SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY

Done by,
1.SHEIK ABDULLAH.J__(420819106016)
2.MUBIN.M_____(420819106010)
3.JASMINERUBINA.M__(420819106004)
4.KALAIYARASAN.S___(420819106006)

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BONAFIDE CERTIFICATE

Certified that this project report **"SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY"** is the bonafide work of "J.Sheikabdullah,M.Mubin,M.Jasminerubina, S.Kalaiyarasan" who carried out the project work under my supervision.

SIGNATURE OF HOD

T.Karunaraiselvi,
H.O.D - Department of ECE,
Chendu college of engineering and technology,
maduranthakam.

CONTENTS

1. **INTRODUCTION:**

In Global Status Report on Road Safety - 2015, the World Health Organization (WHO) noted that the worldwide total number of road traffic deaths has plateaued at 1.25 millionper year, with tens of million either injured or disabled. Different initiatives, such as the United Nations' initiative for the 2011-2020. Decade of Action for Road Safety, have led to improvements in road safety policies and enforcements. However, the WHO notes that the progress has been slow and has maintained the call for urgent action to reduce these circumstances.

Added to the losses in human lives and wellbeing, Consider able monetary losses are incurred in medical expenses, infrastructure repair, and production downtime. While the Worldwide figures have plateaued, the Global Status Report does indicate higher road fatalities and injuries in some countries. Such disparity, as noted and signalsa barring-limitation in some countries to improve road-safety by adopting solutions and need to implement.

Many governments and transport authorities understand the value of smart road technologies. However, developing smart city infrastructure at scale can be costly and complex. Leaders can break down smart road projects into phases, starting with low-investment, narrow-scale initiatives that can provide initial value, setting the stage for high-investment and large-scale efforts.

In the early days of motor-powered mobility, cars were available, but there was no suitable road infrastructure; the first private cars were hardly more effective than horse-driven wagons. Gradually, authorities recognized that only a major investment in road infrastructure would help the population reap the benefits of

new transport technology.

PROJECT OVERVIEW:

Technology has brought fine changes into every portion of our life by making it smart and reliable. There are many situations in which technologies can be used to avoid accidents in roads which opens a wide window for the requirement of Smart Road System. With the dynamic changes in the models of the vehicles the roads need to have same ability to face them. Evolving towards the future, the roads needs to build with advanced sensors and antenna systems to have a pace with the new era. The design involves the road side units and vehicle side units as part of intelligent transport system involving Internet of things(IOT).This project has designed a system to alert the driver about the speed limits in specific areas by reducing the speed of the vehicle in sensitive public zones without any interference of the drivers where controls are taken automatically by the use of a wireless local area network. The main objective of the proposed system is to operate the vehicles in a safe speed at critical zones minimizing the possible risk of unwitting accidents and casualties. Besides, the system is capable of detecting the accidents and give notification to the control room. The system operates in such way that the accident information is passed to the vehicles entering the same zone to take diversion to avoid traffic congestion. The basic steps of this system are:

- Block and circuit preparation
- Hardware Implementation
- Setting up IOT

PURPOSE:

Road accidents are defined as accidents that occurred or originated on a high way or street open to public traffic. These collisions result in injury or death between automobiles or humans. This is a major problem worldwide resulting in significant morbidity and mortality. This project proposes a system which has digital sign boards on which the signs can be changed dynamically. If there is rainfall or unexpected critical weather condition then the roads will be slippery and the speed limit would be decreased and it will be indicated in the app. There is a webapp through which you can enter the data of the device credentials, location, andthe other information. Then data is retrieved and display on the app like current weather condition, speed limits, etc., which helps Ro the person to choose easy destination path. The purpose of this study was to develop a system that uses a smartphone to notify drivers about road signs ahead.

2. LITERATURE SURVEY:

A literature review is a survey of scholarly sources on a specific topic. It provides an overview of current knowledge, allowing you to identify relevant theories, methods, and gaps in the existing research. There are five key steps to writing a literature review:

1.Search for relevant literature

2. Evaluate sources

3.Identify themes, debates, and gaps

4.Outline the structure

5. Write your literature review

EXISTING PROBLEM:

In present system the road signs and speed limit play a vital role which are static. This leads to mislead in driving during critical situation that leads to accidents, etc. Even some of the factor like weather conditions also promotes a way to rash driving and accidents. So to control this we need to replace static sign board with digital and create an app which displays an information and guide the driver to avoid unexpected situation and helps to reach destination.

REFERENCES:

1. Andrzej Czyzewski in his paper titled "Development of Intelligent Road Signs with V2X Interface for Adaptive Traffic Controlling", IEEE 2019, developed IOT based intelligent road signs capable of interacting with both the vehicles and other neighboring sign boardsusing LORA. These sign boards were capable of communicating with one another and changing the speed limit based on traffic and weather.

2. Muhammed O. Sayin, Chung-Wei Lin, Eunsuk Kang, Shinichi Shiraishi & Tamer Basar in their paper titled "Reliable Smart Road Signs", IEEE 2019, proposed a game theoretical adversarial intervention detectionmechanism for reliable smart road signs. A future trend in intelligent transportation systems is “smart road signs” that incorporate smartcodes (e.g., visible at infrared) on their surface to provide more detailed information to smart vehicles. Such smart codes make road sign classification problem aligned with communication settings more than conventional classification.

3. Cyberabad Traffic Police (2017)

   It reveals some guidelines like, the maximum speed on Lane 1 and Lane 2 of the ORR will be 120 KM per hour and minimum speed will be 80 KM per hour. (Lane1is the one closest to the central median) The maximum speed on Lane 3 and Lane4 of the ORR will be 80 KM per hour and minimum speed will be 40 KM per hour.The minimum speed on ORR will be 40 KM per hour. No vehicle is permitted to travel on ORR below this speed. Faster moving vehicles should move in Right Lanes (Lane 1 and 2) and slow-moving vehicles should move in Left lanes (Lane 3 and 4) within the above speed ranges.

4. L.F.P. Oliveira, L.T. Manera, P.D.G. Luz in their paper titled "Smart Traffic Light Controller System", IEEE 2019, developed smart traffic lights capable of traffic accident detection enabling the enhancement of traffic light management systems, blocking and creating alternative routes to not only avoid the traffic jams, but also avoid new accidents.

5. Francis John Gichaga etal. Road Safety and Road Safety Audit inIndia:

   A Review. ISSN: 2347 - 4718 This paper had reviewed the concept of the

road safety audit and its stages. Objective of the RSA is to evaluate ventures for potential mishaps end/lessening on the premise of road client learning, characteristics and aptitudes, day/night, wet/dry road conditions. It suggested on outline and before planning of agreement archives, to evaluate itemized intersection design, markings, signs, signals, lighting points of interest, Detail Design of junctions, Design of geometrics, Cross- fall Marking and Signs, Side drains, Embankment slopes, Presence of clear zone, Traffic Signals Lighting.

6. Dariusz Grabowski & Andrzej Czyzewski in their paper titled "System for monitoring road slippery based on CCTV cameras and convolutional neural networks", Springer Publications 2020, made useof Convolutional Neural Networks to identify slippery roads using CCTV cameras.

PROBLEM STATEMENT DEFINITION:

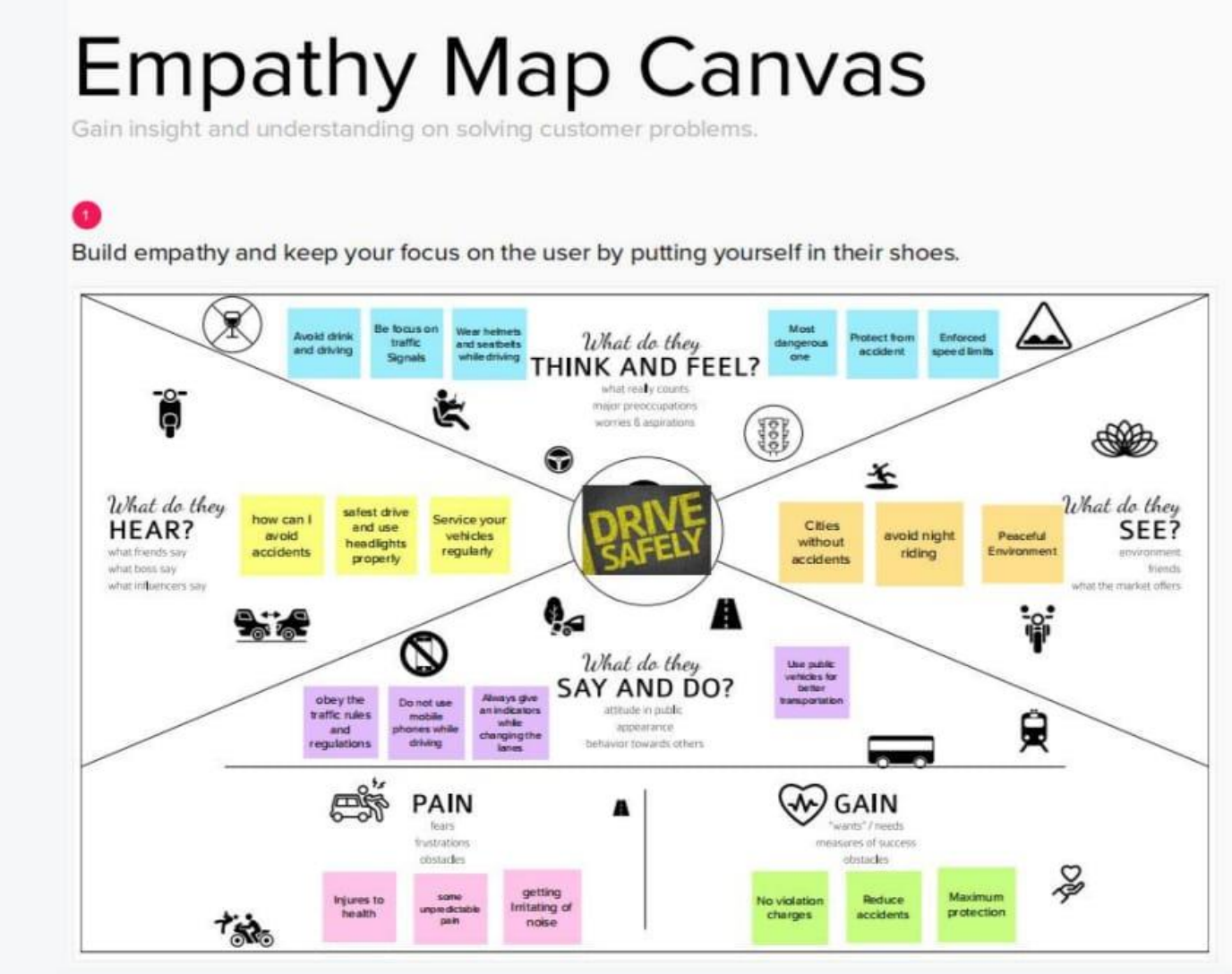
Problem defines that due static board it may or may not be visible to the drivers that leads to accidents and even during critical weather condition , the speed limits of drivers while driving varies frequently that may also leads to road accidents and even in some cases like road works may lead to road diversion and this causes delay to reach destination .To overcome this , we need to replace the static sign boards to smart connected sign boards or digitalized sign boards are need to be 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 that will be indicated to drivers. Based on the traffic and fatal situations the diversion signs in this projectare alert message, buzzer sound are displayed where it helps the driver to reach their destination at right time. While considering Guide (Schools), Warning and Service (Hospitals, Restaurant) signs which are located nearby means it is also indicated with help of location service and in meanwhile we can periodically viewthe traffic situation, weather condition and accordingly the speed limits will also varies. Like this, different modes of operations can be selected with the help of

app that has been created with device credentials and enter the particular detailsof location to check to it.

3. IDEATION & PROPOSED SOLUTION:

EMPATHY MAP CANVAS:

An **empathy map** is a collaborative visualization used to articulate what we know about a particular type of user. It externalizes knowledge about users in order to 1) create a shared understanding of user needs, and 2) aid in decision making. Empathy maps are split into quadrants (*Says*, *Thinks*, *Does*, Hear, *Feels*), with the user.



Here with the help of quadrants the projects can be explained:

1. Say and Do:

- Improved control and safety can be achieved through IoT enabledcars.
- The modes or speeds could be changed if there is any network errorusing the button.
- Does this system helpful in real roads?

2. Hear:

- Is this project can withstand in different climate and weather conditions?
- Road traffic safety refers to the methods and measures used toprevent users from being killed or seriously injured
- Does the board show correct speed limitations?

3. Think and feel:

- How does this system analyse the weather?
- Does this system will avoid accidents?
- Drinking alcohol and driving increases the risk of a crash

4. See:

- Replaced sign boards instead of static boards
- IoT is already working to ensure road safety
- Diversions sign in the board

5. Pain:

- Drivers should not horn endlessly or excessively
- When driving in reverse, you should make sure you do not cause annoyance
- Failure of signal due to electric power failure or any other cause confusion to road users

6. Gain:

- The speed limits and the direction would be shown
- Always keep to your left.
- Opportunity to save lives through static sign boards.

IDEATION AND BRAINSTORMING:

Ideation is the process of forming ideas from conception to implementation, most often in a business setting. Ideation is expressed via graphical, written, or verbal

methods, and arises from past or present knowledge, influences, opinions, experiences, and personal convictions. Ideation is usually derived from brainstorming sessions, online forums, seminars, surveys, social media platforms, and team-building exercises. In this project the ideas are discussed and listed:

- It gives an accurate update on weather monitoring which gives anidea for IoT drivers in route finding and deciding speed limits.
- Suggestion of nearby crowded places such as schools, colleges, hospitals.
- Weather report will be displayed in the sign board using the weatherAPI.
- Traffic density can be viewed using GPS in mobile phone

BRAINSTORM:

Brainstorm is defined as try to solve a problem or come up with new ideas by having a discussion that includes all members of a group and to discuss a problem or issue and suggest solutions and ideas. In this project the brainstorm ideas are discussed, listed and analyzed in following manner:

Team member 1:

- Suggests speed limit while driving
- It helps in detecting temperature both internal as well as external
- Using IoT device, the accidents happened in the road can be alertedto the other drivers
- Weather monitoring using weather API

Team member 2:

- If vehicle speed is more than road speed limits than it generate useralert by buzzer

- It alerts about the upcoming accident prone zones
- Based on the weather the speed limit in the sign board may increaseor decrease.
- Road diversion due to construction and traffic can be avoided

Team member 3:

- Traffic signals will change automatically by detecting the moving vehicles using sensors on the crosswalks.
- Landslide will be detected using the sensors placed in the mountainroads and alerted to the smart signed boards.
- Regulatory checks of the sign boards improve the reliability of thesystem
- Stable technology system for monitoring, maintenance and repair ofroads.

Team member 4:

- We can digitalize the boards that can even more clearly visible to drivers.
- The fundamental data's to guarantee road safety of the connectedvehicles is the geolocation.
- By knowing positions of other vehicles, the IoT driver can decide regarding the speed and there is no need for emergency braking
- Cost efficient and user-friend

PROPOSED SOLUTION:

Proposed solution should relate the current situation to a desired result and describe the benefits that will accrue when the desired result is achieved. In this project it describes the speed limit; weather condition; signs indication like buzzer and notify the message. Here the solutions are described for main six statements.

1. Problem Statement (Problem to be solved):

*To replace the static sign boards, smart connected sign boards or digital sign board are used.

2. Idea / Solution description:

* 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 limit. Based on the traffic, the diversion signs are displayed. Guide (Schools), Warning and Service (Hospitals, Restaurant) signs arealso displayed accordingly

3. Novelty / Uniqueness:

* The weather and temperature details are obtained from the Open Weather Map API.
* Using these details, the speed limit will be updated automatically in accordance with the weather conditions.

4. Social Impact / Customer Satisfaction:

* Guide signs and warning signs are displayed to the public. If there is no traffic, Customer can reach the destination before the expected time.

5. Business Model (Revenue Model) :

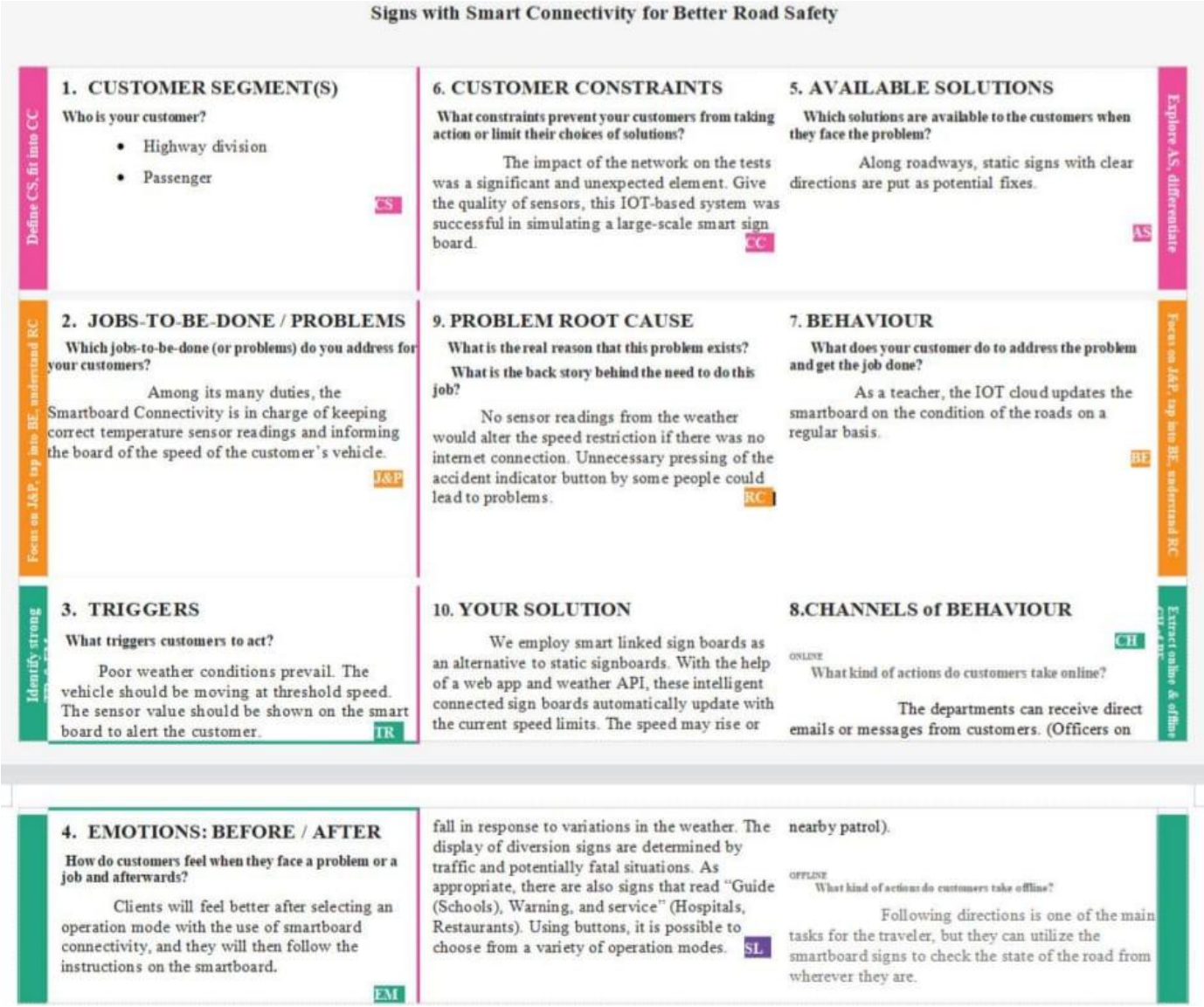
Since APIs are used to actively monitor the customer's environment,this project employs a business strategy in which revenue will be generated on the basis of the length of time in which the customers actively interact with the product.

6. Scalability of the Solution :

* It has greater chance in reducing the risk for the people as it is more visible than the normal signs, which saves a lot of lives at stake.

PROPOSED SOLUTION FIT:

Problem-solution fit is a term used to describe the point validating that the base problem of the project and resulting in an app creation and that idea will be implemented and then the proposed solution where it actually solves the problem.



The problem-solution fit is when-

- **Validate that the problem exists:** When validating the problem hypothesis using real-world data and feedback. That is, the information which is gathered from real users and used to determine, analysis and solve the problem.
- **Validate the solution that solves the problem.**

The problem-solution fit precedes the app development and forms the foundation

upon which an information like speed limits, weather reports and location will be display using the device credentials. It helps to answer the customer queries. Here based on the problem stated and based on various analysis factors the following were stipulated and these are the main factor for considering and needto resolve it.

1. **Defines Customer segment, Customer constrains, Available solutions:**

- Who is customer? -> pedestrians, cyclists, motorists, vehicle passengers and passengers of on-road public transport (mainlybuses).
- What constraints prevent your customers from taking action or limittheir choices of solutions?

-> site-level issues, such as crash patterns at intersections, curves, or corridors.

->The Vehicle should have digitally supported sensors which can be compatible with smart sign boards.

- Which solutions are available to the customers when they face theproblem 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 aspotential fixes.
->Signs painted on walls and roads by corporation

2. **Focus on the jobs what to be done/ problem; problem root cause; Behavior:**

- Which jobs-to-be-done (or problems) do you address for your customers?

->There could be more than one; explore different sides.
-> Damage of sign boards due to external or internal factors.
-> Possibility of malfunction of sensors placed in the smart sign boards.

- What is the real reason that this problem exists? What is the backstory behind the need to do this job?

  ->Position of static sign boards is not visible and is inappropriate. There is no way to predict the weather in the desired destination through the static boards.

- What does your customer do to address the problem and get the jobdone?

  ->As public use various routes for travelling, prediction of the desired routes should be on hand with the weather there.
  ->For above case, we need GPRS which could be modified to work under minimum internet connectivity.

3. Identify strong Triggers and emotion:

- What triggers customers to act?

-> Values show how important something is to us. They also help us make important personal decisions. We make buying decisions every day based on our values and judgments.

-> The smart sign is already implemented in some countries which triggers the customers.

- 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 smartboard connectivity, and they will then follow the instructions on the smartboard.

  ->The customers would able to know weather conditions in advance beforereaching the destination location.

4. Extract online and offline channel behaviour:

- What kind of actions do customers take online?

  -> Videos, advertisements are made to educate the customers or public about the smart sign board.
  -> Online influencers can advertise the smart sign boards through their

influencing medium.

- What kind of actions do customers take offline?
  -> Necessary awareness program should be given to the public.

4. REQUIREMENT ANALYSIS:

The process of determining user expectations for a new or modified product. These features, called requirements that must be quantifiable, relevant and detailed. This is known as requirement analysis. 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. Here the requirement analysis splits into two types:

1. FUNCTIONAL REQUIREMENT:

A Functional Requirement (FR) is a description of the service that the software must offer. It describes a software system or its component. Afunction is nothing but inputs to the software system, its behaviors, andoutputs. Based on user stories, the epic requirements are stated based on proposed problem statements

• User Registration	• Registration through mobile number (or) • Registration through Gmail
• User Confirmation	• Confirmation via Email • Confirmation via OTP
• User visibility	• Sign board should not be too distracting to cause accidents. • It should be made intense coloured LED's capable of attracting driver's attentions
• User understanding	• Should display information like imagesor illustrations with captions so that user can understand the signs correctly
• User convenience	• Speed could be predicted according to weather information

2. NON-FUNCTIONAL REQUIREMENT:

Non- functional Requirements (NFRs) define system attributes such as security,reliability, performance, maintainability, scalability, and usability. They serve as constraints or restrictions on the design of the system across the different backlogs. Also known as system qualities, non - functional requirements are just as critical as functional Epics, Capabilities, Features, and Stories. They ensure the usability and effectiveness of the entire system. Based on problem statement define this requirement analysis is stated as:

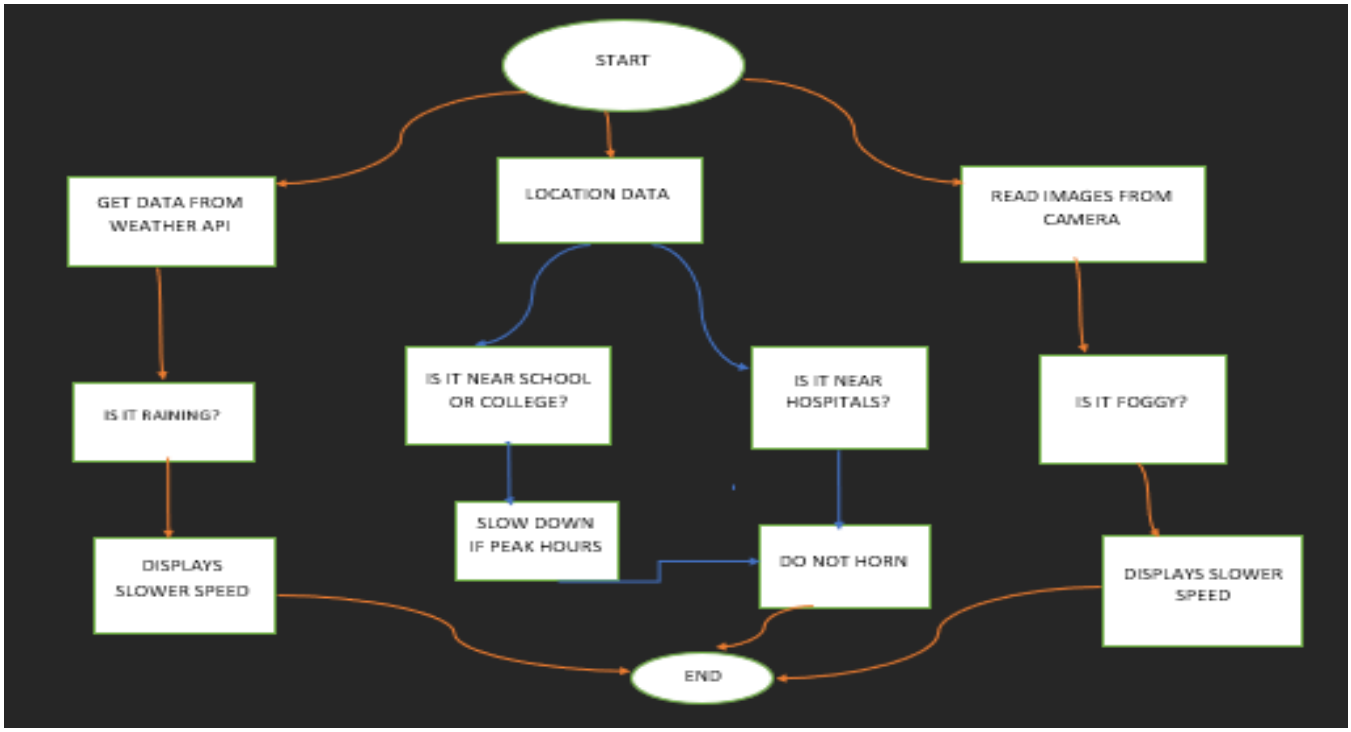
Usability	Should be able to update periodically with respective time (weather)
Security	Should be secure enough that users could access only after getting confirmation through email or OTP
Reliability	Should convey the traffic information Correctly
Performance	Proper functioning of sign board according to weather condition
Availability	Should be available anytime and anywhere(app)
Scalability	Easily adaptable

5. PROJECT DESIGN:

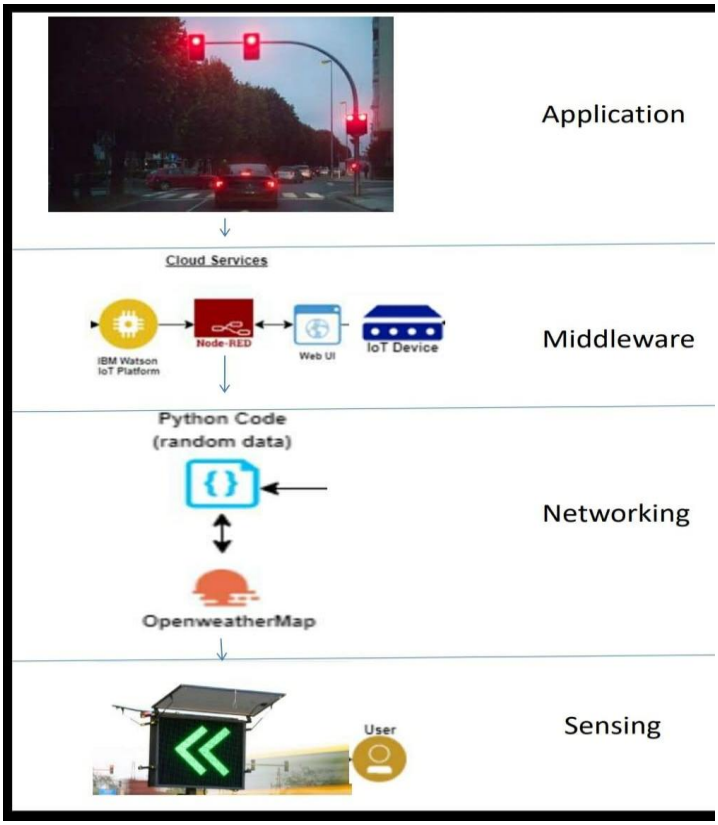
Project design is an early phase of the project lifecycle where ideas, processes, resources, and deliverables are planned out. A project design comes before a project plan as it's a broad overview whereas a project plan includes more detailed information. Here project is designed based on circumstances and preferences like Data Flow Diagrams; Solution & Technical Architecture; User Stories.

6. DATA FLOW DIAGRAM:

The flow of data of a system or a process is represented by Data flow diagram. It also gives insight into the inputs and outputs of each entity and the process itself



SOLUTION & TECHNICAL ARCHITECTURE:



In this project the technical architecture is analyzed through various categories and are discussed here

S.No	Component	Description	Technology
1.	User Interface	How user interacts withapplication e.g. Mobile App	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	Logic for a process in the application	Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	Data Type, Configurations etc.	MySQL
6.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Clouding etc.,
7.	File Storage	File storage requirements	IBM Block Storage or Other Storage Serviceor Local Filesystem
8.	External API-1	Purpose of External API used in the application	IBM Weather API, etc

Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	openweather API
2.	Security Implementations	Strong security system that does not allow anyone without login credentials to enter the app	Firewall
3.	Scalable Architecture	Easy to expand operating range	IoT
4.	Availability	Available anytime and everywhere as long as user signed into the app	IBM Cloud
5.	Performance	Supports large number of users to access the technology simultaneously	IBM Cloud

USER STORIES:

A user story is an informal, general explanation of a software feature written from the perspective of the end user. Its purpose is to articulatehow a software feature will provide value to the customer

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	Speed limitation could be detected using weather application by entering {mail id or phone number}, password	I can receive speed limitations email & click confirm	High	Sprint-1
		USN-3	As a user, I can get my traffic diversion signs depending on the traffic status.	I can predict my traffic status ahead in my travel	Medium	Sprint-2
		USN-4	As a user, I can control my speed according to weather conditions	I can increase or decrease my speed	High	Sprint-1
	Login	USN-5	As a user, I can login to open weather API by using login id and password	After entering the location the weather could be known	High	Sprint-2
	User Profile	USN-6	As a user application should be easily accessible , simple and understandable	I can access the application easily	High	Sprint-2
Customer (Web user)	Data Centre	USN-7	As a user, I can access the traffic, weather condition	I can find route to destination accordingly	Medium	Sprint-2
Customer Care Executive		USN-8	As a user, Help centre could be accessed at any time for any situations	Chat will be available at any time	Medium	Sprint-3
Administrator	Problem solving	USN-9	As an official proper functionality of sign boards and customer care works can also be handle	Officials can monitor the sign board for better function at periodic intervals	Medium	Sprint-2

6.PROJECT PLANNING AND SCHEDULING:

Fundamentally, 'Project planning' is all about choosing and designing effective policies and methodologies to attain project objectives. While 'Project scheduling'is a procedure of assigning tasks to get them completed by allocating appropriateresources within an estimated budget and time-frame.

SPRINT PLANNING AND ESTIMATION:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Resource initialization	USN-1	Create and initialize accounts in various public APIs Like OpenWeather API	2	High	SHEIK ABDULLAH.J MUBIN.M JASMINE RUBINA.M KALAIYARASAN.S
Sprint-1	Software simulation	USN-2	Write a python program that outputs results given the inputs in the form of weather and location	1	High	SHEIK ABDULLAH.J MUBIN.M JASMINE RUBINA.M KALAIYARASAN.S
Sprint-2	Pushing the Software to cloud	USN-3	Push the code fromsprint1 to cloudso that It can be accessed From anywhere	2	Low	SHEIK ABDULLAH.J MUBIN.M JASMINE RUBINA.M KALAIYARASAN.S
Sprint-3	Hardware Initialisation	USN-4	Integrate The hardware to be able to access The cloud functions and provide Inputs to the same	2	Medium	SHEIK ABDULLAH.J MUBIN.M JASMINE RUBINA.M KALAIYARASAN.S
Sprint- 4	UI/UX Optimization And Debugging	USN-5	Optimize all the shortcomings and provide better user experience	1	High	SHEIK ABDULLAH.J MUBIN.M JASMINE RUBINA.M KALAIYARASAN.S

* 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	301Oct 2022	05 Nov 2022	20	31 Oct 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	7 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	14 Nov 2022

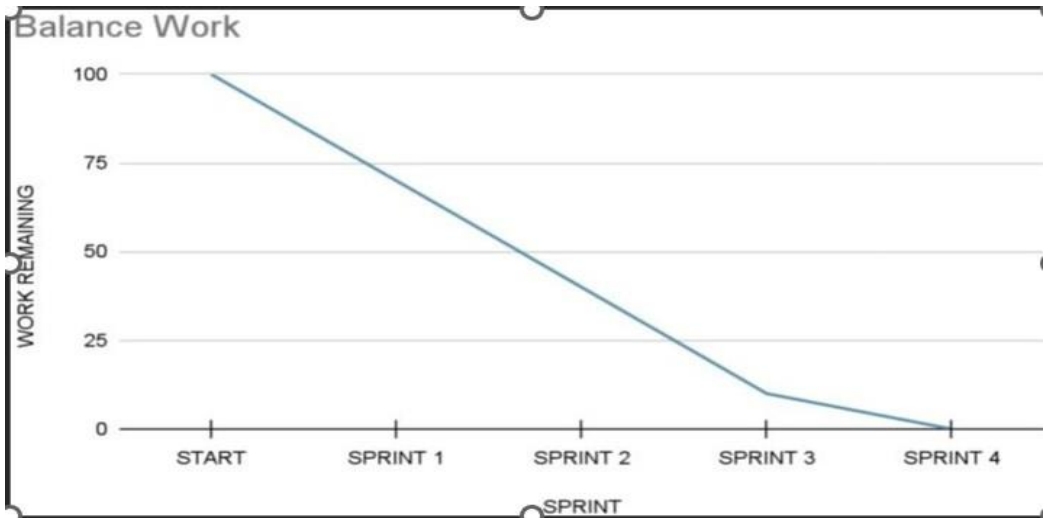
Velocity:

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)

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

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.



SPRINT DELIVERY SCHEDULE:

TITLE	DESCRIPTION	SUBMISSION DATE
1. Prerequisite	This section consider the followings should have an account creation and knowledge about usage: *IBM Cloud Services *Software *Create an account in openweathermap API	1 October2022
2.Ideation Phase	This section identifies the problem motive, find steps to solve	29 September 2022
2.1 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.	29 September 2022
2.2 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, gain and difficulties from their point of view.	30 September 2022
2.3 Ideation – Brainstorming	Brainstorming is a group of problem-solving method that organize various ideas and thoughtsfrom team members.	30 September 2022
3. Project Design Phase-1	This section consider the dimensions of handling the project through various methods:	03 October 2022

3.1 Proposed Solution	It helped us analyze and examine our solution more in the grounds of uniqueness, social impact, business model, scalability etc.	04 October 2022
3.2 Problem Solution Fit	It helped understand and analyze all the thoughts of our customer, their choice of options, problems, root cause, behaviour and emotions.	07 October 2022
3.3 Solution Architecture	Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. It helped us understand the features and components used to complete the project.	08 October 2022
4.Project Design Phase- 2	This section tells about customer satisfaction	10 October 2022

4.1 Customer Journey	It helped to analyzed the various steps, interactions, goals and motivation, positives, negatives and opportunities.	11 October 2022
4.2 Functional Requirements	It briefs about Functional and non-functional requirements. It Involves the variousstеps in the entire process. It also specifies features usability, security, reliability, performance, availability and scalability	19 October 2022
4.3 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 wheredata is stored.	12 October 2022

4.4 Technology Architecture	A tech stack is the combination of technologies a company uses to build and run an application or project. It helps us analyte and understand various technologies that needs to be implemented in the project.	17 October 2022
5. Project Plan Phase	This section describes the project phase at each stages to analyst the growth where it is categorizedinto2	27 October 2022
5.1 Milestone and activity list	Helps us understand and evaluate our progress and accuracy so far.	01 November 2022
5.2 Sprint delivery phase	Sprint Planning is an event in scrum that defines what can be delivered in the upcomingsprint and how that work will be achieved. It helps us to organize and complete thework effectively and efficiently.	05 November 2022
6. Project Development phase	This phase tells the project Phases into 4 categories	11 November 2022

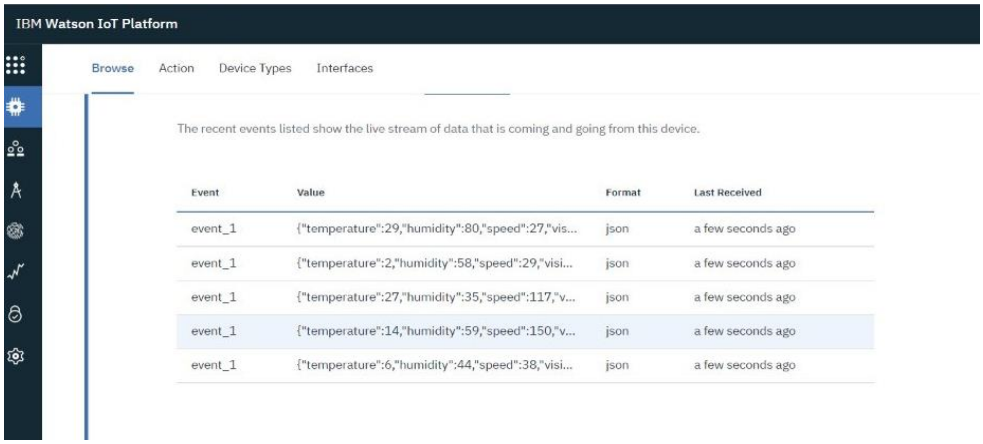
6.1 Project Development Delivery of phase-1	Develop and submit the developed code by testing it	11 November 2022
6.2 Project Development Delivery of phase-2	Develop and submit the developed code by testing it	12 November 2022
6.3 Project Development Delivery of phase-3	Develop and submit the developed code by testing it	13 November 2022
6.4 Project Development Delivery of phase-4	Develop and submit the developed code by testing it	14 November 2022

7.CODING AND SOLUTIONING: FEATURE 1: (IBM WATSON & NODE-RED)

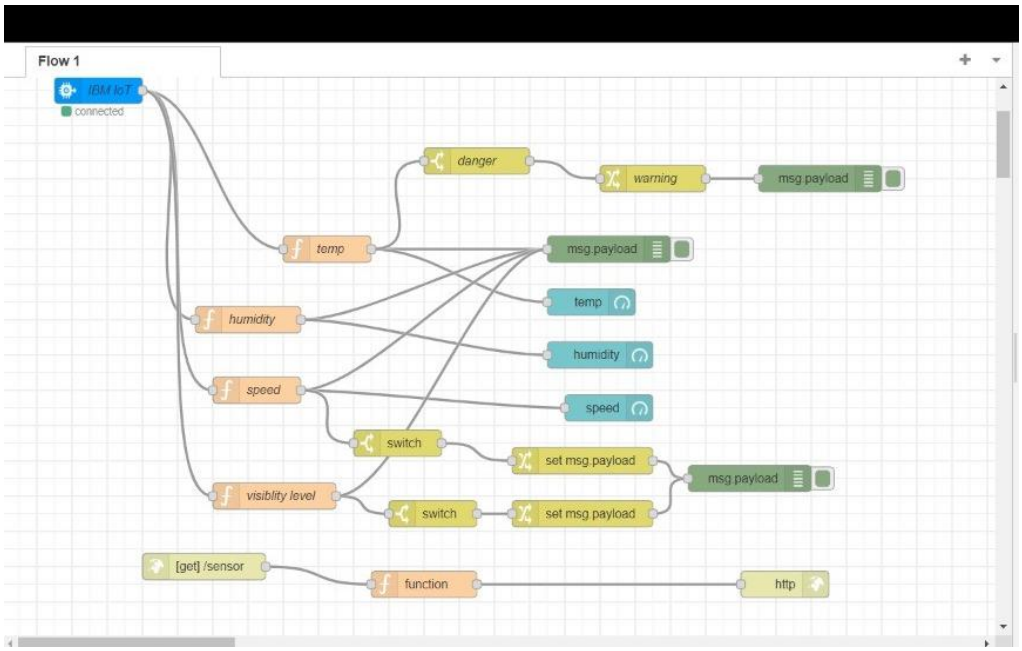
```
import time
import sys
import ibmiotf.application
import ibmiotf.device import random

#Provide your IBM Watson Device Credentials
organization = "7a4i8ha"
deviceType = "sabi"
deviceId = "sabi"
authMethod = "token"
authToken = "Sa&n13juSa!b5iB!t+"

# Initialize GPIO
temp=random.randint(20,50)
humid=random.randint(20,50)
lat =random.uniform(10.781377,10.78643)
lon = random.uniform(79.781377,79.78643)

def myCommandCallback(cmd):
print("Command received: %s" % cmd.data['command'])
print(cmd)
try:
```

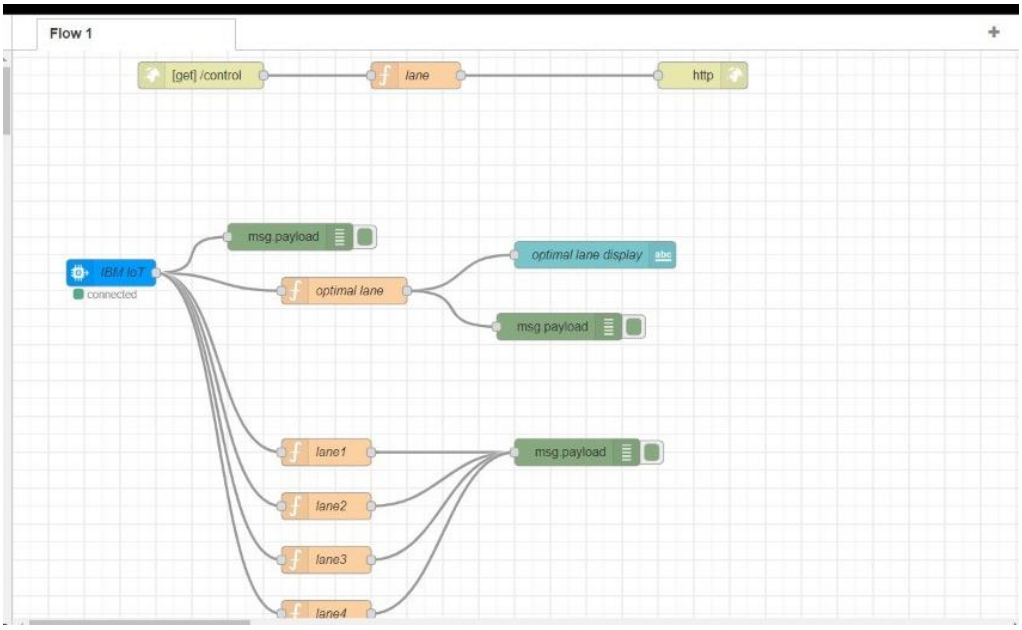
```
deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method": authMethod, "auth-token": authToken}
deviceCli = ibmiotf.device.Client(deviceOptions)
#.....

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

data = {"d":{ 'temp' : temp,"lat":lat,"lon":lon}}
#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()
```

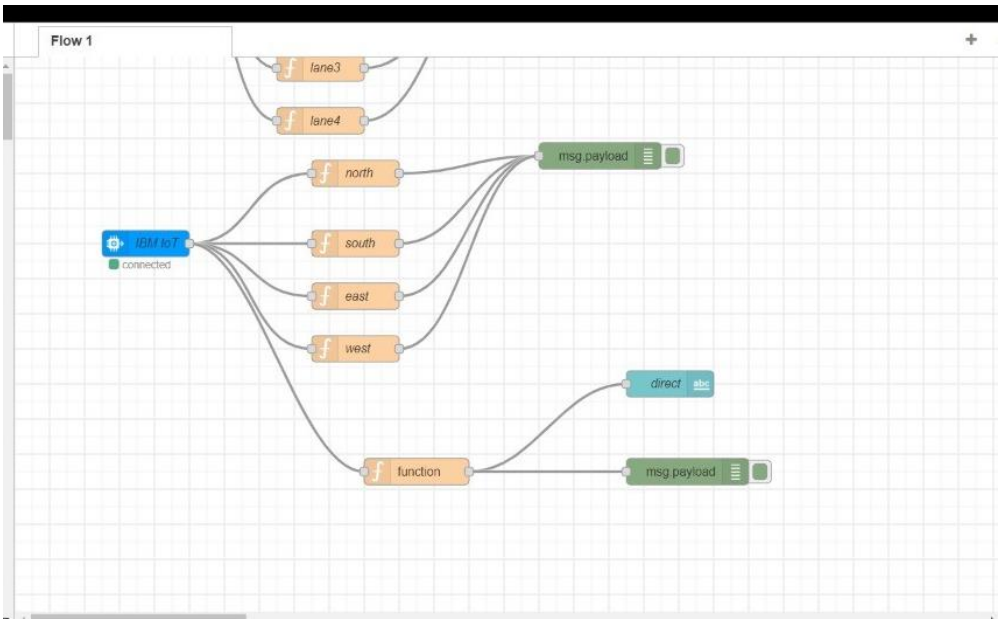
OUTPUT:

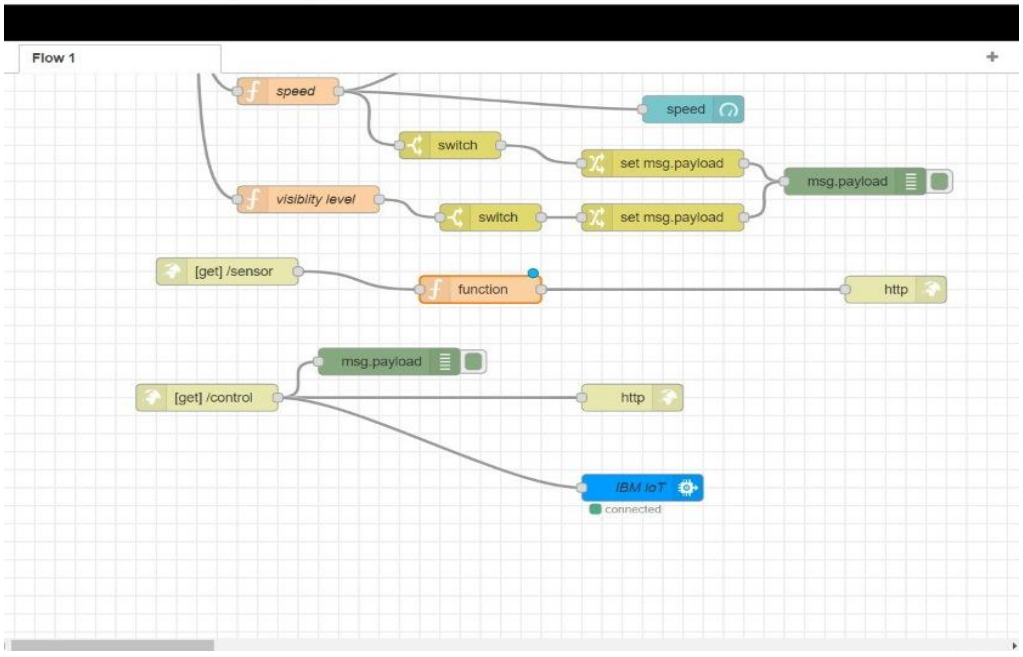

IBM Watson IoT Platform
Browse
Action
Device Types
Interfaces
The recent events listed show the live stream of data that is coming and going from this device.
Event
Value
Format
Last Received
event_1
{"temperature":29,"humidity":80,"speed":27,"vis...
json
a few seconds ago
event_1
{"temperature":2,"humidity":58,"speed":29,"visi...
json
a few seconds ago
event_1
{"temperature":27,"humidity":35,"speed":117,"v...
json
a few seconds ago
event_1
{"temperature":14,"humidity":59,"speed":150,"v...
json
a few seconds ago
event_1
{"temperature":6,"humidity":44,"speed":38,"visi...
json
a few seconds ago


Event Payload
Event Name
event_1
Time Received
Nov 13, 2022 6:11 PM
{
"temperature": 94,
"humidity": 28,
"speed": 1,
"visiblitylevel": 75,
"lane1": 42,
"lane2": 32,
"lane3": 27,
"lane4": 46,
"north": 43,
"south": 30,
"east": 28,
"west": 4
}


Flow 1
IBM IoT
connected
danger
warning
msg.payload
temp
msg.payload
temp
humidity
humidity
speed
speed
switch
set msg.payload
msg.payload
visiblity level
switch
set msg.payload
[get] /sensor
function
http

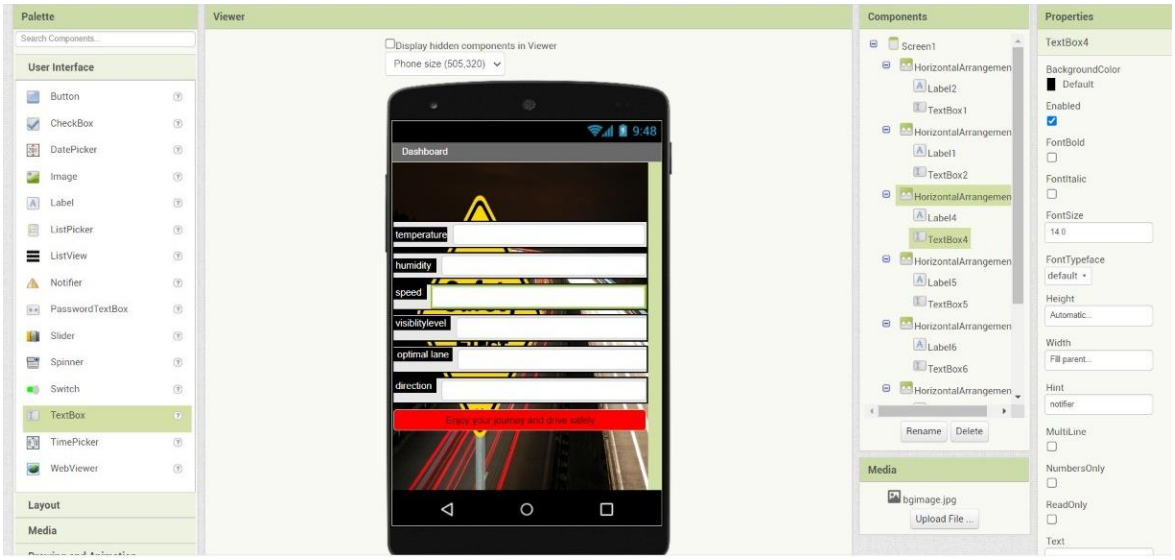

Flow 1
[get] /control
lane
http
msg.payload
IBM IoT
connected
optimal lane
optimal lane display
msg.payload
lane1
msg.payload
lane2
lane3
lane4

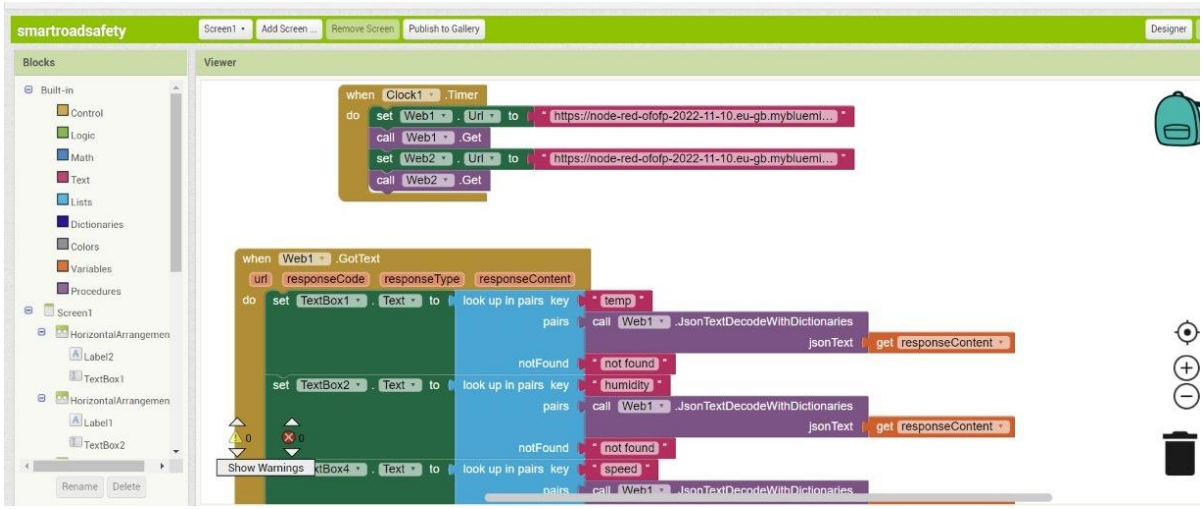


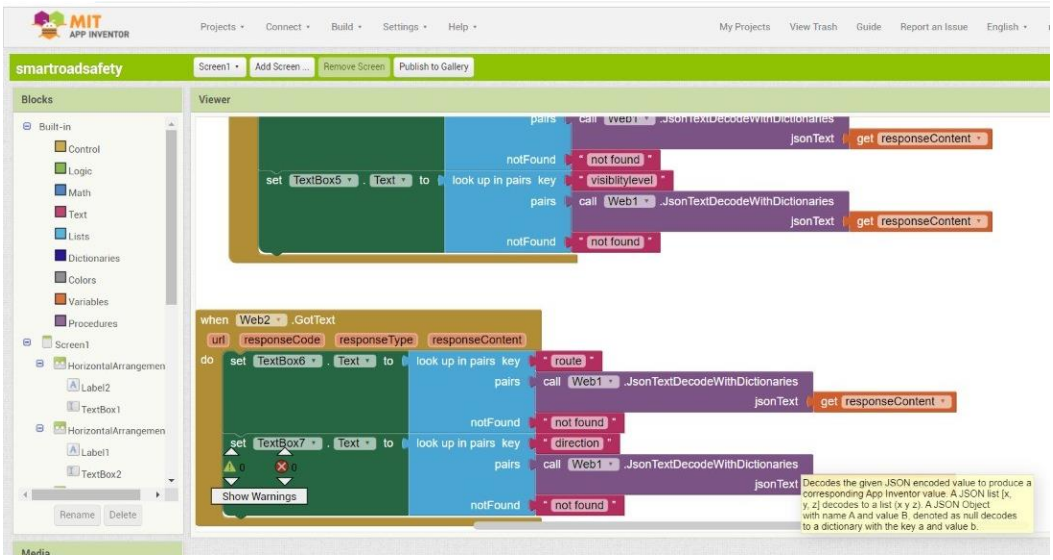


Warning messages are displayed above

FEATURE 2: (MIT APP INVENTOR)





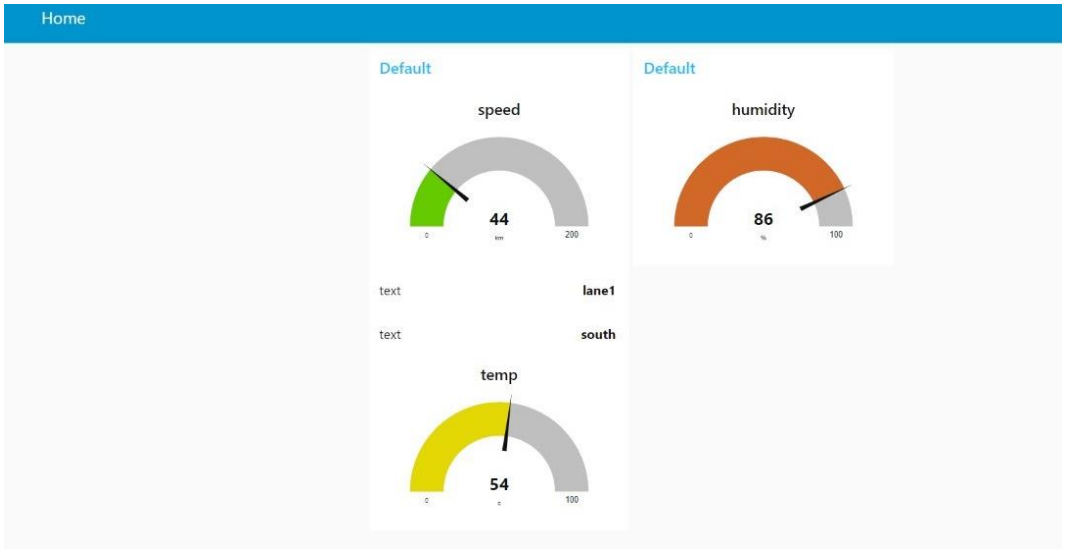


8.TESTING:

The process of evaluating and verifying that a software product or application does what it is supposed to do. The benefits of testing include preventing bugs, reducing development costs and improving performance.

TEST CASES:

NODE-RED URL: https://node-red-ofofp-2022-11-10.eu-gb.mybluemix.net/ui

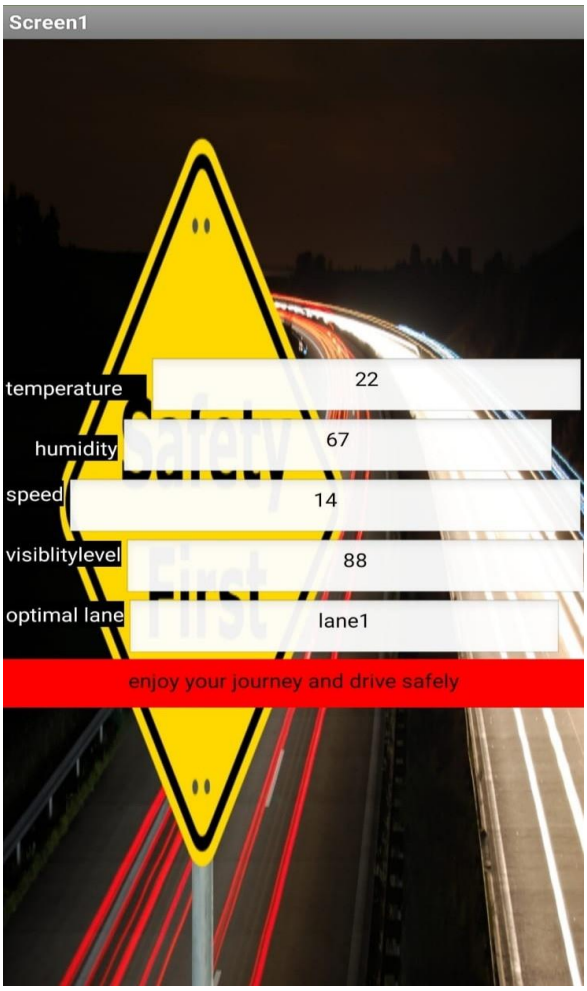


URL LINK GIVEN AS INPUT TO MIT APP INVENTOR ARE GIVEN BELOW:

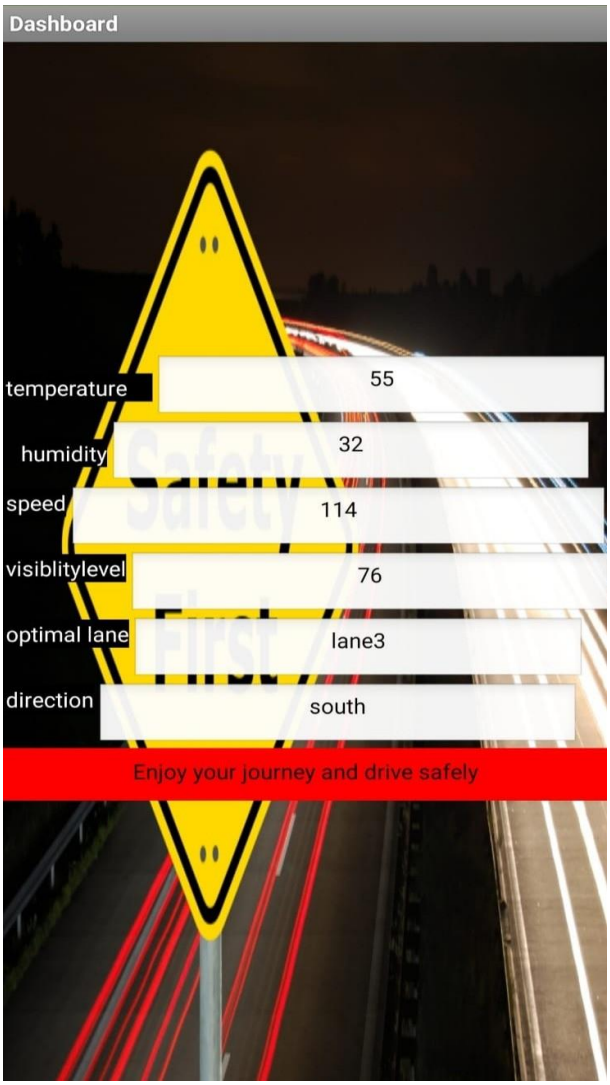
https://node-red-ofofp-2022-11-10.eu-gb.mybluemix.net/sensor

https://node-red-ofofp-2022-11-10.eu-gb.mybluemix.net/control

MIT APP INVENTOR SNAPSHOTS: (FINAL OUTPUT)



TO SHOW DIFFERENCE IN SPEED AND OTHER PARAMETERS



USER ACCEPTANCE TESTING:

User Acceptance Testing (UAT) is a type of testing performed by the end user orthe client to verify/accept the software system before moving the software application to the production environment. UAT is done in the final phase of testing after functional, integration and system testing is done

9. RESULT:

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.

5. ADVANTAGES & DISADVANTAGES:

ADVANTAGES:

- Reduces driving risks
- Improves your driving skills
- Accident free techniques

- Maximum protection
- No violation charges
- Less maintenance
- Save on insurance cost

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.
- Technical complexity
- Integration

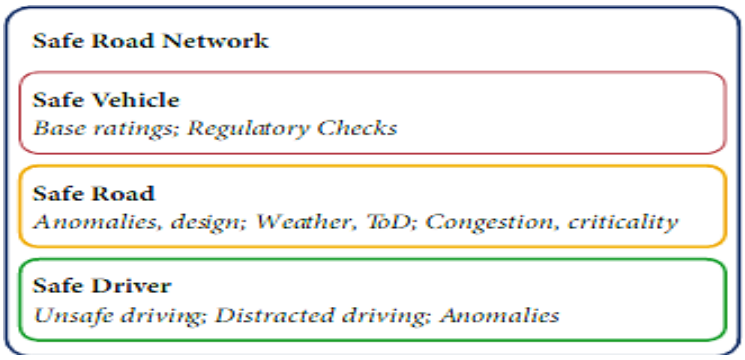
6.CONCLUSION:

The chapters taken into account which includes the potential user of connected technologies :

individual drivers, commercial drivers, pedestrians, cyclist and motor cyclist.

The task force decided to studied first the potential of connected technologies in high and middle income countries. Indeed, middle - income countries represent 72% of the world population, 80% of road traffic death and 47% of registered motorized vehicles, while high income countries areleader in development of connected vehicles. Since the road isn't said to be safelet's make it safer with the technologies present and available to us. The Internetof 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.

7. FUTURE SCOPE:



The future digital reality as follows with these technologies and ideas are :

1. Solar powered roadways
2. Smart Roads
3. Glow in the dark roads
4. Interactive lights
5. Traffic detection

8. APPENDIX:

SOURCE CODE:

```
import time
import sys
import ibmiotf.application
import ibmiotf.device import random


#Provide your IBM Watson Device Credentials
organization = "7a4i8ha"
deviceType = "sabi"
deviceId = "sabi"
authMethod = "token"
authToken = "Sa&n13juSa!b5iB!t+"

# Initialize GPIO
```

```
temp=random.randint(20,50)
humid=random.randint(20,50)
lat =random.uniform(10.781377,10.78643)
lon = random.uniform(79.781377,79.78643)


def myCommandCallback(cmd):

print("Command received: %s" % cmd.data['command'])
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

data = {"d":{ 'temp' : temp,"lat":lat,"lon":lon}}
#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()
```

GIT HUB LINK :

https://github.com/IBM-EPBL/IBM-Project-55274-1667975373

VIDEO LINK :

https://youtu.be/F1n-RpucXb4