ANALYSIS OF TECHNIQUES IN CRIME PREVENTION USING FUZZY

Santhu S Nampoothiri[1], Soumyamurali[2]

[1]*Department of Computer Science and Engineering,*
Sree Buddha College of Engineering, (India)
[2]*Assistant Professor, Department of Computer Science and Engineering,*
Sree Buddha College of Engineering (India)

ABSTRACT

Nowadays volume of crime increases drastically. Crime prevention has become one of the global issues. Government and community officials are doing their best to improve the crime prevention. Most of the crime will happened only if there is an opportunity. This can be prevented using the modern technologies from data mining. This paper takes a literature survey on techniques in crime prevention using fuzzy logic. This paper includes Fuzzy Association Rule Mining (FARM), Decision Supporting System (DSS) and Fuzzy Apriori algorithm techniques.

Keywords: Apriori, Arm, Dss, Farm.

I. INTRODUCTION

Data mining is the process that discovers patterns and relationships in data that may be used to make valid predictions. Data Mining is also popularly known as Knowledge Discovery in Databases (KDD). It refers to the extraction of implicit, previously unknown and potentially relevant information from data in databases. Data mining and knowledge discovery in databases (or KDD) are frequently treated as synonyms but actually data mining is part of the knowledge discovery process. The KDD is an iterative process. Once the discovered knowledge is presented to the user then following can be done to get different or more appropriate results. The evaluation measures can be improved, the mining can be more refined, new data can be selected or further transformed, new data sources can be integrated to old ones, in. Data mining derives its name from the similarities between searching for valuable information in a large database and mining rocks for a vein of valuable ore. In these two imply either filtering through a large amount of data or simply searching the data to exactly pinpoint where the values reside. It is, however, a misnomer, since mining for gold in rocks is usually called “gold mining” and not “rock mining”, thus by analogy, data mining should have been called “knowledge mining” instead. Nevertheless, data mining became the accepted customary term, and very rapidly a trend that even overshadowed more general terms such as knowledge discovery in databases(KDD) that describe a more complete process Other similar terms referring to data mining are: data dredging, knowledge extraction and pattern discovery

Crime data mining is receiving increased attention to discover underlying patterns in crime data. The need to act quickly tosuppress crime activity and discover links between various data sources persists. State law enforcement are continuing to call uponmodern geographicinformation systemsanddata miningtechnologies to

enhance crime analytics and better protect theircommunities and assets. Real-time solutions can save significant resources and push the capability of law enforcement closer to thepulse of criminal activity. DSS has been applied in a wide range of computer applications that commonly manipulate information in a variety of fields. This includes computer-based systems that are being used in handling data in order to achieve an optimization for decision-making in crime prevention. Finding solutions to crime prevention using computer programming is not something new in forensic and information technology. Projects have been done in developed countries and around the world to develop software tools to find solutions for crime prevention.

This paper aims to design and develop a theoretical model of an intelligent system to predict crime that can be happened in future based on previous crime data. This paper uses fuzzy association rules, which are easily understandable by human because of the linguistic terms such as "hot" and "high". Fuzzy logic assigns membership value between 0 and 1to each element of a set allowing a smooth transition between membership and non-membership of a set. This paper uses Fuzzy Apriori algorithm for the Fuzzy Association Rule Mining (FARM). The DSS technology can be applied with association rules (AR) approach where AR is focus to determine the factor and effect for specific patterns. For example in crime, the factor is woman and the effect is rape crime with 80% confidence. It means that this type of crime occurs more frequently with 80% confidence in a specific area. By using the DSS technology, we can make some recommendations to the user on what precaution or strategies to be made to pace particular issues when solving specific crimes based on confidence value. The report is in the following structure. Section II discussed about the related works in this field. Section III explains the design of system in detail. Finally summarize conclusions in section IV.

II. LITERATURE SURVEY

Kaikhah and Doddameti, Texas State University, on a paper [1] proposed a tool to find the existing trends for each type of crime happening in US cities. They Use Neural network as a tool, with control parameters. The neural network is trained to find correlations and relationships that are in a dataset. Then neural network is pruned. Also it is modified to generalize the correlations and relationships. Finally, the neural network is used as a tool to discover all existing hidden trends in four different types of crimes (murder, rape, robbery, and auto theft) in US cities as well as to predict trends based on existing knowledge inherent in the network.The knowledge discovery technique offers two unique features that are not available in other knowledge discovery techniques. First, the control parameters provide a means to set the desired level of confidence for extracting existing and predicted trends. Second, the predicted trends provide reasonable expectations that can be used for monitoring the environment.

Tony H. Grubesic, Drexel University, on a paper [2] discuss about fuzzy clustering to detect the crime hot-spot areas. This paper exploresthe use of a generalized partitioning method known as fuzzy clustering for hot-spot detection. Functional and visual comparisons of fuzzy clustering and two hard-clustering approaches (medoid and k-means), across a range of cluster values are analysed. The empirical results suggest that a fuzzy clustering approach is better equipped to handle intermediate cases and spatial outliers.This paper provides an empirical investigation on the utility of fuzzy cluster analysis for crime hot-spot detection. The results suggest that the geometric properties of convex hulls are useful when combined with the results from partition-based cluster analysis in the delineation of crime hot-spots..

Donald E Brown and Stephen Hagen on a paper [3] discuss about automated association rule mining methods to help law enforcement. This paper describes automated approaches to data association.This method is more

efficient and accurate than manual method.Two methods are mainly used Transformed Categorical Similarities(TCS) and Dynamically Adjusted Weights(DAW) methods. This reduces search time by a factor of 1/3 over SQL based search. It also shows that TCS method is significantly better than DAW method.

YifeiXue and Donald E. Brown, on a paper [4] discussed about a decision model for spatial selection.This paper analyses criminal incidents as spatial choice processes. Spatial choice analysis can be used to discover the distribution of people's behaviour's in space and time. Two adjusted spatial choice models that include models of decision making processes are presented. The comparison results show that adjusted spatial choice models provide efficient and accurate predictions of future crime patterns and can be used as the basis for a law enforcement decision support system. This paper also extends spatial choice modelling to include the class of problems where the decision makers' preferences are derived indirectly through incident reports rather than directly through survey instruments.

Sheng-Tun Li, Shu-ChingKuo and Fu-Ching Tsai on a paper [5] discussed about fuzzy self-organizing map and a rule extraction method for crime prediction. This paper propose a framework of intelligent decision-support model based on a fuzzy self-organizing map (FSOM) network to detect and analyse crime trend patterns from temporal crime activity data. In addition, a rule extraction algorithm is employed to uncover hidden causal-effect knowledge and reveal the shift around effect. This method is accurate on detecting the shift around effect. Here the rules inferred from the data lead to recognition of hidden relationships between crime offenses and locations. One limitation is, more focused on shift around effect.

Anna L Buczak and Christopher M Grifford[6] study the application of fuzzy association rule mining for community crime pattern discovery. Discovered rules are presented and discussed at regional and national levels. Rules found to hold in all states, be consistent across all regions, and subsets of regions are also discussed. A relative support metric was defined to extract rare, novel rules from thousands of discovered rules. Such an approach relieves the need of law enforcement personnel to sift through uninteresting, obvious rules in order to find interesting and meaningful crime patterns of importance to their community.

Hemant K. Bhargava, Daniel J. Power and Daewon Sun [7] reviews and summarizes recent technology developments, current usage of Web-based DSS, and trends in the deployment of such systems.

F.G.Filip[8] on a paper reviewing several aspects concerning the utilization and technology of DSS in the context of LSS control. Particular emphasis is put on real-time DSS and *multi-participant (group) DSS* which support collaborative work. Several advanced solutions such as mixed knowledge systems, that combine numerical methods with AI-based tools, and the prospects of using *Ambient intelligence* (AmI) concepts in DSS construction are described.

S.Alter[9] on a paper discussed about work system of DSS. In his opinion, any DSS of genuine significance is usually an integral part of a work system and often cannot be separated out easily. Analysing the algorithm might be interesting, but anyone trying tounderstand its implementation and success in the organization would need to look at the work system. In addition, the differencebetween automating and not automating the decision can describe strategy alternatives for a work system, but is less interestingfor classifying DSS.

Figure 1 shows the theoretical system architecture.

The execution is as following:

- First the crime data has been taken from the data base.
- Then fuzzy association rule mining done according to the minimum support and confidence
- Using these methods data has been changed to association rules.
- From these rules decisions can be obtained.

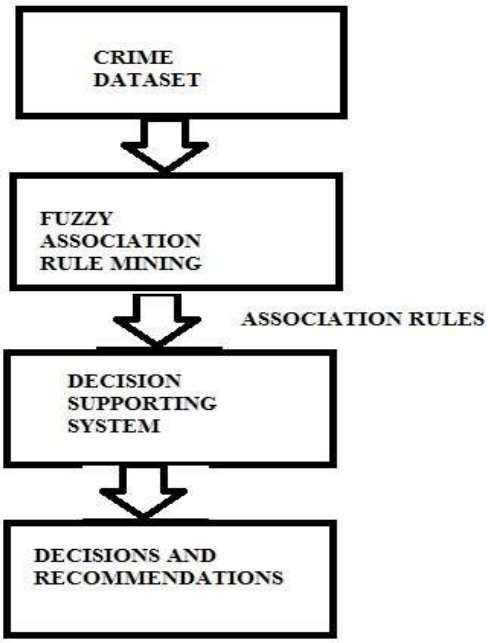

Fig1- General System Architecture

Fuzzy association rules are of the form: (X is A) → (Y is B) where X and Y are attributes, and A and B are fuzzy sets that characterize X and Y respectively.

An example fuzzy association rule is the following:

(temperature, hot) and (humidity, high) → (energy-usage, high)

Fuzzy logic assigns degree of membership between 0 and 1 (e.g., 0.4) to each element of a set, allowing for a smooth transition between membership and non-membership of a set.

The measures of support, confidence and lift have been fuzzified for the purpose of fuzzy association rules.

Confidence can be treated as the conditional probability (P(Y|X)) of a transaction containing X and also containing Y. A high confidence value suggests a strong association rule. However, this can be deceptive. For example, if the antecedent or consequent have a high support, they could have a high confidence even if they were independent. This is why lift was suggested as a useful metric. The lift of a rule measures the deviation from independence of X and Y. A lift greater than 1.0 indicates that transactions containing the antecedent (X) tend to contain the consequent (Y) more often than transactions that do not contain the antecedent (X). The higher the lift, the more likely that the existence of X and Y together is not just a random occurrence, but rather due to the relationship between them.

Main steps in these fuzzy association rule mining is

- Find all frequent itemsets that have fuzzy supports above $FuzzySupp_{min.}$
- Use the frequent itemsets to generate fuzzy confident rules with fuzzy confidence above $FuzzyConf_{min.}$

For the purpose of mining fuzzy association rules, Apriori was extended to Fuzzy Apriori. The difference between the two algorithms is that Fuzzy Apriori uses definitions of fuzzy support and fuzzy confidence instead of their crisp counterparts used in Apriori.

III. CONCLUSIONS

The society we live in is a complicated and culturally revolutionized one, where crime problems are rising in an endless stream and their prevention has become a first priority for the police and the government. In this paper, we apply technologies in knowledge discovery in public security index requirement of linguistic data to support decision making for situational crime prevention.

Fuzzy association rule (FAR) mining is undeniable very crucial in discovering the exceptional cases such as air pollution, rare events analysis, crime prevention etc. It is quite complicated, computationally expensive and thus only few attentions are interested in this area. The traditional support-confidence approach and existing interestingness measuresuch as normal Apriori are not scalable enough to deal with these complex problems with linguistic terms that require high affinity between items.

In this paper, we presented the survey on application of fuzzy on situational crime prevention. The expected outcome such a system is one web-based system that supports decision support in which it can provide intelligence recommendations, so that, we can increase police strategies in an area to make it less attractive to criminal offenders

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