Signs with Smart Connectivity for Better Road Safety

TEAM ID - PNT2022TMID47318

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 delay sin 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 facilities and12, 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 available 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 WHOdescribes different measures that can be implemented with minimal economic impactsin its “Save LIVES: Road Safety Technical Package”. A cornerstone of these steps isrealizing economic systems for “monitoring road safety by strengthening datasystems”. Meanwhile, a key theme in the package is motivating the adoption of a SafeSystemapproach,whichisaholisticapproachtoroadsafetythatpartsfromtraditionalmanagementsolutionsbyemphasizingsafetybydesign.
Mobile-phone-basedapplicationsusebuilt-insensordatatodetectthespeedlimitbasedonenvironmentalsituations.

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 an ewand 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,where as 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 signboard son which the signs can be changed dynamically. If there is rain fall 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 sign boards 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,demonstratingastrongcapacityfordetectionindependentoftheroad 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.,atnight), at lower solutions, 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 are out 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 traffic.

2.1 Existing problem:

TheSafeSystemApproach

The Safe System (SS) approach to transport networks originated with the "SafeRoad Transport System" model developed by the Swedish Transport Agency.
Initsessence,theapproachmigratesfromtheviewthataccidentsarelargelyand 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:

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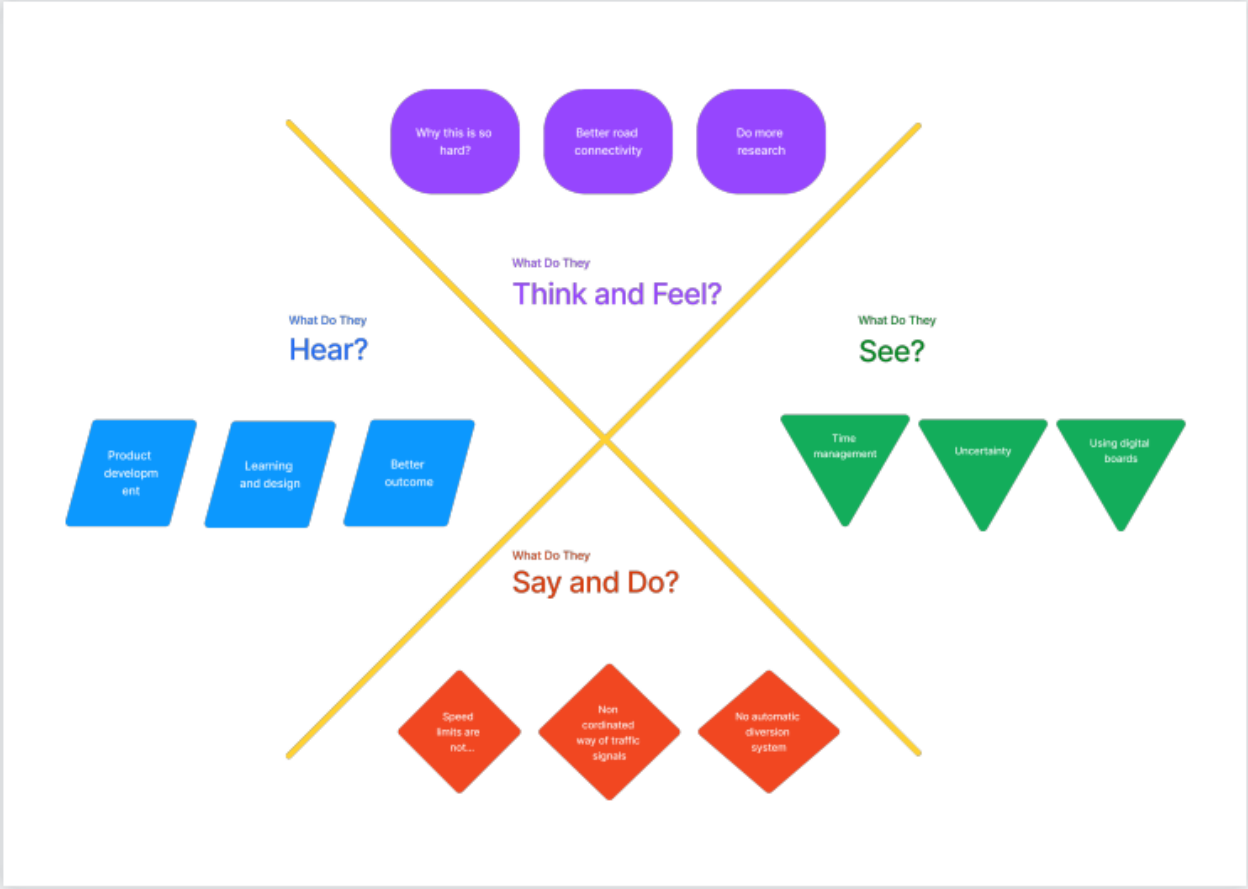
2.3 Problem Statement Definition

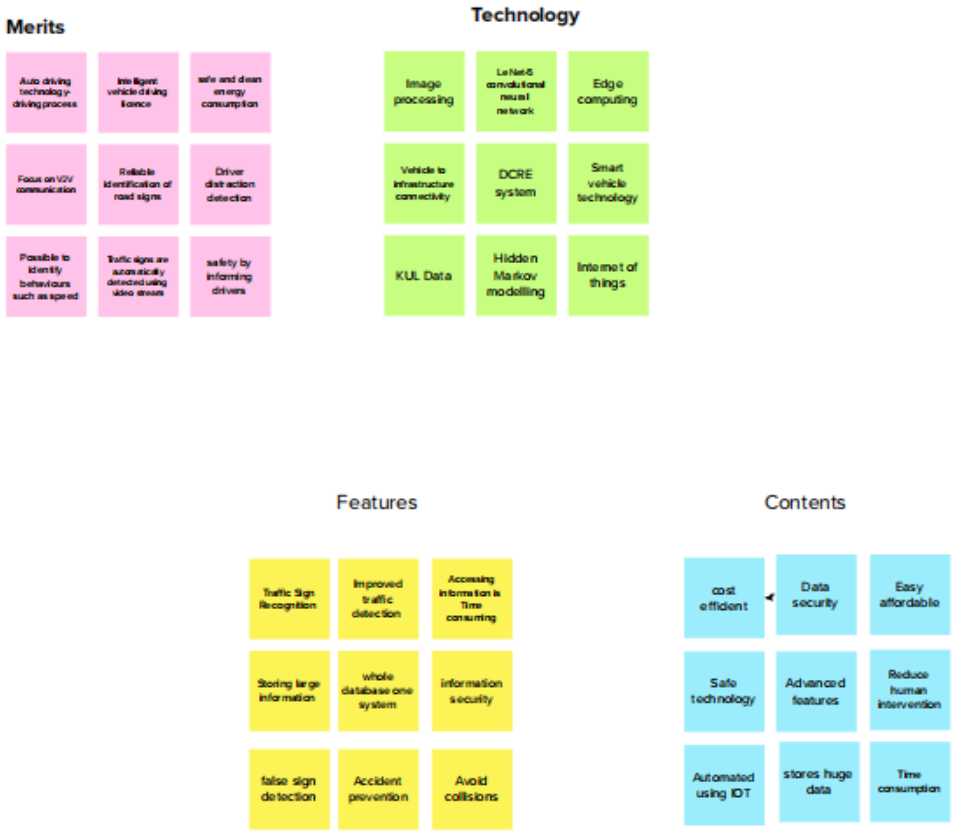
A problem statement is a concise description of an issue to be addressed or a condition to be improved upon. It identifies the gap between the current(problem) state and desired (goal) state of a process or product. Focusing on the facts, the problem statement should be designed to address the Five Ws. 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 signboard son which the signs can be changed dynamically. If there is rain fall then the roads will be slipper yand 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 been through the webapp.This data is retrieved and displayed on the signboards accordingly.

3. IDEATION & PROPOSED SOLUTION:

3.1 Empathy Map Canvas:



3.2 Ideation & Brainstorming:



3.3 Proposed Solution:

Project Design Phase-I
Proposed Solution Template

Date	24 September 2022
Team ID	PNT2022TMID47318
Project Name	Project – Signs with smart connectivity for better road safety.
Maximum Marks	2 Marks

Proposed Solution Template:

Project team shall fill the following information in proposed solution template.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Replacement of static signboards with smart connected sign boards.
2.	Idea / Solution description	The project include features about Time consuming and friendly access to the traffic system.
3.	Novelty / Uniqueness	People can take another alternative way to reach their destination during huge traffic hours.
4.	Social Impact / Customer Satisfaction	It helps people to save time by knowing traffic situation.
5.	Business Model (Revenue Model)	This model is completely useful to all. Takes constant follow up till signs light is repaired/replaced. Errors can be easily corrected.
6.	Scalability of the Solution	Feels frustrated about the heavy traffic situations.

3.4 Problem Solution fit:

4. REQUIREMENT ANALYSIS

4.1 Functional requirement:

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 Boards should be made with LED's whichare bright colored and are capable of attractingthe drivers attention but it should also not be too distracting or blinding cause it may lead to accidents.
FR-2	**User Need**	The smart sign boards should be placed frequentlyin places it is needed and less in places where it isnot needed much to avoid confusion for the user during travel.
FR-3	**User Understanding**	For better understanding of the driver, the signs should be big, clear and legible and it can also include illustrations which will make it easily understandable to the driver.
FR-4	**Product Delivery and installation**	The installation fee will be depend upon the length of the road
FR-5	**User Convenience**	The display should be big enough that it should even be visible from far distance clearly.
FR-6	**Product Feedback**	Will be shared through a website via Gmail

Non-functional Requirements:

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

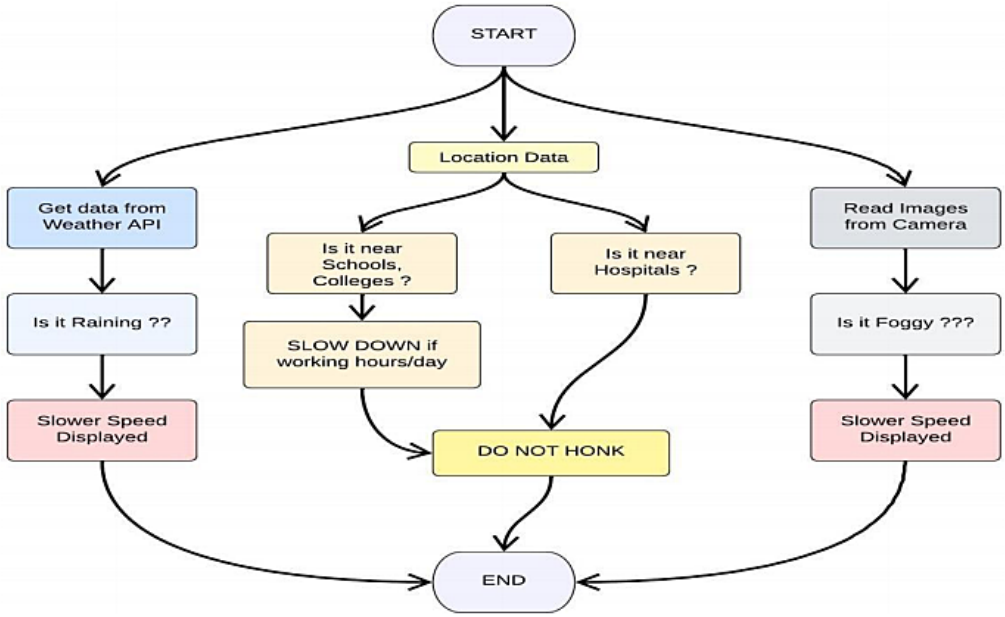
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	It should be able to Upgrade and Update when there is a need for it.
NFR-2	**Security**	It should have good security system so that no other person is able to hack and display their own directions.
NFR-3	**Reliability**	It should be able to display to information correctly and error-free.
NFR-4	**Performance**	It should be able to automatically update itself
NFR-5	**Availabilty**	All of the functions and the user demands will be provided,depend upon the customer needs
NFR-6	**Scalability**	The product is based on road safety and should cover the entire highway system

5. PROJECT DESIGN:

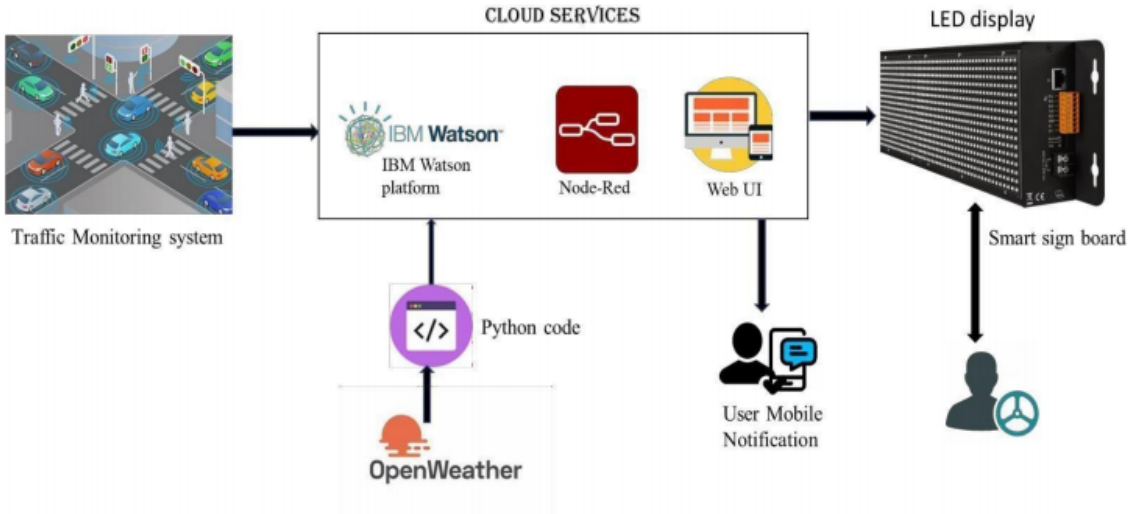
Project design is an early phase of the project lifecycle where ideas, processes,resources, and deliverables are planned out. A project design comes before a project plan as it's abroad overview whereas a project plan includes more detailed information.

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,andwheredataisstored.



5.2 Solution & Technical Architecture:



5.3 Userstories:

UserType	FunctionalRequirement(Epic)	User Story Number	UserStory/Task	Acceptance Criteria	Priority	Release
Customer (Mobileuser)	Registration	USN-1	As a user, I can register for the application by entering my email,and password, and confirming my password.	I can accessmyaccount/dashboard	High	Sprint-1
		USN-2	As a user, I will receive a confirmation email once I haverTown-freeor the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application throughFacebook	I can register access the dashboard with FacebookLogin	Low	Sprint-2
		USN-4	As a user, I can register for the application throughGmail		Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password		High	Sprint-1
	Dashboard					
Customer(Webuser)	Registration	USN-1	Asauser,Icanregister for the application by	I can accessmyaccount/	High	Sprint-1

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

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 number of sprints, each sprint taking the project closer to completion.

6.1 SPRINT PLANNING AND EXECUTION

Sprint	FunctionalRequirement(Epic)	User StoryNumber	UserStory/Task	Story Points	Priority	TeamMembers
Sprint-1	Registration	USN-1	Asauser,Icanregisterfor the application by entering my email,password, and confirming my password.	2	High	MALLIKA
Sprint-1		USN-2	As a user, I will receive confirmation email oncel have registered for the application	1	High	AKSHANA
Sprint-2		USN-3	Asauser,Icanregisterfor the applicationthroughFacebook	2	Low	SNEKA
Sprint-1		USN-4	Asauser,Icanregisterfor the application throughGmail	2	Medium	LOGESWARI
Sprint-1	Login	USN-5	Asauser,Icanlogintothe application by entering email &password	1	High	MALLIKA
	Dashboard					

6.2 Sprint Delivery Schedule:

Project Tracker, Velocity & Burndown Chart:

Sprint	Total Story Points	Duration	Sprint StartDate	Sprint End Date (Planned)	Story Points Completed(a son Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	10Days	31Oct2022	10Nov2022	1	27Oct2022
Sprint-2	20	8Days	10Nov2022	17Nov2022	2	05Nov2022
Sprint-3	20	7Days	12Nov2022	19Nov2022	1	12Nov2022
Sprint-4	20	15Days	12Nov2022	26Nov2022	2	20Nov2022

Velocity:

Imagine we have a 10-day sprint duration, and the velocity of theteamie 20(pointspersprint).Let's Calculate The Team's Average Velocity(AV)periterationunit(story

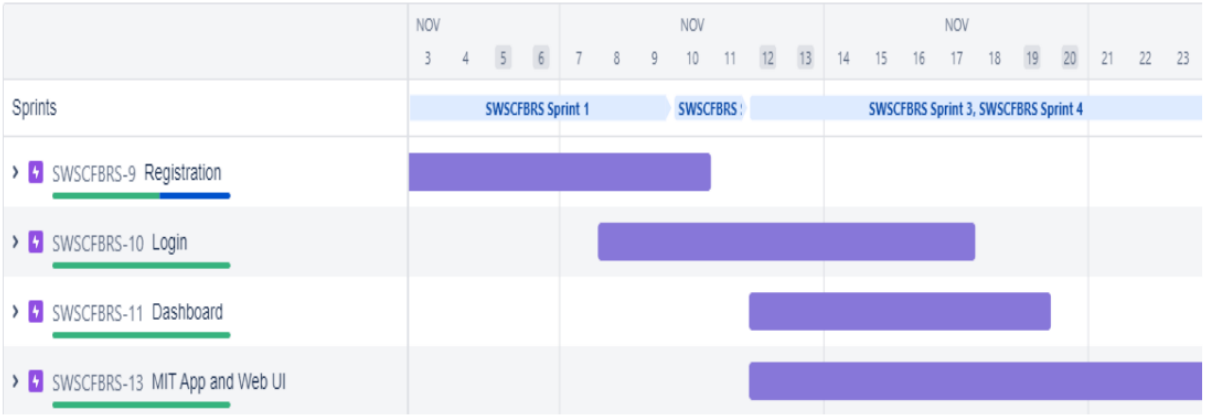
points per day)

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

BurndownChart:

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-downcharts can be applied to any project containing measurable progress overtime.

Reports from JIRA:



7. CODING & SOLUTIONING:

(Explain The Features Added In The Project Along With Code):

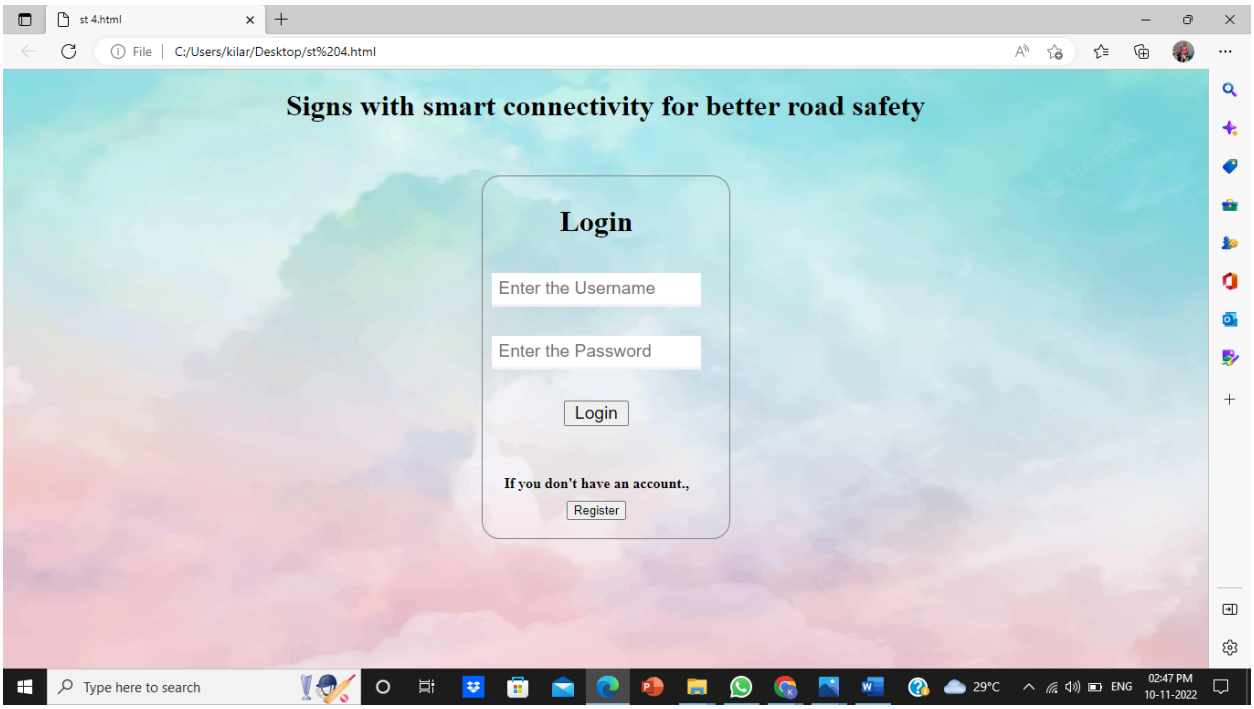
7.1 Feature1(coding and result):

```
import ootp.sdk.device
import time
import random
import ibmiotf.application
import ibmiotf.device
import requests,json
myConfig =
{#Configuratio
n"identity":{
"orgId":"xfx k9",
"typeId":
```

```
"NodeMCU","deviceId":"638547635
8"
},
#APIKey
"auth":{
"token":"9384731286"
}
}
#ReceivingcallbacksfromIBMIOTplatformdef
myCommandCallback(cmd):
print("MessagereceivedfromIBMIoTPlatform:%s"%cmd.data['command'])m=cmd.data['com
mand']
client = wiotp.sdk.device.DeviceClient(config=myConfig,
logHandlers=None)client.connect()
#OpenWeatherMapCredentials
BASE_URL =
"https://api.openweathermap.org/data/2.5/weather?"CITY="Nagercoil
"
URL=BASE_URL+"q="+CITY+"&units=metric"+"&appid="+"01df65417ab3968e3fc2a38c4
aee27bb"
whileTrue:
response=requests.get(URL)ifr
esponse.status_code==200:
data=response.json()main
=
data['main']temperature=m
ain['temp']
humidity=main['humidity']pr
essure =
main['pressure']report=data['
visibility']
#message
partmsg=random.randint(
0,5)ifmsg==1:
message="SLOWDOWN,SCHOOLISNEAR"
elif msg==2:
message="NEEDHELP,POLICESTATIONAHED"
elif msg==3:
message="EMERGENCY,HOSPITAL NEARBY"
elif msg==4:
message="DINE IN,RESTAURENTAVAILABLE"
```

```
else:
message=""#Sp
eedLimitpart
speed=random.randint(0,150)
ifspeed>=100:
speedMsg=" Limit
Exceeded"elif speed>=60
speed<100:
speedMsg="Moderate"else
:
speedMsg="Slow"
#Diversion
partsign=random.randint(
0,5)ifsign==1:
signMsg="Right
Diversion"elfsign==3:
signMsg="Left
Diversion"elfsign==5:
signmsg="UTurn"
else:
signMsg=""
#Visibility
if temperature<24:
visibility="Fog Ahead, Drive
Slow"elif temperature<20:
visibility="Bad
Weather"else:
visibility="ClearWeather"
else:
print("Error 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)#P
UBLISHINGTOIOTWATSON
print("Published data Successfully: %s",
myData)client.commandCallback =
myCommandCallbacktime.sleep(5)
client.disconnect()
```

Output:



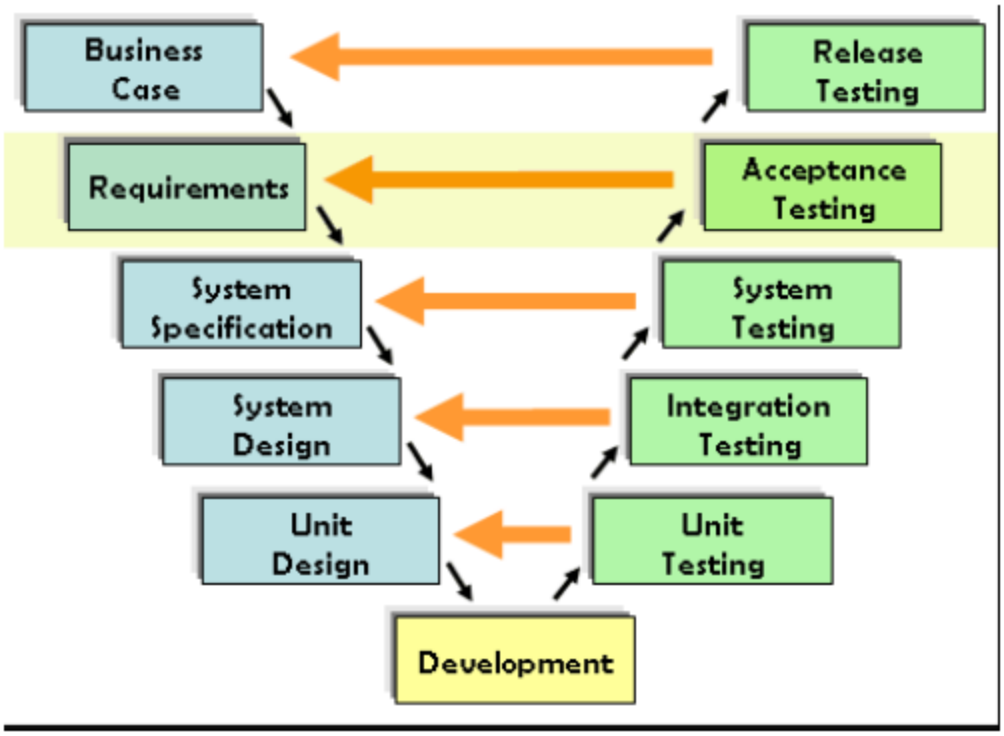
8. TESTING:

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 undertest(AUT).

8.1 TestCases:

8.2 UserAcceptanceTesting:

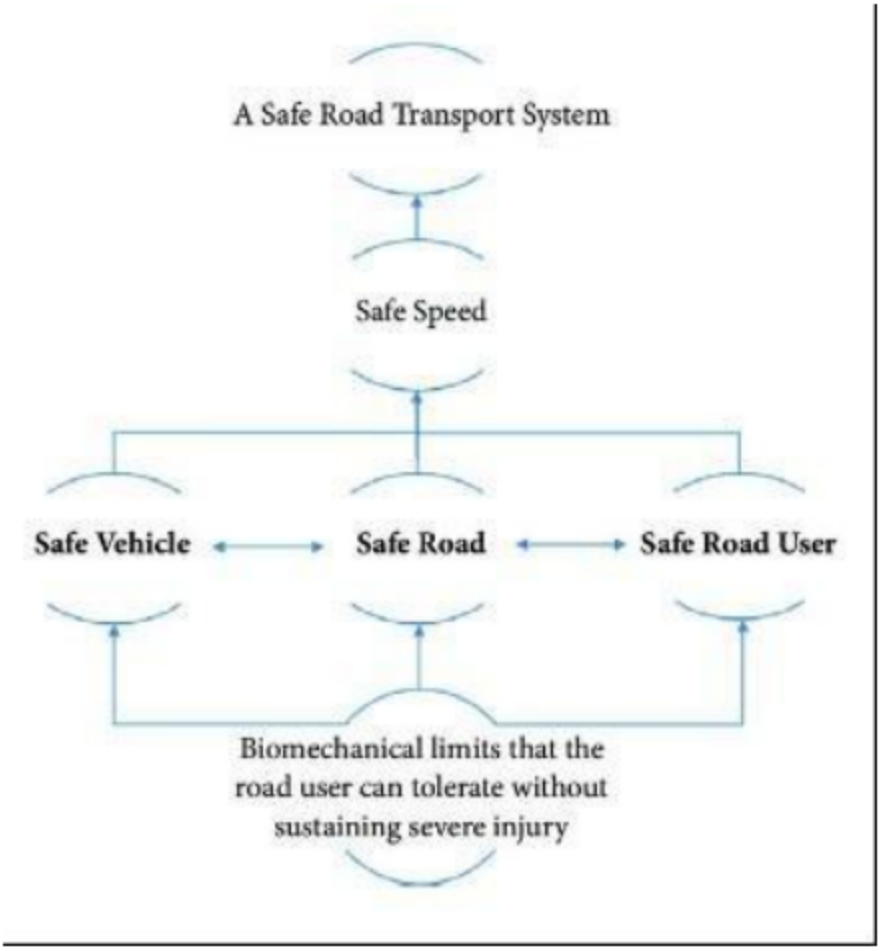
UAT consists, in practice, of people from the target audience using the application.The Defects They find are then reported and fixed.This scenario is what most closely resembles “the real world.” The process allows users to “get their hands dirty” with the application.They can see if things work as intended.



The main purpose of UAT is to validate end-to-endbusinessflow.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 PerformanceMetrics:



10. ADVANTAGES & DISADVANTAGES

Advantages:

Connected vehicles have various benefits such as

● Multi modal sensors and edge computing help speedup the flow of traffic with real-time processing, reducing congestion and emissions.

● Smart road technology can assisting optimizing traffic flow

● It will manage road conditions,creatingamoresustainableenvironmentwithincities.

● Improved control and safety can be achieved through IoT-enabled cars. Incase 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,blackspots,etc.

DISADVANTAGES:

● Securityandprivacy.KeepingthedatagatheredandtransmittedbyIoTdevicessafeischallenging,astheyevolveandexpandinuse....
● 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 tous. 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. FUTURESCOPE:

IoT obtains the majority of its data with the help of connected cars. These incorporate a large number of sensors that hat establish communication whitecloud,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 then ewera.

13. APPENDIX:

SourceCode:

```
import ootp.sdk.device
import time
import random
import ibmiotf.application
import ibmiotf.device
import requests,json
myConfig =
{#Configuratio
n"identity":{
"orgId":"xfx k9",
"typeId":
"NodeMCU","deviceId":"6385476358"
},
```

```
#APIKey
"auth":{
"token":"9384731286"
}
}
#ReceivingcallbacksfromIBMIOTplatformdefm
yCommandCallback(cmd):
print("MessagereceivedfromIBMIoTPlatform:%s"%cmd.data['command'])m=cmd.data['comm
and']
client = wiotp.sdk.device.DeviceClient(config=myConfig,
logHandlers=None)client.connect()
#OpenWeatherMapCredentials
BASE_URL =
"https://api.openweathermap.org/data/2.5/weather?"CITY="Nagercoil"
URL=BASE_URL+"q="+CITY+"&units=metric"+"&appid="+"01df65417ab3968e3fc2a38c4ae
e27bb"
whileTrue:
response=requests.get(URL)ifr
esponse.status_code==200:
data=response.json()main
=
data['main']temperature=m
ain['temp']
humidity=main['humidity']press
ure =
main['pressure']report=data['vis
ibility']
#message
partmsg=random.randint(
0,5)ifmsg==1:
message="SLOWDOWN,SCHOOLISNEAR"
elif msg==2:
message="NEEDHELP,POLICESTATIONAHED"
elif msg==3:
message="EMERGENCY,HOSPITAL NEARBY"
elif msg==4:
message="DINE IN,RESTAURENTAVAILABLE"
else:
message=""
#Speed Limit
partspeed=random.randint(0,
```

```
150)ifspeed>=100:
speedMsg=" Limit
Exceeded"elif speed>=60
speed<100:
speedMsg="Moderate"els
e:
speedMsg="Slow"
#Diversion
partsign=random.randint(
0,5)ifsign==1:
signMsg="Right
Diversion"elfsign==3:
signMsg="Left
Diversion"elfsign==5:
signmsg="UTurn"
else:
signMsg=""
#Visibility
if temperature<24:
visibility="Fog Ahead, Drive
Slow"elif temperature<20:
visibility="Bad
Weather"else:
visibility="ClearWeather"
else:
print("Error 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)#P
UBLI
SHINGTOIOTWATSON
print("Published data Successfully: %s",
myData)client.commandCallback =
myCommandCallbacktime.sleep(5)
client.disconnect()
```

GitHub Link:

https://github.com/IBM-EPBL/IBM-Project-41871-1660645737