TEAM ID	PNT2022TMID03184
PROJECT NAME	Project – Smart farmer-IoT enabled smart farming application.
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SMART FARMER - IOT ENABLED SMART FARMING APPLICATION

NALAIYA THIRAN PROJECT

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CHAPTER 1 - INTRODUCTION

PROJECT OVERVIEW:

Agriculture has always been the backbone of any economic development. To promote further growth of agriculture, it must be integrated with modern practices and technologies. With the wide spread acceptance of technology, it can be used in farming to make farmers perform their activity with ease. Electronics and IoT has found its application in many of the personal assistant devices. This can be extended to many vital fields like agriculture where their assistants can help solve many issues faced. Electronics can help devices get physically connected with their operational environment and analyze and collect data. IoT can help analyze and transfer the data to the user. The combination of these gives rise to an all-in-one device capable of carrying out a task.

PURPOSE:

In recent times, the erratic weather and climatic changes have caused issues for farmers in predicting the perfect conditions to initiate farming. Though on a superficial scale it seems unpredictable, it can be determined with certain parameters with which crop planning can be done. Maintenance of farm fields during and after cultivation are also important. These can be performedby measuring soil moisture, humidityand temperature.

Measurement of these parameters are performed using physical sensors. This system is in turn connected to IoT system which can provide a easyto access interface for farmers to read, analyze and take action based on the presented condition. Taking it a step ahead, the system can also gain access to motors and other electrical equipment used in farming and automate their operation. This can help with unsupervised operation ensuringaccuracy and lesser response time.

CHAPTER 2 - LITERATURE SURVEY

[1] Kolli Revanth, Shaik Mohammed Arshad, Prathibhamol C.P Department of Computer Science and Engineering, Amrita Vishwa Vidyapeetham, Amritapuri, India

This system is designed to collect the values of temperature, soil moisture, humidity etc. Also, at the same time, human detection can be analyzed from the fields which helps the motors to turn on and off which maintainsthe water level of the crop based on the requirement. Also, an algorithm is employed to predict a suitable crop and yield according to the situation.

To make the farming easy and more profitable, IoT will be very helpful in collecting the data from the fields and machine learning will play a keen role in making the prediction of crops and usage of fertilizers suitable for the soil. The system can be improved by adding more sensors like detecting the diseases and bug detection of the crops to alert the farmer in advance to take necessary precautions. Designing a platform that connects the farmers and the dealers in that area could make the farmers easy to sell the products at the best prices.

[2] CH Nishanthi1, Dekonda Naveen , Chiramdasu Sai Ram , Kommineni Divya, Rachuri Ajay Kumar1 Associate Professor, ECE Dept., Teegala Krishna Reddy Engineering College, Hyderabad, India, Teegala Krishna Reddy Engineering College, Hyderabad, India

This system concentrates on monitoring the farming conditions through sensors like Humidity, Temperature, and soil moisture; LDR is used to sense the light intensity for the farm, and also IR sensor is used to detect the pest, birds, and humans by their body temperature and alerts the user through the message format to their mobile These sensors are the interface to process module Arduino-UNO. The LCD is used to display the status of different sensors. When there is a change in temperature condition, the sensor detects and turns ON the DC and cools down the condition. After the temperature comes to a normal state, the DC fan will turn OFF . LDR (Light Dependent Resistor) is used to detect the light intensity in the farm. When the light intensity is less on the farm, the LDR senses the condition and turns ON the bulb. When the required light intensity is back, the bulb will turn OFF . The soil moisture sensor is used to sense the moisture level in soil (water level) when the water levels are reached low in the ground. The ground gets dry, and the sensor detects it, then turn ON the DC water pump. When floor gets moisturized, the DC water pump will turn OFF. The user can monitor these conditions in mobile phone with the help of WiFi module through IOT mobile site.

ADVANTAGES: This system increases the use of IOT devices and make a better crop yielding facilites. The sensors used also provide a best technological solution the all the problems.

[3] Internet of Things (IoT) based Smart Agriculture Aiming to Achieve Sustainable Goals, American International University (AIUB), Bangladesh

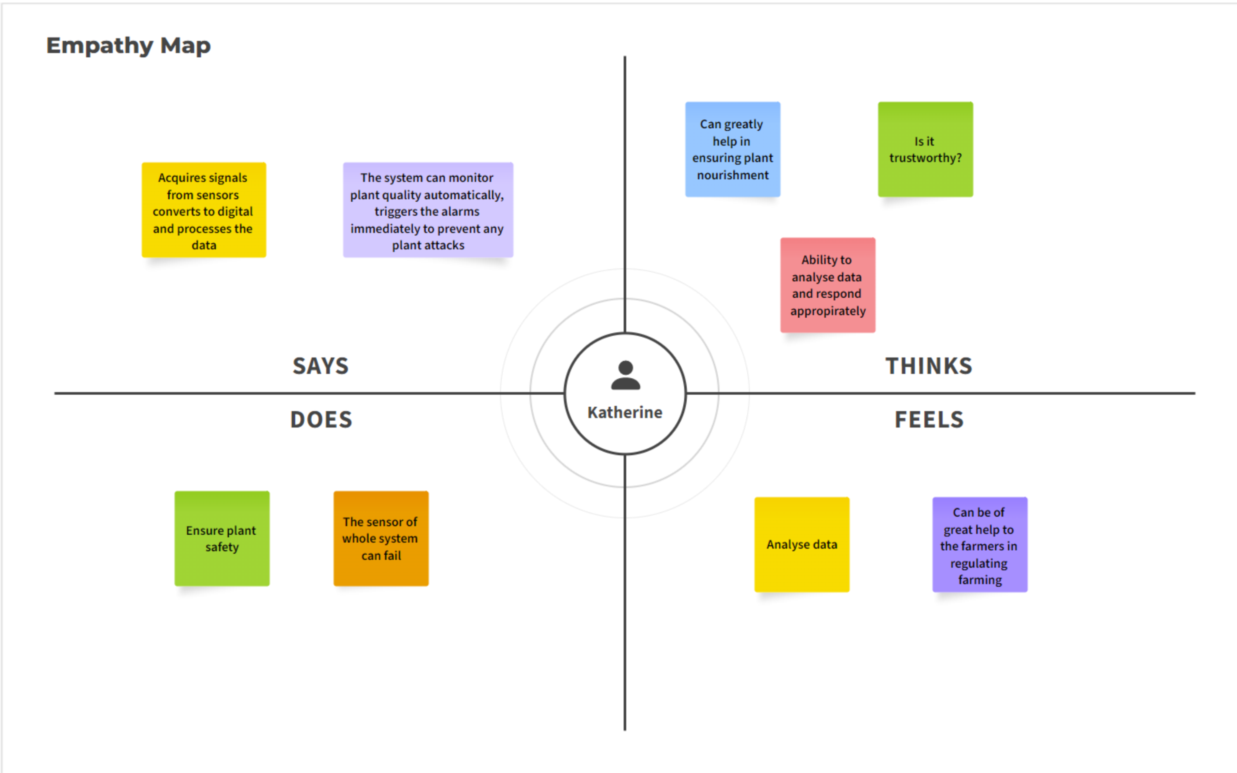
This research presents a model of IoT enabled smart agriculture. centring the model, we provide a descriptive analysis of how the IoT based smart agriculture addresses the SDG targets. The analysis suggests goal No no poverty, Zero hunger,work and economic growth, Industry, Innovation and Infrastructure and lastly goal Responsible Consumption and Production is some of the SDG targets that are expected to be addressed by the model. Like much other research, this research also inherits some limitations. This research is a simulation-based experiment; thus one might criticize that the study lacks empirical knowledge. However, Robinson et. al. purported that in the scenario where the problem description rarely contains sufficient information to make key decisions about the level of granularity, t h e conceptual model provides the opportunity to provide insightful discussions, that is appropriate for specifying behaviour characteristics.

[4] Jirapond Muangprathub, Nathaphon Boonnam, Siriwan Kajornkasirat,Narongsak Lekbangpong, Apirat Wanichsombat

The study developed a WSN model for watering crops to maximize agriculture by designing and developing a control system that connects t h e node sensors in the field to data management via smartphone and web application.

CHAPTER 3 - IDEATION AND PROPOSED SOLUTION

EMPATHY MAP



brain storming session

SHIVANI.K

Idea 1: User friendly application for farmland parameters

Idea 2: Awareness about IoT in agricultural domainthrough various applications

Idea 3: Computer visionfor detecting cropdiseases

Idea 4: Automating watering process to savewater

SHOBIKA.S

Idea 1: Usage of raspberrypi over other processor for IoT applications.

Idea 2: Deciding the specification of sensors to be deployed based on the rangeof operation per square feet of farmlands.

Idea 3: Protection case for sensors to avoid wear and tear during adverse conditions.

Idea 4: Using RF basedcommunication along with IoT protocols todeliver data.

SHRI RAM S R.

Idea 1: A website guide aboutthe product and features

Idea 2: Provision through application to remotely controlagricultural instruments

Idea 3: Data collection about various fieldparameters

Idea 4: Features in website to control agricultural actuators

SHRI YAZHINI .R

Idea 1: Various protocols used in IoT.

Idea 2: Application withsimple UI but efficient usage.

Idea 3: Interface between website, application and sensors.

Idea 4: Utilizing ai toimprovise accuracy.

Problem Solution fit

Define CS, fit into CC

1. CUSTOMER SEGMENT(S)

CS

Who is your customer?
i.e. working parents of 0-5y.o. kids

The customer for this project is Farmer

6. CUSTOMER CONSTRAINTS

CC

What constraints prevent your customers from taking actionor limit theirchoices
of solutions? i.e. spending power,budget, no cash,network connection, available devices.

Internet Connection is the main Constraints. Availability of network,Budget,proper knowledge about the application are also some of the constraints

5. AVAILABLE SOLUTIONS

AS

Which solutions are available to the customers when they facethe problem
or need to get the job done?What have theytried in the past? Whatpros & consdo these solutions have?
i.e. pen and paperis an alternative to digitalnotetaking

Using Sensors the work can be made simple. Irrigation process is automated.Datas are collected and processed to automate the irrigation process

Explore AS, differentiate

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

2. JOBS-TO-BE-DONE / PROBLEMS

J&P

Which jobs-to-be-done (or problems) do you addressfor your customers? Therecould be morethan one; explore different sides.

Smart Farming inclues IOT and this integrates the hardware and software part helping to make the automation easylike the irrigation facilities.The weather API is

9. PROBLEM ROOT CAUSE

RC

What is the real reason that this problem exists? Whatis the back story behindthe need to do this job?
i.e. customers have to do it becauseof the changein regulations.

No Proper knowledge about sensors and technology.Frequent changes and unpredictable weather and climate made it difficult for farmers.Fields are difficultto monitor when the farmer is not at the field leading to crop damage.

7. BEHAVIOUR

BE

What does your customer do to address the problem and get the job done?
i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend freetime on volunteering work (i.e. Greenpeace)

Creating awarness about this technology
and educating farmers about all the new technology. Use a proper drainage system to overcome the effectsof excess water from heavy rai.

Focus on J&P, tap into BE, understand RC used to help farmers make decisionsthrough mobile applications

Identify strong TR & EM

1. TRIGGERS

TR

What triggers customers to act? i.e. seeing theirneigh bour installing solarpanel s, reading abouta more efficient solution in the news.

To produce more crops and doing a better farming

2. EMOTIONS: BEFORE / AFTER

EM

How do customers feelwhen they facea problem or a joband afterwards?

i.e. lost,insecure > confident, in control - use it in

10. YOUR SOLUTION

SL

If you are working on an existing business, write downyour current solution first,fill in the canvas, and check how much it fits reality.

If you areworking on a new business proposition, then keepit blank untilyou fill inthe canvas and come up with a solution that fits within customer limitations, solvesa problem and matches customer behaviour.

Less weed growth increa se crop producti on Control soil erosion.

1. CHANNELS of BEHAVIOUR

CH

a. ONLINE

What kind of actionsdo customers takeonline? Extract onlinechannels from #7

Providing proper knowledge about the technologyand educating them.

b. OFFLINE

What kind of actions do customers takeoffline? Extract offlinechannels from #7and use them forcustomer development.

Awareness programs must be conducted.

Extractonline & offlineCH of BE

yourcommunication strategy &design.

As this technology help farmers to minimize their work and crop productivity will also increases.

CHAPTER 4 - REQUIREMENT ANALYSIS

FUNCTIONAL REQUIREMENTS:

NO:	**REQUIREMENTS**	**SUB-TASK**
1	REGISTRATION	USER CAN REGISTER USING EMIAL
2	CONFIRMATION	OTP IS SENT TO EMAIL.USER CAN CONFIRM THE EMAIL BY ENTERING THE OTP.
3	LOGIN	AFTER CONFIRMATION THE USER CAN LOGIN.
4	CHECK CREDENTIALS	USER CAN CHECK THE CREDENTIALS GIVEN
5	MANAGE MODULES	1.MANAGE SYSTEM ADMINS 2.MANAGE ROLES 3.MANAGE USER PERMISSSION
6	LOGOUT	AFTER COMPLETING USER CAN LOGOUT

NON-FUNCTIONAL:

NO	**REQUIREMENTS**	**DESCRIPTION**
1	Usability	Usability includes easy learn ability, efficiency in use, remember ability, lack of errors in operation and subjective pleasure
2	Security	Sensitive and private data must be protected from their production until the decision-making and storage stages.
3	Reliability	The shared protection achieves a better trade-off between costs and reliability. The model uses dedicated and shared protection schemes to avoid farm service outages.
4	Performance	the idea of implementing integrated sensors with sensing soil and environmental or ambient parameters in farming will be more efficient for overall monitoring.

<u>5</u>	Availability	Automatic adjustment of farming equipment made possible by linking information like crops/weather and equipment to auto -adjust temperature, humidity, etc
<u>6</u>	Scalability	scalability is a major concern for IoT platforms. It has been shown that different architectural choices of IoT platforms affect system scalability and that automatic real time decision -making is feasible in an environment composed of dozens of thousand

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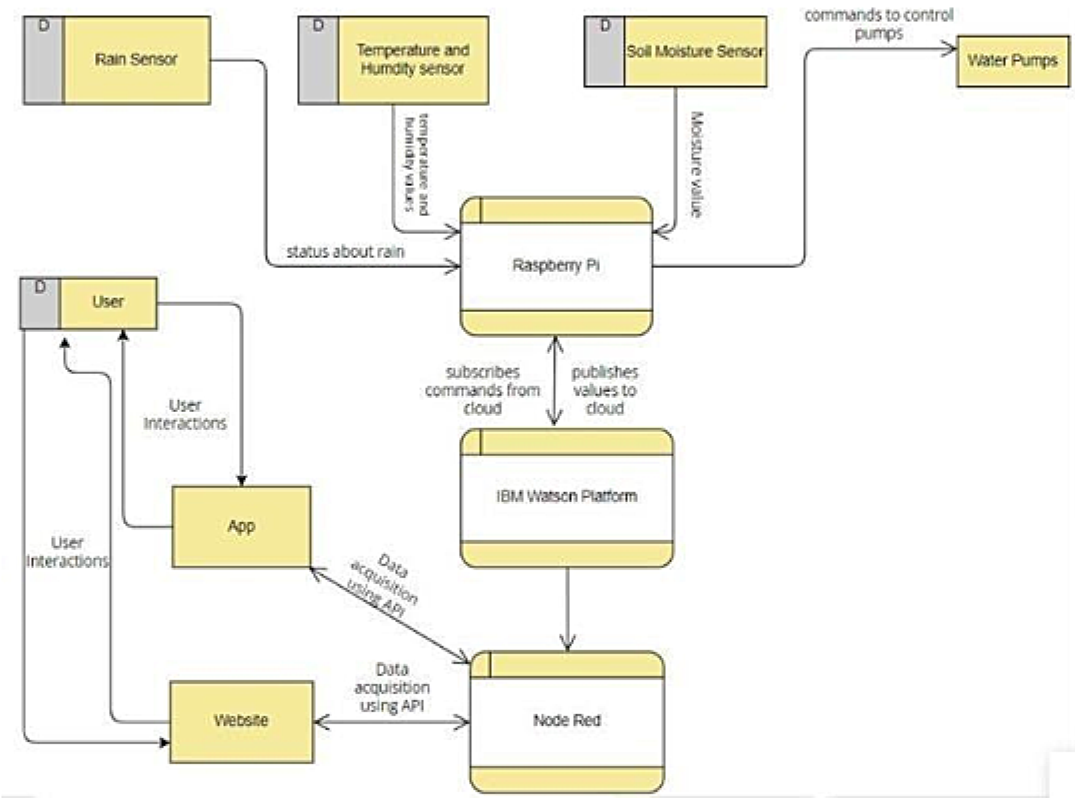
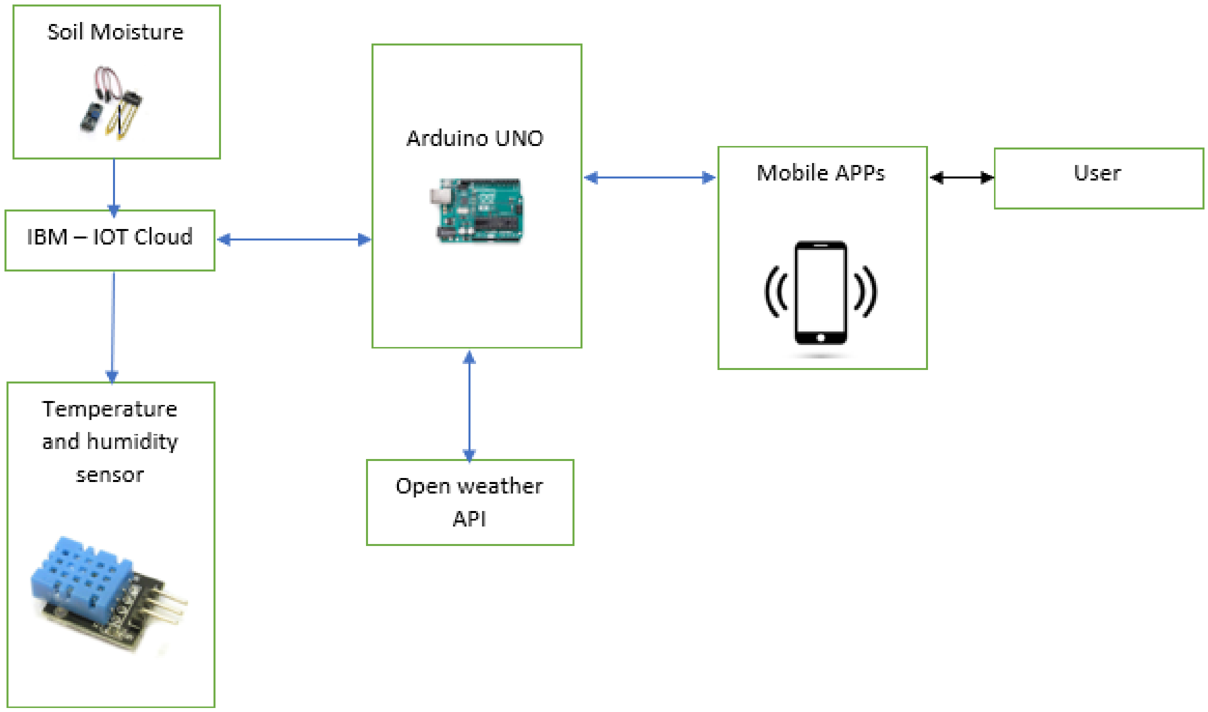
CHAPTER 5 - PROJECT DESIGN

Data Flow Diagrams:



Solution and Technical Architecture



- The different soil parameters (temperature, humidity, Soil Moisture) are sensed using different sensors, and the obtained value is stored in the IBM cloud.

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

- Node-red is used as a programming tool to wire the hardware, software, and APIs. The MQTT protocol is followed for communication.

- All the collected data are provided to the user through a mobile application that was developed using the MIT app inventor. The user could make a decision through an app, whether to water the crop or not depending upon the sensor values. By using the app they can remotely operate the motor switch.

CHAPTER 6 - PROJECT PLANNING AND SCHEDULING

Delivery and Schedule

NO:	TITLE	DESCRIPTION	DURATION
1	Literature survey	Literature survey on the selected project & gathering information by referring the, technical papers, research publications etc.	2 Days

2	Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements.	2 Days
3.	Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	2 Days
4.	Problem Solution Fit	Prepare a document of problem solution-Fit	3 Days
5	Solution Architecture	Prepare solution Architecture document.	1 week
6.	Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application	1 week
7	Data Flow Diagrams	Preparing a data flow diagram	2 days
8.	Technology Architecture	Preparing a technology architecture diagram	1 week
9.	Sprint Delivery	Prepare the Sprint delivery on Number of Sprint planning meetings organized, Minutes of meeting recorded.	1 week
10	Milestone & Activity List	Preparing a document on milestone and activity list	2 days
11.	Project Development	Final stage of developing the project	1 week

Velocity:

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

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

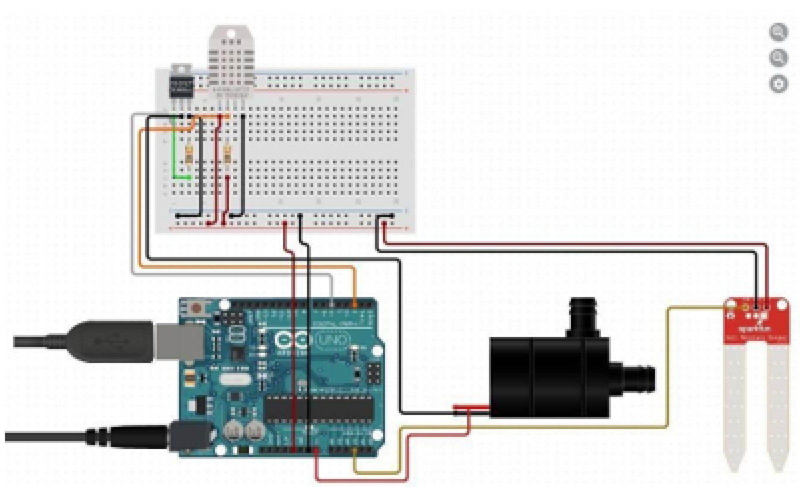
CHAPTER 7 - CODING AND SOLUTION

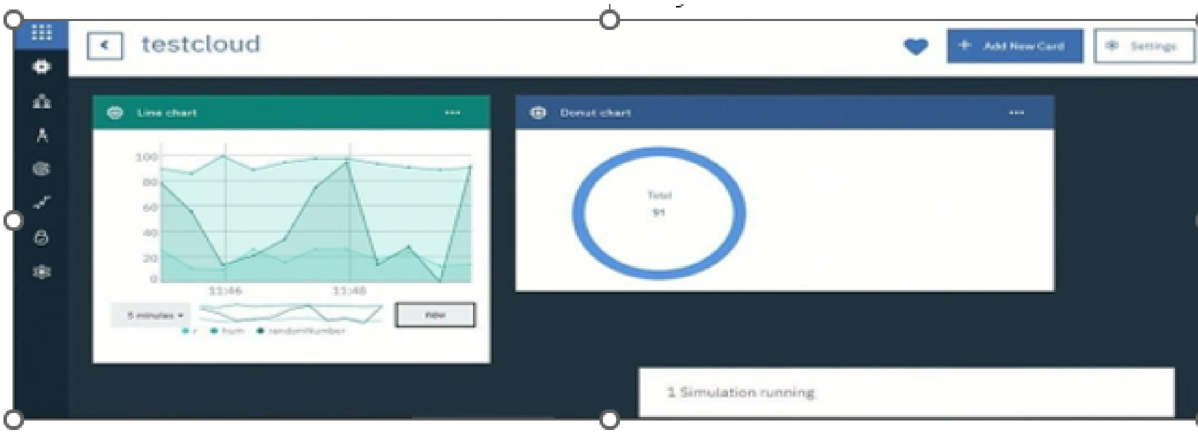
Connecting Sensorswith Arduino using C++ code

```
#include      "Arduino.h"
#include"dht.h"
#include "SoilMoisture.h"

#definedht_apin A0
const int sensor_pin = A1; //soilmoisture int
pin_out= 9;dht DHT; int c=0; void setup()
{
pinMode(2, INPUT); //Pin 2 as INPUT pinMode(3,
OUTPUT); //PIN 3 as OUTPUT pinMode(9,
OUTPUT);//output for pump
}    void
loop()
{
  if (digitalRead(2) == HIGH)
  {
  digitalWrite(3, HIGH);          //turn the LED/Buzz ON
  delay(10000); // wait for 100 msecond digitalWrite(3, LOW);
  // turn theLED/Buzz OFF delay(100);
  }
```

```
{
 Serial.begin(9600);
   delay(1000);
  DHT.read11(dht_apin);        //temprature        float
h=DHT.humidity;

float                 t=DHT.temperature;
delay(5000);      Serial.begin(9600);
float     moisture_percentage;     int
sensor_analog;
sensor_analog                          =
analogRead(sensor_pin);
moisture_percentage = ( 100 - ( (sensor_analog/1023.00)
*  100  )  );  floatm=moisture_percentage;  delay(1000);
if(m<40)//pump
{ while(m<40)
{
digitalWrite(pin_out,HIGH); //open pump sensor_analog
=analogRead(sensor_pin);
moisture_percentage = ( 100 - ( (sensor_analog/1023.00) * 100 )
); m=moisture_percentage; delay(1000);
}
digitalWrite(pin_out,LOW);             //closepump
} if(c>=0)
{
```

```
  mySerial.begin(9600);
  delay(15000);Serial.begin(9600); delay(1000);
  Serial.print("\r"); delay(1000);

  Serial.print((String)"update->"+(String)"Temprature="+t+(String)"Humidity="+h+(String)"Moisture="+m); delay(1000);

    }

}
```





Building Project

Connecting IoT Simulator to IBM WatsonIoT Platform

Give the credentials of your device in IBM Watson IoT PlatformClickon connect

My credentials given to simulator are:

You can see the received data in graphsby creating cardsin Boards tab

You will receive the simulator data in cloud

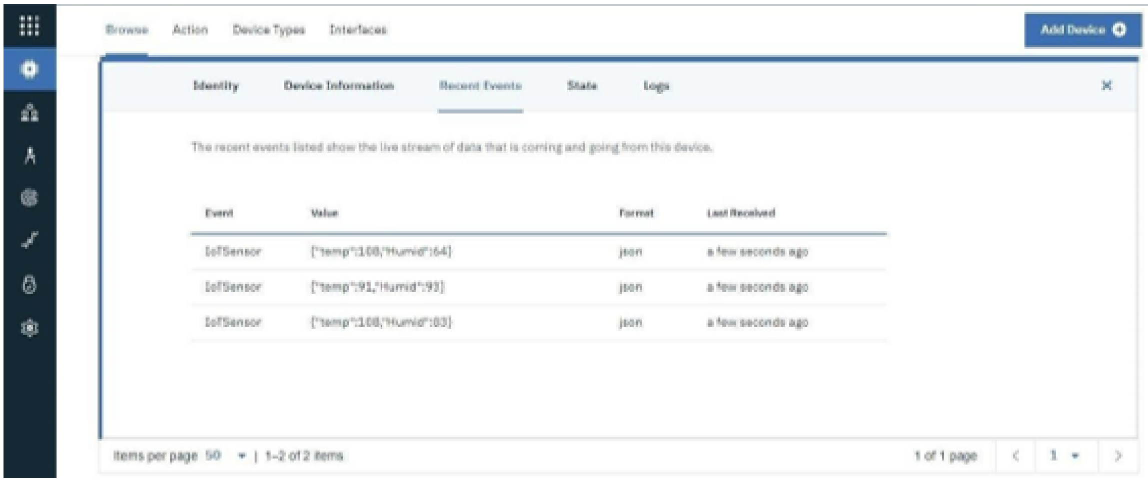
You can see the received data in RecentEvents under your device

Data receivedin this format(json)

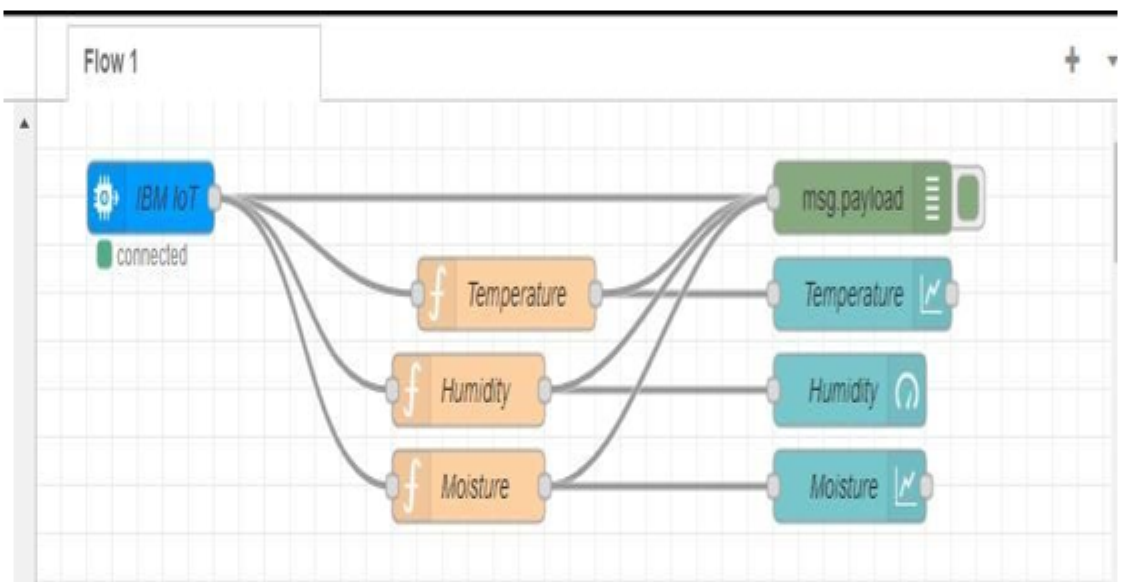
{
"d": {

"name": "abcd",
"temperature": 17,
"humidity": 76,
"Moisture ":25
}

}



Configuration of Node-Red to collect IBM cloud data
The node IBM IoT App In is added to Node-Red workflow. Then the appropriate device credentials obtained earlier are entered into the node to connect and fetch device telemetry to Node-Red.



CHAPTER 8 - ADVANTAGES AND DISADVANTAGES

Advantages:

i. By monitoring the soil parameters of the farm, the user can have a completeanalysis of the field, in terms of numbers.

ii. Using the website and the application, an interactive experience canbe achieved.

iii. As the data gets pushed to the cloud, one canaccess the data anywhere from this world. ○ Without human intervention, water pump can be controlled throughthe mobile application and it's flowcan be customized using servo motors.

iv. By using Raspberry Pi MCU, scalability can be increased due to its high processing powerand enough availability of GPIO pins

Disadvantages:

v. Data transfer is through the internet. So data fetch and push might delay due to slow internetconnection, depending on the locationand other physical parameters.

vi. System can only monitora certain area of the field. In order to sense and monitor an entire field, sensorsshould be placedin many places,which may increasethe cost.

vii. Data accuracy may vary according to various physical parameters such as temperature, pressure, rain.

viii. Cost of the system is high due to usage of Raspberry Pi. ○ Rodent and insects may cause damageto the system.

CHAPTER 9 – CONCLUSION

The project thus monitors important parameters presentin the field such as temperature, humidity, soil moisture etc., and controls important actuators such as motors etc. It is helpful for farmers to remotely monitor their fields even during adverse weatherconditions and help them controlfarming equipments remotelyusing cloud.

CHAPTER 10 - FUTURE SCOPE

The project can be further extended by monitoring other parameters such as nutrient contents in the soil, soil texture etc. AI techniques integrated with cloud can be integrated to monitor any pest attacks present in the plant. The application can be made interactive which provides suggestions to farmers toimprovetheir farmlands.

GITHUB LINK:
https://github.com/IBM-EPBL/IBM-Project-11973-1659363967