Spatial Analysis of Crime with Public Alliance System

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***Abstract*—** Spatial analysis of crime allows the users to map the crime rate in different areas at different times. It enables the user to see the map and the details of various crimes in different parts of the country allowing public to analyze and take better decisions towards their safety. Moreover public can navigate through these maps. In case, if the public becomes a victim to any crime or may either notice one, then they can report it directly to the central team handling the application and the information is passed on to the team of the respective area. Cyber crime can also be reported, undisclosing the identity of the victim. Crime mapping is also used by analysts in law enforcement agencies to map, visualize, and analyze crime incident patterns and implement their further improvement. It is done using Geographic Information Systems (GIS), allowing crime analysts to identify crime hot spots, along with other trends and patterns.

Keywords*—Spatial analysis of crime; GIS; safety of public; location of crime; crime patterns and trends; crime mapping, cyber crime; non disclosure of identity; report crime; evidence of crime*

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I. INTRODUCTION

In the previous years, GIS has become a powerful crime prevention, investigation and analysis tool for mapping crime patterns. Upon looking in the past, until the 1980s, detectives were analyzing crime patterns by positioning different colored pins on wall maps. Many crimes have been solved by this way. But today with the changing scenario and latest technologies in use , we can map crime digitally and may present this entire world.

Spatial analysis of crime helps to map crime rate in various parts of the country for different years with their respective locations. GIS i.e. Geographic

Information Systems is used to identify and analyze major crime spots, along with other trends and patterns. This helps in providing a general layout of the concept which is then used to build the complete structure with more detailing. A geographic information system (GIS) is a system designed to capture, analyze, manage, and present all types of geographical data. GIS applications are tools that allow users to create interactive queries (user-created searches), analyze spatial information, edit data in maps, and present the results of all these operations. Geographic information science is the science underlying geographic concepts, applications, and systems. This system is required in a particular country for various reasons. Firstly, for the ease of public, they can view details whenever and where ever they want. Secondly, it helps the public get a better idea of the crime activity in their area so they can make more informed decisions about how to stay safe. Thirdly, It would make people aware about the crime in their locality. In this manner they could be prepared and may seek training to fight back in case of any mishappening. People may also participate by providing crime occurrence tips anonymously and protect the society from any crime that would take place in near future. Also any sort of misconduct by the police may be reported for any particular location.

The Spatial analysis of crime application is designed as web or a mobile application and constitutes a number of operations. The basic operation includes mapping different types of crimes such as murder, kidnapping, assault, burglary, trespassing and exploitation. The mapping of these crimes is done for all states and union territories of that particular region. The mapping is done on a map and a comparative chart and statistics is carried out to compare and contrast various differences in the particular region.

Apart from this feature, the application also provides other crucial tool in helping the public to directly stay in touch with the officiating team and share their grievances. In many states of USA, this feature is widely used to incorporate public alliance in bringing up crime to the notice of police. However, in India and many other nations, there is no intermediate channel for the communication of police and the victims digitally. This application may provide this medium for the easy communication and may provide breakthrough in previous cases as well help in detecting any crime happening in the nearby locality of any citizen.

Another important area of criminal activity that is taking place is that of Cyber crime. It has been affecting many people in the past and gearing up to cause destruction in

future as well. Many people have been a victim of this crime and usually have no idea about its solution. However, through the medium of this application, many suspects can be nabbed at the correct time limiting their future access to cause harm to anyone. Many such instances of crime that have taken place in the past are:

- Abusive Chat
- Abusive Email
- Banking Fraud
- Copyright Infringement
- Credit Card Fraud
- Cyber Stalking
- Domain Hacking
- E-commerce frauds
- Email Hacking
- Email Threat
- Net Extortion
- Obscene Email
- Online Defamation
- Phishing
- Pornography
- Social Profile Hacking
- Software Piracy
- Spoofing
- Trademark Abuse
- Virus or Trojan attack
- Website Hacking

When the victim suspects, any sort of crime that has taken place, then he/she can immediately contact the team associated with dealing cyber crimes. Any threat can also be directly reported through this medium.

Upon receiving any report from the victims, the cyber cell may act immediately performing all sorts of enquires and can take requisite action to control the situation as soon as possible. The identity of the people can also be hidden who report any crime they notice in the neighborhood.

With the incorporation of such interactive mediums, the public can come together and eliminate crimes and can move ahead for better and safe environment.

II. BRIEF HISTORY

Interestingly, the earliest efforts at crime mapping can be traced to the roots of the discipline of criminology itself. Guerry and Quetelet mapped crimes in France at the department level and found that crimes were not distributed evenly across departments. They also found that there was stability over time in both areas with high crime and areas with low crime over time. These findings were researched in England with studies by Plint, Glyde, and Mayhew.

In the United States, Shaw and McKay's (1942) seminal study of juvenile delinquency in Chicago made extensive use of crime maps. Shaw and McKay borrowed Park and Burgess's (1924) ecological model and divided the city into five different zones.

In the late 19th and early 20th centuries, the movement in policing encouraged police organizations to integrate statistics documenting the extent of crime in their jurisdictions. In fact, one of the main justifications for the creation of Federal Bureau of Investigation was for the explicit purpose of documenting the extent of crime in the United States through the Uniform Crime Reporting program (Mosher, Miethe, & Phillips, 2002). During this time, many agencies began compiling crime statistics and conducting analyses of crime data. Spatial analysis of crime was primarily done using pin maps, which were very time-consuming and provided only a basic visualization of crime patterns. The late 1960s and early 1970s were crucial for the development of spatial analysis of crime. In 1966, the Harvard Lab for Computer Graphics and Spatial Analysis developed SYMAP (Synagraphic Mapping System), one of the first widely distributed computerized mapping software programs. Therefore, the use of GIS for mapping has been the most important advance in the field of spatial analysis of crime. Although the first instances of computerized Spatial analysis of crime occurred in the mid-1960s in St. Louis, Missouri, the adoption of computerized Spatial analysis of crime across the United States remained very slow. A number of agencies, in particular in larger jurisdictions, became early adopters of computerized Spatial analysis of crime technology, the large period of growth in computerized Spatial analysis of crime did not begin until the late 1980s and early 1990s (Weisburd & Lum, 2005). The rate of adoption of Spatial analysis of crime among departments greatly increased as desktop computers became cheaper and more powerful and GIS software became easier to use and more powerful. The Compstat program, which started in 1994 in New York City, emphasized Spatial analysis of crime as a central component to strategic police planning and helped popularize Spatial analysis of crime among police agencies. With assistance from the Office of Community Oriented Police Services and the National Institute of Justice, a large number of departments adopted computerized spatial analysis of crime practices. By 1997, approximately 35% of departments with more than 100 officers reported using spatial analysis of crime (Weisburd & Lum, 2005).

Cyber crime cases date back to those times when the use of computer began among millions of people across the nation. One of the highest profiled banking computer crime occurred during a course of three years beginning in 1970.

The chief teller at the Park Avenue branch of New York's Union Dime Savings Bank embezzled over $1.5 million from hundreds of accounts. The other case was that of Mafia Boy. In February 2000, an individual going by the alias of MafiaBoy began a series denial-of-service attacks against high-profile websites, including Yahoo!, Amazon.com, Dell, Inc., E*TRADE, eBay, and CNN. About fifty computers at Stanford University, and also computers at the University of California at Santa Barbara, were amongst the zombie computers sending pings in DDoS attacks. On 3 August 2000, Canadian federal prosecutors charged MafiaBoy with 54 counts of illegal access to computers, plus a total of ten counts of mischief to data for his attacks.

The recent attacks of cyber crime are that of LinkedIn and eHarmony. In June 2012, the two were attacked, compromising 65 million password hashes. 30,000 passwords were cracked and 1.5 million EHarmony passwords were posted online. On April 23, 2013 saw the Associated Press' Twitter account's hacked - the hacker posted a hoax tweet about fictitious attacks in the White House that they claimed left President Obama injured. This hoax tweet resulted in a brief plunge of 130 points from the Dow Jones Industrial Average, removal of $136 billion from S&P 500 index, and the temporary suspension of AP's Twitter account. The Dow Jones later restored its session gains. The most recent cyber attack is 'Wannacry' ransomware attack. The WannaCry ransomware attack was a worldwide cyberattack by the WannaCry ransomware cryptoworm, which targeted computers running the Microsoft Windows operating system by encrypting data and demanding ransom payments in the Bitcoin cryptocurrency.

III. IMPLEMENTATION

4.1 Basic Concepts:

.Net initiative has tried to build the gap in interoperability between applications. It aims at integrating various programming languages and services. It is designed to make significant improvements in code reuse, code specialization, resource management, multi language development, security, deployment and administration. The .Net infrastructure consists of all the technologies that help in creating & running robust scalable and distributed applications. The core of the .Net infrastructure is the .Net framework which is a collection of services and classes. It exists as a layer between .Net applications and underlying operating system. The .Net Framework consists of Web Forms, Windows Forms, and Console applications that pertain to the presentation layer of an application.

Fig 3: Spatial analysis of crime application (use of GMaps.dll)

For the purpose of building this application, we have made the use of .Net web application forms. The implementation of this website is done by using the technique of Geographical information system. The most important tool for building this application is **GMap.NET** control. Google provides the free API to integrate Google Maps in our application. We can customize Google Maps depending on our requirements.

GMaps.dll is used for this purpose. It helps in placing a map control on a form to initialize it to show the coordinates you want, how to add markers to it, and how to add polygons. GMap.NET requires an internet connection to function properly. However, if no connection is available, we can still use cached information (if available) to show maps.

Respective latitude and longitude are provided for the functioning of maps in web application. The data of all the places with their latitude and longitude are placed in a database integrated in the web application software (Microsoft visual studio 2008).The databases are maintained by SQL SERVER 2008.

4.2 Functions of the application

The functions performed by the Crime Mapping web applications are as follows:

- Portray all the states on the map of India with their respective latitude and longitude.
- Display different types of crimes for particular states.
- Show statistics of crimes for different years
- Show maximum and minimum rates for any particular crime of any state.
- District view is can also be viewed for respective states.
- State-wise ranking is displayed.
- Analysis report is prepared to study crime patters and crime trends.

- Representation of crime is done in the form of tabular, pie-chart and graphical.
- Spotting of a crime in the neighborhood can be notified online by the public.
- Cyber crime can be directly reported to the cyber cell by the victim or the public without revealing the identity

4.3 Feasibility Study:

Feasibility study is a preliminary study undertaken before the real work of a project starts to ascertain the likelihood of the project's success. It is an analysis of all possible solutions to a problem and a recommendation on the best solution to use. It involves evaluating how the solution will fit into the corporation.

It is used to determine if the project should get the go-ahead. If the project is to proceed, the feasibility study will produce a project plan and budget estimates for the future stages of development.

4.3.1 Technical Feasibility

The key customer benefits kept in mind while envisaging this architecture were:

- Higher maintainability, extensibility and configurability
- Improved performance and scalability
- Lower Cost of Ownership
- Better productivity
- Lower business risk
- System Performance
- System Interfaces
- Development Processes
- Risk Assessment
- Staff Qualifications
- Failure Immunity
- Customer Support
- Security

4.3.2 Economical Feasibility

Cost Benefit Analysis was done in this stage. Following activities were performed during this stage:-

- Each phase of the project was analyzed for the cost involved in it.
- This was calculated based upon resources and infrastructure used.
- Benefits of each phase which were the end products were analyzed and listed.
- Both cost involved and benefits obtained were compared to the details to get the final result.

4.3.3 Operational Feasibility

How well the solution will work in the organization and how the end-users and managers feel about the system.

This is important because a workable solution can be thrown away because of end-user or management doesn't want the system. Therefore usability is another important factor.

Usability analysis is often performed with a working prototype of the proposed system. Test of system's user interfaces and measured in how easy they are to learn and to use and how they support the desired productivity levels of users. Easy to learn, use and user satisfaction are other things which are considered here.

Fig 4: Web Application(Crime Mapping)

4.3.4 Other Feasibility Dimensions

Scheduling Feasibility was one of the dimensions. Measure of how reasonable the project timetable is. Schedule can be mandatory or desirable. It's better to deliver a properly functioning information system later than to deliver an error-prone.

- Measure of how reasonable the project timetable is.
- Gantt chart was made.
- Work allocation was finalized.
- Time Value for money was analyzed

IV. CASE STUDY AND FUTURE SCOPE

On the basis of the current research on the spatial patterns of crime, a number of types of research in crime mapping are worth exploring.

Based on the first research, it is found that the criminal events perspective (Meier, Kennedy, & Sacco, 2001; Sacco & Kennedy, 2002) provides a mechanism to link other theories of criminality with theories of criminal events. To date, the implications of other theories of criminality for understanding the spatial distribution of crime remains unexplored and may provide useful insights into offender search patterns and the selection of targets and locations.

A second area of research that would be very helpful in regard to centralized governing body is expanding crime mapping to include additional justice agencies. The vast majority of research in spatial analysis of crime has used calls for service and crime report data, and most applications of spatial analysis of crime have been applied to police decision making. Researchers should consider broadening the scope of spatial analysis of efforts to incorporate data from other justice agencies for better and efficient decision making.

A third area of research would involve increased attention to the differences between types of city features and the production of criminal events. An increase and decrease in crime rates of such areas can be compared based on particular location and recognize the patterns of level of community organization, adjacent land usage, and the level of concentration of other crime generators or attractors, may also be important for differentiating between problematic and non problematic bars.

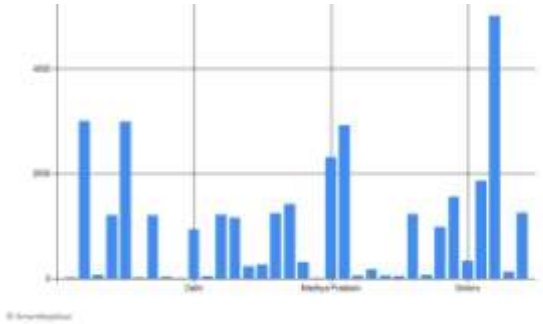

Fig 5: Graphical Representation of crime patterns

The fourth research for future improvement on spatial patterns in crime is to further examine the stability of crime in small areas. Specifically, as Weisburd, Bushway, Lum, and Yang (2004) recognized, few studies have examined the degree to which crime in micro level areas is stable over time. In their study, conducted in Seattle over a 14-year period, Weisburd found that there was a substantial amount of stability in the level of crime on street segments. Despite the high degree of stability in many places, some street segments exhibited either downward or upward crime trajectories. Obviously, additional research is needed to determine whether this pattern holds generally or is specific to the city of Seattle. This type of research will be very helpful in describing the factors that lead to the development, maintenance, and decline of crime in problematic areas.

Discussing about cyber crime, the criminal justice system response to cybercrime is the advent and development of the field of digital forensics, which has its roots in data recovery methods. That is, digital forensics has evolved into a field of complex, controlled procedures that allow for near real-time analysis leading to accurate feedback. Such analysis allows individuals in criminal justice to track the changes and key issues that are pertinent to good investigation of cybercrime. Another method that criminal justice uses to combat cybercrime is through education of the public. This includes publishing important tips for reducing victimization.

A final and practical research with its implementation is seen in the popular computerized Spatial analysis of crime through the Compstat program in New York led to a period of rapid adoption of Spatial analysis of crime that continues today with success.

V. CONCLUSION

The previous research on spatial analysis of crime involved analysis and research by the public anytime and anywhere. It also had various features including reporting a crime or giving any specific hint to the central police force to avoid any mishappening. Various web applications have also included the information of various agencies linked to particular regions. However, with the latest advancement, the spatial analysis of crime may also include reporting any misconduct by the police force and reporting them directly to the governing body. In this manner, efficient manpower can come into practice and the ones who are unable to fulfill their duties properly may be subjected to respective consequences.

Fig 6: Analysis of crime patterns

For the betterment of the society, locals may connect to the centralized security forces to help volunteer in areas where the crime rate is significantly higher.

The other aspect is that of noticing any crime in any particular area. If any person undergoes any misconduct, then he/she can directly report it to the police using the application. Cyber crime, another aspect of illegality can be sorted out using the same application. A number of malicious attacks are being done wherever there is a use of networking. Hence, to overcome this issue, the victim can directly contact police without disclosing his/her identity. The report can be submitted using evidence as well making it easier for the police to act immediately.

Hence, the purpose of this research paper was to review some of the current researches on spatial analysis of crime, the process through which crime analysts and researchers use location information about crime to detect spatial

patterns in criminal activity. Finally, this research paper aimed to elaborate on some of the major findings in crime mapping and spatial crime research, with particular attention to designing strategies to combat crime problems. In particular, Spatial analysis of crime research may benefit from efforts, using crime mapping with additional agencies, further examining the source of differences in the production of criminal opportunities between city features, and examining the stability of crime areas over time.

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