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Abstract
Walkability is a measure of the effectiveness of community design in promoting walking and bicycling as alternatives to driving cars to reach shopping, schools, and other common destinations.), the World Health Organization (WHO), and other health organizations advocate increasing the walkability of communities to promote fitness, combat obesity, and enhance sustainability. The aim of this study is to map spatial walkability area in Northeast Penang area using Geographical Information System (GIS). Spatial data has a potential to be used to construct measures of environmental attributes to model walkability area for this cities.10 spatial factors that influencing walking activities such as business area, education area, public utilities, government institutions, residential area, parking area, port or jetty, open space, places of worship and the industry area were identified. Buffer analysis is used to all the spatial factors to identify all areas that are within a certain distance from the original object that led to the walkability in the city. Then, the weight of importance of each factor determined using expert opinion in Analytic Hierarchy Process (AHP) analysis. Through image calculator in Idrisi 32 software, all map layers that carried their own weightage overlaid to get final walkability map that showed the distribution of walkability area of Northeast Penang. Based on the final map and field data obtained, Accuracy Assessment was conducted to identify the quality of information showed in the map. The study was also able to assess the accuracy of the maps walking ability using field data obtained. The study showed high walkability are such as near industrial areas, transport facilities, beaches, business, education and services, residential and open space and recreation.

Keywords : Walkability Mapping, Geographical Information System (GIS), Analytical Hierarchy Process (AHP)

Introduction
Community activities related to walking is healthy community and living more sustainably. Walking is also an important component of the transportation system, provides a link between homes and transit, parking and destinations, and the airport. Walkability is another form of transport activities.Walkability studies include disciplines such as geography, health, public health, population health, epidemiology, social, psychological, environmental, urban planning and sports science (Andrews et. Al., 2012).

Southworth, (2005) defines walkability as the development of environment to support and encourage activities related to walking by providing for pedestrian comfort and safety, connect people to different destinations within the appropriate time and offers the...
benefit of traveling across the network. World Health Organisation (WHO) also states that walkability is a measure of the effectiveness of the design community in promoting activities related to walking and cycling as alternatives to driving for shopping, school, and other destinations. In fact, many health organizations encourage increased activities related to walking in the community to promote fitness, prevent obesity and promote environmental sustainability.

According to a study by Abley (2005), the concept of walkability is very broad and defined as the extent to which the built environment suite the people activities related to walking, living environment, shopping, visiting, enjoy and spend time in an area. Therefore, the development of environment from the point of the architecture should be appropriate to the activities related to walking. Litman, (2011) defines walkability as a fundamental activity for physical and mental health, providing physical exercise and relaxation. It is a social and recreational activities. Environment that is conducive to activities related to walking are conducive to people. Often, the best way to improve another form of transport is to increase the walkability.

Problems Statement

Walking is one of the physical system of the human body that encourage people to move from one area to another. Walking has many advantages associated with reducing air pollution, traffic congestion and dependence on oil to slow global warming and also to solve the problems of obesity and related health issues (Sungjin Park, 2008). Movement activity can be correlated with high levels of physical movement and Body Mass Index – BMI (Giles-Corti & Donovan, 2002a, b; Saelens et al, 2003). It shows that life, work, socialise, and how we uses the environment or area has a profound implications for health (Macintyre et al 2002). Walks can also bring benefits to the economy, the environment and health of the community. The critical solution is how to encourage people to activities related to walking.

Study to find the most suitable area for walkability based on walking activities in the city will also try to identify whether the activities related to walking may contribute to a decrease in the rate of obesity in the community. Local governments can provide new conducive infrastructures to encourage more people to walk in an urban environment. This will encourage public to do more activities related to walking without the use of a motor car and motorcycle though machinery are synonymous with the era of globalisation.

Literature Review

Ko Ko Lwin and Yuji Murayama (2011) conducted a modeling of urban green space walkability web based ‘Eco-friendly Walk Score Calculator’ that allows users to evaluate the environmental quality of the neighborhood, looking for easy access to the nearest foot, choose the environmentally friendly place to live and to select routes based on environment for recreational purposes.

Cutts et al. (2009) found that Latino / immigrant and African-American population in Phoenix is more likely to live in neighbourhoods that are ‘walkable’ and have improved
access to neighbourhood parks that have the same opportunities for physical activity and give no risk to obesity.

In order to implement the walkability in Putrajaya, it is important to identify the main obstacles in the walkability. There are significant differences in the assessment of the environmental characteristics of pedestrians among those who live in the areas which has high or low walkable. Mixed land use, street connectivity and infrastructure will increase the rate of pedestrians (Sabeen Qureshi and Ho Chin Siong, 2011).

Norsidah Ujang et al., (2012) found that the commercial area of Bukit Bintang as the area can be labeled as a walkable. This area is ideal for walks with the layout of the city is able to guide pedestrians to easily get to their ultimate destination. Increase the quality of living in the pockets of the road will support the walkability of the area.

These literature review does not lead to the production of a map that shows the walkability area related to walking activities based on land use criteria using GIS techniques.

Objectives

This study focuses on analysing the regional or urban environments that direct the people to walk, especially in urban areas by the use of land and existing facilities. The first objective is to develop a database of Geographic Information System (GIS) on the "walkability" in the study area. Secondly to identify and evaluate the factors that led the walkability in the area and finally to develop walkability a map using Analytic Hierarchy Process.

Scope of Study

The study is to identify areas that are suitable for walking based on walking activities in the North East District of Penang using landuse classification. Walkability analysis evaluate the most important factors contributing to the walkability of an area. North East District of Penang has a main focus centres such as shopping malls, tourist attractions such as the historical areas and the UNESCO Heritage site.

The study area is an urban area in North East District, Penang. The study area will be focused to some sub-areas which are in the North East District, Penang. In addition, the study area has factors related to land use. GIS techniques used to identify which areas are most suitable for walking based on walking activities in the area with focusing on important factor leading to the "walkability" of an area.

Source of data used is the land use maps of Penang for 2009. Other information was through interviews with a number of respondents from health experts concerned with getting the weight to see the importance of the distance between the layers involved in mapping "walkability ". Method of AHP (Analytic Hierarchy Process) indicates the level of importance of each land use activities contribute to walkability.

Data analysis using GIS is shown in Figure 1. In the analysis with respect to the case of "walkability" in urban areas in the Northeast Region, the land use that has been identified as factors that contribute to walkability are business, education, public utilities, government institutions / statutory body, residential, parking / bus stations, ports / jetties, terrain / hills, places of worship and industry.
Information of people that walking or moving in the North East District, Penang needed for Accuracy Assessment analysis. Number of people collected will be used to verify whether the results of the final walkability map produced is good or not. The resulting percentage value will reflect the accuracy of the final map.

**Results and Discussion**

The results show that there are many areas around the North East District of Penang is area suitable for walking. This is based on the human activities related to walking. Map of walkability shows that the orange area has a high rate of walkability. Score 0 indicates the minimum rate of walkability and 1 is the maximum. There are two areas showing suitable for walking activities which is the City of George Town and District 16 of Ayer Hitam. Figure 2 shows the walkability map of the study area.
Figure 2: Walkability map of the study area

George Town is an area that has the highest rate of walkability among all districts in the Northeast Region Pinang. It is because the infrastructure architecture of George Town area are suitable for walkability. George Town City is area to be as a pedestrian friendly which has variety of activities that take place in the city.

Areas with the least of walkability rate identified as a land use for vacant land / hill which is the barrier for walking in the area. The central Northeast Region of Penang is a forest area and has lack of an activity walking conducted in the area. Only specific area such as parks and forest involve as recreational activities. Accuracy Assessment based on the contingency table (Error Base Matrix) shows that the accuracy of the walkability map is 93%.

Conclusion

Through the final map that has been generated through GIS analysis, it appears that the city of George Town is the area with very high walkability due to the area is the focus area of the public, especially tourists from abroad and local. In addition, land use factors affecting the "walkability" of an area of the City. The importance of the land use factors different by land use classes. However, we need to take into account the types of activities that occur during the day and night because the city have their activities during the day and night also.
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