Hotspot Mapping of House Breaking Crime Using Geography Information System

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Article history:
Received 12 October 2014
Received in revised form 26 December 2014
Accepted 1 January 2015
Available online 17 February 2015

Keywords:
House breaking, Criminal, Geographic Information System, Hot Spots, Crime Pattern

ABSTRACT

The crime of house breaking is a major problem in almost every country throughout the world. The continuation of house breaking crimes should be prevented in order to avoid the widespread of this circumstance so that less people become victims of this crime as well as to avoid from more loss of properties. Geography can be one of the factors that can contribute to criminal behaviors of house breaking which also involves other factors such as time, external potentials and opportunities that allows house breaking to occur. To effectively control this problem, a crime analysis should be conducted in order to determine the level of crime. The Geographic Information System (GIS) is a system where it has the ability to approach or to map and analyze crime house breaking space due to its effectiveness and efficiency in processing data analysis. Besides that, GIS can also integrate spatial data as well as attribute data. Therefore, the objectives of this paper are to identify crime pattern analysis, locations of house breaking hot spots and relationship the location of hot spots with the location of the police station.

INTRODUCTION

It is extremely important that information management on the locations of the incidents are clearly organized for the use of law enforcement [1]. Management information is closely associated with data collection [2]. Nevertheless, the collection of data would have no impact as well as meaningless if the process does not include any comprehensive analysis. GIS applications in law enforcement is perceived to be less effective because; even though GIS is an official system used by the police in this country, it is rarely used due to limitations of high cost factors as well as lack of expertise in the field of GIS [3]. Various data such as location, types of crimes and also socio-demographic data can be combined under the technological capability and capacity [4]. With the existence of a criminal information system, conventional statistical information can be described digitally as it is able to show patterns and locations of the crime more specifically. [5]. Thus, this study has developed a database that contains a system for storing all the data under house breaking crimes at Planning Block 1, City Centre of Ipoh. The study area was chosen due to a high amount of house breaking cases from years 2011 to 2012. Therefore, it is believed that this result can be beneficial for parties that are connected with urban planners who develop safe cities in they are involved.

Methodology:

The study includes two types of data namely: (i) house breaking crime data in 2011 and 2012 from the Royal Malaysian Police (PDRM) which is then inserted into the GIS system in the form of spatial and attribute data, and (ii) spatial data from the Department of Town and Country Planning (JPBD) Ipoh in digital form. Spatial data consists of maps which are involved in the planning including Planning Block 1 of the Ipoh City Centre, the road map as well as housing and land use. While the attribute data will describe on some of the information regarding to the data on house breaking crimes like the house breaking crime scene of data (which is limited according to specific areas or business blocks only), and also the month and time of the crime. Based on the data collected, the database is developed as a basis for the implementation of the analysis in the next stage. Nevertheless, the house breaking crime data obtained in hard copy will first of all be digitized in data points according to the location of the crime. The main goal is to convert the attribute data into the spatial data

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so that it can be displayed and analyzed using the GIS applications. Additional information about house breaking crimes are included in the attribute table.

In analyzing the spatial data, it is performed according to three types of analysis namely: (i) Nearest Neighbourhood, (ii) Kernel Density and (iii) and Buffering. Nearest Neighbourhood Analysis is used to obtain information on the crime pattern. Nearest neighbour analysis examines the distances between each point and the closest point to it. This attempts to measure the distributions according to whether they are clustered, random or regular. The Nearest neighbour is a method of exploring pattern in locational data by comparing graphically the observed distribution functions of event-to-event or random point-to-event nearest neighbour distances, either with each other or with those that may be theoretically expected from various hypothesized models, in particular that of spatial randomness [6]. Kernel density analysis is used to identify the location of hot spots. It is a division technique in which the analysis calculates the points of occurrence in width, and then the points is broken up into groups according to the same overlapping categories. This analysis is extremely potential in studying patterns of points in locating hot spots [7]. The analysis of buffer involves the creation of a zone with a specified width around a point, line or polygon. This results into a buffer zone that can be used in a query to determine the entities that occur either inside or outside the buffer zone. In this study, the analysis of buffer is used to identify between the locations of hot spots with the location factors of the police station [8].

RESULTS AND DISCUSSION

(i) Nearest Neighbourhood Analysis:

Table 1.1: Results on the Nearest Neighbourhood analysis for Planning Block 1, City Centre of Ipoh from 2011 to 2012.

<table>
<thead>
<tr>
<th>Year</th>
<th>r obs</th>
<th>r exp</th>
<th>R</th>
<th>ZR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>83.1506</td>
<td>235.231</td>
<td>0.353485</td>
<td>11.2688</td>
</tr>
<tr>
<td>2012</td>
<td>56.9032</td>
<td>211.161</td>
<td>0.269477</td>
<td>14.1844</td>
</tr>
</tbody>
</table>

Table 1.1 shows the data distribution of crime house breaking that occurred in 2011, reflecting a cluster pattern based on the value of \( R = 0.353485 \) obtained from the analysis conducted. To prove that there is a difference between the nearest neighbourhood field patterns and the distance between the nearest neighbourhood random hypothesis, a test of significant statistics which is the Z score was conducted. The results show, \( ZR = 11.2688 \). This means that the field pattern and the of random pattern are not significant. If the test result is not significant, \( ZR > 1.96 \), this shows that there are differences in the field pattern as well as the random pattern. These differences indicate that criminal house breaking which occurred in 2011 were clustered, which shows the concentrations of crime. The result is extremely important in analysing the hotspot area of house breaking crime.

Results under the nearest neighbourhood analysis for house breaking crime data in 2012 also showed patterns of cluster based on the value of \( R = 0.269477 \) obtained from the analysis conducted. To prove that there is a difference between the pattern field and the distance between the nearest neighbourhood hypothesis of random distribution with the nearest neighbours, a test of significant statistics which is the Z score was conducted. The results reflect, \( ZR = 14.1844 \). This means that the field pattern and the of random pattern are not significant. If the test result is not significant, \( ZR > 1.96 \), this shows that there are differences in the field pattern as well as the random pattern. These differences prove that criminal house breaking that occurred in 2012 are also clustered. Based on the nearest neighbourhood analysis conducted in 2011 and 2012, it can be concluded that both years show patterns of house breaking crime that lead to patterns of cluster. The findings can be attributed to factors of physical environment which provides comfortable residential areas and the opportunity for criminal house breaking to occur. Physical signs, space, and also culture in a specific area of public housing environments affect how criminals form cognitive maps towards an appropriate target [9]. This cognitive intelligence would constitute to criminal divisions and hot areas or hot spots around residential areas. Moreover, criminals would not choose a crime site randomly, but they would use physical conditions (physical appearance) to select a target [10].

(ii) Kernel Density Analysis:

![Fig. 1.0: Hot spots of house breaking crime areas at Planning Block 1, City Centre of Ipoh from 2011 to 2012.](image)
Figure 1.0 (a) shows the location of house breaking crime areas in 2011. During this year, the location of hot spots occurred in Taman Victoria, Taman Canning and Taman Gopeng. This can be seen through the results of analysis where the dark colour highlights the three locations. Whereas in 2012 (b), the location of hot spots occurred at Taman Chateau and Taman Istana. According to this analysis, it shows that the main focus of house breaking crime locations change every year. The changing of house breaking crime locations is believed to be closely connected to the theory of Crime Displacement where this situation will move from one area to another because of factors that can influence the failure of criminal acts to occur such as the installation of crime prevention elements around residential areas [11].

(iii) Buffer Analysis (Buffering):

![Image of Buffer Analysis](image)

**Fig. 1.1:** Buffer Zone (Buffer) Planning Block 1, City Centre of Ipoh from the year (a) 2011 to (b) 2012.

Figure 1.1 (a) shows the buffer zone conducted between the police station and hot spots of house breaking crime locations which occurred in 2011. The analysis shows that the location of hot spots on house breaking crime occurred within 1000 metres, 1500 metres and 2000 metres from the police station. Figure 1.1(b) shows the buffer zone conducted between the police station and hot spots of house breaking crimes that occurred in 2012. Results show that the location of house breaking crime hot spots occurred 1000 metres and 1500 metres from the police station. Based on this analysis, it can be concluded that the relationship of house breaking crime hot spots with the proximity location of police stations did not determine the factor of crimes to occur. Thus, the findings reflect that the factor of opportunity has a higher influence towards the occurrence of crime than the factor of police station proximity.

**Summary:**

Based on the nearest Neighbourhood Analysis that was conducted in this study, it shows that the crimes occurred in 2011 and 2012 reflect a tendency towards house breaking crimes in clusters. Although the patterns of the house breaking crimes in these two years are clustered, the location of the hot spots however, vary according to years. In 2011 house breaking crimes occurred in Taman Victoria, Taman Canning as well as Taman Gopeng. While in 2012, the location of hot spots occurred in Taman Chateau and Taman Istana. This shows that all locations have the potential to become the focus of a criminal house breaking because house breaking crimes are not concentrated in the same location every year. Hotspot mapping is a popular analytical technique that is used to help identify where to target police and crime reduction resources. In essence, hotspot mapping is used as a basic form of crime prediction to identify the areas of high concentrations of crime and where policing and other crime reduction resources should be deployed.

**REFERENCES**
