Building a GIS Surveillance Conceptual Model for Protecting Tourists in Egypt

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Abstract

Tourist industry is one of the most important economic resources, and keeping this industry growing up depends basically on security and safety. Lack of security and stability led to a drop in the number of tourists visiting Egypt during the period from 2011 to 2016. This reflects the current situation in Egypt, due to the security turmoil prevailing in the country in the recent years and acts of terrorism threatening the state and tourists. This has caused problems that affect the economic and social fields, especially the tourism industry. This research has been done to build a GIS surveillance conceptual model protecting the tourism industry in Egypt. The researcher proposes a GIS model to provide security and safety that helping tourists to be in safe. The proposed model will allow tourists to use the proposed GIS model to locate the nearest police station or the touristic place's guards' office, informing them with their location and the kind of threat. The proposed model can help tourists to determine the shortest and safest roads to reach their destination.

Keywords: *Geographic Information system (GIS), Remote Sensing (RS), Global Positioning Systems (GPS), Free and Open Source Software (FOSS), Personal Digital Assistant (PDAs).*

1. Introduction

Geographic Information Systems (GIS) is generally defined as a computer-based tool for mapping and analyzing information [1].The applications of GIS in the field of tourism management and planning first appeared in the early 90's [2]. Good child stated that GIS is one of the technological developed systems that have improved the information understanding and data display over the last 20 years [3]. GIS Internet applications can allow the emergency managers to view the status of incidents, resources, and the overall situation from remote locations using a browser [4]. GIS provides tourists with valuable information, interactive maps, photos and videos on locations and attractions, all in one place [5].Therefore, it helps them choose and plan their activities more effectively to match their personal preferences and constraints [6]. This is carried out by analyzing and understanding the relationship between numbers of tourists, their socioeconomic and demographic characteristics [7]. Understanding of tourist behavior may further lead to better infrastructure and activities management and protection of environment [8]

2. Using Geographical Information System (GIS), Remote sensing (RS) and digital camera in tourism

Geographical Information System (GIS) is a group of procedures that provide data input, storage and retrieval, mapping and spatial analysis for both spatial and attribute data to support the decision-making activities of an organization [9]. In these definitions, GIS are

computer-based systems that enable users thus provides solutions for managing sustainable tourism development). In tourists' flows management, GIS empowers tourism time-space analysis. This is the kind of analysis that aims at understanding tourists' behavior. GIS can be a powerful tool in such analysis offering a better understanding of tourists flows in a given region or area. This is carried out by demographic characteristics [7].Understanding of tourist behavior may further lead to better collect, store, and process, analyze and present spatial data [10]. It provides an electronic representation of information, called spatial data, about the Earth's natural and man-made features. A GIS references these real-world spatial data elements to a coordinate system. These features can be separated into different layers. A GIS system stores each category of information in a separate "layer" for ease of maintenance, analysis, and visualization. For example, layers can represent terrain characteristics, census data, demographics information, environmental and ecological data, roads, land use, river drainage and flood plains, and rare wildlife habitats. Different applications create and use different layers [11]. GIS can also store attribute data, which is descriptive information of the map features. This attribute information is placed in a database separate from the graphics data but is linked to them [10]. GIS allows the examination of both spatial and attribute data at the same time. Also, a GIS lets users search the attribute data and relate it to the spatial data. Therefore, a GIS can combine geographic and other types of data to generate maps and reports, enabling users to collect, manage, and interpret location-based information in a planned and systematic way. In short, a GIS can be defined as a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information. GIS systems are dynamic and permit rapid updating, analysis, and display. They use data from many diverse sources such as satellite imagery, aerial photos, maps, ground surveys, and global positioning systems (GPS) [11]. GIS is a "smart map" tool that allows users to create interactive queries, analyze spatial information and edit data. During the 1960s and 1970s, people recognized the need to assess the earth's surface in an integrated way according to the independent aspects of the earth's surface. They used a certain technique of overlaying transparent copies of resource maps on light tables and looked for places where the various attributes on the maps coincided. The computer map-making and other related areas, such as soil science, surveying, photogrammetric and remote sensing, developed side by side in the late 1970s [12].At first, this evolution did not produce much until systems evolved, experience grew and geographic information systems emerged. The early 1980s witnessed the expansion of GIS. Nowadays, GIS is widely recognized by public agencies, research laboratories, academic institutions, private industry and public utilities as a useful tool for supporting urban and provincial resource planning and management. Any successful example of GIS is based on two fundamental components: the map data and the computer software to perform calculations and analysis [13].

Remote sensing (RS) is the acquisition of information about an object or phenomenon without making physical contact with the object and thus in contrast to on-site observation. Remote sensing is used in numerous fields, including geography, land surveying and most Earth Science disciplines (for example, hydrology, ecology , oceanography, glaciology, geology); it also has military, intelligence, commercial, economic, planning, and humanitarian applications [14].

A digital camera is a camera that produces digital images that can be stored in a computer, displayed on a screen and printed [15].Most cameras sold today are digital and digital cameras are incorporated into many devices ranging from PDAs and mobile phones (called camera phones) to vehicles [16]. Digital and movie cameras share an optical system,

typically using a lens with a variable diaphragm to focus light onto an image pickup device. The diaphragm and shutter admit the correct amount of light to the imager, just as with film but the image pickup device is electronic rather than chemical. However, unlike film cameras, digital cameras can display images on a screen immediately after being recorded, and store and delete images from memory. Many digital cameras can also record moving videos with sound. Some digital cameras can crop, stitch pictures and perform other elementary image editing [17].

3. GIS applications in Tourism

GIS in tourism can have advantages to both tourists and for the tourism development authorities. Tourism is a spatial phenomenon which uses maps for tracking, interpreting, analyzing and refining data. A great deal of information is present in maps which cannot be easily analyzed. Also, maps of various kinds are in use. The greatest problem faced by travelers and planners is the huge size of maps and its storage. Also, information gets outdated over the years. Some of the maps which were created before the digital era had a lot of errors and deficiencies. Rectifying these errors and updating information manually is not an easy task. GIS allows the user to view, understand, query, interpret and visualize data in many ways. Also, updating and editing digital maps became easy as digitization techniques and GIS tools became popular. Only large organizations could afford to buy the GIS software required for this. With the advent of FOSS (Free and Open Source Software), GIS software was also available free of cost. Consequently, smaller organizations have also started using this technology [9]. With the tremendous development of the technologies of information and its important role in the tourism industry, one can say that both information technologies and the tourism industries are two powerful tools for the economic growth of a country. Most of tourist information is distributed through different sites in the web, which is more difficult to use because of the widespread tourist information. Therefore, a better solution for this problem is the use of maps in order to present the information effectively. Tourism is concerned with travelling between close and distant places and maps are very important for the tourists who want to visit these places. However, explains that, in the traditional form, a map suffers from a number of problems. For example, maps are static, which means they are difficult and expensive to keep to date. Also, maps are often complex people who are not always able to extract particular data of interest [10]. On the contrary, through GIS, one can extract and use the different sets of information from a map. GIS is able to show a large amount of tourism information which is always up to date. The incredible role of GIS in tourism industry is defined Company. “The concepts of time and place are ingrained in the tourism industry. Understanding of your customer base and where they come from, and knowing what they want to see and do and how to get them there are essential to the success of any tourism operation. Whether you are a hotel manager, a diving instructor, or a government official, a GIS can provide you with the tools you need to better prospect, understand and serve the needs of your clients” [10].

4. THE PROPOSED GIS SURVEILLANCE FRAMEWORK FOR PROTECTING TOURISTS

The idea behind this paper is to achieve safety and security for tourism industry by building a GIS surveil-lance conceptual model for protecting the tourism industry, this framework explains how to practically apply the proposed model; it makes clear each step in detail giving more explanation on applying it practically on the touristic places through these steps. First, the researcher began to study Preparation then Determination of objectives by

identifying and collecting data about the touristic sites, number of tourists in each place, tourists activities in each site, collecting data about the security system applied in these places, identifying all tourist police stations located in the study area and identifying the shortest roads between the nearest police stations and the touristic sites. Comes the stage of carrying out survey of all elements by using all the collected primary and secondary data to be followed by implementation. In this step the researcher analyzes all these data depending on context diagram and data flow diagram and then design depending on Entity Relation Diagram, schema design and SQL that will help build the GIS layers and then save and connect these data to hardware like surveillance cameras and remote sensors (RS) that will send alarms to screens monitored by the Tourist Police authorities. Such alarms will help in early detection of any abnormal behavior & protection of tourists. Then the tourist's police will respond to these alarms and use the shortest and safest road using GIS. The final step is putting the model Policy and Plan formulation.

5. BUILDING A GIS SURVEILLANCE CONCEPTUAL MODEL FOR PROTECTING THE TOURISM INDUSTRY

5.1 Study Preparation

This step depends on problems that happened in our society with increase in the risk and spread of terror and insecurity, which adversely affects the economic and social fields, especially the tourism industry. Thus, we will focus on how to provide safety and security to the tourists sites, how to reduce the risk of terrorism attacks and to build up a strong and highly connected network between all police stations and tourist sites that will help to disseminate safety and security and return peace and prosperity for the tourists in the country, which, in turn, will help make strategic plans providing secure and safety tourism industry at present and in the future.

5.2 Determination of objectives

Building a GIS conceptual model for protecting tourism areas will help to disseminate safety and security and return of peace and prosperity for the tourists in our country. Therefore, and according to this model, we need to achieve the following goals: Determine the tourist places (hotels - beaches - Museums – Restaurants and cafes - mosques and churches), locate on a map the tourist police stations sites and the tourist places in each city, build up new police stations in the needed areas and new roads constructions to provide new short and safe roads during the tourists journeys, and put surveillance cameras in the tourist places and these surveillance cameras will be monitored by the Tourist Police authorities to help detect any abnormal behavior and also predict any risk even before it occurs so as to protect the tourists and the tourist places. Applying all these objectives will be reflected on the development and growth of the tourism industry which is considered one of the important resources for many countries.

5.3 Survey of all Elements

Data collection based on primary data and secondary data. Primary data that were collected using questionnaires and interviews with officials from the Ministry of Tourism, tourism police authorities, tourists and workers in the field of tourism. These questionnaires and interviews give insight into the possible challenges that may hinder the effective application of GIS. Secondary data were collected from books, web sites, journals and

literature available in brochures and promotional media. The use of field surveys to collect the data required for this part in the study to ensure the validity of the data and make sure they conform to reality where you may be out of date in the network maps.

5.4 Analysis and Design

Providing Safety and Security in the Study Area: Tourist industry for many countries is considered one of the most important economic resources, and developing this industry depends basically on security and safety. The researcher keeps identifying and collecting data about the tourist sites (the most famous, sensitive and important tourist places, such as hotels, beaches, Museums, Restaurants and cafes, and mosques and churches), number of tourists in each place, and tourist's activities in each site. Also, it is important to collect data about the security system applied in these places, such as level of security, number of security guards, surveillance cameras used in the tourist's places, location of the nearest police stations, safe electronic gates and metal detecting gates and safe entry and exit gates and roads. These data must have a great deal of accurate and detailed information relevant to reality. . And then comes that stage of collecting, organizing, analyzing, presenting and coordinating this information in the form of geographic information systems (GIS) that allow for easy use and recalling. The GIS applications developed for decision makers are the main concern of geographic information systems and their applications have been diversified in the fields of sustainable development. Geographical information systems (GIS) have been able to provide systems to support governments in managing infrastructure processes by addressing geo-related data and dealing with multiple layers of data together to integrate the expertise of different disciplines in development projects. Layers are the mechanism used to display geographic datasets in ArcMap, ArcGlobe, and ArcScene. Each layer references to a dataset and specifies how that dataset is portrayed using symbols and text labels. When you add a layer to a map, you specify its dataset and set its map symbols and labeling properties.

GIS layers will display all kinds of information about the most famous, sensitive and important touristic places, such as hotels, beaches, museums, restaurants and cafes, mosques and churches, tourist police stations sites, and police patrols to locate it on a map.

Devices for providing security: In this part researcher will discuss how to control or reduce the risks of terrorism to provide safety and security by putting surveillance cameras and remote sensors and Screens in the tourist places. All these devices will be connected to monitors in police stations or police patrols to detect any kind of threat in any tourist place as the surveillance cameras and remote sensors will send alarms to the monitors in police stations and police patrols locating the threatened tourist place, the nearest police station or police patrol and the shortest and safest road.

5.5 Policy and Plan formulation

Future plans made by tourism ministries, governments and committees in order to prevent any kind of delinquency and stop possible acts of terrorism should be based on the following elements: coordination, safety, prevention of accidents and assistance on the beaches, hotel safety and security and safeguarding the tourist environment (Tourist environment is defined as all areas other than beaches and hotels where tourists move, visit places of interest and entertain themselves such as museums, ruins, medians, parks, weekly bazaars, trains and local transportation to the beaches, etc). Tourism ministries and Governments a central coordination committee is formed to meet at the beginning of every season for consultation, exchange of views, coordination of joint actions, guidelines

unification, presenting statistics, examining results, drawing conclusions and drafting proposals to help modify or improve the future plans for providing safety and security to tourism industry. Regional committees composed of security, civil protection, tourism officials as well as representatives of local communities and other persons concerned, act under the prefect (governor) authority and follow up the central coordination committee guidelines. They meet on a case basis to study concrete situations, prepare tourist events and prevent problems arising in the future.

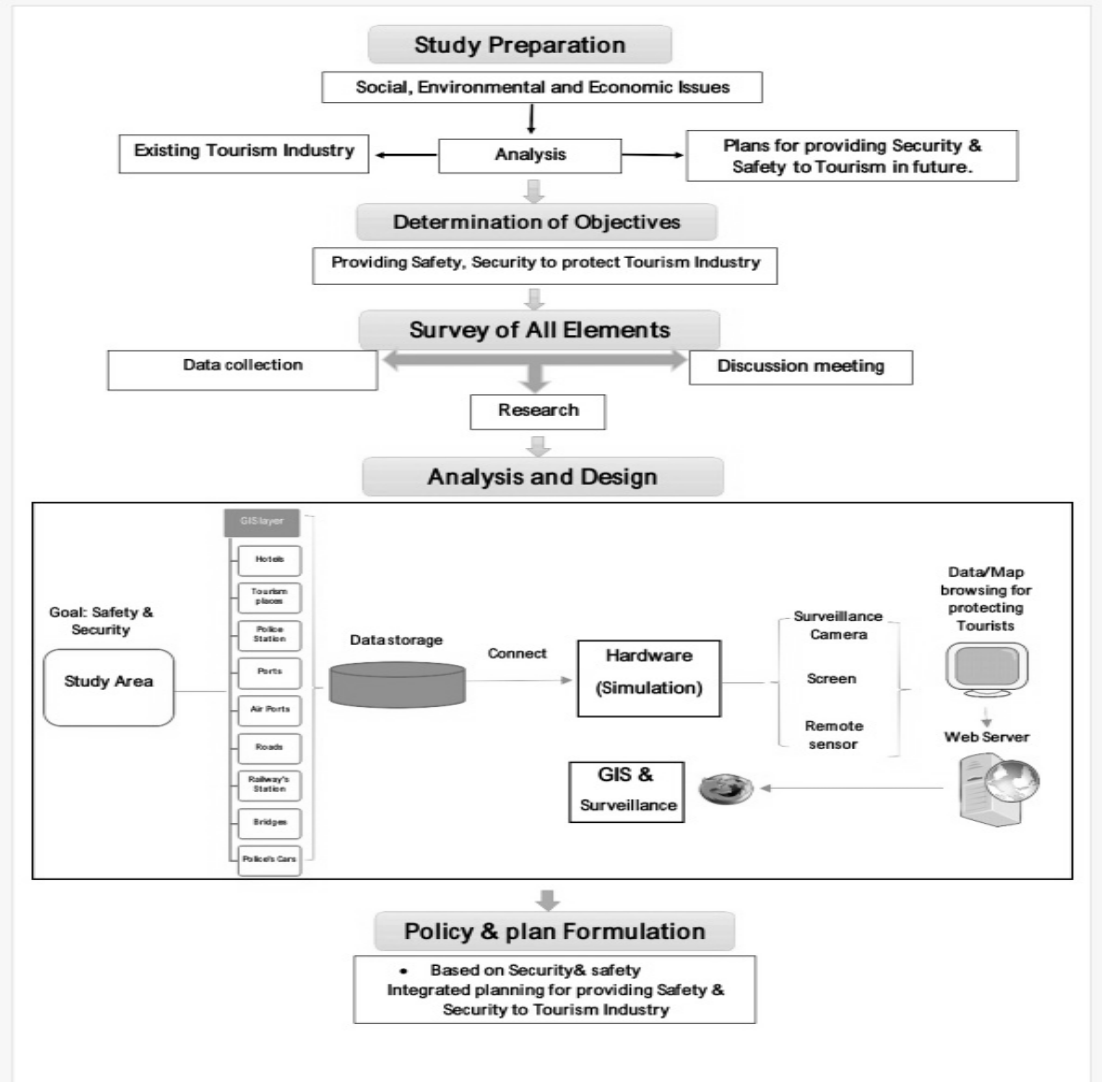

Figure 2: Proposed GIS Surveillance Conceptual Model for protecting tourists

6. Case Study: Applying a GIS Surveillance Conceptual Model for Protecting the Tourists in Alexandria – Egypt

6.1 case study overview

Locate all points on map by locating all the places in Alexandria where tourists are present in it ex (Hotels, Ports, Airport, Police station and tourism points) to be safer by providing it with a surveillance cameras and remote sensors to be monitored by the police station or the security office in this place to help tourists. Locate Railways Stations, bridges &

Roads on map by locating Railways Stations, bridges & Roads in Alexandria where tourists are walking or driving in it to be safer by providing it with a surveillance cameras and remote sensors to be monitored by the police station or the security office in this place to help tourists. Locate dangerous & safe Roads on map by giving the name of safe roads to paved main streets or secondary streets because it has security services for example Po-lice stations, it is populated and has many vital areas and gave the name of dangerous roads to these roads that aren't prepared for tourists to use because it may be un-paved, gravel roads or heavy trucks roads and that's why the researcher considered it not safe for tourist's usage in Figure (3).

6.2 Spatial Analysis on Alexandria Library

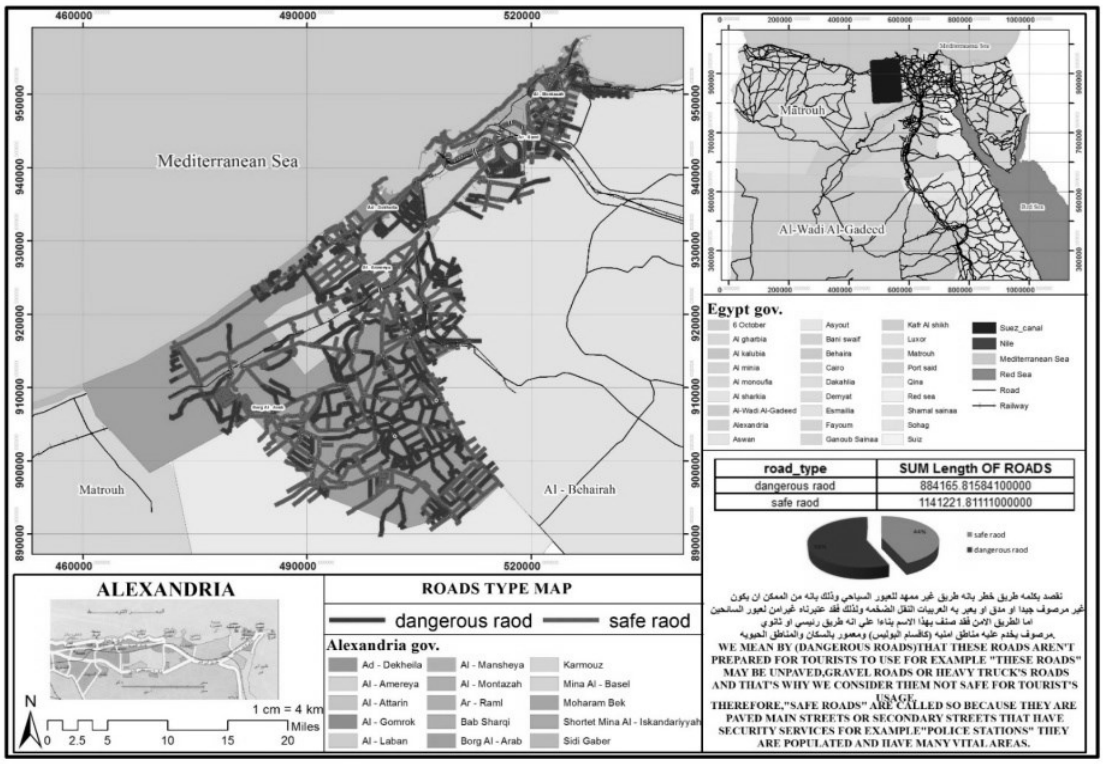

Figure 3: Dangerous and safe Roads in Alexandria on map

By applying the conceptual model on Alexandria Library because it is one of the most important cultural touristic landmarks, and it is always visited by foreigners from all over the world. So, this example illustrates the public idea of the research that is based on making a security network for providing safety and security using these tools see Figure (4):

- Sensors that receive transmissions from cameras when any danger occurs.
- Cameras proposed by the researcher and where they can be put in the touristic places to be secured.
- Alarms that alert the security authorities when there is any danger.

6.3 Current Police Stations

This map shows in detail the current distribution of police stations in Alexandria, Egypt see Figure (5). The researcher notes that the northern part of Alexandria which has high population density and a lot of touristic areas also has the largest number of police stations. In the northeast of Alexandria there is an area called El-Montazah where there are two police stations close to each other. There is another area called Al-Raml where there are three police

stations, two of them are close to each other. There is also an area called Sidi Gaber where there is only one police station, and an area called Moharam Bek with two police stations. There is also an area called Bab Sharqi where there is no police station at all. In the northern part of Alexandria there are three areas called Al-Gomrouk, Al-laban and Karmouz with six police stations close to each other. In the central part of Alexandria there are two areas called Mina El Basel and Al-Amereya where there are no police stations at all. In the northwest of Alexandria there is an area called Al-Dekhila where there is only one police station. Finally, in the southern part of Alexandria there is a large area called Borg El Arab where there is only one police station.

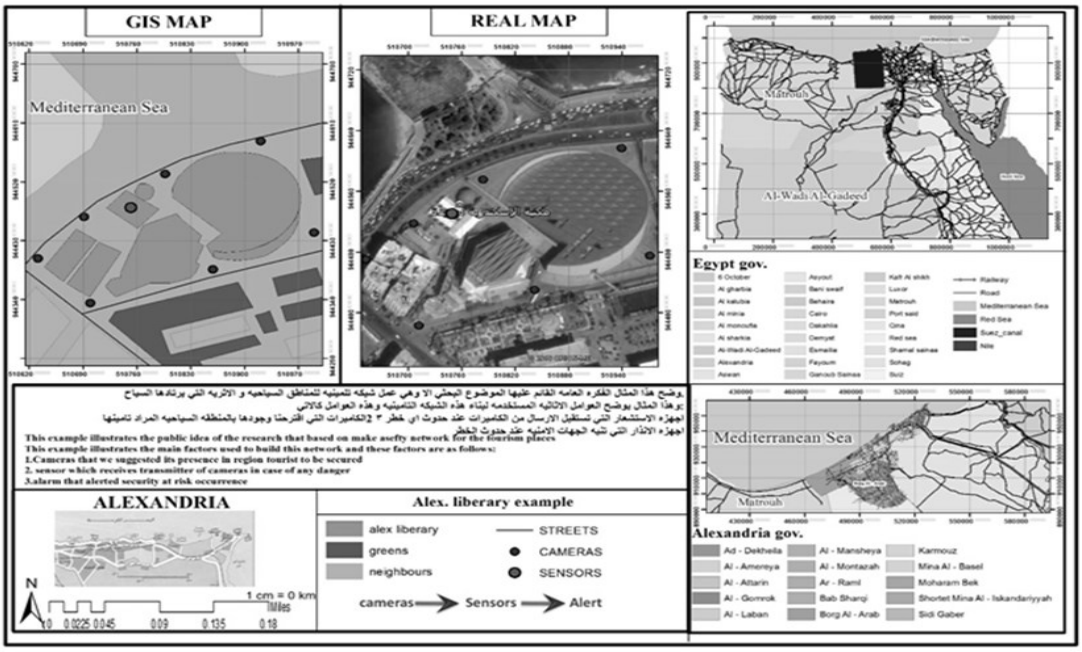

Figure 4: tools (camera, sensor & alarm) that used to build this security network to provide safety

6.4 Proposed redistributed locations and buffering of Police Stations

Buffering: is a service scope for the police station. The researcher proposed to put constant value for the scope of the service as a circle of radius 1 km. The researcher proposed redistribution of police stations locations in other different scattered areas to establish a strong security network which will cover the whole area of Alexandria ,Egypt. For example, in El-Montazah the researcher suggested to locate three police stations in scattered areas instead of two only because of the importance of this area. In Al-Raml the researcher suggested to locate only two police stations instead of three and to move the third police station to be located in the area of Bab Sharqi to be safer because it does not contain any police stations at all. In Moharram Bek the researcher suggested putting one police station instead of two because it is not a highly populated area. In Al-Gomrouk, Al-laban and Karmouz the researcher suggested to keep the same number of police stations but to relocate these police stations to insure complete security coverage. About the two areas Mina El Basel and Al Amerya the researcher suggested to provide them with three police stations in scattered areas as there were no police stations at all. Finally, in Borg Al-Arab area, the researcher proposed to add more five police stat-ions and distribute them in scattered places to provide safety to the whole area see Figure (5).

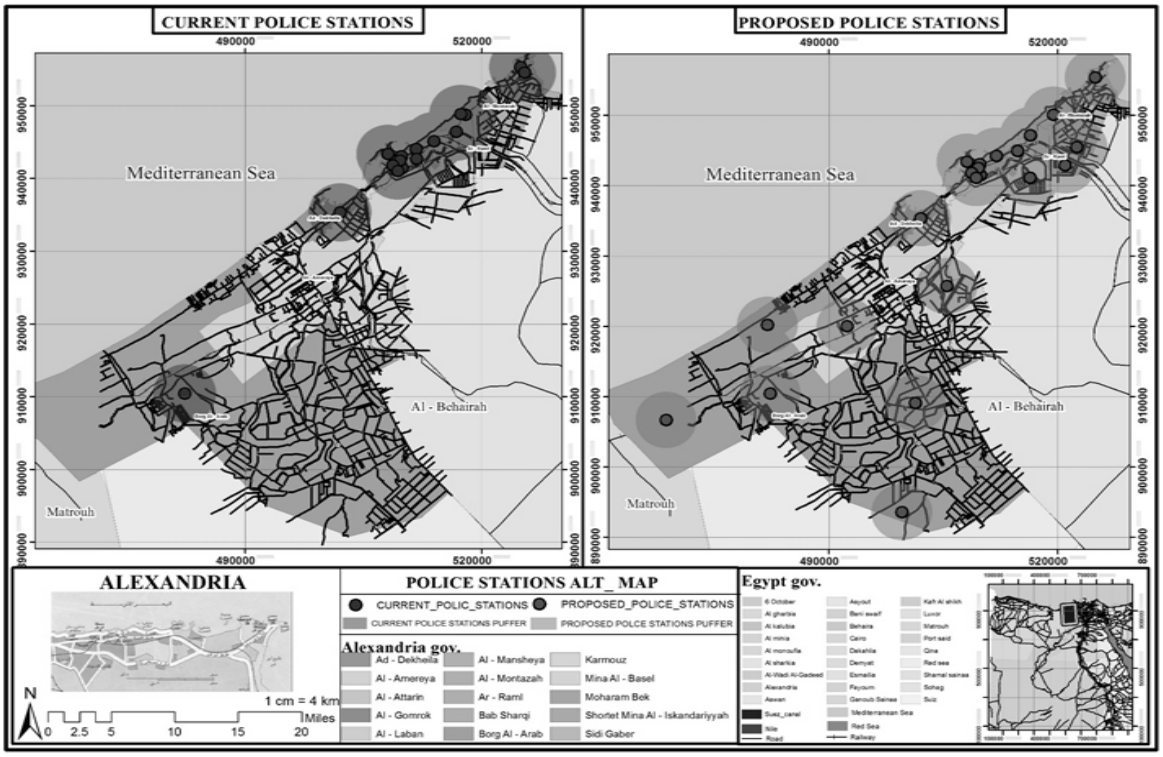

Figure 5: Current and Proposed Police Stations and buffering of Police Stations

6.5 The expected response time for the three police patrols

This map will show how the nearest police patrol will move to the Alexandria Library in response to terrorist attack. In this map there are three police patrols, one located in the nearest police station to Alexandria Library, and the other two police patrols on their duties outside the police station see Figure (6). On detecting any kind of threat in any section in Alexandria library, the surveillance cameras and Remote sensors (RS) will give alarms and the guards or tourists will send alarms to the monitors in police patrols locating the threatened touristic place (Alexandria Library) and any kind of threat. The nearest police patrol of these three patrols will respond and use the shortest and safest road using GIS. So, the researcher calculated the nearest police patrol can reach in short time by using this low (Time= Distance / Speed).

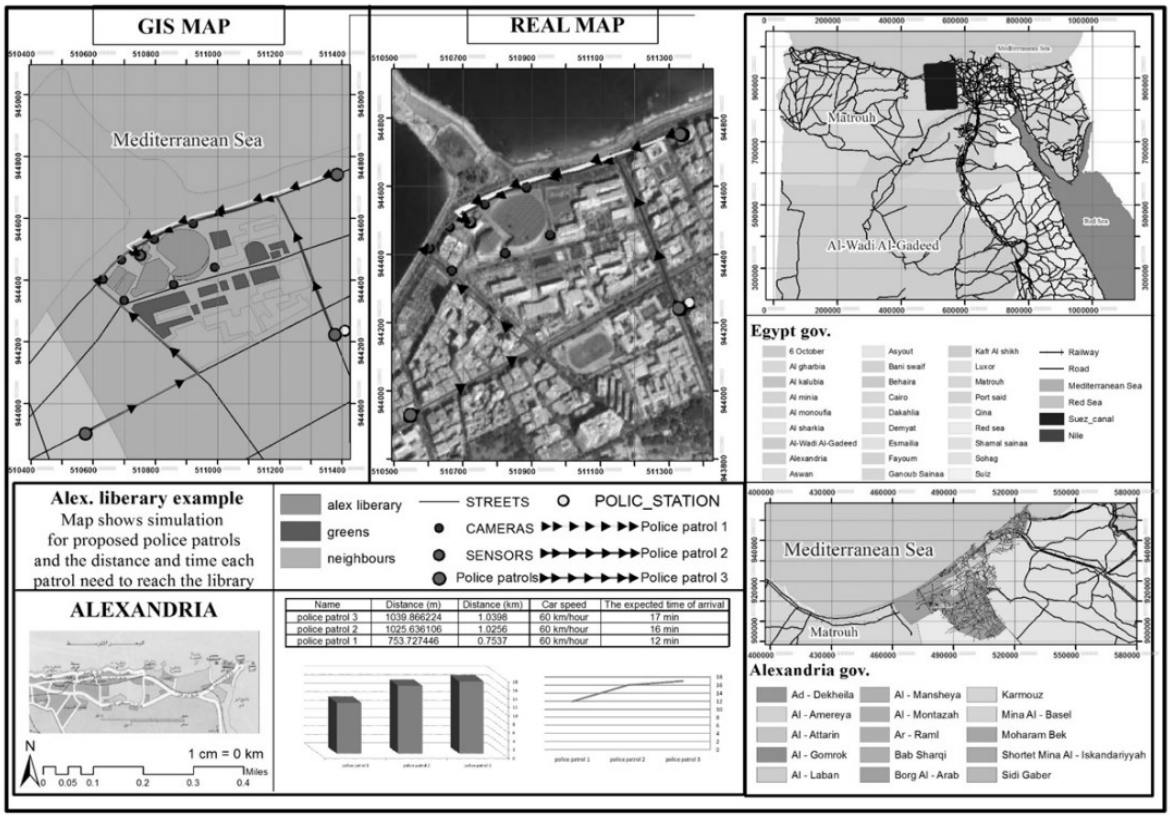

Figure 6: Alexandria Library in response to terrorist attack

7. Discussion

GIS in tourism have advantages for both tourists and the tourism development authorities. Tourism is a spatial phenomenon which uses maps for tracking, interpreting, analysing and refining data. A great deal of information is present in maps which cannot be easily analysed. GIS comes to play an important role to allow the user to view, understand, query, interpret and visualize data in many ways. Also, updating and editing digital maps became easy as digitalization techniques and GIS tools became popular. This paper has aimed to implement and apply a GIS surveillance conceptual model for protecting tourism industry in Egypt to provide more security by reducing risk of terrorist attacks and provide security to touristic places which had affected due to the security turmoil prevailing in Egypt in recent years, acts of terrorism that threaten the country and tourists also, Insufficient surveillance cameras in touristic areas, Lack of access of police services to touristic areas when needed on time, Inability to determine touristic police stations nearby touristic places on the map and Inability to determine all the touristic places on map. Therefore, this paper has aimed to build a surveillance conceptual model using GIS for protecting tourism industry and provide safety and security for the tourists.

8. Conclusion and Future work

This paper has aimed to build a surveillance conceptual model using GIS for protecting tourism industry and provide safety and security for the tourists. So, the proposed model achieved the goals according to the followings:

- The success of employing the combination of Geographical Information Systems (GIS) and latest security equipment to locate the tourist place when there is any kind of risk or threat, reaching this place in the shortest time to control the risk or threat and even to prevent it before occurring.
- Two scenarios have been chosen and implemented; the first scenario shows how to connect the tourist place (Alexandria Library) with the police stations and use GIS to locate the place of threat. The second scenario shows how to calculate the shortest response time by choosing the nearest police patrol to the location of threat and using the safest roads.
- To make sure the model pays off, the simulation was done before the actual implementation.
- The proposed model uses GIS to locate all tourist places, such as hotels, beaches, museums, restaurants and cafes, mosques and churches, airports, roads, bridges, ports, tourist police stations sites, and police patrols.
- The proposed model allows the tourist police to monitor any tourist place through putting surveillance cameras, remote sensors and screens everywhere in any tourist place and connecting them with monitors in police stations and the tourist place's guard's offices.
- The proposed model uses GIS to locate the current location of police stations and the scope of service for each police station. And such information is used in redistribution of current police stations and/or adding new police station to establish strong security network coverage to all areas.
- The police stations can locate the tourist place when there is any kind of risk using GIS in the shortest time to control the risk and even to prevent it before occurring.
- It will help to determine the nearest police patrol that will respond and use the shortest and safest road to move to the tourist place when there is risk to control it by calculating the police patrols speeds and the time needed to reach the tourist place.
- When there is an individual threat to any tourist, the proposed model will allow the tourist to use GIS to locate the nearest police station or the touristic place's guards' office, informing them with his/her location and the kind of threat. Such information will help in saving his/her life.
- Also, the proposed model can determine the safe and dangerous roads so that the tourist will be able to determine which safe road can be used to reach his destination.

According to these results the specification of the building model and framework have been chosen to cover all needed details to achieve the target of providing safe and security for tourists and tourism industry.

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