THE ASPECT OF WALKING ACCESSIBILITY IN THE DEVELOPMENT OF GIS-BASED TRANSIT SYSTEM MODELLING IN KUALA LUMPUR

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ABSTRACT

Traffic congestion has become an increasingly rampant problem throughout Kuala Lumpur. Residents of Kuala Lumpur are encouraged to give a helping hand in reducing traffic congestion by using more public transport such as transit systems. Walking accessibility has been recognized as one of the important factors that will affect people's willingness to travel by transit system.

The advanced technology of Geographic Information System (GIS) and Global Positioning System (GPS) has been applied for providing sufficient information about the transit system to users and planners. This information will help them in decision making on the most economical route as well as to minimize traveling time. The GIS and GPS technique can be enhanced through the use of laptops and pocket PCs. As a result, transit planners are able to evaluate transit system in Kuala Lumpur particularly in the aspect of walking accessibility to transit terminals.

Information on walking accessibility is presented for easy comprehension and interpretation. This paper will be presenting the information on walking accessibility and the parameters for the transit system modeling analysis using GIS. All the information relevant for the analysis stage of transit system modeling was collected to find out the problem that will be encounter and to resolve the solution to overcome the problems. Digital map produced plays an important role for planners and transit users to analyze and make decision. Digital maps on a big scale together with information on walking accessibility that covers every station of the transit system can be viewed. This study has established the ability of planners to plan their journey with transit system according to the information on walking accessibility and all the information will be presented interactively for future study on locating the potential LRT Station.

Keywords: GIS, GPS, Walking Accessibility, Transit System, Digital Maps

1.0 INTRODUCTION AND OBJECTIVE

1.1 Introduction

GIS-based transit system modeling is a computer-integrated tool for evaluating transit system models, providing various information on transit systems. Using this advanced tool to model a transit system, can therefore plan an enhanced transit network so as to increase the effectiveness of a transit system.

Now and then transit agencies rely on printed schedules to provide customers with information about transit routes and schedules. Transit users must select proper routes and transfer points based on the information from the schedule. The use of schedules can sometimes be confusing. In addition, since schedules are infrequently updated, many service changes cannot be reflected in the brochure in a timely manner. Most transit agencies have customer service agents to provide telephone assistance in answering customer inquiries about the system. Customer service agents can suggest itinerary plans for customers based on the printed route maps. This manual planning process is tiring, time-consuming, redundant and often error prone; information may vary from one service agent to another due to miscommunication and misinformation.

In the talk of urban transportations, planners, policy makers, and transit managers are just beginning to comprehend how important GIS can be in their work. Most promising application areas are transit route planning and market analysis, vehicle monitoring and real-time operational control; customer information systems; paratransit and emergency vehicle dispatching, as well as congestion management. Other GIS applications include transit service area analysis, data attribution and network representation, transit demand, transit distribution, linking transportation system and others.

GIS plays an important role in evaluating the effects of LRT systems in terms of social, economic and development of surrounding area. GIS can be employed to calculate spatially related variables such as distance to the LRT station and distance between stations.

The implementation of GIS in public transportation helps enhance public outreach by producing high-quality maps that display public transit facilities and demographic information. Moreover, GIS will enable the immediate display of inventory and selected data associated with the fixed route of public transit. This system promotes better ways to share information to improve the analysis of policy and planning decisions. Transit managers will be able to access information that allow them to better utilize resources and make better informed policy, operations and planning decisions. Meanwhile, public transit users will be provided with real-time information to aid passengers in decision making regarding their trip using public transportation.

The effectiveness of a transit system is influenced by many factors such as the transit route, the transit coverage area, the placement of the stations, facilities provided at stations, the station's accessibility and etc. An accessible transit station means are able to reach the station easily. Walking accessibility is one of the most important factors that influence the transit system use. No matter the distance, people still have to walk to reach a station. Therefore, pedestrian's accessibility is an important factor in the determination of transit route alignment and the location of transit stops.

Walking accessibility is defined as how easy it is for a person to access transit terminals by foot. Walking effort instead of walking distance or walking time is used to represent the utility of walking as an access mode to transit terminals.

1.2 Objective

The main purpose of this study is to analyze the aspect of walking accessibility of existing transit stations in terms of distance, by using digitized maps. This study also aims to develop GIS maps presenting radial distance of 500 meters from each transit terminal, that comprise accessible catchment areas including commercial buildings, government offices, leisure, educational, hotels, places of worships and residential buildings. The catchment area of each transit terminal will be studied as the properties of each station are the most important criteria that influence walking accessibility. Another objective is to familiarize with GIS software and digitizing works, which have been the core procedure in this study.

1.3 Study Area

Transit lines covered in this study are the KL Monorail, Kelana Jaya Line, Sri Petaling Line and Ampang Line. Figure 1.1 below shows the transit network available in Kuala Lumpur and Selangor, and the transit that has been selected are labeled. Since this research focuses on transit lines in Kuala Lumpur, therefore these four transit lines were preferred due to the location of stations of these transit lines are within the Kuala Lumpur vicinity. The KL Monorail has all of its stations located in Kuala Lumpur. As for Sri Petaling Line and Ampang Line, 21 out of 25 stations are located inside Kuala Lumpur. Meanwhile, Kelana Jaya Line places 14 out of 24 stations within Kuala Lumpur and serves most important areas.

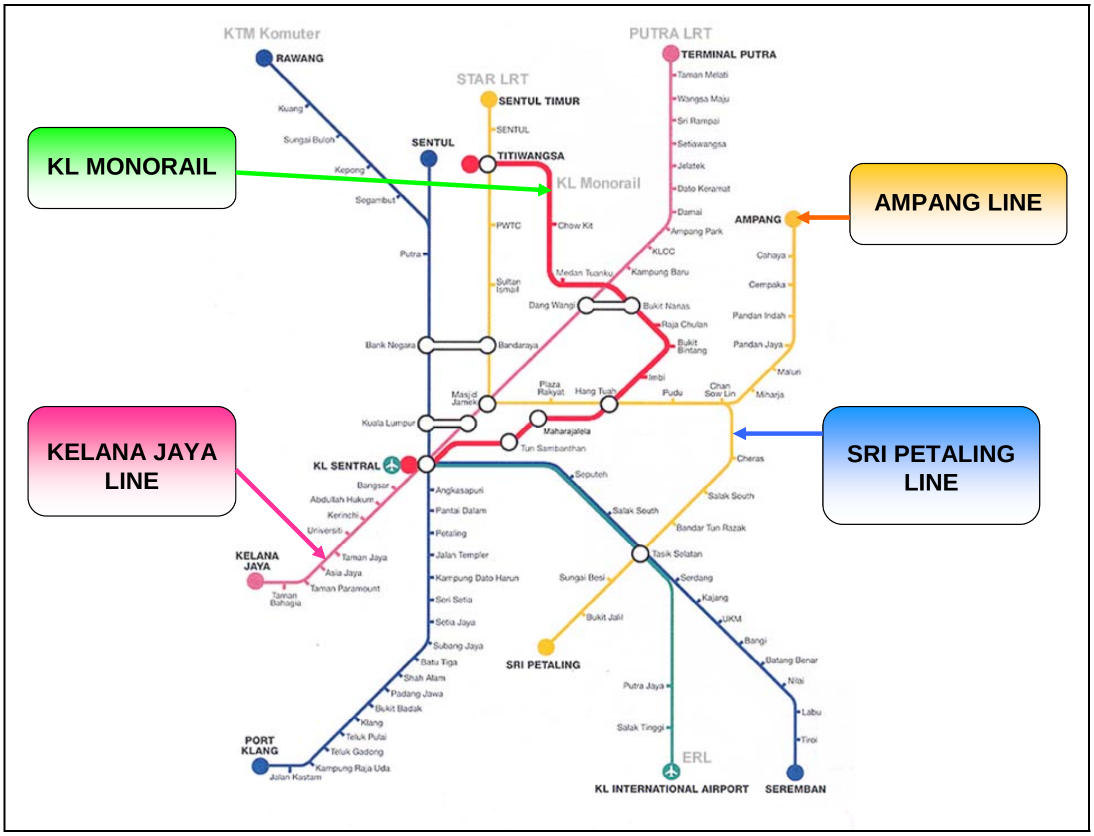

Figure 1.1: Picture of all four transit lines covered in this study.

(Source:RapidKL)

1.4 Modern Transit System

1.4.1 Modern Rail Transport in Kuala Lumpur

Mass transit systems are becoming popular in metropolitan cities. Light Rail Transit (LRT) systems which are the modern version of street cars are one of the more popular transit systems in Kuala Lumpur. LRT is an important part of modern transit system due to its ability to transport high numbers of passengers comfortably, efficiently and quickly. Monorail is also an important mode of public transportation in Kuala Lumpur. Since the tracks of monorail system require minimal space horizontally and vertically, therefore this system is usually located in the middle of busy and congested areas.

Generally, modern transit systems in Kuala Lumpur consist of six transit systems. They are the Ampang Line, Sri Petaling Line, Kelana Jaya Line, KTM Commuter and Express Rail Link (ERL). Ampang Line, Sri Petaling Line and Kelana Jaya Line are the LRT systems operating under one main operator that is the Rangkaian Pengangkutan Integrasi Deras Sdn Bhd (RAPID KL). The routes of these three systems cover most areas of Kuala Lumpur and some areas of Selangor. KL Monorail is operated by KL Monorail System Sdn Bhd which runs through the central areas of commercial buildings, hotels and shopping arenas in the Kuala Lumpur district.

KTM Commuter is Malaysia's first electrified rail system operated by KTMB Berhad. This commuter rail system serves certain areas in Kuala Lumpur and Selangor. ERL is a high-speed air-rail system between Kuala Lumpur City Air Terminal at KL Central Station and Kuala Lumpur International Airport (KLIA).

1.5 Walking Accessibility

1.5.1 Definition of Walking Accessibility

Walking accessibility is defined as how easy it is for people to access public transport stops by the mode of walking. Many studies on public transport have shown that walking is most natural and is the main mode for a person to access public transport. Determination of alignment of a public transit route and location of transit stops are rely mostly on the pedestrian accessibility factor.

1.5.2 Transit Accessibility Factors

Accessibility of public transport terminals is influenced by characteristics of the pedestrian walk. No matter how convenient the trip, when safety is a concern, even for a short distance people would prefer a safer mode. Since sidewalks of a pedestrian's walking route are the main access methods for transit stops, therefore the sidewalk modeling must consider few factors such as street crossings, commercial driveway crossings, overpass or stairs.

A station will be more accessible if there are other transit interchanges such as buses, light rail transits or monorails because the distance passengers need to walk will be less. Stations that are far away from other transportation modes can be inconvenient since passengers do not have other transport that brings them to the station and is therefore inconvenient. For example, the walking distance for passengers can be reduced if shuttle bus or taxi services provided for the passengers, which they only required to walk less then 200 meters, commonly.

People will have more options for how to travel to transit terminals when development occurs around a transit stop which more transit can be supported. People will be able to reach a station easier if there are other transit interchanges or 'Park and Ride' system that helps bring them to a station.

1.5.3 Importance of Walking Accessibility

The quality or performance of public transport service is indicated by many factors, and one of the most important factors is walking accessibility. In recent public transport studies, public transport accessibility is associated with a certain number that is related to walking distance or walking time. Transit stops that are unreachable will affect the effectiveness of the transit system itself.

Walking and transit systems are interrelated. Good walking conditions for pedestrians is important to use public transport, since most public transport trips require people to walk at one or both ends of their trip.

2 RESEARCH METHODOLOGY

2.1 Research Methodology Chart

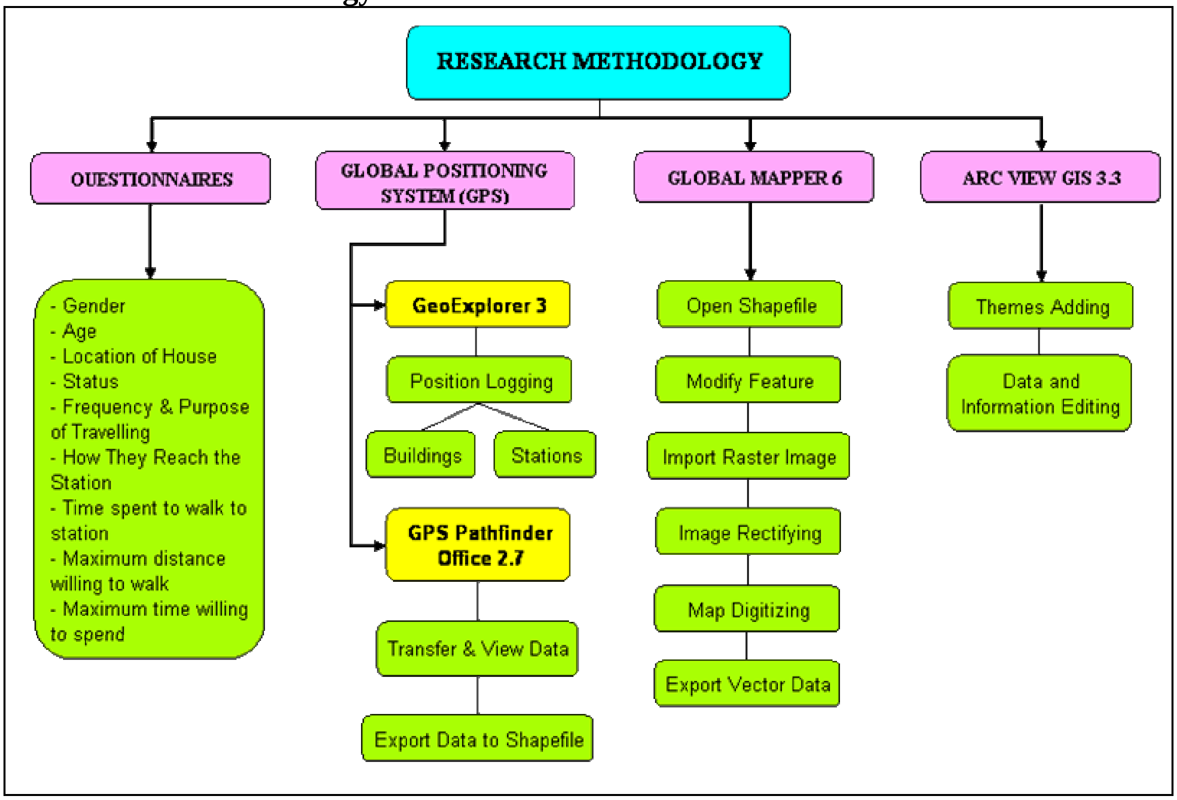

Figure 2.1: Flow chart of research methodology

2.2 Walking Accessibility

2.2.1 Determining Walking Accessibility of Transit Stops

Pedestrian accessibility is an important factor to determine the alignment of a transit route and the locations of transit stops. The calculation of accessibility requires the identification of the catchment area around each transit stop, which is the area from which potential riders are willing to walk to and from the stop. Three ways of determining the catchment area of transit stops are Route Buffer Catchment Areas, Stop Buffer Catchment Areas, and Network-based Catchment Areas. In this study, the “Stop Buffer Catchment Areas” method is used to identify catchment areas.

This second approach to build catchment areas is to create a buffer around each individual stop served by a route. This approach improves the accuracy of resulting measures of accessibility to the route but requires the availability of a transit stop layer to coordinate locations for each stop. Since Malaysia is a hot-climate country, the distance of 500 meters is agreed as the accessible walking distance to transit stations. In addition, according to JKR standards, 500 meters is the standard distance between two bus stops. This means, passengers have to walk to any bus stop the maximum distance of 500 meters.

2.2.2 Questionnaire on Walking Accessibility

A survey on walking accessibility to transit stops has been done randomly at the University Station (Kelana Jaya Line) and KL Central Station (KL Monorail). The purpose of this questionnaire is to study the willingness of a passenger to walk to transit stops, in terms of walking distance and walking time. This survey was participated by passengers of LRT and Monorail stations while waiting for their train to arrive.

The questions have been distributed to a total of 20 respondents. The respondents were selected randomly of different ages and status. The questionnaire consists of 12 simple short questions. The result will be based on age, gender, location of house, and some other basic factors

2.3 GPS Pathfinder & Trimble GeoExplorer 3

2.3.1 Data Acquisition Using Trimble GeoExplorer 3

The positions of LRT and Monorail stations are identified by logging each position using GPS tool, Trimble's GeoExplorer 3.

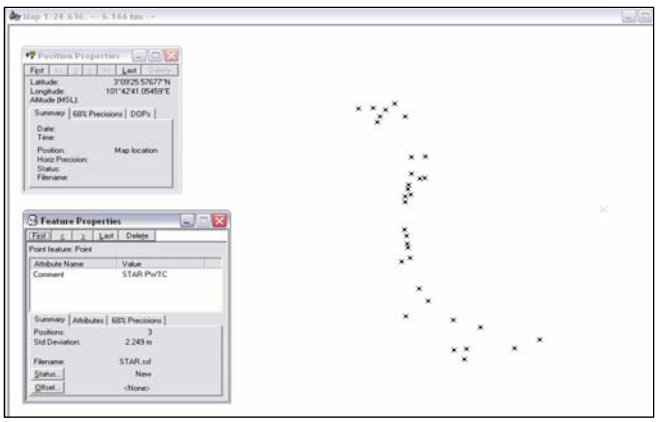

Figure 2.2: Position of buildings and stations around Sri Petaling Line logged by GeoExplorer 3.

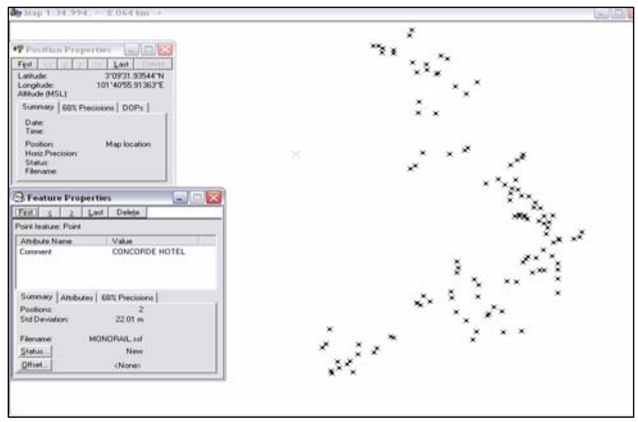

Figure 2.3: Position of buildings and stations around KL Monorail logged by GeoExplorer 3

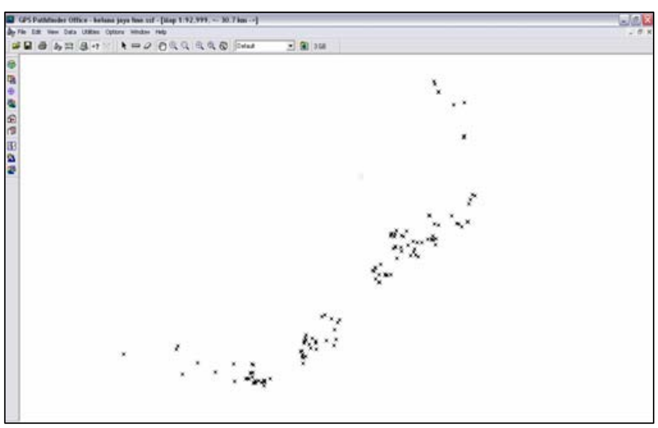

Figure 2.4: Positions of buildings and stations around Kelana Jaya Line logged by GeoExplorer 3

2.3.2 Stations With 500 Meter Radial

The station with the most congested area is Chow Kit Station (KL Monorail). This station serves at area which is highly dense with commercial buildings. Only few buildings are residential, followed by government, educational, hotel, leisure and place of worship. It can be assumed that most people reached the station on foot. This is because the station is surrounded by buildings, and passengers from these buildings need only walk less than 500m to reach the station.

STATIONS	Residential	Place of worship	Leisure	Hotel	Government	Education	Commercial
S. Titiwangsa	11.13	0.00	0.18	0.73	3.28	0.00	84.67
S. Chow Kit	8.85	0.32	0.24	1.66	1.19	0.71	87.04
S. Medan Tuanku	15.45	0.00	0.53	1.95	0.89	2.49	78.69
S. Bukit Nanas	11.01	0.00	1.83	12.84	5.50	6.42	62.39
S. Raja Chulan	54.52	0.00	0.27	7.98	0.53	1.33	35.37
S. Bukit Bintang	39.37	0.22	0.22	7.31	0.00	0.65	52.24
S. Imbi	30.09	0.14	0.14	5.87	0.43	0.57	62.75
S. Hang Tuah	17.74	0.74	0.55	2.96	1.29	2.96	73.75
S. Maharajalela	8.46	0.77	2.31	1.28	5.64	0.26	81.28
S. KL Sentral	7.10	2.37	0.30	0.30	0.30	6.80	82.84
S. Tun Sambathan	8.00	1.33	0.27	0.00	0.27	8.53	81.60

Figure 2.5: Types of buildings available in 500m radial, in percentage (%) for KL Monorail Transit Line

STATIONS	Residential	Place of worship	Leisure	Hotel	Government	Education	Commercial
S. Wangsa Maju	90.54	0.06	0.06	0.00	0.00	0.00	9.35
S. Sri Rampai	99.46	0.54	0.00	0.00	0.00	0.00	0.00
S. Dang Wangi	20.81	0.00	1.01	4.70	2.01	2.01	69.46
S. Kampung Baru	77.87	0.20	0.00	0.20	0.99	0.59	20.16
S. KLCC	48.53	1.47	0.74	6.62	2.21	0.00	40.44
S. Ampang Park	66.50	1.48	0.00	4.43	8.37	0.00	19.21
S. Damai	84.28	0.16	0.00	0.63	2.04	0.63	12.26
S. Masjid Jamek	0.28	1.28	2.14	0.43	1.42	2.71	91.74
S. Pasar Seni	0.21	1.44	1.64	0.62	7.80	1.03	87.27
S. KL Sentral	15.38	1.03	2.05	0.51	3.08	4.62	73.33
S. Bangsar	55.50	1.38	0.69	0.00	3.44	0.23	38.76
S. Abdullah Hukum	61.87	0.00	0.67	0.00	17.39	2.01	18.06
S. Kerinchi	3.23	0.65	6.45	0.00	29.03	3.87	56.77
S. Universiti	32.35	5.88	10.29	1.47	1.47	42.65	5.88

Figure 2.6: Types of buildings available in 500m radial, in percentage (%) for Kelana Jaya Transit Line

STATIONS	Residential	Place of worship	Leisure	Hotel	Government	Education	Commercial
S. Sentul Timur	86.76	0.91	1.37	0.00	0.00	2.74	8.22
S. Sentul	22.47	0.56	0.00	0.00	0.00	4.21	72.75
S. Titiwangsa	9.81	0.00	0.18	0.35	1.93	0.70	87.04
S. PWTC	18.13	0.00	0.39	2.10	0.26	0.00	79.11
S. Sultan Ismail	28.55	0.00	0.00	1.56	0.00	1.90	67.99
S. Bandaraya	1.46	0.29	2.05	3.22	10.82	1.17	80.99
S. Masjid Jamek	0.71	1.27	2.83	0.42	1.98	2.12	90.65
S. Plaza Rakyat	7.24	0.84	0.84	2.79	0.84	4.18	83.29
S. Hang Tuah	19.34	0.66	0.33	1.64	1.15	2.62	74.26
S. Pudu	4.35	0.25	0.25	0.33	0.25	1.76	92.81
S. Cheras	23.17	0.00	0.00	0.00	0.00	0.00	76.83
S. Salak Selatan	73.07	0.00	0.44	0.00	0.00	0.00	26.49
S. Tun Razak	91.44	0.19	0.00	0.00	0.00	0.00	8.37
S. Bandar Tasik Selatan	87.40	0.00	0.00	0.00	0.00	0.00	12.60
S. Sungai Besi	63.33	6.67	3.33	0.00	26.67	0.00	0.00
S. Bukit Jalil	0.00	0.00	100.00	0.00	0.00	0.00	0.00
S. Sri Petaling	99.18	0.00	0.00	0.00	0.00	0.61	0.20
S. Chan Sow Lin	12.54	0.33	0.99	0.00	3.30	1.32	81.52
S. Miharja	3.23	75.27	10.75	10.75	0.00	0.00	0.00
S. Maluri	0.42	81.43	1.69	15.19	0.42	0.00	0.84
S. Pandan Jaya	2.51	75.73	0.00	20.92	0.00	0.00	0.84

Figure 2.7: Types of buildings available in 500m radial, in percentage (%) for Ampang and Sri Petaling Transit Line

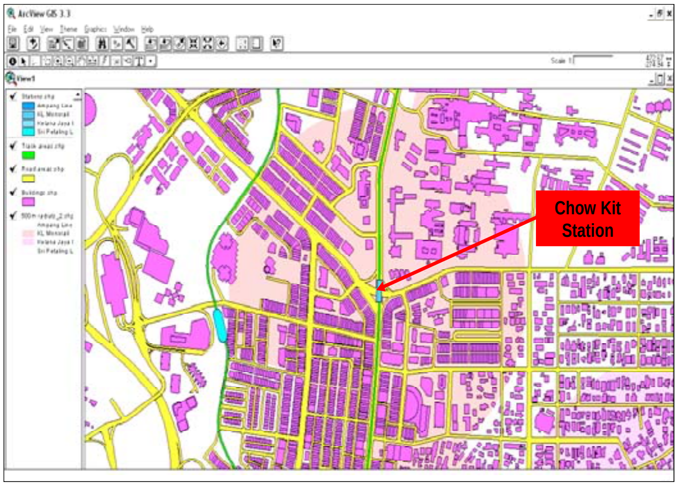

Figure 2.8: 500m radial area for Chow Kit Station.

2.4 Business Potential

Transit industry applications of GIS have expanded greatly over recent years especially in Europe. In Malaysia, this system is still new. More agencies abroad are using this technology for multi purposes.

One of the biggest problems for tourists in a foreign country is, not knowing directions. A map base that can dynamically tell you where you are and how to get to your destination would be invaluable. The ability to update the units electronically will keep the information to date.

GIS offers an opportunity for transit agencies and local planning organizations to accelerate and update the exchange of information in a cost-effective manner, which can lead to more widespread and efficient use of GIS in transit applications.

GIS system assists planners to plan a transit system by considering the effects on economic, environment and socio-cultural.

When this electronic map and data system of transit system is applied entirely to a wide area, it will cause increment in effective mobilization of people and goods. From this effect, more job opportunities will present itself due to the increase in business activity. Hence, all these activities contribute to dynamic economic growth.

Planning a transit system using GIS will help planners consider some important environmental factors such as natural elements that exist along the way. By using the software itself, planners will be provided with digital map with important information such as the topographical condition and existing natural elements. From the information provided, they will find the best way to plan a transit system, without harming the environment.

The final aspect affected by GIS-based transit modeling system is the socio-cultural. As technology grows, it contributes in building a better community with better lifestyle.

3.0 CONCLUSION

3.1 Conclusion

This study is carried out on how to apply Geographical Information System (GIS) software and Geographical Positioning System (GPS) tools in the development of GIS-based transit system modeling in Kuala Lumpur. Four transit systems, which are KL Monorail, Kelana Jaya Line, Sri Petaling Line and Ampang Line, with stations located within Kuala Lumpur, is chosen as the case study. Walking accessibility of these stations is studied. Walking accessibility is one element from many other elements that must be considered when modeling a transit system.

Walking accessibility influences consumer's willingness to go to a transit stop. Most people are able to access a transit stop if the walking distance is short. When a station is surrounded by buildings, it becomes accessible. If a station is surrounded by secluded, it is harder to access via walking. This is because when no activity operates at that area, no passengers will commute from the station. Therefore, when planning a transit route, especially the location of the transit station, walking accessibility is very important. This will result to an effective transit stop and effective transit system.

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