Mapping the Spatial Distribution of Crimes in Iraq

Enas Ali Mohammed¹

¹Department of Computer Science, College of Science, University of Kerbala, Iraq.

the_programmer86@yahoo.com

Abstract. In the last years, Iraq has witnessed challenges in security have led to rise crime's rates. So there is need to map crimes concentrations in place and time from trusted sources and provide crime incidence reports for crime reduction efforts in the field of law enforcement. This study concerned with designing and implementing a web-based GIS system for crime mapping and decision support in Iraq. This system is being developed in Kerbala University with sample databases. The proposed system provides the general public with information of recent crime activity near to their places within a radius of any location (such as place of residence, school, or business). Display the distance from any crime to any address of interest. Filter by crime type as well as date recorded in order to focus on specific patterns. Plot only occurrences for the agency you need to view. Plot all crime incidents as heat map for a specified date.

Keywords: Iraq, Crime Map, Crime Locations, Google Maps API, GIS Cloud.

1. Introduction

In recent years, several factors grouped with the challenges of insecurity have led to rising incidences of crime in both developed and developing countries, these factors are the increased rate of poverty, loss of life and assets, fear of victimization, unemployment, drop in income, displacements, evictions, emotional depression. Despite, all countries apply crime's prevention measures to control crime's rate. Crime's rate becomes the main challenge for the economic and social development of countries all over the world [1]. Manual crime's recording systems haven't returned reliable and accurate data round the clock can help in decision support and crime trend prediction. Therefore, they failed to meet the demands of the current crime situation[2].

Geographic Information System (GIS) can help a great deal through crime analysis and mapping processes to handle the spatial analysis of crimes problems[1]. A GIS is a set of computer-based tools for analyzing and mapping spatial data. GIS uses geography and computer-generated maps as an interface for integrating and reaching large amounts of location-based data[3].

Crime mapping process is an important part of crimes management, monitoring, and control. This process can assist police to protect civilians more effectively. Simple maps that outline positions where crime's concentrations have happened can be manipulated to support direct patrols to exist in areas they are needed[1]. Therefore, an identification of where and why crimes happen can develop efforts to support crime mapping. Crime mapping process offers crime analysts graphic descriptions of crime-related concerns to identify crime hot spots (high-crime-density areas), along with other trends and patterns. Hotspot analysis supports police recognize high-crime places, varieties of crime being committed, and the best action to counter[2].

The growth of internet technologies, especially web-based GIS technologies, is presenting new possibilities for use of crime mapping to raise crime prevention. Web-based GIS becomes technology...
distributed for conventional GIS applications because interactive maps and fascinating cartography are available now for any standard web browser without any plugins and spatial installation [4]. A web-based GIS application makes the users access to GIS and its essential functionalities like receiving directions, navigation, finding locations, panning and zooming maps via web browsers[5]. Current applications of web-based crime mapping concentrate on raising society policing rather than analytical purposes such as pattern analysis and estimate.

A few countries are using such web-based GIS applications to map crime data for people security purposes. The users of those applications are appreciating these applications. These applications are playing an essential role in the security of the community. Hence, a web-based GIS application can be developed to show locations of crimes. The application that will be developed can be manipulated by the general public and law enforcement agencies. Recently, a number of different crime mapping and analyzing techniques are implemented in different regions in the world [6,7,8,9].

2. Problem Statement
The general people want the attention of their areas. Everybody cautions for the lives of kids and their loved ones so they should be aware of the current situations in the area. This study aims towards public to help them in their lives by notifying them the current situation of their areas. Law enforcement offices may use this type of applications to protect the society aware of the present statutes and to assist them to live jointly by communicating and sharing information with each other.

3. Research Methodology
Law enforcement agencies will have the ability to access and inquire data directly in order to form plans, tactical analysis (e.g. crime forecasting), as well as for making better decisions. The general public will use this application to map, visualize, analyze crime incident patterns, and get reports of the crimes in their surrounding areas. Also, it allows you to get detailed information on crimes in your area, such as burglary, assaults, theft or vandalism.

So, the proposed system consists of three main functionalities (data storage, data process, and web service) as shown in figure (1). So, in order to obtain system functionalities, a number of techniques were used as well as a number of interfaces were designed.

![Figure 1. The Proposed System Architecture.](image)

3.1. Tools and Techniques

3.1.1. Microsoft SQL Server Language
The perfect crime's mapping system includes a compatible database platform (e.g., MySQL, SQL server) for the real-time analysis. SQL server was chosen to create system's database. Because of it is considered an effective tool for data management and compatible with most web applications[10].

3.1.2. Microsoft Visual Studio 2015
Microsoft Visual Studio 2015/ Visual C# / ASP.net web application was used to implement the proposed system. Usually, Microsoft Visual Studio is an integrated development environment enables
programmer/developers to write various types of codes and add new various packages (e.g., Subgurim Google Maps API)[11].

3.1.3. JavaScript Language
JavaScript which is the most popular language for programming codes called Jquery instructions, it was used as part of web applications whose implementations client-side scripts to interact with the user. Writing Jquery codes in ASP.NET web pages allow the creation of rich browser-based functionality with Google Maps[12].

3.1.4. Google Maps Application Programming Interface (API)
Google Maps API supplies developer interfaces to access Google satellite images and street maps as well as their geospatial services such as routing and geocoding[13][14][15]. Google Maps API's are commonly used code libraries to enable the programmers and developers to create web applications that read and write data from the Google services. Google Maps API provides four types of maps (Roadmap, Satellite, Hybrid, and Terrain). Each type consists of several layers (e.g., data layer, heat map layer, and cloud layer) where they are objects on the map composed of one or more independent items operate as one unit[13]. A heat-map layer is a thematic map for graphical representation of data. It uses colors to indicate the level of activity, how a measurement varies geographically or to depict the intensity of data at geographical points. It uses gradients or a color scale to depict data per area on the map. Usually, brighter colors to indicate low activity and darker colors were used to indicate high activity[5].

3.1.5. GIS Cloud’s Mobile Data Collection
GIS Cloud’s Mobile Data Collection is a simple application for web and mobile devices for real-time field location, attribute and multimedia data collection. It provides a low-cost and feature-rich services[16].

This application allows you to gather real-time, media-enriched location information in the field. It uses the cloud to send data points and attributes directly to a custom layer on a personalized map. Access, analyze, share, and publish your data in the GIS Cloud Map Editor (available in both free and paid editions) through any web browser in real time. Features include custom form building for data collection through the mobile app and the ability to assign media (image and audio) attributes[16].

Law enforcement agencies may use this kind of applications in data gathering process. In this study, a new project will be designed and created called Crime Data Collection in Iraq. This project will facilitate policemen’s work in gathering crime data using mobile.

3.2. Workflow
The proposed system consists of a number of steps, some of these are listed below. The flowchart of crime mapping process illustrated in figure (2).

Step1: Data gathering process for crimes incidents play a crucial role in enhancing the work of law enforcement and crime analyses to track the movements and changes of crimes events and to increase the validity of crime mapping systems in all regions by identifying more accurate data and best prediction models.

Therefore, the proposed system can receive crime data from many police stations and georeferenced quickly. Admins of police stations can log-in by entering their information (username and password). Then, they can upload the data, edit, and update and delete crimes information from the central database.

Also, they can use the mobile application to upload crimes data. When policemen have to report a crime then they will open application to attach or take photo and send that photo with crime information to GIS Cloud server using mobile data collection as shown in figure (3). The information of the policemen will be verified at the time of signup and then the data will be automatically transferred to system data base.
Figure 2. Flowchart of crime mapping process

System database contains data about both crimes and criminals with the following main attributes:
- Crime-Id: individual crimes are labeled by unique crime Ids.
- Crime-Type: indicates crime type.
- Crime-Date, time: indicate when a crime happened.
- Criminal-Id: individual criminals are designated by unique Ids.
- Criminal-Age: age of individual criminal.
- Criminal-Gender: belongs to which gender.
- Criminal-Job: job of individual criminal.
- Crime-Address, location of individual criminal (longitude, latitude).
- Marital status of individual criminal.
- Crime-Description.

Step 2: users can specify a particular location or an agency to request information about recent crime activity as shown in figure (4).

Figure 3. The main window of crime data collection in Iraq project
Step3: citizens can use this application to view crimes data by various search parameters, to include crime type, a date range (yesterday, last week, last month, or a specified date), or distance from a specific address. The data will be illustrated on a map and the various crimes will be depicted by various crime type icons, each containing general details of the incident as shown in figure (5).

Step4: Google heat map layer was used to generate crime heat map that shows the density of crime in any region and any specified date in Iraq as shown in figure (6).

![Figure 4. System main page](image1)

![Figure 5. The search-view page](image2)
4. Conclusions
Under this system, police stations can upload crimes events to the central system database. These data will help law enforcement protects citizens more effectively in the areas they serve and take preventive measures. Common people can view crimes events daily to avoid some places by the understanding that their chances of being a victim are greater in some of these places than in others. Also, they can identify their choices of places, streets, schools, and neighborhoods. Crime analysts can use the proposed system to make crime forecasts, mapping criminal networks and identifying possible suspects, and finding relationships and possible explanations to make better decisions.

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