SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY

IBM PROJECT

REPORT Team ID -

PNT2022TMID46743

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Final Deliverables Report

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Team ID	PNT2022TMID46743
Project Name	Signs with Smart Connectivity for Better Road Safety

1. Sprint 1 – Create and initialize accounts in various public APIs like OpenWeatherMap API, and write a Python program that outputs results given the inputs like weather and location.
2. Sprint 2 – Push data from local code to cloud
3. Sprint 3 – Hardware & Cloud integration
4. Sprint 4 – UI/UX Optimization & Debugging

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2. LITERATURE SURVEY

3. IDEATION &PROPOSED SOLUTION

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5. PROJECT DESIGN

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1. INTRODUCTION

Traffic has recently become a big issue for the people of India. As a result, it wastes valuable time, fuel, and electricity. The Internet of Things (IOT) is a network of electrical appliances, cars, physical devices, and other items that are integrated with electronics, actuators, sensors, software, and connectivity, allowing these objects to connect and share data. Each object is uniquely identified by its embedded computing system, but it may interact with the existing Internet infrastructure.

1.1 Project Overview

- To replace the static signboards, smart connected signboardsare used.
- These smart connected sign boards get the speed limitations from a web app using weatherAPI and update automatically.
- Based on the weather changes the speed may increase ordecrease.
- Based on the trafficand fatal situations the diversion signs aredisplayed.
- Guide (Schools), Warning and Service (Hospitals, Restaurants)signs are also displayed accordingly.
- Different modes of operations can be selectedwith the help ofbuttons.

1.2 **Purpose**

- Smart Traffic Management is a system to monitor and control traffic signals using sensors to regulate the flow of traffic and toavoidcongestion for a smoothflow of traffic.

- Prioritizing traffic like ambulances, police etc. is also one application comes under smart traffic management.

2. LITERATURE SURVEY

2.1 Existing problem

- Analysis of crash data has suggesteda link betweenroadside advertising signs and safety.
- Research suggests that crash risk increases by approXimately 25–29% in the presence of digital roadside advertising signs compared to control areas.
- Onthe other hand,static roadside advertising signs have not been linked with differences in the crash count.
- However, this finding is contrary to previous researchthat suggests differences in crash

counts exist in the presence of static roadsideadvertising.

- ○ The quantity and qualityof available evidencelimit ourconclusion.
- ○ Fixed object, side swipe and rear end crashes are the most common types of crashes in the presence of roadsideadvertising signs.
- ○ In addition, drivers showed increased eye fixations and increased driftingbetween lanes on the road.

2.2 References

Cairney and Gunatillake, 2000; Sisiopiku et al., 2015

Islam, 2015;Sisiopiku et al., 2015

Yannis et al., 2013, Staffeld (1953) and Ady (1967)

1. https://www.hindawi.com/journals/jat/2022/5829607/

2.https://en.wikipedia.org/wiki/Automotive_safety

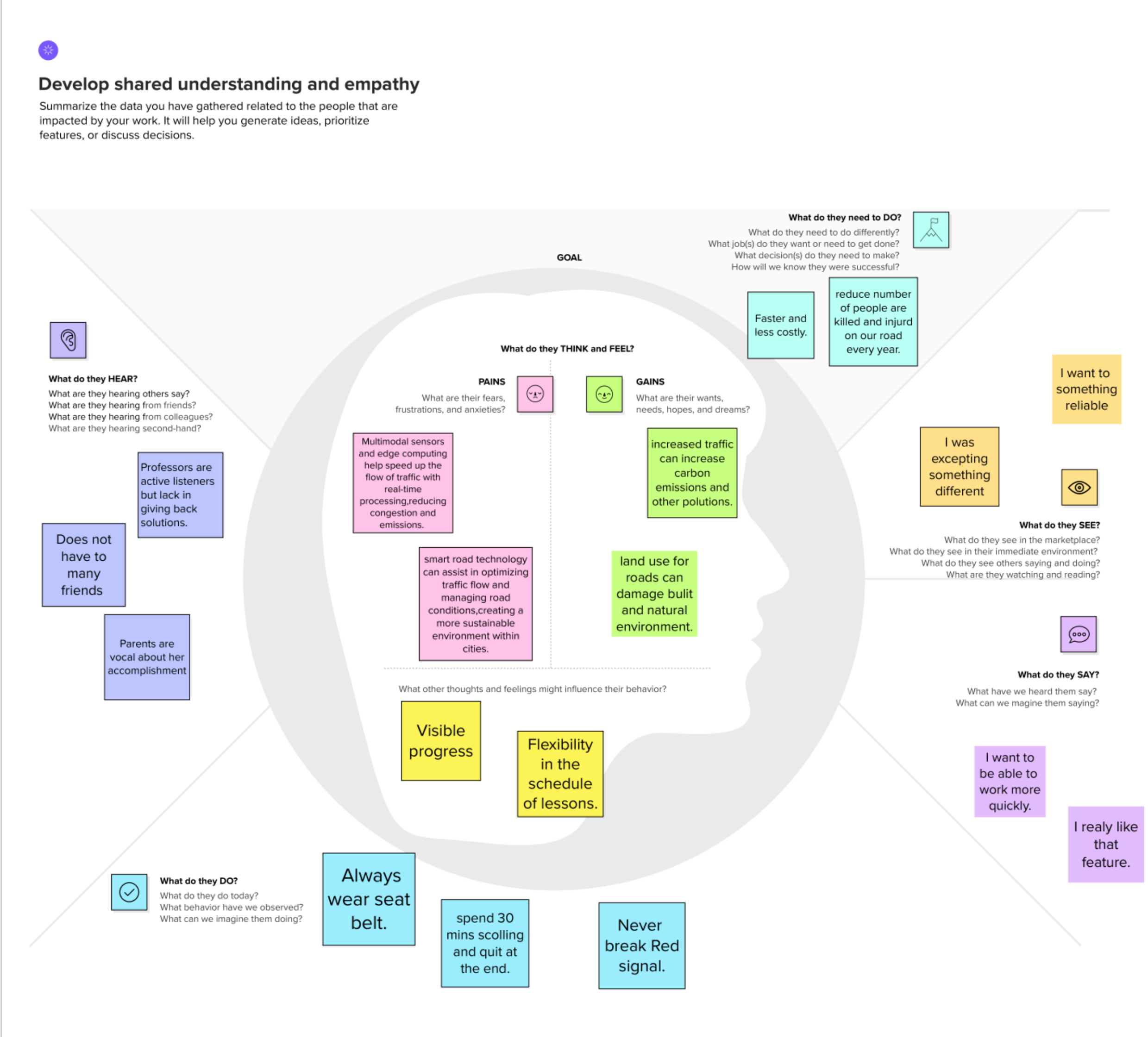
3.https://www.powerbulbs.com/us/blog/2020/01/yellow-or-whiter-light

2.3 Problem StatementDefinition

- This project will replace the static boards to smart signed boards that will change the speed limitsaccording to the weather climate and show diversion messages if there are accidents in the road and alert messages if there is hospital, schools or any roadworks.

3. IDEATION AND PROPOSEDSOLUTION

3.1 Empathy Map Canvas



Develop shared understanding and empathy

Summarize the data you have gathered related to the people that are impacted by your work. It will help you generate ideas, prioritize features, or discuss decisions.

GOAL

What do they need to DO?
What do they need to do differently?
What job(s) do they want or need to get done?
What decision(s) do they need to make?
How will we know they were successful?

Faster and less costly.

reduce number of people are killed and injurd on our road every year.

What do they HEAR?
What are they hearing others say?
What are they hearing from friends?
What are they hearing from colleagues?
What are they hearing second-hand?

Professors are active listeners but lack in giving back solutions.

Does not have to many friends

Parents are vocal about her accomplishment

What do they THINK and FEEL?

PAINS
What are their fears, frustrations, and anxieties?

Multimodal sensors and edge computing help speed up the flow of traffic with real-time processing,reducing congestion and emissions.

smart road technology can assist in optimizing traffic flow and managing road conditions,creating a more sustainable environment within cities.

GAINS
What are their wants, needs, hopes, and dreams?

increased traffic can increase carbon emissions and other polutions.

land use for roads can damage bulit and natural environment.

What other thoughts and feelings might influence their behavior?

Visible progress

Flexibility in the schedule of lessons.

I want to something reliable

I was excepting something different

What do they SEE?
What do they see in the marketplace?
What do they see in their immediate environment?
What do they see others saying and doing?
What are they watching and reading?

What do they SAY?
What have we heard them say?
What can we magine them saying?

I want to be able to work more quickly.

I realy like that feature.

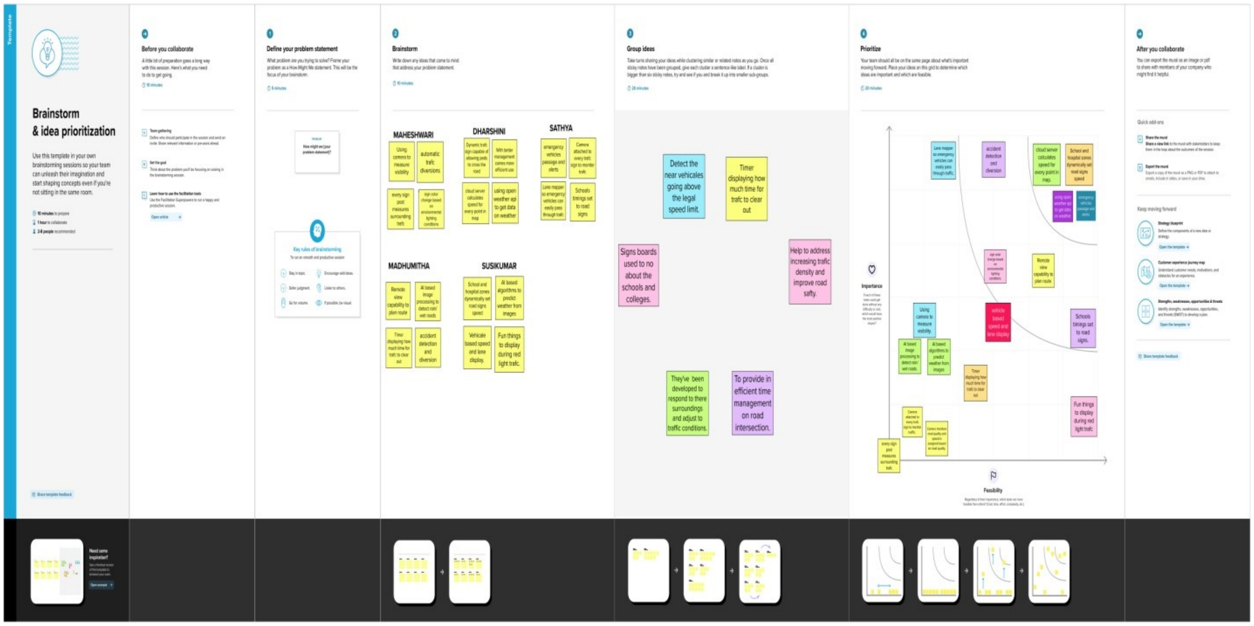
What do they DO?
What do they do today?
What behavior have we observed?
What can we imagine them doing?

Always wear seat belt.

spend 30 mins scolling and quit at the end.

Never break Red signal.

3.2 Ideation & Brainstorming Map


Brainstorm
& idea prioritization
Before you collaborate
Define your problem statement
Brainstorm
Write down any ideas that come to mind that address your problem statement.
MAHESHWARI
Using camera to measure visibility
automatic trafic diversions
every sign post measures surrounding trafc
sign color change based on environmental lighting conditions
DHARSHINI
Dynamic trafc sign capable of allowing peds to cross the road
With better management comes more efficient use
cloud server calculates speed for every point in map
using open weather api to get data on weather
SATHYA
emergency vehicles passage and alerts
Camera attached to every trafc sign to monitor trafc
Lane mapper so emergency vehicles can easily pass through trafc
Schools timings set to road signs
MADHUMITHA
Remote view capability to plan route
AI based image processing to detect rain/ wet roads
Timer displaying how much time for trafc to clear out
accident detection and diversion
SUSIKUMAR
School and hospital zones dynamically set road signs speed
AI based algorithms to predict weather from images
Vehicale based speed and lane display.
Fun things to display during red light trafc.
Group ideas
Detect the near vehicales going above the legal speed limit.
Timer displaying how much time for trafc to clear out
Signs boards used to no about the schools and colleges.
Help to address increasing trafic density and improve road safty.
They've been developed to respond to there surroundings and adjust to traffic conditions.
To provide in efficient time management on road intersection.
Prioritize
Importance
Feasibility
After you collaborate

3.3 Proposed Solution

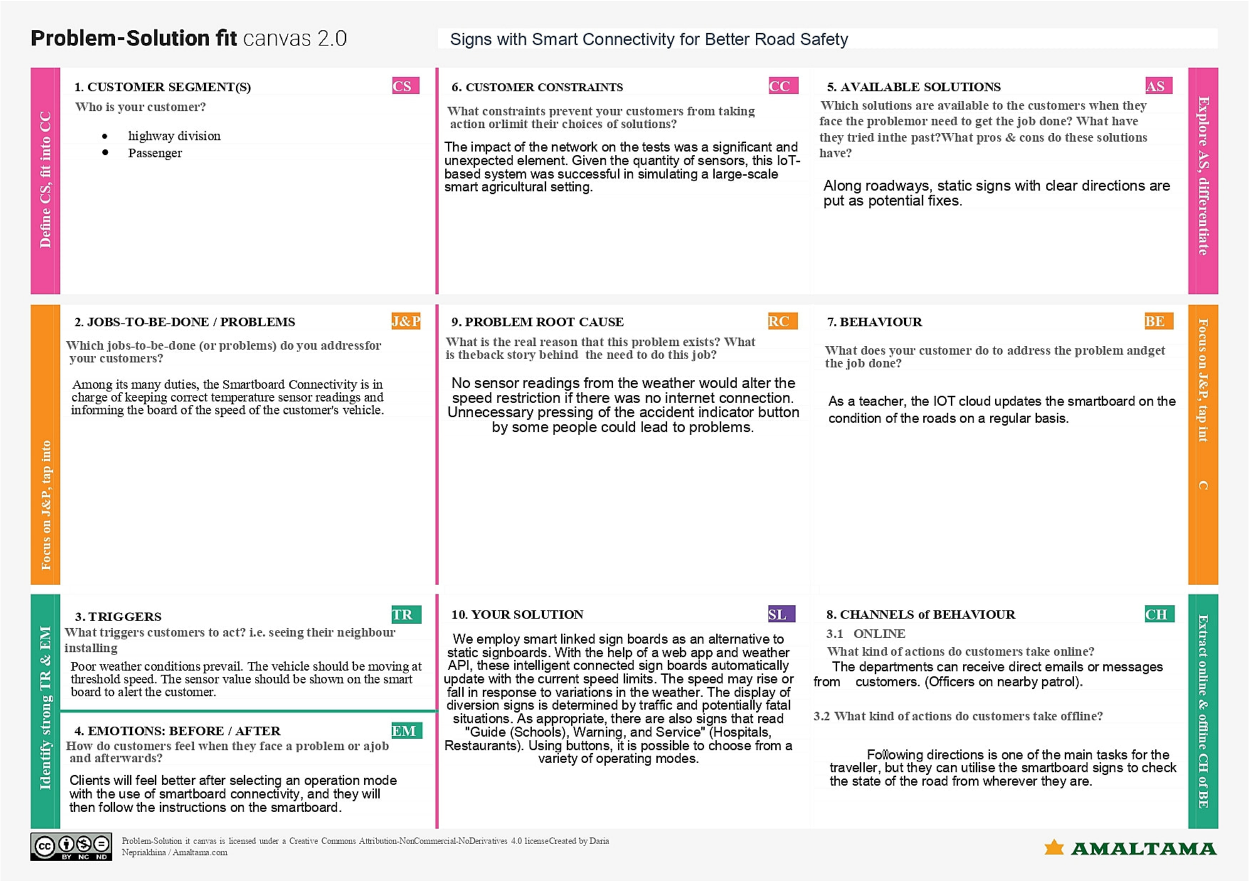
S.No	Parameter	Description
1.	Problem Statement	In present system the road signs and speed limits are static.In some cases, road signs can be changed according to the nature. We can consider some cases when there are few road diversions according the heavy traffic or due to accident and other factors.We can change road signs accordingly if they are digitalized,hence there is a requirement for

		digital sign boards in which the signs can be changed dynamically.
2.	Idea description	The weather and temperature details are obtained from the Open Weather Map API. Using these details, the speed limit will be updated automatically in accordance with the weather conditions. Also, the details regarding road accidents and traffic congestion faced on the particular road are obtained. Based on this, the traffic is diverted followed by a change in map path and the traffic is cleared. So in the traffic sign board, some buttons will be placed which willbe used to make it generic; where each button will be given a functionality such as changing the warning signs, which are predefined and separate signs will be present for both school and hospital zones. By activating this button, either through the web application or the physical buttons, sign of the board can be changed accordingly, and the speed limit will also be set depending upon the zones. Also, the pedestrians are given an option to change the traffic signs if they want to cross the road. If the pedestrian presses the button that is present on the post at the end of the road, then the traffic will be analyzed immediately. Accordingly, the sign of the traffic signal will be changed. This inturn reduces the frequent changing of the traffic signs even if the pedestrians are not present.
3.	Novelty	Generic Sign board for all applications that uses both buttons and web service for updation. Pedestrians are given the access to request the sign

		change of the signal to cross the road.
4.	Customer Satisfaction	Diversion reasons will be displayed If there is no traffic, pedestrians can cross the street without waiting. Customer can reach the destination before the expected time
5.	Business Model	Since APIs are used to actively monitor the customer's environment, this project employs a business strategy in which revenue will be generated on the basis of the length of time in which the customers actively interact with the product. This product is aimed to be free of cost to the public, but the revenue will be generated by selling this product to the government at a low cost, so there will be less accidents and the public will be aware of the discrepancies or accidents in the particular road. The public will also gain all the information about the road, even if they are checking for an alternate path because of some mishaps that happen on the roads and these functionalities will increase the value of the product in the global market.
6.	Scalability of the Solution	In the future, if any update is required either on the hardware or software side, it can be easily implemented. The hardware components can be directly interfaced with the microcontroller and small modifications can be made in the programming of the existing product. In case of the software, the website application has to be updated with the additional functionality by creating a new section for the updated hardware. So this will not affect the existing functionality of the product and new

		functionality can be easily integrated. In addition, a separate circuit will be kept along with the hardware to detect any problem which informs the web application. Also a notification will be sent to the product service department.

3.4 Problem Solutionfit


Define CS, fit into CC
CS
CC
AS
Explore AS, differentiate
Focus on J&P, tap into
J&P
RC
BE
Focus on J&P, tap int C
Identify strong TR & EM
TR
EM
SL
CH
Extract online & offline CH of BE

Problem-Solution fit canvas 2.0

Signs with Smart Connectivity for Better Road Safety

1. CUSTOMER SEGMENT(S)

Who is your customer?

- highway division
- Passenger

6. CUSTOMER CONSTRAINTS

What constraints prevent your customers from taking action orlimit their choices of solutions?

The impact of the network on the tests was a significant and unexpected element. Given the quantity of sensors, this IoT-based system was successful in simulating a large-scale smart agricultural setting.

5. AVAILABLE SOLUTIONS

Which solutions are available to the customers when they face the problemor need to get the job done? What have they tried inthe past?What pros & cons do these solutions have?

Along roadways, static signs with clear directions are put as potential fixes.

2. JOBS-TO-BE-DONE / PROBLEMS

Which jobs-to-be-done (or problems) do you addressfor your customers?

Among its many duties, the Smartboard Connectivity is in charge of keeping correct temperature sensor readings and informing the board of the speed of the customer's vehicle.

9. PROBLEM ROOT CAUSE

What is the real reason that this problem exists? What is theback story behind the need to do this job?

No sensor readings from the weather would alter the speed restriction if there was no internet connection. Unnecessary pressing of the accident indicator button by some people could lead to problems.

7. BEHAVIOUR

What does your customer do to address the problem andget the job done?

As a teacher, the IOT cloud updates the smartboard on the condition of the roads on a regular basis.

3. TRIGGERS

What triggers customers to act? i.e. seeing their neighbour installing

Poor weather conditions prevail. The vehicle should be moving at threshold speed. The sensor value should be shown on the smart board to alert the customer.

4. EMOTIONS: BEFORE / AFTER

How do customers feel when they face a problem or ajob and afterwards?

Clients will feel better after selecting an operation mode with the use of smartboard connectivity, and they will then follow the instructions on the smartboard.

10. YOUR SOLUTION

We employ smart linked sign boards as an alternative to static signboards. With the help of a web app and weather API, these intelligent connected sign boards automatically update with the current speed limits. The speed may rise or fall in response to variations in the weather. The display of diversion signs is determined by traffic and potentially fatal situations. As appropriate, there are also signs that read "Guide (Schools), Warning, and Service" (Hospitals, Restaurants). Using buttons, it is possible to choose from a variety of operating modes.

8. CHANNELS of BEHAVIOUR

3.1 ONLINE

What kind of actions do customers take online?

The departments can receive direct emails or messages from customers. (Officers on nearby patrol).

3.2 What kind of actions do customers take offline?

Following directions is one of the main tasks for the traveller, but they can utilise the smartboard signs to check the state of the road from wherever they are.

AMALTAMA

4. REQUIREMENT ANALYSIS

4.1 Functional Requirements

Following are the functional requirements of the proposedsolution

FR NO	**Functional Requirement (Epic)**	**Sub Requirement (Story / Sub-Task)**
FR-1	User Visibility	Sign Boards should be made of bright coloured LEDs capable of attracting driver's attention Not too distracting to cause accidents
FR-2	User Understanding	Should display information through means like images/illustrations with text so that the user can understand the signs correctly
FR-3	User Convenience	Display should be big enough to display all the signs correctly so that it is visible even to far away drivers

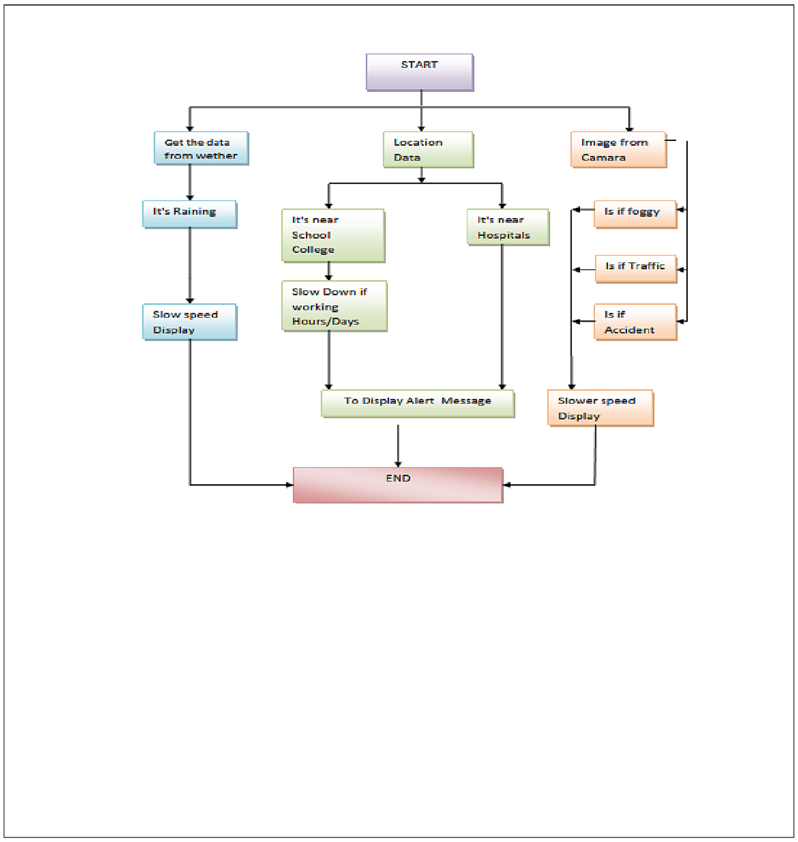
4.2 Non-Functional Requirements

Following are the non-functional requirements of the proposedsolution.

FR NO	**Non-Functional Requirement**	**Description**
NFR-I	Usability	Should be able to dynamically update with respect to time.
NFR-2	Security.	Should be secure enough that only the intended messages are displayed in the display
NFR-3	Reliability	Should convey the traffic information correctly.
NFR-4	Performance	Display should update dynamically whenever the weather or traffic values are updated
NFR-5	Availability	Should be on service 24/7
NFR-6	Scalability	Should be modular and hence able to scale on servers horizontally.

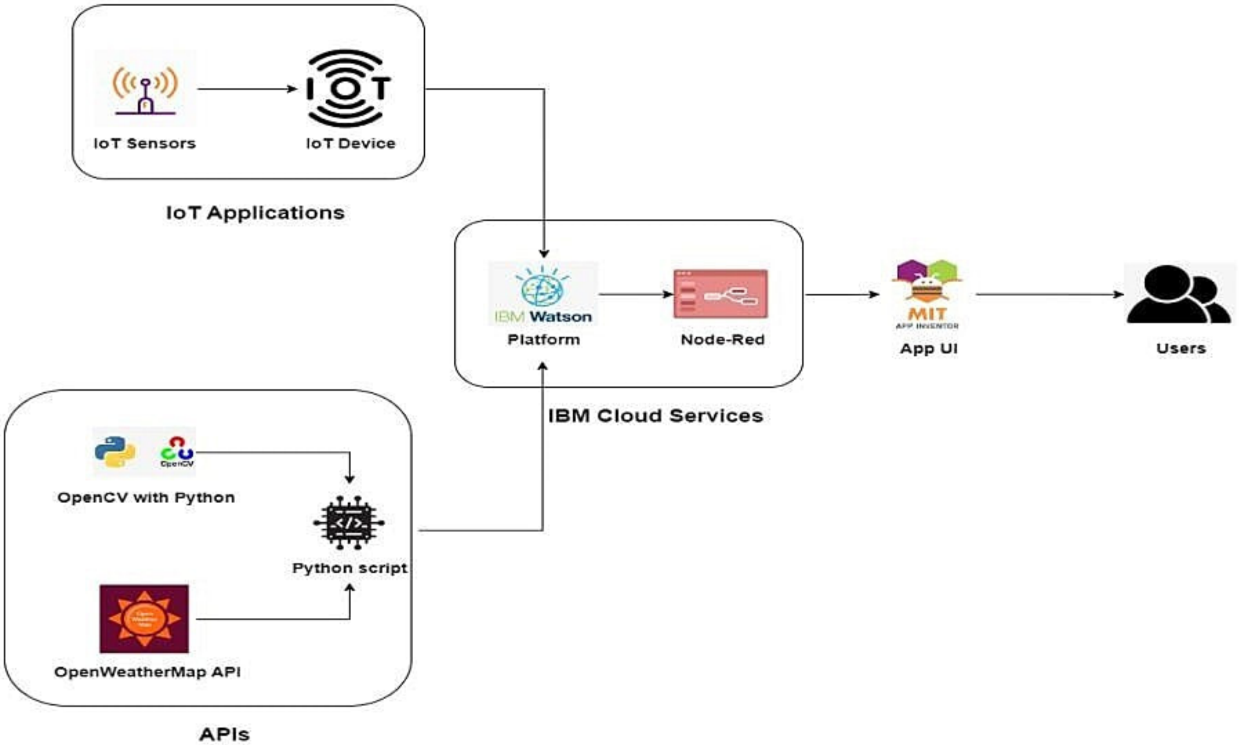
5. PROJECT DESIGN

5.1 Data Flow Diagram



5.2 Solution & Technical Architecture

Following is the Technical Architecture with slightchange and is **without the implementation of OpenCV API**.



Following is the Solution Built

Table-1 : Components & Technologies:

S.No	**Component**	**Description**
1	User Interface	User can interact withthe app usingMIT App
2	Application Logic-1	Logic for a process in the application

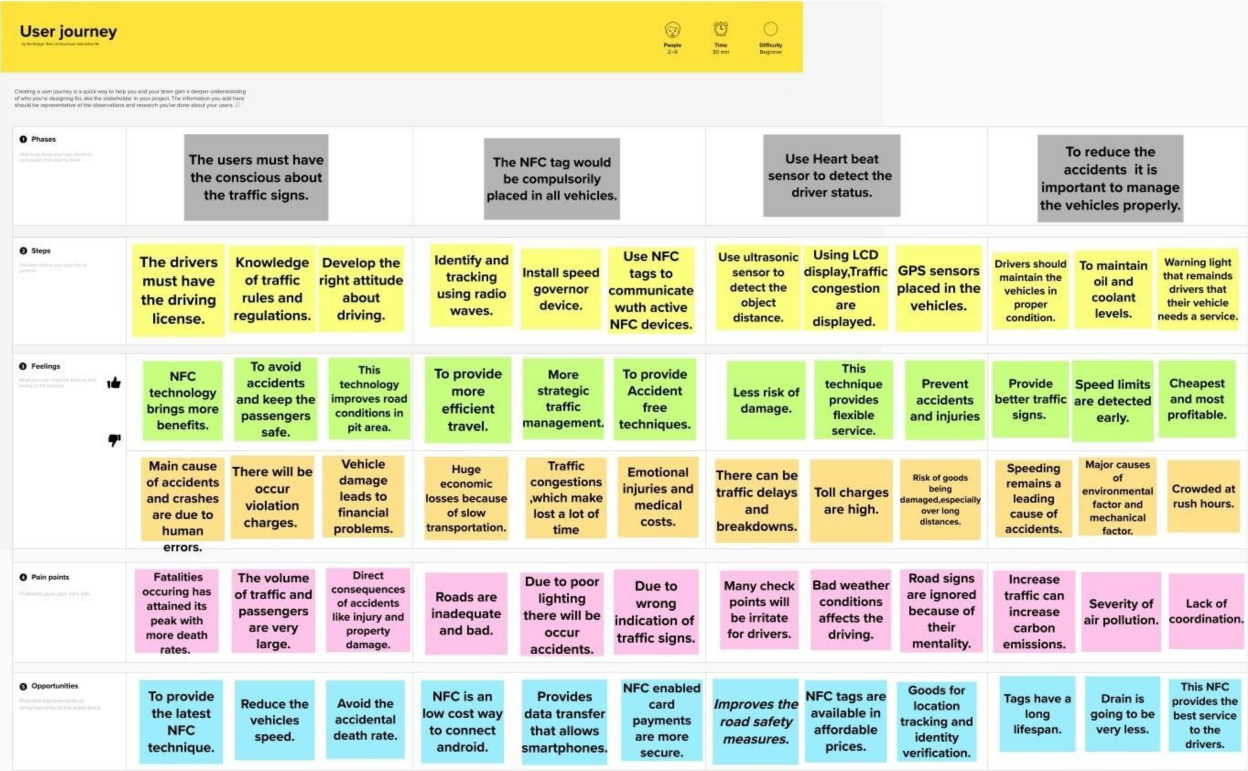
3	Application Logic-2	Logic for a process in the application
4	Application Logic-3	Logic for a process in the application
5	Database	Data Type, Configurations etc.
6	Cloud Database	Database Service on Cloud
7	File Storage	File storage requirements
8	External API-1	Purpose of External API used in theapplication
9	External API-2	Purpose of External API used in theapplication
10	Infrastructure (Server /Cloud)	Application Deployment on LocalSystem / CloudLocal Server Configuration: Cloud Server Configuration:

Table-2: Application Characteristics:

S.	**Characteristics**	**Description**

1.	Open-Source Frameworks	*OpenWeatherMap, NODE- RED, IBM WATSON,MIT App Inventor*
2.	Security Implementations	*Powerful security systemfor everyone'speace of mind No access data Hackers cannot access network*
3.	Scalable Architecture	*EASY TO EXTEND THE NETWORK WITH THEAID OFTHE BANDWIDTH OF THE NETWORK*
4.	Availability	*Available every time and everywhere 24/7so long as the consumer is signed into thenetwork.*
5.	Performance	*AIDS MASSIVE RANGE OFUSERS TO USE TECHNOLOGY*

5.3 User Stories



Creating a user journey is a quick way to help you and your team gain a deeper understanding of who you're designing for, aka the stakeholder in your project. The information you add here should be representative of the observations and research you've done about your users.

Phases	The users must have the conscious about the traffic signs.			The NFC tag would be compulsorily placed in all vehicles.			Use Heart beat sensor to detect the driver status.			To reduce the accidents it is important to manage the vehicles properly.		
Steps	The drivers must have the driving license.	Knowledge of traffic rules and regulations.	Develop the right attitude about driving.	Identify and tracking using radio waves.	Install speed governor device.	Use NFC tags to communicate wuth active NFC devices.	Use ultrasonic sensor to detect the object distance.	Using LCD display,Traffic congestion are displayed.	GPS sensors placed in the vehicles.	Drivers should maintain the vehicles in proper condition.	To maintain oil and coolant levels.	Warning light that remainds drivers that their vehicle needs a service.
Feelings 👍	NFC technology brings more benefits.	To avoid accidents and keep the passengers safe.	This technology improves road conditions in pit area.	To provide more efficient travel.	More strategic traffic management.	To provide Accident free techniques.	Less risk of damage.	This technique provides flexible service.	Prevent accidents and injuries	Provide better traffic signs.	Speed limits are detected early.	Cheapest and most profitable.
👎	Main cause of accidents and crashes are due to human errors.	There will be occur violation charges.	Vehicle damage leads to financial problems.	Huge economic losses because of slow transportation.	Traffic congestions ,which make lost a lot of time	Emotional injuries and medical costs.	There can be traffic delays and breakdowns.	Toll charges are high.	Risk of goods being damaged,especially over long distances.	Speeding remains a leading cause of accidents.	Major causes of environmental factor and mechanical factor.	Crowded at rush hours.
Pain points	Fatalities occuring has attained its peak with more death rates.	The volume of traffic and passengers are very large.	Direct consequences of accidents like injury and property damage.	Roads are inadequate and bad.	Due to poor lighting there will be occur accidents.	Due to wrong indication of traffic signs.	Many check points will be irritate for drivers.	Bad weather conditions affects the driving.	Road signs are ignored because of their mentality.	Increase traffic can increase carbon emissions.	Severity of air pollution.	Lack of coordination.
Opportunities	To provide the latest NFC technique.	Reduce the vehicles speed.	Avoid the accidental death rate.	NFC is an low cost way to connect android.	Provides data transfer that allows smartphones.	NFC enabled card payments are more secure.	*Improves the road safety measures.*	NFC tags are available in affordable prices.	Goods for location tracking and identity verification.	Tags have a long lifespan.	Drain is going to be very less.	This NFC provides the best service to the drivers.

6. PROJECT PLANNING AND SCHEDULING

6.1 Sprint Planning &Estimation

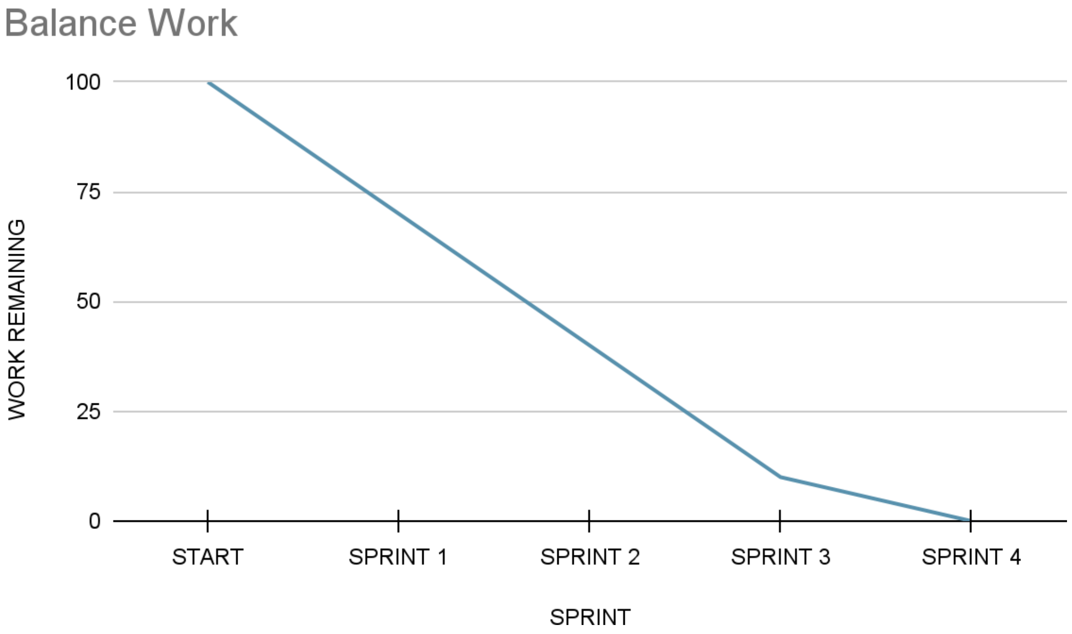
Sprint	Functional Requirement (Epic)	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Resources Initialization	Create and initialize accounts in various publicAPIslike	1	LOW	MAHESWARI DHARSHINI MADHUMITHA

		OpenWeatherMap API.			SATHYA SUSI KUMAR
Sprint-1	Local Server/Software Run	Write a Pythonprogram that outputsresults given theinputs like weather and location.	1	MEDIUM	MAHESWARI DHARSHINI MADHUMITHA SATHYA SUSI KUMAR
Sprint-2	Push the server/software to cloud	Push the code fromSprint 1 to cloud so it can be accessed from anywhere	2	MEDIUM	MAHESWARI DHARSHINI MADHUMITHA SATHYA SUSI KUMAR
Sprint-3	Hardware initialization	Integrate the hardware to be ableto access thecloud functions andprovide inputs to the same.	2	HIGH	MAHESWARI DHARSHINI MADHUMITHA SATHYA SUSI KUMAR
Sprint-4	UI/UX Optimization & Debugging	Optimize all the shortcomings andprovide better user experience.	2	LOW	MAHESWARI DHARSHINI MADHUMITHA SATHYA SUSI KUMAR

6.2 Sprint DeliverySchedule

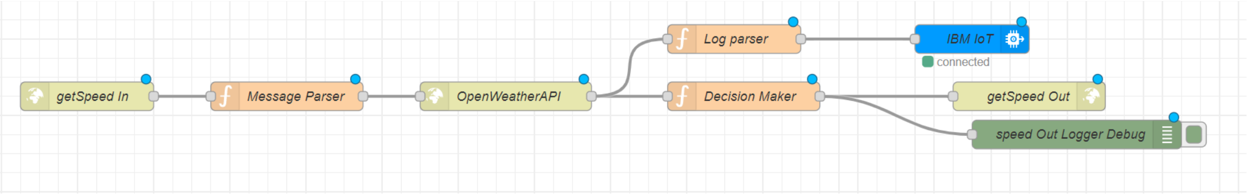
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Plan ned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	31 Oct 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	07 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	14 Nov 2022

Burndown Chart:



7. CODING AND SOLUTIONING

7.1 Feature 1 - GET SPEED FOR GIVEN LOCATION&CLIMATE



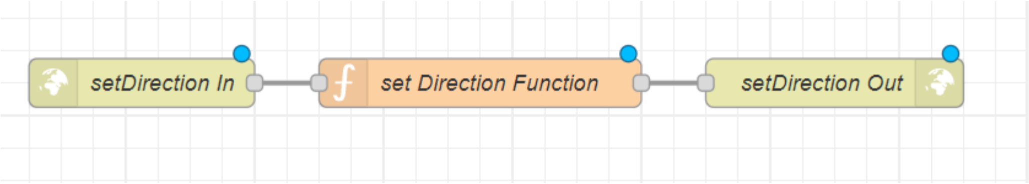
This part of Node RED flow accepts an http GET end point at **"/getSpeed"** from which the location, uid, hospital/school zone infoare passed.

Message parser sets the requiredAPIKEY for **OpenWeatherAPI** for the next block.

This data is then passed onto Decision Maker which makes all the decisions regardingthe message to be output at the display andsends it as a http response.

This data is displayed at the microcontroller. Thus, a lot ofbatteryis saved due to lesserprocessing time.

7.2 Feature 2 - SET DIRECTION REMOTELY FOR AGIVENSIGN BOARD



This part of Node RED flow accepts an **http GET** end point at **"/setDirection"** from which the uid and direction information are passed by the respective authorities**. Set Direction** Function block adds the direction information to the databaseand returns the sameas an http response. This data is sent to the microcontroller along with the **"/getSpeed"** pathand the microcontroller displays it.

8. TESTING

8.1 Test Cases

a. TEST CASE 1

Clear weather - Usual Speed Limit.

b. TEST CASE 2

Foggy Weather - Reduced Speed Limit.

c. TEST CASE 3

Rainy Weather - Further ReducedSpeed Limit.

d. TEST CASE 4

School/Hospital Zone - Do not
Honk sign isdisplayed.

8.2 User Acceptance Testing

Dynamic speed & diversionvariations based on the weather and traffic helps user to avoid traffic and have a safe journey home. The users would welcome this idea to be implemented everywhere.

9. RESULTS

9.1 Performance Metrics

Based on the IBM pack we chose, the performance of the website varies. Built upon NodeJS, a light and high performance engine, Node RED is capable of handling up to 10,000 requests per second. Moreover, since the system is horizontally scalable, an even higherdemand of customers can be served.

10. ADVANTAGES & DISADVANTAGES

10.1 ADVANTAGES

- Lower batteryconsumption since processing is donemostlyby Node RED serversin the cloud.
- Cheaper and low requirement micro controllers can beused since processing requirements are reduced.
- Longer lastingsystems.

- Dynamic Sign updating.
- School/Hospital Zone alerts

10.2 DISADAVNTAGES

- The size of the display determines the requirement of themicro controller
- Dependent on OpenWeatherMap API and hence the speed reduction is same for a largearea in the scale of cities

11. CONCLUSION

Our project is capable of serving as a replacement for static signs for a comparatively lower cost and can be implemented in the very near future. This will help reduce a lot of accidents and maintaina more peaceful trafficatmosphere in the country.

12. FUTURE SCOPE

Introduction of intelligent road sign groups in real life scenarios could have great impact on increasing the driving safety by providing the end-user (car driver) with the most accurate information regarding the current road and traffic conditions. Even displaying the information of a suggested driving speed and road surface condition (temperature, icy, wet or dry surface) could result in smoother trafficflows and, what is more important, in increasing a driver’s awareness of the road situation.

13. APPENDIX

• PROJECT DEVELOPMENT PHASE LINK

https://github.com/IBM-EPBL/IBM-Project-44962-1660727622/tree/main/Project%20Development%20Phase

• SOURCE CODE -1

```
import wiotp.sdk.device

import time

import random

import ibmiot.application

import ibmiot.device

import requests, json


myConfig = {#Configuration

    "identity":{

        "orgId": "ondwbf",

        "typeId": "maheswari",

        "deviceId": "mahi"

},

#API Key

    "auth": {

    "token": "123456789"

}

}

#Receivin callbacks from IBM IOT platform
```

```
def myCommandCallback(cmd):


    print("Message received from IBM IOT platform: %s"%cmdd.data['command'])
    m=cmd.data['command']
client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandledrs=None)
client.connect()


#OpenWeatherMap Credentials
BASE_URL ="https://api.openweathermap.org/data/2.5/weather?"
CITY ="Thanjavur"
URL =BASE_URL + "q="+ CITY + "&appid=" + "d106157c5cca0a4fea1b88efee7d738d"


while True:
   response = requests.get(URL)
   if response.status_code == 200:
     data = response.json()
     main = data['main']
     temperature = main['temp']
     humidity = main['humidity']
     pressure = main['pressure']
     report = data['visibility']
#messge part
msg=random.randint(0,5)
if msg==1:
  message="GO SLOW, SCHOOL / COLLEGE ZONE AHEAD"
elif msg==2:
    message="NEED HELP, POLICE STATION AHEAD"
elif msg==3:
    message="EMERGENCY, HOSPITAL NEARBY"
elif msg==4:
    message="DINE IN, RESTAURENT AVAILABLE"
elif msg==5:
    message="PETROL BUNK NEARBY"
else:
    message=""
#Speed Limit part
speed=random.randint(0,150)
if speed>=100:
    speedMsg=" Limit Exceeded"
elif speed>=60 and speed<100:
    speedMsg="Moderate"
else:
    speedMsg="Slow"
#Diversion part
sign=random.randint(0,5)
if sign==1:
    signMsg="Right Diversion"
elif sign==2:
    signMsg="Speed Breaker"
elif sign==3:
    signMsg="Left Diversion"
elif sign==4:
    signmsg="U Turn"
```

```
else:
   signMsg=""
#Visibility
if temperature < 24:
   visibility="Fog Ahead, Drive Slow"
elif temperature < 20:
   visibility="Bad Weather"
elif temperatue < 30:
   visibility="Clear Weather"
else:
   print("Error in the HTTP request")
   myData={'Temperature':temperature, 'Message':message, 'Sign':signMsg, 'Speed':speedMsg,
         'Visibility':visibility}
   client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,
onPublish=None)
#PUBLISHING TO IOT WATSON
print("Published data Successfully: ", myData)
print("")
client.commandCallback = myCommandCallback
time.sleep(5)
client.disconnect()
```

SOURCE CODE -2

```
#include <WiFi.h>//library for wifi
#include <PubSubClient.h>//library for MQtt
#include "DHT.h"// Library for dht11
#define DHTPIN 5     // what pin we're connected to
#define DHTTYPE DHT22   // define type of sensor DHT 11
```

```
DHT dht (DHTPIN, DHTTYPE);// creating the instance by passing pin and typr of dht connected

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

//-------credentials of IBM Accounts------

#define ORG "ondwbf"//IBM ORGANITION ID
#define DEVICE_TYPE "maheswari"//Device type mentioned in ibm watson IOT Platform
#define DEVICE_ID "mahi"//Device ID mentioned in ibm watson IOT Platform
#define TOKEN "123456789"     //Token
String data3;
float h, t;


//-------- Customise the above values --------
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";// Server Name
char publishTopic[] = "iot-2/evt/Data/fmt/json";// topic name and type of event perform and format in which data to be send
char subscribetopic[] = "iot-2/cmd/command/fmt/String";// cmd  REPRESENT command type AND COMMAND IS TEST OF FORMAT STRING
char authMethod[] = "use-token-auth";// authentication method
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;//client id


//-----------------------------------------
WiFiClient wifiClient; // creating the instance for wificlient
PubSubClient client(server, 1883, callback ,wifiClient); //calling the predefined client id by passing parameter like server id,portand wificredential


void setup()// configureing the ESP32
{
  Serial.begin(115200);
  dht.begin();
  pinMode(33, INPUT); //North
  pinMode(25, INPUT); // South
  pinMode(26, INPUT); // East
  pinMode(27, INPUT); // West
  delay(10);
  Serial.println();
  wificonnect();
  mqttconnect();
}

int n, s, e, w;

void loop()// Recursive Function
{

  h = dht.readHumidity();
  t = dht.readTemperature();
  Serial.print("temp:");
  Serial.println(t);
  Serial.print("humidity:");
  Serial.println(h);

  n = digitalRead(33);
  s = digitalRead(25);
  e = digitalRead(26);
  w = digitalRead(27);

  PublishData(t, h, n, s, e, w);
  delay(1000);
  if (!client.loop()) {
    mqttconnect();
  }
}



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

void PublishData(float temp, float humid, int n, int s, int e, int w) {
  mqttconnect();//function call for connecting to ibm
  /*
     creating the String in in form JSon to update the data to ibm cloud
  */
  String payload = "{\"temp\":";
  payload += temp;
  payload += "," "\"humidity\":";
  payload += humid;
  payload += "," "\"North\":";
  payload += n;
  payload += "," "\"South\":";
  payload += s;
  payload += "," "\"East\":";
  payload += e;
  payload += "," "\"West\":";
  payload += w;
  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);
    }
    initManagedDevice();
    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());
}

void initManagedDevice() {
  if (client.subscribe(subscribetopic)) {
    Serial.println((subscribetopic));
    Serial.println("subscribe to cmd OK");
  } else {
    Serial.println("subscribe to cmd 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]);
    data3 += (char)payload[i];
  }
  Serial.println("data: "+ data3);
```

```
//   if(data3=="lighton")
//   {
// Serial.println(data3);
// digitalWrite(LED,HIGH);
//   }
//   else
//   {
// Serial.println(data3);
// digitalWrite(LED,LOW);
//   }
// data3="";
}
```

Video Demo Link:

https://drive.google.com/file/d/1G9KWlwppZNzNtbEbRIW17Oum4XHvIfqn/view?usp=drive_web

Git Hub Link: https://github.com/IBM-EPBL/IBM-Project-44962-1660727622