



SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY

IBM PROJECT REPORT

TEAM ID – PNT2022TMID38788

SUBMITTED BY,

K. GANESH (420719106010)

S. AKSHAYKUMAR (420719106002)

A. ARUNKUMAR (420719106005)

R. AMANULLAH (420719106003)

FINAL DELIVERABLES REPORT

Date	18.11.2022
Team ID	PNT2022TMID38788
Project Name	Signs with Smart Connectivity for Better Road Safety

Team Members and Their Contributions:

NAME	ROLL NO	CONTRIBUTION
GANESH K	420719106010	CREATED SOURCE CODE FOR THE WOKWISIMULATOR AND MIT APP CODE.
AKSHAYKUMAR S	420719106002	CREATED NODE RED AND IOT WATSON PLATFORM.
ARUNKUMAR A	420719106005	PROJECT REPORT MAKING PROCESS AND GATHERING IDEAS FOR CREATING PROJECT.
AMANULLAH R	420719106003	WORKINGS IN NODE RED FLOW AND IBM CLOUD DEPLOYMENT.

Introduction:

1. **Sprint 1** – Create and initialize accounts in various public APIs like OpenWeatherMap API, and write a python program that outputs results given the inputs like weather and location.
2. **Sprint 2** – Push data from local code to cloud.
3. **Sprint 3** – Hardware & Cloud integration.
4. **Sprint 4** – UI/UX Optimization & Debugging

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.

LITERATURE SURVEY

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.

References:

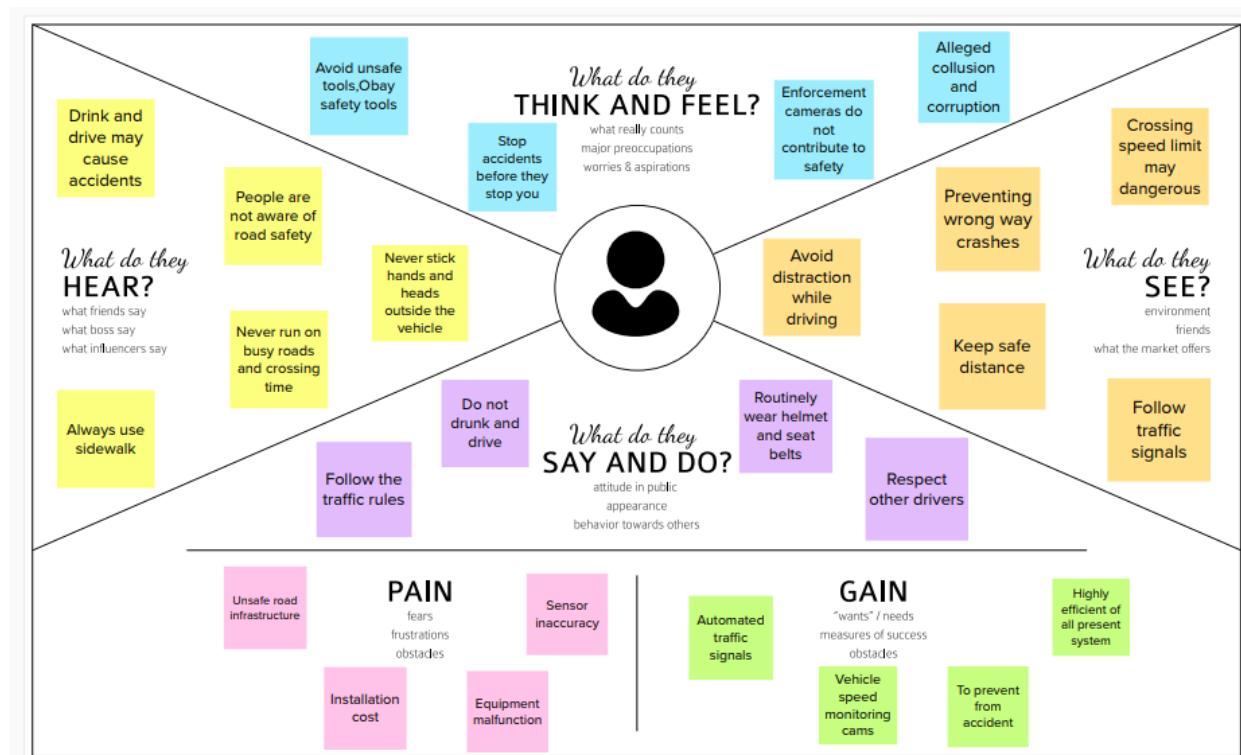
- Cairney and Gunatillake, 2000; Sisiopiku et al., 2015
- Islam, 2015; Sisiopiku et al., 2015
Yannis et al., 2013, Staffeld (1953) and Ady (1967)

Problem Statement Definition:

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

IDEATION AND PROPOSED SOLUTION

EMPATHY MAP CANVAS:



Ideation & Brainstorming Map:

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

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

PROBLEM

In present system the road signs are static but it should change some climatic changes and fatal situations



Key rules of brainstorming
To run an smooth and productive session

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

2

Brainstorm

Write down any ideas that come to mind that address your problem statement.

⌚ 10 minutes

TIP
You can select a sticky note and hit the pencil icon to sketch lines to start drawing!

Ganesh K

Akshaykumar S

Arunkumar A

Amanullah R

Implementation of smart connected sign boards

Requesting the user to obey road safety rules

Placing number of sign boards on the road sides to alert drivers

Keep speaking about the dangers of traffic

Sign boards are changed, based on the weather conditions

Replacing static sign boards

Preventing wrong way crashes

Connectivity to improve the way strategic road network

Combating poor visibility

Widening the roads

Increase the cost efficiency

Smart connection between vehicles will minimize accidents

Intimate the Bad weather

Provide High quality visibility signs

Always drive only in the permissible direction on the road

Implementing IOT devices with live weather

3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you can break it up into smaller sub-groups.

⌚ 20 minutes

Obey traffic rules and regulations

Preventing the Accidents

Implementing smart dynamic sign boards

Improved road safety

Preventing wrong way crashes

Based upon the weather speed should be varied

Intimate to avoid drunk and drive

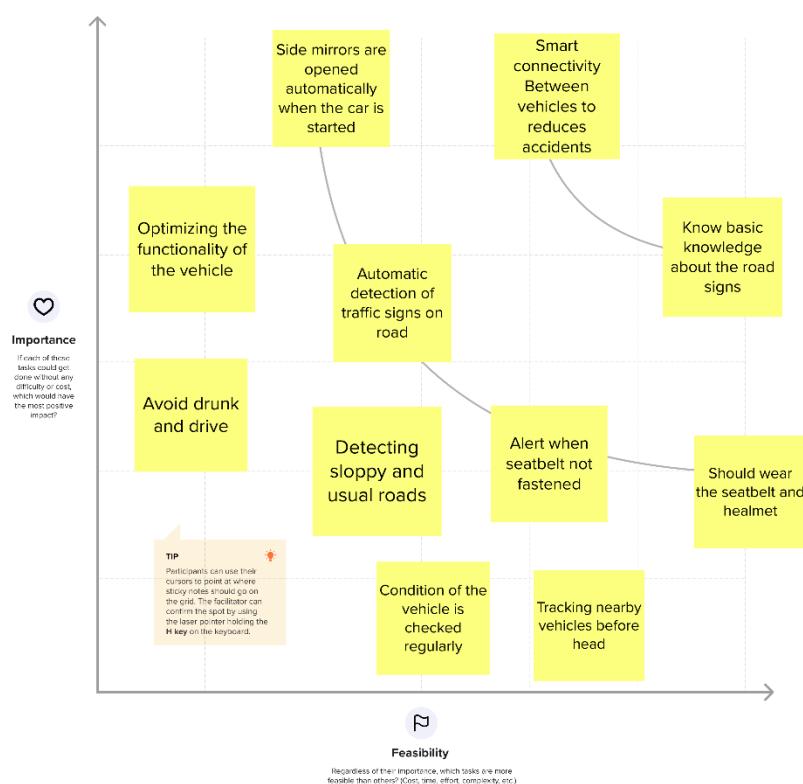
TIP
Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mind.

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



5

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](#)

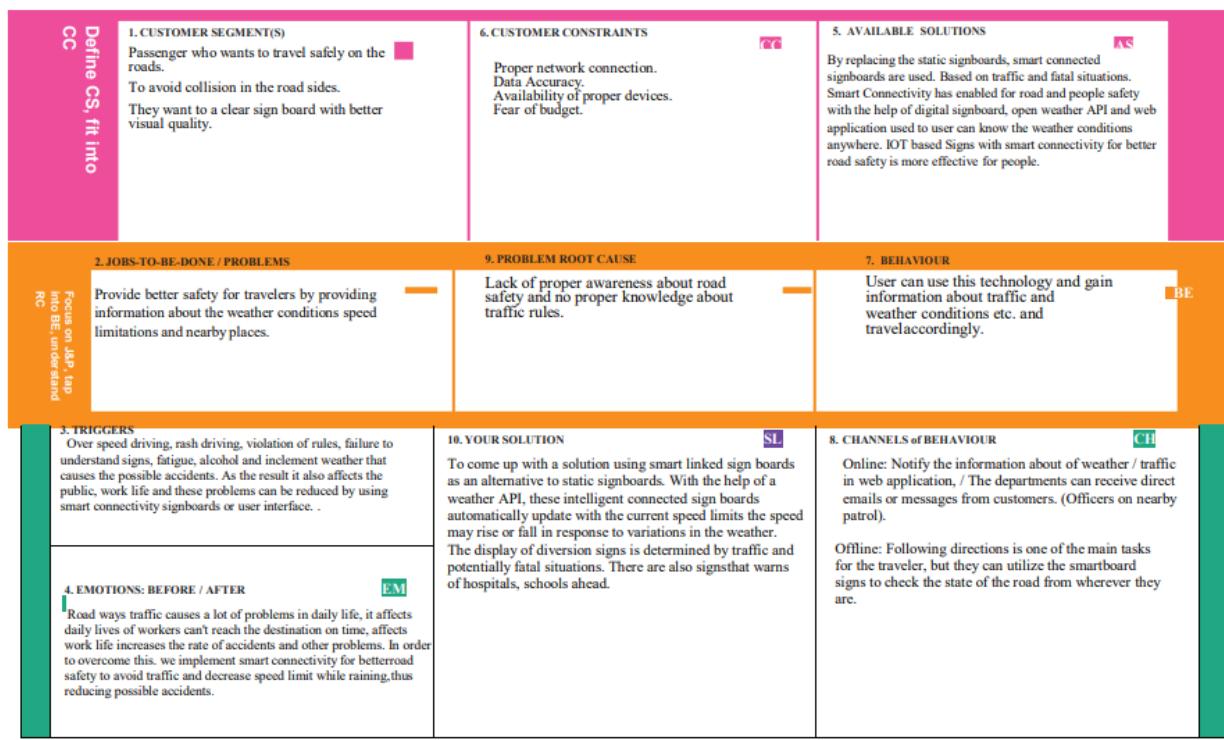
Proposed Solution:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To avoid the road accidents due to collisions over speeding of vehicles due to weather changes. Difficult to follow greater number of static sign boards placed at a same place. People failure to understand the traffic signs and violation of rules
2.	Idea / Solution description	Instead of static sign boards digital sign boards are placed in the roadsides.

		Based on the weather changes the displaying speed may be increased or decreased.
3.	Novelty / Uniqueness	Sign boards are converted to digital display where APIs and online services are integrated in new and interesting ways. Open Weather Map is an online service that provides global weather data, forecasts, and historical weather data for any geographical location
4.	Social Impact / Customer Satisfaction	Reduced accident rates. Increase travel speeds. Increase operational efficiency. Real time information management. Create a platform for sharing traffic to other systems. Environment friendly.
5.	Business Model (Revenue Model)	LED signal lamp which compiles the European standards EN12368 and IP65 grade with 5 years performance warranty. Selling project to the highway departments. It will provide service where the accidents avoid is play vital role in road.
6.	Scalability of the Solution	This project is highly feasible and can later be further updated with other additional features as well

Problem Solution fit:

Project Title: Signs with smart connectivity for better road safety Project Design Phase-I - Solution Fit Team ID: PNT2022TMID38788



REQUIREMENT ANALYSIS

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Requirements	Static signboards will be replaced with smart linked signboards that meet all criteria.
FR-2	User Registration	Manual Registration Through a Website or Gmail
FR-3	User Confirmation	Phone Confirmation Email confirmation OTP authentication
FR-4	Payments options	Bank Transfer

FR-5	Product Delivery and installation	The installation fee will be determined by the length of the road.
FR-6	Product Feedback	Through a website via Gmail

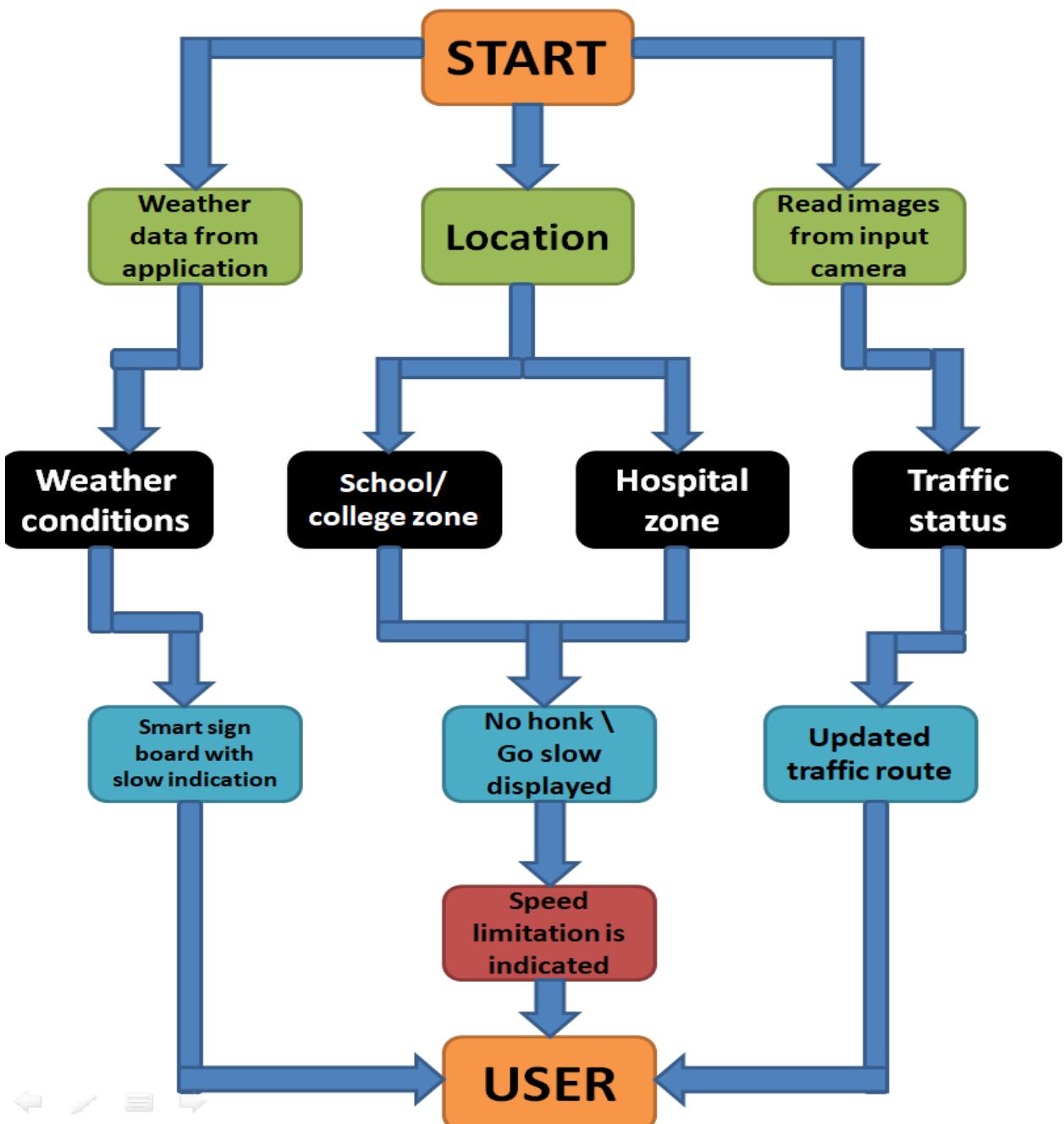
Non-Functional Requirements:

Following is the Non-Functional Requirements of the proposed solution

FR No.	Non-Functional Requirements	Description
NFR-1	Usability	It should be able to Upgrade and Update when there is a need for it.
NFR-2	Security	It should have good security system so that no other person can hack and display their own directions.
NFR-3	Reliability	It should be able to display information correctly and error-free.
NFR-4	Performance	It should be able to automatically update itself when certain weather or traffic problem occurs.
NFR-5	Availability	It should be available 24/7 so that it can be beneficial to the customer i.e., the driver.
NFR-6	Scalability	It should be able to easily change and upgrade according to change and need in requirement.

PROJECT DESIGN

Data Flow Diagram:



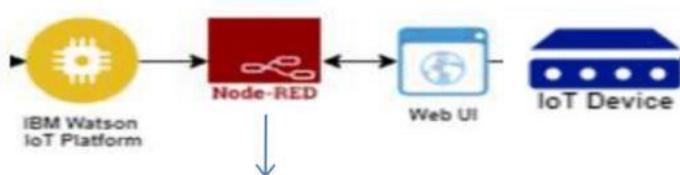
Solution & Technical Architecture:

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



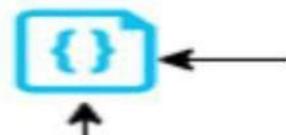
Application

Cloud Services



Middleware

Python Code
(random data)



Networking

Openweathermap



Sensing

Following is the Solution Built:

Table-1 : Components & Technologies:

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

User Stories:

User journey											People ≥ 6	Time 30 min	Difficulty Beginner
Creating a user journey is a quick way to help you and your team gain a deeper understanding of who you're designing for and the stakeholders in your project. The information you add here should be representative of the observations and research you've done about your users. ¹²													
1 Phases													
	The user must know the awareness about traffic rules			Maintains the vehicles properly			Use various sensors to monitor the driver status			The NFC tag would be compulsorily placed in all vehicles			
2 Steps	The user must have the driving license	The user must wear the seat belt	The user must know the traffic signs	Check the break wire weekly once in a manner	Head lights and warning lights should be placed	Side mirror must be installed	GPS sensors placed in the vehicles	Ultrasonic sensor to detect the object distance	Traffic congestion are displayed	The NFC tags to communicate with active NFC devices	Install speed governor device	Identify and tracking using radio waves	
3 Feelings	 Collision will be avoided	Major road accidents will be reduced	This technology improves road safety	Collision will be avoided	Cheapest and most profitable	Provide better traffic signs	Prevent accidents and injuries	Less risk of damage	This technique provides flexible service	To provide accident free techniques	More strategic traffic management	To provide more efficient travel	
	 There will be occur violation charges	Majority of the accidents happen due to the carelessness of human	Damage of the vehicle may cause financial problem	Proceed at the rush hour	Unconditional vehicles may cause accidents	They may rise irritating violence sound	Risk of goods being damaged especially over long distance	There can be traffic delays and breakdowns	Toll charges are high	Emotional injuries and medical costs	Traffic congestions which cause lost a lot of time	Large economic cost of slow implementation	
4 Pain points	The volume of traffic and passengers are very large	Human mistakes causes the huge deaths	Roads are damaged and difficult to drive	Severity of air pollution	Lack of coordination	Increase in car increases carbon emission	Road signs are ignored because of their mentality	Many check points will be irritating for drivers	Bad weather conditions affects the driving	Due to wrong indication of traffic signs	Due to poor lighting there will be occur accidents	Roads are inadequate and bad	
5 Opportunities	Maintains the vehicle speed smoothly	Wearing seat belts and helmets	Avoid the accidental death rate	Tags have a long life span	The NFC provides the best service to the drivers	Drain is going to be very less	Drain is going to be very less	Drain is going to be very less	Drain is going to be very less	NFC enabled card payments are more secure	Provides data transfer that allows smart phones	NFC is an low cost way to connect android	

PROJECT PLANNING AND SCHEDULING

Sprint Planning & Estimation:

Sprint	Functional Requirement (Epic)	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Initialization of Resource S	Create and initialize accounts in various public APIs like Open Weather API.	1	Low	Ganesh K Akshaykumar S Amanullah R Arunkumar A
Sprint-1	Local Server/Software Run	Write a Python program that outputs results given the inputs like weather and location.	1	Low	Ganesh K Akshaykumar S Amanullah R Arunkumar A

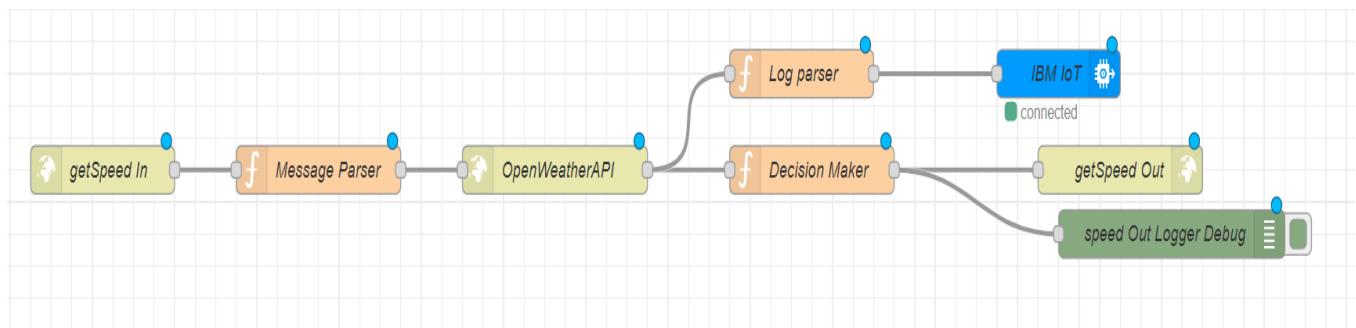
Sprint-2	Push the software to cloud	Push the code from Sprint 1 to cloud so it can be accessed from anywhere	2	Medium	Ganesh K Akshaykumar S Amanullah R Arunkumar A
Sprint-3	Hardware initialization	Integrate the hardware to be able to access the cloud functions and provide inputs to the same.	2	High	Ganesh K Akshaykumar S Amanullah R Arunkumar A
Sprint-4	UI/UX Optimization & Debugging	Optimize all the shortcomings and provide better user experience	2	Medium	Ganesh K Akshaykumar S Amanullah R Arunkumar A

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	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

CODING AND SOLUTIONING

Feature 1 - GET SPEED FOR GIVEN LOCATION & CLIMATE



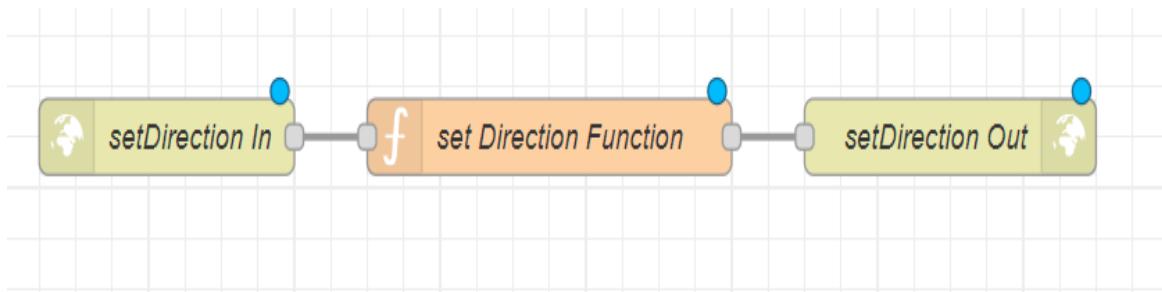
This part of Node RED flow accepts an http GET end point at **/getSpeed** from which the location, uid, hospital/school zone info are passed.

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.

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.

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.

RESULTS:

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.

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 OpenWeatherMap API and hence the speed reduction is same for a large area in the scale of cities.

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.