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IBM – NALAIYA THIRAN

SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY

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1.1 PROJECT OVERVIEW

The speed limits and road signage in use today are static. However, under specific circumstances, the signs may be modified. If the road signs are digitalized, we may consider situations when there are detours due to traffic congestion or accidents and adjust the signs accordingly. This proposal suggests a system that uses digital sign boards with constantly changing signs. Rainfall causes the roads to become slick, and the speed restriction is lowered. There is an online application that allows you to submit information about road detours, accident-prone regions, and informational sign boards. This information is obtained and shown on the sign boards appropriately.

1.2 PURPOSE

People now become discouraged and irritated as it takes more and longer for them to reach their objective.

With the aid of this technology, users may wirelessly get notifications from the database management on their mobile devices.

2.1 EXISTING PROBLEM

- Due to heavy traffic routes the roads are blocked and due to climatic and weather conditions the occurrence of accidents increases.
- Due to the speeding of vehicles, some mishaps might take place leading to risky driving.

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2.2 REFERENCES

S. No	**TITLE OF THE LITERATURE**	**TECHNOLOGIES USED**	**PROS**	**CONS**
1	Road Safety Awareness and Comprehension of Road Signs from International Tourists Perspectives	In the current study, data are gathered by a questionnaire survey.	The system would support the development of design guidelines for roads that promote both local and international users' safety and aid highway and traffic authorities in better comprehending tourists' travel habits.	Although security was highlighted as one of the important aspects for service quality in the tourist business, road safety was not specifically included in the results.
2	Integrating IoT and Block chain for Ensuring Road Safety: An Unconventional Approach	OMNeT++ is used to simulate this model, together with the appropriate design and network description files.	The hash graph may be used to set priorities effectively and provide higher QoS quotient. This essay makes recommendations for decreasing accidents based on factors including speed, security, stability, and justice.	The hash graph's USP, the intrinsic agreement process, will be used by the framework to reduce reaction time.
3	IoT based Traffic Sign Detection and Violation Control	The system's design is primarily focused on an inexpensive, ready-to-use solution employing a Raspberry Pi tiny, embedded computer. With	The suggested prototype uses Convolutional Neural Networks (CNN), an efficient deep learning technology, to identify traffic signals	On this study, edge and cloud computing are combined to approve real-time

		the aid of TensorFlow and Keras, Convolutional Neural Network (CNN) has been employed in deep learning approaches to deliver quickly processed results.	autonomously and manage the system in accordance with the observed indicators.	analytics in wireless IoT networks.
4	Traffic and Road Sign Recognition	A classifier called a Support Vector Machine (SVM) is used for classification.	The development and testing of four-color segmentation algorithms. They are a dynamic threshold, a tweak to de la Escalera's method, a fuzzy colors segmentation technique, and a shadow and highlight invariant. A successful segmentation rate of almost 97% was attained.	The effectiveness of the entire system in general and of each distinct phase, as well as failure assessments. the effectiveness of the classifier and the variables that might have an impact on the classification rate.
5	Development of an IoT based real-time traffic monitoring system for city governance	The suggested system gathers real-time vehicle data using magnetic sensor nodes. Wi-Fi equipped micro controllers process the real-time data and transfer it to an IoT platform for additional processing.	The residents will benefit from time savings thanks to the early warning messages, particularly during rush hour. This approach also describes how well vehicle identification is accurate and how road occupancy estimation has little relative error.	The suggested approach does not anticipate the driver to have any smart gadgets.
6	An IoT Architecture for Assessing Road Safety in Smart Cities	Various real-time and diagnostic data may be obtained using the OBD-II. Telematics enables such monitoring within the IoT/ITS environment and is made possible by a few options as well as the use of specialized sensors.	The Safe System Approach is used by this system. With the aim of evaluating the safety of the transportation road network, this study provides an extensive, IoT-based infrastructure.	in the context of increasing traveler knowledge of the conditions for road safety.
7	Reliable Smart Road Signs	The development of "smart road signs" with embedded smart codes to give intelligent cars more precise information is a potential development in intelligent transportation systems.	Based on the error rate—the difference between the decoder output and the received input—the system offers a randomized detection technique.	It emphasizes how sensor fusion, in which information is gathered from several independent sources, may result in more resilient

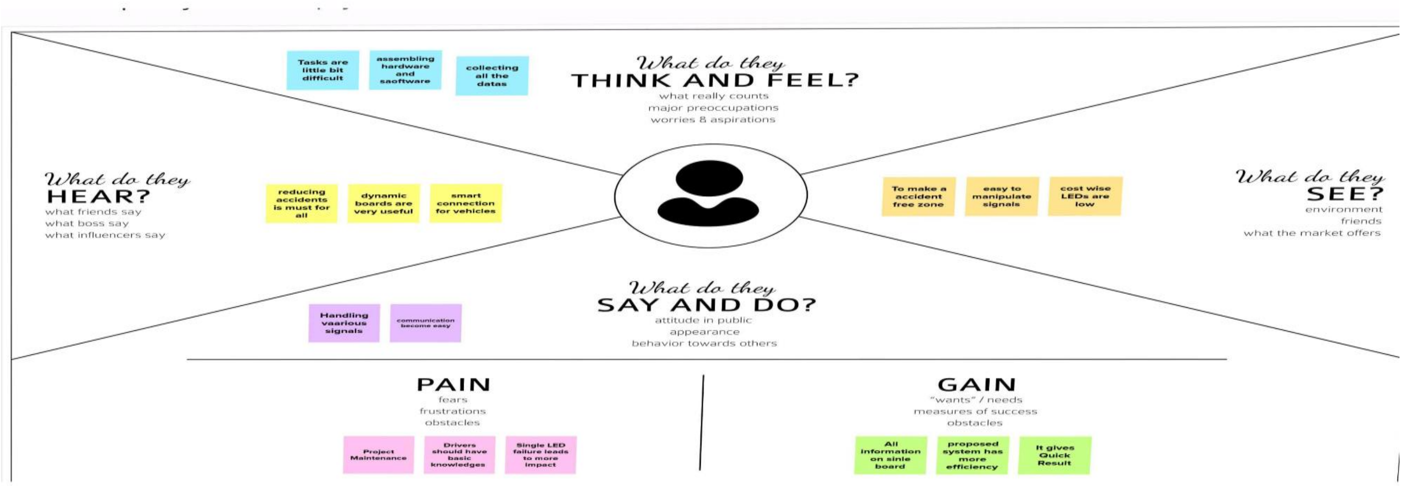
				and robust systems. More dependable traffic networks may result from a network of intelligent automobiles.
8	The Role of Block chain, AI and IoT for Smart Road Traffic Management System	Current information on the route to take is provided through electronic message services.	It is an effective method for resolving the issue of moving from a centralized to a decentralized system. can see the driver and human activity inside the car in real time.	Only stake owners, according to the DPoS algorithm, may be chosen as block producers, however the distributed PoA level is where the actual consensus takes place.
9	Road Safety Performance Associated with Improved Traffic Signal Design and Increased Signal Conspicuity	To guarantee that the results are accurate and dependable, troublesome confounding variables related to road safety evaluation are taken into consideration using the empirical Bayes analysis approach.	C-SVM performs quite well, however v-SVM occasionally produces superior outcomes.	The safety analysis can be expanded in a few ways; it will be finished and released later.
10	Study on Performance of Road Signs and Markings along TANZAM Highway in Mbeya Region, Tanzania	TARURA uses DROMAS, a software for managing road maintenance plans, for maintenance and rehabilitation.	It ends traffic collisions and enhances user safety on networked roads.	The removal of the tree brunches hiding road signs is necessary to improve sight to drivers. .

2.3 PROBLEM STATEMENT DEFINITION

The road signage in use today is static. Due to the climatic and weather conditions, the occurrence of road accidents increases and at some conditions the roads are blocked due to heavy traffic routes.

The speed limits in use today are static. Due to the speeding of vehicles, some mishaps might take place leading to risky driving.

3.1 EMPATHY MAP CANVAS



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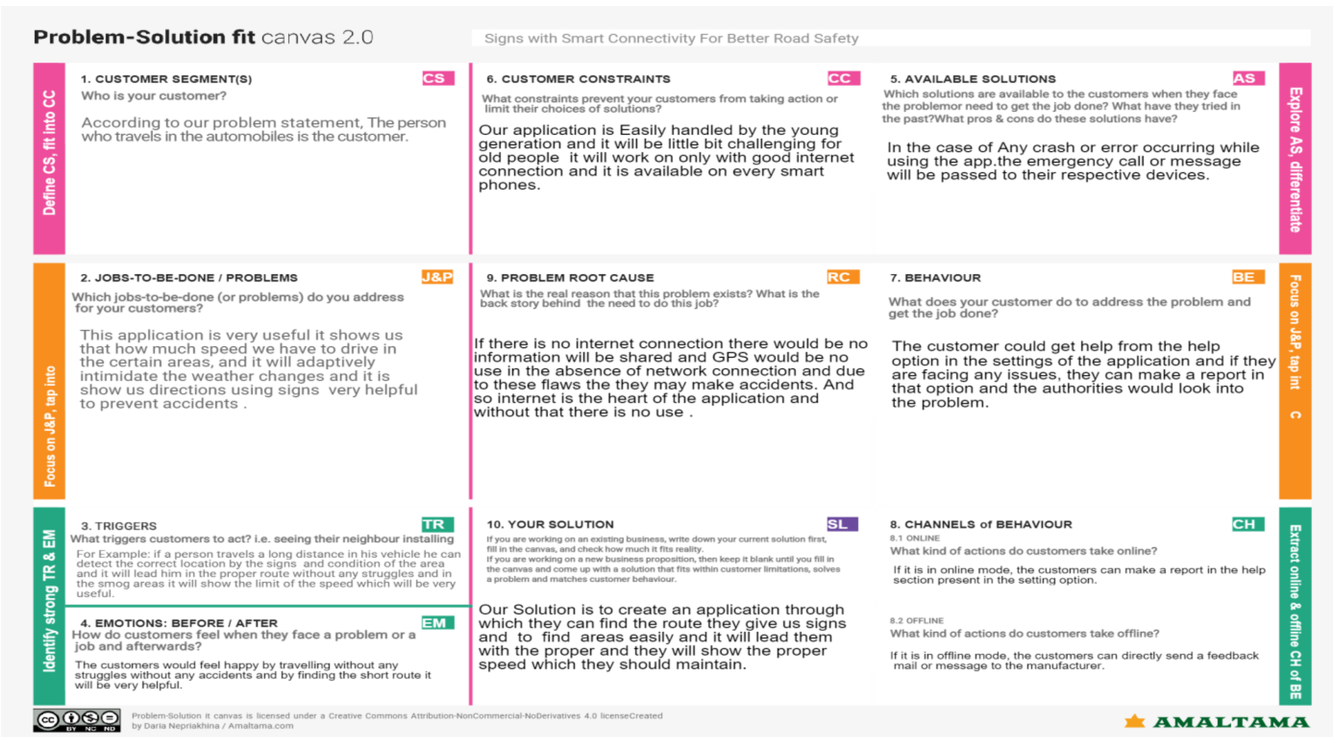
3.2 IDEATION & BRAINSTORM

https://github.com/IBM-EPBL/IBM-Project-19810-1659706828/blob/main/Project%20Design%20%26%20planning/Ideation%20phase/Brainstorming-%20Idea%20Generation-%20Prioritizaation%20Template-1.docx

3.3 PROPOSED SOLUTION

In this project, static signs will be replaced with smart signs that can modify speed limits based on the weather, provide detour warnings in the event of an accident, and display alerts in the event of hospitals, schools, or construction.

3.4 PROBLEM SOLUTION FIT



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4.1 FUNCTIONAL REQUIREMENT

Following are the functional requirements of the proposed solution.

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 tracking	Speed Cap automatically updated to reflect the current weather. The diversion signs are automatically flashed in life-threatening circumstances.
FR-4	User Visibility	Bright colored LEDs should be used in sign boards to draw the attention of drivers.
FR-5	User Understanding	The display should be large enough to accurately display all the signs so that they are clear to see even for far-off cars.
FR-6	Information delivering time	Before a specified distance, the driver must get the accident report in order to modify the intended path.

4.2 NON-FUNCTIONAL REQUIREMENTS

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

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FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Product with an easy user interface. It doesn't require any prior training and may be used and understood by everyone.
NFR-2	**Security**	To prevent hackers from accessing the IoT-based system without authorization, a strong security solution must be implemented.
NFR-3	**Reliability**	Correct and permitted signs should be presented for high dependability.
NFR-4	**Performance**	In the event of unexpected incidents and weather changes, automatic updating should be performed.
NFR-5	**Availability**	The necessary power source or battery should be provided to the sign boards since they must operate continuously.
NFR-6	**Scalability**	It ought to be applied to the whole roadway network.

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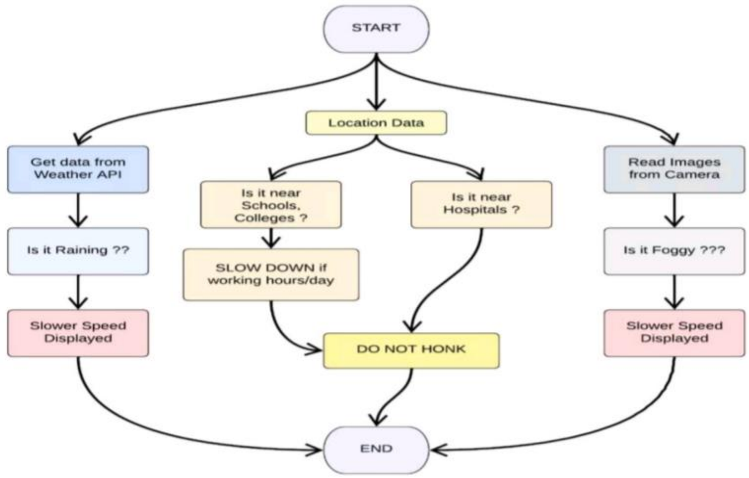
5.1 DATA FLOW DIAGRAMS



5.2 SOLUTION & TECHNICAL ARCHITECTURE

Smart linked sign boards are used to replace static signboards. These intelligent linked sign boards update automatically and obtain the speed restrictions from a web application utilizing weather API. The speed may rise or fall depending on weather changes. The display of the diversion signs depends on the flow of traffic and potential fatalities. The appropriate guide, warning, and service signs are also visible at hospitals, schools and restaurants.

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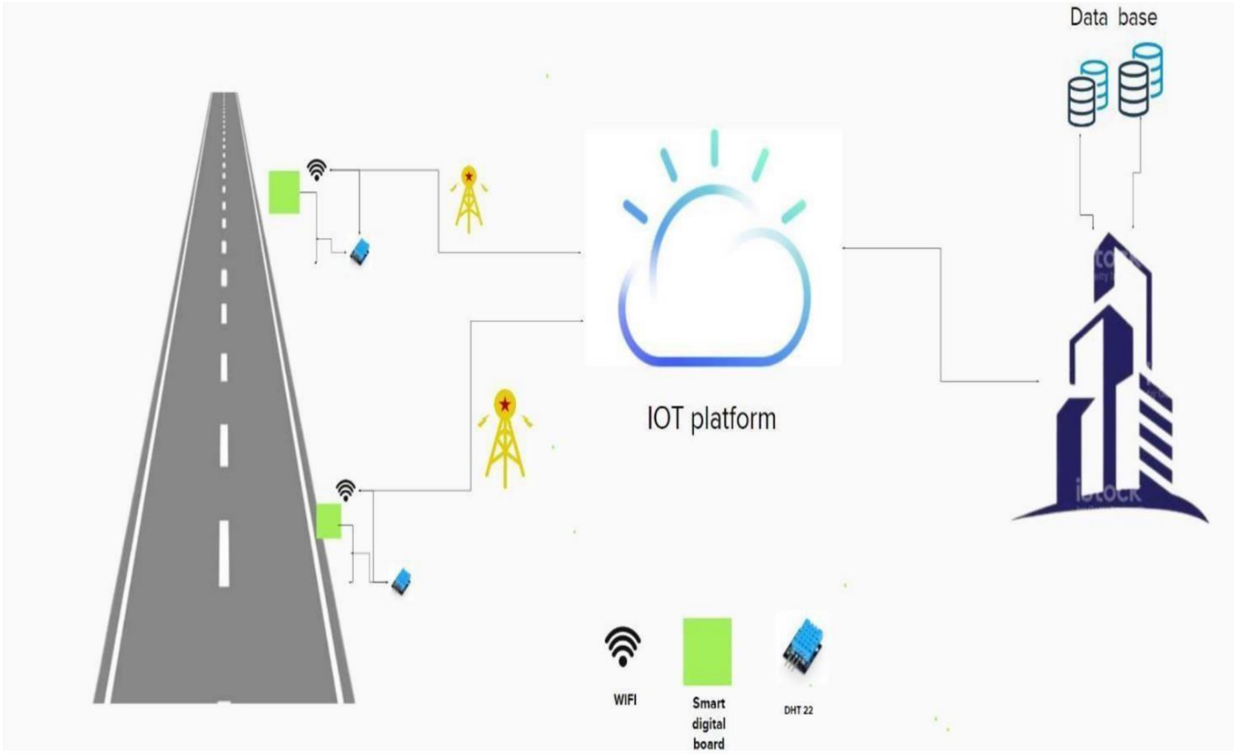

5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	I may use a weather programme to find out my speed limit.	I can get speed restrictions.	High	Sprint-1
		USN-2	I may sign up for the programme as a user by providing my email address, a password, and a password confirmation.	I can access my dashboard or account.	Medium	Sprint-2

		USN-3	I, as a user, may alter my pace in response to a change in the weather.	I can modify the vehicle's speed.	High	Sprint-1
		USN-4	I can receive traffic divert signs as a user based on traffic and potentially deadly scenarios.	To improve my route, I can access the traffic situation up ahead.	Medium	Sprint-1
	Login	USN-5	I may access the open weather map as a user by logging in using my email address and password.	I can log in to the programme using my Gmail account.	High	Sprint-2
	Interface	USN-6	The user interface needs to be straightforward and simple to use.	I can simply access the interface.	Medium	Sprint-1
Customer (Web user)	Data generation	USN-7	I utilize the open weather programme as a user to obtain information on weather changes.	Through the application, I may get weather-related information.	High	Sprint-1
Administrator	Problem solving/ Fault clearance	USN-8	As the authority in charge of ensuring the sign boards work properly must do through routine inspection.	The function of the sign boards may be checked by officials.	Medium	Sprint-2

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6.1 SPRINT PLANNING & ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	I may use a weather programme to find out my speed limit.	2	High	R. GAUTHAM GANESH, T.R. ANATHA KRISHNAN, P. SANTHIYA JINTHAN, R. TAMIZHARASAN
Sprint-2		USN-2	I may sign up for the programme as a user by providing my email address, a password, and a password confirmation.	1	Medium	R. GAUTHAM GANESH, T.R. ANATHA KRISHNAN, P. SANTHIYA JINTHAN, R. TAMIZHARASAN
Sprint-1		USN-3	I, as a user, may alter my pace in response to a change in the weather.	2	High	R. GAUTHAM GANESH, T.R. ANATHA KRISHNAN, P. SANTHIYA JINTHAN, R. TAMIZHARASAN
Sprint-1		USN-4	I can receive traffic divert signs as a user based on traffic and potentially deadly scenarios.	2	Medium	R. GAUTHAM GANESH, T.R. ANATHA KRISHNAN, P. SANTHIYA JINTHAN, R. TAMIZHARASAN
Sprint-2	Login	USN-5	I may access the open weather map as a user by logging in using my email address and password.	1	High	R. GAUTHAM GANESH, T.R. ANATHA KRISHNAN, P. SANTHIYA JINTHAN, R. TAMIZHARASAN

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Sprint-1	Interface	USN-6	The user interface needs to be straightforward and simple to use.	1	Medium	R. GAUTHAM GANESH, T.R. ANATHA KRISHNAN, P. SANTHIYA JINTHAN, R. TAMIZHARASAN
Sprint-1	Data generation	USN-7	I utilize the open weather programme as a user to obtain information on weather changes.	2	High	R. GAUTHAM GANESH, T.R. ANATHA KRISHNAN, P. SANTHIYA JINTHAN, R. TAMIZHARASAN

Sprint-2	Problem solving/ Fault clearance	USN-8	As the authority in charge of ensuring the sign boards work properly must do through routine inspection.	1	Medium	R. GAUTHAM GANESH, T.R. ANATHA KRISHNAN, P. SANTHIYA JINTHAN, R. TAMIZHARASAN

6.2 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	07 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	07 Nov 2022

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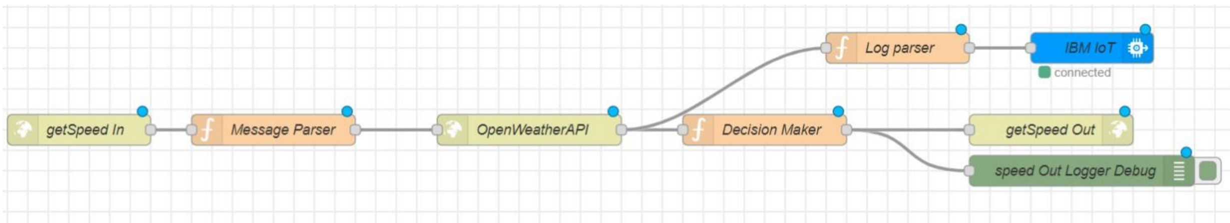
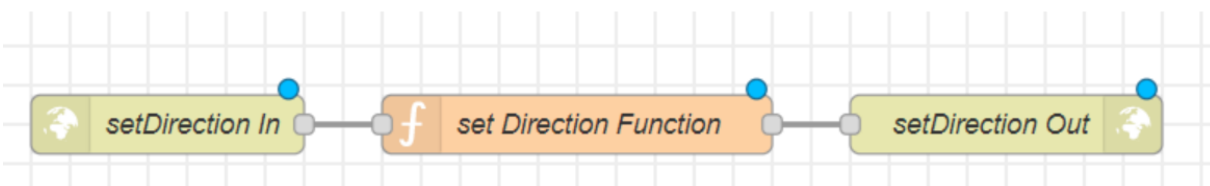
7.1 FEATURE 1-GEľ SPEED ÏOR GIVEN LOCAľION & CLIMAľE



The location, aid, and hospital/school zone information are supplied from a http GET end point at "/get Speed" to this section of the Node RED flow. The needed APIKEY for OpenWeatherAPI for the next block is set by the message parser. This information is then sent to Decision Maker, who decides what message should be shown and delivers it as a http response. This information is shown on the micro-controller. As a result of less processing time, a lot of battery is saved.

7.2 FEATURE 2-SEľ DIRECľION REMOľELY ÏOR A GIVEN SIGN BOARD



This section of the Node RED flow takes a http GET end point at "/set Direction," from which the relevant authorities pass the aid and direction data. The Set Direction function block updates the database with the direction data and provides a result that is identical to a http response. The microcontroller receives this information together with the "/get Speed" route and displays it.

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8.1 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.

8.2 USER ACCEPTANCE TESTING

Users may escape traffic and have a safe trip home thanks to dynamic speed and diversion modifications dependent on the weather and traffic. The users would be in favor of this concept being used worldwide.

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9.1 PERFORMANCE METRICS

The functionality of the website changes depending on the IBM bundle we choose. NodeRED can process up to 10,000 requests per second and is based on NodeJS, a lightweight and high-performance engine. Moreover, a bigger demand of clients may be satisfied because the system is horizontally expandable.

There are several advantages that smart technology and a smart city's transportation system mayoffer.

- Smart Transportation makes travel safer Autonomous transportation systems (both in cars and in stationary infrastructure like junctions) have shown to eliminate the "human factor" in accidents by merging machine learning with IoT and 5G. Computers don't become tired, upset, or distracted.
- Better management of smart transportation: Data gathering is a critical component of competent public management of infrastructure. In addition to providing comprehensive data points for every component of the transportation system, smart transportation also enables managers to more closely monitor operations, keep tabs on maintenance requirements, and pinpoint the major causes of issues that need to be rectified.
- Smart Transportation is More Efficient: Efficient utilization results from improved management. Finding opportunities to increase efficiency can be aided by high-quality data. The town may be better served by bus routes if stations were distributed differently, or even a modest change in train schedules might result in higher fill rates.
- Cost-effectiveness of smart transportation may be attributed to its improved resource use, which results in lower energy costs, fewer accidents, and cheaper expenses for preventative maintenance. When affordable public transportation is effective enough to compete with private automobile ownership, users can also save money.
- Rapid insights are provided by smart transportation: City traffic management centers (TMCs) can receive quick visibility and alerts for problem areas or city-wide issues that affect traffic on city streets, public safety, and emergency response systems. This allows TMCs to act quickly or communicate with other agencies and emergency responders more effectively.

The general public, local governments, and the entire globe may profit from several other advantages in addition to the improved management, safety, and efficiency already mentioned. Which are:

- Environmental aspects
- Security aspects
- Supply Chain Stability

While smart city transportation systems have many advantages, several drawbacks can also become apparent when they are put into place. These issues typically revolve around power usage and sensible data handling.

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Many sensors are needed for smart cities, and all those sensors need power. This requires batteries for sensors mounted to moving objects. Although stationary sensors might be able to run on solar power, they almost always require to be connected to the city's electrical system. Powering so many devices is a challenging issue because of the enormous number of sensors that are necessary for the globe to migrate to smart cities (estimated in the trillions). The number of raw materials required (such as copper) is substantially higher than what the global population is used to generating, even for sensors that are linked into the electrical grid.

Beyond issues of power, the use of personal data online is a hot topic right now. Data is the essential resource that smart cities require to function. Although much of the required data is anonymous when compared to internet data, this will necessitate a change in population mindset and behavior. Positional data will need to be gathered by vehicles, and sensors placed around a city will need to passively gather the signals that smartphones send throughout the day. To ensure that smart cities continue to prosper in the future, responsible rules and regulations for data management must be passed, regardless of how anonymous the data may be.

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In this project, static signs will be replaced with smart signs that can modify speed limits based on the weather, provide detour warnings in the event of an accident, and display alerts in the event of hospitals, schools, or construction.

This project may be put into action right away and, at a far cheaper cost, can take the place of static signage. This will lessen many accidents and provide a calmer traffic environment across the nation.

By giving the end-user (vehicle driver) the most precise information about the present road and traffic circumstances, the introduction of intelligent road sign groupings in real-life scenarios might have a significant influence on boosting driving safety. Smoother traffic flows and, more importantly, increased driver awareness of the road situation might arise from even the simplest of information displays, such as a suggested driving speed and the state of the road surface (temperature, ice, wet, or dry surface).

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13.1 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);
```


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```
}

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
```


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```
    {
      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);
```

13.2 GITHUB & PROJECT DEMO LINK

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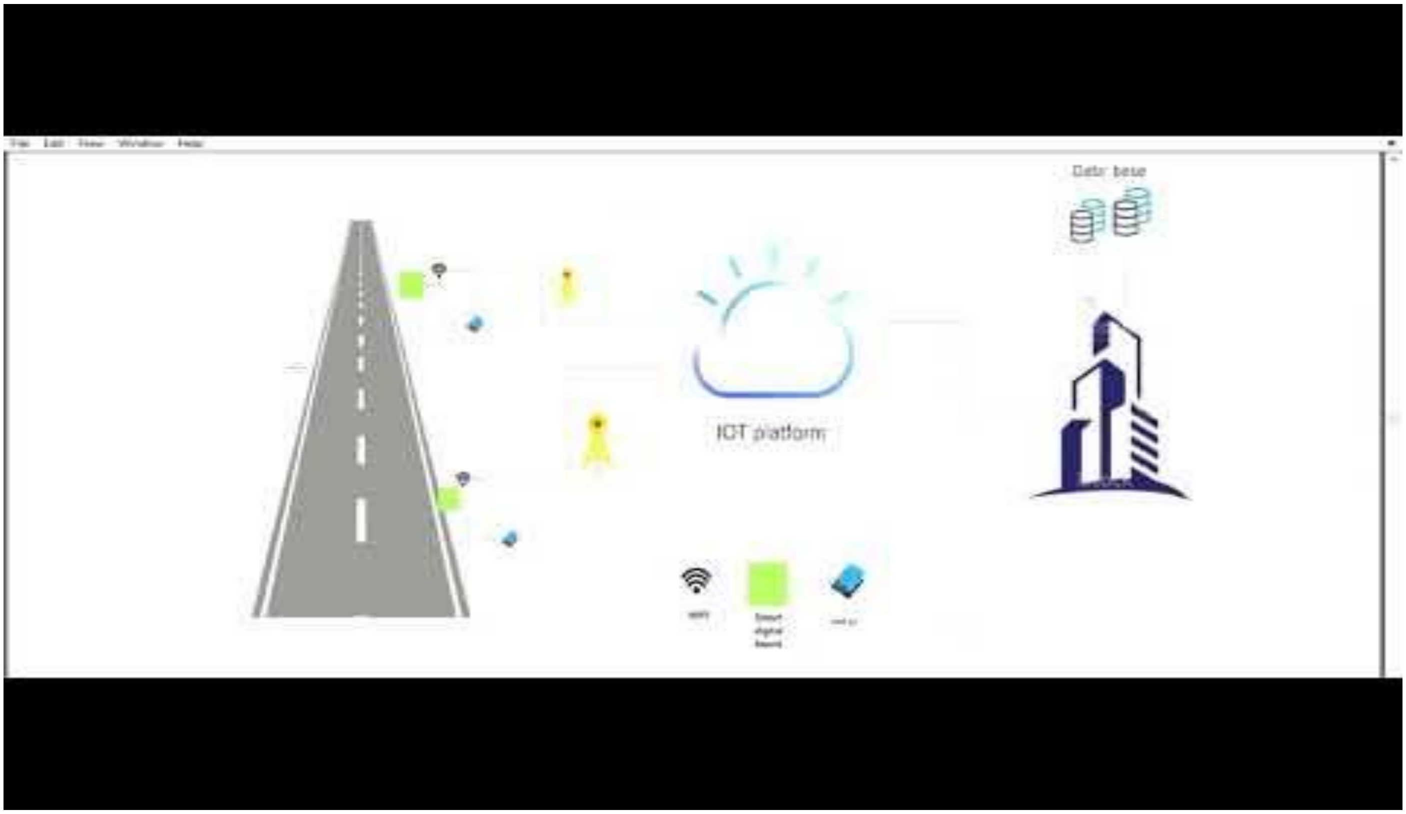

https://github.com/IBM-EPBL/IBM-Project-19810-1659706828/tree/main/Final-%20Deliverable/Project%20doc

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