SELVAM COLLEGE OF TECHNOLOGY NAMAKKAL

DEPARTMENT OF ELECTRONICS AND COMMUNICATION

ENGINEERING

HX 8001-PROFESSIONAL READINESS FOR INNOVATION,

EMPLOYABILITY AND ENTREPRENEURSHIP

Signs with Smart Connectivity for Better Road Safety

NALAIYA THIRAN PROJECT REPORT 2022

Submitted by

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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.

Road signs provide details to drivers to help them operate their vehicles safety. To be efficient, road signs must be visible and legible at a sufficient distance to allow drivers to take particular actions. However, static road signs are frequently missed by drivers making it difficult for them to respond in time.

The purpose of this study was to develop a system that uses a web application to notify drivers about road signs ahead. The development of the web application was motivated by the fact that internets are widely used nowadays. Web application include features such as a global positioning system (GPS), a database, microelectronic systems, and an inertial measurement unit (IMU). These web application features can be used to provide details about the location of road signs, the vehicle's speed, and the time required to reach the road signs ahead. As a result, web application provide a golden opportunity for enhancing vehicle safety.

The main contributions of this research are :

➤ A brief survey on the state of the art related to pre-accident as well as post-accident models, frameworks, and algorithms.

➤ Identification and reporting of disadvantage in previous studies related to accident detection.

➤ The concept of a smart road with an event-sensing capability, plus implementation and testing through various projects.

1.1 Project Overview :

The main aim of this project is to help people automate the roads by providing them with a Web Application through which they can display the parameters of the road like temperature, speed limit, and message, visibility of the roads. They also show guides for schools, colleges and provide services of displaying hospital zone, and restaurant signs accordingly.

1.2 Purpose:

A lot of research is being carried out in the domain of accident avoidance and accident alarms by a large amount of researchers and practitioners. To avoid accidents, many approaches are utilized to enhance safety measurements. For ease of reference, the literature on accident detection and avoidance is separated into three approaches: stand-alone, cooperative, and hybrid.

Stand-alone approaches use sensors, such as radar and light detection and ranging (LiDAR) sensor, for accident avoidance and detection, whereas cooperative approaches rely on V2X technology.

2. LITERATURE SURVEY :

2.1 WHAT IS SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY?

Traffic control is a big issue in today's world. Traffic jam is one of the major problems in a densely populated city where the population and number of running vehicles are much more than its capacity. Due to traffic jam a substantial portion of working is spent on streets which indirectly put adverse impact on economy and unavoidable road accident which results in the loss of lives. The number of vehicles is ever increasing while the city infrastructures are developing at a much slower rate. 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.

2.2 AUTHORS AND THEIR PROPOSAL

a. Fanny Malin∗ , Ilkka Norros, Satu Innamaa

In the year of 2019, Accident risk of road and weather conditions on different road types. This study was designed to investigate the relative accident risk of different road weather conditions and combinations of conditions. The study applied a recently developed method which is based on the notion of Palm probability, originating in the theory of random point processes, which in this case corresponds to picking a random vehicle from the traffic.

b. Chai K. Toh1 , Juan-Carlos Cano , Carlos Fernandez-Laguia , Pietro Manzoni , Carlos T. Calafate

In the year of 2018, Wireless digital traffic signs of the future. This paper discuss about the technological advances in the areas of wireless communications and embedded electronics and software, we foresee that, in the future, digital traffic sign posts will be capable of transmitting the traffic sign information wireless to road users, and this will transform our roads into intelligent roads, where signs will appear promptly and automatically on in-vehicle displays to alert the driver.

c. Kelly Borden, Marc LaBahn, Matt Milliken, Solomon Ortega

In the year of 2017, The goal of our project was to propose current and future Intelligent Transportation Systems (ITS) solutions to decrease fatalities in areas with high crash frequency, or hotspots, in New Mexico.

d. Redouan Lahmyed, Mohamed El Ansari & Zakaria Kerkaou

In the year of 2022, Redouan Lahmyed, Mohamed El Ansari & Zakaria Kerkaou proposed the paper "Automatic road sign detection and recognition based on neural network". This paper describes a novel system for automatic detection and recognition of road signs, which is achieved in two main steps. First, the initial image is pre - processed using DBSCAN clustering algorithm.

2.3 PROPOSED SYSTEM

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.

Significance Of the Study

The significance of this project work are:

- It will help in reducing the occurrence of possible collision or accident and thereby improve the confidence of the driver and the pedestrian plighting through the highways.

- The Project to allay the fear of time wastage at the junctions because of unevenly directions of traffic system.

- Since the system is capable of working for 24 hours uninterrupted thereby assured constant availability of traffic control service hence reduce human effort and energy

Implementation

As shown in Fig. 1, the wireless digital traffic sign post architecture replaces existing physical traffic signs with posts embedded with electronics hardware and software. The hardware functions as a communication device and server. The traffic sign is then wireless transmitted to a client receiver residing in the vehicle. The client device is usually a smart phone. Traffic light control system using microprocessor and also using micro controller is a unique traffic light controller makes simple use of assembly language programming with Intel 8085 microprocessor. It permits accident free control as a separate set of signals has been assigned to a direction. For instance, if one desires to move towards north, east or west from south, he is provided a single light signals for the respective directions. Consequently, the probability of confusion leading to an accident is reduced.

Fig. 3: *Programmable wireless digital traffic sign post architecture – where the sign post is a server capable of transmitting sign wireless to the driver's client device, which can be the car HUDs, car dashboard, ADAS display device, or a smart phone.*

INFERENCE OF LITERATURE SURVEY

The literature review of the papers that were referenced and those that serve as base paper and supporting paper helped to narrow down the main challenges that the proposed application might face. Also, it has served as a guide for the development of the application in the right way, using the necessary tools. From the Table 2.2, the following were inferred from the literature survey.

Table: Inference of the Literature Survey

| AUTHOR NAME	INFERENCE
Fanny Malin* , Ilkka Norros, Satu Innamaa	Accident risk of road and weather conditions on different road types
Chai K. Toh1 , Juan-Carlos Cano , Carlos Fernandez-Laguia , Pietro Manzoni , Carlos T. Calafate	Wireless digital traffic signs of the future
Kelly Borden, Marc LaBahn, Matt Milliken, Solomon Ortega	Improving Road Safety with Intelligent Transportation Systems
Redouan Lahmyed, Mohamed El Ansari & Zakaria Kerkaou	Automatic road sign detection and recognition based on neural network

2.4 Problem Statement Definition :

A problem statement is a concise description of an issue to be addressed or a condition to be improved upon. It identifies the gap between the current (problem) state and desired (goal) state of a process or product. Focusing on the facts, the problem statement should be designed to address the Five. The first condition of solving a problem is understanding the problem, which can be done by way of a problem statement.

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 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 that has digital signboards 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 on road diversions, accidentprone areas, and information sign boards can be entered through the web app. This data is retrieved and displayed on the signboards accordingly.

3. IDEATION & PROPOSED SOLUTION :

      3.1 Empathy Map Canvas :
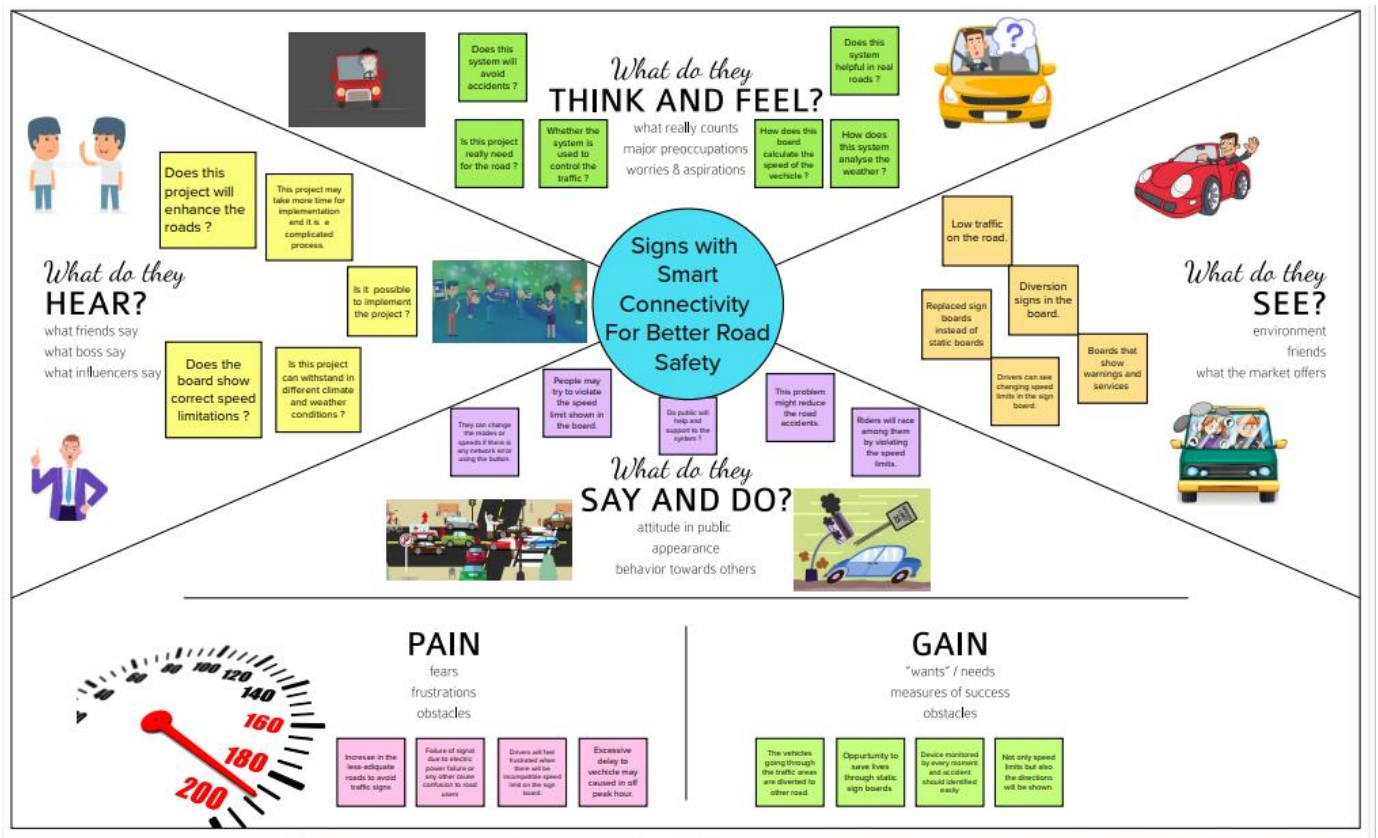
3.2 Proposed Solution :

The project team shall fill in the following information in the proposed solution template

S.No.	Parameter	Description

1.	Problem Statement	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.
2.	Idea description	The weather and temperature details are obtained from the OpenWeatherMap API. Using these details, the speed limit will be updated automatically in accordance with the weather conditions. Also, the details regarding any accidents and traffic congestion faced on the particular road are obtained .Based on this,the traffic is diverted followed by a change in map path and the traffic is cleared. So in the traffic sign board , some buttons will be placed which will be used to make it generic; where each button will be given a functionality such as changing the warning signs, which are predefined and separate signs will be present for both school and

S.No.	Parameter	Description

		hospital zones.By activating this button, either through the web application or the physical buttons, sign of the board can be changed accordingly, and the speed limit will also be set depending upon the zones. Also, the pedestrians are given an option to change the traffic signs if they want to cross the road. If the pedestrian presses the button that is present on the post at the end of the road, then the traffic will be analyzed immediately. Accordingly, the sign of the traffic signal will be changed. This inturn reduces the frequent changing of the traffic signs even if the pedestrians are not present.
3.	Novelty	Generic Sign board for all applications that uses both buttons and web service for updation Pedestrians are given the access to request the sign change of the signal to cross the road
4.	Customer Satisfaction	Diversion reasons will be displayed If there is no traffic, pedestrians can cross the street without waiting. Customer can reach the destination before the expected time
5.	Business Model	Since APIs are used to actively monitor the customer's environment, this project employs a business strategy in which revenue will be generated on the basis of the length of time in which the customers actively interact with the product. This product is aimed to be free of cost to the public, but the revenue will be generated by selling this product to the government at a low cost, so there will be less accidents and the public will be aware of the discrepancies or accidents in the particular road. The public will also gain all the information about the road, even if they are checking for an alternate path because of some mishaps that happen on the roads and these functionalities will increase the value of the product in the global market.

S.No.	Parameter	Description
6.	Scalability of the Solution	In the future, if any update is required either on the hardware or software side, it can be easily implemented. The hardware components can be directly interfaced with the microcontroller and small modifications can be made in the programming of the existing product. In case of the software, the website application has to be updated with the additional functionality by creating a new section for the updated hardware. So this will not affect the existing functionality of the product and new functionality can be easily integrated. In addition, a separate circuit will be kept along with the hardware to detect any problem which informs the web application. Also a notification will be sent to the product service department.

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3.3 Problem Solution fit :

| 1. CUSTOMER SEGMENT(S) **CS**
Who is your customer?

The public people to make the safe journey and elite drive static TIP signboard used. Speed Limit from web app by weather API. IOT it's connected to Open Weather MAP. | 6. CUSTOMER CONSTRAINTS **CC**
What constraints prevent your customers from taking action or limit their choices of solutions?

The digital smart sign boards has enable road and people for safety and open weather API and web application used to user to know the weather conditions any where.
An IOT based smart connected digital sign boards for better road safety is more effective for people | 5. AVAILABLE SOLUTIONS **AS**
Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros & cons do these solutions have?

Static sign boards are replaced and smart sign boards were used
MERITS: It can predict the traffic in earlier is helpful to drivers the people in another way
DMERITS: The highways, static signs |

Define CS, fit into CC ... *Explore AS, differentiate*

| 2. JOBS-TO-BE-DONE / PROBLEMS **J&P**
Which jobs-to-be-done (or problems) do you address for your customers?

There is a need to change static sign boards into dynamic smart connected sign boards.

These smart connected sign boards gather the speed limitations form web application using weather API and update automatically | 9. PROBLEM ROOT CAUSE **RC**
What is the real reason that this problem exists? What is the back story behind the need to do this job?

• The lack of vague road ways
• Based on the weather changes the speed may increase or decrease
• The incorrect road ways
• Overtaking on the wrong side | 7. BEHAVIOUR **BE**
What does your customer do to address the problem and get the job done?

As a guider, the IOT cloud updates the smart connected digital sign boards on the condition of the roads on a regular basics
Guide schools, warning and services, hospitals, restaurants sings are also displayed accordingly |

Focus on J&P, tap into BE, understand RC

| 3. TRIGGERS **TR**
What triggers customers to act?
It can detect the current weather conditions and react automatically according to open the weather map

4. EMOTIONS: BEFORE / AFTER **EM**
How do customers feel when they face a problem or a job and afterwards?
The customers essential need is to avoid accidents, the purpose of making smart sign boards to establish safe journey among to the people | 10. YOUR SOLUTION **SL**
If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality.
• If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behavior.

• The IOT based digital sign boards with smart connectivity for better road safety using open weather API to predict the weather in earlier stage that lead to help the people.
• These smart connected sign boards gather the speed limitations from web application using weather API and a update information's automatically | 8. CHANNELS of BEHAVIOUR **CH**
8.1 ONLINE
What kind of actions do customers take online? Extract online channels from #7

We notify the all information about of weather / traffic in web application

8.2 OFFLINE
What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.

User use the digital sign board that indicates information about road safety |

4. REQUIREMENTS ANALYSIS :

Requirements analysis, also called requirements engineering, is the process of determining user expectations for a new or modified product. These features, called requirements, must be quantifiable, relevant and detailed. In software engineering, such requirements are often called functional specifications. Requirements analysis is an important aspect of project management. Requirements analysis involves frequent communication with system users to determine specific feature expectations, resolution of conflict or ambiguity in requirements as demanded by the various users or groups of users, avoidance of feature creep and documentation of all aspects of the project development process from start to finish. Energy should be directed towards ensuring that the final system or product conforms to client needs rather than attempting to mold user expectations to fit the requirements. Requirements analysis

is a team effort that demands a combination of hardware, software and human factors engineering expertise as well as skills in dealing with people. The purpose of the Requirements Analysis Phase is to transform the needs and high level requirements specified in earlier phases into unambiguous (measurable and testable), traceable, complete, consistent, and stakeholder approved requirements.

4.1 Functional requirements :

5. Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement(Epic)	Sub Requirement(Story/Sub-Task)
FR-1	User Visibility	Sign Boards should be 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 Understanding	illustrations which will make it easily understandable to the driver.
FR-3	User Convenience	The display should be big enough that it should even be visible from far distance clearly.

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 is able to 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 :

Project design is an early phase of the project lifecycle where ideas, processes, resources, and deliverables are planned out. A project design comes before a project plan as it's a broad overview whereas a project plan includes more detailed information.

5.1 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.
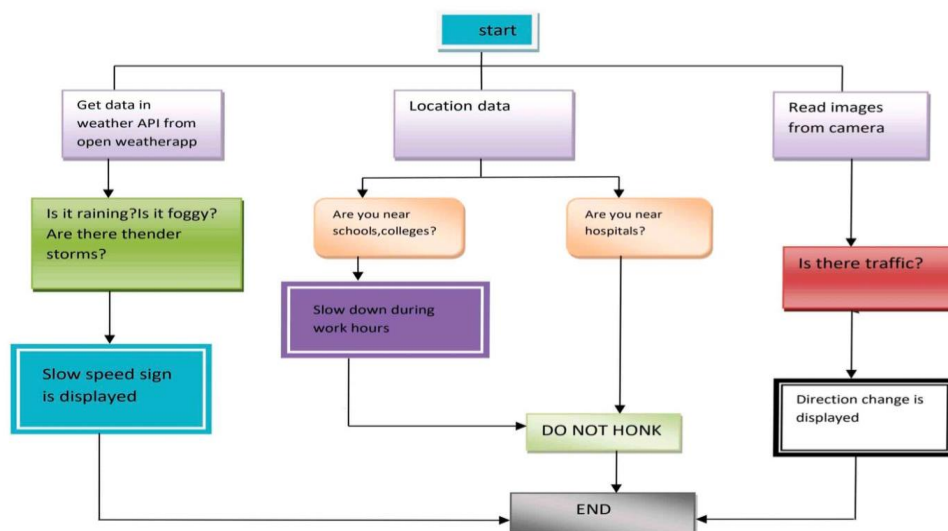
5.2 Solution & Technical Architecture :

The diagram makes it simple to understand how the data you gather about the environment relates to both the physical and logical decisions you make for your design.
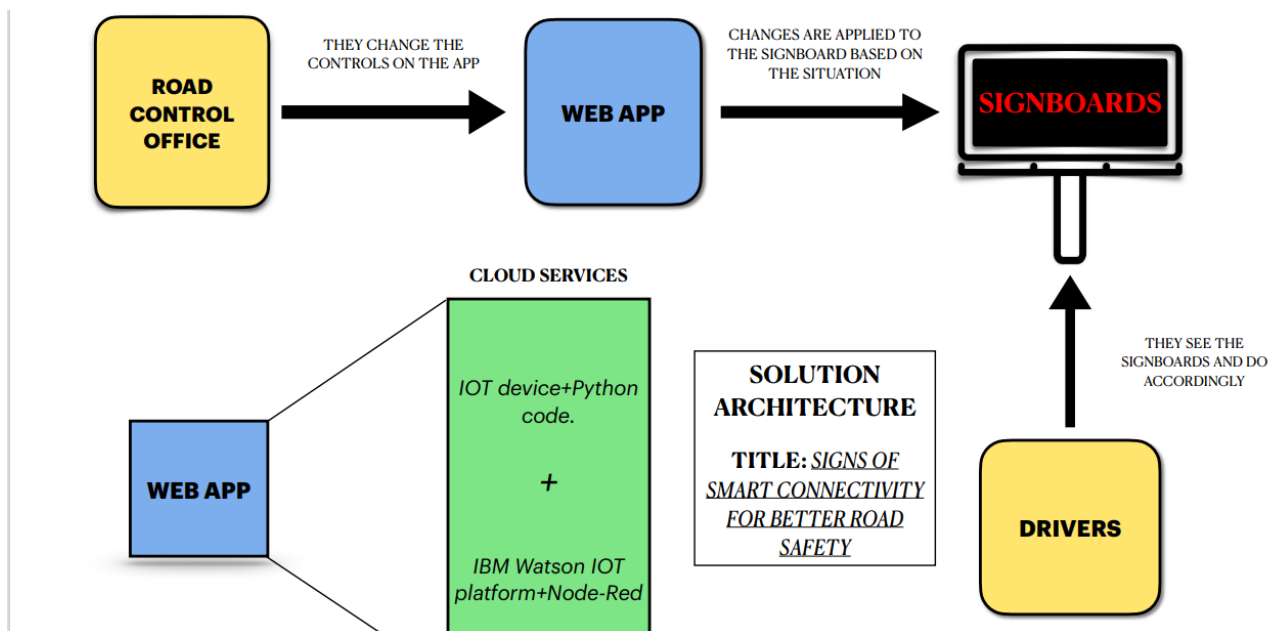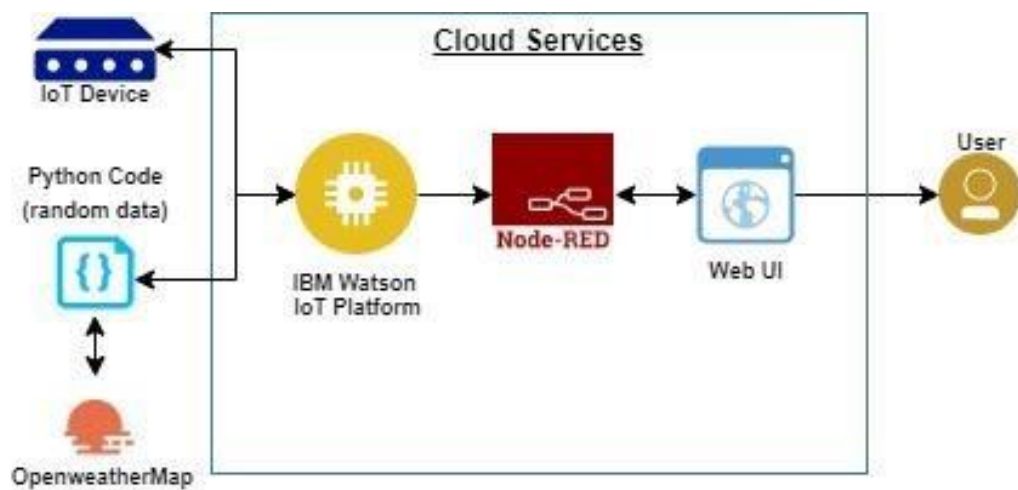
5.3 User stories :

A user story is the smallest unit of work in an agile framework. It's an end goal, not a feature, expressed from the software user's perspective. 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. Note that "customers" don't have to be external end users in the traditional sense, they can also be internal customers or colleagues within your organization who depend on your team. User stories are a few sentences in simple language that outline the desired outcome. They don't go into detail. Requirements are added later, once agreed upon by the team.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	I can get my speed constraint utilizing climate application	I can get speed restrictions	High	Sprint-1
		USN-2	As a client, I can enroll for the application byentering my email, secret phrase, and confirmingmy secret phrase.	I can get to my account/dashboard	Medium	Sprint-2
		USN-3	As a client, I can increment or diminishing my speed as indicated by the weather conditions change	I can increment or decline my speed	High	Sprint-1
		USN-4	As a client, I could I at any point get my traffic redirection signs relying upon the traffic and the lethal circumstances	I can get to my traffic status ahead in my movement	Medium	Sprint-1
	Login	USN-5	As a client, I can sign out from the dark climate map by entering email and secret key	I can get to the application through my Gmail login	High	Sprint-2
	Interface	USN-6	As a client the connection point ought to be straightforward and effectively open	I can access the point of interaction without any problem	High	Sprint-1
Customer (Web user)	Data generation	USN-7	As a client I utilize open climate application to access the information in regards to the weather conditions changes.	I can get to the information concerning climate through the application	High	Sprint-1
Administrator	Problem solving/ Fault clearance	USN-8	As an in authority charge for the legitimate working of the sign sheets need to keep up with it through occasional observing	Authorities can screen the sign sheets for legitimate working.	Medium	Sprint-2

6. PROJECT PLANNING & SCHEDULING :

The definition of a sprint is a dedicated period in which a set amount of work will be completed on a project. It's part of the agile methodology, and an Agile project will be broken down into a number of sprints, each sprint taking the project closer to completion.

6.1 Sprint Planning & Estimation :

Use the below template to create product backlog and sprint schedule.

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register on the website by entering my email, password, and confirming my password.	3	High	Syed Hussain S
	Registration	USN-2	As a user, I will receive confirmation email once I have registered on the website.	3	High	Maanish J
	Login	USN-3	As a user, I can log into the website by entering email & password.	1	Low	Tamilarasan T
	Develop UI	USN-4	Develop UI for the website	3	High	Sanjay R

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2	Dashboard	USN-1	As a user, I can view details of road rules and safety.	2	Medium	Syed Hussain S
	Dashboard	USN-2	As a user, I can check if there are any fines charged on me.	2	Medium	Maanish J
	Admin	USN-3	As an admin, I can login to the website using my credentials	3	High	Tamilarasan T
	Admin	USN-4	As an admin, I can access the data regarding any traffic violations and I can charge fines.	3	High	Sanjay R

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-3	API Integration	USN-1	Integrate the necessary API's.	3	High	Syed Hussain S
	Data Collection	USN-2	Collect data for image processing	2	Medium	Maanish J
	API Data	USN-3	Check data from weather and map API.	2	Medium	Tamilarasan T
	Hardware Integration	USN-4	Integrate NodeMCU, Display, Speed Cam with Raspberry Pi.	3	High	Sanjay R

6.2 Sprint Delivery Schedule :

Project Tracker, Velocity & Burndown Chart :

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

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 = Sprint duration / Velocity)
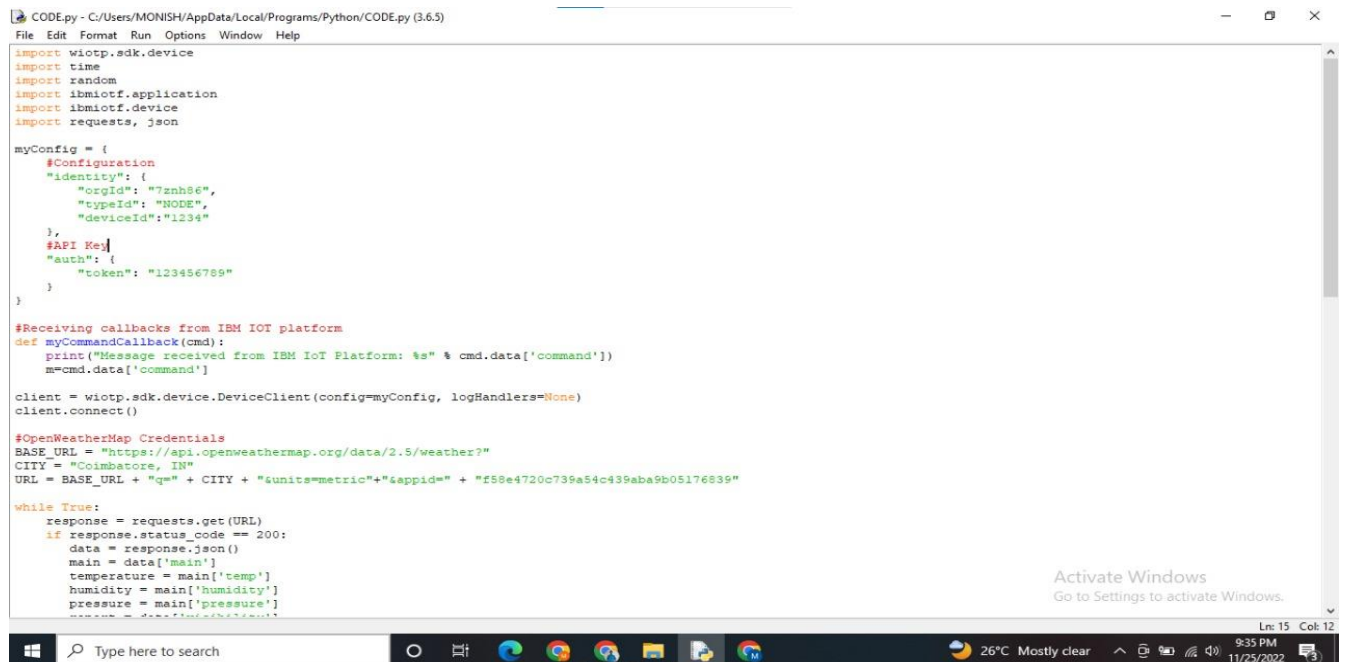
Burndown Chart :

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.

7. CODING & SOLUTIONING :

7.1 Feature 1 :

OUTPUT:

To connect the IBM watson IOT platform:

7.2 Feature 2 : (Node-red web UI Output)

Message
NEED HELP, POLICE STATION AHEAD

Speed **Limit Exceeded**

gauge

104

Sign

Visibility

Temperature

Message
DINE IN, RESTAURENT AVAILABLE

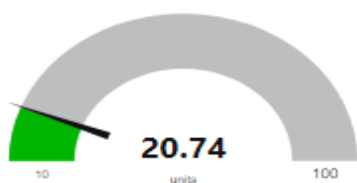Speed **Slow**

Sign

Visibility **Fog Ahead, Drive Slow**

gauge
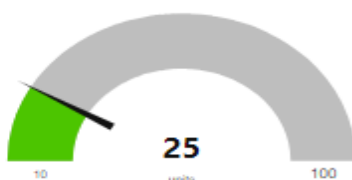
17

temperature

20.74
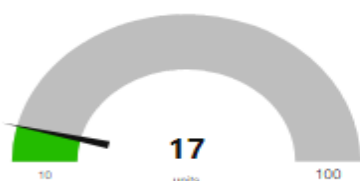
Message
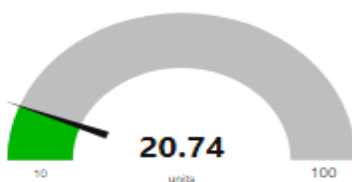**EMERGENCY, HOSPITAL NEARBY**

Speed **Slow**

Sign **Speed Breaker**

Visibility **Fog Ahead, Drive Slow**

gauge

25

temperature

20.74

Message
NEED HELP, POLICE STATION AHEAD
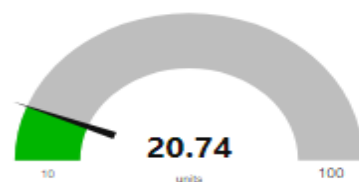
Speed **Limit Exceeded**

Sign **Speed Breaker**

Visibility **Fog Ahead, Drive Slow**

gauge

121

temperature

20.74

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).

8.1 User Acceptance Testing :

User Acceptance Testing (UAT), also known as beta or end-user testing, is defined as testing the software by the user to determine whether it can be accepted or not. This is the final testing performed once the functional, system and regression testing are completed. The main purpose of this testing is to validate the software against the business requirements. This validation is carried out by the end-users who are familiar with the business requirements. UAT, alpha and beta testing are different types of acceptance testing. As the user acceptance test is the last testing that is carried out before the software goes live, obviously this is the last chance for the customer to test the software and measure if it is fit for the purpose. Need for user acceptance testing arises once software has undergone Unit, Integration and System testing because developers might have built software based on requirements document by their own understanding and further required changes during development may not be effectively communicated to them, so for testing whether the final product is accepted by client/end-user, user acceptance testing is needed. • Developers code software based on requirements document which is their "own" understanding of the requirements and may not actually be what the client needs from the software. • • Requirements changes during the course of the project may not be communicated effectively to the developers.

Defect Analysis :

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	3	2	2	17
Duplicate	1	1	3	0	5
External	2	1	1	1	5
Fixed	9	2	3	18	32
Non Reproduced	1	1	1	0	3
Skipped	1	1	2	1	5
Won't Fix	0	2	1	2	5
Totals	24	11	13	24	72

Test case Analysis :

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	4	0	1	3
Client Application	42	0	3	39
Security	3	0	0	3
Outsource Shipping	3	0	0	3
Exception Reporting	12	0	3	9
Final Report Output	6	0	1	5
Version Control	2	0	0	2

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.

9.   RESULTS :

9.1 Performance Metrics :

Performance metrics are defined as figures and data representative of an organization's actions, abilities, and overall quality. There are many different forms of performance metrics, including sales, profit, return on investment, customer happiness, customer reviews, personal reviews, overall quality, and reputation in a marketplace. Performance metrics can vary considerably when viewed through different industries. Performance metrics are integral to an organization's success. It's important that organizations select their chief performance metrics and focus on these areas because these metrics help guide and gauge an organization's success. Key success factors are only useful if they are acknowledged and tracked.

10. ADVANTAGES & DISADVANTAGES :

Advantages :

Connected vehicles have various benefits such as,

➤ It will manage road conditions, creating a more sustainable environment within cities.

➤ Multimodal sensors and edge computing help speed up the flow of traffic with real-time processing, reducing congestion and emissions.

➤ Smart road technology can assist in optimizing traffic flow

➤ Improved control and safety can be achieved through IoT-enabled cars. In case of overspeeding, the notification gets displayed.

➤ Ensuring a safe driving experience with real-time assistance, navigation, and even monitoring driving patterns and any emergency. Additionally, along with the state of the traffic, IoT drivers can receive updated information on the state of the roads, i.e., potholes, ice, grade changes, black spots, etc.,

Disadvantages :

Security and privacy. Keeping the data gathered and transmitted by IoT devices safe is challenging, as they evolve and expand in use.

➤ Technical complexity.

➤ Connectivity and power dependence

➤ Integration.

➤ Higher costs (time and money)

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.

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 design 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.

13. APPENDIX :

13.1: Source Code :

```
import wiotp.sdk.device

import time import

random import

ibmiotf.application

import ibmiotf.device

import requests, json


myConfig = {

#Configuration

   "identity": {

      "orgId": "7znh86",

      "typeId": "NODE",

      "deviceId":"1234"

   },

   #API Key

   "auth": {

      "token": "123456789"

   }

}


#Receiving callbacks from IBM IOT platform def

myCommandCallback(cmd):

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

   m=cmd.data['command']
```

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


#OpenWeatherMap Credentials
BASE_URL = "https://api.openweathermap.org/data/2.5/weather?"
CITY = "Salem, IN"
URL = BASE_URL + "q=" + CITY + "&units=metric"+"&appid=" +
"f58e4720c739a54c439aba9b05176839"


while True:
    response = requests.get(URL)
    if response.status_code == 200:
        data = response.json()
        main = data['main']
        temperature = main['temp']
        humidity = main['humidity']
        pressure = main['pressure']
        report = data['visibility']
        #messge part
        msg=random.randint(0,5)
        if msg==1:
            message="GO SLOW, SCHOOL ZONE AHEAD"
        elif msg==2:
            message="NEED HELP, POLICE STATION AHEAD"
        elif msg==3:
            message="EMERGENCY, HOSPITAL NEARBY"
        elif msg==4:
            message="DINE IN, RESTAURENT AVAILABLE"
```

```python
    elif msg==5:
        message="PETROL BUNK NEARBY"
    else:
        message=""


    #Speed Limit part
    speed=random.randint(0,150)
    if speed>=100:
        speedMsg=" Limit Exceeded"
    elif speed>=60 and speed<100:
        speedMsg="Moderate"
    else:
        speedMsg="Slow"


    #Diversion part
    sign=random.randint(0,5)
    if sign==1:
        signMsg="Right Diversion"
    elif sign==2:
        signMsg="Speed Breaker"
elif sign==3:
        signMsg="Left Diversion"
    elif sign==4:
        signmsg="U Turn"
    else:
        signMsg=""


    #Visibility
```

```python
    if temperature < 24:

        visibility="Fog Ahead, Drive Slow"

    elif temperature < 20:

        visibility="Bad Weather"

    else:

        visibility="Clear Weather"


else:

    print("Error in the HTTP request")

myData={'Temperature':temperature, 'Message':message, 'Sign':signMsg, 'SpeedValue': speed,

'Speed': speedMsg, 'Visibility':visibility}

client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,

onPublish=None) #PUBLISHING TO IOT WATSON

print("Published data Successfully: ", myData)

print("-------------------------------------------------------------------------------------------------------

---------------------------------------------------------------------------------------------------------------")

client.commandCallback = myCommandCallback

time.sleep(5)

client.disconnect()
```

13.2. GitHub & Project Demo Link :

GitHub Link :

https://github.com/IBM-EPBL/IBM-Project-47311-1660798099

Demo Link : https://youtu.be/XDZejAAD77s