AVOID: Advanced Vehicle Optimization and Intelligent Dispatch

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Introduction

The importance of motorcycle-based delivery services within the logistics sector of the Philippine industry is evident because it faces no substitute as the logistics solution can be said to be the most flexible and economical when it comes to last-mile delivery in traffic and the high-density urban settings of the Philippines. Their size, along with their agility, allows riders to avoid the bottlenecks that usually stop the work of larger vehicles, so these vehicles are crucial in response to the increasing role of e-commerce and on-demand delivery. But with this increment in motorcycle delivery, there are big challenges in terms of operation. Riders are often exposed to an unstable traffic flow, closure of roads, weather related damages e.g. flooding, which hinder the routes and consequently result in high delays. Besides impacting customer satisfaction, these problems cause inefficiency as well as enhance higher costs to be incurred by the logistics firms. Besides, managers do not usually have tools that provide real-time information on exactly where riders are, at what stage of delivery delays or other issues, so they cannot make informed decisions and guarantee timely delivery of orders. Unless there is intelligent route design and tracking, real-time tracking and open reporting channels, the delivery process will continue being reactive and susceptible to preventable breakdowns.

In order to meet these urgent needs, the capstone project suggests the creation of an Android-based all-purpose mobile and web application **AVOID: Advanced Vehicle Optimization and Intelligent Dispatch** optimized to be used in a delivery business. The mobile application will provide the riders with real-time navigation with weather responsive, and traffic-aware rerouting on the A algorithm, flood-prone areas mapping, dynamic multi destination planning that re-sequences stops by closest location to save time. Audio alerts will

keep the riders up to date with directions to follow and other traffic conditions and any possible dangers. In the meantime, the dashboard of the web interface will supply managers with real-time tracking of in-transit deliveries in form of GPS coordinates, a log of delivery histories, profiles of riders with performance rating to manage incentive plans, and extensive statistics on delivery schedules and areas of regular delays. AVOID offers multi-factor authentication, role-based access to administration capabilities, heatmaps of violations, and exportable reports, among other possibilities trying to change the nature of delivery management to a more proactive one, rather than trying to solve problems and investigate incidents all the time. The system aims to enhance logistics services with a guarantee of delivering reliability in urban areas in the Philippines by empowering riders and administrators with real-time information and creative capabilities to track on-time delivery success as well as efficiency.

Background of the Study

Motorcycle has emerged as a mainstream mode of transport in the Philippines with more than 7.8 million registered motor cycles and tricycles in the year 2023 alone (Statista, 2024). They are so popular thanks mostly to their low prices, fuel consumption, and ease of maneuvering in congested city roads in the country. Such strengths have positioned motorcycles as the mainstay of city of last mile deliveries and logistical activities in cities such as Metro Manila and Antipolo. Growth in delivery services involving motorcycles has been on a faster pace as of late due to the multiplication of motorcycle taxi services like Angkas, JoyRide, and Move It since 2016 (Rosales, 2024). This growth has led to an even more competitive environment within the sphere of logistics, with the prompt and flawless delivery of parcels often being the key to meeting the expectations of the customers and remaining profitable in the work of the company in question.

Nevertheless, in addition to the factors contributing to the appealing nature of motorcycles as a means of logistics, speed, maneuverability, and densely-metered urban traffic, these operational issues also create major impediments. Delivery riders are also faced with much fluctuating traffic, small or busy roads, and limited routes which may consequently result in delayed delivery, and late customer time windows. Planning the routes is further complicated by external environmental conditions like unpredictable weather, urban floods when it is pouring heavily, etc. that can cause the need to go through unexpected detours or halt (Topnatch Logistics, 2023). These concerns have first-hand effects on service reliability provided by logistics companies, as well as leading to escalating costs due to time loss associated with it, fuel costs and graver effects that happen to the reputability of logistics companies. The failure in timely and quality last-mile delivery will leave an ever-spreading impact in the supply chain and undercut the effectiveness of overall logistics and customer confidence.

In addition to the traffic and environmental barriers, there is another issue ensuring the successful real-time control and supervision of the delivery riders. Most logistics processes do not have a single system that can track the location of the riders in real-time, document the current delivery status, and assess the frequent reasons why it is delayed. In the absence of an accurate picture of live rider data, dispatch and supervisor teams find it hard to manage their fleets, reposition tasks on a real-time basis, and proactively catch up with route upheaval. Existing solutions can exist, but despite the basic GPS tracking or navigation they are not able to implement the significant features on the logistics side e.g. weather-based rerouting, multiple stop deliveries optimization, or integration with the warehouse dispatch. Consequently, logistics companies, notably the smaller ones, often use manual techniques of coordination or disjointed tools that are ineffective to implement as the demand rises.

This research proposes to develop **AVOID: Advanced Vehicle Optimization and Intelligent Dispatch**, which is a mobile and web-based system to support motorcycle delivery operation in the Philippines. The android mobile will have real-time navigation using the GPS and smart rerouting by use of A* algorithm which makes it give dynamic rerouting based on the traffic and the flood-prone regions. It will have flood display maps, stop-delivery route planning, and auto re-sequencing (destination order-based on proximity) as well as voice-based alerts to guide the users to follow the direct routes through a dense urban set up. How to ride safely and road rules will also be integrated in the educative contents which will be supporting rider readiness. The web-admin dashboard will enable the logistics managers to view an overview of the location of the riders in realtime, as well as log of deliveries made, violation notification and delivery status which can be either in delivered, delayed or in transit status, and perform analytics in heatmap view and reports. AVOID will allow the logistics operators to anticipate and control the delivery process, minimize delays, and spend less time attracting riders to adhere to safe and efficient routes and eventually deliver superior customer experience with multi-factor authentication, role-based access control, and robust reporting functions.

Project Objectives

The primary objective of this project is to design and implement AVOID: Advanced Vehicle Optimization and Intelligent Dispatch, an Android-based mobile and web application that assists motorcycle riders in following traffic regulations through real-time alerts and provides administrators with tools to monitor rider behavior and delivery performance.

Specifically, the study aims to:

- To design a mobile app with real-time GPS navigation, A route planning, and multi-stop delivery, accounting for traffic and flood-prone areas.

- To enable rerouting to provide safer delivery routes in weather-conscious, flood-avoidant routes is made possible.
- To give clear voice instructions and warnings in the matters of prohibitions of the road like no overtaking places and one-way directions.
- To contain educational information about safe driving and road-specific rules of driving delivery.
- To develop a secure web dashboard to track the real time location of the vehicle, create logs of trips, track the delivery status, and monitor the performance.
- To adopt the multi-factor authentication and role-based access to the system security.
- Evaluate the overall system based on ISO 25010 software quality standards: Functional Suitability, Performance Efficiency,Compatibility, Usability, Reliability, Maintainability, and Portability.

Significance of the Study

The proposed AVOID (Advanced Vehicle Optimization and Intelligent Dispatch) project holds substantial importance by providing a practical and real-time intervention to mitigate traffic violations committed by motorcycle operators through mobile alert functionalities.

Motorcycle Riders: Riders are anticipated to experience enhanced road safety and cultivate heightened situational awareness. Provision of real-time warnings in relation to traffic signs and speed limits, as well as the contemporary road regulations, will enable them to avoid the occurrence of violations that are not intended, thus leading to a decrease in the number of accidents occurring and enhancing a safer commuting process.

Logistics Companies and Delivery Operations: AVOID aids effective route scheduling and checks on delays in delivery and driver patterns. This may result in better reliability of the

deliveries, transparency of operations, and, possibly, an incentive program available to high-performing riders.

Traffic Authorities and Policy Makers: The information based on the collected data (e.g., app logs, certain areas with committing violations) and the success of any real-time alerting tools could help develop traffic control, city planning, and a more specific campaign/public safety intervention to be created to control road behavior better and decrease congestion.

ICT Sector and Developers: The project can be of immense value to the ICT community as it shows how real-time location monitoring, a dynamic route planning with A* algorithm, flooding-prone areas visualization, and multi-factor authorization could be combined together in a single application. The design and approach can be used by ICT professionals and researchers to develop more superior, user-oriented, as well as responsive transport and logistics management systems.

Scope of the Study

The AVOID app will be designed in Flutter framework, which specifically supports devices based on the Android operating system. The admin dashboard will be a web-based system utilizing modern browsers.

Key Functionalities of the Mobile Application include:

- Real-Time GPS Navigation and Route Optimization
    - Real time GPS navigation, along with A* algorithm route optimization which will make the assurance that the shortest path will be given.
    - Delivery routing support multiple stops and flexible dynamic reordering of stops depending upon their proximity to each other.
    - Weather-based rerouting of the predicted visualization of flood-prone areas.

    - Option for riders to enable flood avoidance re-routing.

- Flood-Prone Area Visualization

  Integration with location-based APIs to display high-risk flood zones on the navigation map, allowing riders to make safer routing decisions.

- Pop-Up Alerts with Voice Commands

  The app will provide real-time alerts regarding:

    - Speed limits
    - Safety zones
    - Pedestrian areas
    - Dataset mapping of officially marked no-overtaking zones and one-way streets to enable highly specific, context-aware rider warnings.

- Trip Logging Monitoring:
    - Logging of delivery status.
    - Synchronizes data with the backend on the admin dashboard.

- Traffic Rules and Penalties Page

  A dedicated section providing educational content, including:

    - Common road signs and their meanings
    - Corresponding penalties for violations
    - Voice-based reminders for enhanced rider awareness

- User Account Functions
    - Multi-Factor Authentication (MFA)
    - Account registration, and login

Key functionalities of the Admin Dashboard include:

- Rider and User Management
    - View and manage rider profiles, delivery status, and violation records
    - View real time the rider's location on the map
    - CRUD operations for user and admin accounts
    - Role-based access (e.g., Analyst, Supervisor, Read-Only).
- Delivery Monitoring:
    - Delivery trip logs and status (delivered, delayed, in transit)
- Violation and Delivery Analytics
    - Exportable reports in CSV/PDF formats
    - Violation heatmaps and delivery delay tracking
    - Rider performance scores (min. 70, max. 100) used to support incentive distribution
- Incentive Tracker
    - Displays the frequency of riders scoring above 90 to help determine eligibility for rewards

A logistics warehouse in Antipolo will be involved along with the study and it will also specifically focus on the delivery routes in Brgy. Mayamot, Cupang and Mambugan.

Delimitation

The application is limited to the following functions:

- The Android app will be designed exclusively to work with Android handsets and will not work with either iOS-based or other operating systems.

- The system is set to guide the riders and remind them of the traffic rules in real life, but does not identify and confirm the real traffic violations made by the rider.
- It will contain only some traffic regulations (e.g. speed limits, zones of safety, zones of no overtaking, zones of pedestrians); the system does not contain the entire list of traffic regulations.
- Weather-based rerouting and flood-prone area visualization depend on integration with external weather APIs and databases.
- Real-time GPS tracking, traffic conditions, flood-prone areas visualization, and the synchronization of data with Supabase all need an active connection to the internet.
- The application is not used to track the accuracy of driving, settle penalties, or confirm the compliance of the driver.
- The system is designed for the riders in the J&T motorcycles. It has no association to the other types of delivery services (like Toktok) and cannot work on three-wheeled vehicles (like the Bajaj or other tricycles).
- It is spatially constrained as the pilot implementation is in Brgy. Mayamot, Cupang, and Mambugan in Antipolo City, in partnership with a local warehouse logistics.
- Delivery status and timeliness are the only two factors that are used to determine the scoring and rewarding system in the company.

Chapter 2

Theoretical Framework

This chapter contains details on previous research that is related to the creation of AVOID: Real-time Road Rules Mobile Application Guide, which is aimed at helping J&T motorcycle riders. The project is conducted in the sphere of traffic safety, motorcycle rider behavior, the real-time location-based system, and the development of a mobile application. The notions help to achieve the objective of the study to enable safer driving by giving adequate road rule advice and warnings to motorcycle riders.

Review of Related Literature

Motorcycles have become one of the most widely used modes of transport in the Philippines, with more than 7.8 million units registered nationwide in 2023 (Balita, 2025). This widespread use extends beyond personal travel, with many logistics firms such as J&T Express depending on motorcycle riders for timely last-mile delivery services. While this has improved accessibility and delivery reach, it has also introduced a set of issues related to traffic law compliance, road safety, and delivery efficiency.

Data from the Metropolitan Manila Development Authority (MMDA) revealed that motorcycle drivers are among the most frequent traffic violators. Out of the 20,656 recorded traffic offenses 4,527 or 21.92% of those involved, were motorcycle riders who were using the lanes that were not designated for motorcycles (Mendoza, 2023). Also, during a given period of enforcement, more than 20,000 traffic violations were documented with many of them being motorcycle riders abusing lanes that are not supposed to be used by them (Rosales, 2024). These violations may lead to parcel delays and an adverse effect on the customer satisfaction level, which is specifically relevant to such logistic businesses as J&T Express, which specialises in delivery parcels.

A contributing factor to these problems is the lack of formal traffic education among riders. According to research by Villanueva et al. (2024), many Filipino motorcycle drivers learn road rules through informal methods or peer instruction rather than formal training. This incomplete knowledge base leads to frequent traffic violations, especially among younger and less experienced riders. Beltran et al. (2022) also observed that this demographic were the ones to struggle with understanding the basic traffic signs, leading to their chances of violations during delivery tasks to increase. Even with the introduction of programs like the No Contact Apprehension Program (NCAP), traffic violations remain high. In just one month following its reimplementation, over 24,000 traffic sign violations were recorded (Malonzo, 2025). The most common offenses were the violation of posted signs, mostly committed unknowingly due to a lack of rider awareness (Rosales, 2024). Reports have shown thousands of violations in the weeks following NCAP's reinstatement, underscoring persistent noncompliance and a gap between regulation and actual rider behavior (Zurbano, 2025) These continued violations highlight the need for educational tools and a guidance system to support better compliance during deliveries.

Weather conditions are another major challenge for motorcycle riders and the logistics area. Flooding, heavy rains, and typhoons usually disrupt the normal delivery routes, placing riders and their motorcycle at risk and delaying their parcel deliveries. Topnatch Logistics (2024) noted that unpredictable weather patterns consistently affect shipment reliability across the country. As a result, there has been a growing need for logistics tools that incorporate flood detection, dynamic navigation, and smarter route planning to prevent delays and ensure safety.

In response to these problems, the researchers proposed the AVOID mobile application which is designed specifically to support logistics riders from J&T Express. The system offers real-time alerts tied to the rider's current location, including information about speed regulations, one-way restrictions, areas that prohibit overtaking, and flood-prone areas. It also includes educational content on traffic signs and corresponding penalties to improve compliance and understanding among users. This design follows principles in human-computer interaction, which emphasize the effectiveness of delivering location-based feedback to shape user behavior (Galang et al., 2020).

The reviewed studies clearly show that the delivery riders in logistics areas face a lot of different difficulties, ranging from bad road rule knowledge to weather disruptions that can cause them to have delays in delivery. AVOID is seeking to address these issues through a combination of real-time data, map visualization, and user education. Similar applications in other fields have already proved the impact of a system in improving decision-making and reducing human error. With these functions tailored specifically for J&T Motorcycle riders, AVOID presents a solution to support safer and more efficient delivery practices for J&T Express motorcycle riders.

Conceptual Framework

Figure 1

Conceptual Framework of AVOID

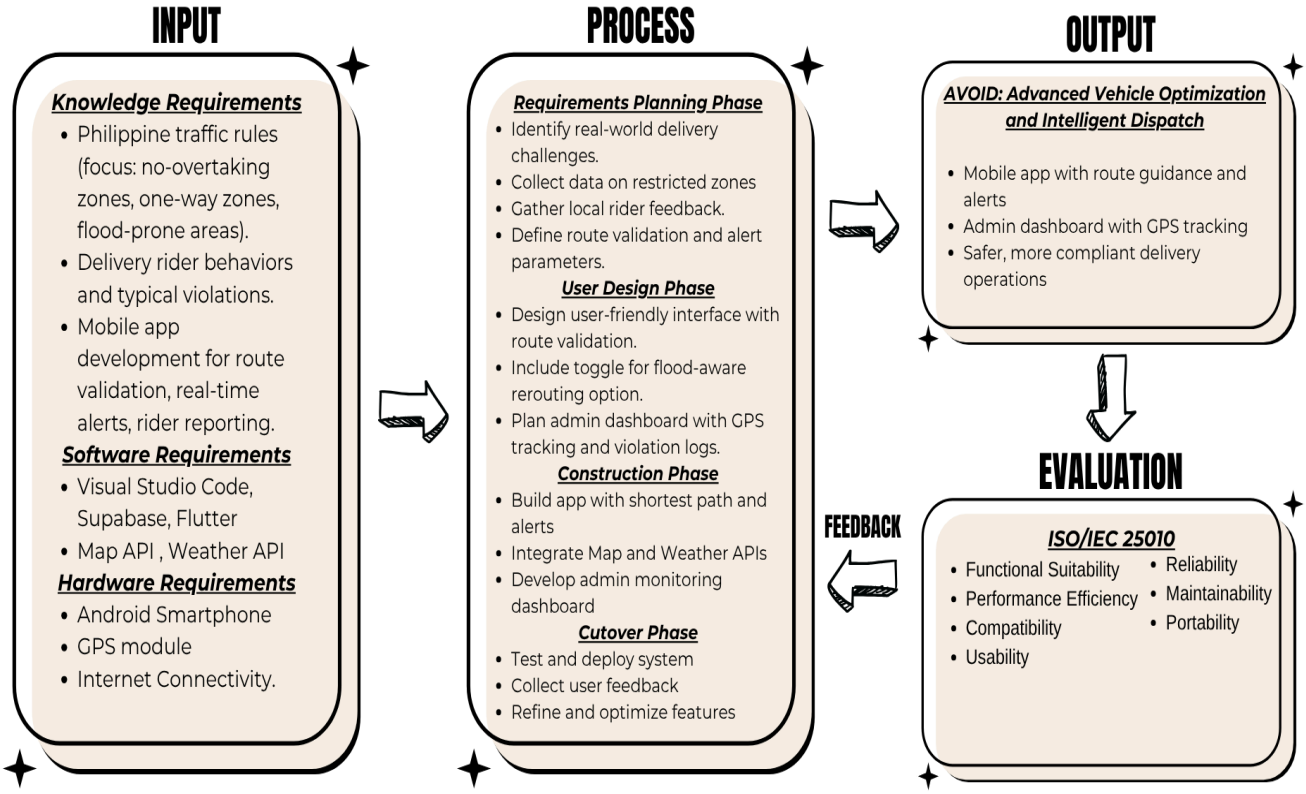


Figure 1 shows the inputs will include the knowledge of traffic rules and regulations in the Philippines (no-overtaking area, one-way area, and flood-prone streets), common patterns and violation behaviors of motorcycle riders in the J&T company, and technical requirements to implement the system including Flutter, APIs (Map and Weather), Visual Studio Code, and Supabase compatible Android systems with GPS and internet access.

Its development is according to a Rapid Application Development (RAD) model, which entails four major steps, viz., Requirements Planning, User Design, System Construction, and Cutover (Transition to Use). In Requirements Planning, the delivery issues in reality like incorrect pins, prohibited areas and flooded areas are studied, and the experience of riders is collected. User Design envisaged easy destination pinning using the interface, computation of a shortest path, and real-time traffic warnings involving restricted areas as well as a switch allowing flood-based rerouting to be freely enabled or disabled. The admin dashboard would also be set to have live tracking of the GPS and delivery.

The mobile app is developed in the Construction phase comprising integrated Map API, Weather API, where shortest-path calculation is made, and limited zone validation done along with riders alerting in real-time. Admin web dashboard is designed to show in real-time the locations of riders, past delivery records, and violation history including suspension management. In the Cutover stage, the system is piloted and implemented and feedback provided by users is taken to improve systems such as pin validation systems, restricted zone warning, and the ability to reroute.

The AVOID system currently has as its final output a completed fully working mobile application of the J&T delivery riders with shortest path guidance, notifying of the traffic rules in real time, optionally performing flood aware rerouting, and providing rider feedback report. There is a live GPS tracking, violation tracking, and the delivery log activity that is administered through the admin web dashboard. On the whole, the project will provide safer activities of delivery work and minimize traffic violations and delays due to better routing and monitoring compliance.

System Architecture

Figure 2

System Architecture of AVOID

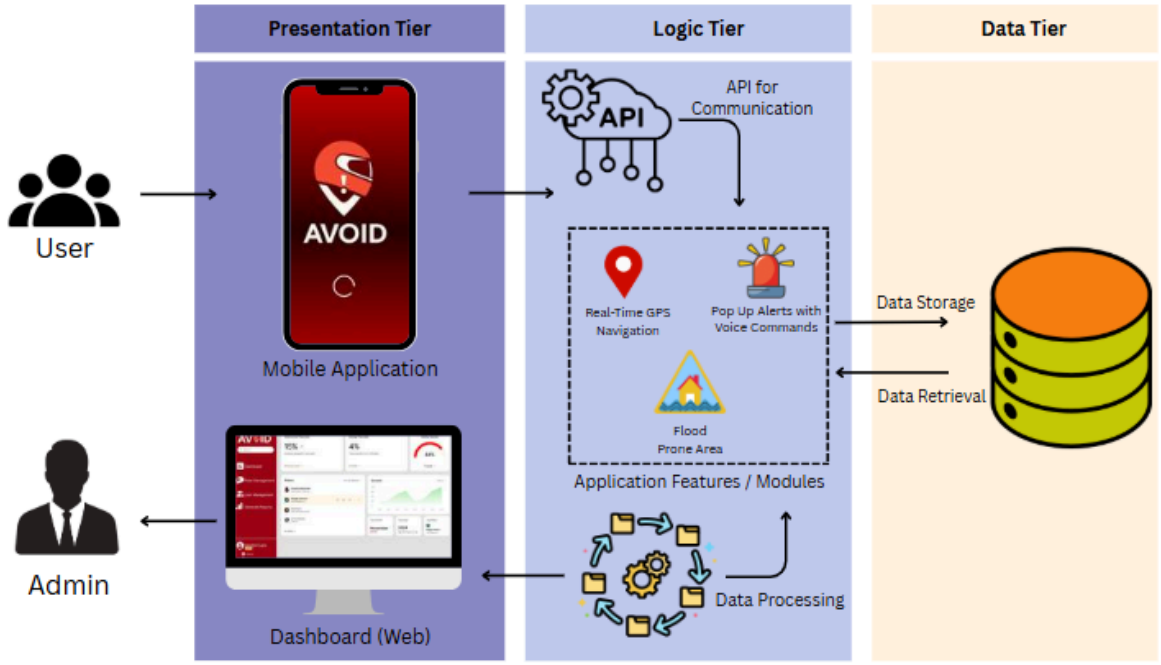


Figure 2 comprises three major components, namely, Presentation Tier, Logic Tier, and Data Tier. The Presentation Tier is the place where users and administrators communicate with the system. To users this is composed of the mobile application whereby the user can access the content which includes location tracking, and pop up alerts for warnings of violation on road rules. With the user-friendly interface, the riders will get real-time alerts using pop-up notifications with voice commands, flood-prone locations, and will be likely to use navigation functionalities. The dashboard (web) gives access to system data to the administrators so that the activities of users could be monitored, thus making the oversight and analysis really efficient. The Logic Tier does all processing and organization of applications features. This level does the real time GPS navigation, alert, and processing of data which runs the functionalities of the

application. The APIs used in this layer are used as mediators between the presentation layer and the data layer. This level makes sure that users get information in time, functions of voice commands, observation of the behavior and location of a rider to enhance safety and traffic rules adherence.

Data Tier is involved in the storage and retrieval of the data. It is blowing all the vital records, including location logs, road rules data, and alerts. The logic layer gets access to such information and transmits it back to the presentation layer which visualizes it and makes decisions. Also the data stored is fed to the admin dashboard, thus easy monitoring and reporting of the system is possible.

Definition of Terms

Android – A mobile system made by Google. It is mostly used on smartphones and tablets with touchscreens. The AVOID app is made only for Android.

AVOID (Advanced Vehicle Optimization and Intelligent Dispatch) – The name of a mobile app to help J&T motorcycle riders.

Conceptual Framework – A model or plan that shows main ideas and how they connect in research or system design.

Data Tier – The part of the system that keeps and manages all data, like user activities, traffic rules, and alerts.

Disregard of Traffic Signs (DTS) – A traffic violation when a driver does not follow traffic signs like stop signs or speed limits. This is common in Metro Manila.

Flood-Prone Area Visualization – A map feature in the AVOID app that displays locations likely to experience flooding, helping riders reroute and avoid delays**.**

Flutter – A free software tool by Google to build apps for Android and iOS using one **code.**

GPS (Global Positioning System) – A satellite system that gives real-time location to devices, helping the app give alerts based on location.

ISO/IEC 25010 – An international standard to check software quality, like functions, ease of use, and reliability.

J&T Express – A major logistics and parcel delivery company in the Philippines that utilizes motorcycle riders for last-mile delivery services.

Logic Tier – The middle part of the app that processes data and controls how information moves between user interface and data storage.

Location-Based Alerts – Notifications that happen because of the user's location to tell about traffic rules nearby.

MMDA (Metropolitan Manila Development Authority) – The government agency that manages traffic and transport in Metro Manila.

Mobile Application – Software made for use on smartphones or tablets.

Motorcycle Taxi Services – Apps like Angkas and JoyRide that give motorcycle rides to commuters.

Multi-Destination Route Optimization – A smart feature that automatically arranges delivery points from the nearest to the farthest, minimizing travel time.

NCAP (No Contact Apprehension Program) – A program using cameras and automatic systems to catch traffic violators without police contact.

Presentation Tier – The part of the app that the user sees and uses.

Pop-Up Alerts with Voice Commands – Notifications that appear on-screen with accompanying voice prompts to inform riders of immediate traffic rules, such as no-overtaking zones or speed limits.

RAD (Rapid Application Development) – A method for creating an application quickly and fixing it using feedback.

Real-Time Alerts – Notification that alerts the users so that they can act quickly to violations or changes.

Road Rules – The laws that everyone on the road needs to follow.

Supabase – A free service that helps the app save data and manage user accounts.

System Architecture – The big plan that shows how all parts of the software work together.

Traffic Violations – Breaking road laws can result in fines or punishment.

Three-Tier Architecture – A way to design an app by dividing it into three parts: user interface, logic, and data storage.

User Interface (UI) – The part of the app where users see and use buttons and screens.

Visual Notifications – Messages or icons that show on screen to warn or tell users.

VS Code (Visual Studio Code) – A free program from Microsoft to write and fix app code.

Chapter 3

Research Methodology

This project mainly aims to design and develop AVOID: an Android mobile application, which would give motorcyclists real-time location-based traffic law information and routes. The system will also facilitate road safety and compliance by the riders, especially those within the Philippines as the results can be obtained immediately via the app.

Project Design

The study uses a Developmental Research Design structure which the researcher shall attempt to design, construct and test AVOID, being a mobile Android application. This project is specifically designed to be implemented to J&T motorcycle delivery riders where they are given

real-time and location-based advice on the set of chosen rules on traffic and optimized routes in order to make safer and more efficient deliveries in the pilot localities of Brgy. Mayamot, Cupang and Mambugan in Antipolo City.

AVOID is to assist the riders by providing prompt instructions in a simple understandable way, in real-time, with regards to major traffic rules that are applicable to their route, i.e., no-overtaking zones (e.g., bridges, curves), one-way streets, and pedestrian areas. The system is not about identifying and confirming real violations but precedently gives riders recommendations so that they do not make various mistakes. It is based on built-in GPS tracking and third-party APIs (maps and weather) to compute and display the most efficient route and ensure a route is not blocked.

In addition to safety and efficiency, the optional flood-aware rerouting functionality is also incorporated in the app since it allows riders to decide that they do not wish to route to flood-prone areas, based on weather predictions and on local hazard information sets. The riders are also allowed to pin their delivery location where the system will automatically calculate the best route within the shortest time and in line with compliance. Voice messages and real-time warnings will be pop-up to warn of any restrictions or dangers ahead.

More than just guiding the riders through, AVOID has the integrated feedback aspect that the riders can provide to report on wrong pins or confusing signages that will enable further enhancement on the accuracy of the route. Management has its own web-based admin dashboard that shows the real-time GPS position of active riders, previous delivery reports, and documented violation notifications that help J&T manage its operation.

Some important user management functionality of the app are secure access, account management, password reset, and history page of the previous alerts received. This enables riders

to review their delivery routes and warnings, supporting ongoing learning and improved compliance.

Altogether, the project is restricted to the Android-based devices, targeting motor vehicle riders (not three-wheeled vehicles or other companies offers such as Toktok), and usable by J&T Express within the targeted pilot area. It focuses on on-road assistance and routing, not actual enforcement, determining of violations, or comprehensive evaluation of driving behavior, preferring to prevent delivery delays and increase the safety of riders through preemptive and convenient assistance.

Design Trade Off

Table 1

Models	Number of Trials (App Interaction)	Loading Process Time (seconds)	Response Time (seconds)
Design 1 – Route Navigation + Speed Alert	Trial 1	0.791	0.483
	Trial 2	0.467	
	Trial 3	0.451	
	Trial 4	0.458	
	Trial 5	0.462	

Design 2 – Violation Detection + Voice Prompt Alert	Trial 1	0.803	0.495
	Trial 2	0.472	
	Trial 3	0.446	
	Trial 4	0.454	
	Trial 5	0.459	

Table 1 shows speed performance of the AVOID system is shown in Table 3. It shows how fast the app responds during use. The data presents the loading time and response time for two designs over five trials. Design 1 includes route navigation and overspeeding alerts, while Design 2 adds voice prompts and automatic violation detection. The results show that both designs work quickly—under one second—making the system efficient for real-time use. This helps users understand how well the app performs in helping riders follow traffic rules and improve road safety.

Table 2

Design Constraints of AVOID

Category	**Constraints**
Platform Compatibility	It can only be used in smartphones using the Android operating

	system (made on Flutter framework).
Connectivity Requirement	Needs active internet connection to communicate in real time location based notifications, as well as information coordination with Supabase.
Core Functionality Scope	Its basic use is to give users alerts and notes in real time based on the location in regards to traffic regulations and navigation systems.
Rule Coverage	Deals only with certain rules in the road (e.g. speed limit zone, single traffic, safety zones, flood-prone areas).
Behavioral Impact	Attempts to generate awareness and remind about it in a timely manner in the future; it fails to directly assume the ability to manipulate and measure actual driving behavior.
Hardware Dependencies	Needs Android Smartphone that has a GPS module and Internet Connectivity.
Database Integration	Uses Supabase to store and maintain historical alerts and application usage records.

Table 2 shows the AVOID mobile application has the limitation in terms of platform (Android only), and it can only work with a running internet connection and Supabase data. It also does not enforce any road rule, but acts only as a location-based reminder of specified road rules, and its effects on behavior is restricted to that of awareness and informed decision making, as it is hardware dependent on a GPS activated Android smartphone.

Table 3

Summary of Design Trade-Offs for AVOID

Component/Model	Strengths/Uses	Weakness/Constraints	Performance
Flutter (Frontend)	Flutter speeds up the process of development, and it takes a single code base to do cross-platform development in Android, iOS, and the web in general.	The performance of UI can vary with the platforms, and working with Dart can unnecessarily require developers to learn more languages.	It is supposed to provide a stable and seamless UI/UX that would be appropriate both in the MVP and production versions.
Supabase (Backend)	Supabase offers real-time database functionality, user authentication, and activity logging, which go well with Flutter.	It needs a stable internet connection to work without any trouble, and this can create an impact on the performance in low-connection regions.	The system is supposed to be able to deal with data storing and tracking user performance effectively, and be very scalable towards growth.

Component/Model	Strengths/Uses	Weakness/Constraints	Performance
Push Notification System	Push notifications allow sending alerts regardless of whether the app is open or closed, which is why they are suitable when it is necessary to warn in emergencies involving road and traffic.	Could also encounter some delays in delivery and proper approval within the mobile operating system.	Works well in real-time notifications and warnings that do not require the user to launch the app.
In-App Alerts	In-app alerts are contextual and interactive notifications that the user can receive when they are using the application.	Alerts appear only when the app is being used, and thus, it can lead to a lost update when the app is not at the forefront.	Most useful for educational content and participation while the app is in use.
GPS	GPS has real-time	Continuous GPS	Accurate

Component/Model	Strengths/Uses	Weakness/Constraints	Performance
	location tracking to offer such traffic information that is area-specific according to the movement made by the user.	usage may increase battery consumption and require user permission for location access.	location-based notifications and the foundation of traffic management features in the app.

Table 3 outlines the main components of the AVOID system: Flutter (frontend), Supabase (backend), push notifications, in-app alerts, and GPS tracking. Each element contributes to real-time traffic guidance and user interaction. Their strengths, limitations, and expected performance are summarized to show their roles in the system's design.

Figure 3

Steps in Creating Data Models

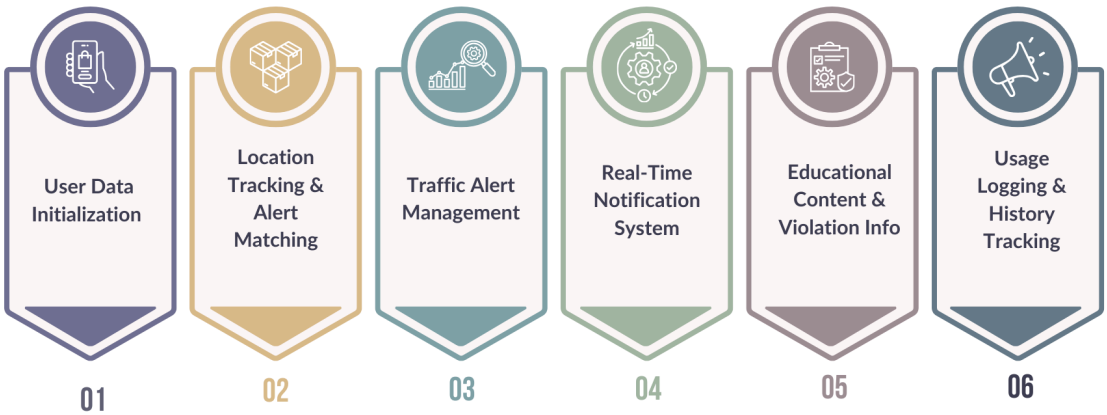


Figure 3 shows initialization of user data is the initial step within the workflow of an AVOID system. After the installation of the application, users establish accounts by setting up accounts with details that contain username and password, device details, and preferences. Upon the user becoming active, the system will start capturing the real-time data of the user based on their location, and this is key when determining the current location of the rider. This information is then compared with pre-programmed rules or the road and alert areas in the database. In case of match detection, the system will issue contextual warnings like speed restrictions, roadside markers, or no passing zones, and these are sent out as a pop-up on the phone or as a program.

Each of those events that cause the alerts to fire is stored in the Alert_History table to be tracked and evaluated. Such warnings are meant to alert the rider according to their current location and make sure that they remember the road requirements. In the meantime, there is a knowledge base of traffic rules in the application, with access to visual graphics of familiar traffic signs, their description, and respective penalties, which can be viewed and learnt by a user at their discretion. Each operation of the user in the app is stored in the Usage_Log, making it possible to trace a trend in user behaviour and system performance by developers and traffic authorities. This data model will assist to make sure that the AVOID system is not just an app that gives out alerts but also creates long-term awareness and compliance of motorcyclists.

Design Prototype

Figure 4

UI of the Splashscreen of the App

Figure 5

UI of the RegisterPage of the App

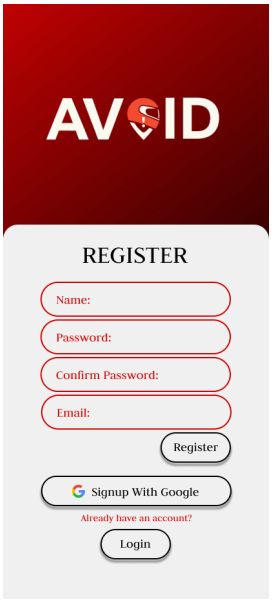


Figure 6

UI of the Verification Page of the App

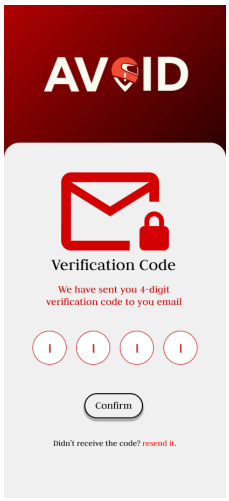


Figure 7

UI of the Home Page of the App

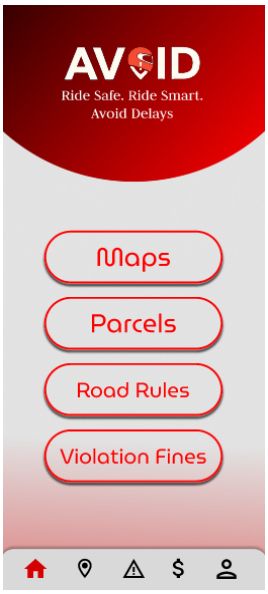


Figure 8

UI of the Navigation Page of the App

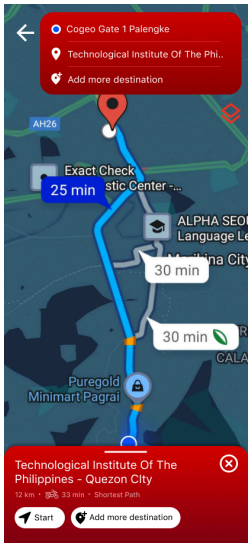


Figure 9

UI of the Alert Notification

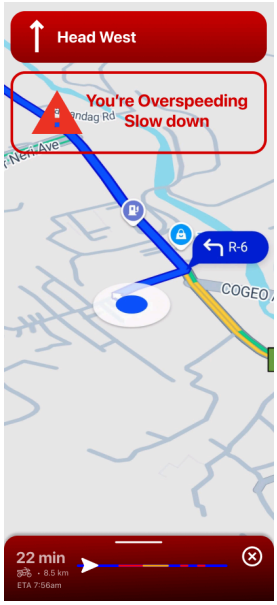


Figure 10

UI of the Map Types of the App

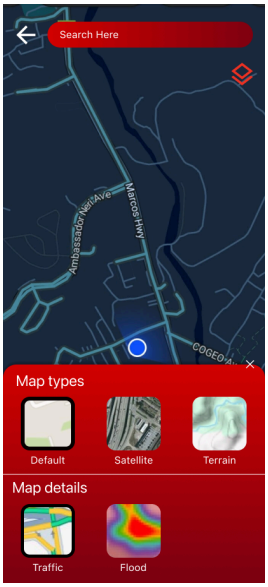


Figure 11

UI of the Heat Maps of the App

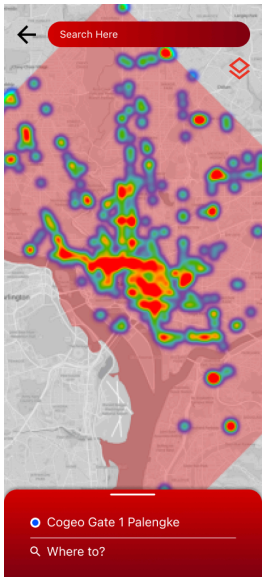


Figure 12

UI of the Parcel Page of the App

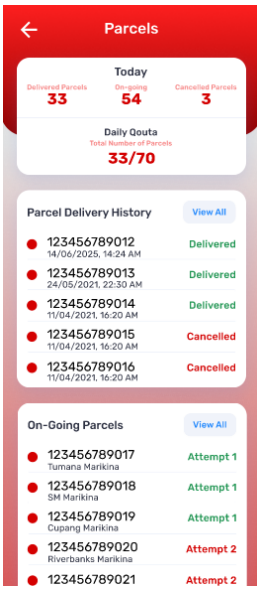


Figure 13

UI of the Shortest Route of the App

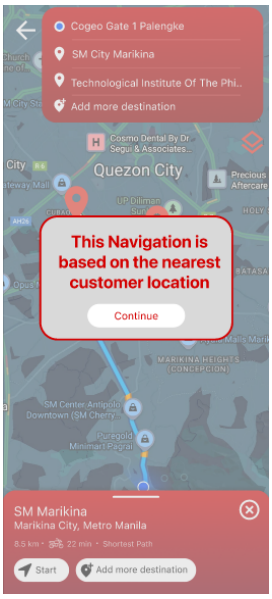


Figure 14

UI of the Educational Content of the App

Figure 15

UI of the ViolationsPage of the App

Figure 16

UI of the Admin Dashboard

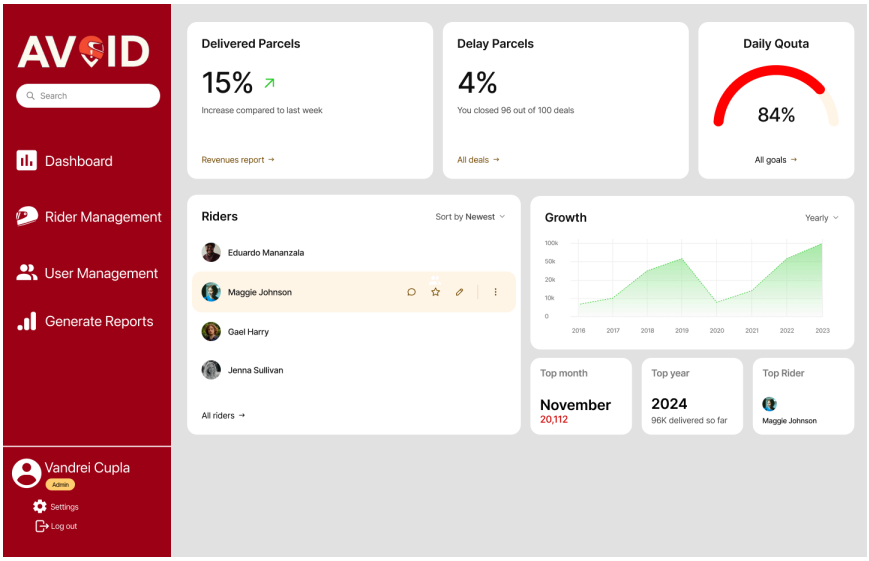


Figure 17

UI of the Track Rider Dashboard

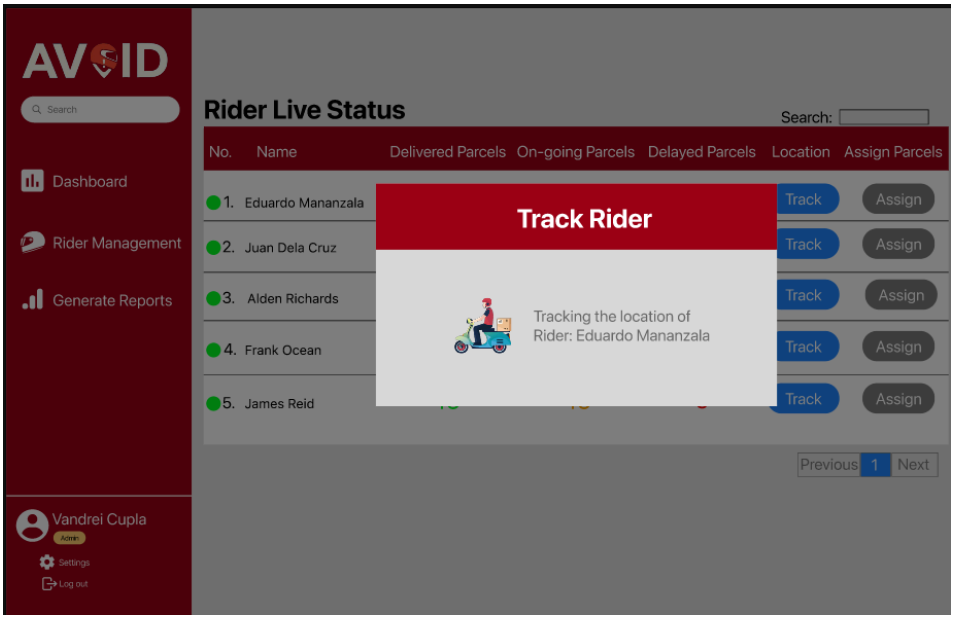
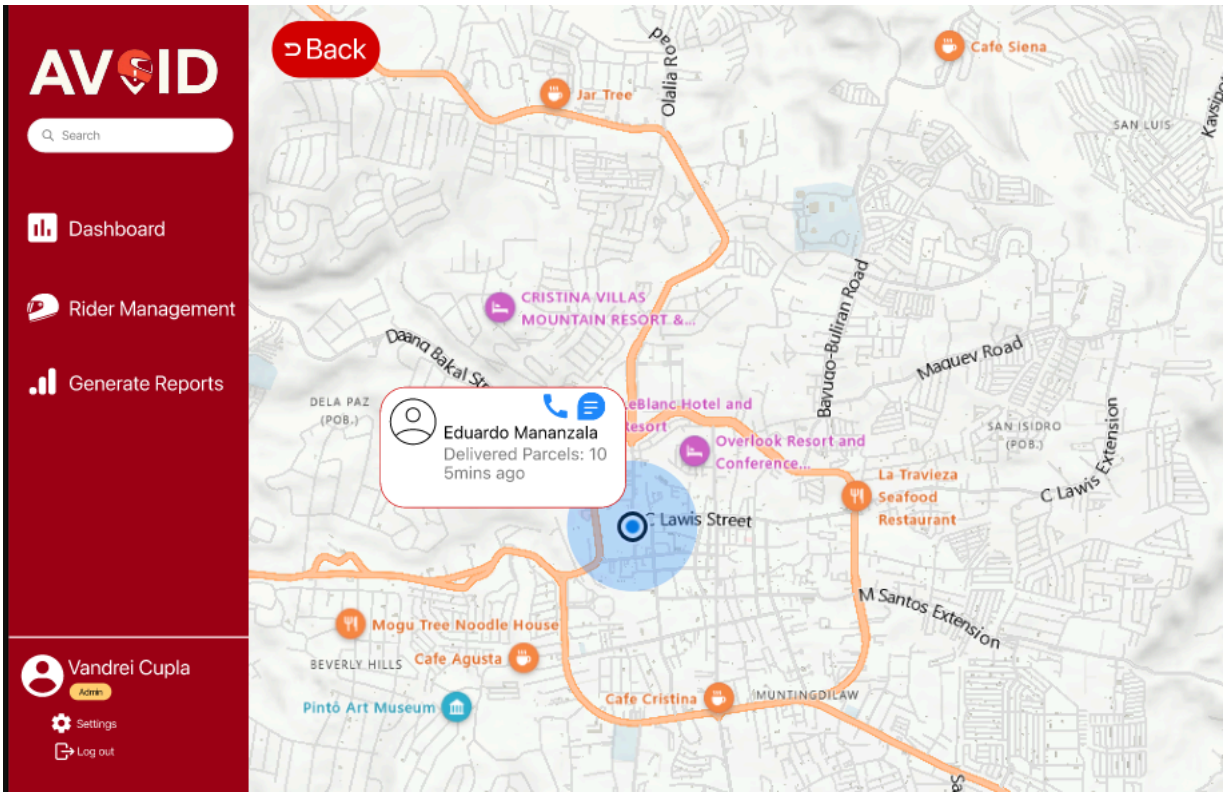


Figure 18

UI of the Track Rider Map



Design Discussion

AVOID is an android application with its complementary web-based administrative tool, which was developed to enhance the safety and operating efficiency of J&T motorcycle delivery riders in the pilot districts of Brgy. Mayamot, Cupang and Mambugan in the city of Antipolo, Philippines. The app also offers real-time and place-based advice to guide the riders to avoid the usual road hazards and abide by the traffic regulations of their choice, including no-overtaking lanes on bridges and bends, one-way roads, and pedestrian zones. In contrast to such enforcement systems that only authenticate violations, AVOID is a proactive warning system which provides a preliminary warning to the riders thus averting violations. Its major mobile

capacities are safe registration and log in, map pinning with shortest route routing, multiple map layers, including flood prone area graphic representation, and optional flood aware toggle rerouting of live weather conditions. The riders will also be have pop-up and audio alerts in real time that indicate upcoming restrictions or danger and also have the option of giving feedback on inaccurate pins or confusing signs to increase the accuracy of the system.

The administrative dashboard is in aid of the operations of J&T to track active riders in real-time using the capabilities of GPS trackers, historical deliveries that contain logs and the routes of deliveries, as well as violation notifications that are issued by the system to review the operations. Admins are able to control the rider accounts, monitor the performance of the delivery, as well as suspend controls. Both mobile app and dashboard are highly usable and visually consistent so that riders and non-technical users could access it simply. Technically, AVOID uses GPS modules, mapping APIs and integration of weather APIs to achieve the functionality through the secure and scaling than Supabase data storage asset. AVOID will minimize potential delivery delays and opportunity to increase road safety of J&T motorcycle riders by providing convenient, accessible, and smart route support that is proactive and real-time as an alternative to punitive real-time monitoring.

Project Development

The figure shows the Rapid Application Development (RAD) model comprising four (4) major steps, namely Requirements Planning, User Design, Construction, and Cutover. All the stages play a crucial role in the evolution of the AVOID system, which is a mobile application that helps motorcyclists receive real-time traffic warnings and location-based assistance to help them travel more securely. The use of GPS technology and backend development with Supabase

facilitates streamlined data management of the app. This is how each RAD step facilitates the development of the AVOID application (see Figure 17):

Figure 15

Rapid Application Development (RAD) Model

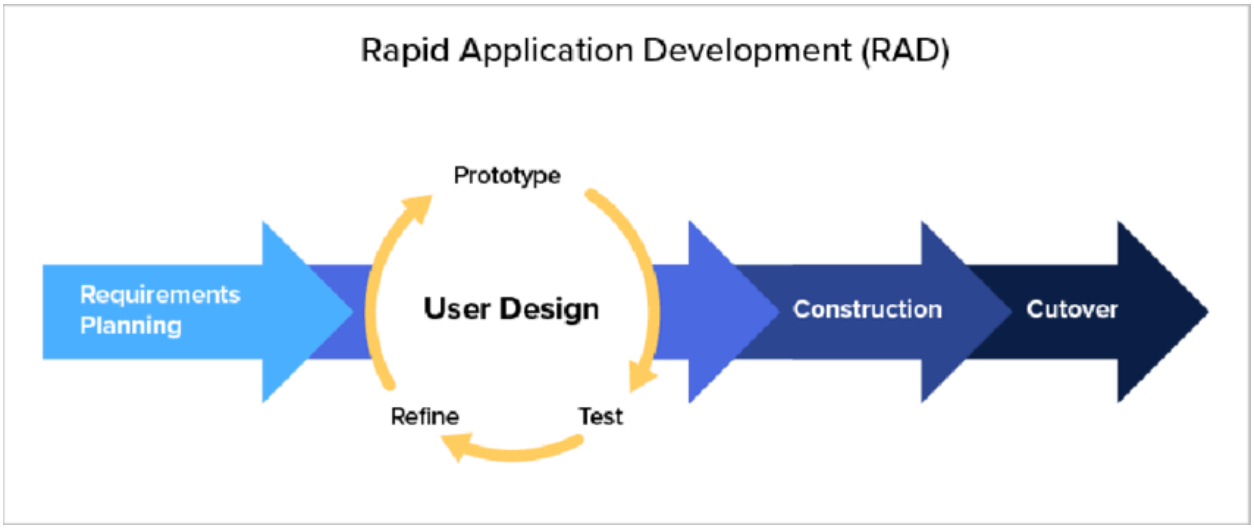


Figure 15 shows **Requirements Planning**. This initial step aimed to determine the information on user needs that was collected and elicited in the context of designing the AVOID mobile application, which responds to current traffic situations and road regulations in real-time. Its main capabilities were identified, among which include real-time warnings of speed limits, directions to one-ways, and safety zones, depending on locations. Additional features such as multi-destination auto-reordering, flood-prone area visualization, and pop-up voice alerts for pedestrian zones and no-overtaking areas were also outlined. Feedback was also taken concerning user management features, and details on storing information and data in Supabase and usability, efficiency, and security demands. Multi-factor authentication was planned to ensure secure access for both riders and admins.

User Design Phase. In this phase, prototypes were created for the AVOID mobile application's interface and alert presentation. The mobile application was developed through

Flutter to offer an intuitive visual and in-app notification experience, real-time updates, and user control. User screens were designed to show flood visualizations, route optimization options, and traffic regulation reminders using HERE Maps and OSM API integrations. The two-way communication between the front-end of the application and the Supabase backend, including the location service, was both developed and optimized to guarantee the responsiveness and the reliability of the prompt alerts delivery. The inclusion of an educational content module covering all major road rules was refined during this stage. User feedback played a significant role in optimizing the interface and interaction flow of the app to be clear and effective for motorcyclists.

Construction Phase. The AVOID application and its integrated system components were constructed and coded during this phase. The Android application was built using the Flutter framework and the Dart programming language. Logic was developed and adjusted to ensure accurate real-time location monitoring, precise rule identification, and timely alert triggering based on GPS data and integrated road rule information. Additional construction was made to integrate pop-up alerts with voice commands, support multi-destination routing, and connect incentive-based scoring features. The setup was secure, reliable, and resilient due to the comprehensive coding and testing of the system to support effective contextual reminders and user information using Supabase APIs.

Cutover Phase. The last stage was testing and system deployment. The effectiveness of the AVOID application was confirmed by its field testing in the rush hour conditions, especially in the predetermined zones of Antipolo City, Rizal. Using feedback from test users, the accuracy in raising alerts, the user friendliness of the interface, and the user experience have been greatly enhanced. Again, before the preliminary deployment took place, final checks and adjustments

were done on the system so that the evaluation phase could begin. AVOID system was developed by use of the RAD methodology, which is fast and user-centered. This enabled the group to prototype at a fast pace, solicit feedback, and test iteratively the elements of the mobile app and the back-end integration. The repetitive procedures also determined that the end product was not just reliable and helpful but also easy to incorporate by individuals into their riding schedules. The admin dashboard with rider monitoring, violation scoring, daily quota tracking, and CSV/PDF report generation was also finalized during this stage. To sum it up, the use of the RAD approach allowed us to create a more responsive and user-friendly mobile application, which better fits the current reality in terms of road safety within the circuits belonging to motorcyclists.

Testing and Operating Procedures

AVOID mobile application will be tested by selected J&T motorcycle riders, who regularly drive through different areas in Antipolo City. These testers are our partners and are chosen because they operate motorcycles daily and are often exposed to road signs, traffic rules, and unpredictable traffic conditions, making them ideal for evaluating our application's effectiveness and usability.

For the testers to be able to operate the application, the testers will download the AVOID app onto their Android smartphones. The application will then run with real-time GPS tracking, providing location-based alerts on traffic signs, road rules, speed limits, and flood-prone areas. Testers will have access to the following features:

- Real-time navigation with dynamic route adjustments
- Notifications for traffic regulations
- An informational section on road rules and penalties

- User profiles with ride history logs
- Map overlays highlighting areas susceptible to flooding
- Pop-up voice alerts
- Multi-destination route planning with automatic reordering

Key areas of evaluation during testing:

- System Speed: Timeliness and precision of alerts and map refreshes while riding
- App Stability: Smooth operation across various Android models
- Ease of Use: Rider familiarity with app navigation and functionality
- Satisfaction Level: How beneficial and enjoyable the app is for users
- Adaptability: How effectively the app responds to changing routes, traffic, and hazard zones.

User input will guide enhancements to the app's dependability, interface, bug fixes, and GPS alert efficiency. Regular updates will be rolled out throughout testing to maintain optimal performance during active rides.

Project Evaluation

The AVOID system was quantified based on ISO/IEC 25010 software quality model that has eight primary characteristics to determine qualities of software. Functional suitability, performance efficiency, usability, reliability, and maintainability are the most appropriate qualities in this project.

The functional suitability is also very crucial because AVOID will have to correctly trace the real-time location of riders and provide them with alerts regarding existing traffic regulations on the go; that is, it needs to communicate on-time about one-way streets, no-overtaking zones, and pedestrian areas. The system needs to react immediately to the variation of the position and

orientation of the riders and give them understandable and clear warnings, whether in form of pop-up notifications or voice messages. Other solutions, like planning shortest-route, the possibility to plan the route with potential re-route basing on the weather forecasts, and real-time hazard alerts are additional components that reinforce the functional objectives of the app.

It is also necessary to have performance efficiency due to the necessity of working with the continuous GPS tracking, fast access to the rule information, but with the ability to remain responsive to the user within the restricted mobile signal range or with mobile device limitations. AVOID utilizes the services of HERE Maps, Overpass Turbo, and Supabase, which provide the opportunity to offer dynamic routing, a visual representation of areas at risk of floods, and smooth synchronization of data without delays, which requires regularization of the rider traffic safety.

The particular focus into usability is due to the target audience of the app who is a motorcycle rider and therefore would require fast and unfettered and focused interaction. The interface is largely intuitive and clean, and the alerts are easy to read, allowing voice assistance to control the system hands-free and easy navigation and pin the destinations and review the routes. The application should be easy to run and the users with less technical expertise should learn little before they can operate it.

Dependability is a critical element in ensuring proper and consistent performance despite the long deliveries and changing weather sets. AVOID will provide reliable real-time alerts to prevent crash or inaccuracy. Proper GPS mapping of the various types of roads in the city of Antipolo and flood-prone area transparencies, means that the system can be used even by riders in the real world as well as during extreme weather events.

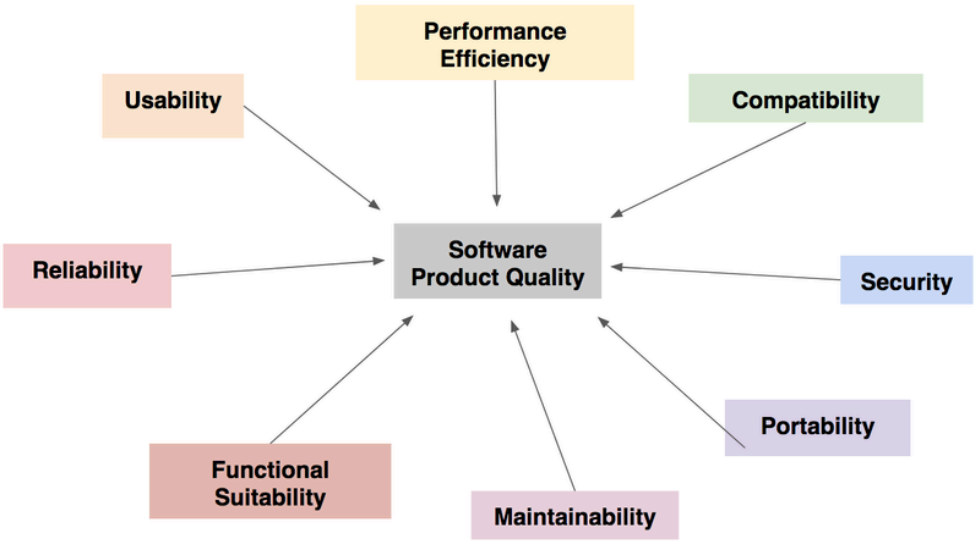
Sustainability of the project also focuses on maintainability. When AVOID is scaled up to cover an increased number of traffic regulations or even other platforms such as the iOS, the code base being written in a modular design philosophy based in Flutter and Supabase will ensure updates and allow addition of features easily in future. With this method, the extension of the system can be carried out to further the level of details in the dashboards created administratively and rule database, or tracking module of incentive without having to undertake a complete renewal.

Although the issues of security and compatibility always matter, they are less relevant in this case. Performances in terms of security requirements are aimed at protecting basic user credentials through secure authentication processes. The compatibility is already limited to Android devices, as it fits the prospective users of J&T motorbike delivery riders in pilot regions.

Finally, assessing AVOID in the bounds of ISO 25010 family of standards, the app can be noted as having the significant provision in terms of functionality, performance, usability, reliability, and maintainability. This helps it in achieving its mission to provide practical, real-time and easy-to-use support to J&T riders such that they avoid mishaps on the roads of the city of Antipolo and, in turn, help the company deliver goods efficiently and that riders are safe.

Figure 16

ISO/IEC 25010



Work Plan

Table 3

Work Plan for AVOID

Phases	Activities	Members	June-July Schedule (2025)					
			Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Planning Phase	Project Topic Proposal	Team						
	Adviser Approval	Team						
	Project System	Team						

	Request							
	Development of Cost Estimate and Feasibility Analysis	Team						
Design Phase 1	Use Case Diagrams	Team						
	Process and Data Modeling	Team						
	System Architecture and UI Design	Team						
Design Phase 2	Process and Data Modeling (Refinement)	Team						
	System Architecture and UI Design (Refinement)	Team						
System Model Development	Building and Designing the System Model	Team						

Legend:

Done	On-going	To-do

Potential for Commercialization

The AVOID project was created to assist the rapidly growing population of motorcycle riders by offering a real-time guidance solution that enhances road safety, promotes compliance, and ultimately reduces traffic violations. With over 7.8 million registered motorcycles and tricycles in the Philippines (Balita, 2025), and the increasing prevalence of motorcycle taxi and delivery services such as J&T Express, it aims to significantly improve daily commuting and delivery safety. Some of the challenges which the application deals with include informal training of riders and the inability of riders to remember complicated traffic regulations amidst changing environments, hence providing early warnings and reminders.

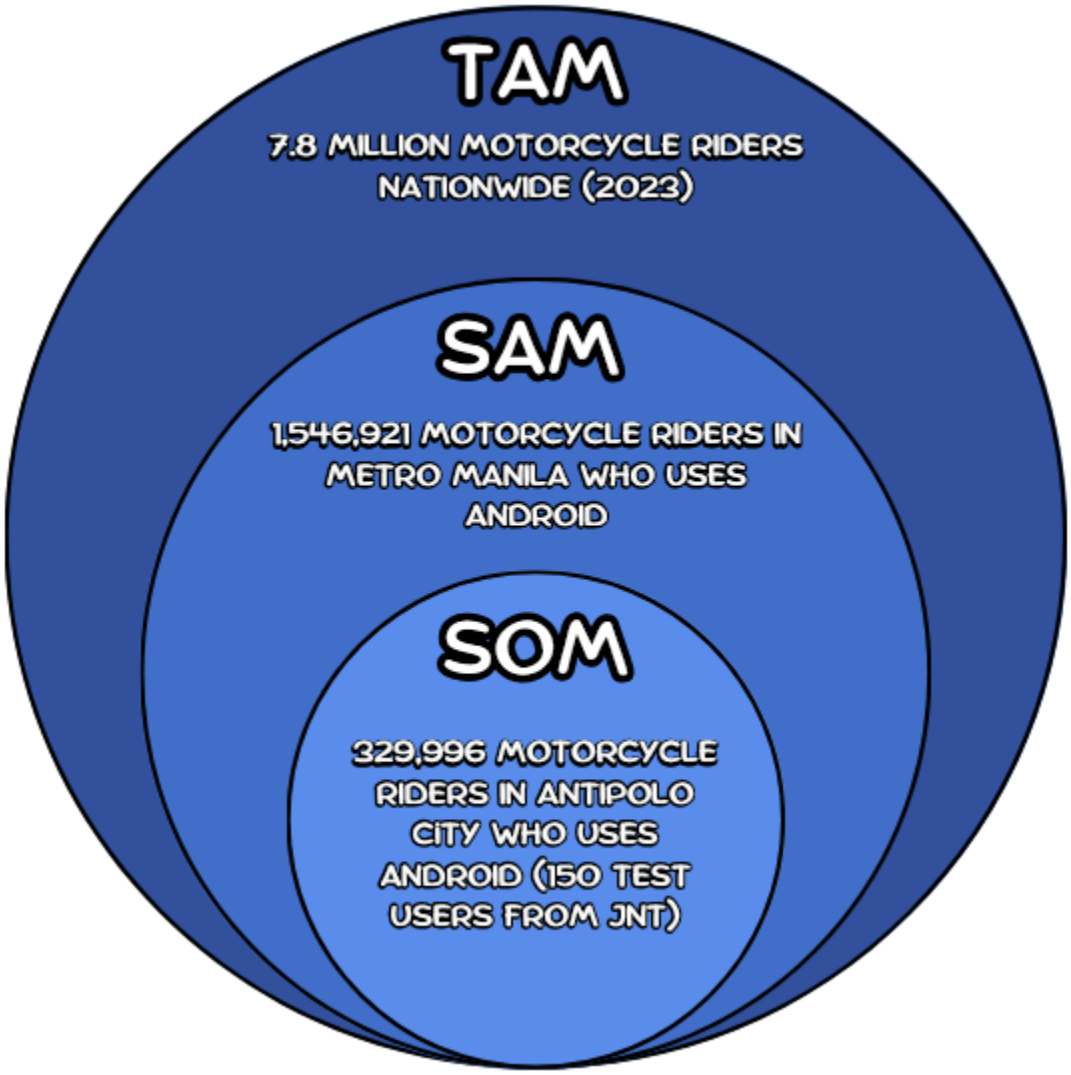
We are working with the J&T warehouse at Brgy. Mambugan, Antipolo City, Rizal, with delivery areas extending as far as Brgy. Cupang and Brgy. Mayamot, which offer an excellent test site in real-life situations. This will prove that the solution will work well in a region with high motorcycle traffic and complex road conditions.

Although it has a high commercial value due to the tremendous market of the target audience, as it has been defined in TAM-SAM-SOM analysis, the primary objective of the project is to bring about an effective and affordable solution that could help the common Filipino motorcycle riders. The AVOID application is also scalable and can be customized to serve the whole J&T company. Commercialization may follow as a result of partnerships, licensing, or bulk deployment for fleet management. However, our team prioritizes functionality, accessibility, and social impact over immediate profit.

Market Model

Figure 9

Market Model



Measurable Benefits

The AVOID mobile application, developed by Technological Institute of the Philippines – Quezon City, Bachelor of Science in Information Technology students, is designed to empower

motorcycle riders across the Philippines by providing measurable advancements in road safety and compliance during dynamic traffic conditions.

The system will be auto location-based alerting in real-time that will automatically provide vital reminders of traffic signs, speed limit conditions, and lane guidance with direct action to decrease unintended violations and anxiety in the rider. Such proactive performance capabilities aim at making the occurrence of traffic violations and the possibility of accidents rather unlikely.

The addition of flood-prone area visualizations, voice-based alerts, and multi-destination route optimization also extends the benefit of the application by helping reduce delivery delays and detours. Riders will be better equipped to navigate difficult road conditions and remain compliant with traffic laws.

The user feedback will be obtained through the information collected on forms of standardized surveys (e.g., System Usability Scale, Technology Acceptance Model) and through analyzing the application usage logs in the Supabase storage. The efficiency and timeliness of the location-based alerting systems, such as the specificity of identifying a traffic sign and rule enforcement, will be strictly tested using predetermined performance attributes by the documentation of the ISO/IEC 25010, Functionality, and Performance Efficiency attributes.

These aspects of the AVOID app, as seen on the user side, including delivering alert information in real-time and handling user interaction, will be assessed through the rate of user acceptance and the level of overall user satisfaction, which correlates with the attribute of Usability as provided in ISO/IEC 25010. The decision to use the Flutter development framework would likely enhance efficiency in the project by facilitating a powerful application with optimal timeframes and code reusability.

The fact that Supabase provides data handling functions with high reliability in the safe management of user and alert logs, together with the fact that there will be shorter development cycles due to the Rapid Application Development (RAD) model of development, will also be used to quantify the overall success of this project.

Additionally, the app's built-in scoring and delivery tracking system, including rider performance logs, daily quota completion, and incentive thresholds, will provide measurable indicators of behavior change and compliance improvement among J&T riders.

Finally, AVOID will create itself as an effective and efficient solution to solving common motorcycle traffic law violations and towards the safety of the roads by the riders in the Philippines. This smartphone app aims to be a workable, effective solution to the problem of traversing complicated traffic situations with the motorcycle commuters of the Philippines as the main beneficiaries.

Three-Year Product Roadmap

Table 4

Three-Year Product Roadmap

	Year 1	**Year 2**	**Year 3**
Price	Free	Free on Google Play and App Store	Free
Performance	Usable on Android devices	Usable on Apple devices and launched on the App Store.	Usable on all devices, future Android, iOS, and future mobile/OS versions

App Features	Develop MVP: real-time traffic alerts, basic UI, GPS-based location tracking. User testing on Android.	Add features: alert history, voice alerts, educational traffic content, and user preferences. Optimize UI/UX.	Add smart suggestions, offline support, and multilingual content. Enhance performance, security, and scalability.
System & Deployment	Set up Supabase backend, log data, and begin ISO/IEC evaluation (Functionality, Usability).	Optimize data storage, expand testing, and conduct pilot release in selected regions.	Nationwide release, ongoing support and updates. Final ISO/IEC evaluation (Maintainability, Portability).

Go-To-Market Strategy

Table 5

Go-To-Market Strategy

Offerings	Customer	Channels
• Instantaneous, point-of location alerting on traffic laws	• Key beneficiaries: Riders of motorcycles in the Philippines (the	• Android app with Google Play Store to make it wide-reaching

like speed limits, lane use and signages. ● Promotes improved rider safety, fewer violations/fines, better awareness, and user management (e.g., alert history, profiles). ● Assists to anticipate roads risks in advance, improves the knowledge of the traffic rules as well as enhances safer commuting behavior.	first area of action is J&T riders since an existing partnership formed). ● Secondary users: Angkas, JoyRide, Move It riders and urban commuters using two-wheel vehicles. ● Every user is at a great risk of road hazards and requires practical safety help in a real-time scenario.	and accessible. ● Antipolo (Warehouse, Barangays, Pilot testing, onboarding and feedback will be carried out in (Mambugan, Cupang and Mayamot) villages. ● The outreach and future development of the organization through motorcycle riding community (online groups, associations) and social media campaigns.

Business Model

The Business Model Canvas of the AVOID project, as well as the given strategy of its implementation, fully reinforces its feasibility and desirability. The system can provide an apparatus of twofold value: by offering riders increased safety and decreased potential of traffic distraction caused by work-crippled turnarounds. One can easily visualize a flood-prone area or

optimize the most efficient multi-stop route or get pop-up voice alerts, and these features are the most helpful in the unpredictable driving environment, so the platform is likely to become very popular among delivery riders working in a densely populated area or where weather conditions are likely to change.

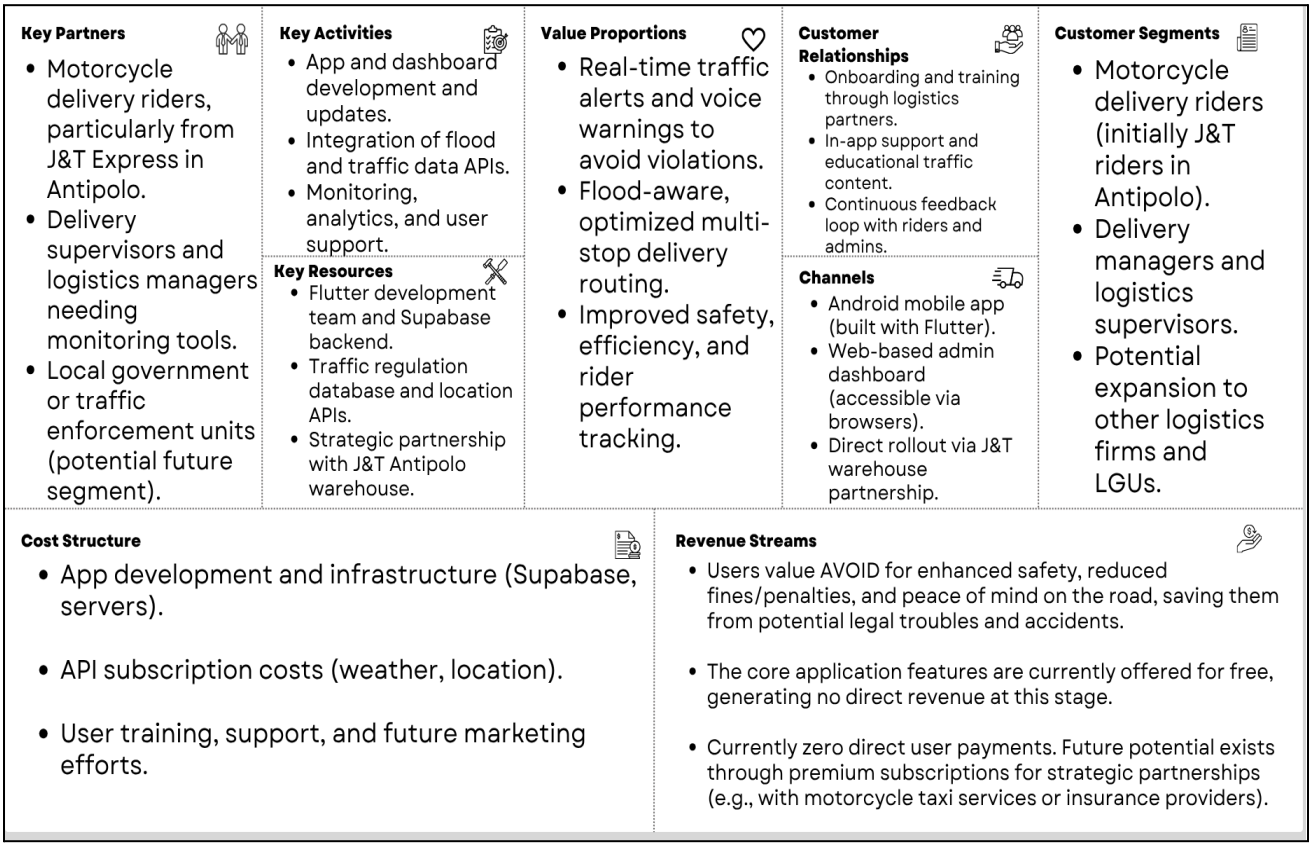
Strategic alliances The strategic alliances especially with the J&T warehouse in Brgy. Mambugan, Antipolo Cityenhance the AVOID deployment and make sure that there is constant feedback by the actual users. Such partnerships make it possible to make successive upgrades and customized features, which suit ground realities.

Its business model lays its focus on the stable service and thoughtless user experience. The core costs will be spent on the app development, backend infrastructure on Supabase and future marketing plans. The key actions are the updating of Android application created in Flutter, keeping the information about traffic rules actual, as well as providing user support and synchronicity of the data.

The most significant resources are our specially designed traffic regulation database, routing and location algorithms, team of dedicated developers, and Supabase backend system. The value proposition of the system, which focuses on the increased level of safety, reduced number of violations and peace of mind, is up to the mark with the target users of the system. Despite the availability of core features without a fee, the riders are likely to use the app because of the objective benefits of undertaking it. The bottom line is that AVOID is a potential, scalable, and effective proposal to combat road safety and delivery efficiency by the riders of motorbikes in the Philippines.

Figure 18

Business Model



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