SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY

IBM PROJECT REPORT

Team ID -

PNT2022TMID14966

Project Report by

Manoj kumar M-111519106085
Harikrishnan T-111519106045
Jegan S-111519106057
Kirthik Saran P-111519106070

Bachelor of Engineering In

R.M.D Engineering College
Kavaraipettai

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Project Name	Signs with Smart Connectivity for Better Road Safety

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

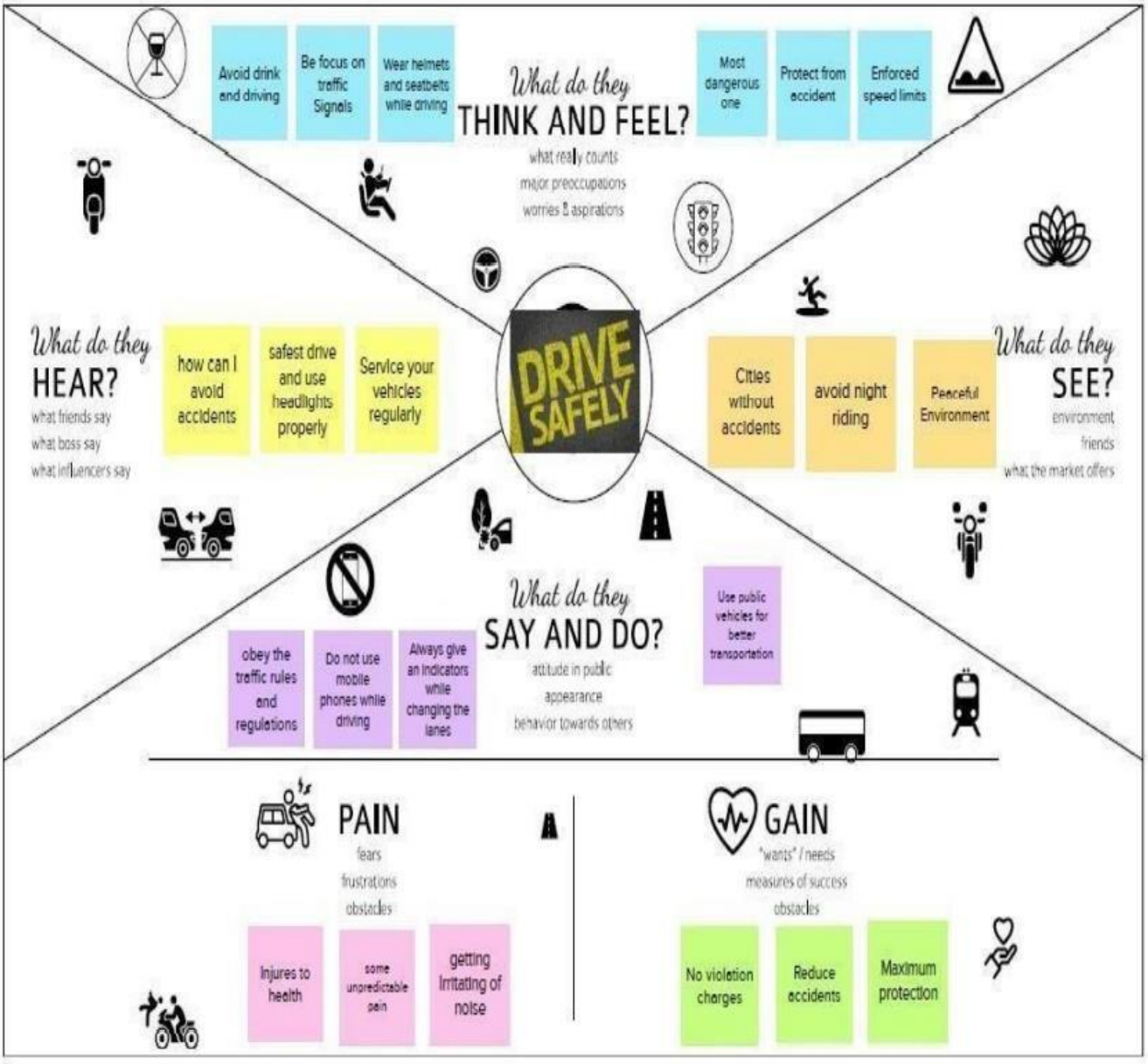
- Islam, 2015; Sisiopiku et al., 2015
- Yannis et al., 2013, Staffeld (1953) and Ady (1967)

2.3 Problem Statement Definition

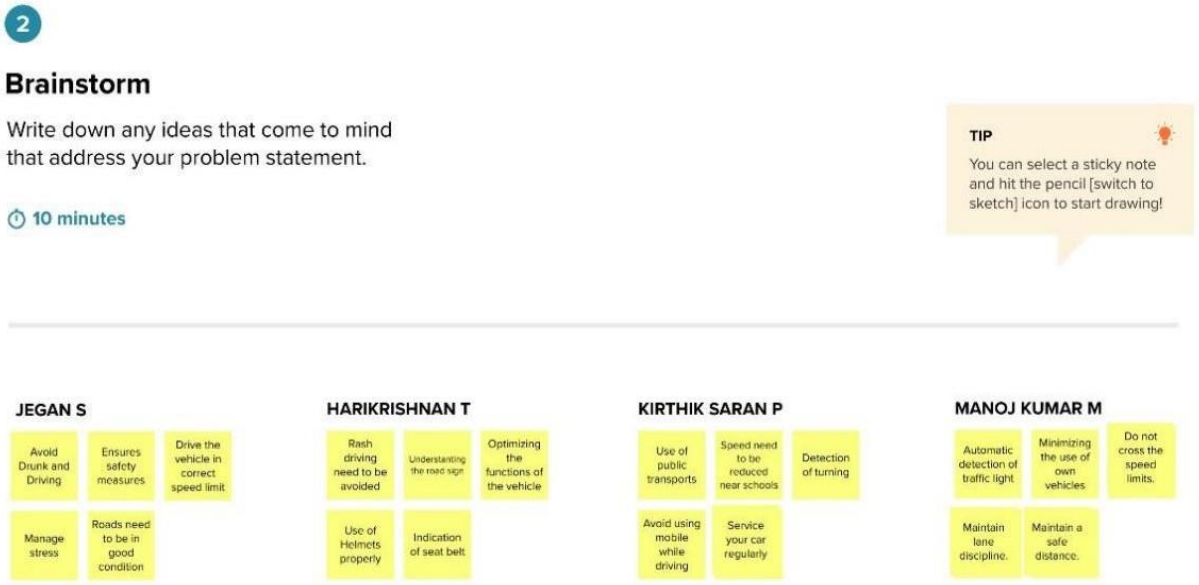
This project will replace the static boards to smart signed boards that will change the speed limits according to the weather climate and show diversion messages if there are accidents in the road and alert messages if there is hospital, schools or any roadworks.

3. IDEATION AND PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming Map

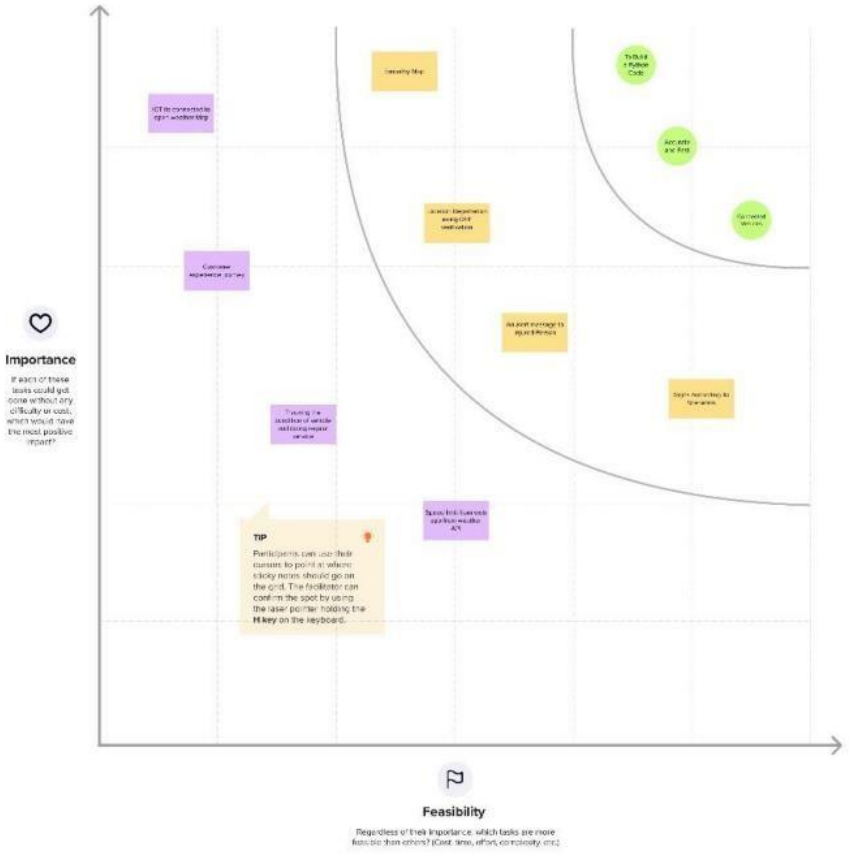


4

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



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

A **Share the mural**
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.

B **Export the mural**
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

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 →

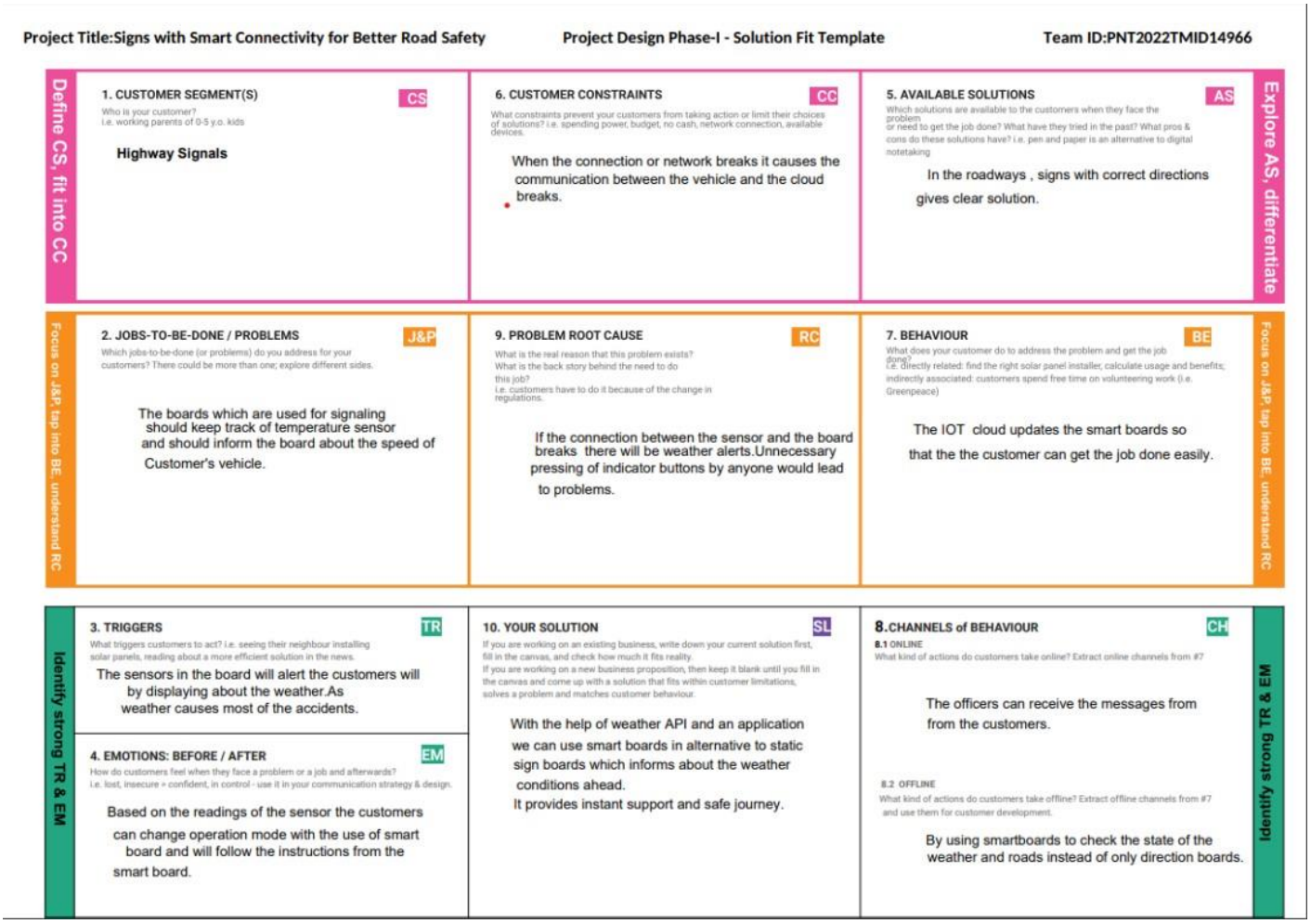
Strengths, weaknesses, opportunities & threats
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
Open the template →

Share template feedback

3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	➢ To prevent road accidents by ensuring suitable measures usingIOT.
2.	Idea / Solution description	➢ By Preparing smart signs using IOT instead of regular signs hung on theroad. ➢ These smart signs provide a better clarity and are built with IOT and LED.
3.	Novelty / Uniqueness	➢ Since LED is highly energy efficient – Less heat, more light, lower cost. Use less electricity for the same light output. ➢ The smart signs consist of temperature, humidity, wind speed. ➢ This information is received from weather monitoring app. ➢ It also gives information about nearby Places such as hospitals, schools, etc. so that the users can decide their speeding according to that information.
4.	Social Impact / Customer Satisfaction	➢ These create a noticeable impact on the road safety department. ➢ By deciding a speed limit for the user, there is significant chance in reducing the accidents.
5.	Business Model (Revenue Model)	➢ By executing these for commoners by the government, it is great initiative increating an awareness among the people. ➢ A separate budget can be allotted for this by the government, which paves away for a safer environment.
6.	Scalability of the Solution	➢ It has greater chance in reducing the risk for the people as it is more visible than the normal signs, which saves a lotof lives at stake.

3.4 Problem Solution fit



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	Sign Boards should be made of bright colored 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 awaydrivers

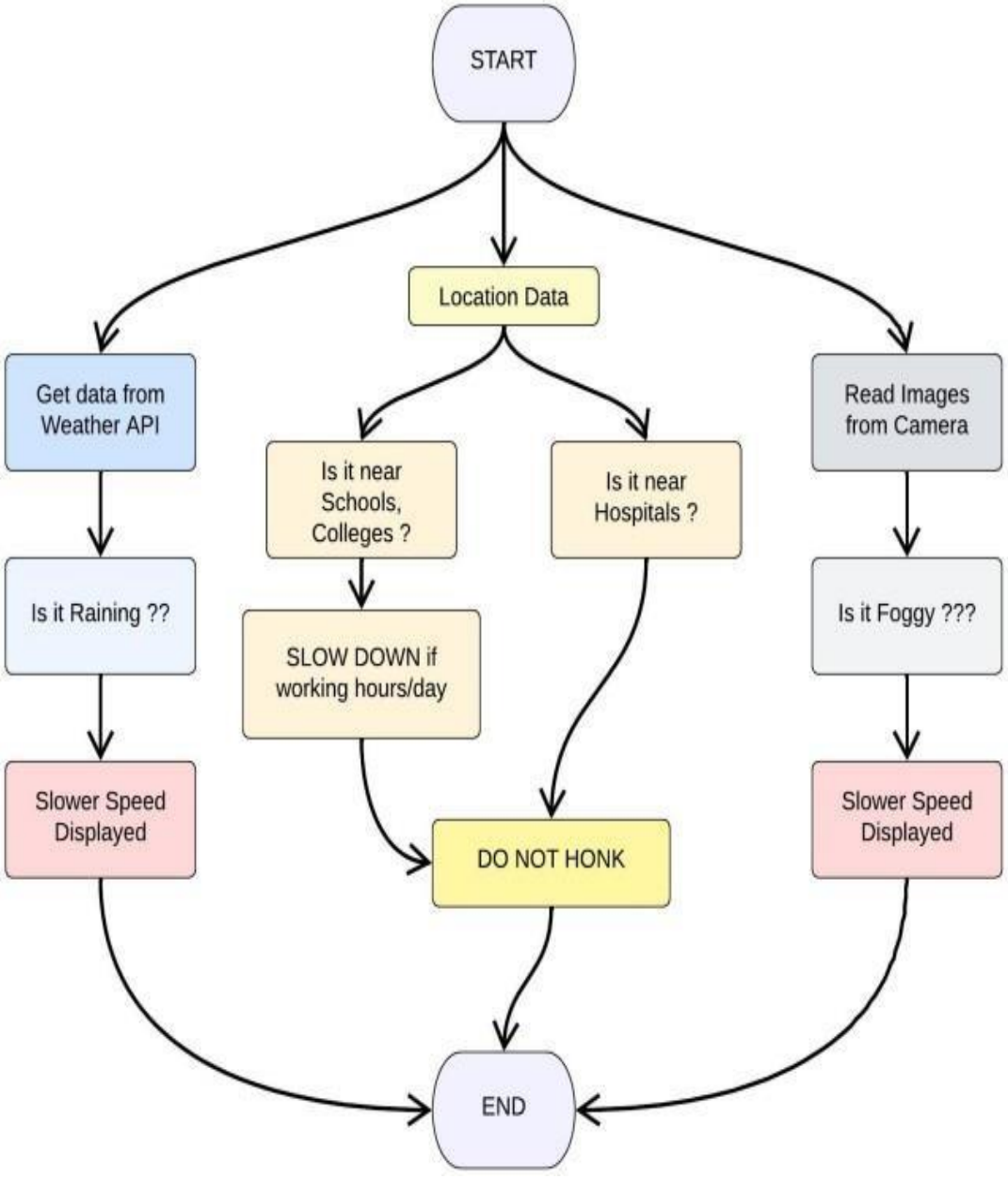
4.2 Non-Functional Requirements

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

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.

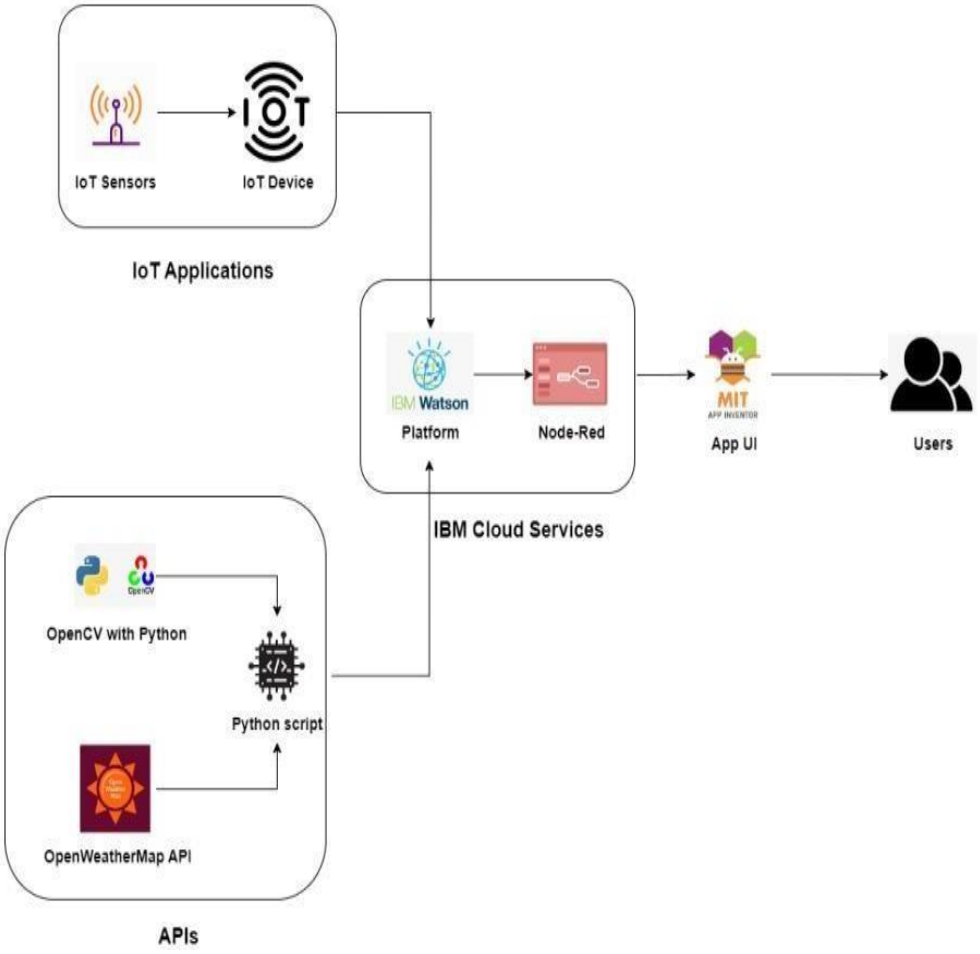
5. PROJECT DESIGN

5.1 Data Flow Diagram



5.2 Solution & Technical Architecture

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



Following is the Solution Built

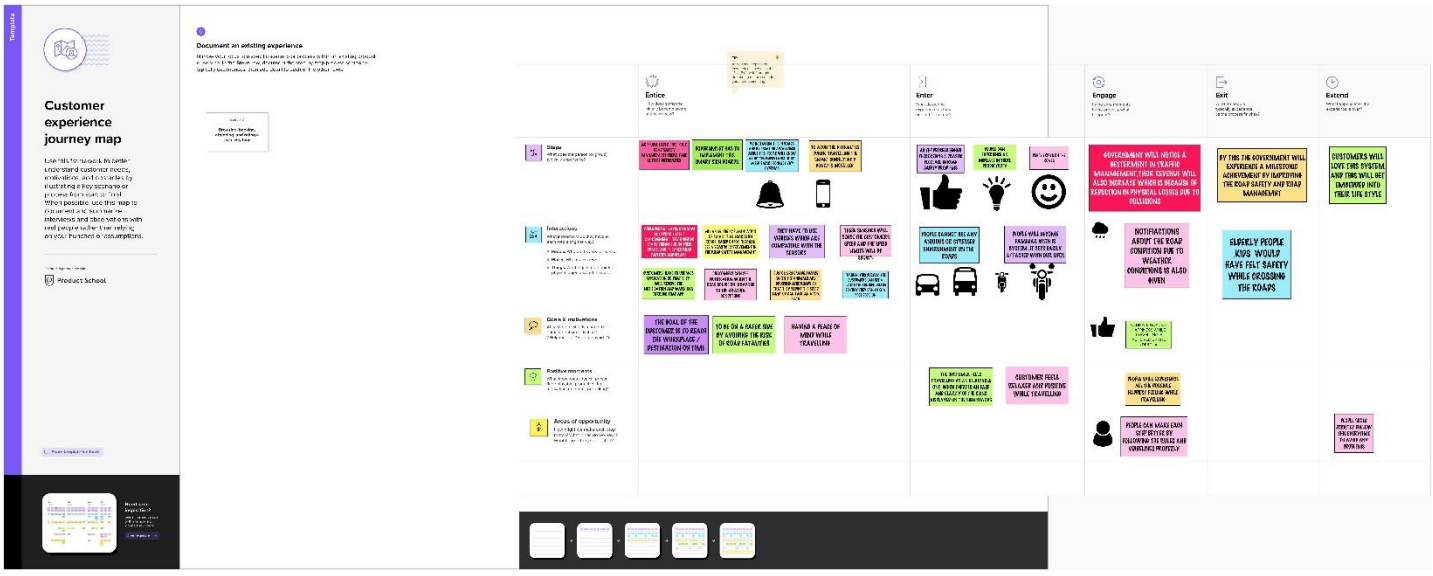
Table-1 : Components & Technologies:

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	Logic for a process in the application	Java / Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	Data Type, Configurations etc.	IBM Cloud
6.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
7.	File Storage	File storage requirements	IBM Block Storage or Other StorageService 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 / CloudLocal Server Configuration: Cloud Server Configuration:	Local, Cloud Foundry, Kubernetes

Table-2: Application Characteristics:

S. No	Characteristics	Description	Technology
1.	Open-Source Frameworks	*OpenWeatherMap, NODE-RED, IBM WATSON,MIT App Inventor*	IoT, internet
2.	Security Implementations	*Powerful security system for everyone's peace of mind No access data Hackers cannot access network*	Firewall, Firebase, cyber resiliency, strategy
3.	Scalable Architecture	*EASY TO EXTEND THE NETWORK WITH THEAID OF THE BANDWIDTH OF THE NETWORK*	IBM Cloud
4.	Availability	*Available every time and everywhere 24/7so long as the consumer is signed into the network.*	IBM Cloud
5.	Performance	*AIDS MASSIVE RANGE OF USERS TO USE TECHNOLOGY*	IBM Cloud

5.3 User Stories



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	Initialization of All required Services	USN-1	Initialize services like OpenWeatherMap, NodeRED, etc.	2	High	Manoj kumar Harikrishnan Jegan Kirthik Saran
Sprint-2	Implementation of Code	USN-2	Coding to integrate all services as one	2	High	
Sprint-3	Hardware Integration	USN-3	Hardware implementation on IoT Enabled Device	2	Medium	
Sprint-4	Optimization	USN-4	Bug fixes and improvements	2	Low	

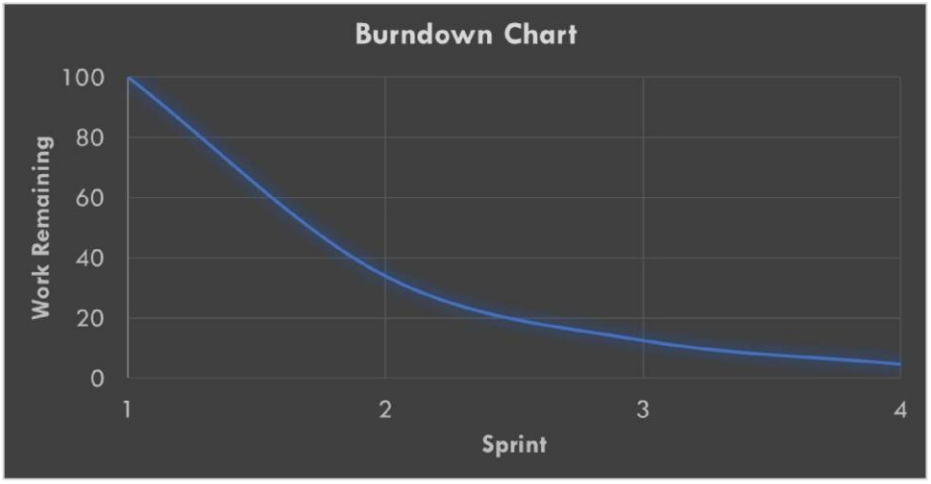
6.2 Sprint Delivery Schedule

Project Tracker, Velocity & Burndown Chart:

Project Tracker, Velocity & Burndown Chart: (4 Marks)

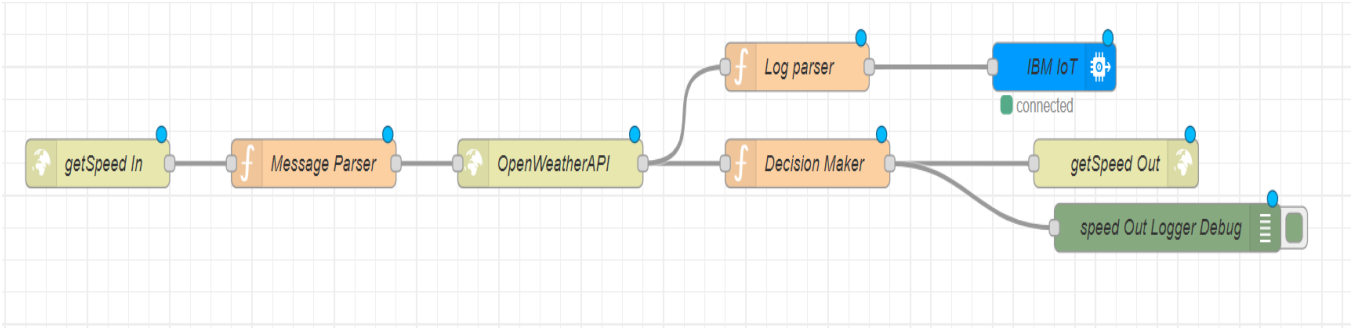
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	14 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	18 Nov 2022

Burndown Chart:



7. CODING AND SOLUTIONING

7.1 Feature 1 - GET SPEED FOR GIVEN LOCATION & CLIMATE



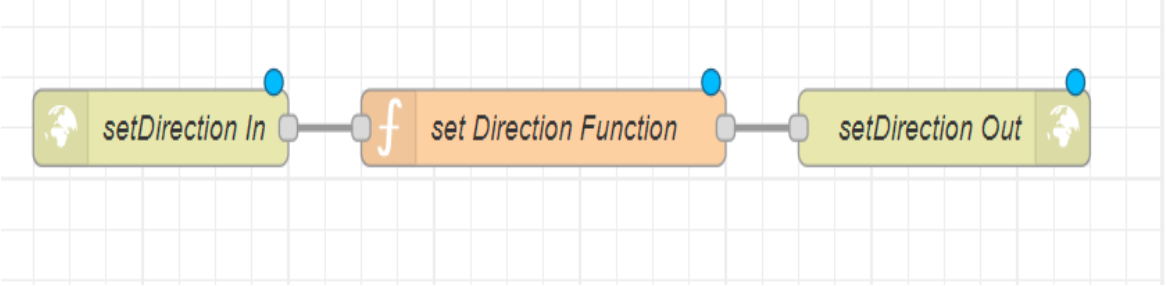
This part of Node RED flow accepts an http GET end point at **"/getSpeed"** from which the location, uid, hospital/school zone info are passed.

Message parser sets the required APIKEY for **OpenWeatherAPI** for the next block.

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

This data is displayed at the microcontroller. Thus, a lot of battery is saved due to lesser processing time.

7.2 Feature 2 - SET DIRECTION REMOTELY FOR A GIVEN SIGN 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 database and returns the same as an http response. This data is sent to the microcontroller along with the **"/getSpeed"** path and the microcontroller displays it.

8. TESTING

8.1 Test Cases

- **TEST CASE 1**

  Clear weather - Usual Speed Limit.

- **TEST CASE 2**

  Foggy Weather - Reduced Speed Limit.

- **TEST CASE 3**

  Rainy Weather - Further Reduced Speed Limit.

- **TEST CASE 4**

  School/Hospital Zone - Do not Honk sign is displayed.

8.2 User Acceptance Testing

Dynamic speed & diversion variations 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 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 speed reduction 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 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) could result in smoother traffic flows and, what is more important, in increasing adriver's awareness of the road situation.

13. APPENDIX

- **GITHUB:**

  https://github.com/IBM-EPBL/IBM-Project-34101-1660231714

- **SOURCE CODE – ESP 32:**

```
#include <WiFi.h>
#include <HTTPClient.h>
#include <Adafruit_GFX.h>
#include <Adafruit_ILI9341.h>
#include <string.h>

const char* ssid = "Wokwi-GUEST";
const char* password = "";
```

```
#define TFT_DC 2
#define TFT_CS 15
Adafruit_ILI9341 tft = Adafruit_ILI9341(TFT_CS, TFT_DC);

String myLocation = "Chennai,IN";
String usualSpeedLimit = "70"; // kmph

int schoolZone = 32;
int hospitalZone = 26;

int uid = 2504;

String getString(char x)
{
    String s(1, x);
    return s;
}

String stringSplitter1(String fullString,char delimiter='$')
{
    String returnString = "";
    for(int i = 0; i<fullString.length();i++) {
        char c = fullString[i];
        if(delimiter==c)
            break;
        returnString+=String(c);
    }
    return(returnString);
}

String stringSplitter2(String fullString,char delimiter='$')
{
    String returnString = "";
    bool flag = false;
    for(int i = 0; i<fullString.length();i++) {
        char c = fullString[i];
        if(flag)
            returnString+=String(c);
        if(delimiter==c)
            flag = true;
    }
    return(returnString);
}

void rightArrow()
```

```
{
  int refX = 50;
  int refY = tft.getCursorY() + 40;

  tft.fillRect(refX,refY,100,20,ILI9341_RED);
  tft.fillTriangle(refX+100,refY-
30,refX+100,refY+50,refX+40+100,refY+10,ILI9341_RED);
}

void leftArrow()
{
  int refX = 50;
  int refY = tft.getCursorY() + 40;

  tft.fillRect(refX+40,refY,100,20,ILI9341_RED);
  tft.fillTriangle(refX+40,refY-
30,refX+40,refY+50,refX,refY+10,ILI9341_RED);
}

void upArrow()
{
  int refX = 125;
  int refY = tft.getCursorY() + 30;

  tft.fillTriangle(refX-
40,refY+40,refX+40,refY+40,refX,refY,ILI9341_RED);
  tft.fillRect(refX-15,refY+40,30,20,ILI9341_RED);
}

String APICall() {
  HTTPClient http;

  String url = "https://node-red-nwmrt-2022-11-04.eu-
gb.mybluemix.net/getSpeed?";
  url += "location="+myLocation+"&";
  url += "schoolZone="+(String)digitalRead(schoolZone)+(String)"&";
  url +=
"hospitalZone="+(String)digitalRead(hospitalZone)+(String)"&";
  url += "usualSpeedLimit="+(String)usualSpeedLimit+(String)"&";
  url += "uid="+(String)uid;
  http.begin(url.c_str());
  int httpResponseCode = http.GET();

  if (httpResponseCode>0) {
    String payload = http.getString();
    http.end();
```

```
    return(payload);
  }
  else {
    Serial.print("Error code: ");
    Serial.println(httpResponseCode);
  }
  http.end();
}

void myPrint(String contents) {
  tft.fillScreen(ILI9341_BLACK);
  tft.setCursor(0, 20);
  tft.setTextSize(4);
  tft.setTextColor(ILI9341_RED);
  //tft.println(contents);

  tft.println(stringSplitter1(contents));
  String c2 = stringSplitter2(contents);
  if(c2=="s") // represents Straight
  {
    upArrow();
  }
  if(c2=="l") // represents left
  {
    leftArrow();
  }
  if(c2=="r") // represents right
  {
    rightArrow();
  }
}

void setup() {
  WiFi.begin(ssid, password, 6);

  tft.begin();
  tft.setRotation(1);

  tft.setTextColor(ILI9341_WHITE);
  tft.setTextSize(2);
  tft.print("Connecting to WiFi");

  while (WiFi.status() != WL_CONNECTED) {
    delay(100);
    tft.print(".");
  }
```

```
  tft.print("\nOK! IP=");
  tft.println(WiFi.localIP());
}

void loop() {

  myPrint(APICall());

  delay(100);
}
```