SIGNS WITH SMART CONNECTIVITY FOR BETTER ROAD SAFETY

TEAM ID : PNT2022TMID03059

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1. INTRODUCTION:

With new pressures for cities to develop more effective roadways and highways, smart infrastructure is essential for modernization. Smart roads built on IoT and information and communications technology (ICT) can make it possible for cities and transportation authorities to collect and analyze data to improve day-to-day traffic management. Smart road infrastructure can also help cities adapt for long-term sustainable transportation needs. With IoT sensors, cameras, radar, and 5G-equipped technologies, data can be analyzed in near-real time and used to improve congested roadways, streamlining traffic flow. Data can also be sent to the cloud for long-term analysis, providing critical insight for efforts such as reducing CO2 emissions.

1.1 PROJECT OVERVIEW:

This project is 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 and methods of this project are,

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

1.2 PURPOSED WORK:

Smart traffic signs provide the necessary information and warn of potential dangers. They are an important part of keeping drivers and pedestrians safe on the road. The Bedrock expert team can assist you if you are unsure why traffic signs are important or which traffic signs will work best in your construction site. Before traffic signs can be installed on a road, a municipality or construction company will hire an engineer to conduct a study to determine whether certain signs are necessary or even

useful in a given location. When traffic signs aren't placed correctly, they can actually cause more traffic accidents instead of preventing them. In order to avoid confusion for drivers operating a vehicle in unfamiliar areas, traffic signs are kept fairly consistent in every country.

2 LITRATURE SURVEY:

2.1 EXISTING PROBLEMS:

- From the beginning of civilizations, transportation has been one of the most important requirements for humans. Over the years, it has been evolved to modern transportation systems such as road, train, and air transportation. With the development of technology, intelligent transportation systems have been enriched with Information and Communications Technology (ICT). Nowadays, smart city concept that integrates ICT and Internet-of-Things (IoT) have been appeared to optimize the efficiency of city operations and services. Recently, several IoT-based smart applications for smart cities have been developed. Among these applications, smart services for transportation are highly required to ease the issues especially regarding to road safety. In this context, this study presents a literature review that elaborates the existing IoT-based smart transportation systems especially in terms of road safety. In this way, the current state of IoT-based smart transportation systems for safer roads are provided. Then, the current research efforts undertaken by the authors to provide an IoT-based safe smart traffic system are briefly introduced. It is emphasized that road safety can be improved using Vehicle-to-Infrastructure (V2I) communication technologies via-the cloud (Infrastructure[1]to-Cloud – I2C). Therefore, it is believed

that this study offers useful information to researchers for developing safer roads in smart cities.

- According to United Nations (UN) 2030 agenda, the transportation system needs to be enhanced for the establishment of access to safe, affordable, accessible, and sustainable transport systems along with enhanced road safety. The highway road transport system is one of the transport systems that enables to transits goods and humans from one location to another location. The agenda of UN 2030 for the transport system will be accomplished with the assistance of digital technologies like the internet of things (IoT) and artificial intelligence (AI). The implementation of these digital technologies on highways empowers to provide reliable, smarter, intelligent, and renewable energy sources experience to the users travelling along the highways. This study discusses the significance of the digitization of highways that supporting and realizing a sustainable environment on the highways. To discuss the significance of digitization, the study has categorized digitalization into five subcomponents namely smart highway lighting system, smart traffic and emergency management system, renewable energy sources on highways, smart display and AI in highways. An architecture-for smart highway lighting, smart traffic, and emergency management are proposed and discussed in the study. The significance of implementing smart display boards and renewable sources with real-time applications is also addressed in this study. Moreover, the integration of AI in highways is addressed with the perspective of enhancing road safety. The integration of deep learning (DL) in the edge-based vision node for predicting the patterns of traffic flow, highway road safety, and maintenance of quality roads have been addressed in the discussion section. Embedding the deep learning techniques in the vision node at the traffic junction and the highway lighting controller is able to deliver an intelligent system that provides sustained experience and

management of the highways. Smart reflectors, adoption of renewable energy, developing vehicle-to-vehicle communication in vehicles, and smart lamppost are the few recommendations for the implementation of digitalizing highways.

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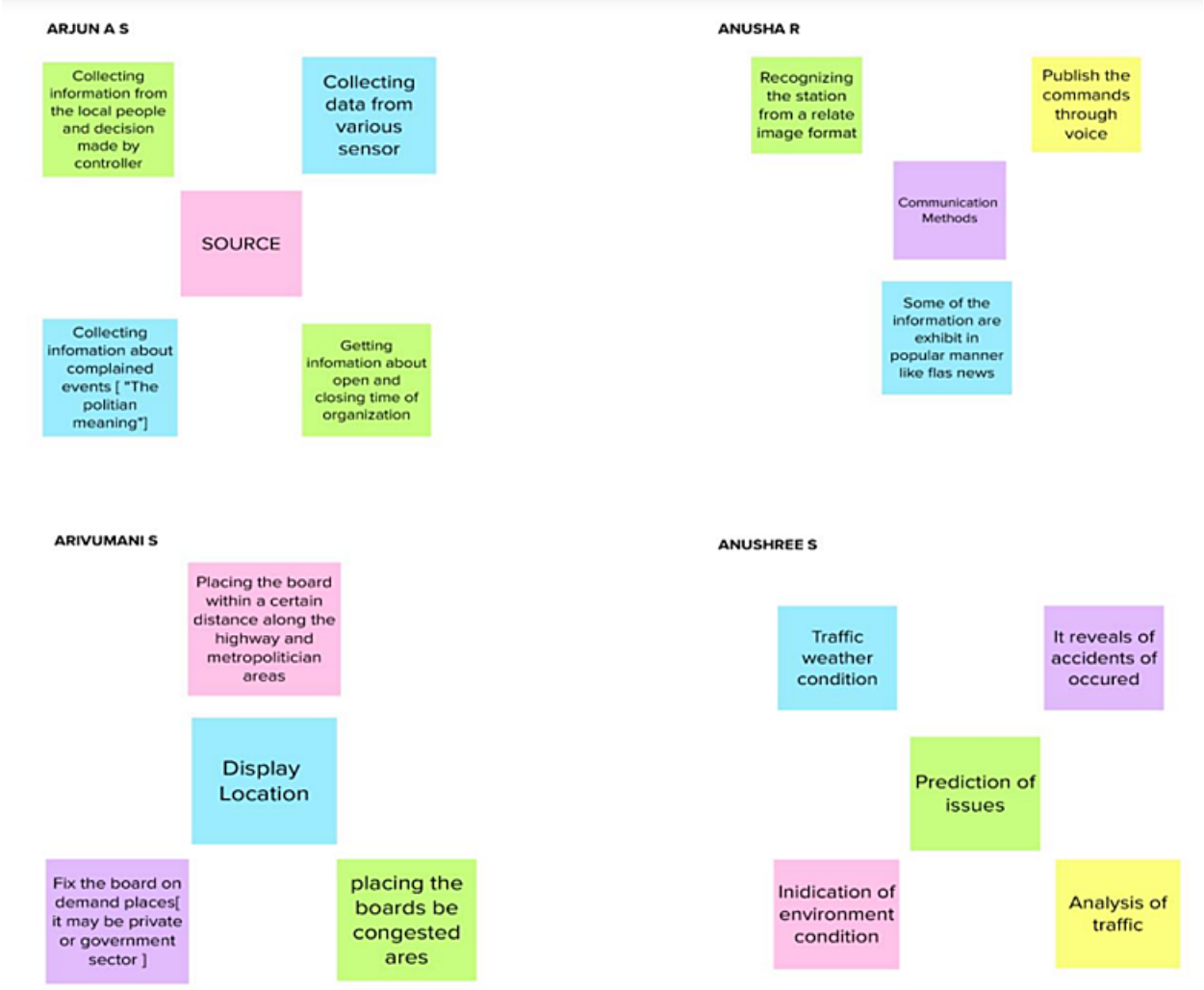
2.3 PROBLEM STATEMENT DEFINITION:

- 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. If the pedestrian presses the button that is present on the post at the end of the road, then the traffic will be analyzed immediately. Accordingly, the sign of the traffic signal will be changed. This inturn reduces the frequent changing of the traffic signs even if the pedestrians are not present.

3 IDEATION AND PROPOSED SOLUTION:

3.1 EMPATHY MAP CANVAS:

3.2 IDEATION AHD BRAINSTROMING:



3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

In this Architecture helps to travellers behaviour towards the awareness of travel

Intimation of speed range depend upon the roadway condition

Guiding a traveller to choose a best path, when crowding / accident may occur

Makingthe tavel easy through thhe idea notification

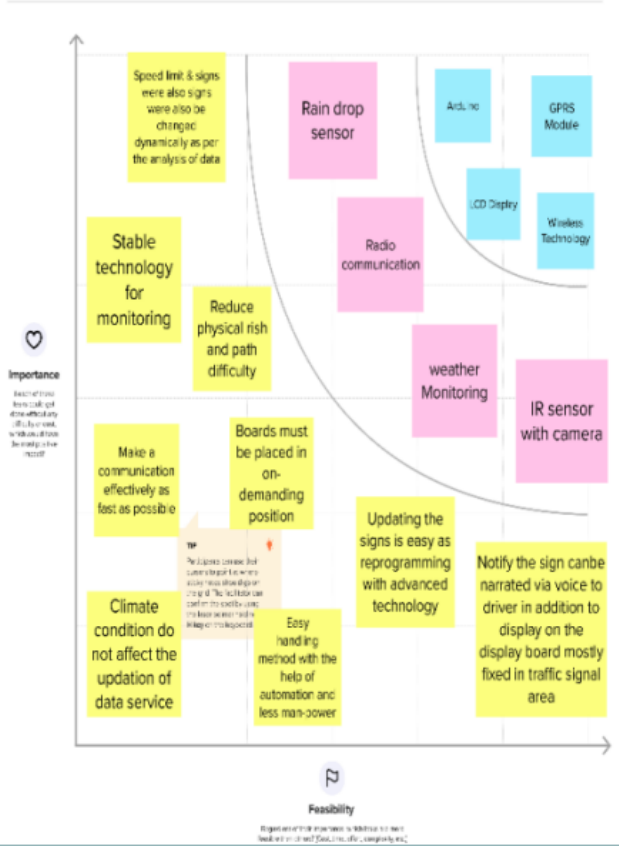
Prediction of data gives them a fair and better understanding about their upcoming of road events

4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes



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 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

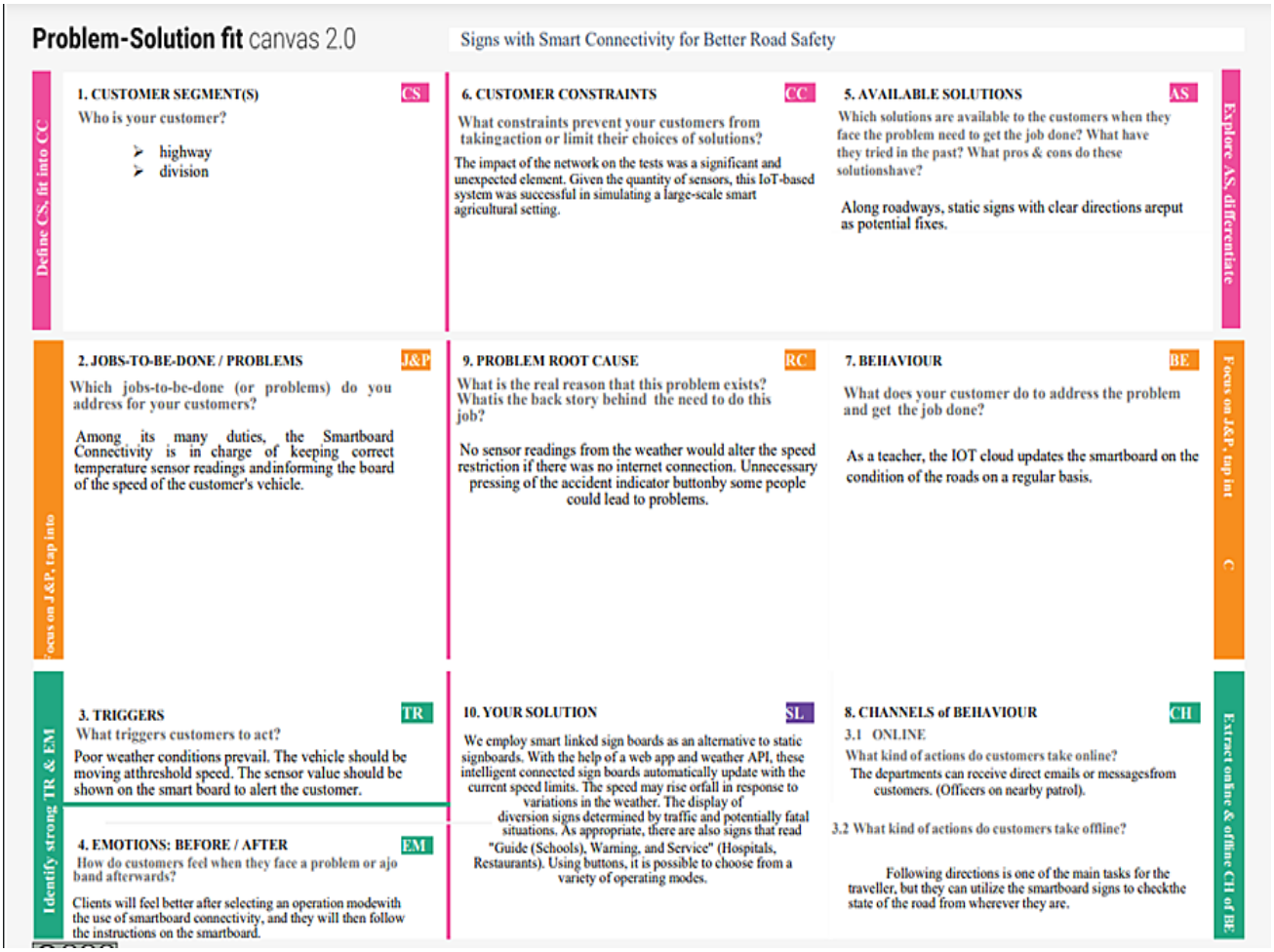
		accordingly, and the speed limit will also be set depending upon the zones. Also, the pedestrians are given an option to change the traffic signs if they want to cross the road. If the pedestrian presses the button that is present on the post at the end of the road, then the traffic will be analyzed immediately. Accordingly, the sign of the traffic signal will be changed. This in turn reduces the frequent changing of the traffic signs even if the pedestrians are not present.
3.	Novelty	Generic Sign board for all applications that uses both buttons and webservice for update. Pedestrians are given the access to request the sign change of the signal to cross the road.
4.	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	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. The public will also gain all the information about the road, even if they are checking for an alternate path because of some mishaps that happen on the roads and these functionalities will increase the value of the

		product in the global market.
6.	Scalability of the 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 a new section for the updated hardware. So, this will not affect the existing functionality of the product and new

		functionality can be easily integrated. In addition, a separate circuit will be kept along with the hardware to addition, a separate circuit will be kept along with the hardware to detect any problem which informs the web application.

3.4 SOLUTION FIT TEMPLATE:



4. REQUIRMENT ANALYSIS:

4.1 Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Visibility	Sign Boards should be made of bright coloured LEDs capable of attracting driver's attention Not too distracting to cause accidents
FR-2	User Understanding	Should display information through means like images/illustrations with text so that the user can understand the signs correctly
FR-3	User Convenience	Display should be big enough to display all the signs correctly so that it is visible even to far away drivers

4.2 Non-functional Requirements:

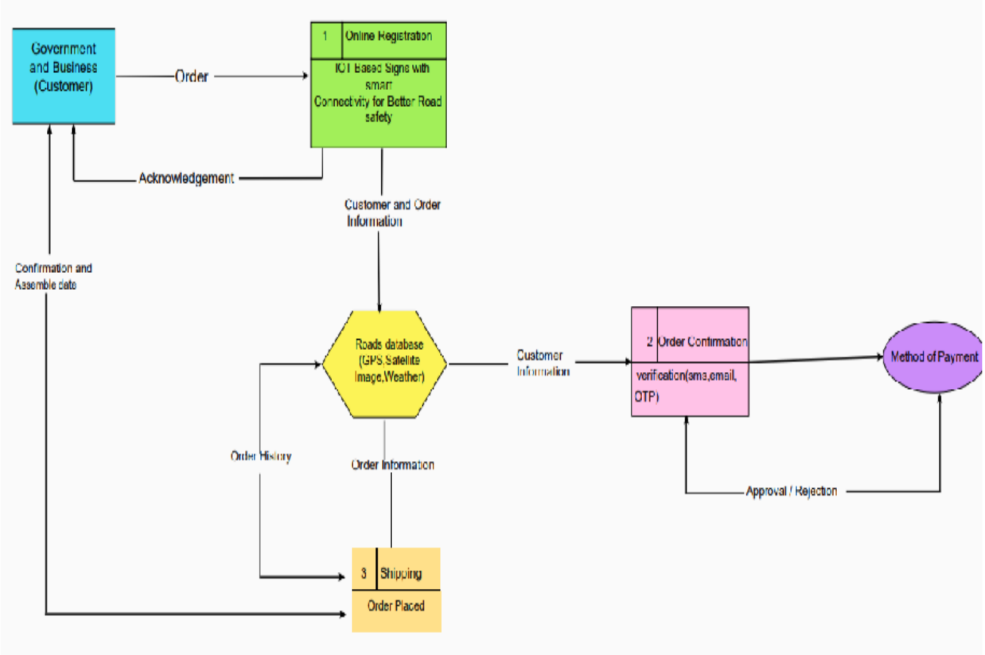
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Should be able to dynamically update with respect to time
NFR-2	Security	Should be secure enough that only the intended messages are

		displayed in the display.
NFR-3	Reliability	Should convey the traffic information correctly.
NFR-4	Performance	Display should update dynamically whenever the weather or traffic values are updated
NFR-5	Availability	Should be on service 24/7
NFR-6	Scalability	Should be modular and hence able to scale on servers horizontally.

5 PROJECT DESIGN:

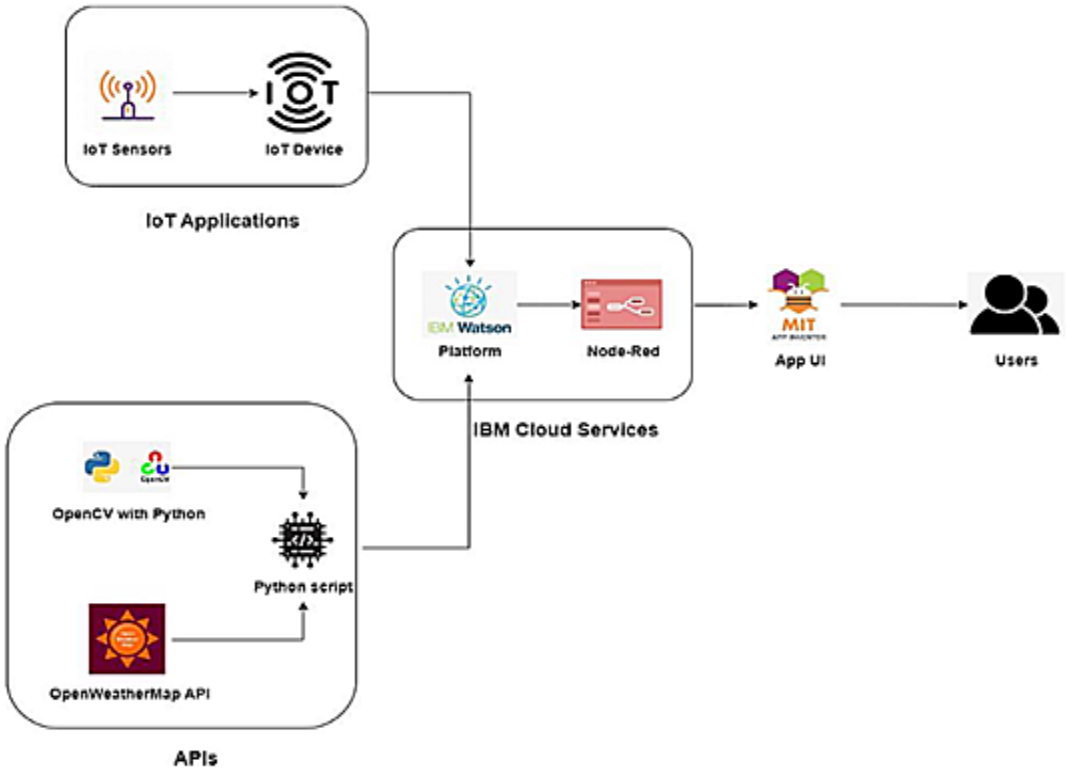
5.1 DATA FLOW DIAGRAM:



5.2 SOLUTION AND TECHNICAL ARCHITECTURE:

SOLUTION ARCHITECTURE:

TECHNICAL ARCHITECTURE:



5.3 USER STORIES:

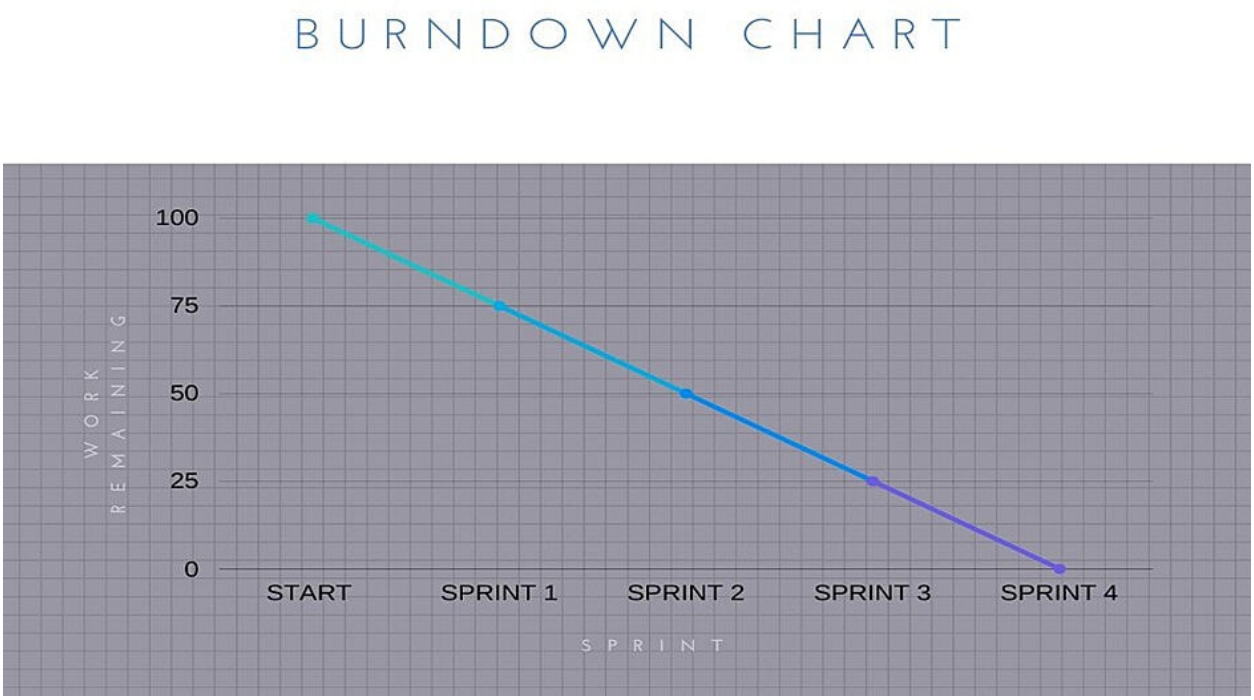
6. PROJECT PLANNING:

6.1 SPRIT DELIVERY PLAN:

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Functional Requirement (Epic)	User Story / Task	Story Points	Priority	Team Members
Resources Initialization	Create and initialize accounts in various public APIs like OpenWeatherMap API.	1	LOW	Anushree S, Arjun A S, Anusha R, Arivumani S
Local Server/Software Run	Write a Python program that outputs results given the inputs like weather and location.	1	MEDIUM	Anushree S, Arjun A S, Anusha R, Arivumani S
Push the server/software to cloud	Push the code from Sprint 1 to cloud so it can be accessed from anywhere	2	MEDIUM	Anushree S, Arjun A S, Anusha R, Arivumani S
Hardware initialization	Integrate the hardware to be able to access the cloud functions and provide inputs to the same.	2	HIGH	Anushree S, Arjun A S, Anusha R, Arivumani S
UI/UX Optimization & Debugging	Optimize all the shortcomings and provide better user experience.	2	LOW	Anushree S, Arjun A S, Anusha R, Arivumani S

Burndown Chart:



7.CODING & SOLUTIONING:

7.1 IMPORTING REQUESTS MODULE:

- Requests library is one of the integral part of Python for making HTTP requests to a specified URL. Whether it be REST APIs or Web Scrapping, requests is must to be learned for proceeding further with these technologies.

- When one makes a request to a URI, it returns a response. Python requests provides inbuilt functionalities for managing both the request and response.

7.2 TO MAKE A PUBLISHER AND SUBSCRIBER IN THE PROCESS OF PYTHON AND IBM CLOUD:

Publish/subscribe is a style of messaging application in which the providers of information (publishers) have no direct link to specific consumers of that information (subscribers), but the interactions between publishers and subscribers are controlled by pub/sub brokers.

In a publish/subscribe system, a publisher does not need to know who uses the information (publication) that it provides, and a subscriber does not need to know who provides the information that it receives as the result of a subscription. Publications are sent from publishers to the pub/sub broker, subscriptions are sent from subscribers to the pub/sub broker, and the pub/sub broker forwards the publications to the subscribers.

7.3 ADDING WEATHER MODULE:

A free and asynchronous weather API wrapper made in python, for python.

7.4 TEST MODEL APPLICATION:

Project evaluation is a systematic and objective assessment of an ongoing or completed project. The aim is to determine the relevance and level of achievement of project objectives, development effectiveness, efficiency, impact and sustainability.

8. ADVANTAGES AND DISADVANTAGES:

ADVANTAGES:

- Preventing Wrong-way Crashes – As discussed in a Phys.org article in 2018, the National Highway Traffic Safety Administration has stated that hundreds of lives are lost annually to wrong-way crashes. In addition, thousands of people sustain injuries in such accidents.Based on research and field tests performed by the Florida Department of Transportation, certain kinds of intelligent road indicators may effectively catch the attention of people driving the wrong way on a roadway. The indicators that were tested included blank indicators that light up when they detect the presence of wrong-way vehicles.Another type of sign was designed with lights that light up in an asynchronous manner. Once a driver is alerted by the lights and can see the “Wrong Way” lettering, that person can turn around and proceed in the correct direction. This could save numerous lives and prevent countless injuries.

- Better Traffic Management and Safety – Through refined telematics and intelligent technology, it can be easier to “read” the locations and speeds of vehicles, such as those in a fleet.When vehicles and smart traffic control systems are connected via the cloud, the end results may be more manageable traffic, decreased gridlock, and better traffic

- Increased Cost Efficiency – We need to explore more cost-effective ways to strengthen the infrastructure. Building roads is expensive. While there is no substitution for new and upgraded roads, smart roadway indicators can be added to increase efficiency.They provide innovative ways to improve traffic flow, reduce congestion, regulate the patterns of traffic, and create an optimal balance of public and private transportation.

- Combating Poor Visibility – Road placards cannot help us if we are unable to read them. Many factors may cause drivers to misinterpret roadside signage or to miss it altogether. Aging drivers can have difficulty seeing roadway signs as they drive past them.Inexperienced drivers can easily misunderstand their meanings. Even those of us who have driven for years may find it challenging to remember the messages conveyed by conventional road signs. Additionally, bad lighting and weather can further decrease our capacity to use the signage as intended. Smart road indicators make it easier for us to detect and implement their alerts and instructions.

DISADVANTAGES:

You should note that these signals may not be a solution to various problems that occur in road intersections. For instance, an unwarranted signal can affect the efficiency and safety of the traffic. This means that it can cause these disadvantages:

- Increasing traffic congestion, air pollution, and fuel consumption
- Some drivers disobey these signals
- Increase in use of less-adequate roads to avoid traffic signs
- Excessive delay due to time allocated by the traffic signals

9. CONCLUSIONS:

A future trend in intelligent transportation systems is smart road signs equipped with smart codes. In addition to incorporating relatively larger amount of information, smart codes constructed via error-correction methods can provide robustness against small scale perturbations. We have introduced a game theoretical adversarial intervention detection mechanism for reliable smart road signs against threats that can perturb the smart codes at small or large scales intelligently. This has enabled us transform the problem into an LP with considerably small computational complexity. Finally, we have examined the performance numerically over various scenarios. A network of smart vehicles can lead to more reliable traffic networks. Particularly, a detection mechanism faces a trade-off between detecting an adversarial intervention and avoiding false alarms.

GITHUB LINK:

https://github.com/IBM-EPBL/IBM-Project-24776-1659948738