

Data mining techniques for detecting the crime hotspot by using GIS

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Abstract— A GIS is a computer system capable of capturing, storing, analyzing, and displaying geographically referenced information. GIS works by relating information from different sources. The power of a GIS comes from the ability to relate different information in a spatial context and to reach a conclusion about this relationship. Most of the information we have about our world contains a location reference, placing that information at some point on the globe. . Geographic Information System (GIS) plays an important role in crime mapping and analysis. GIS uses geography and computer-generated maps as an interface for integrating and accessing massive amounts of location-based information. GIS allows police personnel to plan effectively for emergency response, determine mitigation priorities, analyse historical events, and predict future events. GIS can also be used to get critical information to emergency responders upon dispatch or while en route to an incident to assist in tactical planning and response. GIS helps identify potential suspects to increase investigators suspect base when no leads are evident. This paper presents a survey on how GIS is implemented in various crime activities.

Index Terms— Crime Analysis, Crime Mapping, Geographic Information System.

I. INTRODUCTION

Geographic Information System (GIS) uses geography and computer-generated maps as an interface for integrating and accessing massive amounts of location-based information. GIS allows police personnel to plan effectively for emergency response, determine mitigation priorities, analyse historical events, and predict future events. GIS plays an important role in crime mapping and analysis. Response capabilities often rely on a variety of data from multiple agencies and sources. The ability to access and process information quickly while displaying it in a spatial and visual medium allows agencies to allocate resources quickly and

more effectively. In the ‘mission critical’ nature of law enforcement, information about the location of a crime, incident, suspect, or victim is often crucial to determine the manner and size of the response. GIS software helps coordinate vast amounts of location-based data from multiple sources. It enables the user to layer the data and view the data most critical to the particular issue or mission. It is used world over by police departments, both large and small, to provide mapping solutions for crime analysis, criminal tracking, traffic safety, community policing, Intranet/Internet mapping, and numerous other tasks. GIS helps crime officers determine potential crime sites by examining complex seemingly unrelated criteria and displaying them all in a graphical, layered, spatial interface or map. It also helps them map inmate populations, fixtures, and equipment to provide for the safety of inmates by separating gang members, identifying high-risk or potentially violent inmates, and identifying hazardous locations in an area. It reduces the potential for internal violence by providing better command and control. GIS functions, when combined with capabilities of location identification devices such as GPS facilitate tracking the movement of high-risk inmates or at risk personnel throughout an area. It is more cost-effective for the crime analyst to come up with the information than for patrol officers to do it themselves.

II. DATA MINING

Data Mining (DM) denotes discovery of patterns in a data set previously prepared in a specific way. Data mining is the process of discovering actionable information from large sets of data. Data mining uses mathematical analysis to derive patterns and trends that exist in data. GIS is related to data mining, in order to represent the data in graphical format which is most likely represented as a graph cluster analysis is done on the data set.

III. CLUSTERING

Data clustering is one of the fundamental tools to

understand the structure of the data set. Clustering aims to categorize data into groups or clusters such that the data in the same cluster are more similar to each other than those in different clusters. Clustering is a data mining (machine learning) technique used to place similar data elements into related groups. A cluster is a collection of objects which are “similar” between them and are “dissimilar” to the objects belonging to other clusters. The notation of the cluster varies between different algorithms. The clusters found by different clustering algorithms are vary in their properties. Clustering is used in many areas such as Statistical Data Analysis, Machine Learning, Data Mining, Pattern Recognition, Image Analysis, Bioinformatics, etc., The various clustering algorithms are Distance-based, Hierarchical, Partitioning, Probabilistic. These clustering algorithms are used to cluster the various data sets. Some of the applications are similarity searching in medical image database, data mining, etc.

IV. CRIME ANALYSIS

Crime analysis is a law enforcement function that involves systematic analysis for identifying and analyzing patterns and trends in crime and disorder. Crime analysis also plays a role in devising solutions to crime problems, and formulating crime prevention strategies. Quantitative social science data analysis methods are part of the crime analysis process, though qualitative methods such as examining police report narratives also play a role. Crime analysis can occur at various levels, including tactical, operational, and strategic. Crime analysts study crime reports, arrests reports, and police calls for service to identify emerging patterns, series, and trends as quickly as possible. They analyze these phenomena for all relevant factors, sometimes predict or forecast future occurrences, and issue bulletins, reports, and alerts to their agencies. They then work with their police agencies to develop effective strategies and tactics to address crime and disorder. Other duties of crime analysts may include preparing statistics, data queries, or maps on demand; analyzing beat and shift configurations; preparing information for community or court presentations; answering questions from the public and the press; and providing data and information support for a police department's Comp Stat process.

V. CRIME MAPPING

Maps offer crime analysts graphic representations of crime-related issues. An understanding of where and why crimes occur can improve attempts to fight crime. Mapping crime can help police protect citizens more effectively. Simple maps that display the locations where crimes or concentrations of crimes have occurred can be used to help direct patrols to places they are most needed. Policy makers in police departments might use more complex maps to observe trends in criminal activity, and maps may prove invaluable in solving criminal cases.

VI. LITERATURE SURVEY

GIS is used to view the hotspot of any type of crime activities. It is very efficient software for identifying the

crime hotspot in an easy manner. Through this view the police department can identify that where more number of crimes occurred in particular place, in future these crimes can be reduced by giving more protection at that place. Haifeng Zhang et al (2007) suggests that this paper analyzed the spatial patterns of four types of crime (assault, robbery, autotheft, and burglary) and their relationship with neighbourhood characteristics in the City of Omaha, Nebraska by using geographic information systems procedures and ordinary least square regression methods. Location quotients of crime and crime density were employed as two alternative measures of crime rates. This article has three important findings: First, the rationale of the employment of official crime rates for neighbourhood crime study is questionable; Second, while location quotients can be used to highlight the prevalent types of crime across urban neighbourhoods, they have limited use for the statistical analysis; and third, crime density focuses on the spatial intensity of crime and is more appropriate as the indicator of neighbourhood level crime than population-standardized crime rates and location quotients. This article not only presents important insights into the enhanced interpretation of the geography of neighbourhood crime, but also can be considered as testing the social disorganization theory and routine activity theory by using different measures instead of crime rates.

Cynthia A. Mamalian et al (1999) suggests that the Computerized crime mapping technology enables law enforcement agencies to analyze and correlate data sources to create a detailed snapshot of crime incidents and related factors within a community or other geographical area. Interest in this technology within the law enforcement community appears to be gaining momentum, but until recently no systematic data existed on how widely it is used.

As a first step in understanding law enforcement agencies' knowledge of crime mapping, the Crime Mapping Research Center (CMRC) of the National Institute of Justice (NIJ) conducted the nationwide Crime Mapping Survey over 15 months to determine who uses geographical information systems (GIS) and why other agencies are not using this mapping technology. Based on the survey findings, the CMRC will further develop its understanding of how law enforcement agencies use GIS software and the types of maps they produce. The CMRC will then identify training and technical assistance needs, further develop crime mapping resources, and disseminate information to researchers and practitioners. Although the survey found that use of computerized crime mapping is not widespread at this time, interest among law enforcement agency executives and planners appears to be growing. This comes at a time when the cost for computer hardware and software is declining; the technology's efficiency continues to improve; and access to digital calls-for-service, arrest, and incident data within police departments is increasing.

Gupta.R et al (2012) suggests that the need of effective utilization of Information Technology in public safety management is increasing in the present Indian scenario of crime. This paper applies the utilities of GIS to identify the hotspots of crime as well as to facilitate the development of

investigation preference strategy for policing. The capabilities of Kriging as well as weighted overlay analysis were effectively applied to identify the crime patterns in the district of Jhunjhunu on a GIS platform, integrated with socio-economic attributes. The study identified the social factors affecting different types of crime in the study area. The methodological framework applied in the present investigation for crime mapping can be effectively applied for development of user-interfaces platform for the development of safe city strategies.

K. Jaishankar et al (2004) suggests that In India, though the Police agencies of Bangalore, Hyderabad, Goa, Mumbai, Delhi, Kolkata, Chennai and Trivandrum use customized GIS, its application is still in a rudimentary stage. There is a felt need for the fullest application of this potent technology in Indian policing. Hence, researchers in the University of Madras collaborated with the Chennai Police department and developed this study. This research work was submitted to the Police Commissioner, Chennai city and was implemented. The findings of this study showed that, using GIS is a much more compatible means of crime pattern analysis than current processes because of its geographic referencing capabilities. This research has provided valuable information concerning property crimes in Chennai city, including data on the social and physical characteristics of these areas that contribute to localized criminal activity.

Arthur Getis et al (2000) suggests that this paper reviews modern crime analysis with regard to the research and educational challenges outlined by the University Consortium for Geographic Information Science. In the context of Geographical Information Systems (GIS), attention is devoted to the role that crime analysis currently and potentially plays in reducing crime and improving the efficiency of police activity. It is our aim to stimulate interest in advancing crime analysis in the areas of crime mapping and visualization. It is hoped that an outcome of this effort will be the attention that granting agencies may give to this rich and productive mixture of state-of-the-art technology and social responsibility.

Timothy Waters (2002) suggests that Java web-based public participation GIS was developed using a spray-can tool, a feature familiar from many graphics programs. Internet GIS and the application of web-based public participation GIS are reviewed. The spray-can tool enables users to spray areas of interest on map, with the ability to weight areas using the intensity of the spray. Users can attach comments to their inputs. The research, design and development of the system is described in detail. The system is applied to a study on the perception of crime in Leeds. Background on fear of crime and previous public perception studies are reviewed. The case-study's results indicate that the composite view of where in Leeds has the most crime matched official data quite well. Feedback received was very positive, with people finding the system very easy and intuitive to use. A discussion of the limitations of the system recommendations for further study is given.

VII. CONCLUSION

In this paper we have discussed about the authors suggestion for finding out hotspot of crimes. The GIS software is used to view the crime hotspot for particular type of crime activity. The crimes will be classified and then it will be clustered, clustering will be done based on the type of crimes. For classification and clustering the crimes the data mining techniques are used. By using this the police department can give more protection on the particular place and crime activities will be reduced in future.

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