Applied Information Technology And Computer Science Vol. 2 No. 2 (2021) 1199-1217

AITCS

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/aitcs
e-ISSN :2773-5141

MYLORRY: An Android Based Mobile Application for Lorry Transport Services

Shivashakthi Krishnan, Suhaimi Abd. Ishak*

Faculty of Computer Science and Information Technology, Universiti Tun Hussein Onn Malaysia, Parit Raja, 86400, MALAYSIA

DOI: https://doi.org/10.30880/aitcs.2021.02.02.075
Received 01 August 2021; Accepted 14 November 2021; Available online 30 November 2021

Abstract: Transportation can be considered as a competitive major contributor for the economy in terms of business. In particular, lorry transport service industry is huge, diverse and very competitive industry worldwide as there are various type of lorries that will be needed based on the cargo which being transported. However, lorry transport companies have very few platforms to promote their lorry transport service. MyLorry application is a mobile application designed and developed for lorry transport services on Android. It is a systematic application used for online lorry transport service for Malaysians that needs to book lorries with affordable price to transport bulk cargos for business or personal reasons. In addition, it serves a Management Information System for lorry transport service companies. This project applies Object-Oriented System Development (OOSD) Methodology. An object-oriented software consist of a set of objects that interrelate with one another. The application consists of three modules which are Admin module, Lorry Owner module and Customer module. Testing such as user acceptance testing and functional testing has been carried out on this application at the end of this project to ensure this application has fulfilled the objectives and functionalities. This application benefits lorry companies in handling the online transport service management and helps customers to find suitable lorries services with affordable price.

Keywords: Lorry, Mobile Application, Transport services, Booking, Rental

1. Introduction

Transportation can be considered as a competitive main backer for the economy in terms of business. It substantially associates the business to its supply chain, for instance suppliers and customers, and is a major stimulus on the customer's contentment with the company [1]. By moving goods from locations where they are sourced to locations where they are demanded, transportation provides the essential service of linking a company to its suppliers and customers [2]. Lorry is a motor vehicle designed to transport cargo. Cargo could be described as utilities being produced for commercial gain. Commercial lorry can be very large and powerful and may be configured to be mounted with specialized equipment. This MyLorry mobile application is an online lorry transport service booking application for Malaysians that require lorries to transport bulk cargos for business or personal reasons.

*Corresponding author: suhaimiabd@uthm.edu.my

It will function where the lorry owners can easily handling the order by only using the system rather than manually and customers also can make early booking online for the lorry that they want to book. Having a system like this increases efficiency and reliability of the lorry transport service business process. This system also enables complete automation of the order process, cutting out the requirement for a middlemen so that customers deal directly with business owners, cutting out the need for operational staff. Having such a direct customer-business runner relationship increases the transport service business profitability

1.1 Problem Statement

Lorry transport service is one of the most competitive business as there are many lorry companies that wants to expand their business by gaining more customers. For new lorry owners, it will be very difficult to survive in this competitive industry without promoting their business online. Conventionally, when a customer or companies need lorry transport services, they will have to contact several lorry owners they know or through online advertisement on website. However, it will be a long and difficult process to find lorries that are available when the delivery time is around the corner.

In addition, it might take longer time to arrive for the lorries that are farther from pick up location. Part of the reason why is due to the tedious process of ordering a lorry transport service. Many customers find that the current manual system being used for lorry transport service is inefficient and obsolete, so much so that it dissuades them from booking altogether. Additionally, being completely manual, it requires a customer to provide documents needed such as invoice, delivery order and etc. in person.

Thus, it is necessary to have a mobile application to find lorries that will be able to deliver cargos efficiently. Our project was developed to provide a convenient platform for Malaysians and lorry companies for easier record and book a lorry for delivery service. The process is to be done fully online digitally, requiring no manual submissions by the customer. The target customers of the system are Malaysians. Our system will provide a comprehensive system that allows customers to easily and conveniently order lorry transport services. The target customers for this system are lorry owners, who can register their lorry details, driver details and promote their lorries through promotions to attract customers.

1.2 Objective

The objectives of the project are as follows:

i. To design a proposed mobile application for lorry transport services named MyLorry based on its users' requirements.

ii. To develop the proposed MyLorry application using appropriate methods and tools.

iii. To evaluate the proposed MyLorry application, whether it meets user specifications and works as expected.

2. Related Work

In order to develop the lorry transport service mobile application, literature survey has been done in order to ensure that the system developed reflects both the advantage and disadvantage. There are several research that has been done on other existing systems to ensure that the development of the project runs smoothly by reviewing the advantages and disadvantages of other systems. The literature review also discusses the difference between the existing technologies which has been use different method. Identified disadvantages in the existing systems can be used as a guide in order to be avoided by the MyLorry Application. The advantages of these systems also provide guidance to improve the quality of the system. In addition, there is a way to obtain an idea to introduce new elements which makes the MyLorry different and much more interesting than the existing system. There are some

existing systems which are related to the proposed systems. Three existing systems were chosen for comparison, which are the TheLorry, LalaMove, eTRUCX, JustLorry and MyLorry2u. The comparison between the proposed system and the 5 existing system is structured in Table 1.

2.1 Supply Chain Management

In today's hypercompetitive environment, a business organization can no longer operate and survive alone [3] [4]. Due to globalization, an organization should be an open system and relative to supply chain. Thus, logistic functional efficiency which affect the level of success of supplier implies that logistic is one of the key elements of Supply Chain Management [5]. Since logistics is a wide range of area responsible to transport products and services, the importance of logistics is further established in the context of supply chain management (SCM) as the flow of activities infers that an extent of integration between activities needs to exist [6].

2.2 Android Operating System

Android is one of the modern open source mobile operating system that is widely used globally mainly because of its flexibility and functionality. Android operating system can be defined as mobile operating system that is based on Linux Kernel, Google developer and Open Handset Alliance. In mobile device market, Android operating is used not only by phones and even tablets, netbooks, game devices from numerous brand with their own touch unlike iOS which is used to release Apple brand products only [7].

2.3 Study of Existing Related System

Table 1: Comparison table of the existing system

System / Features	TheLorry Mobile Application	LalaMove Mobile Application	eTRUCX Website	JustLorry Mobile Application	MyLorry2u Website	MyLorry Application
User Module	Customers, Lorry Owners	Customer, Drivers	Customers, Lorry Owners	Customers, Lorry Owners	Customers, Lorry Owners, Affiliate	Customers, Lorry Owners, Admin
Platform	Android and iOS mobile application	Android and iOS mobile application	Website.	Android and iOS mobile application	Website	Android mobile application
Delivery Track Status	Yes	No	Yes	No	Yes	Yes
Login and Register	Yes (Using email id and password)	(Using email id and password)	(Using email id and password)	Yes (Using username and password)	Yes (Using email id and password)	Yes (Using username and password)
Notification	Yes	Yes	No	Yes	No	Yes

Table 1: (cont.)

System / Features	TheLorry Mobile Application	LalaMove Mobile Application	eTRUCX Website	JustLorry Mobile Application	MyLorry2u Website	MyLorry Application
Chat Feature	No	Yes	No	Yes	No	Yes
Price negotiation	Not available	Not available	Not available	Not available	Not available	Available

3. Methodology/Framework

Methodology explains the systematic, theoretical analysis of methods applied to develop MyLorry Application. It encompasses theoretical analysis of process and principles associated with a branch of knowledge. In this chapter, the development process of website will also be discussed in more detail. MyLorry Application is developed using Software Development Object Orientation methodology approach or better known as Object-Oriented System Development (OOSD) methodology.

3.1 Object-Oriented System Development

An object-oriented software consist of a set of objects that interrelate with one another. OOSD is a user case driven approach that emphasizes object-oriented requirement analysis, object-oriented design and object-oriented implementation as three major phases because of the impact they have on development of system [8]. Object- Oriented Analysis analyses the user's need through methods and translate it into system and user requirement. Object-oriented Design plans a system of interacting objects to solve software problem [9]. Object Oriented Software Development (OOSD) comprises five phases such as planning phase, analysis phase, design phase, implementation phases and testing phase to develop a complete software system development.

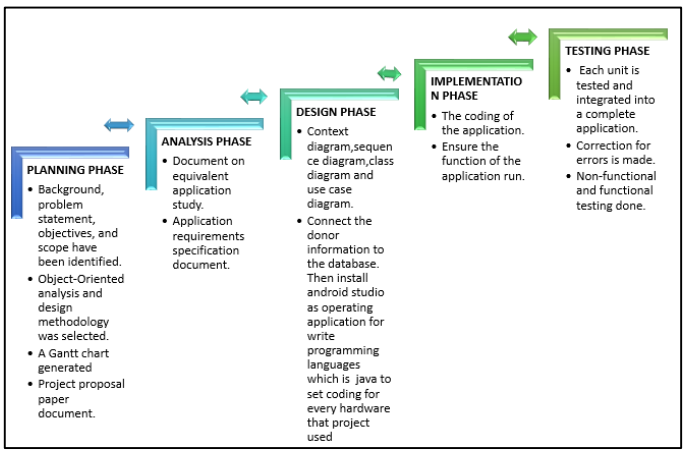

Figure 1: Phases of Object Oriented Software Development implemented in proposed application.

3.1.1 Planning Phase

This section discusses the planning phase which is the first phase initiated to identify the issues involved with the in the process of MyLorry application development. Firstly, the type and title of project has been decided which is Lorry Transport Service mobile application. Next, SSKD Lorry Transport Service and SS Devi Enterprise has been selected in accordance with the project title for the process of data collection such as problem statement, user requirement, system requirement, objective and many more. Structure and overview of MyLorry application was determined in this phase. This

phase proposed how the application need to be developed and helped to structure the testing process. The methodology to develop this application has been determined after problem statement, objective and scope is finalized. Gantt chart has been structured to determine time duration, progress and flow for each activity. According to the Gantt Chart structured, this project began on 1st September 2020 and expected to end on 30th June 2021 which is approximately 223 days. Then, the process of collecting information through observation, reference and research through the internet. All the information collected is included in title proposal document for approval.

3.1.2 Analysis Phase

Analysis phase is essential as it includes identifying, documenting the system requirement and defining classes and relationships before developing MyLorry application [10]. Detailed studies and surveys had to be done in pre-development process to prevent any mistakes in future. Hence, existing applications are observed and investigated in order to survey the improvements in the features that needed to satisfy the user requirement. Mobile application, data management and software management has been studied to gain more information that could be applied during the development of MyLorry Application. In order to find the system requirement, survey and interview has been carried out with stakeholders such as lorry drivers, users and lorry owners. Through this process, details regarding system requirement and system constraint has been identified. Observations also made to find the most needed types of lorries. Collection of lorry types information collected by meeting the lorry owners at KL. Reviews of applications, journals and reports are also studied to collect more data for this project.

3.1.3 Design Phase

During design phase, Unified Modeling Language which can be defined as standard language in model system will be developed based on requirements and data collected in analysis phase. Diagrams such as use cases, class diagrams, sequence diagrams and activity diagrams will be designed.This phase will emphasize the interface, theoretical approach, programming language, software and hardware that will be used in developing the application. After the UML is designed, the interface which consists of types of text, colors and images will be designed in simple and easy form to ease user from all ages. This phase determine type of database that will be used. Database would be designed to store data efficiently and consistently to prevent any error as it plays an essential role for an application.

3.1.4 Implementation Phase

.Implementation phase focus on each and every page of interface to ensure prototype building meet the user and system requirement. It also important to ensure the functionality and features of MyLorry Application complies the objectives of the application and project. The functions and features will be developed in Android Studio to ensure the project progress as planned. All the features and interface will be designed to ensure it's user-friendly for all groups of people in Malaysia. Graphical User Interface will also be considered and designed in an efficient way. Implementation benefits to measure the performance and reliability of the application to confirm the success of the project.

3.1.5 Testing Phase

Testing phase is the most underrated phase that need to be carried out more effectively. Once the implementation phase is complete, each unit will be tested to integrate it into a complete MyLorry Application. It comprises two parts which is functional testing and non-functional testing. Functionality test is a method to ensure all functionality of an application met the functional requirements specified in analysis phase. The non-functionality test refers to user acceptance testing where the stakeholders will test the complete application in the "real world" using real database. Testing phase is an essential phase to detect the vulnerability of the application and mitigate it before publishing it.

3.1.6 Maintenance Phase

In maintenance phase, system modifications and improvements are made based on user feedback and results from the testing phase. Modifications and improvements are carried out to meet the needs of users.

3.2 Hardware and Software Requirement Analysis

Data was collected from various source in analysis phase to create detailed specifications for MyLorry applications. Based on the requirements, data model would be generated to understand the system requirement deeper.

3.3 General System Architecture

The Figure 2 below shows the general architecture design of the MyLorry application. It shows that user will enter the interface of the application.

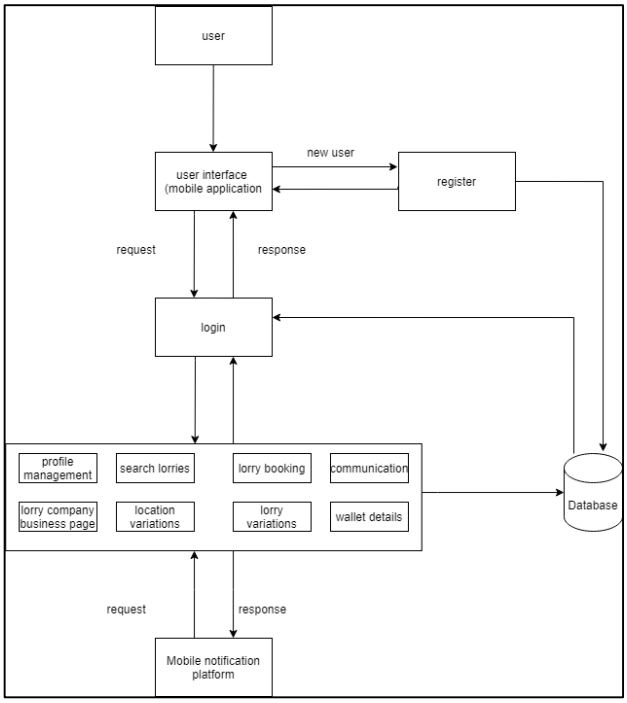

Figure 2: System Design Diagram

3.4 Requirement Analysis

Requirements are essential data definition of a system that need to be structured in order to develop a design for the system. System requirements analysis (SRA) defined as structured conversion process between the user's system need and the design concept energized by the organized application.

3.4.1 User Requirement

User requirement discusses about user roles when using the application, functional requirements discusses about features need to be in the application and system requirement provide a view on how the application should be built. The features and functionalities for MyLorry Application is discussed in user requirement. Table 2 below depicts the user requirement for the proposed application which is obtained through interview from users.

Table 2: User Requirements obtained from users.

No.	User Requirements
1.	User should be able to input the email and password for registration and login purpose.
2.	User should be able to reset their password.
3.	User should be able to manage their profile.
4.	User should be able to search the lorry companies
5.	User should be able to communicate with each other.
6.	User should be able to logout from the application.
7.	User should be able to cancel their booking.
8.	User should be able to negotiate the price.

3.4.2 Functional Requirements

A functional requirement can be defined that the function and capabilities existing in a system or its components. Functional requirements also describe a list of functions that the system must accomplish.

3.4.3 Non-functional Requirements

Non-functional requirements describe the overall attributes and qualities of the resulting system. This requirement usually specifies the criteria that can be describes as constraints to the application behavior.

3.4.4 Use Case Diagram

A use case diagram shows the interaction among the elements of a system. Figure 3 shows the use case of MyLorry application interaction among admin, customer and lorry owners system.

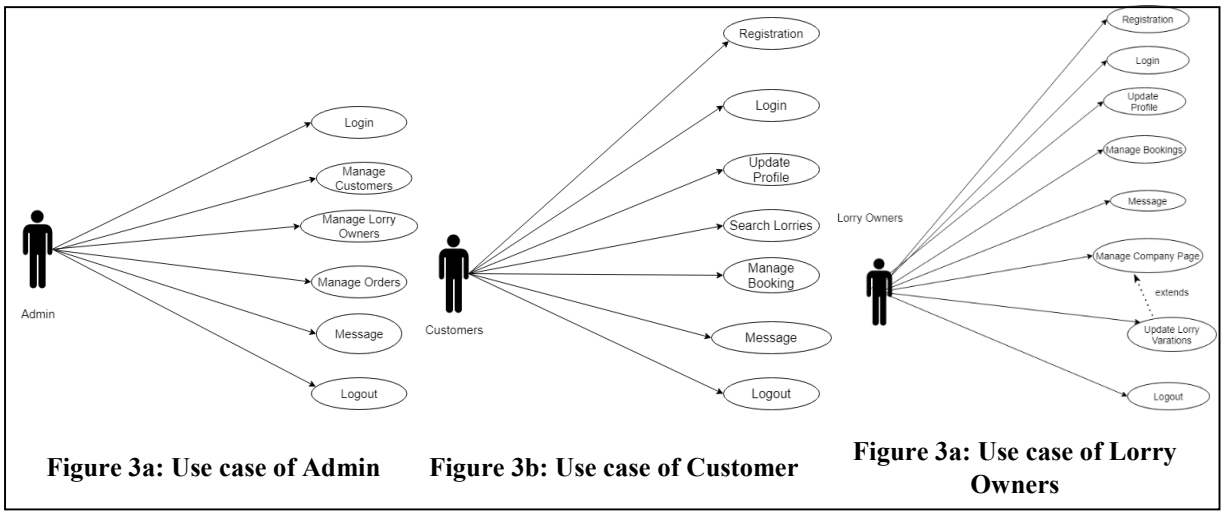

Figure 3a: Use case of Admin **Figure 3b: Use case of Customer** **Figure 3a: Use case of Lorry Owners**

Figure 3: Use case of MyLorry Application

Figure 3a shows the use case model of admin for MyLorry Application which define the interaction between the admin and proposed application. Figure 3b shows the use case model of admin for MyLorry Application which define the interaction between the admin and proposed application. Figure 3c shows the use case model of lorry owners for MyLorry Application which define the interaction between the lorry owners and proposed application.

3.4.5 Sequence Diagram (Register)

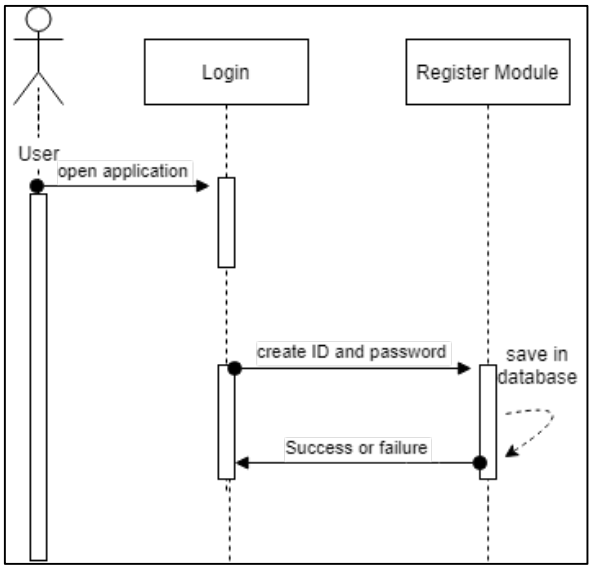

Figure 4: Register sequence diagram

Figure 4 shows the register sequence diagram module. If the user is new and needs to create an account, they will have to go to register page by clicking the sign up button. They will be redirected to register page where they have to create ID and password by inputting other required details as well. The data of the new user will be stored inside database. The page will redirect to login and user will have to login by inserting ID and password.

3.4.6 Sequence Diagram (Login)

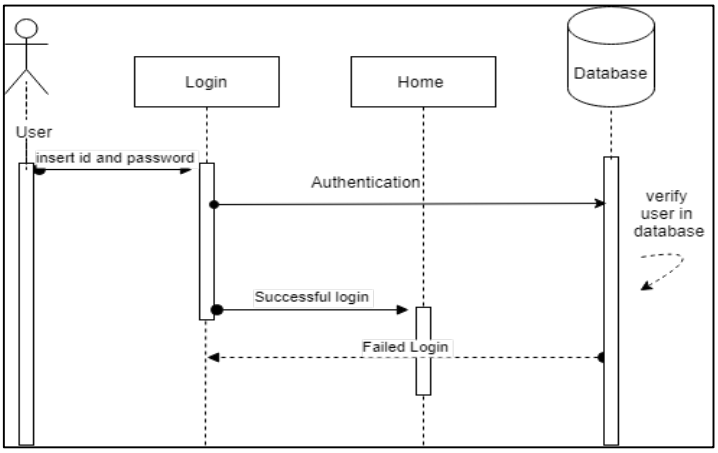

Figure 5: Login sequence diagram

Figure 5 shows the login sequence diagram module. When user enter id and password to login, they will have to be confirmed as verified user in database. Once the user is verified and the login is successful, they will be redirected to the home page. If the login is unsuccessful, the user have to login again by inputting id and password.

3.4.7 Sequence Diagram (Customer Booking Page)

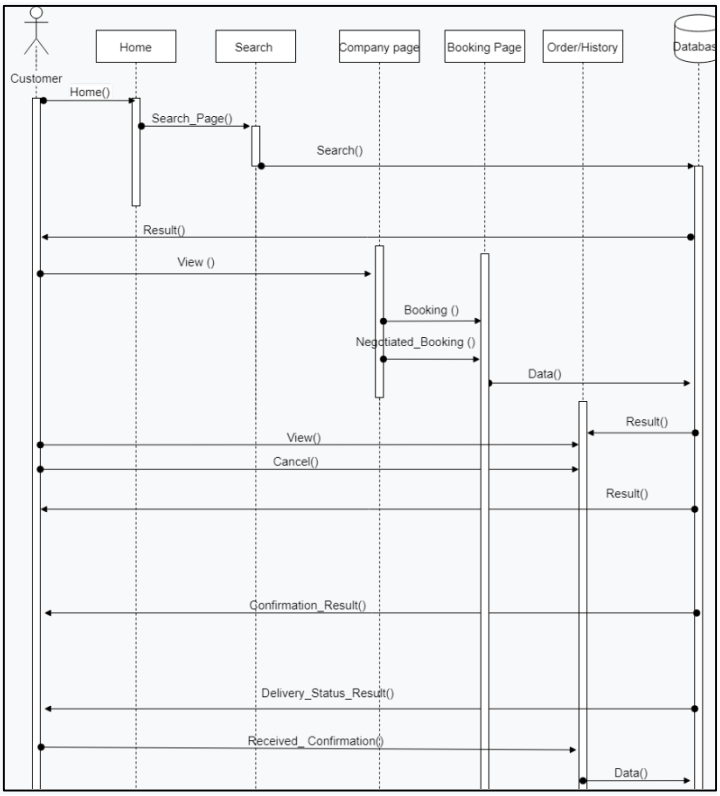

Figure 6: Customer Booking Page

In Figure 6, the customer booking page are shown. Customer can make booking by choosing the most suitable lorry, pickup and drop-off location along with pick up time and date. The customer can also enter negotiated price. After submitting the booking data, it will display on order/history page on users. There the customer able to view or cancel the booking if they want. The lorry companies will view the order and negotiate the price if they're available. If customers are satisfied with negotiation price made by lorry company, they can confirm the order with that lorry company. On the delivery day, customer able to track to know the delivery status of the lorry service. The customers also can search for lorries by searching in search page. They can view the company profile from the search result and make their booking with the specific lorry company.

3.5 Class Diagram

A class diagram static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations, and the relationships among objects. In a class diagram, the classes are arranged in groups that share common characteristics. Figure 7 shows the class diagram of the proposed application with the classes which includes Customer, Lorry Owners, Lorry, Booking, Payment and Admin. User is public user.

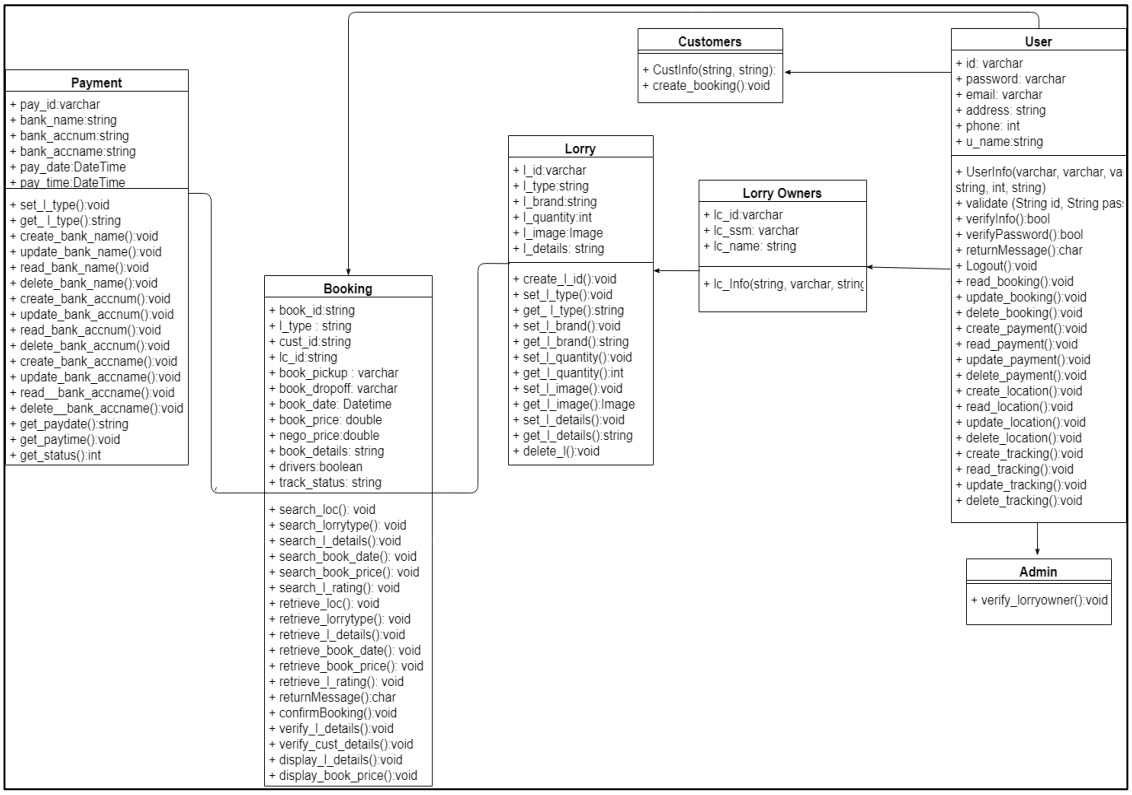

Figure 7: Class Diagram of MyLorry application

3.6 Activity Diagram

Activity diagram is one of the essential part in UML to explain the features of the system. Activity diagrams flows from one to another activity to clearly show us the navigational structure of the application. The activity box depict through rectangular boxes and diamond-shaped box shows the decision the box. The flow from one activity to another can be sequential, branched, single, concurrent and parallel. Activity diagram is a very important advanced version of flow chart that model the system. Figure 8 below shows the administrator's activity diagram for the MyLorry application.

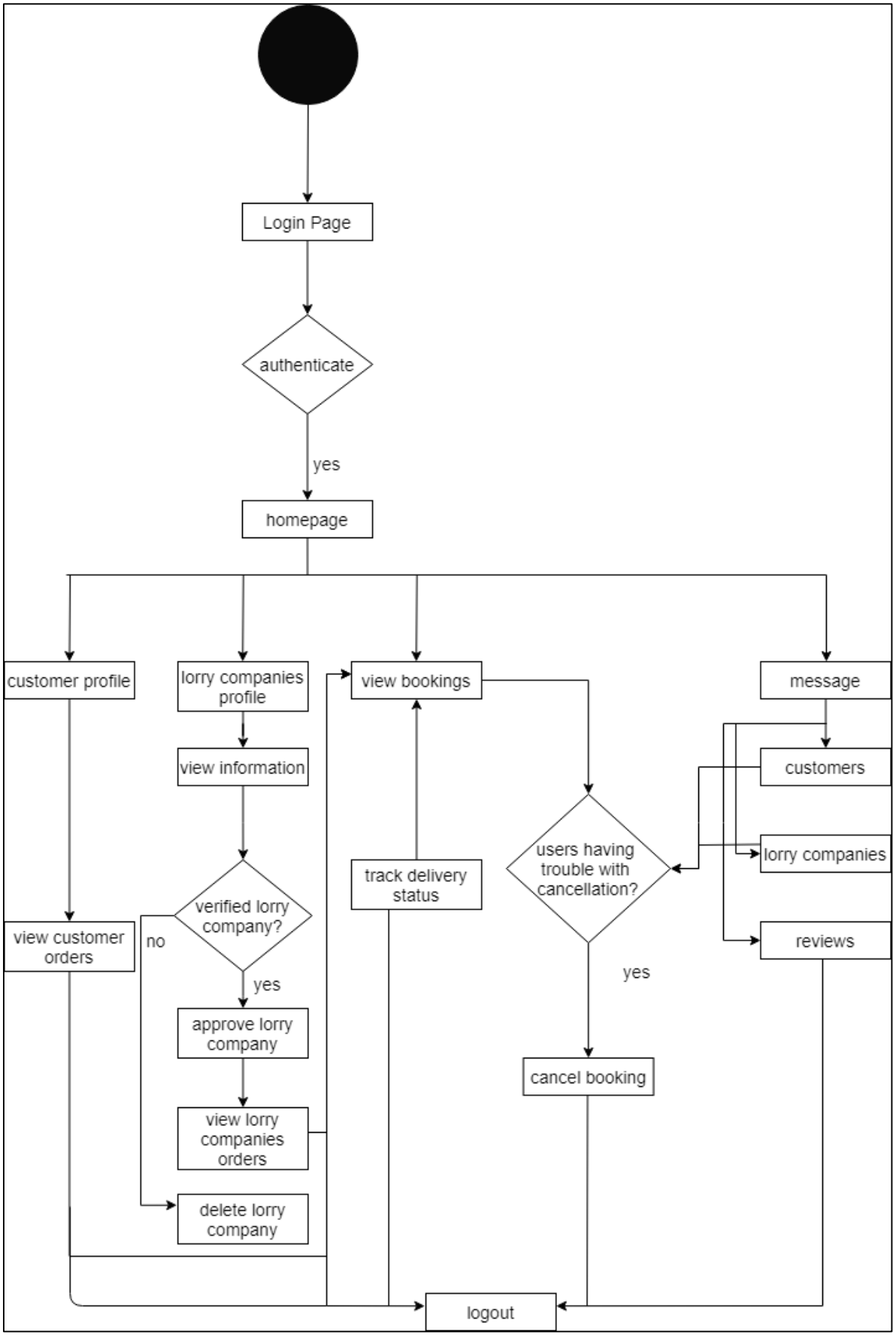

Figure 8: Activity Diagram of Admin

Figure 9 below shows the customer activity diagram for the MyLorry application.

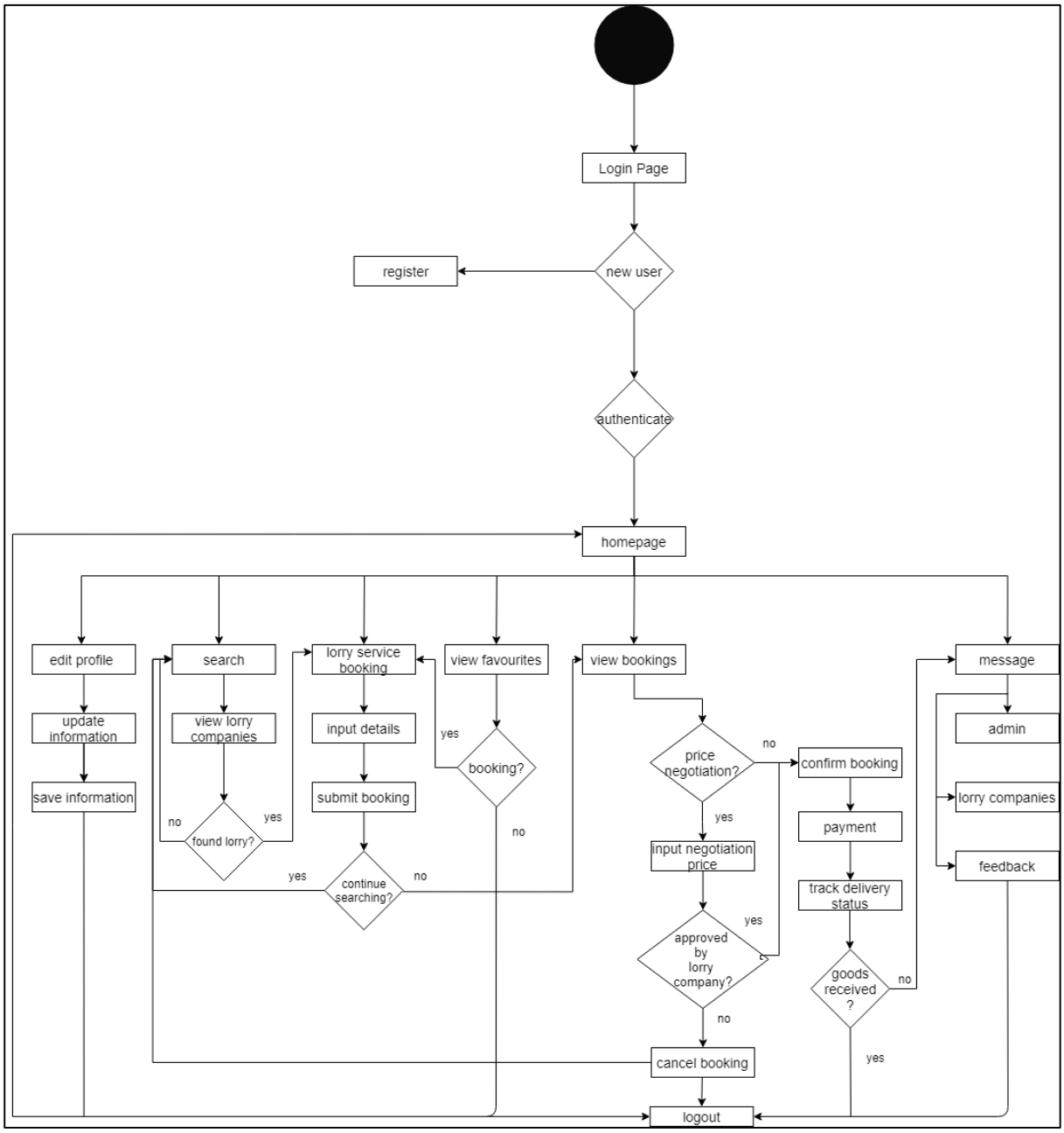

Figure 9: Activity Diagram of Customer

Figure 10 below shows the lorry company's activity diagram for the MyLorry application.

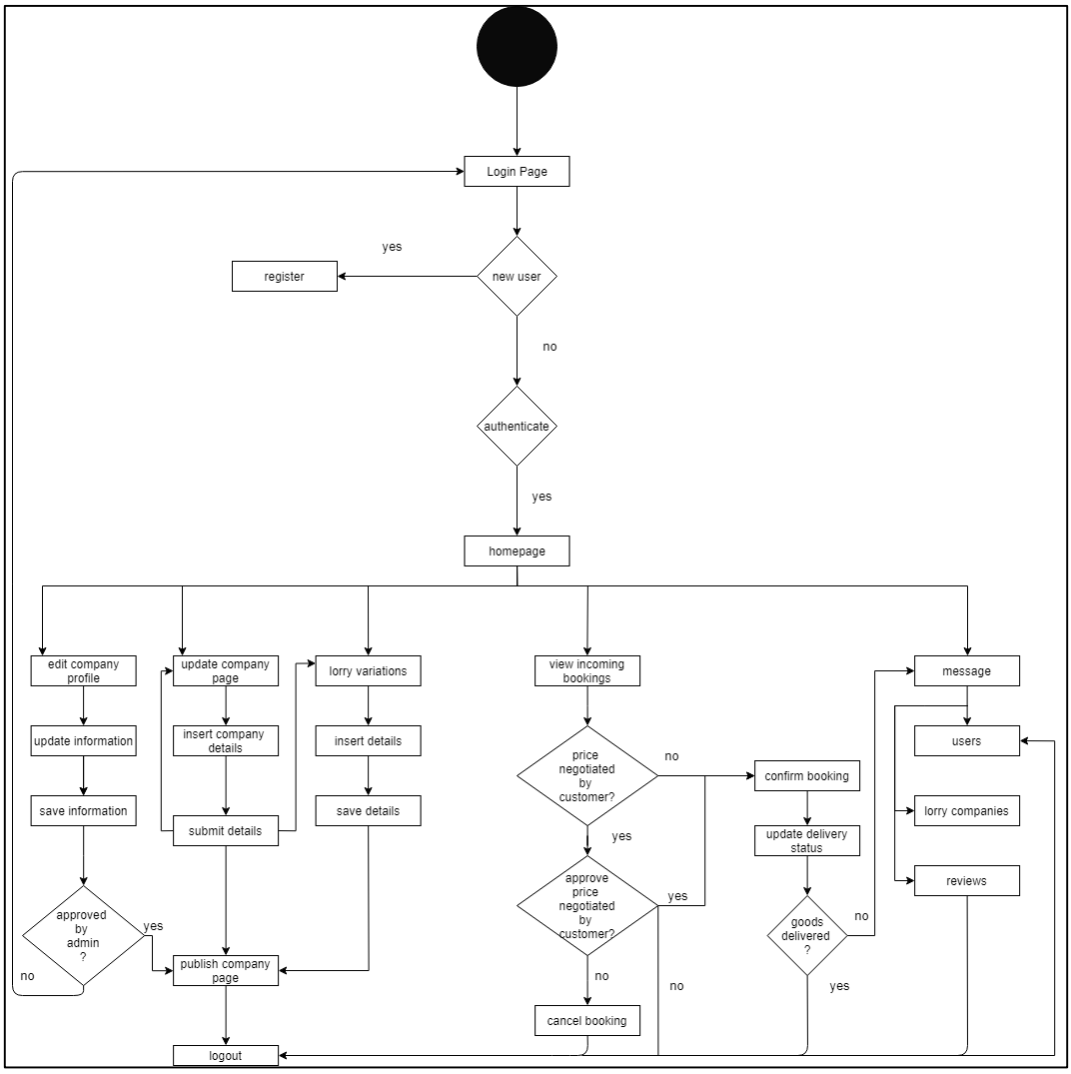

Figure 10: Activity Diagram of Lorry Company

4. Implementation and Results

This section discusses the implementation and results of this project. Functionalities of this project such as login, registration, booking page and so on will be discussed by including partial codes of the functions.

4.1 Implementation

MyLorry is an android based mobile application that was developed using Java and XML programming language in Android Studio. Firebase is the database management system used to store data of the application

```
<?xml version="1.0" encoding="utf-8"?>
<resources>
    <string name="default_web_client_id" translatable="false">738874343518-4ch8ck0a6i9jgdbf60qh1046f0e46g3n.apps.googleusercontent.com</string>
    <string name="firebase_database_url" translatable="false">https://my-application-adcd6-default-rtdb.firebaseio.com</string>
    <string name="gcm_defaultSenderId" translatable="false">738874343518</string>
    <string name="google_api_key" translatable="false">AIzaSyBtdSNZTJVIr0I5_gGakB4qU6zx5XLwwOw</string>
    <string name="google_app_id" translatable="false">1:738874343518:android:61a23571ec887ec229f4cf</string>
    <string name="google_crash_reporting_api_key" translatable="false">AIzaSyBtdSNZTJVIr0I5_gGakB4qU6zx5XLwwOw</string>
    <string name="google_storage_bucket" translatable="false">my-application-adcd6.appspot.com</string>
    <string name="project_id" translatable="false">my-application-adcd6</string>
</resources>
```

Figure 11: Source Code for Firebase Connection

Login form is the first interface of MyLorry application. Users will have to enter their email address and password that had been registered in the registration form to login to their account. The information will be checked using Firebase where users' registered account details are stored when users register an account. Figure 12 shows the partial code of login activity.

Figure 12: Source Code for User Login Activity

Adding lorries in Lorry Company account is one of the functionalities for the MyLorry application. Lorry companies can enter their details and images to display in recyclerview. Figure 13 shows partial code for adding lorry activity.

Figure 13: Source Code for Adding Lorry in Lorry Company Account

In booking page, customers need to enter the full address of pick up and drop off location. Google Places API has been implemented to make it easier for users to autocomplete the address while typing. Figure 14 shows the partial codes of implementation of Places API in lorry booking activity.

```
    Places.initialize(getApplicationContext(),  s: "AIzaSyD4tEBmaPR-48RHzDjMqXmv8AUEUT3gOYs" );

    pick.setFocusable(false);
    pick.setOnClickListener(new View.OnClickListener() {
        @Override
        public void onClick(View v) {
            List<Place.Field> fieldList = Arrays.asList(Place.Field.ADDRESS,
                    Place.Field.LAT_LNG,Place.Field.NAME);
            Intent intent = new Autocomplete.IntentBuilder(AutocompleteActivityMode.OVERLAY,
                    fieldList).build( context: CustRequestOrder.this);

            startActivityForResult(intent,  requestCode: 100);
        }
    });
}

@Override
protected void onActivityResult(int requestCode, int resultCode, @Nullable Intent data) {
    super.onActivityResult(requestCode, resultCode, data);
    if(requestCode == 100 & resultCode == RESULT_OK){

        Place place = Autocomplete.getPlaceFromIntent(data);
        pick.setText(place.getAddress());
        textView.setText(String.format("Locality Name : %s", place.getName()));
```

Figure 14: Source Code for Google Places API

The user interface of MyLorry application is displayed in Figure 15.

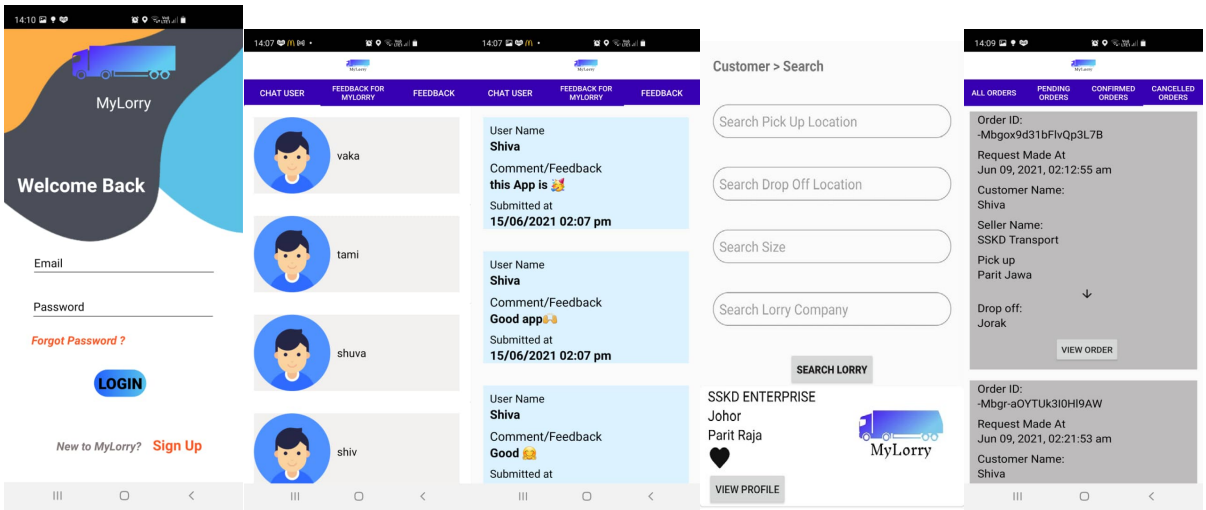

Figure 15: User Interface of MyLorry Application

4.2 Testing

After the completion of implementation phase, testing phase is another important phase that need to be carried out. Through testing phase, errors in the system will be noted and corrected to fulfil the functional criteria and improve the application to provide better service to the users. The testing is divided into two which is functional testing and user acceptance testing.

4.2.1 Functional Testing

Functional testing is done to test whether all the functions and features of the module in this application works as expected. Test plans is categorised according to the related test cases of each modules to check the interface, database and functionality of the application. Test report of the functional testing done on every module will be recorded in the test plan. The result has been recorded by executing suitable test cases, validate the output and comparing the actual output with expected output stated in system analysis design phase.

4.2.2 User Acceptance Testing

User acceptance testing is very crucial to test the functionalities of the application by letting the users to use the application and determine their satisfaction level with the application. This testing helps the developers to recognise the limitations and shortcomings of the application. 18 users and 2

representatives from lorry company were involved in this testing to provide feedback on the application. The data is collected, analysed, and depicted in the graph form to provide an overview of the user acceptance testing on the application. Table 3, Table 4 and Table 5 shows the result of users' feedback regarding the features according to the module and interface of MyLorry application.

Table 3: System Interface Evaluation's result
(Likert scale: 1-Poor, 2-Fair, 3-Good, 4-Very Good and 5- Excellent)

No	Features	Ranking					Total
		1	2	3	4	5	
1	Layout interface design	0	0	7	9	3	20
2	It is easy to understand the widgets function	0	0	0	7	13	20
3	Text Style is suitable (font size, color, type, font style)	0	0	0	7	13	20
4	Layout of content	0	0	5	8	6	20

Table 4: Customer's Features of Application Evaluation's result
(Likert scale: 1-Poor, 2-Fair, 3-Good, 4-Very Good and 5- Excellent)

No	Features	Ranking					Total
		1	2	3	4	5	
1	Login	0	0	1	11	8	20
2	Register	0	0	0	7	13	20
3	Reset Password	0	0	0	7	13	20
4	Dashboard	0	0	0	4	16	20
5	Profile (create, display and update profile)	0	0	0	3	17	20
6	Search	0	0	2	10	8	20
7	Booking (Create and cancel booking)	0	0	0	5	15	20
8	Manage Booking (Negotiate price, view and confirm booking)	0	0	1	12	7	20
9	Favorites (Add, view and remove)	0	0	0	5	15	20
10	Message	0	1	9	8	2	20
11	Logout	0	0	0	0	20	20

Table 5: Lorry Companies Features of Application Evaluation's result
(Likert scale: 1-Poor, 2-Fair, 3-Good, 4-Very Good and 5- Excellent)

No	Features	Ranking					Total
		1	2	3	4	5	
1	Login	0	0	0	0	2	2
2	Register	0	0	0	0	2	2
3	Reset Password	0	0	0	0	2	2
4	Dashboard	0	0	0	0	2	2
5	Profile (Create, View and update profile)	0	0	0	0	2	2
6	Company Page (View, Edit and update page)	0	0	0	2	0	2
7	Lorry Variations (Add, update and delete lorries)	0	0	0	0	2	2
8	Manage Booking (Negotiate price, view and confirm booking)	0	0	0	1	1	2
9	Track Delivery Status (View and update)	0	0	0	0	2	2
10	Message	0	0	0	1	1	2
11	Logout	0	0	0	0	2	2

All the data gathered for user acceptance testing through questionnaire from Table 3, Table 4 and Table 5 are analyzed and illustrated in bar charts as shown as displayed in Figure 16, Figure 17 and Figure 18. Feedbacks and recommendations of respondents have been recorded to improve the interface

and functionality of the application. Overall, most of the respondents feel satisfied with the user interface and features of MyLorry Application.

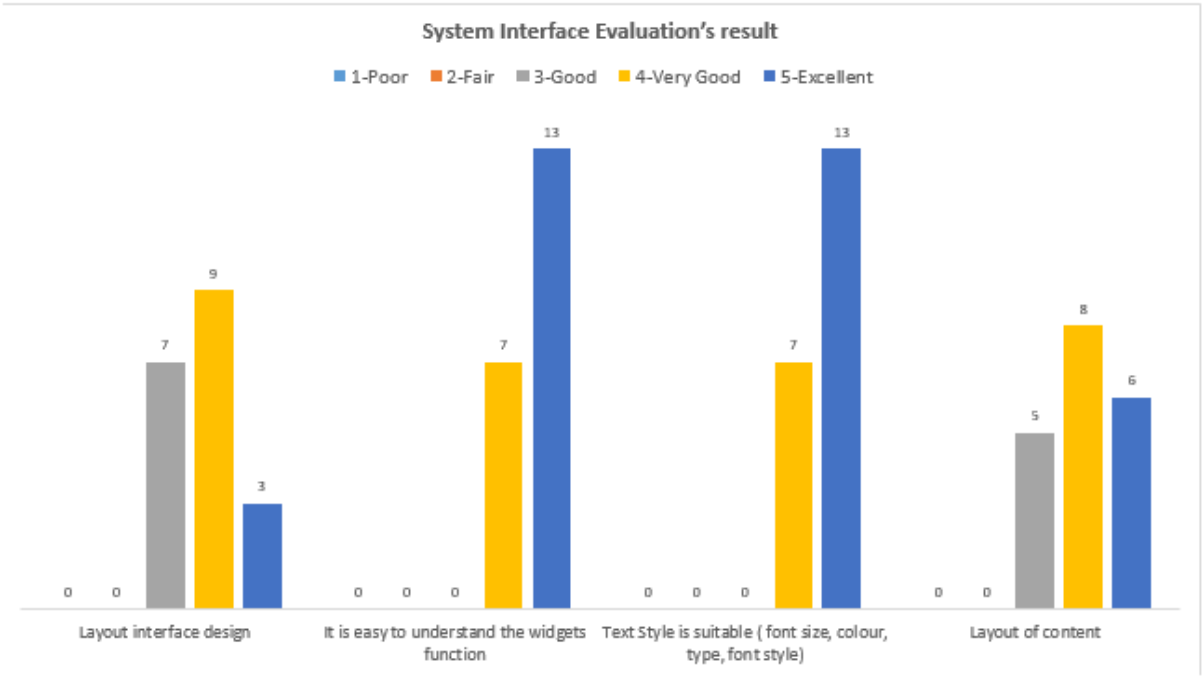

Figure 16: System Interface Evaluation's result in bar chart

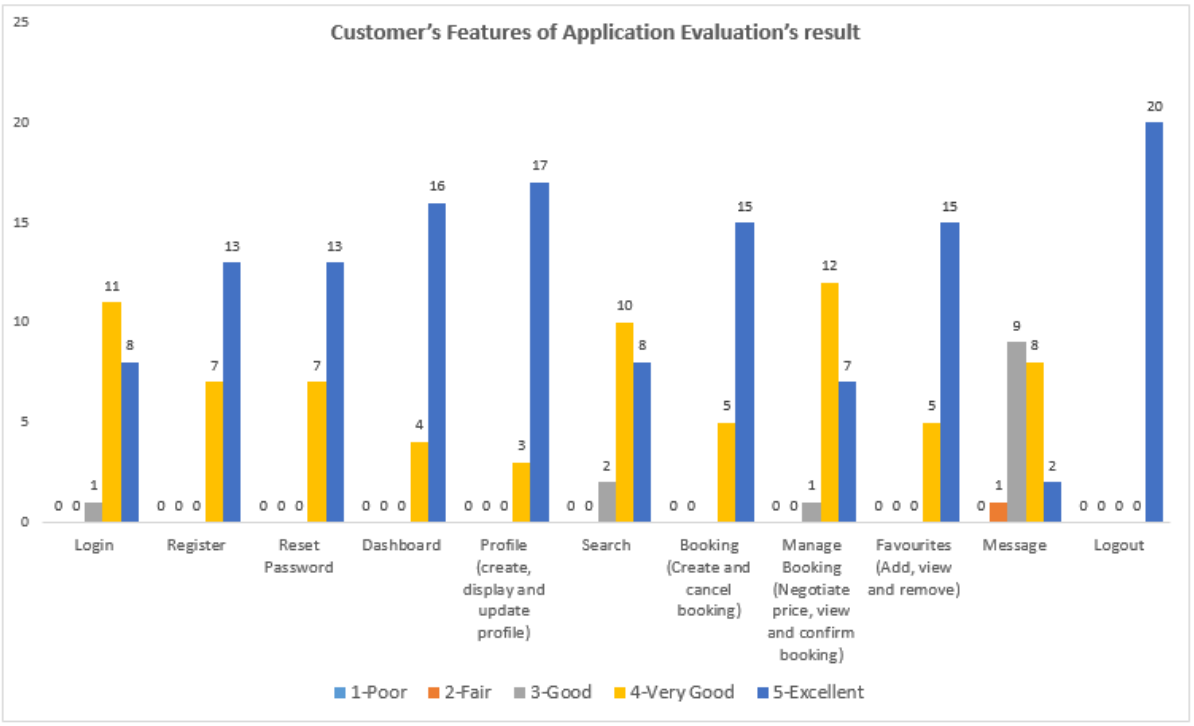

Figure 17: Customer's Features of Application Evaluation's result in bar chart

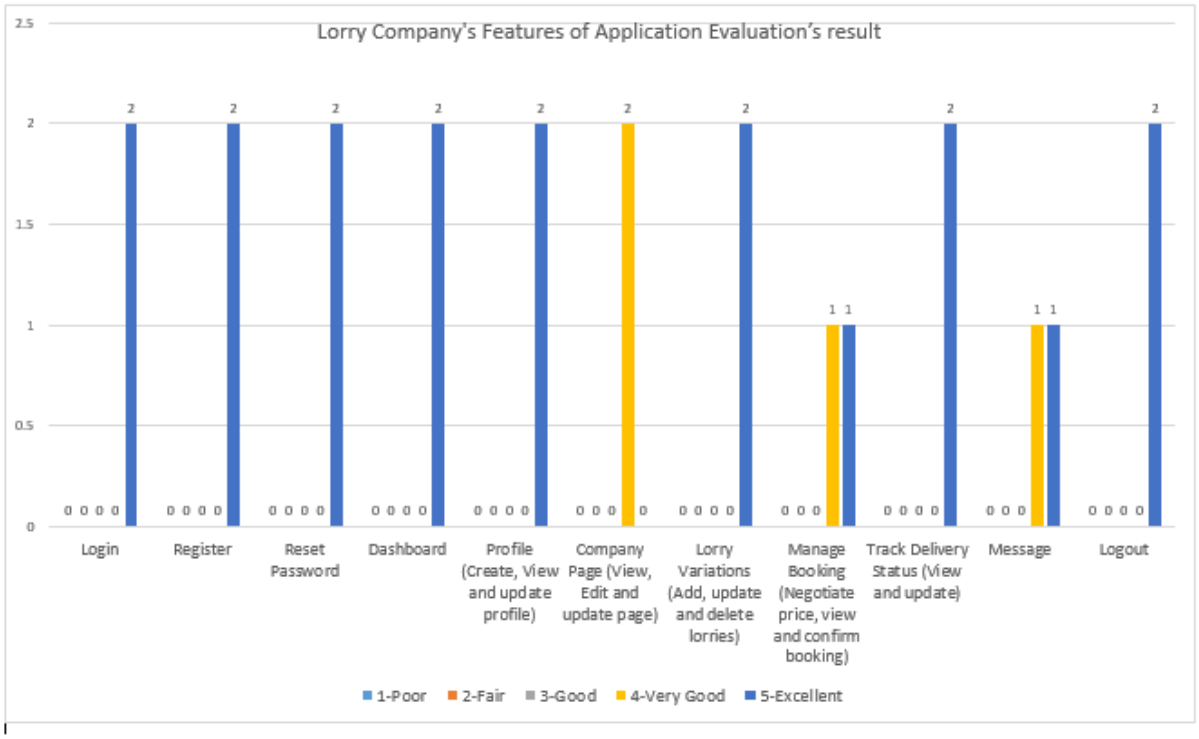

Figure 18: Lorry Companies' Features of Application Evaluation's result

5. Conclusion

The success of a project is measured through the ability to successfully achieve the predefined objective of the project. MyLorry application has been successfully developed and tested according to goals set in the planning phase. This application benefits the users to order lorry service quickly according to their budget price by helping them to negotiate with the lorry companies. This application helps them to find more lorry companies that charges differently and make the search for lorry services more scalable. This helps the lorry companies to promote themselves better by interacting with customers from all over the Malaysia. Customers able to find lorries that are suitable for their orders by checking the lorries availability and price. Users also able to chat with each other to enquire and negotiate the price for their orders. The lorry companies able to receive incoming orders and negotiate their prices with the customers without having any 3rd party interruption.

Although the application achieve the predefined objectives, several application's constraints discovered in this application. Improvements are important to keep the system updated and receive great response from the users. This application can be improved in terms of interfaces, functionalities and performance. An e-wallet feature can be implemented in this project to ease the money transaction between the users. Moreover, this application is limited to Android smartphones only as it is developed on Android Studio. In future, developing this application into an iOS based application will benefit more users. This application can be registered and login using email address and password only. In future, integrating the login and registration with Facebook and Google account could save more time for the users.

In conclusion, MyLorry application has proven to achieve the predefined objectives, scope, system requirements and user requirement. The limitations of the application can be overcome by putting further efforts to improve and add features that help to satisfy the users with better performance and functionality.

Acknowledgement

The authors would like to thank the Faculty of Computer Science and Information Technology, Universiti Tun Hussein Onn Malaysia for its support and encouragement throughout the process of conducting this study.

References

[1] S.Wanchompoo, "The Study of Thai Consumers' Selection Criteria When Choosing On-Demand Logistics Services", Master Thesis, Thammasat University, 2017.

[2] A. Shende, P. Ramteke, A. Kadu, R. Raut, "Truck Load and Monitoring Analysis for Vehicle Routing System", Department Of Computer Science and Engineering, Guru Nanak, 2018.

[3] K. Foerstl, M.C. Schleper, M. Henke, "Purchasing and supply management: From efficiency to effectiveness in an integrated supply chain". 23, 223–228, 2017.

[4] K. Korpela, J. Hallikas, T. Dahlberg, "Digital Supply Chain Transformation toward Blockchain Integration", In Proceedings of the 50th Hawaii International Conference on System Sciences, 2017.

[5] T. Tonmoy, K. P. Sanjoy, F. R. Humyun, J. Zhenguo, S. Nagesh, "A systematic literature review on the service supply chain: research agenda and future research directions", Production Planning & Control 31:16.1363-1384, 2020.

[6] Zhu, Qinghua, Yihui, "Developing a remanufacturing supply chain management system: a case of a successful truck engine remanufacturer in China", Production Planning & Control 27.9:708-7160, 2016.

[7] Wukkadada, Bharati, N. Ramith, N. Amala, "Mobile operating system: Analysis and comparison of Android and iOS", International Journal of Computing and Technology 2.7, 2015.

[8] Tomyim, Jessada, P. Amnart, "Requirements change management based on object-oriented software engineering with unified modeling language", 7th IEEE International Conference on Software Engineering and Service Science (ICSESS), IEEE, 2016.

[9] Suri, R. Pushpa, S. Harsha, "Object oriented software testability survey at designing and implementation phase", International Journal of Science and Research 4.4, 2015.

[10] Maplesden, David, "Performance analysis for object-oriented software: A systematic mapping", IEEE Transactions on Software Engineering, 2016.