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Public Transportation Selection Application Based on Decision Support System

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ABSTRACT

In Kuala Lumpur, there are various types of public transport such as bus and multiple types of rail transport. This facilitates the residents in Kuala Lumpur in terms of mobility and can reduce the level of traffic congestion around Kuala Lumpur. However, some people might get confused about the alternative routes when they are using the public transport. Next, road user might find information from maps and Internet which requires them to analyze and decide the routes by themselves. In addition, complex scheduling and routes of public transportation are hard to understand for the public. Besides, road users are not aware of better route and public transport available based on their requirement. In the end, they might be getting jam-packed on the road due to the limited information on the current available public transportation. Therefore, a decision support system is proposed to generate a type of public transport which suits with the criteria selected by the user. The system consists of five main modules and involves common users and system administrators. The application is written in Java programming language. Android Studio is used as software development and MySQL database. It is expected that this application will be able to help users to get public transportation options that suit the criteria they need.

1. Introduction

The public transport is transport of passengers by group travel systems available for use by the public, typically managed on a schedule, operated on established routes, and that charge a posted fee for each trip [1]-[2]. Nowadays, public transportation is a common pool resource. There are a few options to travel around Kuala Lumpur including public buses and railway system. However, some of them might get confused about the route alternatives to their destination when they are using public transportation [3]. These situations mostly happened on those who are not residents in that certain areas. Since they are not familiar enough with the area, they might be getting jam-packed on the road and even on poorly served routes due to the limited information on current available public transportation [4]. This will cause a lot of wasted time and money spent when they do not choose the right destination route. A computerized system is likely beneficial to help the user by suggesting the best public transportation available for user based on criteria such as price and distance.

Traffic congestion problem faced by road users promote the demand of the use of public transportation [2]. Complex scheduling and routes of public transportation are hard to understand. Besides, multiple modes of transportation might be needed to reach a certain destination in big cities [3]. Maps contain access information of other connections that aren't relevant to the trip which distracting and confusing. Road users are not aware of better route and public transport available

based on their interest. Time is the greatest concern of road users to reach a certain destination [4]. Thus, a decision support system is required to address above-mentioned problems. The system should be able to provide a suggestion on the best public transport to be chosen based on their preference.

Hence, a public transportation selection system is developed based on decision support system approach. There are two types of user in this system which are public user and system administrator. System administrator is the officers in the transportation department. While, public user are the residents anyone in Kuala Lumpur which need a public transport to go to their destination. For the decision-making purpose, the identified criteria included the time, price, distance and capacity. The developed application is beneficial to encourage the residents in Kuala Lumpur to utilize public transport to reduce the traffic congestion around the city. It is also significant to reduce the air pollution [5] around Kuala Lumpur as public transportation helps to lower the energy consumption, greenhouse gases and other pollutants.

This report contains several sections. Part II explains the literature review. Part III specifies the methodology used by the system. Whereas, section IV describes the analysis and design of the system. Part V specifies the results of the system implementation and Section VI summarizes the overall findings of the project.

2. Literature Review

This chapter is spent to describe about public transportation system, decision support system method and review of an existing system. Three existing systems related to public transportation are investigated and compare with the proposed system.

2.1 Public Transportation System

The public transport system includes a variety of transit options such as bus, train, taxi, and subway. This system is available to the public which requires fares and runs at scheduled times. The transportation system helps ensure that people can reach everyday destinations, such as jobs, schools, health food stores and healthcare facilities, safely and reliably [5]. In Malaysia, Land Public Transport Commission (SPAD) acts as the central authority for managing all aspects of public transport [6]. A total of RM106.5 million was spend in 2016 to improve the connectivity and accessibility of the public transportation network within the Kuala Lumpur area. It is also aimed to enhance the network's capacity and increase overall customer satisfaction.

Traffic congestion in the city is increasing and it is taking longer to get to one’s destination [8]. As the national capital of Malaysia, Kuala Lumpur is facing highly congested traffic during peak hours. This results in growing demand for public transport. Today, Kuala Lumpur Public Transport has developed into one of the most modern transportation systems in this region. It has a comprehensive network of buses, taxis, monorail, light rail transit and commuter trains that provide convenient and quick access to various parts of this city and its surrounding [5]. However, some of the residents in Kuala Lumpur are not familiar with the use of public transport due to the complexity of public transport network. They are not aware of the alternative routes or available public transports which can reduce the time taken of travelling to their destination. This project is also significant to reduce the air pollution around Kuala Lumpur as public transportation helps to lower the energy consumption, greenhouse gases and other pollutants [10]. Therefore, this project possesses a strong impact on the convenience of the public as well as on the environment.

2.2 Concept of Decision Support System

Decision support systems (DSS) is computerized information system that support decision-making activities. It helps people make decisions about semi-structured and unstructured problem. DSS support various features [12]. For example, DSS facilitate and support specific decision-making activities and/or decision process. Meanwhile, DSS are computer-based systems designed for interactive use by decision makers or staff users who control the sequence of interaction and the operations performed. DSS are not intended to replace decision makers. DSS is utilized to support the decision-making process by automating repeating process. A specific DSS may be used routinely or used as needed for ad hoc decision support tasks.

For instance, Trivago is a well-known existing decision support system application that returns the highest reviewed hotel in a selected region. This application uses two types of decision support systems to run the business: that is, knowledge-driven DSS and model-driven DSS. For knowledge-driven DSS, the systems provide recommendation or suggestion schemes which aid the user in selecting an appropriate alternative to a problem at hand. Knowledge-driven DSS are often referred to as management expert systems or intelligent decision support system [13]. They focus on knowledge and recommend action to managers based on an analysis of a certain knowledge base. Moreover, it has special problem-solving expertise and are closely related to data mining. Model drive DSS emphasize the access and manipulation of a model, rather than data. For example, it uses data and parameters to aid decision makers in analysing a situation. These systems usually are not data intensive and consequently are not linked to very large databases. Managers and staff members use it to provide solution to queries or problems.

One of the analysis techniques for DSS is the decision tree. Tree analysis techniques can find solutions for decisions that have multiple choice options. in system development, this decision tree provides a node to represent criteria and evaluation activities.

2.3 Comparison with the existing system

Three existing system namely Malaysia Map for LRT & Train, Rapid KL Bus Schedule, RapidKL Fare are compared.

2.3.1 Malaysia Map for LRT & Train

Developed by AndroidRich, Malaysia Map for LRT &Train is a train map for rails such as Komuter, LRT, MRT and monorail around the area of Kuala Lumpur and Klang Valley. In this application, user can browse the station from the offline map, or search the station by using the filter function. User can also navigate to any station using the map. After browsing the station, the fare module of the application will display the fare price between the selected two stations. Malaysia Map for LRT & Train will also display the train frequency and operating hour detail which facilitate the users. The developer also implemented push notification in the application.

2.3.2 Rapid KL Bus Schedule

Rapid KL Bus Schedule is another similar public transport application published on Google Play Store. However, this application only displayed the schedules and fair price of RapidKL bus. It did not provide any further information regarding the bus frequency or map of the bus routes. This reduced the feasibility of the application.

2.3.3 RapidKL Fare

This mobile application is another existing system which is similar to the proposed system. This application is able to show the fair price, route, map and twitter for RapidKL buses, KTM Komuter,

MRT and also KLIA Line. It also shows the train frequency detail for the RapidKL train. In addition, the developer also added Waze and HERE WeGo navigation application in RapidKL Fare which improved the navigation of the application. Besides, this application also constantly updates the train map which increase the dependability of the application.

2.3.4 EasyGo Public Transport

EasyGo Public Transport which is developed in this project is a system dedicated for tourists and residents of Kuala Lumpur. It is a mobile application for navigation to a certain destination within the area of Kuala Lumpur. In this application, user can browse a certain location from a selection of destinations. The results will display a few routes to the selected destination using different types of public transport. EasyGo Public Transport Application covers almost every type of public transports in Kuala Lumpur such as trains, and buses. Comprehensive route can help user to decide on a better selection. User can also filter the result using few requirements such as price, distance, capacity, and time. The select function in the system is enhanced through the implementation of filter function as user can search according to their respective requirement.

Malaysia Map for LRT & Train and RapidKL Fare are applications designated to guide public on using the different type of trains in Kuala Lumpur and Klang Valley. They provide informations such as the schedules of train, the fare price and map function which help in navigating the train network. However, both applications only cover the rail transport. They did not provide the information on the bus schedules. Conversely, Rapid KL Bus Schedule provided the bus schedules and the fair prices. However, there are no other functions other than these. As opposed from the three-existing system, the proposed system is a comprehensive application which can help to guide the user all the way from the depart location to his or her destination by the means of public transport. The proposed system covers all types of land public transport such as trains and buses. The proposed system also shows alternate routes to the destination and facilitate decision-making process.

3. Methodology

Waterfall model is selected due to a couple of reasons. Firstly, this model is simple and easy to understand and use. Secondly, it is easy to manage due to the rigidity of the model. This means that each phase has specific deliverables and review process. Moreover, phases in this model are completed one at a time so the phases do not overlap. Lastly, waterfall model works well for smaller projects where requirement is very well to understood. Waterfall model development consist of four phases [11]: specification, design, integration and testing, and operation and maintenance. The workflow process of waterfall model and its activity is illustrated in Figure 1.

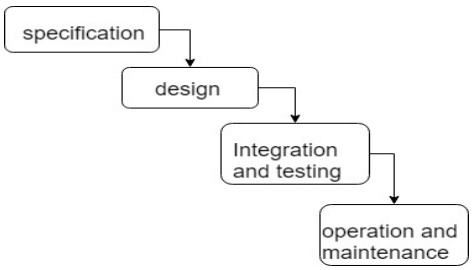

Figure 1. Development phase

Table 1 Development activities

Phase	Activity	Result
Requirement specification	• Distribute questionnaire	• elicited critical features of the under developed application • noted functional and non-functional user requirement • brief ideas of the application
Designing	• research of appropriate method to development the application • time manage of the project	• architecture and backbone of the application will be decided • progress follows the gantt chart that has been drawn • design UML diagram
Integration and testing	• blackbox testing	• error and unwanted output of the application found and detected
Operation and maintenance	• application is delivered to the end users for feedback	• changes and improvement are made until the due date of the project

4. System Analysis and Design

Requirements analysis is a process to determine user expectations outcome [14] from the proposed system. The analysis is done by designing the use-case diagram, sequential diagram and class diagram following object-oriented approach.

4.1 System Design

In the use case diagram, there are two actors, which are the public user and system administrator. Five use cases are included such as "Register as user", "Decision Making", "Login", "Display Public Transportation Information" and "Data management". Figure 2 shows the use case diagram for the system.

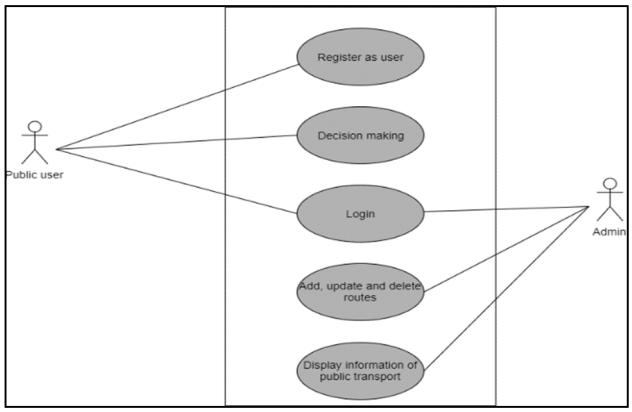

Figure 2. Use case diagram

Six sequence diagrams are designed for the system. These includes "Public User Registration Sequence Diagram", "Public User Login Sequence Diagram", "Public User Decision Making Sequence Diagram", "Administrator Login Sequence Diagram", "Administrator Add, Edit, Delete Route Sequence Diagram".

4.2 Database Design

Database design is the process of producing a detailed data model of a database. Class diagram is used to design the system database. There are eight classes involved in this system included user, administrator, route, choice, route_price, route_speed, route_capacity, and route_time. Classes are

grouped together to create class diagrams. Different relationships between classes are shown by different types of arrows. Class diagram is as shown in Figure 3.

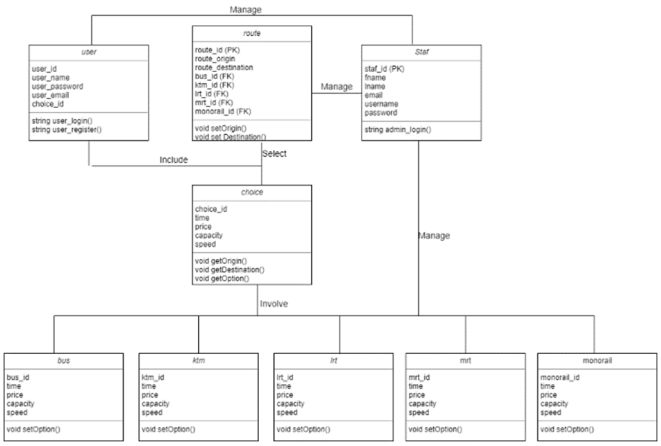

Figure 3. Class diagram

4.3 Decision Support System Design

This system component consists of data sources, DSS database, user interfaces, and users as illustrated in Figure 4. Data sources are like route types, public transport schedules, and estimated time to destination. The DSS database stores all system information and data. Content in the database is managed by the system administrator. Basic operations such as adding, updating and data deletion can be done with permission. The user interface has two versions - administrator websites and user applications.

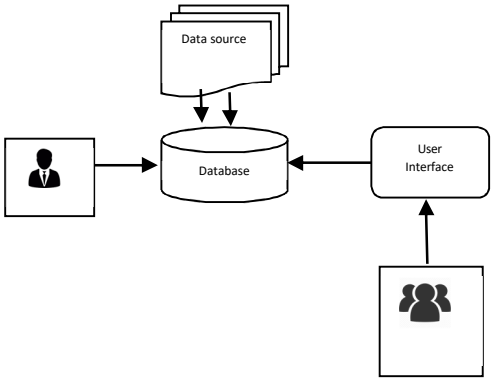

Figure 4. Decision support system design and components

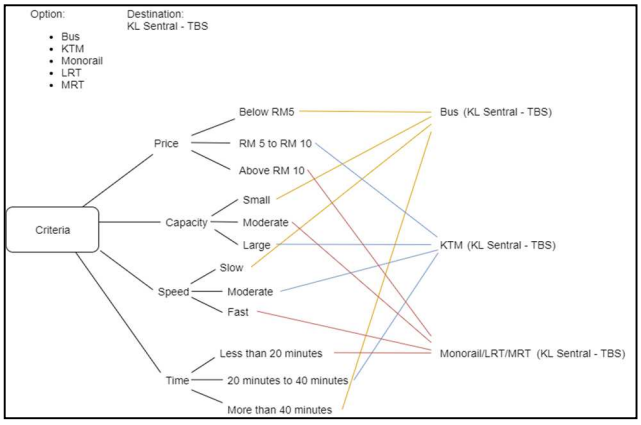

Figure 5. Decision tree analysis

The decision tree for this system is illustrated in Figure 5. There are four criteria used in this system for decision-making purposes, namely price, capacity, speed, and time. Users need to choose one of the options for each criterion provided. The system will generate results based on user-defined information and match through decision tree.

If the user chooses a combination of criteria such as (under RM5 and small capacity and slow speed and more than 40 minutes), results generated from the decision tree is bus. For a combination (RM 5 to RM 10 and medium capacity and medium speed and 20 minutes to 40 minutes), the result is KTM. The last combination is (above RM 10 and large capacity and fast speed and less than 20 minutes). In this case, the decision resulted from the decision tree is Monorail / LRT / MRT.

5. Implementation and Testing

The system is built following the outcome from analysis and design. Program code is written for the five system modules which are user registration and user log in, public transportation information, decision making, searching, and data management. This includes the system implementation for both user and administrator. After the system is implemented, the final phase is system testing. In this phase, user acceptance test is conducted.

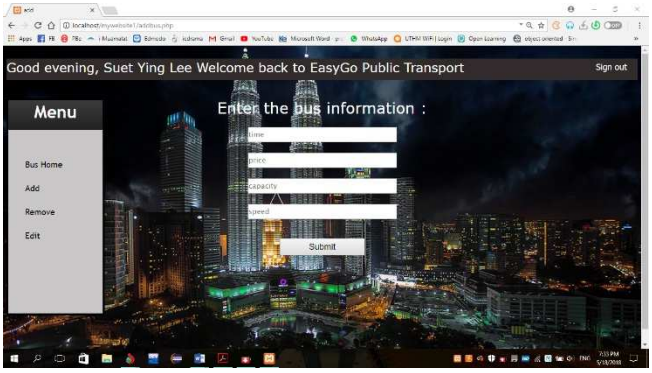

Figure 6. Administrator Dashboard

Figure 6 and 7 shows administrator page which contains menu such as transport information, schedule, and route. Administrator is able to perform data addition, update and delete unnecessary information. Administrator also able to manage the decision-making engine which is derived from the decision tree and coded into the program.

Bus id	Bus time duration	Bus price	Bus capacity	Bus speed
1	19	2.50	Small	Slow
2	32	3.00	Small	Slow
3	28	2.00	Small	Slow
4	30	2.00	Small	Slow

Figure 7. Bus table operation

Public user accessed the system from the application. API is required to connect the database information for others to access. Php code is written to enable data retrieval from phpmyadministrator mysql database and return it in JSON format. Its functionality can be invoked by forming a network connection in android app through an URL. Php app (API) will be backend and android app will be frontend. RegisterRequest.java and LoginRequest.java are used to retrieve data.

Figure 8. Register interface

The first operation is user registration as depicted in Figure 8. Username, email and password are details required from the user to register. The user will then be directed to LoginActivity.java. Validation of username and password will occur in that activity. If validation succeed, then user will be directed to RouteActivity.java.

In select information, JSONArray and JSONObject are used to retrieve the data from the database and display them automatically in the spinner. If validation succeed, then user will be directed to RouteActivity.java. In that section, user will need to select the desire departure and arrival location. From there, user will need to choose the desire range for all four criteria which are price, duration, capacity and speed.

Figure 9. User interface for spinner

Selection result will be displayed when there is a matching from user-input value and database. Public transport that matches all the criteria and location selected will be displayed as the result.

Table 2 System functional testing

Testing Modules	Testing	Expected results	Actual results
User registration and user log in	User input correct username and password	Display the homepage of the system.	Login successfully.

User registration and user log in	User input wrong username or password	Display an error message.	Login failed.
Public transportation information	Administrator clicked on the homepage of route and each of the public transports.	The information of each table is displayed.	Successfully displayed the information in table form.
Decision making	User select a particular route and select the option for each criterion	System generates a decision based on the criteria.	Successfully generate a decision for the user.
Data management	Administrator add, edit and delete a row in a particular table.	A new row is added, and a selected row is deleted or edited.	Successfully update the table.

The five modules are tested and the expected as well as the actual results are tabulated in Table 2. User acceptance test have been conducted to collect the level of satisfaction from the users. Improvement towards the system can be made based on the comments and feedback from the respondents.

6. Conclusion

The Decision Support System for Public Transportation Selection is divided into two parts, user application and web-based system that allow administrator to perform data management. The name of the user application is EasyGo Public Transport. It can generate a decision for the user based on the criteria selected by the user. Thus, this system addresses the problem due to complex scheduling and routes of public transport. This application also promoted the use of public transport which can overcome the traffic congestion around Kuala Lumpur especially at city centre. Additionally, this system promotes the use of public transportation. However, the limitations of this system included lacking Google Map API and GPS function. This resulted in the unavailability for user to identify the actual location when they are using the application. In the future work progress, Google Map API and GPS function will be added to improve the system.

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