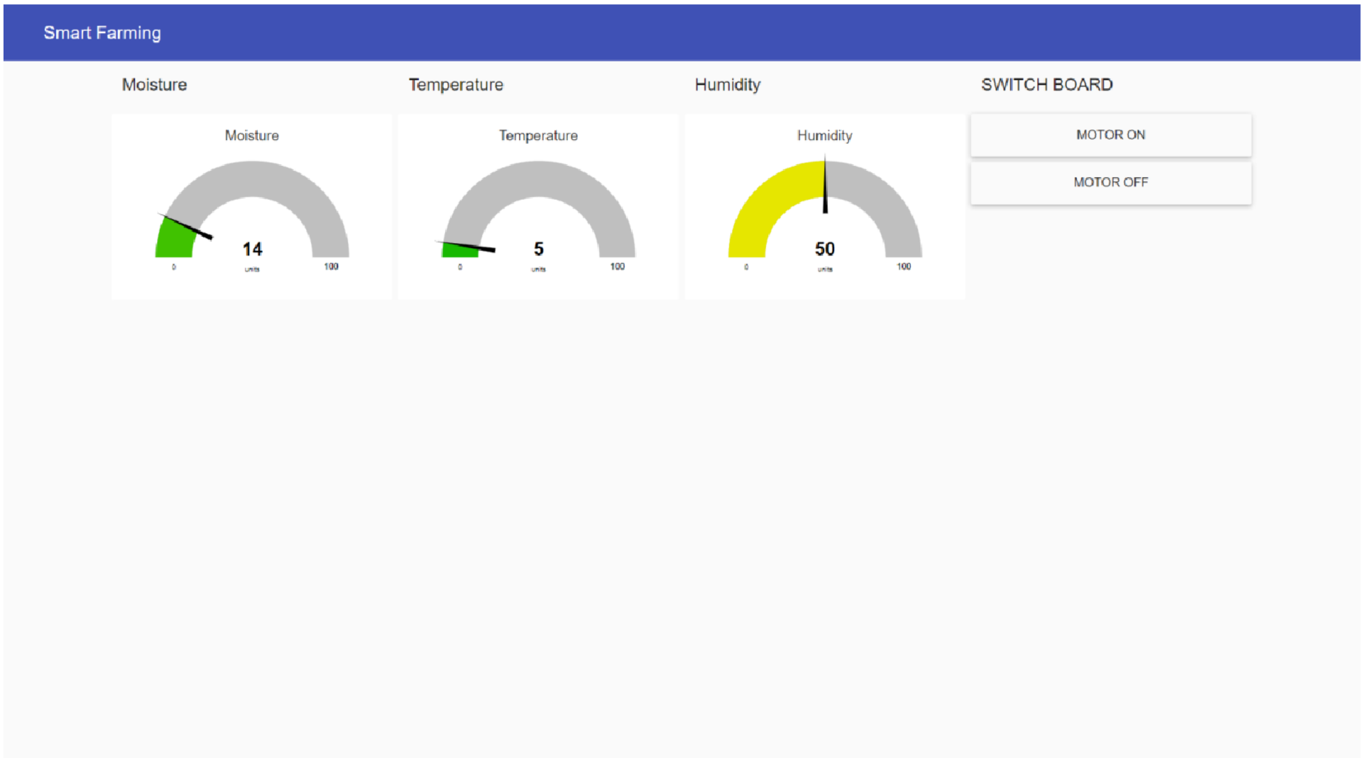
Date	24-Nov-22
Team ID	PNT2022TMID38592
Project Name	Smart Farmer-IoT enabled smart farming application
Maximum Marks	4 marks

Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Commnets	TC for Automation(Y/N)	BUG ID	Executed By
Home page	Dashboard UI	Info Page	It should get the date from the field and cloudant db	MIT App Inventor	1.Enter UserName and Password in the respected boxes. 2.Click on sign up to store the values. 3.Now click login to view the parameters. 4.If invalid password entered in password text box 5.Click on login button	http://mitapp:3000/	User should able to view the parameters	working as expected	Pass	got the exact results	yes	Nil	Senthilkumar.V
Backend	App configuration	Node.JS	It should gives the data to the info page and database	wokwi	1.Navigate to the Soil Moisture UI 2.User should see the measurement fields for Temperature, Pressure, Humidity and SoilMoisture 3. All those fields should initially	Arduino board, ESP8266, Soil Moisture Sensor	users should navigate the motor ON or OFF manually to click the button	working as expected	pass	Got the exact results	yes	nil	Narasimhan.D

9 Result:

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

9.1 PERFORMANCE METRICS



10 Advantages & Disadvantages:

Advantage:

- monitoring weather parameters such as temperature, pressure, humidity, soil moisture remotely
- controlling motors easily through buttons
- alert farmers in case of any calamities
- threshold values are set any anomalies will be reported to the farmer
- user friendly and efficient
- low cost

Disadvantage:

- sensors may sometime malfunction
- maybe inaccurate sometimes
- farmer needs internet connectivity
- farmer must have a phone and have basic knowledge to operate it

11 Conclusion:

Smart Farming and IoT-driven agriculture are paving the way for what can be called a Third Green Revolution.

The Third Green Revolution is taking over agriculture. That revolution draws upon the combined application of data-driven analytics technologies, such as precision farming equipment, IoT, “big data” analytics, Unmanned Aerial Vehicles (UAVs or drones), robotics, *etc*.

In the future this smart farming revolution depicts, pesticide and fertilizer use will drop while overall efficiency will rise. IoT technologies will enable better food traceability, which in turn will lead to increased food safety. It will also be beneficial for the environment, for example, more efficient use of water, or optimization of treatments and inputs.

Therefore, smart farming has a real potential to deliver a more productive and sustainable form of agricultural production, based on a more precise and resource-efficient approach. New farms will finally realize the eternal dream of mankind.

Future Scope:

With the exponential growth of world population, according to the UN Food and Agriculture Organization, the world will need to produce 70% more food in 2050, shrinking agricultural lands, and depletion of finite natural resources, the need to enhance farm yield has become critical. Limited availability of natural resources such as fresh water and arable land along with slowing yield trends in several staple crops, have further aggravated the problem. Another impeding concern over the farming industry is the shifting structure of agricultural workforce. Moreover, agricultural labor in most of the countries has declined. As a result of the declining agricultural workforce, adoption of internet connectivity solutions in farming practices has been triggered, to reduce the need for manual labor.

IoT solutions are focused on helping farmers close the supply demand gap, by ensuring high yields, profitability, and protection of the environment. The approach of using IoT technology to ensure optimum application of resources to achieve high crop yields and reduce operational costs is called precision agriculture. IoT in agriculture technologies comprise specialized equipment, wireless connectivity, software and IT services.

Bibliography:

https://cloud.ibm.com/login

https://openweathermap.org/

https://smartinternz.com/assets/docs/Sending%20Http%20request%20to%20Open%20weather%20map%20website%20to%20get%20the%20weather%20forecast.pdf

https://www.youtube.com/watch?v=cicTw4SEdxk

13 Appendix:

Python code for the motor is:

https://github.com/IBM-EPBL/IBM-Project-17576-1659673609/blob/main/Project%20Development%20Phase/Sprint%203/SPRINT%203.pdf

FOR UI:

https://smartinternz.com/assets/docs/Smart%20Home%20Automation%20using%20IBM%20cloud%20Services%20(1).pdf

Demo video

(1) Smart Farmer - IoT Enabled Smart Farming Application || IBM || Nalaiya Thiran Project - YouTube