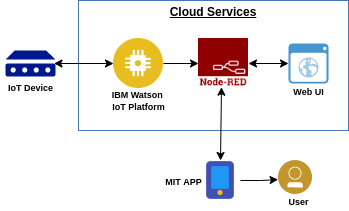
**REPORT**

|  |  |
| --- | --- |
| Date | 19 November 2022 |
| Team ID | PNT2022TMID22393 |
| Project Name | Smart Farmer -IOT Enabled Smart Farming Application |

**Abstract:**

* IoT-based agriculture system helps the farmer in monitoring different parameters of his field like soil moisture, temperature, and humidity using some sensors.
* Farmers can monitor all the sensor parameters by using a web or mobile application even if the farmer is not near his field. Watering the crop is one of the important tasks for the farmers.
* They can make the decision whether to water the crop or postpone it by monitoring the sensor parameters and controlling the motor pumps from the mobile application itself.

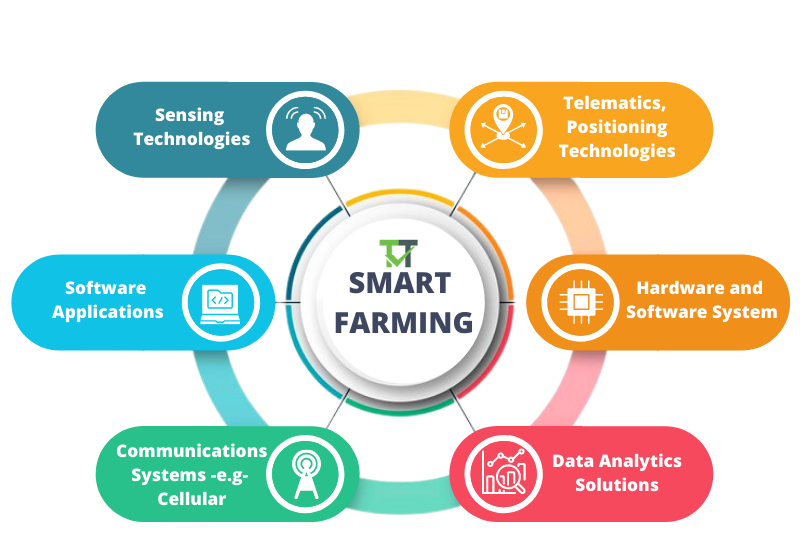
**Block Diagram:**



**Literature Survey on IOT Enabled Smart Farming Application**

**1) Introduction of the Internet of Things**

* ITU (International Telecommunication Union) defined the Internet of things as:
* “IoT is a technology that mainly resolves the interconnection between human to a thing, thing to thing, and human to human.” IoT is a world-shattering technology that signifies the future of computing and information interchange. It is based on the communication between intelligent sensors, RFID (radio-frequency identification), GPS (global positioning systems), infrared sensors, remote sensing, mobile communication, and other communication networks. It refers to a network of objects and is often a self-configurable wireless network. The basic purpose of IoT is to make a huge network by the combination of diverse sensor devices such as GPS, RS, RFID, laser scanner, and networks to comprehend the information sharing of global things. IoT can encompass millions of networked embedded smarts devices also called smart things; these smart things are capable of accumulating information about themselves, their environment, and associated smart devices and interconnect this information to other devices and systems via the all connecting Internet.
* IOT applications include diverse areas including transportation, smart agriculture, atmosphere, marketing, supply chain management, health care, infrastructure monitoring, etc.. To achieve a comprehensive perception, intelligent processing and reliable transmission between information sensing equipment and systems, all physical objects can be individually interconnected and addressable in accordance with agreed protocol according to the needs of different applications.



**2) Problem Statements**

* This paper focused on a basic trade that is Agriculture, which is closely related to
* the welfare of any nation and the people’s livelihood. In India, Agriculture
* sector is shrinking day by day which disturbs the ecosystem’s production capacity.
* There is a burning requirement to resolve this problem in the area to reestablish
* vitality and place it back on higher progression.
* The reemerging of the worldwide recession has caused flows across both the
* developed and the developing economies. Agriculture domain required to be
* more competent and irrepressible to ensure universal food security. Farmers of
* India are at excessive detriment in terms of technology, size of farms, government, policies, trade, etc. The Internet of Things technology can diminish some of the problems of Indian farmers.
* While in the world, agriculture is experiencing industrialization, it is very significant to develop “agricultural information network”. Agricultural information network has become the trend of enlargement for the world’s agriculture.
* In concern of the Indian agriculture development, “agricultural information network” is a major concern in stimulating agricultural development and its transformation.
* In India, there are many problems in the agricultural information system. For
* example, here more importance is given to hardware instead of software and cannot deliver high eminence information to get production requirements of farmers. Besides, information is not adequately used by the farmers of India and the influence of information on a rural area, agriculture, and farmers are not remarkable.
* The demand and supply of agricultural products has not been controlled properly, because of the demand and the consumption of the agricultural crops could be anticipated quantitatively, nevertheless, the deviation in crop and production by the weather change, change in cultivated area of farms, damage by insects, disease in crop, etc., could not be truly predicted. To change this situation and endorse the speedy development of agricultural information network, it is required to use the Internet of Things to appreciate smart agriculture.

**3) Applications of IoT in Agriculture**In the domain of digital Agriculture, IoT supports a variety of applications like soil and plant monitoring, crop growth observing and selection, precision agriculture, irrigation assessment support, greenhouse environment monitoring and control systems, monitoring of food supply chain etc. . Following are the established technologies that are used in applications of IoT in agriculture:

* Sensor Technology in Agriculture: Vast variety of sensors are used in agricultural
* products such as soil moisture sensors, water-level sensors, equipment used to
* sample the state of the atmosphere at a given time meteorological sensors (monitors the current state of atmosphere), heavy metal detection sensors, biosensors (detection of an Analyte), gas sensors (detects presence of gas), and so on.
* RFID Technology: RFID is extensively used in animal tracking and identification.
* It helps to achieve intelligent monitoring, recognizing, traceability of animals, and their management.
* Radio Transmission Technology in Agriculture: Self-organizing wireless data
* transmission can be achieved with ZigBee wireless sensor networks.
* In large-scale farming, it has been widely used for data transmission.
* Intelligent irrigation Technology: Based on satellite positioning network and
* “shallow wells underground cables + field + automatic irrigation system pipe”
* technology, it can accumulate irrigation water, irrigation, electricity, and time data to accomplish automation of farmland irrigation and through a complete analysis of information technology software to monitor irrigation.
* Technical Quality Safety of Agricultural Products: In the agricultural industrial
* chain (production–circulation–sales) , recording and monitoring of the chain can
* understand the entire procedure of regulation.
* Precision Seeding and Spraying Techniques: Depending on the technology
* combined with Global Positioning System (GPS) navigation technology, seeding
* technology, and fertilization at a variable rate, it can achieve identical implementation of the spraying, planting, and refining the consumption of pesticides, seeds, and so on.

**4) Benefits of IOT in Agriculture**

* There are various benefits and advantages to use IoT in agricultural sector some of the benefits are as follows:
* Efficiency of input: It will improve the efficiency of inputs of agriculture like Soil,
* Water, Fertilizers, Pesticides, etc.
* Cost reduction: It will reduce the cost of production.
* Profitability: It will increase the profitability of farmers.
* Sustainability: Improves sustainability.
* Food safety: It will help to accomplish the Food Safety Mission.
* Environment protection: It plays important role in the environment protection.

**5) Literature Review**

* This paper discusses the various applications of IoT and cloud computing in the
* field of agriculture and forestry. According to the text, the use of IoT plays an
* important role in smart agriculture. The basic technologies of IoT like laser scanner, RFID, photo acoustic electromagnetic sensors, etc. these technologies can be used to make great innovations in agricultural. Basically in agricultural information transmission, precise irrigation, intelligent cultivation control, agricultural product safety, and many more. This paper also focuses some applications of IoT in forestry.
* IoT can play an important role in forest identification and wood tracking and
* its management. Finally, this paper concludes that the integration of IoT and cloud computing has become a tendency.
* In this research work, possible applications of the Internet of Things in
* agriculture for sustainable rural development has been identified. Various business opportunities related to agriculture domain and its benefits that can be generated, using the Internet of Things is discussed in this text. This literature is intended to stimulus strategy on the acceptance of IoT in agriculture and rural development.
* According to the literature, developers can use IoT technologies to build
* country-specific technologies based on the agricultural domain. Development of
* technology will uplift the standard of people and support poverty alleviation.
* In this research work , many challenges related to the agricultural domain
* were, addressed. An architecture was also framed for meeting these challenges.
* According to the text of this paper, farmers should be guided on the right time
* during different stages of crop growth. In this research work, a knowledge base is created. This knowledge base has various crop details. These crop details speak about knowledge acquisition, market availability, geospatial data flow and the weather prediction data. Monitoring module includes monitoring of various stages of growing plant, calamity check, planning for irrigation, crop profit calculation, etc. Per day need of water of a plant is calculated using evapotranspiration method.
* This method is based on the devised algorithm. At last, a comparative study was
* prepared among several applications existing developed system, having properties like efficiency, the knowledge base, reliability and monitoring modules.
* This research work explains the importance of cloud computing in IoT and
* the importance of these two technologies in Agricultural System. In this paper, it is discussed that IoT is closely correlated to cloud computing. The relation between IoT and cloud computing was explained in such a way that IoT gets influential computing tools with cloud computing. In this research work, an agricultural information cloud is assembled. In this agricultural information cloud, smart agriculture system is constructed through the assemblage of the Internet of Things and RFID. Component of IoT generates a large amount of data like data generated by using RFID, sensors, wireless communication etc. this large amount of data is handled by agricultural information cloud. It is concluded that, in the agricultural information network, hardware resources are integrated into the resource pool for achieving the dynamic distribution of resources and to balance the load, it improves the efficiency of resource use.
* In this paper, an application prototype for precision farming using a wireless
* sensor network with an IoT cloud is proposed. In this work, an alert system for the control of water stress of plants using IoT technology was presented. The first part of this paper described the steps of the creation of the decision support system intended for an agricultural community in order to be able to estimate the quantities of water required. For irrigation management, the farmer will on the benefit from a dashboard software in the form of a graph, to monitor in real time the variations of the soil conditions and on the other hand, a process of notification by SMS will be transmitted via the application when a critical level is reached to avoid water stress.
* This application can be improved to make it a very sophisticated one envisages the integration of the method of evapotranspiration to calculate the water requirement of a plant per day in the system of decision support.
* In the paper, a “Greenhouse monitoring system” with a combination of
* wireless communications and Internet is proposed. The “greenhouse monitor system”, designed using IoT has the definite precision of control and monitor, it is very easy to operate and the interface of this system is user-friendly and this system offers real-time monitoring of the environmental parameters in the greenhouse. This system also has some characteristics like high performance, run reliable and can be improved easily.
* This paper explains the architectural components of Internet of Things,
* shows some application areas where Internet of Things is applicable, discussed
* about some challenges that have to be discussed along with the securities issues that require consideration like extensive deployment, standardization, interoperability, security of data, efficient spectrum usages and unique identification, gathered object safety, security, and energy consumption. IoT getting rapid momentum due to advances in sensing, actuating, and RFID technologies. It aims at blending the virtual world with the real world seamlessly.
* In this research work, a platform Phenonet is developed using an
* open-source platform called Open IoT. Phenonet is basically a semantically
* enhanced digital agriculture use case. This paper demonstrated the applications and efficiency of Phenonet in a number of use cases. The researchers demonstrated that how an Open loT platform can help to handle the challenges encountered by the Phenonet application. In project Phenonet, the basic concept of the collection, validation, processing, annotation, and storing of data captured from smart sensors in the field has been proposed. The related semantic queries, reasoning, and experimental results are presented.
* In this paper, an application for precision agriculture, a customized architecture
* for agriculture, based on IoT is presented. This is a cloud-based IoT
* architecture. This project is applicable to various precision agriculture applications.
* The research proposed a three-layer architecture. The first layer collects the environmental information and supplies for needed actions. The second layer is a gateway layer, this layer connects the front-end and back-end via Internet or network in which data can be stored and processed. Researchers built a prototype of this architecture to test and illustrate its performance. The efficiency of the proposed architecture is demonstrated by the performance evaluation results.

**6) Conclusion**

* Issues regarding agriculture, rural area, and farmers have been always deterring
* India’s growth. Agricultural modernization is the only solution to these three
* problems. Still, India’s agriculture is far away from modernization. The use of IoT in agricultural modernization will possibly solve the problems. Based on features of IoT and cloud computing, cloud service, SOA (service-oriented architecture) and visualization technologies can generate huge data involved in agricultural production.
* RFID with IoT technologies can help to build plant factory that can control
* agricultural production automatically. A perfect use of modern technology and IoT and blend of them can stimulate the rapid development in the modernization of agricultural system. Use of smart IoT in agriculture could effectually solve the
* issues concerning farmers, agriculture, and rural area.
* According to the above analysis, information technology personnel and agricultural scientist should be encouraged to exchange ideas. Especially, those personals understand planting and understand IT can innovate and promote the
* modernization of farming. Modernization of farming can improve agricultural
* production and management, the goal of environmental protection and energy
* saving could be achieved. By using IoT in agricultural, farmers would be able to
* understand the current choice of agricultural soil, they would be able to know which crops are appropriate for farming in the current stage, other environmental information of farmland, through intelligent analysis and better management.
* In the meantime, the following scenario could be seen: Instead of toiling the field
* in hot water, farmers would be able to manipulate on computers like a mobile phone or on some intelligent tools, to understand watering, cultivating, seeding, reaping, then they can easily finish heavy farm labor. Continued and rapid development of microelectronic technology, network technology is an opportunity for professionals to actively explore the technological development of modern agriculture. Use of Internet of Things is playing important role in the development of world’s modern and smart agriculture which sets a foundation for industrial development.

**Empathy Map Canvas:**

* An empathy map is a simple, easy-to-digest visual that captures knowledge about a user’s behaviours and attitudes.
* It is a useful tool to helps teams better understand their users.
* Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user’s perspective along with his or her goals and challenges.

**Example:**

Diagram

Description automatically generated

**Brainstorm & Idea Prioritization Template:**

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions.

Graphical user interface, application

Description automatically generated

**Customer Problem Statement Template:**

Create a problem statement to understand your customer's point of view. The Customer Problem Statement template helps you focus on what matters to create experiences people will love.

A well-articulated customer problem statement allows you and your team to find the ideal solution for the challenges your customers face. Throughout the process, you’ll also be able to empathize with your customers, which helps you better understand how they perceive your product or service.

**Problem Statement 1:**

Reference: <https://miro.com/app/board/uXjVPLp3anE=/?share_link_id=900547452917>



**Problem Statement 2:**

Reference: <https://miro.com/app/board/uXjVPLp3apg=/?share_link_id=796111599183>



**Proposed Solution Template:**

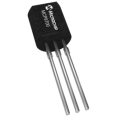
Project team shall fill the following information in proposed solution template.

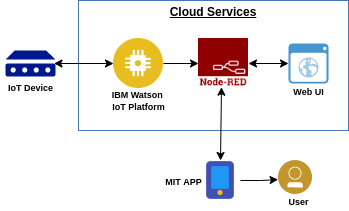
|  |  |  |
| --- | --- | --- |
| **S.No.** | **Parameter** | **Description** |
|  | Problem Statement (Problem to be solved) | * Supplying water to the land is one of the challenging tasks for the farmers. * Getting proper internet connection at every area in village is a difficult task. * The biggest challenge in smart farming toward farmers is lack of information, cost and illiterate. |
|  | Idea / Solution description | * Smart Farming enables farmers to monitor and maintain the temperature and humidity level accordingly. * Giving a free knowledge session to the farmers get aware of do’s and don’ts in the smart farming application. |
|  | Novelty / Uniqueness | * IoT sensors collect data from the farming environment such as humidity, temperature, soil moisture, pest images, and then transmit data to the cloud services. * So the farmers can operate the motor from anywhere. |
|  | Social Impact / Customer Satisfaction | * It makes the labours jobless. * It saves a lot of time. * Damage to the crops can be avoided. * It makes wealthy society. * Maintenance needs can be easily identified. * Reduces the wages for the labours working in the agricultural field. |
|  | Business Model (Revenue Model) | * By collecting the fair amount of money from the person who crossed the barrier which was used to protect the crops. * By making use of the mobile applications for tracking the information on soil, water and air. |
|  | Scalability of the Solution | * Scalability in smart farming refers to the adaptability of a system to increase the capacity. Eg, the number of technology devices such as sensors and actuators, while enabling timely analysis. |

**Solution Architecture**

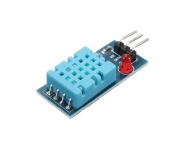
Temperature sensor

senor



****

Humidity  
sensor



****

Soil moisture

* The various soil parameters such as temperature, humidity, soil moisture are sensed using various sensors and the values obtained are stored in the IBM cloud.
* Arduino UNO is used as a processing unit that process the data obtained from sensors and weather data from weather API.
* Node Red is used as a programming tool to write the hardware, software, and APIs. The MQTT protocol is followed for communication.
* MIT app inventor is used to develop app and the data collected from the sensors are transmitted to the cloud which is seen in the mobile application.
* The user can make a decision through the app, whether to water the crop or not depending upon the sensor measurements.
* With the help of app developed by the MIT app inventor, the users can access the motor switch remotely.

**Codings to connect sensors with Arduino:**

int resist, celsius;

void setup() {

Serial.begin(9600);

pinMode(3, OUTPUT);

pinMode(A0, INPUT);

pinMode(6, INPUT);

pinMode(10, INPUT);

pinMode(11, INPUT);

}

void loop() {

resist = (analogRead(6)+analogRead(10)+analogRead(11))/3;

celsius = map(((analogRead(A0) - 20) \* 3.04), 0, 1023, 40, 125);

if (resist > 350 || celsius > 45)

{

Serial.println("Pump ON");

Serial.println(resist);

Serial.println(celsius);

Serial.println();

digitalWrite(3, LOW);

}

else

{

Serial.println("Pump OFF");

Serial.println(resist);

Serial.println(celsius);

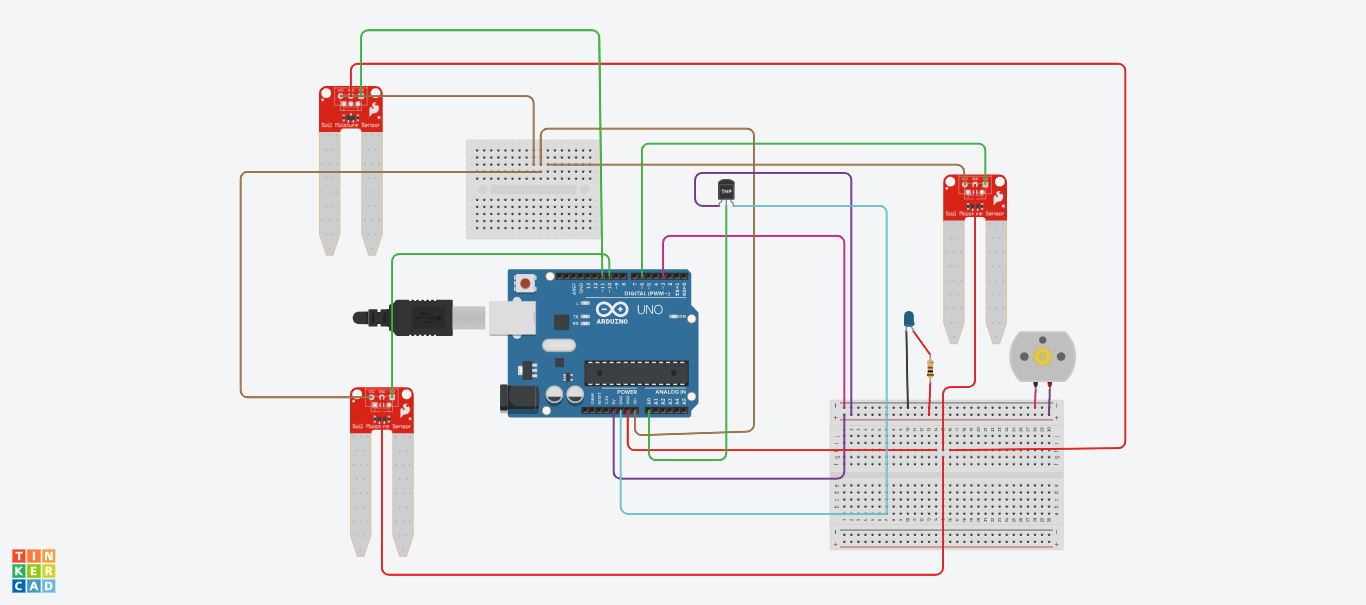
Serial.println();

digitalWrite(3, HIGH);

}

delay(100);

}



**Program:**

import time

import sys

import ibmiotf.application

import ibmiotf.device

import random

#Provide your IBM Watson Device Credentials

organization = "1ykvy2"

deviceType = "smartfarming"

deviceId = "smartfarmer\_avvs"

authMethod = "token"

authToken = "12345678"

# Initialize GPIO

def myCommandCallback(cmd):

print("Command received: %s" % cmd.data['command'])

status=cmd.data['command']

if status=="lighton":

print ("led is on")

elif status == "lightoff":

print ("led is off")

else :

print ("please send proper command")

try:

deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method": authMethod, "auth-token": authToken}

deviceCli = ibmiotf.device.Client(deviceOptions)

#..............................................

except Exception as e:

print("Caught exception connecting device: %s" % str(e))

sys.exit()

# Connect and send a datapoint "hello" with value "world" into the cloud as an event of type "greeting" 10 times

deviceCli.connect()

while True:

#Get Sensor Data from DHT11

temp=random.randint(90,110)

Humid=random.randint(60,100)

data = { 'temp' : temp, 'Humid': Humid }

#print data

def myOnPublishCallback():

print ("Published Temperature = %s C" % temp, "Humidity = %s %%" % Humid, "to IBM Watson")

success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0, on\_publish=myOnPublishCallback)

if not success:

print("Not connected to IoTF")

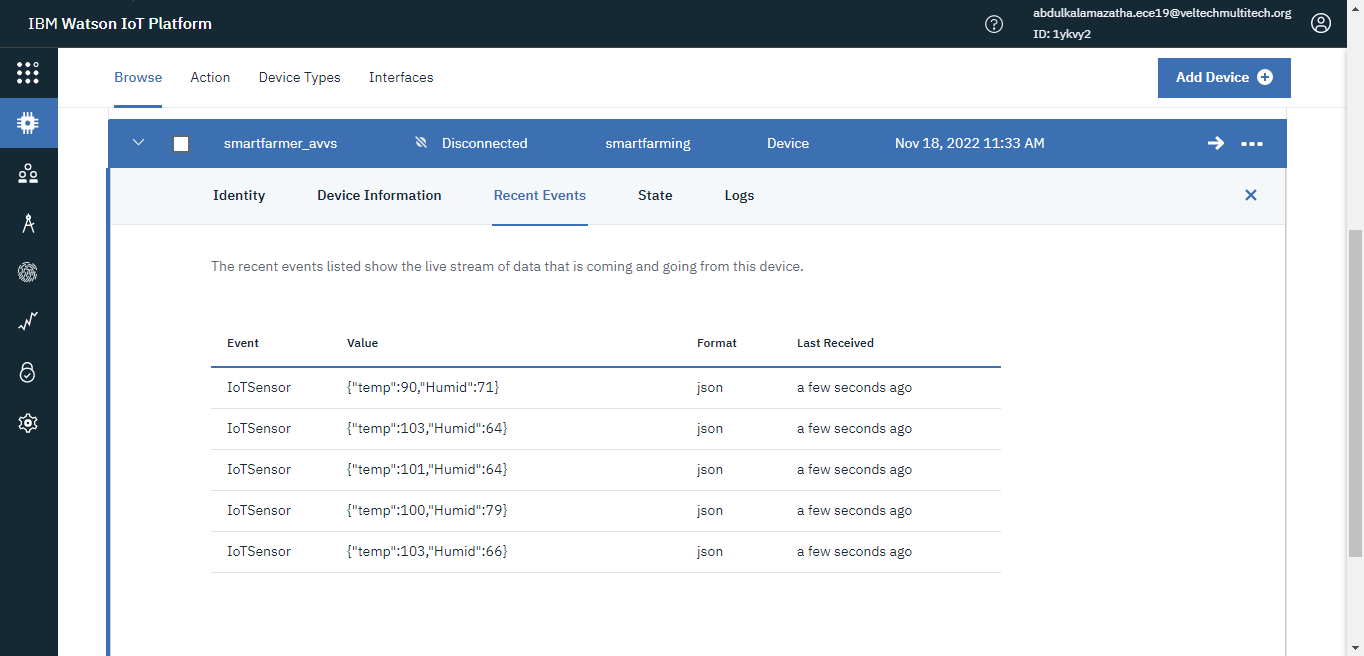
time.sleep(10)

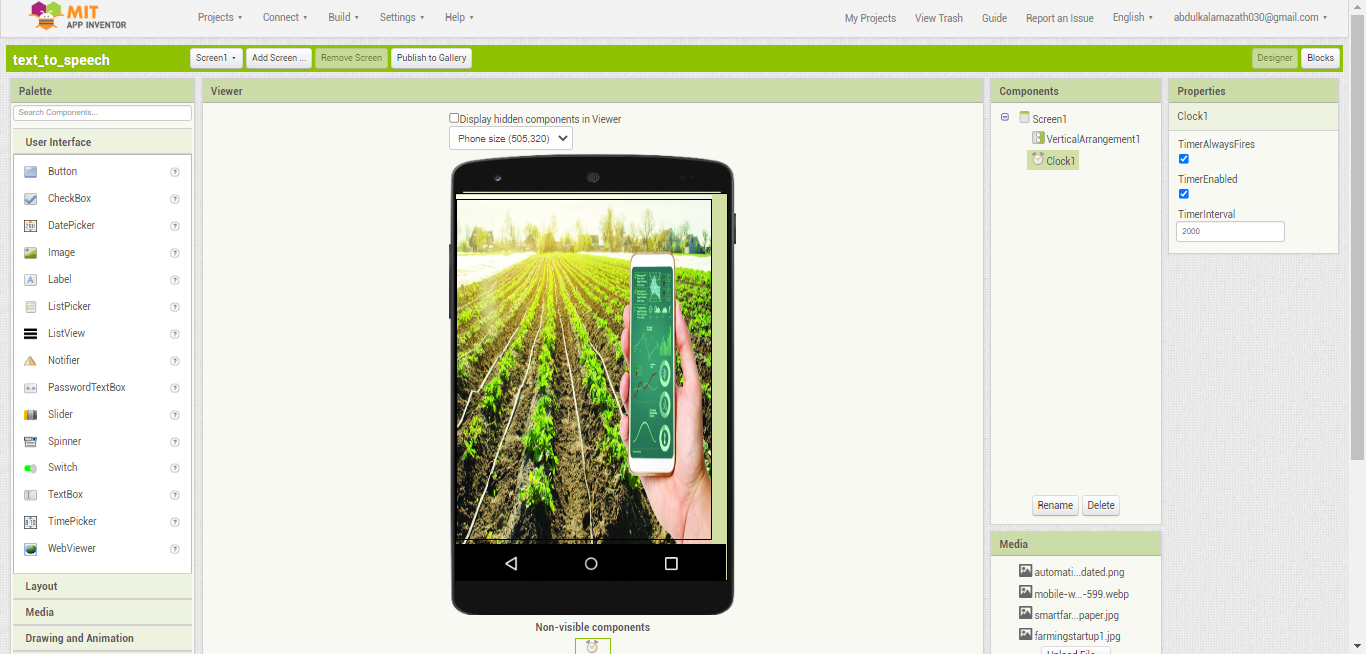
deviceCli.commandCallback = myCommandCallback

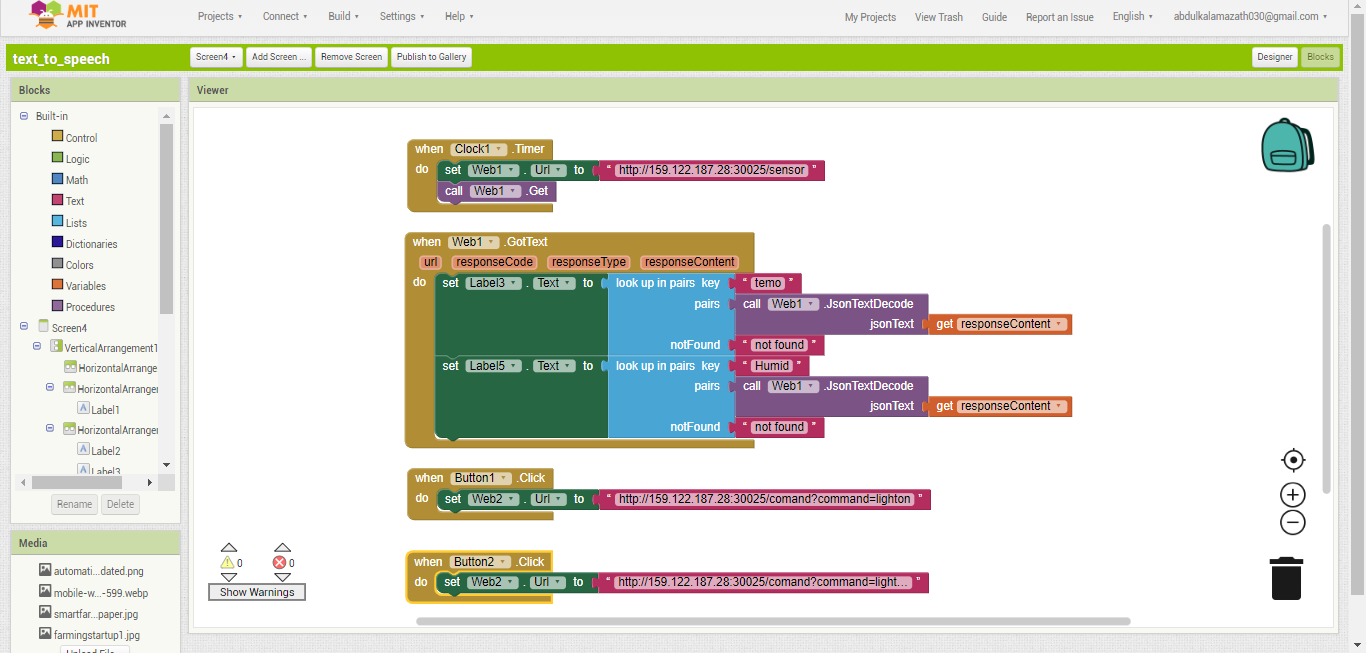
# Disconnect the device and application from the cloud

deviceCli.disconnect()

**Device details:**



**Design in MIT app inventor:**

**Blocks in MIT app inventor:**

**Screen in Android:**

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**CONFIGURATION OF NODE RED TO SEND COMMAND TO IBM CLOUD:**

msg.payload = msg.payload.temp

global.set("t", msg.payload)

return msg;

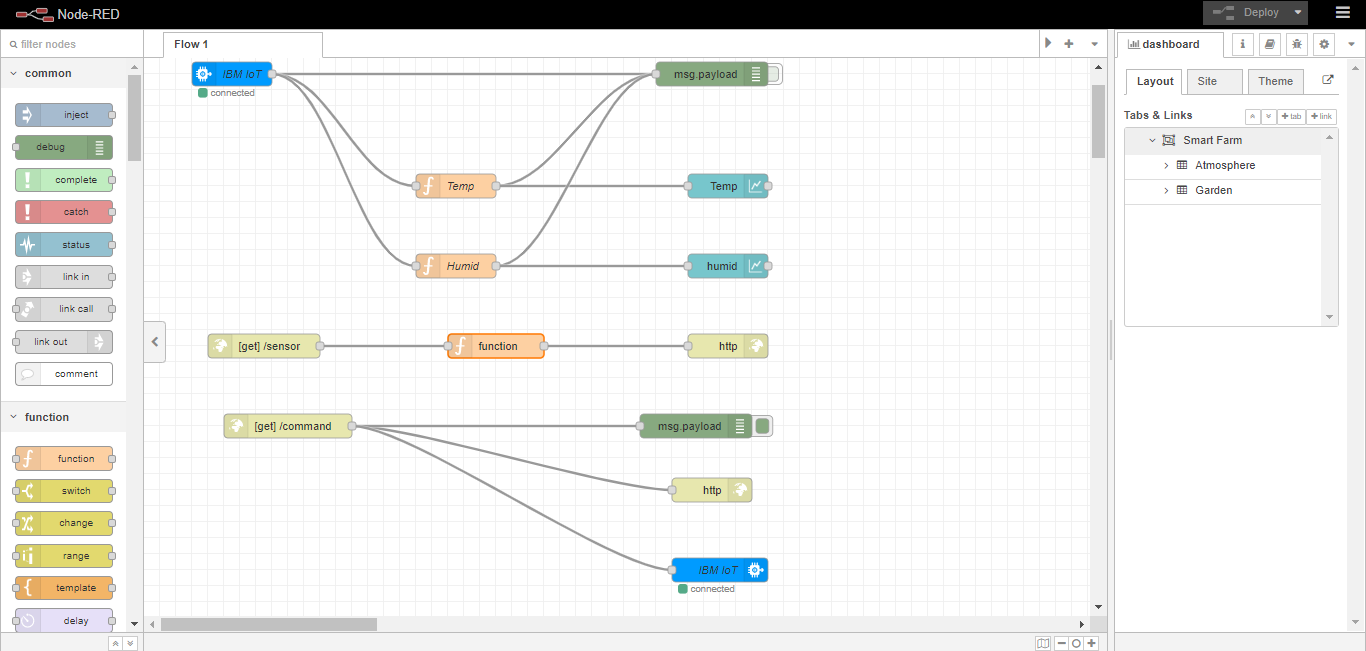
msg.payload = msg.payload.Humid

global.set("h", msg.payload)

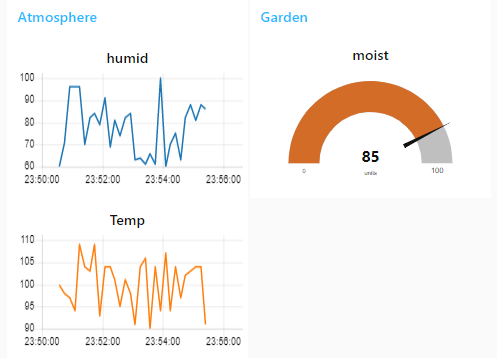
return msg;

msg.payload = {"temp":global.get('t'),"Humid":global.get('h')}

return msg;

**NODE RED FLOW:**

**SMART FARM STATUS:**

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