

Crime Mapping System for the Royal Malaysia Police

Mohd Hanizan Mohd Wasli, Norehan Abdul Manaf, Nalini Dharmarajan, Wan Adilah Wan Adnan

Abstract—Crime mapping is the process of producing a geographical representation of crime levels, crime types or the locations of particular incidents. This paper aims to develop a data model for the crime mapping system. The development of a prototype includes the creation of spatial database to cope with the spatial and temporal features which exist in the crime mapping system. The data which was used was collected from police reports from the Kajang Police Department. This data was for crime cases which were reported and opened for investigation between February and March 2013. Classification of the type of crime was based on the index crime which is published in the Malaysia's National Key Result Area Report 2010. Based on the visualized data on the crime map, and with manipulation of date range or the type of crime on the system, the administration is able to plan for resource allocations and possibly the restructuring of resources either permanently or temporarily. This system could be implemented into the organization to improve the policing strategies by district level police headquarters.

Keywords—crime, crime mapping, spatial database

I. Introduction

Crime is universal in this world. It occurs every single day without a miss. Crime is defined as “*an act or the commission of an act that is forbidden or the omission of a duty that is commanded by a public law and that makes the offender liable to punishment by that law*”, by Merriam-Webster (2013) dictionary. Meanwhile Oxford online dictionary (2013) defines crime as “*an action or omission which constitutes an offence and is punishable by law*”. Both dictionaries define crime as the act of a person that is forbidden, or wrong, in accordance to the law.

Generally, the law enforcement agency that responsible in fighting and curb crime rates is the police. Managing crime has been the first priority of the police organization. Crime management of the Royal Malaysia police (RMP) is to reduce crime rates as well as to protect and maintain law and order of the community. The responsibilities of the RMP personnel is stated in the section 3(3) of the Police act 1967, “The Force shall subject to this Act be employed in and throughout Malaysia (including the territorial waters thereof) for the maintenance of law and order, the preservation of the peace and security of Malaysia, the prevention and detection of crime, the apprehension and prosecution of offenders and the collection of security intelligence”[1].

RMP, in response to crime incidence, are supposed to plan appropriate response task, such as to respond to call for service, apprehend suspect(s), to conduct investigations, the commencement of prosecution and investigation of major and serious crimes [2]. In order to manage crime efficiently, the RMP has to formulate policing strategies. Currently the RMP is concentrating on the implementation of the 4P concept (Proactive, Protect, People Oriented and Performance and Outcome Oriented) [3].

The policing strategies that are implemented by the RMP require thorough analysis of current crime problems to ensure efficiency and effective crime management as well as other planning. For that purpose, RMP has exhaustive resources for gathering information at the decision maker disposal for analyzing crime problems. Information is manipulated, transformed and represented in many different forms to describe, and visualize the information. Data visualization and transformation are methods of viewing and looking at the problem from a different perspective, with the expectation that it would give an insight to the real problem. Crime management is a gruesome task and an extensively exhaustive process. Comprehending and analyzing crime patterns have never been an easy task for police administration. Thus tools for data visualization play an important role in examining and analyzing the existing problems.

Currently, there are numerous techniques been used by RMP in visualizing information regarding crime problems and its management planning, examples are using charts, graphs and statistical figures. However, the latest technological breakthrough in crime analysis is the use of computerized mapping system also commonly known as crime mapping system.

Crime mapping rewards are promising and substantially beneficial to the RMP [4]. Spencer Chainey and Jerry Ratcliffe, in their book GIS and Crime Mapping, laid out several areas where crime mapping can be applied into law enforcement agencies. The areas are command and control, as administrative and management analysis, operational analysis, crime auditing, problem solving analysis, geographical profiling as well as monitoring, assessment, evaluation and performance review.

In 2008, the government introduced the Government Transformation Program, which is also known as National Key Result Area (NKRA), which is targeting to improve the government agencies service delivery efficiency. Under the NKRA initiative program, RMP was handed with the responsibility to reduce crime rate [5].

Mohd Hanizan Mohd Wasli, Norehan Abdul Manaf,
Nalini Dharmarajan, Wan Adilah Wan Adnan
Universiti Teknologi MARA
Malaysia

Thus, this paper is to propose a crime mapping system prototype that would map crime incidents at the police district level administration in Kajang, Selangor. However, there is a need to understand the RMP perspective of crime and to determine the type of crime that would contribute to the crime rates in Malaysia.

II. Literature Review

A. Policing Strategies

Policing strategy has been introduced and implemented by police around the world, as a means of fighting crime and to reduce crime rates. Current policing strategies implemented by police include standard model policing, community policing, problem oriented policing, hotspot policing and broken window policing [6].

Standard model policing is the simplest policing strategy, where the administrators impose increase police personnel and random patrols. With the low ratio of community to police personnel, it is expected to reduce the response to call for service time [6].

On the other hand, community policing strategy, emphasis on the importance of close relationship between the police and the community to fight crime [7]. The sharing of information between both parties would create a greater chance of ensuring a safe and peaceful environment.

Problem oriented policing focus police activities, such as patrols, on profiled crime prone areas. These areas are analyzed and labeled as problematic in term of its crime rates. By focusing prevention on the specific area it is hoped to reduce the crime at the designated area [8]. Broken window policing, on the other hand, is policing strategy, where police take stern action on the slightest offence committed such as being drunk, public place loitering or public urination [6]. The rationale of broken window policing is by arresting people for small offences would reduce the tendency of the community to commit more serious crime.

B. Index Crime

Crime classification, from RMP perspective is the classification of crime based on the corresponding statute. There are currently countless number of statute that gives the RMP personnel with responsibilities and duties. However, the basis of crime investigation for RMP is the Penal Code [9]. There are 20 classification of offences in the Penal Code as in Fig. 1.

The crime investigation is done by separate department of the RMP. There are two departments, Crime Investigation Department and the Commercial Crime Department, which directly refers to the penal code as the basis of offence classification and toward the investigation.

Commercial Crime Department conducts investigation with regard to crime that involves documents forgery, fraud, documents based offences, and other normally business oriented crime. Crime Investigation department, on the other hand investigates offences that is clearly stated in any gazette Malaysia statute. Nonetheless, as aforementioned, the most

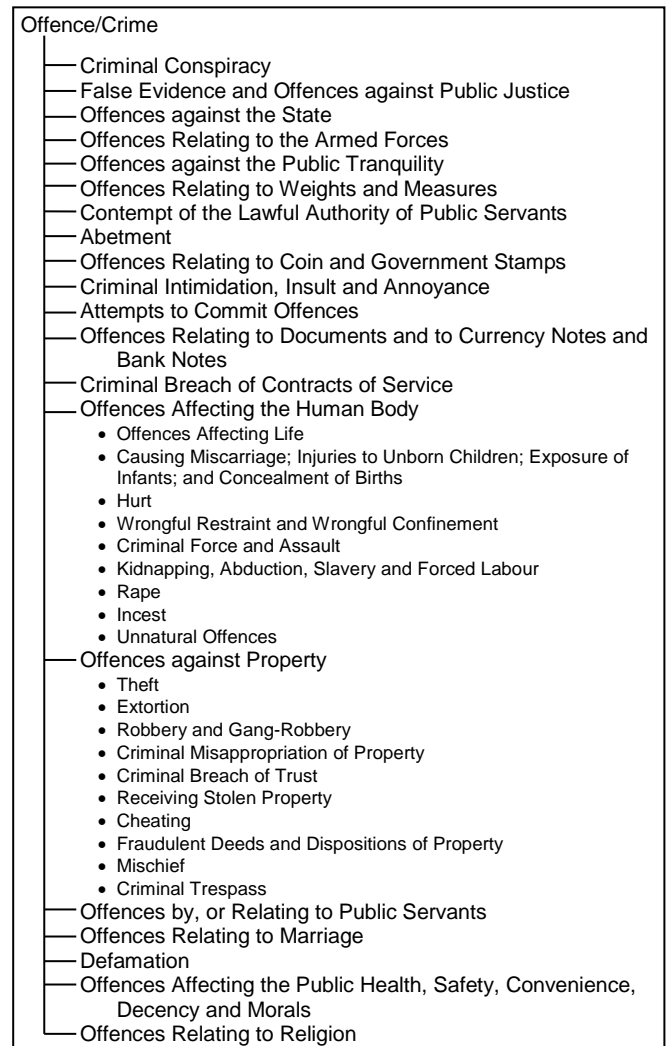


Figure 1 Crime taxonomy under the Malaysia Penal Code

crimes reported in Malaysia are offences classified in the penal code. There are 13 different categories of crime, as mentioned in the Government Transformation Program [5] that deemed serious offences occurring with sufficient frequency and regularity to serve as a measure of the overall crime situation in the country. The 13 types of crime are:

- a) Murder
- b) Rape
- c) Robbery
- d) Gang Robbery
- e) Armed Robbery
- f) Theft
- g) Motorcycle Theft
- h) Car Theft
- i) Heavy Machinery Theft
- j) Daytime House Break-in
- k) Nighttime House Break-in
- l) Assault
- m) Snatch Theft

III. Results and Findings

Identifying the crime categories signify the type of offences that belongs to the category. Fig. 1 is part of the crime taxonomy under the Malaysia Penal Code context classification. From the RMP perspective, it requires the analysis of the based statute that is the Penal Code.

The focus of this paper is offences affecting humans and offences against property. The development of a crime mapping system for these offences would assist the decision makers in understanding and analyzing crime patterns, as it contributes to the overall measure of crime situation in the country. This is aligned with suggestion made by Salmi, Satu, Martti Grönroos, and Esko Keskinen [10]. The type of crime that contributes to public fear are rape, assault in public place, robbery, motor vehicle theft, burglary and theft. These are crimes which are classified under the offences affecting the human, and offences against property as shown in Fig. 1.

A. Index Crime Incidence Data Model

Index crime incidence information is recorded in reports lodged by the complainants. The information with regard to the incidence is crucial to investigators and analysts are:

- a) Complainant's details
 - i. Name
 - ii. Address
 - iii. Telephone Numbers
 - iv. Identification Numbers
- b) Crime incidence
 - i. Location/Address
 - ii. Time
 - iii. Victim/property involved
 - iv. Duration

According to the crime triangle theory, by Cohen and Felson[11], three elements need to co-exist for crime to occur i.e the space/location, victim/property, and the suspect. The element of location however, could be extended further with the temporal features, which verify to when the opportunity existed for the offender to commit the crime. Thus the development of the crime mapping data model, would include the spatial and temporal aspect.

The following Fig. 2 is the data model for the crime mapping system prototype.

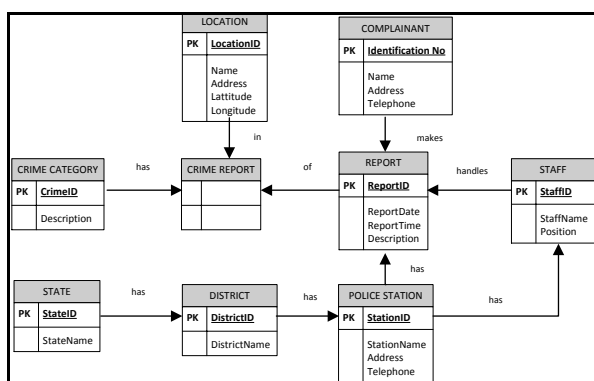


Figure 2 Crime mapping entity-relationship diagram

B. Crime Mapping System

There are a number of advantages for RMP to apply crime mapping system in management and administration. As mentioned in earlier section, the application of crime mapping can benefit the administrator in a way that, crime mapping can be used as management analysis, operational analysis, crime auditing, problem solving analysis, geographical profiling as well as monitoring, assessment, evaluation and performance review. However, in general the advantages of using crime mapping can be summarized into two main categories, in depth and thorough analysis of crime pattern, which would help the administrator in predicting crime and as the measure for plan and management effectiveness.

Crime pattern analysis is specialized task that would examine information with regard to modus operandi, location, time, suspect profiling, and other types of derivations. The result of the analysis is to determine the suspect profile, understanding the questions to who, where, when, what, why and how, regarding to specific or series of crime incidents. Understanding crime pattern is important to the police for countermeasures planning. It would be best that they first understand the underlying problem.

For the purpose of understanding and viewing the problem from a different perspective, crime mapping system, can help to visualize overall and general understanding of the crime situation [11]. The problem with conventional presentation of crime information is the data visualizations are in term of statistical figures and graphs or charts. Crime mapping as an additional tool for administration and management in police organizations helps decision makers in understanding the crime situation, both in overall and specific to area of location. With data availability and reliability, data consistency and reduction of human error, management is capable of making efficient decision with regard to crime management, as well as organization's planning.

The critical roles of crime analyst are to understand the crime incidence, pattern and predict crime. These information, if channeled to active crime prevention personnel would be what is known as intelligence led policing. Jerry Ratcliffe defines intelligence led policing is the application of criminal intelligence analysis as an objective decision making tool in order to facilitate crime reduction and prevention through effective policing strategy and external partnership project drawn from evidential base. Crime mapping provides insight to potential crime incident by understanding the criteria of crime that has occurred. Information such as the modus operandi, location, victim profile as well as time to commit the crime, could bring to series of possibility of when, where and who the suspect would strike next. Crime mapping, also with the vast knowledge of the area surroundings, would give advantages to the prevention strategy by deploying appropriate manpower as a countermeasure.

There have been doubts among the public in the effectiveness of policing strategies implemented by the RMP in their effort to maintain peace and order. Human resource planning, performance evaluation and monitoring has become the issue among the administrators. Administrator has been

haunted with questions, such as how many personnel should be deployed, where and when should they be deployed, what type of resources need to deploy together with the personnel. Upon deployment, there is a need to measure its effectiveness. However, how should the strategy be measure of its effectiveness?

Applying crime mapping system could offer an alternative to determine the effectiveness of resources management. One of the methods is by segregating the crime locations to patrols district. Patrol district is, the area which assigned to patrol vehicle or foot patrol. Determining the number of reported crime incidents per the patrol district could signal, whether the area covered by the patrol, is too big for effective prevention, or the assigned personnel effort is insufficient toward preventing crime. There is a lot of information that can be derived from analyzing crime mapping against patrol districts, or other type of performance measurement criteria. Resulting from the performance based analysis with crime mapping, a better resource planning and management can be possible for police organization.

iv. Construction of the Crime Mapping System Prototype

The crime mapping system prototype uses web based concept, where it is easily accessible from any computer without the need for any installation of any other third party software. The construction of the crime mapping prototype server was done using the following software in Table I.

The database for the system was developed using the Oracle 11g Express Edition (XE) on the server. Tables and field was created using software provided by Oracle, the SQL Developer. After the database was completed, data from the police reports are imported into the database. The data import, however, initially lack the spatial and temporal data, due to the actual process of RMP reporting system and procedures. The spatial and temporal data are only extracted from the report content or the preliminary investigation briefing.

The next module that was constructed was the mapping module. The mapping system of the prototype rely on the Google map services. This free mapping services require registration and subscription. Upon the registration, the API key provided is used for access to the Google mapping system.

TABLE I. CRIME MAPPING SYSTEM PROTOTYPE DEVELOPMENT SOFTWARE

Category	Software	Description
Web Server	Apache Web Server Version 2.44	Web server application provided by the Apache Software Foundation
Database Server	Oracle Database 11g Express Edition	Database management system provided by Oracle
	SQL Developer	Integrated Development Environment for database management.
Map Server	Google Map API	Mapping service provided by Google map.
GUI Development	Adobe ColdFusion 9 Standard Edition	Application server that is used to develop system user interface
	Adobe Coldfusion Builder 2	Application for the development of the web pages and database access.

Moving on from the subscription to the Google map service is the development of the mapping page of the system. The mapping page consists of icons that would represent the crime type. The following Table II shows the type of crime and its corresponding icon that is used in the prototype.

The last module that was developed is the data entry module, where the web page will be used as a medium for entering the data regarding the crime reported. The data entry page will consist of a form that will request for complainant's particulars, incident's information, as well as the location of the incident. The location of the incident will be in the form of point and click on a map canvas. From the point clicked by the user, the page will generate the latitude and longitude coordinates of the location.

The last phase of the development was the integration of the modules of the system, where, the database of the system, mapping web page and the data entry web page is integrated to compose of a complete prototype of the system.

In order to populate and complete the data, which has been imported subsequent to the development of the database, the latitude and longitude data of each of the crime reports was updated using the data entry web page.

v. Conclusion

The system developed was tested using actual data of crime reported from the district of Kajang, Selangor. From the crime mapping of the reported cases, it shows that, analytically, there are numerous tactical strategies that can be implemented by the administrator to reduce the crime rates. For example, Fig. 3 shows the vehicle theft locations which were reported for the month of February 2013. From the figure, the location with the most reported case is concentrated in the town area, denoted by the circle mark. The administrator, from the analysis of the pattern, could further need to determine the type of vehicle involved and the time spread of each case so that appropriate preemptive countermeasure can be formulated to reduce the vehicle theft in the location.

TABLE II. TYPE OF CRIME AND RESPECTIVE ICON

Type of Crime	Icon
Theft	
Vehicle Theft	
House Break-in	
Robbery	
Arm Robbery	
Murder	
Rap	





Figure 3: Vehicle theft in Kajang district in February 2013

The crime mapping system allows the user to manipulate the mapping system to display various combination of crime incidence on to the mapping system. These can be useful to determine the general overview of the crime situation of the area. Knowing the level of crime rates puts the administrator to make effective decision on the most suitable strategy to overcome the problem.

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About Author (s):



M.Hanizan

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