SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

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INTERNAL EXAMINER **EXTERNAL EXAMIN**

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1. INTRODUCTION

1.1 Project Overview

RAM-Minimum 4GB Processor-Min. Configuration OS-Windows/Linux/MAC

To replace the static signboards, smart connected sign boards are used.These smart connected sign boards get the speed limitations from a web app using weather API and update automatically.Based on the weather changes the speed may increase or decrease.Based on the traffic and fatal situations the diversion signs are displayed. Guide(Schools), Warning and Service(Hospitals, Restaurant) signs are also displayed accordingly.Different modes of operations can be selected with the help of buttons.

Project Objectives

By the end of this project you will:

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

Project Flow:

- Receiving road sign values to the IBM IoT platform from Node-RED Web UI
- Weather conditions can be viewed in the Web Application
- To accomplish this, we have to complete all the activities and tasks listed below:

- Create and configure IBM Cloud Services
    - Create IBM Watson IoT Platform
    - Create a device & configure the IBM IoT Platform
    - Create Node-RED service
    - Create a database in Cloudcroft DB to store location data
- Develop a web Application using Node-RED Service.
    - Develop the web application using Node-R

1.2 Purpose

- saves thousands of lives
- easily implementable to the existing roads
- full automated (no person is required to operate)
- installation cost is very less
- vehicle monitoring systems can be implemented easily

2.LITERATURE SURVEY

2.1 Existing problem

- The early effects to prevent road accidents and to ensure road safety includes the use of speed detection devices , CCTVs , speed limiters and emergency accident units as the first phase. Des pit achieving the state-of-the-art performance, the existing systems suffer from two main problems.
- Over Speed : These systems cannot control speed at some specific zones.
- Exact location of accident occurred: These systems cannot give the precise location of accident .

2.2 References

1.A.Zanellaet al., "Internet of things for smart cities," IEEE Internet of Things Journal, von. 1, no. 1, pp. 22–32, Feb. 2014.

2.Y.Mehmood*et al*., "Internet-of-things-based smart cities: recent advances and challenges," IEEE Communications Magazine, von. 55, no. 9, pp. 16–24, Sept 2017.

3.K.N.Pallavi,V.R.Kumar,and B.M.Chaithra,"Smart waste management using internet of things:a survey," in Pro c.International Conference on I-SMAC (IoT internet of things) Social, Mobile, Analytics and Cloud) (I-SMAC), Allada, India, 2017, pp. 60-64.

2.3 Problem Statement Definition

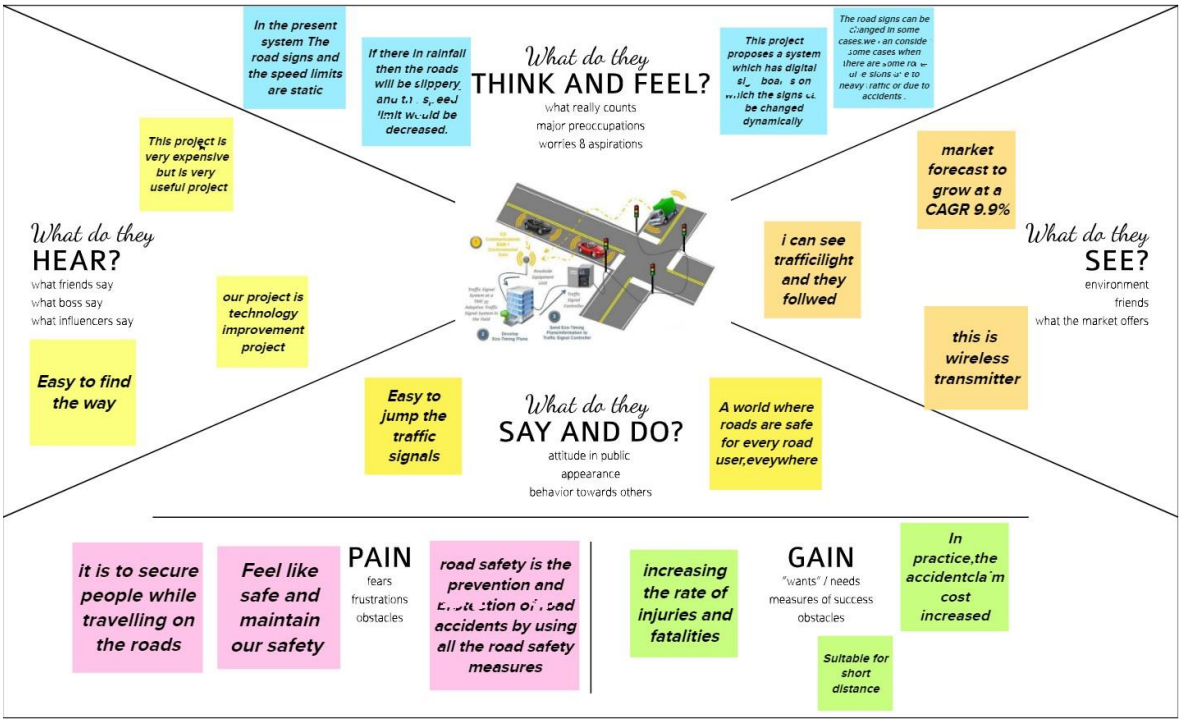
A problem statement is a concise description of an issue to be addressed or a condition to be improved upon. It identifies the gap between the current (problem) state and desired (goal) state of a process or product. Focusing on the facts, the problem statement should be designed to address the Five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

3. IDEATION &PROPOSED SOLUTION

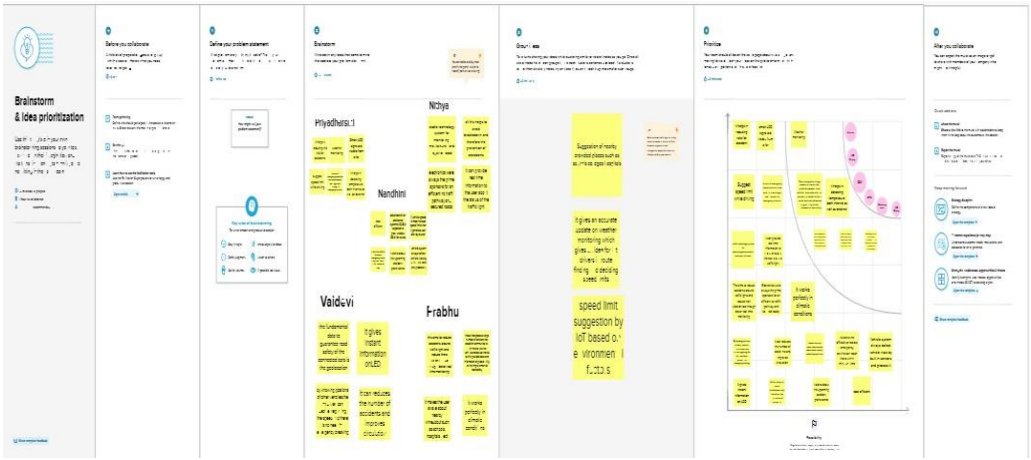
3.1 Empathy map

An empathy map is **a collaborative tool teams can use to gain a deeper insight into their customers**. Much like a user persona, an empathy map can represent a group of users, such as a customer segment. The empathy map was originally created by Dave Gray and has gained much popularity within the agile community.



3.2 Ideation & Brainstorming

Ideation is often closely related to the practice of brainstorming, a specific technique that is utilized to generate new ideas. A principal difference between ideation and brainstorming is that ideation is commonly more thought of as being an individual pursuit, while brainstorming is almost always a group activity.



3.3 proposed solution

S/No	Parameter	Description
1	Problem Statement	To replace the static signboards, smart connected sign boards are used. These smart connected sign boards get the speed limitations from a web app using weather API and update automatically. Based on the weather changes the speed may increase or decrease Based on the traffic and fatal situations the diversion signs are displayed. Guide(Schools), Warning and Service(Hospitals, Restaurant) signs are also displayed accordingly. Different modes of operations can be selected with the help of buttons.
2	Idea/Solution description	The weather and temperature details are obtained from the OpenWeatherMap API. Using these details, the speed limit will be updated automatically in accordance with the weather conditions. Also, the details regarding any accidents and traffic congestion faced on the particular road are obtained .Based on this,the traffic is diverted followed by a change in map path and the traffic is cleared. So in the

		traffic sign board , some buttons will be placed which will be used to make it generic; where each button will be given a functionality such as changing the warning signs, which are predefined and separate signs will be present for both school and hospital zones.By activating this button, either through the web application or the physical buttons, sign of the board can be changed accordingly, and the speed limit will also be set depending upon the zones. Also, the pedestrians are given an option to change the traffic signs if they want to cross the road.
3	Novelty/uniqueness	Generic Sign board for all applications that uses both buttons and web service for inundation Pedestrians are given the access to request the sign change of the signal to cross the road
4	Social impact/customer satisfaction	Diversion reasons will be displayed If there is no traffic, pedestrians can cross the street without waiting. Customer can reach the destination before the expected time
5	Business model/financial benefits	Since APIs are used to actively monitor the customer's environment, this project employs a business strategy in which revenue will be generated on the basis of the length of time in which the customers actively interact with the product. This product is aimed to be free of cost to the public, but the revenue will be generated by selling this product to the government at a low cost, so there will be less accidents and the public will be aware of the discrepancies or accidents in the particular road.
6	Scalability of solution	In the future, if any update is required either on the hardware or software side, it can be easily implemented. The hardware components can be directly interfaced with the microcontroller and small modifications can be made in the programming of the existing product. In case of the software, the website application has to be updated with the additional functionality by creating anew section for the updated hardware. So this will not affect the existing functionality of the product separate circuit will be kept along with the hardware to detect any problem which informs the web application.

3.4 Problem solution fit

Defifine CS, fifit into CC	**1.Customer segment** **Who is your customer?** • highway division • Passenger	**6.Customer Limitations** **What constraints prevent your customers from taking action or limit their choices of solutions?** The impact of the network on the tests was a significant and unexpected element. Given the quantity of sensors, this IoT based system was successful in simulating a large-scale smart agricultural setting.	**5.Available Solution** **Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros & cons do these solutions have?** Along roadways, static signs with clear directions are put as potential fixes.	Explore AS, differentiate
Focus on J&P, tap into	**2. JOBS-TO-BE-DONE / PROBLEMS** **Which jobs-to-be-done (or problems) do you address for your customers?** Among its many duties, the Smart board Connectivity is in charge of keeping correct temperature sensor readings and informing the board of the speed of the customer's vehicle.	**9.Problem Root/cause** **What is the real reason that this problem exists? What is theback story behind the need to do this job?** No sensor readings from the weather would alter the speed restriction if there was no internet connection. Unnecessary pressing of the accident indicator button by some people could lead to problems.	**7.Behaviour** **What does your customer do to address the problem and get the job done?** As a teacher, the IOT cloud updates the smart board on the condition of the roads on a regular basis.	Focus on J&P, tap in to
Identify strong TR & EM	**3.Triggers to act** **What triggers customers to act? i.e. seeing their neighbor installing** Poor weather conditions prevail. The vehicle should be moving at The should speed. The sensor value should be shown on the smart board to alert the customer. **4.Emotions** **How do customers feel when they face a problem or a job and afterwards?** Clients will feel better after selecting an operation mode with the use of smart board connectivity, and they will then follow the instructions on the smart board.	**10.Your Solution** We employ smart linked sign boards as an alternative to static sign boards. With the help of a web app and weather API, these intelligent connected sign boards automatically update with the current speed limits. The speed may rise or fall in response to variations in the weather. The display of diversion signs is determined by traffic and potentially fatal situations. As appropriate, there are also signs that read "Guide (Schools), Warning, and Service" (Hospitals, Restaurants). Using buttons, it is possible to choose from a variety of operating modes.	**8.Channels of behavior** **3.1 ONLINE** **What kind of actions do customers take online?** The departments can receive direct emails or messages from customers. (Officers on nearby patrol). **3.2 What kind of actions do customers take offline?** Following directions is one of the main tasks for the traveler, but they can utilize the smart board signs to check the state of the road from wherever they are.	Extract online & offline CH of BE

4.REQUIREMENT ANALYSIS

4.1 Functional Requirements

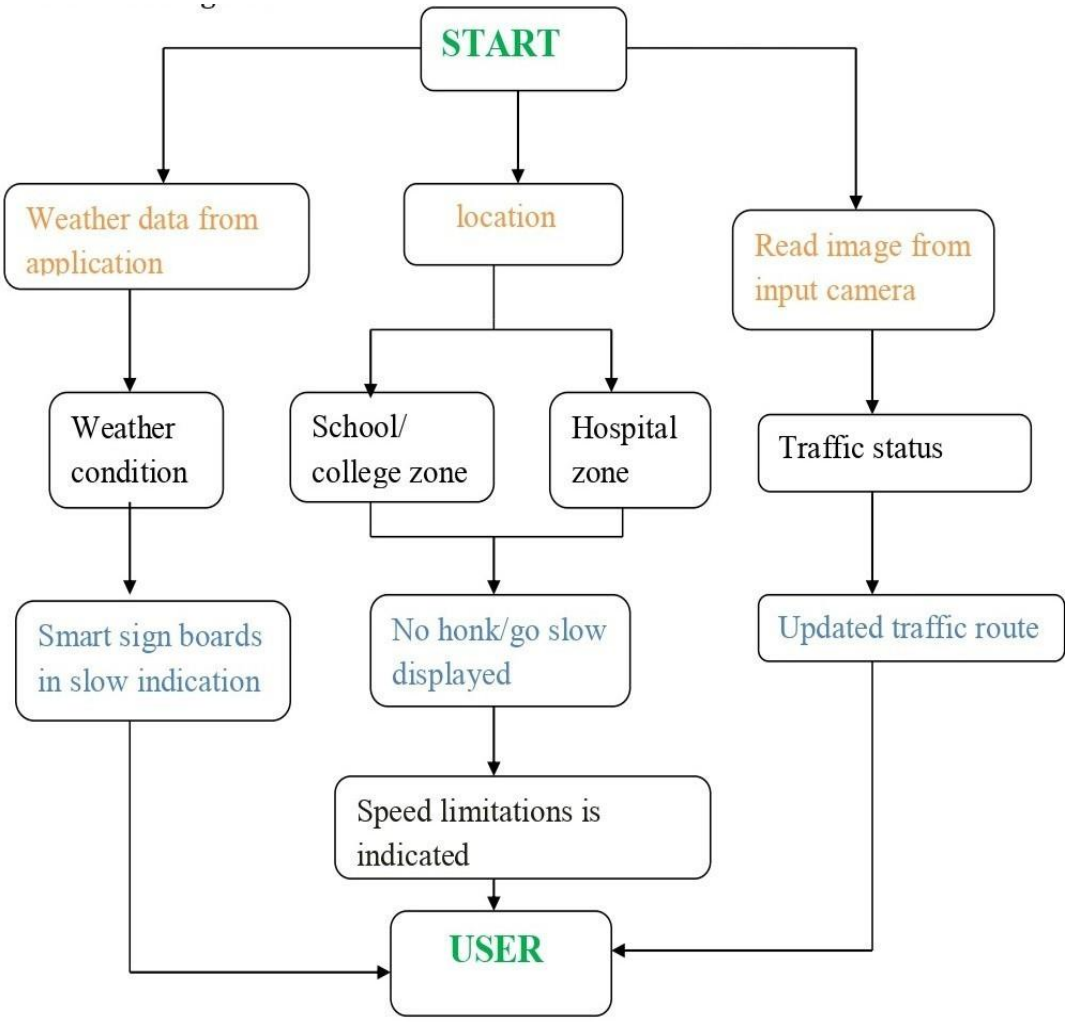
Fr no.	Functional requirement(epic)	Sub requirements(story/sub-task)
Fr 1	**user visibility**	Sign boards should be made with LED'swhich are bright coloured and are capable of attracting the drivers attention but it should also not be too distraction blinding cause it may lead to accidents.
Fr 2	**user need**	The smart sign boards should be placed frequently in places it needed and lessin places where it is not needed much to avoid confusion for the user duringtravel.
Fr 3	**user understanding**	For better understanding of the driver thesigns should be big, clear and legible and it canalso include illustrations whichwill mak e it easily understandable to the driver.
Fr 4	**user convenience**	The display should be big enough that it should even be visible from far distanceclearly

4.2 Non Functional Requirement

Fr no.	Non-functional requirements	Description
NFR-1	**Usability**	It should be able to upgradeand update when there is a need for it.
NFR-2	**Security**	It should have good security system so that no other personis able to hack and display their own direction.
NFR-3	**Real ability**	It should be able to display to information correctly anderror-free.
NFR-4	**performance**	It should be able to automatically update itself when certain weather or traffic problem occurs.
NRF-5	**availability**	It should be available 24/7 sothat it can be beneficial to the customer i.e the driver.
NRF-6	**Scalability**	It should be able to eily change and upgrade according to change and need in requirement.

5. PROJECT DESIGN

5.1 Data flow diagrams

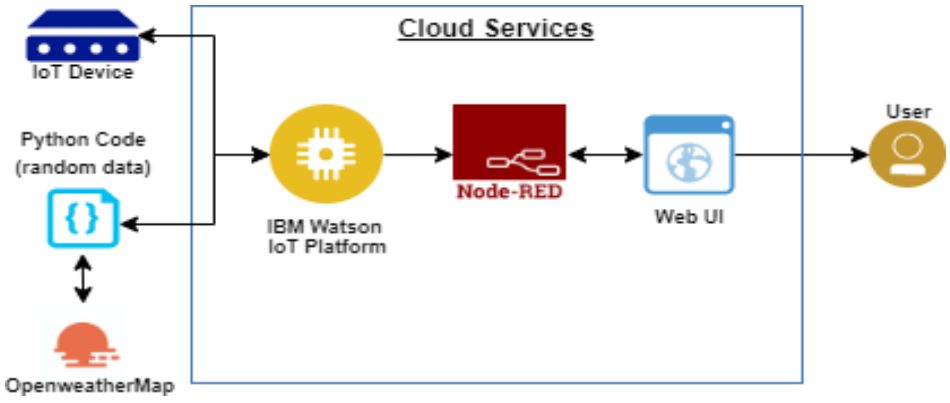


5.2 Solution &technical architecture

- To replace the static signboards, smart connected sign boards are used.
- These smart connected sign boards get the speed limitations from a web app using weather API and update automatically.
- Based on the weather changes the speed may increase or decrease.

- Based on the traffic and fatal situations the diversion signs aredisplayed. Guide (Schools), Warning and Service (Hospitals, Restaurant) signsare also displayed accordingly.

5.3 Technical architecture



6. PROJECT PLANNING & SCHEDULING

6.1 Sprint planning & Estimation

TITLE	DESCRIPTION	DATE
Literature Survey& Information Gathering	A literature review is a comprehensive summary of previous researches on the topic. The literature review surveys scholarly articles, books, and other sources relevant to a particular area of research.	O3 October 2022
Prepare Empathy Map	An empathy map is a collaborative tool teams can use to gain a deeper insight into their customers. It helps us to understand the customers pain.	06 October 2022
Ideation Brainstorming	Brainstorming is a group problem-solving method that helped us to gather and organize various ideas and though from team members.	08 October 2022
Define Problem statement	The Customer Problem Statement helps us to focus on what matters to create experiences people will love.	07 October 2022
Problem Solution Fit	It helped us understand and analyze all the thoughts of our customer, their choice of options, problems, root cause, behavior and emotions.	09 October 2022
Proposed solution	It helped us analyze and examine our solution more in the grounds of uniqueness, social impact, business model, scalability etc.	07 October 2022
Solution Architecture	Solution architecture is a complex process –with many sub-processes – that bridges the gapbetween business problems and technology solutions.	08 October 2022
Customer journey map	It helped to analyze the various steps, interactions, goals and motivation, positives, negatives and opportunities.	17 October 2022
Solution requirements	Here functional and non-functional requirements are briefed. It has specific features like performance, availability and scalability.	12 October 2022
Technology Stack	A tech stack is the combination of technologies a company uses to build and run an application or project. It helps us analyze and understand various technologies that needs to be implemented in the project.	15 October 2022
Data flow	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.	12 October 2022
Sprint Delivery Plan	Sprint Planning is an event in scrum that defines what can be delivered in the upcoming sprint and how that work will be achieved	In progress
Prepare milestone and activity list	Helps us understand and evaluate our progress and accuracy so far.	In progress

6.2 Sprint Delivery Scheduling

Product Backlog, Sprint Schedule and Estimation

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story/Task	Story Points	Priority	Team Members
Sprint 1	Initializing the Resources	Create an account in Open Weather API	1	low	Priyadharsini.T Nandhini.R Nithya.K Vaidevi.M Prabhu.M
Sprint 1	Code in software is written	Write a python script using the input given from open weather API	2	MEDIUM	Priyadharsini.T Nandhini.R Nithya.K Vaidevi.M Prabhu.M
Sprint 2	Sending the software cloud	The python code from sprint 1should be sent to cloud so that it easily accessible	1	MEDIUM	Priyadharsini.T Nandhini.R Nithya.K Vaidevi.M Prabhu.M
Sprint 3	Initialize the connection between hardware and cloud	The hardware should be integrated for the easy access of the cloud functions	2	HIGH	Priyadharsini.T Nandhini.R Nithya.K Vaidevi.M Prabhu.M
Sprint 4	User input-output optimization and error identification and rectification	Rectify all the short coming /error andinitialize the optimization for better	3	HIGH	Priyadharsini.T Nandhini.R Nithya.K Vaidevi.M Prabhu.M

Project Tracker, Velocity & Burn down Chart

Sprint	Total points	Duration	Story points
Sprint 1	20	6days	20
Sprint 2	20	6days	20
Sprint 3	20	6days	20
Sprint 4	20	6days	20

Velocity :

The average velocity(AV) per iteration unit (story points per day) can be defined as sprint duration by velocity (points per sprint)

AV= Sprint duration/Velocity

Given :

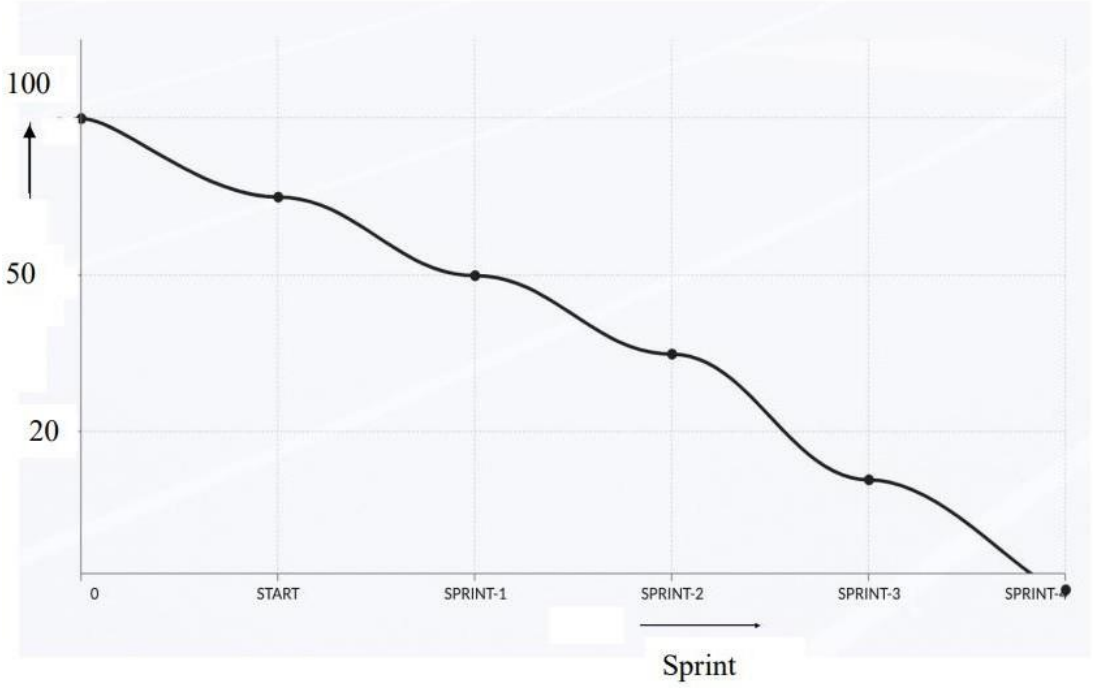
Sprint duration= 6days

Velocity= 20

AV = 6/20 = 0.3

AV =0.3

Burn down Chart :



7.CODING & SOLUTIONING

(explain the features added in the project along with code)

7.1 Feature 1

```
#IBM Watson IOT Platform
#pip install wiotp-sdk
import wiotp.sdk.device
import time
import random
myConfig = {
"identity": {
      "orgId": "hj5fmy",
      "typeId": "NodeMCU",
      "deviceId":"12345"
   },
   "auth": {
      "token": "12345678"
   }
}
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()
while True:
   temp=random.randint(-20,125)
   hum=random.randint(0,100)
   myData={'temperature':temp, 'humidity':hum}
   client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,
onPublish=None)
   print("Published data Successfully: %s", myData)
```

```
    client.commandCallback = myCommandCallback

    time.sleep(2)

client.disconnect()
```

7.2 Feature 2

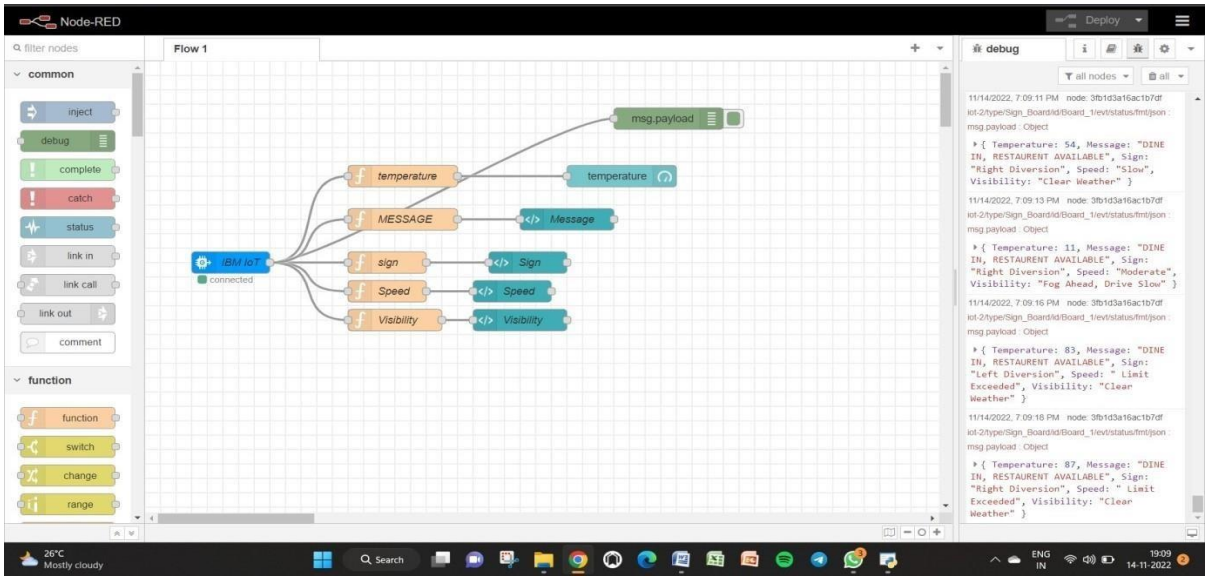
```
 import time
import sys
import ibmiotf.application
import ibmiotf.device
import random
#Provide your IBM Watson Device Credentials
organization = "w5704q"
deviceType = "PNTIBM"
deviceId = "PNTIBM"
authMethod = "token"
authToken = "WZi6IvG7x2rEYl?pc8"
# Initialize GPIO
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="lighton":
        print ("led is on")
    else :
        print ("led is off")
    #print(cmd)
 try:
deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method":
authMethod, "auth-token": authToken}
            deviceCli = ibmiotf.device.Client(deviceOptions)
            #.....................................................
            except Exception as e:
            print("Caught exception connecting device: %s" % str(e))
            sys.exit()
# Connect and send a datapoint "hello" with value "world" into the cloud as an event of type
"greeting" 10 times
deviceCli.connect()
while True:
        #Get Sensor Data from DHT11
        temp=random.randint(0,100)
        Humid=random.randint(0,100)
        data = { 'temp' : temp, 'Humid': Humid }
        #print data
        def myOnPublishCallback():
            print ("Published Temperature = %s C" % temp, "Humidity = %s %%" % Humid, "to
IBM Watson")
success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
```

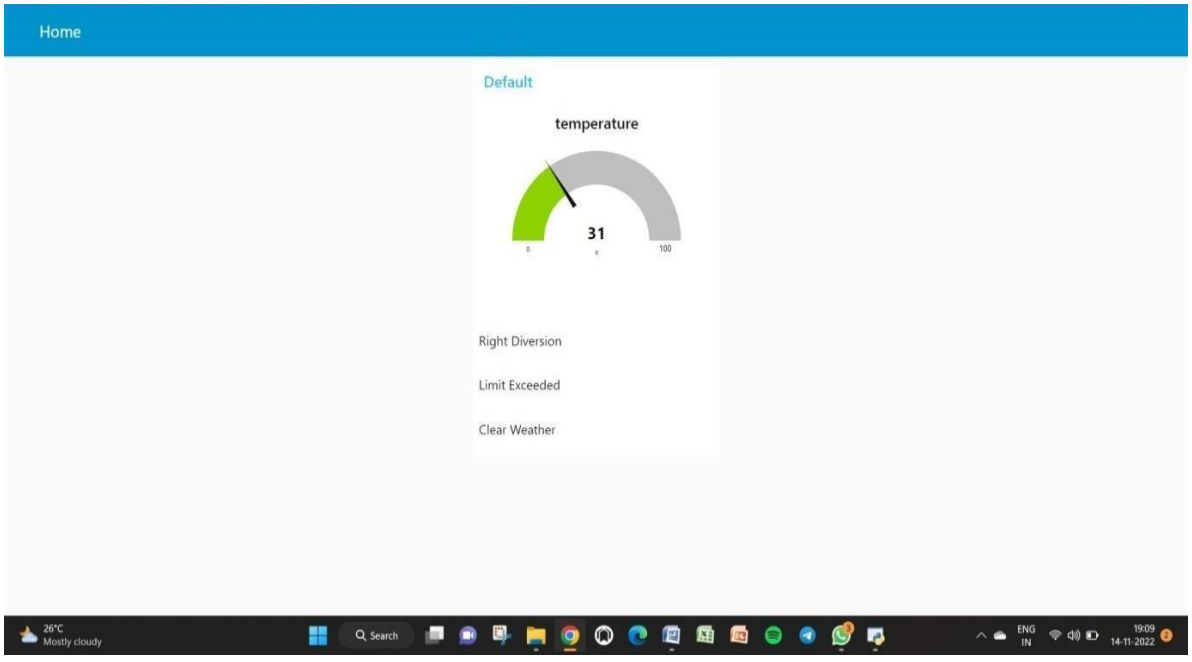
```
        if not success:
         print("Not connected to IoTF")
        time.sleep(1)
        deviceCli.commandCallback = myCommandCallback
# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

7. TESTING

Test cases help guide the tester through a sequence of steps to validate whethera 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)

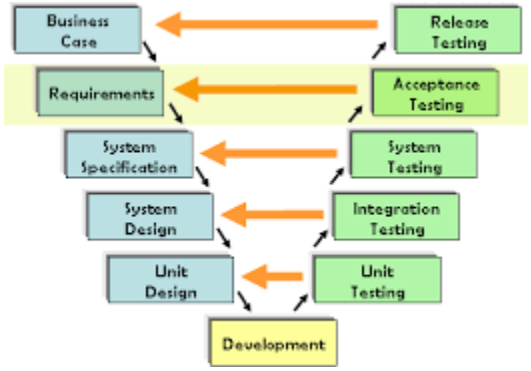
8.1 Test case





8.2 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



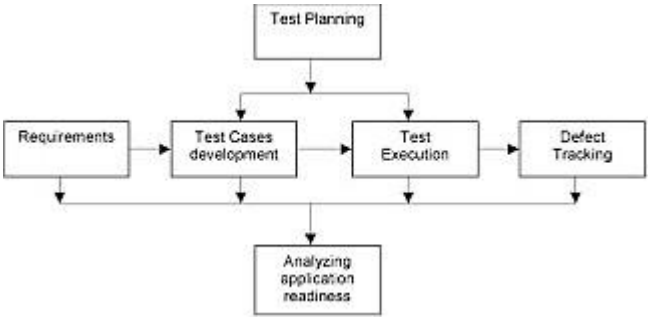
The main purpose of UAT is to validate end-to-end business flow. It does not focus on cosmetic errors,spelling mistakes, or system testing. User Acceptance Testing is carried out in a separate testing environment with a production-like data setup. It is a kind of black box testing where two or more end-users will be involved**.**

8. RESULTS

By application of this smart accident prevention system, the number of accidents occurring in curves of hills have not only decrease but also providing signal information to vehicle driver which are coming from opposite side, hence it alerting us. This is an innovative approach where we have also used counters to count the number of vehicles progressing from the opposite side, i.e. for example, if two cars coming from right-siden then the left side counter shows two and if three cars are coming from left side then right-side counter shows three. Moreover, there will be red signals alerting drivers to drive slow and consequently green signals to convey message that no vehicle is coming from the opposite side. In case accident happen only when we know the exact location of accidental place. This project presents an in expensive but intelligent framework that can identify and report an accident to the family member. If in case accident occurs, button will get pressed and it will send message to the family members using GSM module and send location of accidental place using GPS mod

9.1 Performance Metrics

Performance Testing is a software testing process used for testing the speed, response time, stability, reliability, scalability, and resource usage of a software application under a particular workload. The main purpose of performance testing is to identify and eliminate the performance bottlenecks in the software application.



9. ADVANTAGES

- The goal of the project is to reduce the number of accidents.
- This system helps people to drive day and night carefully.
- It is a simple and effective concept of alerting the drivers with sounds and honks that they are familiar with.
- This system is an innovative application of IOT to road safety to save lives.
- Intelligent transport system (ITS)based on Internet Of Things(IOT)are getting popular and can be seen as a solution to improve the road safety.
- Improved traffic and pedestrian safety.
- Extended connectivity alongside transportation infrastructure.

DISADVANTAGES

- Increased traffic can increase carbon emissions and other pollution.
- Land use for roads can damage built and natural environment, impose mortality on wildlife if habitats are severed, and construction has associated environmental costs

10. CONCLUSION

The goal of this project is to reduce the number of accidents that occur on hilly and curved roads.This is accomplished by placing an Ultrasonic sensor on one side of the road before the curve and an LED light on the opposite side, so that if a vehicle approaches from one end of the curve, the sensor detects it and the LED light glows on the opposite side. Road accidents cannot be eliminated but can be reduced by enhancing the safety of the drivers. This study developed a smart mobile-based application that uses in-built sensors to alert drivers with voice and image notifications. The application provides a voice alert to a needed action that enhances the driver's attention.

11. FUTURE SCOPE

- In this paper, the project infrastructure has been conceptually presented. Currently, a research group has been working on the limitations of the infrastructure (light poles from COMLIGHT AS) and the integration of IQRF technology.
- As a next step, the most important safety information to communicate between the vehicles and the infrastructure at the testing area will be identified.
- Further, the requirements and considerations when designing such an adhoc network of connected vehicles and fixed infrastructure elements will be determined.

12. APPENDIX

12.1 Source Code

```
Import wiotp.sdk.device
import time
import random
import ibmiotf.application
import ibmiotf.device
import requests, json
myConfig = {
#Configuration
"identity": {
"orgId": "3dpjnk",
"typeId": "Sign_Board",
"deviceId":"Board_1"},
#API Key
"auth": {
"token": "1234567890"
}
}
#Receiving callbacks from IBM IOT platform
defmyCommandCallback(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 = "Chennai"
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"
elifmsg==2:
message="NEED HELP, POLICE STATION AHED"
elifmsg==3:
message="EMERGENCY, HOSPITAL NEARBY"
elifmsg==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"
elifsign==3:
signMsg="Left Diversion"
elifsign==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 =
myCommandCallbacktime.sleep(5)
client.disconnect()
```

12.2 GitHub & Project Demo Link

https://github.com/IBM-EPBL/IBM-Project-14736-1659589297