

SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY

IBM PROJECT REPORT
TEAM ID – PNT2022TMID48694

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FINAL DELIVERABLES REPORT

Date	20.11.2022
Team ID	PNT2022TMID48694
Project Name	Signs with Smart Connectivity for Better RoadSafety

TEAM MEMBER AND THEIR CONTRIBUTIONS

NAME	ROLL NO	CONTRIBUTION
Asma Roshan T	920819106007	Created source code for the wokwi simulator and MIT app code.
Divya Dharshini S	920819106017	Created node red and IOT Watson platform.
Amizhthaa B	920819106004	Project report making process and gathering ideas for creating project.
Porkodi S	920819106043	Working in node red flow and IBM cloud deployment.

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1.INTRODUCTION

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.

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 EXISTING PROBLEM

- Andrzej Czyżewski in his paper titled "Development of Intelligent Road Signs with V2X Interface for Adaptive Traffic Controlling", IEEE 2019, developed IOT based intelligent road

signs capable of interacting with both the vehicles and other neighbouring sign boards using LORA. These sign boards were capable of communicating with one another and changing the speed limit based on traffic and weather.

- Muhammed O. Sayin, Chung-Wei Lin, Eunsuk Kang, Shinichi Shiraishi & Tamer Basar in their paper titled "Reliable Smart Road Signs", IEEE 2019, proposed a game theoretical adversarial intervention detection mechanism for reliable smart road signs. A future trend in intelligent transportation systems is "smart road signs" that incorporate smart codes (e.g., visible at infrared) on their surface to provide more detailed information to smart vehicles. Such smart codes make road sign classification problem aligned with communication settings more than conventional classification .
- L.F.P. Oliveira, L.T. Manera, P.D.G. Luz in their paper titled "Smart Traffic Light Controller System", IEEE 2019, developed smart traffic lights capable of traffic accident detection enabling the enhancement of traffic light management systems, blocking and creating alternative routes to not only avoid the traffic jams, but also avoid new accidents.
- Dariusz Grabowski & Andrzej Czyzewski in their paper titled "System for monitoring road slippery based on CCTV cameras and convolutional neural networks", Springer Publications 2020, made use of Convolutional Neural Networks to identify slippery roads using CCTV cameras.

PROBLEM STATEMENT DEFINITION

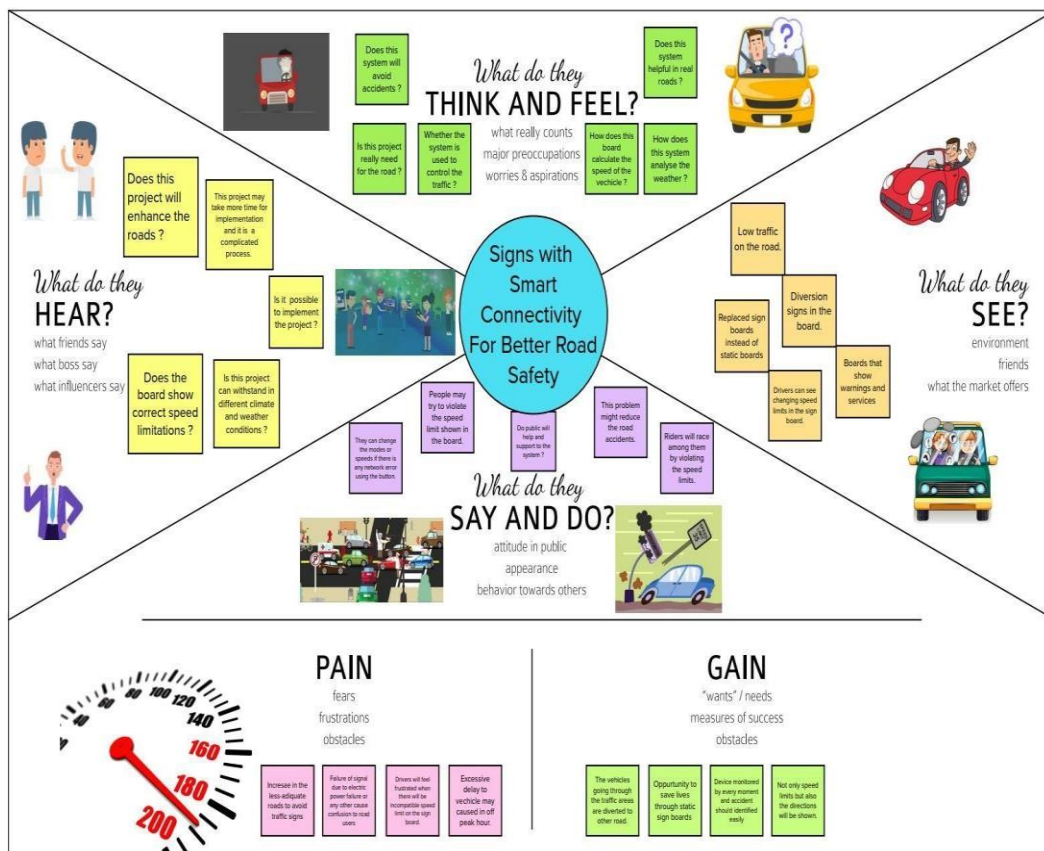
- The road signs and speed limit are static. So sometimes when there is extreme weather conditions it is very hard for

the riders to see the speed limit and directions.

- This project can be very useful for the riders. That is we can change the road signs accordingly if they are digitalized.
- When there is a rainfall the roads get very slippery which may lead to the accidents. So that can be prevented by using technology .

3.IDEATION AND PROPOSED SOLUTION

EMPATHY MAP CANVAS



PROPOSED SOLUTION

S.No.	PARAMETER	DESCRIPTION
1.	Problem Statement (Problem to be solved)	Project - Signs with Smart Connectivity for Better Road Safety is used to educate the drivers digitally using IOT who do not have knowledge about traffic signs and weather indication for the drivers and passengers convenience.
2.	Idea / Solution description	Replacing the man made painted signs into digital as well as their name which is more visible compared to current signs and also indicating weather in the same sign boards for driver where weather is not predictable.
3.	Novelty / Uniqueness	Weather indication on sign boards is unique which will help mostly the two wheelers from unfortunate heavy rains and winds. Digital traffic signs also educates the drivers to follow traffic rules easily.
4.	Social Impact / Customer Satisfaction	It makes the people to know about traffic signs if they don't know, it shows signs digitally to avoid the accidents and weather indication based on IOT to avoid accidents and it helps mostly for two wheeler passengers.

5.	Business Model (Revenue Model)	This project can make revenue by selling many equipments to the government sector and also private sectors(educational & medical institutions).Maintain services are also taken by the company.
6.	Scalability of the Solution	It makes the daily life of drivers and passengers better. The product can be scalable by adding new features to the product makes more revenue.

PROBLEM SOLUTION FIT

ProjectTitle: Signs with smart connectivity for better road safety			ProjectDesignPhase-I-SolutionFitTemplate			TeamID: PNT2022TMD48694		
Define CS, fit into CC	1. CUSTOMER SEGMENT(S) <small>Who is your customer? i.e. working parents of 0-5 yrs. kids</small>	6. CUSTOMER CONSTRAINTS <small>What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, no work connection, available devices.</small>	5. AVAILABLE SOLUTIONS <small>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 past it costs do these solutions have? i.e. pen and paper is an alternative to digital</small>	Explore AS, differentiate				
	1. Passengers 2. This is useful for drivers those who are travelling In Different road structures.	Customers no need to spend any money . power, network Connection. These project will available anytime until itsigns. Gets damaged.	This project gives proper and clear understanding about traffic signs and day to day current weather conditions.					
Focus on J&P, up into RC, address and RC	2. JOBS-TO-BE-DONE / PROBLEMS <small>Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one, explore different sides.</small>	9. PROBLEM ROOT CAUSE <small>What is the real reason that this problem exists? What is the back story behind the need to do this job? i.e. customers have to do it because of the change in regulations.</small>	7. BEHAVIOUR <small>What does your customer do to address the problem and get the job done? Secondary sources: find the right order panel installed, calculate usage and benefits, indirectly associated: customers spend less time on volunteering work (i.e. Gasstation)</small>	Focus on AS, up into BE, address and RC				
	1. It educates people about traffic signs who are travelling in roads 2. Showing different weather conditions and Most people indicating Temperature Values for passenger Convenience Back story: Most of the people forget to wear seat belts	are not following traffic conditions & not The Digital signs educating the customers and the smart trying to have knowledge about various traffic signs. Weather condition detection, this helps the customer to address the problems and get job done. And using mobile phones during travelling due to this This type of behaviour it leads to major road accidents.	This project gives proper and clear understanding about traffic signs and day to day current weather conditions.					
Identify strong TR & ER	4. EMOTIONS-BEFORE/ AFTER <small>How do customers feel before they face a problem or opportunity to do the job? i.e. how do customers feel before they face a problem or opportunity to do the job?</small>	<small>come up with a solution that fits within customer limitations, address both hardware and software behaviour.</small> 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.	8.2 OFFLINE <small>What kind of feedback mechanism will you use? (Emails, feedback form?) And what other customer development</small> Customer can address their feedback through toll free number or text messaging .	Identify strong TR & ER				
	2. Conditions of the weather can't be predictable in some of the times so it shows temperature values to the people who are travelling in roads or highways.	Some people don't have basic knowledge about various traffic signs & cannot Predict weather conditions while travelling so, due to that most of the road accidents happening. After implementing this project it helps and educate the people about various traffic signs & indicating the current weather condition to the passengers. Due to this we can prevent major road accidents.	This project gives proper and clear understanding about traffic signs and day to day current weather conditions.					

4.REQUIREMENT ANALYSIS

FUNCTIONAL REQUIREMENT

FN.NO	FUNCTIONAL REQUIREMENT	SUB REQUIREMENT
FR1	User Visibility	Sign Boards should be made of bright colored LEDs capable of attracting driver's attention Not too distracting to cause accidents.
FR2	User Understanding	Should display information through means like images/illustrations with text so that the user can understand the signs correctly.
FR2	User Convenience	Display should be big enough to display all the signs correctly so that it is visible even to far away drivers.

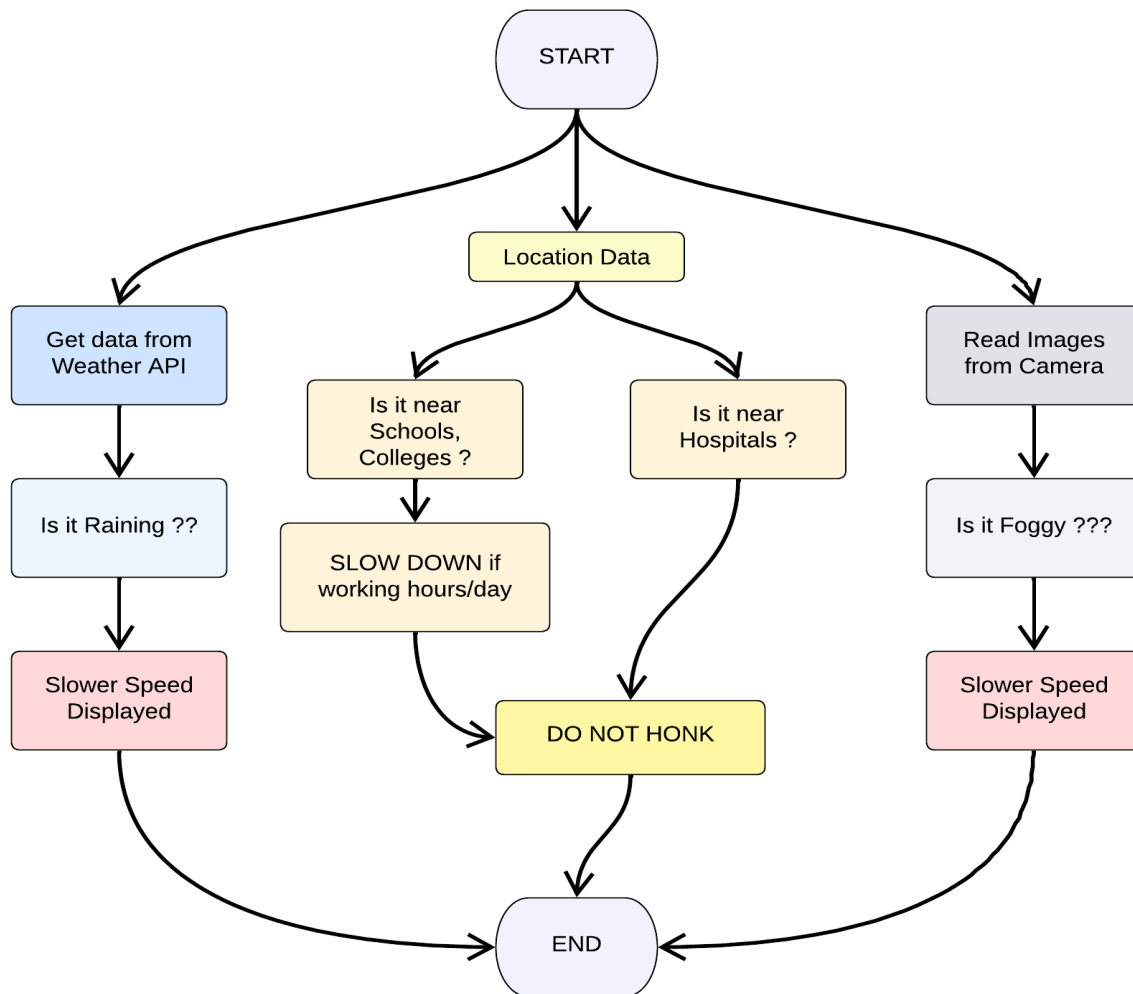
NON FUNCTIONAL REQUIREMENT

NFR .No.	NON FUNCTIONAL REQUIREMENT	DESCRIPTION
NFR 1	Security	Should be secure enough that only the

		intended messages are displayed in the display.
NFR 2	Reliability	Should convey the traffic information correctly.
NFR3	Performance	Display should update dynamically whenever the weather or traffic values are updated
NFR 4	Availability	Should be on service 24/7
NFR 5	Scalability	Should be modular and hence able to scale on servers horizontally.
NFR 6	Usability	Should be able to dynamically update with respect to time.

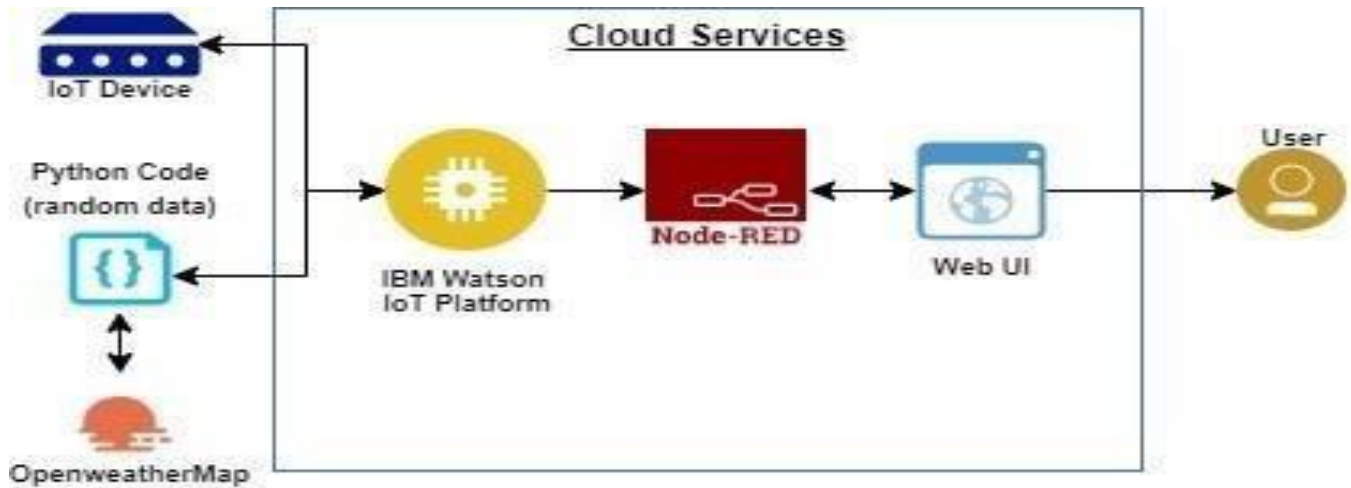
5.PROJECT DESIGN

DESIGN FLOW DIAGRAM



SOLUTION & TECHNICAL ARCHITECTURE

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2.



- 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 alsodisplayed accordingly.
- **6.** Different modes of operations can be selected with the help of buttons.

TABLE-1: COMPONENTS & TECHNOLOGIES

Sl.No	COMPONENTS	DESCRIPTION	TECHNOLOGY
1.	User Interface	How user interacts with application e.g.	HTML, CSS, JavaScript / Angular Js / React

		Web UI, Mobile App, Chatbox etc.	Js etc.
2.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
3.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
4.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
5.	External API-1	Purpose of External API used in the application	IBM Weather API, etc.

TABLE-2: APPLICATION CHARACTERISTICS

SI.NO	CHARACTERISTICS	DESCRIPTION	TECCHNOLOGY
1.	Security Implementations	Strong security system that anyone without login credentials and hackers are not allowed to enter the network.	Firewall, Firebase, cyber resiliency strategy.
2.	Scalable Architecture	Easy to expand the operating range by increasing the	IOT, internet.

		bandwidth of the network.	
3.	Availability	Available anytime and everywhere 24/7 as long as the user is signed into the network.	IBM Cloud
4.	Performance	Supports a large number of users to access the technology simultaneously.	IBM cloud

USER STORIES

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

6.PROJECT PLANNING & SCHEDULING

SPRINT PLANNING & ESTIMATION

SPRINT	FUNCTIONAL REQUIREMENT	USER STORY(TASK)	STORY POINTS	PRIORITY	TEAM MEMBERS
Sprint-1	Resources Initialization	Create and initialize accounts in various public APIs like Open Weather API.	1	LOW	PORKODI S AMIZHTHAA B ASMA ROSHAN T DIVYA DHARSHINI S
Sprint-1	Local Server/Software Run	Write a Python program that outputs resultsgiven the inputs like weather and location.	1	MEDIUM	PORKODI S AMIZHTHAA B ASMA ROSHAN T DIVYA DHARSHINI S
Sprint-2	Push the server/software tocloud	Push the code from Sprint 1 to cloud so it can be accessed from anywhere	2	MEDIUM	PORKODI S AMIZHTHAA B ASMA ROSHAN T DIVYA DHARSHINI S
Sprint-3	Hardware initialization	Integrate the hardware to be able to access thecloud functions and provide inputs to the same.	2	HIGH	PORKODI S AMIZHTHAA B ASMA ROSHAN T DIVYA DHARSHINI S
Sprint-4	UI / UX Optimization & Debugging	Optimize all the shortcomings and provide better user experience.	2	LOW	PORKODI S AMIZHTHAA B ASMA ROSHAN T DIVYA DHARSHINI S

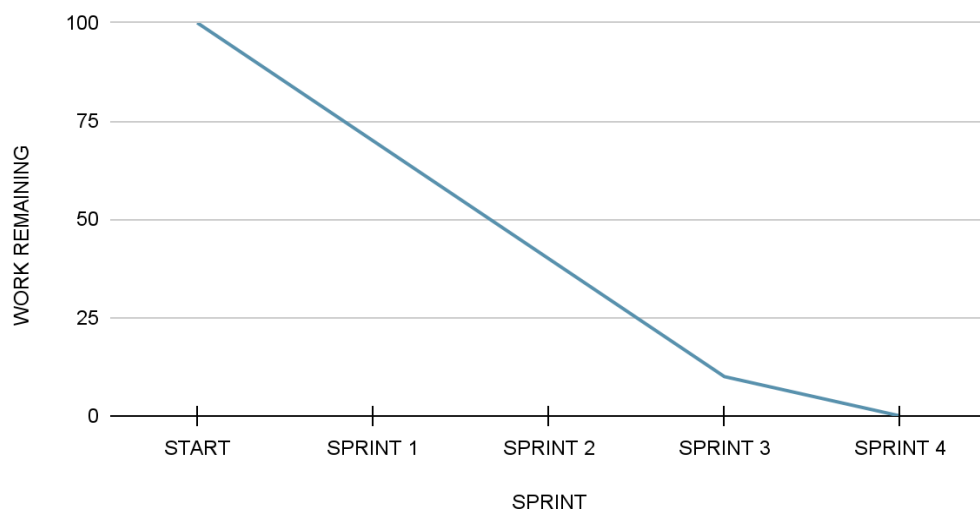
SPRINT DELIVERY SCHEDULE

PROJECT TRACKER, VELOCITY & BURNDOWN CHART

Sprint	Total Story Points	Duration	Sprint StartDate	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	31 Oct 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	07 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	14 Nov 2022

BURN DOWN CHART

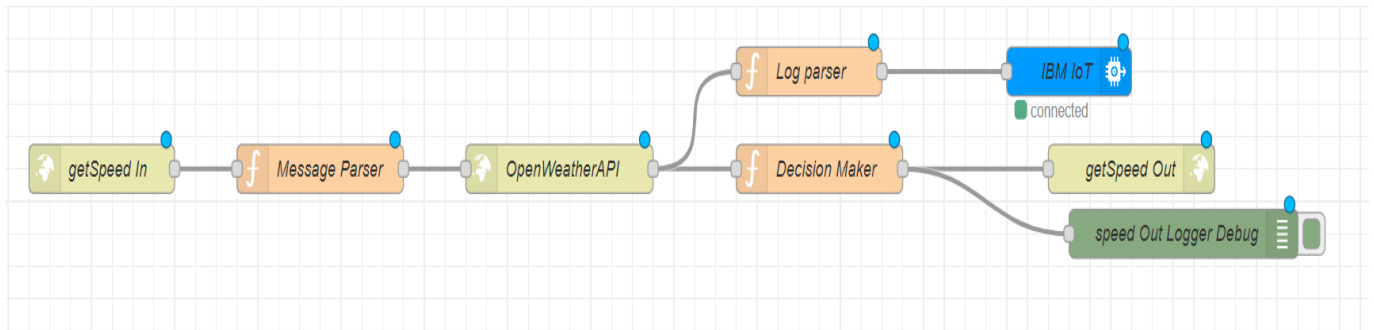
Balance Work



7.CODING & SOLUTIONING

FEATURE - 1

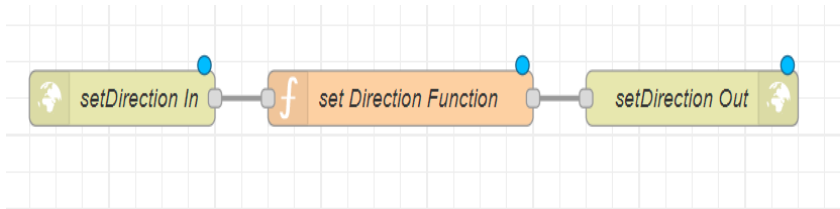
GET SPEED FOR GIVEN LOCATION & CLIMATE



- This part of Node RED flow accepts an http GET end point at **"/get Speed"** from which the location, uid, hospital/school zone infare passed.
- Message parser sets the required APIKEY for **Open Weather API** 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 andsends it as a http response.
- This data is displayed at the microcontroller. Thus, a lot of battery is saved due to lesser processing time.

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

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.

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.RESULT

PERFORMANCE METRICES

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.

DISADVANTAGES

- The size of the display determines the requirement of the micro controller.
- Dependent on Open Weather Map 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 (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 driver's awareness of the road situation.

13.APPENDIX

GITHUB LINK

<https://github.com/IBM-EPBL/IBM-Project-46319-1660745135>

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;


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+=Stri
```

```
ng(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+=Str
```

```
ing(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-eaicw-2022-11-08.au-  
syd.mybluemix.net/getSpeed?";  
url += "location="+myLocation+"&";  
url += "schoolZone="+digitalRead(schoolZone)+(String)"&";  
url +=
```

```

"hospitalZone="+((String)digitalRead(hospitalZone)).toString()+"&";url +=
"usualSpeedLimit="+((String)usualSpeedLimit).toString()+"&";
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_W
HITE);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);
}
```

