SELVAM COLLEGE OF TECHNOLOGY

NAMAKKAL

DEPARTMENT OF COMPUTER SCIENCE 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 :

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 :

[1] Topic: Development and Testing of Road Signs Alert System Using a Smart Mobile Phone

Road traffic accident is a major problem worldwide resulting in significant morbidity and mortality. Advanced driver assistance systems are one of the salient features of intelligent systems in transportation. (ey improve vehicle safety by providing real-time traffic information to the driver. Road signs play an important role in road safety. To be effective, road signs must be visible at a distance that enables drivers to take the necessary actions. However, static road signs are often seen too late for a driver to respond accordingly. In this study, a system for alerting drivers about road signs has been developed and tested using a smart mobile phone. (e study was carried out in Tanzania along an 80 km highway stretch from Arusha to Moshi town. (e aversine formula was used to measure and estimate the distance between two pairs of coordinates using the smartphone-based navigation application, Google Map. (e application provides a voice alert to a needed action that enhances driver's attention. We propose an alternative method that dentifies and modifies a specific class of energy inefficiencies. According to the experimental results, the proposed methodology has the benefits of high accuracy within a user radius of 10 meters, minimum bandwidth, and low-cost application. Furthermore, the system application was secured by limiting access to the application program interface key to avoid unauthorized access to sensitive information.

Author: Eric M. Masatu , Ramadhani Sinde , and Anael Sam

Year: 21 April 2022

[2] Topic: Analysis of Sustainable Transport for Smart Cities

For decades, transportation has been considered as a link to all aspects of life worldwide. In this case, the world's natural environment, social well-being and economic development all usually depend on transportation systems. In most cases, safe, clean, sustainable and equitable transport systems help countries, especially in cities and urban centers, to thrive. However, a wide range of research shows that transportation systems in most of the cities and urban areas are unsustainable. In fact, some of these transportation systems are considered to be a threat to the environmental, social and economical aspects of future generations. In this perspective, therefore, changing such trends in transportation requires the collaboration of various stakeholders at regional, national and international levels. In this paper, therefore, a wide range of definitions of sustainable transport are discussed. More so, some of the aspects of smart transport for modern cities such as cycling and the role of women in sustainable transport were explored. With the aim of getting to the core of the subject, cases of women in bicycle transport, especially in the Netherlands and Germany compared to Kenya and Uganda are equally elucidated. Although not fully outlined, the idea of smart cities and sustainable transport have heterogeneous characteristics globally as discussed herein.
AUTHOR: Dastan Bamwesigye and Petra Hlavackova

YEAR: 10 April 2019

[3] Topic: An Overview on the Current Status and Future Perspectives of Smart Cars

In recent years, the smart car sector has been increasing enormously in the Internet of Things (IoT) market. Furthermore, the number of smart cars seems set to increase over the next few years. This goal will be achieved because the application of recent IoT technologies to the automotive sector opens up innovative opportunities for the mobility of the future, in which connected cars will be more and more prominent in smart cities. This paper aims to provide an overview of the current status and future perspectives of smart cars, taking into account technological, transport, and social features. An analysis concerning the approaches to making smart a generic car, the possible evolutions that could occur in the coming decades, the characteristics of 5G, ADAS (advanced driver assistance systems), and the power sources is carried out in this paper.

AUTHOR: Fabio Arena , Giovanni Pau , and Alessandro Severino

YEAR: 30 June 2020

[4] Topic: LTE SCHEDULER ALGORITHMS FOR VANET TRAFFIC IN SMART CITY.

A new concept such as smart city was introduced in the last years where the Intelligent Transportation system (ITS) plays a critical role to provide road safety and manage Vehicular Ad Hoc Networks (VANETs) traffic. Nevertheless, VANETs have significant constraints like nodes high mobility, intermittent connectivity, variable network density and heterogeneity. However, the different types of traffic, the different Quality of Service requirements, the need to exchange mobile data, multi-services and data diversity leads mainly to load and time constraints in this specific and stringent type of networks. The main characteristic of this kind of networks is the very changing topology that poses supplementary constraints and makes achieving QoS constraints a very challenging task. In VANET network the vehicle generated traffic will be transferred to the data center from road side unit to the base station by using Long Term Evolution (LTE) in an urban area. Despite LTE has a larger system capacity and it provides a higher transmission speed, the network performance is affected by the implemented scheduling algorithm. In this context, we study the efficiency of LTE scheduler algorithms such as Proportional Fairness, Round Robin, Priority Set Scheduler, Maximum Throughput Scheduler and Throughput to Average Scheduler and Blind Equal Throughput mainly at the road side unit using Network Simulator 3(NS3) to determinate the most suitable scheduler for VANET traffic. Results demonstrate that the round robin algorithm is more effective for volumetric VANET traffic in terms of throughput, delay, packet loss rate and fairness.

AUTHOR: Khadija Raissi and Bechir Ben Gouissem
YEAR: 2020

2.1 Existing problem :

The Safe System Approach :

The Safe System (SS) approach to transport networks originated with the “Safe Road Transport System” model developed by the Swedish Transport Agency. In its essence, the approach migrates from the view that accidents are largely and automatically the driver’s fault to a view that identifies and evaluates the true causes of accidents. Through the categorization of safety into the safety of three elements (vehicle, road, and road user), SS minimizes fatalities and injuries by controlling speeds and facilitating prompt emergency response. The model has been widely adopted since its introduction and is currently motivated by the WHO as a basis for road safety

planning, policy-making, and enforcement.

2.2 Reference :

1. C.Torfs, K.Areal, A.Goldenbeld, C.Vanlaar, S.Jankowska-Karpa: Car drivers 'roadsafety performance: a benchmark across 32 countries. IATSS Re. 44(3), 166-179 (Published : 2020).
2. D.Babic, A.Scukanec, D.Babic: Determining the correlation between daytime and night-time road markings visibility Baltic J. Road Bridge Eng., 11 (Published : 2020).
3. R.Saleh, H.Fleyeh: Factors affecting night-time visibility of Retro reflective road traffic signs: a reviewInt. J. Traffic Transp.Eng., 11 (Published : 2020).
4. AnanyaRoya1, MoinulHossainb, YasunoriMuromachic: A deep reinforcement learning-based intelligent intervention framework for real-time proactive road safety management Author links open overlay panel 18(11), 3006-3016 (Published : 2021)
5. PanelKhaledShaaban, MazenElamin, MohammedAlsoub: Intelligent Transportation Systems in a Developing Country: Benefits and Challenges of Implementation: 21 July 2021, Version of(Published:21 July 2021).
6. Dhaya Kanthavel, S.K.B.Sangeetha, K.P.Keerthana: An empirical study of vehicle to infrastructure communications - An intense learning of smart infrastructure for safety and mobility, 29 July 2021, (Published:29 July 2021).
7. Qunwei Tang, Guangqing Liu, Haiyang Wen: Triboelectric sensor array for internet of things based smart traffic monitoring and management system19 November 2021, Version of (Published: 22 November 2021).
8. Francesco Rundo, Ilaria Anfuso, Maria Grazia Amore: Advanced eNose-Driven PedestrianTracking Pipeline for Intelligent Car Driver Assisting System: Preliminary Results. (Published :January 2022).
9. Roshani Raut, Khushi Desarda, Saylee Gulve: Traffic Signs Recognition and Detection using Deep Convolution Neural Networks for Autonomous Driving (Published : 08 June 2022).
10. Paule Kevin, Vitalice Oduol, George N. Nyakoe : Roadside Units for Vehicle-to-Infrastructure Communication: an Overview. (Published 05-04-2022).

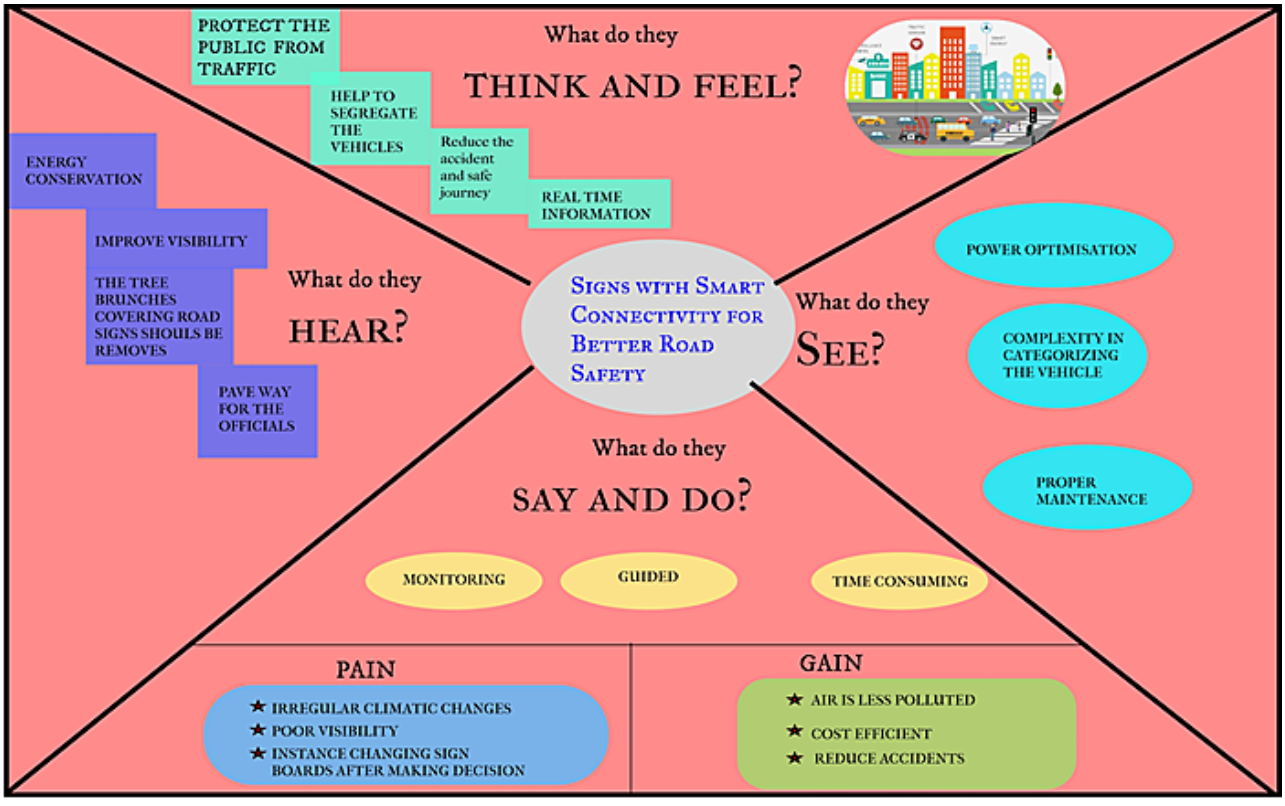
2.3 Problem Statement Definition :

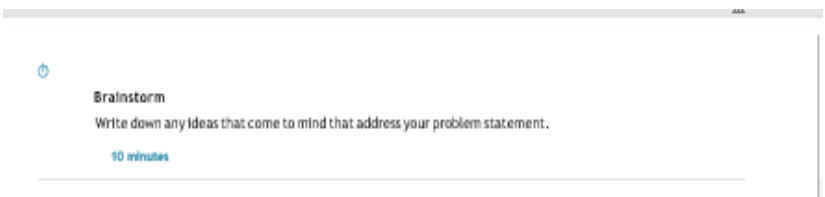
A problem statement is a concise description of an issue to be addressed or a condition to be improved upon. It identifies the gap between the current (problem) state and desired (goal) state of a process or product. Focusing on the facts, the problem statement should be designed to address the Five. 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, accident-prone 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 :

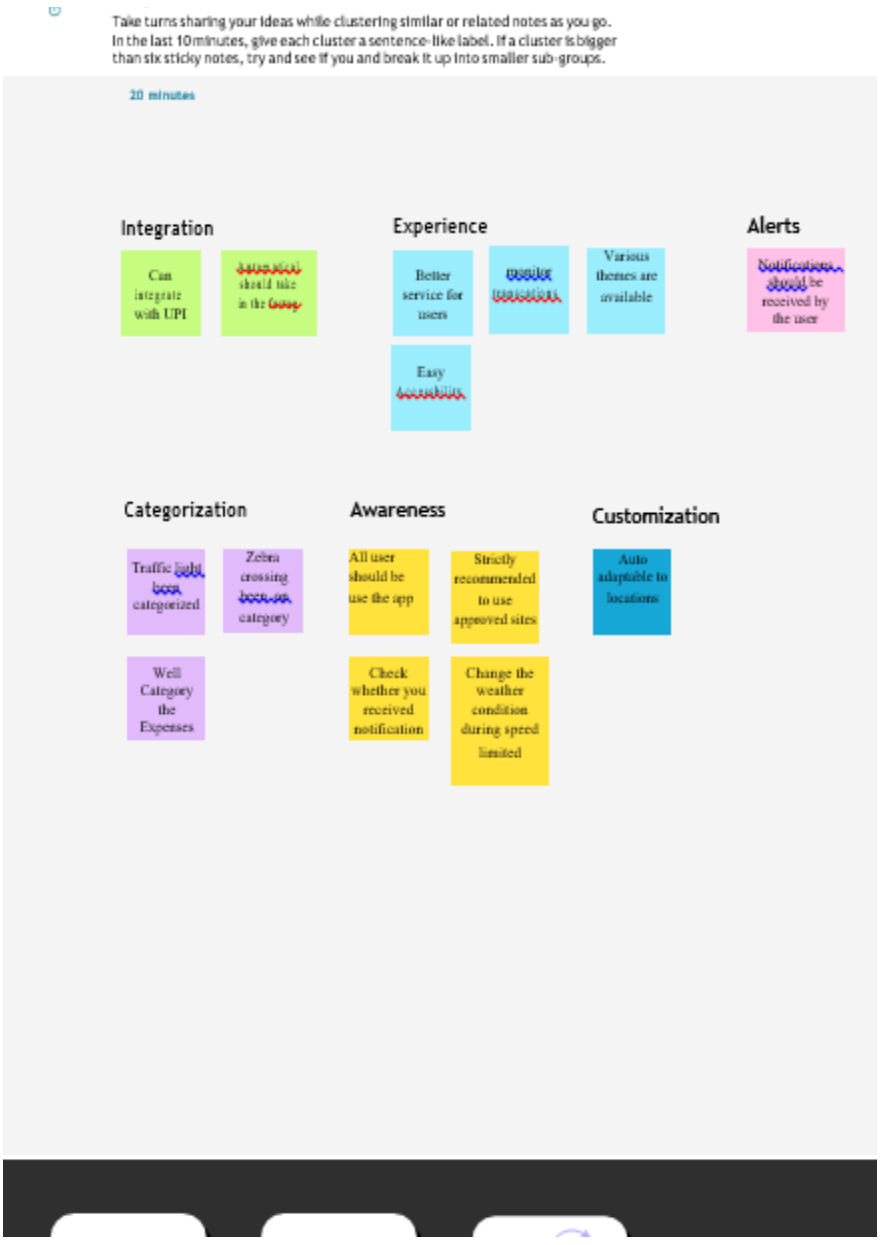
3.1 Empathy Map Canvas :



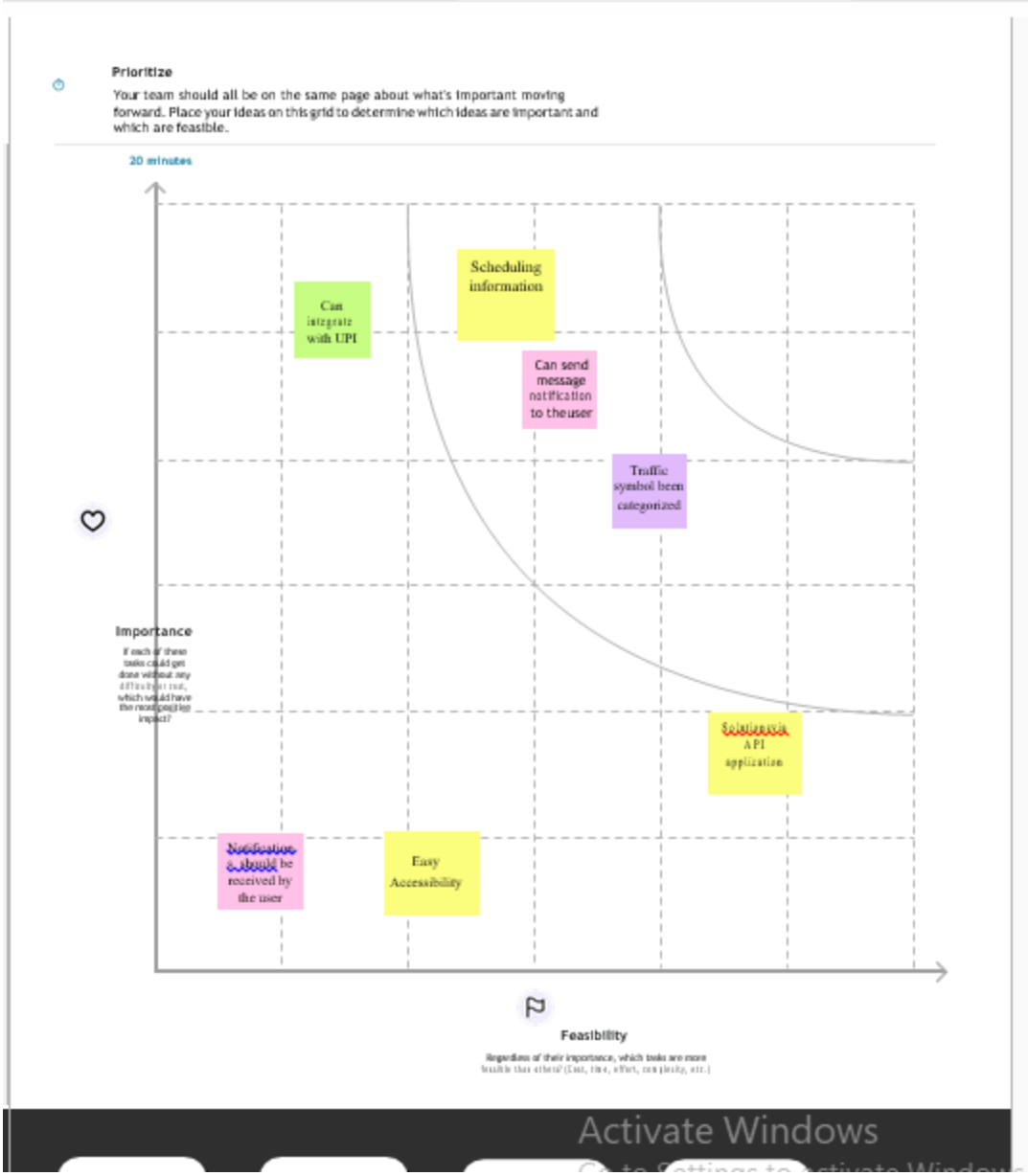


3.2 Ideation & Brainstorming :

GROUP IDEAS:


Take turns sharing your ideas while clustering similar or related notes as you go.
In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.
20 minutes
Integration
Can integrate with UPI
Experience
Better service for users
Various themes are available
Easy
Alerts
Notifications should be received by the user
Categorization
Traffic light categorized
Zebra crossing category
Well Category the Expenses
Awareness
All user should be use the app
Strictly recommended to use approved sites
Check whether you received notification
Change the weather condition during speed limited
Customization
Auto adaptable to locations

GRAPH:

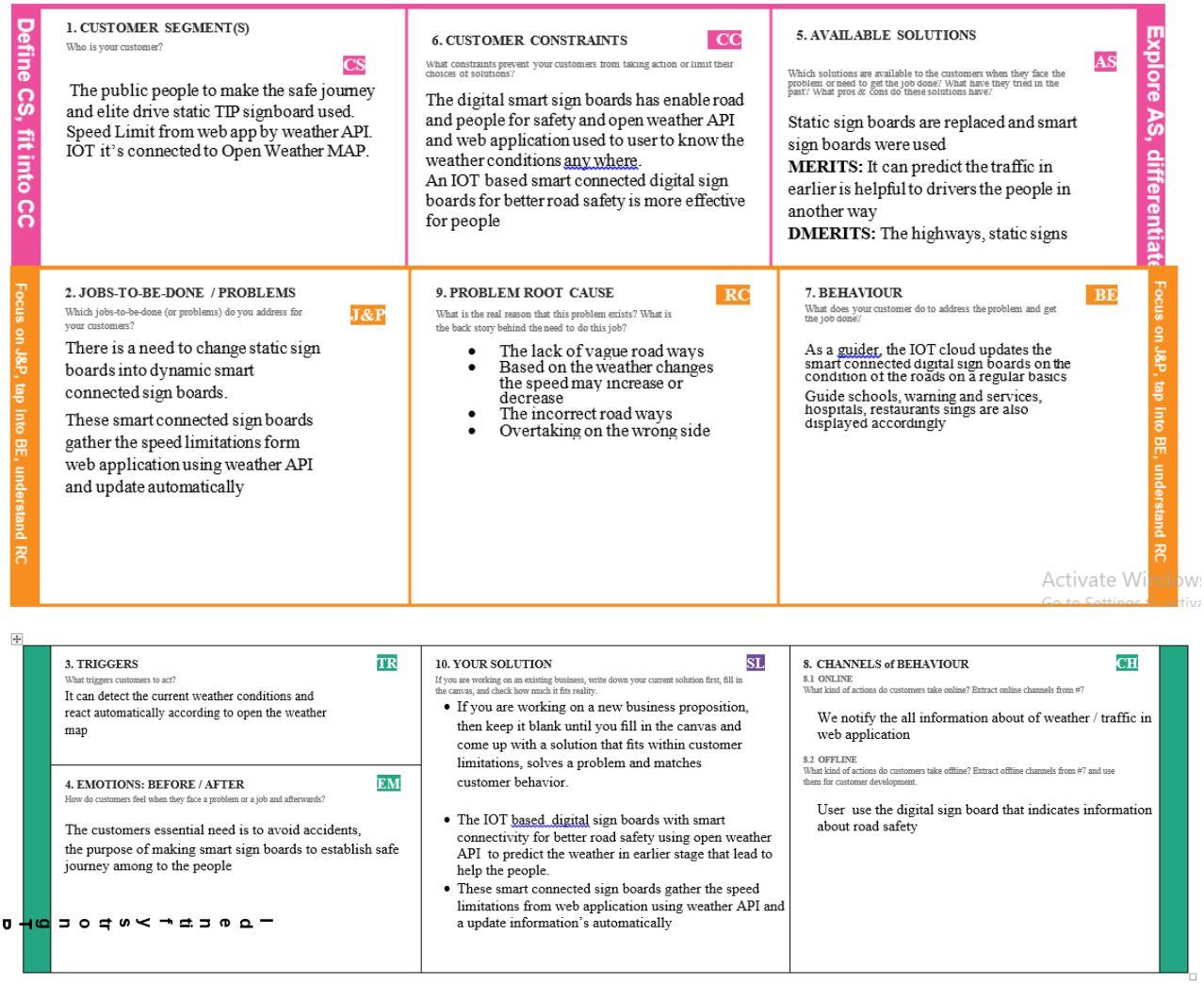


3.3 Proposed Solution :

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

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	• Need to replacement a static sign board to smart digital boards and to notify the drivers ahead in case of any accidents.
2.	Idea / Solution description	• Requiring drivers to obey the speed limit, yield to pedestrians and cyclists, wear seatbelts, avoid drunk driving, and use child restraints can have a powerful impact on changing road user behaviour. • In this system can be implemented by extracting weather data from open weather map using API'S. • Through the extracted data from the web app the sign boards get the speed limitations and update automatically • This can be done by either the web application or by the buttons that are predefined with separate symbols. • Conventional traffic lights are replaced with smart sign boards as well as web application is used to send warnings , notification about the road conditions with the help of sensors
3.	Novelty / Uniqueness	• The uniqueness of IOT based smart connectivity for better road safety is its flexibility to the present and current situations of the roads. • Always Overtake from the right side. When being overtaken by another vehicle, never increase your speed to prevent the other driver from overtaking you. Be extra careful on intersections. Also, when passing through them, ensure your vehicle doesn't cause inconvenience to other road users
4.	Social Impact / Customer Satisfaction	• We can obey the traffic rules and speed limited, it will save file. • Many lives can be saved due to this idea so the customer is statisfied
5.	Business Model (Revenue Model)	• 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.
6.	Scalability of the Solution	• Slight modification in the programming of the existing product and website application has to be updated with the additional functionality for further are updating.

3.4 Problem Solution fit :



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 :

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Visibility	Sign Board will have clear and interactive UI so that it will be clearly visible to all the users.
FR-2	User Registration	The User Registration can be done through a Website or Gmail
FR-3	User Confirmation	User can confirm with phone User can confirm with Email User can confirm with OTP
FR-4	User Requirements	The Static signboards will be replaced with smart linked sign boards that meet all criteria.
FR-5	Payment options	Bank Transfers

4.2 Non-Functional requirements:

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

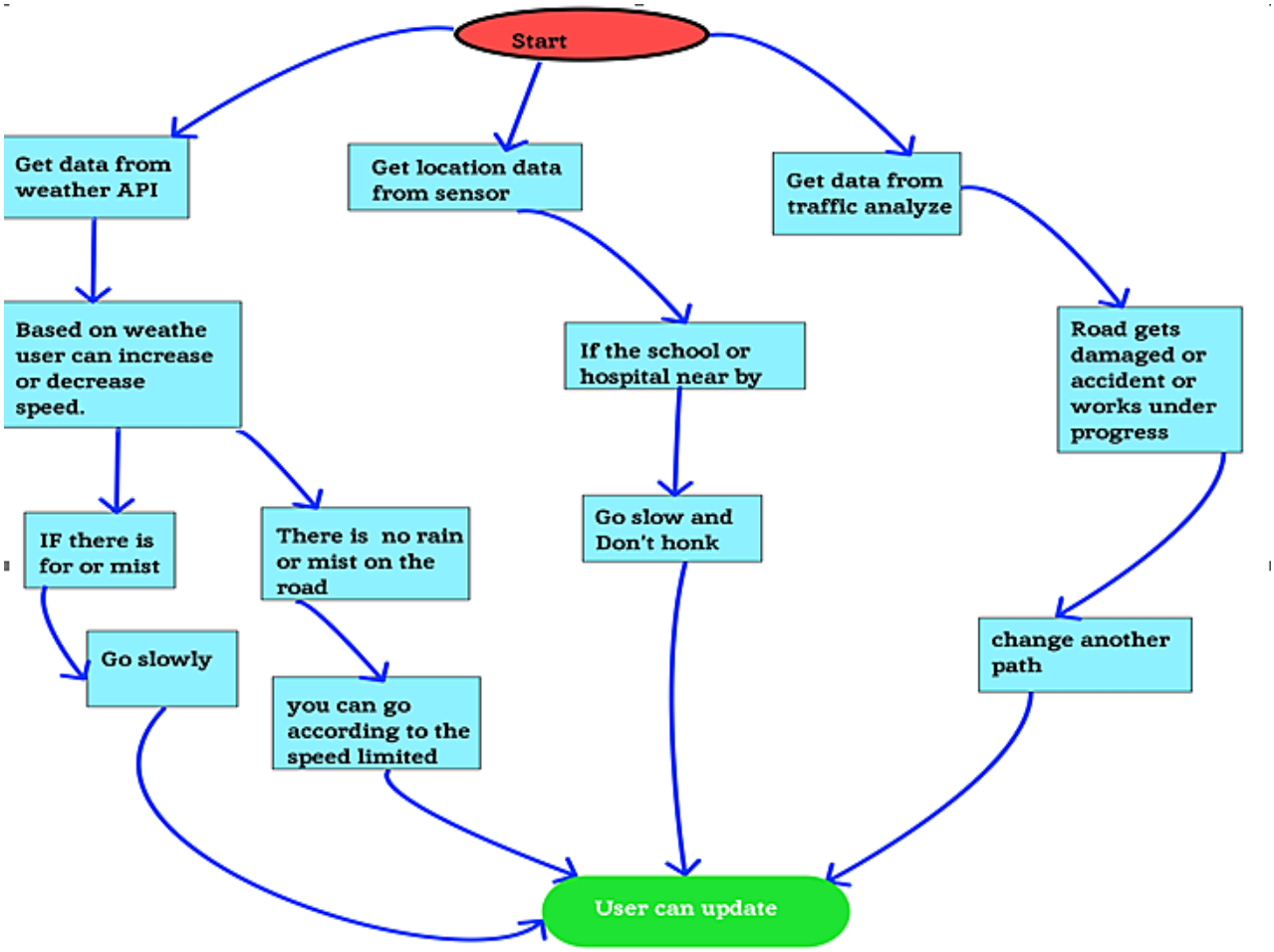
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Will provide the clear product instructions And a self-explanatory product which is simple to use
NFR-2	**Security**	Cloud data must be contained within the network, collapsing to be the real-time avoid an be avoided ,and the board will be monitored constantly
NFR-3	**Reliability**	The hardware will be frequently tested
NFR-4	**Performance**	• The smart board must provide a better user experience and deliver the accuracy output. • Focus on the speed ,efficiency and work load
NFR-5	**Availability**	All of the functions and the user demands will be provided, depend upon the customer needs
NFR-6	**Scalability**	Extending the functionality and features of the system on the regular basis based on traffic density

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.

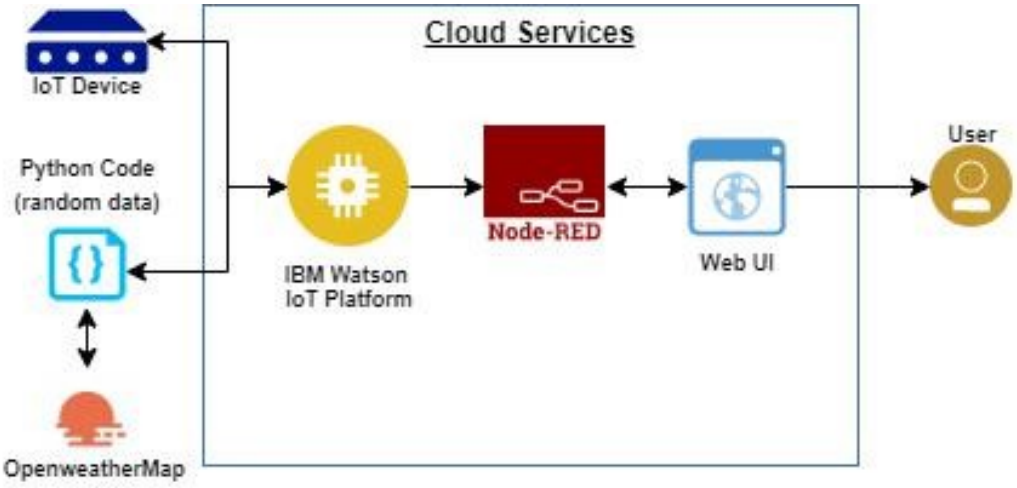
5.1. Data Flow Diagrams :

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 Story Number	User Story / Task	Story Points	Priority	Team Members
USN-1	Getting into IBM Watson IOT Platform confirm, To create a New device and then Enter the Device Type, Device ID and separate the Organization ID, Authentication tokens in it.	1	Low	Santhosh
USN-2	- Getting into Cloud DB to store out data in it and can be retrieved when the database is called. - Create a database in cloudant DB and to store the location data	2	Low	Santhosh
USN-3	Develop the web application Using node-red	2	Medium	Kowsalya
USN-4	Open the Node Red and creating a design flow how the process will be work and connecting it with wold map and IBM Watson and cloudant DB	2	Medium	Kowsalya
USN-5	Open the weather app account go to the API key, copy the key. Then enter the python code for weather and then, past the key values in that code.	2	High	Monishkumar
USN-6	-Getting into the python code and Write a Python program to find the location of near by and weather condition. -And then to publish the location details to the IBM IOT platform.	2	High	Monishkumar
USN-7	Optimize all the short comings and provide better user experience.	2	Medium	Manojkumar

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	IBM Watson IOT Platform confirm	USN-1	Getting into IBM Watson IOT Platform confirm, To create a New device and then Enter the Device Type, Device ID and separate the Organization ID, Authentication tokens in it.	1	Low	Santhosh
	Cloudant DB	USN-2	- Getting into Cloud DB to store out data in it and can be retrieved when the database is called. - Create a database in cloudant DB and to store the location data	2	Low	Santhosh
Sprint-2	Node-Red	USN-3	Develop the web application Using node-red	2	Medium	Kowsalya
		USN-4	Open the Node Red and creating a design flow how the process will be work and connecting it with wold map and IBM Watson and cloudant DB	2	Medium	Kowsalya
Sprint-3	weather.	USN-5	Open the weather app account go to the API key, copy the key. Then enter the python code for weather and then, past the key values in that code.	2	High	Monishkumar
	location	USN-6	-Getting into the python code and Write a Python program to find the location of near by and weather condition. -And then to publish the location details to the IBM IOT platform.	2	High	Monishkumar
Sprint-4	Testing	USN-7	Optimize all the short comings and provide better user experience.	2	Medium	Manojkumar

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

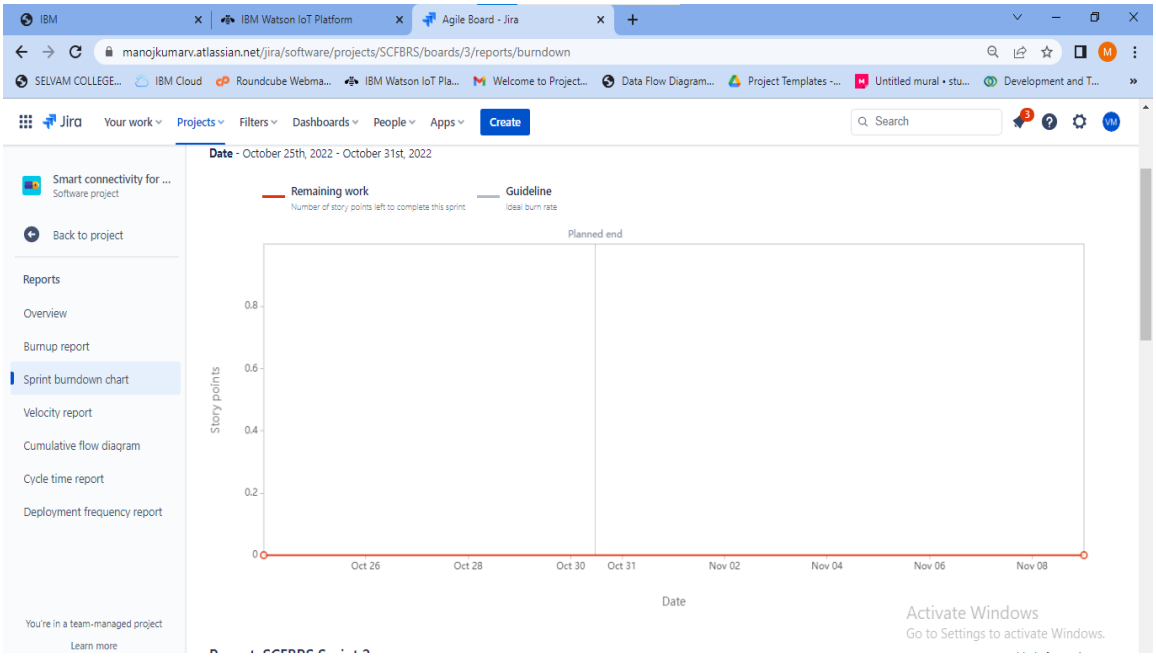
Velocity :

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 :

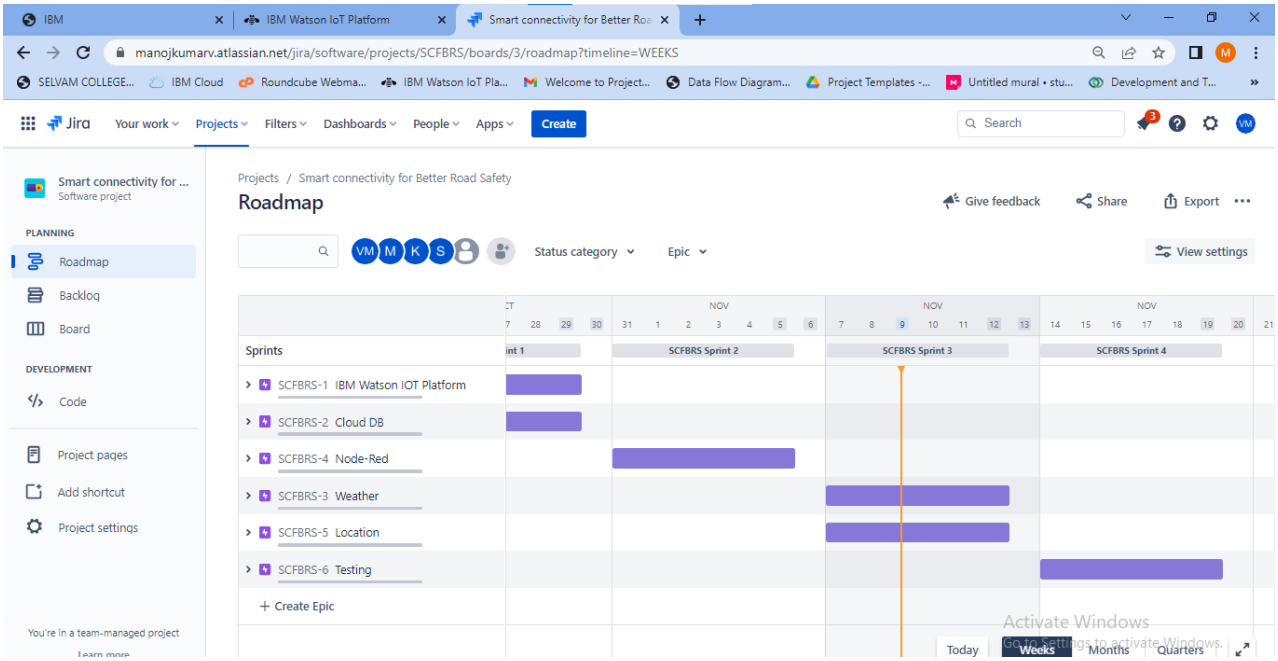
A burn-down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as scrum. However, burn-down charts can be applied to any project containing measurable progress over time.



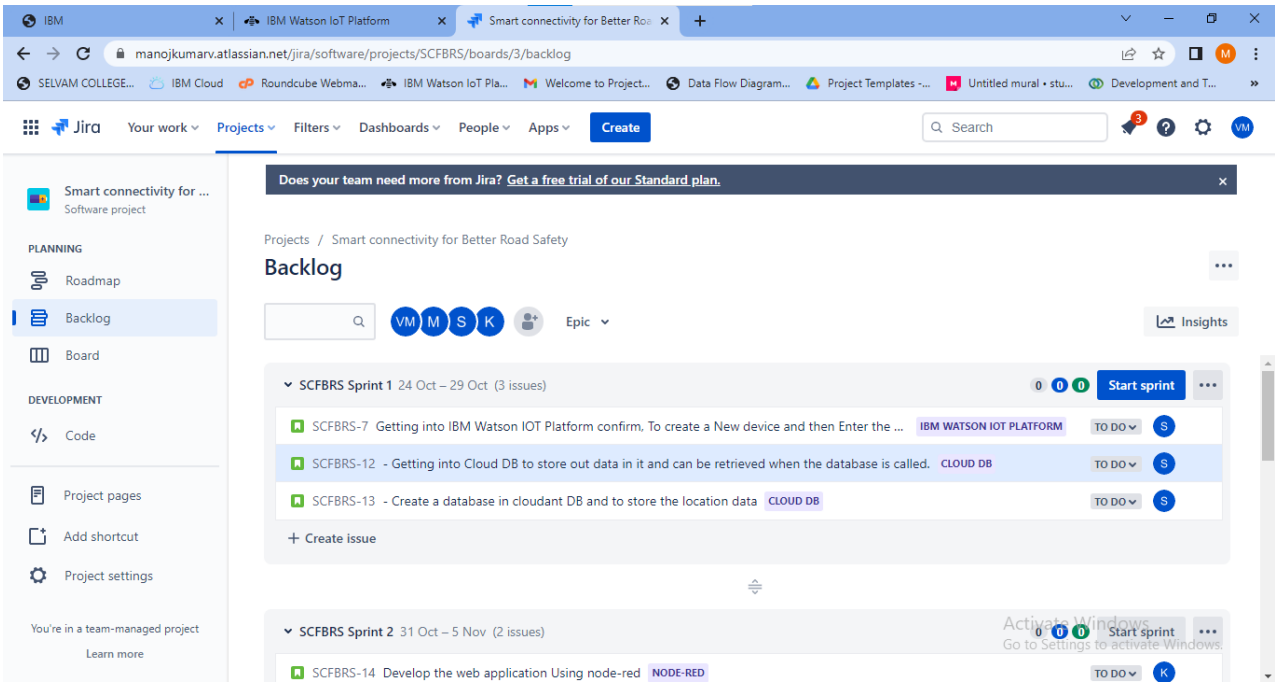
Reference :

https://manojkumarv.atlassian.net/jira/software/projects/SWSCFBRS/boards/1/roadmap

6.3 Reports from JIRA :



BACKLOG:



7. CODING & SOLUTIONING :

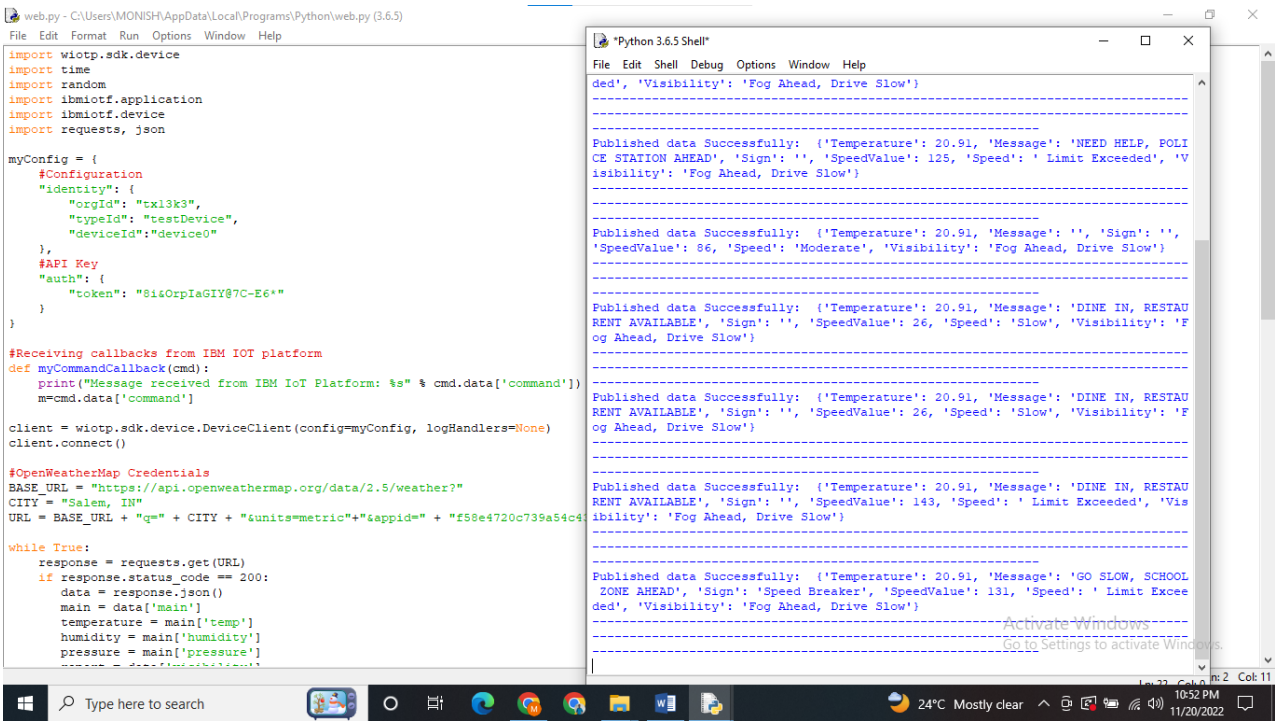
7.1 Feature 1 :

web.py - C:\Users\MONISH\AppData\Local\Programs\Python\web.py (3.6.5)

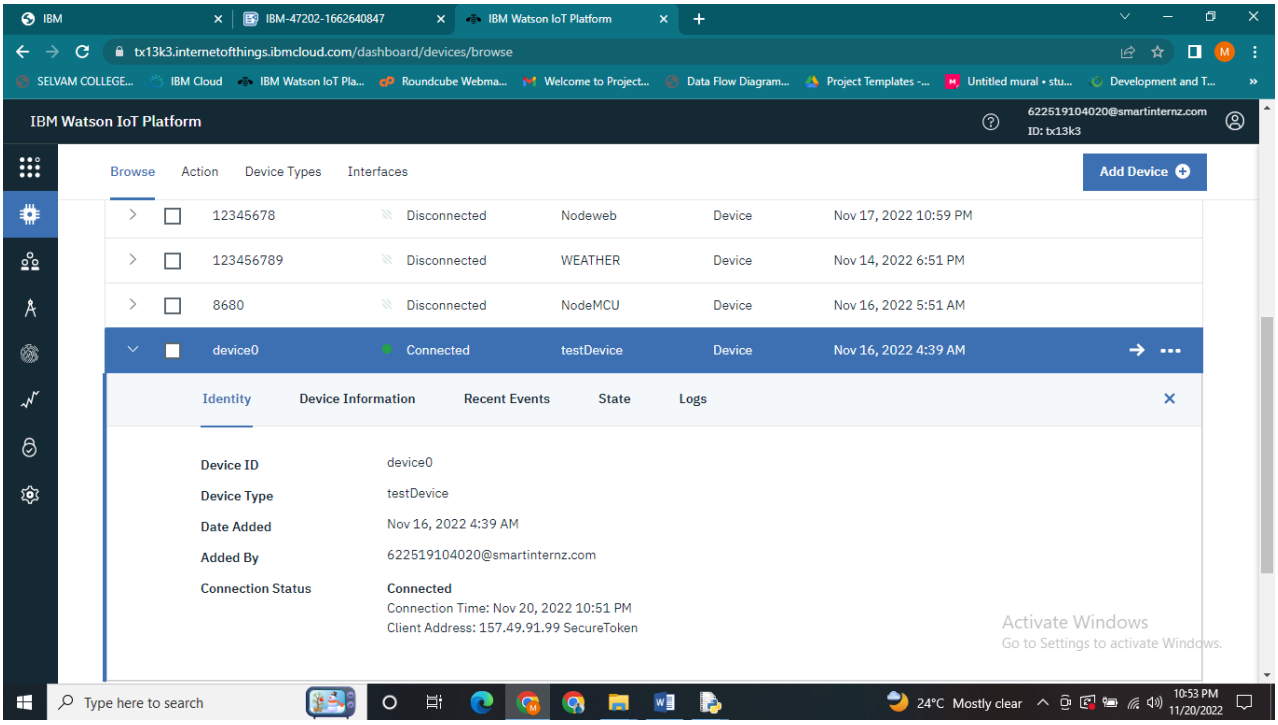
File Edit Format Run Options Window Help

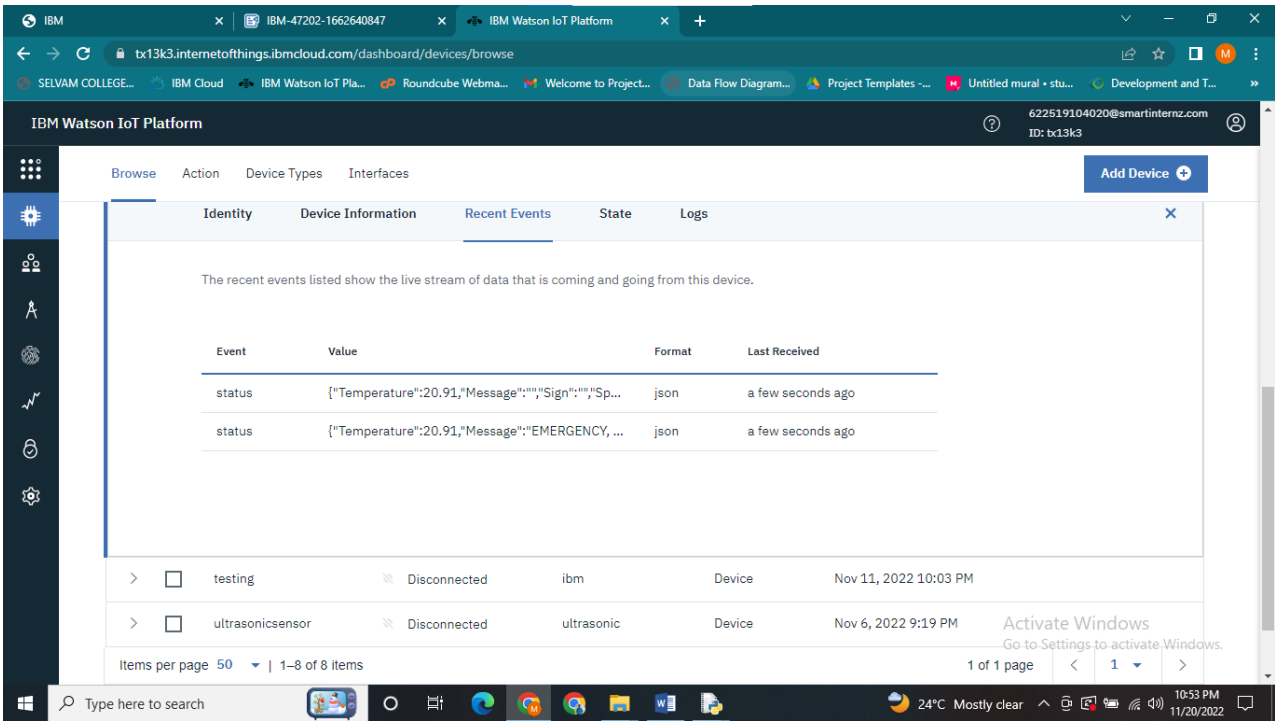
```
import wiotp.sdk.device
import time
import random
import ibmiotf.application
import ibmiotf.device
import requests, json

myConfig = {
    #Configuration
    "identity": {
        "orgId": "tx13k3",
        "typeId": "testDevice",
        "deviceId":"device0"
    },
    #API Key
    "auth": {
        "token": "8i&OrpIaGIY@7C-E6*"
    }
}

#Receiving callbacks from IBM IOT platform
def myCommandCallback(cmd):
    print("Message received from IBM IoT Platform: %s" % cmd.data['command'])
    m=cmd.data['command']

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

#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']
```

OUTPUT:

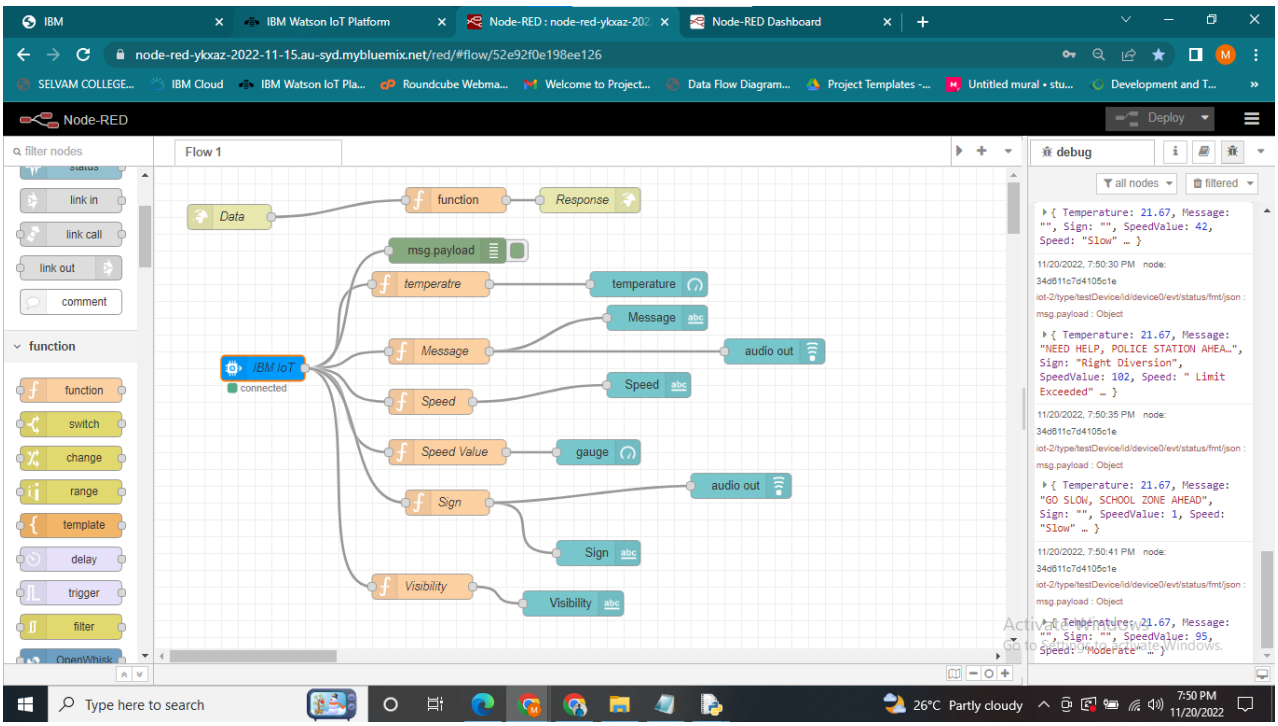


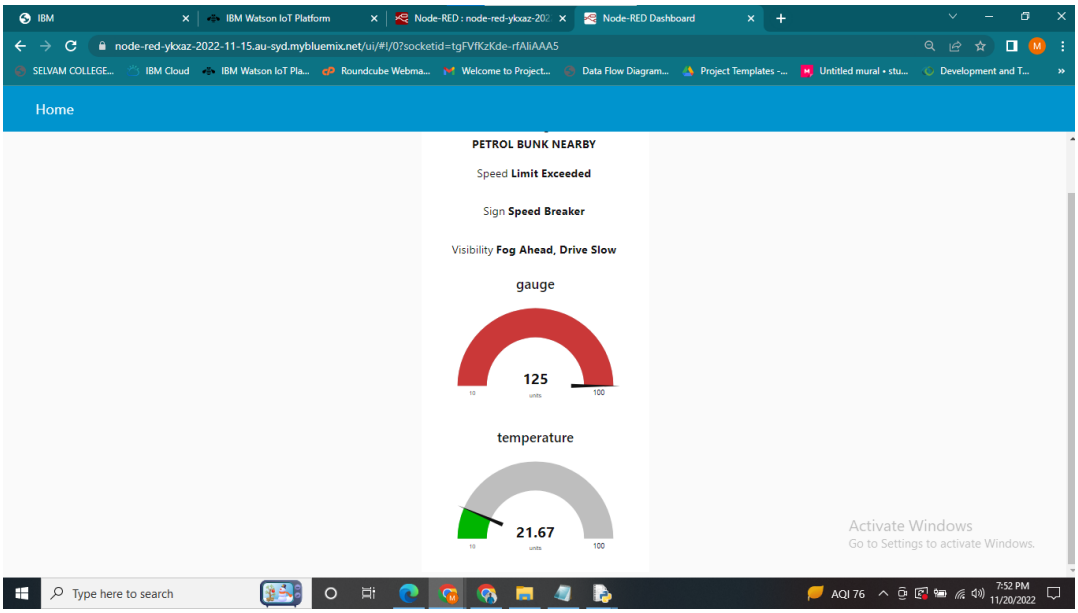
To connect the IBM watson IOT platform:

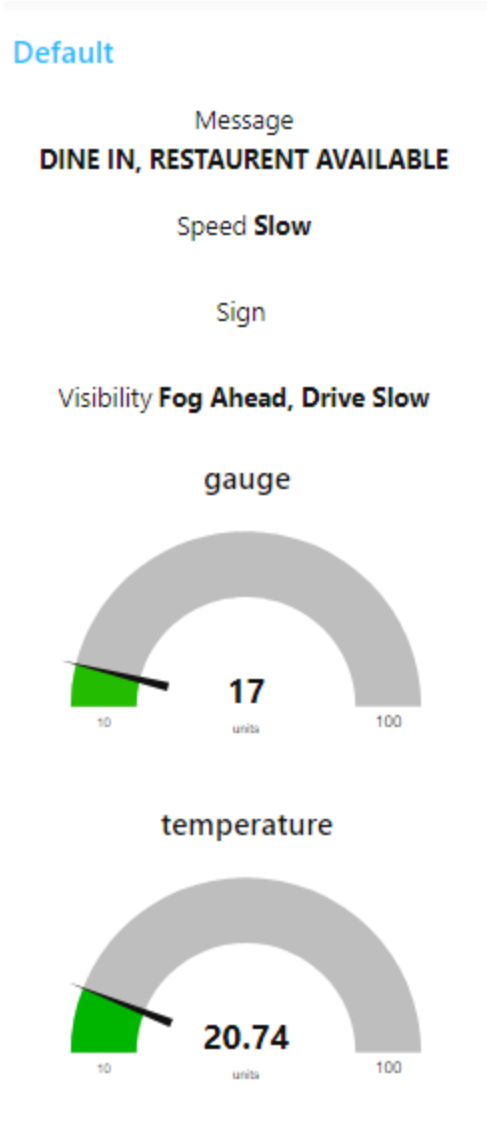


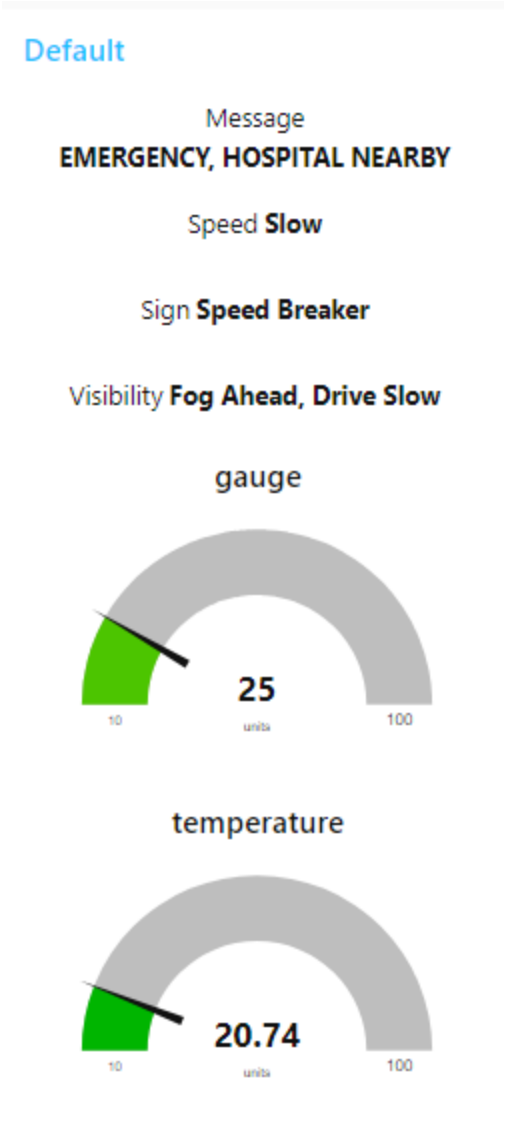


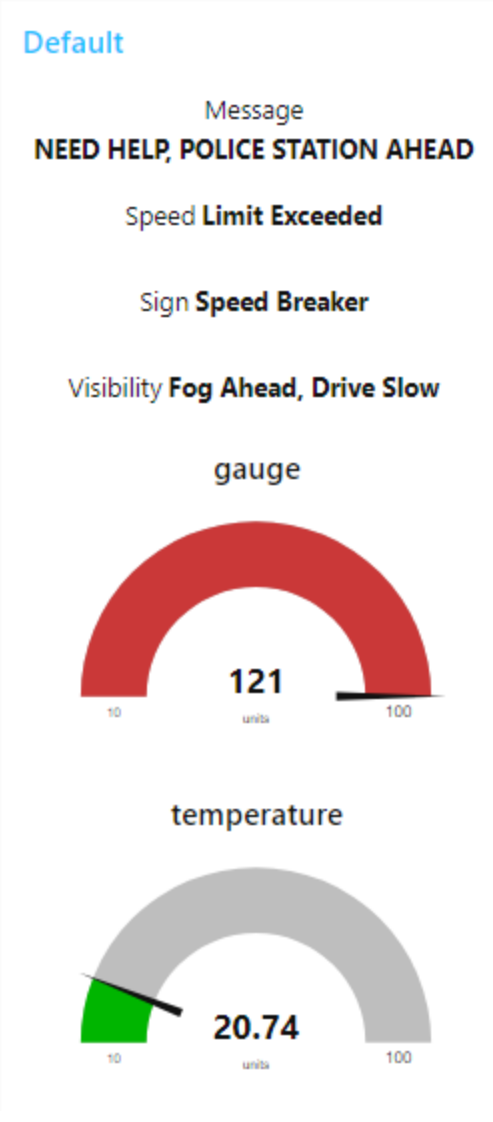
7.2 Feature 2 : (Node-red web UI Output)




IBM
IBM Watson IoT Platform
Node-RED : node-red-ykxaz-202
Node-RED Dashboard
node-red-ykxaz-2022-11-15.au-syd.mybluemix.net/ui/#!/0?socketid=tgFVfKzKde-rfAliAAA5
Home
PETROL BUNK NEARBY
Speed Limit Exceeded
Sign Speed Breaker
Visibility Fog Ahead, Drive Slow
gauge
125
temperature
21.67
Activate Windows
Go to Settings to activate Windows.
Type here to search
AQI 76
7:52 PM
11/20/2022


Default
Message
DINE IN, RESTAURENT AVAILABLE
Speed Slow
Sign
Visibility Fog Ahead, Drive Slow
gauge
17
10
units
100
temperature
20.74
10
units
100

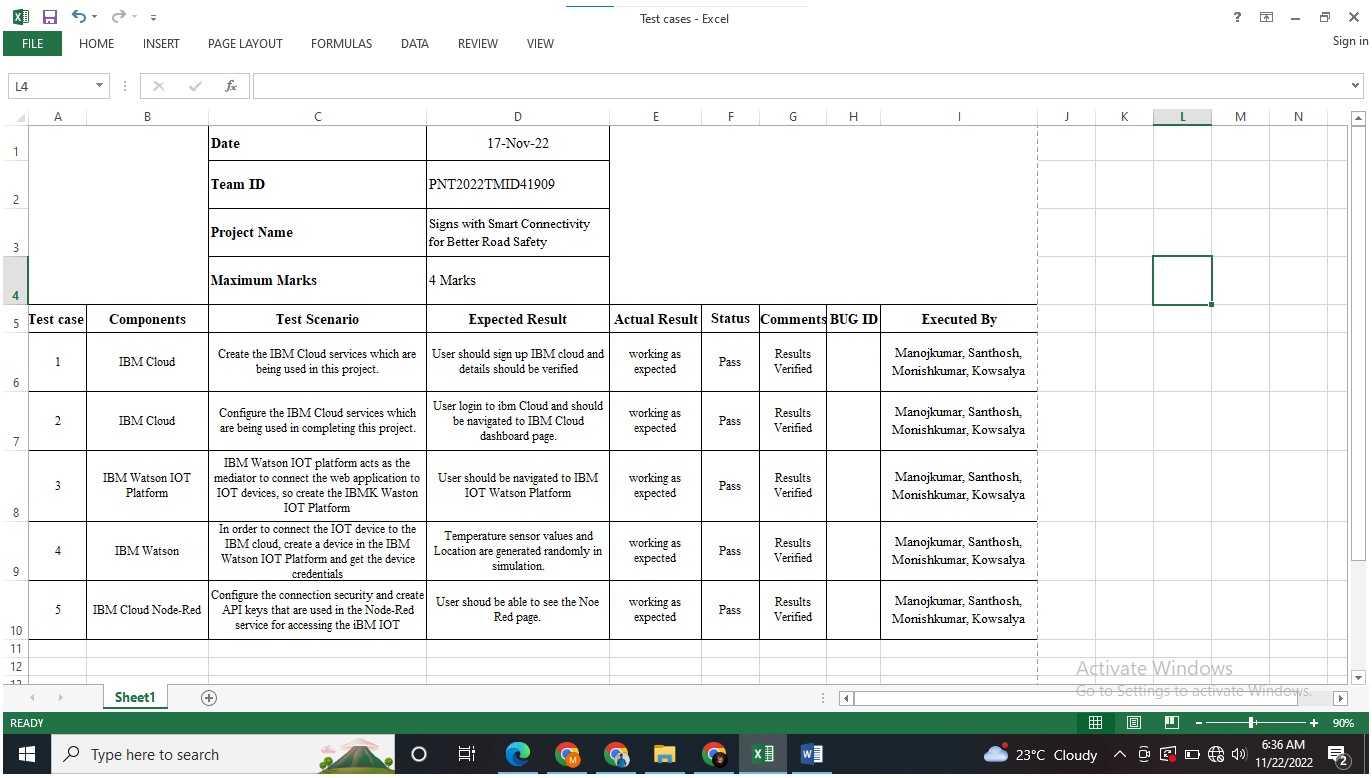

Default
Message
EMERGENCY, HOSPITAL NEARBY
Speed Slow
Sign Speed Breaker
Visibility Fog Ahead, Drive Slow
gauge
25
10
units
100
temperature
20.74
10
units
100


Default
Message
NEED HELP, POLICE STATION AHEAD
Speed Limit Exceeded
Sign Speed Breaker
Visibility Fog Ahead, Drive Slow
gauge
121
10
units
100
temperature
20.74
10
units
100

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 Test Cases :



Date	17-Nov-22
Team ID	PNT2022TMID41909
Project Name	Signs with Smart Connectivity for Better Road Safety
Maximum Marks	4 Marks

Test case	Components	Test Scenario	Expected Result	Actual Result	Status	Comments	BUG ID	Executed By
1	IBM Cloud	Create the IBM Cloud services which are being used in this project.	User should sign up IBM cloud and details should be verified	working as expected	Pass	Results Verified		Manojkumar, Santhosh, Monishkumar, Kowsalya
2	IBM Cloud	Configure the IBM Cloud services which are being used in completing this project.	User login to ibm Cloud and should be navigated to IBM Cloud dashboard page.	working as expected	Pass	Results Verified		Manojkumar, Santhosh, Monishkumar, Kowsalya
3	IBM Watson IOT Platform	IBM Watson IOT platform acts as the mediator to connect the web application to IOT devices, so create the IBMK Waston IOT Platform	User should be navigated to IBM IOT Watson Platform	working as expected	Pass	Results Verified		Manojkumar, Santhosh, Monishkumar, Kowsalya
4	IBM Watson	In order to connect the IOT device to the IBM cloud, create a device in the IBM Watson IOT Platform and get the device credentials	Temperature sensor values and Location are generated randomly in simulation.	working as expected	Pass	Results Verified		Manojkumar, Santhosh, Monishkumar, Kowsalya
5	IBM Cloud Node-Red	Configure the connection security and create API keys that are used in the Node-Red service for accessing the iBM IOT	User shoud be able to see the Noe Red page.	working as expected	Pass	Results Verified		Manojkumar, Santhosh, Monishkumar, Kowsalya

8.2 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 over-speeding, 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": "tx13k3",
        "typeId": "testDevice",
        "deviceId":"device0"
    },
    #API Key
    "auth": {
        "token": "8i&OrpIaGIY@7C-E6*"
    }
}

#Receiving callbacks from IBM IOT platform
def myCommandCallback(cmd):
    print("Message received from IBM IoT Platform: %s" % cmd.data['command'])
    m=cmd.data['command']

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

```
#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"
        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
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-2741-1658481981

Demo Link :

https://www.youtube.com/embed/o-PRd9ZYgcA