ABSTRACT

This Ph.D. thesis describes research concerning the application of criminal network visualization in the field of investigative analysis. There are number of way with which the investigative analysis can locate the hidden motive behind any criminal activity. Firstly, the investigative analyst must have the ability to understand the criminal plot since a comprehensive plot is a pre-requisite to conduct an organized crime. Secondly, the investigator should understand the organization and structure of criminal network. The knowledge about these two aspects is vital in conducting an investigative analysis. Thirdly, the investigator should perform a certain set of rules for conducting the investigative analysis. Finally, the investigator ought to think at an abstract level and view the details from an angle, overlooked by others.

Visualization comes handy in this situation. The purpose of doing visualization is to let the users put less effort into recognizing the requirements, preferably within a short instance of time. In this way, the investigator focuses on his/her cause rather than using resources on irrelevant details.

Much research is being conducted in visual analytics, dynamics in social networks, network analysis, composites, temporal data visualization, clustering and hierarchical clustering of data but there are a number of areas which are overlooked by the researchers. Moreover there are some issues, for instance, lack of effective filtering techniques, computational overhead to conduct the analysis, access to criminal data, and data transformation. It is difficult to analyze the data properly - thus finding patterns by way of visualizing data becomes complex. There is no standard global platform that may expedite the investigation process. The complexity in the bulk of data, which keeps on accumulating and so does the information along with it.

We conducted a review of investigative analysis and have found that the cognitive abilities of the investigative analysts can be enhanced by focusing on interactivity, which stirs the analysts mind and thus productivity may increase. The visual interactivity comprises a set of network visualization features, formulated after re-designing the current features or proposing novel features where necessary. Based on these features, we have proposed a framework called "PEVNET- A Framework for Visualization of Criminal Networks". Network, temporal, and composite visualization features are three key areas and sixteen network visualization features have been proposed. The features are classified into basic, pre-requisite, and follow up or primary features. Based on the challenges, we posed some research questions. These research questions were addressed to satisfy the main research question of our study. We have addressed these research questions in the shape of the implementation of the network visualization features. We have evaluated our work by way of conducting a usability evaluation and qualitative feedback in a controlled experiment. There were a number of participants, in the experiment, whose input was compiled. We also compared PEVNET with other state-of-the-art tools. We have used the case study of Chicago Narcotics datasets by the Chicago Police Department, which is one of the prime law enforcement agencies in Chicago, Illinois in the United States of America.

In this study, we have used different parts of visual and investigative analyses into a framework to provide a cognitive support for the investigative analysts.