VELALAR COLLEGE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

IBM PROJECT REPORT

Team ID : PNT2022TMID22921

Project Title : Signs with Smart Connectivity for Better Road

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Faculty Mentor(s) Name : R.Menaka

Team (5) :

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5. MohanRaj.E.J

Abstract:

In this paper, we propose a game theoretical adversarial intervention detection mechanism for reliable smart road signs. A future trend in intelligent transportation systems is “smart road signs” that incorporate smart codes (e.g., visible at infrared) on their surface to provide more detailed information to smart vehicles. Such smart codes make road sign classification problem aligned with communication settings more than conventional classification. This enables us to integrate well-established results in communication theory, e.g., error-correction methods, into road sign classification problem. Recently, vision-based road sign classification algorithms have been shown to be vulnerable against (even) small scale adversarial interventions that are imperceptible for humans. On the other hand, smart codes constructed via error-correction methods can lead to robustness against small scale intelligent or random perturbations on them. In the recognition of smart road signs, however, humans are out of the loop since they cannot see or interpret them. Therefore, there is no equivalent concept of imperceptible perturbations in order to achieve a comparable performance with humans. Robustness against small scale perturbations would not be sufficient since the attacker can attack more aggressively without such a constraint. Under a game theoretical solution concept, we seek to ensure certain measure of guarantees against even the worst case (intelligent) attackers that can perturb the signal even at large scale. We provide a randomized detection strategy based on the distance between the decoder output and the received input, i.e., error rate. Finally, we examine the performance of the proposed scheme over various scenarios. Index Terms—Game theory; Autonomous driving; Traffic sign recognition; Adversarial classification; Certifiable machine learning.

Project Objectives:

By the end of this project you will:

- Gain knowledge of Watson IoT Platform.
- Connecting IoT devices to the Watson IoT platform and exchanging the data and to display values.
- Gain knowledge of OpenWeatherMap API Service
- Creating a Web Application through which the user interacts with the device.

Project Flow:

- Receiving road sign values to the IBM IoT platform from Node-RED Web UI
- Weather conditions can be viewed in the Web Application

To accomplish this, we have to complete all the activities and tasks listed below:

- Create and configure IBM Cloud Services
- Create IBM Watson IoT Platform
- Create a device & configure the IBM IoT Platform
- Create Node-RED service
- Create a database in Cloudant DB to store location data
- Develop a web Application using Node-RED Service.
- Develop the web application using Node-RED.
- Develop a python script to publish the location details to the IBM IoT platform

Literature survey on Signs with Smart Connectivity For better road safety.

***Cyberabad Traffic Police (2017)Data from the official websiteabout Nehru Outer Ring Road*:**

It reveals some guidelines like, the maximum speed on Lane 1 and Lane 2 of theORR will be 120 KM per hour and minimum speed will be 80 KM per hour. (Lane1 is the one closest to the central median) The maximum speed on Lane 3 and Lane 4 of the ORR will be 80 KM per hour and minimum speed will be 40 KM per hour. The minimum speedon ORR will be 40 KM per hour. No vehicle is permitted to travel on ORR below this speed. Fastermoving vehicles shouldmove in Right Lanes (Lane1 and 2) and
slow-moving vehicles should move in Left lanes (Lane 3 and 4) within the above speed ranges. Heavy vehicles should move in Lane 3 or Lane4 only. All vehicles which change their speed shall have to go to the lane having the concerned speed range and No Zig – Zagmovement between the lanes is permitted. All vehicles wanting to change lanes as per the above speeds should do so only after using indicator lights and all precautions shall be taken while changing lanes. No Vehicle shall stop on any of the 4 lanes of ORR.Zarul azham Eusofe et al. Assessmentof Road Safety Management at Institutional Level in Malaysia, IATSS Research This paper had examined the current institutional arrangements for the management of road safety in Malaysia in a systematic manner. It focused on road safety funding and seemed to provide an insight into how funding factors may affect both the effectiveness and the efficiency or road safety management. The study followed an exploratory approach based on semi-structured interviews targeting key stakeholders in road safety management such as policy makers from various government agencies, private sector representatives and academia. The analysis revealed that the efficiency and effectiveness of the road safety management system in Malaysia may be sustainably improved by addressing the current dependence of funding solely on government sources, the fragmentation of the decision-making process of this de facto multi-disciplinary area, the road safety legislative framework, public awareness, local needs and institutional capacity. An institutional model based on 2nd generation road funds is tentative suggested to this effect. The paper presented a systematic analysis for the assessment of road safety management applicable in countries where financial resources are limited or reduced, focusing on road safety funding and seeking to provide an insight into how appropriately designed funding mechanisms may affect both the effectiveness and the efficiency of road safety management.

Francis John Gichaga etal. Road Safety and RoadSafety Audit in India:

A Review. ISSN:2347 - 4718 This paperhad reviewed the concept of the roadsafety audit and its stages. Objective of the RSA is to evaluate ventures for potential mishaps end/lessening on the premise of road client learning, characteristics and aptitudes, day/night, wet/dry road conditions. It suggested on outline and before planning of agreement archives, to evaluate itemized intersection design, markings, signs, signals, lighting points of interest, Detail Design of junctions, Design of geometrics, Cross-fall Marking and Signs, Side drains, Embankment slopes, Presence of clear zone, Traffic Signals Lighting.

Shalini Kanugantietal. Road Safety Analysis Using Multi CriteriaApproach, A Case Study in India:

World Conference on Transport Research - WCTR 2016 Shanghai. 10-15 July 2016 In this paper a study was carried out to determine the priority of safety requirements of a certain category of rural roads, viz., Pradhan Mantri Gram Sadak Yojana(PMGSY) roads in the Jhunjhunu district of Rajasthan, India. Multi-criteria techniques were used to quantify the safety levels. Further analysis was done on the road having the worst safety features to rank various stretches. The parameters vital for safety have been selected and quantified using three multi- criteria decision making analysis tools: Simple AdditiveWeightage (SAW), Analytical Hierarchy Process (AHP) and Fuzzy AHP methods andresults are compared. Analysis has been done in two phases. In the first phase the prioritization of roads for safety provision was carried out considering the total length of each road as an alternative and the most critical road was identified. The parameters in theroad were measured and rated (on a scale of 1-5). In the second phase, the road found critical from the first phase was considered for detail analysis. The entire stretch of the road was divided into stretches of 1 km and the stretch-wise prioritization of roads for safety provision was determined. The average values per km for the severity score of the parameters were obtained like the first phase. The methodology suggested can be used to determine the level of contribution of parameters towardssafety hazard.

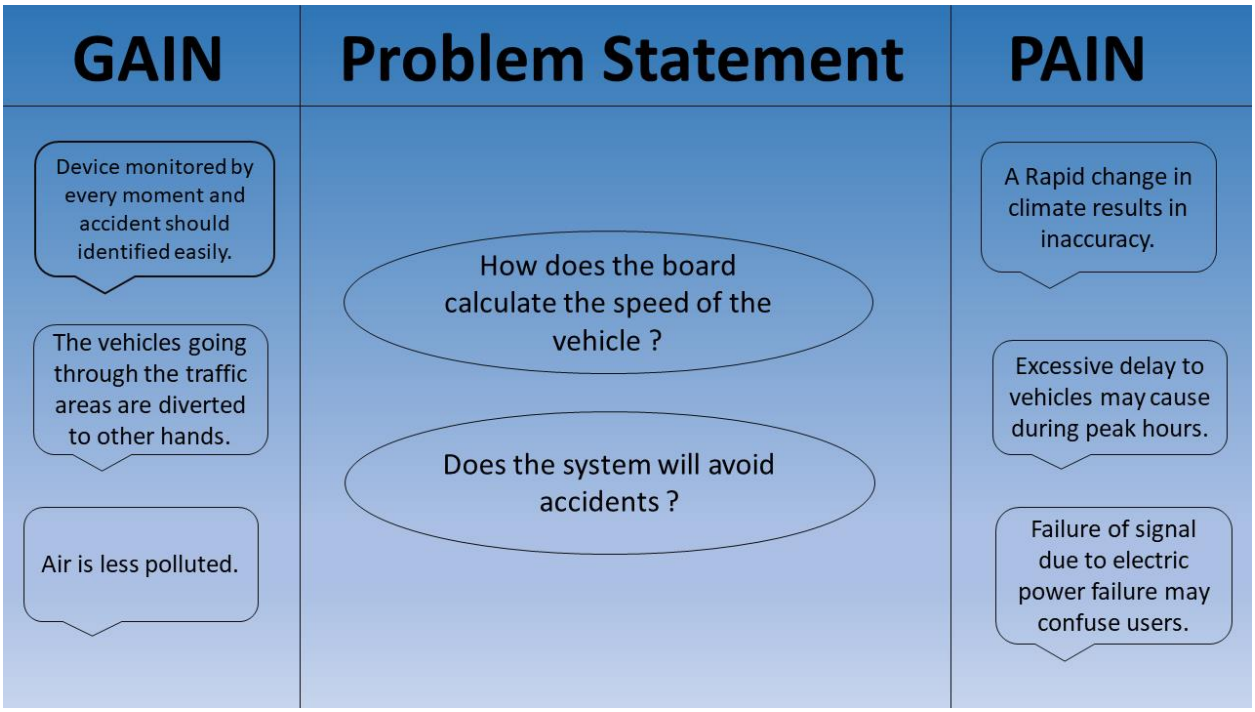
REFERENCE:

[1]. Cyberabad Traffic Police (2017)

[2].Francis John Gichaga,The Impact of Road Improvements on Road Safety and RelatedCharacteristics. IATSS Research(2016), University of Nairobi, Kenya

[3]. Shalini Kanugantietal. Road SafetyAnalysis Using Multi Criteria Approach:A Case Studyin India. World Conference on Transport Research- WCTR 2016 Shanghai. 10-15 July 2016.

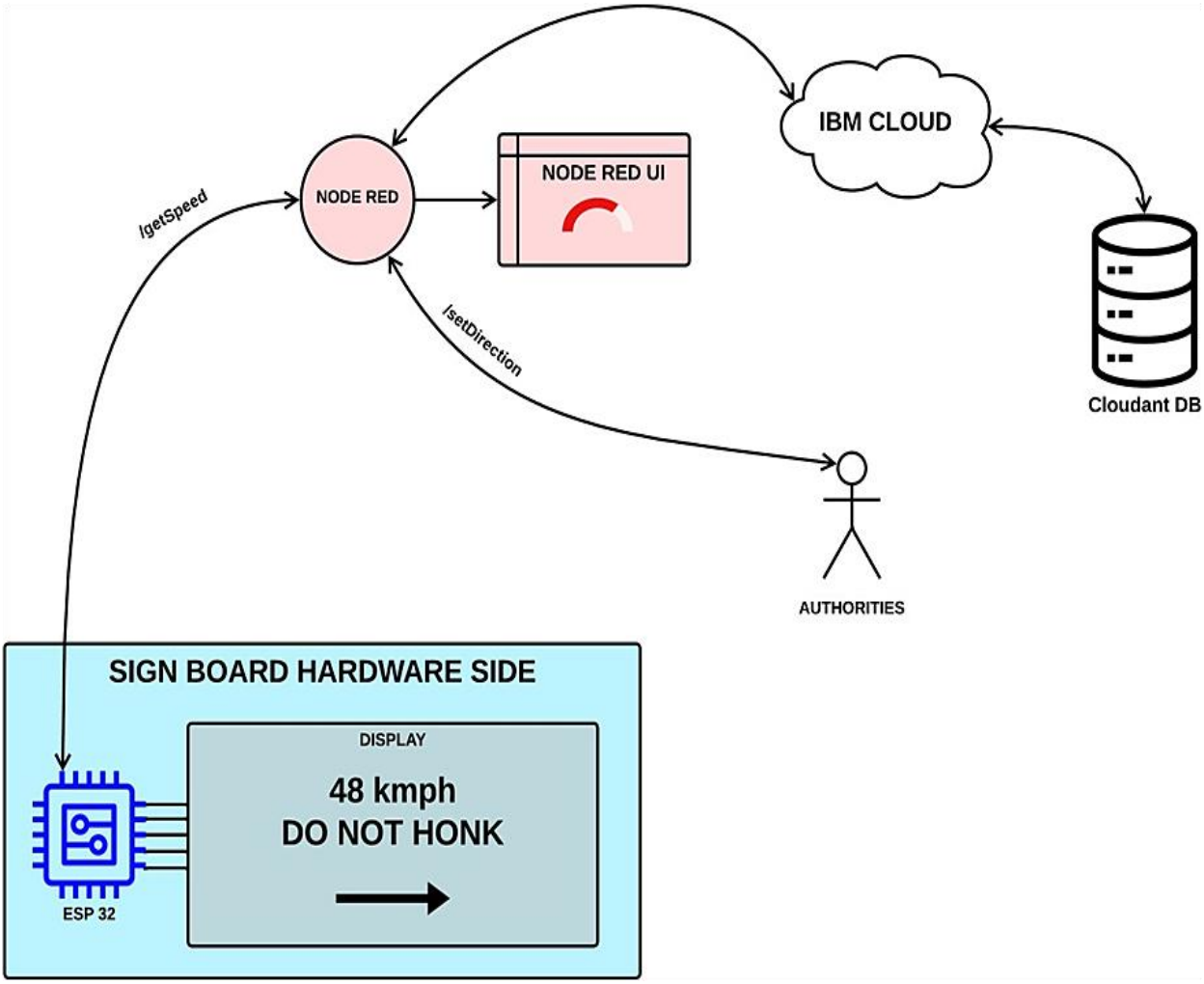
Empathy Map:


GAIN
Problem Statement
PAIN
Device monitored by every moment and accident should identified easily.
The vehicles going through the traffic areas are diverted to other hands.
Air is less polluted.
How does the board calculate the speed of the vehicle ?
Does the system will avoid accidents ?
A Rapid change in climate results in inaccuracy.
Excessive delay to vehicles may cause during peak hours.
Failure of signal due to electric power failure may confuse users.

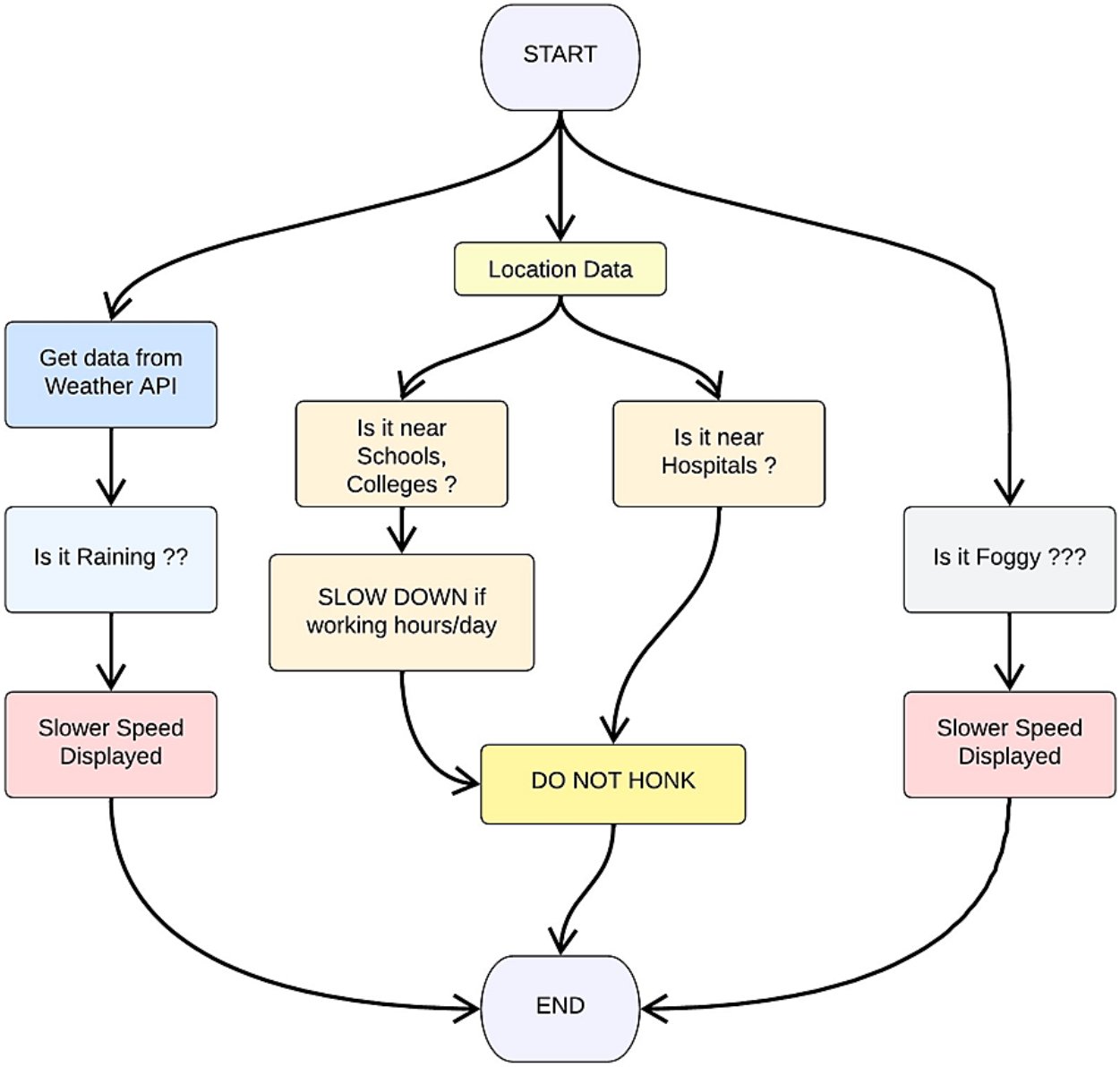
Methodology:

The embedded technology is the prime technology used here under the wireless as main domain; to achieve the concept here we are using ARDUINO UNO as the prime controller which uses ATMEGA-328 controller which is driven by 5V DC supply, the coding is donethrough the ARDUINO IDE and it is also dumped to the controller through the same IDE,the Embedded C language is used as the coding language, Arduino comprises of 12 digital pins, 6 analog pins, 1 5v, 3 ground pins and one serial pin. The digital pins can be used as the serial pins using the software serial communication, here we are using totally 5 sensor in which the alcohol and vibration sensors are used as the analog sensors while the eyeblink, proximity, and the seatbelt/helmet sensors are used as digital sensor. Each and everysensor consists of a 5V and ground pin which is given to the Arduino's 5V and ground pin,the input pin is given to the corresponding Arduino's input pin which is declared in the coding, since the alcohol sensor and the vibration sensor must met certain threshold so we are using that sensors as analog sensors which is connected to the corresponding analog as such like declared in the code. Here the eye blink sensor is used to detect the drowsiness of the driver; the proximity sensor is used to detect a very closeobstacle present in from of the vehicle, the alcohol sensor senses whether the driver consumes the alcohol[9], the seat belt/helmet sensor detect whether the driver is wearing the seat belt/helmet, the vibration sensor detects the accident of the vehicle. Here the 5V DC motor is used to indicate the vehicle's wheel is running or not, the buzzer is used for alarm indication, the GPS is used to get the location, the GSM is used to send the message the IOT is used to publish the datain cloud.

Process Flow :

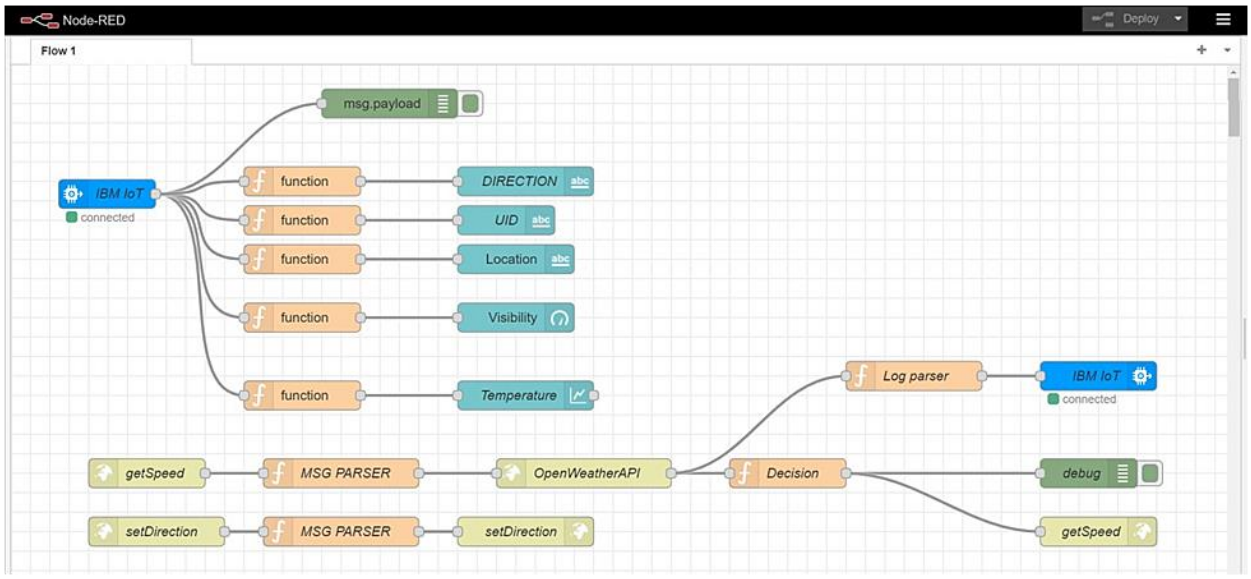


Code Flow :


START
Location Data
Get data from Weather API
Is it near Schools, Colleges ?
Is it near Hospitals ?
Is it Raining ??
SLOW DOWN if working hours/day
Is it Foggy ???
Slower Speed Displayed
DO NOT HONK
Slower Speed Displayed
END

Node RED :

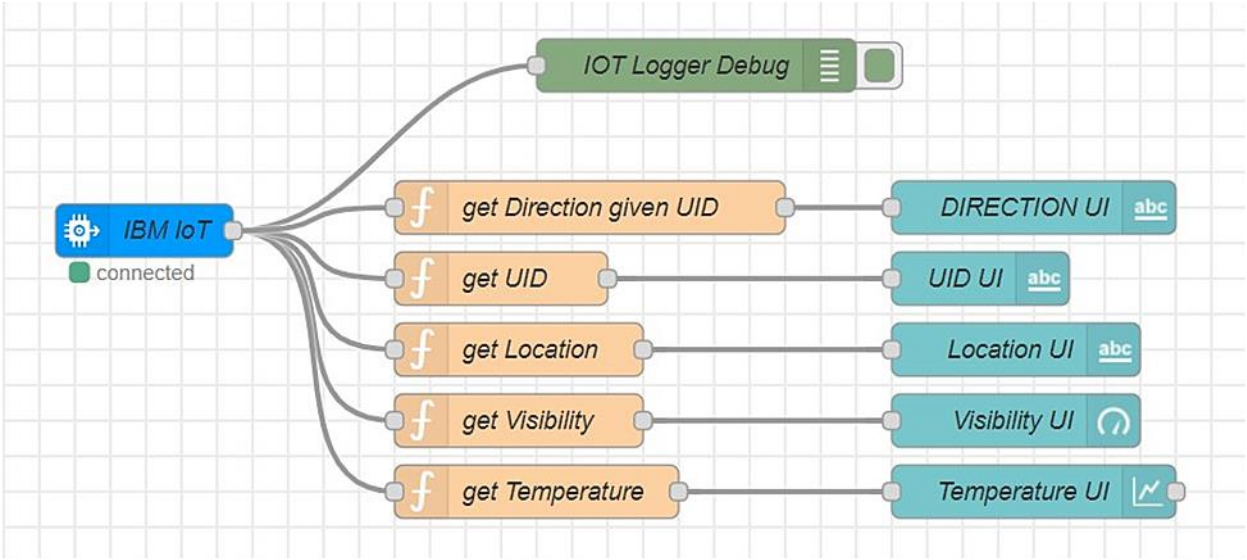
Node RED flow



There are 3 flows in the above Node REDflow. They are

1. Node RED UI flow
2. /getSpeed API flow
3. /setDirection API flow

1.Node RED UI flow :



1. "**IBM IOT**" node connects the backend to Node RED UI

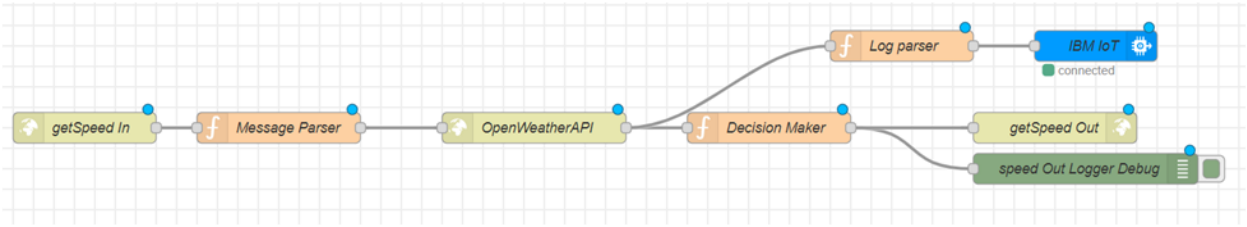
2. The function nodes such as "**get Direction given UID**", "**get UID**", "**get Location**", "**get Visibility**" & "**getTemperature**" extract the respective data out and provides them to the UI nodes "**Direction UI**", "**UIDUI**", "**Location UI**", "**Visibility UI**" & "**Temperature UI**".

```
// get Direction given UID
msg.payload =
global.get(String(msg.payload.uid));return msg;

// get UID
msg.payload =
msg.payload.uid;return msg;

// get Location
msg.payload =
msg.payload.location;return msg;

// get Visibility
msg.payload =
msg.payload.visibility;return msg;

// get Temperature
```

msg.payload =
msg.payload.temperature;return msg;

3."IOT Logger Debug" node logs the data at debugger.

1./getSpeed API flow :



1. "getSpeed In"node is an httpend point. It accepts parameters like microcontroller UID, location, school & hospital zones info.

2. "MessageParser" node parses the data and passes on only requiredinformation to the nextnode.

global.set("data",msg.payload);

msg.payload.q = msg.payload.location;
msg.payload.appid =
"bf4a8d480ee05c00952bf65b78ae826b";return msg;

3. "OpenWeatherAPI" nodeis a http request node which calls the OpenWeather API and send the data to the next node.

4. "Log Parser" node extracts specificparameters from the weather data andand sends it to the next node.

weatherObj =
JSON.parse(JSON.stringify(msg.payload));localityObj
= global.get("data");
var suggestedSpeedPercentage =

100;var preciseObject = {

```
    temperature : weatherObj.main.temp -
    273.15,location : localityObj.location,
    visibility :
    weatherObj.visibility/100,uid :
    localityObj.uid,
    direction: global.get("direction")
};
msg.payload =

preciseObject;return msg;
```

5. "IBM IoT" node here (IBM IoT OUT)connects the **"IBM IoT"** node (IBMIoT IN) metioned in the **Node RED UI flow** which enables UI updation andlogging.

6. "Decision Maker" node processes the weather data and other information from the microcontroller to form the stringthat is to be displayed at the SignBoard

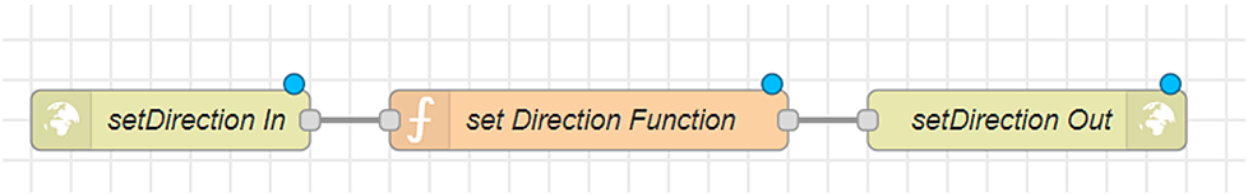
```
weatherObj =
JSON.parse(JSON.stringify(msg.payload));localityObj
= global.get("data");

var suggestedSpeedPercentage = 100;

var preciseObject = {
    temperature : weatherObj.main.temp - 273.15,
    weather : weatherObj.weather.map(x=>x.id).filter(code =>
    code<700),visibility : weatherObj.visibility/100
};

if(preciseObject.visibility<=40)
    suggestedSpeedPercentage -
    =30

switch(String(preciseObject.weather)[-1]) //
https://openweathermap.org/weather-conditions refer weather codes meaning
here
{
```

```
    case "0" : suggestedSpeedPercentage -
    =10;break;case "1" : suggestedSpeedPercentage
    -=20;break; case "2" :
    suggestedSpeedPercentage -=30;break;
}

msg.payload = preciseObject;

var doNotHonk = 0;
if(localityObj.hospitalZone=="1"||localityObj.schoolZone=="1")
    doNotHonk = 1;

var returnObject =
    {suggestedSpee
    d :
localityObj.usualSpeedLimit*(suggestedSpeedPercentage/100),
    doNotHonk : doNotHonk
}

msg.payload = String(returnObject.suggestedSpeed) + " kmph \n\n"
+(returnObject.doNotHonk==1?"Do Not Honk":"") + "$" +
global.get(String(localityObj.uid));

return msg;
```

7. "getSpeed Out"node returns a http responsefor the requestatnode **"getSpeedIn"**.

8. "speed Out LoggerDebug" logs the data for debugging.

3./setDirection API flow :



1. "setDirection In"node is an http end point. It accepts parameters like microcontroller UID & direction.

2. "set Direction Function" node sets the directionfor the given UID.
global.set(String(msg.payload.uid),msg.payload.dir);return msg;

3. "setDirection Out" node returns a http responsefor the requestatnode **"setDirection In"**.

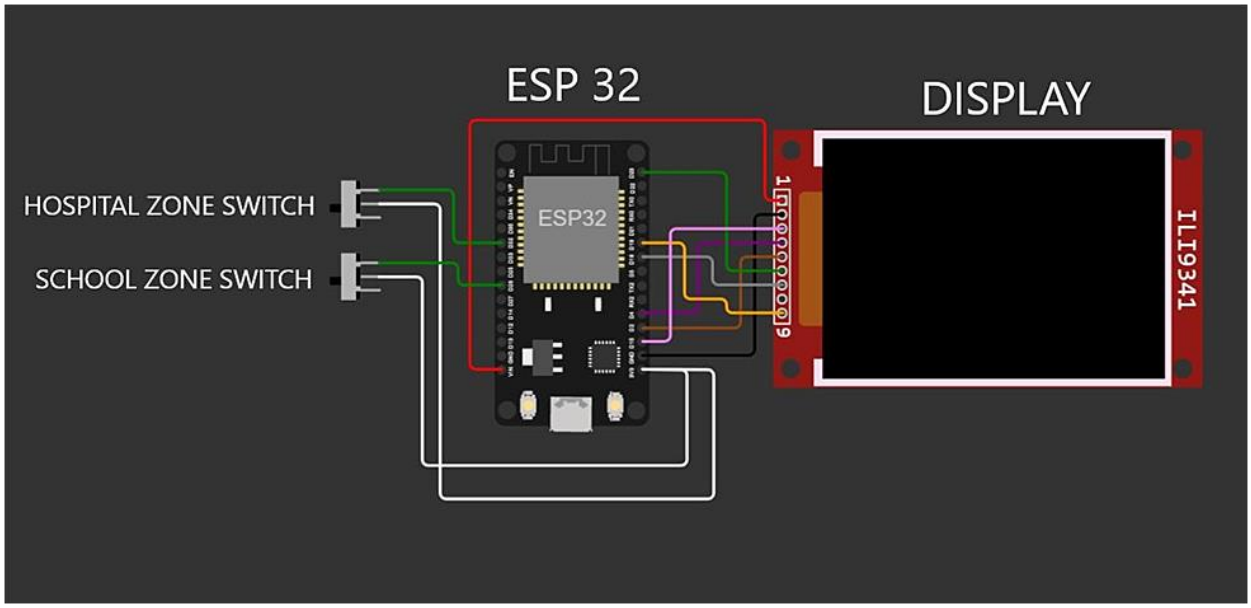
Wokwi

Circuit:

Wokwi Code

Wokwi Link

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 = "Wokwi-
GUEST";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
```

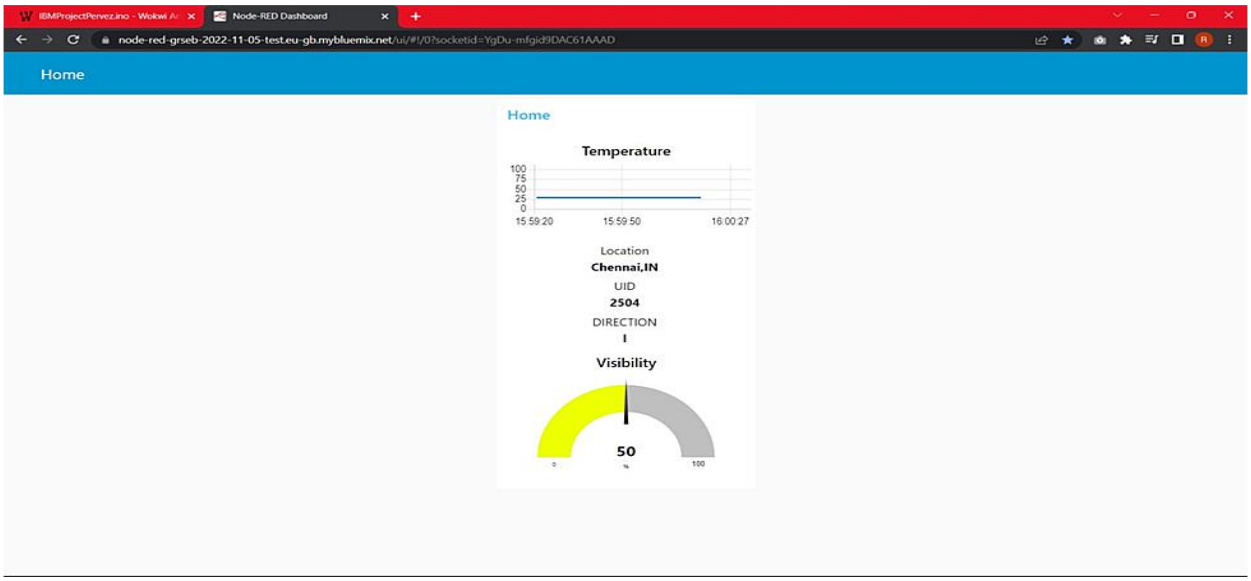
```
int schoolZone =
32; int hospitalZone
= 26;

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;
```

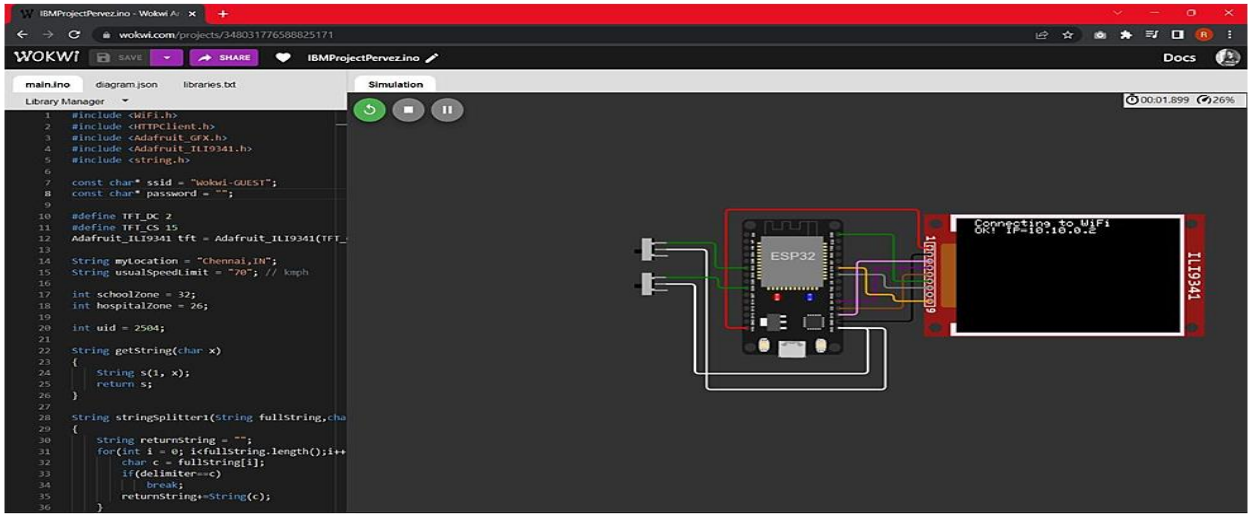
```
  String url = "https://node-red-grseb-2022-11-05-
test.eu-gb.mybluemix.net/getSpeed?";
  url += "location="+myLocation+"&";
  url += "schoolZone="+(String)digitalRead(schoolZone)+(String)"&";
  url +=
  "hospitalZone="+(String)digitalRead(hospitalZone)+(String)"&";url
  += "usualSpeedLimit="+(String)usualSpeedLimit+(String)"&";
  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_RE
  D);
  //tft.println(contents);

  tft.println(stringSplitter1(contents)
  );          String          c2          =
  stringSplitter2(contents);
  if(c2=="s") // represents Straight
  {
    upArrow();
```

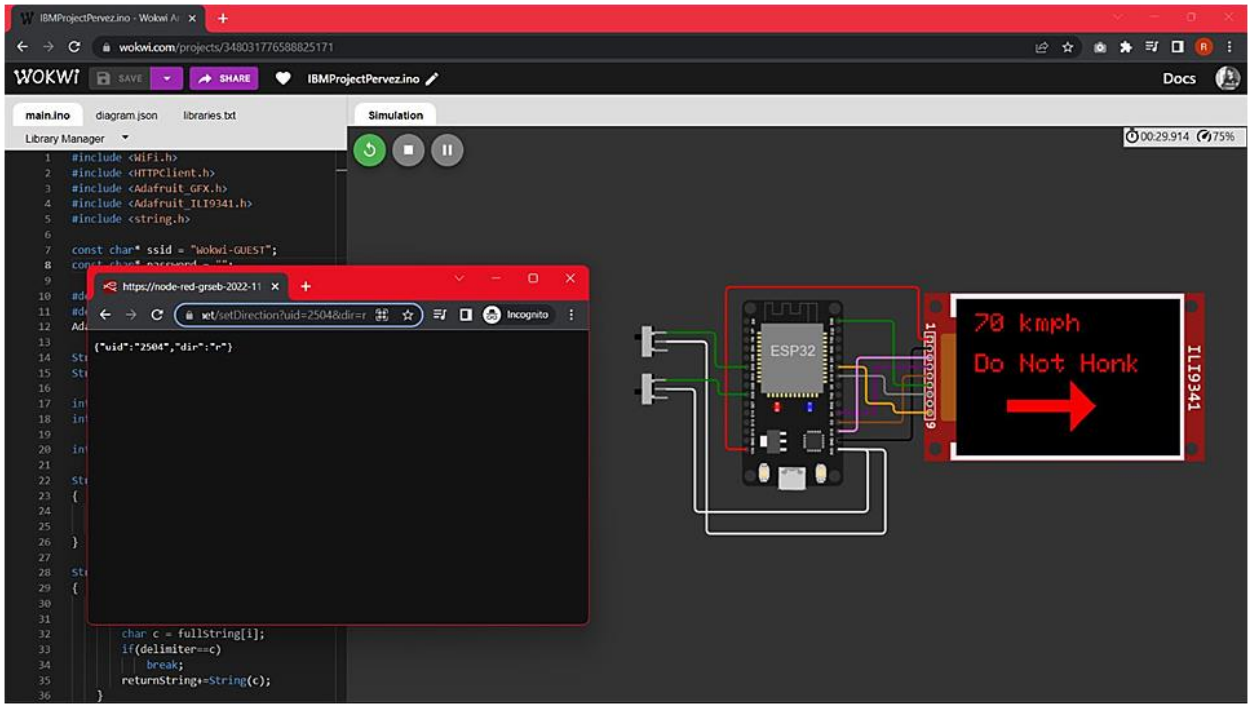
```
  }
  if(c2=="l") // represents left
  {
    leftArrow();
  }
  if(c2=="r") // represents right
  {
    rightArrow();
  }
}

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);
}
```

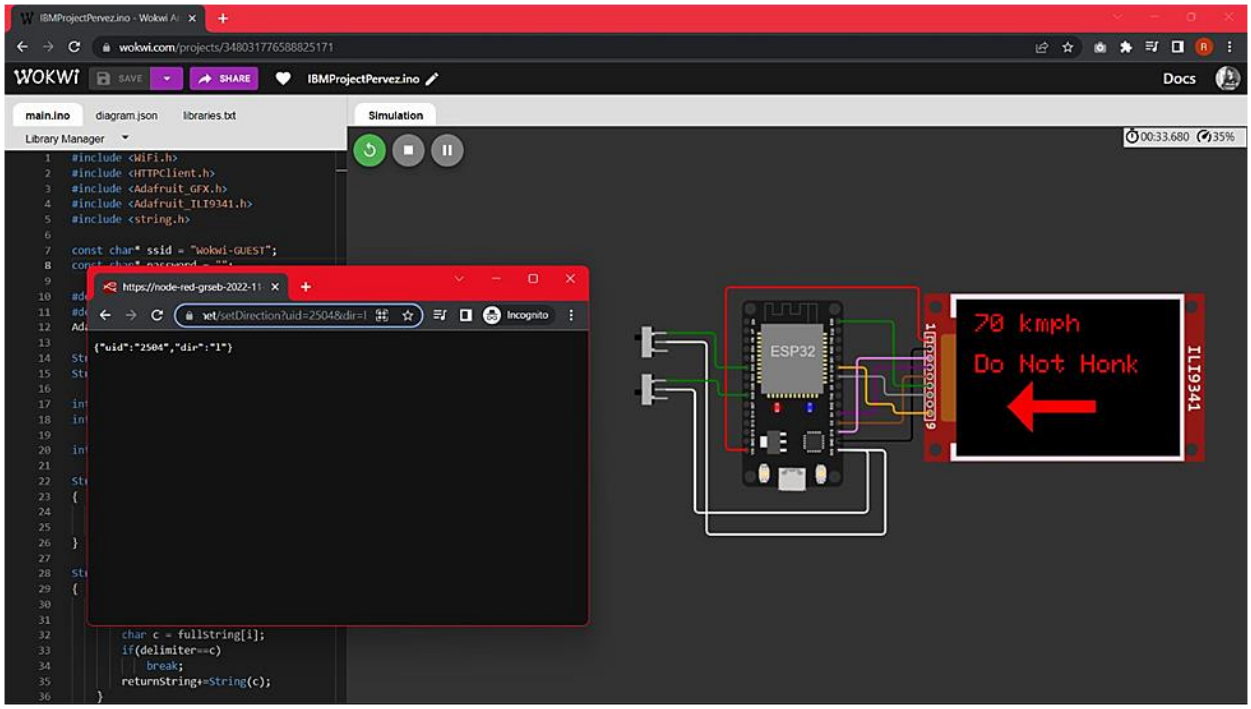
Output :



Wokwi Output :




wokwi.com/projects/348031776588825171
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
Incognito
{"uid":"2504","dir":"r"}
ESP32
70 kmph
Do Not Honk
ILI9341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SHARE
IBMProjectPervez.ino
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main.ino
diagram.json
libraries.txt
Library Manager
Simulation
00:33.680
35%
https://node-red-grseb-2022-11
Incognito
{"uid":"2504","dir":"l"}
ESP32
70 kmph
Do Not Honk
ILI9341

CONCLUSION:

A future trend in intelligent transportation systems is smart road signs equipped with smart codes. In addition to incorporating relatively larger amount of information, smart codes constructed via error-correction methods can provide robustness against small scale perturbations. The proposed game theoretical framework brings in new research directions for the applications of smart road signs in intelligent transportation systems. In the following, we identify some of these future research directions: We emphasize that sensor fusion where we collect information through several separate sources can lead to more resilient and robust systems . In the future, smart road signs combined with state-of-the-art vision-based roadsign recognition algorithms can provide both reliable and effective recognition by smart vehicles.For example, computer vision for (warehouse) inventory management or intelligent robotic sorting would constitute other interesting applications for the framework developed here.