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ROAD ACCESSIBILITY AND SAFETY ANALYSIS IN GATED AND NON-GATED HOUSING COMMUNITIES

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Abstract
The relationship between crime and the built environment has been extensively investigated in the field of urban design and planning. Gated housing area refers to a physical personal area with limited access and is governed by special rules, restricting or controlling access to and outside of the homeowner (via electronic devices or with the safety of workers). Therefore, gated housing communities are assumed to be safer than non-gated housing communities in relation to crime occurrence with limited road point accessibility which is deemed reliable to prevent undesirable property crime. The purpose of this research is to analyse the property crime incidents in gated and non-gated housing communities of Subang Jaya, Selangor with regards to road accessibility points. Three years of crime surveillance data from 2014 to 2016 was obtained from the Royal Malaysian Police Department. Findings indicated that crime incident is less at the gated community as compared to non-gated with the most of the hot spot area are located at the multiple road points access such as Subang Perdana Good Year Court 7 and few USJ, Subang Jaya housing areas and also the residential area which located nearest to the above stated locations as opposed to the gated housing community.

Keywords: Gated, Non-Gated, Housing Community, Geospatial, Hot Spot Analysis

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INTRODUCTION

Crime is an act in which the act is in violation of criminal law. Crime is not capped by a single factor wherever it occurs, there are various factors that influence criminal activity. Major factors that indicate potential criminal behaviour including employment, poverty, poor governance and weaknesses in law enforcement or crime control agencies. Property crimes involve theft of property with or without bodily harm, such as burglary, larceny, fraud, theft, and arson.
Gated community is a term that refers to any type of neighbourhood that has access to it and where it uses no more than two gates to be accessible to the visitor. Some even have guard huts with security guards to ensure that only residents or guests pass through the gates with authorised permission. While others use an automatic entrance barrier that residents must open with a registered access card. Usually, the gated community has a geographical name and definition that is obscured by the barriers and gates that control access to the area. Gated communities can be located in any location, either urban or rural areas (Samsuddin, 2016).

In Malaysia, gated and guarded communities are commonly known as a group of residents or communities who reside in landed properties with Strata Titles. The guideline also explains that a guarded neighbourhood refers to a residential area controlled in whole or in part in the scheme of the existing housing or new landholdings with individual land titles. The schemes also provide security services (Bachok, Mohammed Osman, & Rabe, 2011). Domestic burglaries or robberies are common nowadays and it seems to be an alarming trend especially in the urban cities with high population. Gated community is a residential area that has a good level of security and should be safe and less prone to robbery crime (Mokhtar et al., 2023). A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analysing, and displaying all forms of geographically referenced information. One of the products of GIS is a mapping crime. Mapping crime, using GIS methods, allows crime analysts to identify crime hot spots, along with other trends and patterns (Othman et al., 2020; Zandbergen and Hart, 2013). With GIS software, it is possible to map crime by type and also be able to indicate which crime is prevalent in a particular area. It is also a key component in crime analysis and police strategies to secure community safety. Accuracy in identifying these hot spots will provide significant benefits to the police force in crime detection and control (Zakaria and Rahman, 2014).

Therefore, the aim of this research is to evaluate crime incidence within gated and non-gated housing communities using geospatial analysis for the Subang Jaya area. Road accessibility and safety will also be linked to understand the possibility factor of crime hotspots within the study area. The analysis will involve the types of property crimes as well as the hotspot map using Kernel

density estimation (KDE) method for determination whether property crime has more prevalence within gated or non-gated housing communities, thus safeness of gated housing communities can be proven.

RESEARCH STUDY AREA AND METHODS

The data collection can be categorised into two which are GIS layer for Subang Jaya area data consisted of *'Blok Perancangan Kecil'* (BPK) and *'Blok Perancangan'* (BP) from Subang Jaya Municipal Council (MPSJ) as well as road network for road accessibility and safety assessment (Figure 1(a)). Crime data cases from the Royal Malaysian Police Department from years 2014 to 2016 was also obtained. The area involved in each BPK and BP as shown in Table 1. The GIS layer of Subang Jaya housing area is classified into two; either it is gated community or non-gated community housing as shown in Figure 1 (b) with red line polygon.

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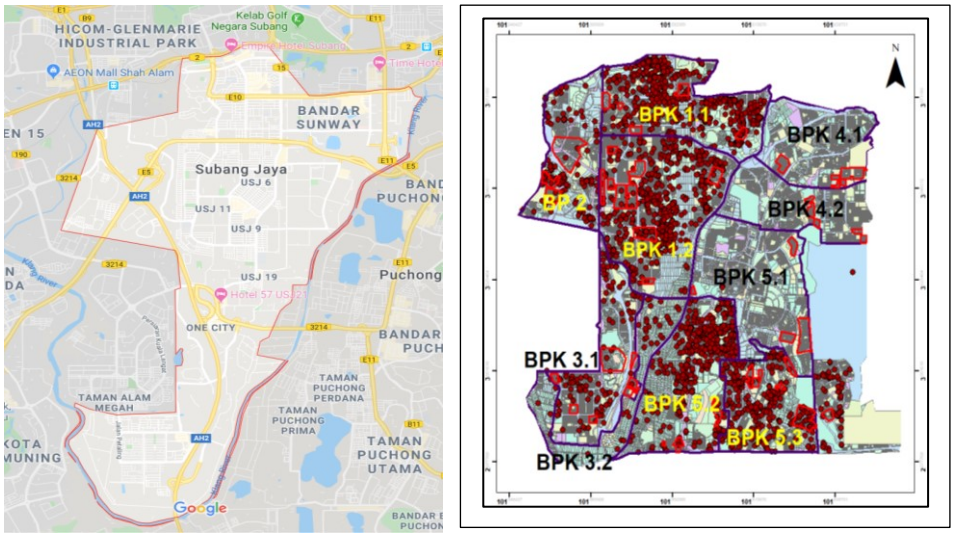

Figure 1: (a) The Subang Jaya boundary and (b) gated and non-gated housing communities in each BPK.

Table 1: *'Blok Perancangan Kecil' (BPK)* and '*Blok Perancangan'* for Subang Jaya area

BPK/BP No.	Area Coverage
BPK 1.1	SS12 – SS19, Bandar Sunway
BPK 1.2	USJ 1 – USJ 21, Subang Perdana Goodyear Court 7-10
BP 2	Taman Batu Tiga, Subang Height West, USJ Heights
BPK 3.1	One City. USJ 23 – USJ 27, Putra Heights
BPK 3.2	Kg. Tengah, Kg. Kuala Sg Baru, Kg. Bkt Lanchung
BPK 4.1	Bandar Puchong Jaya, Impian Heights, Kg. Lembah Kinrara
BPK 4.2	Bandar Kinrara5, Vistana Residence
BPK 5.1	Taman Perindustrian Puchong, Bandar Puteri Puchong, Taman Mutiara Puchong
BPK 5.2	Taman Puchong Perdana, Taman Puchong Prima, Taman Puchong Intan, Taman Puchong Indah, Taman Puchong Permai, Kg, Sri Langkas.
BPK 5.3	Taman Puchong Utama, Puchong Perdana, Bandar Bukit Puchong, Taman Maju Jaya.

Table 1 represents the coverage area of each BPK/BP in Subang Jaya with 10 BPK/BP areas. BPK 1.1 coverage for residential area of SS12 until SS19 and residential area in Bandar Sunway. BPK 1.2 coverage for residential area of USJ 1 until USJ 21, and residential area in Subang Perdana Goodyear Court 7 until Court 10. BP 2 stands for "*Blok Perancangan*" coverage for the residential area of Taman Batu Tiga, Subang Heights West and USJ Heights. BPK 3.1 coverage for residential areas of One City, USJ 23 until USJ 27 and Putra Heights. BPK 3.2 coverage for residential areas of Kg. Tengah, Kg Kuala Sg. Baru and Kg. Bukit Lanchung. Meanwhile, BPK 4.1 covers the residential area of Bandar Puchong Jaya, Impian Heights, and Kg. Lembah Kinrara. The BPK 4.2 covers the residential area of Bandar Kinrara 5 and Vistana Residence. BPK 5.1 covers the residential area of Taman Perindustrian Puchong and Bandar Puteri Puchong, and Taman Mutiara Puchong. BPK 5.2 covers the residential area of Taman Puchong Perdana, Taman Puchong Prima/Intan/Indah and Permai and Kg. Sri Langkas. Furthermore, BPK 5.3 covers the residential area of Taman Puchong Utama and Bandar Bukit Puchong.

Meanwhile, crime data was obtained from the Royal Malaysian Police Department of Subang Jaya. The data given in excel file and then converted to shapefile format for GIS. Each of the data collections in MPSJ and PDRM has some attributes such as year happened, types of crime (property or violence), and the location coordinates for georeferenced processes in GIS software. The crime types are an assertive crime which is relating to the crime against a person such as violent crime, and simple assault. The crime against property is bribery, burglary, theft from a motor vehicle, robbery and stolen property. The analysis of point patterns appears in many different areas of research (Sohn, 2016) such as crime incident points as investigated in this research. Point patterns are only deemed not enough since it is utilising basic statistical analysis such as data mean,

maximum, standard deviation and unable to highlight valuable information for the pattern analysis. Therefore, better analysis in exploring point patterns, such as density analysis or statistical operations of KDE (Garson and Vann, 2001) is adopted in this research to visualise and analyse the spatial data for pattern events prediction (Boessen and Hipp, 2015). KDE is specifically useful due to the pattern estimations are made over a grid placed on the entire point pattern and able to provide certain crime location intensity and finally detecting the highs and lows of crime point pattern densities (Kalinic and Krisp, 2018). Furthermore, according to Zakaria and Rahman (2014) KDE is also considered to be the most accurate of these common hotspot mapping techniques.

ANALYSIS AND DISCUSSION

Property Crime Incident Cases for the years of 2014, 2015 and 2016.

The property crime data used in this research study were obtained from the PDRM. The data were given in excel format then it is converted into a point shapefile format to be used in the ArcGIS software. Figure 2 shows the number of crime cases that occur in Subang Jaya in the year 2014, 2015 and 2016. In 2014 the crime cases were recorded at 2385 incidents, 2071 in 2015 and in the year 2016 is only 1319 cases, which clearly indicated decreasing pattern of crime cases based on data statistics.

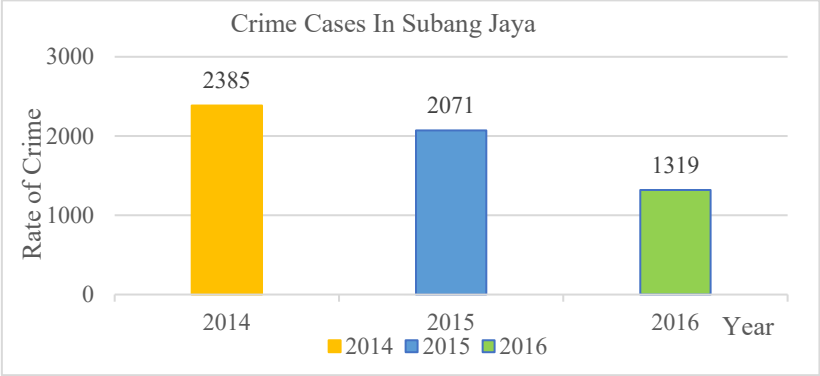

Figure 2: Crime Cases in Subang Jaya for the years 2014, 2015 and 2016.

Two types of crime data are provided by the PDRM for Subang Jaya, known as property crime and violence crime. Figure 3 shows property crime is higher compared to violence crime. In 2014, recorded 2094 cases of property crime as opposed to violence crime with only 291 cases. Meanwhile, in 2015, recorded 1692 cases of property crime as opposed to violence crime of 379 cases and finally in 2016, 1084 cases of property crime were recorded as opposed to violence crime with only 235 cases.

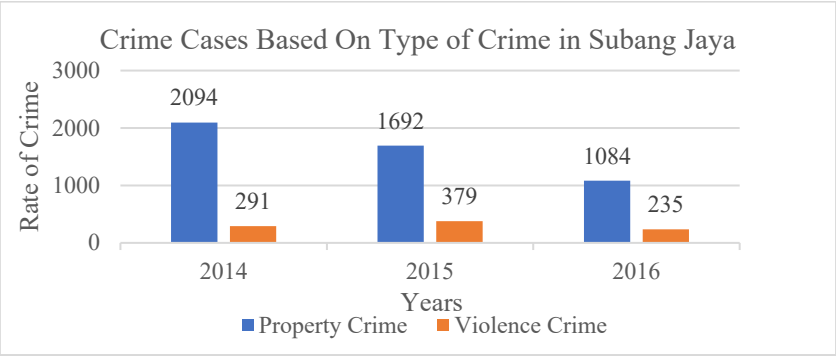

Figure 3: Type of crime cases in Subang Jaya from 2014 – 2016.

Crime Cases Occurrence at Residential Area Subang Jaya

Crimes that occurred from 2014 to 2016 are shown in the form of a point distribution map using GIS (Figure 4). Not much difference in crime point distribution from 2014 to 2016, with 2014 showing higher distribution of crime incidence in Subang Jaya housing areas as compared to the years 2015 and 2016. Most of the crime cases point distribution map occurred in non-gated housing areas as compared to the gated community type housing (red polygon). The point distribution of crime cases from 2014 to 2016 indicated some of the crimes that happened in the same area such as at BPK 1.1, BPK 1.2, BKP 5.2 and BKP 5.3. However, it can be seen that in the year 2016 significant differences with lower point crime cases as compared to the year 2014 was observed.

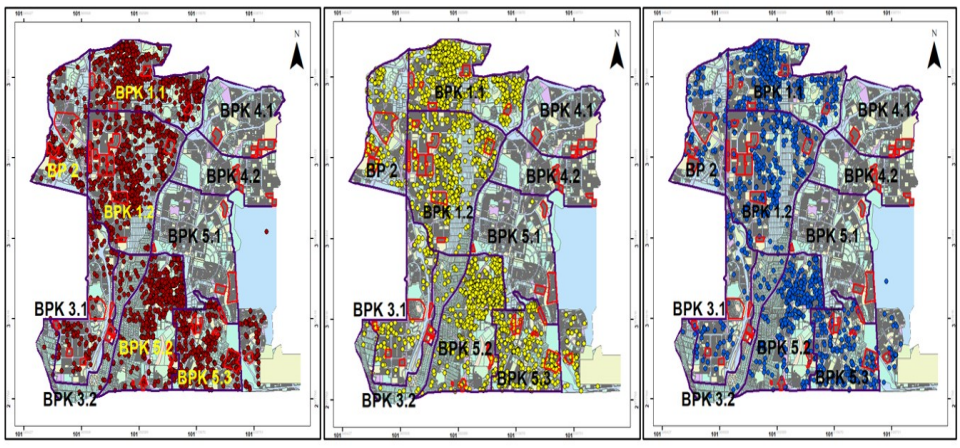

Figure 4: Point distribution map for crime cases in 2014, 2015, and 2016

Figures 5 show randomly selected gated residential in Subang Jaya area of Bandar Bukit Puchong. The type of housing of this residential area is double-storey terrace house area with 931 total units. The area for this residential area is 184929.9 m^2 equivalent to 12% of the selected residential area. The criminal incidents that occurred in 2014 were 24 cases, of which a total of 21 criminal cases involved property crimes, and a total of 3 criminal cases involved violent crime. In 2015, an increase of 9.23% or 28 cases in the gated residential area where 17 criminal cases were property crime cases and 11 criminal cases involving violent crimes. However, in 2016 there was a decreased trend of 23.08% where 13 cases were recorded in total with property crime and violence cases of 10 cases and 3 cases respectively. Again, from the analysis conducted, the number of criminal cases that occur in the gated housing community area is decreasing from 2014 to 2016 which indicated positive impact.

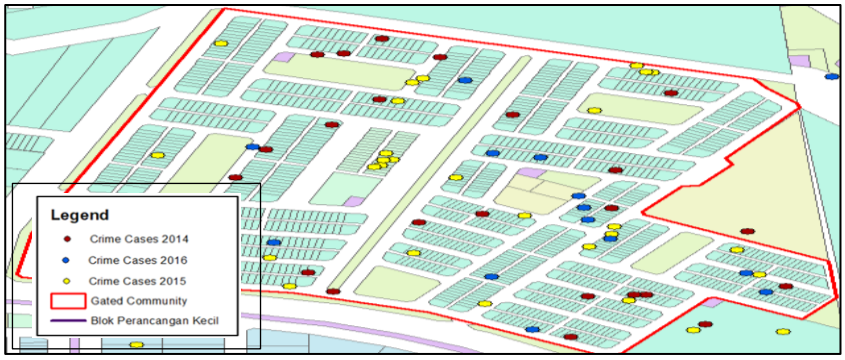

Figure 5: Gated Residential area Bandar Bukit Puchong with limited road access

Figure 6 shows another gated housing community of the USJ Pinggiran Park where it is close to Sri Kayan Apartments and Sri Nipah Apartments. The total area is 68648.19m^2 with double-storey terrace housing. Criminal cases are lower if compared to the other gated housing areas as shown in Figure 5. The criminal cases that occurred in 2014 are only 10 cases, of which 7 cases were

from property crimes and 3 cases involving violent crime cases. Meanwhile, 2015 recorded decreased cases by 50% (5 cases) with 3 cases of property crime and 2 cases of violent crime. While in 2016 again showing decreased trend with only 4 criminal recorded cases, where violent and property crimes have 2 cases each.

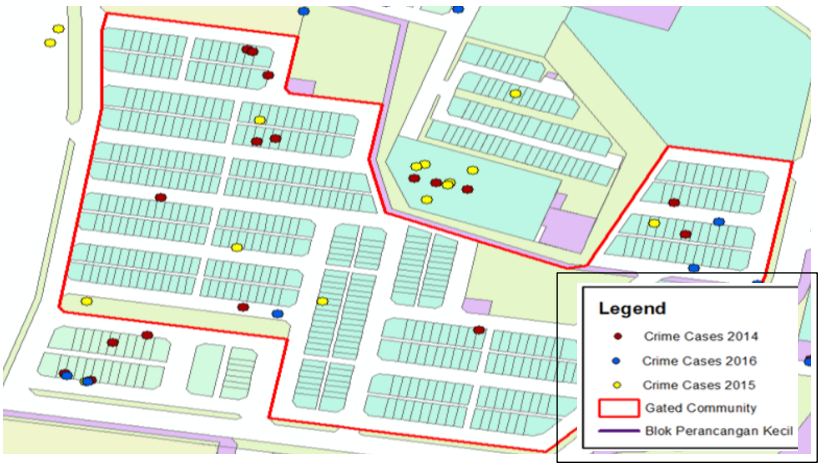

Figure 6: Gated Residential area Taman Pinggiran USJ with limited road access

Hotspot Mapping of Crime Occurrences in Subang Jaya

The hotspot analysis was done using bandwidth or search radius of 500 metres only since it provides a significant impact on the crime spatial patterns prediction (Chainey, 2013). The KDE method was used to assess crimes hotspots that occur in a gated and non-gated housing community in Subang Jaya area based on individual point crime data occurrence and later the link of road access point as a cause of crime was also analysed.

Figure 7, shows the hotspot maps of 3 years (2014 – 2016) using KDE method with lowest hotspot (dark green colour) to the highest hotspot (red colour). The maps indicated that the highest hotspot of crime cases happened on the same location for all three of years with highest hotspot within BPK 1.1, BKP 1.2 and BKP 5.2 of a non-gated area which has multi point road accessibility to the housing area. The red polygons are the gated housing community. The result reveals that the gated area with limited road access point showing lower crime hotspot than non-gated residential area as shown in BPK 4.1 and 4.2. The hotspot area for the crime cases for the years 2014, 2015, and 2016 were identified in Subang Jaya Flat and Bandar Puchong (BPK 5.2).

The location with high density of crime cases is located at residential of Subang Perdana Goodyear Court 10, Subang Perdana Good Year Court 7, USJ 1, USJ 2, USJ 3, USJ 6, USJ 7, USJ 8 and the residential area which are nearest to the above stated locations (Figure 8). These areas are the crowded areas where it

is located within the industrial area (Ultramine Industrial Park) close to the housing location. The types of housing areas consist of single-storey terrace housing and double-storey terrace housing. While Subang Perdana Goodyear Court 10 and Subang Perdana Goodyear Court 7 are flat houses. Furthermore, this area with high density occurrence of crime cases is also located within a double-storey office shops area located at the USJ 10, and USJ 11 which also have multiple road access and deemed less safe in regard to criminal activity accessibility to the housing area.

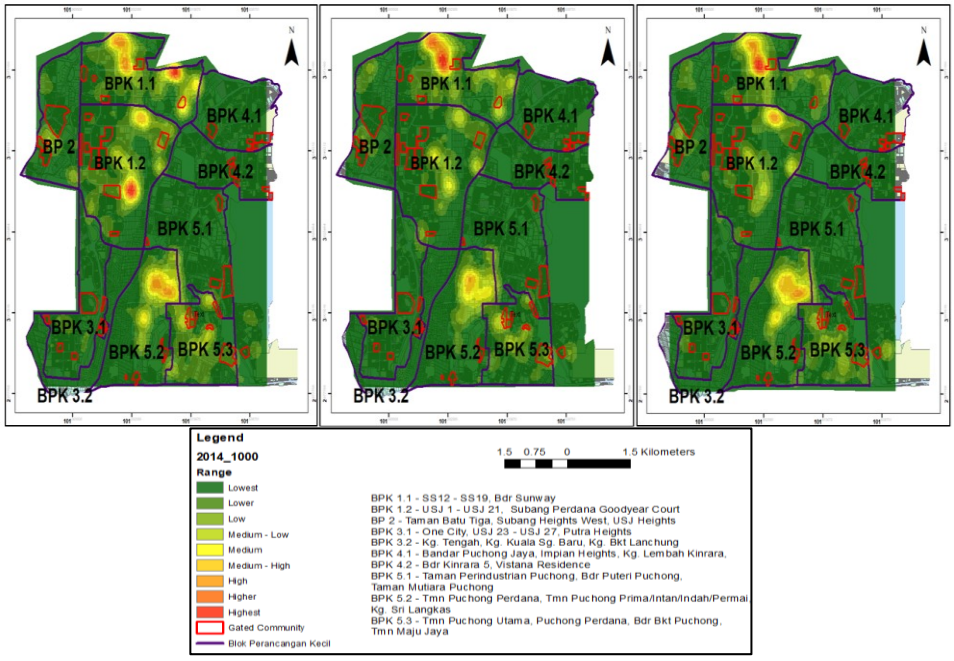

Figure 7: KDE Crime Hot Spot of Subang Jaya for 2014, 2015, and 2016

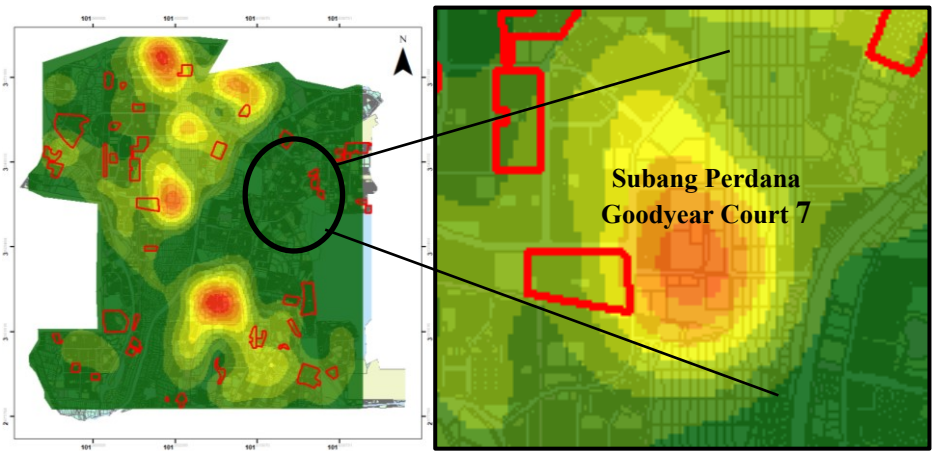

Figure 8: Hotspot Crime Map area near the Subang Perdana Good Year Court 7

Road accessibility to the residential area of the Subang Perdana Goodyear Court 7, 8, and 9 as shown in Figure 9 indicating multipoint accessibility which is possible to be used as an entrance and exit to the or out of the main road. The Subang Perdana Goodyear Court 7, 8 and 9 housing area is a part of the housing area in USJ 14 road accessibility with total area 423253.9m^2 which is equivalent to 27.47% of the selected study area. The Subang Perdana Goodyear Court area is adjacent to the USJ 14 housing. Goodyear Court flat housing type while the USJ 14 is a double-storey terrace house. However, at each entrance of the Subang Perdana Goodyear Court it has a security guard house and patrolling, but crime hotspot is still higher.

For the non-gated housing community such as located at the Bandar Bukit Puchong with high density population at the housing residential of Taman Puchong Indah, Taman Puchong Perdana, Taman Puchong Permai in Bandar Puteri Puchong. These areas consisted of single-storey and double-storey terrace houses with high accessibility points. Apart from that, Taman Puchong Indah, Taman Dahlia (single-storey and double-storey terrace houses) and Flat Taman Permai also have non-gated housing communities with high crime property incidents recorded. The accessibility road or way into the residential area is more than 10 accessibility which show less road safety accessibility for the resident when it relates to possibility of property criminal crime access.

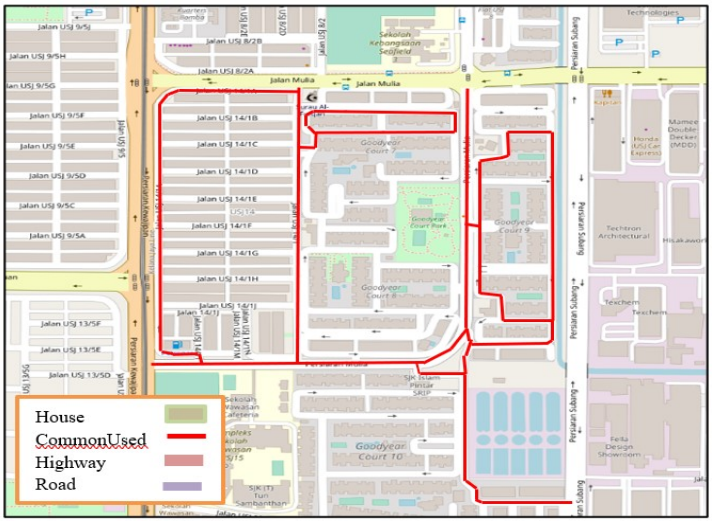

Figure 9: Accessibility Road Area Subang Perdana Goodyear Court Residential

Table 2: Property Crime Cases of Selected Residential Area (Gated and non-gated)

RESIDENTIAL	Area (m2)	Area %	Crime cases Record					
			2014	%	2015	%	2016	%
USJ Pinggiran Park (Gated)	68618.19	4.45%	10	2.1	5	0.96	4	0.90
USJ 13 (Gated)	128887.3	8.36	18	3.8	8	1.54	1	0.23
Bdr. Bkt. Puchong (Gated)	184929.9	12%	24	5.1	28	5.37	13	2.93
Subang Perdana	423253.6	27.47%	100	21.4	138	26.49	203	45.82
Taman Puchong Perdana	392288.1	25.46%	200	42.7	177	33.97	126	28.44
Flat Subang Jaya	343018.93	22.26	116	24.8	165	31.67	96	21.67
Total	**1540996**	**100**	**468**	**100.0**	**521**	**100.00**	**443**	**100.00**

Comparison of crime incident cases reported in gated and non-gated areas as presented in Table 2. Based on Table 2, the non-gated housing community contributed higher property and violence crime incidents as opposed to gated residential. Other than that, both gated and non-gated showing decreasing trend over 3 years periods of incident recorded. The analysis indicated that with the gated community and good security surveillance it has caused less property and violence crimes committed as compared to non-gated housing areas with the percentage of crime ranges from 8.36% to 12% only as compared to non-gated housing of between 21.4% to 45.82%.

Similar studies related to gated housing community with regards to housing robbery or crime were also reported in several studies in Malaysia, South Africa, North America and the United Kingdom (Atkinson et al., 2004; Mohit and Abdulla, 2011; Wilson Doenges, 2000; Blakely and Snyder, 1998). According to Wilson Doenges (2000) and Blakely and Snyder (1998) no significant difference in crime rates between gated and non-gated neighbourhoods. Meanwhile, other studies concluded that gated community is rather higher crime cases rate compared to non-gated communities in two low-middle income housing (Mohit and Abdulla, 2011) while Atkinson et al. (2004) stated that little evidence to support the common conception that crime is reduced in gated communities. More interestingly, a study by Breetzke, Landman and Cohn (2014) stated that smaller gated communities are less vulnerable to burglary as opposed to larger gated communities with higher number of land parcels. Similar findings of gated community housing units experience less burglary than their non-gated counterparts as reported by Addington and Rennison (2015) which have a similar pattern as in this study of the Subang Jaya area.

The road accessibility and road safety also provide a close link with the level of criminal activities such as house robbery and burglary as reported by Olajuyigbe et al. (2015). The study, based on Akure Metropolis, Nigeria, highlighted that the main road network in the city provides easy access and exit to criminals' activities such as armed robbery attacks or burglary. Furthermore, a study by Sohn (2016) found that improved streets connectivity, street density such as multi point access and diversity of adjacent land use near to housing areas has adverse effects on prevention of residential crime. Therefore, the findings from the study in Subang Jaya gated and non- gated communities are deemed important since it manages to highlight that gated communities are safer as compared to non-gated communities with almost 50% different. A local authority can use this finding as an alternative approach to understand better about a safe city concept especially when it relates to housing areas and crime such as burglary, robbery and violence. Many approaches can be adopted to achieve safe cities in residential communities such crime control known as 'crime prevention through environmental design' (CPTED) by modifying the built environment to reduce crime with four principles of territoriality, natural surveillance, activity support, and access control.

CONCLUSION

Geographic distribution and environmental factors determinants of crime have received high consideration in many fields such as criminology, environmental psychology, and urban design and planning. In spite of the theoretical importance in understanding crime based on criminal physiological behaviour aspects,

relatively less attention has been paid to whether areas near physical activity actually have more or less crime such as road accessibility.

This finding revealed that gated community housing types have fewer property crimes as compared to the non-gated community. The analysis indicated that with the gated community housing type and security surveillance less crime of property and violence occurred as compared to non-gated housing areas with the percentage of crime ranging from 8.36% to 12% only. No doubt that crime activities are more dominant in some parts of the city core due to physical and social boundaries. However local authorities related to land use or urban planning can enhance the city safety concept by integrating many relevant factors to reduce property crimes occurrence as investigated in this study, where highlighting about road accessibility and safety to gated and non-gated communities and its effects to property crime.

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