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Finding the Best Analysis for the Sleeper Cells of Terrorist Acts in the Crowded Areas of Human Activities in the City of Baghdad

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Abstract

Terrorist operations disturbed societies and threatened their existence due to destructive ideas carried by those groups that believe in radical change and the use of multiple methods to implement their ideas, as well as taking methods of concealment among society, so it has become difficult to detect them. The study's purpose is to locate sleeper cells of terrorist operations in areas dense with various human activities using remote sensing techniques and geographic information systems programs. The programs were used to analyze the group of terrorist incidents data that occurred in Baghdad in 2011 and study how to limit the crimes spreading in Baghdad. The study included building a model in spatial information systems for sites by identifying the accidents by simulating the reality with the Global Positioning System (GPS) to be a starting point for the spatial analysis of the accidents and devising a scientific approach to locate sleeper cells using statistical methods and theories. Moreover, predictive research focuses on several spatial studies to produce predictive maps for the sleeper cell sites spreading from their location toward the cities. The GIS proved to be one of the primary software packages that help decision-makers take appropriate measures at the right time, predict the spatial spread of future accidents, and control them in the future to be an effective model for researchers.

Keywords: Terrorist acts, sleeper cells, Remote sensing technique, Geographic Information system, Prediction Maps.

إيجاد افضل تحليل للخلايا النائمة للأعمال الارهابية في المناطق المزدحمة للنشاطات البشرية في مدينة بغداد

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الخلاصة

اصبحت العمليات الارهابية تؤرق المجتمعات وتهدد كيانها و وجودها للأفكار الهدامة التي تحملها تلك الجماعات التي تؤمن بالتغير الجذري واستخدام اساليب متعددة لتنفيذ افكارها، وكذلك اتخاذها طرق التخفي بين المجتمع، فاصبح من الصعوبة كشفها، لهذا السبب قدمنا نموذج في نظم المعلومات الجغرافية لمعالجة طرق التخفي لمشاركة العالم همومه وايجاد الحلول المناسبة .

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تهدف الدراسة إلى تحديد مواقع الخلايا النائمة للعمليات الإرهابية في مناطق كثيفة الأنشطة البشرية المختلفة ، باستخدام تقنيات الاستشعار عن بعد ، وبرامج نظم المعلومات الجغرافية في تحليل بيانات مجموعة الحوادث الإرهابية التي وقعت في مدينة بغداد لسنة 2011 ودراسة كيفية الحد من انتشار الجرائم الارهابية في بغداد .
تضمنت الدراسة بناء نموذج في نظم معلومات مكانية لتلك المواقع من خلال تحديد الحوادث التي حدثت داخل بيئة نظم المعلومات الجغرافية عن طريق محاكاة الواقع بنظام تحديد المواقع العالمي(GPS) ، ليكون نقطة انطلاق للتحليل المكاني للحوادث وابتكار منهج علمي لتحديد موقع الخلايا النائمة باستخدام الأساليب والنظريات الإحصائية والتنبؤية، يركز البحث على عدة تحليلات مكانية باستخدام عدة أدوات من أجل إنتاج خرائط تنبؤية لانتشار مواقع الخلايا النائمة من موقعها نحو المحيط ، استنتجت الدراسة تحليل التنبؤ بانتشار المواقع الخطرة في المناطق المحيطة بنقطة الوسط بمقدار نصف ربع مسافات حوادث الجوار من نقطة المركز إلى ابعد نقطة.
اثبتت نظم المعلومات الجغرافية انها احدى الحزمة البرمجية الاساسية التي تساعد متخذي القرار اجراءات مناسبة في الوقت المناسب والتنبؤ بالانتشار المكاني للحوادث مستقبلا والسيطرة عليها في المستقبل وأن تكون نموذجاً فعالاً للباحثين في المستقبل.

Introduction

The development in recent decades for all technologies and information management with organized crime analysts has had a significant role in producing crime maps that help prevent and limit its spread.

The crime analysis was based primarily on the definition of general crime concepts and types of analysis. Crime analysis often refers to three different types of operations [1]:

1. Tactical crime analysis
2. Strategic crime analysis
3. Administrative Crime Analysis

Crime data analysis enhances response and rapid understanding of field situations. Tactical Crime Analyst provides information assisting operations personnel in identifying specific crime problems and apprehending criminals if they come into direct contact with the individual and community [2]. Strategic crime analysis provides information regarding groups' persistent problems with a long history of criminal activity and a direct impact on threatening society, such as terrorist attacks with a program, goals, and ideology to implement forcefully in the community. Strategic crime analysts provide data on perceptions and long-term solutions to crime; these concepts are used in criminology to establish concepts and ideas in investigating a crime that threatens society and individuals. These concepts enhance the understanding of crime analysis and one editing phenomena that became a constant threat. Exploring and developing methods based on modern technologies, computer software, and statistical concepts and theories to understand the phenomena are to be a working guide for law and justice enforcement agencies [3, 4].

Some secondary software packages were applied by following up the organized crime to reveal the style, work, and presence of terrorist crimes in 2011, especially in Baghdad Governorate (the capital of Iraq) and in places overcrowded with human activities, which gained the world’s concern and attention for the victims and the destruction caused by these criminal operations [5]. All methods and tools of retaliation by suicide bombers, such as explosive devices placed under vehicles, assassinations with silenced weapons, remote sniping, and remote bombing with mortar bombs [6]. The applications include using available aerial and satellite images and related remote sensing techniques, mastering modern computers in implementing specialized programs in determining maps, and relying on collecting and

scheduling spatial data and metadata [7]. All of that must be done with the help of methods, statistical processes, and accompanying treatments [8].

The study focuses on producing a large-scale map and analyzing crime [9]. It is a crucial tool in crime prevention theory, working on determining spreading and helping reveal the sleeper cells, helping those crime analysts, law enforcement, and justice officials in the official institutions of society [10]. Also, it aids in pursuing organized crimes in general and terrorist operations exceptionally, to be a basis for learning how to use what was stated in the study of concepts and hypotheses developed in the analysis and design of criminal maps, computer use, and design of Advanced Software [11].

The study aims to discover the areas of sleeper cells that run terrorist operations in Baghdad.

The study area

The study area is Baghdad, which represents Iraq's political and administrative capital, and a city that represents a center of overcrowding and human activity. Baghdad represents Iraq's commercial, economic, cultural, and population center, as well as the center of gravity, with a population of 8.5 million. Baghdad is located between the longitude and latitude from the far top left of 43 55.11° → 33 42.49° and the far lower right 44 49.62° → 32 51.29°. The coordinates were converted to the metric projection Universal Transverse Mercator (UTM), which are (391702.29 3735948,898) and (495669.702 3629719.819), respectively. The area of Baghdad is 5215.3 Km^2. The height of Baghdad in the north is 48 m above sea level, and in the south is 23 m above sea level, Figure 1 [12] and [13].

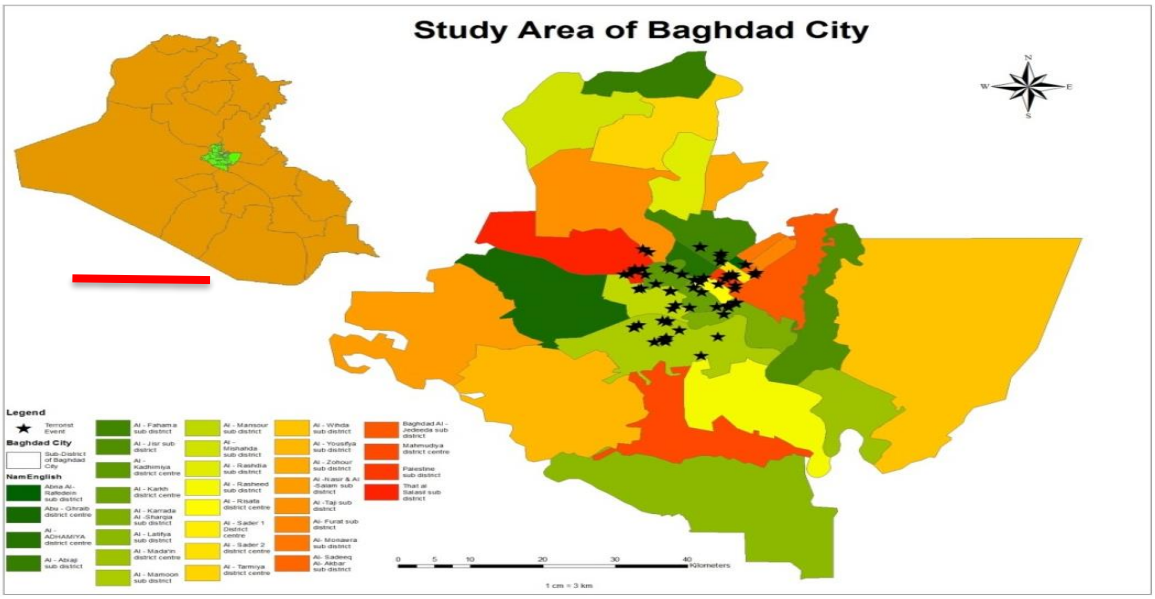

Figure 1: Location of the study area

Description of the study area

Administratively, Baghdad consists of 13 Districts and 31 Sub-Districts. Human activities are concentrated spatially in the center of Baghdad. It is also surrounded by human activities such as orchards, agricultural areas, laboratories and stores, and many international, primary, and secondary roads as entrances and exits to the city and three rivers. Two main rivers are the Diyala river on the eastern side, the Tigris river in the center of Baghdad, and the Euphrates river occupies part of the western side [14]. It is covered with orchards, farms, natural plants, and artificial lakes for fish farming. The international highway network covers the center of Baghdad and the western side, and the primary and secondary roads cover most of Baghdad. The road facilitates movement and activity quickly and gives alternative options for

transporting terrorist and evasive groups to avoid pursuing law enforcement and justice authorities, as in Figure 2.

The religious extremism has widened due to the change of the Iraqi government system from dictatorial rule to a democratic multi-party, accompanied by weakness in law enforcement procedures. Moreover, strict laws have changed to ones that consider human rights and individual freedom and neglect harsh restrictions due to weak prosecution, law enforcement, and the spreading bribery. The retirement and migration of experiences were also other reasons that encouraged that [15].

It was exploited by the extremist Islamic organizations supported by the neighboring countries, with the projection and recruitment of Baghdad's people for some money due to the economic stagnation, unemployment spreading, and the control of jobs by the monopoly of the power parties [16].

Terrorist operations were carried out outside the areas crowded with human activities through Baghdad entrances and exits. Consequently, this is what prompted to study this phenomenon and suggest a model in geographic information systems (GIS) detect terrorist gangs

Methodology and Material

Data acquisition

The data of the satellite Landsat 8 OLI sensor were downloaded from the United State Geological Survey (USGS) website to determine the prominent landmarks of Baghdad in order to identify the center of human activities. The terrorist activities data for 2011 were taken from the Security Agency of the Iraqi Ministry of Interior and the Directorate of Combating Terrorism, most of which were used.

The terrorist operations that took place in the areas of human activities in Baghdad were 64 operations in that year. The martyrs and wounded statistics and the damage caused by terrorist attacks are shown from the information on their locations in Table 1 and Figure 2.

Table 1: The total terrorist incidents that occurred in 2011 with the number of victims of martyrs and wounded, and the damage.

NO	Address (crime scene)	Martyrs	Wounded	Damage
1	Al-Alam District	2	8	Visitors to the Spring of Imam Hussein, peace be upon him
2	Kadhimiya District	1	19	Visitors to the imam damage some houses and shops
3	Al-Shula District	0	9	Imam Arbaeen visitors, damage to some cars
4	Al-Shula District	45	134	Funeral council and damage to homes and cars
5	Al-Amil District	6	30	Victims and material damage to the regiment's headquarters in the area
6	Al-Amil District	1	4	Burning a car near Saeed bin Al-Musayyib school
7	Al-Saidyia District	0	12	Material damage in the commercial street of the area
8	Al-Habibyia	1	2	Al-Rasheed Bank material damages
9	Al-Habibyia	0	5	Near the popular clinic, material damage
10	Talbiya	0	6	Near the College of Administration and Economics, some cars were damaged
…	…….....	……..	……	……..
54	Jihad District	0	0	Nothing
55	the green Zone	1	3	Damage to some vehicles
56	Taji District	9	21	Material damage and destruction of six wheels
57	Behind the Ministry of Interior	3	30	Damage to government and private wheels
58	Karrada	1	0	The assassination of director and journalist Hadi Al-Mahdi's home

59	Our District	0	6	Damage to the mosque building
60	Bab Al Mu'adham	1	0	An employee in the Sunni Endowment
61	Al-Doura	2	0	Assassination in front of the Suhaib Mosque with an employee
62	Umm Al-Qura Mosque	5	0	A policeman killed a guard with the mosque employees
63	Adhamiya	1	0	The imam of the mosque was killed
64	Al-Shula District	7	0	A taxi driver from the area

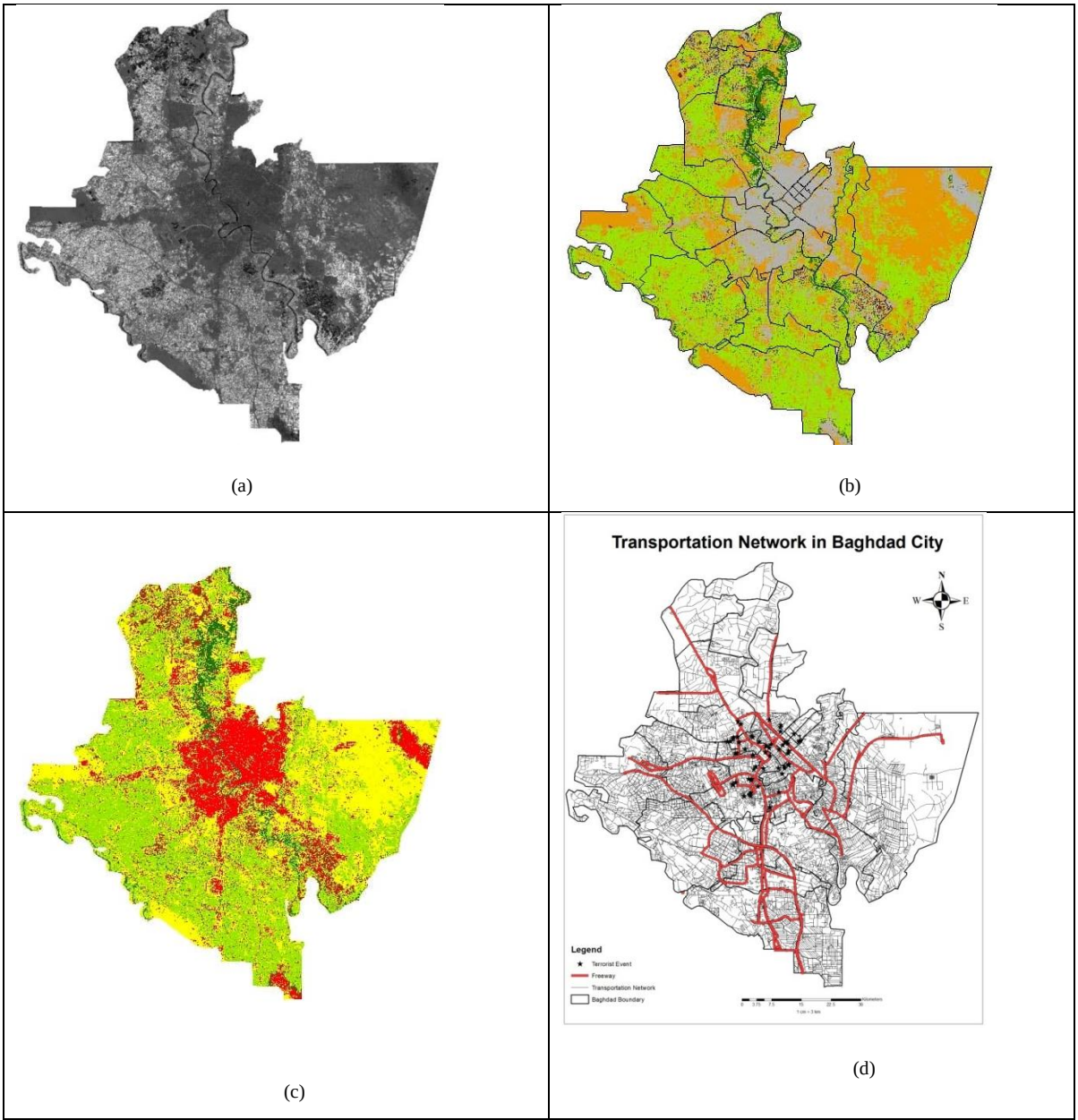

Figure 2. (a) Remote sensing data using satellite Landsat8 OLI sensor, (b) Composite bands 7,4,3 processing for visualization imagery, (c) The main features of the study area showing the areas that are overcrowded with human activities, (d) The international and regular transportation network represents the entrances and exits of Baghdad, while black stars represent terrorist operations.

Remote sensing data was used to determine the boundaries of Baghdad and drop and simulate the terrorist operations taken in the direction of GPS. Moreover, installing regular and international transportation routes helped the movement of terrorist gangs with absolute ease.

Verify Coordinate Systems

To achieve accurate measurements, the conversion of coordinate projection must follow a spatial accuracy of flat surfaces. Coordinating systems are a frame of reference consisting of points, lines, and surfaces and a set of rules used to determine the positions of points in space in either two or three dimensions. The Cartesian coordinate system and the geographic coordinate system used on the Earth's surface are typical examples of coordinate systems.

The reference system identifies a position in space and determines the relationships between positions using ArcGIS. Coordination systems enable individual data sets to be geo-referenced to one another. Specifying the coordinate system is one of the initial steps in creating a new feature class or raster dataset.

It specifies the coordinate system that can be applied to the spatial data generated by operating tools. A coordinate system (geographic or projection) determines the location of spatial data on the Earth, shown table 2.

Table 2: Illustrate converting geographic coordinates with accurate degree measurement to UTM projection.

NO	Address (crime scene)	Longitude (λ) degrees	Latitude (ϕ) degrees	X-axis (UTM) meters	Y-axis (UTM) meters	Martyrs	Wounded
1	Al-Alam District	44.330817	33.242855	437659	3678410	2	8
2	Kadhimiya District	44.338945	33.373504	438508	3692890	1	19
3	Al-Shula District	44.285041	33.370048	433491	3692540	0	9
4	Al-Shula District	44.286207	33.373392	433602	3692910	45	134
5	Al-Amil District	44.333920	33.276696	437972	3682160	6	30
6	Al-Amil District	44.327995	33.279190	437422	3682440	1	4
7	Al-Saidyia District	44.353318	33.261555	439768	3680470	0	12
8	Al-Habibyia	44.463642	33.363733	450102	3691740	1	2
9	Al-Habibyia	44.466138	33.366990	450336	3692100	0	5
10	Talbiya	44.413557	33.387047	445457	3694350	0	6
……	……..	……	……	……..	……	.....	…….
54	Jihad District	44.285445	33.266595	433450	3681070	0	0
55	the green Zone	44.408783	33.304404	444961	3685190	1	3
56	Taji District	44.305766	33.403899	435444	3696280	9	21
57	Behind the Ministry of Interior	44.435864	33.344127	447506	3689580	3	30
58	Karrada	44.425844	33.303853	446549	3685120	1	0
59	Our District	44.414222	33.401753	445528	3695980	0	6
60	Bab Al Mu'adham	44.382800	33.350008	442572	3690260	1	0
61	Al-Doura	44.410148	33.249931	445054	3679150	2	0
62	Umm Al-Qura Mosque	44.292049	33.336806	434118	3688850	5	0
63	Adhamiya	44.356486	33.363764	440133	3691800	1	0
64	Al-Shula District	44.297628	33.374088	434665	3692980	7	0

The concept of spatial distribution

It can be noted that the prevalence of crime sites in three pattern points distributions was more randomly distributed than regular and cluster distributions. The statistics used to describe the spatial distribution of crime incidents in this study will be clarified [17]. Central statistics are the most detailed specification for the spatial distribution of crime incidents; indicators estimate the basic parameters of the distribution.

1. Means Center.
2. Center of Minimum Distance or Median Center
3. The intermediate position.
4. Minimum center distance.
5. Standard deviation of the X and Y coordinates.
6. Standard deviation distance.
7. Ellipse for standard deviation.

They are called Centro Graphics in that they are two-dimensionally related to the essential statistical moments of a single variable distribution (mean, standard deviation, skewness, and kurtosis). Since the two dimensions add complexity not seen in one, these statistical moments have been modified to be appropriate [18].

GIS and crime analysis

The GIS software has played an essential role in controlling all community-organized crimes using GPS to form an essential spatial information database, where it is better to deal with tabulated data with extreme accuracy to facilitate management. Dealing with these data efficiently forms a primary key for circulation and data analysis, becoming an ideal approach and an excellent opportunity to use analytical tools to elicit basic information. Then helps understand any event that negatively poses a problem to society while developing appropriate solutions and recommendations to be an ideal working approach for the supervisory and executive bodies of the crime control agency through the appropriate outputs. It is a visual or paper map or report that helps decision-makers to issue appropriate plans and instructions for crime study and analysis departments.

Law enforcement-department in all world countries have adopted maps as a deductive approach in operating rooms to be a visual alternative to the fallen and proven data related to organized crime [19]. The maps became a key to explaining many points that were not visible and scattered at first glance, helping in controlling crime sites and their inputs and outputs and follow-up perpetrators. Because the movement of gang members is always comprehensive and fast at the various entrances to the city, they are the most capable of maneuvering, hiding, and tuning. It becomes difficult and impossible to control without having accurate maps [20].

Basic Statistical Operations

Mean Center

The processing is sum minimizes the sum of squared distances of accident events, between itself and all points, and the mean of the X and the Y coordinates for a set of points, or the sum of differences between the mean X and all other X is zero (same for Y) and called the center of gravity or Centroid [21] [22].

$$min \sum d_i c^2 \quad \ldots\ldots\ldots, (1).$$

Where;

d_i, distance of i = 1,2,3,4,5, ……

c^2, squared distances of accident events

The mean of x and y can be calculated;

$$\bar{X} = \sum_{i=1}^{n} \frac{X_i}{N} \quad \ldots\ldots\ldots, (2).$$

$$\bar{Y} = \sum_{i=1}^{n} \frac{Y_i}{N} \quad \ldots\ldots\ldots, (3).$$

Where;

$\bar{X}$ is mean center, n is the number of points of events or the number of terrorist operations.

Any point in this process affects the location of the mean center, even far from it, and the result is shown with a unique point representing the mean center.

The Center of Minimum Distance or Median Center

The arithmetic means the maximum and minimum distances of accident events and the point of minimum aggregate travel, also called the end Mid Distance (MD), which reduces the sum of the spaces between them. All other issues (i) can only be derived by approximation, not a specific solution. Multiple points may meet these criteria; see the next point.

$$min \sum d_{iMD} \quad \ldots\ldots\ldots, (4).$$

Where;

$\sum d$, Sum of all distances,

i =1,2,3,4,5,……. of one dimensional for a single variable,

MD, Mean Distance.

Same as Median center:

The intersection of two orthogonal lines (at right angles to each other), such as each line has half of the points on the left and half on the right. Because the orientation of the axis for these lines is random, multiple issues may meet this criterion, see figure 3.

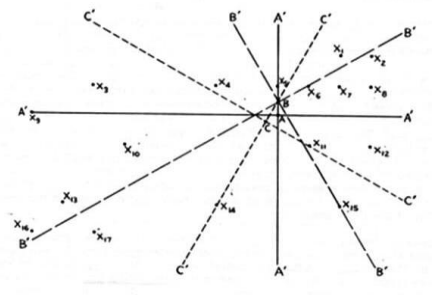

Figure 3: How determined Median Center [23].

Standard deviation distance.

It is called the standard deviation on the distances of all points and their distance from the mean center point. The average distance of the points from the center can be represented as one unit to measure the dispersion of the distribution [24]. It can also take the standard distance options from the center of the weighted mean according to the importance of the study and come up with satisfactory and controlling results.

Standard deviation formulas of one dimensional for a single variable

given by [25].

$$SDD = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{N}} \quad \ldots\ldots\ldots.., (5).$$

for the two-dimensional equivalent of standard deviation for a single variable.

Given by;

$$SDD = \sqrt{\frac{\sum_{i=1}^{n}(X_i - X_c)^2 + \sum_{i=1}^{n}(Y_i - Y_c)^2}{N}} \quad \ldots\ldots\ldots., (6).$$

Essentially the average distance of points from the center provides a single unit measure of the dispersion distribution.

The Results and Discussion

To know the locations of terrorist sleeper cells, a center must be determined for the site where terrorist operations occur. Thus, the places where to be careful should be identified so it will be easier for law enforcement to ensure that they have taken control of the situation to catch the criminals and to be able to foresee any future actions. After determining the points of the locations of terrorist operations, finding a central point for these operations by finding the average midpoint of these points, and then determining standard distances from this point from the nearest to the farthest, and here it is assumed that the locations of the sleeper cells of terrorism are as shown in Figure 4.

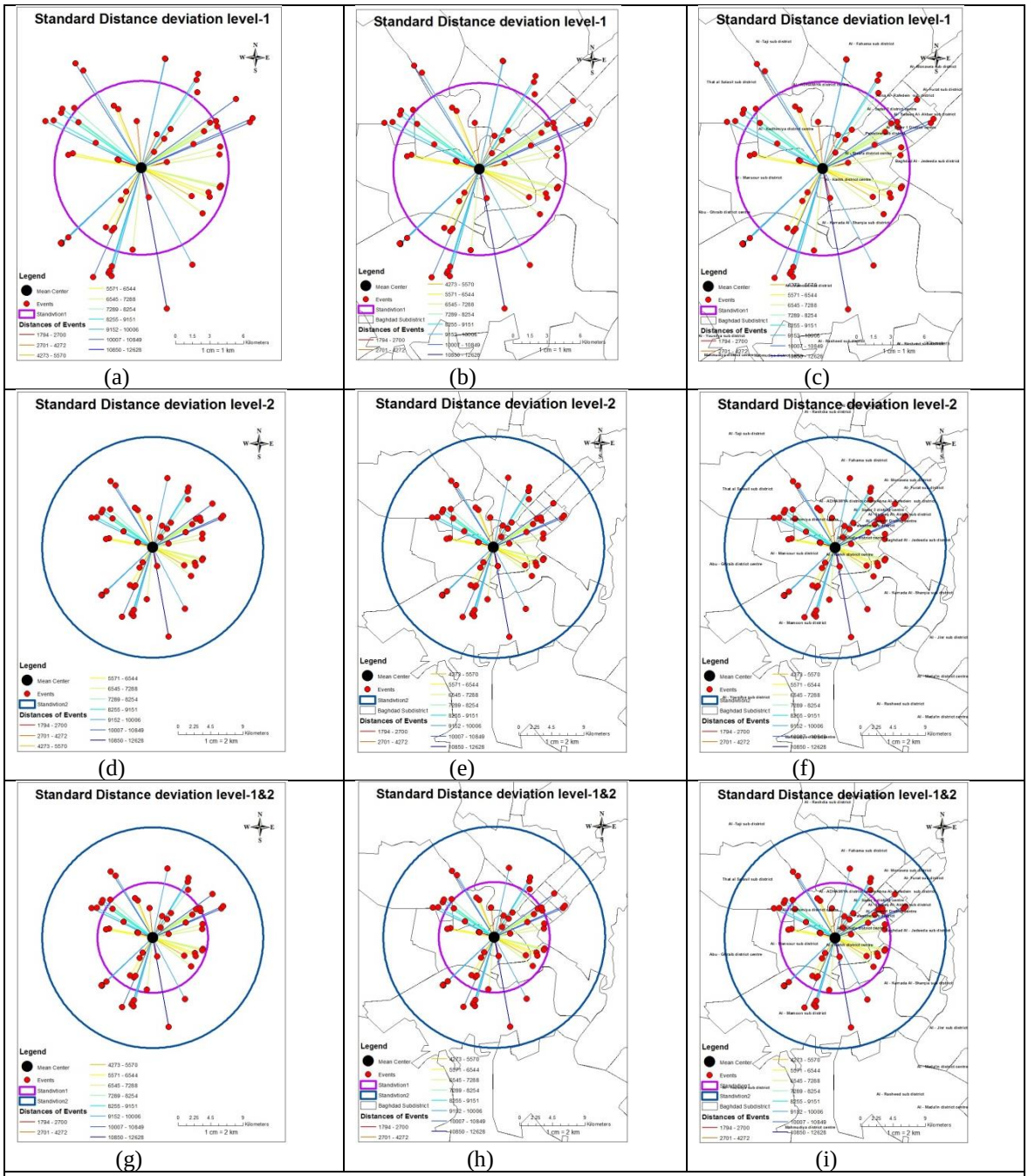

Figure 4: The black dot represents the mean central, (a, b, c) represents the first level of standard deviation, which is a technique to control the numerical density of events, and (d, e, f) represents the second level to control the numerical density of events, (g, h, i) represent both levels of control of events within the study area.

In order to find the sleeper cells, the distances between the Mean Center (MC) with each event (terrorist operation) were determined by connecting the lines. Thus, the distances were determined and recorded in the Vector Mathematical Model (VMM) file, the type of line shape file, to calculate the distance of each event from the mean center, see table 3, Figures 5 and 6. The analytical results using statistical techniques identified the potential areas for the presence of dormant cells, Table 4.

Table 3: Length Statistics of the terrorist operations in the study area.

Serial. NO	Statistical Tool	Quantities
1	Count:	63
2	Minimum:	1030
3	Maximum:	9985
4	Sum:	392245
5	Mean:	6226.11
6	Standard Deviation:	2907.82
7	Nulls:	0

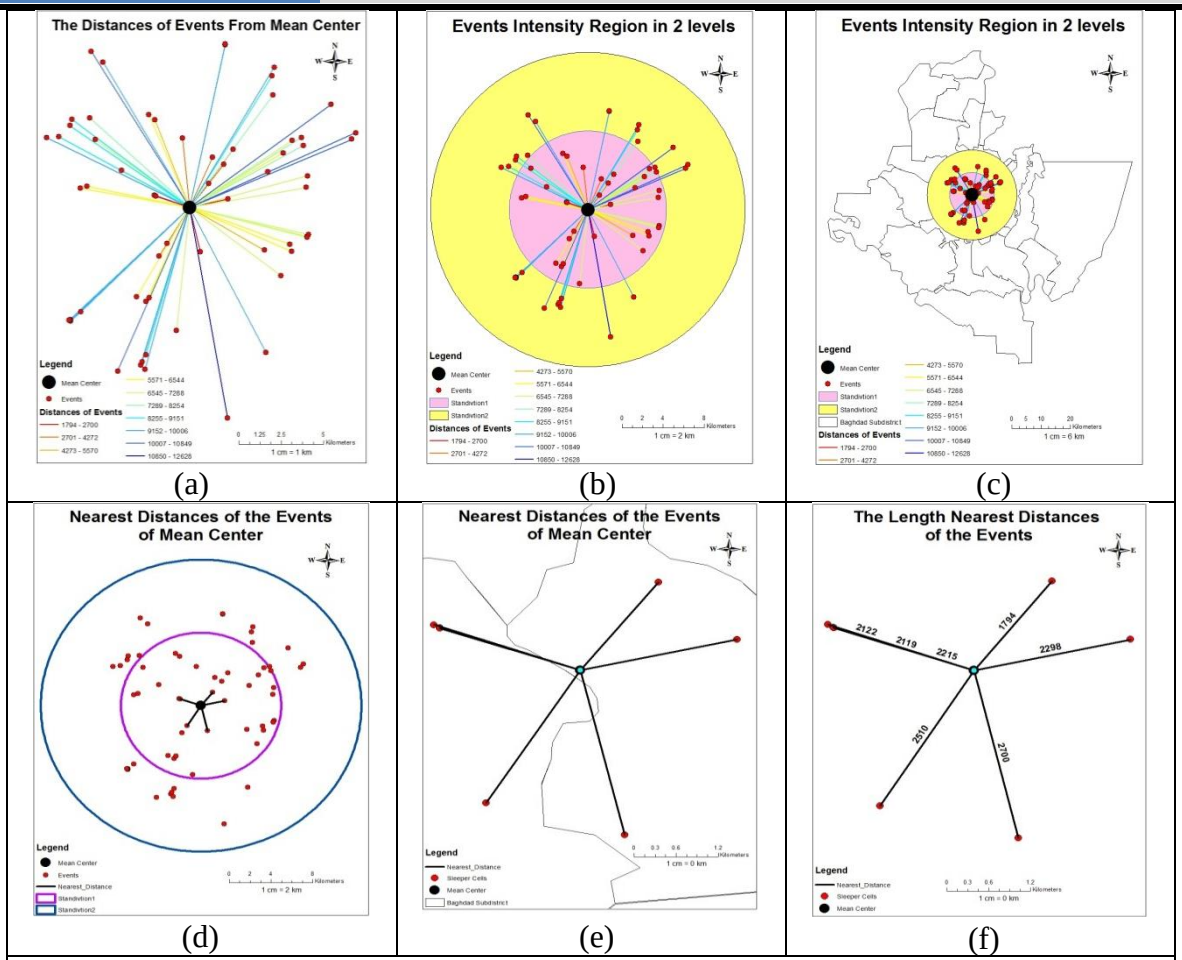

Figure 5: (a) The lines represent the distances between the mean central and the dispersed events, (b) the distances for the standard deviation levels, (c) show the processes in the study area (Baghdad), (d) the Statistical Sharpening process, which represents the last half quarter text in descending order of the lengths the distances with deviation levels standard distances, (e) the shortest distances of events from the mean center with the measurements which represented sleeper cells, (f) represents the area of sleeper cells of the dispersed density in the study area.

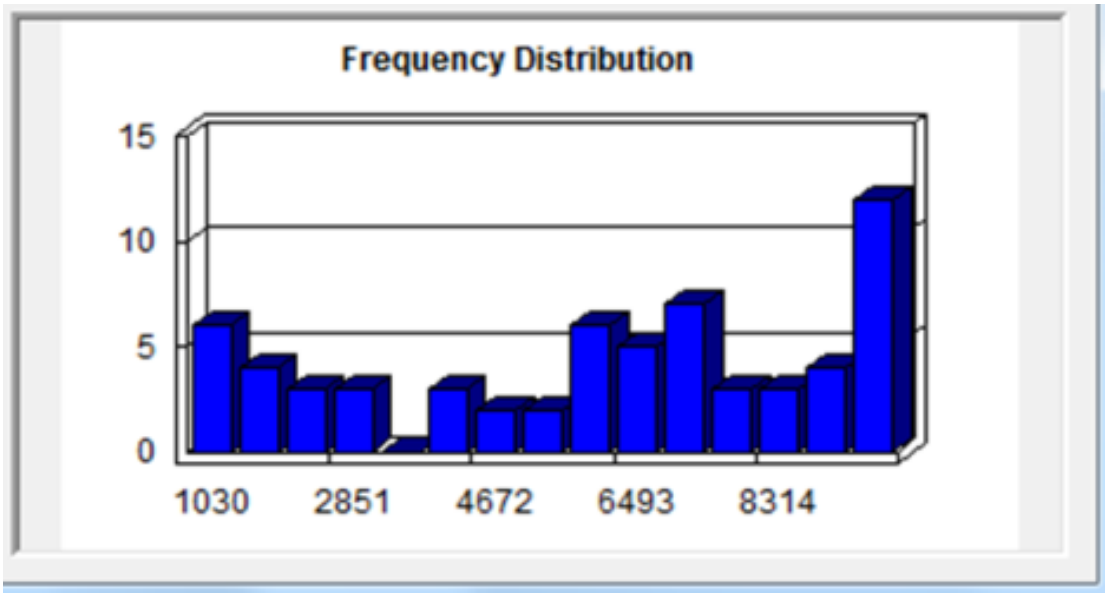

Figure 6: represents the frequency distribution for all events and the length of distances

Table 4: : Represents the probability of the sleeper cells' locations and the standard deviation of the expected distances.

NO	Distance From Mean Center (m)	Address (Crime Place)	Damage
1	1794	Rahmaniyah Karkh	Nothing
2	2119	Washash	Nothing
3	2122	Washash	Nothing
4	2215	Mansour	Nothing
5	2298	Allawi Hilla area	Damage to hotels, shops, and wheels
6	2510	Al-Mansour, Princesses Street	Material damage to homes, shops, and cars
7	2700	Al-Kindi Street in Al-Harithiya	Nothing

The results showed that by applying statistical methods and calculating the lengths of the distances of the events, the closest distances are half of the last quarter of the descending order of the event's distances. The ones that are close to the median center are seven scattered events, and the lengths of the distances are 1794, 2119, 2122, 2215, 2298, 2510, and 2700 m, respectively, and for the areas Rahmaniyah Karkh, Washash, Mansour, Allawi Hilla, Al-Mansour, Princesses Street, Al-Kindi Street in Al-Harithiya, respectively. These regions can be considered the potential density for terrorist operations of sleeper cells, as shown in Figure 7. Law enforcement and justice forces can intensify their surveillance and arrest operations in this potential area.

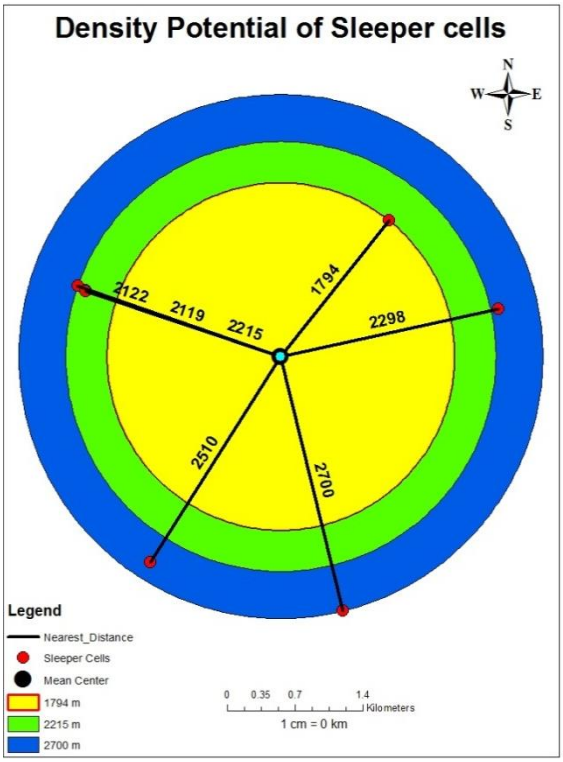

Figure 7: Represents the probability of spatial density movement of sleeper cells in three sectors, where the yellow region is the most likely, the green region is the least likely, and the blue region is the probability and the weak region.

Conclusions

The ability of the GIS system to use and analyze the events area scientifically and accurately depends on remote sensing techniques, the most important of which is the high accuracy based on GPS devices. Our study concluded the following:

1. Seamless integration of stored geospatial data with descriptive information.
2. Ease of displaying the extracted data and information in a map based on the vector mathematical model and point maps.
3. Landsat-8 satellite imagery and linear, raster, and polygon vector maps are based on 2D resolution and, according to some technologies, can be converted into 3D.
4. Sleeping cells were detected using accurate statistical methods and Sharpe's half-quarter lengths technique.
5. The following events represented the seven sleeper cells, namely Rahmaniyah Karkh, the farthest distance, 1794 from the mean center, and Al-Kindi Street in Al-Harithiya, which was the shortest distance from the mean center.

Therefore, the use of remote sensing techniques and geographic information systems helped us find sleeper cells for a group of terrorist operations that the responsible authorities could not detect.

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