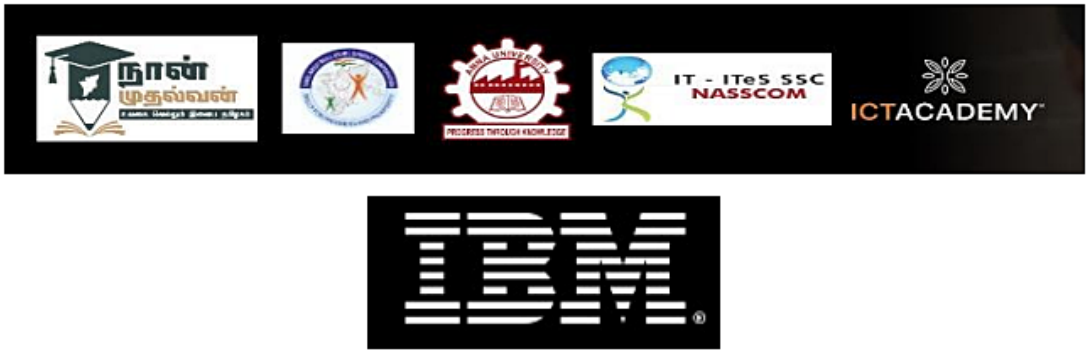


SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY

IBM PROJECT REPORT

Team ID - PNT2022TMID54276

SUBMITTED BY

SHARMILA (711519BEC307)
VARSHA K G (711519BEC116)
SAGILI VENKATA PAVAN REDDY (711519BEC089)
YASWANTH K M (711519BEC125)

Project Report

1. **INTRODUCTION**
    a. Project Overview
    b. Purpose
2. **LITERATURE SURVEY**
    a. Existing problem
    b. References
    c. Problem Statement Definition
3. **IDEATION & PROPOSED SOLUTION**
    a. Empathy Map Canvas
    b. Ideation & Brainstorming
    c. Proposed Solution
    d. Problem Solution fit
4. **REQUIREMENT ANALYSIS**
    a. Functional requirement
    b. Non-Functional requirements

5. **PROJECT DESIGN**
    a. Data Flow Diagrams
    b. Solution & Technical Architecture
    c. User Stories
6. **PROJECT PLANNING & SCHEDULING**
    a. Sprint Planning & Estimation
    b. Sprint Delivery Schedule
7. **CODING & SOLUTIONING (Explain the features added in the project along with code)**
    a. Feature 1
    b. Feature 2
    c. Database Schema (if Applicable)
8. **TESTING**
    a. Test Cases
    b. User Acceptance Testing
9. **RESULTS**
    a. Performance Metrics

INTRODUCTION

In present Systems the road signs and the speed limits are Static. But the road signs can be changed in some cases. We can consider some cases when there are some road diversions due to heavy traffic or due to accidents then we can change the road signs accordingly if they are digitized.This project proposes a system which has digital sign boards on which the signs can be changed dynamically.If there is rainfall then the roads will be slippery and the speed limit would be decreased.There is a web app through which you can enter the data of the road diversions, accident prone areas and the information sign boards can be entered through web app. This data is retrieved and displayed on the sign boards accordingly.

A) Project Overview

Road traffic accident is a major problem worldwide resulting in significant morbidity and mortality. Advanced driver assistance systems are one of the salient features of intelligent systems in transportation. They improve vehicle safety by providing real-time traffic information to the driver. Road signs play an important role in road safety. To be effective, road signs must be visible at a distance that enables drivers to take the necessary actions. However, static road signs are often seen too late for a driver to respond accordingly. In this study, a system for alerting drivers about road signs has been developed and tested using a smart mobile phone.

B) Purpose

The study was carried out in India along an 80 km highway stretch from new Delhi to banchari town. The Haversian formula was used to measure and estimate the distance between two pairs of coordinates using the smartphone-based navigation application, Google Map. The application provides a voice alert to a needed action that enhances driver's attention. We propose an alternative method that identifies and modifies a specific class of energy inefficiencies. According to the experimental results, the proposed methodology has the benefits of high accuracy within a user radius of 10 meters, minimum bandwidth, and

low-cost application. Furthermore, the system application was secured by limiting access to the application program interface key to avoid unauthorized access to sensitive information.

LITERATURE SURVEY

TITLE	AUTHOR	YEAR	DESCRIPTION
SmartVehicle Connectivity for Safety Application	Usha Devi Gandhi, Arun Singh	2013	Automobile manufacturers all over the world are currently developing, exhibiting, producing and promoting new vehicle features that make possible the exchange of information with the Internet via specific interfaces, bringing the Internet into the automobile world. The vision of the Project is to provide the Multi-modal transportation system that gives inter-connection of transportation environment giving help to millions of vehicles inter-communicate on traffic problems and safety issues.
Energy Efficient Virtual Network	Leonard Nonde, Taisir E. H. ElGorashi, and	2019	The ever growing uptake of cloud computing as a widely accepted computing paradigm calls for novel architectures to support QoS and

Embedding for Cloud Networks	Jaafar M. H. Elmirghani		energy efficiency in networks and data centers. Estimates indicate that in the long term, if current trends continue, the annual energy bill paid by data center operators will exceed the cost of equipment. Given the ecological and economic impact, both academia and industry are focusing efforts on developing energy efficient paradigm for cloud computing.
AnIoT Architecture for Assessing Road Safety in smart cities	Abd-Elhamid M. Taha	2021	The Safe System (SS) approach to road safety emphasizes safety-by-design through ensuring safe vehicles, road networks and road users. With a strong motivation from the World Health Organization (WHO), this approach is increasingly adopted worldwide. Considerations in SS, however are made for the medium-to-long term. Our interest in this work is to complement the approach with a short-to-medium term dynamic assessment of road safety
Developme nt of an IoT based real-	Pulparambil A , Medhat Awadalla	2020	The sustainability and smartness of the smart city concept rely on the technologies adopted to improve the

time traffic monitoring system for city governance			people’s quality of life. The smart city governance is one significant aspect of smart city initiatives, which will facilitate the planning techniques for better decision making. One of the key elements of the smart city governance framework is the public value generated out of the smart services provided. The government has to work on different aspects of smart city solutions such as smart health care, smart building management.

Existing problem

Traffic management is an essential part of modern mobility, and traffic signals help optimize the existing network in the best possible way. It monitors and controls various modes of traffic in order to avoid congestion and to improve traffic flow.

SWARCO is a professional traffic light provider and a has long-standing experience modern traffic management and traffic signal systems for cities.

Problem statement definition

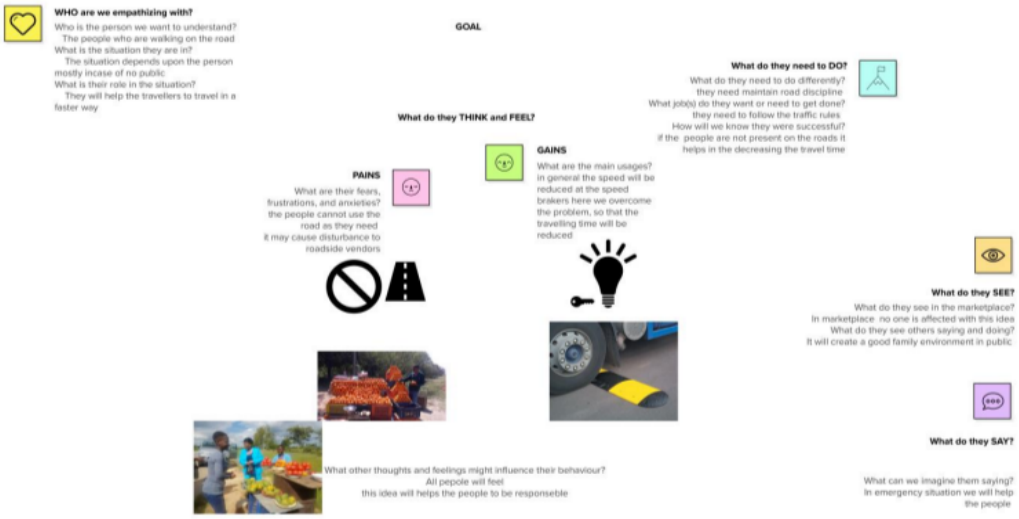
In present systems the road sighs and the speed limits are static but the road sings can be changed in some cases. We can consider some cases when there are some road diversions due to heavy traffic or due to accidents then we can change the road signs accordingly if they are digitized.

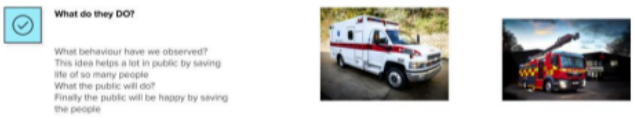
This project proposes a system which has a digital sign boards open which the signs can be changed dynamically. If there is a rainfall then the roads will be slippery and the speed limit would be decreased.

The Challenges in current system are Speed limits are not dynamic, No automatic diversion system and Non-coordinated way of traffic signals.

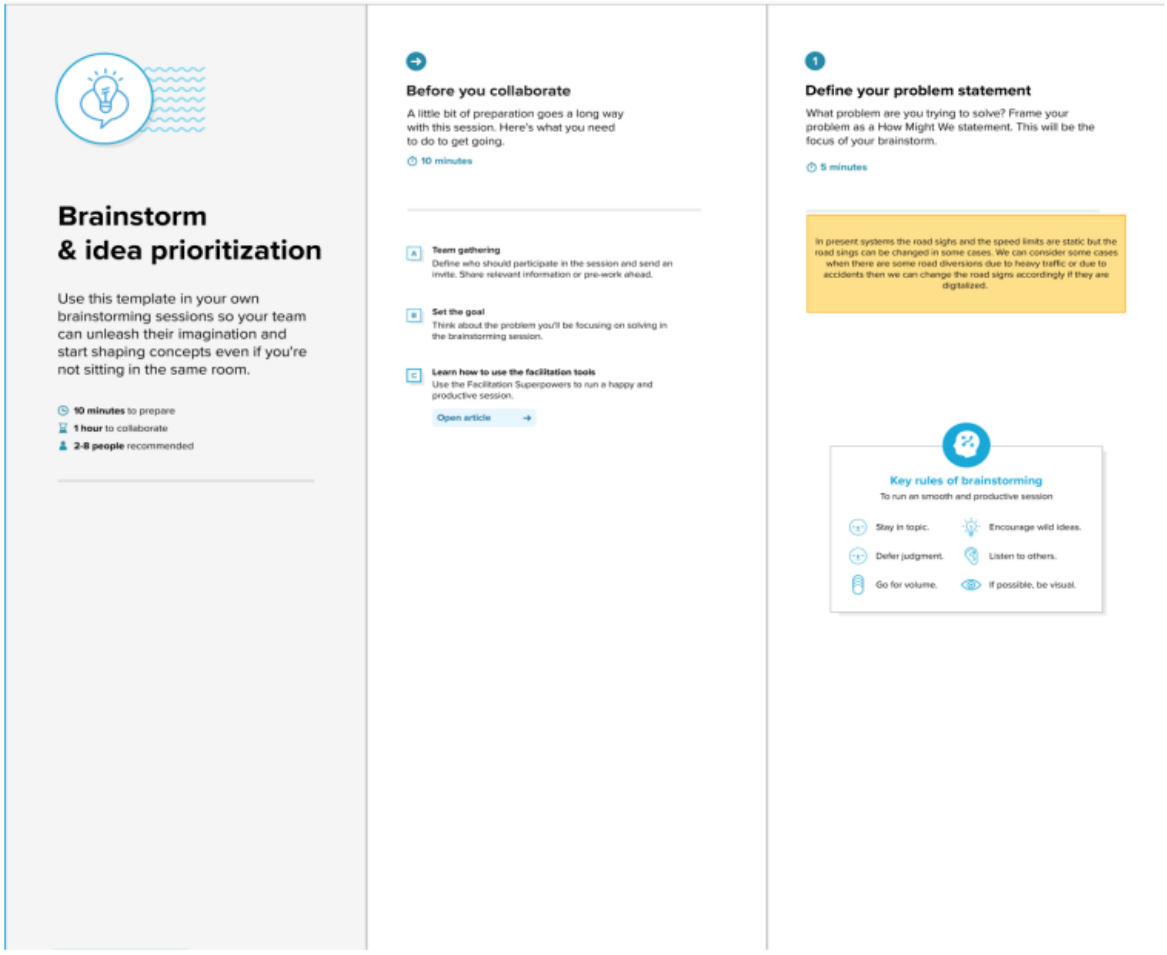
IDEATION & PROPOSED SOLUTION

a. Empathy Map Canvas





b. **Ideation & Brainstorming**



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.

10 minutes to prepare
1 hour to collaborate
2-8 people recommended

Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

A **Team gathering**
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.

B **Set the goal**
Think about the problem you'll be focusing on solving in the brainstorming session.

C **Learn how to use the facilitation tools**
Use the Facilitation Superpowers to run a happy and productive session.

Open article →

1

Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

In present systems the road sighs and the speed limits are static but the road sings can be changed in some cases. We can consider some cases when there are some road diversions due to heavy traffic or due to accidents then we can change the road signs accordingly if they are digitalized.

Key rules of brainstorming

To run an smooth and productive session

Stay in topic.
Encourage wild ideas.
Defer judgment.
Listen to others.
Go for volume.
If possible, be visual.

c. **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	Smart traffic signals can also be programmed to react properly to conditions like gridlock or blockage or to the movement of heavier vehicles. 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. In addition to that we have ultrasonic sensor to measure the distance of the vehicles and control the speed breaker, If the vehicles are present, the speed breaker will be present otherwise it is absent.
3	Novelty / Uniqueness	Generic Sign board for all applications

		that uses web service and sensors Pedestrians are given the access to request the sign change of the signal to cross the road
4	Social Impact / Customer Satisfaction	Pedestrians do not need to wait to cross the street if there is no traffic. Customer can reach at the target destination earlier than expected time. Presence of speed breaker is shown at a long range
5	Business Model (Revenue 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	Future updates that are needed can be quickly applied, whether they are on the hardware or software side. The programming of the present product can

		be slightly modified and the hardware components can be directly interfaced with the micro-controller. The website application must be updated with the new capabilities in the case of software by adding a new section for the updated hardware.

d. Problem Solution fit

1. CUSTOMER SEGMENT(S)

Passenger Road Navigators

2. JOBS-TO-BE-DONE / PROBLEMS

Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides. The smart board connectivity is responsible for a variety of task including maintaining accurate temperature sensor readings and telling the board of the speed of the customers vehicle

3. TRIGGERS TR What triggers custOmers tO act?

The vehicle should be moving the smart board of at edge speed.

4. EMOTIONS: BEFORE / AFTER

How do customers feel when they face a problem or a job and afterwards? Clients will feel better after selecting an operations mode with the use of this smart board connectivity and they will then follow the instructions on the smart board

5. AVAILABLE SOLUTIONS

Which solutions are available to the customers when customers from taking action or limit 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 Along roadways, inactive signs with clear directions are put as potential fixes

6. CUSTOMER CONSTRAINTS

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.There was a network effect on the testing. a significant and unexpected component Because of this was successful in simulating a large-scale smart sign board.

7. BEHAVIOUR

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

As a teacher, the IOT cloud upgrades the smart board on the condition of the roads on a regular basis

8. CHANNELS of BEHAVIOUR

What kind of actions do customers take online? Extract online channels from #7

What kind Of actions dO custOmers take offline? Extract Offline channels frOm #7 and use them fOr custOmer develOpment. The division can get cO-Ordinate emails Or messages frOm the custOmers. These are the fOllOwing directions Install the web application and follow

9. PROBLEM ROOT CAUSE

What is the real reason that this problem exists? What is the back story behind the need to do this job? RC Speed breakers are unused when the public was not There so the vehicle needs to decreases the speed

10. YOUR SOLUTION

If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality. If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within custOmer limitations, solves a problem and matches customer behavior. We utilize smart connected sign boards as an alternative to inactive signboards. With the help of a web app and automatically Speed increased and decreases

REQUIREMENT ANALYSIS

a. Functional requirement

FR No	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-I	User Visibility	The display board must be big enough and also bright at the same time, so that the information is visible to the users
FR-2	User Understanding	The display must be perfect in such a way that it is suitable to all the people and all

		the age groups
FR-3	User Convenience	The display should have all the different types of signs which are known to the people and it should be convenient

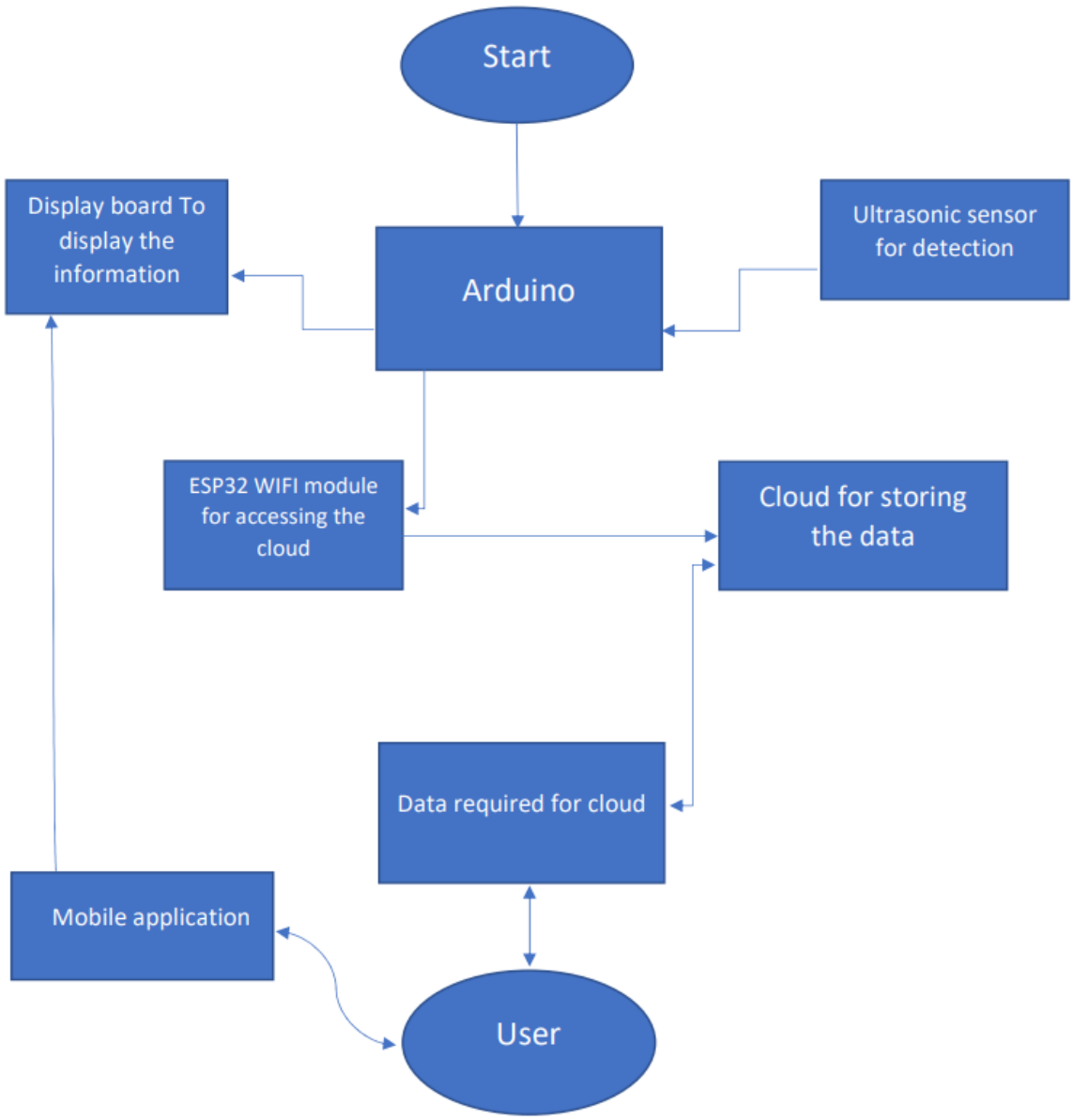
b. **Non-Functional requirements**

FR No.	Non-Functional Requirement	Description
NFR-I	Usability	It should be dynamic so that it doesn't need any replacement
NFR-2	Security	It should display only the required data and the user information or any other information should not be disclosed
NFR-3	Reliability	It should convey the information about the traffic perfectly
NFR-4	Performance	It should be dynamically adopted for different kinds of situations
NFR-5	Availability	It should be available for 24/7
NFR-	Scalability	It should be reliable and must check for all

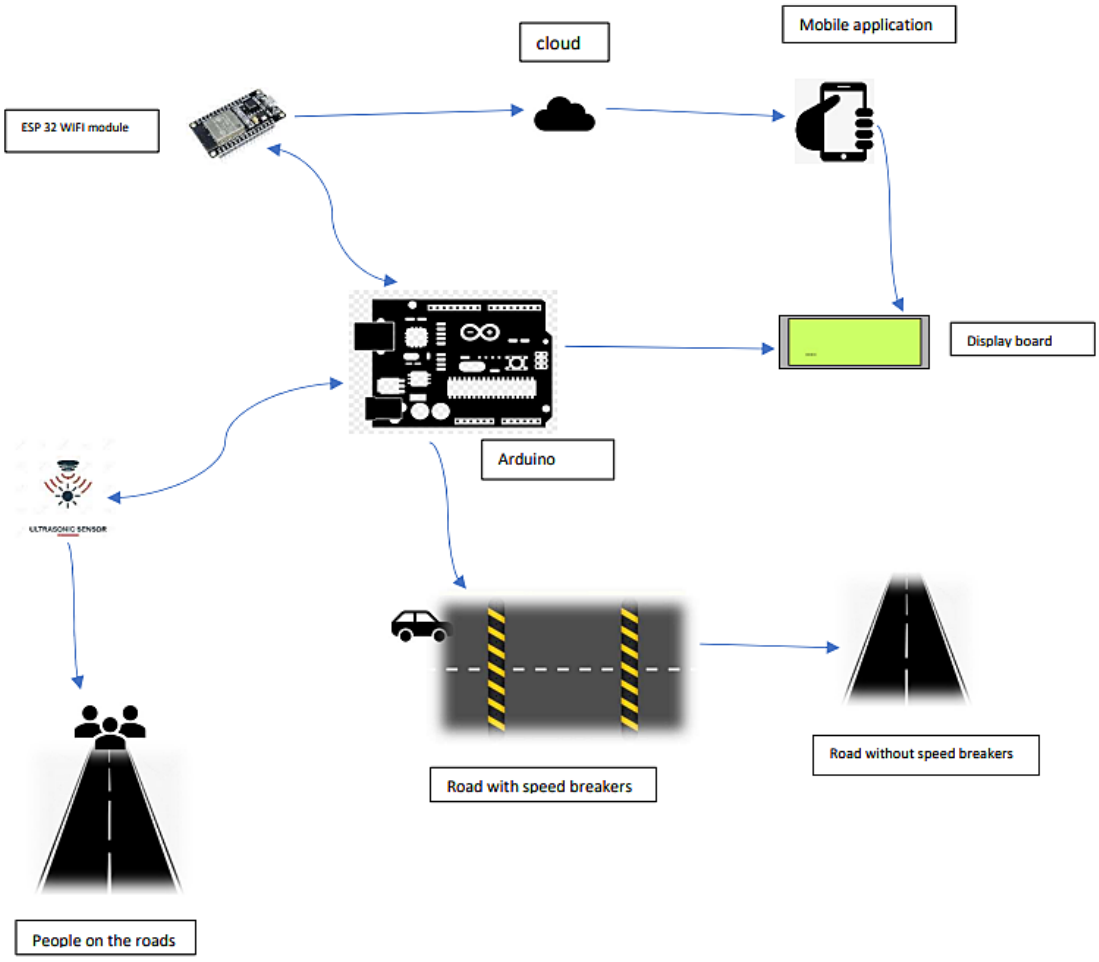
6		the required conditions and the possibilities

PROJECT DESIGN

a. Data Flow Diagrams



b. **Solution & Technical Architecture**



c. User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	I can get my speed limitation using weather application	I can receive speed limitations	High	Sprint-1
		USN-2	As a user, I can register for the application by entering my email, password, and confirming	I can access my account / dashboard	High	Sprint-1

			my password.			
		USN-3	As a user, I can I get my traffic diversion signs depending on the traffic and the fatal situations.	I can access my traffic status ahead in my travel	High	Sprint-1
		USN-4	As a user, I can get the notification of any strikes or disturbances about that road	I can get the required notification to alter my route	Medium	Sprint-1
		USN-5	As an official who is in charge for the proper functioning of the sign boards have to maintain it	I can access the interface easily	High	Sprint-1

			through periodic monitoring.			
Customer (Web user)	Data generation	USN-6	The user interface must be straight forward and simple to use	I can access the data regarding the road through the application	High	Sprint-1
Administrator Or officials	Problem solving/ Fault clearance	USN-7	As a user I can reach the destination faster	Officials can reduce the size of the speed breaker according to the situation	Medium	Sprint-2

1. **PROJECT PLANNING & SCHEDULING**

a. Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Resources Initialization	USN-1	Create and initialize accounts in various public APIs like Open Weather Map API	1	Low	Sagili Venkata Pavan Reddy, K M Yaswanth, Sharmila M, Varsha K G
Sprint-1	Local Server/Software run	USN-2	Write python program that outputs results for given inputs like weather and location And also for the Speed breaker control.	1	Medium	Sagili Venkata Pavan Reddy, K M Yaswanth, Sharmila M, Varsha K G
Sprint-2	Push the Server/Software to cloud	USN-3	Push the Weather part code from Sprint 1 to cloud so it can be accessed from anywhere	2	Medium	Sagili Venkata Pavan Reddy, K M Yaswanth, Sharmila M, Varsha K G

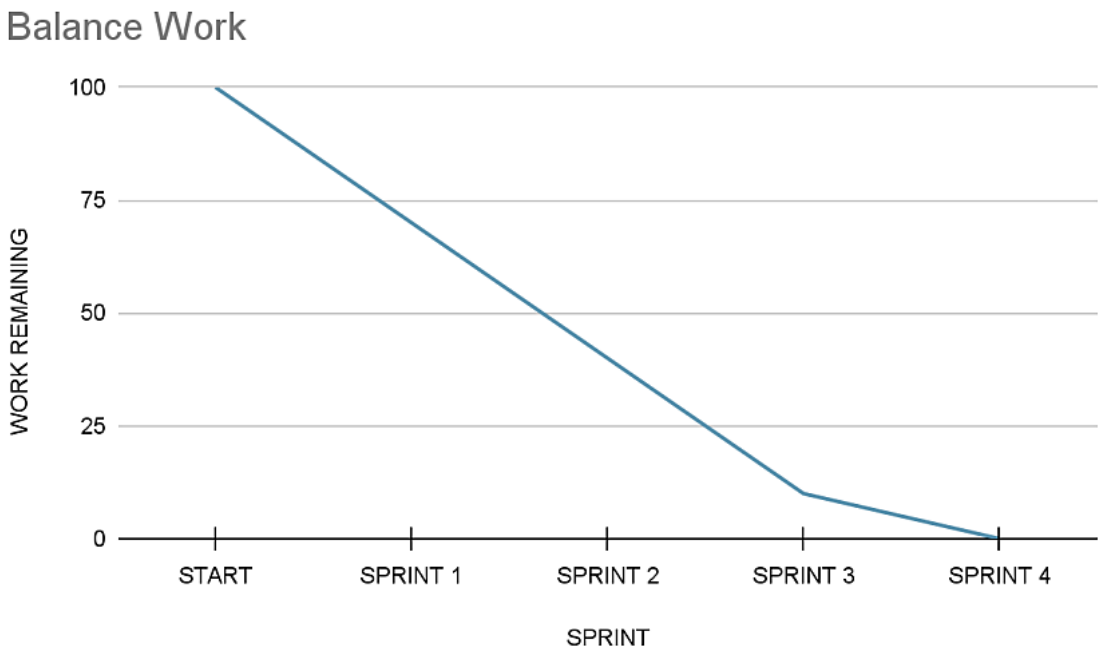
Sprint-3	Hardware Initialization	USN-4	Integrate the hardware to be able to access the cloud functions and provide inputs to the same	2	High	Sagili Venkata Pavan Reddy, K M Yaswanth, Sharmila M, Varsha K G
Sprint-4	UI Optimization and Debugging	USN-5	Optimize the errors and provide a better user experience	2	Low	Sagili Venkata Pavan Reddy, K M Yaswanth, Sharmila M, Varsha K G

b. Sprint Delivery Schedule

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	1 Nov 2022

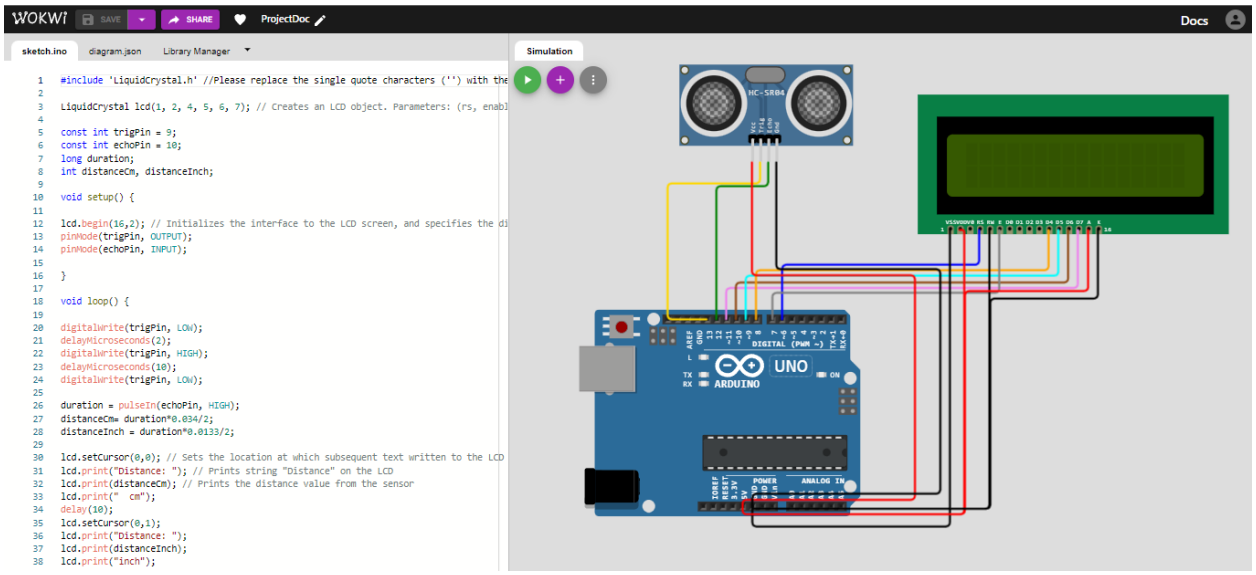
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	10 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	15 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

Burndown Chart:

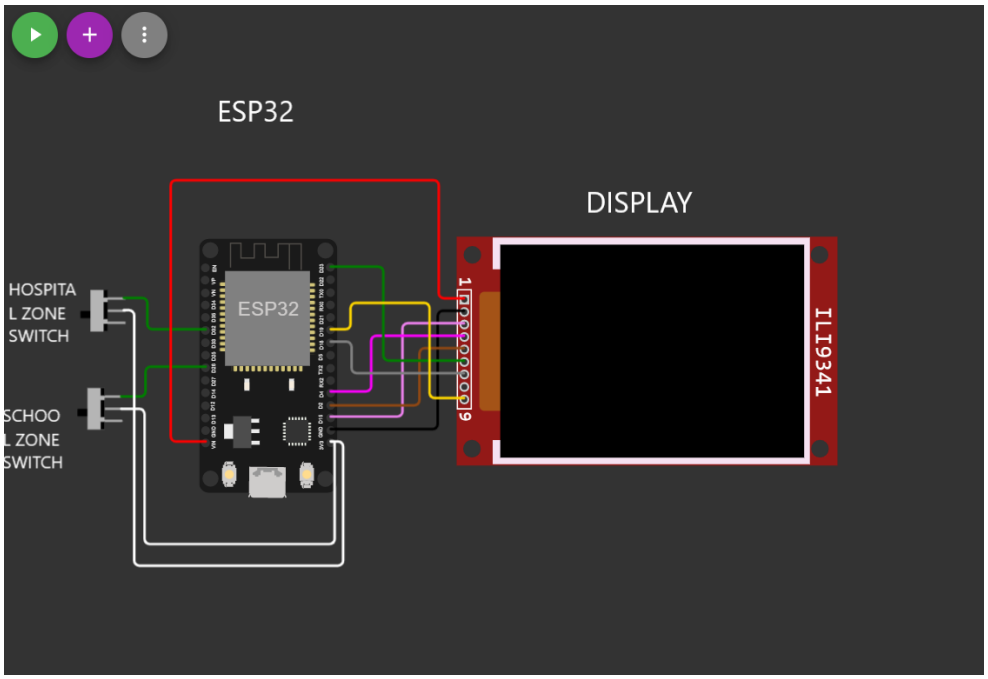


CODING & SOLUTIONING (Explain the features added in the project along with code)

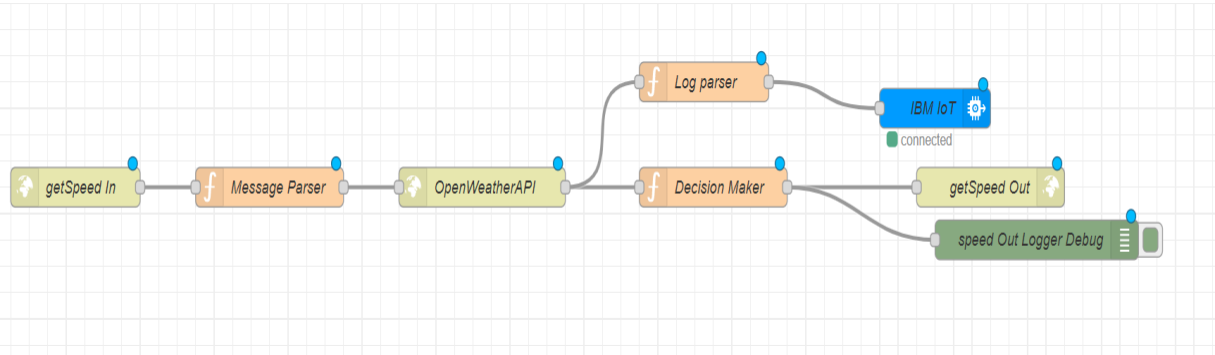
Simulation 1



Simulation 2

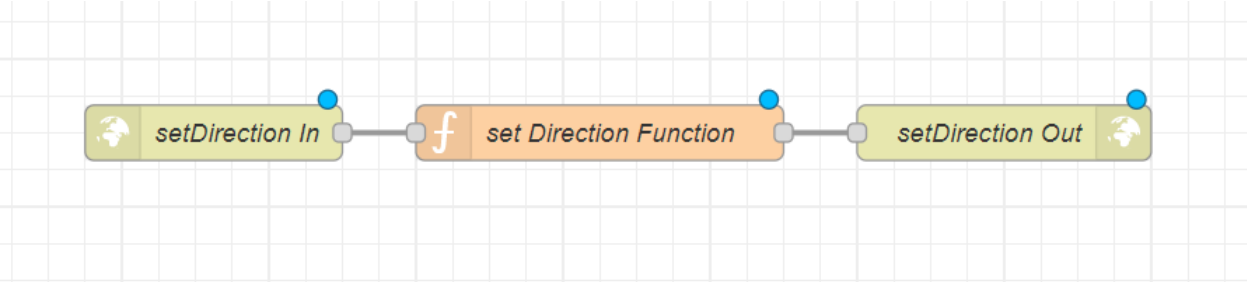


a. Feature 1



This part of Node RED flow accepts an http GET end point at "/getSpeed" from which the location, u id, hospital/school zone info are passed. Message parser sets the required APIKEY for OpenWeatherAPI for the next block. This also Hepls in overcoming the drawback of transparency 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 micro controller. Thus, a lot of battery is saved due to lesser processing time

b. Feature 2



This part of Node RED flow accepts an http GET end point at "/setDirection" from which the u id 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 micro-controller along with the "/getSpeed" path and the micro-controller displays it.this help in recognition of the vehicles present int the road , so that the travelers can be aware of the restrictions or the diversions.

TESTING

Test Cases

- TEST CASE 1 Clear weather - Usual Speed Limit.
- TEST CASE 2 Foggy Weather - Reduced Speed Limit.
- TEST CASE 3 Rainy Weather - display the required information

- TEST CASE 4 no people on the road - the size if the speed breaker is reduced

c. 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. according to the project the size of the speed breaker can be reduced under certain circumstances like night times, whenever the crowd is low or moderate on the road at those particular times the officials or the administrator can reduce the size of the speed breaker so that the travelers can reach their destination in a more faster way.

RESULTS

d. 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. also several number of users can be connected to the link at the same time and there is very very low chance of error probability.Hence the performance is very well reliable and also flexible.

ADVANTAGES & DISADVANTAGES

- 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.
- travelling time is reduced for most of the people.
- diversions can be avoided and the journey can be changed accordingly.

DISADVANTAGES

- 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.
- this cannot be applicable to places where the crowd is too much, it performs best in the places of moderate or low crowd.

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.this also help in reducing the travelling time for most of the vehicles. it also helps in maintaining a good traffic atmosphere,

which is the most needed requirement in the society. it also helps in maintaining a clam and good atmosphere.

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. This project has a very good future scope as the population in the world is rapidly increasing, similarly the number of vehicles on roads will also increase as well as the traffic. so the project can play a major role in our society as well as in the coming generations. as the cost required is also very low comparatively other models, updates or the expansion in the technical industry in the coming generations may also helps in reducing installation, maintenance, security cost in a very low margin, as well as by increasing the speed and performance of the total system

APPENDIX

Source Code

```
#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; // ID Unique to this Micro Contoller

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

String stringSplitter1(String fullString,char delimiter='$')
{
```

```
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()
{
```

```
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() {
```

```
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);
```

```
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);
```

```
  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);
}
```

GitHub & Project Demo Link

GITHUB AND PROJECT DEMO LINK:

https://github.com/IBM-EPBL/IBM-Project-42167-1660654093

PROJECT DEVELOPMENT PHASE LINK:

https://github.com/IBM-EPBL/IBM-Project-42167-1660654093/tree/main/Project%20development%20phase

DEMO VIDEO DOWNLOAD LINK:

http://youtu.be/z57gyJvEk-U