PROJECT DOCUMENTATION

Date	17 November 2022
Team ID	PNT2022TMID22104
Project Name	Signs with Smart Connectivity for Better Road Safety
Mentor	Mr.M.Sherrif
Team Leader	C. Rujesh Kumar
Team Members	Pokala Rohith Praveen.G Yokesh.G

1. INTRODUCTION

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

1.1. Project Overview

The project aims to replace the static signboards with smart connected sign boards which can be changed frequently according to the purposes like weather, traffic condition, particular zones, etc.., These smart connected sign boards get the speed limitations for a particular city from a web app using weather API and update automatically.

Based on the weather changes the speed may increase or decrease. So, the signboards will display “slow down”, if the weather is bad. Based on the traffic and fatal situations the diversion signs are displayed. The driver can change the location pins in the map to their current location and destination location. The app shows the route and navigation instructions like “turn left on abc road”, “take U turn”. Using the location sensor, it can sense the speed of the vehicle.

Sign boards near school zone, hospital zone, construction zone, uneven and narrow roads, animal zone should display appropriate signs according to the zone. Different modes of operations can be selected with the help of buttons.

1.2. Purpose

- 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 also displayed accordingly

2. LITERATURE SURVEY

2.1. Existing Problem

Due to the old Sign Boards and signals there will be delay in the traffic by stopping the vehicles at the intersection during peak hours. During signal breakdowns , there are serious and widespread traffic difficulties during peak hours .The weather conditions are Not shown in the boards , so we are digitilaizing the Normal boards in to digital board for the road safety.

2.2. References

Development and Testing of Road Signs Alert System Using a Smart Mobile Phone

Eric M. Masatu , Ramadhani Sinde , and Anael Sam School of Computational and Communication Sciences and Engineering, Nelson Mandela African Institution of Science and Technology, Arusha, Tanzania.

A review of the literature on road safety revealed several approaches that are being used to avoid accidents. According to the review, the related approaches are divided into three themes: road sign colour and shape recognition, vehicle-to-roadside infrastructure communication, and vehicle-to-vehicle communication.

Road Signs Colour and Shape Recognition

Several studies on road safety have been conducted using a device onboard a vehicle to detect and recognize signs. developed a traffic sign recognition system that uses a vision camera mounted on a vehicle. Based on the colours and shapes of the road signs, the system detected and recognized them and found a recognition of road signs with an average accuracy of about 95.53% and 92.8%, respectively .However, recognizing road signs based on colours and images presents numerous challenges. Include lighting conditions that vary naturally with the time of day and weather conditions; images that have been buffed by a moving vehicle’s vibration; fading of paint on the sign; and occlusion of the sign by obstacles such as a tree, street lamp, or buildings. Another study by Ling and Seng used a mobile phone, the study used a smartphone back camera to recognize traffic signs and alert drivers for an incoming sign. Phone was placed on a windscreen for the camera to face the road. distinct advantage of the system was that it did not require additional hardware. However, the main problem experienced was the low detection rate, light variation, and weather conditions.

Vehicle-to-Roadside Infrastructure Communication

Other approaches have used mobile devices on a vehicle and communication infrastructure on the road. developed a road sign notification system based on the global positioning system (GPS) and wireless radio frequency identification (RFID) technology . A database of road signs and their locations was created. RFID transmitters were placed at the locations of road signs, and a receiver was placed in the vehicle. Using the system, drivers were alerted about the next road signs at some predetermined specific distance before the road signs were encountered. However, the use of RFID transmitters in two-way traffic could be limited, in the sense that their signals might be detected by vehicles traveling in the opposite direction.

This situation can be misleading the drivers. Also, the devices are expensive and require a constant power supply and regular maintenance. Few studies have used wireless local area network (WLAN) mobile device technology to provide information about road signs. However, when the transmitters were close to each other, the separation of relevant traffic sign information from the vehicle was problematic. Developed a communication system consisting of two devices; a road side unit (RSU) deployed on the road sign and an on-board unit (OBU) deployed in a vehicle. Information about the road signs ahead was wirelessly communicated to drivers using two units.

However, information transfer between modules was hindered by the speed of the vehicles in terms of delay and packet loss. Furthermore, the attenuation of wireless signals decreases as the transmitter-receiver increases distance. Proposed the use of Wi-Fi connectivity for wireless digital traffic signs. It has capable of transmitting the traffic sign information wirelessly in the vehicle displays. Drivers were informed at an average distance between 70 and 98 meters. However, the device required a constant power supply. In addition, when a driver travelled at a speed greater than 60 km/h, the average distance was not enough to provide timely alerts, were prioritization and queuing due to the number of data processed from many nodes.

Vehicle-to-Vehicle Communication (V2V)

V2V communication is used to interchange reliable information between automobiles on a network. In this approach, the broadcast information can include a warning while traveling on a similar road. V2V wireless technology works as an automated system to control and properly inform drivers by exchanging accurate information. However, the most challenging issues with this approach were the connectivity between V2V and vehicle infrastructure (V2I), mobility that allows vehicle area network (VAN) to change its topology quickly, and violation of driver privacy and security. Another challenge is the variation in the broadcast information offered by different types of vehicle manufacturers.

2.3. Problem Statement Definition

A driver who wants to drive safely on road but there are many obstacles because of heavy traffic, weather condition, etc..,

• A driver who wants to avoid the heavy traffic roads but they are unpredictable because they change from time to time.

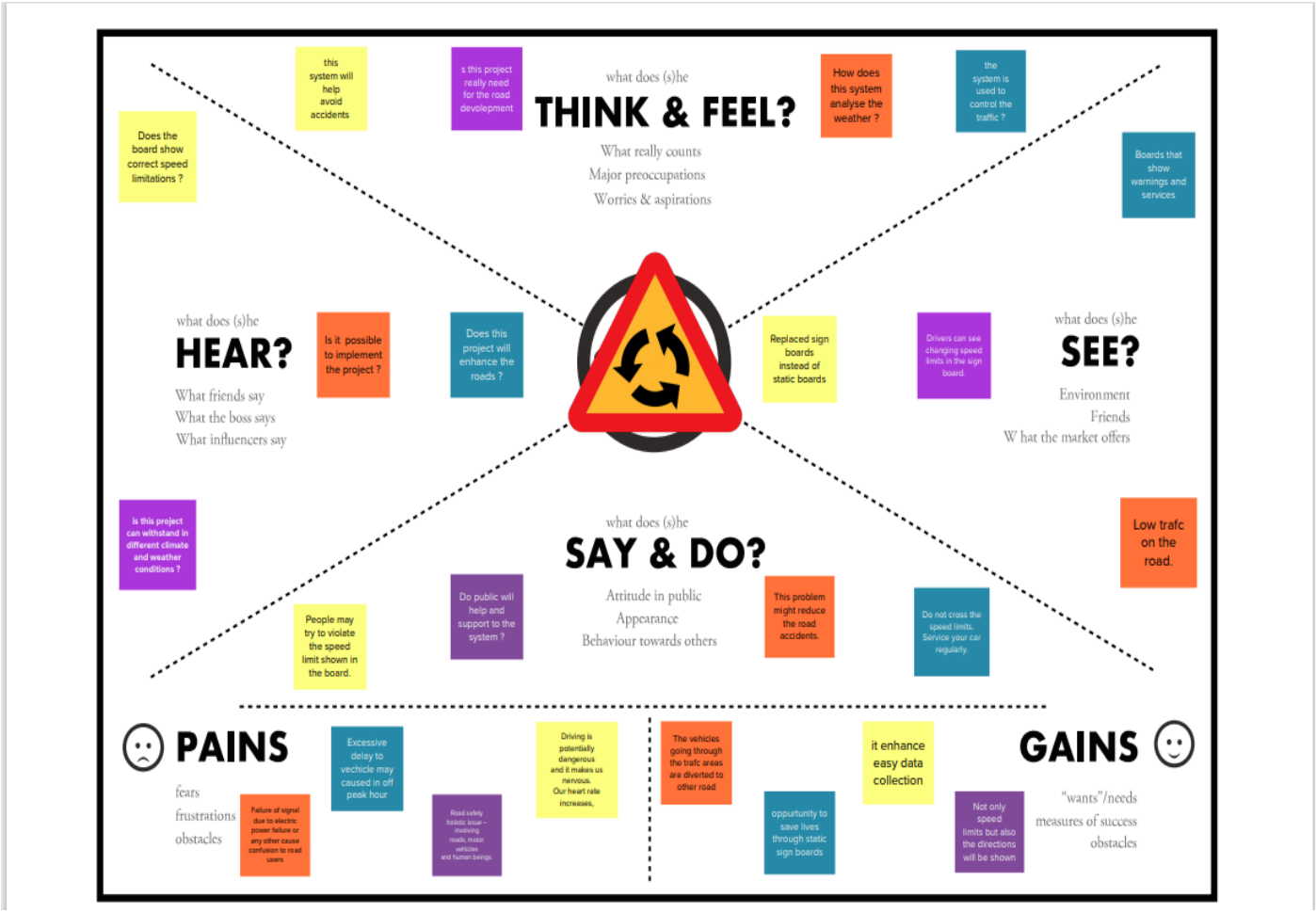
• A passenger who wants to travel safely but there are many road accidents because of some drivers who drive very fast and carelessly.

• A driver who wants to reach the destination but unable to choose the route and turn in wrong direction because there are no navigation instructions.

3. IDEATION AND PROPOSED SOLUTION

3.1.Empathy Map Canvas

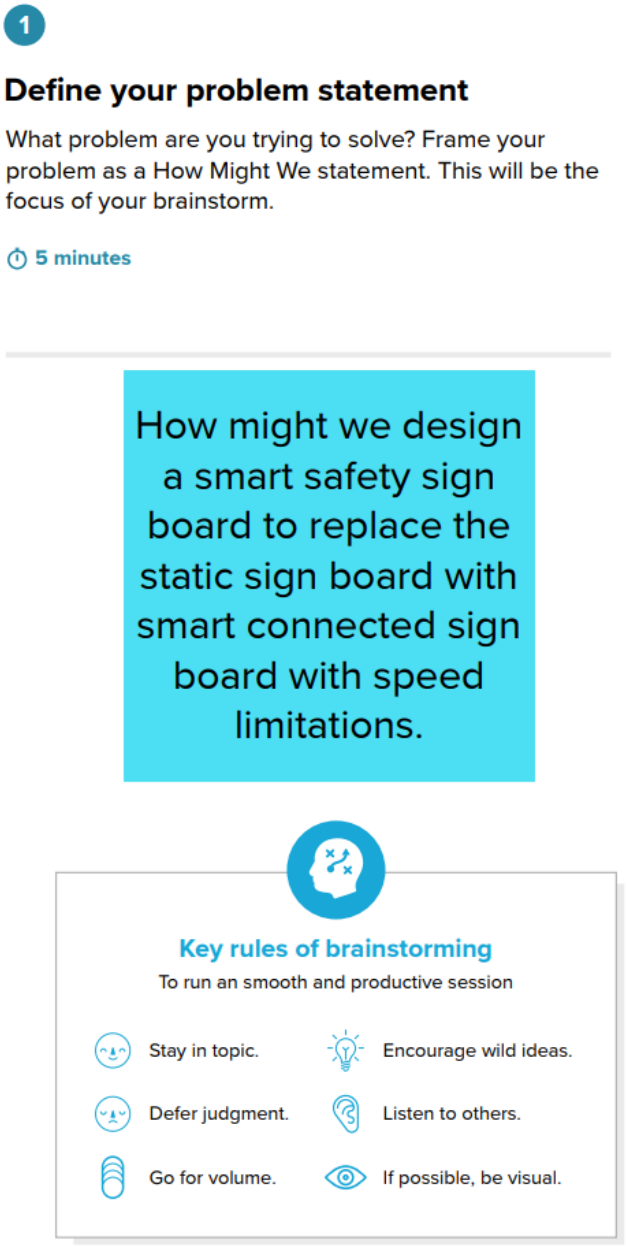
An Empathy Map is a collabrative tool teams can use to gain a deeper insight into their customers . Much like a user personal ,an Empathy map can represent a group of users , such as a customer segment .



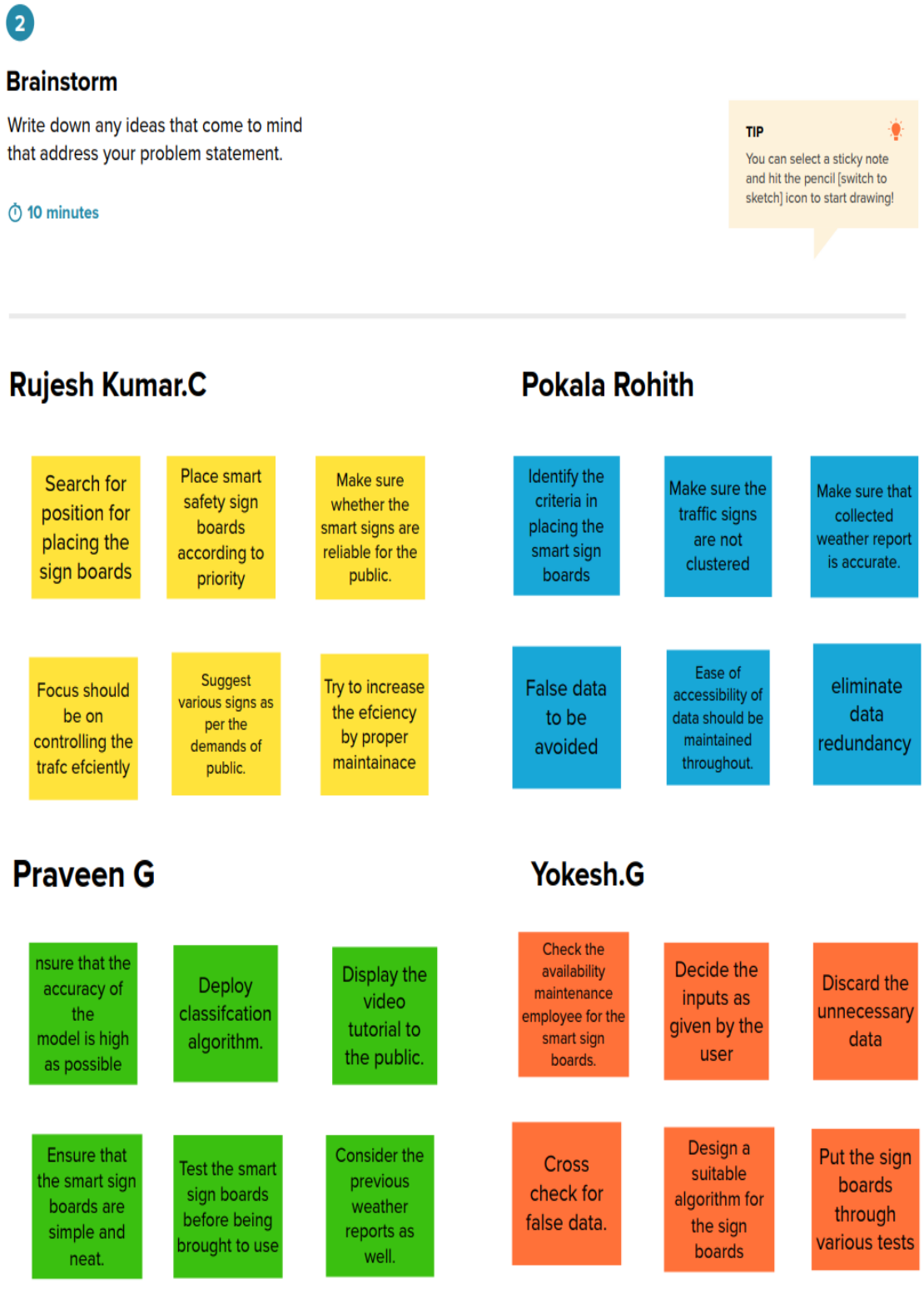
3.2. Ideation and Brainstroming

Brainstorming combines a relaxed, informal approach to problem solving with lateral thinking. It encourages people to come up with thoughts and ideas that can, at first, seem a bit crazy. Some of these ideas can be crafted into original, creative solutions to a problem, while others can spark even more ideas. These are the steps for Brainstroming .

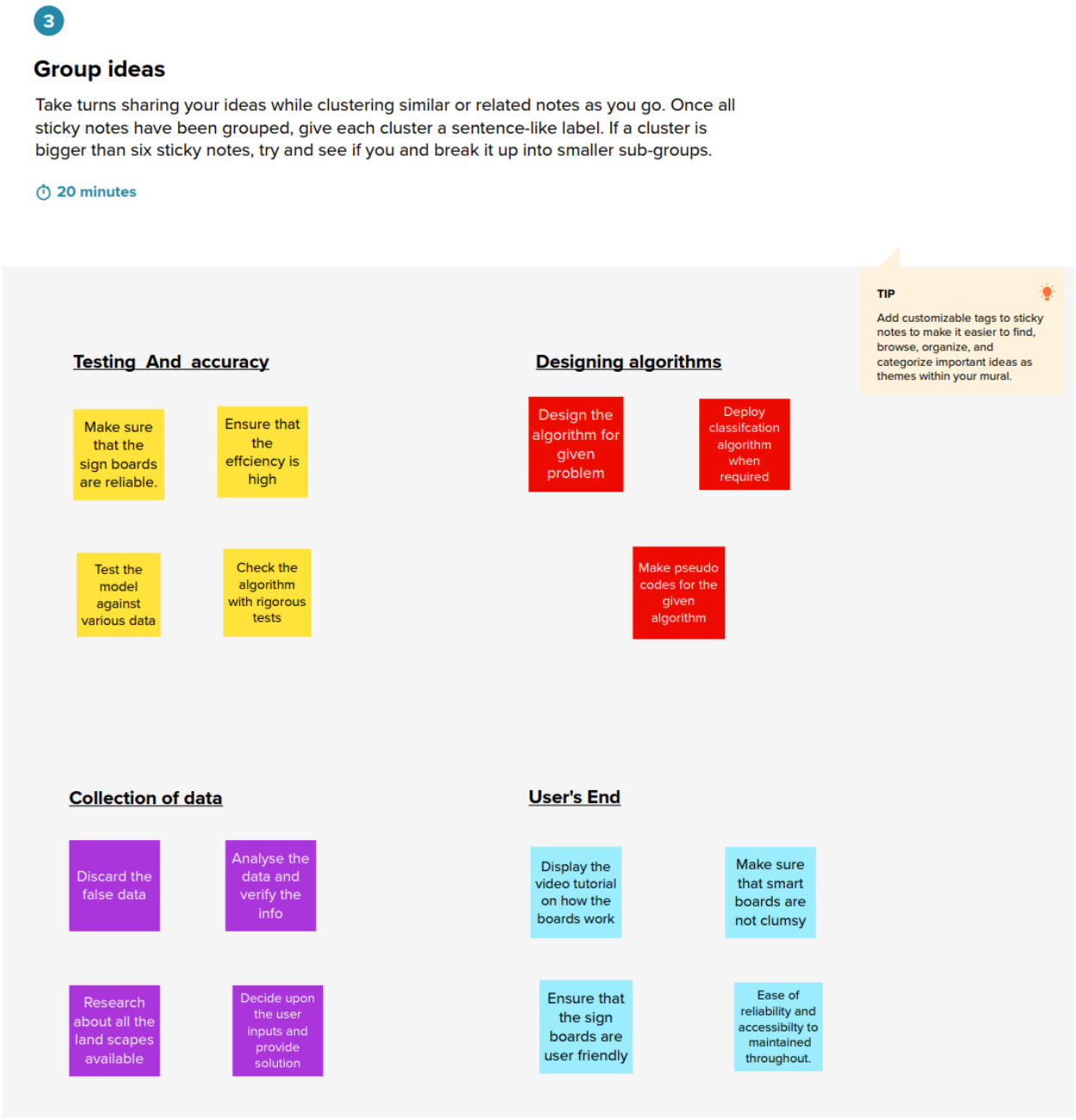
Step 1- This process involves in Team Gathering, Collaboration and Selecting the Problem Statement.



Step 2- This Process involves in Brainstorm, Idea Listing.



Step 3- This process involves in Group ideas



Step 4- This Process involves in 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

Importance

If each of these tasks could get done without any difficulty or cost, which would have the most positive impact?

TIP

Participants can use their cursors to point at where sticky notes should go on the grid. The facilitator can confirm the spot by using the laser pointer holding the **H key** on the keyboard.

Feasibility

Regardless of their importance, which tasks are more feasible than others? (Cost, time, effort, complexity, etc.)

3.3. Proposed Solution

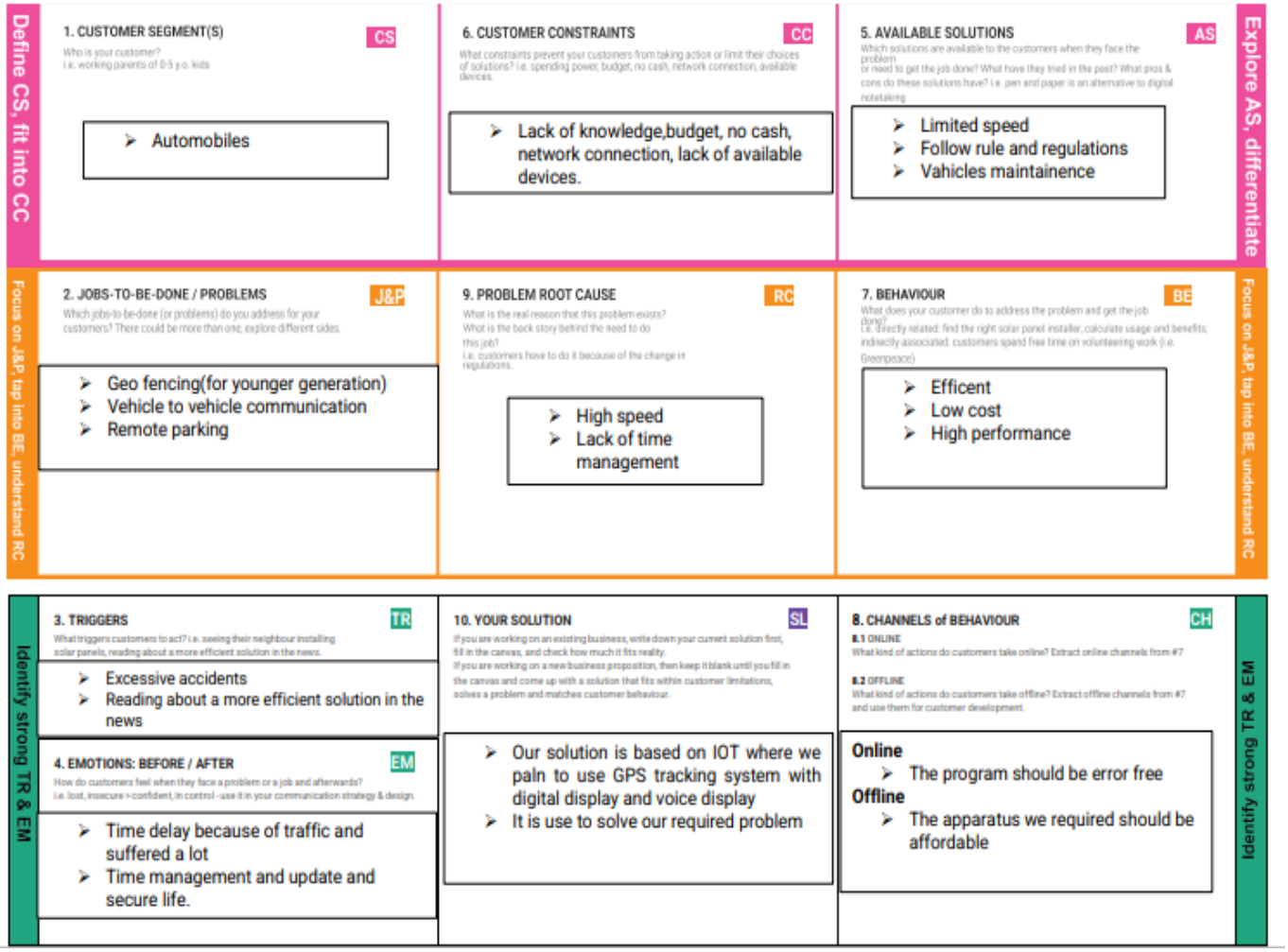
Relating the current situation to a desired result and describe the benefits that will accrue when the desired result is achieved.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	➢ The ultimate aim of the Project is to prepare a smart signs using IOT technology for better road safety.
2.	Idea / Solution description	➢ Smart signs combine the easiness of use of traditional static signs with the flexibility and reactiveness of navigation systems. ➢ The Smart Signs system uses context information such as user's mobility limitations, the weather, and possible emergency situations to improve guidance and messaging.
3.	Novelty / Uniqueness	➢ LED plays a major concern in our project it acts as an indication tool. ➢ The smart signs consist of LEDs, with various combinations the signals are being displayed. ➢ This information of wind humidity distance for the next location are being collected using various sensors. ➢ It also gives information about nearby Places such as hospitals, school ,Bus station etc. So that the users can decide their speeding according to that information.
4.	Social Impact / Customer Satisfaction	➢ Due to implementation of smart signs at correct point of time we can save many lives. ➢ By displaying road rules and regulation and also speed limit for the user, there is significant chance in reducing the accidents.
5.	Business Model (Revenue Model)	➢ By executing these for people in well organized manner by the government, This will have great initiative and also creating an awareness among the people. ➢ Separate subject for transforming roads with smart sign must be implemented in the parliament with great impact on the society for road safety in our country.
6.	Scalability of the Solution	➢ Thus, they can recognize obstacles and other road users out of plain sight, which prevents accidents and allows more efficient traffic flows, The smart intersection warns cars about the presence of pedestrians. This improves the safety of pedestrians and other vulnerable road users.

3.4. Problem Solution Fit

The Problem-Solution Fit simply means that you have found a problem with your customer and that the solution you have realized for it actually solves the customer's problem.

Project Title: Signs with Smart Connectivity for Better Road Safety **Project Design Phase-I - Solution Fit Template** **Team ID: PNT2022TMID22104**



4. REQUIREMENT ANALYSIS

4.1. Functional Requirements

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirements (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 E-mail or An website.
FR-3	**User Confirmation**	Confirmation Through E-mail (or) Confirmation Through OTP
FR-4	**User Approval**	Done by mails (or) by messages via SMS.
FR-5	**Payments options**	Can be done by Bank Transfer or by UPI.
FR-6	**Product Delivery and installation**	The installation fee will be determined by the length of the road.
FR-7	**Product Feedback**	Through a website via E-mail.
FR-8	**End Result**	Product features decides the end result

4.2. Non-functional Requirements:

Following are 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 according to change and need in requirement.

5. PROJECT DESIGN

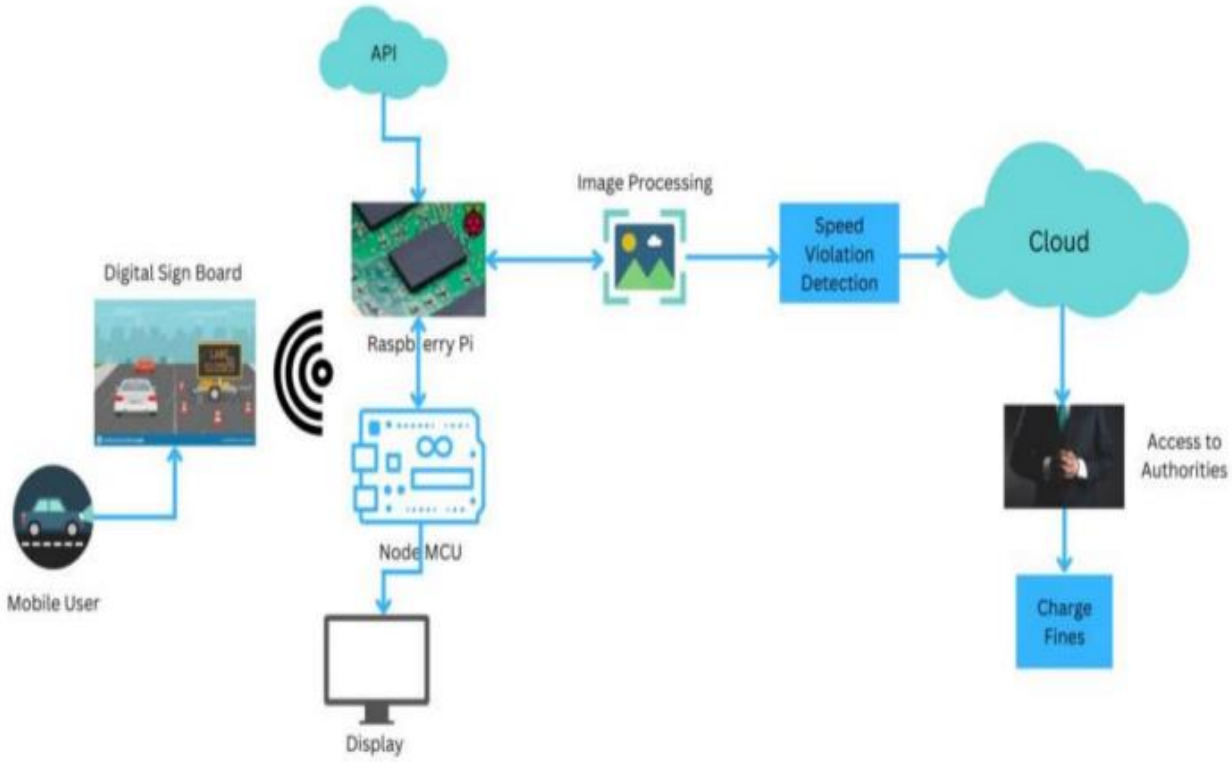
5.1. Data Flow Diagrams

A data flow diagram shows the way information flows through a process or system. It includes data inputs and outputs, data stores, and the various subprocesses the data moves through.

5.2. Solution & Technical Architecture

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- ✓ Find the best tech solution to solve existing business problems.
- ✓ Describe the structure, characteristics, behavior , and other aspects of the software to project stakeholders.
- ✓ Define features, development phases, and solution requirements.
- ✓ Provide specifications according to which the solution is defined, managed, and delivered.



Architecture And Data Flow Of Digital Sign Board

Reference: https://www.visionect.com/technology-and-research/traffic-signs

5.3. User Stories

A user story is an informal, general explanation of a software feature written from the perspective of the end user or customer. The purpose of a user story is to articulate how a piece of work will deliver a particular value back to the customer.

Req No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	**User Visibility**	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.
FR-2	**User Need**	The smart sign boards should be placed frequently in places it is needed and less in places where it is not needed much to avoid confusion for the user during travel
FR-3	**User Understanding**	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.
FR-4	**User Convenience**	The display should be big enough that it should even be visible from far distance clearly.

6.1. SPRINT PLANNING & SCHEDULING

6.1. Sprint Planning & Estimation

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	40	6 Days	24 Oct 2022	29 Oct 2022	40	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

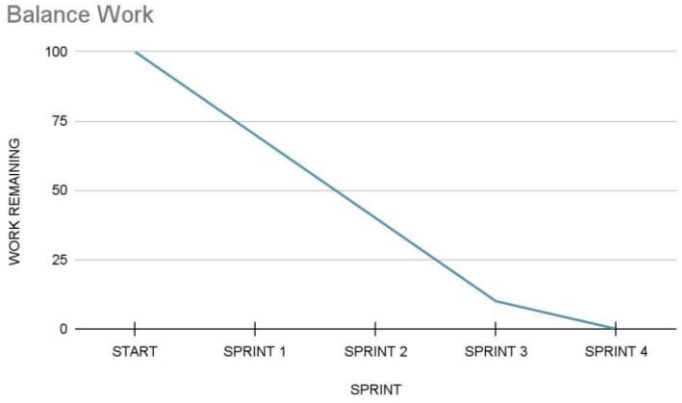
Velocity :

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day).

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

Burndown Chart

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.



6.2. Sprint Delivery Schedule

Sprint	Functional Requirement (Epic)	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Resources Initialization	Create and initialize accounts in various public APIs like Open Weather API.	20	Low	C.Rujesh Kumar Pokala Rohith Praveen.G Yokesh.G
	Local Server/Software Run	Write a Python program that outputs results given the inputs like weather and location	20	Medium	C.Rujesh Kumar Pokala Rohith Praveen.G Yokesh.G
Sprint-2	Push the server/software to cloud	Push the code from Sprint 1 to cloud so it can be accessed from anywhere	20	Medium	C.Rujesh Kumar Pokala Rohith Praveen.G Yokesh.G
Sprint-3	Hardware initialization	Integrate the hardware to be able to access the cloud functions and provide inputs to the same.	20	High	C.Rujesh Kumar Pokala Rohith Praveen.G Yokesh.G
Sprint-4	MIT Software and Testing the Outputs	Optimize all the shortcomings and provide better user experience.	20	High	C.Rujesh Kumar Pokala Rohith Praveen.G Yokesh.G

7. CODING & SOLUTIONING

(Explain the features added in the project along with code)

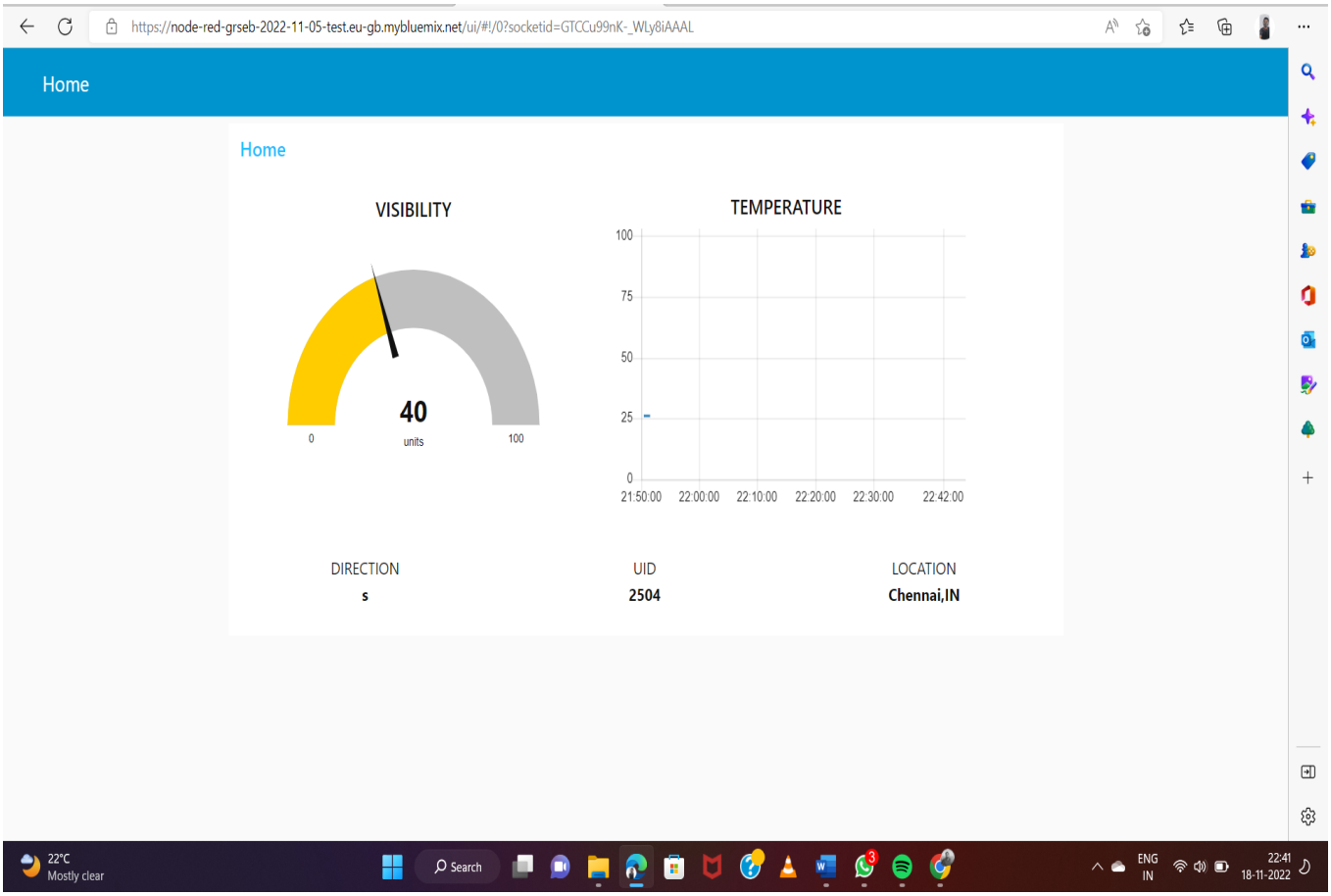
7.1. Feature 1

WEATHER UPDATE AND CORRESPONDING COMMAND

Getting temperature and humidity from OpenWeatherMap for a particular city and displaying warning regarding the speed when humidity is below 100

This code pushes data to the cloud and logs data. IBM Cloud is configured such that the data is displayed in the following website: CLICK TO OPEN NODE RED DASHBOARD

https://node-red-grseb-2022-11-05-test.eu-gb.mybluemix.net/ui/#!/0?socketid=GTCCu99nK-_WLy8iAAAL



Program

```
# IMPORT SECTION STARTS

import wiotp.sdk.device # python -m pip install wiotp
import time

# IMPORT SECTION ENDS
# ---------------------------------------------
# API CONFIG SECTION STARTS

myConfig = {
    "identity" : {
        "orgId" : "epmoec",
        "typeId" : "testDevice",
        "deviceId" : "device0"
    },
    "auth" : {
        "token" : "?-KDXUPMvDo_TK2&b1"
    }
}

# API CONFIG SECTION ENDS
# ---------------------------------------------
# FUNCTIONS SECTION STARTS

def myCommandCallback(cmd):
    print("recieved cmd : ",cmd)


def logData2Cloud(location,temperature,visibility):
    client = wiotp.sdk.device.DeviceClient(config=myConfig,logHandlers=None)
    client.connect()
    client.publishEvent(eventId="status",msgFormat="json",data={
        "temperature" : temperature,
        "visibility" : visibility,
        "location" : location
    },qos=0,onPublish=None)
    client.commandCallback = myCommandCallback
    client.disconnect()
    time.sleep(1)

# FUNCTIONS SECTION ENDS
```

7.2. Feature 2

Getting the Coordinates from the open weather website and Displaying in the digital Board and displaying the warning signs in the MIT app inventor , That a driver or an user should follow or use it.

Program

```
#IBM WatsonIoT Platform
import wiotp.sdk.device
import time
import random
myConfig = {
"identity": { "orgId":
"hj5fmy",
"typeId": "NodeMCU",
"deviceId":"12345"
},
"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()
```

publishibm.py - C:/Users/LENOVO/AppData/Local/Programs/Python/Python37/publishibm.py (3.7.9)

File Edit Format Run Options Window Help

```
#IBM WatsonIoT Platform
import wiotp.sdk.device
import time
import random
myConfig = {
"identity": { "orgId":
"en9jhc",
"typeId": "roh",
"deviceId":"12345678"
},
"auth": {
"token": "GyAIdlJ?u!b-g(KQnx"
}
}
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()
```

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Python 3.7.9 Shell

File Edit Shell Debug Options Window Help

```
Python 3.7.9 (tags/v3.7.9:13c94747c7, Aug 17 2020, 18:58:18) [MSC v.1900 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
= RESTART: C:/Users/LENOVO/AppData/Local/Programs/Python/Python37/publishibm.py
2022-11-16 06:30:12,580   wiotp.sdk.device.client.DeviceClient  INFO    Connected successfully: d:en9jhc:roh:12345678
Published data Successfully: %s {'temperature': 94, 'humidity': 90}
Published data Successfully: %s {'temperature': -11, 'humidity': 34}
Published data Successfully: %s {'temperature': 109, 'humidity': 39}
Published data Successfully: %s {'temperature': 109, 'humidity': 29}
Published data Successfully: %s {'temperature': 122, 'humidity': 30}
Published data Successfully: %s {'temperature': 92, 'humidity': 2}
Published data Successfully: %s {'temperature': 81, 'humidity': 58}
Published data Successfully: %s {'temperature': 53, 'humidity': 80}
Published data Successfully: %s {'temperature': -8, 'humidity': 77}
Published data Successfully: %s {'temperature': 85, 'humidity': 78}
Published data Successfully: %s {'temperature': 123, 'humidity': 31}
Published data Successfully: %s {'temperature': 77, 'humidity': 19}
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Published data Successfully: %s {'temperature': 113, 'humidity': 32}
Published data Successfully: %s {'temperature': 43, 'humidity': 72}
Published data Successfully: %s {'temperature': 67, 'humidity': 76}
Published data Successfully: %s {'temperature': 71, 'humidity': 63}
Published data Successfully: %s {'temperature': 61, 'humidity': 61}
Published data Successfully: %s {'temperature': 3, 'humidity': 52}
Published data Successfully: %s {'temperature': 49, 'humidity': 66}
Published data Successfully: %s {'temperature': -10, 'humidity': 69}
Published data Successfully: %s {'temperature': 95, 'humidity': 15}
Published data Successfully: %s {'temperature': -19, 'humidity': 59}
Published data Successfully: %s {'temperature': 108, 'humidity': 47}
Published data Successfully: %s {'temperature': 121, 'humidity': 74}
Published data Successfully: %s {'temperature': -2, 'humidity': 81}
Published data Successfully: %s {'temperature': 97, 'humidity': 18}
Published data Successfully: %s {'temperature': 28, 'humidity': 0}
Published data Successfully: %s {'temperature': 11, 'humidity': 12}
Published data Successfully: %s {'temperature': 19, 'humidity': 15}
Published data Successfully: %s {'temperature': 2, 'humidity': 14}
Published data Successfully: %s {'temperature': 99, 'humidity': 89}
Published data Successfully: %s {'temperature': 97, 'humidity': 66}
Published data Successfully: %s {'temperature': 115, 'humidity': 51}
```

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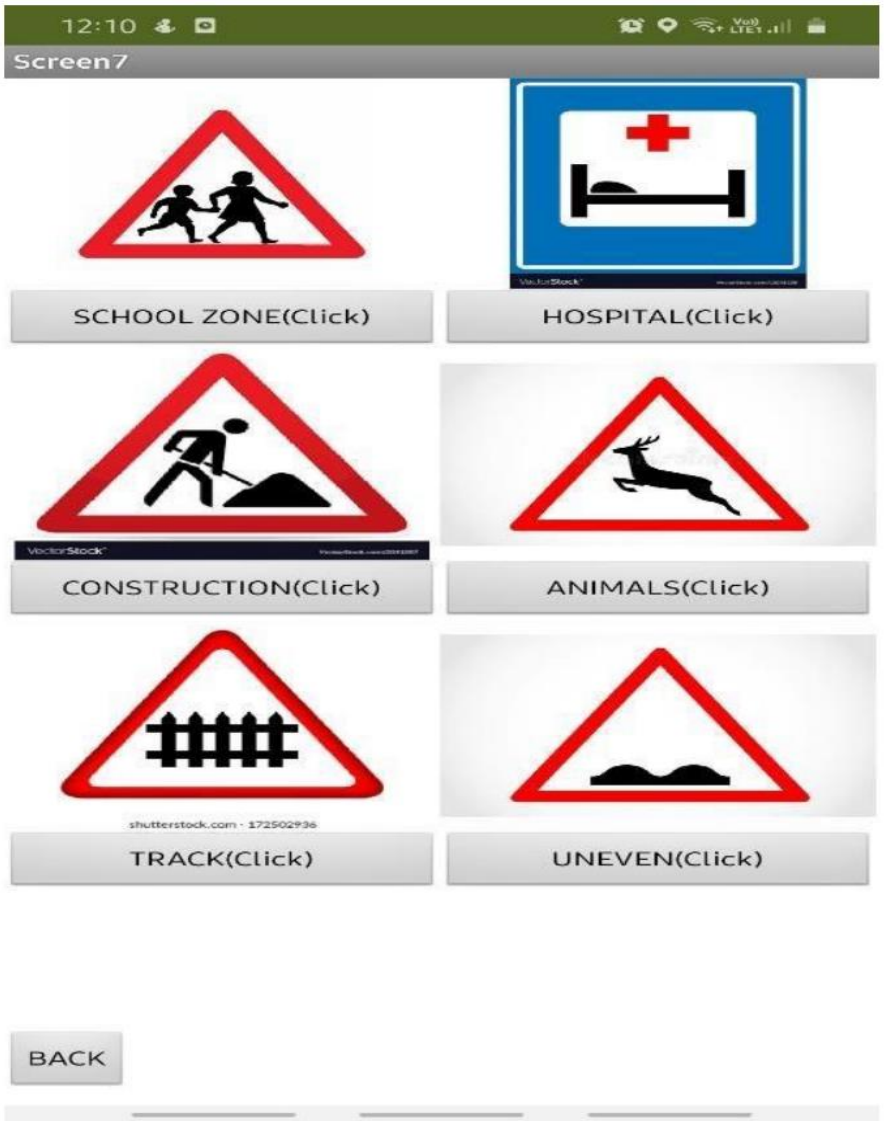
MIT APP INVENTOR

(Images)



Example signs

SCHOOL ZONE

HOSPITAL ZONE

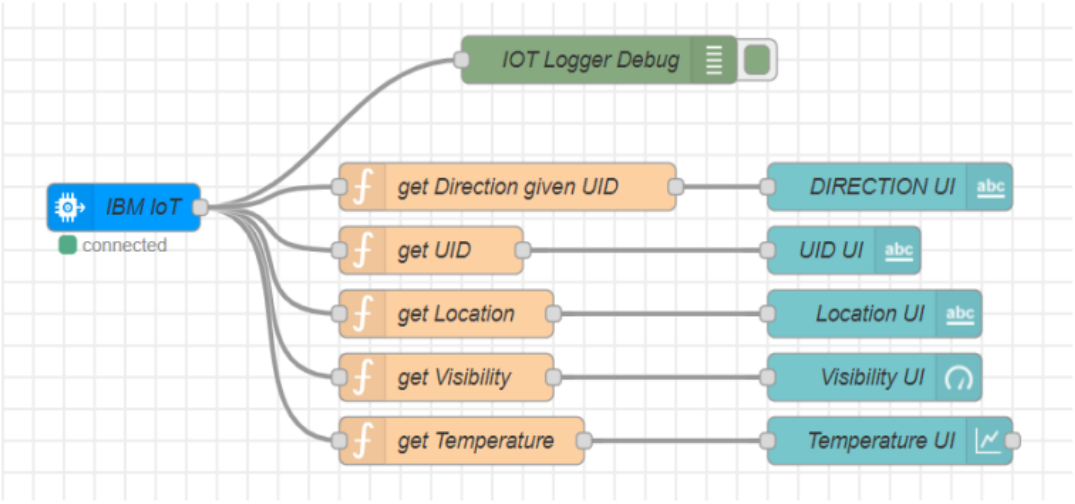
8. TESTING

Test cases help guide the tester through a sequence of steps to validate whether a software application is free of bugs, and working as required by the end-user. Learning how to write test cases for software requires basic writing skills, attention to detail, and a good understanding of the application under test (AUT).

Test case 1

Testing the Node red

URL : Node-RED Dashboard (mybluemix.net)



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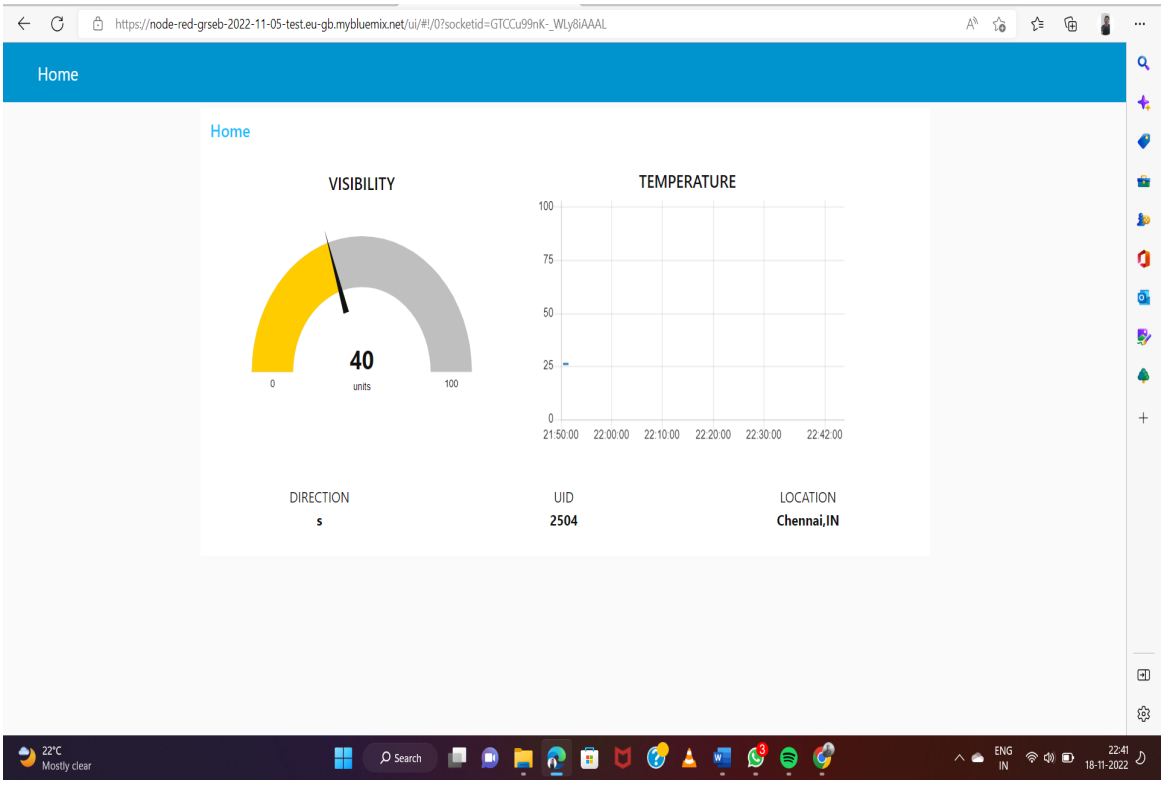
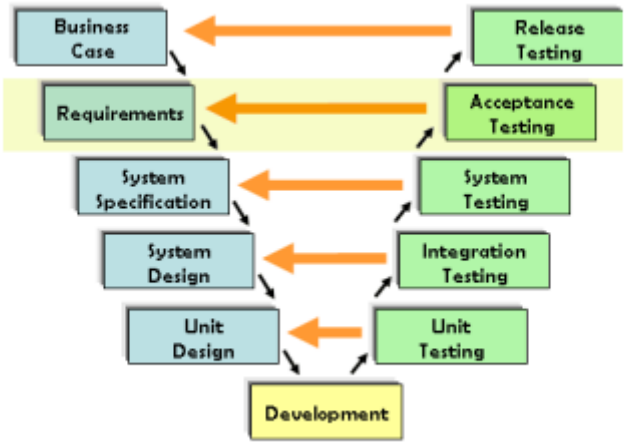


8.2. User Acceptance Testing

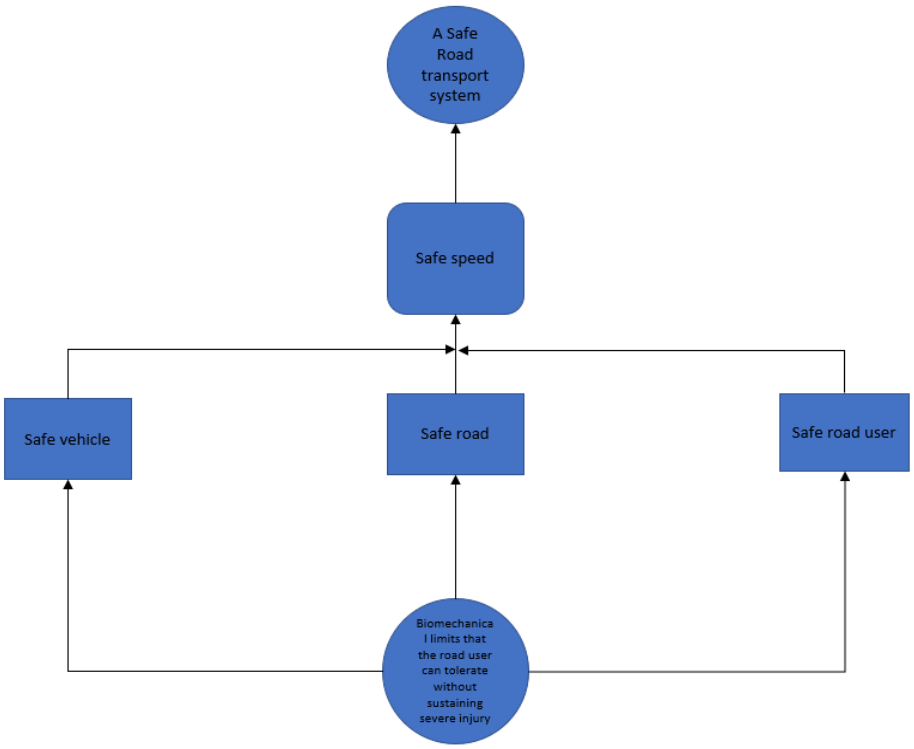
UAT consists, in practice, of people from the target audience using the application. The defects they find are then reported and fixed. This scenario is what most closely resembles “the real world.” The process allows users to “get their hands dirty” with the application. They can see if things work as intended.



The main purpose of UAT is to validate end-to-end business flow. It does not focus on cosmetic errors, spelling mistakes, or system testing. User Acceptance Testing is carried out in a separate testing environment with a production-like data setup. It is a kind of black box testing where two or more end-users will be involved .In further project we will implement it.

9. RESULTS

9.1. Performance Matrics



10. ADVANTAGES & DISADVANTAGES

Advantages

- ✓ Signs with smart connectivity are an inexpensive and flexible medium that can help transmit information according to particular situation and entertain passengers.
- ✓ The digital signboards helps in reducing the air pollution due the emission of vehicles in heavy traffic area.
- ✓ The drivers can able to know about the weather condition and accordingly follow the speed limit displayed on the sign boards.
- ✓ The increased flexibility of these digital sign boards makes it easy for any private or government department to change the message as per the need of the hour.
- ✓ The driver can easily find the route and navigation instructions to reach the destination.
- ✓ The speed of the vehicle can be identified using location sensor.
- ✓ The digitals sign boards and the app are user-friendly.

Disadvantages

- ✓ The digital signboards involves high Installation Costs.
- ✓ Getting digital signboards up and running is a far more involved process than print media.
- ✓ If the people managing the screens are not graphic designers, it can be difficult to update the content regularly on the screen.
- ✓ The digital signboards are still new and developing technology in the road safety sector.
- ✓ While digital sign boards require power and therefore can’t claim to be green, there is high energy use in the printing, erecting and replacement of traditional print media.

11. CONCLUSION

The world doesn’t change on its own but we humans can change the world to be safe, better, and harmless. Since the road isn’t said to be safe let’s make it safer with the technologies present and available to us. The Internet of Things is one of the technologies that can lead us to travel on enhanced safe roads. So let's come together to create a better world with no accidents and a smart road for the future generation. Digital road signs are an important part of modern infrastructure and are becoming increasingly common. Digital road signs are becoming more common as technology improves and more states adopt them. The use of digital road signs is expected to continue to grow in the future as it would be observed user-friendly, economic, environment friendly, profitable promoting road safety. Digital road signs are designed to improve road safety and efficiency by providing real-time information to drivers. These signs can display a variety of information, including speed limits, traffic conditions, and weather warnings. Digital road signs can help drivers by providing information that is not always available from traditional signs.

12. FUTURE SCOPE

IoT obtains the majority of its data with the help of connected cars. These incorporate a large number of sensors that establish communication with the cloud, other vehicles, and devices. Thanks to this it provides data and information of great utility for the improvement of road safety. The safe system approach to road safety emphasizes safety by desigh ensuring safe vehicles, road networks, and road users. Evolving towards the future, the road needs to boil with advanced sensors and antenna systems to have peace with the new era.

One of the benefits of digital road signs is that they can be updated in real-time, which means that they can be used to provide motorists with up-to-the-minute information about conditions on the road ahead. This can be particularly useful in the case of accidents or other incidents that might cause delays. In the future, digital road signs could also be used to provide information about alternative routes that might be available in the event of a problem on the road. This could be particularly useful in the case of major incidents, such as road closures due to bad weather. Finally, digital road signs could be used to provide motorists with information about the best times to travel in order to avoid traffic congestion. This could be particularly useful in areas where there is a lot of traffic.

13. APPENDIX

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 = "";
```

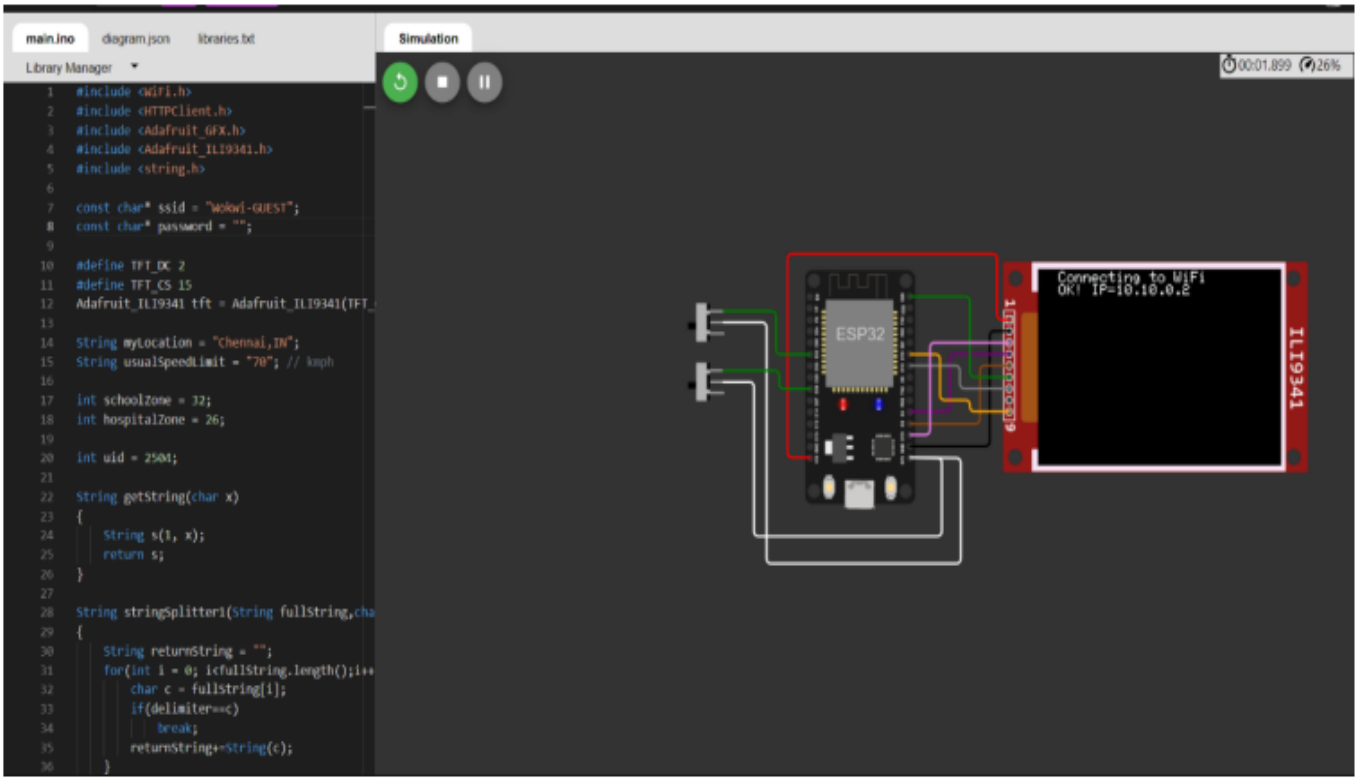
```
#define TFT_DC 2
#define TFT_CS 15
Adafruit_ILI9341 tft = Adafruit_ILI9341(TFT_CS, TFT_DC);

String myLocation = "Chennai,IN";
String usualSpeedLimit = "70"; // kmph

int schoolZone = 32;
int hospitalZone = 26;

int uid = 2504; // 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;
```

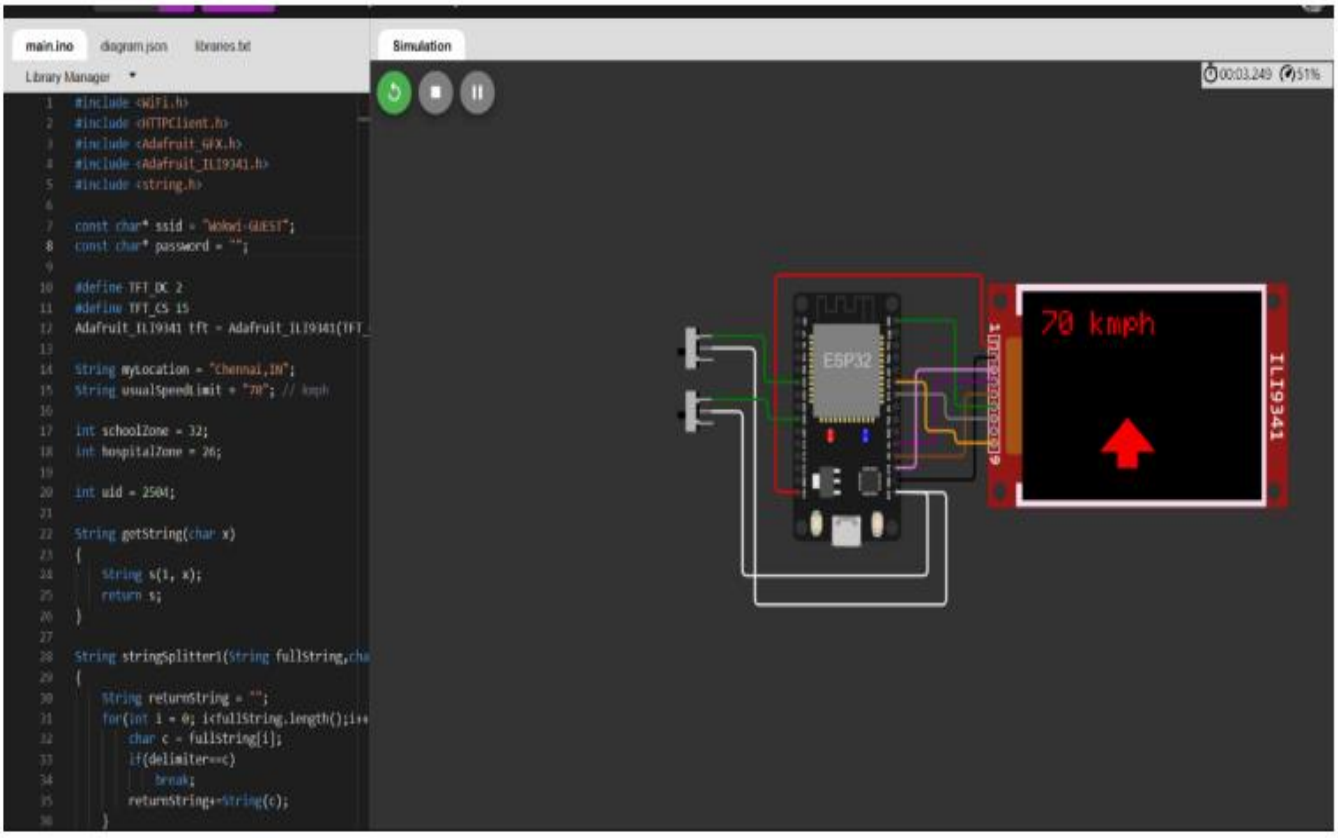
```
  tft.fillRect(refX,refY,100,20,ILI9341_RED);
  tft.fillTriangle(refX+100,refY-
30,refX+100,refY+50,refX+40+100,refY+10,ILI9341_RED);
}

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 = "https://node-red-grseb-2022-11-05-test.eu-
gb.mybluemix.net/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();
```

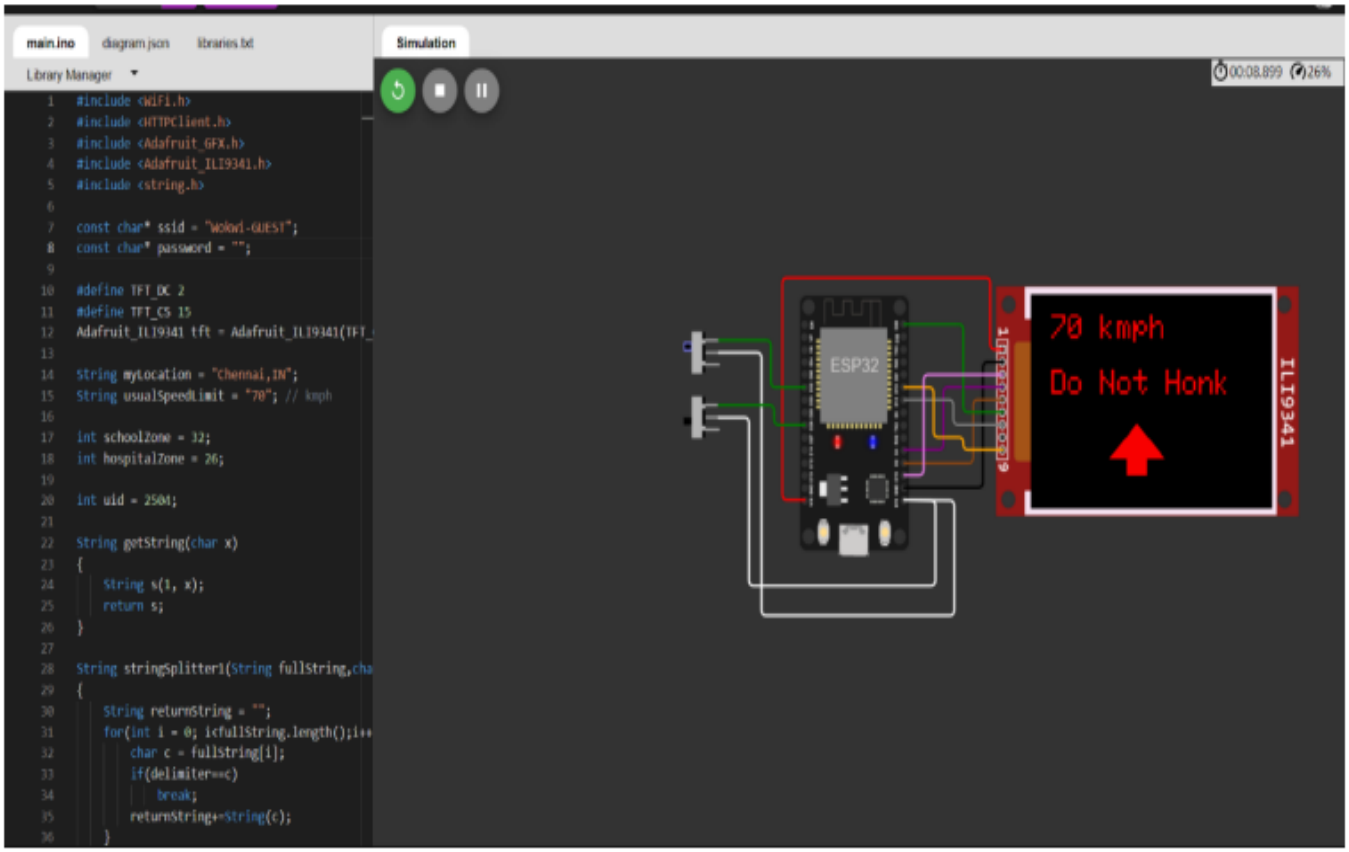
```
}

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);
}
```

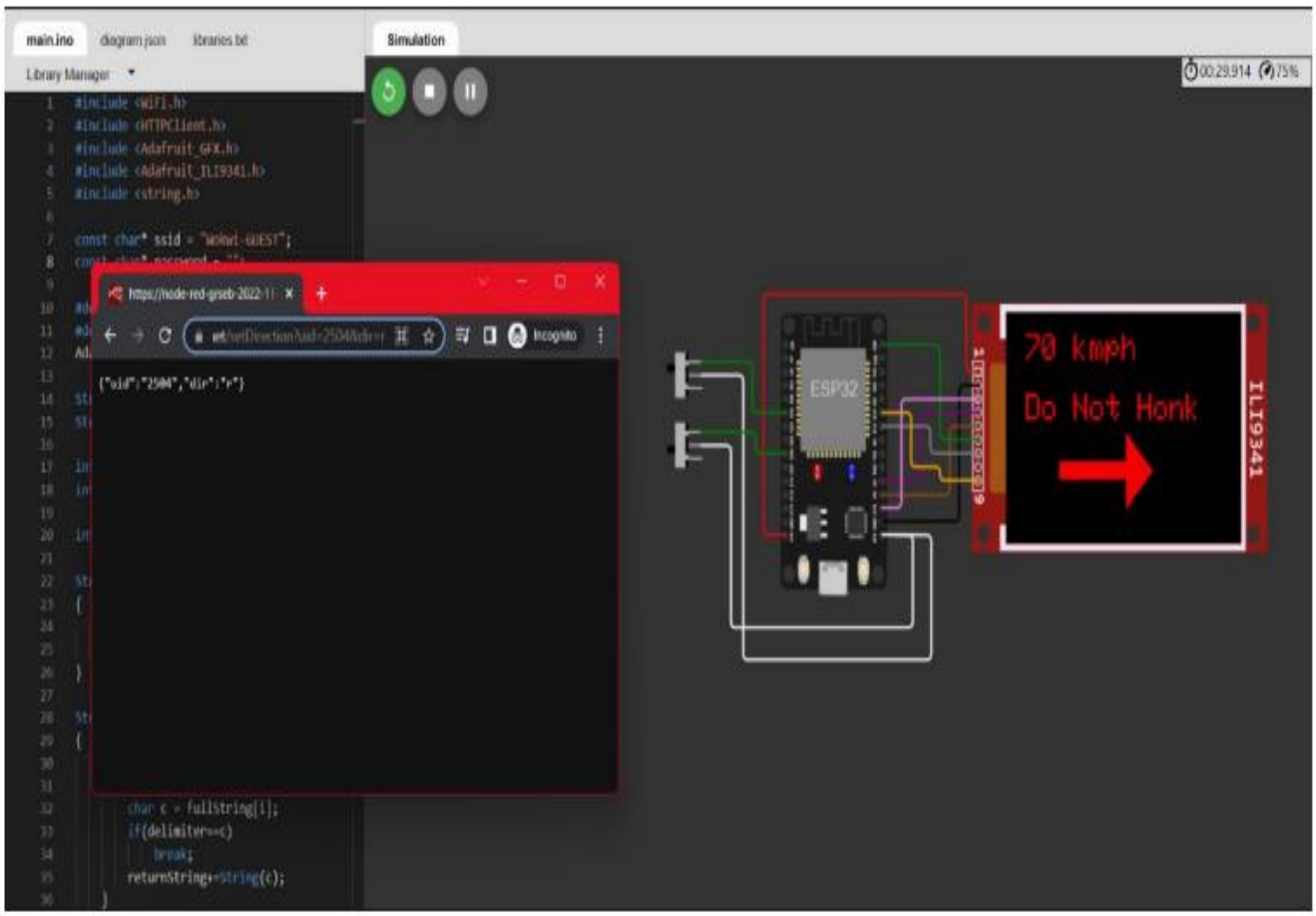
Output

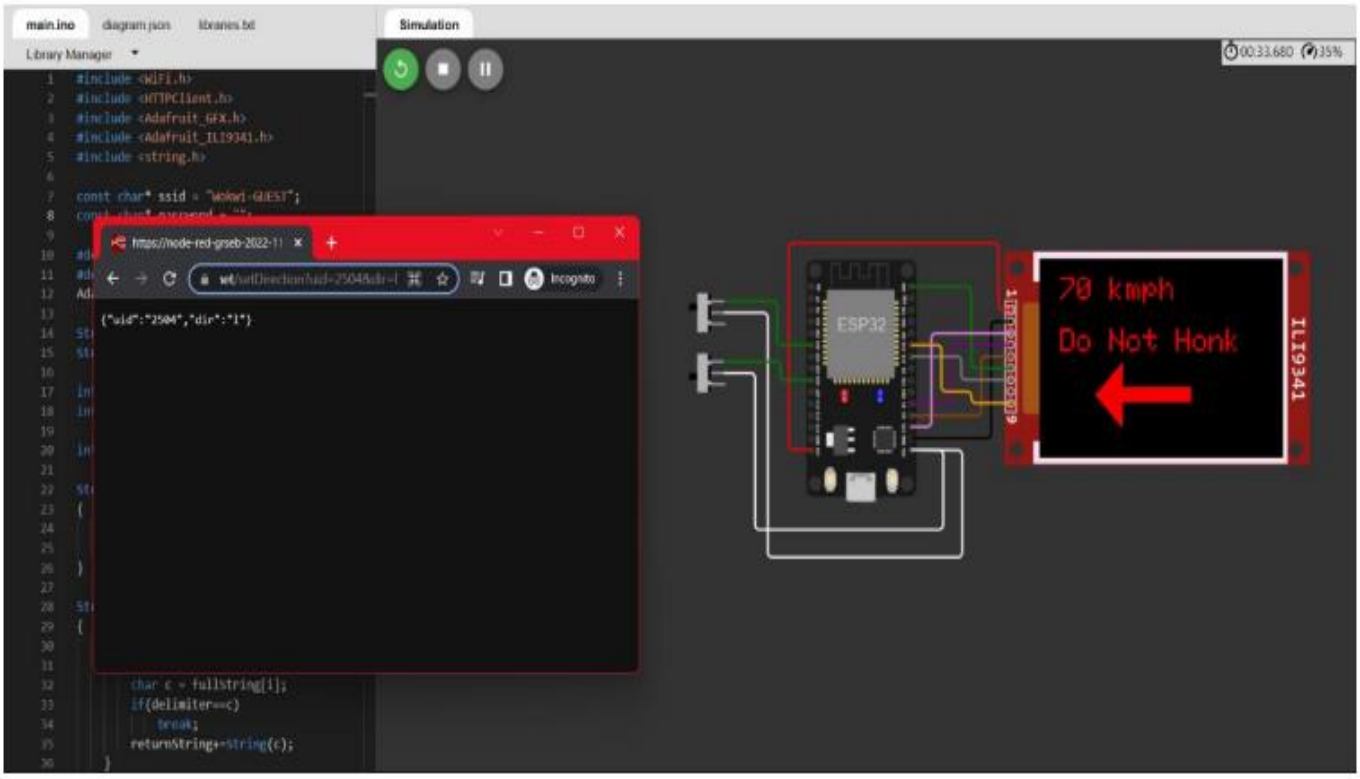
[IBMProjectPraveen.ino copy - Wokwi Arduino and ESP32 Simulator]

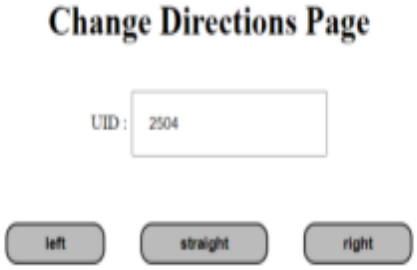





main.ino
diagram.json
libraries.txt
Library Manager
Simulation
00:08.899
26%
#include <WiFi.h>
#include <HTTPClient.h>
#include <Adafruit_GFX.h>
#include <Adafruit_ILI9341.h>
#include <string.h>
const char* ssid = "WOWd-GUEST";
const char* password = "";
#define TFT_DC 2
#define TFT_CS 15
Adafruit_ILI9341 tft = Adafruit_ILI9341(TFT_
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,cha
{
String returnString = "";
for(int i = 0; icfullString.length();i++
char c = fullString[i];
if(delimiter==c)
break;
returnString+=String(c);
}
ESP32
70 kmph
Do Not Honk
ILI9341


main.ino
diagram.json
libraries.txt
Library Manager
Simulation
00:29.914
75%
https://node-red-grseb-2022-11
Incognito
{"uid":"2504","dir":"r"}
ESP32
70 kmph
Do Not Honk
ILI9341





GitHub Link

https://github.com/IBM-EPBL/IBM-Project-1791-1658413941

wokwi link

IBMProjectPraveen.ino copy - Wokwi Arduino and ESP32 Simulator

Project Demo link

https://youtu.be/k08vEkNOFtw

References

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[2] Who, “Global status report on road safety,” Who, Geneva, Switzerland, 2018.

[3] A. M. Bachani, P. Koradia, H. K. Herbert et al., “Road traffic injuries in Kenya: the health burden and risk factors in two districts,” Traffic Injury Prevention, vol. 13, no. sup1, pp. 24–30, 2012.

[4] V. Paul Nyakyi, “Modelling assessment on causes of road accidents along kilimanjaro-arusha highway in Tanzania,” Applied and Computational Mathematics, vol. 7, no. 2, pp. 71–74, 2018.