SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY

IBM PROJECT REPORT

TEAM ID – PNT2022TMID38788

SUBMITTED BY,

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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 GATHERINGIDEAS 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 signboardsare used.
- These smart connected sign boards get the speed limitationsfrom a web app using weather API and update automatically.
- Based on the weather changes the speed may increase ordecrease.
- Based on the traffic and fatal situations the diversion signs aredisplayed.
- Guide (Schools), Warning and Service (Hospitals, Restaurants)signs are also displayed accordingly.
- Different modes of operations can be selected with the help ofbuttons.

Purpose:

- Smart Traffic Management is a system to monitor and control traffic signals using sensors to regulate the flow of traffic and toavoid 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 havenot been linked with differences in the crash count.
- However, this finding is contrary to previous research thatsuggests 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 themost

common types of crashes in the presence of roadside advertising signs.

- In addition, drivers showed increased eye fixations andincreased drifting between lanes on the road.

References:

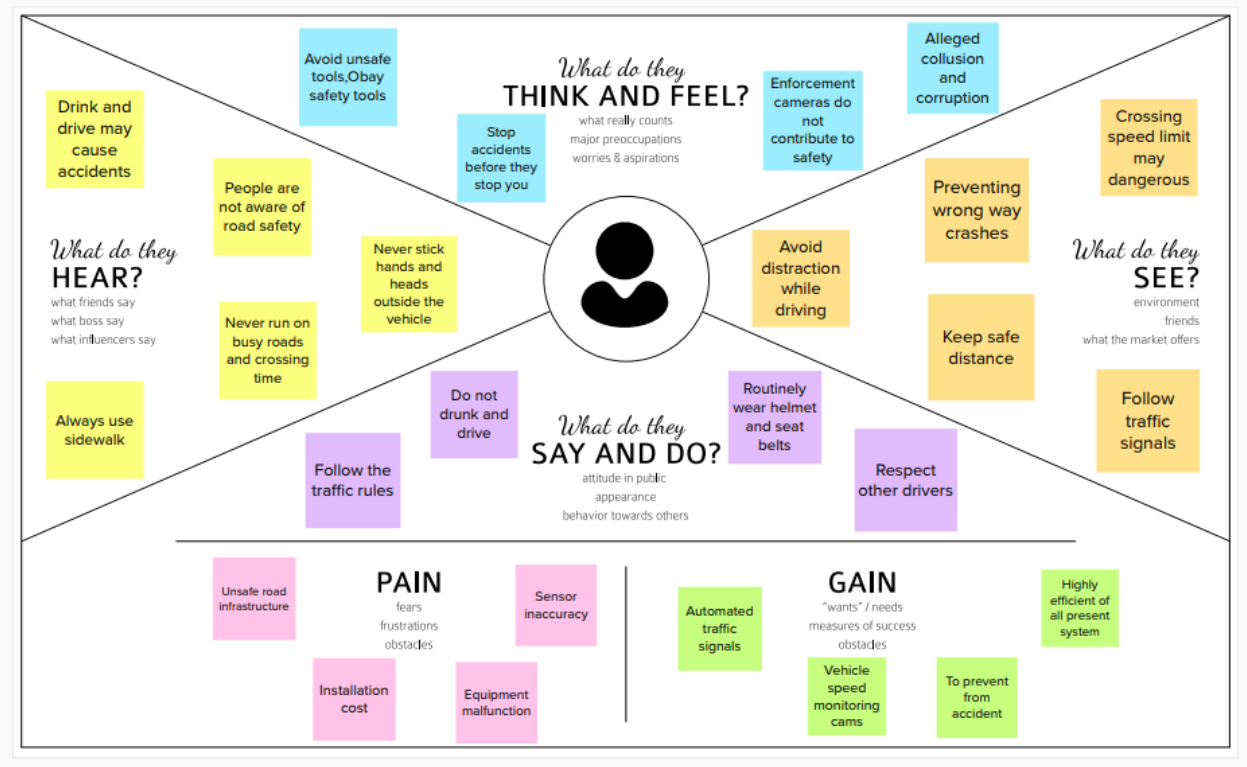
- Cairney and Gunatillake, 2000; Sisiopiku et al., 2015
- Islam, 2015; Sisiopiku et al., 2015
  Yannis et al., 2013, Staffeld (1953) and Ady (1967)

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 theroad 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.
- Encourage wild ideas.
- Defer judgment.
- Listen to others.
- Go for volume.
- 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 [switch to sketch] icon 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 and break it up into smaller sub-groups.

20 minutes

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

Obey traffic rules and regulations

Preventing the Accidents

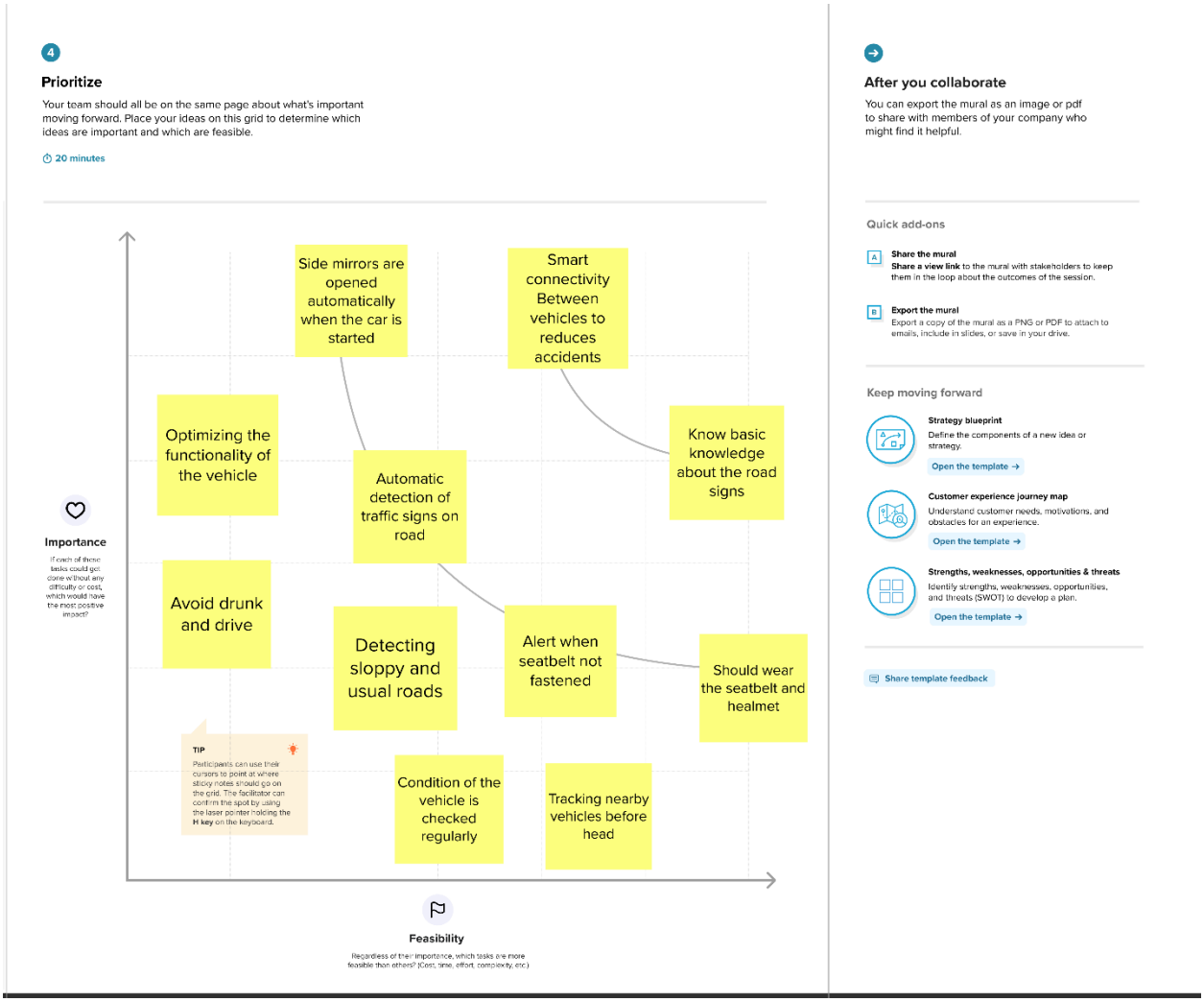
Based upon the weather speed should be varied

Implementing smart dynamic sign boards

Improved road safety

Intimate to avoid drunk and drive

Preventing wrong way crashes

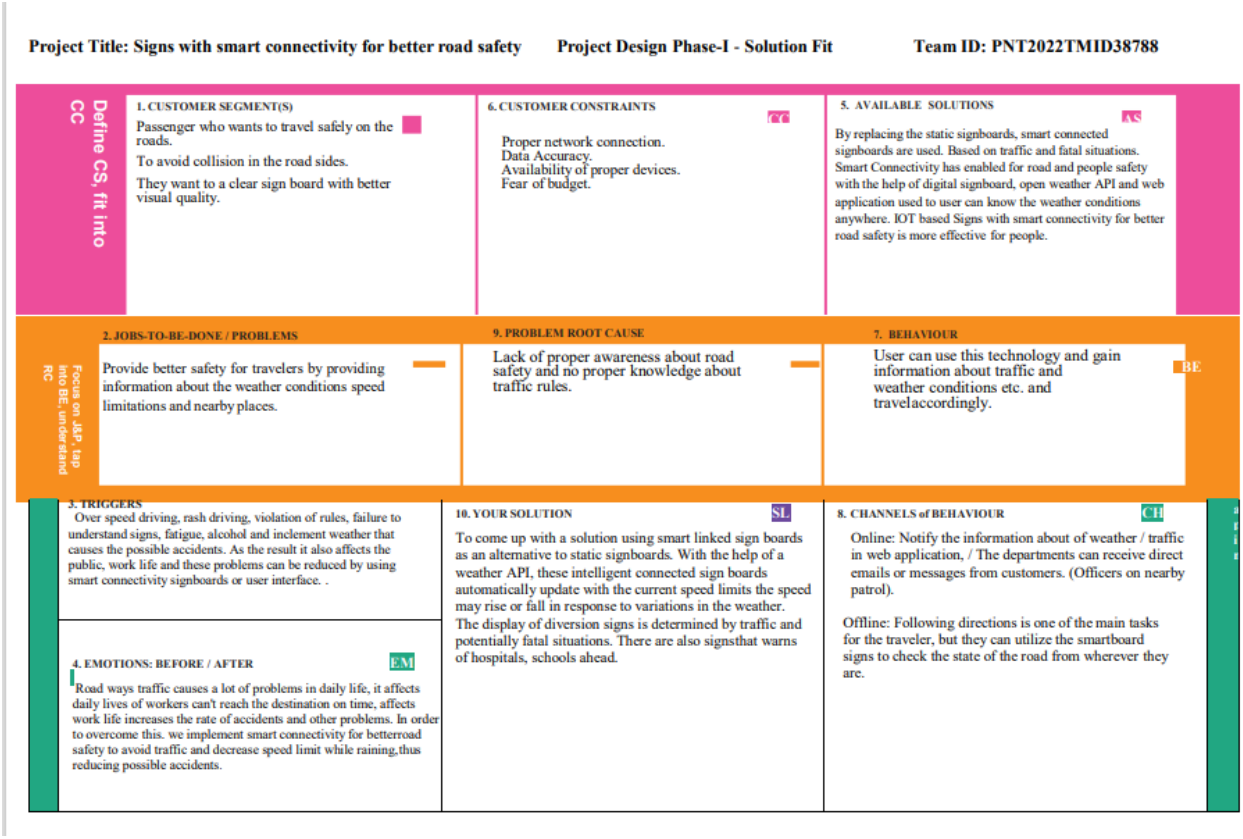


Proposed Solution:

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:



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 ofthe road.
FR-6	**Product Feedback**	Through a websitevia Gmail

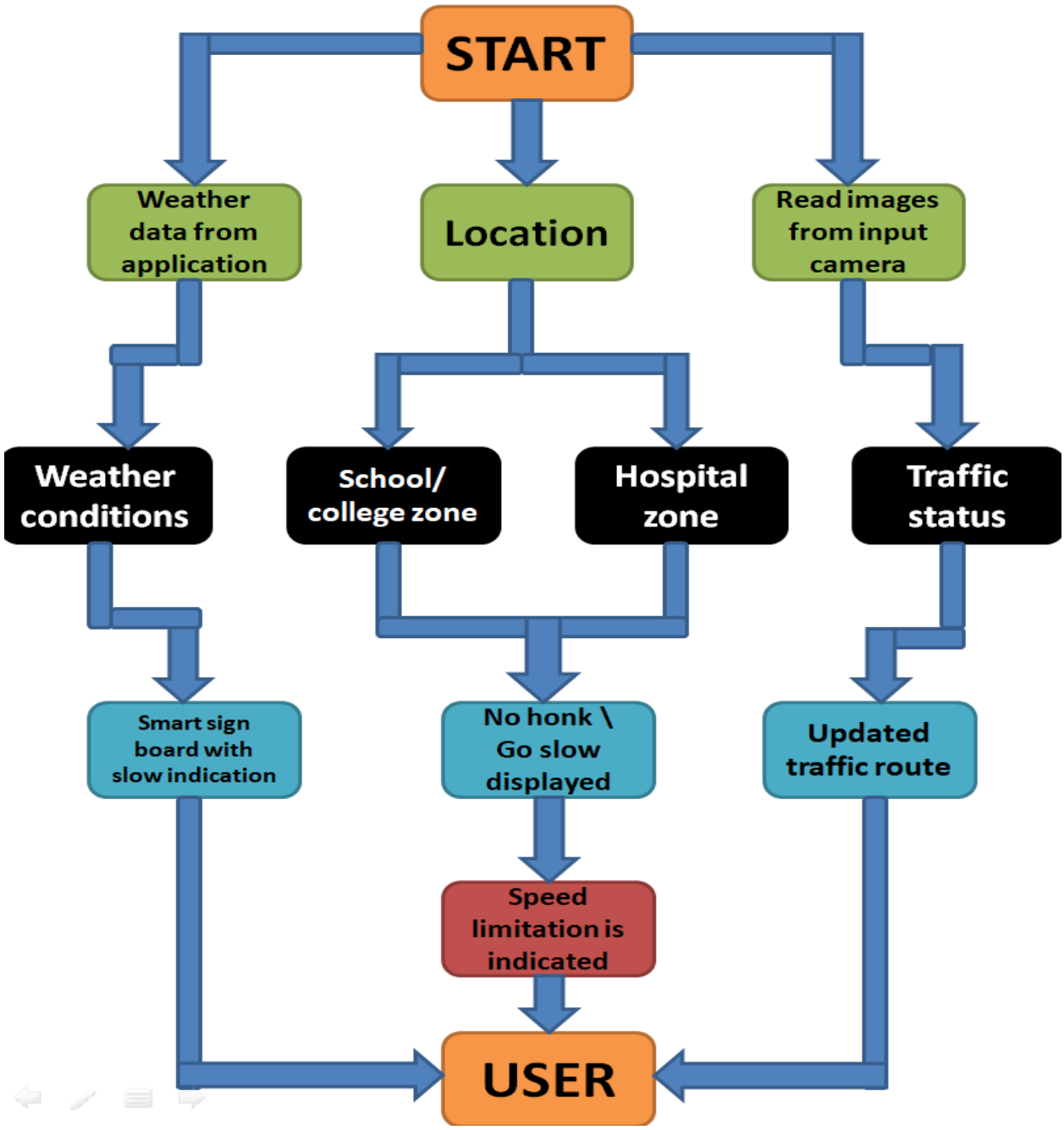
Non-Functional Requirements:

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 to 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 accordingto change and need in requirement.

PROJECT DESIGN

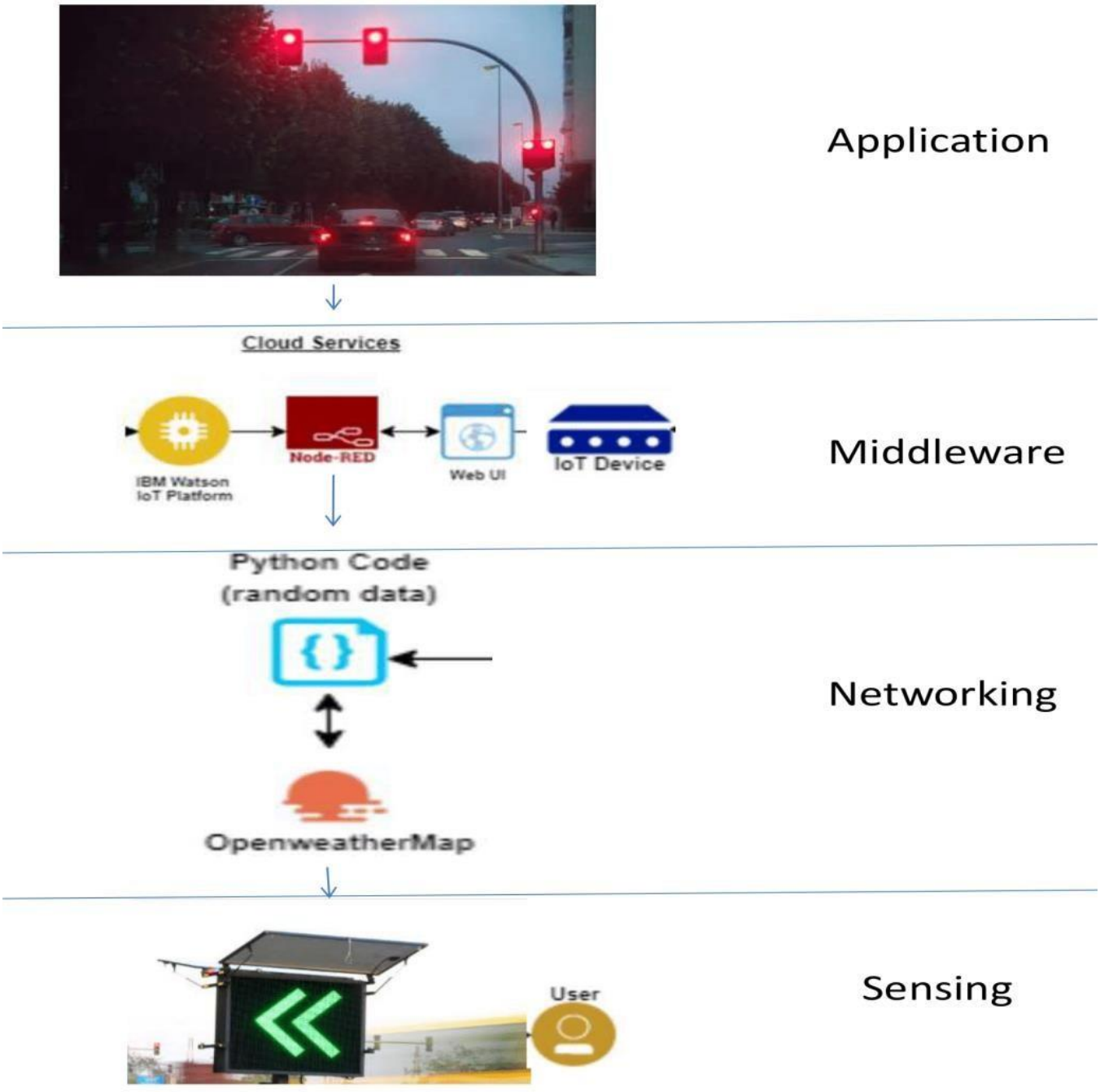
Data Flow Diagram:



Solution & Technical Architecture:

Following is the Technical Architecture with slight change and is

without the implementation of OpenCV API.



Following is the Solution Built:

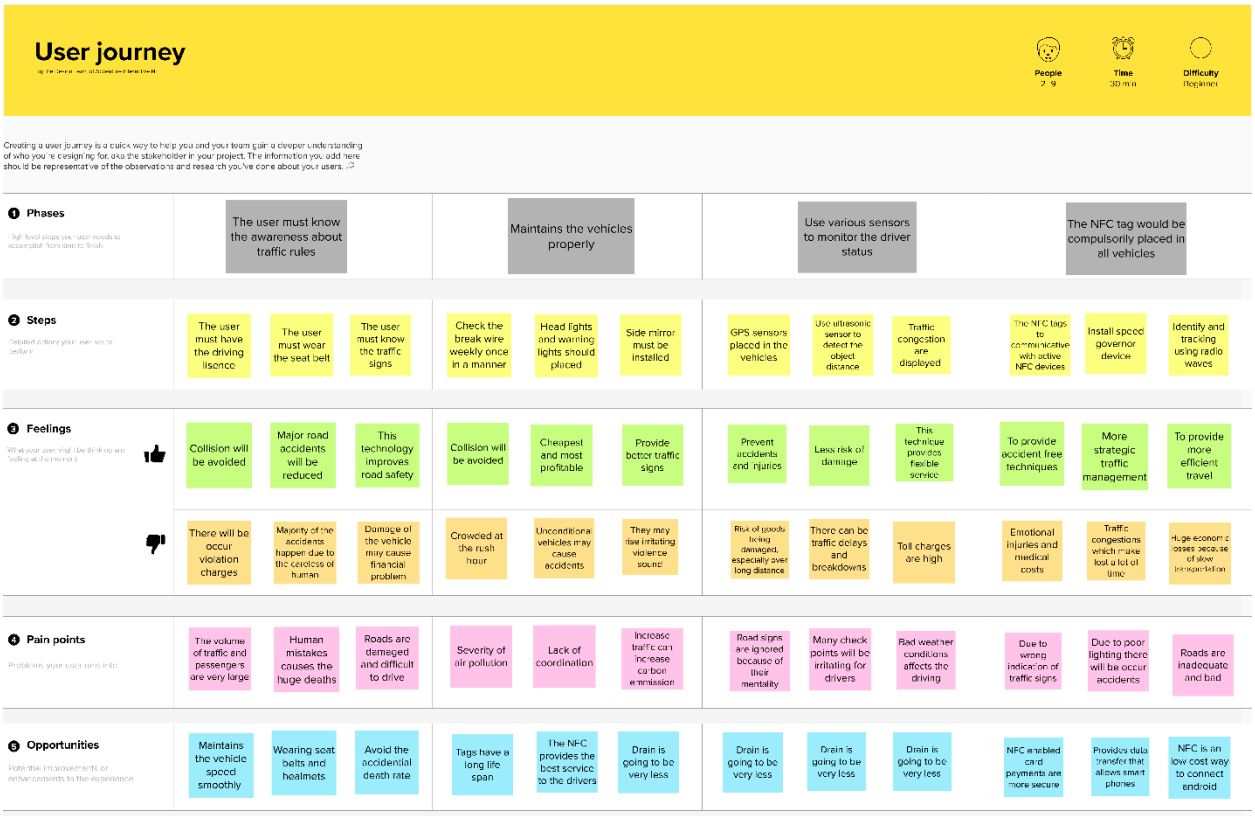
Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	User can interact with the app using MIT App	HTML, CSS, JavaScript / Angular Js /React Js
2.	Application Logic-1	Logic for a process in the application	Java / Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	Data Type, Configurations etc.	IBM Cloud
6.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
7.	File Storage	File storage requirements	IBM Block Storage or Other StorageService or Local Filesystem
8.	External API-1	Purpose of External API used in the application	Open Weather Map API
9.	External API-2	Purpose of External API used in the application	IBM Watson Platform, Node - Red
10.	Infrastructure (Server / Cloud)	Application Deployment on Local System / CloudLocal Server Configuration: Cloud Server Configuration:	Local, Cloud Foundry, Kubernetes

Table-2: Application Characteristics:

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

User Stories:



PROJECT PLANNING AND SCHEDULING

Sprint Planning & Estimation:

Sprint	Functional Requirement (Epic)	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Initialization of Resources	Create and initialize accounts in various publicAPIs 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

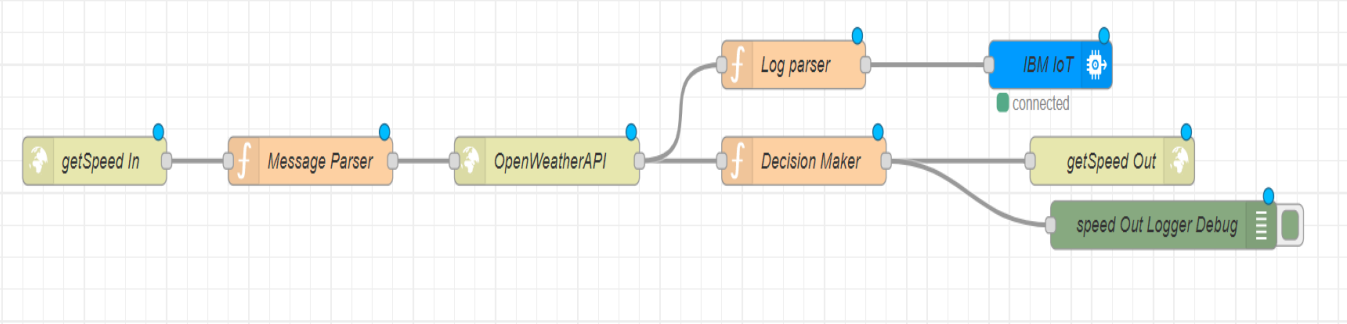
Sprint-2	Push the software to cloud	Push the code from Sprint 1 to cloud so it can be accessed from anywhere	2	Medium	Ganesh K Akshaykumar S Amanullah R Arunkumar A
Sprint-3	Hardware initialization	Integrate the hardware to be able to access the cloud functions and provide inputs to the same.	2	High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



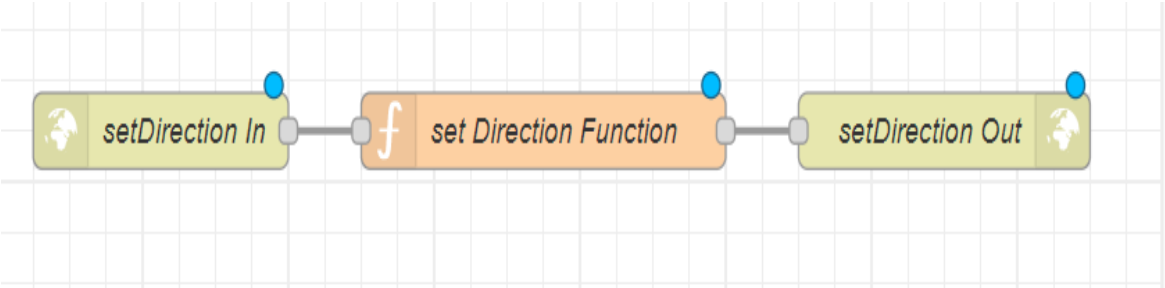
This part of Node RED flow accepts an http GET end point at **"/getSpeed"** from which the location, uid, hospital/school zone info are passed.

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 AGIVEN 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
- **DISADAVNTAGES**
  - The size of the display determines the requirement of the micro controller
  - Dependent on OpenWeatherMap API and hence the speed reduction is same for a large area in the scale of cities.

CONCLUSION:

Our project is capable of serving as a replacement for static signs for a comparatively lower cost and can be implementedin the very near future. This will help reduce a lot of accidents and maintain a more peaceful traffic atmosphere in the country.