

# IBM – NALAIYA THIRAN

## PROJECT REPORT

PROJECT NAME	SIGNS WITH SMART CONNECTIVITY FOR BETTER ROADS SAFETY
TEAM ID	PNT2022TMID15892
TEAM MEMBERS	NARMADHA A NIVEDHITHAA S A (TEAM LEADER) NIVETHIKAA A PRATHIKSHA M
DEPARTMENT	ELECTRONICS AND COMMUNICATION ENGINEERING

### 1. INTRODUCTION

#### 1.1. PROJECT OVERVIEW:

Connected vehicle technology aim to solve some of the biggest challenges in the transportation in the areas of safety, mobility and environment. The safety application for Intelligent Transport System (ITS) is one of the main objectives in this project. Safety application is research and industrial initiative which aim to contribute to the global advancement of automobile industry. In this project we focus on V2V communication, once cars are connected which is able to share data with other cars on the road and which help to reduce Highway accidents. Ultimately, vehicles are connect via multiple complementary technologies of vehicle to-vehicle (V2V) and vehicle-to-infrastructure (V2I) connectivity based on Wi-Fi, GPS, Dedicated Short Range Communication (DSRC). VANETS are also considered as one of the most important Simulator for safety of intelligent transportation systems. The use of the DSRC technologies support low latency vehicle-to-vehicle (V2V) communication. 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 digitalized. 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. Clearly, intelligent roadway placards can be a vital part of our driving experience. They enable a better way for drivers to access the information they need in real time on the roads. These signs can increase awareness of upcoming issues, which people might otherwise discover too late. They may also augment the functionality of driverless vehicles.

## 1.2. PURPOSE

The value of implementing this technology should not be underestimated. Smart roadway indicators have the potential to increase cost-efficiency, which eases the burden on governments and taxpayers. They facilitate a smoother driving process for both human drivers and autonomous vehicles. The placards can be more user-friendly than the analog route signs we currently employ. Above all, they may ultimately lead to a safer network of roads for everyone. Smart roadway signage is not simply an objective for the future. Two UK Companies have collaborated to produce these signs for use on England's roads. The signs are technologically advanced, with graphics and text that drivers can see clearly. The messages are easy to comprehend quickly, keeping drivers informed of route conditions as they change. In addition to enhancing the roadway experience for users, this new signage costs less to maintain than traditional indicators. The new signs require fewer materials and less cabling, resulting in less time, upkeep, and expense. Increasing volumes of traffic are using municipal road infrastructure, with severe consequences for traffic efficiency and the safety of road users. Vulnerable road users (VRUs), such as pedestrians or cyclists, are involved in 46 % of lethal accidents. Exchanging information between road users increases their perception and is thus a critical building block to improve this situation. We have presented a system, to alert the driver about the speed limits in specific areas and reduce the speed of the vehicles in sensitive public zones without any interference of the drivers where controls are taken automatically by the use of a wireless local area networks.

## 2. LITERATURE

### 2.1. EXISTING PROBLEM

The Existing road system and connectivity, emphasis on the traffic and route reckoning features which cordially provisions the user acceptability to have better connectivity management. But, this often results in nonparallel road conditions and high noise ratios through the calibrations. It reiterates various subjections in its compilation and leading to segmentation error throughout. It penetrates the various unit cases in order to subsequently manifest the output. This alternatively symbolizes the ineffectively programmed web user interface. The IOT based model of our project complies of the verdict to specify the soft zone in the path. It manually ask the user to turn off the horn, which in variably decreases the decibel level of the power output. Illustratively, it confides the work schematics of the precedent evaluation under the system and allows the user to access the terminals of the app nodes variably. IBM Cloud indefinitely helps in reviving the data sets required in web application. MIT app inventor segments the creation of the user interface.

### 2.2. REFERENCES

1. Ashish Dhar: **Traffic and road condition monitoring system**  
Indian Institute of Technology, Mumbai. - 2008.

- Reports severity, intensity and dimension of a damaged road segment.
- Proposed a different solution using AMR Magnetic Sensor.

2. Pooja Pawar, Suvarna Langade, Mohini Bandgar: **IOT Based digital Notice Board using Arduino ATmega 328.**

International Research Journal of Engineering and Technology (IRJET).- 2019.

- Circulates notice regularly & reduce physical efforts.
- Send message at any distant location within a second.

3. Sandeep Chaware, Trushitha Chaware: **Proposed Algorithm for Smart Traffic Control using Ultrasonic Sensor.**

International Journal of Engineering and Advanced Technology (IJEAT).- 2019.

- The outcome of the project is to learn insights of the traffic controlling and management at the signal with the dynamically changing in timing of timer as per need.

4. Kamna Singh, Deepa Bura: **IOT distinct algorithms for the Sensor Connectivity with Comparative Study between node MCU and Arduino MCU.**

NVEO Journal– 2021

- Presents different algorithms for the connection between different types of sensors.
- Brief description of node MCU & Arduino MCU.
- Step by step solution to provide connectivity with IOT technology.

5. Jack Greenhaigh: **Recognizing Text Based Traffic Signs.**

IEEE – 2015

- Detect all possible Road sign candidates.
- Reduce total regions based on contextual constraints.
- A Novel System for the automatic detection and recognition of text in traffic sign based on MSER & MSV.

6. Bhumika.R, Harshita. S.A, Meena. D, Asha. N: **Accident Prevention and Road Safety in Hilly Region using IOT Module**

International Research Journal of Engineering and Technology (IRJET) – 2021

- Stay away from mishap & forestall clog in sloping region & hairclip twist.
- As a significant part of street mathematical plan bended street portion

7. Sowparnika: **IOT Road Safety**

- This project paves a system to alert the driver about the speed limit in specific areas and to reduce the speed of vehicles in sensitive public zones without any interference of drivers where controls are taken automatically by use of wireless local area network.

8. S.S. Sugania, D. S. Vishalis Hwaran, J. Vignesh Kumar: **Automated System for Road Safety**

Enhancement using big data reports.

- The speed is controlled accordingly to situations to give suggestions.

- The suggested system can control the vehicle but at same time can collect data and manipulate it using the big data technologies.

**9. IOT Based Smart Road Safety & Vehicle Accident prevent System for Mountain roads.**

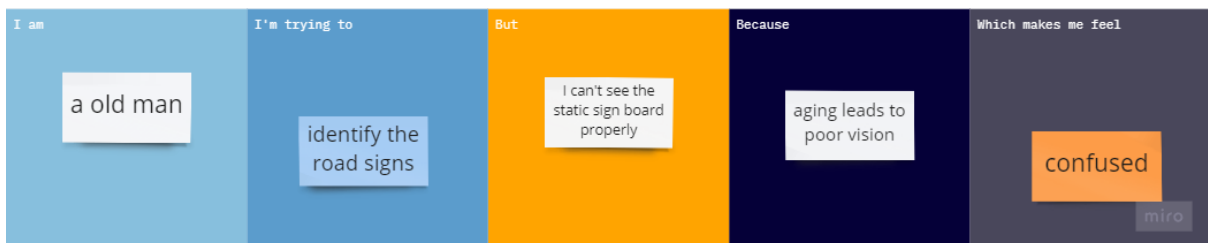
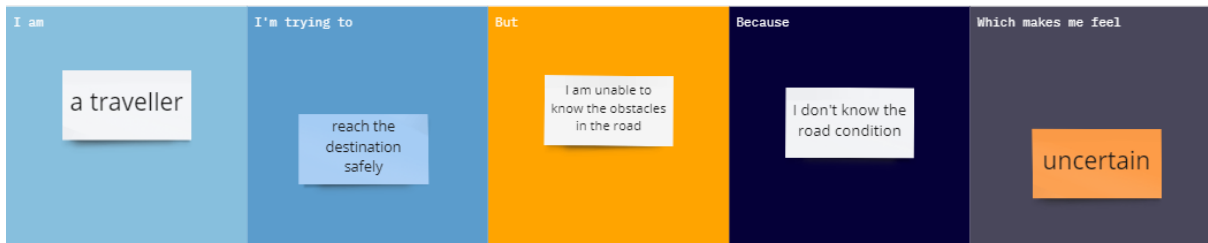
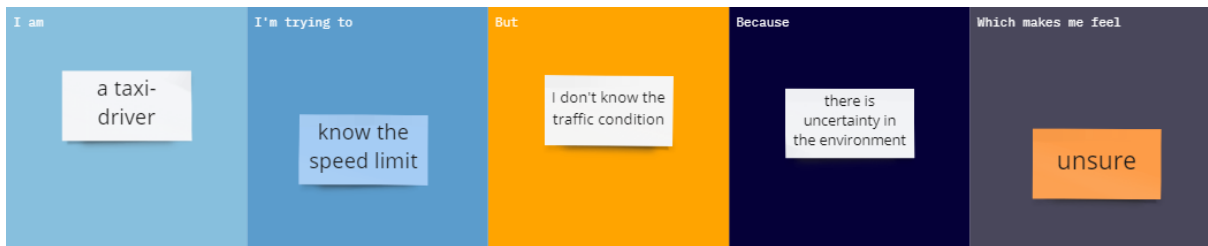
- This system is divided into 2 half (Accident Detection & Prevention) and alerting the members of family by causation message and placement of accidental place.

**10. Shweta Vyas, Pooja Awhale, Shreya Kukdeja, Prashant Jawalkar: A Modern Approach to identify Traffic Sign Symbols in Color Images.**

- In this technique proposed more reliable and robust method of Traffic Sign Detection Recognition (TSDR).

### **2.3. PROBLEM STATEMENT DEFINITION**

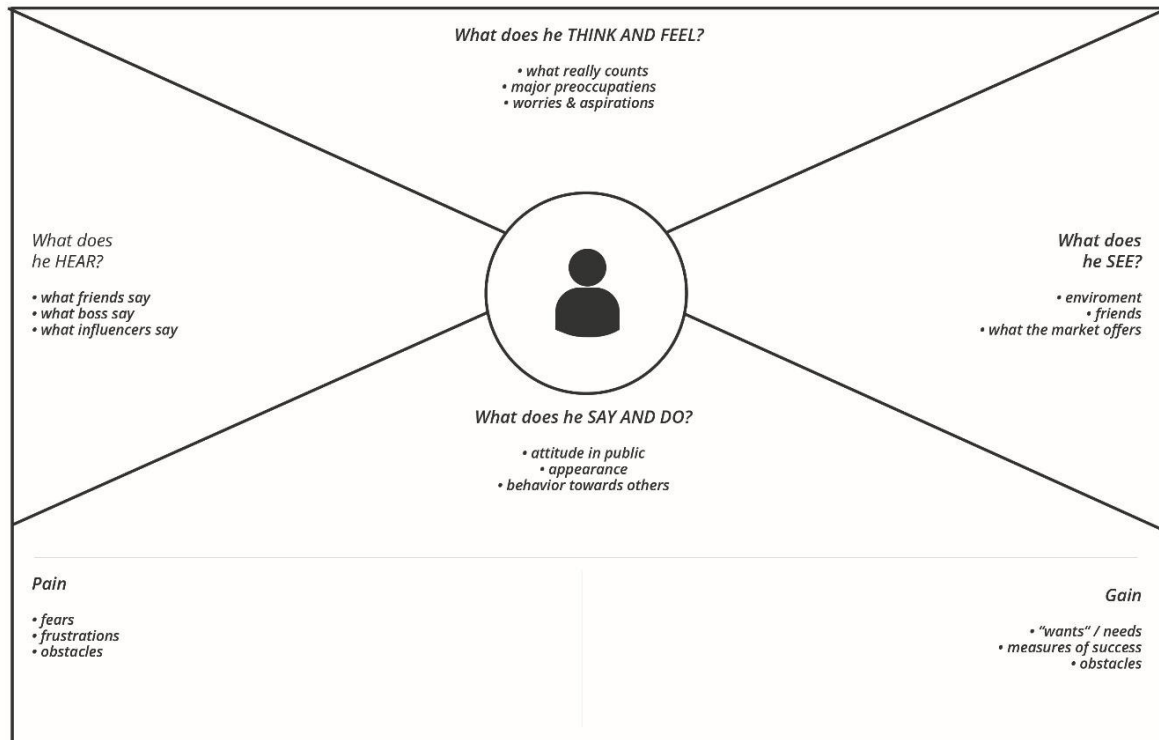
Nowadays road signs and speed limits are static, road signs and speed limits can't be changed in some cases. If we replace static signs with dynamic signs, the signs can be changed at any time and anywhere, even we can change the signs during a sudden change in weather conditions or if any accidents happened we can change the signs & tell the people to have another route or direction. If we replace ordinary signs with smart signs a large number of happening accidents can be reduced and we can save a lot of time by reducing the traffic. Even this type of system is helpful for education and medical institutions.



### 3. IDEATION AND PROPOSED SOLUTION

#### 3.1. EMPATHY MAP

## Empathy Map



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Business Model **Toolbox**


1

Build empathy and keep your focus on the user by putting yourself in their shoes.






**SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY**

Template



## 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

[Share template feedback](#)

➔

### 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

To help a person to travel which has less difficulties to reach the destination safely and without any time delay.

 5 minutes


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PROBLEM


Because of dynamic changes of crowding, unexpected roadblocks, reconstruction areas.


2%


**Key rules of brainstorming**  
 To run an smooth and productive session


 Stay in topic.

 Encourage wild ideas.

 Defer judgment.

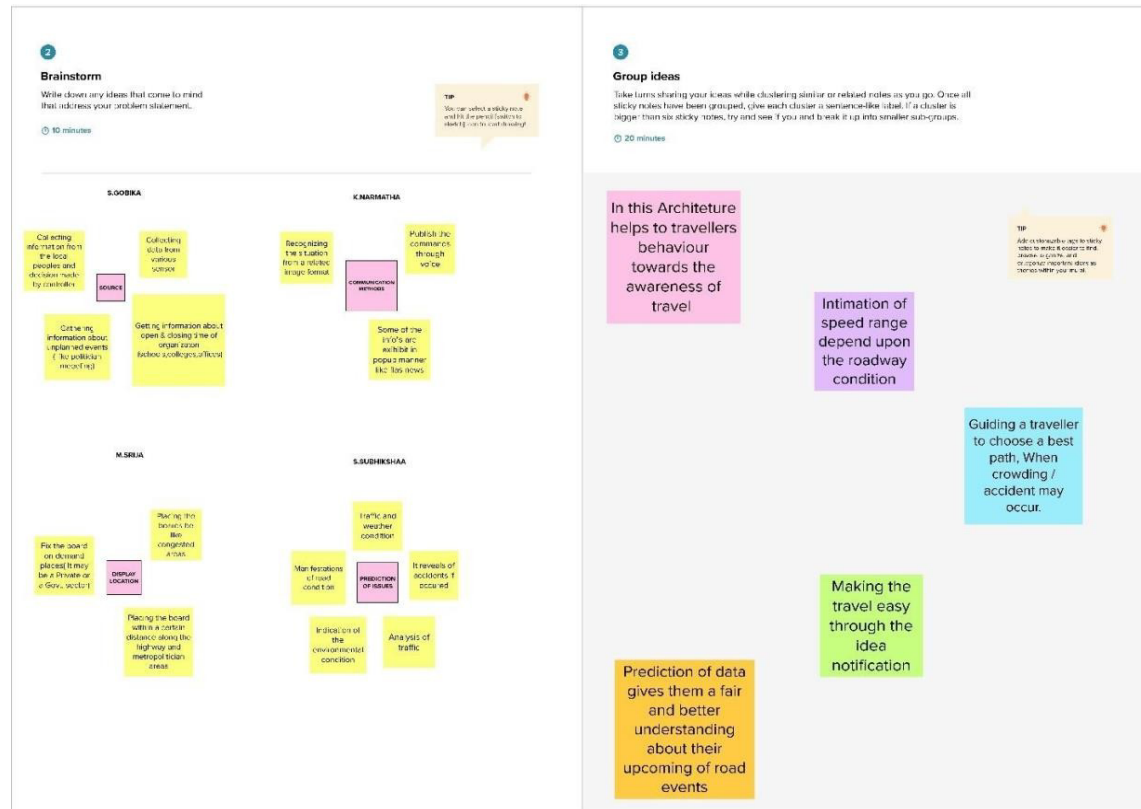
 Listen to others.

 Go for volume.

 If possible, be visual.

BRAINSTORMING, LISTING AND GROUPING

**SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY**



### 3.3. PROPOSED SOLUTION

S.NO	PARAMETERS	DESCRIPTION
1	PROBLEM STATEMENT (PROBLEM TO BE SOLVED)	<ul style="list-style-type: none"> <li>To prevent the road accidents from happening using IOT.</li> </ul>
2	IDEA/SOLUTION	<ul style="list-style-type: none"> <li>By preparing a smart sign using IOT instead of regular signs hung on the road.</li> <li>Smart signs are built with IOT and LED are used.</li> </ul>
3	NOVELITY	<ul style="list-style-type: none"> <li>Since LED's are used which is visible from afar.</li> <li>The smart signs consists of temperature, humidity, wind speed.</li> <li>This information is received from weather monitoring app.</li> <li>It also gives information about nearby places such as hospitals, schools etc.,so that the users can decide their speeding according to that information</li> </ul>
4	CUSTOMER SATISFACTION	<ul style="list-style-type: none"> <li>These create a noticable impact on the road safety department.</li> <li>By deciding a speed limit for the user,there is significant chance in reducing the accidents</li> </ul>



**Problem-Solution fit canvas 2.0**

Signs with Smart Connectivity for Better Road Safety

TEAM ID – PNT2022TMIDI15892

**1. CUSTOMER SEGMENT(S)** CS

Who is your customer?

- ☐ highway division
- ☐ Passenger

**6. CUSTOMER CONSTRAINTS** CC

What constraints prevent your customers from taking action or limit 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** 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?

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

**2. JOBS-TO-BE-DONE / PROBLEMS** J&P

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

There may be having of different duties, the Smartboard Connectivity is in charge of keeping correct temperature sensor readings and should inform 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?

If there was no internet connection, no sensor readings from the weather would alter the speed restriction. Unnecessary pressing of the accident indicator button by any 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 smartboard on the condition of the roads on a regular basis. So that the customer would address the problem and get the job done.

**3. TRIGGERS** TR

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

Weather will be bad most of the time. The car ought to be travelling at its threshold speed. To alert the customer, the sensor value should be shown 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 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** CH

**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 major tasks for the traveler, but they can utilize the smartboard signs to check the state of the road from wherever they are standing.

**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 smartboard connectivity, and they will then follow the signs on the smart board.

## 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-1	User visibility	<ul style="list-style-type: none"> <li>Sign Boards should be made with LED's which are bright colored and are capable of attracting the drivers attention but it should also not be too distracting or blinding cause it may lead to accidents..</li> </ul>
FR-2	User convenience	<ul style="list-style-type: none"> <li>For better understanding of the driver, the signs should be big, clear and legible and it can also include illustrations which will make it easily understandable to the driver</li> </ul>
FR-3	User need	<ul style="list-style-type: none"> <li>The display should be big enough that it should even be visible from far distance clearly</li> </ul>

#### 4.2. Non-functional Requirements:

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

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	<ul style="list-style-type: none"> <li>It should be able to Upgrade and Update when there is a need for it.</li> </ul>
NFR-2	Security	<ul style="list-style-type: none"> <li>It should have good security system so that no other person is able to hack and display their own directions.</li> </ul>
NFR-3	Reliability	<ul style="list-style-type: none"> <li>It should be able to display to information correctly and error-free</li> </ul>

### 5. PROJECT DESIGN

#### 5.1 DATA FLOW DIAGRAM AND USER PLANNING

<https://github.com/IBM-EPBL/IBM-Project-14365-1659584285/blob/1d5136489696501487c770bbb5d219f5e269ee95/PROJECT%20DESIGN%20AND%20PLANNING/PROJECT%20DESIGN%20PHASE-II/Data%20Flow%20Diagrams.pdf>

#### 5.2 SOLUTION ARCHITECTURE

<https://github.com/IBM-EPBL/IBM-Project-14365-1659584285/blob/1d5136489696501487c770bbb5d219f5e269ee95/PROJECT%20DESIGN%20AND%20PLANNING/PROJECT%20DESIGN%20PHASE-I/Solution%20architecture.pdf>

### 6. PROJECT PLANNING

#### 6.1. SPRINT PLANNING AND SCHEDUELING

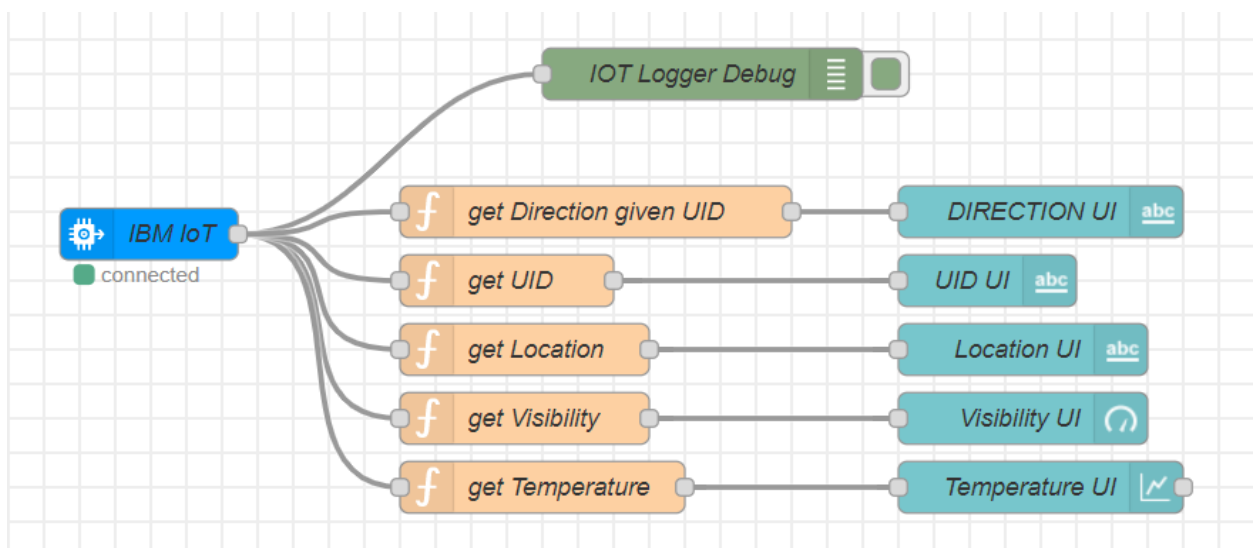
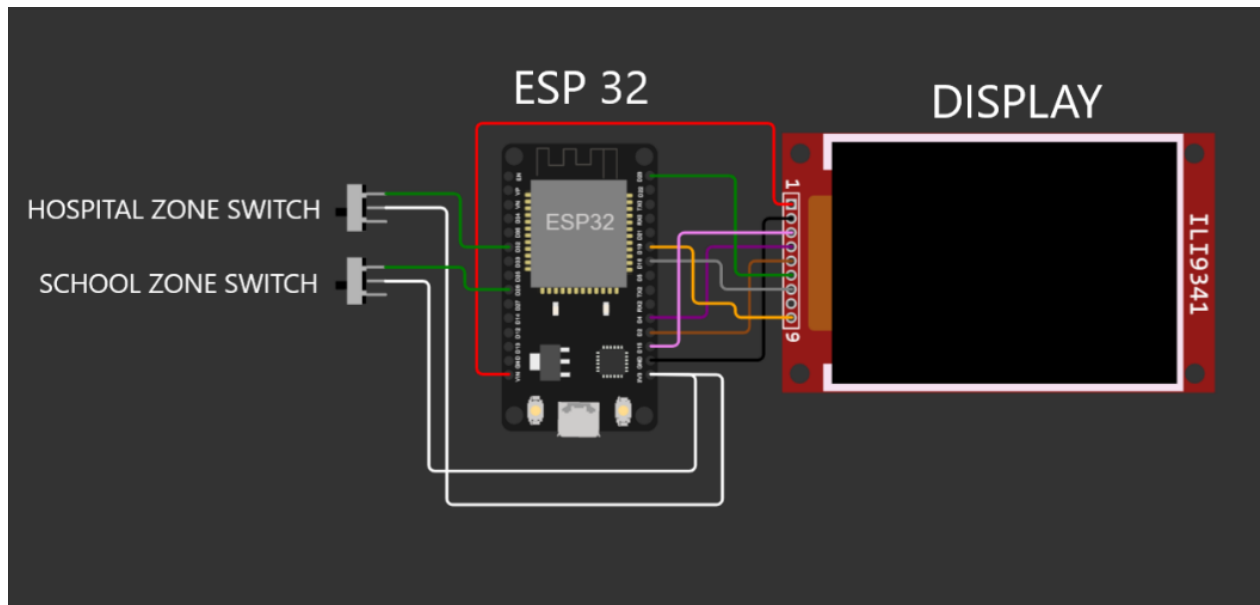
<https://github.com/IBM-EPBL/IBM-Project-14365-1659584285/blob/1d5136489696501487c770bbb5d219f5e269ee95/PROJECT%20DESIGN%20AND%20PLANNING/PROJECT%20PLANNING/Sprint%20Delivery%20Plan%20.pdf>

#### 6.2. SPRINT DELIVERY SCHEDULE

<https://github.com/IBM-EPBL/IBM-Project-14365-1659584285/blob/1d5136489696501487c770bbb5d219f5e269ee95/PROJECT%20DESIGN%20AND%20PLANNING/PROJECT%20PLANNING/Sprint%20Delivery%20Plan%20.pdf>

## 7. SCHEMATIC CIRCUIT AND CODING SOLUTION

### 7.1. CIRCUIT



- "IBM IOT" node connects the backend to Node RED UI. The function nodes such as "get Direction given UID", "get UID", "get Location", "get Visibility" & "get Temperature" extract the respective data out and provides them to the UI nodes "Direction UI", "UID UI", "Location UI", "Visibility UI" & "Temperature UI".
- For the detailed explanation refer the url: <https://github.com/IBM-EPBL/IBM-Project-14365-1659584285/tree/main/PROJECT%20DEVELOPMENT%20PHASE>

## 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, NodeRED is capable of handling upto 10,000 requests per second. Moreover, since the system is horizontally scalable, a 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 updation.
- School/Hospital Zone alerts
- **DISADVANTAGES**
  - The size of the display determines the requirement of the micro controller
  - Dependent on OpenWeatherAPI 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 (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

- **GITHUB AND PROJECT DEMO LINK**

<https://github.com/IBM-EPBL/IBM-Project-14365-1659584285>

- **DEMO VIDEO DOWNLOAD LINK**

<https://github.com/IBM-EPBL/IBM-Project-14365-1659584285/blob/1d5136489696501487c770bbb5d219f5e269ee95/FINAL%20DELIVERABLES/DEMO%20SMART%20CONNECTIVITY%20FOR%20BETTER%20ROADS.mp4>

- 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; // ID Unique to this Micro Contoller

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 = "http://169.51.194.120:31149/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);  
}
```

#### LINK TO NODE RED DASHBOARD

<http://169.51.194.120:31149/ui/#!/0?socketid=AE2oxZhewQ6TYiYrAAD7>

<http://169.51.194.120:31149/set>

#### LINK TO WORKWI SIMULATION

<https://wokwi.com/projects/348310225114104404>

