TRICYPOOL: AN ONLINE TRICYCLE POOLING SYSTEM IN BULAN, SORSOGON

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CHAPTER I

Introduction

Ride-sharing is one of the most efficient ways to reduce vehicle demand by making full use of scattered social resources in the transportation industry. Quite often, passengers and drivers find each other through digital platforms, then discuss among themselves the details of their joint trip through booking and reservations [1]. The term ridesharing means that a ride is literally "shared". This ridesharing makes it possible for commuters to share the cost of transportation, and has become a hot trend in the sharing economy. Effective ride-sharing requires a strong matching mechanism to match up appropriate commuters. This shared service utilizing information and knowledge matching, can make full use of social resources which are scattered to decrease the demand for vehicles on the urban road network. One of the most popular business trends in emerging paradigm is that of a sharing economy. One of the essential components to facilitate efficient ride-sharing is about the matching mechanism that matches up suitable commuters.

The tricycle is one of the most important modes of public transportation in the Philippines. A tricycle is defined as a motor-driven vehicle that serves as public transport in the Philippines. The study entitled "Determining Tricycle Service Quality and Satisfaction in the Philippine Urban Areas: A Servqual Approach" compared the tricycles available in other countries, this motorcycle has an attached cab manufactured to handle 4-5 passengers depending on their size at a time, operated by a tricycle driver in order to transport the people to a specified destination at a cheap price [2]. This method is meant to capture consumer expectation and perception of a service, for instance, various modes of public transport. Tricycles are used to reach destinations in this province of Sorsogon. The traditional tricycle remained quite common and a principal mode of transportation in Sorsogon generally in municipality of Bulan particularly, despite modernization of new forms of transportation. Under the collaboration of the provincial government and LGU Bulan, 1134 tricycle drivers and operators in Bulan were given free tires [3]. This was a drive towards progress and in support of the livelihood of the tricycle drivers.

The proposed Tricypool system answers the initiatives that the governing body, LTFRB is pushing, for productive and sustainable solutions in transportation. By the power of technology and collaboration between the government and communities, Tricypool itself is bent on seeking the improvement of transportation experiences for both tricycle drivers and commuters moving around Bulan, Sorsogon. The waiting and traffic congestion faced by tricycles remain terrible even to date. Their stream of income is also reliable, yet uncertain for it is based on the number of people they carry every single day. The issues mill down to the proposition of an online tricycle pooling system called Tricypool. Tricypool seeks to change the tricycle transportation system through an effective reservation and booking system. Tricypool will enhance the ease of use by passengers through an interface for booking tricycle rides and facilitate ride-sharing. This system

does not only enhance convenience to passengers but also optimizes tricycle routes to reduce waiting time and traffic congestion.

1.1 Project Context

Tricypool is a web application pooling system for tricycles intended to make transport convenient within Bulan, Sorsogon. By authorize, The Sangguniang Bayan of Bulan deliberate on the application for franchise and approve or disapprove the application for franchise, to be known as Motor Tricycle Operators Permit (MTOP). MTOP is a document granting franchise or license to a person, natural or juridical, allowing them to operate tricycles for hire over specified zones. Upon issuance of MTOP, Certification is issued to operators to verify the validity of the franchise. In Bulan, Sorsogon, MTOP for Sanggunian Bayan is a mandatory requirement to ascertain safety and efficiency of tricycle services [4]. Tricycle service is widely in the Philippines, in particular in towns or remote areas like Bulan. They provide convenient and relatively cheap transport to people, especially over short distances within the urban center. One of the features of the MTOP is that it controls the maximum number of tricycles that can be allowed to routes in a certain area. This prevents oversaturation of tricycles in a certain area, which may lead to traffic congestion and unfair competition of operators. The control in the number of tricycles through the MTOP system provides local authorities with a means of maintaining order and balance within the sector of transport.

However, the MTOP system in Bulan, Sorsogon, also had its own share of problems. Among those problems at present is the illegal operation of tricycles. As a result, some tricycle operators may opt to operate without proper permits, thus allowing for unregulated and unsafe tricycle services, either due to the high cost of obtaining MTOP or other reasons; this endangers the safety of the passengers and undermines initiatives that could bring order in the transport sector. Another challenge is how regulation would be enforced with respect to compliance within the MTOP system. This would require the local authorities, more particularly in Bulan, Sorsogon, and other areas, to see to it that these tricycle operators strictly abide by whatever is stated in their permits. This includes adherence to designated routes, well-maintained vehicles, and safe and reliable transport services accorded to the riding public. MTOP System is very essential for Bulan, Sorsogon, regulating tricycle operations and carefully ensuring the safety and efficiency of transport to the public, taking into consideration challenges to drivers, Tricypool has been developed as one step to better tricycle transportation services. This would lessen the traveling cost of the passenger, reduce the congestion in traffic, and sustain the environment. Local authorities can work on the betterment of the quality of tricycle services. This will give both residents and visitors a much better experience with transport. Tricypool also benefits the commuters and the drivers themselves. On the side of the commuters, they have reduced fares with the added advantage of advance booking and lesser travel time. On the side of the drivers, it gives them the opportunity to increase their income by filling up empty seats and allowing

the routes to be maximally efficient. This system thus aligns with providing sustainable transport solutions in the municipality.

The system is designed and will be develop using Laravel as framework. Laravel is a free and open-source PHP-based web framework for building web applications. In terms of Frontend, the system use HTML that is used to structure the web application and its content. CSS for laying out and design. JavaScript (JS) is the programming language used by to make web pages interactive. By using this it will allows the developer design forms for users to input their details, and implement logic to check for availability. Drivers can accept or decline those requests by also creating user profiles. Leaflet is the leading open-source JavaScript library for mobile-friendly interactive maps. It has all the mapping features that the developer needs for the development of Tricypool. Passengers can track the location of their assigned tricycles, and share their real-time location with their family ensuring their safety and providing peace of mind. For Back-end, the developer use MySQL, as an open-source relational database management system (RDBMS) used with PHP. Running a PHP file using XAMPP is a common way to develop and test PHP applications on our local machine.

On the other hand, it is equally important to note that Tricypool is only available on Android phones. Since Android is the most used mobile operating system, this thus gives Tricypool the ability to reach many people. At the exact time, it means that those with iOS devices, say iPhones, cannot use Tricypool. Although this could reduce the number of people who can use Tricypool, focusing on Android let the developers be focused on making the best that can be done in one system, it also makes easier the update and maintenance of an app. Tricypool is an excellent solution towards attaining much better and more sustainable transport in Bulan, Sorsogon. By focusing on Android, the developers can ensure that the app works really well for a large number of people.

1.2 Purpose and Description

Several key drivers and passengers' needs are addressed in this proposed capstone project.

Firstly,it aims to improve accessibility by providing a convenient online booking system for passengers. This will ensure that users have easy access to reliable transport options, in particular at peak hours or areas where tricycles are limited. In addition to accessibility, Tricypool promotes cost effectiveness commuting. Passengers have the opportunity to share fares with other travellers and reduce their individual transport costs by introducing a sharing feature. This not only benefits passengers, but also contributes to a more sustainable and effective use of tricycle resources. Furthermore, Tricypool emphasizes communication and passenger safety. In order to ensure that both parties are aware of each other's whereabouts during the journey, passengers will be able to share their real time location with the driver through the web application.

This will enhance security and provide passengers with peace of mind.

In addition, Tricypool is an online platform and a web application specifically designed for the specific needs of Bulan Sorsogon's transport. The system is based on the server client architecture and had three expected users; administrator, passengers and drivers. The administrator shall be responsible for the management and oversight of the Tricypool system. The passenger's reservation may be accepted or rejected by the driver. On the other hand, passengers are able to book a ride and initiate their matching with each other. Tricypool makes it easy for passengers to connect with nearby tricycle drivers and other passengers willing to share a ride. The system will then optimise the route and minimise any diversions, reduce traffic costs and congestion on the roads by matching them with passengers travelling in a similar way. In addition, passengers have the choice of sharing their location with family and friends while travelling.

1.3 Objectives of the Study

This capstone project aims to develop an online tricycle pooling system in Bulan, Sorsogon. Specifically, the proposed project aims to:

1. Develop a reservation and booking platform for passengers and drivers.
2. Develop a ride-sharing platform for passengers.
3. Provides real-time location sharing for passengers' safety.
4. Test and evaluate the proposed tricycle pooling system using the ISO 25010, specifically in terms of:
   (a) functionality;
   (b) usability; and
   (c) portability of the system.

1.4 Scope and Limitations

This capstone project focuses on the development of the system entitled "Tricypool: an online tricycle pooling system in Bulan, Sorsogon." In this section, there are certain scope and limitations that should be acknowledged.

Making a reservations and booking platform for Tricypool allows flexibility to the passengers by booking for a tricycle immediately or reserve the ride at a later date. In this way, passengers can plan in advance to make use of the tricycles at a particular time. The platform provides an option for passengers to make

solo trips or select one to identify that they have another passenger, hence eliminating the need for a ride-sharing arrangement. This flexibility is designed to meet the various needs of passengers in a form that avails convenience and personalized travel experiences within the different modes of booking offered in Tricypool—as Individual Booking or Special Trips. Single reservations are best for passengers who prefer to have a pooled ride with no other passenger. On the other hand, Special Journeys are for passengers with special requirements or special likings, such as groups of more than a person and the need to have some additional space. Hence, flexibility in the method of reservation assures that Tricypool can accommodate a wide array of passenger needs and preferences. Other uses that the system could be put into service for, by pooling the tricycles, include the provisioning of specific services other than normal transport, such as shuttle services to events or group trips where passengers can pre-book a tricycle at a specific point in time and space. This, in turn, enables the drivers to have a wider reach of services for better income potential and easier ways of taking care of their passengers in different instances. Tricypool reduces the process of tricycle transport by introducing a reservation and booking system that gives convenience to drivers and passengers alike. Passengers can easily plan out their journey while drivers can optimize the route, save fuel.

A key feature of Tricypool that enhances the overall experience of tricycle transport is ride-sharing. The difference is that passengers still need to book a ride, but the option of being accompanied by other passengers through their matching features. This will facilitate cost sharing and support more sustainable use of tricycle resources, by allowing passengers to ride together with others who are headed in that direction. The benefits of reduced fares can be enjoyed by passengers, while contributing to the optimisation of routes, through the use of ridesharing tricycles. This includes a matching algorithm that optimises the route according to the destination of the passengers and reduces the delays and travel times for all passengers involved. Passengers are provided with real time information on the status of their vehicle and estimated arrival times, which will ensure transparency and convenience during a journey.

Tricypool features a real-time location sharing feature that significantly enhances passengers' safety and puts them at peace. It allows visibility of where the tricycle driver, assigned to the passenger, is when near or picking up another passenger on the map. On the other hand, it also shows the passenger's location on the map to the driver. Real-time location sharing assures both parties of each other's safety during the journey. Sharing real-time location data makes Tricypool very visible and transparent to offer more safety for passengers in a ride. At the same time, passengers can trace their journey and also can share real-time location with their families to ensure further safety. This feature comforts the loved ones since passengers can share their journey and destination in real-time. On a different angle, real-time location sharing has the following limitations which is the real-time location sharing will only work when the driver or passenger is near, or during the actual ride. Location sharing will no longer be active after the ride is complete. This limitation prevents continuous monitoring of persons outside of their intended path and ensures privacy.

Realtime location sharing is a feature of Tricypool, striking a balance between the safety of passengers and privacy.

Tricypool limits to cover other municipalities in Sorsogon, it only focuses on the municipality of Bulan. It should also be noted that Tricypool is specifically designed for tricycle drivers who operate their own routes and do not belong to a tricycle operator or driver's association. The aim of the system is to help by optimising their operation, these independent tricycle drivers are able to operate independently. Instead of wasting fuel waiting for passengers, drivers can use the Tricypool system to reserve seats, reducing their time on the road. This not only benefits drivers, but also contributes to reducing traffic congestion in the region. In addition, Tricypool limits the possibility to have access to the driver profile, in order to allow passengers to request specific tricycle drivers. In addition, to provide passengers with a cancellation option, Tricypool limits to cancel or change a booking tricycle or reservation after it has been made. Any change would require a direct communication between passengers and the tricycle driver.

It also doesn't have the feature of any payment gateway in the system; hence, a passenger has to pay the fare directly to the tricycle driver. In contrast, Tricypool is designed with a standard payment system in place, transparently and conveniently between passengers and tricycles. The price is estimated on the map by the system upon searching for available drivers by passengers in booking a trip. For instance, it may read that 2-5 kilometers costs 20 pesos. In this manner, prices reflected in the display lead the passengers to gauge their fare in relation to the distance they travel. This feature enables passengers to calculate their fare as per convenience and allows them to compute travel expenses. Other than that, since the estimated price is distance-based, it is for price fairness and consistency. Note that, with the specific rates determined by tricycle drivers and local rules, variations may occur. Tricypool does allow for tricycle drivers to adjust prices within an appropriate range but still maintains a normal mode of payment. This makes it easier to take into account, by drivers, fuel consumption, travel time, and other miscellaneous expenses. Moreover, it has the elements of cost-sharing and incentivizes passengers to adopt ride-sharing. In other words, when there are multiple passengers on the ride, the fare is divisible among them and hence the individual fare would be less than the single fare. These features also make it affordable and help optimize the tricycle resources, thereby reducing traffic congestion.

CHAPTER II

Review of Related Systems

Introduction

This chapter discusses the scope of this capstone project, the main objective of the study, purposes of the system review, novelty, and outline of information that would be presented. The overall objective of this capstone project is to design a friendly platform where tricycle drivers and passengers can easily connect in order to enhance accessibility to an affordable means of transportation while encouraging pocket-friendly commuting through ride-sharing. Touting its communication capacity and passenger safety features, it enables location sharing. The research of similar systems makes way for understanding the context of the project and to identify opportunities for innovation. The related system is presented, in a logical structure, discussing themes such as functionalities, development application and deployment of Tricypool. Each theme includes a review of related systems discussing the functions, similarities, differences, adaptations, modifications, and possible additions. This gives an overview of the whole project and the reasoning behind its direction and focus.

Theme 1: On the Functionalities of TricyPool: an online tricycle pooling system in Bulan, Sorsogon.

1. Building an Application Model for Efficient Ride Booking in the Ride-Hailing Industry

This system was developed on December 2023 with a working ride-booking app in the ride-hailing sector so as to provide an easy and cost-effective way of ride reservation. The aim is to enhance the concept of the ride-hailing industry by facilitating real-time applications. It mainly revolves around three basic questions: the technology infrastructure requirements of the centralized ride-sharing app; examples of application aggregators in various industries; and steps for aggregating existing ride-sharing applications. Comparing ride fares, wait times and car types, the developed Android application in Java in Android Studio used a dummy dataset in JSON format[5]. It takes origin and destination as input from the user to return the availability, wait times, costs, type of cars. The development process involves making datasets, setting up the project in Android Studio, retrieving and merging data via Java, and finally showing the table data on mobile screens. It helps customers in comparing ride services with their prices to select the best ride according to one's choices. Multiple languages, advanced filtering, integration of real-time APIs, payment options, customer reviews, personally customized recommendations based on preferences, map integration, and multi-modal growth may be some of its future enhancements.

Some features and functional features of the related system above, entitled "Building an Application Model for Efficient Ride Booking in Ride-Hailing Industry," include a strategy plan, which would involve initial planning and strategizing on how the application would work, to whom it is targeted, and what the unique selling propositions are. The features would range from basic to useful, like GPS tracking, fare estimation and ride history. Entering the market, studying the needs of the potential users is vital in designing an effective ride-sharing application. In comparing these features with our system, "Tricypool: an online tricycle pooling system in Bulan, Sorsogon," both systems aim to provide easy transportation services through a web application. Both require a strategic plan, key features, and market research. All require separate interfaces for drivers and passengers. The main difference is in the mode of transportation. While the infrastructure of the related system above caters to cars, Tricypool is designed for tricycles. This difference in transportation mode may affect the features, and this may subsequently affect the overall functionality of the app. For instance, Tricypool may consider such factors as tricycle capacity, which is usually lower than cars. In this regard, Tricypool will easily get accommodated to features in RideSharing Application Infrastructure that include Geolocation and Routing, which are very integral in a ride-sharing app to easily keep on tracking the rides and making decisions on best routes. Secondly, Real-time Data Processing will be able to manage the ride requests between tracking and fare calculation to be done in real time. However, some if these features are implemented, there could be a need for modifications. For example, the routing feature may want to consider the fact that tricycles are small and move at relatively slow speeds when compared to cars. Not all features could be implemented with Tricypool at all times. Suppose among the features of the Ride-Sharing Application Infrastructure would be a payment gateway, and this would not be feasible for Tricypool, then the fare the passenger must pay will be directly given to the tricycle driver. In such a case of addition of features for Tricypool, it could not make it Also, to support this feature, there should be Tricycle Pooling, where several passengers headed in the same direction will be able to ride on the same tricycle. Other localized features may also include support for local languages since Tricypool is localized to Bulan, Sorsogon, the locale community.

2. SRP: A Sustainable Dynamic Ride-Sharing Platform Utilizing Blockchain Technology

It is a developed ridesharing service in May 2022, that allows the user to use cars much more effectively by filling the vacant spaces with passengers having similar itineraries and time schedules. This project proposes SRP-A sustainable ridesharing platform where the third party/central server was replaced by Blockchain technology. This platform makes use of Blockchain's capabilities such as consensus mechanism (Proof of Stake); smart contracts; and solvers, making the entire system more secure and less prone to attacks along with tackling the issue of excessive emissions of CO2 in the environment[6].

There are several functions and features of the system above entitled "SRP: A Sustainable Dynamic Ride-Sharing Platform utilizing Block Chain Technology." This includes Blockchain technology, consensus mechanism in Proof of Stake, smart contracts, solvers. Its sub-features will provide transparency, security, efficiency, and decentralization. In the case of Tricypool, the basic features it needs are, it would be expected to have the same features as a ridesharing platform, such as user registration, booking of a ride, GPS tracking, rating system, among others. The main difference would be in the kind of technology used. On the other side, tricypool is eying some of the features in SRP. smart contracts that would enhance transaction security and transparency, while at the same time, smart contracts would make certain processes automatic thereby enhancing efficiency. Adopting smart contracts: This could bring immense novelty to the architecture of Tricypool. This might involve a new database system, developing new smart contracts for several processes, and probably redoing the user interface to accommodate this innovative adoption. On the other hand, features which would not be adopted would be the use of Block Chain Technology since Tricypool tries to keep its system simple and clean for this could further limit the diffusion of more challenging features like the consensus mechanism—in this case, Proof of Stake—and solvers. Looking at the SRP ahead, Tricypool may potentially add features such as peer-to-peer transactions, secure data storage for identity and transaction information, and a system encouraging more shared rides or implementing eco-friendly behavior.

3. Online Ride-Sharing with Meeting Points

It first formally defined MORP, the MeetingPoint-based Online Ridesharing Problem, while developing this system. It proves that MORP is NP-hard and there is no polynomial time deterministic algorithm with a constant competitive ratio for it. We observe that a structure of vertex set, kskip cover, fits well to the MORP, that Kskip cover tends to find the vertices meeting points which are convenient for riders and drivers to come and go[7]. MORP tends to be offering services to more riders with these convenient vertices as meeting points. With this observation, we introduce a convenience-based meeting point candidate selection algorithm. On the system above related developed in the year 2022, the function being discussed is a system designed to optimize routing and scheduling for transportation services in particular in a ride-sharing, it uses something called a k-skip cover. It is the vertices on a graph representing the key points within a transportation network. These are points selected to be passed through often therefore efficient in moving. This system is made to lower cost of query time costs overall. Comparing this to the Tricypool, in regards to their similarities, the Tricypool system, it is designed to optimize transportation routes—the K-skip cover framework. The objective of both systems is to increase efficiency and reduce the traveling time. Nevertheless, it seems that the k-skip cover framework is designed for a bigger and more complex transportation network. In contrast, the Tricypool system is probably designed for a small, local

area. Again, the K-skip cover system does appear to focus on routing and scheduling, while the Tricypool system probably also envisions functionality for ride booking and other user-facing functionality. Discussion of A k-skip cover could be designed for the Tricypool system. It shall, in particular, be able to work out a number of key points within the local transportation network which are mostly passed through to optimize routes and minimize travel time. Once again, this would require proper modifications to be relevant to the local context, where one has to consider things like the size and layout of the town, the number of available tricycles, and the ride demand at the different times and locations. If the k-skip cover concept were adopted, this would no doubt need to be scaled down to suit the smaller scale of the Tricypool system. For example it might use a far simpler model with fewer key points than a complex graph with hundreds of vertices.

4. Bus Pooling: A Large-Scale Bus Ride-Sharing System

This paper formulates the problem of bus ridesharing and designs a large-scale bus ridesharing system in May 2019 to solve this problem. In the above system, the rider can upload passenger trip demand by using an online bus-hailing service and wait to be picked up when it gathers enough people. The provider assigns drivers to riders after the matched ride requests have been integrated. In pursuit of fully exploring the success of ride sharing, the system developed both exact algorithms and approximate algorithms to optimize the ride matching service [8]. This paper will show that this service could provide higher cost performance and on-demand bus services for every user with the help of using a real-life dataset which includes 65,065 trip instances and was extracted from 10,585 Shanghai ride request. While doing so it reduces the number of vehicles by 92. The functionalities of the associated system are a fully functional system for managing bus ride share service. The functions of the associated system are a fully functional system for managing bus ride share service. It consists of the interfaces for riders, providers, and drivers; modules for routing, scheduling, pricing, matching and infrastructure management. Apart from these, there is a service layer and a data access object layer dealing with quite a few back-end functions. This can be compared with "Tricypool: an online tricycle pooling system in Bulan, Sorsogon, ". In general, both systems are trying to administer transportation services. They both probably share the routing, scheduling, and matching functions. However, the bus pooling system would appear to have greater complexity, with pricing and infrastructure management added. The Tricypool system is basically these additional modules are smaller and more localized, thus easily limited in scope of work. In particular, the Tricypool system can potentially adopt the rider, provider, and driver interfaces from the bus pooling system, together with its routing, scheduling, and matching modules. These would have to be modified to the requirements and context of the Tricypool system. For example, the routing and scheduling modules may have to be the smaller scale and different traffic patterns of a tricycle service in Bulan, Sorsogon. If the Tricypool system were to incorporate elements of the bus pooling system, some changes may well be needed. Furthermore, the infrastructure

module may also prove to be redundant in the Tricypool system since tricycles presumably require less infrastructure compared with buses. The same goes with the call center module, which may also limit if the system is primarily run through an online platform. In addition, the Tricypool system could introduce features to better monitor and improve its service. This may include real-time monitoring and identification of tricycles on the road. Further, it should also have a rating and reviewing mechanism wherein riders could rate their experience and provide suggestions for improvement.

5. Baysakay: A mobile-based ride-sharing application

Translation of the technology would help the developers facilitate the problems by coming up with a "BaySakay: A Smartphone Application" in May 2022 that will ride-share with other passengers. BaySakay enables passengers to share the ride with other passengers and be able to divide the total fare. The ride-sharing app will allow consumers to share rides with other consumers at the same time as them and, at the same time, split the cost for the fare. The car-riding app targets all the commuters who are finding it hard to get a ride and commuters in a hurry [9]. The car-riding app targets all generous commuters, who are kind enough to share their ride while being charged in full for all commuters who are having difficulty paying for their fare which they can ride free. Comparisons and contrasts between BaySakay and Tricypool: Both systems are ride-sharing targeted to provide more accessible and affordable modes in commutation. The platforms allow riders to book one universal carriage and share the total amount fare, spending less on transport cost. The former is a mobile application-based, while the latter is accessible via web browser. Individually, both encourage efficiency on transportation resources hence reducing road times. And for their differences, Tricypool primarily functions within the services of tricycles as the city transport in Bulan, Sorsogon while BaySakay Vehicle for rides. An added feature to Tricypool will be a function wherein a passenger can post his location at the moment to his relatives. This would add security to the passengers, and peace of minds afterward. Since BaySakay has also been given the same limiter, what is suitable for this application, with the objectives of Tricypool in mind, are only the ride-sharing and fare-splitting functions. Since the other worthy attributes that could be emulated by Tricypool are added, such as hassle-free, commuting, accessible to all—further emphasized by BaySakay. In case there is a counterpart to that available in BaySakay, then it has to be modified in accordance with the demand and scenario of tricycle riders here in Bulan, Sorsogon. That functionality of BaySakay that one may settle other riders who were not able to settle their full fare may not apply to Tricypool because of the market. Socio-economic backgrounds. Tricypool can also add other features that would increase the security and interaction between the passengers and drivers. Like BaySakay's term, 'Hassle-Free and Helpful passenger on the run', other features can also be added that will enhance better route optimization and expense saving on travel in addition to the set-up feature of functionalities of the basic Tricypool[9].

6. Traykseeker web-based with mobile application

It is a digital system to better improve tricycle transport services in Lahao, Pampanga. It composes a mobile-based application both for passengers and drivers and a web-based system for the administrative side. The mobile app shall provide features such as registering, booking rides, viewing transactions, and risk/disaster alerts for passengers. The booking feature is integrated with Google Maps on the location input, the fare, which is calculated by an algorithm that takes into consideration the number of passengers and distance. The driver may log in their vehicle details, upload documents for validation of the vehicle, see their recent trips and acknowledge passenger bookings from the same mobile application. The web-based application makes admin work easier in managing drivers and passengers, managing fares, transactions, staff data, and security concerns of accounts. Also has a feedback and review module from passengers and a disaster alert system. Comparing these two, the systems were compared based on their similarities; both provided a platform where passengers could book their tricycle rides and drivers could log on to accept these bookings to improve accessibility and convenience. Both systems had the aim of improving commuting efficiency, with Tricypool attaining this through the inclusion of a ride-sharing feature matching passengers going in the same direction, and the associated system computes fares depending on the number of passengers and distance. In terms of their differences, the related system includes a full web-based administrative system where modules for driver, passenger, fare, transaction, staff, account security, feedback from users, and disaster notifications are to be included. This level of administrative control is not part of the Tricypool system. Tricypool includes real-time location-sharing for passenger safety, which is not explicitly part of the related system. The rideshare feature of Tricypool could be ported into a system that will lead to economical ways of getting to places and efficient use of available resources. If it were to adjust to the ride-sharing feature, the fare estimation algorithm may be modified correspondingly for shared rides. On the other hand, considering the limitations of related features of the system, an example of which is an electronic payment system and the capability for offline usage, they limit adoption in TricyPool.

Theme 2: On the Development Application of TricyPool: an online tricycle pooling system in Bulan, Sorsogon.

1. Usability of "Traysi": a Web Application for Tricycle Commuters

A web application has been developed for tricycle commuters using Hypertext Markup Language, Cascading Style Sheet, and JavaScript with the aid of Google Artificial Programming Interfaces APIs. To this end, effectiveness, efficiency, and user satisfaction were measured using common metrics. Success was measured by task completion rate and user errors, while efficiency was measured through time on task.

For user satisfaction, post-task questionnaires in the form of the Single Ease Question (SEQ) were used. To recheck whether the web application would be usable even by a first-time user, usability testing was conducted three times [10]. Results identified from the test proved that highly usable web acceptability during first trial, and its usability improved with the repeated use of the application. However, proof emerged in this improvement from the third trial that obtained a 93.33 percent completion of tasks with just one user error. For each trial given, the average time on task was less than the maximum acceptable task time and the user satisfaction was high (X= 6.00). Therefore, the web application obtained high usability regarding the execution of tasks that it was built for, especially when used constantly. In relation to this, Programming Language of the associated system is titled as "Usability of "Traysi": A Web Application for Tricycle Commuters, " made this November 2019. This content tackles the comparison and contrast to our system titled "Tricypool: an online tricycle pooling system in Bulan, Sorsogon," HTML, CSS and JS comprise the skeletal structure web development. HTML is applied for organize the content on the webpage, CSS is for styling, and JS to add interactivity on the webpage. The Google Maps APIs were listed, meaning Maps Embed API, Distance Matrix API, Directions API, and Places API, allow embedding maps, distance computation, directions, and places details are applied in the both system above in developing. In HTML, CSS, JS and APIs, will be use to write and maintain the code yourself. Developing the function referring to the programming language that was being used in the both system, and it can add the features like user authentication, database handle, and design with responsiveness way too easily.

2. Online Car-Pooling System

Carpooling is one of the most popular modes of transport, especially for working people who would like to save some money. A carpooling website is a good idea for people seeking to share rides. The system has been implemented as a carpooling website in Python. This website will include user registration and log-in, posting of ride, search, and payment processing, [11]. Carpooling is an eco-friendly mode of movement. It has been significantly accepted by almost all countries worldwide. Correspondingly, the website will propose the features of User Registration and Login, creation and searching of a ride, and finally Payment Processing. Features. Moreover, handling user requests and responses will be done by the Flask web framework to provide a more user-friendly and secure website. In terms of Programming Language, the related system entitled "Online CarPooling System," developed on April 2023. This section contains the comparison and contrast to our system entitled "Tricypool: an online tricycle pooling system in Bulan, Sorsogon." First of all, the related system uses Flask Web Framework — Python. At the carpooling website, it is in charge of processing all the requests and their respective responses of each user in a friendly and secure manner. It provides an ordered way of handling user interaction with the system. Comparatively speaking, both systems

have implemented the ability to register users and user login. This allows user registration, safe login, and entitlements to the system. Also, in both, a ride can be created and searched for. Any user can create ride listings specifying their starting point, destination, and other details. Unlike the carpooling website developed above, Using Python, "Tricypool" is built using Laravel as framework. In terms of Frontend, the system uses HTML, used to structure the web application and its content. CSS for laying out and design. JavaScript (JS) is the programming language used to make web pages interactive. Leaflet is the leading open-source JavaScript library for mobile-friendly interactive maps. It has all the mapping features that the developer needs for the development of Tricypool. The developer used MySQL for Back-end, used with PHP and running a PHP file using XAMPP to test PHP applications on our local machine. In adapting the programming language of carpooling website to a tricycle pooling system, there would be customizations to be made. Additional features would typically be added, which enable the indication of the number of available tricycles, capacity per tricycle, and booking of tricycles on specific routes. But not all functions will adopt in the programming language of the related system above. The functions, referring to the used programming language in the related system, which will add as the carpooling website is developing using Python; it could consider. Features such as real-time tracking of the rickshaws, which make it possible for users to trace their booked vehicle, make everything easier.

Theme 3: On the Deployment of TricyPool: an online tricycle pooling system in Bulan, Sorsogon.

1. Pool: A Peer-to-Peer Ride-Sharing App

This system developed the blueprint and application of a peer-to-peer or a dynamic pooling app that allows drivers and riders to enroll themselves in the system so that drivers find rides for riders, and vice-versa, in a particular area within a bandwidth of time. Special features include fare recommendations based on distance, time, and mileage; ride recommendations devised basing on the ride type and ride history of to the rider[12]. In terms of Deployment, there are several functions and features of the related system above entitled "Pool: A Peer-to-Peer Ride-Sharing App," developed in April 2021. The system's Deployment and Software Testing includes verification, this function makes sure that the product satisfies the conditions imposed at the beginning of the development phase. It is to ensure that the product behaves the way users want it. Another is the validation, this function sees to it that the product meets the desired requirements at the end of the development phase, making sure that the product is made according to the client need. Next, is the Black-box Testing, this testing method is interested in the output that the system produces and not concerned with its internal structure. Lastly is the White-box Testing, this testing method, also

referred to as structural testing, it deals with the internal structure of the system and is used for validation purposes. Comparing the functions of deployment/software testing mentioned above to "Tricypool: an online tricycle pooling system in Bulan, Sorsogon, it can identify similarities and differences. Verification and validation functions will be adapted. These both help to ensure that the system is working as it ought to, and all requirements stipulated are met. In both cases blackbox testing can be applied by testing the output produced by the system. When it comes to its differences, the deployment / software testing mentioned in the related system is more general and applicable to any software development project. In contrast, Tricypool is a specific system for online tricycle pooling, so there could be additional functions / features unique to this system. Additional testing or deployment considerations unique to the functionality of Tricypool may be required, such as testing the tricycle pooling algorithm, and user interface testing. In the deployment specifically, the software testing functions mentioned above are adopted in Tricypool. Some modifications may be required to tailor them to the specific needs of the additional specific requirements in the verification process might need to be included, such as making sure that passengers will be fairly distributed among the tricycles. Additional criteria specific to the "Tricypool" system, the validation process checking if it is the correct one, and for instance, whether it shares a location to which passengers can send back to their families during the trip. However, while basic functions of deployment and software testing are very essential parts of any software development project, some may not be applicable or relevant to the "Tricypool" system. Types of testing that would include performance testing for large-scaled systems would not be required for Tricypool since it is a localized tricycle pooling system. Deployment issues on cloud-based systems would not be applicable. If "Tricypool" is hosted on local servers, with regard to the associated system above, probable added functions that could be added into the "Tricypool" system would include testing of the tricycle pooling algorithm, to ensure passengers are effectively and equitably allocated onto respective tricycles. User Interface testing, ensuring a smooth and friendly user experience for both the passenger and the tricycle driver. Security testing to identify and address any vulnerabilities in the system to protect user data and prevent unauthorized access.

2. Isakay: Android-Based Booking System for Tri-Bike Operators and Drivers

This online booking system was designed to perform the mapping and location of passengers within a specific area. The system incorporated the use of the Global Positioning System (GPS). The collecting of driver passenger and vehicle information and transaction information were implemented in the system to allow for recording that could be utilized in the booking operation [13]. The cloud-based online booking system can interact and integrate passengers, drivers, owners, useful information, and records, and so on, while collecting data for carrying out data analytics for future use. Truly, this will benefit all commuters,

drivers, and operators because monitoring of trips becomes easy, booking is fast, and even the drivers are accessible since everything works using mobile phones through network connectivity. The system graded 4.69 or very acceptable in terms of the standard of ISO/IEC 25010:2011 and that it is enough to answer problems of commuters, and drivers in the booking of trips in Odiongan, Romblon. This can be summed up, by their works on functions and features of the related system above entitled " Isakay: Android Based Booking System for Tri-Bike Operators And Drivers Association with Cloud-Based Data Analytics" was developed in the year 2019. Four phases of the deployment process are involved in the developments initiated in the above system-related deployment process which is the Implementation, Integration and Testing, Deployment of System, and Maintenance. System evaluation, bug detection and correction, server deployment, device and system configuration, mobile app connectivity testing, record updates verification, and user training are some of its key features. Compared with the online tricycle pooling platform, which might share some of the deployment characteristics with the Tricypool system, this will show a difference according to its unique nature. For instance, it might have additional features built into it to incorporate GPS tracking for the location and real-time updates on the availability of a ride. The functions that could be adapted from the related system's deployment to the Tricypool system could include the general structure of the deployment phases. This includes system evaluation, server deployment, and user training. The client-server technology and mobile app connectivity testing could also be useful in ensuring smooth communication between users and the system. While assuming these roles, certain changes may be required to cater to the needs of the Tricypool system. For instance, system evaluation should be more emphasized on user experience since the platform is customer-centric by its very nature. Furthermore, with the real-time demands in ride-sharing services, the intensity of testing for mobile app connectivity is much more heightened. Some features, therefore, would be unnecessary to the Tricypool system, particularly one that involves different modules with distinctly different login security levels.

CHAPTER III

Technical Background

3.1 System Development Specification

This section details the kind of Hardware, Software and Specifications used in the development of Tricypool.

3.1.1 Hardware Specification

In this section the hardware specs which be needed for creation and launch of the Tricypool system. This specifications are important to ensure that the online tricycle pooling platform is able to operate smoothly and efficiently. Below is a table with the hardware requirements, which are tailor-made to enable the system capabilities.

Table 1: Hardware Specifications

Components	Specifications
Processor (CPU)	Intel Core i7-9750H 2.6GHz
Memory (RAM)	16 GB DDR4
Hard Drive	512 GB SSD
Computer Monitor	17.3" with 1920 x 1080 resolution

The Developer Hardware Specification table is chosen so that the developer responsibly supports the effective development of Tricypool system. (Intel Core i7-9750H) provides sufficient computational resources to meet the processing demand of this type of development environment and run smoothly during coding and testing [14]. A 16 GB of DDR4 RAM, which helps to run a lot more tasks at once without completely falling apart due to lags. A 512 GB SSD hard drive will give ample space to store project files and relevant development tools. The developer used a 17.3" LCD with resolution at 1920x1080 to provide designers and developers with plenty of room to design their user interfaces and can be used to implement the systems.

3.1.2 Software Specification

The developer's software specification is the list of what necessary tools that will need to install and, more importantly, on which version in order for the development-based tricypool system build successfully.

Therefore, exact software tools are required to design the web application and test it as well with all its functionalities.

Table 2: Software Specifications

Components	**Specifications**
Operating System	Windows 10
Development Platform	JavaScript, Laravel
Web Browser	Google Chrome
Database Management System	MySQL
API Testing Tool	Postman
Design Tool	Figma

The above developer's software specification table had selection of the software components to enable effective development of Tricypool system. Developer use Windows 10 as the Operating system due to its best-advanced features, it's security and comfortable with developing tools. JavaScript, which allow developer to build cross-platform powerful web applications using HTML, CSS and other functions of JavaScript. This enables the smooth and quick development of the Tricypool system[15]. Web Browser, which supports with high compatibility standard for developer tools of developing than testing is Google Chrome that is good to develop on Test Site. The Database Management System needs to be MySQL, as it is more reliable and easy setup for storage of data. Postman: Postman is an API testing tool for developers. Keeping the API services working and resilient Figma as a design tool allows you to create modern and beautiful interfaces, which in turn provides an effective system layout for prototyping.

3.1.3 Service Specification

The service specification table identifies the services that will be required for the Tricypool system to develop and implement. The services are selected with reasons which take into account the individual. The table below details out the service provider and necessary requirements of each services to take care on what infrastructure, tools and support are made available regarding how well system is capable enough in delivering a sensible end user experience. This service specification will therefore serve as document to provide an aid guidance for the developers in implementing and administering such system that would benefit passengers of tricycle drivers from Bulan, Sorsogon.

Table 3: Service Specifications

Service	Services Provider
Internet Connection	Local Internet Service Provider (PLDT)
Web Hosting	Hostinger
Testing and Debugging Tools	Postman

Services specification is shown in the table above, which displays a list of service specification requirements by the Tricypool system. It requires stable internet of things and broad brand high-speed internet connectivity, in which human-technical interaction should provide the ease for communication access development[16]. It can be hosted on robust public/private cloud platforms like Hostinger which allows for adequate storage, bandwidth and scalability sufficient to handle the platform's traffic and data requirements. Tools like Postman and Browser Develop Tools are used to test the system and debug the system. These are quite useful when testing APIs as well as frontend code. This is very important because it makes everything work well and also to identify bugs if any and debug them in order to deliver a stable error-free system.

3.2 User's System Specification Requirements

In this sub-chapter, a set of standards and specifications are outlined which can be utilized across all hardware, software, services the use by the end users.

Table 4. List of Hardware, Software, and Services Requirements

List of Computer Hardware	**Minimum Requirements**	**Recommended Requirements**
Computer Monitor	1024 x 768 resolution	1920 x 1200 resolution or higher
Processor	Intel(R) Pentium(R)	Intel(R) CORE(TM)i3-N300 800MHz or better
Memory	4GB DDR4 @ 2133Mhz	8GB DDR5 @ 4800Mhz or higher
Storage	128GB SSD or HDD	256GB SSD or HDD
GPU	Integrated graphics	Intel (R) UHD Graphics or better
Mobile Phone	Android 7.0	Android 8.0
List of Computer Hardware		
Operating System	Windows 10 Home 64bit	Windows 11 Home 64-bit or latest
Browser	Google Chrome	Google Chrome Version 123.0.6312.106
List of Service		
Internet Connection	10Mbps	15 Mbps or higher

The table lists the hardware, software and services demands establish the minimum as well recommended specification for a user's computer or mobile device. The user should have sufficient processing power, memory and storage as well as appropriate display resolution and internet connectivity to support access of the system[17]. The specs, if adhered to will provide a seamless and good user experience when using the platform. Due to the fact that this requirement is inherent in specification of user system hardware, software and services requirements which enable provision these resources, services as well ensure support for the full capability available from those systems delivery a best practice secure environment[18].

3.3 Technical terms

This section provides an overview of essential technical terms used in the context of the Tricypool system's development and user specifications. These terms are essential in understanding the hardware, software, and services necessary for both the creation and usage of the Tricypool system.

RAM (Random Access Memory): These are the places computer uses to store data in a temporary fashion.

Operating System: A software that provides a common interface for devices and applications to the computer hardware, such as programs are operated by using this layer functionality.

Development Platform: Hardware, software, and other tools used to create the software that use by the developer.

Database Management System: It's a bundle of software applications that allow us to store, retrieve and manage data in an organized way.

API (Application Programming Interface): Rules and protocols to define how the new software components should interact with each other.

Broadband Internet Connection: The provision of wireless high-speed Internet transmission.

Continuous Integration/Continuous Deployment (CI/CD): In software development, when the code commit happens regularly and deploy it to production environments automatically.

Testing and Debugging Tools: Software which are used to test the computer software or perform detection of errors, also it allows attempts to locate fix errors application bugs.

Service Provider: The firm or organization that gives service at the best instance internet connectivity at finest cloud hosting.

Web Browser: It is a software application works to access and view websites on the internet.

CHAPTER IV

Design and Methodology

This chapter presents the proponent's design and methodology for the project development. It contains the Project Concept, Analysis and Design along with Development Model and Approach with Development Tools Schedule and Time. It also includes the Responsibilities, Cost Management, Verification, Validation and Testing, along with the diagrams, tables and figures used in the methodology of the Tricypool System.

4.1 Concept

This subchapter talks about the design and conduct of the Tricypool system that includes a strategy for the pool management with an incorporation of classical features and modern technologies to enhance the interaction between the user and the interface for purposes of enhancing usability. With the friendly user interface and flexibility to be able to adjust to various pool forms, the system came as equipped with suitable solutions depending on the desired individuals preferences.

4.1.1 System Architecture Diagram

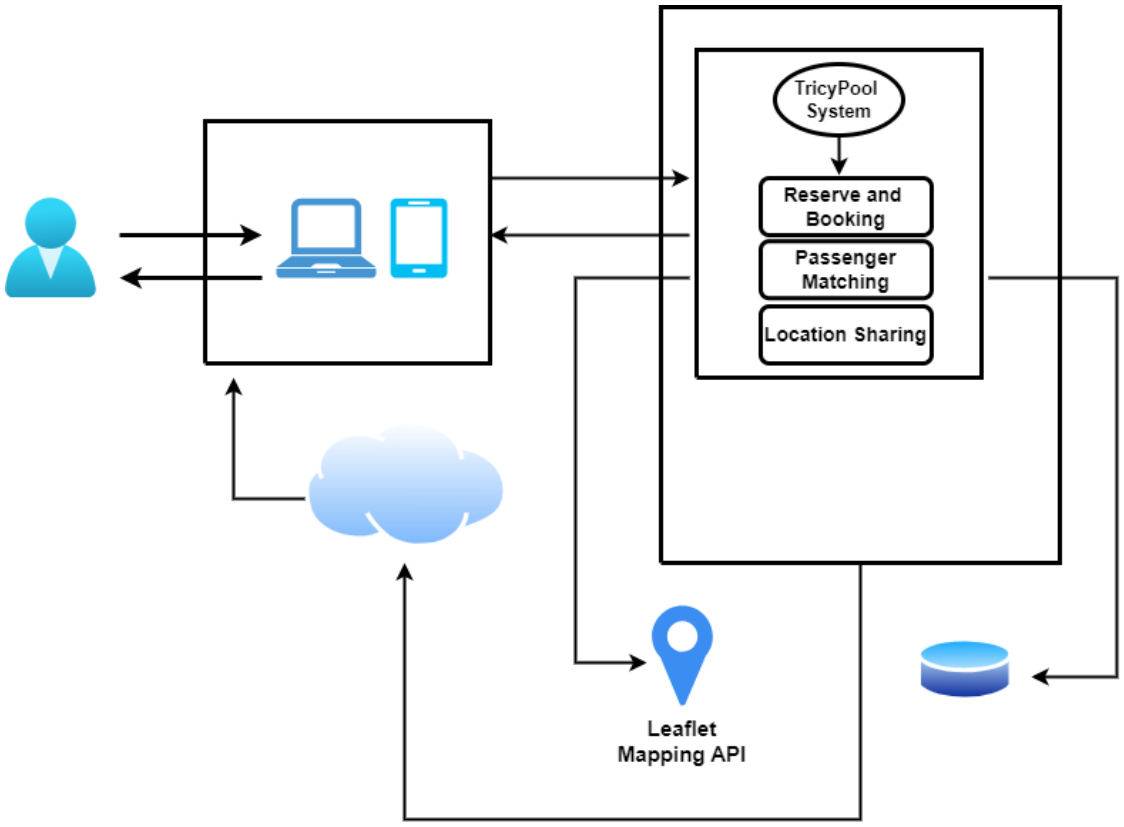

Figure 4.1 System Architecture Diagram

System Architecture Diagram is used in this case define the overall structure and components of a given system. The structure of the system is the web hosting service on AWS, which hosts the Tricypool System. The system consists of three main objectives: the Reservation Booking Platform the Ride-sharing and the Location-sharing utilities. A MySQL database is used to store and manage the above stated objectives so as to ease and enhance data integrity. Data are inputted and received through various interfaces namely a monitor or an android phone which is the interface for the system. The connection made between users and the Tricypool System is made through the TCP/IP protocol since the system is an online one. Further, Leaflet Mapping API integrated in the system enables the mapping of routes for the drivers before going to the trip, for passenger matching to have a more efficient navigation. This feature increases the overall communication and security within the system to fulfil the requirements of both ride-sharing and location-sharing services.

4.1.2 Data Flow Diagram

The Data Flow Diagram illustrate the flow of the data and process within the Tricypool system. Highlighting the interaction and task performed by each entity.

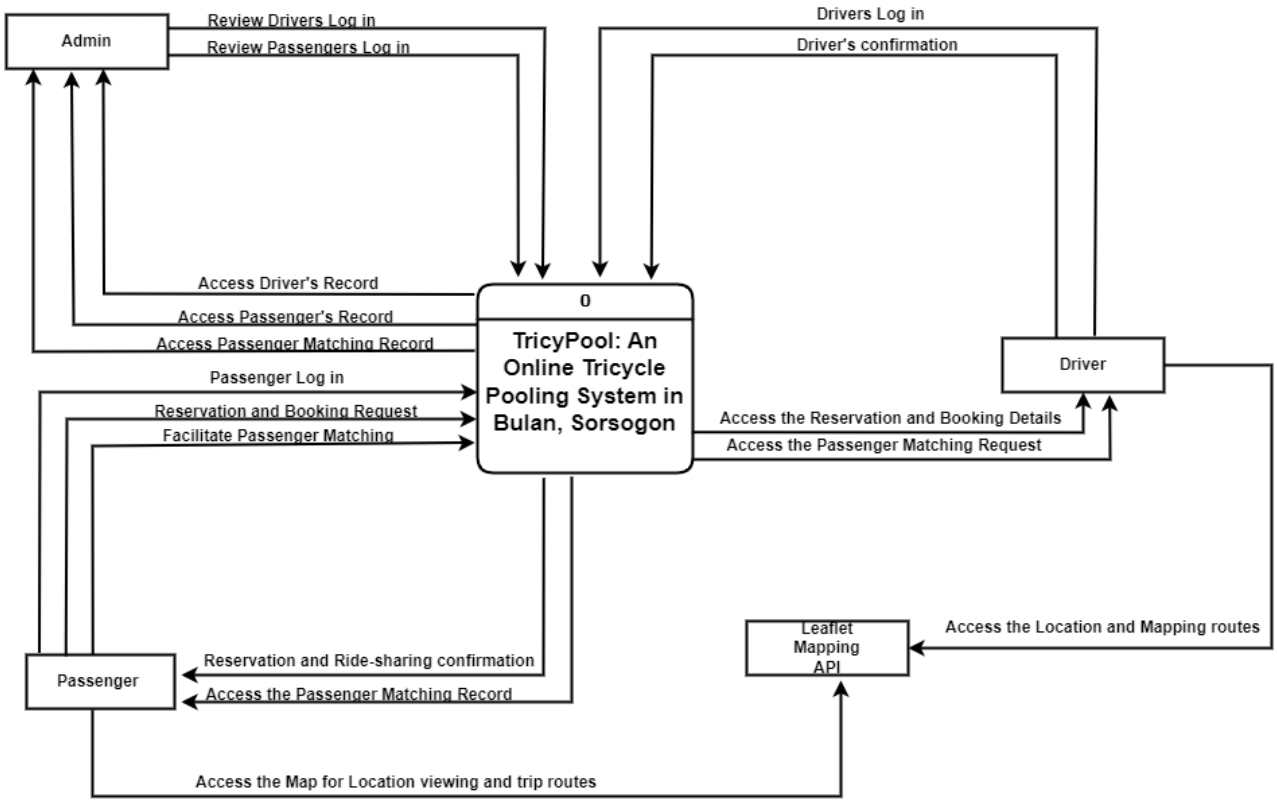

Figure 4.2 Data Flow Diagram Level 0

At Level 0 Context Diagram, the system involves three external entities on such as Admin, Passenger, Driver and a 3rd party association which is the Leaflet Mapping API. This level provides a high-level overview of the system, showcasing main processes such as Reservation and Booking Platform, Ride-Sharing Platform and Location Sharing along with its interactions with external entities.

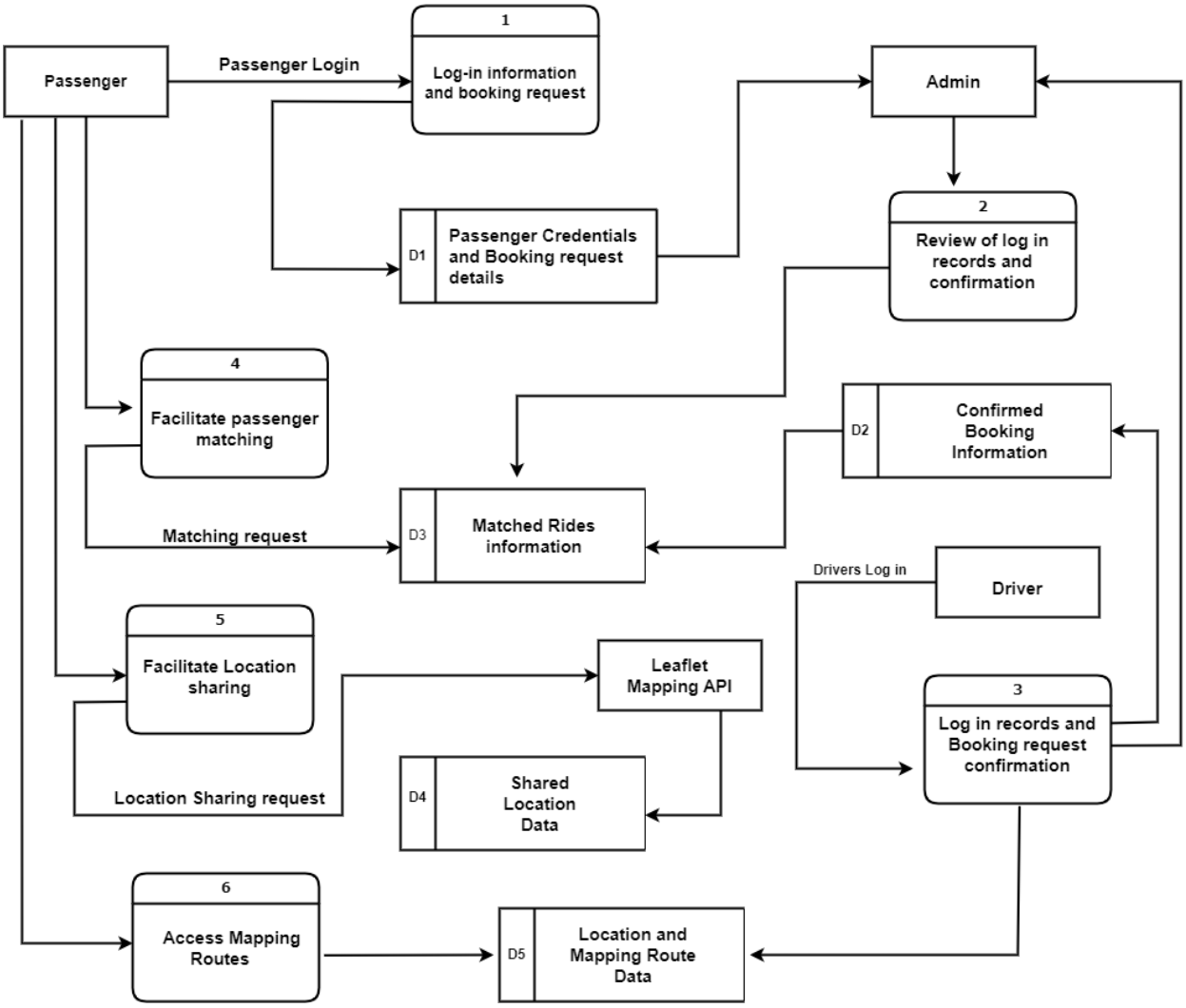

Figure 4.3 Data Flow Diagram Level 1

The Level 1 Data Flow Diagram for the Tricypool System illustrates the activity which pertains to Passenger log in. A reservation confirmation of the books by getting a response of the driver through the ride. Admin, on the other hand, can receive, accept and manage the log in credentials of a passenger and that of the driver as well. Passenger on the same note, can also facillitate ride-sharing with other passengers heading for the same destination. Other passenger confirms it with ride-sharing, and both the passengers are able to see the matched ride details. They can get login IDs and passwords and then they be able

to view. These include, its booking details, and then see and confirm from it. Leaflet Mapping API for passenger, where passenger for that can request to view location, with granted confirmation. Passenger can share the location with other passenger, and the other passenger can see the location and information about it. Plotting out the paths and to be able to pass this same path to other members of the family. Likewise, drivers can conceive map routes in the similar manner. For navigation purpose, the current work used the Leaflet Mapping API.

4.1.3 Use Case Diagram

The primary context use case diagram presents usage of and driver in the system. Passenger, who is involved in all the three use- cases, can reserve and ride, ride-shares and location-share. The driver, if it is a new booking the reactor affirms the booking and review the matched passengers list. Other passenger, on the other hand, requires more complex thought, self motivation and disregards the physical necessity as well as detrimental health consequences of sexual abstinence and does not have the functionality to select a car type and its specific service. But can rather board a join that has already been called by other riders to a specific destination, which can be booked by sharing the ride and the people can share their location to their family members. This goes to show that the system permits relative flexibility according to the position and behavior of the user.

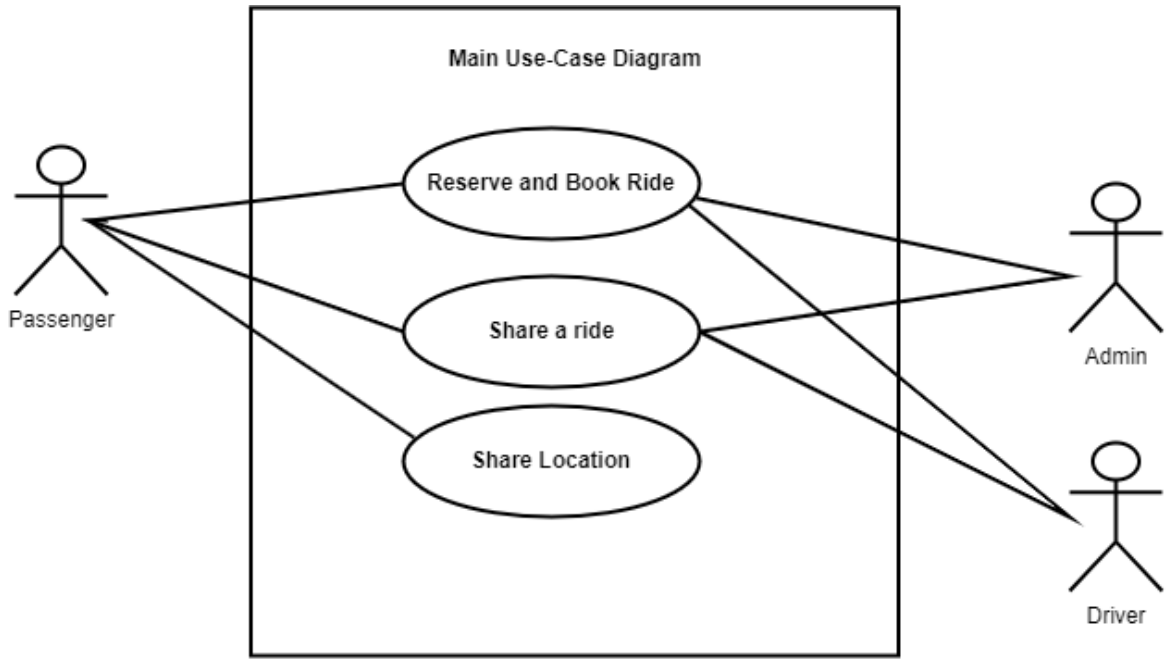

Figure 4.4 Use Case Diagram

Reserve and Book ride Extracted Diagram reveals that an active role is played by Passenger that comprises the basic information which is the pick up place or point and the drop off place or point. The generalization of this use case is the "View notification from Driver", this has been used in the preceding text. Furthermore, this is indicated by the notification from driver, where passenger gets update of the ride. there is an include relationship on this use case specifically the" View drivers mapping information", and it is only triggered when passenger access the mapping information of the driver allowing them to track driver's route and estimated time of arrival before the trip. Driver, as the reactor can see the ride requests, and it has an extended relationship of "Share the information with other driver", whereby the drivers cancel the request, that's the time that this extended relationship will be triggered, and the drivers thereafter sends a notification that should be given to the passenger in connection to the decision made. Admin, can see all the transaction of the driver and the passenger but for one reason or another don't have privilege to interfare on it.

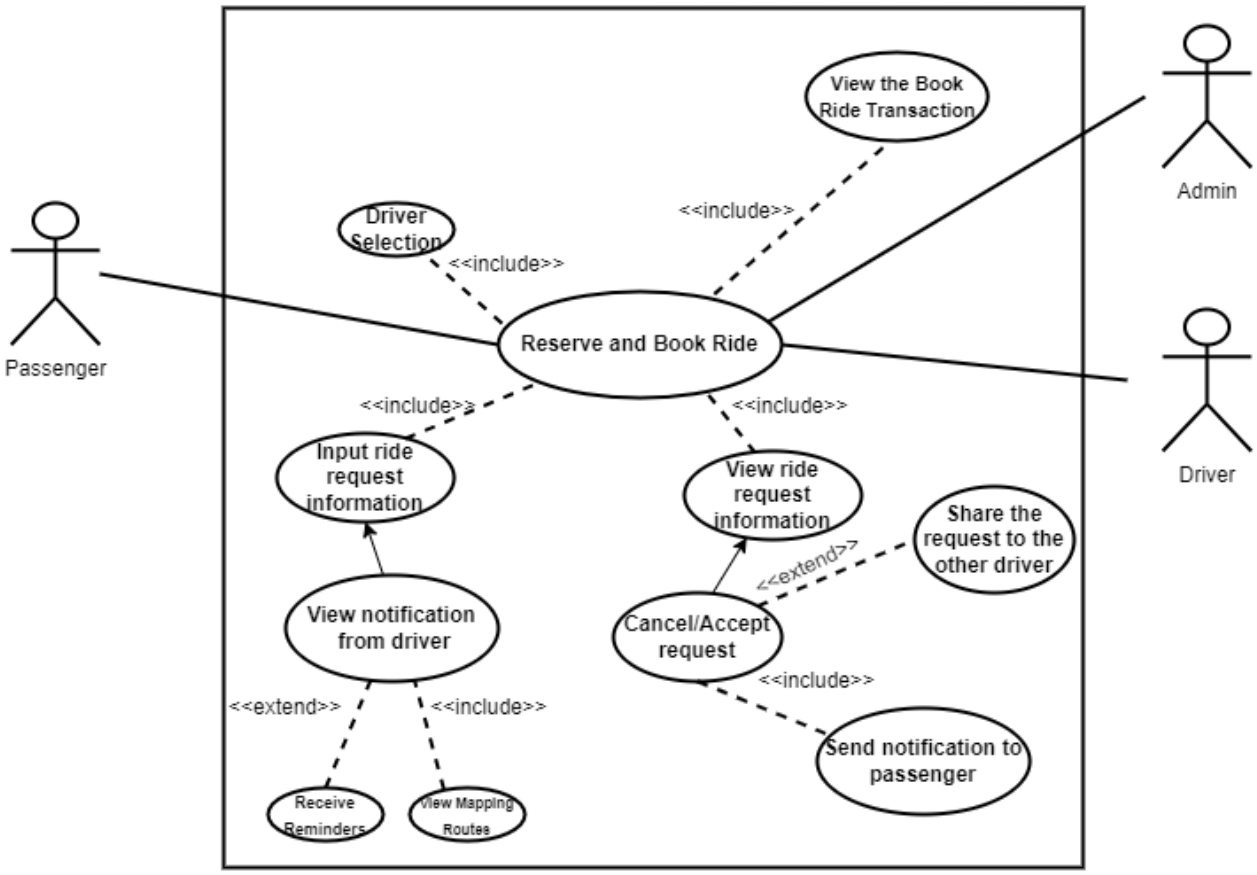

Figure 4.5 Reservation and Book Ride Extracted Diagram

The Share a Ride extracted diagram reveals that passenger occupies the role of the initiator, that is entails searching for an appropriate matches for those willing to share a ride. The generalization associated with this use case is the “Passenger matching”. where all the actors can view information of matched passengers.Furthermore, there’s an included relationship which is the “View notification from Driver and Passenger,” when either the drivers update and matched passenger confirms their participation. Notification to Passenger will also be part of this include action. Driver side also has passenger matched information that he or she can view. ”Selecting passenger” is an important feature, which is set off when the driver selects which of the request to accept the ride. This action is performed once the passenger matching is done and the driver has the privilege of choosing passengers to pick depending on the routes they are taking. Admin, can view all the transaction regarding on the matched passenger of passengers but they do not have a right to interfere on it.

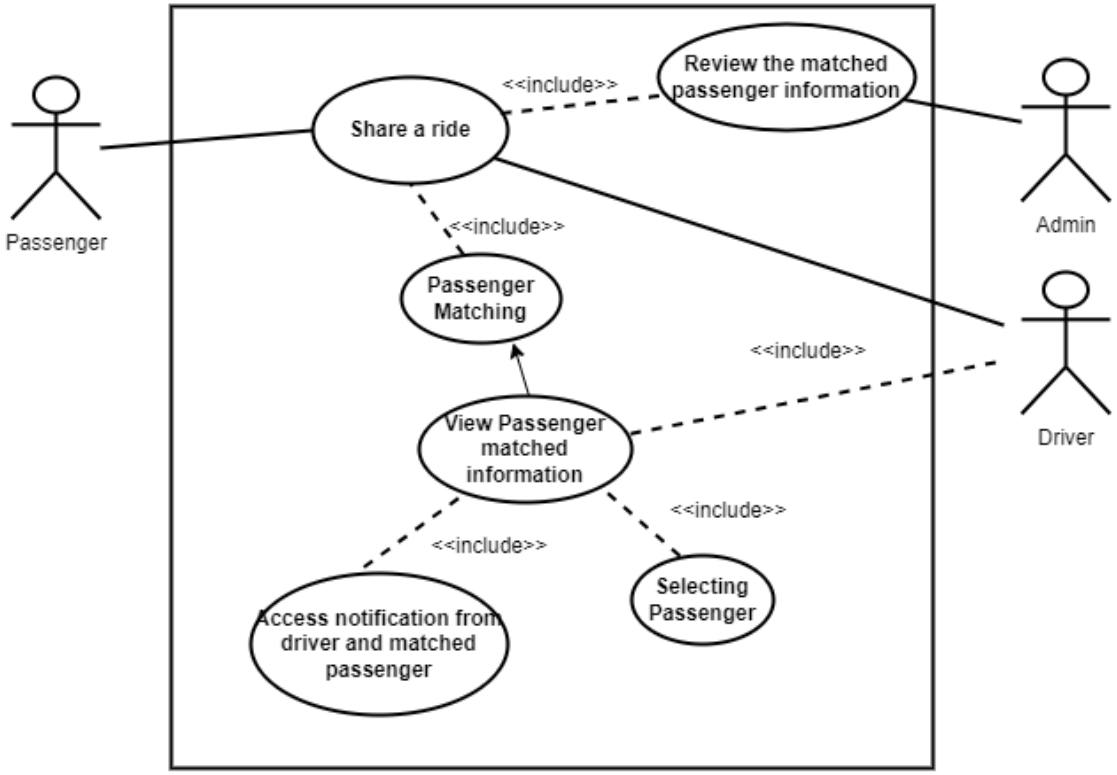

Figure 4.6 Share a Ride Extracted Diagram

Share location extracted diagram involves passenger sharing their location with both passengers and family members This use-case is further generalized into" Track and monitor routes", wherein they can continuously track their location. But there's an extended relationship in this use-case, which is the" estimate the time of arrival", that only triggered When passengers per the shared location. on the other hand, other passenger is characterized by a generalization of an actor. However, there's an includes that trigger when passenger decides to opt-out of tracking or monitor the shared location. This transaction involved works through the use of a "3rd party Association" which is the Google Map API [19] . This enables the sharing, tracking, and monitoring of location between passengers and their family members.

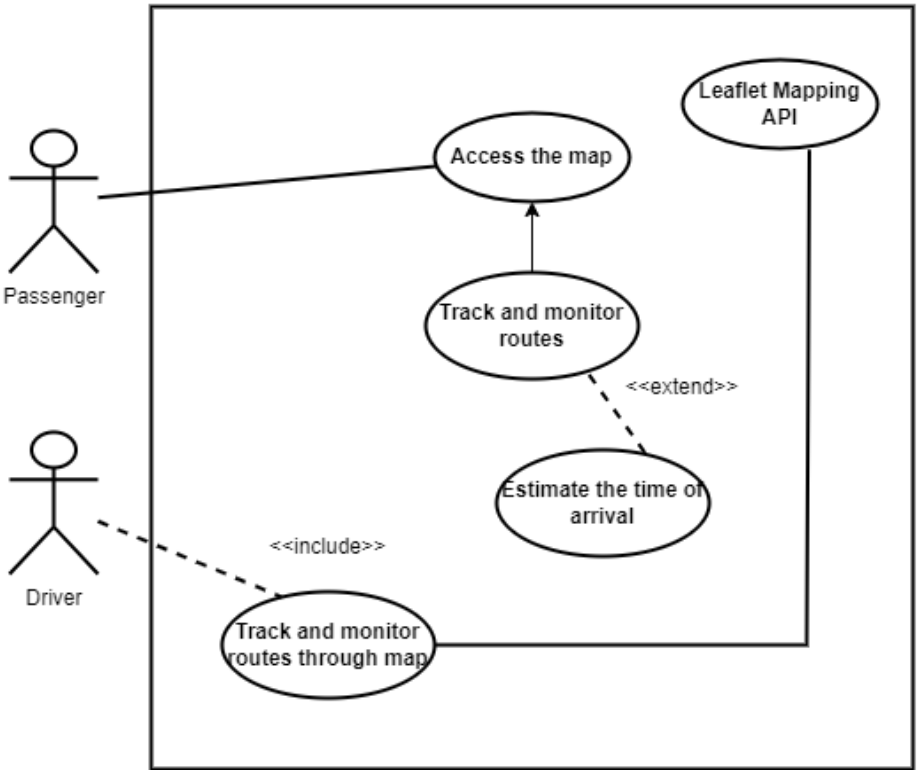

Figure 4.7 Share Location Extracted Diagram

4.1.4 UML Activity Diagram

The Passenger in the Reserve and Book Ride Extracted Diagram serve as the initiator of Reservation and Booking ride swim lane. The passenger first chooses a driver and checks of availability, they send ride request information to inputs. The driver gets the booking request and chooses to accept or reject it. If accepted, the reservation updates, and the clients as well as the driver can see the mapping routes that are marked the end. In case of rejection, passenger can select another available driver, enter a new ride request and hence come across the matching result ensuring a smooth booking experience. Admin, on the other hand can view all the transaction of driver and passenger but don't have a privilege to interfere on it.

In the Reservation and Booking swim lane diagram, Passenger starts by selecting a driver and checking availability, then inputs ride request information. The driver receives the booking request and decides to accept or reject it. If accepted, the reservation updates, and both parties can view mapping routes, marking the end. If rejected, Passenger can choose another available driver, input a new ride request, and repeat the process until the request is accepted, ensuring a smooth booking experience. Admin, on the other hand can view all the transaction of driver and passenger but don't have a privilege to interfere on it.

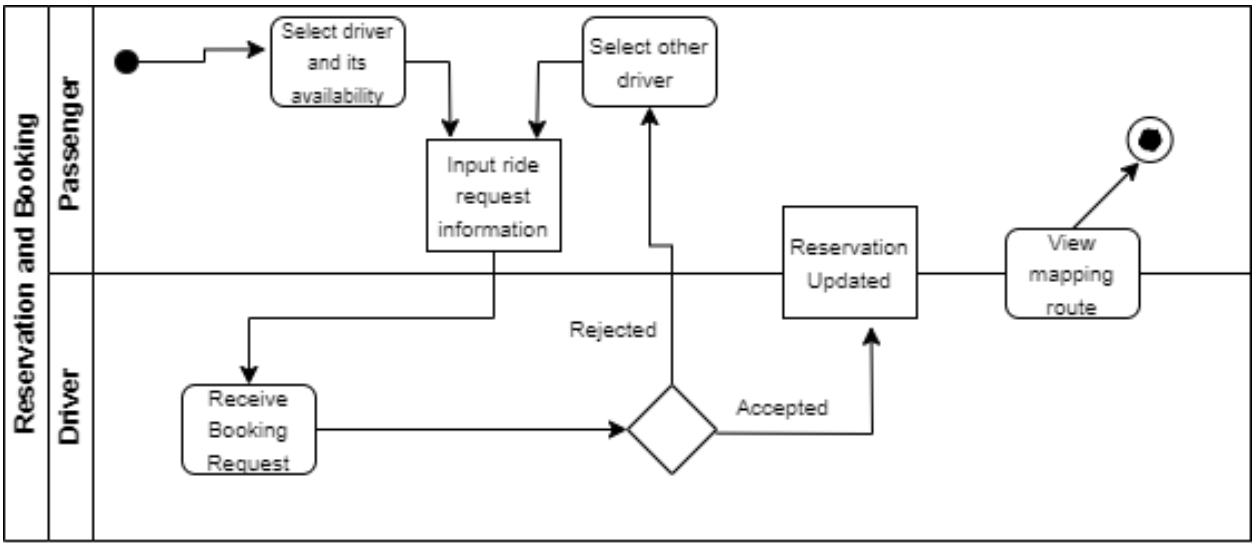

Figure 4.8 : Reservation and Booking Swimlane Diagram

In the Passenger Matching and Sharing swim lane diagram, Passenger starts the process by initiating passenger matching, allowing passengers to access and view the matched information. Other passenger then decides whether to accept the ride, with rejection prompting the initiator to repeat the matching process until the ride is accepted. The driver reviews the matched information and decides whether to accept all

matched passengers. If accepted, the tricycle capacity is updated, if rejected, the passenger matching process continues until acceptance, thus providing efficient call-up and pick-up ride sharing Admin, can view all the transaction of driver and passenger but don't have a privilege to meddle on it.

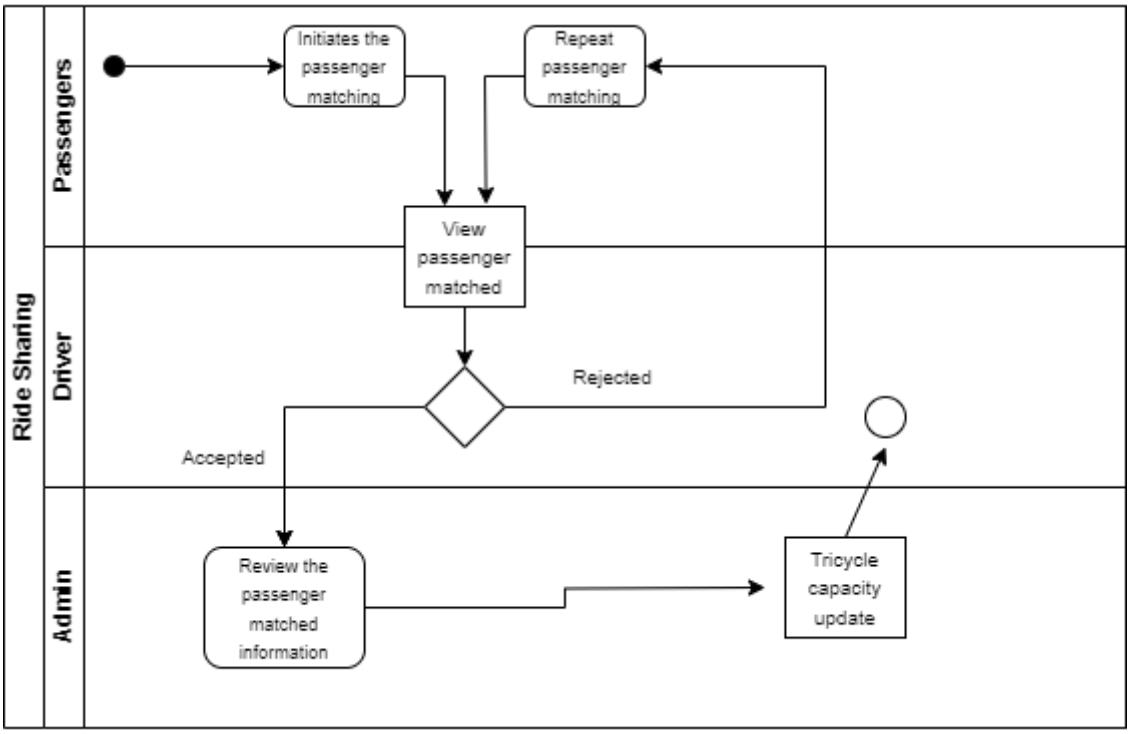

Figure 4.9 : Ride Sharing Swimlane Diagram

In the Location Sharing swimlane diagram, Passenger starts by enabling location sharing with other passenger, and other passengers then decides whether to accept the sharing. If rejected, other passenger can turn off the location sharing, if accepted, both passengers can share the location with their family members. They had an option to track their routes, choosing yes allows them to estimate their arrival time, while choosing no enables them to turn off their location sharing, ensuring control and convenience throughout the journey. Admin, on the other hand can view all the transaction of passengers regarding on the location sharing but don't have a privilege to interfere on it.

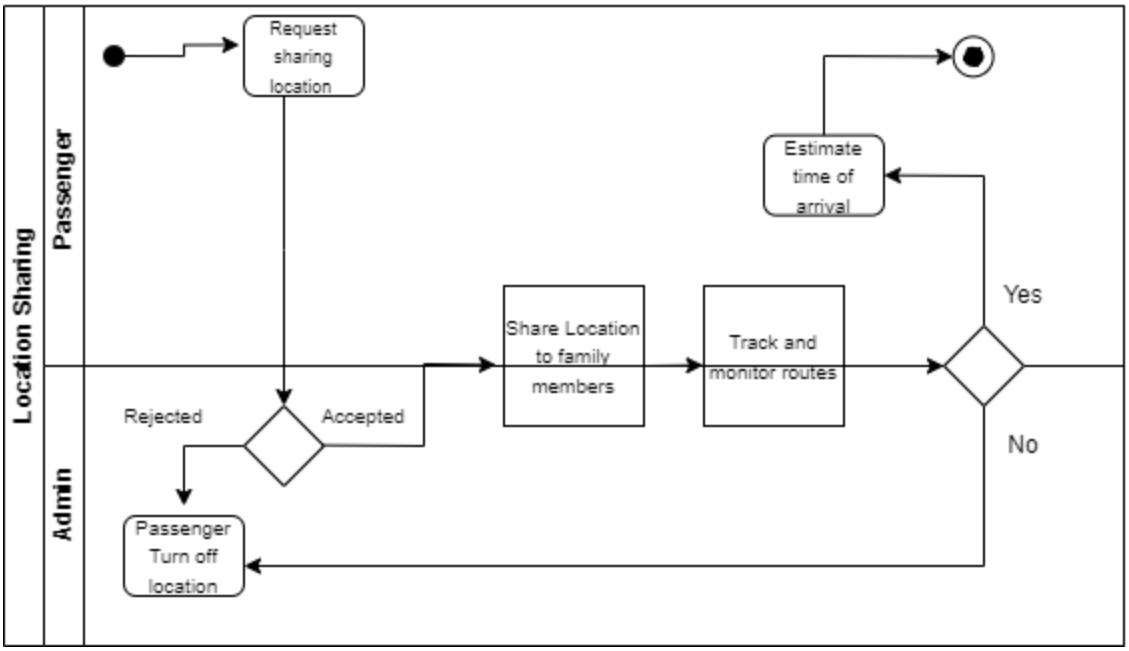

Figure 5 : Location Sharing Swimlane Diagram

4.1.5 Entity-Relationship Diagram

Entity Relationship Diagram use for designing the database structure and understanding the relationships between different components of the system. To further explain the diagram above, it has multiple entities such as Passenger, Driver, Reservations, Passenger Match, and Location Sharing Entity, with its attributes. The Passenger and Driver entity represents individuals who use the transportation service. Each passenger and driver are uniquely identified by their PassengerID and DriverID and can have associated information such as their name and phone number and other details. In terms of Passenger-Driver Relationship, one Passenger can book multiple Drivers (if there's many drivers available) (One-to-Many). When it comes to Passenger-Reservation Relationship, one Passenger can have multiple Reservations (One-to-Many). To add, Passenger-Location Sharing Relationship, one Passenger can initiate multiple location sharing instances with other Passengers or Family Members (One-to-Many). And lastly, Passenger-Passenger Match Relationship, one Passenger can have multiple passenger matches with other passengers (Many-to-Many).

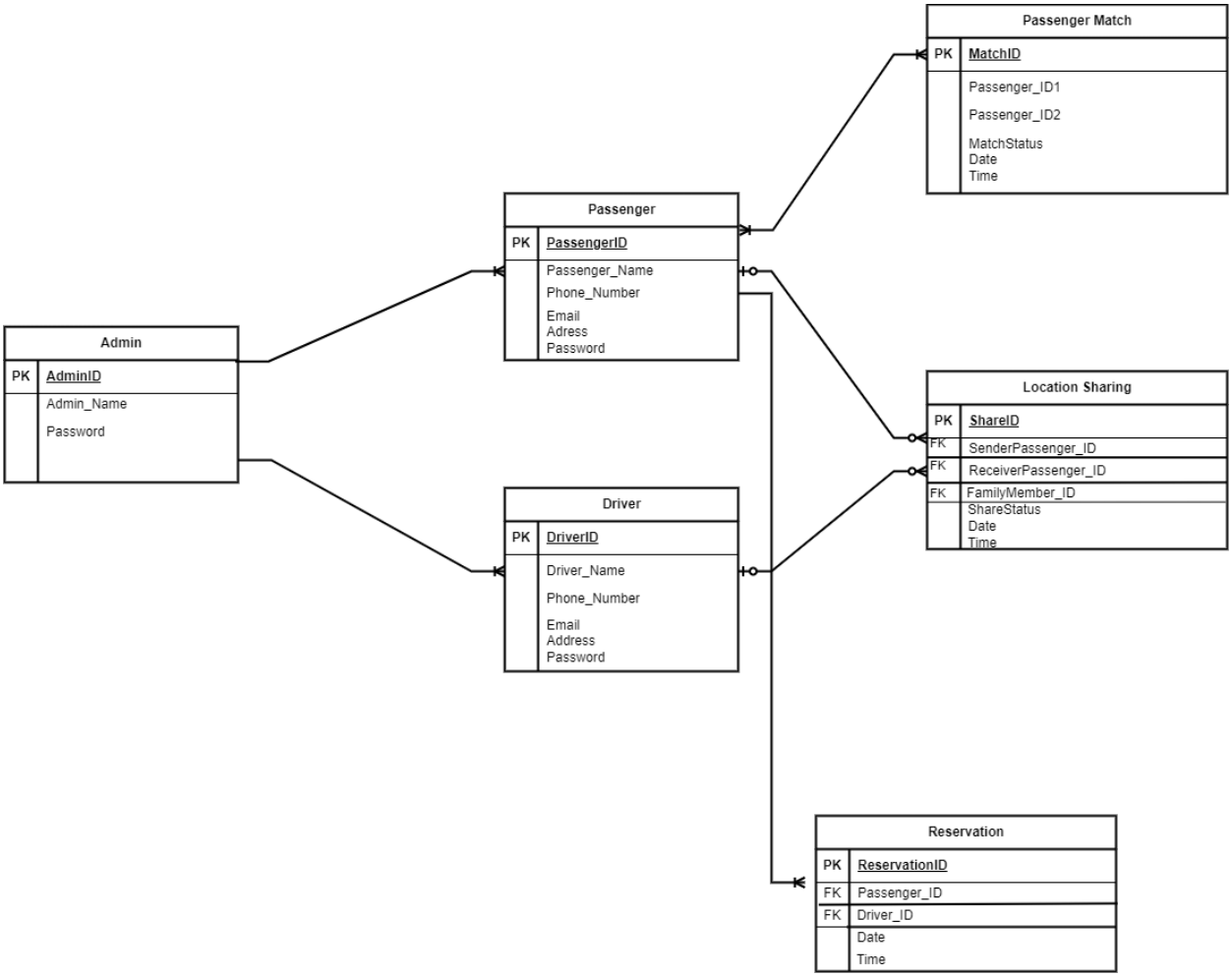

Figure 5.1 : Entity Relationship Diagram

4.2 Analysis and Design

This subchapter chapter involves understanding and defining what the system needs to do. It includes two types of requirements such as functional (what the system should do) and non-functional (quality and performance aspects such as functionality, usability, and portability). By focusing on these requirements, programmer can build the system that meet user needs and work well.

4.2.1 Requirements Analysis

This subchapter is one of the important steps in the software development life cycle because it is at this stage where the requirements of the system to be newly developed are collected, documented and analyzed. It can act as a basis for enhancing the chances of coming up with a good blueprint to start creating a software solution.

4.2.1.1 Functional Requirements

Functional requirements define specific task that are to be accomplished by the Tricypool system. These requirements state explicitly what the system has to and should be capable of in terms of inputs, processing, as well as outputs. It emphasizes on which steps the system has to execute and which outcomes the system must yield.

Table 4.1 Functional Requirements

Task Requirements	**Task Reference**
Users should be able to perform a reservation task	Reservation and Booking Platform
Users should be able to perform a ride-sharing activity	Ride-Sharing Platform
Users should be able to perform a location sharing activity	Location Sharing Platform

4.2.1.2 Non-functional Requirements

Non-functional requirements are other requirements that are normally defined with an aim of specifying the quality standards that ought to be met by a given system. Such requirements also refer to aspects such as functionality, usability and reliability. It describes in what manner the system should be organized as to their characteristics inasmuch as they are not specific functions.

Table 4.2 Non-functional Requirements

Task Requirements	**Task Reference**
Refers to the set of functions that covers all of the specified tasks and user objectives.	Functionality
Refers to how well a product or system can be used to achieve specified goals effectively, efficiently, and satisfactorily.	Usability
Refers to how well a system, product, or component can be transferred from one environment to another.	Portability

4.3 Development Model

This model divides the development process into even further segments or 'cycles of work' allowing for continuous refinement and improvement of the platform over time. Each iteration delivers a portion of the system's functionality, providing opportunities for feedback and adaptation as the project progresses. By following the Incremental Iterative Model in the development of the Tricypool system it can lead to a robust and feature-rich platform that meets the evolving needs of both passengers and drivers.

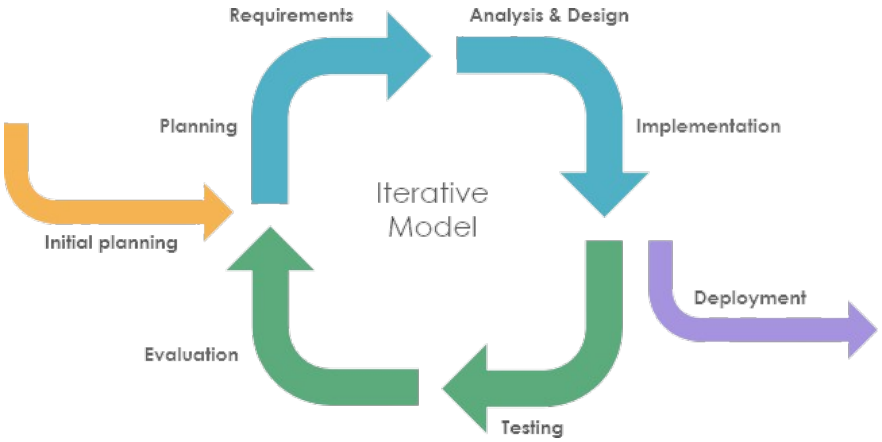

Figure 4.9 Development Model

4.4 Development Approach

For the development approach, the best model that can work is the Rapid Application Development (RAD). RAD is characterized by the rapid development of concrete prototypes of the future program and is focused on its rapid release, while receiving feedback from the users in the early stages of work. This approach is well synchronized with the Incremental kind of methodology or the one that adopt the principles of it. Flexible Implementation model through the provision of fast and successive cycles of development addition [20].

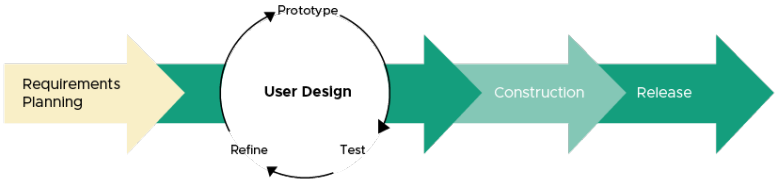

Figure 5. Rapid Application Development

The main characteristic of the Rapid Application Development approach is that it is possible to change some aspects of the application at any stage of development, the focus is made on the constant improvement and feedback from the end-users. Thus, this approach can be easily incorporated into the development of the platform for Reservation and Booking , Ride-Sharing and Real-Time and Location Sharing feature. The four system Planning and requirements, user design, construction, and cut over. are attended to in order to provide the customers with working prototypes; refine them if necessary so as to achieve the overall objective of a happy and efficient. development process.

While for the Reservation and Booking platform the RAD approach starts with requirements planning then user registration, login or even reservation initial requirements are collected at this step. We conduct an interview to the client such as the driver and the passengers for their credentials. The design phase involves the proponent to ensure that stake holder are involved in the process of quick prototyping to validate and iterate on the requirement. The construction phase is all about step-by-step usage of basic elements of a framework for building incremental features that can be improved according to the feedback received from the users and various other dynamic requisites. Testing will take place at various stages, with an aim of uncovering problems and rectifying them and with a view of achieving working models and incorporating changes where necessary for rapid improvements.

Likewise, for the Ride-Sharing platform, the RAD approach is also the same four-phased approach. Requirements planning means to first identify initial requirements for match making algorithm for the passengers, users and their preferences real-time updates. In the design phase the activity is developing high-speed prototypes of the interface for the passengers matching and whenever possible, collection of feedback for modification. The construction phase will contains the basic passenger matching algorithm and the graphical user interface to enhance the system's functionality, step by step depending on the feedback and changing preferences. Testing will be done in parallel, and then users' feedback can be incorporated into the system passenger matching system.

Finally, for the Real-Time Location Sharing, the RAD approach has also been adopted in the same four phases. The process starts from requirements planning that focuses on the initial requirements needed for meeting the purpose of the application, which is real-time location sharing and user preferences. The design phase is centred on the establishment of a prototype of the GUI and its subsequent usability at the specific location discussion and feedback to allow changes to be made in a short time. In the construction phase the basic will be implemented sharing location functionality, which gradually extend out characteristics considering the feedback of users. Testing will be conduct in a cycle manner, to enhance the real-time location sharing option based on the users' feedback they gave.

4.5 Development Tools

The following are the development tools to be used by the researchers in developing the system.

Front-end Development:

Figma

Figma design is for people to create, share, and test designs for websites, mobile apps, and other digital products and experiences. It is a popular tool for designers, product managers, writers and developers and helps anyone involved in the design process contribute, give feedback, and make better decisions, faster [21]. Developers utilize this to create the wireframe and UI/UX design of a system, making it an essential component of a capstone project.

Hypertext Markup Language

HTML's the basic structure of a web page. It is used to specify the structure and content of a website that uses tags. It would be the skeleton and muscles of a website, if an analogy we needed. HTML language creates the website's skeleton, using different tags for paragraphs, headings, pictures, links and more. This is the information that browsers use to display.

Cascading Style Sheets

CSS is in charge of website visual presentation. It adds styles, colors, fonts and layout to the HTML structure. Think of it as the clothing and accessories that make a website visually appealing. CSS is using rules to define what elements on a page must look like. For example, using CSS you can set the page's background color, change font sizes for headings or place elements.

JavaScript

JavaScript adds interactivity and dynamic behavior to your website. It'll allow you to create animations, handle user input and make your site more interactive. Think about it as the brain and nervous system that makes a website come alive. It uses code to create interactive elements. It can be used to make buttons respond to clicks, create drop down menus, validate forms, and even retrieve data from servers.

Leaftlet JavaScript

Leaflet is a popular JavaScript library specially designed for the creation of interactive maps on web pages. It offers a simple and effective way of displaying maps, adding labels, drawing shapes or creating different map interaction. It allows to use tiles based maps from a variety of sources, such as OpenStreetMap, Google Maps, and Mapbox and to control the zoom level of the map, pan the map, add popups with information, and create custom map layers.

Back-end Development:

Laravel

Laravel is a popular PHP framework that provides a robust structure and features to build web applications. The aim is to simplify and accelerate the development process by providing tools for managing databases, route planning, authentication. It follows the Model-View-Controller (MVC) architectural pattern, which helps organize code into logical components.

MySQL

MySQL is a type of relational database management system that utilizes structured query language (SQL) to manage and manipulate data. A relational database is a type of database that uses structured format that allows us to identify and access data in relation to another piece of data stored within the database. This format is commonly organized as tables, each containing rows and column of data. Developer utilize MySQL as the primary database management system for storing and managing critical data related to users, rides, driver-partners, transactions, and system configurations. MySQL serves as the backend infrastructure that supports data storage, retrieval, and manipulation, enable Tricypool to efficiently manage user accounts, match riders with available drivers, and maintain system integrity.

PHP (Hypertext Preprocessor)

PHP is a scripting language that runs on the server and generates dynamic content for websites. Before being sent to the browser, it will interact with databases, handle user input and process data. Think of it as the engine that powers the website's backend functions. It is used for tasks like processing forms, managing

user sessions, creating dynamic content based on user interactions, interacting with databases to store and retrieve information, sending emails and generating PDF documents.

XAMPP

XAMPP is a free and open source package that provides a local development environment for web applications. It's made up of Apache Web server, MySQL database, PHP and other essential components. It enables developers to create a complete web development environment on local computers. Without deploying to a live server, they can test code, build applications, and debug issues.

4.6 Schedule and Timeline

The developer utilizes the Work Breakdown Structure (WBS), Gantt Chart and Critical Path Method (CPM), to outline tasks, analyze their dependencies, and estimate the time needed to finish the project.

Work Breakdown Structure (WBS)

The Work Breakdown Structure (WBS) for the implementation of this system can be divided into four key phases: Requirements Planning, User Design, Implementation and Testing.

Table 4.3 Work Breakdown Structure

Task ID	**Task Name**	**Duration (Days)**	Predecessor
Requirements Planning			
1	Define Project scope and objectives	4	-
2	Gather information from stakeholders	4	1
3	Identify system features and functionalities	6	2
User Design			
4	Design user interface	14	3
5	Create wireframes and prototypes	20	4
6	Gather feedback from client and refine	8	5
Construction			
7	Develop application components based on the final design	31	6
8	Develop main functions of the system	75	7
9	Develop features of the system	41	7
10	Perform unit testing and integration testing	14	7, 8, 9
Cutover			
11	Perform Final testing	5	10
12	Prepare system for deployment	3	11
13	Train staff on system usage	5	12
14	Evaluate system based on ISO 25010 standards	2	13
15	Document system architecture and design	6	14

Table 4.4 Gantt Chart

Gantt Chart

The Gantt Chart highlights the four phases of developmental approach use in Tricypool along with its duration.

Task ID	**Task Name**	**Start Date**	End Date	Duration (Weeks)
1	Requirements Planning	03/18/2024	04/01/2024	2
2	User Design	04/02/2024	05/13/2024	6
3	Construction	05/13/2024	10/24/2024	23
4	Cutover	24/10/2024	11/14/2024	3

Critical path

The figure below highlights the critical path of tricypool during its developmental phases.

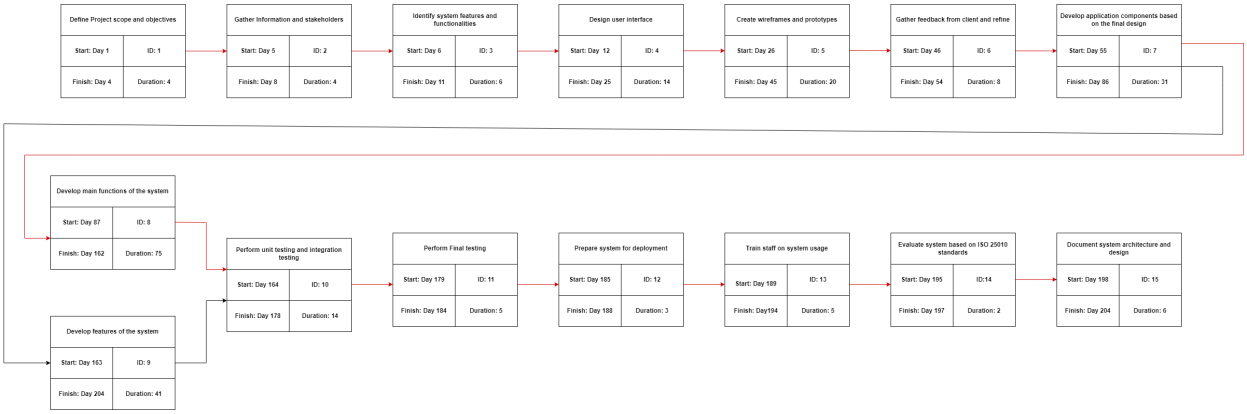

Figure 5.1 Critical Path

4.7 Responsibilities

The study is composed of three student researchers from BSIT. The following discusses the roles and responsibilities together with their names.

Table 4.5 Responsibilities of the Proponents

Name	Position	Responsibilities
Maria Amanda R. Labini	Project Manager/Technical Writer	Oversee project completion, ensuring to meet time, budget, and requirements. Create documentation and manuals for technical products.
Bethy Mhel O. Goyal	Designer/Programmer	Create UI/UX of the proposed system. Write code to create the proposed system, translating the design into functionality.
Rene N. Leona	Data Analyst	Conduct research and analyze data to gather information.

4.8 Budget and Cost Management

In this chapter, the budget breakdown of the Tricypool system's development is included. The budget breakdown allows the project team and stakeholders to assess the financial feasibility of the Tricypool system, it helps in effective financial planning, resource allocation, and cost control, ensuring that the Tricypool project remains financially sustainable and achieves its objectives within the allocated budget.

4.8.1 Proponent's Budget and Cost Management

The proponent's budget for the proposed System includes costs for hardware, software, personnel, and other resources. The total estimated costs are broken down in the table below.

Materials and Supplies

Details the list of items used in implementing the system and printing the manuscript and other paper requirements.

Table 4.6 Materials and Supplies

Item	Quantity	Unit Price	Amount
Laptop	2pcs	32,299.00	64,598.00
Internet	7 months	1,399.00	9,793.00
Printer	1pc	8,350.00	8,350.00
Ink	3pcs	390	1,170.00
Bond Paper	1 ream	250.00	250.00
Others			5,000.00
Total Estimated Cost:			89,161.00

Services and Hosting Budget

Details the list of service provider along with its monthly fee and total amount.

Table 4.7 Services and Hosting Budget

Service	**Provider**	**Monthly Fee**	Amount
Internet Connection	PLDT	1399.00	9,793.00
Web Hosting	Hostinger	499.00	499.00
Total Estimated Cost:			10,292.00

4.8.2 System's Operation Cost in Development

The system's operation cost in development covers expenses for creating and maintaining the proposed System. This includes costs for hardware, software, services, and other resources needed during the development phase. Proper budgeting and management of these costs are crucial to keep the project on budget and achieve its goals.

Estimated Budget when Deployed

Below is the Web Hosting that will be used to deploy the system along with its price and plan.

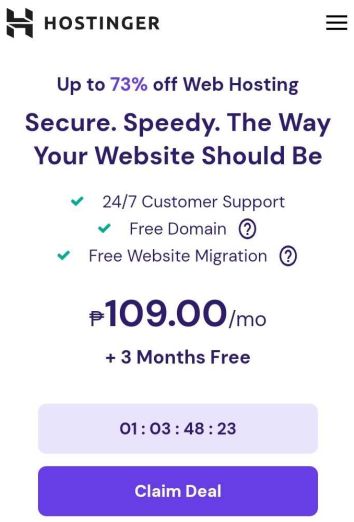

Figure 5.2: Hostinger Cart

Table 4.8 Estimated Budget when Deployed

Service	**Provider**	**Monthly Fee**	Amount
Internet Connection	PLDT	1399.00	16,788.00
Web Hosting	Hostinger	499.00	7,291.00
Total Estimated Cost:			24,079.00

4.9 Verification and Validation

4.9.1 Verification

Verification methods are again very important in as far as security and reliability of tricycle pooling is concerned. Therefore, through having strong verification procedures put in place ensure the platform is credible to the users. It allow passengers to keep safe as well as safeguard the drivers on the roads there and then. When it comes to verifying the system before implementing it in the IT structure of a particular firm, several questions need to be answered: showing the work to the client and panelists during the defense there are a number of things that we did right, reliability and functionality. Besides illustrating complete functionality and capabilities of the system, there is a number of crucial so as to perform adequate low level testing in order to find out such problems and fix them. These are unit testing, integration testing, as well as system testing, to verify how the system behaves based on the various inputs that are fed to it. Furthermore, it is crucial to provide detailed information of the system, its architectural design and the decisions that thus leading to its design and its working for making usable information and a clear output available to the stakeholders. Furthermore, a presentation can be also employed in improving the performing and addressing any last-minute adjustments. Finally, the last step involves asking other users or even professional designers regarding their opinion on the design can be useful for the purpose of further improvements and enhancements in a given subject. These additional steps contribute from a simple validation to an elaborate validation process that helps verify that the system is as per the expectations of both the client as well as the panelists.

4.9.2 Validation

The system also went through validation mechanisms where the actual system or the system modules were subjected to the test; whether it was capable of meeting the defined user requirements or not. The validation was done using surveys as well as interviews. The survey questionnaire was developed and consisted of questions borrowed from ISO 25010 software quality standard model, and was assessed by the clients using the 5-point Likert scale in order to respond to the above questions. The clients or respondents of the study were the tricycle drivers of Bulan, Sorsogon. The table mentioned above shows the 5-point Likert scale adopted as the index of the characteristics validating the system. It included the rating, the mean range as

well as the verbal rating.

Table 4.9 Likert Scale

Rating	**Mean Range**	**Verbal Interpretation**
5	4.21 - 5.00	Outstanding
4	3.31 - 4.20	Very good
3	2.61 - 3.30	Acceptable
2	1.81 - 2.60	Needs Improvement
1	1.00 - 1.80	Unacceptable

4.10 Testing Strategy

The process of testing is considered to be one of the most important elements in the development of the TricyPool. It encompasses the ability to determine the effectiveness of the system in a given mode. Usability, accessibility, functionality, and quality to deliver the best possible online performance to the user. Some of the activities that are used to test the ideas include the following: phases including the unit, integration and user acceptance testing phases respectively. Unit testing is basically aimed at testing parts or sub systems of the system that can be tested to check on their functionality that is required for the system. Integration testing verifies how the varied elements of a system connect to other placed in order to operate harmoniously. User acceptance also in testing methods, real user acts as test users to see whether the system is usable and if there are any problems.

Table 5.0 Testing Strategy

System	**Tricypool: An Online Tricycle Pooling System in Bulan, Sorsogon**
Test Module	• Registration • Login • Book ride • Facilitate Passenger Sharing
Access Requirements	Log-in Credentials: • Name • Email • Phone Number • Password • User Type (Admin/Passenger/Driver)
Goal of the Test	To check if the system can accept booking from passenger. And to test if they can facillitate a passenger matching.
Out of Scope	The functionality of the client of SB MTOP login process in the testing is excluded.
Additional Requirements	• System will provide clear data error for invalid inputs. • System will ask the user to provide information regarding on their ride details.
Testing Steps	• Pull up any browser listed on the device section. • Open the Tricypool URL. • Check if you are redirected to the log in page and provide the login credentials. • Check if you are redirected to the map (home). • Tap the "Looking for the nearest driver button" • Tap the profile of the driver that you want o book. • Provide the needed details on your reservation. • Press the "solo-ride booking confirmation" if you want a solo-ride or, • Press the facilitate passenger matching" confirmation button, and press "yes" to proceed.
Device	A desktop computer is the target device for the admin and mobile phone for drivers and passengers. While in software required by the client is a Web browser (Chrome, Firefox, Safari)

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