Date	05TH NOVEMBER 2022
Team ID	PNT2022TMID52636
Project Name	Project - Signs with Smart Connectivity for Better Road Safety

Project Documentation

Contents

1. Introduction

1.1 Project Overview

Road travel is an essential part of all individuals and day by day technology is making life more convenient. We intend to make commuting and general travel for the public more safer by incorporating smart signboards to roads which update and display information dynamically with real time data collected from the area.

IoT technology is used to collect real time data from roads, such as the vehicle density and Open Weather Map is used to collect real time weather data to dynamically adjust speed limits. We are hence able to make roads safer for travellers and pedestrians equally.

1.2 Purpose

Roads get very dangerous when weather conditions get bad and may present to be a threat to general public who makes use of it. We intend to make commuting and general travel for the public more safer by incorporating smart signboards to roads which update and display information dynamically with real time data collected from the area.

2. Literature Survey

2.1 Existing Problem

Roads get very dangerous when weather conditions get bad and may present to be a threat to general public who makes use of it. We intend to make commuting and general travel for the public more safer by incorporating smart signboards to roads which update and display information dynamically with real time data collected from the area.

2.2 References

2.2.1 Paper: Development and Testing of Road Signs Alert System Using a Smart Mobile Phone(2022)

Authors : Eric M. Masatu , Ramadhani Sinde , and Anael Sam

Parameters considered	Methodology used	Components used	Advantages

Data from sensors like,light detection and ranging(LIDAR), videoimage detectors, ultrasonic sensors, acoustic sensors, microwave sensors andOn-board transponder units	The vehicles are connectedwith one another and are called as connected vehicles, which communicate the signal location with one another and also the extent of any vehicle collision if any.	LIDAR video image detectors, ultrasonic sensors Inductive magnetic loops Capacitive sensor vibratory sensor, accelerometer, infrared etc	Mobility efficiency improvement and environmental performance improvement. Advanced traffic control strategies implementation. Life-cycleanalysis of construction and maintenance costs and energy inputs examination.safety and security performance improvements Long term validity.

2.2.2 Paper: Smart Road Safety and Accident Prevention System.(2022)

Authors : Pramod Mali , Aditya Pachpunde , Rohit Ballal , Yash Kulkarni

Parameters considered	Methodology used	Components used	Advantages
The distance between the vehicles approaching the curve and the ultrasonic sensor placed at the curve	Ultrasonic sensors present will detect the approaching vehicles and send the signal to the LED lights, whether the vehicle is coming in the correct direction(Green) or not(Red)	AT mega 328p Ultrasonic sensor LDR Metal Oxide Semiconductor Field Effect Transistor(MOSFET) Solar Panel	The goal of the project is to reduce the number of accidents This system helps people to drive day andnight carefully With the help of thissystem we can save thousands of lives.

2.2.3 Paper: Smart roads: A state of the art of highways innovations in the Smart Age(2021)

Authors : Andrea Pompigna , Raffaele Mauro

Parameters considered	Methodology used	Components used	Advantages

Vehicle speed, location of the road sign, distancebetween the road sign and the vehicle	When the vehicle is in thevicinity of the road sign, an alert sign is sent to the vehicle to alert the driver so that the driver has a prior knowledge about the upcoming road sign	GPS sensor Inertia measure unit IDE for android studio and google map API	Accidents can be reduced and since the driver is aware of the road sign, there is very less chance that he will be fined for not following the rules

2.2.4 Paper: Smart Real-Time Tracking and Controlling System During Health Emergency for ImprovedRoad Safety(2021)

Authors :Nithish M, Thippesha J, Yathishgowda H R, Nagaraju J N , Yaswanth Kumar B

Parameters considered	Methodology used	Components used	Advantages
This paper takes into consideration the inputs like the vehicle details, the family information, driver's health, road condition, location of the vehicle	To effectively communicate the message between driver and the signal. Since the system is activated only during emergency situations, main control and sub control units are used with sub control under the control of main control unit.	Infra red sensor Motion sensor Ultrasonic sensor Permanent magneticstepper motor GPS and GSM module Arduino sub-control unit Raspberry Pi main control unit DC motor	The emergency vehicles will be able to travel with ease since the communication is effectiveThe parking system considers all the possible obstacles that will occur during a parking

2.2.5 Paper: Priority Based Traffic Management System

Authors : Deepika G, Kowsalya S, Prathushalaxmi B

Parameters considered	Methodology used	Components used	Advantages
Region of interest of vehicles in that locality,which also time dependent and location dependent.Traffic congestion, types of vehicle.	The Blynk application is integrated with the traffic signal using ESP8266 wifi module.This application will be controlled by the ambulance driver to change the traffic signal. The light changes to blue when he does so.	ESP8266 Transformer	This system will make less complexity for the ambulance to cross the traffic signal.

2.2.6 Paper: Application of IoT and Artificial Intelligence in Road Safety (2022)

Authors : Srimantini Bhattacharya, Harsh Jha , Radhikesh P. Nanda

Parameters considered	Methodology used	Components used	Advantages
Real time traffic details and other details about the vehicles and the trip details, speed limit, GPS.Driver and pedestrian's behaviours also taken into consideration.	With the help of artificial intelligence and IOT to getthe details, the model predicts the likelihood of any actions that may causeaccident and alerts the driver to take the necessary precautions	PI camera Alcohol sensor Gas sensor Cloud storage device	Detecting human behaviour to take actions in case of negligence Detecting the conditions ofthe path of travel and alerting the driver and the upcoming vehicles during any event that damaged theroad.

2.2.7 Paper: IoT Based: Smart Traffic Light Controller

Authors : Faisal Al Kalbani, Nada Al Bulushi, Syed Imran

Parameters considered	Methodology used	Components used	Advantages
Vehicle type,Calling the system using GSM technology,number of vehicles passing,traffic congestion	The traffic density is measured b IR sensors. RFID technology is used for ambulance vehicles to give a green path. The system uses cameras for detecting traffic congestions and controlling signals. There is one camera for each direction fixed alongside the trafficlight	Arduino UNO RFID IR sensors	The system detects how long is the congestion in one direction and will give the traffic light a suitable time to let all vehicles passing the congestion smoothly. The system gives priority for passing for emergency vehicles.

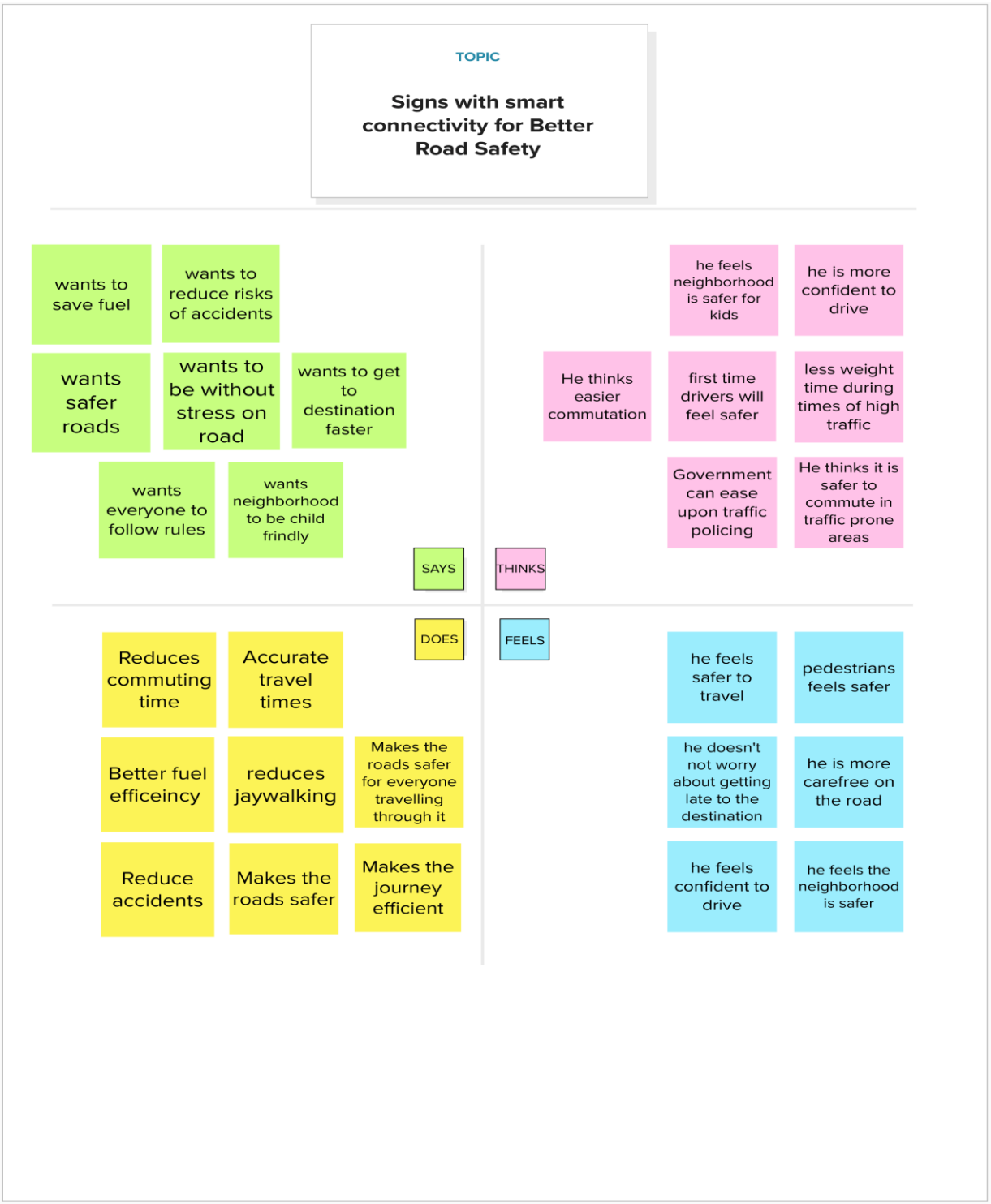
2.2.8 Paper: IoT Based Smart Road Safety and Vehicle Accident Prevention System for Mountain Roads(2021)

Authors : Kailas Shinde , Pranjal Shinde , Shivani Valhvankar , Swapnil Narkhede

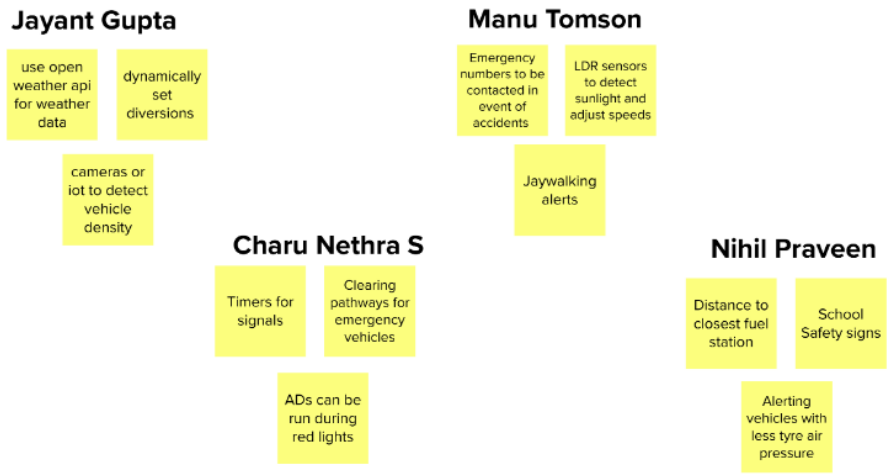
Parameters considered	Methodology used	Components used	Advantages
Light from the vehicles, the vehicle details, distance from the vehicleand sensors, and other basic requirements like speed, location and inputs form GSM module are considered	The model is placed at the curves and bends of the mountain region and gets the input from the proximity sensors. The proximity sensors will the show the number of vehicles approaching to the vehicles to the other end.	Ultras onic sensor Arduin o Uno LED Accelerometer SIM 808	Accidents occurring at thecurves and bends are reduced. If at all any accidents dohappen, the system will inform the same to their family members The location of the placeof accident is also sharedwith the family member and to the emergency services for immediate assist

3.Ideation and proposed solution

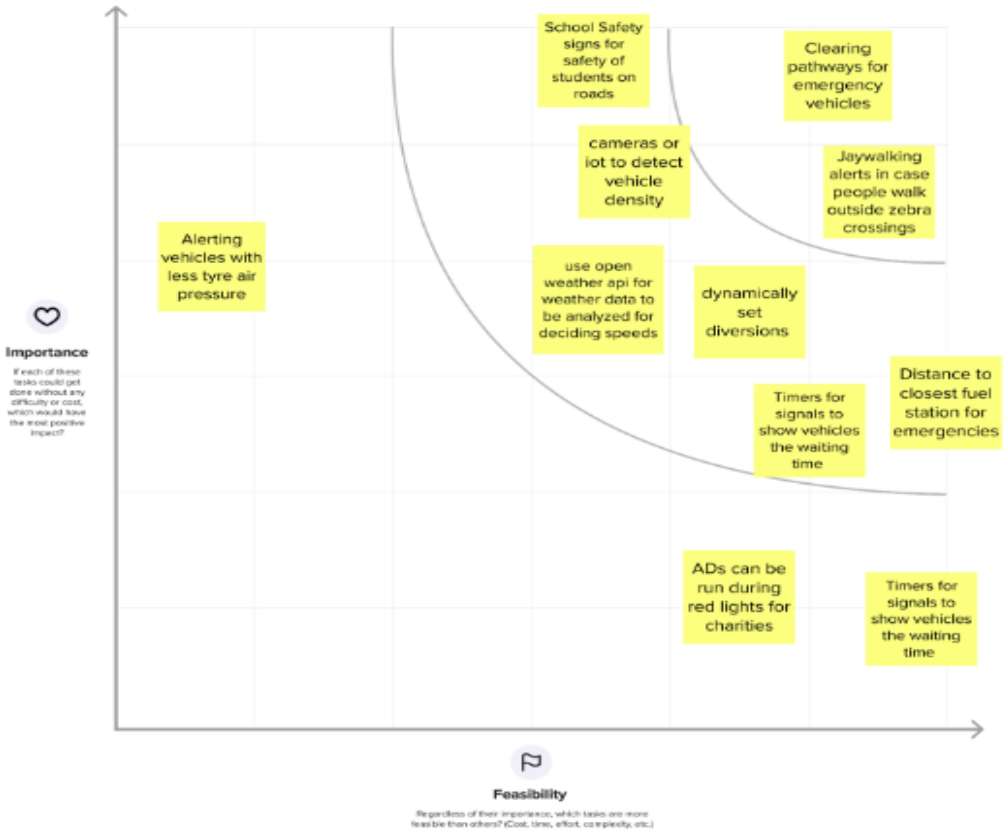
3.1 Empathy Map



3.2 Ideation and Brainstorming



Prioritization



3.3 Proposed Solution

1. Problem Statement (Problem to be solved)

• To ease the journey of the drivers and passengers by using smart road signs that dynamically change based on the situations like accidents, traffic jam, intensity of traffic, etc

2. Idea / Solution description

• To prepare smart signs using IOT to replace the conventional signs to make the signs more reliable

3. Novelty / Uniqueness

• Easily visible even in complete darkness

• They provide the driver's with information like humidity and weather conditions which isn't available now

• Since the signs are dynamically changing, we can use as many signs as we want I single board

4. Social Impact / Customer Satisfaction

• Drivers can be easily notified with the road conditions ahead

• Fear of getting in an accident is reduced

• Efficient rerouting in high traffic

5. Business Model (Revenue Model)

• The smart road signs are placed in places where there are multiple signs in a place and people get confused.

• Revenue can be generated in a large scale by installing the sign boards in busy cities which have more traffic

6. Scalability of the Solution

• The project can be installed in rural areas with less traffic to highly congested metropolitan cities thus saving people's precious time and also lives

4. Requirement Analysis

4.1 Functional requirement

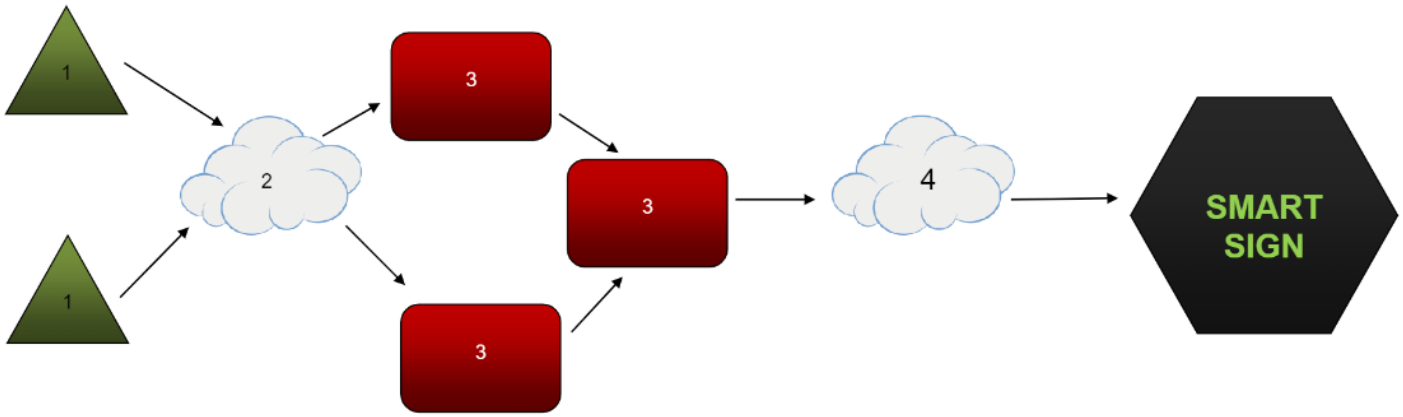
- Transport Agency Registration
  Register for getting approval to implement the smart sign boards for better road safety
- Sensor implementation
  Monitoring traffic density and road condition, pedestrian monitoring and controls traffic signals.
- Weather Monitoring
  Open weather API implemented to monitor weather reports and update in database
- Web UI
  Information on the smart boards will also be displayed in the web UI when the pedestrians travel in the road

4.2 Non-Functional requirements

- Usability
  Easy to follow instructions displays on the board. Understanding the signs should be clear.
- Security
  Provide better security, any other third party can't able to display information in the board, Users data are kept confidential.
- Reliability
  It can be able to withstand in any weather condition and the hardware parts require periodic monitoring to avoid any damage. It is dynamic in nature and reduce traffic congestion.
- Performance
- The smart display improves the safety, and it makes user tense free and keep them in a comfort
  Zone. Also, quality of service is improved.
- Availability
  The solution is available 24X7 and withstand any climate changes
- Scalability
  It can be implemented efficiently in anywhere and data execution will be faster. Provides better safety

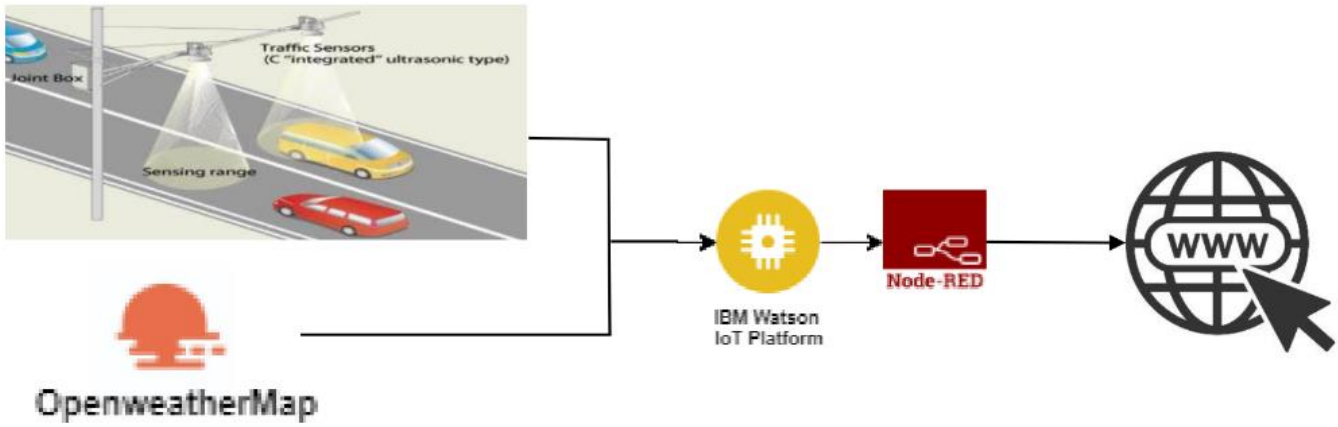
5.Project Design

5.1 Data Flow Diagram



1: IOT recorded values, Open weather API values.
2: Values uploaded to IBM Cloud.
3: Values are taken from Cloud and functions are made in Node Red.
4: The processed values are uploaded again to IBM Cloud.
5: the information is taken from the cloud and displayed on the Smart Sign.

5.2 Solution and Technical Architecture



5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority
Customer (Web user)	Data generation	USN-1	Use of OpenWeather map.	Weather related Information.	High
		USN-2	Use of Node-Red.	To connect devices.	High
Data validation	Checking accuracy	USN-3	As a user, I can check the ability and accuracy of the model in obtaining the required information.	Check the capability of the model.	High
Data extraction	Obtaining the data	USN-4	As a user, I can retrieve the result data from the application for data storage for further uses.	Download the result in the form of data.	High
Administrator	Problem Solving	USN-5	Future updating and monitoring.	Can monitor sign board.	Medium

6. CODING & SOLUTIONING

Ultrasonic sensor code for traffic analysis

```
#include <WiFi.h>

#include <PubSubClient.h>



#define ORG "4i2rfo"

#define DEVICE_TYPE "Traffic_Analyser"

#define DEVICE_ID "Ultrasonic_Sensor"

#define TOKEN "12345678"


char server[] = ORG ".messaging.internetofthings.ibmcloud.com";

char publishTopic[] = "iot-2/evt/UltraSonic_Sensor/fmt/json";

char subscribetopic[] = "iot-2/cmd/command/fmt/String";

char authMethod[] = "use-token-auth";

char token[] = TOKEN;

char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;


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


WiFiClient wifiClient; // creating the instance for wificlient

PubSubClient client(server, 1883, wifiClient); //calling the predefined client id by passing parameter like server id,portand wificredential


const int trigPin = 18;
```

```
const int echoPin = 5;

long duration;

float distanceCm;

String data3;

int count = 0;

int sec = 0;


void setup()// configureing the ESP32

{

  Serial.begin(115200);

  pinMode(trigPin, OUTPUT);

  pinMode(echoPin, INPUT);

  wificonnect();

  mqttconnect();

}


void loop()// Recursive Function

{

  digitalWrite(trigPin, LOW);

  delayMicroseconds(2);


  digitalWrite(trigPin, HIGH);

  delayMicroseconds(10);

  digitalWrite(trigPin, LOW);


  duration = pulseIn(echoPin, HIGH);
```

```
// Calculate the distance
distanceCm = duration * 0.034/2;

// Prints the distance in the Serial Monitor
Serial.print("Distance (cm): ");
Serial.println(distanceCm);

if (distanceCm < 210)
{
  count++;
}

delay(2000);
sec += 2;

if (sec > 60)
{
  PublishData(distanceCm, count);
  count = 0;
  sec = 0;
}

if (!client.loop()) {
  mqttconnect();
}
```

```
}




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


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



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



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

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


}



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


  WiFi.begin("Wokwi-GUEST", "", 6);//passing the wifi credentials to establish the connection
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
```

```
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
}
```

Weather API code:

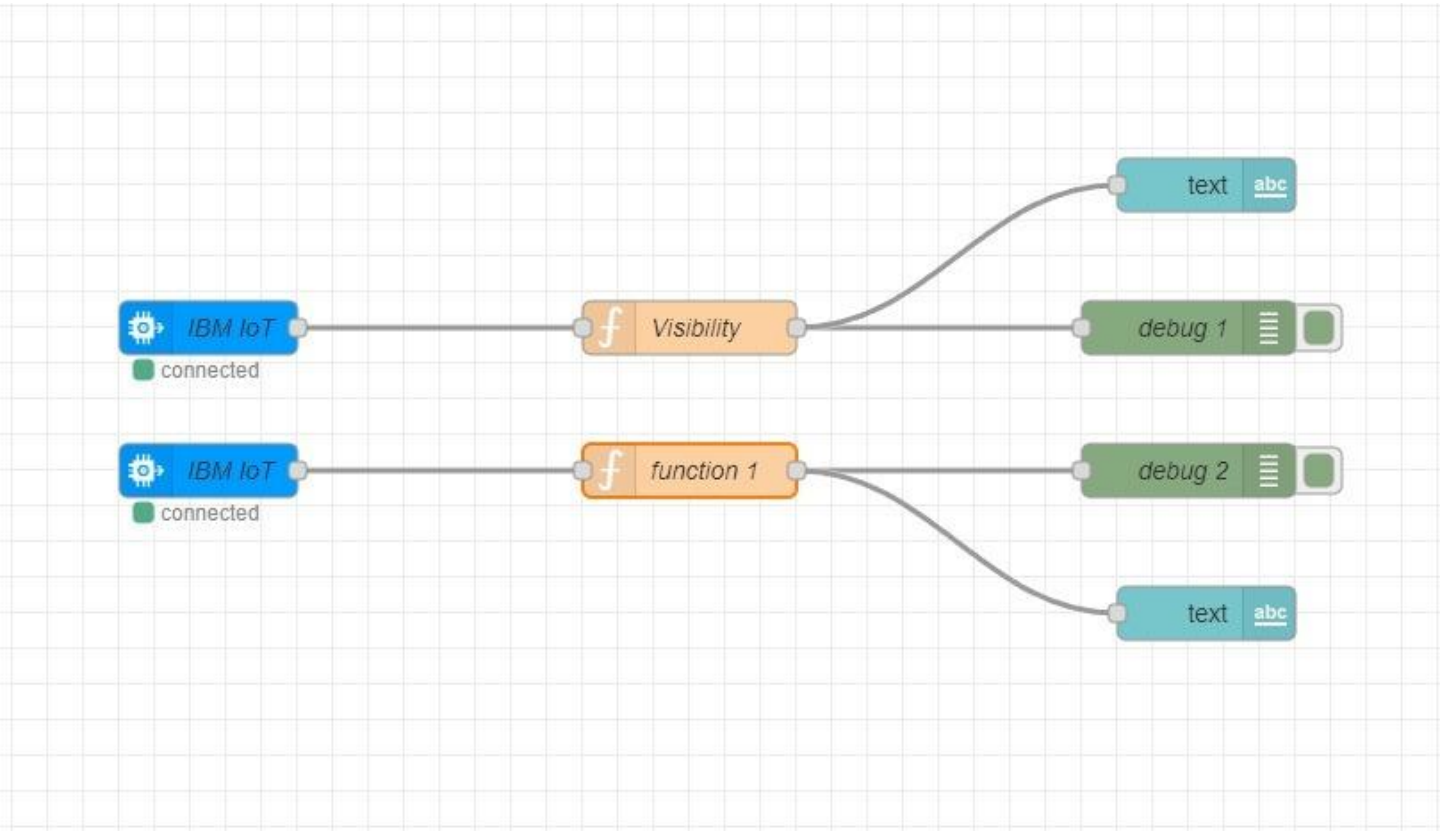
```
import requests
import paho.mqtt.client as mqtt
import time
import random
import json

a =
"https://api.openweathermap.org/data/2.5/weather?q=Chennai,IN&appid=edc64d6a64cdea76f74ae48da4cea3e6
"
r = requests.get(url = a)
data = r.json()

x = data["weather"][0]["main"]
y = data["visibility"]
rawdata = {
    "Weather" : x,
    "Visibility" : y
    }

jsondata = json.dumps(rawdata)

print("Weather is: ", x)
```

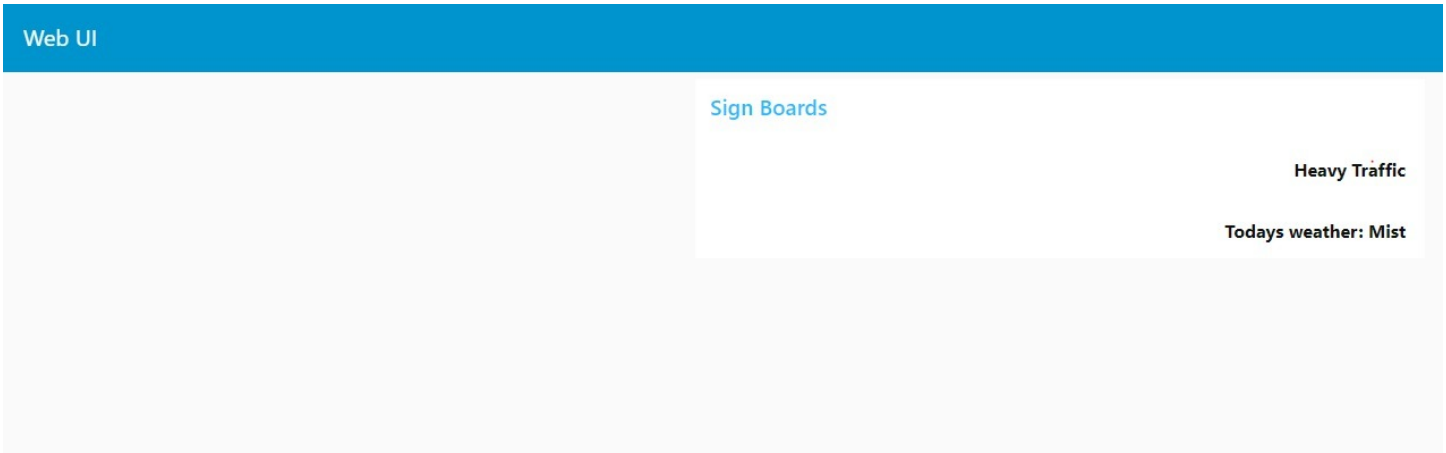
```
print("Visibility is: ", y)



ORG = "4i2rfo"
DEVICE_TYPE = "Weather_Analyser"
TOKEN = "12345678"
DEVICE_ID = "OpenWeather"

server = ORG + ".messaging.internetofthings.ibmcloud.com";
pubTopic1 = "iot-2/evt/Weather/fmt/json";
authMethod = "use-token-auth";
token = TOKEN;
clientId = "d:" + ORG + ":" + DEVICE_TYPE + ":" + DEVICE_ID;

mqttc = mqtt.Client(client_id=clientId)
mqttc.username_pw_set(authMethod, token)
mqttc.connect(server, 1883, 60)

while True:
   try:
      mqttc.publish(pubTopic1, jsondata)
      print ("Published")

   except RuntimeError as error:
      # Errors happen fairly often, DHT's are hard to read, just keep going
      print(error.args[0])
      time.sleep(2.0)
      continue
   except Exception as error:
      dhtDevice.exit()
      raise error
```

time.sleep(3600.0)

mqttc.loop_forever()

7. Outputs:





8. Conclusion:

The proposed model has been executed successfully. We hope to develop more on the project and would improve upon it to implement it as the real world applications for this project have very broad potential.

Github Link:
https://github.com/IBM-EPBL/IBM-Project-11867-1659349173

Demo Video Link:
https://drive.google.com/file/d/17czfqoI1GveSI_k-4GNkK7wL_hqjoZc8/view?usp=sharing