DEVELOPING THE RAPIDKUANTAN SYSTEM TO REDUCE IDLE TIME AMONG THE STATIONS USING SIMULATION MODEL

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SUPERVISOR'S DECLARATION

I hereby declare that I have read this project report and in my opinion this report is adequate in term of scope and quality in fulfilment of the requirement for the award of the Bachelor Degree of Industrial Technology Management with Honors.

Signature: ……………………………..

Name: En. Hasahudin bin hassan

Position: Lecturer

Date:

STUDENT DECLARATION

I declare that this project report entitled "Developing the Rapidkuantan System to Reduce Idle Time among the Stations Using Simulation Model" is the result from my own research except as cited in references. This report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

This research focus on the route of public transportation from Kuantan to Gambang (UMP). The research aim to reduce time taken by Rapid bus from one stop to another stop. Currently, there are quite number of stops in between these two destination. Yet, some of the stop are close with each other. Thus, it increased the total time of the route. By using the simulation software, this study try to reduce the route time from Kuantan to Gambang by eliminating certain stops which is economically less.

Keywords: idle time, waiting time, total time, simulation model, arena software

ABSTRAK

Penyelidikan ini memfocuskan laluan pengangkutan awam dari Kuantan ke Gambang (UMP). Kajian ini bertujuan untuk mengurangkan masa yang diambil oleh bas Rapid dari satu perhentian ke perhentian yang lain. Pada masa ini, terdapat perhentian yang agak banyak di antara jalan ini. Namun, terdapat beberapa perhentian yang dekat antara satu sama lain. Oleh itu, ia meningkat jumlah masa perjalanan. Dengan menggunakan perisian simulasi, kajian ini cuba untuk mengurangkan masa diambil dari Kuantan ke Gambang dengan membuang perhentian tertentu yang kurang dari segi ekonomi.

Kata kunci: masa terbiar, masa menunggu, jumlah masa, model simulasi, perisian arena

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CHAPTER 1

INTRODUCTION

1.1   BACKGROUND

Public transportation can be define as the occupancy vehicle services designed to transport customers on local and regional routes (Vuchic, V. R) [14]. It has been recognized as a potential way to reduce air pollution, improving mobility, and also lessen the traffic congestion. The designing of bus transit network is very crucial in order to make it more efficient especially in the urban areas. The transportation that can be included is busses, rail, taxis, van, or others that give the service to the public to make any of the movement from one place to another place easier. All this type of transportation are served to the public are either being paid or free as the fee based on the regulations that have been made in every country. To meet the satisfaction of the public, all these type of transportation must be operate effectively in order to get the trust from the users. To achieve that, the network of the transportation must be carefully planned.

The situation is same goes to the Malaysia. Lately, Malaysia has develop rapidly impact from the good world competition. Along with this, the public transport in Malaysia also has develop. Providing the good service, all the public transportation in Malaysia promise the user with its comfort with the reasonable price. The mostly used public transportation in Malaysia can be said is busses. From this situation, many company taking the risk to involve in this area. One of the most successful company is the rapid busses.

Rapid Bus Sdn Bhd are establish on January 1, 2013 operate under its parent company, Prasarana Malaysia Berhad (Prasarana Rapid Bus) [10]. The buses currently operates is RapidKL, RapidPenang and RapidKuantan which each of them take the name of the place operate to make the buses name. RapidKL are operates around the Klang Valley and also Selangor. As for RapidPenang, it operates around the island of Penang and Butterworth and for RapidKuantan operate around the state capital of Pahang, mostly in kuantan. As the business get the good feedback from the public, Rapid Bus receives support from the Government.

The significant of this public transport is it can reduce the primary transportation which is car to avoid traffic jam. Based on the statistic from PDRM, there are massive increase in the uses of personal car. Estimated, there are about 40% increase in the vehicle registration in Malaysia in year 2002. The result from this, there are a lot of problem arise, include the traffic jam, insufficient parking space and also air pollution problem. With the come of the RapidKuantan, it expected to solve all this problem.

For the Rapidkuantan, the operation of the busses just begun around December 1 2012 (Prasarana Rapid Bus) [10]. As the new comer, there are a lot of weakness can improve. The most popular issues is about the time punctuality which are due to the routing problem, estimation that are not accurate, different time taken for each point, can lead to the inefficient service. In this research, it is purpose the way to improve indirectly to solve this problem. In order to develop new public transportation solutions, it can be said it is almost impossible to use direct experimentation. Thus, to solve this problem, we adopt the computer simulation as a solution for analysis and planning the new public transportation systems.

A simulation of a system is the operation of a model of the system. The model can be reconfigured and experimented with; usually, this is impossible, too expensive or impractical to do in the system it represents (Maria, A. 1997) [7]. Simulation is a very crucial in the problem-solving methodology in the real-world problems. With this simulation, this kind of problem related to the public transport can be solve without applying it before the modelling is completely

works. From this, we will implement the computer simulation as a solution for planning and analysing this Rapidkuantan systems.

1.2   PROBLEM STATEMENT

There are a few problem faced by the user of this bus. Firstly is about the about time taken for the bus to reach certain point. The problem may occur due to the location for the bus to stop seem not too strategic. This will increase the queuing time for the passenger. At the certain stopping point, sometimes there is no passenger waiting there. Then is about the capacity. There are certain time that the bus will exceed the allowed number of passengers. This situation is usually happen during the peak hour. There are also different in the total number of passengers when using the bus during the weekdays and also during the weekend. The correct sequent and the number of busses depart from the terminal also do not schedule correctly resulting in the bunching of the buses at certain time.

1.3   OBJECTIVE OF THE STUDY

    i.   To enhance the Rapidkuantan system by reducing the total time taken for the bus.

    ii.   To develop the simulation model to enhance the Rapidkuantan service system.

    iii.   To create a new network system road using the data analysis for each bus station point.

1.4   METHODOLOGY

From the problem that have been arise, the method that have been propose is through the simulation model.

Simulation model is the imitation of the operation of a real-world process or

system over time (Banks, J. 1999) [1]. Simulation is involving about an artificial history of the system and to draw about the inferences regarding to the operating features from the real system that is represented now. Meanwhile, the word model describe about the representation of a real system (Banks, J. 1999) [1]. Simulation is used before an existing system is altered or a new system built to reduce the chances of failure to meet specifications, to eliminate unforeseen bottlenecks, to prevent under or over-utilization of resources, and to optimize system performance (Maria, A. 1997) [7].From this, the model can be used in order to study of "what if" questions regarding to the real-world system. Resulting from this model, there are chances to make changes to the system and can predict their impact on the system that we have change. So, before we implement it to the real word, an adequate parameters are required in order to make the system run well. From this, it can be summarize that the simulation model can be used as a tool to analysis and also a tool to predicate the performance of new system.

There are few examples of the software that are related to this field of research, one of it is MITSIMLab. This software is developed to design and also evaluate the dynamic traffic strategies. From this, a scheduled bus data was implemented to represent the real movements of buses and their performance. Within this software, it allow us to simulate the connections between numerous modes of transportation, for example is bus bunching and also estimating the impacts on system performance.

Besides MITSIMLab, there are also simulation model called CORBUS (CORridor for BUSes). By using this model, it can guided the operation of the buses running on a segregated way, such as a bus lane. The up-to-date traffic theories need to be used to describe the sources of delay and to decide the optimum stop spacing for the buses. The results of this model can be seen in term of the speeds of public transport vehicles (mean) and also their delays at each road they take.

Advance uses of the computer has led emerge of the simulation software. As computer the computer making helpful to the human, simulation software can make more accurate, faster solution for any problem. There are a few advantages using this simulation model, one of it is, it can compress and expand the time. By compressing or expanding the time, simulation model can help you to speed up your process of

analysis of the problem. You can spend just a couple of minute analysis the events by using simulation method compared the longer time if analysis it manually.

By using the simulation model also can allow us to explore all the possibilities that are available. Once you have established a valid simulation model, you are able to explore new operating procedures, or methods without using any expense and disruption while conducting the experiment with the real system. Modifications can be made within in the model. This will allow you to observe the effects of those changes you have been made on the computer rather than in the real system. Study of the effects that you have been is very significant to reduce the risk of experimenting with the real system. Besides that, the uses of the simulation can be call as the wise investment for the certain behalf. The typical cost of a simulation study is substantially less than 1% of the total amount being expended for the implementation of a design or redesign (Banks, J. 1999) [1]. Since the modification to a system after the installation can result in higher cost, so the uses of simulation as the initiator is a wise investment.

In this research, the simulation can help to reduce the about time taken for the bus to reach certain point. The study of the location for the bus to stop will allow the software determine the most frequent and least frequent station use in the network. Hence this, the least frequent station maybe can be eliminated in order to improve the time uses by the bus top reach the final destination. Through this research also able to help to recognize the peek time that the passenger mostly uses the buses, especially during the people went back from work, and also weekends. From this, the total number of passengers will not exceed the total number of allowed passengers. At the same time, the time for the bus to depart from the terminal to their location also will be reschedule according the right time to improve the efficiency and also the customer satisfaction.

1.5   SIGNIFICANCE OF THE STUDY

The main objective of this study is to learn and know the current services of the bus in Kuantan, Pahang especially Rapidkuantan. Besides that, this study also can help to improve services and quality of the buses in term of time, comfort, customer

satisfaction and at the same time making the bus as the first choices to be uses compared to the private car. Mostly of the citizen nowadays are prefer to use a car as a primary transportation. This can be seen as the number of the car on the road is increasing drastically year by year. By using this public transportation, we can reduce the accident rate involving cars, and also can save our environment from polluted.

1.6   SCOPE OF THE STUDY

This research are more focus on the studies about the bus service time taken for the bus reach their destination, the number of passengers for each trip during weekdays and also for weekends, the location where the buses need to stop. The public transport that have been chosen in this study is the Rapidkuantan that is operation all the way long from Kuantan road until Gambang Resort. From all this criteria, all the problems will be identified and will be taken for evaluation, and make the improvement on the quality of the bus services in Kuantan, Pahang. All the network for this research is identified along the Kuantan and Gambang road.
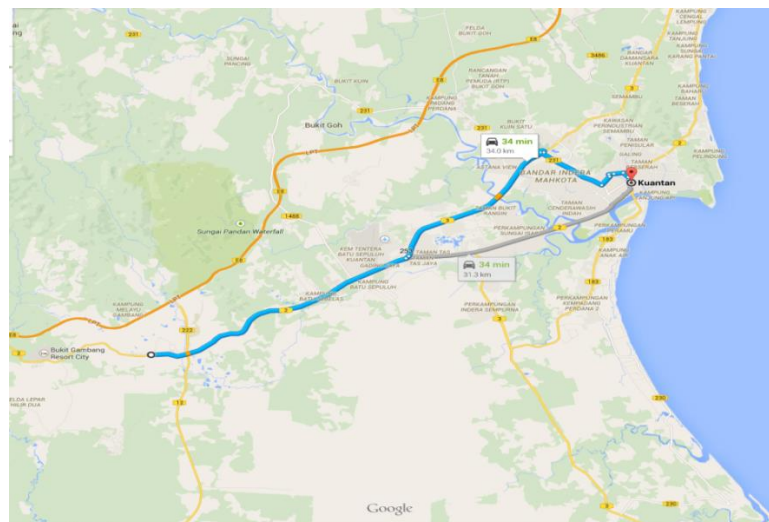
Figure 1.1: Showing the Study Location

1.7   EXPECTED RESULT

From the research, it will be expected that the total time for the bus travel from one point to another point will be reduce. This study will be minimizing the queuing time among the bus stations by selecting a best route for the bus. Moreover, the research also will reduce the time by skipping the certain point where there are lesser passengers waiting. By identified this stopping point, the bus can skip and even terminate the point so that the time taken for the busses travel from the starting point until the last point can be reduce.

CHAPTER 2

LITERATURE RIVIEW

2.1   INTRODUCTION

Managing traffic transportation is really important nowadays. The best choice to solve this problem is the simulation model. The time taken for the bus to reach certain point, the location for the bus to stop seem not too strategic is the example of the problem that commonly occur. The result from this problem is, it can increase the queuing time for the passenger. There are also problem with the capacity of the public transportation. The exceed number of passengers sometimes can happen. The uses of simulation model, let someone to make any change to reduce the chances of failure before applying it to the real world. By the uses of larger-scale model, it may result to the higher computational cost. So, to solve this, by using this simulation model, it is expected to reduce the average trip travel times of the transportation from one point to another point, improving the capacity problem and at the same time, while doing so with the reduction of the computational cost.

2.2   PROBLEM BACKGROUND

This study will be focuses on the way to optimize the time taken for the busses travel. There is no doubt that the public transportation play an important role to help people moving from certain point to another. There are a few problem faced by the user of this bus. Firstly is about the about time taken for the bus to reach certain point. This problem may occur due to the location for

the bus to stop seem not too strategic. This will increase the queuing time for the passenger. There are also sometimes no passenger are waiting at certain stopping point. Then is about the capacity problem. The total number of passengers using the bus during the weekdays and also during the weekend are different. For all the reason for the problem occur, in this study will be analyse of optimal routes where can optimize the time taken and distance that the bus take. The uses of the simulation model will be approach in order to analyse this problem.
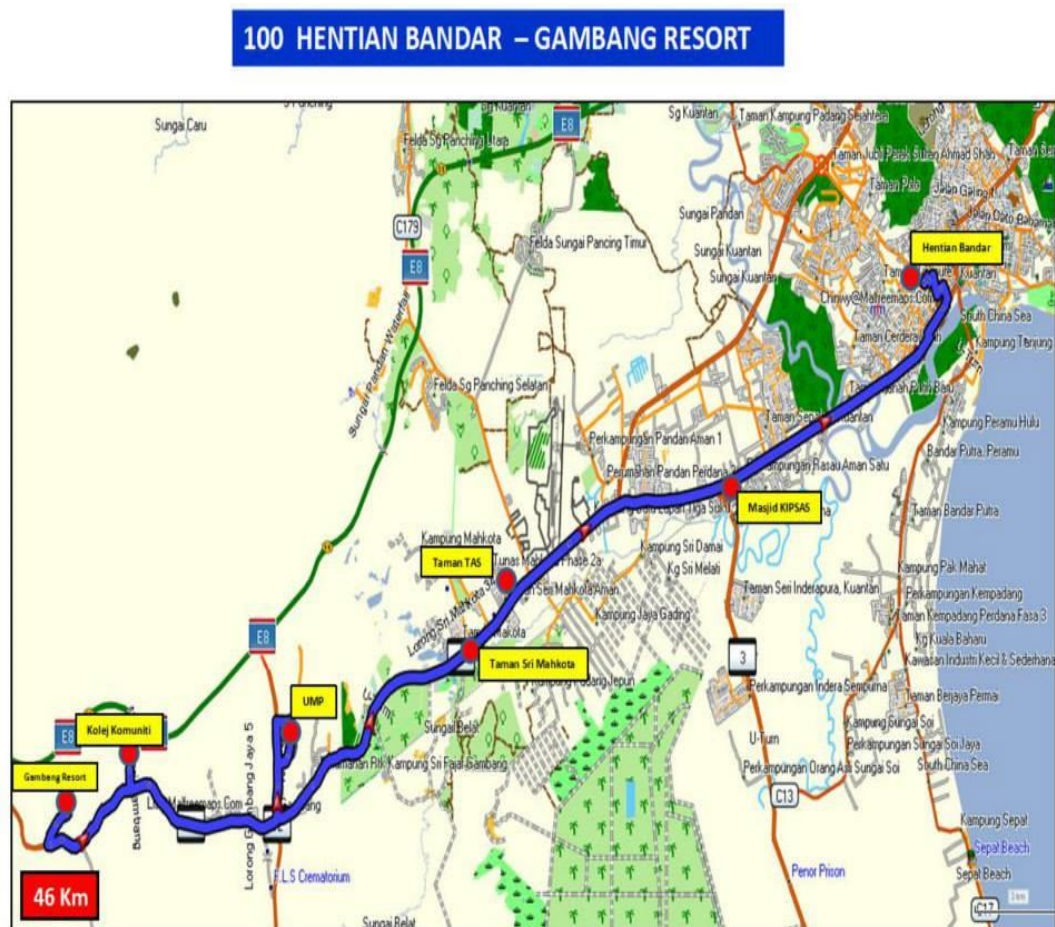
Figure 2.1: RapidKuantan route from Hentian to Gambang

2.3   METHODOLOGY

The methodology that have been use in this research is the simulation model. The term "simulation" has been used to mean quite a number of things. Usually it refers to a realization of a representation of some larger, more complex activity (Krajzewicz, D etc 2002) [6]. Then, the simulations will use the model to symbolise the actual behaviour of the system and it is usually are more complex. The purpose of the simulation is mainly to analyse and recognise about the behaviour of the

System and providing the various alternative actions or decisions to improve some problem. From this, it can be summarize that the simulation model can be used as a tool to analysis and also a tool to predicate the performance of new system. There are many field that the simulation model can be applied, for the example is in the computer systems, manufacturing, business, business and many more. The simulation are used in an existing system can be altered or built a new system. Before we can apply the method to the real word, adequate parameters are important to make the system run well and can prevent it from fail. Figure 2.2 below showing the Simulation Study Schematic.
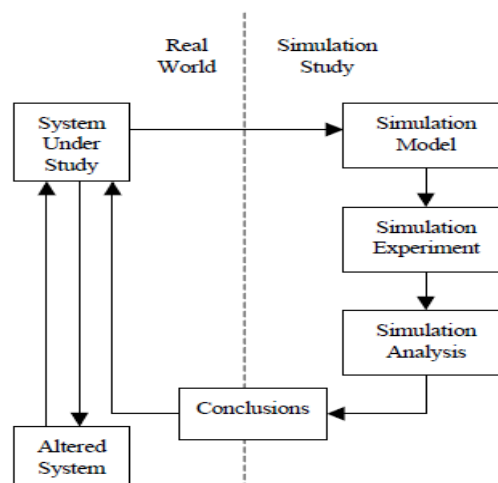
Figure 2.2: Simulation Study Schematic

Figure 2.2 show the schematic of a simulation study (Maria, A. 1997) [7]. The all process is directed through the system under study and becoming the altered system. Then it will becomes the system under study and the process of this cycle will be repeats. In the simulation study, the decision making is required to the all stages, namely, model development, experiment design, output analysis, conclusion formulation, and making decisions in order to make the alter to the system under study. The running of the simulations is the only stage where human interference are not required because most of the simulation software packages will perform efficiently.

2.4   LITERATURE RIVIEW

According to (Selvam, K. K. 2014) [12], Traffic microsimulation models can be describe as the interaction between the vehicles and also as the interaction between the individual with the vehicles and also with the transportation infrastructure such as traffic signal design. All those behaviour and interactions were taken by a set of model. Meanwhile for the route choice model will determines how the users are able to decide on their destination. By applying this model to every vehicle available the network, it will results in increasing of the computation times. As the model are based on the human behaviour, so it is stochastic in the nature. Hence, if two runs of the same model can lead to different results. Therefore, some of the applications need averaging multiple of evaluations from the same point using a traffic microsimulator. A large-scale traffic problem have been solve by using the simulation-based optimization framework. The problem have been solve by the use of an analytical traffic assignment model. Queuing network model and the multinomial logit model are being combine for better route

Choice with the good accuracy of the traffic network. By using the traffic assignment result, the relative inaccuracy for small-scale model have been forecast. By this way they are able to trade-off the high costs of computational with the using of lower costs with the less accurate and with the smaller-scale simulators. The approach has been approach with the signal control problem on a

toy network. Through this way, it can identifies the signal plans that come with good performance. It also can be done at a lower computational cost when the systematically being running at the larger scale of simulator. The approach that are applied producing the similar results when the approach are applied to a large-scale model that covering all the entire city. It give a result reduction in a 78% of the computation time that are spent on simulation. It also showed the method are able to reduce the total of computation time by 46% in the case of SO algorithms which using the multiple replications at every point. From this result, it is expect this method will be useful to solve any of large-scale optimization problems.

Another use of the simulation model that can be used in this public transportation area is the microscopic traffic simulation models. This model is the most advanced tools to represent the vehicles movement in a transportation network. This model have been applied mainly with the movement of the cars. Even for the commercial packages have some options to transit systems, they are insufficient to model, optimize and evaluate the real impact of changes in the public transport system over the transport system performance, (Cortés, C. E., Fernandez, R., & Burgos, V. 2007) [2]. Due to this reason, the MISTRANSIT (Microscopic Simulation TRANSIT) have been developed. MISTRANSIT will combines all changes in the aspects of:

1. Buses have new characteristics
2. Passengers are incorporated in the simulation like new individual objects
3. Specific models to improve the representation of the interaction among passengers and vehicles at bus stops or terminals are also explicitly included.

MISTRANSIT simulation which is based on PARAMICS, is a model that able to model both interactions between transit vehicles with the traffic at links and also with the passengers at stops. By using this model, it will give an advantages in term of holding strategy and also the way selecting priority at the traffic signals. Through this, it can be said that the transit simulation can be categorized into three different methods

Method 1: Default in facilities for the transit management. The first approach is the about the default in facilities for the transit management. This is somewhat is a complex simulation details because of the modeller that are being used to control the transit vehicles are limited with the use of the default functions only. The common commercial packages that are used in simulating the transit systems are:

1.   AIMSUM/2
2.   CORSIM (CORridor SIMulation)
3.   DRACULA (Dynamic Route Assignment Combining User Learning and microsimulAtion)
4.   VISSIM (Verkehr In Stadten - SIMulation)
5.   PARAMICS (PARAllel MICroscopic Simulation)

The above microsimulators are able to define the fixed frequencies, fixed-route lines and also the bus stop operations. The stopping time are predicted by assuming the arrival of passenger rate distribution.

Method 2: Ad-hoc strategies. A second approach is called the ad-hoc strategies. This techniques is use to overcome the insufficiencies in the commercial packages. For the example is how to formulate a BRT (Bus Rapid Transit) in Inga using VISSIM, the corridor had to be divided into shorter sections in order to model the center-running guided bus way on an arterial street, (Cortés, C. E., Fernandez, R., & Burgos, V. 2007) [2]. Another example this simulation can be found in Multisystem. The network being coded same as the previous case but additional signals have to be coded in order to hold the vehicles for the pre-specified.

Method 3: Routing scheduling modules. The third method is the most flexible option which is routing scheduling modules. The entities such as passengers, vehicles, stops are coded separately in the simulation by using the Application Programmer Interfaces (API's). By using this application, it allow the user to control the components of the transit system. There have been a studied about the TSP algorithm related to the bus stops located. By implementing it in VISSIM through the interaction with external program, the actuated signals VAP (Vehicle Actuated Programming) are able to be controlled.

Meanwhile, according to Meignan, D., Simonin, O., & Koukam, A. (2007) [8] has explain about the multiagent simulation of bus networks. The buses operation, traveller behaviour's and also a road traffic model are being combine. This model has been applied in order to manage the bus network of Belfort town (France). This model is essential to regulate the bus networks in certain situation such as traffic jam and also accidents. There are three main components in the bus-network system:

6.   People behaviour's

7.   Road traffic dynamics

The complexity of a bus-network system is the result from the interactions among the buses, passengers and also the road traffic. By using the multiagent approach, it will derives two main thing, firstly is about the urban public transport network. This will describe the system as a naturally complex system which will be involving with the distributed and interacting entities. Second is about the global system behaviour which is involve with several emergent situation that are came from the entities of individual behaviour and also their interactions. Through this multiagent approach, a complex systems where numerous autonomous entities interaction will be able to be describe to produce any solution.
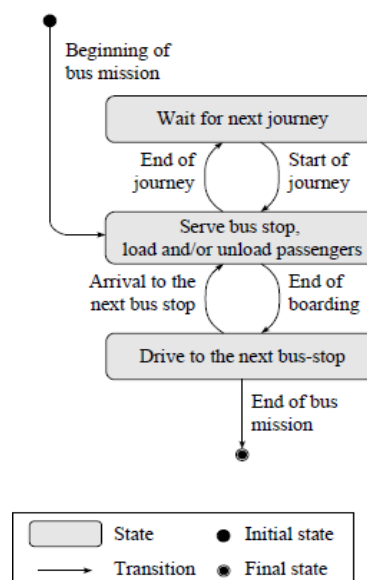
Figure 2.3: Agents behaviour's presented in Bus agent

Meanwhile, for Hadas, Y., & Ceder, A. A. (2010) [4] state that the simulation model is discrete and not continuous. Each time the buses are moved to the next road-segment, the calculations are extra-segment such as the arrival time for each bus to each road-segment is identified. All this activities are performed in just one step of simulation. The simulation can be implemented in three ways:

1. Not optimized in which the operation of the buses is not altered during the simulation run; this is the basis for evaluating the optimization

2. Global optimization in which the optimization is carried out for the whole network; and

3. Local optimization in which the optimization is performed locally for each road segment.

For this three optimizations modes two, there are two parameters are used which is space horizon and also time horizon. Space horizon parameter is only relevant for local optimization. The collaboration between neighbour and road-segments is effected by this parameter. If there are two or more road-segments the process of optimization is performed jointly vice versa, the optimization will be carried locally. For the time horizon parameter, it will determines the forecast range of optimization. This type of parameter is suitable for global optimization and also well for local optimization. When the optimization is carried out, the upcoming arrivals of buses within the time horizon are treated. The total travel time is composed of travel time and waiting time according to the total travel time objective function (TTT).
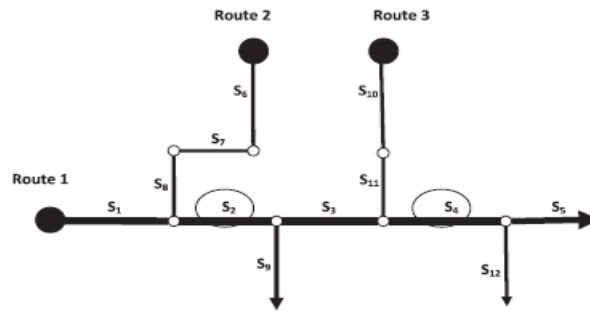
Figure 2.4: network example with 14 road-segments, three bus routes

Through the simulation, it show that the simulation are able to reduce the total average travel time for each passenger. The simulation results, which depend on the optimization parameters and also with the scenario's characteristics, is important in the development of a full scale simulation.

According to Rieser, M. (2010) [11], the existing C/C++ version of MATSim, the simulation tool was re-implemented in Java. This re-implementation is based on some data-structures created for the demand modelling framework for the network and population model. After the simulation being renewed, the framework was then applied to a concrete research project. In this project, the effects of the time-dependent road-pricing measures are being studied. The application is then showed the simulation tool are working as expected. It generate the observable change in term of the traffic pattern during the morning in the rush hour. Resulting from this, the study on how additional modes of transportation can be integrated into the simulation making the modeled agents able to choose the mode. This mode choice model are able to work properly and can be applied to a large-scale scenario.

While according to Cortés, C. E., Burgos, V., & Fernández, R. (2010) [3], the possibility of including external modelling via APIs will allow the modeller to simulate those transit operations which are not considered in default options. The enhancement by adding the transit vehicles with the particular buses into the traffic microsimulation allowing the transport analyst the measure that is important in the traffic. One of the important measures is about the efficient design of bus stops. This describe about enter and exit distances, the queuing space is enough or not for the case of bus bunching, etc. mostly, the traffic engineers is always forget this issues

when come to the buses. Regarding to the interactions between buses and also passengers. This is important that the bus stops need the specific patterns between the bus and arrivals of passenger. Then about the traffic flows at junctions need to be more specific in traffic network models. This factors is really important to be incorporated when using the microsimulation of transit operations. A better control of vehicles and also with the other entities, such as passengers, control strategies, scenarios and others is really important. The better the control to the entities will result to better result.

Differ for Hollander, Y., & Liu, R. (2008) [5]. According to them, that is really important to do the transport analysts in order to estimate the distribution of travel times (DTT). The approach of repeated simulation was used in estimating the DTT. From the research, three different parameter sets for three DTTs have been managed to be calibrate. Firstly is about the multidimensional calibration problems. This risk should be always be managed through proper constraining of feasible range of values for each parameter. Other than that, a clear methodology should always be identified by separating the dataset; search for the irregular of performance in the calibrated model; and finally, the calibration procedure should be run for more than once with different inputs. A better a better result, the specified set of calibration should be use and need to be focusing on the most important parameters. The strength this repeated simulation approach is depends on further improvement of the traffic microsimulation

Models (TMMs) themselves. The analogy between a single TMM run and also multiple times should been establish. By using this, the TMM will give the different values in every run. But there are also range of factors that can affect the real-world DTT the example of this problem is the absent bus driver, road blockage, accident, and many other things that can increase the in a TMM. In addition, many TMM applications do not let the travellers the freedom to change their travel choices such as the mode of. It the factor that can affect the real DTT not being modelled, it will cause the analogy to be imperfect. From this, it will give bad effect in the calibration procedure because it will influent the values of the wrong model parameters, and cause a compromised model. The effect of an un-modelled phenomenon that affects the DTT is not always a major problem. For example, the

increasing in time travel for a place where an accident happen is easily to detect. If measurements are influent directly by such events, then the error will occur because they are not avoided the explicitly modelled.
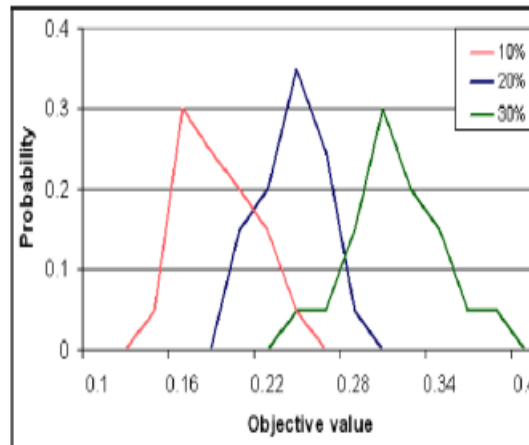
Figure 2.5: Evaluation for the same objective value repetitively.
(Using same parameter set and different DTTs).

The above figure show the result when the experiment was repeated with the different parameter sets. The result values lied within the narrow range when the objective function was repeatedly which is evaluated with the same parameter set. From the result, it can be conclude that the specific parameter set able to capture a specific DTT.

The simulation case study under Upreti, G, etc. (2014) [13] shows that by using the dynamic simulation methodology can help to develop a self-adapting simulation model. This mean that the simulation can changes itself with the various critical conditions. For the uses of the traditional simulation model, the random values are taken with the specified values in each repetition. From this, the average of all runs then are used to create results. For the dynamic simulation model, each run, the controlled input data will be allocated and trigger a sequences of events that are specific to the particular condition. Because of this reason, the dynamic simulation model able to replicate with all conditions that occur. By using the

dynamic simulation modelling, it will minimizes the time effort that are needed for updating the simulation model when the critical events are added during the development stage. This will increasing the reliability to this simulation model. Figure 2.6 below show the lists of the critical performance metrics that can be used in the case study model.

Critical performance metrics in transportation model.

Critical metrics	Critical events	Deliverables
No. of people waiting	Demand of students Time of day	Resource allocation
Avg. waiting time of people	Day of week Special events Parking facilities	Routing of buses

Figure 2.6: critical performance metrics in transportation model

There are few scenarios that have been identified and being kept in this model. All include:

- The number of bus stops and the buses must not exceed more than six at any given time.
- The buses will be provided at the places where they are required the most dependent to the average waiting time of passengers for each bus top.
- The bus need to deliver on-board passengers according to their destinations and then have to exit the system to the bus depot when additional buses are needed
- The model will be run for four scheduling types which is high frequency schedule, medium frequency schedule, low frequency schedule and schedule with gaps in between.
- The number of passengers in each bus is limited to 30.
- It will be assume that the boarding time of passengers is negligible.
- There are two different routes in this study. The shortest route will has four bus stops while the longest will has six bus stops.

2.5   Summary

From all the literature review above, the simulation model will be developed and all the important parameter will be collected to be use in this study. The time taken required for the bus to reach certain point will be used minimize the time. Some of the location for the bus to stop which not too strategic will be eliminated. The number of passengers also will be identified at the important time such as during the peak hour, weekdays, and also for the weekends. At the same time, the busses depart from the terminal also will be schedule correctly. The study that have been made by the others researcher about this problem and how they solve their problem by using the simulation model will be the guideline to this study.

CHAPTER 3

METHODOLOGY

3.1   INRODUCTION

In this chapter, the methodology that will be involve in this research will discussed. To achieve the objectives in this study, the essential data must be collected. The methods on how the data such as time taken for the travel, no bus stooping and others will be collected and how the data will be evaluated will be described to in this chapter. Besides that, under this chapter also will be describe about the simulation software that will be use and how this software can help to solve the problem regarding to this field. The step to use the simulation model also will be explain to make the process of simulating clearer.

3.2   METHOD DESCRIBTION

The method that will be used in this research is the simulation model approach. This approach will be used in order to improve the route taken by RapidKuantan and at the same time reducing the time taken for the buses to reach each stooping point. The number of user also will be identified to make sure the user comfortable during certain specific time. By this way, the company can also reduce the cost and improving the service to meet the satisfaction of the users by improving the efficiency of the time their use. The measures that will be collected must accurate in order to avoid any error related data during the simulation process. There are several step in computing the simulation model. Figure 3.1 will show the flow in formulating the simulation model.
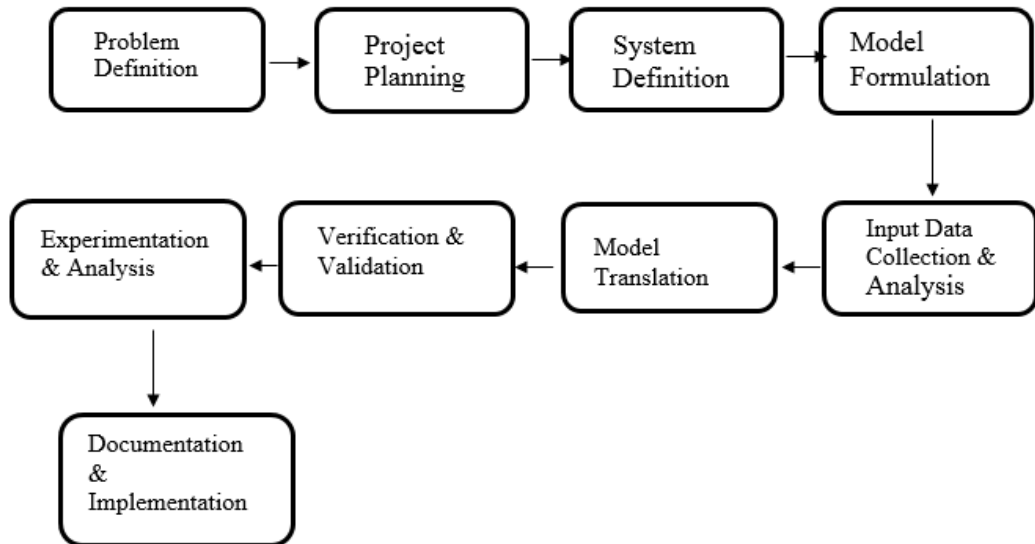
Figure 3.1: Steps in a Simulation Study

I. The problem definition.

The first step that involve defining the goals and determine the problem.

II. Project planning.

This process is for completing the project within time. The milestones will indicate the tracking progress. This process is important to determine whether there is sufficient time and also resources are available for completion.

III. System definition.

The system components that will be modelled and the performance measures to be analysed will be identified. The system may very complex, so there is important to have experienced simulator to find appropriate level of detail and flexibility.

IV. Model formulation.

This process is to understanding how the actual system behaves. The basic requirements of the model that are necessary in developing the right model are being identified. Creating the flow chart of how the system operates will improve the understanding of what variables are involved and how these variables interact.

V. Input Data Collection & Analysis.

After the model was formulated, then the type of data to collect will be determined. The existing or the new data will be gathered.

VI. Model Translation.

During this process, the model will be translated into programming language. There are general purpose languages such as fortran or the simulation programs for example is Arena.

VII. Verification & Validation.

Verification process is a process of ensuring the model will behaves as intended. This can be done through debugging or animation. While the validation will ensures that there is no difference exists among the model and also with the real system. The validation can be attained through the statistical analysis.

VIII. Experimentation & Analysis.

For this stage, the experimentation will be involves developing the alternative model, execute the simulation, and comparing the performance of alternative system with the real system.

IX. Documentation & Implementation.

For this stage, the documentation will be in written report and/or presentation. The results and implications of the study will be analysed. The best solution is identified, recommended, and justified.

The simulation model can be used when there is a need to model to develop and also analyse randomness in a system. There are few situations which the simulation modelling and can be use:

1. When there is impossible and extremely expensive to processes that should be observe in the real world such as the effect of Internet advertising on a company's sales, the statistic of cancer and many more.

2. The situation where the problems which the mathematical model can be formulated such as job shop scheduling problem and also the situation that involving the large scale of queuing models.

3. When there is impossible to validate the mathematical model in order to describing the system. This situation happen due to insufficient data.

Most of the simulation that being applied in studies today are implemented by using the simulation package. From the usage of this package, it can reduced the programming requirements, the natural framework, the automated gathering of statistics; symbol for communication; animation and also the ability to change the model. There are two types of simulation packages available, which is the simulation languages and also the application-oriented simulators (Table 1). For the simulation languages, it is more flexible compared to the application-oriented simulators. In contrast, the simulation languages require many programming expertise. For the application-oriented simulators, they are simpler to learn and it has been constructs related to the application.

Table 3.1: Type of simulation

Type Of Simulation Package	Examples
Simulation languages	Arena (previously SIMAN), AweSim! (previously SLAM II), Extend, GPSS, Micro Saint, SIMSCRIPT, SLX *Object-oriented software*: MODSIM III, SIMPLE++ *Animation software*: Proof Animation
Application-Oriented Simulators	*Manufacturing*: AutoMod, Extend+MFG, FACTOR/AIM, ManSim/X, MP$IM, ProModel, QUEST, Taylor II, WITNESS *Communications/computer*: COMNET III, NETWORK II.5, OPNET Modeler, OPNET Planner, SES/Strategizer, SES/workbench *Business*: BP$IM, Extend+BPR, ProcessModel, ServiceModel, SIMPROCESS, Time machine *Health Care*: MedModel

In this study, the schedules and also the list of trip will be developed for the scheduling and pre-simulation part respectively. Before we do the simulation for routing-scheduling, the trip serviced by the system must be identified. The route that are being used also should be identified so that we can know how long the time require for the buses to reach certain point. All this route can be improve from time to time by improving the stopping with the strategic locations. The coordination of this point also need to be schedule in order to reduce the waiting time for both parties at the route network. This route is then will be analyze and stimulate repetitively to get the optimal route. This optimal route can be achieve by eliminate the point for the bus to stop where there are less user waiting at that point. The route that have been optimize is then will be compared with the original route. The final and the most optimize route will be select. The final route will be selected if all the criteria is achieve:

1. Reducing in-vehicle travel time of passengers.
2. Reducing queuing time for both parties
3. Reduce in number of pit stop.

The number of users also will be identified to identified at what time the buses is being used most such as during the people back from work or during the weekend. This will help to improve the service and make the user feel more convenient. The time for the buses to depart from the terminal will be schedule depending on this situation.

The Clock Model

The clock model is employing the loop simulation which is part of the base simulation model. This model has its own seconds, minutes, and hour variables. All this variables then used to control the main simulation model. In figure 3.2 showing the details about the clock simulation model and its ARENA modules.
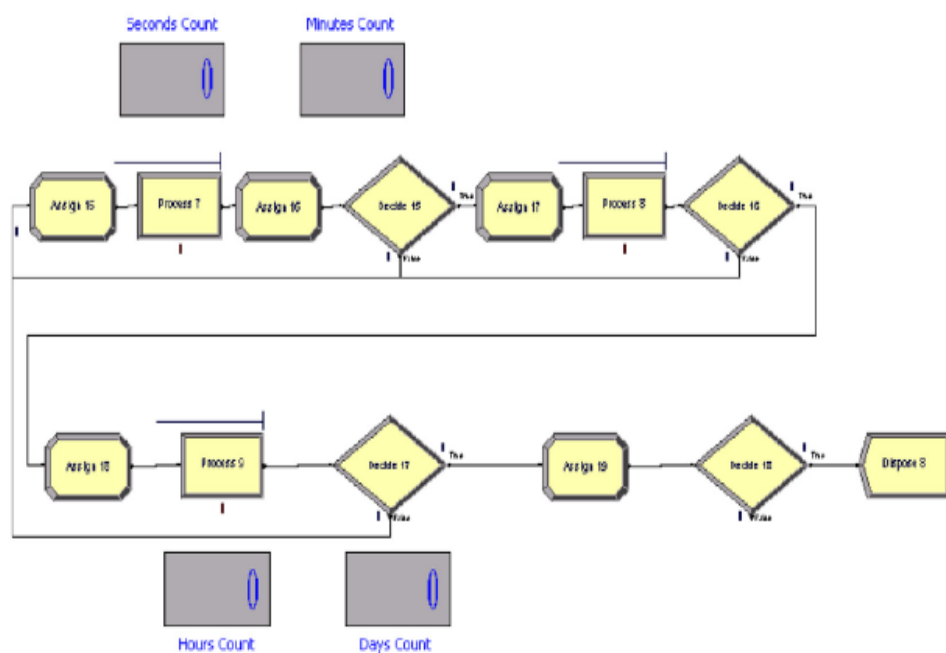
Figure 3.2: The clock model

Dynamic Assignment of Buses

One of the function for this model is about the addition of buses within the specific bus stop when the average of waiting time of the passengers is higher than normal. This addition can be obtain by calculating the average number of passengers in waiting at the bus stop and this average number will be used as a condition to release additional buses into the system.

CHAPTER 4

RESULT AND ANALYSIS

4.1   INRODUCTION

The timetable and also bus scheduling is one of the vital focus in the urban transportation. From the aspect of the passenger demand, the average travelling time for bus has been used in scheduling the time for the buses. Though, in the real situation, the arrival of the buses are different at every stages. Hence, in order to find the best regularity, the travelling time between the stages have to be taken into consideration. Generally, the passengers have to wait for the bus because of bad traffic, scheduling, and also overcrowding. All this things may happen due to improper scheduling.

In this chapter, all the result from that are obtain from the observation will be discuss and analysis. This have been done to determine the result, the observation are similar to the real situation. Regarding to the main objective of this research, the time for the bus arrived/depart, how long does it take from Kuantan to arrive to Gambang, the station of the buses stop, the idle time of the bus at each station are being observed and recorded.

The procedure to record the data start from the bus start departing from Kuantan to its next station. The time taken for the busses to reach each station was recorded. Beside the time taken, the queuing time for the buses stop for each stopping point also being observed and recorded. The total time that the buses take to reach Gambang from Kuantan was totalled up to take the overall time

taken. This is the actual time taken that the buses required to reach Gambang. The time was taken during the normal hours and also the peak hours which people going back from work, in weekdays, and the same time, during weekends. The data then was compared.

4.2   BASE SIMULATION MODEL

The Hentian Bandar to Gambang Resort route has been selected as the base model to test this simulation methodology. This route are connects the campus to Kuantan. This is essential for the student who does not have own transportation to move anywhere safely especially to Kuantan. There are plenty of station in order to complete this route before the buses can reach to Gambang. Figure 4 show the detail station in this route for the bus to stop. For the route, the time for the bus to reach every station will be observed. The other thing that should be consider also is the queuing time for the buses stop for each stopping point. This is crucial to determine whether the station is relevant to use or not. The total time for the buses take to reach Gambang was calculated. In this research, it is expected to cut down the time for bus reaching the destination by selecting the best route for the bus to take.
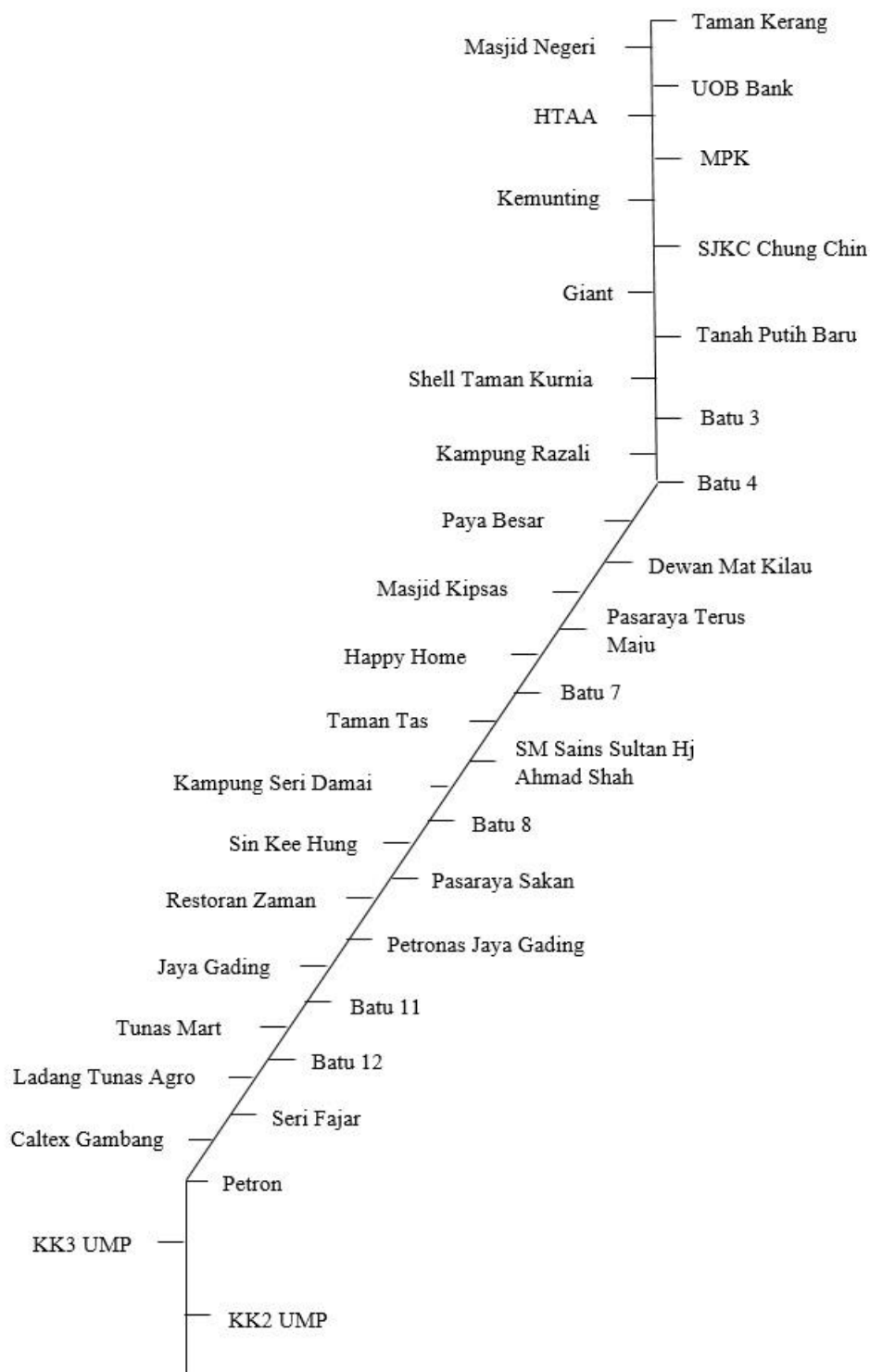
Figure 4.1: Show the detail station in this route for the bus to stop

HENTIAN BANDAR

Taman Kerang - Jln Bukit Ubi	UTC – Jln Stadium
Masjid Negeri - Jln Mahkota	LKPP – Jln Gambut
UOB Bank - Jln Besar	Ibu Pejabat Polis Kontinjen Pahang – Jln Merdeka
Hospital Tengku Ampuan Afzan - Jln Tanah Putih	Masjid Negeri – Jln Mahkota
Ibu Pejabat MPK - Jln Tanah Putih	Ibu Pejabat Polis Daerah Kuantan – Jln Mahkota
Kemunting - Jln Tanah Putih	Hospital Tengku Ampuan Afzan - Jln Tanah Putih
SJKC Chung Ching – Jln Tanah Putih	Kemunting - Jln Tanah Putih
Pasaraya Giant - Jln Tanah Putih	Pasaraya Giant-Jln Tanah Putih
Tanah Putih Baru - Jln Gambang	Tanah Putih - Jln Gambang
Shell Taman Kurnia – Jln Gambang	Tanah Putih Baru - Jln Gambang
Batu 3 - Jln Gambang	Batu 3 - Jln Gambang
Kampung Razali - Jln Gambang	Tunas Manja – Jln Gambang
Batu 4 – Jln Gambang	Sg Isap – Jln Gambang
Paya Besar – Jln Gambang	Sg Isap Jaya– Jlln Gambang
Dewan Mat Kilau - Jln Gambang	Taman Sepakat – Jln Gambang
Masjid KIPSAS - Jln Gambang	Paya Besar – Jln Gambang
Pasaraya Terus Maju-Jln Gambang	Permatang Badak Jaya – Jln Gambang
Happy Home – Jln Gambang	Dewan Mat Kilau– Jln Gambang
Batu 7 -Jln Gambang	Giat Mara – Jln Gambang
Taman Tas - Jln Gambang	Batu 6 – Jln Gambang
SM Sains Sultan Hj Ahmad Shah -Jln Gambang	Happy Home – Jln Gambang
Kampung Seri Damai - Jln Gambang	Taman Tas – Jln Gambang
Batu 8 - Jln Gambang	Maybank Taman Tas – Jln Gambang
Sin Kee Hung - Jln Gambang	Batu 9 – Jln Gambang
Pasaraya SAKAN – Jln Gambang	Restoran Zaman – Jln Gambang
Restoran Zaman - Jln Gambang	TUDM – Jln Gambang
Petronas Jaya Gading -Jln Gambang	Jaya Gading - Jln Gambang
Jaya Gading - Jln Gambang	SMK Sri Mahkota - Jln Gambang
Batu 11 - Jln Gambang	Mahkota Aman - Jln Gambang
Tunas MART - Jln Gambang	Tunas Mart – Jln Gambang
Batu 12 - Jln Gambang	Batu 12 - Jln Gambang
Ladang Tunas Agro -Jln Gambang	Ladang Tunas Agro - Jln Gambang
Seri Fajar - Jln Gambang	Batu 16 - Jln Gambang
Caltex Gambang - Jln Gambang	Seri Fajar - Jln Gambang
ESSO - Lebuhraya Tun Razak	Medan Selera - Jln Gambang
Kediaman UMP 3 – Pers.MEC	Caltex Gambang - Jln Gambang
Kediaman UMP 2 - Pers.Bandar Gambang	ESSO – Lebuhraya Tun Razak
Universiti Malaysia Pahang – Lebuhraya Tun Razak	Universiti Malaysia Pahang - Lebuhraya Tun Razak
ESSO – Lebuhraya Tun Razak	Kediaman UMP 2 – Pers.Bandar Gambang
Klinik Kesihatan Gambang - Jln Gambang	Kediaman UMP 3 – Pers.MEC
Balai Polis Gambang - Jln Gambang	ESSO - Lebuhraya Tun Razak
BHP Gambang-Jln Gambang	Klinik Kesihatan Gambang - Jln Gambang
Kedai Buah - Jln Gambang	Balai Polis Gambang – Jln Gambang
Perumahan Rakyat-Jln Gambang	BHP Gambang - Jln Gambang
Kolej Matrikulasi Gambang - Jln Gambang	Kedai Buah - Jln Gambang
Kolej Komuniti Gambang - Jln Gambang	Perumahan Rakyat-Jln Gambang
UIA Gambang – Jln Gambang	Simpang Kolej Matrikulasi – Jln Gambang
	UIA Gambang – Jln Gambang
	Kolej Komuniti Gambang - Jln Gambang
	Kolej Matrikulasi Gambang - Jln Gambang
	Persimpangan Gambang Resort

GAMBANG RESORT

Figure 4.2: Show the station from Kuantan to Gambang

4.2.1   DATA COLLECTION

The early stage in this simulation process is the better understanding about the actual system, situation and also the valid data collection. The first thing that need to be approach for this process is the data collection concerning about the route in the system. The data about the bus schedule, bus timing and frequency, the station for the buses to stop including the queuing time for the buses stop for each stopping point are being observed and recorded.

The data collection process start from the bus departing from Kuantan to its next station. The main thing that need to be consider is the time taken for the bus to reach each station. This time need to be observe and recorded. During the bus reach their each station, the queuing time for the buses stop also need to be observe. After all the procedure is done, the total time for the buses take to reach Gambang from Kuantan need to be totalled up to take the overall time taken. The totalled time is the actual time taken that the buses required to reach Gambang and this time is actual need to be study and need to be reduce. In order to reduce the total time, the best route for the bus to take need to be chosen well. All the stopping point that has fewer passengers waiting at the station is identified. All identified stopping point that are none passengers waiting can be skipped and even terminate the point so that the time taken for the busses travel from the starting point until the last point can be reduce.

Table 4.1: Show the time taken for the busses during normal hours during weekdays
(first day)

STATION	TIME TAKEN TO REACH NEXT STATION (min)	QUEING TIME AT EACH STATION (min)	NO. OF PASSANGER	
			IN	OUT
Hentian Bandar	7.36			
Taman Kerang	1.11	0.28	1	
Masjid Negeri	0.45	0.26	4	
UOB Bank	3.14			
HTAA	0.35	0.40	1	
MPK	0.40			
Kemunting	0.37			
SJKC Chung Chin	0.15			
Giant	0.26			
Tanah Putih Baru	4.40			
Shell Taman Kurnia	0.43			
Batu 3	0.38			
Kampung Razali	0.44			
Batu 4	4.49			
Paya Besar	0.38			
Dewan Mat Kilau	0.26			
Masjid Kipsas	0.29			
Pasaraya Terus Maju	9.12			
Happy Home	1.04	1.31		3

Batu 7	1.55	0.18		
Taman Tas	0.45	0.07		
SM Sains Sultan Hj Ahmad Shah	0.52			
Kampung Seri Damai	0.38			
Batu 8	0.56			
Sin Kee Hung	1.43			
Pasaraya Sakan	1.13			
Restoran Zaman	1.45			
Petronas Jaya Gading	1.32	0.11		
Jaya Gading	1.09	0.05		
Batu 11	1.11	0.06		
Tunas Mart	1.36			
Batu 12	1.10	0.16		1
Ladang Tunas Agro	3.39			
Seri Fajar	1.12			
Caltex Gambang	1.42			
Petron	4.35			
KK3 UMP	0.55	0.36	4	
KK2 UMP				
TOTAL	1.10.31	4.73	10	4

- There are few passengers drop not at the Rapidkuantan Station

Table 4.2: Show the time taken for the busses during normal hours during weekdays (second day)

STATION	TIME TAKEN TO REACH NEXT STATION (min)	QUEING TIME AT EACH STATION (min)	NO. OF PASSANGER	
			IN	OUT
Hentian Bandar	7.16			
Taman Kerang	0.56	0.36	3	
Masjid Negeri	0.50	0.42	2	
UOB Bank	3.23			
HTAA	0.30	0.31	2	
MPK	0.35			
Kemunting	0.37			
SJKC Chung Chin	0.13			
Giant	0.34	0.42	4	
Tanah Putih Baru	4.58			
Shell Taman Kurnia	0.32			
Batu 3	0.46			
Kampung Razali	0.53			
Batu 4	3.57			
Paya Besar	0.33			
Dewan Mat Kilau	0.41			
Masjid Kipsas	0.36			
Pasaraya Terus Maju	9.31			
Happy Home	1.24	0.52		3

Batu 7	1.36			
Taman Tas	0.48	0.26	2	1
SM Sains Sultan Hj Ahmad Shah	0.51	0.18	1	
Kampung Seri Damai	0.29			
Batu 8	0.42			
Sin Kee Hung	2.03			
Pasaraya Sakan	1.12	0.36	1	1
Restoran Zaman	1.24			
Petronas Jaya Gading	1.07	0.18		1
Jaya Gading	0.57	0.23		1
Batu 11	1.21			
Tunas Mart	1.13			
Batu 12	1.03	0.18		1
Ladang Tunas Agro	3.48			
Seri Fajar	1.23			
Caltex Gambang	1.20			
Petron	5.35			
KK3 UMP	0.55	0.28	3	
KK2 UMP				
TOTAL	1.06.53	6.17	18	8

- There are few passengers drop not at the Rapidkuantan Station

Table 4.3: Show the time taken for the busses during normal hours during weekend (first day)

STATION	TIME TAKEN TO REACH NEXT STATION (min)	QUEING TIME AT EACH STATION (min)	NO. OF PASSANGER	
			IN	OUT
Hentian Bandar	7.45			
Taman Kerang	2.26	0.58	4	
Masjid Negeri	1.36	1.13	5	
UOB Bank	2.54			
HTAA	0.40	0.28	1	
MPK	0.38			
Kemunting	0.46			
SJKC Chung Chin	0.18			
Giant	0.47	0.56	5	
Tanah Putih Baru	5.12			
Shell Taman Kurnia	1.24	0.38	1	3
Batu 3	0.58			
Kampung Razali	1.18			
Batu 4	5.21	1.12	3	2
Paya Besar	0.57	0.34	2	1
Dewan Mat Kilau	0.36			
Masjid Kipsas	0.43	0.41	1	3
Pasaraya Terus Maju	9.51	0.56	2	3
Happy Home	1.24	0.36		3

Batu 7	2.17			
Taman Tas	0.58	0.51	2	2
SM Sains Sultan Hj Ahmad Shah	0.53			
Kampung Seri Damai	1.07			
Batu 8	0.52	0.28	1	
Sin Kee Hung	1.54			
Pasaraya Sakan	1.29	0.31	2	2
Restoran Zaman	2.03	0.21		2
Petronas Jaya Gading	1.34	0.36		2
Jaya Gading	1.02	0.24	2	
Batu 11	1.15			
Tunas Mart	1.28	0.22		1
Batu 12	1.13			
Ladang Tunas Agro	3.43			
Seri Fajar	1.15			
Caltex Gambang	2.19			
Petron	4.21	0.21		2
KK3 UMP	0.56	0.56	4	2
KK2 UMP				
TOTAL	1.16.02	11.29	35	28

- There are few passengers drop not at the Rapidkuantan Station

Table 4.4: Show the time taken for the busses during normal hours during weekdays (second day)

STATION	TIME TAKEN TO REACH NEXT STATION (min)	QUEING TIME AT EACH STATION (min)	NO. OF PASSANGER	
			IN	OUT
Hentian Bandar	8.06			
Taman Kerang	2.15	0.42	5	
Masjid Negeri	1.21	0.58	4	
UOB Bank	2.13			
HTAA	0.54			
MPK	0.49			
Kemunting	0.57			
SJKC Chung Chin	0.20			
Giant	1.12	1.13	4	2
Tanah Putih Baru	4.56	0.23	1	
Shell Taman Kurnia	1.37	0.37	2	1
Batu 3	1.08			
Kampung Razali	1.25			
Batu 4	5.21	0.53	1	3
Paya Besar	0.42			
Dewan Mat Kilau	0.32			
Masjid Kipsas	0.58	0.32		2
Pasaraya Terus Maju	9.46	0.42	1	3
Happy Home	1.31			
Batu 7	2.11			

Taman Tas	1.02	0.38		3
SM Sains Sultan Hj Ahmad Shah	0.55			
Kampung Seri Damai	0.58			
Batu 8	0.47			
Sin Kee Hung	1.52			
Pasaraya Sakan	1.34	0.21	2	
Restoran Zaman	2.10			
Petronas Jaya Gading	1.28	0.32	1	2
Jaya Gading	1.12	0.24	2	
Batu 11	1.18			
Tunas Mart	1.30	0.17		1
Batu 12	1.11	0.28	1	1
Ladang Tunas Agro	3.54			
Seri Fajar	1.30	0.20		1
Caltex Gambang	2.08			
Petron	3.57			
KK3 UMP	0.53	1.07	3	5
KK2 UMP				
TOTAL	1.16.55	10.12	27	24

- There are few passengers drop not at the Rapidkuantan Station

4.2.2 DATA ANALYSIS

The data that have been is then being analysed. After the data have been analysed, there are various situation was identified along the route. The situation are as below.

1. The distance between each bus stop is not fixed.
2. There are the chance the stacking of buses near a bus stop happens. This situation happen when there is presence of more than one bus at a bus stop.
3. To satisfy the passengers, stops will be made whenever the person ask the bus to stop.
4. The seat capacity of the buses rarely filled except for peak hours and the weekend.

All the situation happen along the route need to be study in order to understand how the transportation network works. Based on the data that have collected, most of the busses need around one hour to reach Gambang from Kuantan. This time is run during the normal hours. For the peak hours, the time taken needed is greater than that. The time for the weekend is different because most of the people are going out. By using the collected data, the simulation model will be created in the ARENA platform. The model will be build same as the actual situation happen in the real world. The number of station, the time taken needed in each bus stop will be used to build this simulation model.

In this research, the main area that will be focus is on the time taken needed by the bus reaching Gambang. The observation take 2 times which is during the normal hours of the weekdays starting at 3.00 pm. While the other data is being collect during the weekends at the same time.

Table 4.5: Show the time taken for the busses during normal hours during weekdays (first day)

STATION	TIME TAKEN TO REACH NEXT STATION (min)	QUEING TIME AT EACH STATION (min)	NO. OF PASSANGER	
			IN	OUT
Hentian Bandar	7.36			
Taman Kerang	1.11	0.28	1	
Masjid Negeri	0.45	0.26	4	
UOB Bank	3.14			
HTAA	0.35	0.40	1	
MPK	0.40			
Kemunting	0.37			
SJKC Chung Chin	0.15			
Giant	0.26			
Tanah Putih Baru	4.40			
Shell Taman Kurnia	0.43			
Batu 3	0.38			
Kampung Razali	0.44			
Batu 4	4.49			
Paya Besar	0.38			
Dewan Mat Kilau	0.26			
Masjid Kipsas	0.29			
Pasaraya Terus Maju	9.12			
Happy Home	1.04	1.31		3

Batu 7	1.55	0.18		
Taman Tas	0.45	0.07		
SM Sains Sultan Hj Ahmad Shah	0.52			
Kampung Seri Damai	0.38			
Batu 8	0.56			
Sin Kee Hung	1.43			
Pasaraya Sakan	1.13			
Restoran Zaman	1.45			
Petronas Jaya Gading	1.32	0.11		
Jaya Gading	1.09	0.05		
Batu 11	1.11	0.06		
Tunas Mart	1.36			
Batu 12	1.10	0.16		1
Ladang Tunas Agro	3.39			
Seri Fajar	1.12			
Caltex Gambang	1.42			
Petron	4.35			
KK3 UMP	0.55	0.36	4	
KK2 UMP				
TOTAL	1.08.17	4.73	10	4

- There are few passengers drop not at the Rapidkuantan Station

Table 4.6: Show the time taken for the busses during normal hours during weekdays (second day)

STATION	TIME TAKEN TO REACH NEXT STATION (min)	QUEING TIME AT EACH STATION (min)	NO. OF PASSANGER	
			IN	OUT
Hentian Bandar	7.16			
Taman Kerang	0.56	0.36	3	
Masjid Negeri	0.50	0.42	2	
UOB Bank	3.23			
HTAA	0.30	0.31	2	
MPK	0.35			
Kemunting	0.37			
SJKC Chung Chin	0.13			
Giant	0.34	0.42	4	
Tanah Putih Baru	4.58			
Shell Taman Kurnia	0.32			
Batu 3	0.46			
Kampung Razali	0.53			
Batu 4	3.57			
Paya Besar	0.33			
Dewan Mat Kilau	0.41			
Masjid Kipsas	0.36			
Pasaraya Terus Maju	9.31			
Happy Home	1.24	0.52		3

Batu 7	1.36			
Taman Tas	0.48	0.26	2	1
SM Sains Sultan Hj Ahmad Shah	0.51	0.18	1	
Kampung Seri Damai	0.29			
Batu 8	0.42			
Sin Kee Hung	2.03			
Pasaraya Sakan	1.12	0.36	1	1
Restoran Zaman	1.24			
Petronas Jaya Gading	1.07	0.18		1
Jaya Gading	0.57	0.23		1
Batu 11	1.21			
Tunas Mart	1.13			
Batu 12	1.03	0.18		1
Ladang Tunas Agro	3.48			
Seri Fajar	1.23			
Caltex Gambang	1.20			
Petron	5.35			
KK3 UMP	0.55	0.28	3	
KK2 UMP				
TOTAL	1.06.53	6.17	18	8

- There are few passengers drop not at the Rapidkuantan Station

Table 4.7: Show the time taken for the busses during normal hours during weekend (first day)

STATION	TIME TAKEN TO REACH NEXT STATION (min)	QUEING TIME AT EACH STATION (min)	NO. OF PASSANGER	
			IN	OUT
Hentian Bandar	7.45			
Taman Kerang	2.26	0.58	4	
Masjid Negeri	1.36	1.13	5	
UOB Bank	2.54			
HTAA	0.40	0.28	1	
MPK	0.38			
Kemunting	0.46			
SJKC Chung Chin	0.18			
Giant	0.47	0.56	5	
Tanah Putih Baru	5.12			
Shell Taman Kurnia	1.24	0.38	1	3
Batu 3	0.58			
Kampung Razali	1.18			
Batu 4	5.21	1.12	3	2
Paya Besar	0.57	0.34	2	1
Dewan Mat Kilau	0.36			
Masjid Kipsas	0.43	0.41	1	3
Pasaraya Terus Maju	9.51	0.56	2	3
Happy Home	1.24	0.36		3

Batu 7	2.17			
Taman Tas	0.58	0.51	2	2
SM Sains Sultan Hj Ahmad Shah	0.53			
Kampung Seri Damai	1.07			
Batu 8	0.52	0.28	1	
Sin Kee Hung	1.54			
Pasaraya Sakan	1.29	0.31	2	2
Restoran Zaman	2.03	0.21		2
Petronas Jaya Gading	1.34	0.36		2
Jaya Gading	1.02	0.24	2	
Batu 11	1.15			
Tunas Mart	1.28	0.22		1
Batu 12	1.13			
Ladang Tunas Agro	3.43			
Seri Fajar	1.15			
Caltex Gambang	2.19			
Petron	4.21	0.21		2
KK3 UMP	0.56	0.56	4	2
KK2 UMP				
TOTAL	1.16.02	10.68	35	26

- There are few passengers drop not at the Rapidkuantan Station

Table 4.8: Show the time taken for the busses during normal hours during weekdays (second day)

STATION	TIME TAKEN TO REACH NEXT STATION (min)	QUEING TIME AT EACH STATION (min)	NO. OF PASSANGER	
			IN	OUT
Hentian Bandar	8.06			
Taman Kerang	2.15	0.42	5	
Masjid Negeri	1.21	0.58	4	
UOB Bank	2.13			
HTAA	0.54			
MPK	0.49			
Kemunting	0.57			
SJKC Chung Chin	0.20			
Giant	1.12	1.13	4	2
Tanah Putih Baru	4.56	0.23	1	
Shell Taman Kurnia	1.37	0.37	2	1
Batu 3	1.08			
Kampung Razali	1.25			
Batu 4	5.21	0.53	1	3
Paya Besar	0.42			
Dewan Mat Kilau	0.32			
Masjid Kipsas	0.58	0.32		2
Pasaraya Terus Maju	9.46	0.42	1	3
Happy Home	1.31			

Batu 7	2.11			
Taman Tas	1.02	0.38		3
SM Sains Sultan Hj Ahmad Shah	0.55			
Kampung Seri Damai	0.58			
Batu 8	0.47			
Sin Kee Hung	1.52			
Pasaraya Sakan	1.34	0.21	2	
Restoran Zaman	2.10			
Petronas Jaya Gading	1.28	0.32	1	2
Jaya Gading	1.12	0.24	2	
Batu 11	1.18			
Tunas Mart	1.30	0.17		1
Batu 12	1.11	0.28	1	1
Ladang Tunas Agro	3.54			
Seri Fajar	1.30	0.20		1
Caltex Gambang	2.08			
Petron	3.57			
KK3 UMP	0.53	1.07	3	5
KK2 UMP				
TOTAL	1.16.55	10.12	27	24

- There are few passengers drop not at the Rapidkuantan Station

 Refer to less uses statio

 Refer to none uses station

The above table shows the analysis of the data that had been collected along the route taken by the bus to reach Gambang. The analysis of the data at table 5 show that the total time taken for the bus is about 1 hour 08 minutes with the queuing time is 4 minutes 73 second. Table 6 show the other day which is the total time taken for the bus is about 1 hour 06 minutes and the queuing time is 6 minutes 17 second. While table 7 and 8 show the result during the weekend. For the table 7, the total time taken by the bus is about 1 hour 16 minutes with the queuing time of 6 minutes 17 second and for table 8, the total time taken by the bus is about 1 hour 16 minutes and the queuing time is 10 minutes 12 second. From the data that have been collected, it can be said that the average time taken for the bus to reach Gambang is up to 1 hours, this is a long time to wait. Thus, this time need to be reduce to improve the time efficiency for the bus.

From the table above, all the station are being identified including the less uses station and none uses station. The station that are less uses are marked with the yellow colour meanwhile the station that are no passengers waiting are marked with the red colour. This is important to make sure where is the station that is really working to be maintain. The station that are no use can be terminate to reduce the total time taken for the bus. Based on the table, there are few station that are no passenger waiting at it. There are 11 station that are useless and can be terminate. By terminating all this point, the total time travel for the bus can be reduce and can improve its time efficiency. The station that can be consider to be eliminated is UOB Bank, Majlis Perbandaran Kuantan (MPK), Kemunting, SJKC Chung Chin, Batu 3, Kampung Razali, Dewan Mat Kilau, Kampung Seri Damai, Sin Kee Hung, and Ladang Tunas Agro. Besides that, the station that is very close also can be considered to be remove. The passengers may wait at the nearest stations. For the example is the Petronas Jaya Gading and Jaya Gading station. This station is not very far, so the passengers may wait at one of the station only.
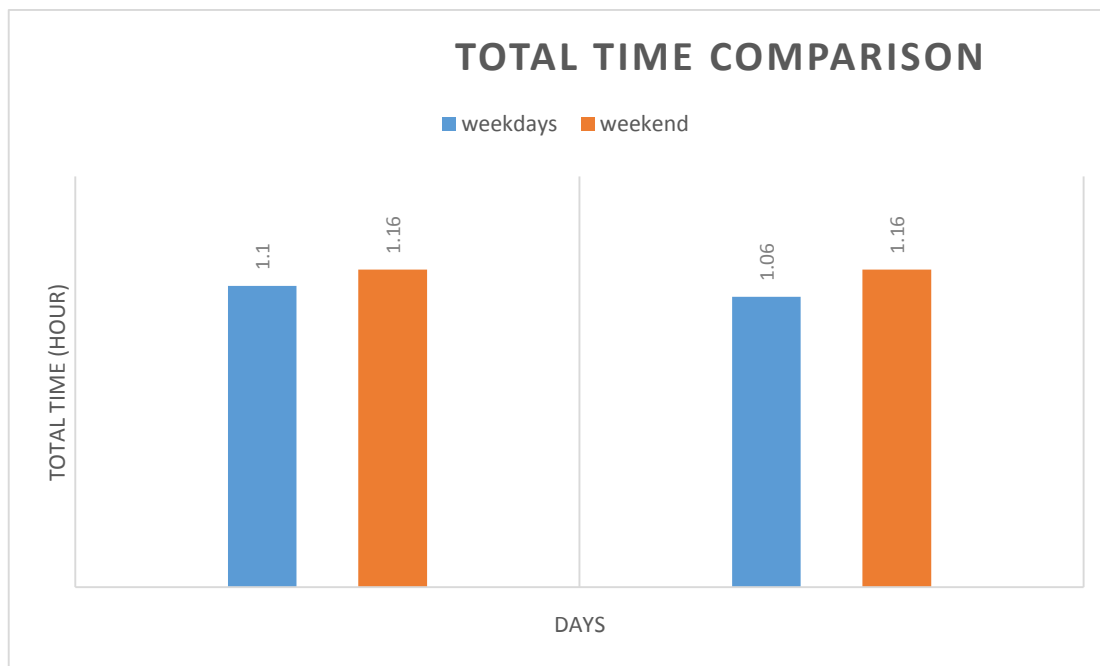
Graph 4.1: Show the total time comparison between weekday and weekend

The graph above Show the total time comparison between weekday and weekend that have been collected. Based on the graph, it can be told that the total time that required by the bus during the weekend is lower compared to the total time during the weekend.
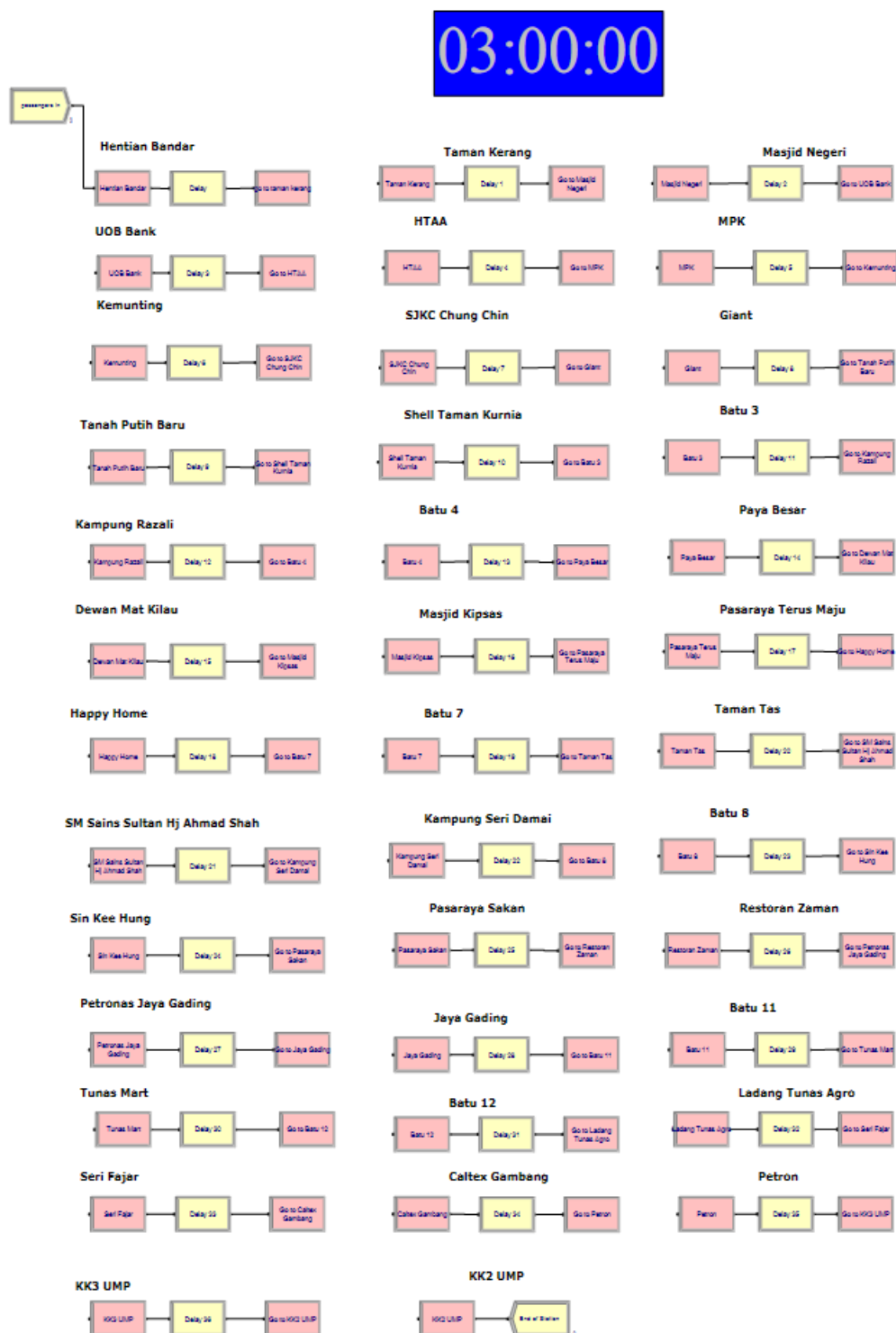
4.3   SIMULATION MODEL

Figure 4.3: Show the simulation of the real situation (first day)

From the real situation that happen in the real world, the simulation model was developed as the figure above. The process developing this model is starting by creating the passengers at the initial station which is Hentian Bandar. Then, from this station, the bus will move to the next station which is Taman Kerang along through the route. The delay will be calculated if there are passengers are there waiting at the station to aboard into the bus. All of this process are continuously repeated along the road until it reach the final destination, which is Kolej Kediaman 2, University Malaysia Pahang. When this process are running, the time will be calculated.
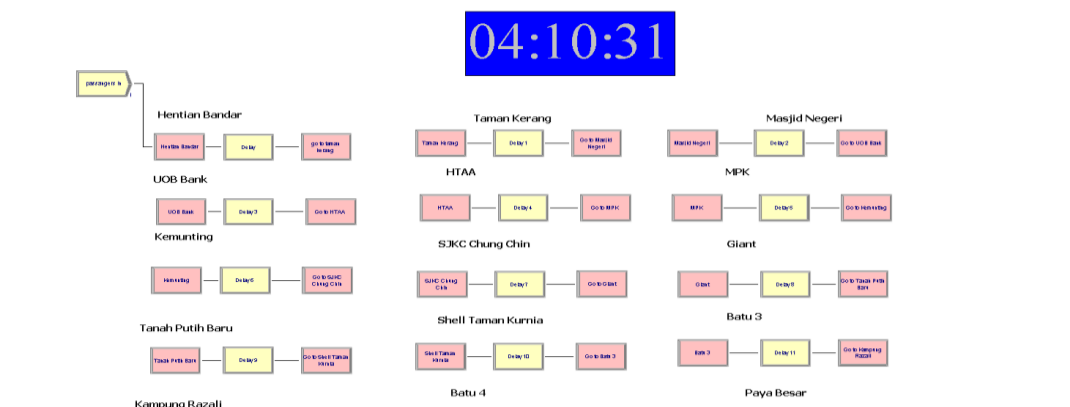
Figure 4.4: Show the total time for the bus to reach UMP before remove some station during weekday (first day)

The figure above show the total time for the bus to reach University Malaysia Pahang (UMP) during weekday on the first day before removing some station. The simulation showing that the clock is at 4.10 pm. Since the bus start the journey at 3.00 pm, then the bus required about 1 hours and 10 minutes to reach UMP. It is a long time to wait for the student to take the bus. So, the main concern about this study is to minimize the total time taken so that it can reduce the waiting time for the student to take the bus. In order to reduce the total time, the best route for the bus to take need to be chosen well. To do that, the stopping point that has fewer passengers waiting at the station is need to be identified. All

identified stopping point that are none passengers waiting will be skipped and even terminate the point so that the time taken for the busses travel from the starting point until UMP can be reduce.
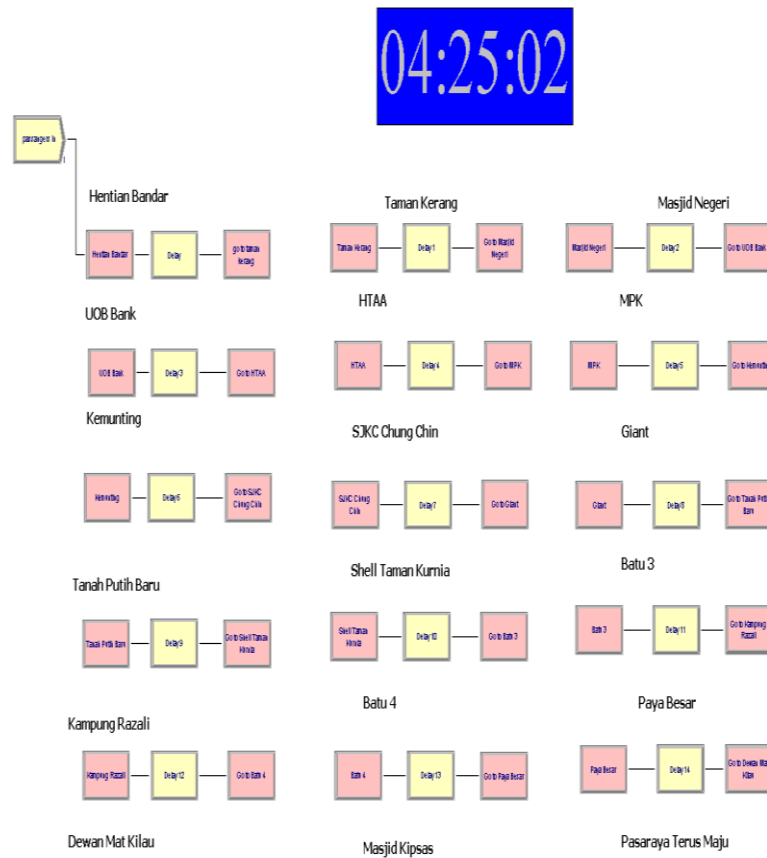

Figure 4.5: Show the total time for the bus to reach UMP after remove some station during weekday (first day)

From the above figure, it show the total time for the bus to reach UMP after remove some station. The simulation is run after that. With some of the station are removed, it show that the total time taken for the bus can be reduce. From the result, the total time needed by the bus is about 56 minutes and 13 second. This is lesser compared to the real situation which is need almost one hour. The different now is almost about 15 minutes. By this, the student can get the bus quicker compared before. The location if the station is really important determine the effective time consumption of the bus. By this, the station need to be studied further.
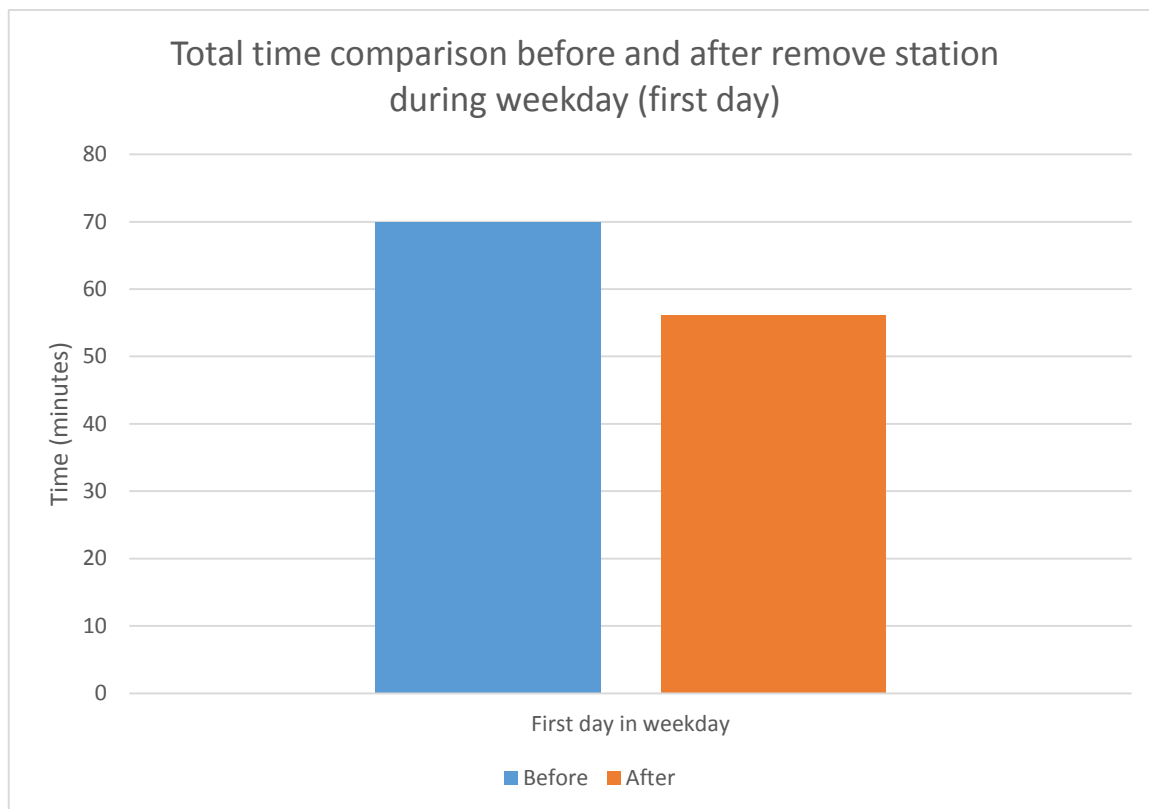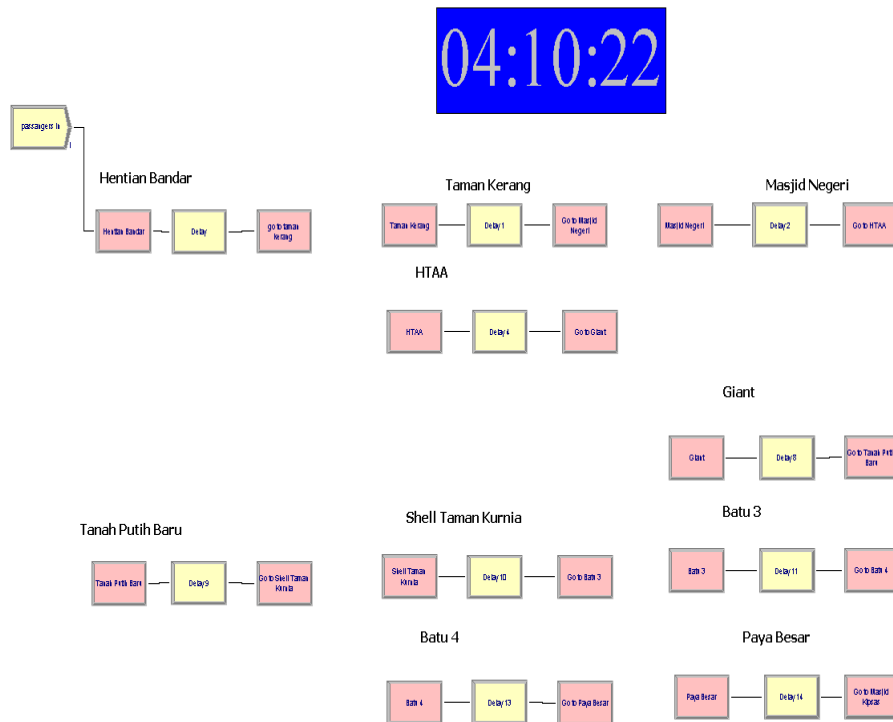
Graph 4.2: Show the total time comparison before and after remove station during weekday (first day)

The graph above Show the total time comparison before and after remove station during weekday (first day). From the graph, we can see that there is a lot of different in time taken by the bus to reach the final destination. Before removing the station, the busses need almost one hour. After removing the station, it only required about 56 minutes. The different now is almost about 15 minutes.
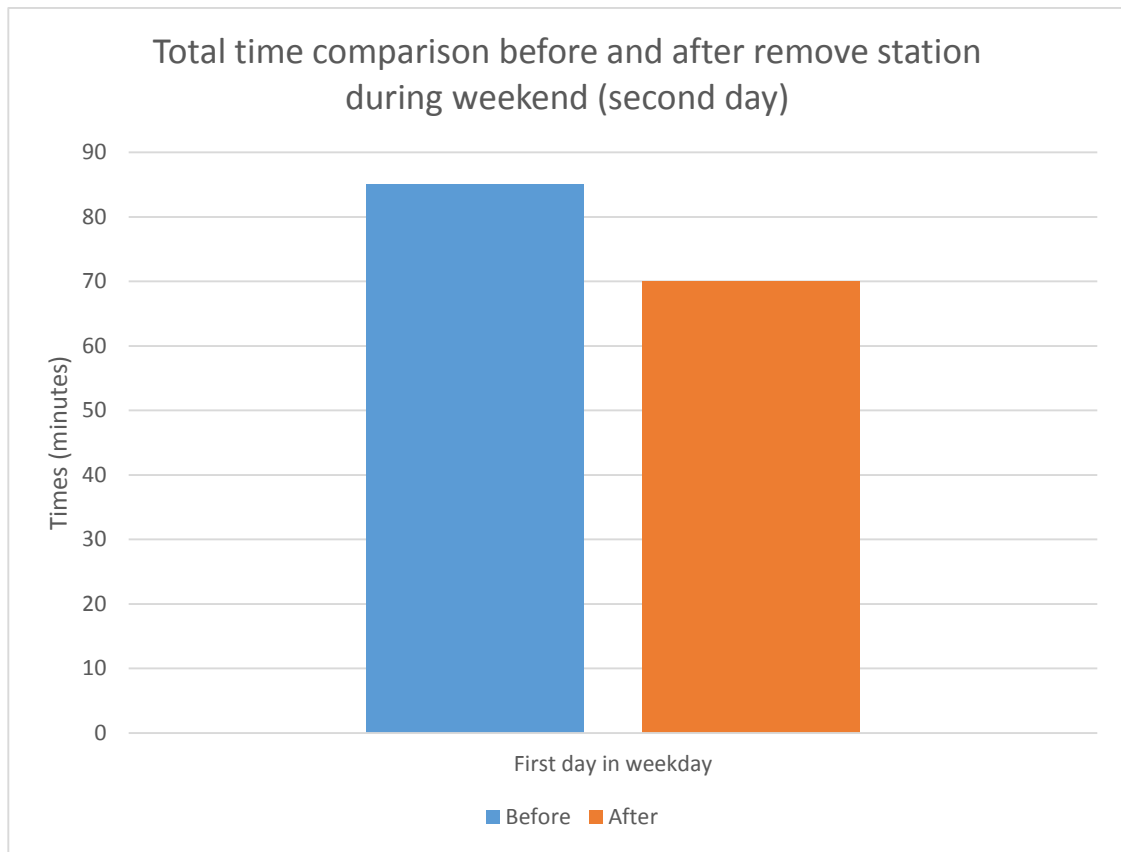
Figure 4.6: Show the total time for the bus to reach UMP before remove
some station during weekend (second day)

Meanwhile, the above figure show the total time for the bus to reach
UMP before remove some station during weekend on the second day. The figure
above show the total time for the bus to reach University Malaysia Pahang (UMP)
during weekday on the second day before removing some station. The simulation
showing that the clock is at 4.25 pm. Since the bus start the journey at 3.00 pm,
then the bus required about 1 hours and 25 minutes to reach UMP.

Figure 4.7: Show the total time for the bus to reach UMP after remove some station during weekend (second day)

While the above figure, it show the total time for the bus to reach UMP after remove some station that have been mention. After the station are removed, it show that the total time taken for the bus can be reduce from 1 hours and 25 minutes to 1 hours and 10 minutes. This is lesser compared to the route that consist all station before.

Total time comparison before and after remove station during weekend (second day)

Graph 4.3: Show the total time comparison before and after remove station during weekend (second day)

The graph above Show the total time comparison before and after remove station during weekend (second day). From the graph, we can see that there is a lot of different in time taken by the bus to reach the final destination. Before removing the station, the busses required about 1 hours and 25 minutes to reach UMP. But after removing the station, it only required about 1 hours and 10 minutes.
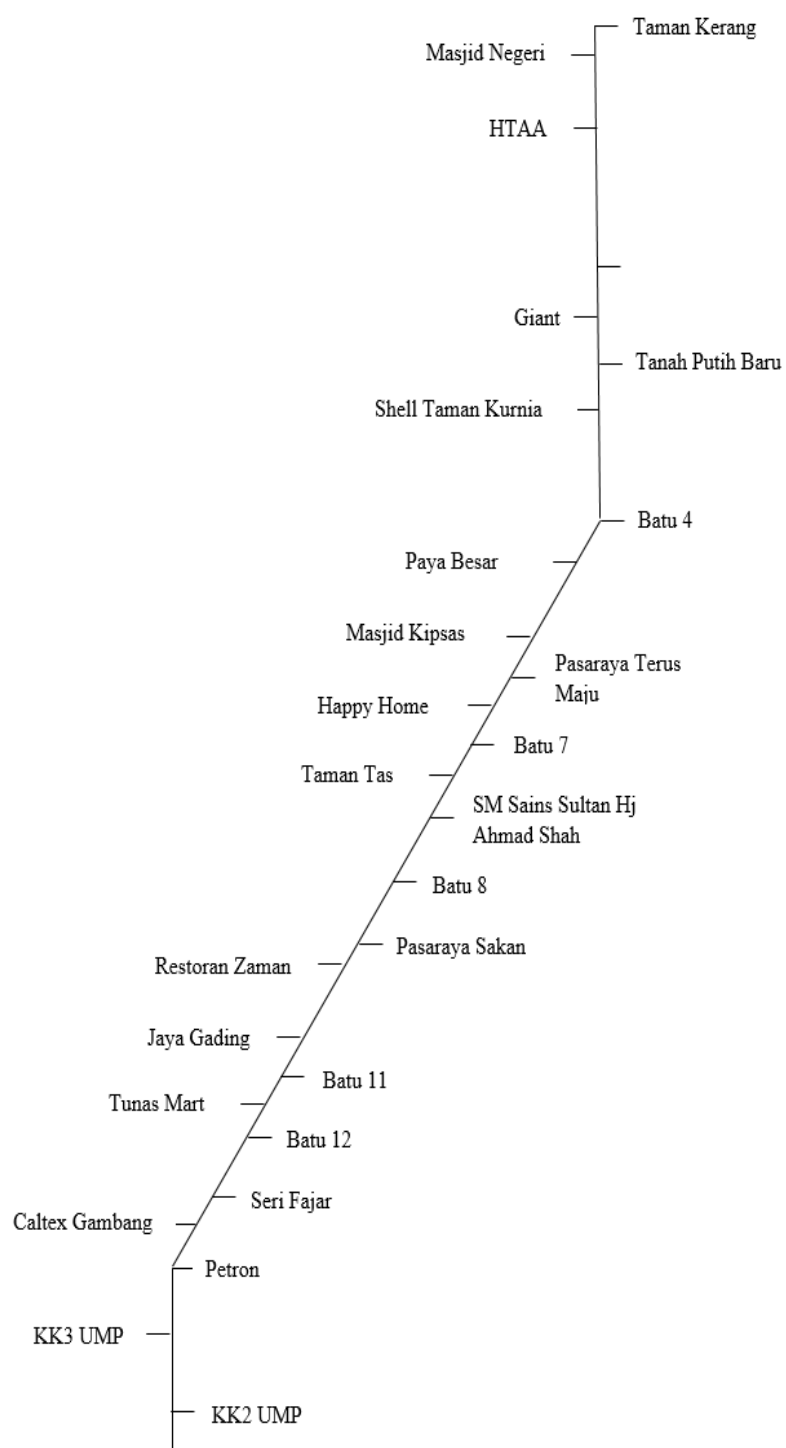
Figure 4.8: Show the new route and station for the bus to stop

4.4   SUMMARY

As the conclusion from this research, it has been prove that the total time taken for the bus to reach University Malaysia Pahang can be reduce by minimizing the total station of the bus. By minimize the total time taken of the bus, it can reduce the waiting time for the student to take the bus. To do so, the best route for the bus to take need to be chosen well by chosen the correct location of the station. Based on the study that have been done, the total time can be reduce about 15 minute if the unusable station that have been identified are removed. By doing this, the company can improve the time efficiency and improve their service.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1   INTRODUCTION

In this chapter, there will be the conclusion about the overall of this thesis. All the data that have been analysed about the about the about time taken for the bus to reach certain point, waiting time for the passengers in each stations, and the efficiency of the bus in term of time also will be concluded in this chapter. Based from the result that are collected, the recommendation will be listed and reviewed in this chapter as the alternatives in improving the efficiency of the buses and also for the further research.

Time is one of the most important thing when using the public transportation. It can be said that the public transportation is really important to help people moving around. But, there is a common problem faced by the user of this bus and it almost clear to said it is about the about time taken for the bus to reach the destination. The factor that can lead to this problem is the location for the bus to stop are not strategic. Due to this problem, it also can increase the queuing time for the passenger at the station. There are certain stopping point which is less favourable for the passengers which mean that, there is no passengers waiting there. Based on the problem that occur, the optimal routes that can optimize the time taken and distance for the bus will be studied and analysed.

5.2   SUMMARY OF RESEARCH

The main purpose of this research was to develop the simulation model to enhance the Rapidkuantan service system. The second purpose of this research is to enhance the Rapidkuantan system by reducing the queuing time at each bus station. The uses of the simulation model was chosen because the ability to adjusting the simulation parameters depending on the input conditions. Collecting data for a limited period of time and analysing it is essential to get the desire result. There are events that can play important key role in the performance of a system. To get the correct simulation model, it is requires to consider all the events that happen. From this research, the total time for the bus needed to travel from one point to another point will be reduce. Based on the observation and the data that have collected, the research will be able to reduce the time taken by skipping the certain stopping point where there are lesser passengers waiting on the station. The bus can skip or can terminate the point that are lesser passenger waiting so that the time taken for the busses to reach Gambang can be reduce.

5.3   ROCOMMENDATION

The purpose of the recommendation in this section is improving the time efficiency of the time taken for the bus to reach the final destination. In order to obtain the objective of the research, queuing time at each station need to be minimize. A single route of the busses consist of 38 station, this can be said it is a route needed to be taken. This long route will result in higher total time for the buses to reach its destination. To reduce this time, the number of station need to minimize and terminate whenever it is not required If this change are made, it can decrease the total time of the time taken for the busses to travel from initial point to Gambang. For the future research, the study can be done during all the time for the bus depart from the initial station. This is to will strengthen the data collected to achieve more accurate result. Besides that, the duration of the research also can be lengthen such as three weeks to one month in order to improve the data about the pattern and the situation that may affect the time taken for the busses.

5.4   CONCLUSION

The good design of the bus transit network is very important in order to make it more efficient in term of time. The example of this public transportation is buses that give the service to the public to make any of the movement from one place to another place easier. By conducting this study, it also can help to improve services and quality of the buses in term of comfort, customer satisfaction and at the same time making the bus as the first choices as the medium of the transportation compare to the private car. By using this public transportation, we can reduce the accident rate involving cars, and also can save our environment from polluted.

By using the simulation model, it can help to reduce the time taken for the bus to reach its final destination. By identified the location for the bus to stop, it will allow the software to determine the most frequent and least frequent station use in the route network that use by the bus. Hence this, the least frequent station can be eliminated to improve the time uses by the bus top reach its final destination.

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