IN PARTNERSHIP WITH PLYMOUTH UNIVERSITY

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Module Code: PUSL2023	Module Name: Mobile App Development
Coursework Title: Final Report	
Deadline Date:17th of May 2022	Member of staff responsible for coursework: Mr. Iman Ashly
Programme: BSc (Hons) Software Engineering	
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Group work: please list all names of all participants formally associated with this work and state whether the work was undertaken alone or as part of a team. Please note you may be required to identify individual responsibility for component parts.

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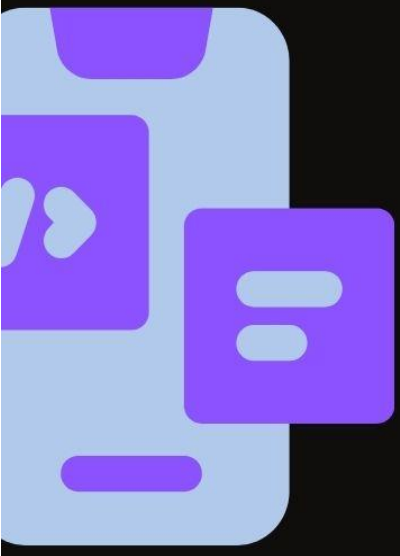
HEAD-UP DISPLAY WIDGETS

PUSL2023 Mobile App Development

Group No: 53



Acknowledgement

Without the collaboration and support from many people who contributed to this Mobile Application Development project, it would not have been feasible to complete it. However, we want to convey our gratitude and indebtedness to our module leader, Mr. Iman Ashly for their continuing support, compassion, and understanding throughout the project. Thank you so much for your continuous support and presence at all times. Our gratitude also goes to our university for providing us with the resources we needed to complete the project. Thank you to everyone who has generously offered their expertise and recommendations to assist us improve our project.

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Chapter 1 – Introduction

1.1 Introduction

The Head-Up Display (HUD) is a technology that projects an essential information about directly the driver's line of sight onto the vehicle's windscreen without restricting it. HUDs have become more popular in automobiles in recent years. HUDs, which are common in both real and simulated airplanes, convey information to the pilot (or driver) without requiring them to adjust their line of sight. HUDs are not a new concept in vehicles because they first appeared in 1988. In the last 20 years, technological advancements have enabled additional data to be displayed in higher quality. Several automobile manufacturers, like Lexus, BMW, and General Motors, have HUDs incorporated into their vehicles nowadays. The driver's concentration remains on the road ahead, which not only improves safety but also reduces eye fatigue by decreasing the need to move focus between the road and the instruments. Because of that they don’t have to struggle looking for information inside the car and Eyes tend to re-focus faster on the road when you take your eyes off the it.HUD technology has advanced significantly over time. For instance, now it can react to ambient light, so the displays are just as clear whether you're driving at night or during the day.

This in-built HUD technology is only available at new luxury vehicles. There are some third-party systems can be purchased and installed to serve comparable functions. However, it is a very expensive task. Therefore, as a solution for that we launched our Head-Up Display Widgets for vehicle drivers who are lacking built-in HUDs.To achieve this, we use android device to projects a transparent image on to the windscreen. Driver can see the compass, vehicle speed, pitching of the vehicle, rolling of the vehicle, live location of the vehicle and trip info. Drivers will get all the information that you need while driving at single place.

1.2 Requirements

1.2.1 Functional Requirements

- Check the Speed

  To display the accurate speed of the vehicle, at least vehicle speed should have 4kmph speed.

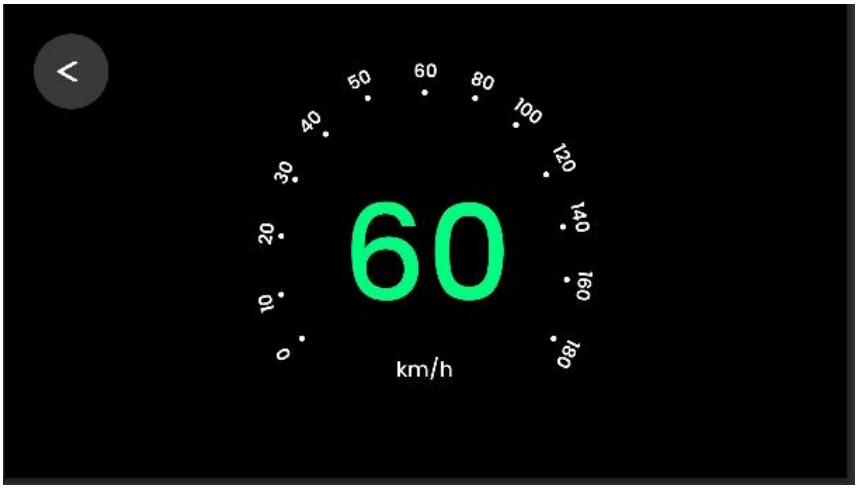


Figure 1: Speedometer

- Check the Pitching

  We get X axis value by using android device acetometer sensor, we decide the pitching of the vehicle.

- Check the Rolling

  By using the android device acetometer sensor, we get Y axis value and decide the rolling of the vehicle.

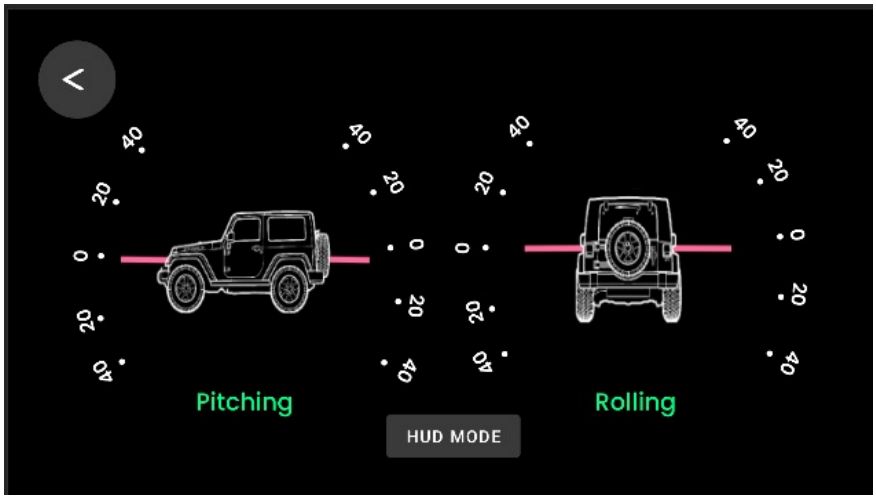


Figure 2: Pitching & Rolling

- Compass

  By using the magnetic sensor of the android device, we display all the 8 directions.

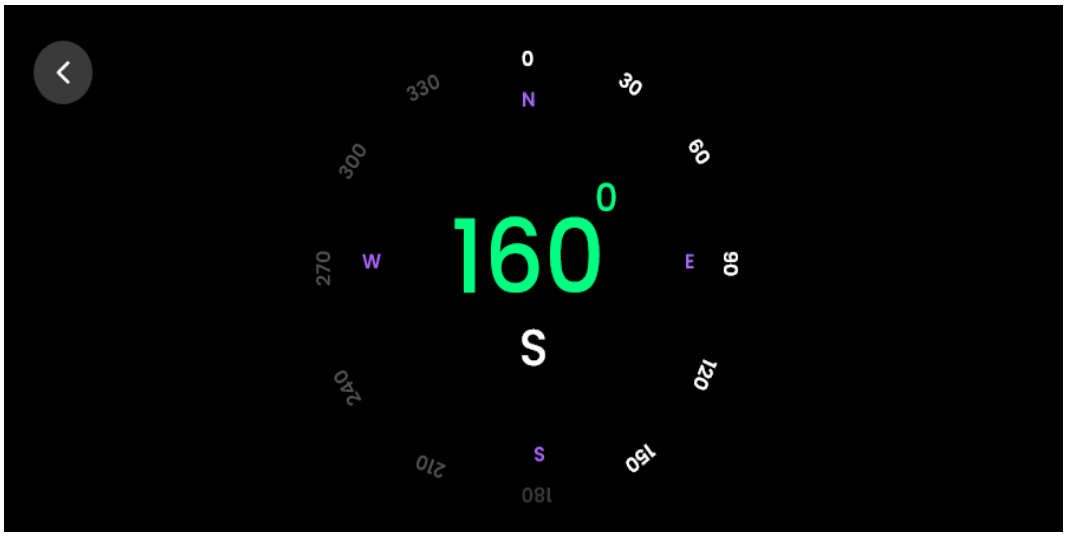


Figure 3: Compass

- Live Location Tracking

  We use Google Maps API (Night Mode) for live location tracking.

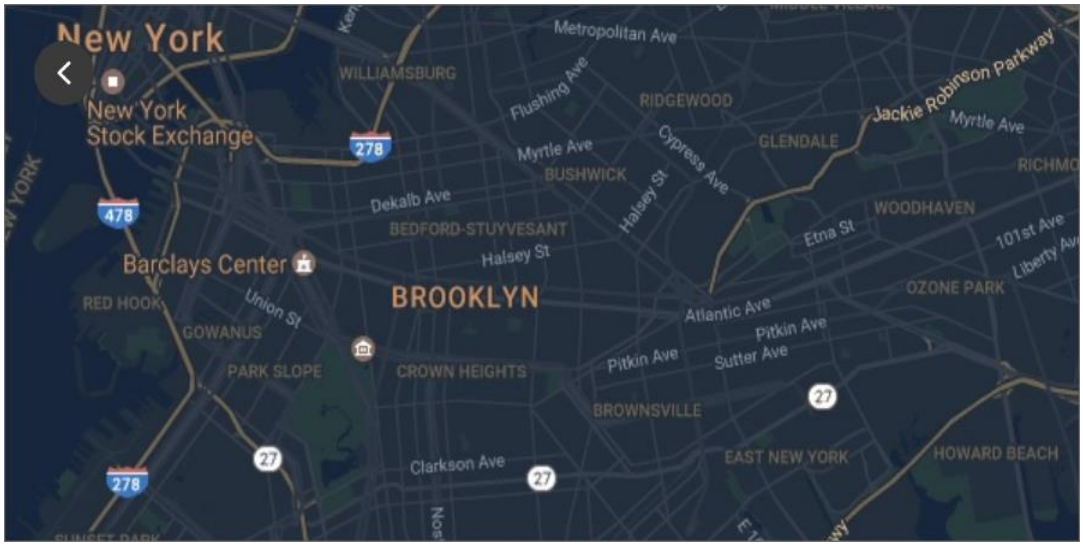


Figure 4: Live Location Tracking

- Check Trip Info

  In here, users can click the ‘’Start’’ button in the beginning of a new journey and click the ‘’End’’ button in the end of the journey. After the end of the journey, user can see the mileage, max speed, average speed, and the duration of the journey.

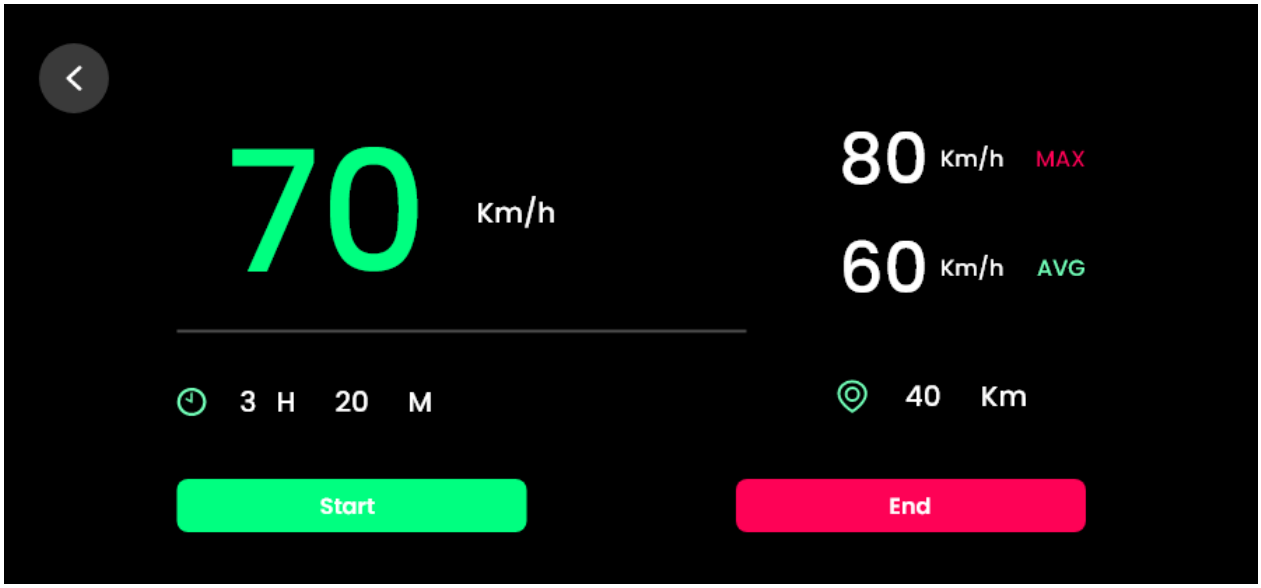


Figure 5: Trip Info

1.2.2 Non – Functional Requirements

- Performance

  The system should perform fast and respond to user interactions within less time. The accuracy of the location might change depending on the GPS signal strength. Since we'll be using an android device, the accuracy of the directions depends on the compass.

  Android Version should be 10 or higher.

- Usability

  The user should be able to easily understand how to use the app. So, the UI design should be simple to avoid any confusion. Therefore, we use green, red, white, and black as colors. We will be using black as our mobile app background color.

- Scalability

  Since we're developing this app for the vehicles, we can assume that the scale won't change much over time. So, we can identify the required resources and performance quantity wise from the beginning.

1.3 Scope of the Project

This is a Head-Up Display Widget for vehicle drivers who are lacking built-in HUDs.To achieve this, we use android device to projects a transparent image on to the windscreen. Driver can see the compass, vehicle speed, pitching of the vehicle, rolling of the vehicle, live location of the vehicle and trip info. In trip info driver can see mileage, max speed, average speed, and the duration of the journey. Using this widget drivers will get all the information that you need while driving at single place.

Using this HUD Widgets mobile application users can mainly check information of their vehicle. There are 6 types of widgets,

- Speedometer
- Rolling
- Pitching
- Compass
- Live Location Tracking
- Trip Info

Chapter 2 – System Overview

2.1 High Level Architecture Diagram

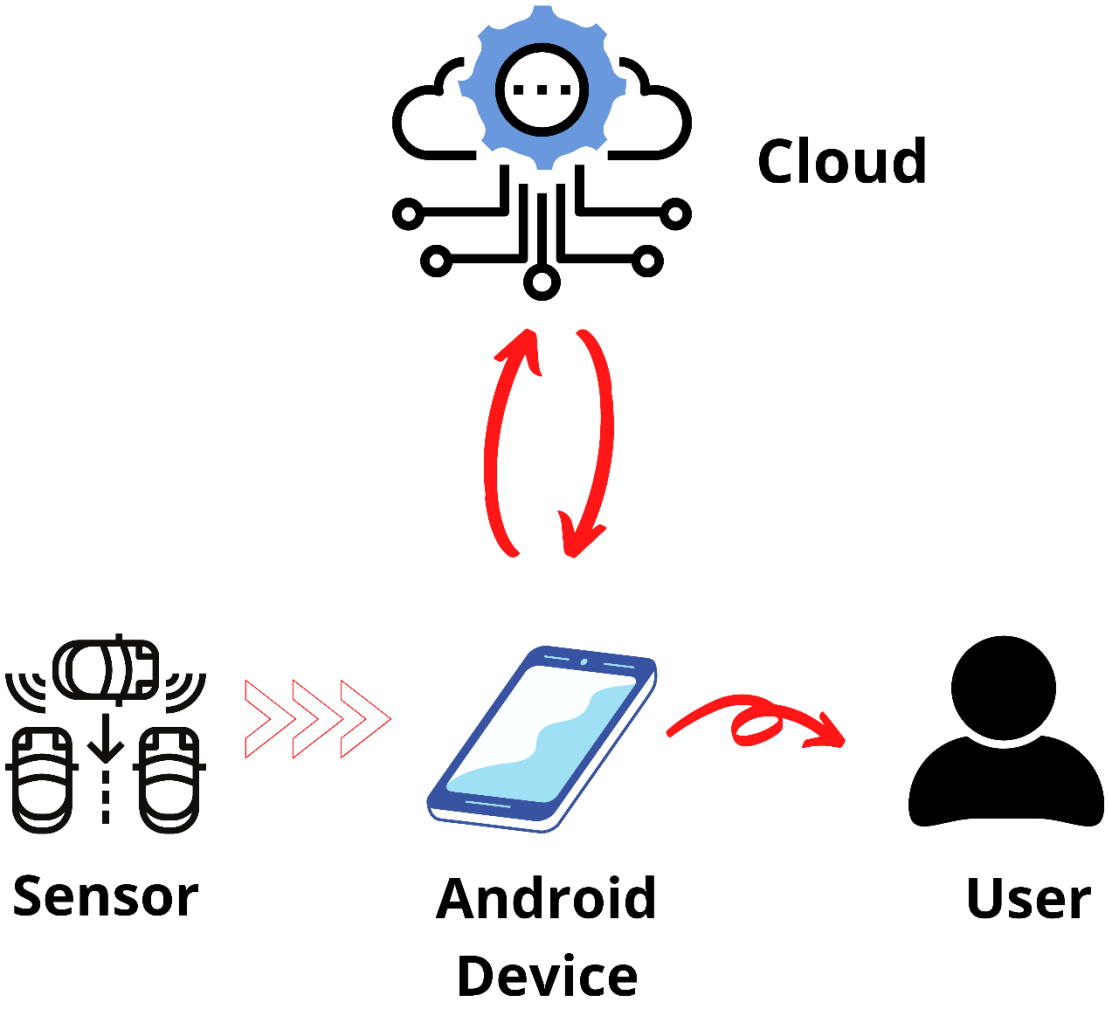
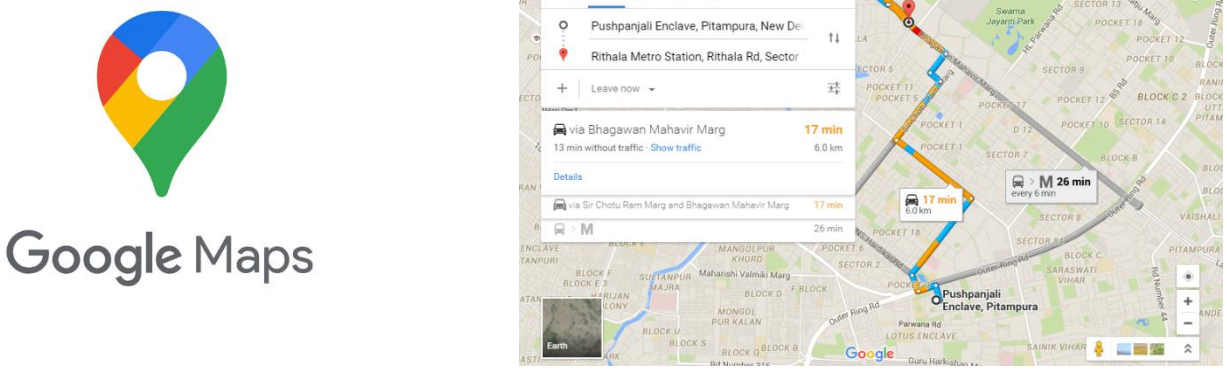


Figure 6: High Level Architecture Diagram

2.2 APIs and Technologies Used

2.2.1 Used APIs

Google Map API is being used for tracking the live location of the user. Dark theme of the google map is being used because it will be visible in windshield during daytime.



2.2.2 Used Technologies

1) Firebase

Firebase is being used to save user(driver) details and Trip Info. In trip info User Id, Max Speed, Distance, Starting Time, and End Time of the journey will be saved in Firestore Database.

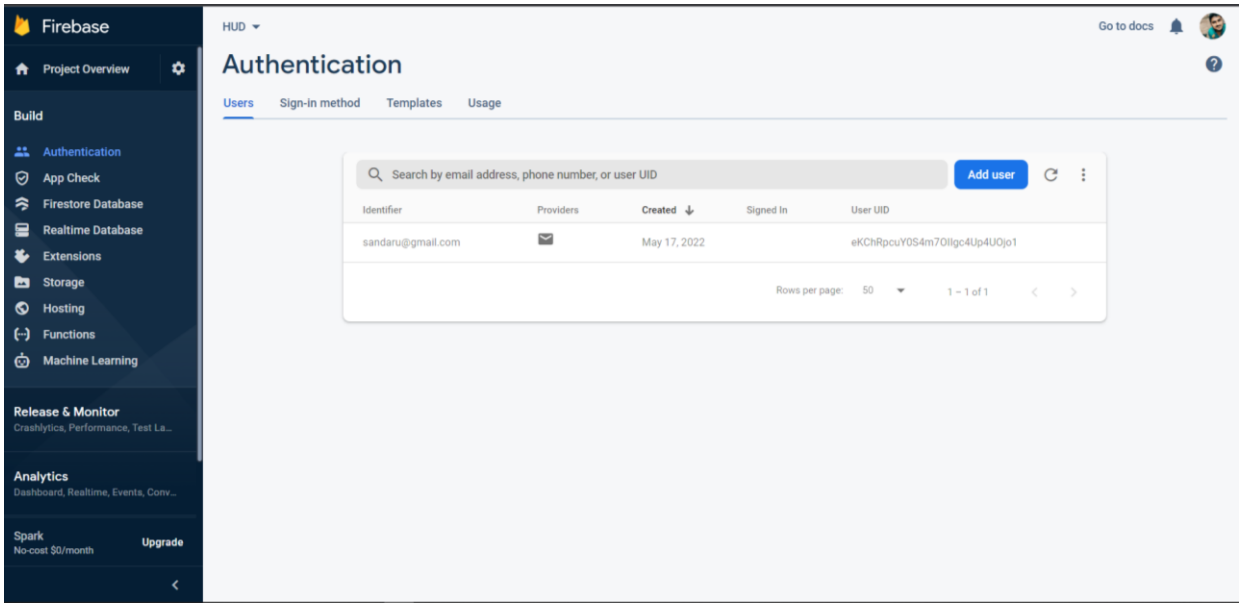


Figure 7: Firebase Authentication

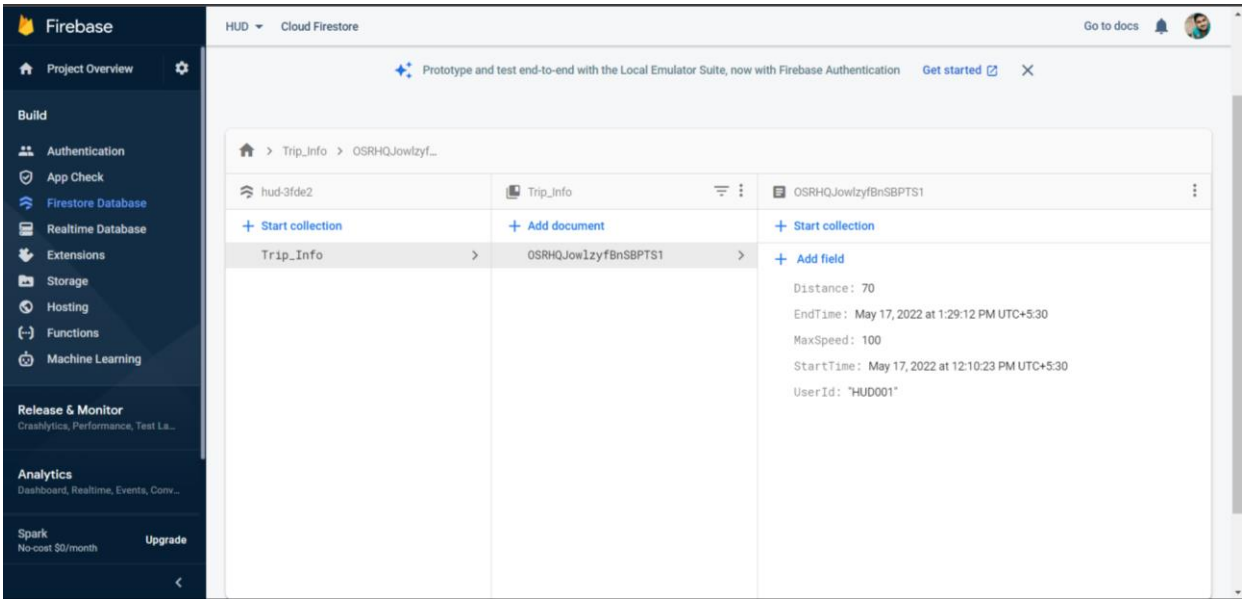


Figure 8: Firestore Database

2) Sensor Library

In this project we used sensor type orientation library file. Angles in degrees are used for all values.

Azimuth is the angle between the y-axis and magnetic north, measured around the z-axis (0 to 359). 0 denotes north, 90 denotes east, 180 denotes south, and 270 denotes west.

Pitch, rotation about the x-axis (-180 to 180), with positive values as the z-axis approaches the y-axis.

Roll, increasing rotation around the y-axis (-90 to 90) as the gadget rotates clockwise.

3) Android Studio

All the backend development of the user mobile application is developed using Android Studio Apllication.This application is developed based only on Android devices. Kotlin is being used as main programming language of the project development process.

2.3 Challenges and the Actions Taken to Overcome

There were lot of challenges faced during this project development process and because of that lots of changes were made to overcome those obstacles. However, proper steps and observations conducted early in the project might determine the ideal course for the development process.Following are some problems faced during project development.

Firstly, there were issues when installing this mobile application into an Android device. Some android devices cannot install the app or after the installation application will get crashed when trying to open it. Even its android version is 10 or higher than that still some devices will not support this application. That issue occurs because of the Orientation. The sensor values which are taken from Gyroscope sensor of the user's mobile phone device will be convert into degrees by Orientation. It is not a physical sensor, but it is software sensor using the combination of Pitching (X axis), Rolling (Y Axis) and Azimuth (Z Axis). Therefore, that errors could not been fixed by developer perspective of this HUD Widget. This narrates, to install the app and to use the HUD Widget App, powerful orientation is more important than the android version.

Also, there were some errors on the speedometer. Speed of the vehicle was not calculated correctly. But with some changes of the back-end code perspective now speedometer is working correctly.

Chapter 3 – Real-World Applications and Future Enhancement

3.1 Usefulness in the Real-World Applications

The 1988 Oldsmobile Cutlass Supreme Indianapolis 500 Pace Automobile Parade Convertible was the first car to include a Head-Up Display. While the range of content offered has expanded from vehicle status (such as fuel and speed) to trip information (such as navigation and collision warnings) since then, most HUDs, whether basic or add-on on the road continue to reproduce the information accessible in existing displays. HUDs have become more popular in automobiles in recent years. HUDs, which are common in both real and simulated airplanes, convey information to the driver (or pilot) without requiring them to adjust their line of sight. HUDs are not a new concept in cars because HUD technology has advanced significantly over time. In the last 20 years, technological advancements have enabled more information to be displayed in higher quality. Several car manufactures, like Lexus, BMW and General Motors, have HUDs incorporated into their vehicles nowadays. By using this HUDs, driver will get all the information that you need while driving at single place. They don't have to struggle looking for information inside the car and Eyes tend to re-focus faster on the road when you take your eyes off the it.

3.2 Future Enhancements

The presented Head-Up Display Widget in this study, is developed using mobile phone capabilities, making the entire system less cost effective when compared to other HUDs on the market. It needs to be integrated with gesture control, voice control and voice recognition in the future, allowing the HUD to execute functions without touching the touch screen of the android device while driving. The HUD on display can display instructions and turn by turn guidance, making driving safer and more comfortable. Vehicles Heads-up display can be utilized to provide a variety of functions and help to the driver. With the enhancement of technology, the mass population has adopted to use GPS. The use of mobile phones and applications such as Google Maps has revolutionized navigation technology. Today, anyone with a GPS-enabled phone can travel routes with ease using Google Maps. Users can also navigate routes for driving or walking. The route's traffic condition, navigation instructions for each turn, and the anticipated time to reach the destination are only a few of the elements featured in Google Map. In addition to navigation, the HUD may be used for answering calls, messaging, playing music, controlling music volume, regulating car headlights, windows, and roof, and many other things. HUD with integrated sensors can be utilized to create an Ad-hoc network for traffic management. HUD is a software platform, and it is the way of the future. With advancements in Augmented Reality (AR), HUDs will be able to sense objects in the future and can be connected with automatic driving systems to provide the greatest possible experience for the user.

Chapter 4 – Conclusion

Head Up Display (HUD) will show various forms of information in a specific location, allowing the driver to see it without having to concentrate on a display console or a GPS screen that is out of their field of vision. It will completely reduce driver immersion in their vehicle, displaying speed, rolling, pitching, and other information on any accessible windscreen. A-HUD develops a network of cars using a wireless network with high bandwidth and powerful servers to gather crucial information that can help drivers better understand their route. By following the line of sight of the driver, it provides substantially more info than any current navigation system or HUD while keeping a simplistic display technique. The major application is traffic monitoring and navigation, but the increased amount of data combined with the Augmented Reality display of information will enable numerous additional uses. With advancements in Augmented Reality (AR), HUDs will be able to sense objects in the future and can be connected with automatic driving systems to provide the greatest possible experience for the user.

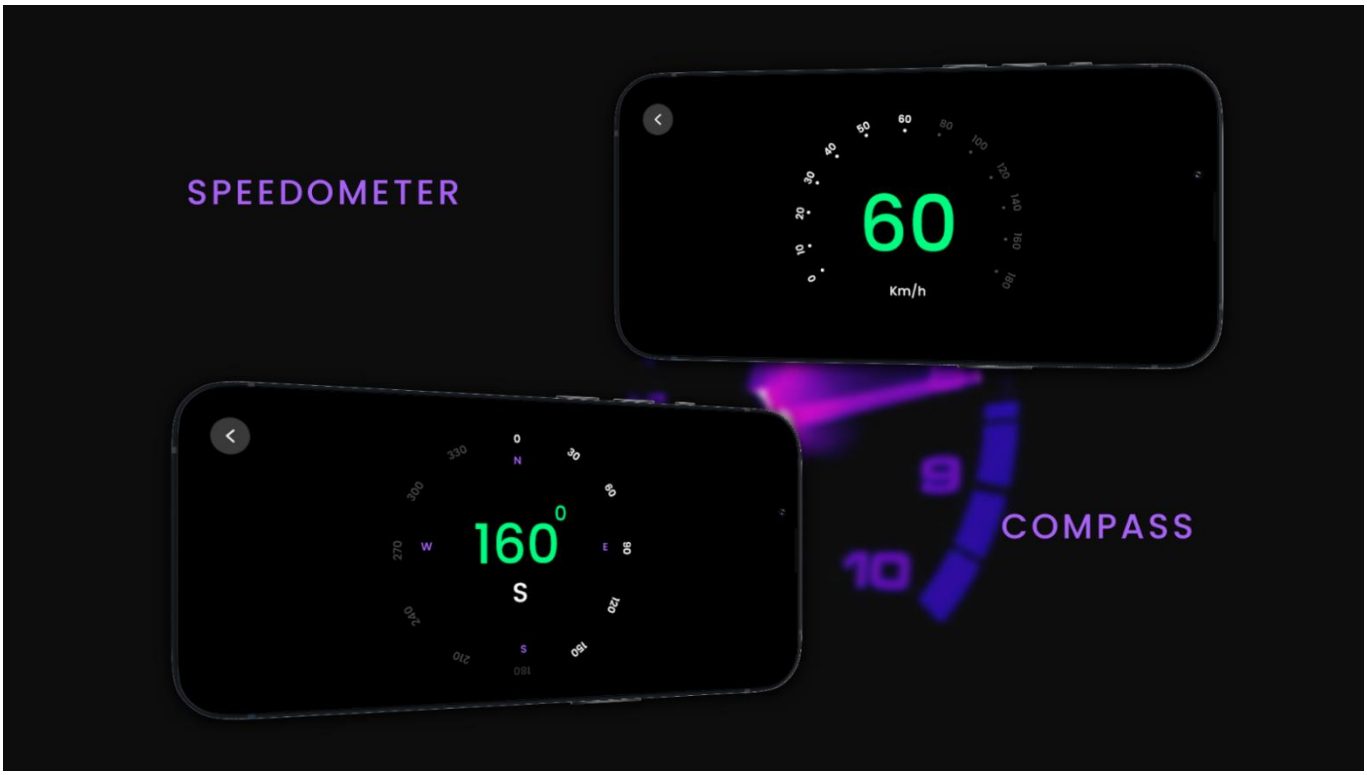
Team Plan & Responsibility Matrix

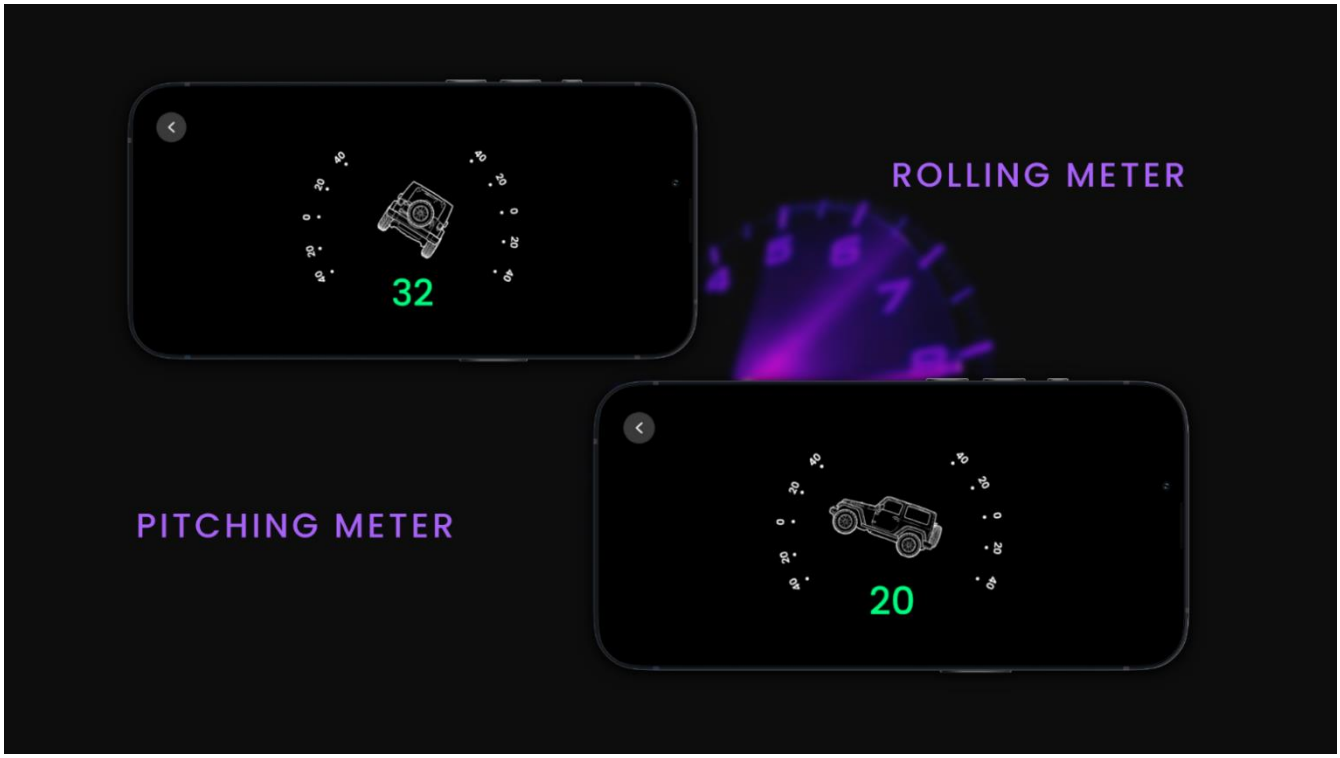
Plymouth ID	Name	Tasks Carried Out
10749139	Udugama Nuwanthika	• Development of Speedometer
10749121	Rajapaksha Rajapaksha	• Firebase Authentication and User Profile
10749150	Merenna Amarasinghe	• UI & UX Design
10749110	Sakaladhipathige Fernando	• Development of Compass • Documentation
10749145	Bopage Muthumala	• Development of Rolling & Pitching
10749185	Randeera Withanage	• Development of Navigation System

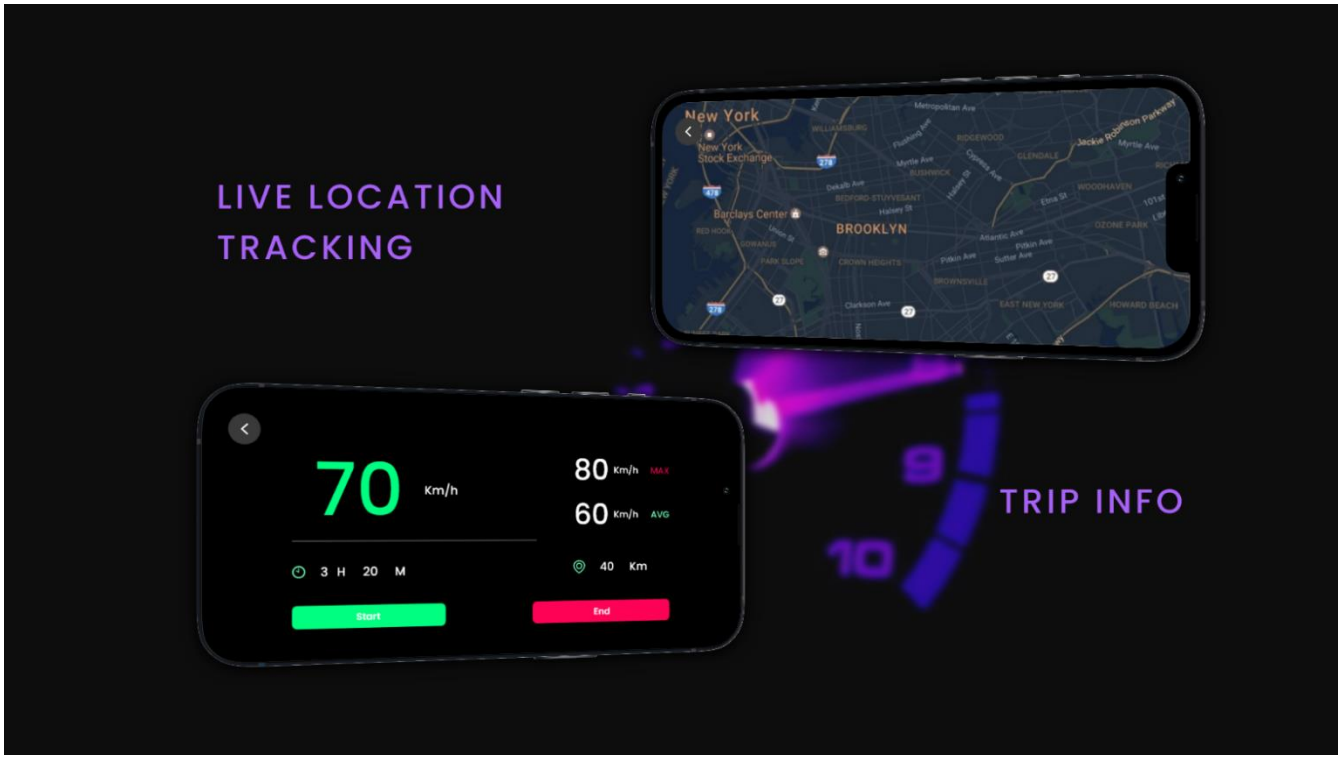
Mock-ups


SPEED


SPEED
Speedometer
Rolling Meter
Pitching Meter
Navigation
Compass
Trip Info


SPEEDOMETER
60
Km/h
160°
S
COMPASS


ROLLING METER
32
PITCHING METER
20


LIVE LOCATION
TRACKING
New York
New York
Stock Exchange
Barclays Center
BROOKLYN
70
Km/h
80 Km/h MAX
60 Km/h AVG
3 H 20 M
40 Km
Start
End
TRIP INFO

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