IBM NALAIYA THIRAN 2022-23 PROJECT REPORT

SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY

PNT2022TMID27426

1. INTRODUCTION

1.1 Project Overview

Extreme weather conditions can cause low visibility on the road, making it difficult to see and follow static sign boards and increasing the risk of accidents. Damaged or improperly placed static sign boards could result in accidents or misguided directions that would take users in the wrong direction. As a result, we define the problem as static signboards that do not adequately serve users.

1.2 Purpose

- In present Systems the road signs and the speed limits are Static. But the road signs can be changed in some cases.
- During rainfall, the roads will be slippery and the speed limit would be decreased accordingly if they are digitalized.
- This project proposes a system that has digital signboards on which the signs can be changed dynamically.

2. LITERATURE SURVEY

2.1 Existing problem

a) Digital Notice Board Based on IoT

This project presents a digital notice board using an IoT module. The idea behind this project is to provide its users with a simple, fast, and reliable way to put up important notices in an LED where the user can send a message to be displayed in the LED. The message can be sent through an android application designed for this project, through the IoT module. So, notices can be put up in an LED display from any location in the world. It uses a microcontroller for system control, IoT-based technology for communication, and sends the message through the android application. The project consists of an Arduino

UNO board, an IoT module, an LED, and an android application for user interface with the hardware. This device can be used anywhere irrespective of the place of deployment provided mobile network connectivity is available. This is a project that displays messages that the user desires, on an LED Display Matrix. The Display consists of 256 LED lights, sequentially arranged in 8 rows and 32 columns (8*32). Apart from the display, the project consists of a Node MCU controller which helps the system to connect to the Wi-Fi. This system makes use of Google Assistant to accept speech inputs from the user, through the user's Android smartphone. User needs to login into their Google account. A USB cable acts as the power cable for the system. The speech input is converted into a text display in an alphanumeric format which is predefined. The displayed message will either scroll or remain static, based on the size of display and the length of the message. This project can widely use in offices, schools, educational institutions as well as government and corporate offices to display important notices and messages. This can prove to help users save a lot of time as against the use of traditional pin and paper notice displays.

b) An IoT-based Smart Monitoring System for Vehicles

There is increased adoption of penalties and fine for traffic rule violators in the public sector but there is a tendency for people to evade those imposed fines and restrictions for their own safety. Our system will completely monitor all traffic violations namely overspeeding, rash driving, drunken driving, driving without a seat belt, and so on right from the start of the car. There is an increasing demand to develop a system to check passengers without coming out of the vehicle. A new system for the police force to check the vehicle's details with a smart device placed in the vehicle. The device is equipped with speed monitoring, Alcohol detection, Seat belt checking, etc. If any violation is detected the controller sends an emergency data to the cloud, thus the vehicle is in continuous monitoring mode, and RTO will get updates about the vehicles which are violating rules. Alcoholic breath sensor will continuously monitor the driver's breath, speed sensor will be connected with the speedometer and checks for over speeding, Seat belt sensor will warn the driver if he/she is not using the seat belt, vehicle details including license, pollution details, insurance, etc. will be uploaded to the server or cloud. If any of the above things are violated, automatically defaulter will be imposed fines and the details will be sent to the Motor vehicle department.

c) Congestion Adaptive Traffic Light Control and Notification Architecture Using Google Maps APIs

Controlling of traffic signals optimally helps in avoiding traffic jams as vehicle volume density changes on temporally short and spatially small scales. Nowadays, due to embedded system development with the rising standards of computational technology, condense electronics boards as well as software packages, system can be developed for controlling cycle time in real time. At present, the traffic control systems in India lack

intelligence and act as an open-loop control system, with no feedback or sensing network, due to the high costs involved. This paper aims to improve the traffic control system by integrating different technologies to provide intelligent feedback to the existing network with congestion status adapting to the changing traffic density patterns. The system presented in this paper aims to sense real-time traffic congestion around the traffic light using Google API crowdsource data and hence avoids infrastructure cost of sensors. Subsequently, it manipulates the signal timing by triggering and conveying information to the timer control system. Generic information processing and communication hardware system designed in this paper has been tested and found to be functional for a pilot run in real time. Both simulation and hardware trials show the transmission of required information with an average time delay of 1.2 seconds that is comparatively very small considering cycle time. Mishra, Sumit Kumar, Devanjan Bhattacharya and Ankit K. Gupta. "Congestion Adaptive Traffic Light Control and Notification Architecture Using Google Maps APIs." Data 3 (2018): 67.

d) An IoT based Weather Information Prototype Using WeMos

The Internet of Things (IOT) describes the interconnection of devices and people through the traditional internet and social networks for various day-to-day applications like weather monitoring, healthcare systems, smart cities, irrigation field, and smart lifestyle. IOT is the new revolution of today's internet world which monitors live streaming of the entire world's status like temperature, humidity, thunderstorm, earthquake, floods etc. that can stagger an alarm to human life. This paper proposes a low-cost weather monitoring system which retrieves the weather condition of any location from the cloud database management system and shows the output on an OLED display. The proposed system uses an ESP8266-EX microcontroller based Wemos D1 board and it is implemented on Arduino platform which is used to retrieve the data from the cloud. The main objective of this paper is to view weather conditions of any location and allows to access the current data of any station. R. K. Kodali and A. Sahu, "An IoT based weather information prototype using WeMos," 2016 2nd International Conference on Contemporary Computing and Informatics (IC3I), 2016, pp. 612-616, doi: 10.1109/IC3I.2016.7918036

e) Incorporating Weather Updates for Public Transportation Users of Recommendation Systems

This work presents a system for augmenting the functionality of Yelp-like recommendation sites by enabling users to search for places bounded by travel-time when using public transportation, and modifying recommendations based on updated weather conditions. Using public transport, although is cheaper and efficient, entails that only fixed places of boarding/exiting may be used which, in turn, implies walking to (from) a particular location from (to) a given station. Given the impact of the weather on the mood and activities, preferences for a certain type of services may need to be dynamically

adjusted based on the current weather or the near-future forecast, modulo travel-routes to preferred locations. In this work, we develop a model to predict a user's preferred mode of transport (car, or public transit) from their old check-ins and incorporate the weather context into the recommendation process. We use event-based modeling to control the extent of walking depending on user-defined tolerance information and live weather conditions. We implemented a web application (both desktop and mobile platforms), utilizing existing tools such as Google Maps Direction API and OpenWeatherMap API for retrieving real-time information.

f) System Natural Data is now becoming more valuable in a day to get real-time data for natural data

Physical monitoring of the environment allows for the identification of areas suitable for agriculture, industry, and other purposes. In this article, the Arduino-UNO microcontroller- based board is used for the data acquisition strategy and the use of analog and digital sensors. Temperature, humidity, light intensity and gas concentrations can be monitored in real-time

g) The impact of daily weather on daily travel trips

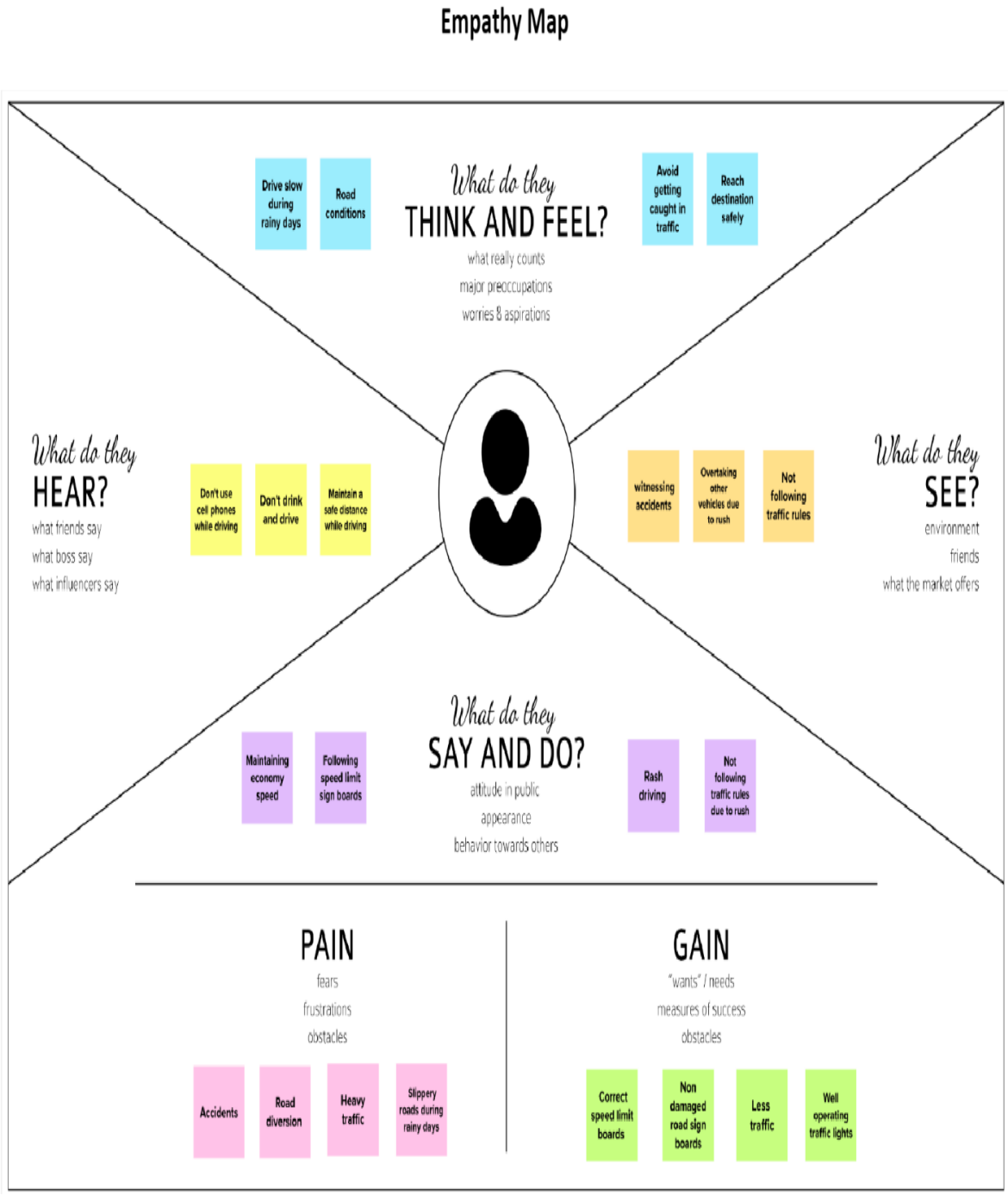
It is of increasing social interest - climate change and increasing scarcity, understanding the climatic implications of travel behavior, especially walking and biking. Recently, various courses are travel, health, and biometeorology.

2.2 Problem Statement Definition

Extreme weather conditions can cause low visibility on the road, making it difficult to see and follow static sign boards and increasing the risk of accidents. Damaged or improperly placed static sign boards could result in accidents or misguided directions that would take users in the wrong direction. As a result, we define the problem as static signboards that do not adequately serve users

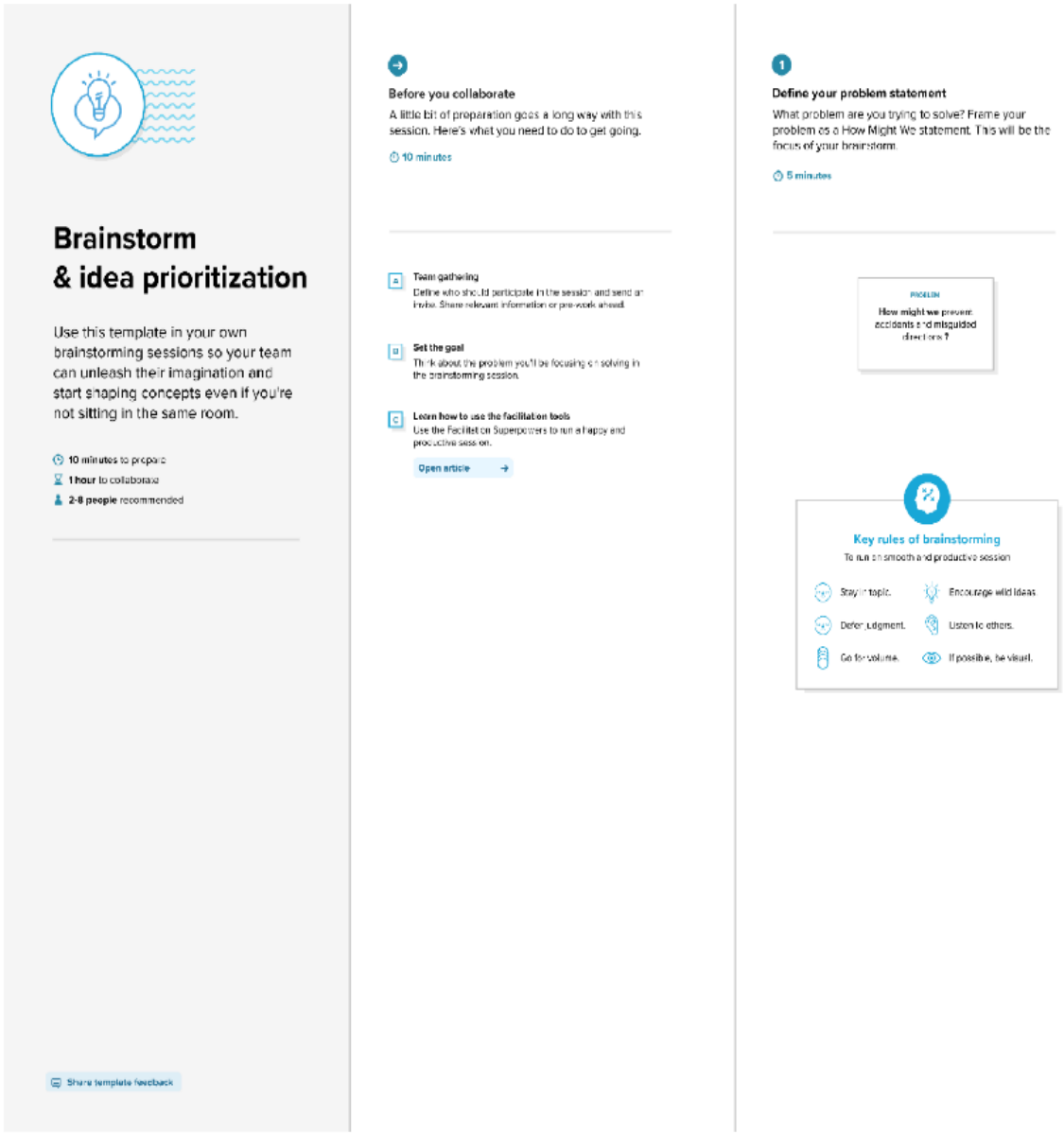
3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming

Step-1: Team Gathering, Collaboration and Select the Problem Statement



Step-2: Brainstorm, Idea Listing and Grouping

2

Brainstorm

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

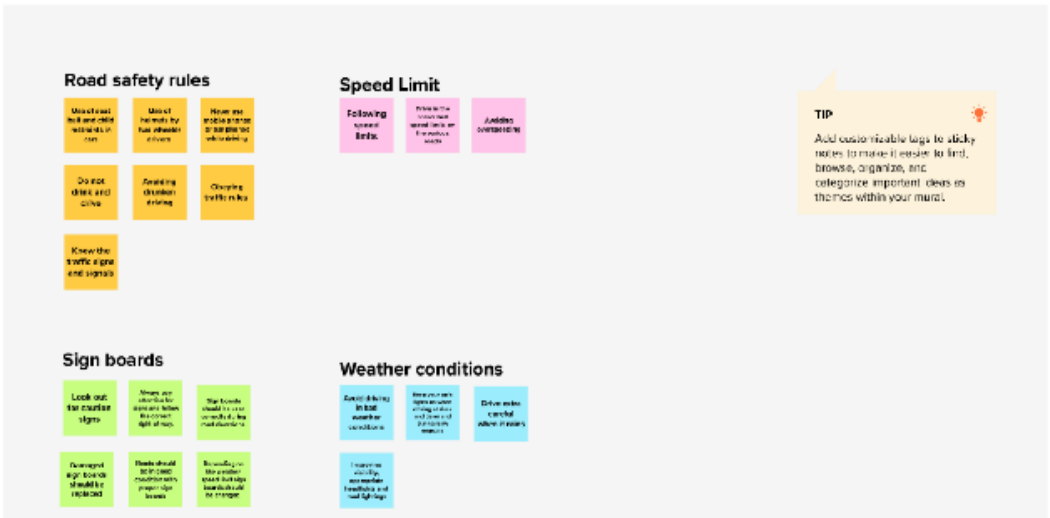
10 minutes

3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, 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



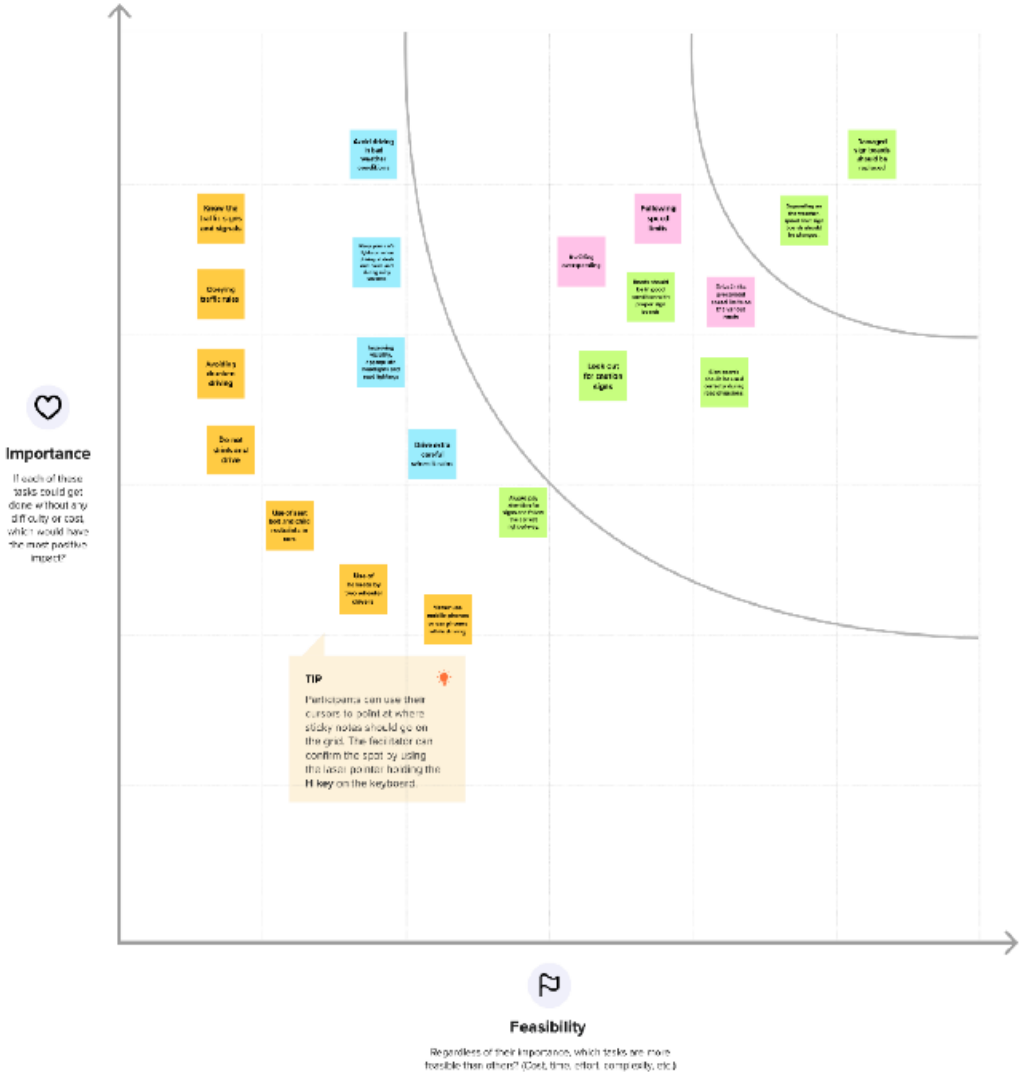
Step-3: Idea Prioritization

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.

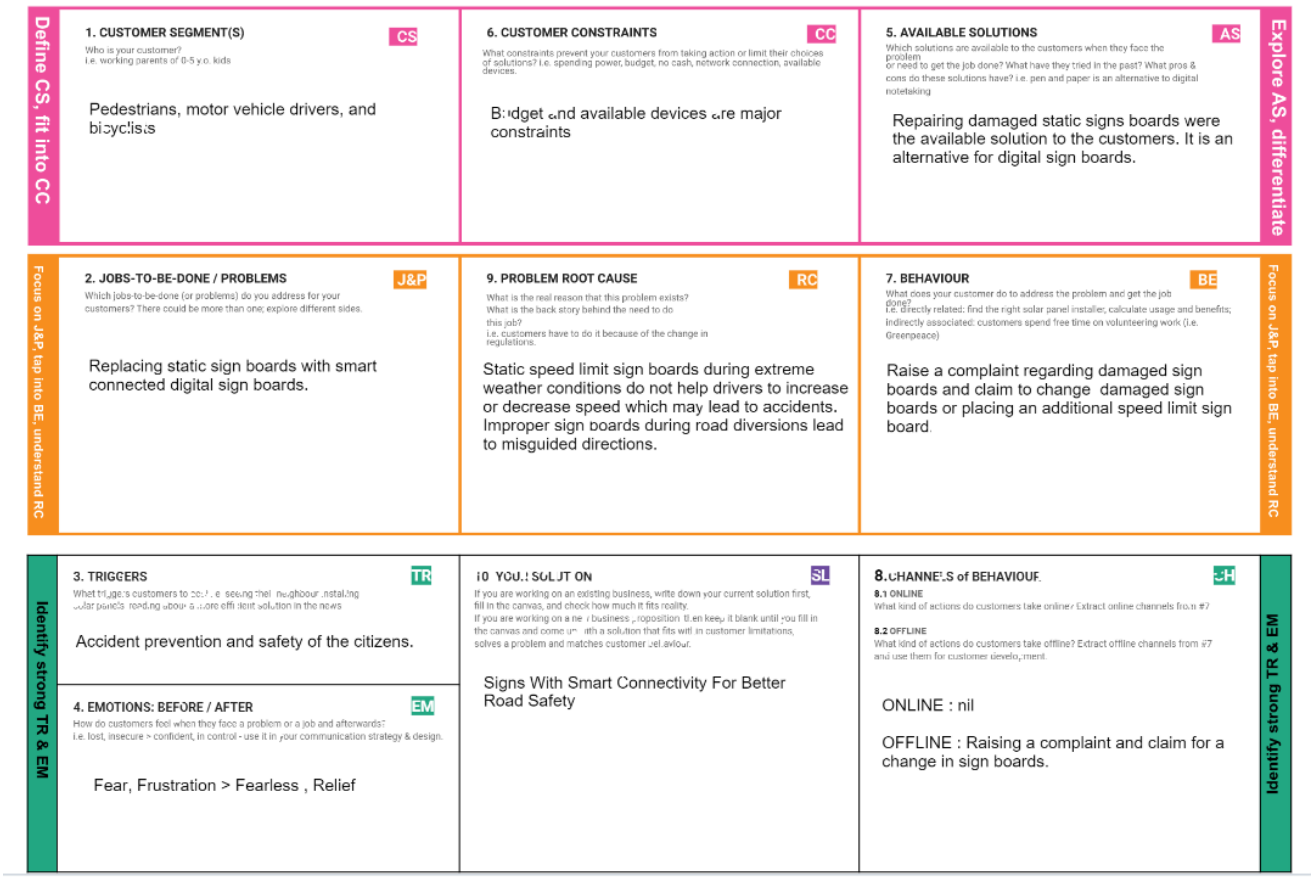
20 minutes



3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Extreme weather conditions can cause low visibility on the road, making it difficult to see and follow static sign boards and increasing the risk of accidents. Damaged or improperly placed static sign boards could result in accidents or misguided directions that would take users in the wrong direction. As a result, we define the problem as static sign boards that do not adequately serve users.
2.	Idea / Solution description	In present Systems the road signs and the speed limits are Static. But the road signs can be changed in some cases. During rainfall the roads will be slippery. and the speed limit would be decreased accordingly if they are digitalized. This project proposes a system which has digital sign boards on which the signs can be changed dynamically.
3.	Novelty / Uniqueness	Digital sign boards with constantly changing signs are cost-effective and need low maintenance.
4.	Social Impact / Customer Satisfaction	The impact could be a decrease in traffic-related injuries during extreme weather conditions and fatalities among populations.
5.	Business Model (Revenue Model)	Apart from highways and traffic sign areas, Digital speed sign boards can be used in corporate campus to calm the traffic down and in residential societies for the safety of their citizens.
6.	Scalability of the Solution	nil

3.4 Problem Solution fit



4. REQUIREMENT ANALYSIS

4.1 Functional requirement

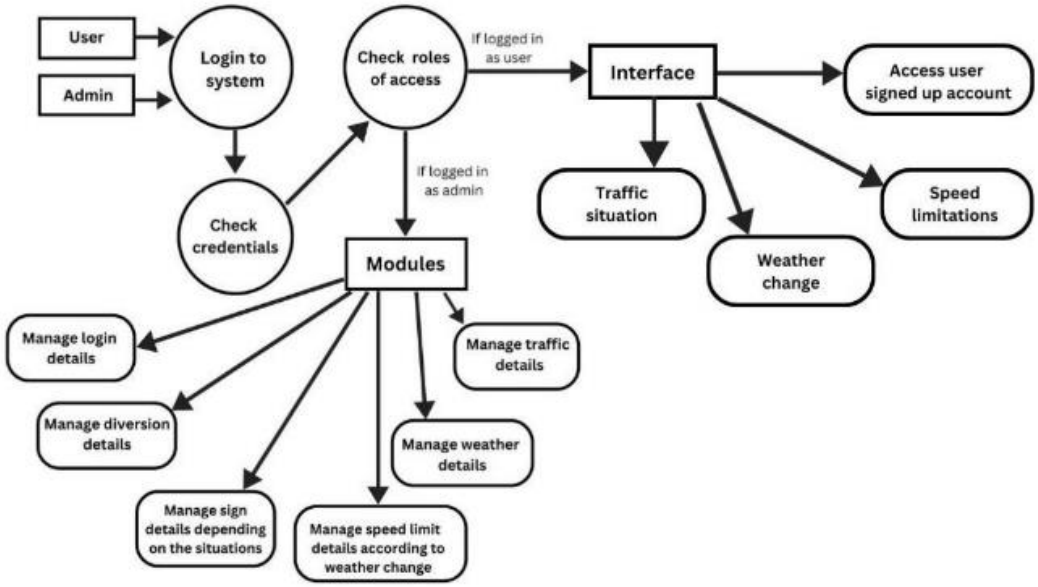
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Approval	Approval via Email Approval via SMS
FR-4	Testing	Test API and UI
FR-5	Result	Result is determined by product features

4.2 Non-Functional requirements

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Continuous sensing through sensors that simultaneously change the signs of the signboards.
NFR-2	**Security**	Robust security system must be used to prevent hackers from accessing the IoT based system.
NFR-3	**Reliability**	For people to make the best decisions while travelling on the road without confusion, the Signs displayed on the board must be clear and precise.
NFR-4	**Performance**	High performance and affordable pricing are both required. The sign board should be clearly visible and placed in correct place so that it helps in preventing accidents
NFR-5	**Availability**	Sign boards must operate 24x7, so appropriate power supplies or batteries should be provided.
NFR-6	**Scalability**	To be used to control and prevent accidents in highly populated areas.

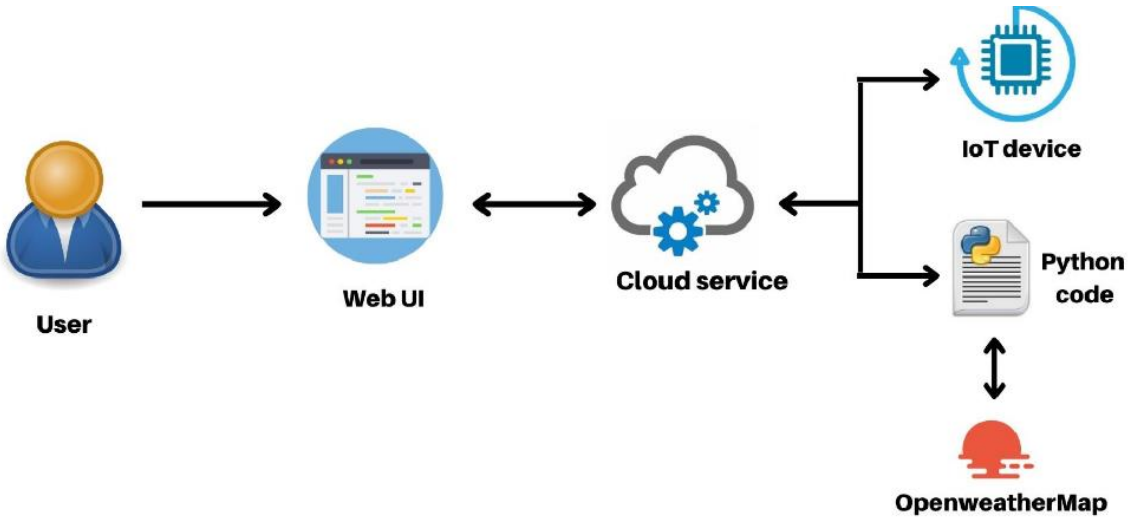
5. PROJECT DESIGN

5.1 Data Flow Diagrams

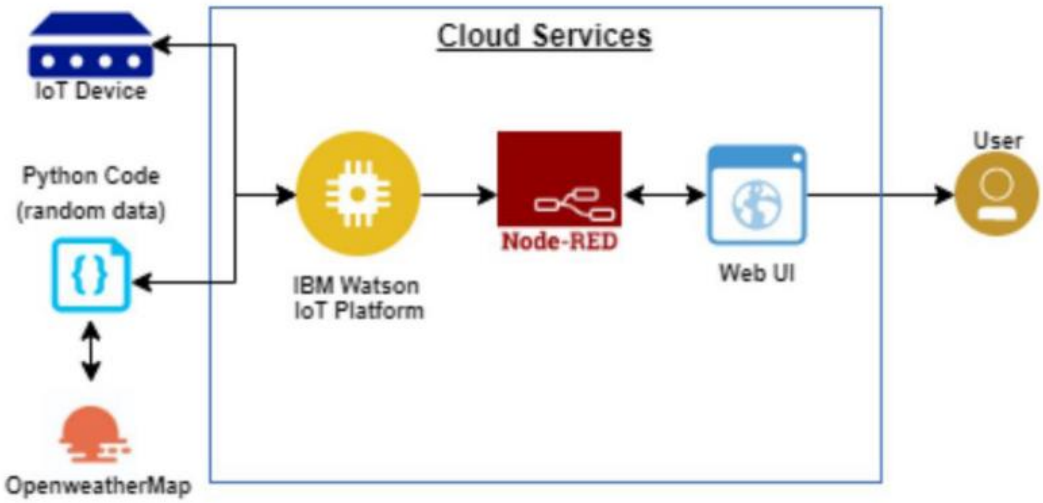


5.2 Solution & Technical Architecture

SOLUTION ARCHITECTURE:



TECHNICAL ARCHITECTURE:



5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Web user)	Registration	USN-1	As a user, I can view speed limitations using smart weather application.	I can receive speed limitations	High	Sprint-1
		USN-2	As a user, I can sign up for the application by providing my email address, password, and password confirmation.	I can access my account	Medium	Sprint-1
		USN-3	As a user, I can change my speed in response to weather changes.	I can change my speed	High	Sprint-1
		USN-4	As a user, I can see traffic diversion signs depending on the traffic and the fatal situations.	I can check traffic situation before I go.	Medium	Sprint-1
	Login	USN-5	As a user, I can log in to the open weather map with my email address and password.	I can access the web application through my Gmail login.	Medium	Sprint-1
	Interface	USN-6	As a user, the interface must be straightforward and simple to use.	I can access the interface easily.	High	Sprint-1
Customer Care Executive	Data generation	USN-7	As a user, I utilize the open weather app to access information about weather changes.	I can utilize the application to have access to weather data.	High	Sprint-1
Administrator (Officials)	Problem solving	USN-8	As an official, I am responsible to maintain the sign boards are operating properly by routine inspection.	I am responsible to monitor the sign boards to work properly.	Medium	Sprint-1

6. PROJECT PLANNING & SCHEDULING

a. Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story/Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	Preethi, Janani, Malathy, Nithya Kalyani
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application.	1	Low	Preethi, Janani, Malathy, Nithya Kalyani
Sprint-1		USN-3	As a user, I can register for the application through Gmail.	2	Medium	Preethi, Janani, Malathy, Nithya Kalyani
Sprint-1	Login	USN-4	As a user, I can log into the application by entering email & password.	2	High	Preethi, Janani, Malathy, Nithya Kalyani
Sprint-1		USN-5	As a user, I can log in to the open weather map with my email address and password.	1	Medium	Preethi, Janani, Malathy, Nithya Kalyani
Sprint-2	Interface	USN-6	As a user, I can access the interface easily.	1	Medium	Preethi, Janani, Malathy, Nithya Kalyani
Sprint-2		USN-7	As a user, I can view speed limitations using smart weather application.	2	High	Preethi, Janani, Malathy, Nithya Kalyani
Sprint-2		USN-8	As a user, I can change my speed in response to weather changes.	2	High	Preethi, Janani, Malathy, Nithya Kalyani
Sprint-2		USN-9	As a user, I can see traffic diversion signs depending on the traffic and the fatal situations.	2	High	Preethi, Janani, Malathy, Nithya Kalyani
Sprint-3	Data generation	USN-10	As a user, I utilize the open weather app to access information about weather changes.	2	Medium	Preethi, Janani, Malathy, Nithya Kalyani
Sprint-4	Problem solving	USN-11	As an official ,I am responsible to maintain the sign boards are operating properly by routine inspection.	1	Medium	Preethi, Janani, Malathy, Nithya Kalyani

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

c.) Reports from JIRA

Burndown Chart:

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

8. TESTING

8.1 Test Cases

● TEST CASE 1 Temperature': 303.03, 'Humidity': 51, 'Pressure': 1010, 'Message': 'SLOW DOWN, SCHOOL IS NEAR', 'Sign': '', 'Speed': '', 'Visibility': 'Clear Weather

● TEST CASE 2 Temperature': 303.03, 'Humidity': 51, 'Pressure': 1010, 'Message': '', 'Sign': 'Left Diversion <-', 'Speed': 'SLOW DOWN, Speed Limit Exceeded', 'Visibility': 'Clear Weather

● TEST CASE 3 Temperature': 303.03, 'Humidity': 51, 'Pressure': 1010, 'Message': 'SLOW DOWN, HOSPITAL NEARBY', 'Sign': 'Left Diversion <-', 'Speed': '', 'Visibility': 'Clear Weather

● TEST CASE 4 Temperature': 303.03, 'Humidity': 51, 'Pressure': 1010, 'Message': 'NEED HELP, POLICE STATION NEARBY', 'Sign': 'U Turn', 'Speed': 'Moderate Speed', 'Visibility': 'Clear Weather'.

8.2 User Acceptance Testing

Dynamic speed & diversion variations based on the weather and traffic helps user avoid traffic and have a safe journey home. The users would welcome this idea to be implemented everywhere.

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	3	4	7	2	16
Duplicate	0	3	0	1	4
External	2	1	0	3	6
Fixed	10	18	3	2	33
Not Reproduced	1	0	0	0	1
Skipped	0	1	0	1	2
Won't Fix	5	0	2	1	8

9. RESULTS

9.1 Performance Metrics

The performance of the website varies based on the software chosen for implementation. Built upon NodeJS, a light, and high-performance engine, NodeRED is capable of handling up to 10,000requests 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 microcontrollers 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 microcontroller

  - Dependent on OpenWeatherAPI and hence the speed reduction is the 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 traffics and maintain a peaceful environment.

12. FUTURE SCOPE

The introduction of intelligent road sign groups in real-life scenarios could have a great impact on increasing driving safety by providing the end-user 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

Source Code:

main.py

```
#IBM Watson IOT Platform

#pip install wiotp-sdk

import wiotp.sdk.device

import time

import random

myConfig = {

  "identity": {

    "orgId": "2r52ij",

    "typeId": "Roadsafety",

    "deviceId":"1234"

  },
```

```
    "auth": {
        "token": "12345678"
    }
}

def myCommandCallback(cmd):
    print("Message received from IBM IoT Platform: %s" % cmd.data['command'])
    m=cmd.data['command']

client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
client.connect()

while True:
    temp=random.randint(-20,125)
    hum=random.randint(0,100)
    myData={'temperature':temp, 'humidity':hum}
    client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0, onPublish=None)
    print("Published data Successfully: %s", myData)
    client.commandCallback = myCommandCallback
    time.sleep(2)
client.disconnect()
```

weather.py

```
import requests as reqs
def get(myLocation,APIKEY):
    apiURL = f"https://api.openweathermap.org/data/2.5/weather?q={myLocation}&appid={APIKEY}"
```

```
    responseJSON = (reqs.get(apiURL)).json()
    returnObject = {
        "temperature" : responseJSON['main']['temp'] - 273.15,
        "weather" : [responseJSON['weather'][_]['main'].lower() for _ in range(len(responseJSON['weather']))],
        "visibility" : responseJSON['visibility']/100, # visibility in percentage where 10km is 100% and 0km is 0%
    }
    if("rain" in responseJSON):
        returnObject["rain"] = [responseJSON["rain"][key] for key in responseJSON["rain"]]
    return(returnObject)
```

GitHub & Project Demo Link

GitHub link - [IBM-EPBL/IBM-Project-20130-1659712952: Signs with Smart Connectivity for Better Road Safety (github.com)]

Project Demo link - https://youtu.be/rbYiarhzzh0