Internet Of Things

In partial fulfillment for the completion of

Signs with Smart Connectivity For Better Road Safety PROJECT REPORT

Submitted by

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BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

SSM COLLEGE OF ENGINEERING,

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1. INTRODUCTION:

Traffic has recently become a big issue for the people of India. As a result, it wastes valuable time, fuel, and electricity. The Internet of Things (IOT) is a network of electrical appliances, cars, physical devices, and other items that are integrated with electronics, actuators, sensors, software, and connectivity, allowing these objects to connect and share data. Each object is uniquely identified by its embedded computing system, but it may interact with the existing Internet infrastructure.

1.1Project Overview:

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.
By using the Weather API we can get the weather reports based on which we can set the speed limit to particular area. 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. There are three switches through which you can switch the display to different modes.

1.2Purpose:

Due to this heavy traffic, the number of road accidents are increased which is a major issue. Our project helps to decrease the number of road accidents using smart connected sign boards using Internet Of things (IOT).

2. LITERATURE SURVEY:

2.1Existing System:

The individual traffic signals are connected with traffic control system to perform network wide traffic operation .These control systems contain a central computer, a communication network, and intersection traffic signals. Coordination of control system can be implemented through different techniques like time-base, hardwired interconnection method. Coordination between traffic signals and agencies requires the development of data sharing and traffic signal control agreements. A traffic-signal system has only one purpose i.e. to deliver signal timings to the driver. The system provides features that improve the traffic engineer's ability to achieve this goal. These are primarily access features. They provide access to the intersection signal controller for maintenance and operations. The more complete and convenient the access, the more efficient the operator will be and the more effective the system. In addition to control the traffic signals, modern technology also provide surveillance capabilities, including different kinds of video surveillance and traffic detection.

2.2References :

1. https:/

www.hindawi.com/journals/jat/2022/5829607/

2.https:/ en.wikipedia.org/wiki/Automotive_safety

3.https:/ www.powerbulbs.com/us/blog/2020/01/yellow-or-whiter-light

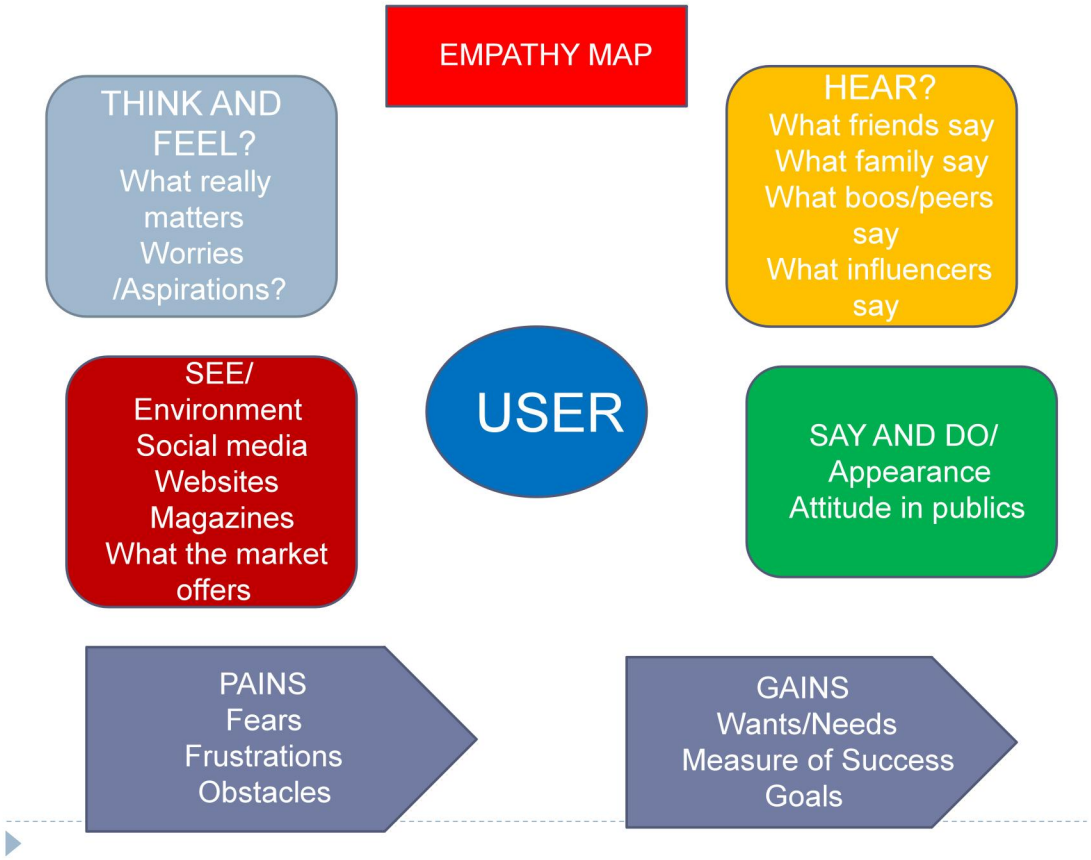
2.3Problem Statement Definition :

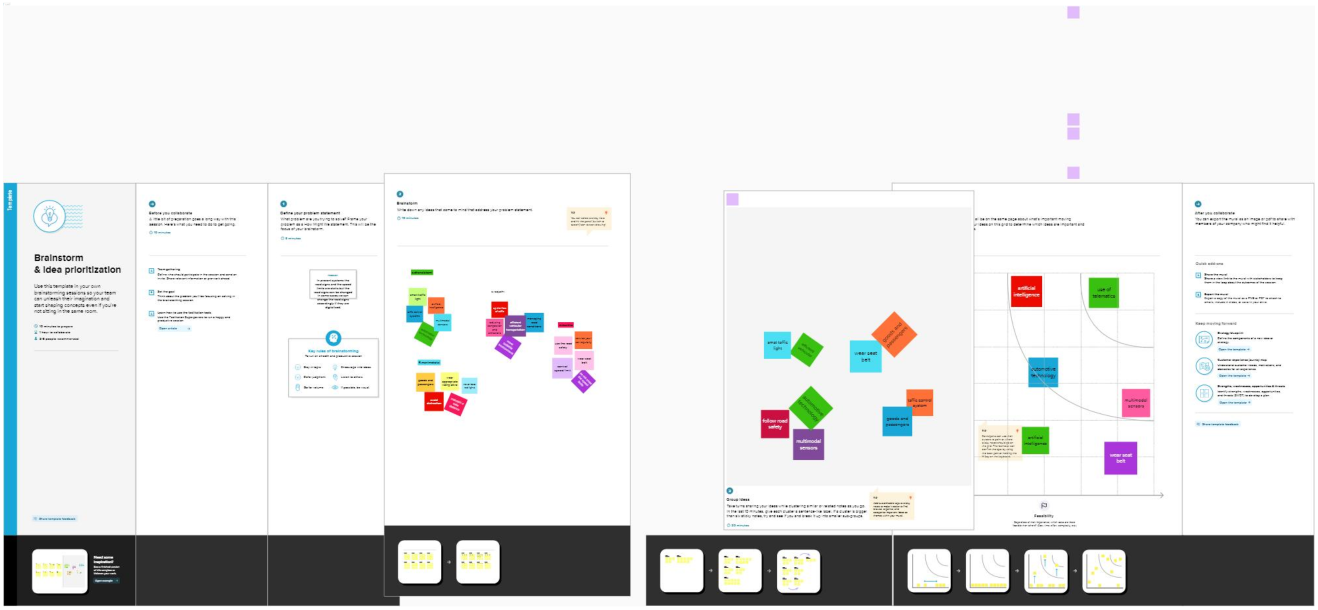
This project will replace static signs with smart signs that can adjust speed restrictions based on the weather and climate, display detour instructions in the event of an accident, and display alert messages in the event of hospitals, schools, or roadworks.

3.IDEATION & PROPOSED SOLUTION :

3.1Empathy Map Canvas :

Fig 3.1 Empathy Map




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.
artificial intelligence
use of telematics
multimodal sensors
Feasibility

Proposed Solution Template:

S.No.	Parameter	Description
•	Problem Statement (Problem to be solved)	The problem statement for road safety today road disaster and harrowing of value lives in road accident is commonly in india . keeping this view arranging "Road safety awareness program " in different places.
•	Idea / Solution description	Oizom Weathercom is a smart device to be used at accident-prone zones on the roads and highways. The intelligent road sensors monitor critical parameters like road visibility, road surface temperature, and rainfall in real-time. Oizom Polludrone needs to be installed at crossroads, tunnels and multi-level parking facilities to monitor vehicular emission. Weathercom and Polludrone push the real-time data obtained to the Oizom cloud. The top-speed limit is calculated based on weather speed index. The dynamic speed limit is then served to the drivers in the form of push notifications through maps, and Visual Messaging Displays. Effective vehicular route management is performed in case of higher pollution levels. Tunnel and parking ventilation are automated based on the pollution level.
•	Novelty / Uniqueness	Using new technology such as smart traffic light and traffic control systems, artificial intelligence, the use of telematics and automotive technology can contribute to prevent and reduce the number of road related accidents and improve road safety. Mobile network and fast data transmission solutions can be used, for instance, to collect data on vehicles on the road and condition of roads, as well to provide real-time weather information and warnings. Ultimately with the objective of reducing accidents. Attended by over 80 government officials, experts and business leaders from China and the Asia-Pacific region to exchange best practices and ideas on how technology can be applied to enhance road safety. The conference focused on China's road safety and innovative digital solutions to reducing traffic casualties.

•	Social Impact / Customer Satisfaction	Integrating weather and road condition monitoring into Intelligent Transport Systems (ITS) helps in reducing road accidents by 12-16%. Air quality monitoring on the roadways and tunnels ensures human exposure to vehicular emission is within the permissible limits. Automation of the ventilation manages the air circulation and improves the air quality inside tunnels and multi-level parking facilities.
•	Business Model (Revenue Model)	RoadSafe is a knowledge transfer facilitator designed to demonstrate a commitment by our sponsors and partners to road safety and to involve themselves with professionals by working together to provide a safer road environment. Our core activity will demonstrate this commitment. Our reputation rests on having good communication, with the road safety community and other key stakeholders is essential to RoadSafe. Resources will therefore be concentrated on: Representation Developing the web site A twice monthly RoadSafe News Organising regular expert meetings Developing a series of events and conferences in association with partners to promote improved road safety at work. Developing a sound relationship with the media Through active participation in public road safety events Through private influence.
•	Scalability of the Solution	Identify localities with the majority of accidents by periodic analysis; Systematically eliminate safety deficits on the basis of detailed inspections; Determine efficiency of realised measures by periodic analysis; Remove the most serious safety deficits identified by the inspections; Systematically find solutions from the most dangerous roads to less severe ones; Prioritise detailed inspections for individual road sections; Educate administration and maintenance personnel performing the periodic inspections according to the Road Act and its implementing regulations directing to deal with safety deficits and deficits; Include reconstruction of intersections and road sections with high accident rate as a priority in the action plan for investment measures;

		and Conduct the safety inspections of the road network periodically.

3.2Problem Solution Fit :

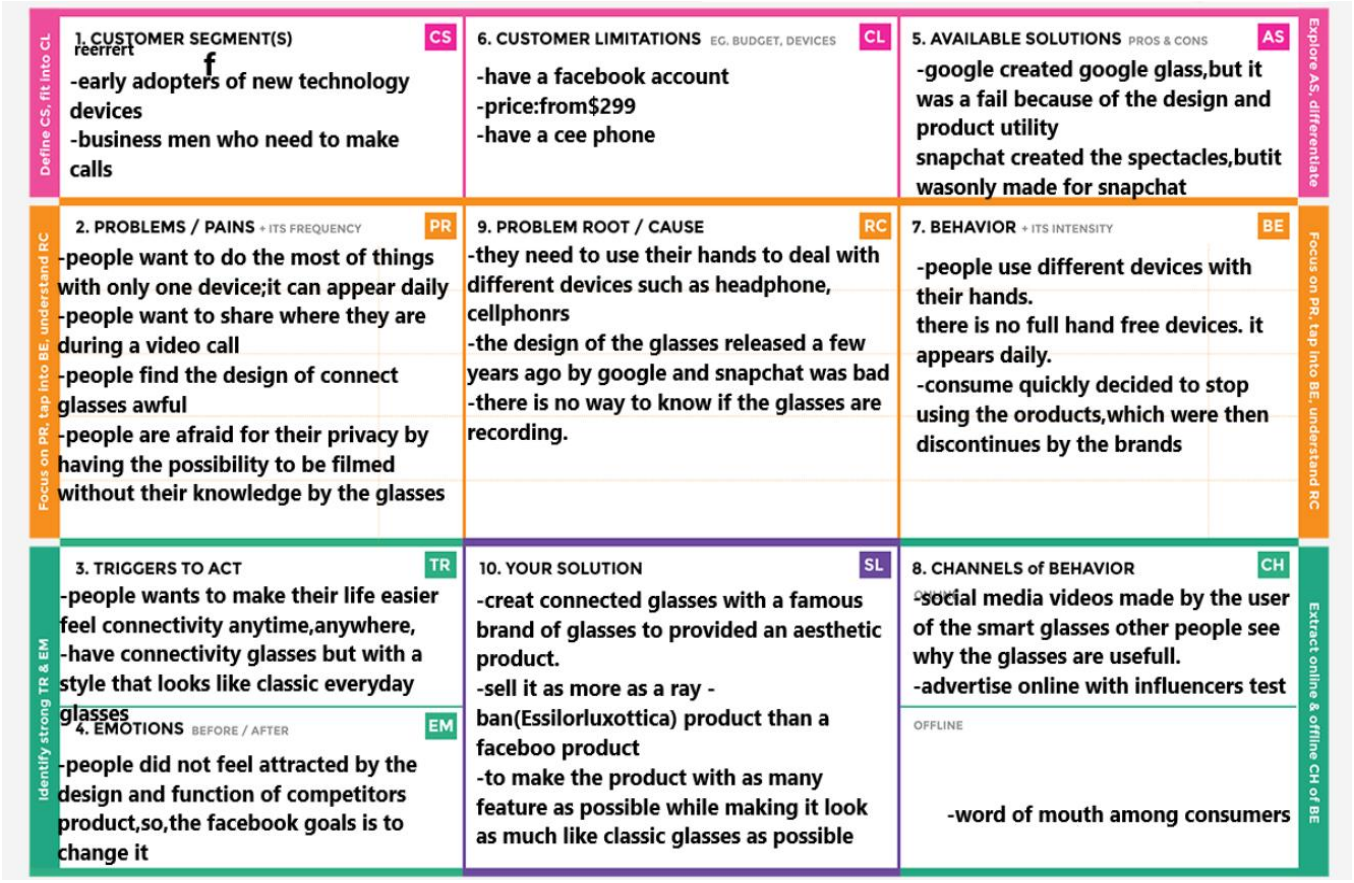


Fig 3.4 Problem Solution Fit

4. EQUIREMENT 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 sign boards that meet all criteria.
FR-2	User Registration	User Registration can be done through a Website or Gmail
FR-3	User Confirmation	Phone Confirmation Email confirmation OTP authentication
FR-4	Payments options	Bank Transfers
FR-5	Product Delivery and installation	The installation fee will be depend upon the length of the road.
FR-6	Product Feedback	Will be shared through a website via Gmail

Non-functional Requirements:

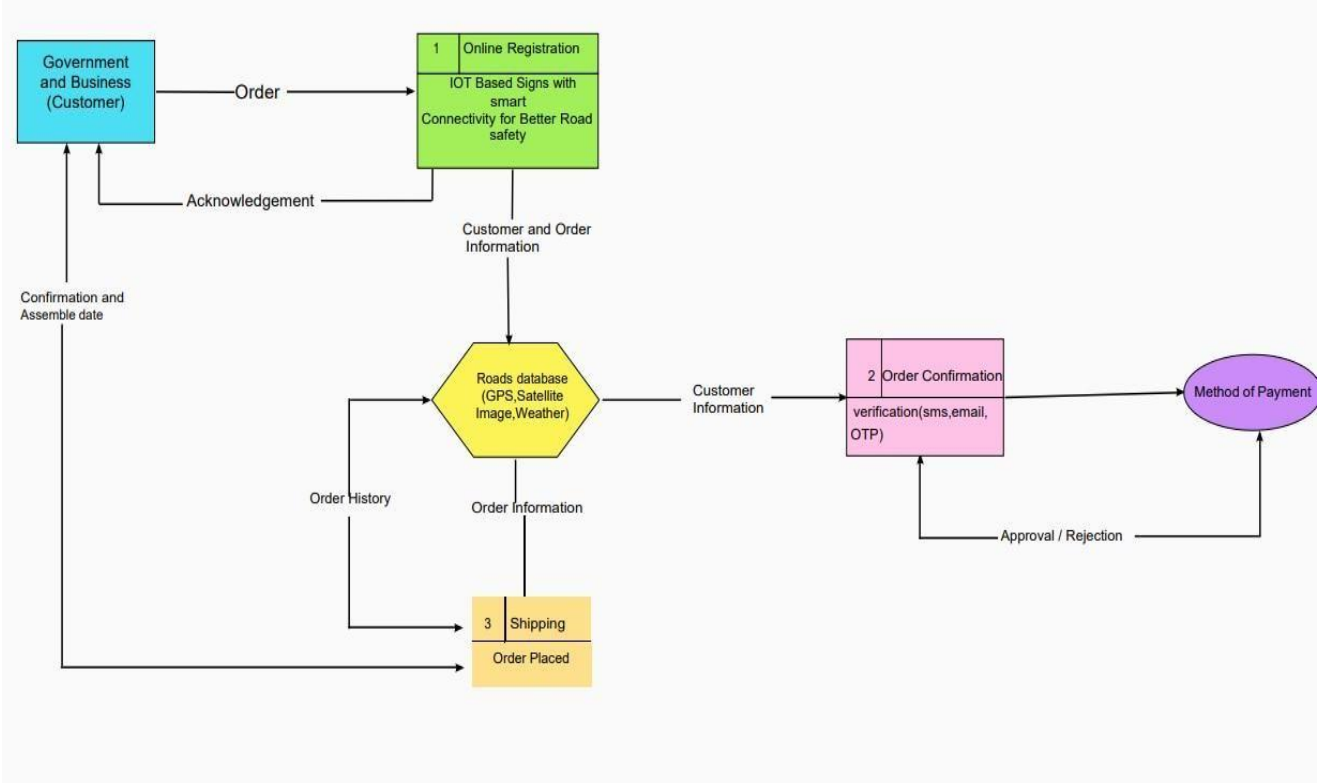
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Will provide the clear product instructions and a self-explanatory product which is simple to use.
NFR-2	**Security**	Cloud data must be contained within the network, collapsing to be the real-time avoidance should be avoided, and the board will be monitored constantly.
NFR-3	**Reliability**	Hardware will be frequently tested.
NFR-4	**Performance**	The smart board must provide a better user experience and deliver the accuracy output.
NFR-5	**Availability**	All of the functions and the user demands will be provided, depend upon the customer needs.
NFR-6	**Scalability**	The product is based on road safety and should cover the entire highway system.

5. PROJECT DESIGN :

Data Flow Diagrams:

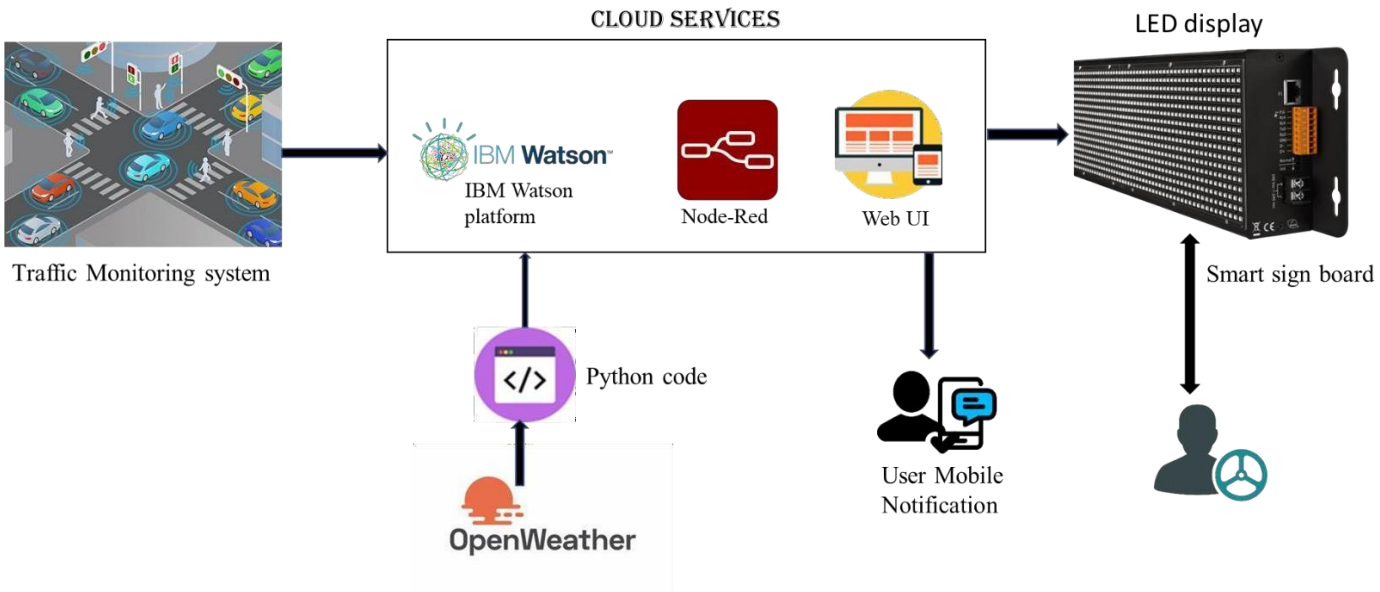
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



Data Flow Diagram- Signs with smart connectivity for better road safety:

Technical Architecture:

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table2



GUIDELINES:

- 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.
- Different modes of operations can be selected with the help of buttons.

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js / React Js etc.
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.	MySQL, NoSQL, etc.
6.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
7.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
8.	External API-1	Purpose of External API used in the application	IBM Weather API, etc.

Table-2: Application Characteristics:

S. No	Characteristics	Description	Technology
1.	Security Implementations	Strong security system that anyone without login credentials and hackers are not allowed to enter the network.	Firewall, Firebase, cyber resiliency strategy
2.	Scalable Architecture	Easy to expand the operating range by increasing the bandwidth of the network.	IoT, internet.
3.	Availability	Available anytime and everywhere 24/7 as long as the user is signed into the network.	IBM Cloud
4.	Performance	Supports a large number of users to access the technology simultaneously.	IBM cloud

User Stories

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	Access my account / dashboard	High	Sprint-1
Weather	openweathermap	USN-2	As a user, I want to check the weather of that location	Get the weather of that location	High	Sprint-1

IoT devices	Automation	USN-3	As a user, I want to use IoT devices for automation purposes	Get the work done without manual effort	High	Sprint-2
Python code	Random data	USN-4	As a user, I want to give some input to the devices for performing some action to complete the tasks very easily	Get the data workflow	Medium	Sprint-1
IBM Cloud	Cloud services	USN-5	As a user, I want to deploy these application for public version	Useful for all domain users	High	Sprint-1
Node-Red	Integration	USN-6	As a user, I want to integrate the applications with hardware	To precise for linear workflow	Medium	Sprint-3
Web UI	Interaction	USN-7	As a user, I want to interact with the digital products	To interact with the users	Medium	Sprint-2

Data validation	Checking accuracy	USN-8	As a user, I can check the ability and accuracy of the model in obtaining the required information	Check the capability of the model	High	Sprint-2
Data extraction	Obtaining the data	USN-9	As a user, I can retrieve the result data from the application for data storage for further uses	Download the result in the form of data	High	Sprint-3

PROJECT PLANNING & SCHEDULING :

Sprint Planning & Estimation:

Product Backlog, Sprint Schedule, and Estimation (4 Marks)
Use the below template to create product backlog and sprint scheme

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 OpenWeatherMap API.	1	LOW	Dhanalakshmi S Kavitha M Manimekalai R Rajaathi S
Sprint-1	Local Server/Software Run	Write a Python program that outputs results given the inputs like weather and location.	1	MEDIUM	Dhanalakshmi S Kavitha M Manimekalai R Rajaathi S
Sprint-2	Push the server/software to cloud	Push the code from Sprint 1 to cloud so it can be accessed from anywhere	2	MEDIUM	Dhanalakshmi S Kavitha M Manimekalai R Rajaathi S
Sprint-3	Hardware initialization	Integrate the hardware to be able to access the cloud functions and provide inputs to the same.	2	HIGH	Dhanalakshmi S Kavitha M Manimekalai R Rajaathi S
Sprint-4	UI/UX Optimization & Debugging	Optimize all the shortcomings and provide better user experience.	2	LOW	Dhanalakshmi S Kavitha M Manimekalai R Rajaathi S

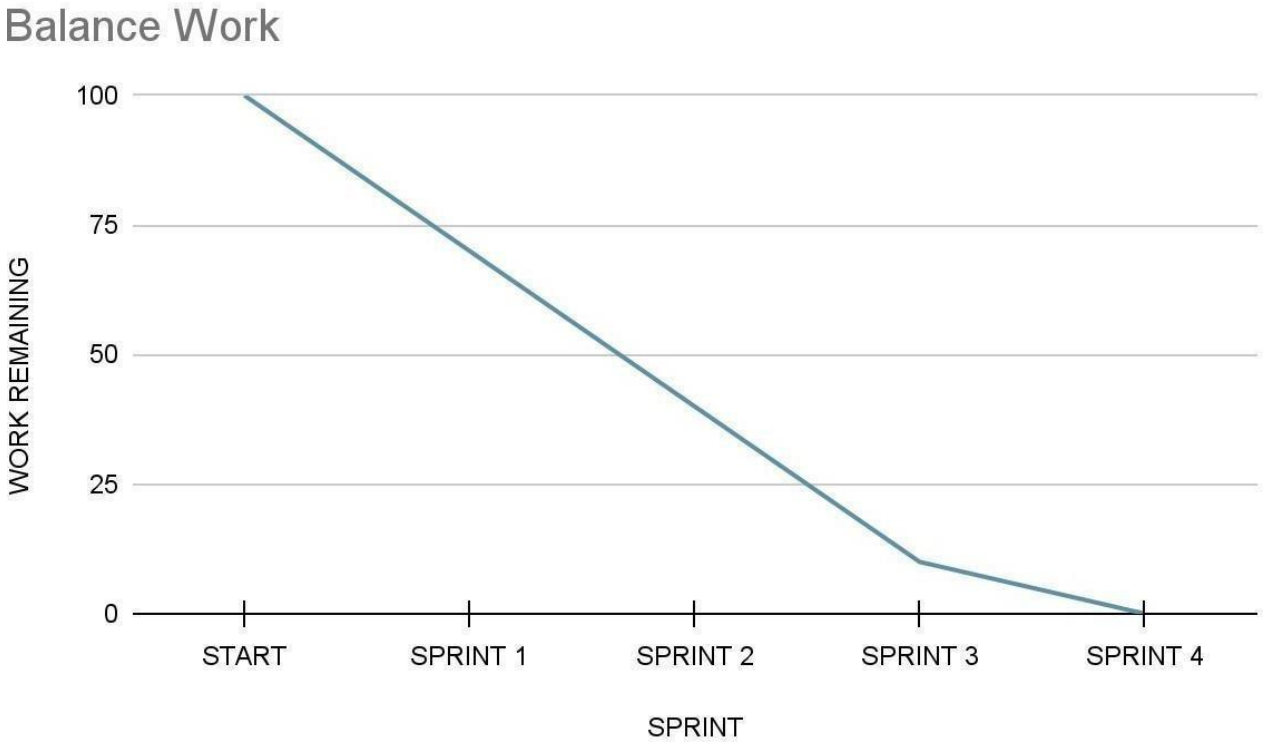
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	31 Oct 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	07 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	14 Nov 2022

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)

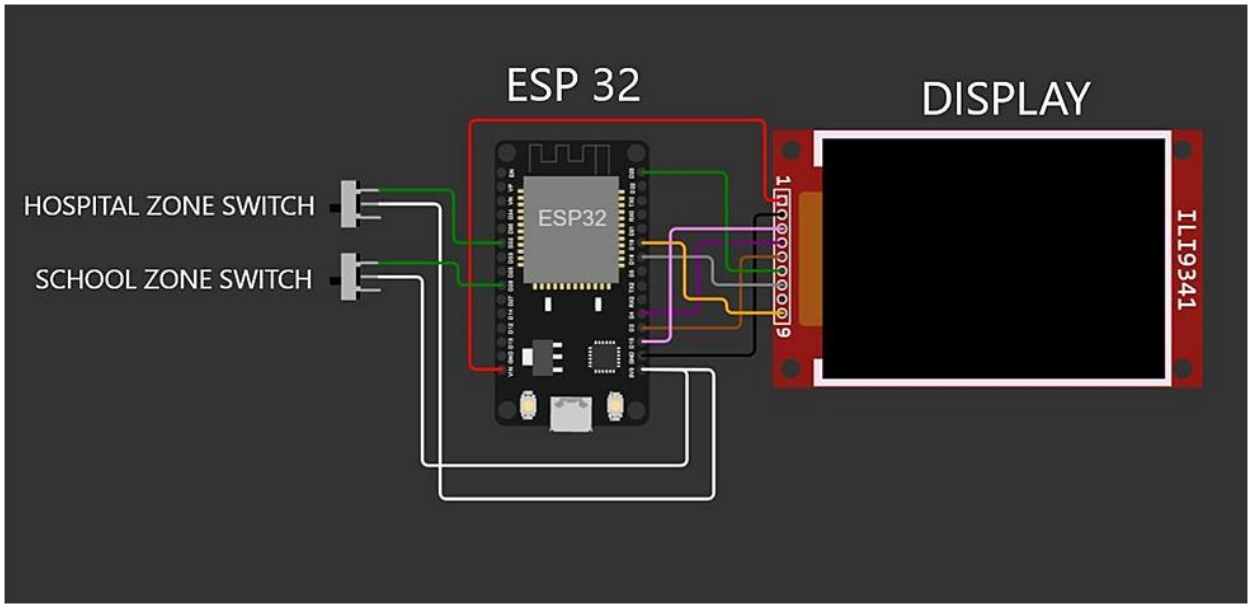
$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

Burndown Chart:



Coding and and solutioning

Circuit Diagram:



ESP 32 CODE :

```
#include <WiFi.h>
#include
<HTTPClient.h>
#include <Adafruit_GFX.h>
#include
<Adafruit_ILI9341.h>
#include <string.h>

const char* ssid = "WokwiGUEST";
const char* password =
"";

#defineTFT_DC 2
#defineTFT_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 MicroContoller


String getString(char x)
{ String s(1,
   x); return s;
}

StringstringSplitter1(String fullString,char delimiter='$')
{
   StringreturnString = "";
   for(int i = 0; i<fullString.length();i++)
      { char c = fullString[i];
      if(delimiter==c)
         break;
      returnString+=String(
      c);
    }
   return(returnString);
}

StringstringSplitter2(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
```

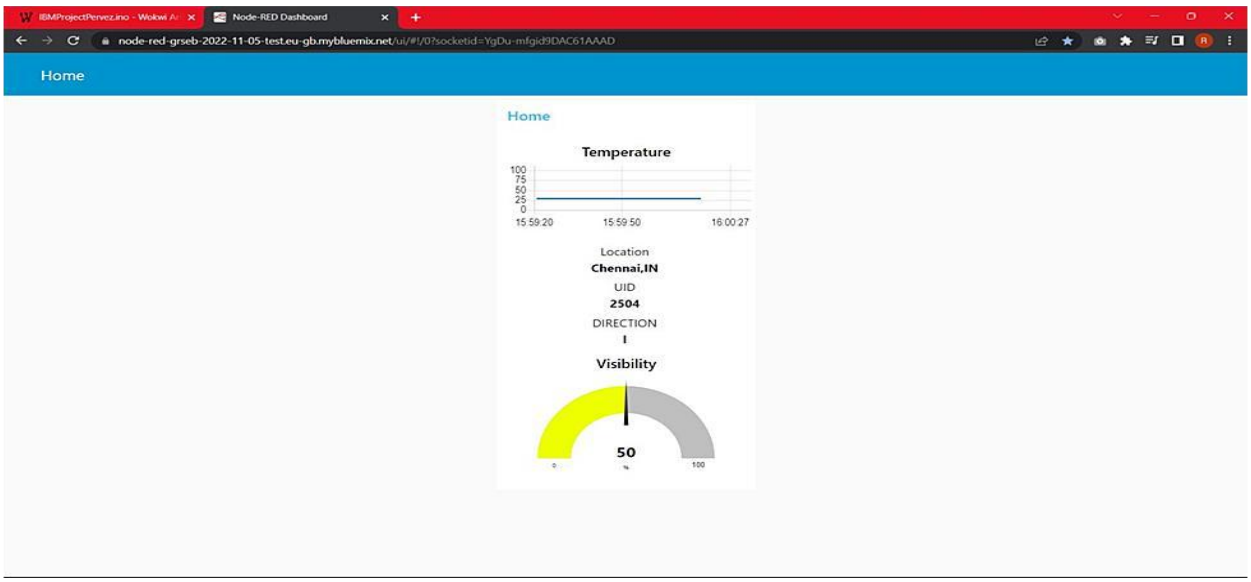
```
      );if(delimiter==c)
          flag = true;
    }
    return(returnString);
}

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-
05test.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_RE
  D);
  //tft.println(contents);
```

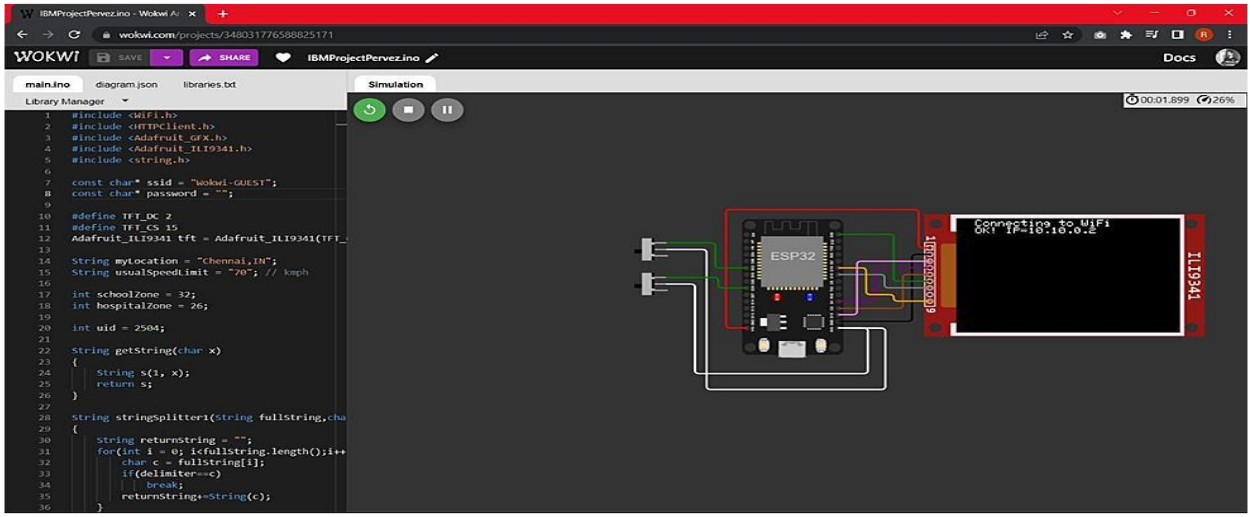
```
  tft.println(stringSplitter1(contents)
  ); String c2 =
  stringSplitter2(contents);
  if(c2=="s") // represents Straight
  { upArrow()
    ;
  }
  if(c2=="l") // represents left
  { leftArrow()
    ;
  }
  if(c2=="r") // represents right
  { rightArrow()
    ;
  }
}

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=");
```

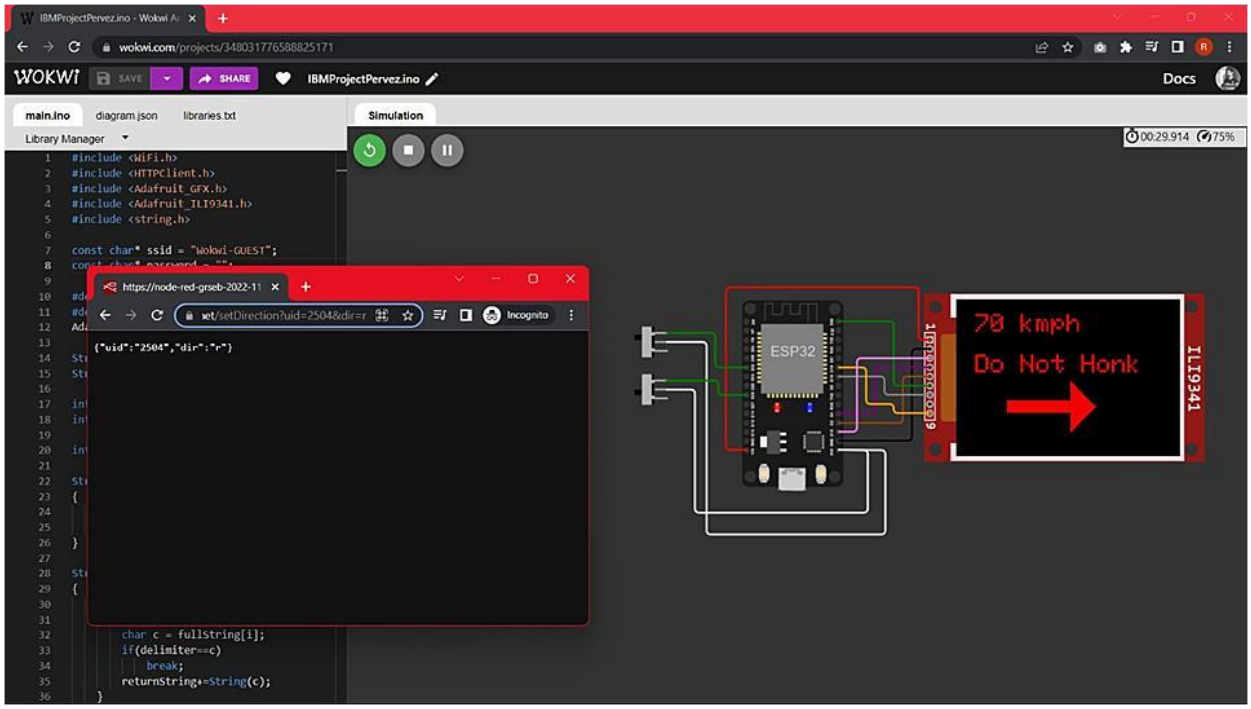
```
  tft.println(WiFi.localIP(
  ));
}

void loop()
  { myPrint(APICall(
  )); delay(100);
}
```

Output :



Wokwi Output :


IBMProjectPervez.ino - Wokwi Ar
wokwi.com/projects/348031776588825171
WOKWI
SAVE
SHARE
IBMProjectPervez.ino
Docs
main.ino
diagram.json
libraries.txt
Library Manager
Simulation
00:01.899
26%
#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_
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; i<fullstring.length();i++
char c = fullstring[i];
if(delimiter==c)
break;
returnString+=String(c);
}
ESP32
Connecting to WiFi
OK! IP=10.10.0.2
ILI9341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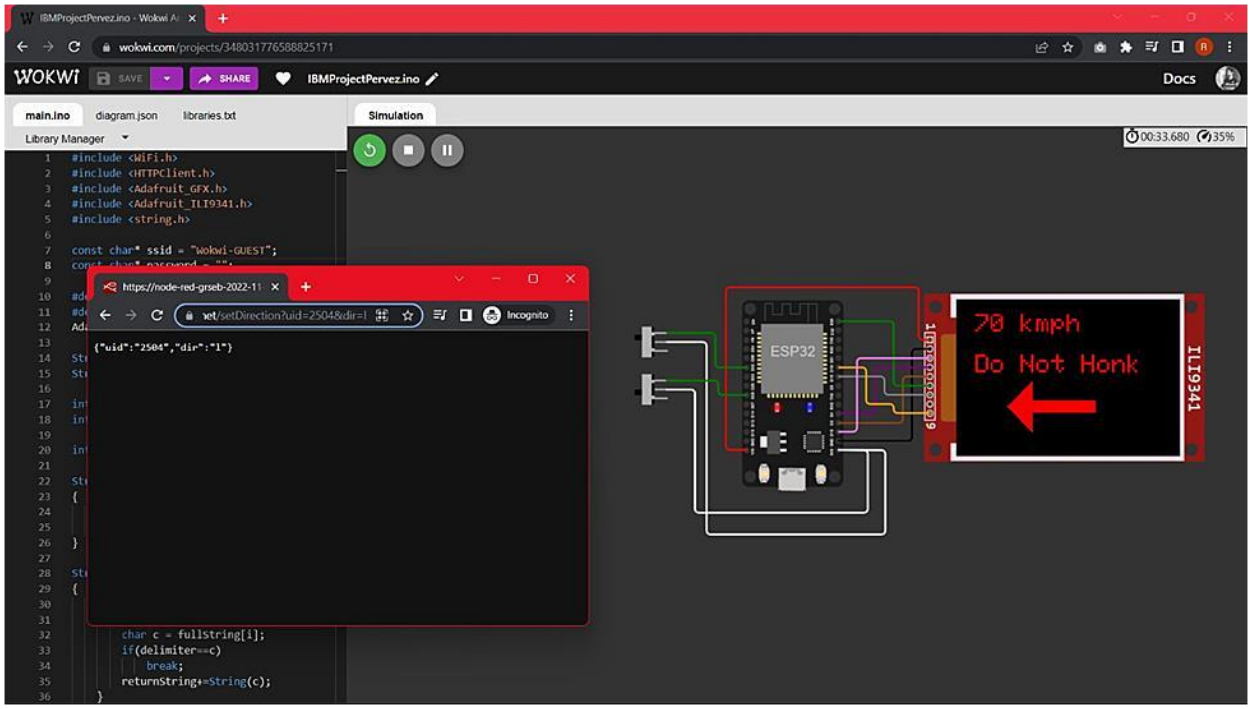
WOKWI
SAVE
SHARE
IBMProjectPervez.ino
Docs
main.ino
diagram.json
libraries.txt
Library Manager
Simulation
00:29.914
75%
https://node-red-grseb-2022-11
wet/setDirection?uid=2504&dir=r
Incognito
{"uid":"2504","dir":"r"}
#include <WiFi.h>
#include <HTTPClient.h>
#include <Adafruit_GFX.h>
#include <Adafruit_ILI9341.h>
#include <string.h>
const char* ssid = "Wokwi-GUEST";
char c = fullstring[i];
if(delimiter==c)
break;
returnString+=String(c);
}
ESP32
70 kmph
Do Not Honk
ILI9341



8.TESTING

8.1TEST 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/Hosipital Zone – Do not Honk sign is displayed.

8.2USER ACCEPTANCE TESTING

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

9.RESULTS

9.1PERFORMANCE METRICS

Based on the IBM pack we chose, the performance of the website varies. Built upon NodeJS, a light and high performance engine, NodeRED is capable of handling upto 10,000 requests per second. Moreover, since the system is horizontally scalable, a even higher demand of customers can be served.

10.ADVANTAGES & DISADVANTAGES

- **ADVANTAGES**
    - Lower battery consumption since processing is done mostly by Node RED servers in the cloud.
    - Cheaper and low requirement micro controllers can be used since processing requirements are reduced.
    - Longer lasting systems.
    - Dynamic Sign updation.
    - School/Hospital Zone alerts
- **DISADVANTAGES**
    - The size of the display determines the requirement of the micro controller
    - Dependent on OpenWeatherAPI and hence the speed reduction

is same for a large area in the scale of cities.

11.CONCLUSION

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

12.FUTURE SCOPE

Introduction of intelligent road sign groups in real life scenarios could have great impact on increasing the driving safety by providing the end-user (car driver) with the most accurate information regarding the current road and traffic conditions. Even displaying the information of a suggested driving speed and road surface condition (temperature, icy, wet or dry surface) could result in smoother traffic flows and, what is more important, in increasing a driver's awareness of the road situation.

13.APPENDIX

Project demonstration link

https://drive.google.com/file/d/19usG5JUwO_YNHqM1PPxOyGSltOxO_cA9/view?usp=drivesdk

Github link

https://github.com/IBM-EPBL/IBM-Project-44710-1660726399