NALAIYA THIRAN PROJECT 2022

SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY

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1. INTRODUCTION

Roads are the foremost source of linking between cities and villages. Due to the ease of traveling by road, vehicles have become the main way people travel. The chances of vehicular accidents (Vas) have increased with the growing number of vehicles on the roads. During a journey, one does not know what will happen on the next road, particularly during bad weather conditions (BWC). In such a situation, driving can be difficult due to bad visibility, which can lead to an accident. It was also noticed that in BWC, multiple vehicle collisions (MVCs) can occur owing to delays in receiving information about an incident. According to one study by the Islamabad police, there were 9582 accidents from 2016 to 2017 all over Pakistan, involving 11,317 vehicles, leading to 5047 fatalities and 12,696 persons injured

Digital technologies like the Internet of Things (IoT) are reshaping road safety measures. Many technology initiatives are undertaken the world over to make smarter and safer roads, the ones that can interact with traffic and pedestrians. Assuming that by giving in vehicle technology information to the driver, accidents can be averted, several technology-based products have been developed. The latest technology researchers are working on is based on the Internet of Things (IoT). IoT is all about data. Data is becoming a valuable resource for our world.

Many sectors and industries have adopted IoT to reduce errors and improve performance in manufacturing, energy, health care, and communication. The WHO describes different measures that can be implemented with minimal economic impacts in its "Save LIVES: Road Safety Technical Package". A cornerstone of these steps is realizing economic systems for "monitoring road safety by strengthening data systems". Meanwhile, a key theme in the package is motivating the adoption of a Safe System approach, which is a holistic approach to road safety that parts from traditional management solutions by emphasizing safety by design.

Mobile-phone-based applications use built-in sensor data to detect the speed limit based on environmental situations.

The main contributions of this research are

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

2. Identification and reporting of limitations in previous studies related to accident detection;

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

4. Demonstration of a new and modern way to quickly detect accidents and

communicate with nearby vehicles and EOCs.

The risks for loss of life, injuries, and other damage may increase if an incident is not reported to an EOC in a timely fashion. Lives can be saved by sending timely information about an accident through an automated mechanism. Moreover, quick automobile accident detection and an alert system are required to protect approaching vehicles against an MVC. Several methods have been implemented in advanced vehicles (Avs) for avoiding an accident. An accident threat is detected through sensors installed in vehicles or by using smartphone sensors. Previous researchers have used accelerometers, smoke detectors, infrared (IR) obstacle sensors, proximity sensors, and biosensors to detect an accident.

1.1. Project Overview:

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

1.2 Purpose:

A large amount of research is being carried out in the domain of accident avoidance and accident alarms by a large number of researchers and practitioners. To avoid accidents, many approaches are utilized to enhance safety. 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), for accident avoidance and detection, whereas cooperative approaches rely on V2X technology and hybrid approaches.

2. LITERATURE SURVEY

Abstract:

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

Introduction:

An automated deep learning (DL)-based system was developed for detecting accidents from video data. The system uses visual components in temporal order to represent traffic collisions. As a result, the model architecture is composed of a visual-features-extraction phase followed by transient pattern identification. Convolution and recurrent layers are used in the training phase to learn visual and temporal features. In public traffic accident datasets, an accuracy of 98% was attained in the detection of accidents, demonstrating a strong capacity for detection independent of the road structure. The solution is limited to automobile crashes, not motorbikes, bicycles, and pedestrians. Furthermore, the model makes mistakes when determining accident segments under poor illumination (e.g., at night), at low resolutions, and when there are occlusions.

An accident management system was proposed in that makes use of cellular technology in public transportation. This method enables communication across various components, including those in ambulances, RSUs, and servers. Furthermore, in this system, an optimal route-planning algorithm (ORPA) is proposed to optimize aggregate spatial utilization of road networks while lowering the travel cost to operate a vehicle. The ORPA was evaluated through simulations, and findings were compared with other current algorithms. In congested areas, the proposed method can also be used to offer fast routes for ambulances. All vehicles, including ambulances, are required to

have a route indicator installed, as well as the ability to use remote correspondence. The ORPA outperformed in terms of average speed and travel duration, according to the evaluation data. The proposed system only works for predicted patterns and can fail due to the unpredicted behavior of traff

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

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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 Ws. 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

2.4 Empathy Map Canvas:
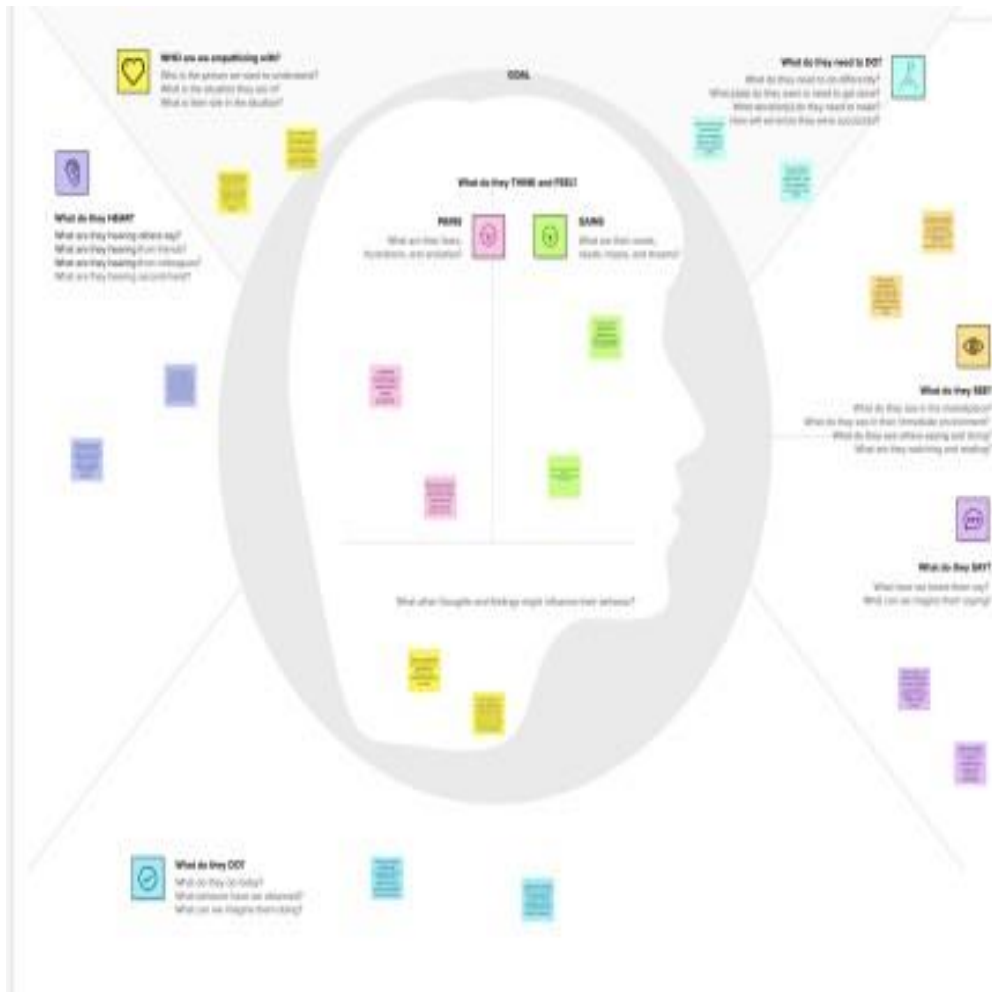
2.5 Ideation & Brainstorming:
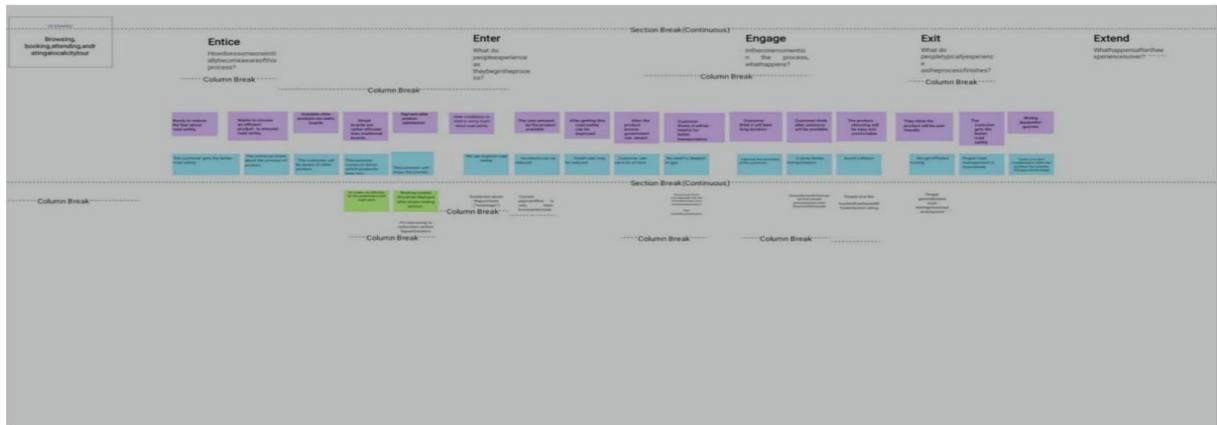
2.6 Proposed Solution:

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

S.No.	Parameter	Description
•	Problem Statement (Problem to be solved)	The Safe System (SS) approach to road safety emphasizes safety by design by ensuring safe vehicles, road networks, and road
•	Idea / Solution description	Ensuring safe driving experience with real-time assistance, navigation, and even monitoring driving patterns and any emergency.
•	Novelty / Uniqueness	IoT is already working to ensure road safety in areas such as vehicle maintenance, improved circulation, navigation, and monitoring environmental conditions
•	Social Impact / Customer Satisfaction	While the literature presented in this systematic review shows that IoT can positively impact the perceived or explicit happiness of people,

•	Business Model (Revenue Model)	IoT will not only enable driving new decision making but may well increase your revenue too.
•	Scalability of the Solution	IoT road sensors can provide real-time data from roads to help divert the flow of traffic away from areas of hazard.

2.7 Problem Solution fit:

Define CS, fit into CC

CS

1. CUSTOMER SEGMENT(S)

people is our customer

CC

6. CUSTOMER CONSTRAINTS

A safe system requires the complex and dynamic interaction between operating speeds, vehicles, road infrastructure and road user

AS

5. AVAILABLE SOLUTIONS

With 3M™ Temporary Traffic Control Solutions, you can design safer work zones and traffic management through the use of highly visible sheeting for work zone ...

EXPLORE AS DIFFERENTIATE

FOCUS ON J&P, TAP INTO BE, UNDERSTAND RC

J&P

2. JOBS-TO-BE-DONE / PROBLEMS

Ensuring safe driving experience with real-time assistance, navigation, and even monitoring driving patterns and any emergency situation.

RC

9. PROBLEM ROOT CAUSE

IoT has proved its potential in vehicle maintenance, navigation, monitoring leading to improved transportation.

BE

7. BEHAVIOUR

Drivers can receive updated information on the road, traffic, and weather conditions, and real-time information about their vehicles' pressure and temperature of tires, fluid levels, deterioration, and battery state, decreasing breakdowns and, therefore, prevent accidents.

FOCUS ON J&P, TAP INTO BE, UNDERSTAND RC

IDENTIFY STRONG TR & EM

TR

3. TRIGGERS

Ensuring safe driving experience with real-time assistance, navigation, and even monitoring driving patterns and any emergency situation.

SL

10. YOUR SOLUTION

To make road transport more secure, IoT obtains its data through connected vehicles, incorporated with many sensors

CH

8. CHANNELS OF BEHAVIOUR

Learn how companies around the world are using the IoT to improve road safety by minimizing car accidents and improve drivers' behaviors.

IDENTIFY STRONG TR & EM

4. EMOTIONS: BEFORE / AFTER

AFTER:
Increased Customer Satisfaction
Meeting Regulatory Compliance
BEFORE:
Increased traffics and accidents

4.REQUIREMENT ANALYSIS

2.8 Functional requirement:

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIn
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Verifying Email	Verification Email is sent to respective Email IDs for verification.
FR-4	Authentication	Using Biometrics or PIN Authentication to perform some sensitive actions on the app.
FR-5	Exporting Reports	Allowing users to export their yearly, monthly, and weekly stats.
FR-6	Sharing of data to third-party applications	Allowing users to share some data via WhatsApp and other mediums.

2.9 Non-Functional requirements:

| FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Dashboard must be simple, clean, and customizable.
NFR-2	**Security**	Using two-factor authentication and maintaining session period for some actions.
NFR-3	**Reliability**	Ensure the code is well and good before making it to production.
NFR-4	**Performance**	Writing an efficient code to give better performance to the low-end devices too.
NFR-5	**Availability**	Deploying the application in two or more Availability Zones to ensure the availability SLA of 99.999%
NFR-6	**Scalability**	Using auto-scalable services in the cloud for database, compute, etc….

3. 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.

3.1 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.

3.2 Solution & Technical Architecture:
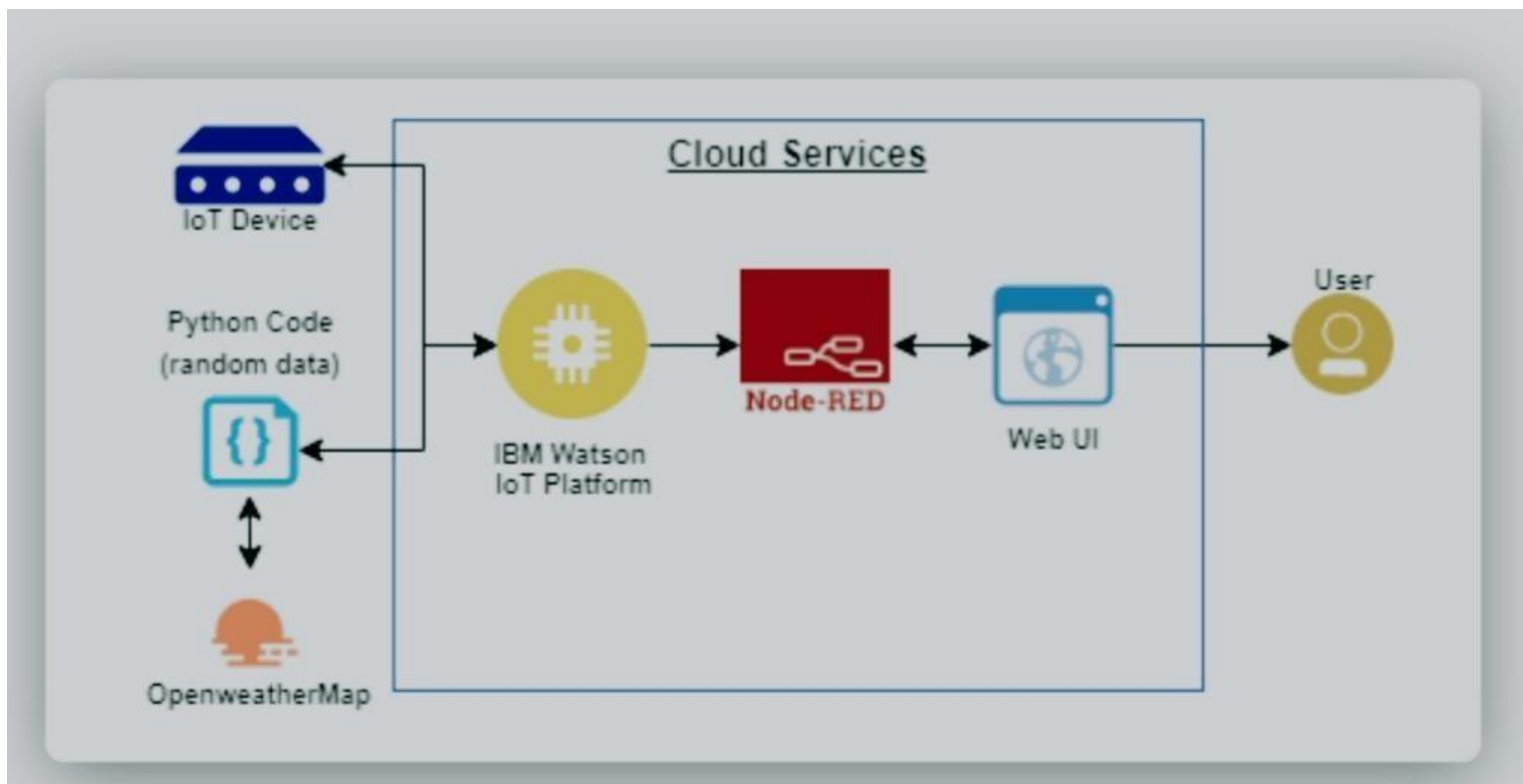
3.3 User stories:

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

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, and password, and confirming my password.	I can access my account/dashboard	High	Sprint-1
		USN-2	As a user, I will receive a confirmation email once I have regToll-freeor the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail		Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password		High	Sprint-1
	Dashboard					
Customer (Web user)	Registration	USN-1	As a user, I can register for the application by	I can access my account/	High	Spirnt-1

			entering my email, password, and confirming my password	dashboard		
Customer Care Executive	Toll free number	USN-1	As an executive I can solve people queried and complaints	I can acces account information of users	Medium	Spirnt-1
Administrator	Login	USN-1	As a administration, I can log into application and web by entering my email, password and confirming my password	I can access all data in the application, I can change Or alter	High	Spirnt-1
	Update	USN-2	As an administrator I can update the information given by the user .	I can change the data based on user given	High	Spirnt-1
	Monitor	USN-3	As an administrator I have to monitor the details given and make use of that.	I will make the monitoring needs to check the information.	Medium	Spirnt-1
	Testing	USN-3	As an administrator, testing is needed to check how reliable the application is.	I will ensure the testing process correctly and make it for user usage.	High	Spirnt-1

4. 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.

4.1 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 for the application by entering my email, password, and confirming my password.	2	High	JOSHUA
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	BRAISELIN SHIBU
Sprint-2		USN-3	As a user, I can register for the application through Facebook	2	Low	KARTHIK
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	CALEB SAMUEL
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	CALEB SAMUEL
	Dashboard					

4.2 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	10 Days	31 Oct 2022	10 Nov 2022	1	27 Oct 2022
Sprint-2	20	8 Days	10 Nov 2022	17 Nov 2022	2	05 Nov 2022
Sprint-3	20	7 Days	12 Nov 2022	19 Nov 2022	1	12 Nov 2022
Sprint-4	20	15Days	12 Nov 2022	26 Nov 2022	2	20 Nov 2022

Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

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

Burndown Chart:

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.

https://www.visual-paradigm.com/scrum/scrum-burndown-chart/
https://www.atlassian.com/agile/tutorials/burndown-charts

Reference:

Reports from JIRA:
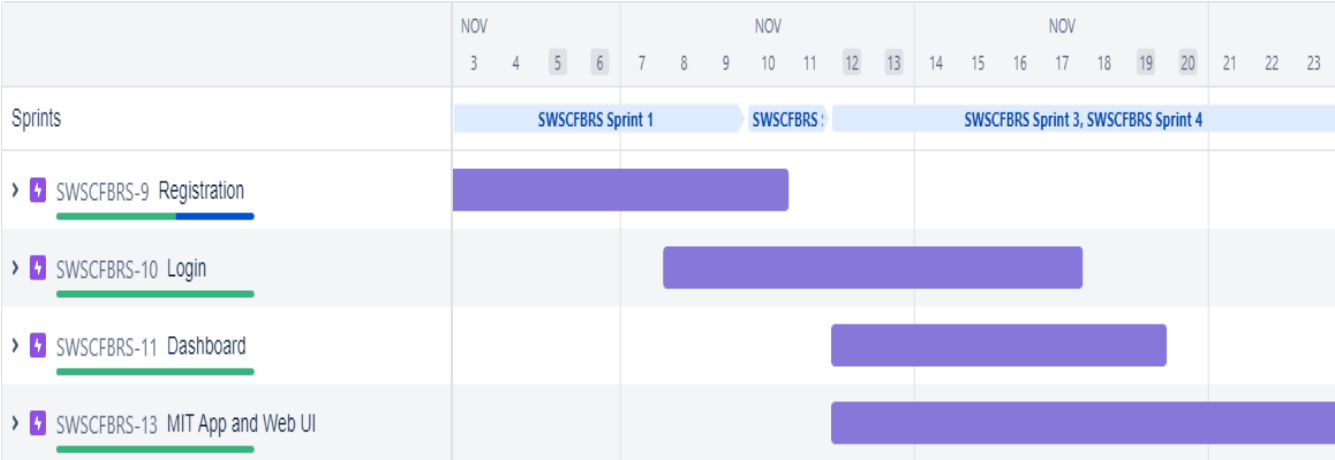
5.CODING & SOLUTIONING

(Explain the features added in the project along with code):

4.3 Feature 1 (coding and result):

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

myConfig = { #Configuration "identity": {
    "orgId": "xfxok9",
    "typeId": "NodeMCU", "deviceId":"6385476358"
    },
    #API Key
    "auth": {
    "token": "9384731286"
    }
    }

#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 =
"Nagercoil"
URL = BASE_URL + "q=" + CITY + "&units=metric"+"&appid=" +
"01df65417ab3968e3fc2a38c4aee27bb"

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="SLOW DOWN, SCHOOL IS NEAR"
elif msg==2:
message="NEED HELP, POLICE STATION AHED"
elif msg==3:
```

```python
message="EMERGENCY, HOSPITAL NEARBY"
elif msg==4:
message="DINE IN, RESTAURENT AVAILABLE"
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==3:
    signMsg="Left Diversion" elif sign==5:
    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,
'Speed':speedMsg, 'Visibility':visibility}
    client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,
onPublish=None) #PUBLISHING TO IOT WATSON
print("Published data Successfully: %s", myData) client.commandCallback =
myCommandCallback time.sleep(5)
client.disconnect()
```

Output:

```
Python 3.7.0 (v3.7.0:1bf9cc5093, Jun 27 2018, 04:59:51) [MSC v.1914 64 bit (AMD64)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
============ RESTART: C:/Users/paulj/OneDrive/Documents/final.py ============
2022-11-12 15:40:27,733   wiotp.sdk.device.client.DeviceClient   INFO    Connected successfully: d:xfxok9:NodeMCU:6385476358
Published data Successfully: %s {'Temperature': 28.76, 'Message': 'NEED HELP, POLICE STATION AHED', 'Sign': '', 'Speed': 'Slow', 'Visibility': 'Clear Weather'}
Published data Successfully: %s {'Temperature': 28.76, 'Message': '', 'Sign': '', 'Speed': 'Slow', 'Visibility': 'Clear Weather'}
Published data Successfully: %s {'Temperature': 28.76, 'Message': 'NEED HELP, POLICE STATION AHED', 'Sign': '', 'Speed': 'Slow', 'Visibility': 'Clear Weather'}
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Published data Successfully: %s {'Temperature': 28.76, 'Message': 'SLOW DOWN, SCHOOL IS NEAR', 'Sign': 'Right Diversion', 'Speed': ' Limit Exceeded', 'Visibility': 'Clear Weather'}
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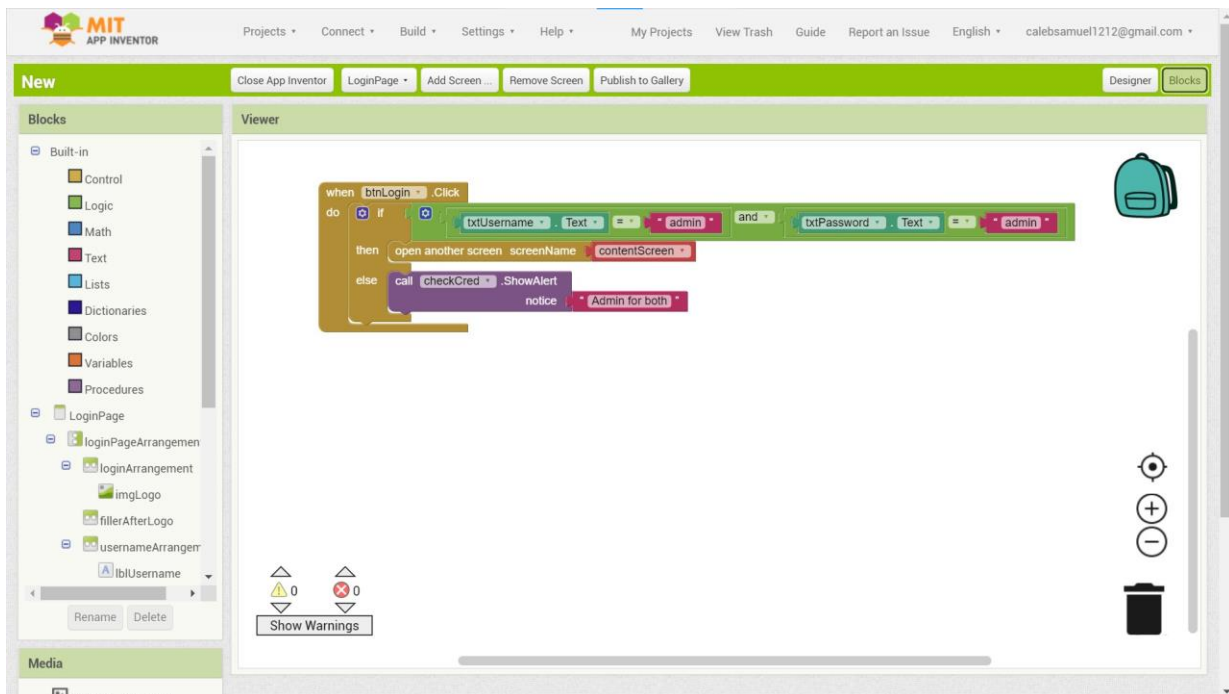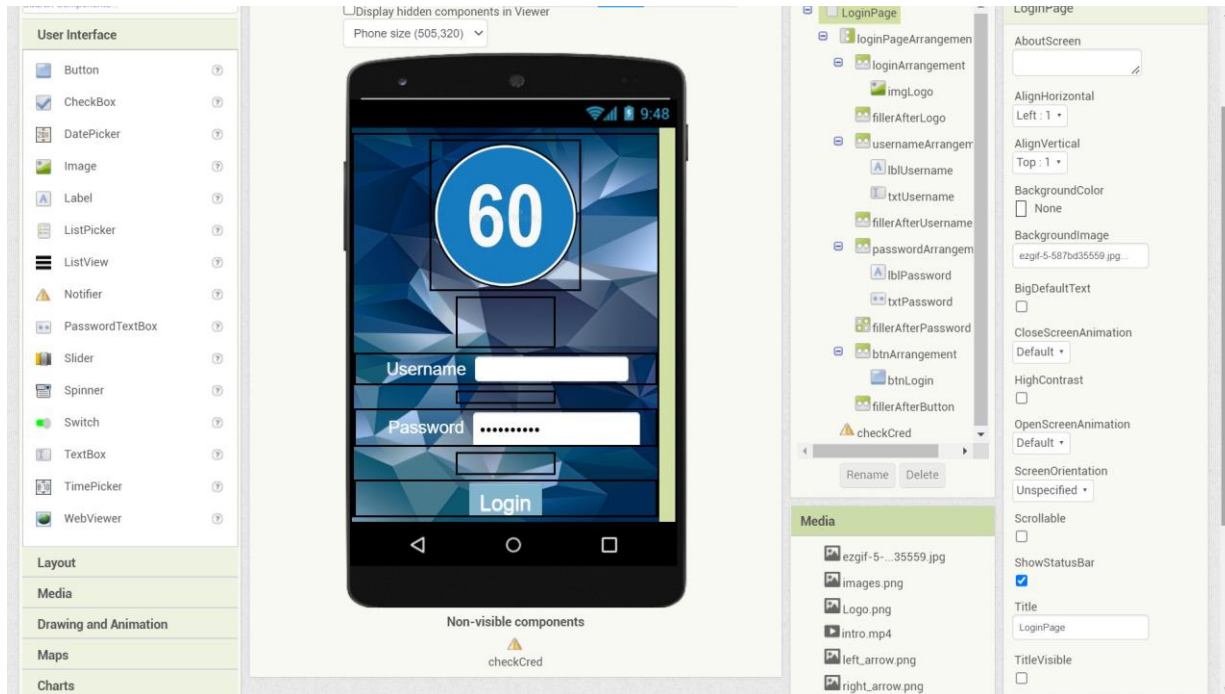
4.4 Feature 2: (MITAPP INVENTER)
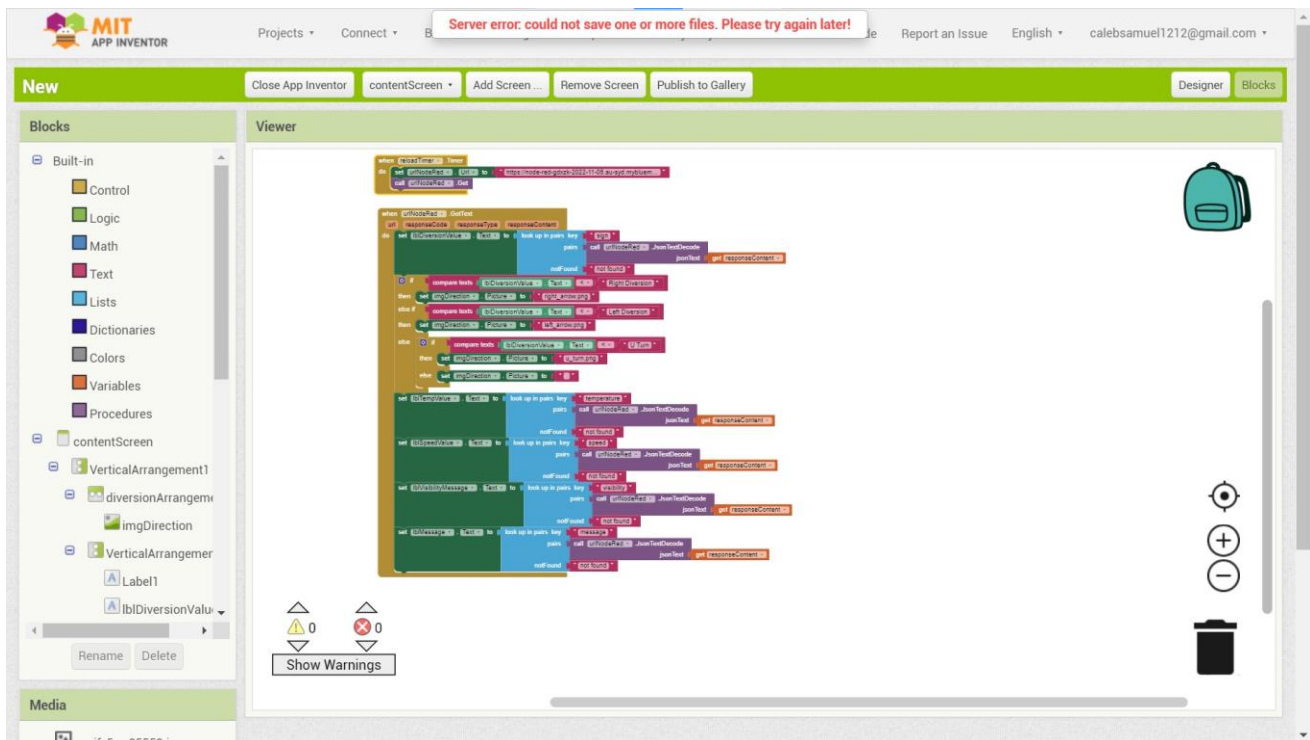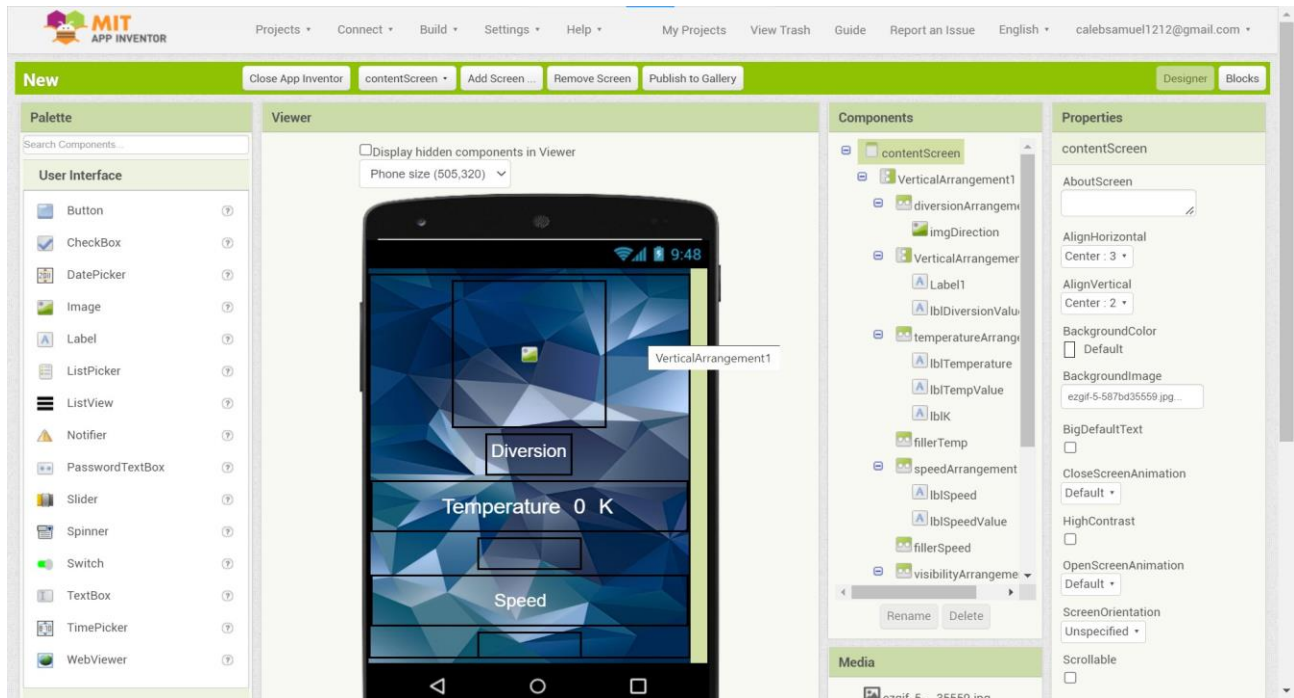
MIT APP INVENTOR: ICON PAGE:

For Screen 1:
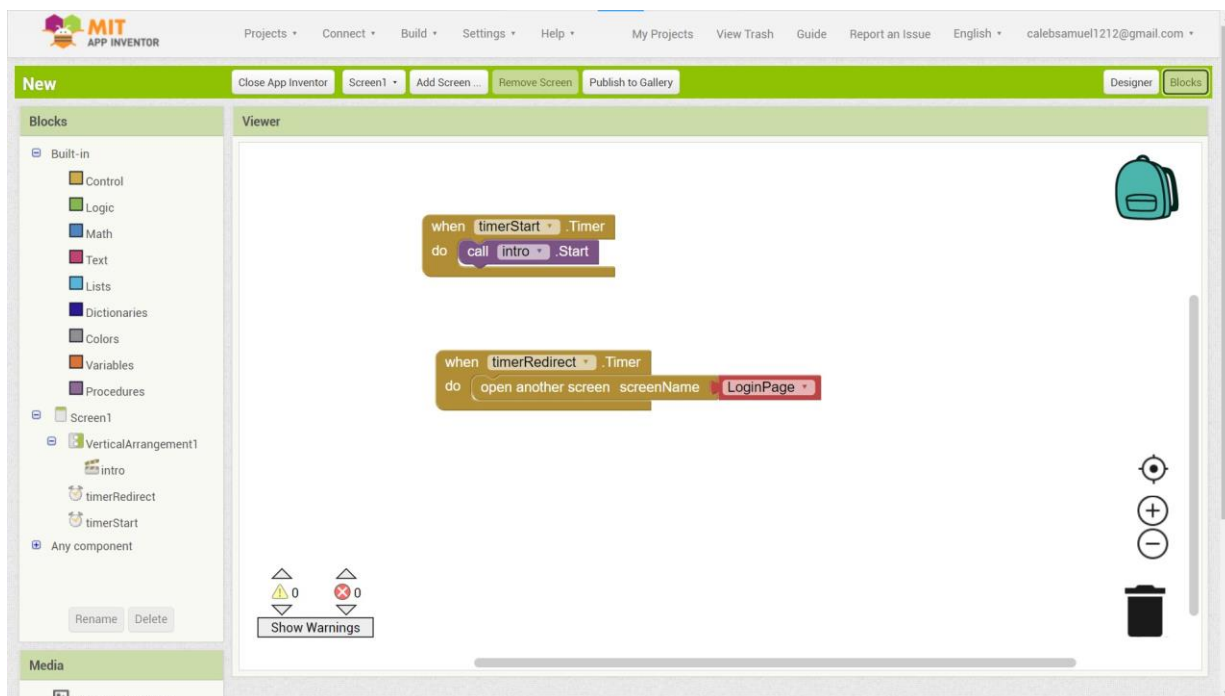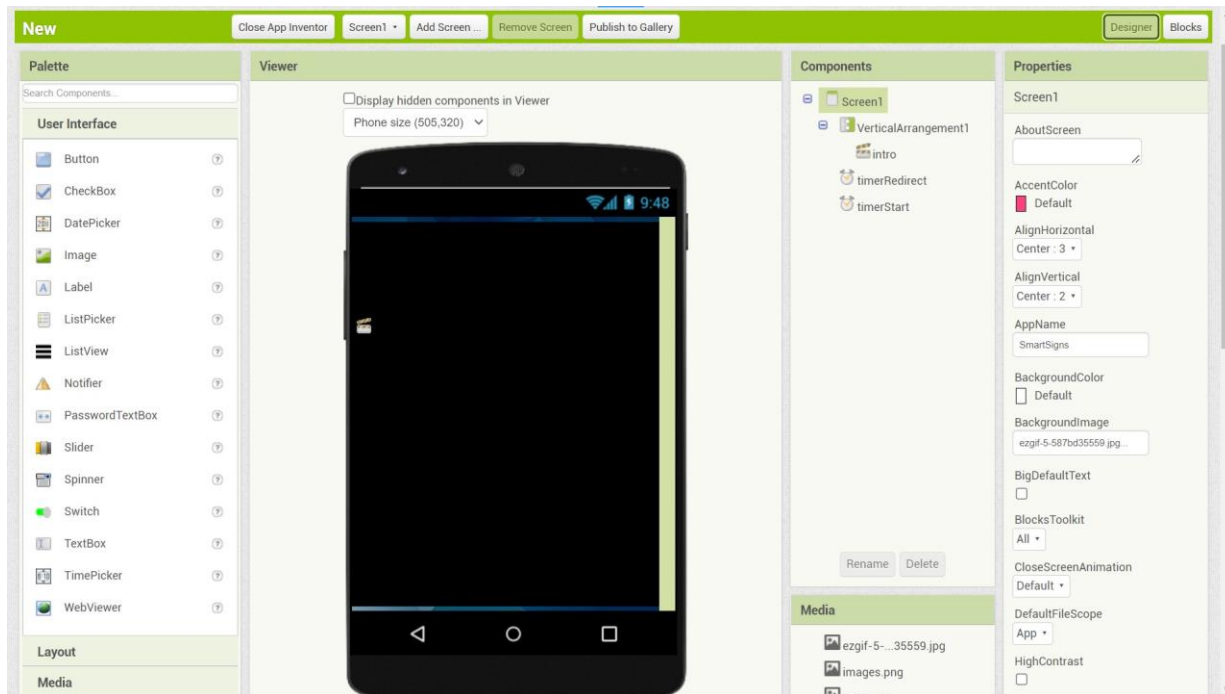
For Screen 2 :

For Screen 3 :

5.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).

4.5 Test Cases:
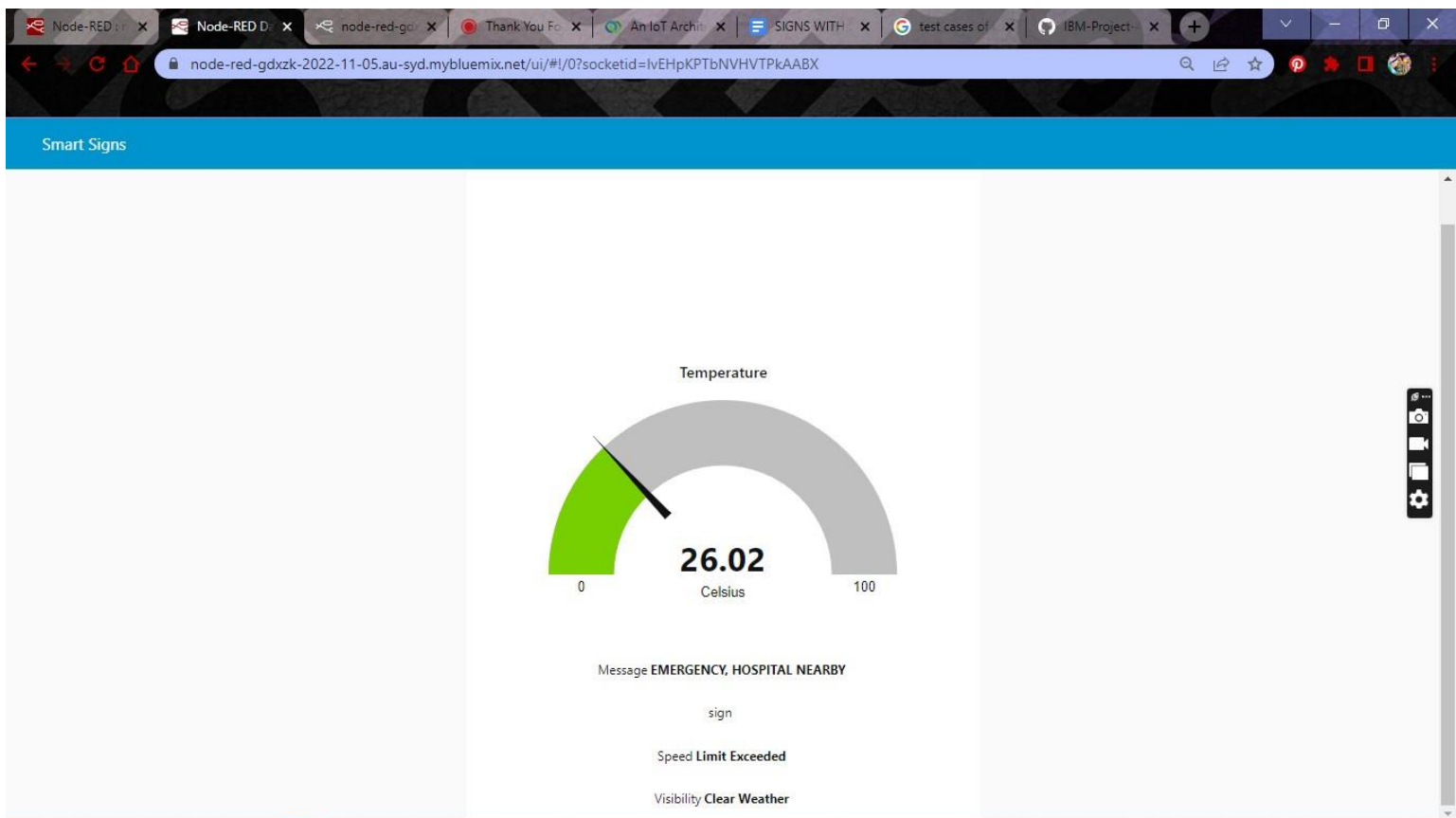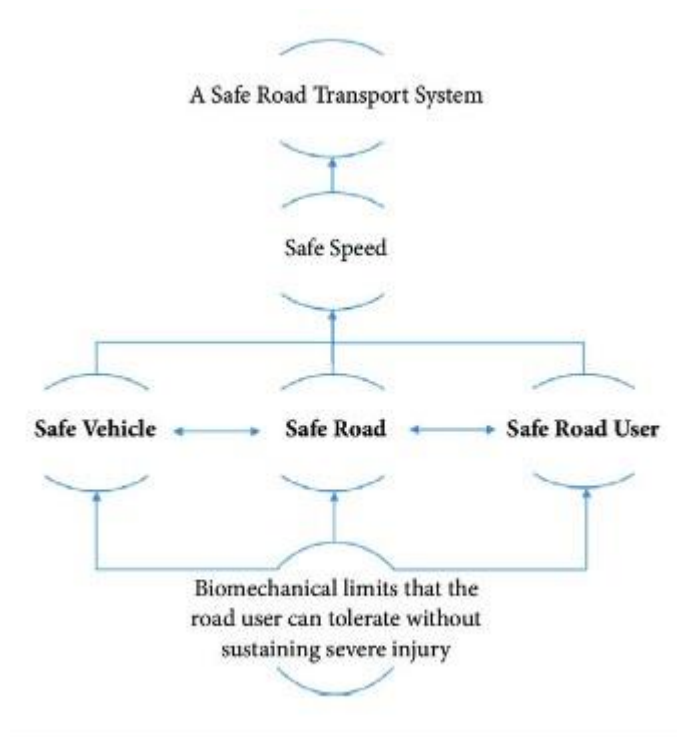
4.6 User Acceptance Testing:

UAT consists, in practice, of people from the target audience using the application. The defects they find are then reported and fixed. This scenario is what most closely resembles "the real world." The process allows users to "get their hands dirty" with the application. They can see if things work as intended.
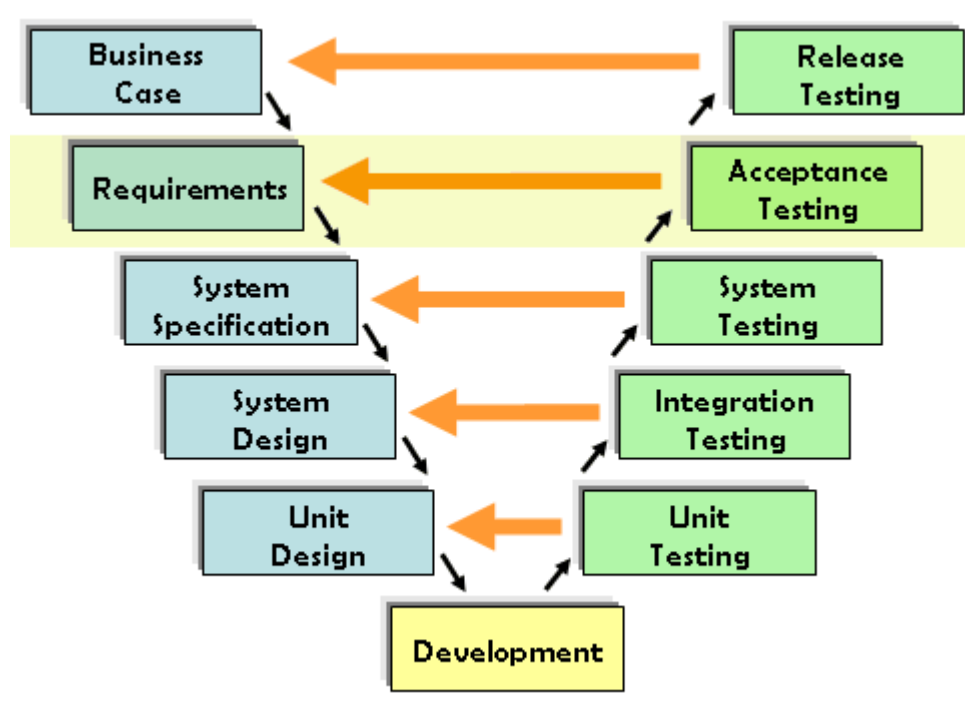
The main purpose of UAT is to validate end-to-end business flow. It does not focus on cosmetic errors, spelling mistakes, or system testing. User Acceptance Testing is carried out in a separate testing environment with a production-like data setup. It is a kind of black box testing where two or more end-users will be involved.

5. RESULTS:

5.1 Performance Metrics:

A Safe Road Transport System
Safe Speed
Safe Vehicle ← → Safe Road ← → Safe Road User
Biomechanical limits that the road user can tolerate without sustaining severe injury

6. ADVANTAGES & DISADVANTAGES

Advantages:

Connected vehicles have various benefits such as

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

- 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)

7. 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.

8. 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 desigh 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.

9. APPENDIX:

Source Code:

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

myConfig = { #Configuration "identity": {
   "orgId": "xfxok9",
   "typeId": "NodeMCU", "deviceId":"6385476358"
   },
   #API Key
   "auth": {
   "token": "9384731286"
   }
   }

#Receiving callbacks from IBM IOT platform def myCommandCallback(cmd):
```

```python
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 = "Nagercoil"
URL = BASE_URL + "q=" + CITY + "&units=metric"+"&appid=" +
"01df65417ab3968e3fc2a38c4aee27bb"

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="SLOW DOWN, SCHOOL IS NEAR"
elif msg==2:
message="NEED HELP, POLICE STATION AHED"
elif msg==3:
message="EMERGENCY, HOSPITAL NEARBY"
elif msg==4:
message="DINE IN, RESTAURENT AVAILABLE"
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"
```

```python
 #Diversion part sign=random.randint(0,5) if sign==1:
    signMsg="Right Diversion" elif sign==3:
    signMsg="Left Diversion" elif sign==5:
    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,
'Speed':speedMsg, 'Visibility':visibility}
    client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,
onPublish=None) #PUBLISHING TO IOT WATSON
print("Published data Successfully: %s", myData) client.commandCallback =
myCommandCallback time.sleep(5)
client.disconnect()
```

GitHub & Project Demo Link :

https://github.com/IBM-EPBL/IBM-Project-35974-
1660291313/tree/main/Project%20Development%20Phase
Demo Link :

https://youtu.be/bZCt7DyoHsY