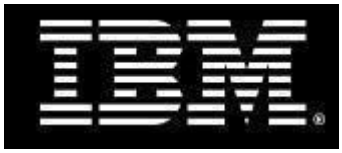


SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY

IBM PROJECT REPORT

Team ID - PNT2022TMID23936

SUBMITTED BY

M. MOUIDEEN SAMEER (110119104054)
L. MOHAMED ISMAIL (110119104050)
M. MYDEEN (110119104301)
S. MOHAMED AARIFEEN (110119104033)

CONTENTS

1. INTRODUCTION

1.1 Project Overview

- To replace the static signboards, smart connected signboards are used.
- These smart connected sign boards get the speed limitations from a web app using weather API and update automatically.
- Based on the weather changes the speed may increase or decrease.
- Based on the traffic and fatal situations the diversion signs are displayed.
- Guide (Schools), Warning and Service (Hospitals, Restaurants) signs are also displayed accordingly.
- Different modes of operations can be selected with the help of buttons.

1.2 Purpose

- Smart Traffic Management is a system to monitor and control traffic signals using sensors to regulate the flow of traffic and to avoid congestion for a smooth flow 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 suggested a link between roadside 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.
- On the other hand, static roadside advertising signs have not been linked with differences in the crash count.
- However, this finding is contrary to previous research that suggests differences in crash counts exist in the presence of static roadside advertising.
- The quantity and quality of available evidence limit our conclusion.

- Fixed object, side swipe and rear end crashes are the most common types of crashes in the presence of roadside advertising signs.
- In addition, drivers showed increased eye fixations and increased drifting between lanes on the road.

2.2 References

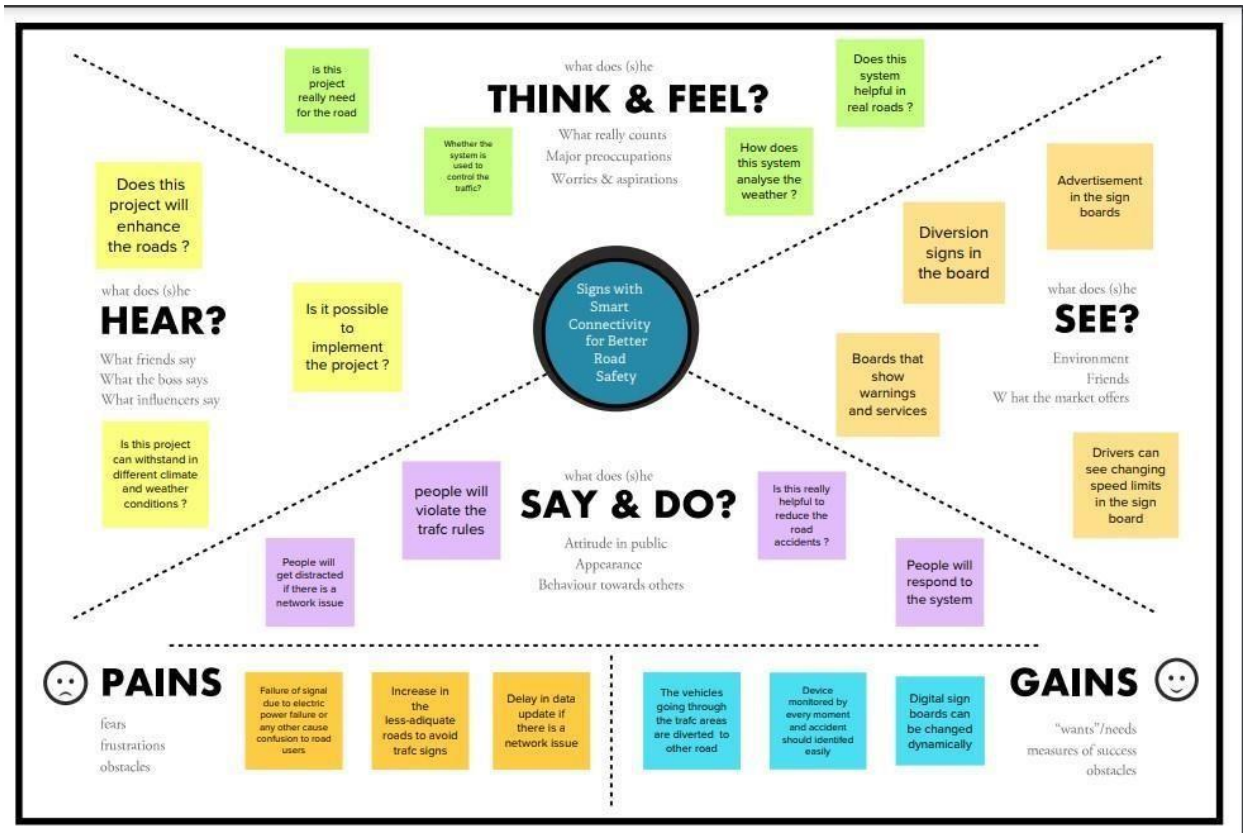
- Cairney and Gunatillake, 2000; Sisiopiku et al., 2015
- Islam, 2015; Sisiopiku et al., 2015
- Yannis et al., 2013, Staffeld (1953) and Ady (1967)

2.3 Problem Statement Definition

This project will replace the static boards to smart signed boards that will change the speed limits according 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.

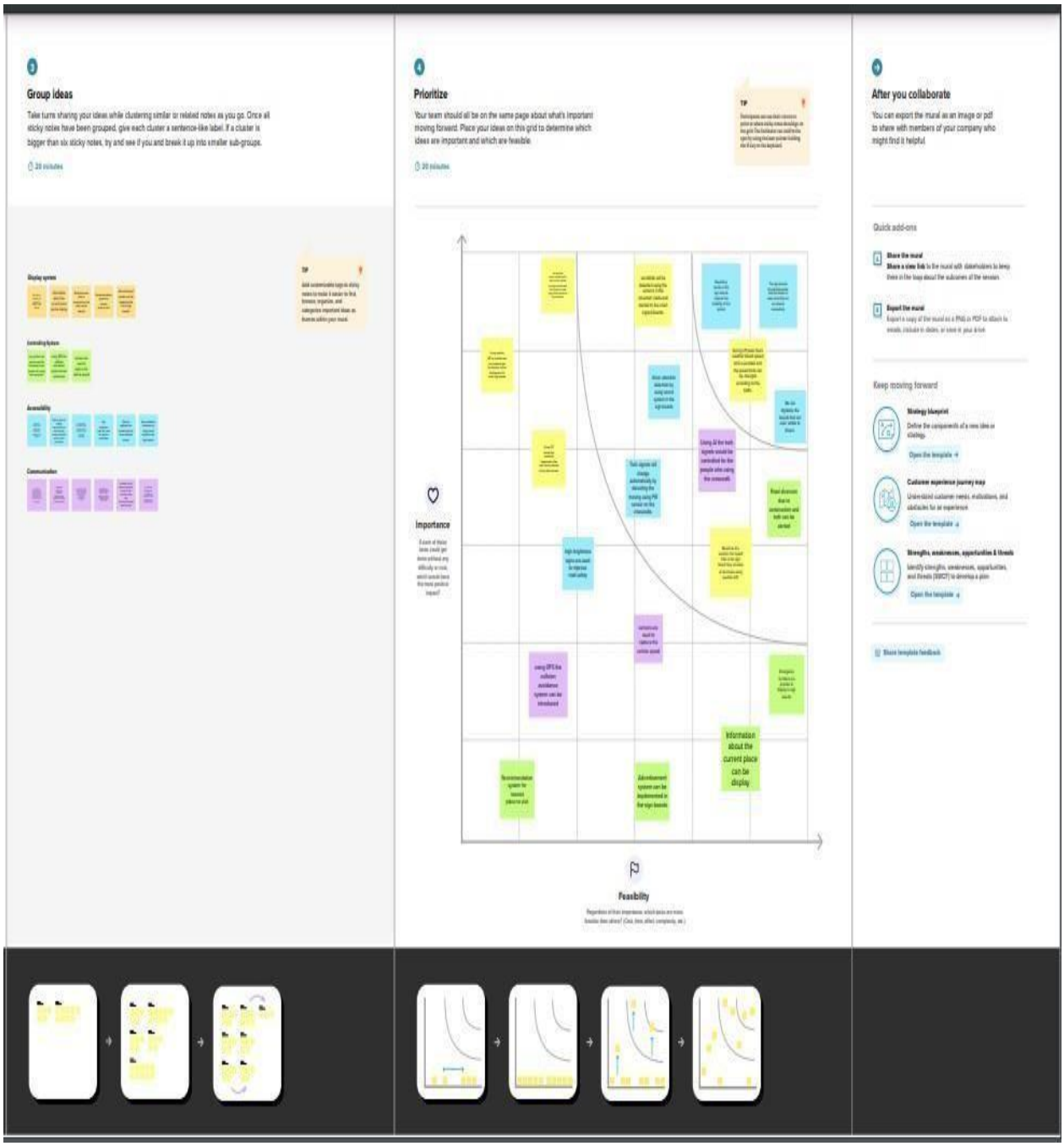
3. IDEATION AND PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming Map


Brainstorm
& idea prioritization
Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.
Before you collaborate
Define your problem statement
Brainstorm
Key rules of brainstorming


Group ideas
Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.
20 minutes
Prioritize
Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.
20 minutes
Importance
Feasibility
After you collaborate
You can export the mural as an image or pdf to share with members of your company who might find it helpful.
Quick add-ons
Keep moving forward
Strategy blueprint
Define the components of a new idea or strategy.
Open the template
Customer experience journey map
Understand customer needs, motivations, and obstacles for an experience
Open the template
Strengths, weaknesses, opportunities & threats
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan
Open the template
Share template feedback
Information about the current place can be display

3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To replace the static signboards, smart connected sign boards are used. These smart connected sign boards get the speed limitations from a web app using weather API and update automatically. Based on the weather changes the speed may increase or decrease Based on the traffic and fatal situations the diversion signs are displayed. Guide (Schools), Warning and Service (Hospitals, Restaurant) signs are also displayed accordingly. Different modes of operations can be selected with the help of buttons.

2.	Idea/solution description	The weather and temperature details are obtained from the OpenWeatherMap API. Using these details, the speed limit will be updated automatically in accordance with the weather conditions. Also, the details regarding any 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 will be 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

S.No.	Parameter	Description
		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 in turn reduces the frequent changing of the traffic signs even if the pedestrians are not present.

3.	Novelty /Uniqueness	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 Solution fit


Define CS, fit into CC
1. CUSTOMER SEGMENT(S)
CS
Who is your customer?
Traveller
Passenger
Tourist
Pedestrian
6. CUSTOMER CONSTRAINTS
CC
What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices.
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 sign board.
5. AVAILABLE SOLUTIONS
AS
Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen and paper is an alternative to digital notetaking
Along roadways, static signs with clear directions are put as potential fixes.
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 address for your customers? There could be more than one; explore different sides.
Among its many duties, the Smart board 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
RC
What is the real reason that this problem exists? What is the back 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
BE
What does your customer do to address the problem and get the job done?
As a teacher, the IOT cloud updates the Smart board on the condition of the roads on a regular basis.
Focus on J&P, tap into BE, understand RC
Identify strong TR & EM
3. TRIGGERS
TR
What triggers customers to act?
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
EM
How do customers feel when they face a problem or a job and afterwards?
Clients will feel better after selecting an operation mode with the use of smart board connectivity, and they will then follow the instructions on the Smart board.
10. YOUR SOLUTION
SL
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 are 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
CH
8.1 ONLINE
What kind of actions do customers take online?
The departments can receive direct emails or messages from customers. (Officers on nearby patrol)
8.2 OFFLINE
What kind of actions do customers take offline?
Following directions is one of the main tasks for the traveller, but they can utilize the smart board signs to check the state of the road from wherever they are
Identify strong TR & EM

4. REQUIREMENT ANALYSIS

4.1 Functional Requirements

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-I	User Visibility	• Implementing crystal clear display boards • Showing warning signs on the display • Blinking light system to attract driver's attention • Traffic light signal countdown on display
FR-2	User Understanding	• Alert notification system • Manual crossing button • Manual information display system
FR-3	Traffic Detection	• Implementing traffic detection system • Crossing based on traffic detection

FR-4	Communication	• Weather alert based on location • Traffic diversion based on detection

4.2 Non-Functional Requirements

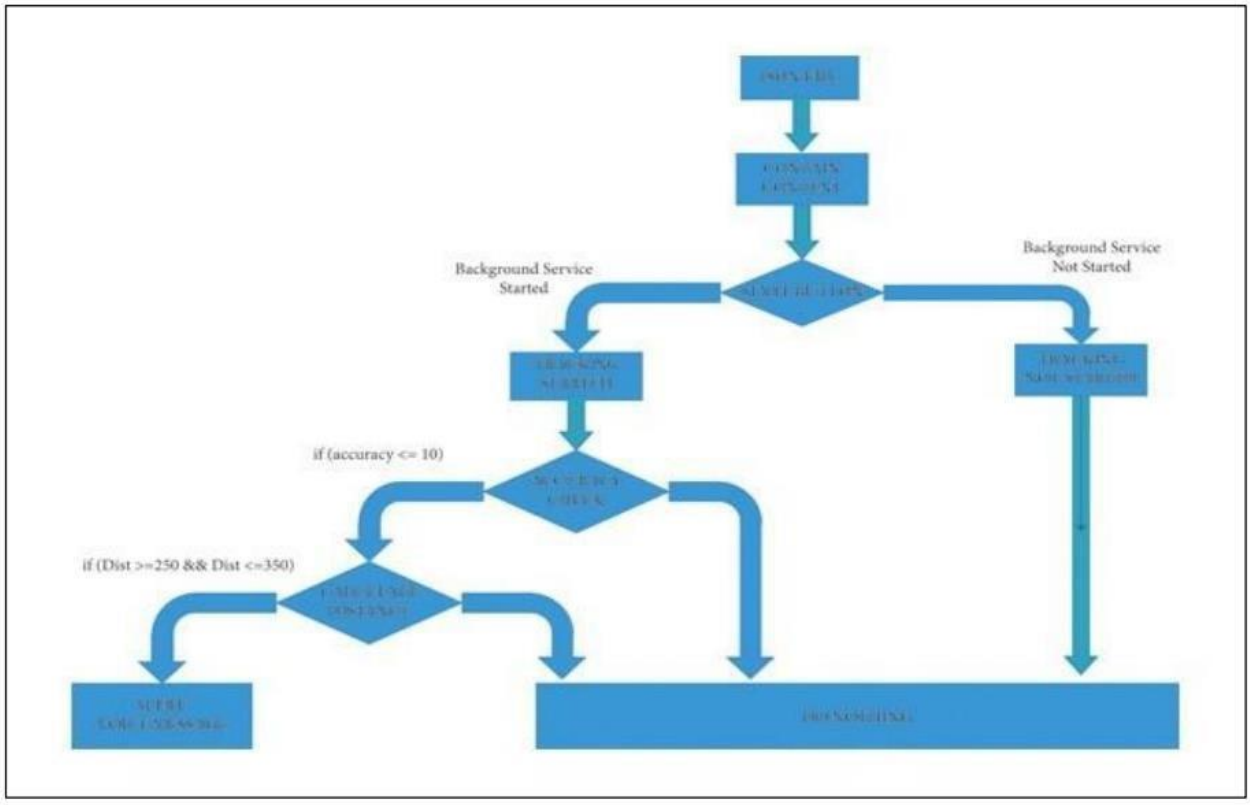
Following are the non-functional requirements of the proposed solution.

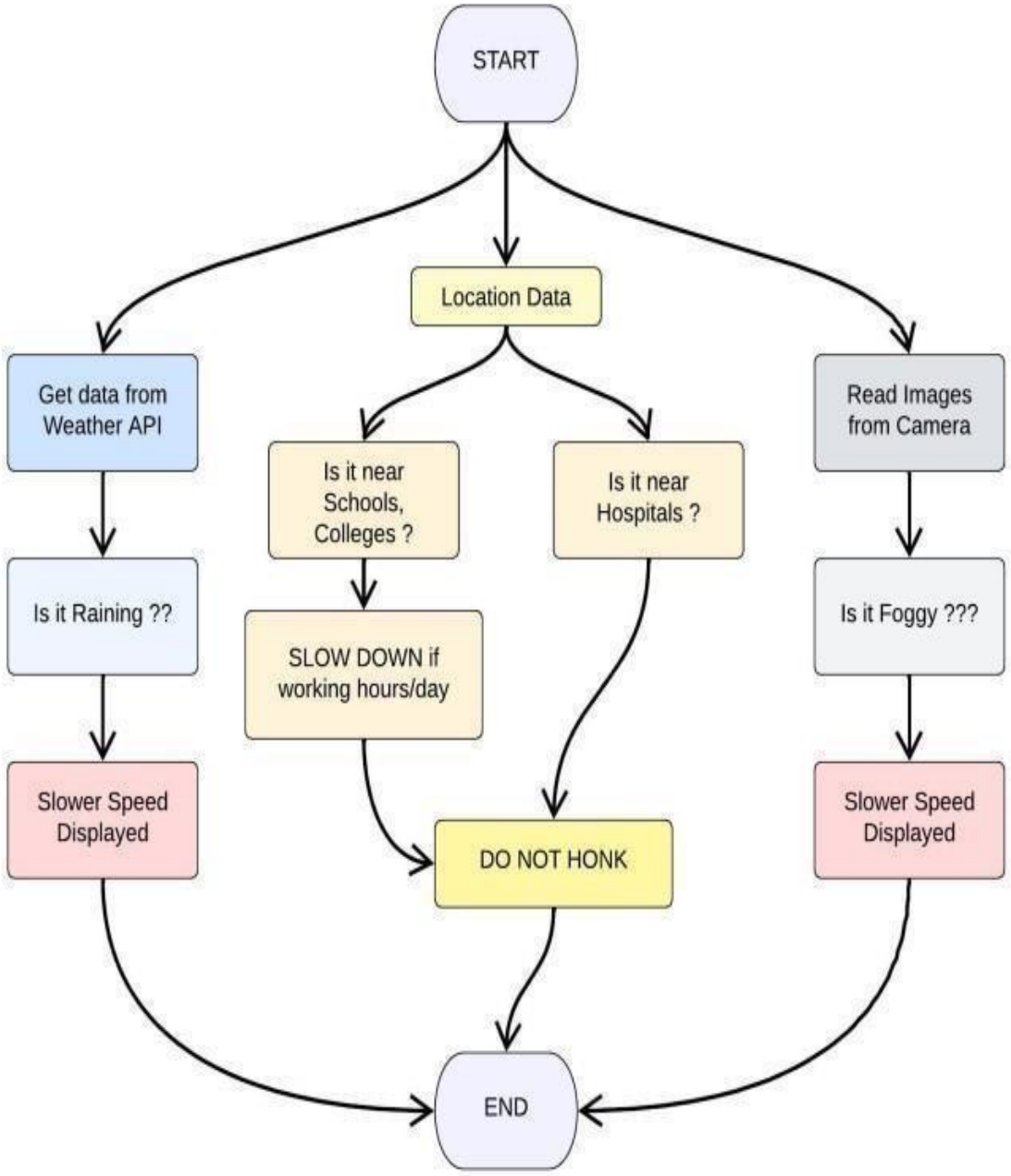
FR No.	Non-Functional Requirement	Description
NFR-I	Usability	It should convey the right message to user and to save the customer's travel time.
NFR-2	Security	The manual information button should be secured with a key to prevent misinformation
NFR-3	Reliability	It should convey the updated message on time and to build with service quality.

NFR-4	Performance	Display should be dynamically updated over cloud communication.
NFR-5	Availability	It should available 24/7 service with risk management measures
NFR-6	Scalability	It should consume server space based on the usage and extend server space based on demand.

5.PROJECT DESIGN

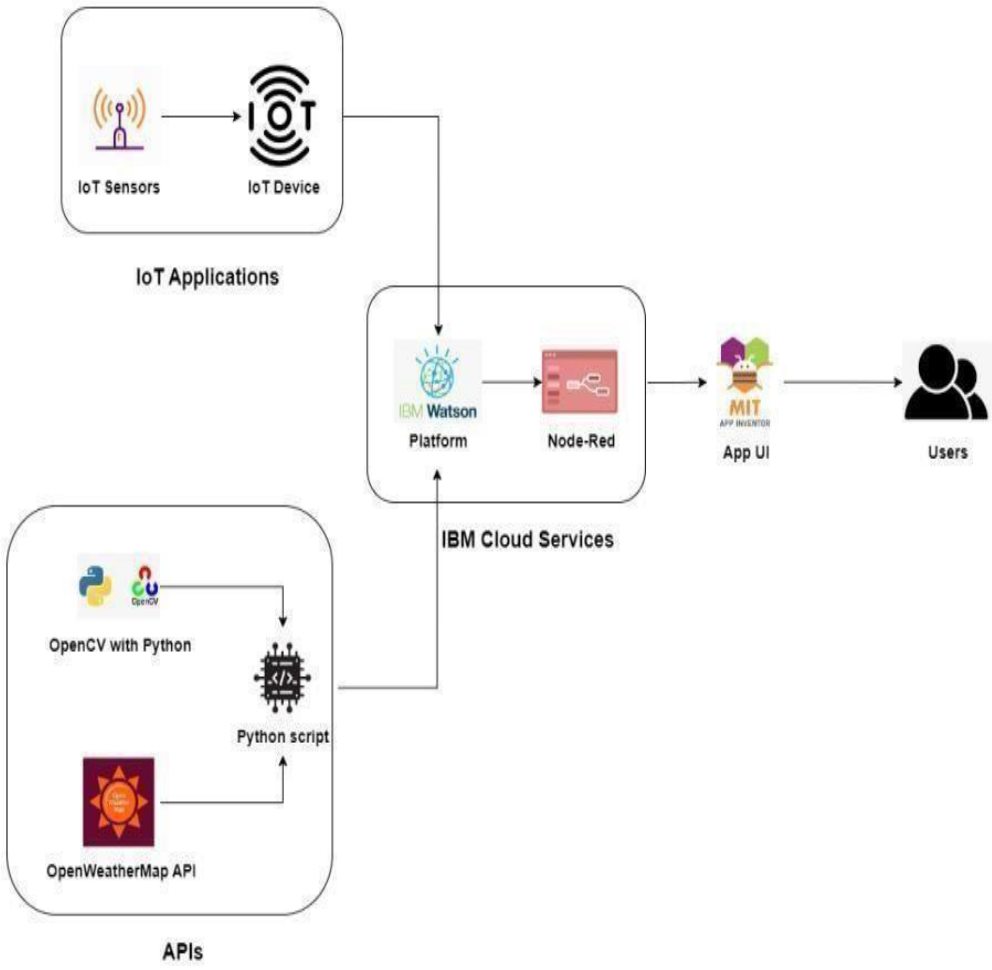
5.1 Data Flow Diagram


Background Service Started
Background Service Not Started
if (accuracy <= 10)
if (Dist >=250 && Dist <=350)



5.2 Solution & Technical Architecture

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



Following is the Solution Built

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	User can interact with the app using MIT App	HTML, CSS, JavaScript / Angular Js / React Js
2.	Application Logic-1	Detecting traffic and displaying information	Java / Python

3.	Application Logic-2	Sending notification to nearby users	IBM Watson STT service
4.	Application Logic-3	Communicating with physical device	IBM Watson Assistant
5.	Database	Storing on local phone storage	IBM Cloud
6.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
7.	File Storage	Storing on local phone storage	IBM Block Storage or Other Storage Service or Local Filesystem
8.	External API-1	Purpose of External API used in the application	Open Weather Map API
9.	External API-2	Purpose of External API used in the application	IBM Watson Platform, Node - Red
10.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration:	Local, Cloud Foundry, Kubernetes

Table-2: Application Characteristics:

S. No	Characteristics	Description	Technology
1.	Open-Source Frameworks	*OpenWeatherMap, NODERED, IBM WATSON, MIT App Inventor*	IoT, internet

2.	Security Implementations	Private cloud, Limited database access, Security layer implementation, Private key to access physical device	e.g. SHA-256, Encryptions, IAM Controls, Private key etc.
3.	Scalable Architecture	Server provisioning, Server availability, Local phone storage	IBM Cloud
4.	Availability	24/7 service, Continuous update, Data maintenance, Private staff	IBM Cloud
5.	Performance	Distributed servers, Cloud communication, Notification system, Effective information sharing	IBM Cloud ,python

5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Traveller)	User Visibility	USN-1	As a user, I can able to read the message on the display and became aware of it	I can able to read the message	High	Sprint-1
		USN-2	As a user, I can able to know the nearby warning signs and became aware of it	I can able to know the nearby warning signs	Medium	Sprint-2
		USN-3	As a user, I can became aware of crossing by blinking light system and it keeps me awake	I can aware of road crossing places	Medium	Sprint-1
		USN-4	As a user, I can able to know the traffic signal countdown and get ready to move	I can know traffic signal countdown	Low	Sprint-4
	User Interaction	USN-5	As a user, I can get to know about the road conditions through the notification	I can know road conditions in notification	Low	Sprint-4
Customer (Pedestrian)		USN-6	As a user, I can able to change the crossing button manually to cross the road	I can change the crossing button manually	High	Sprint-2
Administrator		USN-7	As an admin, I can able to change the display messages manually using a security key	I can change the display message manually	Medium	Sprint-2
	Traffic Detection	USN-8	As an admin, I can able to track the traffic and able to display the message accordingly	I can track the traffic density	High	Sprint-3
		USN-9	As an admin, I can able to change the traffic lights based on the traffic detection	I can change traffic lights in case of emergency	High	Sprint-3
Customer (Traveller)	Communication	USN-10	As a user, I can get the weather alert based on the location	I can get weather alerts	Medium	Sprint-4
Administrator		USN-11	As an admin, I can able to alert the diversion to the user based on the traffic	I can alert the diversion to the user	High	Sprint-4

6. PROJECT PLANNING AND SCHEDULING

6.1 Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	User Visibility	USN-1	As a user, I can able to read the message on the display and became aware of it.	2	High	Mouideen sameer, Mohamed ismail, Mohamed Aarifeen, Mydeen.
Sprint-2		USN-2	As a user, I can able to know the nearby warning signs and became aware of it.	1	Medium	Mouideen sameer, Mohamed ismail, Mohamed Aarifeen, Mydeen.
Sprint-1		USN-3	As a user, I can became aware of crossing by blinking light system and it keeps me awake.	2	Medium	Mouideen sameer, Mohamed ismail,Mohamed Aarifeen, Mydeen

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-4		USN-4	As a user, I can able to know the traffic signal countdown and get ready to move.	1	Low	Mouideen sameer, Mohamed ismail, Mohamed Aarifeen, Mydeen.
Sprint-4	User Interaction	USN-5	As a user, I can get to know about the road conditions through the notification.	1	Low	Mouideen sameer, Mohamed ismail, Mohamed Aarifeen, Mydeen.
Sprint-2		USN-6	As a user, I can able to change the crossing button manually to cross the road.	2	High	Mouideen sameer, Mohamed ismail, Mohamed Aarifeen, Mydeen.
Sprint-2		USN-7	As an admin, I can able to change the display messages manually using a security key.	2	Medium	Mouideen sameer, Mohamed ismail, Mohamed Aarifeen, Mydeen.

Sprint-3	Traffic Detection	USN-8	As an admin, I can able to track the traffic and able to display the message accordingly.	2	High	Mouideen sameer, Mohamed ismail, Mohamed Aarifeen, Mydeen.

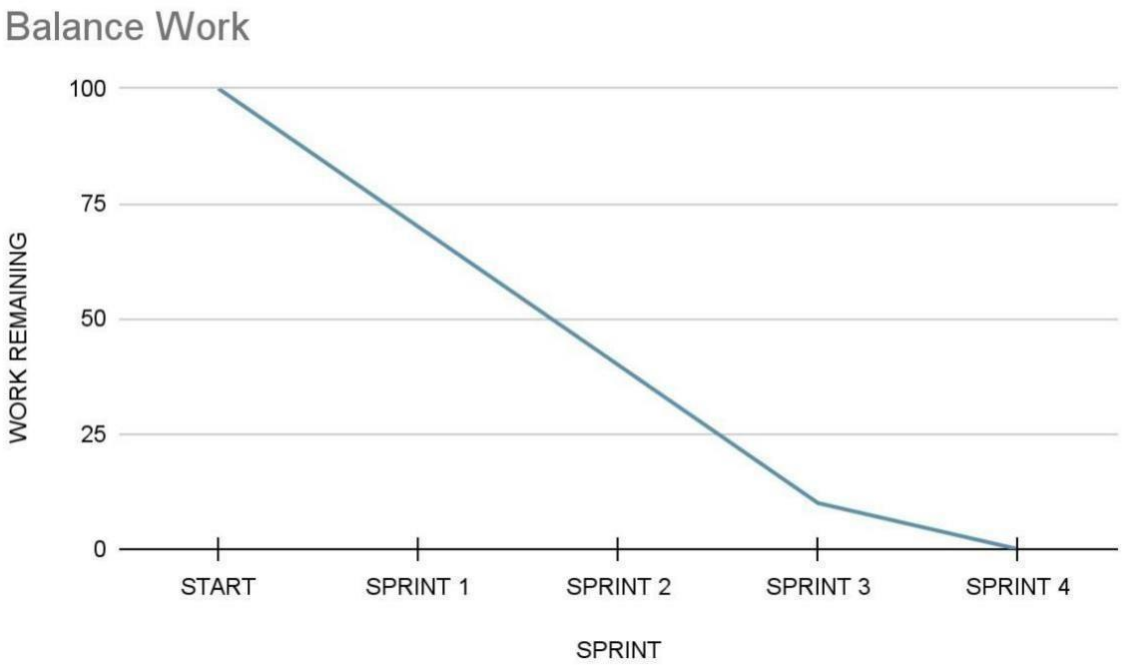
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-3		USN-9	As an admin, I can able to change the traffic lights based on the traffic detection.	2	High	Mouideen sameer, Mohamed ismail, Mohamed Aarifeen, Mydeen.
Sprint-4	Communication	USN-10	As a user, I can get the weather alert based on the location.	1	Medium	Mouideen sameer, Mohamed ismail, Mohamed Aarifeen, Mydeen.
Sprint-4		USN-11	As an admin, I can able to alert the diversion to the user based on the traffic.	2	High	Mouideen sameer, Mohamed ismail, Mohamed Aarifeen, Mydeen.

6.2 Sprint Delivery Schedule

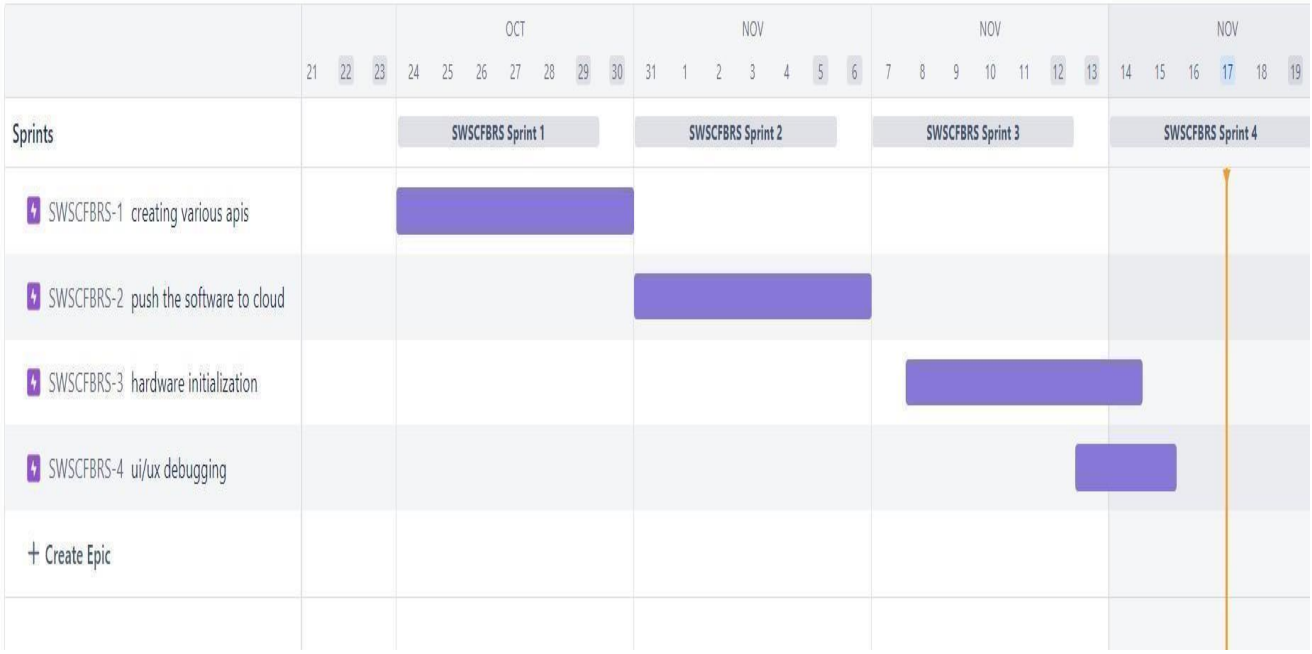
Project Tracker, Velocity & Burndown Chart:

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	11 Nov 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	14 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	16 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

Burndown Chart:

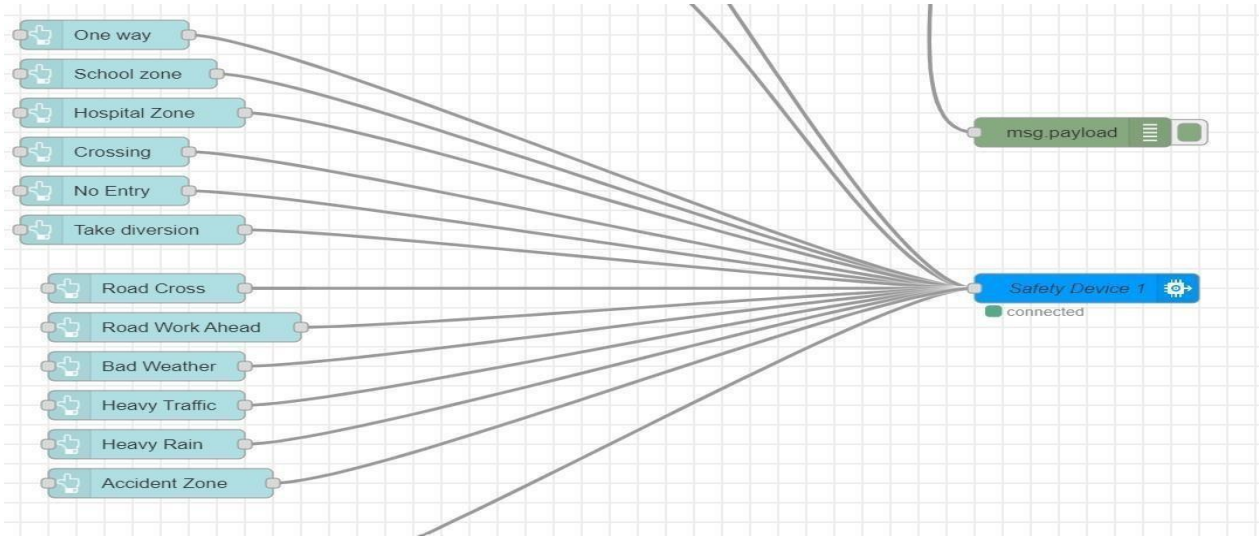


6.3 Reports from JIRA Software



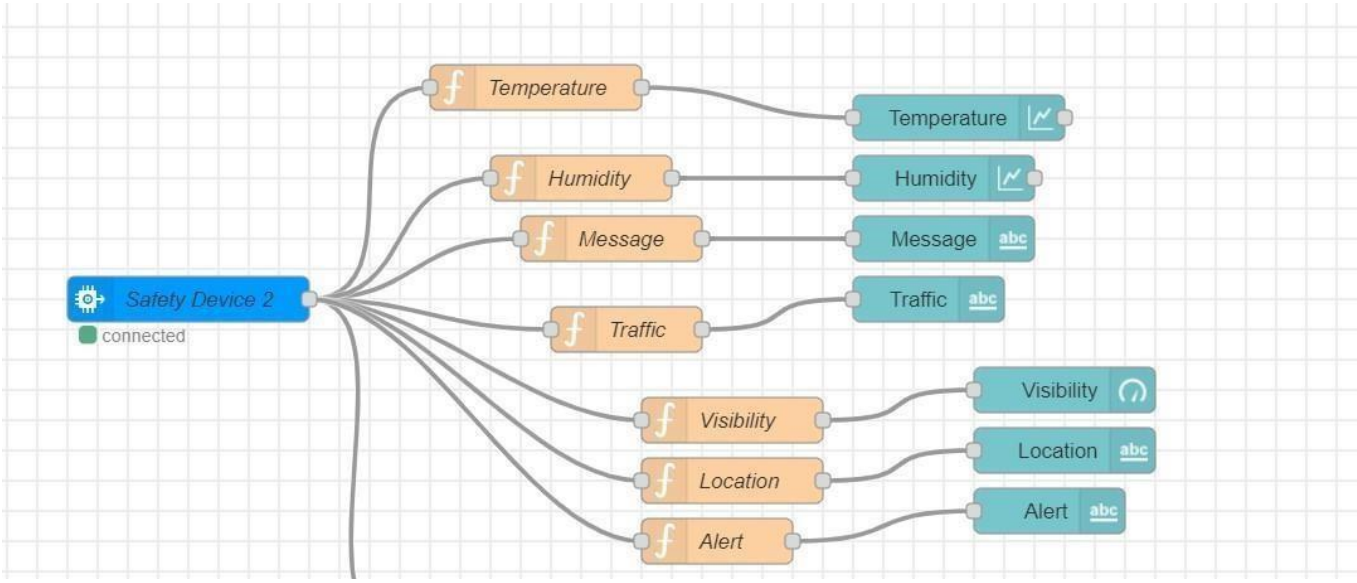
7. CODING AND SOLUTIONING

7.1 Feature 1 – Admin UI



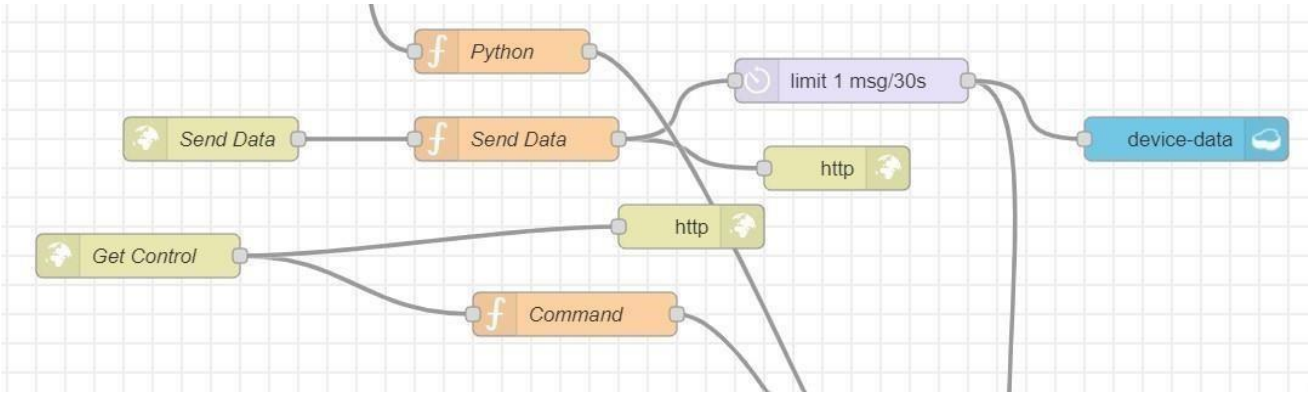
This part of Node RED flow creates aUI for Admin to control the display board to change the sign manually from a remote location. There is also an App for Admin to control the sign boards.

7.2 Feature 2 – user UI



This part of Node RED flow Creates a UI for Users Where User can able to see current weather update and road conditions . A phyton code sends the Data to the User UI through IOT Watson

7.3 Feature 3 – Data Send Flow



The part of Node RED flow gets the information from HTTP request and store in the cloudant DB named “device data” for every 30 seconds from the MIT App.

8. TESTING

8.1 Test Cases

Test Case 1: Display welcome message on the digital sign board when no data received from IOT Watson.

Test Case 2: Display message on the digital sign board based on the information from the IOT Watson.

Test Case 3: Display alert message on the digital sign board based on the admin input from the IOT Watson.

Test Case 4: Change the traffic lights when manual crossing button is pressed by the user.

8.2 User Acceptance Testing

Dynamic changes in the sign boards based on the input from the python to the IOT Watson 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 higher demand of customers can be served.

10. ADVANTAGES & DISADVANTAGES

- **ADVANTAGES**

- Lower battery consumption since processing is done mostly by Node RED servers in the cloud.

- Cheaper and low requirement micro controllers can be used since processing requirements are reduced.

- Longer lasting systems.

- Dynamic Sign updating.
- School/Hospital Zone alerts

• **DISADAVNTAGES**

- The size of the display determines the requirement of the micro controller
- Dependent on OpenWeatherMap API and hence the Weather Data is same for a large area 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 maintain a more peaceful traffic atmosphere 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 traffic flows and, what is more important, in increasing a driver's awareness of the road situation.

13. APPENDIX

SOURCE CODE

1. IOT Device (ESP 32)

Sketch.ino:

```
#include <WiFi.h>//library for wifi
#include <PubSubClient.h>//library for MQtt
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>//library for display

#define LED 2
#define RED 19 //Red light
#define YELLOW 18 //Yellow light
#define GREEN 5 //Green light
#define CROSS 13
#define CROSSIN 4
#define CROSSOUT 15
#define Crossing 34 //White Button
#define SchoolZone 35 //Yellow Button
#define HospitalZone 32 //Red Button
```

```
#define NoEntry 25 //Black Button
#define OneWay 26 //Blue Button
#define TakeDiversion 27 //Grey Button

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

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

#define ORG "m1r2sh"//IBM ORGANITION ID
#define DEVICE_TYPE "Roadsafety"//Device type mentioned in ibm watson
    IOT Platform
#define DEVICE_ID "safetydevice1"//Device ID mentioned in ibm watson
    IOT Platform
#define TOKEN "!_1ZsGYHI9TsD5kvOu"     //Token
String message; int buttonState = 0,i=30;
#define SCREEN_ADDRESS 0x3C

//-------- 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

//-------------------------------------
Adafruit_SSD1306 oled (128, 64, &Wire, -1);
```

```
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);
oled.begin(SSD1306_SWITCHCAPVCC, SCREEN_ADDRESS);
pinMode(LED,OUTPUT);   pinMode(RED,OUTPUT);
pinMode(YELLOW,OUTPUT);   pinMode(GREEN,OUTPUT);
pinMode(CROSSIN,OUTPUT);
pinMode(CROSSOUT,OUTPUT);   pinMode(CROSS, INPUT);
pinMode(Crossing, INPUT);   pinMode(SchoolZone, INPUT);
pinMode(HospitalZone,   INPUT);
    pinMode(NoEntry, INPUT);   pinMode(OneWay, INPUT);
pinMode(TakeDiversion, INPUT);

 oled.clearDisplay();   oled.setTextSize(1);
oled.setTextColor(WHITE);
oled.setCursor(10, 10);
oled.println("Welcome to Chennai");
oled.setCursor(20, 20);
oled.println("Speed Limit 40");
oled.setCursor(40, 30);
oled.println("Go Slow!");
oled.display();

 digitalWrite(GREEN, HIGH);
digitalWrite(CROSSOUT, HIGH);   delay(10);
Serial.println();
```

```
wificonnect();
mqttconnect();
}

void loop()// Recursive Function
{
  changeText();
roadCross();
PublishData();
ledBlink();   delay(1000);
if (!client.loop()) {
mqttconnect();
  }
}

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

void PublishData() {     mqttconnect();//function call
for connecting to ibm
  /*
     creating the String in in form JSon to update the data to ibm cloud
*/
  String payload = "{\"Message\":\"Enter Command to Display\"}";


  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 definition 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 ledBlink(){//function for led blinking system
digitalWrite(LED,LOW);   delay(1000);
digitalWrite(LED,HIGH);
}

void countDown(){//traffic light countdown system
for(i;i>0;i--){     oled.clearDisplay();
oled.setTextSize(3);     oled.setCursor(48, 20);
oled.println(i);     oled.display();      delay(1000);
  }
  oled.setTextSize(1);
i=30;
}

void roadCross(){//manual crossing function
  buttonState = digitalRead(CROSS);
  if(buttonState == LOW){
```

```
    trafficOff();
    digitalWrite(CROSSOUT,LOW);
  digitalWrite(CROSSIN, HIGH);    countDown();
  crossing();     trafficOn();
  digitalWrite(CROSSIN, LOW);
  digitalWrite(CROSSOUT, HIGH);
   }
  }

  void trafficOn(){//traffic light set to go
  digitalWrite(RED,HIGH);   delay(1000);
  digitalWrite(RED,LOW);
  digitalWrite(YELLOW,HIGH);
  delay(1500);   digitalWrite(YELLOW,LOW);
  digitalWrite(GREEN,HIGH);
  }

  void trafficOff(){//traffic light set to stop
  digitalWrite(GREEN,HIGH);
  delay(1000);   digitalWrite(GREEN,LOW);
  digitalWrite(YELLOW,HIGH);
  delay(1500);
  digitalWrite(YELLOW,LOW);
   digitalWrite(RED,HIGH);
  }

  void crossing(){//crossing display
  oled.clearDisplay();   oled.setCursor(20, 25);
  oled.println("Crossing Ahead");   oled.setCursor(40,
  35);   oled.println("Go Slow!");    oled.display();
```

```
}

void schoolZone(){//school zone display
oled.clearDisplay();   oled.setCursor(30,
25);   oled.println("School Zone");
oled.setCursor(28, 35);
oled.println("Do Not Honk!");
oled.display();
}

void hospitalZone(){//hospital zone
display     oled.clearDisplay();
oled.setCursor(25, 25);
oled.println("Hospital Zone");
oled.setCursor(28, 35);   oled.println("Do
Not Honk!");     oled.display();
}

void noEntry(){//no entry display
  oled.clearDisplay();
  oled.setCursor(40, 25);
  oled.println("No Entry");
  oled.setCursor(10, 35);
oled.println("No Vehicles Allowed");
oled.display();
}

void oneWay(){//one way display
oled.clearDisplay();   oled.setCursor(40, 25);
```

```
oled.println("One Way");   oled.setCursor(30, 35);
oled.println("Single Lane");   oled.display();
}

void takeDiversion(){//take diversion
display     oled.clearDisplay();
oled.setCursor(20, 25);   oled.println("Take
Diversion");   oled.setCursor(10, 35);
oled.println("Bad Road Condition");
oled.display();
}

void roadWorkAhead(){//alert road work
ahead     oled.clearDisplay();
oled.setCursor(40, 15);
oled.println("CAUTION!");   oled.setCursor(17,
25);
  oled.println("Road Work Ahead"); oled.setCursor(15, 35);
  oled.println("Work On Progress");
  oled.display();
}

void badWeather(){//alert bad weather
oled.clearDisplay();   oled.setCursor(40,
15);   oled.println("CAUTION!");
oled.setCursor(30, 25);
oled.println("Bad Weather");
oled.setCursor(20, 35);
oled.println("Low Visibility");
oled.display();
```

```
}

void heavyTraffic(){//alert heavy traffic
oled.clearDisplay();   oled.setCursor(40,
15);   oled.println("CAUTION!");
oled.setCursor(25, 25);
oled.println("Heavy Traffic");
oled.setCursor(22, 35);
oled.println("Take Diversion");
oled.display();
}

void heavyRain(){//alert heavy rain
oled.clearDisplay();   oled.setCursor(40,
15); oled.println("CAUTION!");
oled.setCursor(33, 25);
oled.println("Heavy Rain");
oled.setCursor(40, 35);
oled.println("Go Slow!");
oled.display();
}

void accidentZone(){//alert accident zone
oled.clearDisplay();   oled.setCursor(40, 15);
oled.println("CAUTION!");
oled.setCursor(25, 25);
oled.println("Accident Zone");
oled.setCursor(20, 35);   oled.println("Speed
Limit 30");     oled.display();
}
```

```
void changeText(){//change display text
if(digitalRead(Crossing) == LOW){
crossing();
  }else if(digitalRead(SchoolZone) == LOW){
schoolZone();
  }else if(digitalRead(HospitalZone) == LOW){
hospitalZone();
  }else if(digitalRead(NoEntry) == LOW){
noEntry();
  }else if(digitalRead(OneWay) == LOW){
oneWay();
  }else if(digitalRead(TakeDiversion) == LOW){
takeDiversion();
  }
}

void editText(String msg){//edit didplay
text   if(msg == "Crossing"){     crossing();
}else if(msg == "SchoolZone"){
schoolZone();
  }else if(msg ==
"HospitalZone"){
hospitalZone();   }else if(msg ==
"NoEntry"){     noEntry();     }else
if(msg == "OneWay"){
oneWay();
  }else if(msg == "TakeDiversion"){
takeDiversion();   }else if(msg
```

```
== "RoadCross"){ trafficOff();
digitalWrite(CROSSOUT,LOW);
digitalWrite(CROSSIN, HIGH);
countDown(); crossing();
trafficOn(); digitalWrite(CROSSIN,
LOW); digitalWrite(CROSSOUT,
HIGH); }else if(msg ==
"RoadWorkAhead"){
roadWorkAhead(); }else if(msg ==
"BadWeather"){ badWeather();
}else if(msg == "HeavyTraffic"){
heavyTraffic();
 }else if(msg == "HeavyRain"){ heavyRain();
 }else if(msg == "AccidentZone"){
accidentZone();
 }
}

//CallBack function  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++) {
message += (char)payload[i];
 }
 editText(message);
 Serial.println("data: "+ message);
message="";
}
```

2. PYTHON CODE

```
import time import sys
import
ibmiotf.application
import ibmiotf.device
import random as r
import weather
#Provide your IBM Watson Device Credentials organization = "m1r2sh"
deviceType = "Roadsafety" deviceId = "safetydevice2" authMethod = "token"
authToken = "t3USLaRSVT*BbaPGlA"
 #Data List
Message_list = ["Crossing","School Zone","Hospital Zone","No Entry","One
    Way","Take Diversion"]
Traffic_list = ["High","Moderate","Low"]
Notify_list = ["Heavy Traffic","Heavy Rain","Bad Weather","Road Work
    Ahead","Accident Zone"]
myLocation = "Chennai,IN"
APIKEY = "3833389c301e845d271b287e18bfba2f"
 # Initialize GPIO
 def myCommandCallback(cmd):
   print("Command received: %s" % cmd.data['command'])
print(cmd)

try:
    device
Options =
{"org":
organizat
```

```
        ion,
        "type":
        deviceTy
        pe, "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:
            #Random Data
            Message = r.choice(Message_list)
            Traffic = r.choice(Traffic_list)
            Alert = r.choice(Notify_list)

            #Get Weather from OpenWeatherMap
            weatherData = weather.get(myLocation, APIKEY)

            if Traffic == 'High':
                Message = "Go Slow!"            Alert =
        "Heavy Traffic"        elif weatherData["weather"]
        == "['rain']":
                Alert = "Heavy Rain"
```

```
        #JSON Data          data = {"d":{ 'temp' :
  round(weatherData["temperature"], 2),                    'humidity' :
  weatherData["humidity"],
                    'visibility' : weatherData["visibility"],
                    'location' : myLocation,
                    'message' : Message,
                    'traffic' : Traffic,
                    'alert' : Alert}
                }
        #print data         def
  myOnPublishCallback():
             print ("Published Temperature = %s C" %
      round(weatherData["temperature"], 2), "Humidity = %s %%" %
      weatherData["humidity"], "to IBM Watson")

        success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
  on_publish=myOnPublishCallback)         if not success:
  print("Not connected to IoTF")         time.sleep(5)

        #CallBack
        deviceCli.commandCallback = myCommandCallback

  # Disconnect the device and application from the cloud
  deviceCli.disconnect()
```

Weather.Py:

```
import requests as reqs
def get(myLocation,APIKEY):
apiURL =
```

```
f"https://api.openweathermap.org/data/2.5/weather?q={myLocation}&appi
d={APIKEY}"     responseJSON = (reqs.get(apiURL)).json()

   #JSON Object
returnObject = {
      "temperature" : responseJSON['main']['temp'] - 273.15,
      "humidity" : responseJSON['main']['humidity'],
      "weather" : [responseJSON['weather'][_]['main'].lower() for _ in
range(len(responseJSON['weather']))],
      "visibility" : responseJSON['visibility']/100
   }
   return(returnObject)
```

GITHUB LINK:

https://github.com/IBM-EPBL/IBM-Project-19416-1659697551

PROJECT DEMO LINK:

https://drive.google.com/file/d/1HfANkX3NR-B9y-WyywHHSsyqspOLgkmb/view