

**PAY AS YOU PARK SMART PARKING SOLUTION:
SUGGESTING OPTIMAL PARKING YARD TO PARK**

2021-198

Project Proposal Report

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Sri Lanka Institute of Information Technology

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Declaration

We declare that this is our own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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ABSTRACT

Parking in urban cities is the most difficult task for drivers. As the result of high population; number of vehicles in the road also gradually increased. As a result, finding a correct parking place is a difficult task for most of the drivers as the result of unavailability of spaces. Proposed system provides an optimal and accurate suggestion for drivers to find the correct parking yard for their vehicles based on distance, physical characteristic of vehicle and availability of free spaces in that parking yard. Hence the system predicts the availability and distance drivers will receive the most optimal solution for their parking. This system also provides a service to direct users for the selected parking yards. Control of fuel wastage and emission of Carbon Dioxide are environmentally impacting of the proposed system. And, this proposed system will save the users time wastage on streets.

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1. INTRODUCTION

1.1 Background and Literature Survey

The concept of smart cities and smart technology is rapidly growing with growth IoT. As a result, smart parking systems also introduced to the urban areas. But still most of the users find it is hard to find the optimal and accurate parking yard to park their vehicle. Negative effect of this scenario is rapid environment pollution, wastage of fuel and high traffics in urban areas.

Though there are newer technologies available today the present parking system fails to overcome by providing optimal results [3]. Finding the correct parking yard to park the vehicle is still a hard task to most of the users. Impact of higher growth of population can be seen on urban cities as high traffics. Most common reason for this is unethical and illegal parking practices that are followed by the drivers as they could not find the accurate and optimal parking places to park their vehicle.

Parking is an essential task that need to be performed by every driver when they go out from their residences. The result of survey conducted depicts most of the users use parking yards to park their vehicle as shown in the Figure 1.1; This also indicates that users are more considering about the security when they going to park. As shown in Figure 1.2 which depicts that majority of the drivers are facing difficulty in finding the correct parking yard. This will lead drivers to stress and being tired.

Although there are few smart parking systems used among the users, the result data collected by the conducted by the survey shown in Figure 1.3 illustrates that users are not satisfying on its performance and accuracy. Smart parking solution with optimal and accurate parking yard suggestions is a necessity in urban areas.

Optimal and accurate smart parking suggestion can reduce the wastage of fuel consumption and generally it will reduce the unusual traffic condition in urban areas. Also, this will reduce air pollution done by vehicles, with reducing the emission of Carbon Dioxide gas to the environment. Users can reduce the time wasted on streets to find a parking yard to park.

How often you are using parking yard for parkin

24 responses

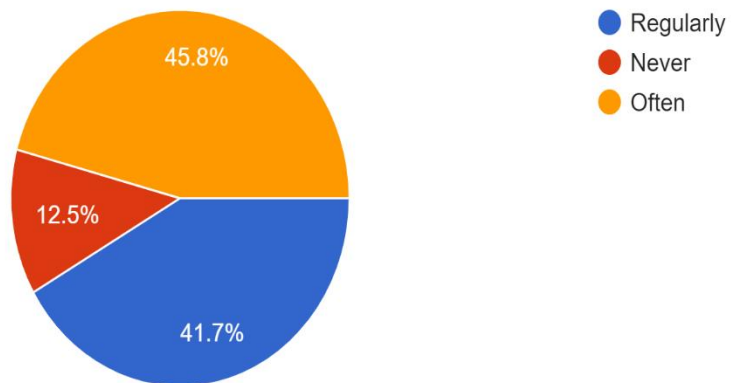


Figure 1.1 - How frequent people use parkin yards

Are you facing difficulty in finding a correct parking yard
24 responses

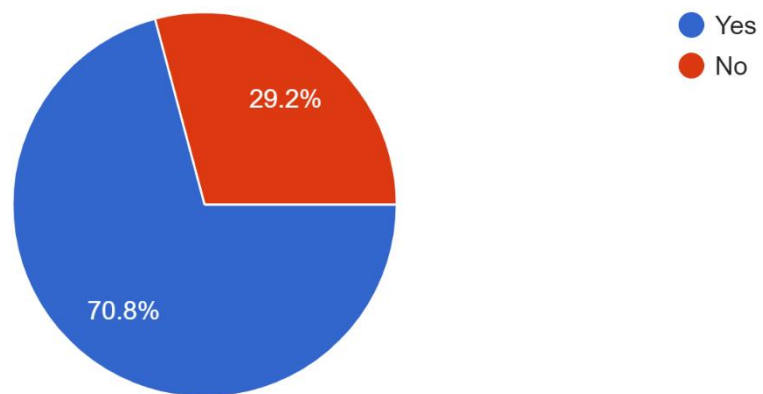


Figure 1.2 - Difficulty faced to find a parking yard to park

Are you satisfying on the app accuracy
24 responses

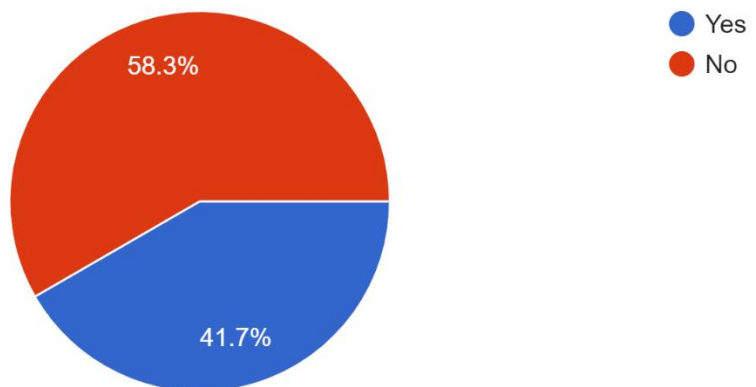


Figure 1.3 - Satisfaction of users on current app accuracy

Many researches have conducted to locate the nearest location of user. In a research conducted to locate the nearest police station, they have used Global Positioning System (GPS) device to identify the location of user. It works in any weather if the device has a clear line of sight to the satellites [2]. It indicates the GPS technology got a high availability in global. According to many authors GPS is a widely used technology to locate the current position of user, as in current smart world each one got a smartphone on their hands, it will be able to reach many users. A-GPS, Assisted Global Positioning System, works on the same principles as the GPS [2]. The main difference between these are A-GPS obtain the user coordinates via assistant servers while GPS coordinates with satellites directly.

Google Map is a service provide by Google; many researchers use this tool to digitally visualize the locations to the users. Just after the closest location is found, the coordinates of this location is sent on Google Maps [3]. And, Google Map API provides different service to integrate with the map. Direction to the location service API is used by many authors to direct user to the destination.

Authors have been many Machine Learning algorithms to find the nearest parking location to the user. They have used the user current location coordinates which retrieve by using GPS and A-GPS. In a research conducted to identify the nearest medical service provider, they have used algorithm called TOPSIS to get information about nearest medical service provider. TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) algorithm is a multiple-criteria decision-making algorithm [1].

The Haversine theorem is used to calculate the lengths of two points on the surface of the earth based on latitude and longitude [4]. This research was conducted to find the nearest mosque for a user. Author have used Haversine theorem to identify which is the nearest to the user.

Ahuja-Dijkstra's Algorithm is to calculate for routing analysis to find the shortest route to reach the nearest facility [5]. In the reading it is noticeable that Ahuja-Dijkstra's Algorithm is mention by majority of authors in order to find the shortest path from current location to destination.

As per the above mentioned reading main component of a smart parking system is identifying the most appropriate parking yard to park. By suggesting optimal solution to park, it will be benefit for both users and the environment.

1.2 Research Gap

There are many facts that need to be considered when suggesting a parking place to a driver. In the present parking systems researchers have only considered about the distance. As it mentioned in the research A [3] author has built up the parking suggestion using K-Nearest Algorithm.

From the information gathered in survey and analyzation, identified that following variables must be considered when finding a optimal parking yard for a driver.

- Distance
- Availability
- Physical characteristics of vehicle

In the research B [1], research conducted to identify the nearest medical service provider, author have mentioned about the availability term. But in the scenario of smart parking it has to consider about a new algorithm to find out the availability of free parking spaces in each and every nearest parking yards.

Research C [6], is consider about individual parking slots. In that proposed system they are considering the availability of free slots, but they are not considering about the other main facts.

When we consider about availability when user reach the parking yard without pre booking it, in a busy time the slots may get already filled. To avoid those kind of unfavored situation we decided to optimize the suggestion by using the future prediction also, in here it will give the suggestions by considering the number of vehicles that may come to the parking yard with that particular period time of the day. We will provide must accurate and optimal suggestions to our users to park their vehicle.

Table 1.1 shows the summarized details in tabular format.

Table 1.1 - Comparison of Former Researches

Product	Distance	Availability	Physical Characters	Optimize suggestions
Research A	✓	✗	✗	✓
Research B	✓	✓	✗	✗
Research C	✗	✓	✗	✓
Pay as You Park Smart Solution	✓	✓	✓	✓

Pay as You Pay Smart Parking System introduced most accurate and optimal parking yard suggestions to the users than the existing systems available.

1.3 Research Problem

In day to day life when people go out for their need with their vehicle, they need to park the vehicle some where it is secure and near to the destination place. Most of the drivers prefer and use parking yards to satisfy their needs. But when we consider about the availability of free spaces in that parking yard, driver need to be aware of the availability. Otherwise driver must find another parking yard repeatedly. This scenario impact in fuel wastage and unusual traffic jam in urban areas.

Also, drivers always prefer to park their vehicle near to their destination. To provide an optimal suggestion, it must suggest the nearest available parking yard to park. Different vehicle got different physical characteristics. It is needed to be consider about the physical characters like height, width, and length because there may be some constrains related with the parking yards. When providing suggestions to drivers we need to consider about those constrains and provide the suggestions, else drivers have to find another parking yard to park. This will cost time and as well as wastage of fuel.

2. OBJECTIVES

2.1 Main Objectives

The main objective of Pay as You Park Smart Parking solution is to provide optimal and accurate parking yard suggestions to users to securely park their vehicle effectively. With this proposed system users can save their valuable time and fuel. And also, with the introduction of optimal parking suggestions; unusual traffic conditions in urban areas will get reduced.

Since smart solution plays a major role in society, when users get used to this system, difficulty faced to park their vehicle will be reduced. This fact clearly demonstrates that drivers can avoid illegal parking in streets, and this will help to reduce the street traffic in urban areas.

2.2 Specific Objectives

- Implement a user-friendly mobile application which support cross platforms to demonstrate the maps and directions. Introduce rich User Experience with the application
- Identify the nearest and available parking yard to the user's destination. As a initial process, have to retrieve the nearest parking yard for user's destination or location as the preference.
- Implement an algorithm to identify the vehicle physical characteristics and filter the option which the vehicle can be used. Assume that vehicle height over than the height of entrance to the parking yard system will remove that yard from the suggestions.

- Implement an algorithm to identify the availability of free spaces in parking yard.
This is the mandatory objective which will filter out the available parking yards and suggest to user. Finally, user will receive most accurate and appropriate suggestions.

3. METHODOLOGY

The proposed “Pay as You Park” smart parking solution has the capability of read user’s current location and suggest user an optimal parking yard to park the vehicle based on the distance, availability, and physical characteristic of vehicle. And, maps and directions to the users will be graphically visualized to users.

- **Retrieving the current location User.**

GPS related technology will be used to fetch the user’s current location in longitudes and latitudes from their smart phones. For graphically visualization it will be used Google Map API to indicate user’s current location in map and map will be rendered to the user interface.

- **Identifying nearest parking yard to user destination or location**

With the use of existing available algorithms like Haversine algorithm it can be identified the nearest parking yard within the user radius. Those identified location will be filtered according to availability of slots and by considering physical characteristics of vehicle using an algorithm implemented for this specific functionality. Considering the estimated time, day of the month and time period it is needed to be get the prediction of number of vehicle that would fill the slots. We can use a suitable machine learning prediction algorithm to achieve this task. Filtered parkin yards location coordination will be rendered to map using Google API.

3.1 System Architecture

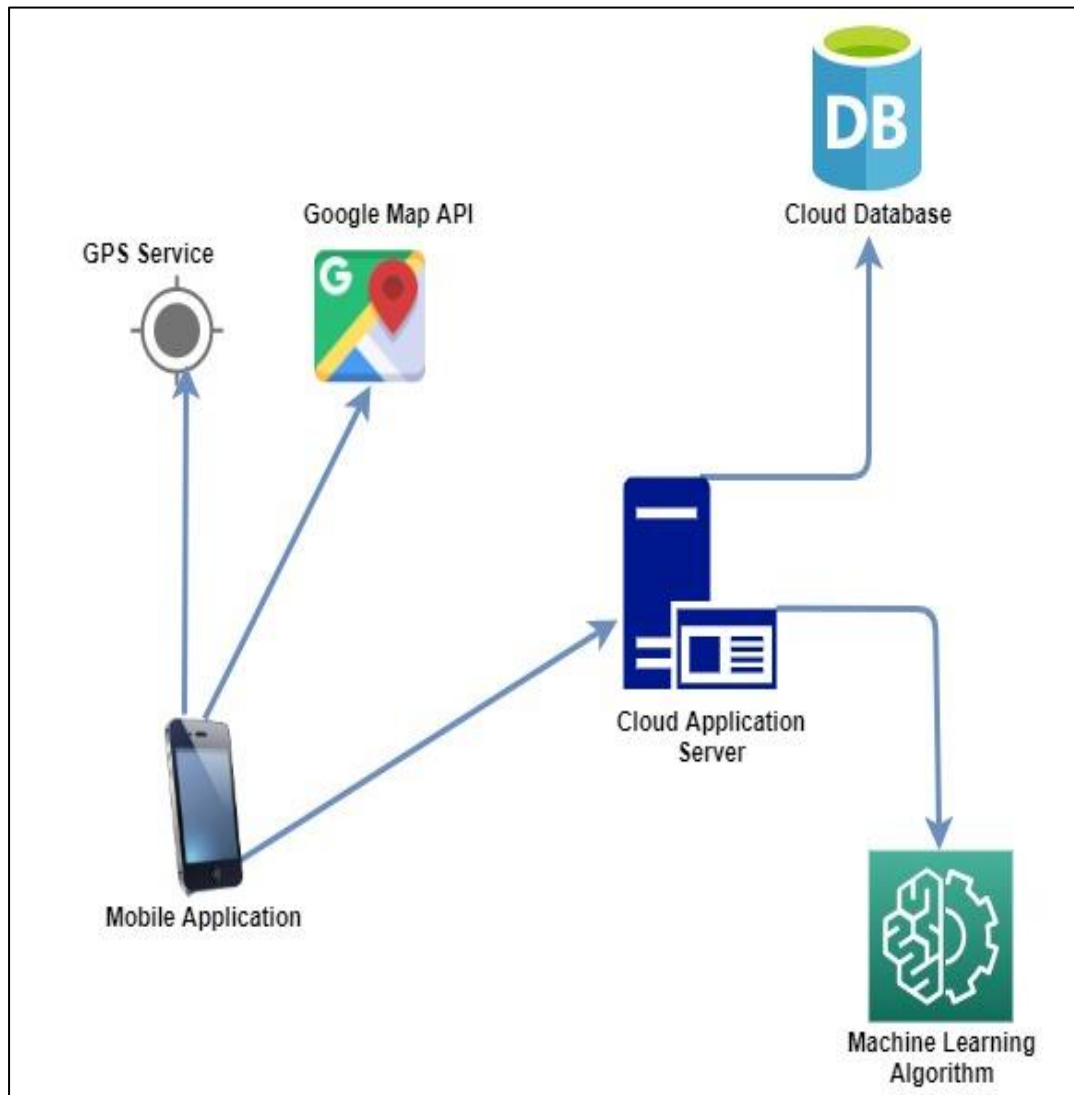


Figure 3.1.1 – System Diagram

3.1.1 Software Solution

Software development process of proposed system is following agile methodology as the software development life cycle. Scrum methodology used to follow the agile development process. Agile methodology is one of the leading software developments life cycle method which is used in industry. Agile advocate adaptive planning, evolutionary development, and continual improvement. Agile method includes and take the requirement arise within the development process and development need to adapt new requirements.

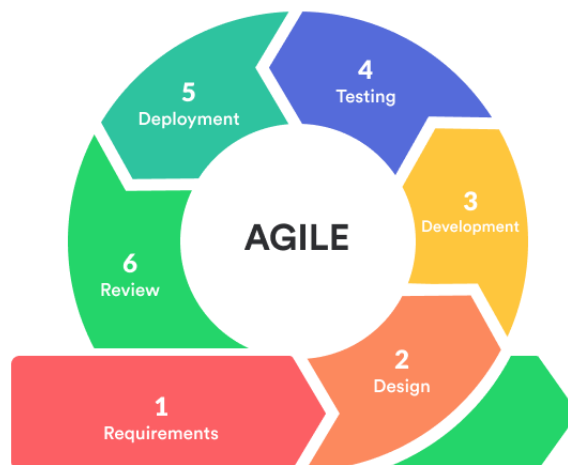


Figure 3.1.1.1 – Agile Development Cycle

- **Requirement gathering and analysis.**

This is the first phase of Software Development life cycle. Requirements were gathered using conducting survey result and evaluating existing researches. Survey conducted manipulate the need of an optimal parking system to users. Through the existing researches identified the gaps and user requirements in modern society is evaluated.

- **Design and Implementation**

Implementation phase consist two major application. We will be providing a mobile application for drivers or regular users to perform parking operation and a web desktop web application will be provided to parking yard owners to perform parking yard related operations.

- **Cross platform mobile application**

Using the mobile application, users will be providing the functionalities to search and book parking slots. Flutter is cross platform mobile development platform which support android and IOS which provided by google. It will be easier for developer to handle both main mobile operating system using flutter. Smartphone contains GPS services which can locate the current user location, GPS technology will e used to get the location coordinates of user and for visually demonstrate the locations and direction Google map API tool will be used. Google map API tool also provide other different API services related to map service like directing users to the destination.

- **Web application development**

Final product consists a web application which will be using by parking yard owners. Management of parking yard and generating basic reports will be available for parking yard owners through this web application. React is leading front end library provide by Facebook, where developers can handle dynamic and responsive web views. And for the back-end service we will be using Express.js , which also a leading framework in the industry related with react provided by Node Package Manager.

- **Database Handling**

Cloud related database will be used to store data and maintain data. Thousands of data needed to handle for that we will be using a cloud related database. MongoDB is a NoSQL document-based database provided by Atlas. MongoDB uses aggregate query method to retrieve data. Data stored in database as document in JSON format. Also, when consider about performance and availability MongoDB process a high speed and availability.

- **Deployment**

- **Node Package Manager**

Node Package Manager (npm) is the package for Node.js platform. Each and every model used in RECT development will be inside this Node Package Manager. External libraries and packages will be handled through Node Package Manager. It is an open source platform which contain more than 80,000 code packages, also considered as the world's largest software registry.

- **Cloud Application Provider**

Among the cloud service providers Azure and Amazon Web Services are leading in the industry. Spring based Java Application will be hosted to the cloud and connect to the system using API. Azure is owned and maintained by Microsoft. It supports variety of technologies including Java, JavaScript and .NET, also it provides multiple services like database service and API services. Using Azure REST API front end application will communicate with cloud server. Azure machine learning platform provide ML as a service which is used to build, train and track models.

4. DESCRIPTION OF PERSONAL FACILITIES

4.1 Internal Navigation in Parking Area

Implement a navigation guide to park the vehicle inside a parking yard will be given to the drivers using mobile application. Beacon is a web-based GIS and web-based reporting tool, using that technology it is able to create a map for inside navigation of parking yard. User will be guided to the free nearest slot that is suitable for the vehicle.

4.2 Suggest an optimal parking plan for the parking yard

Implement provide an optimal parking solution to the parking yard owners they have to provide the images of parking yard. Functionality to upload image will be given in the web application, images will be process and validate using image processing and machine learning algorithms. Final output includes a plan for the parking yard owners to arrange their parking yard in more beneficial way.

4.3 Find the availability of free parking spaces inside the parking yard

Test and evaluate the availability of free spaces in a parking yard by identifying empty parking slots using CCTV video processing and machine learning algorithms. Resulted data will keep the cloud database on update with the parking slot availability.

4.4 Suggesting Optimal and accurate parking yard to the vehicle

Implement the functionality to identify most appropriate and optimal parking yard for the vehicle based on the user's destination, free slot availability and physical characteristics of vehicle. Mobile application will be design by providing graphical visualization of location of user and the optimal parking yard's location. Using Google Map API tools, map related functionalities will be implemented.

5. GANTT CHART

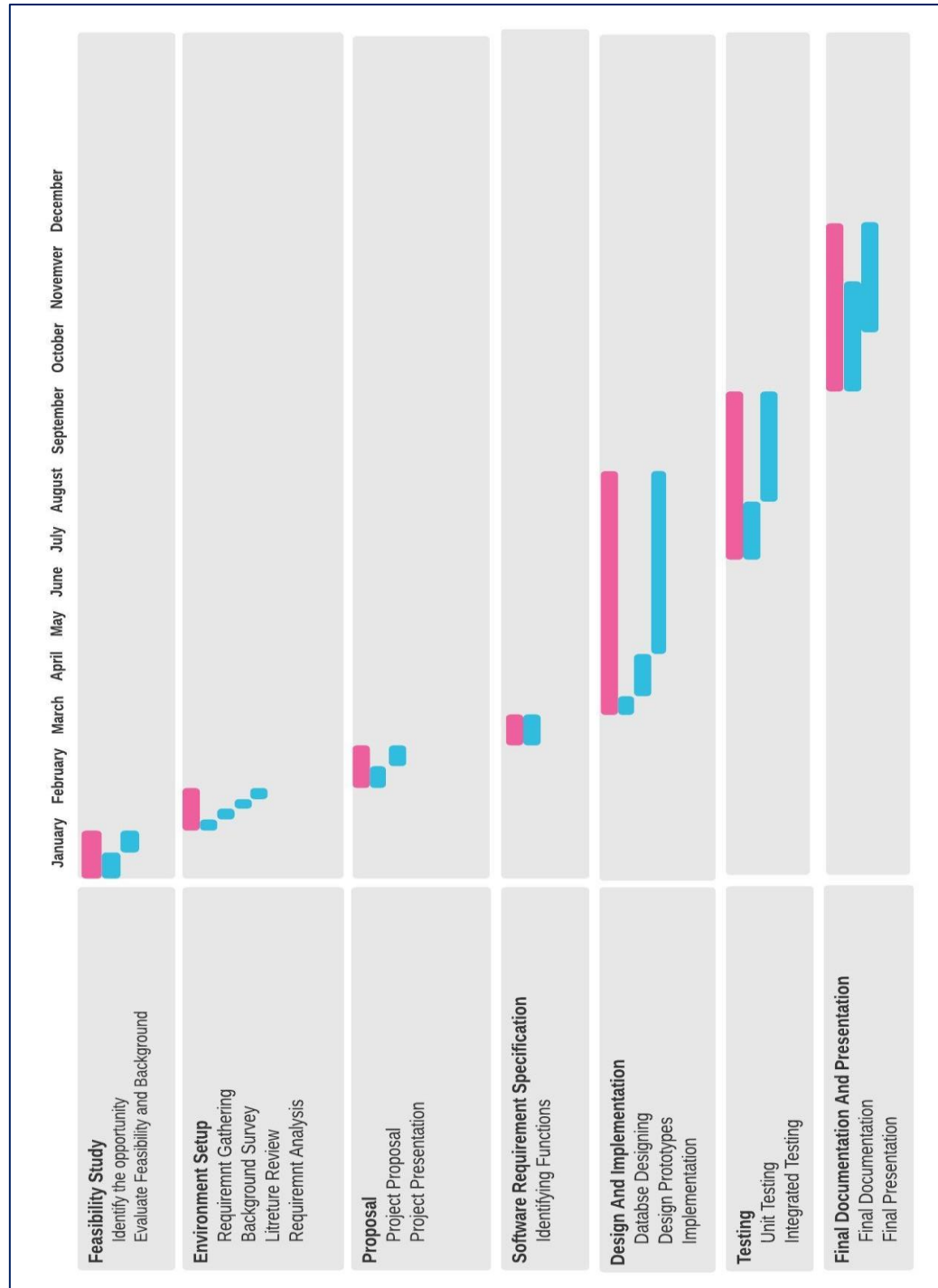


Figure 5 – Gantt Chart

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