GEO STATISTICAL APPROCH FOR CRIME HOTSPOT DETECTION AND PREDICTION

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Abstract - *Crime maps are becoming significant tools in crime and justice. Advances in the areas of information technology and Geographic Information Systems (GIS) have opened new opportunities for the use of digital mapping in crime control and prevention programs. Crime control and monitoring activities in crimes affected areas and it has the ability to examine spatial relationships. The degree of crime events occurrence is higher in the major cities such as Pune. The study resolves that the hotspots generated by choropleth and density map can be refined and more precisely located with the help of spatial statistical approach. The data acquired from these hotspots can be utilized for the study of advanced analysis such as offender movement pattern such as urban street crimes were analyzed. Applications of geographical information systems within policing: hotspot mapping, CompStat and geographic profiling. Main purpose understands about crime occurrence, where hotspots of crime lie, where the density of crime rate is high.*

Key Words*:* **Hotspot mapping, Hotspot, Hotspot Shifting, Sparse matrix analysis, Prediction of future hotspot.**

1. INTRODUCTION

Many officers and agencies visualized individual crime events and crime distribution early by using all kinds of pins on city and area maps. With the fast advancement of GIS techniques, visualizing and detecting the order of criminal activities become more necessary and effective. GIS techniques provide many methods for combining spatial information with other data. Furthermore, GIS is one of the most influential tools for integrating a wide variety of spatial information and facilitating exploration of crime distribution. [1] GIS is the main idea to deliver the information required to the administrative staff to analyze and make a quick decision by providing the final product with graphic information permitting the law enforcement agencies to understand where crime events are occurring, where the crime rate and density of crime is high [2]. Mapping crime hotspots can assist the law enforcement agencies to protect the inhabitants of that area where crime rate is very high. [3] Crime hot spots are areas that have a greater than average number of criminal or disorder events, or an area where people have a higher than average risk of victimization. Mapping crime hotspots has been proved to be useful to the law enforcement agencies in dealing with crime

incidents. The spatio-temporal data mining provides the platform to analyze the spatial data. It concerns with both spatial and temporal relationships. Two important attributes of spatial –temporal data mining are Location and Time. In this paper sparse matrix analysis based spatial clustering technique for serial crime prediction model is used which is based on spatial temporal data mining and also used for predicting future crime location.

2. RELATED WORK

Bekir Cakar, B.A., M.S.[1] has discussed the situations and problems that police officers face are more complex in today's society, due in part to the increase of technology and growing complexity of globalization. Accordingly, to solve these problems and deal with the complexities, law enforcement organizations develop and apply new techniques and methods such as geographic information systems (GIS).

Mark A. Stallo et.al, introduces the strategies to overcome crime and identify high crime areas. Also gives statement about when to use these types of methods. States that the importance of should know method to identify and routines to identification of hotspots to the crime analyst. Discussed techniques to identify crime areas and the traditionally used method or techniques [2].

Dr. Ajay Kumar Singh describes the analysis of crime data and spatio-temporal process. Stated the importance of the GIS application how this is important in crime analysis and advancement of application. The motto of GIS applications is to visualize the crime patterns. This application helpful to agents and where the crime is occurring and what preventives measures to be taken also help to police to plan and analysis of crime. This will find crime pattern from the crime details over the regional map and shows in the map. These maps are called crime density maps used find crime hotspots. Finally these maps used for study in GIS application [3].

Luc Anselin et.al, states that there is need of giving special attention to the crime analysis. By using data analysis methods that should be start of analysis on the crime dataset. The crime demonstrated on the relationship between places

where crime happens and what crime happens. Crime hotspot detection is essential because peoples are located there; intervention of crime people activated affects crime [4].

To better appreciate its reasons, native, local and nationwide security experts rotated to new decision support mechanisms such as Geographic Information Systems (GIS) and extra info tools to discover better keys/solutions. To comprehend the scale of all the variables tangled it is essential to spatially capture and relate them. Only by doing that it´s possible to measure and succeed some unseen aspects of the phenomena. Implies an enormous degree of uncertainty in the observation and location of criminal data. As the crime is not preserved with a careful point, but at the equal of community, it implies that larger communities are treated by the regular crime irrespective of place of incidence. This investigation trusts statistical methods (cluster analysis) and spatial models formed with GIS, based on police crime intelligences. It also particulars a background for short-term tactical placement of police properties in which the neutral is the identification of zones where the offense altitudes are high (sufficient) to enable precise analytical prototypes as well as to create rigorous thematic charts [5].

Jerry h. Ratcliffe explores the development in crime mapping. Examines three approaches hotspot mapping; CompStat; and geographic profiling. Discusses the training needs to reduce crime. Lastly suggest that managers should know how to analyze and present crime data and importance of improve ability of crime analyst [7].

Sumanta Das et.al studied Crime prediction model critical and the challenging task and proposed model. Today the large amount of crime data available in the city. For the crime prediction the efficient and the best models are required which is able to handle the data and predict the crime location. Data mining is the effective concept to dealing with such a problem and useful technique. Author presented the crime prediction model which calls the sparse matrix based analysis spatial clustering. Which is applied on the historical crime data from the various cities. Cluster are obtained from the dataset and they compared results with existing system which show good results[10]
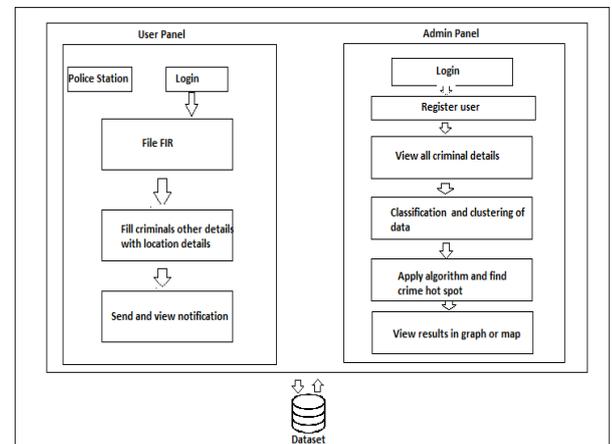
3. PROPOSED SYSTEM

Fig- 1: System Architecture.

Above figure shows the schematic diagram of the proposed system. Proposed system implemented for the crime prediction and crime analysis based on the crime dataset in the city. There is the large amount of crime data available at the police stations we can call the raw data where a lots of crime records are present. For the analysis it is the critical task to manually analyze and generate the report. Generate hotspot and cold spot. Our proposed system we process data by applying the data mining algorithms and applied dynamism in the project. In this system the admin can register the police stations and generate the login credentials.

Algorithm : Sparse Matrix Analysis based Spatial Clustering Technique

1. Retrieve crime data from the dataset in the yearly greed
2. Add all values of same cell from the starting year grid to last year grid
3. If resultant value contains at least one event of specified crime type then it is considered as the hotspot assign 1 otherwise 0.
4. Apply sparse matrix technique for removing the cold spot from final grid and obtaining location for specified crime.
5. Merge all crime type location for the final crime prediction.

Algorithm : Sparse Matrix Analysis

Through the login credential local stations login to the system. Users i.e. police stations have the authority to file the Fir and other actions. Main functionality works at the admin side. The analysis is done at this side- crime hotspots are generated by clustering the data using K-means algorithm based on the crime types and crime prediction based on the historical criminal dataset. Sparse matrix analysis based spatial clustering technique is used to find the prediction of

crime hotspot. In which all dataset is mined and the depending on that cold spot and hotspot are generated and based on this results future crimes are predicted.
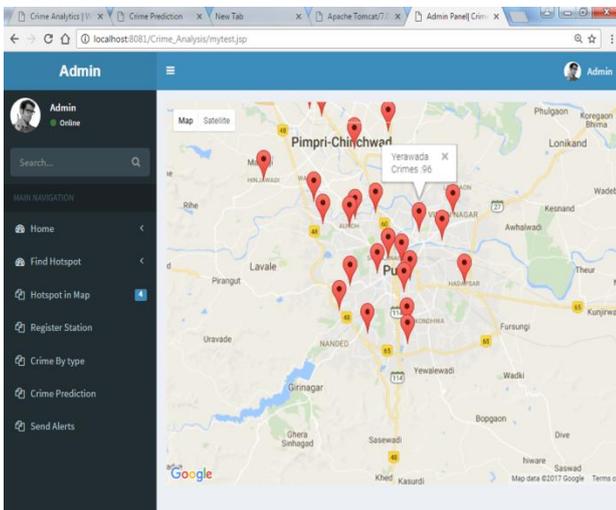
4. RESULTS

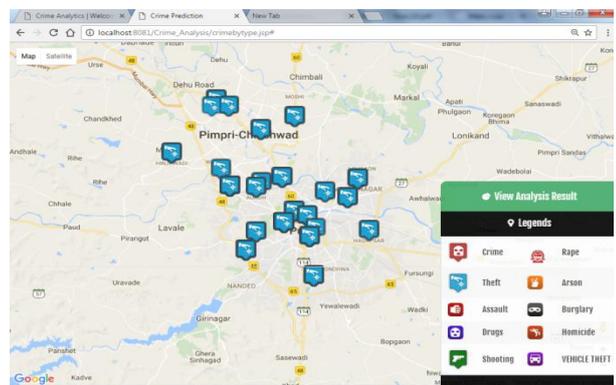**Fig-2**: show the crime hotspot with number of crimes
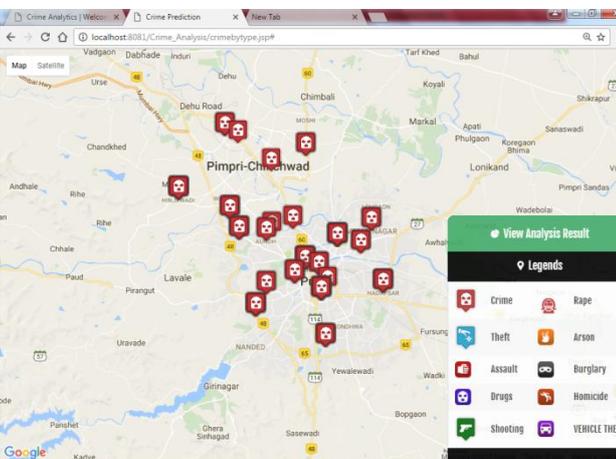

Fig-3: shows the crime by type (Theft).

Fig-4: shows the crime by type (crime).

5. CONCLUSION

The proposed methods are adopted to identify crime hotspots from regional scale to local scale and to pin point the crime locations. Data mining concept is used to prevent and identify the crimes. Clustering technique is used to cluster the similar type of crimes together by k-means algorithm. Study resolves that spatial statistical approach to generate crime hotspots is better and more precise way to spatially represent the crime data. Spatial statistical approach can identify small geographical environments or local scale hotspots where there is high concentration of crime incidents.

REFERENCES

[1] B. Cakar, "Factors Affecting Police Ofcers' Acceptance of GIS Technologies: A Study of The Turkish National Police," Doctor of Philosophy, information Science, University of North Texas, Texal, 2011.

[2] Mark A. Stallo, "Identifying High Crime Areas", 2013.

[3] A. K. Singh, "Identification of Crime Hotspots And Its Relationship With Offenders," presented at the Third International Conference & Exhibition, Kingdom of Barain,2004.

[4] S. Chainey,J. Ratcliffe,S. Chainey,and J. Ratcliffe, "Mapping for Operational Police Activities," in GIS and Crime Mapping, John Wiley & Sons,Inc. ,pp. 257-286,2005.

[5] J. Ferreira, P. J030, and J. Martins, "GIS for Crime Analysis: Geography for Predictive Models," The Electronic Journal information Systems Evaluation, vol. 15,pp. 36-49,2012.

 [4] L. Anselin, J. Cohen, D. Cook, W. Gorr, and G. Tita, "Spatial Analyses of Crimes," Criminal Justice, vol. 4,pp. 2 13-262,2000.

[5] Sukanya.M, "Criminals and crime hotspot detection using data mining algorithms: clustering and classification", 2012

[6] Xiang Zhang," Detecting and Mapping Crime Hot Spots Based on Improved Attribute Oriented Induce Clustering", 2008.

[7] J. Ratcliffe, "Crime Mapping and the Training Needs of Law Enforcement," European Journal on Criminal Policy and Research, vol. 10, pp. 65-83, 2004.

 [8] B. Z. Ezra, C. M. Philip, and B. Monika, "Crime Analysis Geographic In-formation System Services: Advanced Tools Report," Environmental Systems Research institute, New York, USA,2002.

[9] Jonathan J. Corcoran, Ian D. Wilson, J. Andrew Ware "Predicting the geo-temporal variations of crime and disorder", International Institute of Forecasters , Elsevier, 623-634 ,2003.

[10] Sumanta Das, Malini Roy Choudhury,"A Geo-Statistical Approach for Crime hot spot Prediction", Department of Civil Engineering.,2016.