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Detection of Crime Using the Application of Regression Mechanism

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Abstract— Crime, an unlawful act, causes terror and threat to our society and is a major concern for national security. However, very negligible work has been done to develop models and methods to hold an active collaboration between forensic science and criminal investigation systems. The need is felt to develop a system that collects as well as categorise the data on crimes along with an analysis of crime affected areas identification. In this study, an efficient crime investigation system is proposed in which fuzzy rules and Regression clustering algorithm is employed to identify and detect crime affected region along with showing it on the map. The study of DATA GATHERING is incorporated for crime detection and prevention with an aim to provide a safer society to live.

***Keywords*:-** Crime detection, cloud computing, data mining, clustering, Internet of things.

I. INTRODUCTION

Crime intelligence investigation is necessary for the resolution of crimes at any time and any region of a country. Now a day, criminal intelligence is implemented with law enforcement organisations and through technologies such as databases, data mining techniques [1]. While investigation, Forensic science has contributed a lot in crime resolution. Within intelligence units, crime analysis proceeds through daily interpretation of crime data coming from new cases. The activities of offenders, their plans about a new crime can be accessed from information collected in dedicated databases separately. The basic intelligence system consists of very general process: planning, collecting, collation, dissemination and feedback [1]. Visualisation of information supports analysis of information by decomposing information into simpler perspectives. It helps to gather and summarise data. Link charts can be used to gather all information. It can be combined with other techniques such as databases to memorise and data mining. Investigative problems can be analysed through spatial, temporal and relational dimensions.

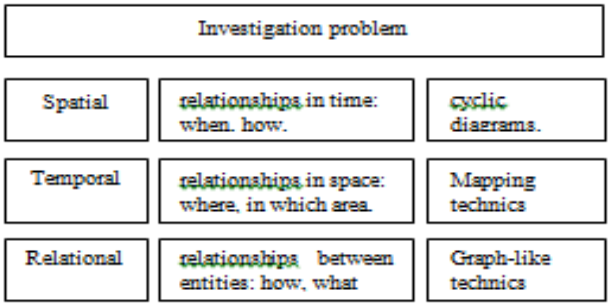

Fig. 1 Analysis of investigation problem.

- DNA- DNA samples collected from crime scenes can be used to find the link between crimes [2].
- Shoe marks- Shoe marks are used in investigation by use of shoe mark databases located in each state's forensic unit [2].
- Fingerprints- Fingerprints are also be used in crime investigation. Fingerprint patterns are divisible into four main types: Arches, Loops, Whorls, and Composites [2].
- Images -Images are used when banks, ATMs are targeted then CCTV images are directly obtained in collaboration with security agencies [2].
- Crimes are categorised into soft crimes and hard crimes. Huge Forensic data is analysed, processed, and stored within the cloud [3]. Then, with the use of data mining techniques, this stored data is extracted out in four major steps as Classification, Clustering, Regression and Association rule mining [4, 5]. Various data mining techniques are available to mine crime data like K-means, Hierarchical and Fuzzy clustering based techniques. Then Internet of things paradigm in which smart objects are interconnected through the internet is used for the purpose of crime prevention. Crime information system is shown in Table 1. The aims of proposed system are:
- To plot he crime affected region with the help of geographical maps e.g. Google, yahoo, etc.
- Keeping track of all the criminals released on bail.
- To secure confidential information related to crime and criminals.
- Risk assessment for public safety using internet of things concept.

Table 1 Crime Information system

Tools	Functions	Technique
Crime analysis	Analysis of data for prediction	Crime data and k-means clustering technique
Crime hotspot detection	Visualisation of crime for crime hotspot detection	k-means clustering, location recognition
Crime map	Risk assessment	Geographical information, location recognition
Information offering	Text, picture, video, map	GPS based technique, location recognition
Guarding	Alarming	GPS based, SMS
User participation	Map	Geographical information

In our proposed system, first of all, fuzzy based inference system is used. Then k-means clustering technique is used to detect the regions of crime and is shown with the help of the map. K-means technique is used over any supervised technique since crimes vary in nature widely and crime database often contains several crimes. Thus, for detecting newer and unknown patterns in future, clustering techniques work better. This help in a careful investigation of crime and guarding safety to citizens. As crime data is huge so the cloud-based storage is used.

The rest of paper is organised as follows. Section 2 gives information about related work about crime, data mining, cloud computing and internet of things. In Section 3, the proposed system is presented. Before concluding the paper in Sect. 5, experimental results are presented in Sect. 4.

II. RELATED WORK

In 2002, E. R. Groff et al. [6] described what is required to use crime mapping methods, and assesses how accurate they are in predicting future crime concentrations, or "hot spots." Factors such as data requirements and applicability for law enforcement have also been used. In 2003, W. Gorr et al. discussed that the crime forecasting can control crime. They used The GIS (Geographical Information System) to detect the location wherein crime happened instead of a single specific location. In 2012, Sylvain Ioset et al. [2] revealed that there can be a common database for analysis of high volume crimes. Systematic procedures have been analysed by them to integrate links mainly through DNA profiles, shoemarks patterns and images. In 2013, Quentin Rosy et al. [1] discussed that forensic science and criminal investigation is essential for resolution of crimes. There is need to bridge the gap between intelligence process, analyses of investigation problem and visualisation method. In 2013, S. Ismail et al. [7] carried out a research in which a particular location of Malaysia was considered. The crime location and mindset of the criminal was also considered in this case. In practice, usually the police target persons with their criminality and study their strategy of implementing crime. The police also monitor the current crime situation and will take necessary action when the crime index increases. Their finding showed that economic crisis was obvious in increase of crime rate. In 2016, Valerie Spicer et.al. [21] presented a crime mapping technique for identification of crime patterns along street segments.

In our proposed system, first of all, fuzzy based inference system is used. Then k-means clustering technique is used to detect the regions of crime and is shown with the help of the map. K-means technique is used over any supervised.

In 2003, Giles C. Oatley et al. [8] developed OVER Project primarily to assist the Police with the high volume crime, burglary from dwelling houses. The final predictions on the likelihood of burglary are calculated by combining all of the varying sources of evidence into a Bayesian belief network. In 2006, Jiawei Han et al. discussed [4] the data mining concepts and techniques. In 2006, Tony H. Grubesic [9] described that one of the fundamental challenges in crime mapping and analysis is pattern recognition. He explored the use of a comprehensive partitioning technique known as fuzzy clustering for hot-spot detection. Functional and visual comparisons of fuzzy clustering and two hard-clustering approaches that are k-medoid and k-means, across a range of cluster values are analyzed. In 2006, Shyam Varan Nath et al. [10] discussed that k-means clustering is used in the identification of crime patterns. In 2012, Kilian Stoffel et al. [11] demonstrated a methodology and an automatic procedure, based on fuzzy set theory and designed to infer precise and intuitive expert-system-like rules from original forensic data. In 2014, Apurva Jyal et al. [12] discussed that Clustering is a process of grouping a set of objects in such a way that objects in same group share the same similarity. In 2014, Tae-Heon Moon et al. studied [13] that crime has damaged citizens lives and properties, establishing a safe urban environment has been a crucial social issue.

In 2010, Qi Zhang et al. [3] clearly demonstrated cloud computing, highlighting its key concepts, architectural principles, state-of-the-art implementation as well as research challenges to provide a better understanding of the design challenges of cloud computing. In 2014, Sandeep K. Sood et al. [14] discussed that aim of cloud computing is to provide bigger data center that will cater the needs of the user. . He proposed a new approach in which cloud customer (CC) establishes the session to access the resources.

data. It provides a model in relation to RFID. In 2013, Jayavardhana Gubbi et al. [16] presented a cloud centric vision for implementation of internet of things. They have explained the concept of public and private clouds. In 2014, Eleonora Borgia described [17] that DATA GATHERING is a new concept that combines technologies and aspects from different approaches. Internet protocol, sensing technologies, RFID concepts, communication technologies, embedded devices are merged together to form a system. When intelligence is embedded in objects, they become intelligent objects and gather information from the environment and also connect with the physical objects through Internet to transfer data and information. The physical-cyber world interaction takes place with these three different phases: (i) collection phase, (ii) transmission phase and (iii) process, management and utilization phase. In 2014, Jeong-Yong Byun et al. [18] has presented the idea that internet of things can be used in smart crime detection. The proposed system can detect the crime in real time by analysing human emotions. In 2014, Nomusa Dlodlo et al. discussed that internet of things can be used in crime prevention [19]and community safety. They had taken advantage of information and communication technologies. In 2015, Sheeraz A. Alvi et al. [20] discussed that internet of things can also be used for multimedia devices. They have introduced a paradigm in which smart multimedia things can interact with each other and with other things connected to internet. Internet of things communication stack consists of link layer, network layer, transport layer and application layer. It is used in enhancing public safety and security.

III. PROPOSED TECHNIQUE

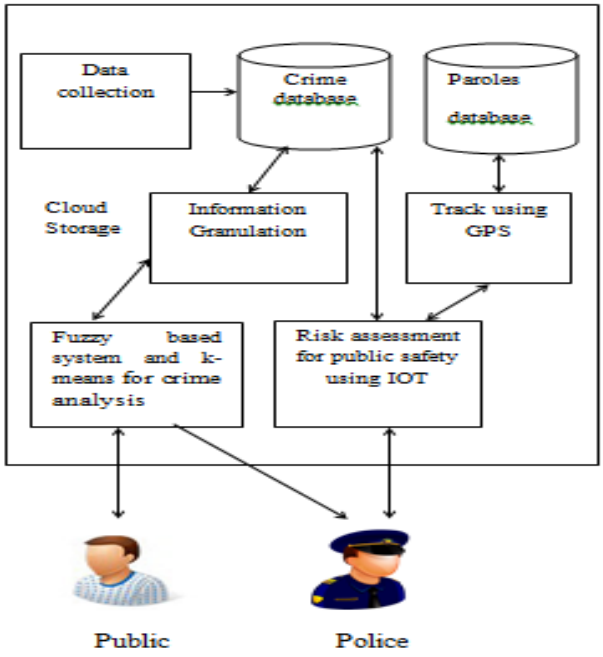

Fig. 2 Proposed model

Figure 2 shows the proposed system related to crime prevention and for the safety of public. It consists of data collection, Fuzzy inference system for prediction and k-means clustering for hotspot detection, risk assessment for public safety and security of confidential information. The data-collection component is responsible for collecting the information related to criminals and crime from police. Then fuzzy inference system is used for making rules. For purpose of crime analysis, k-means clustering over classification is preferred as crime rates changes rapidly. Personal information about users is truncated, and a unique case number is provided for further usage of the system. All compiled information and results generated are stored in a cloud storage repository termed as crime database. This database provides easy, flexible, and secure way to share information among public and police. Figure 3 shows system information flow for crime analysis for public and Figure 4 shows system information flow for crime prevention for police.

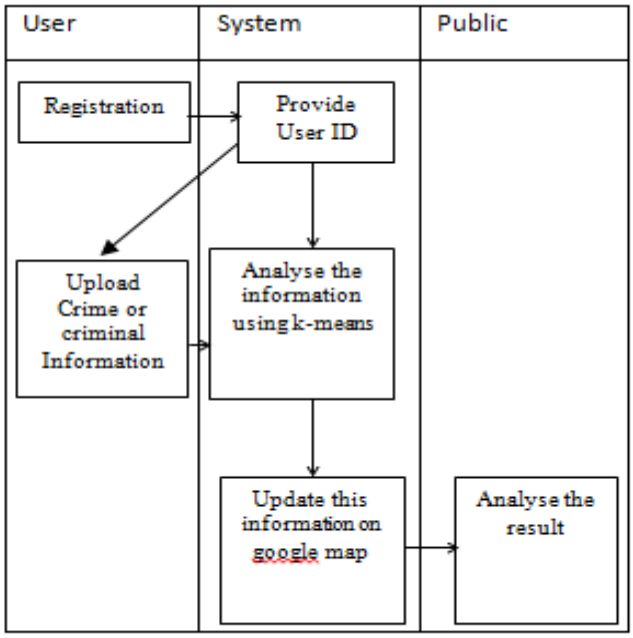

Fig. 3 System information flow for crime analysis for publc.

a. Data collection – Data related to crimes can be taken from police records, from various websites from internet. Attributes related to crime can be divided into two types.

Table 2 Attributes of criminal related data.

S.no.	Attributes	Description
1.	Fingerprint	Fingerprint of criminal
2.	Name	Name of criminal
3.	Address	Permanent address of criminal
4.	Age	Age of criminal
5.	Gender	Male or female

a. Criminal related private data- This information is private and cannot be displayed on maps.

Table 3 Attributes of crime related data

S.no.	Attributes	Description
1.	Date	Crime date
2.	Crime location	Location of crime
3.	Type of crime	Burglary
4.	Number of particular crime	Numerical

b. Crime related Public attributes

Table 4 Parole attribute table

S.no.	Attributes	Description
1.	Date	Crime date
2.	Crime location	Location of crime
3.	Type of crime	Burglary
4.	Number of particular crime	Numerical

c. Parole attributes

Table 5 Crime code table

S.no.	Crime	Code given
1.	Attempt to murder	1
2.	Burglary	2
3.	House theft	3
4.	Kidnapping for ransom	4
5.	Murder	5
6.	Motor vehicle theft	6
7.	Rape	7
8.	Robbery	8
9.	Other kidnapping	9

d. Crime code table

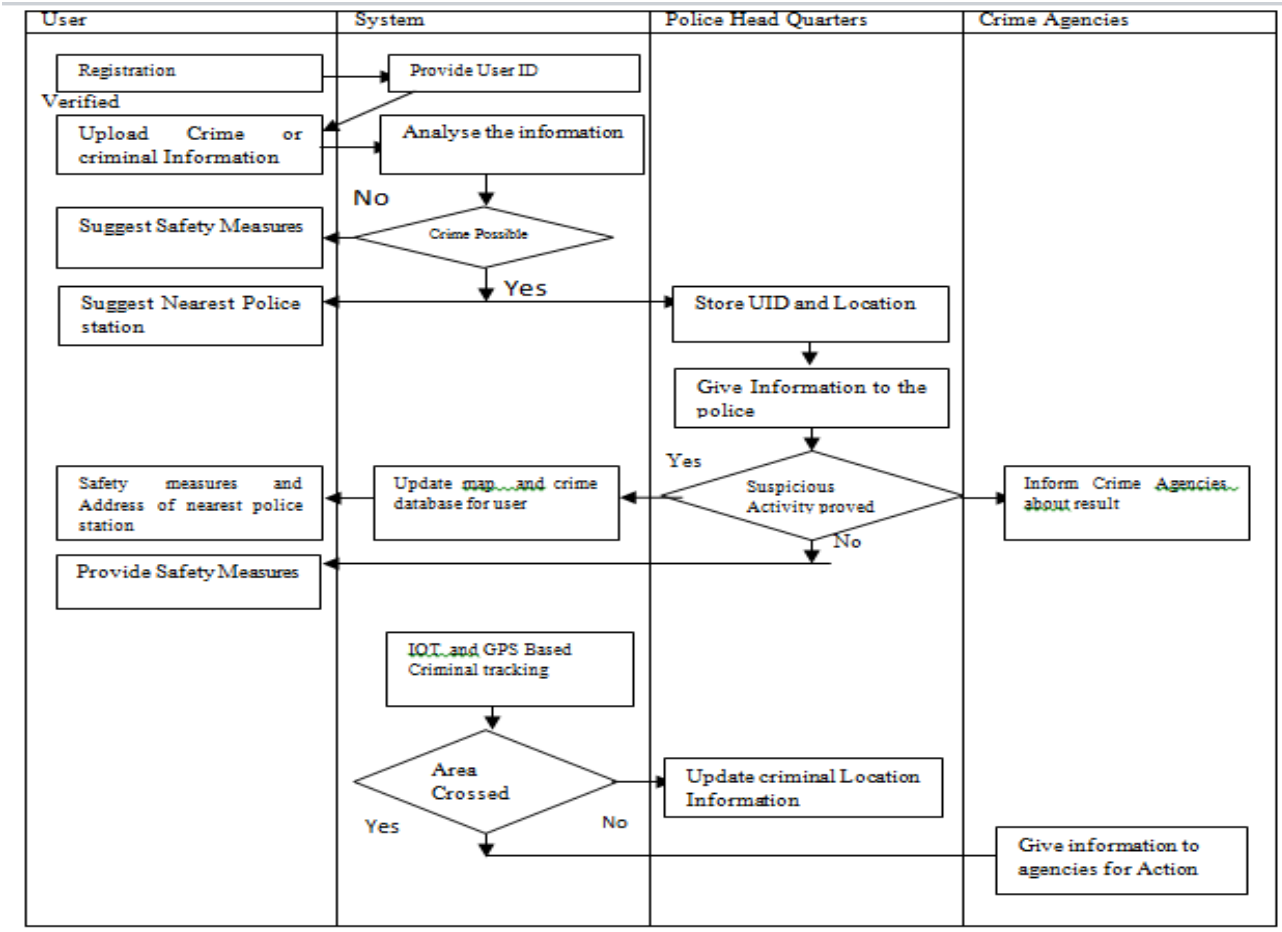

Fig. 4: System information flow for crime prevention for police

b. Information granulation– Data collection contains criminal related attributes, crime related private attributes, crime related public attributes. All information is uploaded in crime database. These attributes have different security levels: Level 1 (private information related to criminals), ,Level 2 (private information related to paroles) is the mediocore level of information, Level 3 (crime information) is the least sensitive level of information. We only show Level 3 information that is crime location on google map.

Fingerprint	Name	Address

Fingerprint	Name	Address

Location	Crime type	name

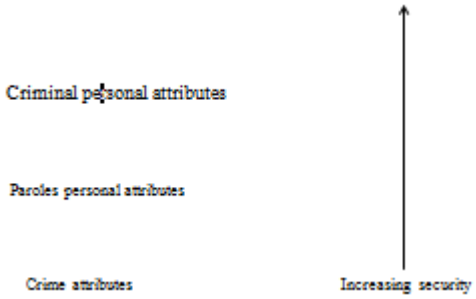

Fig. 5 Information granulation

c. Fuzzy based inference system for detecting types of crime and k-means clustering in crime analysis to predict the crime-

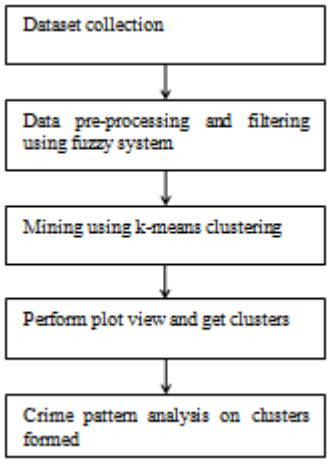

Fig. 6 Proposed system for crime analysis

To detect the type of crime fuzzy techniques will be utilized and in order to predict the crime k-means clustering will be used. The main things used in fuzzy system are fuzzy logic, fuzzy inference system. Fuzzy logic detects the degree of statement in a fuzzy way.

• In Fuzzy inference system, sets have associated a membership function (denoted μ(x)) which maps an input value to its appropriate membership value [11].

• A membership function may be any arbitrary function with values in [0, 1]. Fuzzy rules are used in inference system [11].

• Fuzzy rules have formed like if x is A then Y is B [11].

In the proposed system the fuzzy rules are used to determine whether the crime is soft or intense. The dataset will be sued for this purpose.

The count of crimes and percentage can vary according to crime incidents reported to police. As we have various types of crimes in the database, this database can be updated after every week.

1. **Sensitive crimes-** These crimes are also known as expressive crimes. The risk associated with these crimes is high. These crimes are listed in following table.

Table 6 sensitive crimes

Crime type	Code given	Total count of crimes
Att. to murder	1	22
Murder	5	31
Rape	7	0

2. Materialistic crimes- Materialistic crimes are known as instrumental crimes. An instrumental crime, are motivated to achieve a tangible goal, such as obtaining a physical good through theft. The risk associated with these crimes is low.

Table 7 Materialistic crime

Crime type	Code given	Total count of crimes
Burglary	2	22
House Theft	3	31
Motor vehicle theft	6	0
Robbery	8	0

Miscellaneous crimes – Miscellaneous crimes are very soft crimes. These are related to social issues of a city.

Table 8 Miscellaneous crimes

Crime type	Code given	Total count of crimes
Kidnap. for Ransom	4	22
Other Kidnap.	9	31

The rules to determine the type of crime are as follows. These rules are formed through fuzzy based inference system.

If crime1 is burglary, then crime is materialistic
If crime1 is robbery, then crime is materialistic
If crime1 is theft, then crime is materialistic
If crime1 is motor vehicle theft, then crime is materialistic
If crime2 is kidnapping for ransom, then crime is miscellaneous

If crime2 is other kidnapping, then crime is miscellaneous

If crime3 is attempt to murder then crime is sensitive
If crime3 is murder then crime is sensitive
If crime3 is rape then crime is sensitive

We can also make rules to identify risk associated with these crimes. Rules which are formed for these can be expressed as follows:

If crime1 is burglary then identify risk is medium
If crime1 is robbery then identify risk is medium If crime1 is theft then identify risk is medium
If crime1 is motor vehicle theft then identify risk is medium
If crime2 is kidnapping for ransom then identify risk is low
If crime2 is other kidnapping then identify risk is low
If crime3 is attempt to murder then identify risk is high
If crime3 is murder then identify risk is high
If crime3 is rape then identify risk is high

d. Crime Analysis

Selecting k-means technique - We choose k-means clustering method for crime analysis. The K-means clustering algorithm will be step by step execution of series of instructions. These instructions if followed successfully then desired result will be obtained. In our proposed system we have to load the crime dataset into the proposed model and then the dataset will be evaluated using the techniques of clustering. The clustering technique will partition the same types of crime into the different clusters of groups. The crime is sensitive or not then will be determined. The crime analysis is the important aspect of the proposed system. If this system is successful, then the crime location and crime itself can be forecasted and hence may result in the reduction in the crime. The proposed system to detect and plot the crime locations on the map is described through the following procedure.

The basic k-means clustering algorithm consists of following steps [5]
Input
K: the number of clusters.
D: a dataset containing n objects
Output: A set of k clusters

Method
(1) Arbitrary choose k objects from D as initial centroids
(2) Repeat
(3) (re)assign each object to cluster to which the object is most similar, based on mean value of objects in cluster;
(4) Update the cluster means, i.e. , calculate the mean value of objects for each cluster;
(5) Until no change

Regressions algorithm complexity is O (tkn), where n is instances, c is clusters, and t is iterations and relatively efficient.

e. Crime prevention and risk assessment–

1. Crime prevention by tagging criminals-When a criminal in major case is released on parole, all his details are captured. For unique identification of criminals, their biometric details like fingerprints and face image is added in crime database. Fingerprints can be taken using a fingerprint scanner, face image can be taken using face scanner[19]. As in crime database, we have the biometric information of major criminals involved in different crimes and total crime related information of city. This all concept is explained with the help of following figure:

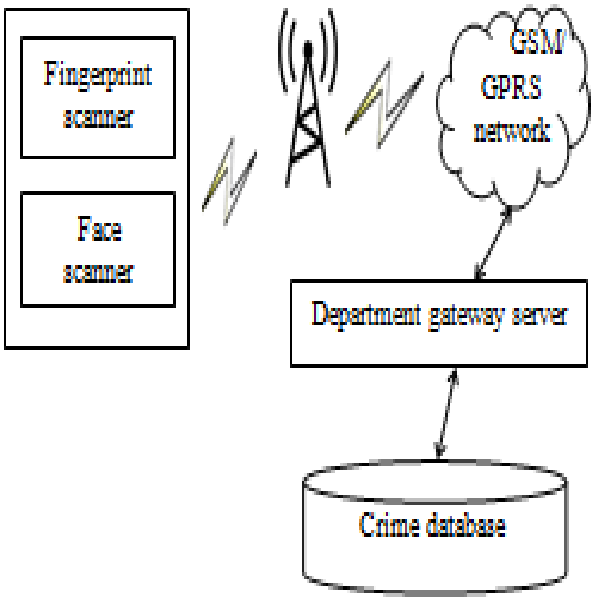

Fig. 7 Criminal identification system

f. Criminal monitoring system

Parole is tagged with a tracking device like a sensor in the form of the bracelet. We assume that tag is not detachable. The sensor has GPS or GSM sim card in that so that location of that person can be known at any time. The database is connected to correctional services department. The database containing parole conditions is also linked to this correctional services department [19]. So when criminal released on bail violates any conditions like when

•The parole moves out to area in which he is not allowed.
•Meeting some another criminal.
•The parole again commits some crime. Then alarm is triggered on a system in department. The crime database release details of monitoring officer for further action.

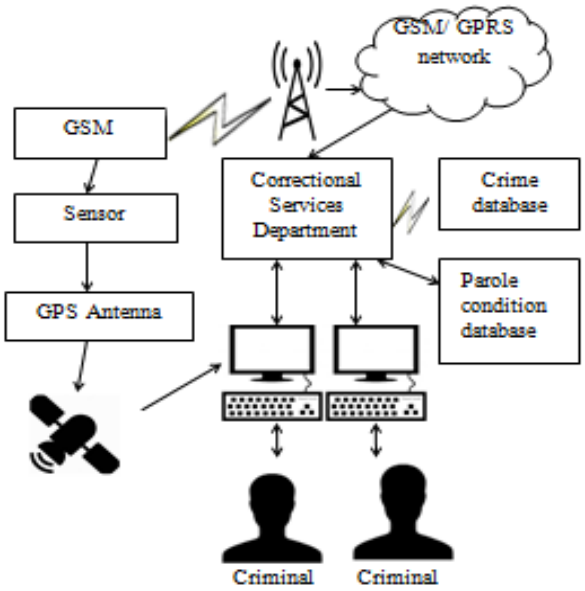

Fig. 8 Criminal monitoring system

g. Risk assessment for safety of public

Risk assessment is used is to guarding safety to citizens. As we have used k-means clustering for detecting hotspots of crime and to group similar types of crimes into group. If proper up to date information is available, then citizens can be alerted in time. Crimes are shown on pie chart according to percentage of crime. The major crime areas are plotted on Google map.

Dark blue = D > 50%
Dark purple = 40% < D ≤ 50%
Green = 30% < D ≤ 40%
Red = 20% < D ≤ 30%
Light red = 10% < D ≤ 20%
Yellow = D ≤ 10%

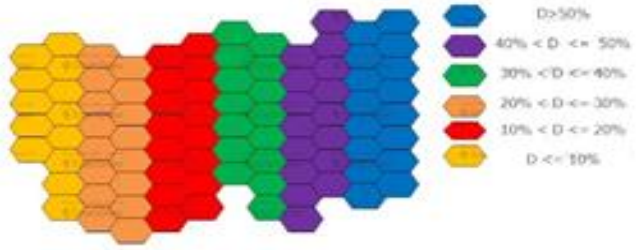

Fig. 9 To show particular crimes according to crime density.

h. Internet of things in updating crime information in database –

The Internet of things is the network of physical objects, vehicles etc. which are embedded within electronics, software, sensors etc. which enables these to collect and exchange the data. The rapid growth in the technology also resulted in the increase in the crime. The technology can be used to timely detect the crime and taking appropriate measure to avoid such situation. The emotion of the human beings are scanned and matched against the stored information [18]. Police officers are primarily focused to reduce the crime in the region.

The DATA GATHERING will help in crime detection which will be described through the following steps.

1) Emotion Sensing- The sensor is required to be fitted within the cloth which is most often is with the user. The sensor attached will check the emotion by analyzing the heart beat, inner temperature of the user etc.
2) Emotion Recording- In order to improve the crime detection, emotions are recorded using CCTV camera.
3) Crime Detection-The real time crime detection will be based upon the emotion sensing and emotion recording. The information is sent to the relevant agencies for investigation
4) Crime database updation- All this information will be updated in database.

Algorithm 1: Mapping crime areas
Step I: Identify types of crime and crime areas
Step II: Use fuzzy based system for dividing crime into types and K-means clustering for mapping.
Step III: Use Google maps to plot that crime area.
Step IV: When crimes increase
Step IV.1 Increase particular crime percentage.
Step V: Exit

Algorithm 2: Crime detection using internet of things
Step I: Use sensor to sense emotions of user.
Step II: Record all the emotions in CCTV camera.
Step III: If emotions of user not good.
Step III.1: Send that information to police for investigation.
Step IV: If after investigation result is true.
Step V: Update that information in crime database.

Algorithm 3: Tracking criminals released on bail
Step I: Store information of criminals released on bail in database.
Step II: Use sensor that has GPS to track criminal.
Step III: Use bail condition database and crime database.
Step IV: If bail condition violated then alarm is triggered in concerned police department.

i. Security of confidential information – Information regarding crime areas and major criminals is stored in crime database. This information can be used by concerned people and crime agencies, police using SSL and secure shell (SSH) technologies. SSL is a security protocol, which encrypts the data flowing from server to user, and vice versa. SSL certificate will be provided for each website that uses specified technology to send or receive data. However, SSH provides a secure remote connection with the system.

IV. CONCLUSION

Crime detection and prevention is one of major concern of any nation's police for public safety. With advancement in technologies, these technologies are used in the detection of the regions in which crime takes place. In this paper, a cloud based crime investigation system is proposed for crime prevention. This will be useful in enhancing safety of public. This paper contributes a major support in the crime analysis through the usage of fuzzy rules and k-mean algorithm for clustering of identified data. The key point of this paper is to plot crime locations on google map so that citizens can be alerted in time and it is useful for police for doing proper security arrangements. It is shown that clustering algorithms can be used in crime analysis and Internet of things is helpful in reducing and preventing criminal activities.

ACKNOWLEDGMENT

The above paper content I have mentioned are studies form different papers and the contents are true to my knowledge.

REFERENCES

[1] Q.Rossy, O.Ribaux, " A collaborative approach for incorporating forensic data into crime investigation using criminal intelligence analysis and visualisation" Forensic Science and Justice, Vol. 54 , 2014 , pp. 146-153.
[2] Q.Rossy, S.Ioset, D. Dessimoz, and O. Ribaux, "Integrating forensic information in a crime intelligence database," Forensic Sci. Int., vol. 230, no. 1–3, pp. 137–146, 2013.
[3] Q. Zhang, L. Cheng, and R. Boutaba, "Cloud computing : state-of-the-art and research challenges," pp. 7–18, 2010.
[4] S. H. Liao, P. H. Chu, and P. Y. Hsiao, "Data mining techniques and applications - A decade review from 2000 to 2011," Expert Syst. Appl., vol. 39, no. 12, pp. 11303–11311, 2012.
[5] J. Han and M. Kamber. Data Mining: Concepts and Techniques. Morgan Kaufmann Publishers, 2001.
[6] E. R. Groff and N. G. La Vigne, "Forecasting the Future of Predictive Crime Mapping," Crime Prev. Stud., vol. 13, pp. 29–57, 2002.
[7] W. Gorr, A. Olligschlaeger, and Y. Thompson, "Short-term forecasting of crime," Int. J. Forecast., vol. 19, no. 4, pp. 579–594, 2003.
[8] G. Oatley, "Crimes analysis software : ' Pins in Maps ', clustering and Bayes net prediction, " Expert Systems with Applications , vol. 25, no. March, pp. 569–588, 2016.
[9] T. H. Grubesic, "On the application of fuzzy clustering for crime hot spot detection," J. Quant. Criminol., vol. 22, no. 1, pp. 77–105, 2006.
[10] S. V. Nath, "Crime Pattern Detection Using Data Mining," Web Intell. Intell. Agent Technol. Work. 2006. WI-IAT 2006 Work. 2006 IEEE/WIC/ACM Int. Conf., vol. 1, no. 954, pp. 41–44,2006.
[11] K. Stoffel, P. Cotofrei, and D. Han, "Fuzzy Clustering based Methodology for Multidimensional Data Analysis in Computational Forensic Domain," Itcf 2010, vol. 4, pp. 400–410, 2011.
[12] A. Juyal, O. Gupta, "A review on clustering techniques", International Journal of Advanced Research in Computer Science and Software Engineering, Vol. 4, 2014.
[13] T.Moon, S.Heo, S.Lee, "Ubiquitous crime prevention system for a safer city", Environmental Sciences, Vol. 22, pp. 288-301,2014.
[14] S. K. Sood, "Dynamic Resource Provisioning in Cloud based on Queuing Model," vol. 2, no. 4, 2013.
[15] CASAGRAS, RFID and the inclusive model for the Internet of Things report, EU Project Number 216803, pp 16–23, 2011.
[16] J. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, "Internet of Things (Data gathering): A vision , architectural elements , and future directions," vol. 29, pp. 1645–1660, 2013.
[17] E. Borgia, "The Internet of Things vision : Key features , applications and open issues," vol. 54, pp. 1–31, 2014.
[18] J. Byun, A. Nasridinov, Y. Park*," Internet of Things for Smart Crime Detection", Contemporary Engineering Sciences, Vol. 7, no. 15, pp.749 - 754, 2014.
[19] N. Dlodlo, P. Mbecke, M. Mofolo, and M. Mhlanga, "The internet of things in community safety and crime prevention for South Africa," Innov. Adv. Comput. Informatics, Syst. Sci. Netw. Eng.,pp.531–537,2015.
[20] S. A. Alvi, B. Afzal, G. A. Shah, L. Atzori, and W. Mahmood, "Ad Hoc Networks Internet of multimedia things : Vision and challenges," Ad Hoc Networks, vol. 33, pp. 87–111, 2015.
[21] V. Spicer, J. Song, P. Brantingham, A. Park, and M. A. Andresen, "Street pro fi le analysis : A new method for mapping crime on major roadways," Appl. Geogr., vol. 69, pp. 65–74, 2016.

Authors Profile

Ms. Minakshi Pathania is pursuing M Tech in computer science from Punjab Technical University. She is working on crime detection using regrassion mechanism and her main focus is to impliment her work identify and detect crime affected region.

Ms Isha Aswasthi pursed Master of technology from Punjab technical University in 2011. She is currently working as Assistant Professor in Department of Computer Science, SSCET Pathankot. She has published more than 5 research papers in reputed international journals. She has 3 years of teaching experience.

