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CELLULAR PHONE NUMBER TRACKING SYSTEM BASED ON ARCGIS AND GOOGLE MAPS

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***Abstract*- Over 4 billion individuals are projected to own a mobile device, with smartphone use continuing to rise around the world. Associated with this trend is the collection and usage of location information provided by these devices. The procedure for tracking and evaluating a mobile phone number is crucial for crime and terrorist attacks preventing concerns, especially in countries with deteriorated security conditions. The locational tracking information can enable real-time operational awareness and can save people's lives. In this aspect, the Geographic Information System (GIS) system is frequently used to provide intensive spatial information along the tracking process. This research aims to examine, follow up on, and trace a certain person's phone number inside a certain area using a combination of ArcGIS and Google Maps application software they are programs used to track and determine locations through the use of various types of coordinates, including latitude and longitude. In the ArcGIS program, there are several methods and algorithms used in various fields, including (locating people, determining tourist places, determining water and sewage networks, forecasting in the event of storms or floods, and many other areas), an example of these methods in the program is (Kriging method, Idw method, Spline method) and many other methods, each method is used for a specific purpose and field. In this research, the kriging method was used, which is a design algorithm that is used in many analysis and tracking processes and gives clear and accurate results. The process of determining locations in the maps used in the search depends on taking the longitude and latitude coordinates and downloading them to those maps. The maps that have been worked on in the research provide a set of basic concepts adopted in the process of tracking a particular personâs phone number, such as (the personâs location, the numbers connected to him, and the duration of a call to numbers in his contact list). The tracking system used is tested by creating a virtual contact list for a specific personâs phone number and making use of all the data in the contact list and applying it in the ArcGIS program, knowing that the duration of the contact list used is 9 months (from January to October 2021). The obtained results are analyzed and sorted in different ways to provide a wide model of the locational communication and movement activity of the tracked person. They showed that the system is efficient and can be applied to enhance the security in Iraq for tracking suspected people in crimes like terrorism, kidnapping, drugs, extortion âŠ etc.**

keywords: **ArcGIS, Google Maps, GPS, Kriging method, Tracking System.**

I. INTRODUCTION

The appearance of the tracking mobile phone system has added a value-creating tool for people responsible for law enforcement without the need for federal funds. Upon the huge rise in using the cell phone, the Drug Enforcement Administration (DEA) in the United States, for example, would use traditional tracking equipment that is owned (or borrowed) and would have to surreptitiously install it, typically on or in a vehicle, aircraft, or boat or secreted in containers carrying precursor chemicals needed to manufacture controlled substances. The great advantages of cell phone tracking include: (1) taking into consideration that many if not most adults have at least one cell phone, this allows tracking an infinite number of people rather than following the trips of a very limited category of transport and other means of communication, (2) law enforcement persons will no longer need for any legal and official approvals to install the tracking devices[1].

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Nowadays, mobile phones have become a very important need in human lives. For example, if any person loses his or one of his family members' cell phones, then this cell phone could be found using the tracking operation. Any person or target's location could be reached through Global Positioning System (GPS). GPS is a satellite-based navigation system developed by the United States Department of Defense in the early 1970s (DOD). GPS was originally intended as a military system to meet the needs of the US military. However, it was later made available to civilians and is now a dual-use system that can be accessed by both military and civilian users. Regardless of the weather, GPS provides continuous positioning and timing information anywhere in the world. Because it serves an infinite number of users and is used for security, GPS is a one-wayranging (passive) system. As a result, users can only receive satellite signals [2].

A GIS is a computer-based tool capable of acquiring, storing, manipulating, analyzing, and displaying spatially referenced data. Spatially referenced data is the data that is identified according to its geographic location (e.g., features such as streets, light poles, and fire hydrants are linked by geography). With the advancement of mobile communications and internet technologies, mobile GIS has recently received a lot of attention[3]. GIS / GPS could be used to identify the disturbances who are sending irrelevant SMS or calling us. At the same time, many challenges might be faced to do the tracking operation including technical and other related security issues. GSM technology could be used for tracing and finding a person's location through mobile phones that are using the 2G, 3G, and 4G technologies[4].

Some tracking systems based on GIS were presented in the literature for use in certain applications. In 2014, Xiaoguo Wan [5] demonstrated how to design, develop, and apply GIS applications to electric fieldwork. Java is used to create an Android mobile application that is integrated with GIS. Employees of China Southern Power Grid (CSPG) tested and evaluated the CSPG prototype using the above-integrated tools.

In 2018, Oyvind Hanssen [6] used one of the special cases of GIS which is tracking the movement of people in the field. This has proven useful for both safety (rescue personnel) and monitoring, planning, and documenting field operations. In 2020, Muhammad Ajmal Azad and an author's group with him analyzed a wide range of smartphone applications designed to contain the spread of the COVID-19 virus and return people to their normal lives. They also analyzed the type of permission for these smartphone applications, whether these permissions are necessary for tracking and tracking, how data is transferred from the user's devices to the analysis center, and the analysis of security measures for these applications was published to ensure the privacy and security of users.

In 2020 Iwara I. Arikpo and Gabriel I. Qsuobiem[7], They have improved the recovery process for lost phones by developing a mobile application to locate and recover lost mobile phones in real-time. The system design methodology was based on object-oriented analysis and design using the Unified Modeling Language. The system was implemented using Android SDK Tools version 23.0.5 along with the Google Maps service and the underlying Firebase real-time database. The app was tested with Android 5.0 (Lollipop). The software has been successfully used to track mobile devices in real-time using other recovery tools like lock, ring, and wipe (if the owner wants) applied during the recovery process[8].

In 2019 Prithvi Raju Kunder, Neha Maruti Nayak, and DishaSantosh Pandey Review existing systems and propose a new smart bus tracking system. A traveler with a smartphone can view bus routes on the map as well as the current location of the bus. The bus conductor will send real-time location updates once the bus starts moving, which will be sent through

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a real-time database to user devices. In addition to continuously updating the bus tracking process.[9]

Although the development in communication and information technology has facilitated people's lives and provided many services, criminals and terrorists have exploited this technology to achieve their criminal operations. Because of the rapid changes and instability experienced by most countries of the world, especially Arab countries such as (Iraq), this led to the spread of many phenomena that affect the security and safety of society, such as (the phenomenon of organized crime, which includes (kidnapping, extortion, threats), and most of these threats are made By using mobile phone networks illegally, and to reduce, control, and abort these phenomena before they occur, it requires temporal and spatial tracking of criminals and suspects by pairing mobile phone number tracking systems with geolocation systems. This work aims to find efficient solutions to these challenges through reaching the location of the target to be tracked, determining the places of work and residence as well as trying to determine the identity of the person using the phone number by analyzing his contact list and identifying the most important contact numbers and their locations. The above aim has been achieved through performing the following objectives: building a tracking system using ArcGIS software that gives a geographic image in which the location of a phone number can be found using mobile base stations, using the kriging method for allocating, analyzing the target's contact list, extracting additional databases, and displaying them easily and clearly, and tracking the movements of the target using a phone number and reaching his place of work and residence.

II. Materials & Methods

A. Study area

The tracking system is implemented to track a phone number in a specific city using the ArcGIS program and link it with a database of the phone number used. To illustrates the working mechanism of the designed system, it is applied to a specific geographic area in Iraq with an intensive population which is Baghdad. Baghdad city is almost in the center of Iraq, in the northern part of the Arabian Peninsula, and it forms the largest metropolitan zone of the Asian continent's Middle Eastern region as shown in Fig. 1. Baghdad is located on both the western and eastern banks of the Tigris River and has a total area of nearly 127.138176 square km, making it the largest city in the entire region of southwestern Asia. Baghdad's central business district is about 128.74752 km west of the Iraq-Iran border. Basrah is located approximately 523.0368 km southeast of Baghdad, and Erbil is located approximately 362.1024 km north of Baghdad[10]. In this research, a map of Baghdad was taken as a study area, the boundaries of the map were divided according to the areas in the province of Baghdad. Part of the Rusafa areas was taken (Zayouna, Karada Mariam, Al-Suleikh, Al-Baldeyat, Palestine Street, Adhamiya, Al-Mashtal, Al-Shaab, Al-Ghadeer, Al-Waziriyah) and areas Karkh (Al-Mansour, Al-Bayaa, Salhiya, Al-Sidiya, Al-Zaytoun Street, Kadhimiya, Taji, Atatiya, Amriya, Al-Hurriya, Tobji, Yarmouk).

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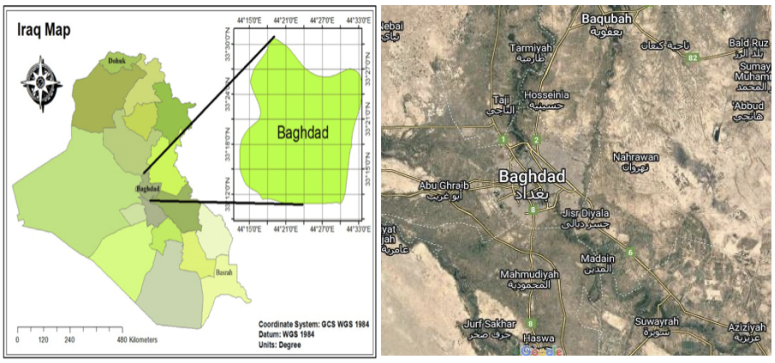

Figure 1: Location of the study area Baghdad city IRAQ

B. Methodology

The process of following up on phone numbers is one of the most important aspects of studies and research that provide a comprehensive view of the process of changing the locations and movements of these numbers, and it has several social security and political effects. Fig. 2 shows a flowchart that explains the methodology used in this work for following up and analyzing a phone number of a specific suspected person. Initially, phone numbers information provided by different mobile company providers should be stored in an excel sheet form. A map of Baghdad (or any geographic area) is also entered. The numbers and location information are then communicated using ArcGIS software. The next step is defining the global coordinates for mapping. After that the coordinated points in terms of longitude and latitude are determined. Then the locations that are represented as circles on the map are converted into a ready-to-work layer in the program (ArcGIS). Among the available methods, the Kriging technique is used ArcGIS program for analyzing the information. Different reporting plots and tables are then produced according to the required parameters of the tracking process (time, call intensity, location, contact list, ...etc.). Finally, an overview map is produced to show the tracking of the target phone number with associated spatial information.

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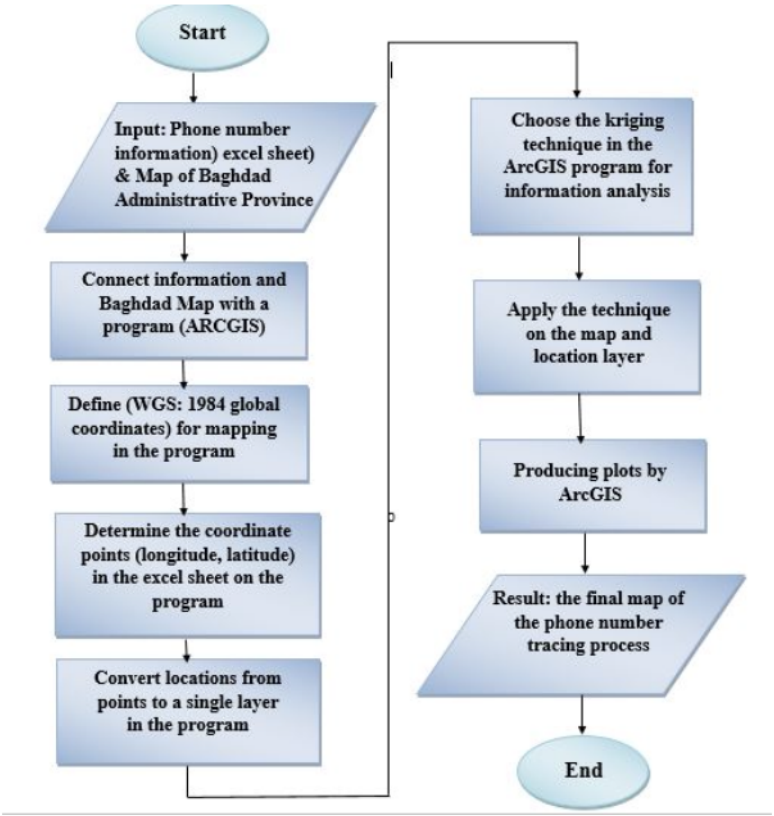

Figure 2: Flowchart of the methodology followed to implement the tracking system.

C. Kriging method

It is a method of interpolation created by engineer Krige who developed the mechanism of spatial distribution to get a more accurate prediction. The Kriging method is a group of linear regression that reduced the spatial estimation difference from a predefined covariance sample. In this method, the analysis of the statistical variation in the data on various ranges and in several directions to set the form and size of the selected area beside the set of weighting operators creates the minimum error in the (REV) estimate.[11] This method established the hypothesis that parameters that are interpolated may be processed as a regionalized variable (REV), and provide a transformation among a full random variable and deterministic variable. All Kriging estimators differ from the primary linear regression estimator Z*(u) denoted by[12]:

$$Z*(u) - m(u) = \sum_{\alpha=1}^{n(u)} \lambda\alpha(u)[[Z(u\alpha) - m(u\alpha)] \quad (1)$$

where u and $u\alpha$ are position vectors to the valuation point and one of the neighboring data points, denoted by α. n(u) is the number of data points in domestic proximity applied to estimate $Z^*(u) - m(u)$ and $m(u\alpha)$ are expecting values (average) for $Z(u), z(u\alpha)$. where $\lambda\alpha(u)$ is the weight assigned to each nearby known value $z(u\alpha)$, it is designed to the

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TABLE I
Locations of Main Number (9647712262485)

Tower main	location
5235 for Asia	Al-Mansour - Doctors Syndicate - near Asia Aseel Company
5240 for Asia	Al-Bayaa - near the real estate registration department in Al-Bayaa
5245 for Asia	Salhiya - near the Ministry of Foreign Affairs
5255 for Asia	Al-Sidiya - Al-Tijari Street - near the Sidiyah gas station
5277 for Asia	Al-Mansour - Princesses Street
5663 for Asia	Al-Zaytoun Street - near Al-Zawraa Park
5875 for Asia	Karada Mariam - near the Jumhuriya Bridge
6103 for Asia	Zayouna - near Wahib Al-Faraj Mosque
6112 for Asia	Zayouna - near the seal sundae
6123 for Asia	Zayouna - Al-Qazzaza Mosque - behind Al-Rubaie Street
6150 for Asia	Al-Iskan-Child Central Teaching Hospital
6153 for Asia	Al-Suleikh - near Al-Furqan Mosque
6223 for Asia	Albaldeyat-Bank street
6223 for Asia	Karrada - near the Iraqi National Theater
6235 for Asia	Palestine Street - Mahalla 508 - Beirut Petrol Station
6323 for Asia	Adhamiya - Corniche Street - near Al-Numan Hospital
6443 for Asia	Al-Mashtal - Al-Matbak Street

information $z(u\alpha)$ to estimate the size of u, the same inputs will extradite various weights to various estimation sites. $Z(u)$ is a random domain with a trend component, $m(u)$, and a remainder component, $R(u) = Z(u) - m(u)$.

D. Materials

In this part, we will display the main database used in the analysis process, which is shown in Table I. The tracking of the sites that the main target number has moved to is displayed, which is (9647712262485), by analyzing its calls with a list of contact details stored in Table II, The target locations are listed in Fig. 3 on the administrative map of Baghdad.

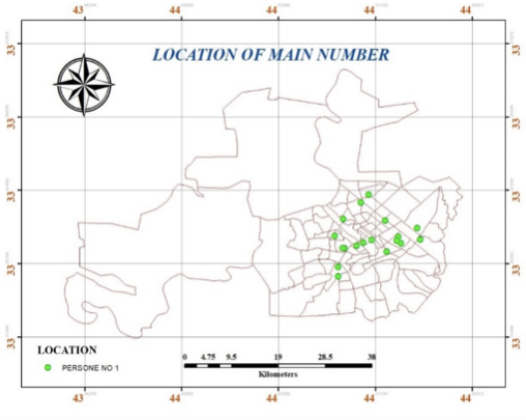

Figure 3: Locations of Main Number

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TABLE II
Most Calling Number and Main Number Locations

Most Calling Numbers &Main Number Locations			
Class Color	Number of Calls	Most Calling Numbers	Main Number Location
	4	9647502233446	Albaldeyat-Bank street
	13	9647801234657	Zayouna - Al-Qazzaza
	22	9647811668899	Al-Sidiya - Al-Tijari
lowest Call (4)			
Highest Call (22)			

Class Color					
Class Number	1	2	3	4	5
Number of Call	1-4	5-10	11-13	14-19	>20

III. Implementation Result

A. *Google Map with ArcGIS*

This section illustrates the process of linking the GIS program with Google Map using the program Portable Basemap Server. This program acts to fetch any source of existing global maps such as GoogleMaps, Raster Image, and OGCWM Service. can choose the type of connection we need in the tracking system. In this study, GoogleMapsRoads is selected, and the WMTS URL of Google Map is considered. Fig. 4 shows the map that depicts the locations of the assumed main number by connecting Google Map with ArcGIS while Fig. 5 shows the portable base map server. WMTS is a web service for geographical coverage and defines the standard of operations that allow users to access tiled maps. Finally, In the GIS program, and from the list Catalog file GIS Server (WMT Server) is added to link Google Map with the GIS program using the service WMTS. The resulting map from the linking process is shown in Fig. 6.

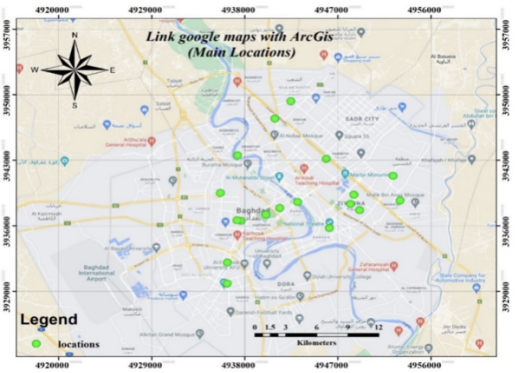

Figure 4: Locations of Main Number through Connecting Google Map with ArcGis

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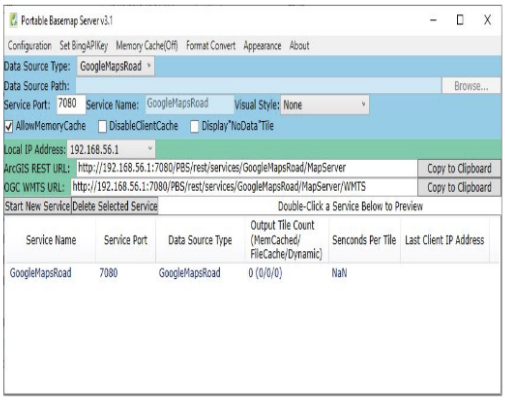

Figure 5: Portable Basemap Server

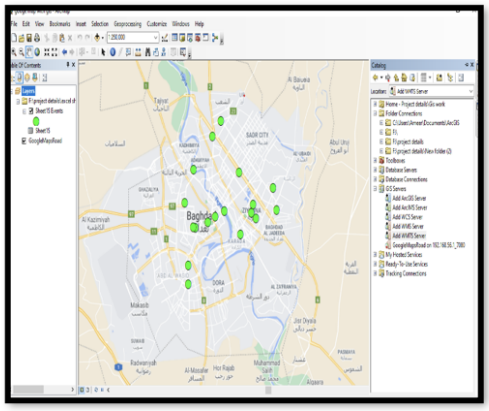

Figure 6: Connecting GoogleMap with ArcGis through WMTS Server

B. Most Call Numbers and Main Locations

In this part, the real process of analyzing the phone number of the main target to be tracked begins as shown in Fig. 7. The figure shows the most phone numbers found in the main number list, according to the color distribution shown on the map. The map is divided according to the indicated color as follows:

1) The red area represents a percentage of (1-4) calls of any number in this area that has contacted the main target number within the period used in this research (9 months).
2) The dark gray area represents a percentage of (5-10) calls of any number in this area that has contacted the main target number within the period used in this research (9 months).
3) The yellow area represents a percentage of (11-13) calls of any number in this area that has contacted the main target number within the period used in this research (9 months).
4) The green area represents the number of calls that are more than 20 calls of any number in this area that has contacted the main target number within the period used in this research (9 months).

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Table III shows the classifications used in the analysis process for this map from the color classification, the number of calls, and the most connected numbers. The green points represent the location of the main target number during the communication process.

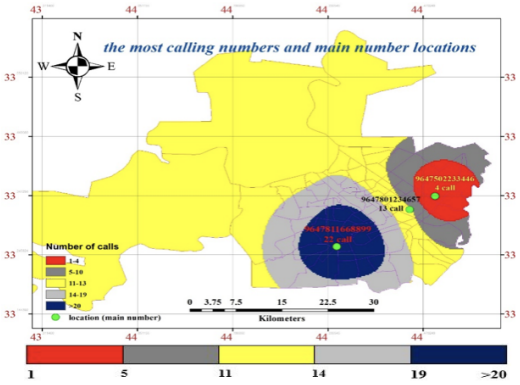

Figure 7: Most Call Numbers and Main Locations

TABLE III
Most Calling Numbers & Main Number Locations

Most Calling Numbers &Main Number Locations			
Class Color	Number of Calls	Most Calling Numbers	Main Number Location
	4	9647502233446	Albaldeyat-Bank street
	13	9647801234657	Zayouna - Al-Qazzaza
	22	9647811668899	Al-Sidiya - Al-Tijari
lowest Call (4)			
Highest Call (22)			

Class Color					
Class Number	1	2	3	4	5
Number of Call	1-4	5-10	11-13	14-19	>20

C. Most Existing Locations of Main Phone Number

This part of phone number data analysis is considered one of the most important parts and methods used to find out some important and useful sites in the process of tracing a specific person's phone number (the target). These important sites are housing, work, and practicing various activities. It is natural for a person to frequently move a lot to his places of work and residence, and through the use of this stage of the analysis process, it is possible to anticipate these places. Thus, it will facilitate the process of reaching the target quickly and with high accuracy. This approach is used by most of the security services in the world to reach or know the places of work or residence of the target and thus will facilitate the process of monitoring and accessing it.

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In this paper, the most frequented sites of the number to be tracked are identified, as shown in Figure (8). The map of Baghdad is divided into several colored areas using the Kriegging technique, as shown below:

1) The blue area represents the number of times the target has been in this location between (5-9) times.
2) The yellow area represents the number of times the target has been in this location between (10-14) times.
3) The gray zone represents the number of times the target has been in this location between (15-19) times.
4) The crayon area represents the number of times the target has been in this location between (20-24) times.
5) The red area represents the number of times the target has been in this location from 25 or more times.

Table IV explains in detail the classifications used in dividing the map, the colors, and the number of times the target is located in the colored areas and frequent sites.

TABLE IV
Lost Calling Numbers & Main Number Locations

Most Existing Locations of Main Number		
Class Color	Number of Location Repetition	Repeated Location
	5	Al-Suleikh - near Al-Furqan Mosque
	10	Al-Mashtal - Al-Matbak Street
	15	Al-Bayaa
	20	Al-Mansour- near Asia Aseel Company
	30	Zayouna - Al-Qazzaza Mosque - behind Al-
Lowest Number of Location Repetition(5) Highest Number of Location Repetition (30)		

Class Color					
Class Number	1	2	3	4	5
Number of Repetition location	5-9	10-14	15-19	20-24	>=25

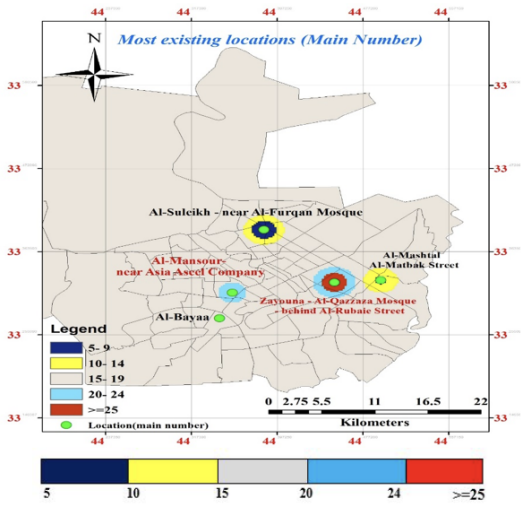

Figure 8: Most Call Numbers and Main Locations

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D. Most Call Times for Main Number

Time is one of the most important factors used and influencing the process of analyzing phone numbers. In this map, the most connected numbers are reviewed in terms of call duration (call time). This process is helpful to know the secondary numbers that are frequently and continuously connected to the main number (the target). This part of the analysis process provides the analyst with a clear view of the numbers that are connected to the main number as long as possible. Baghdad map areas are divided into several sections according to the information that was entered into the map using the Kriging technique within the GIS program. The areas of the Baghdad map are divided, as shown in Fig. 9, into:

1) The red zone indicates that the call time taken between the secondary and main numbers ranges from 1 to 1100 seconds.
2) The yellow area indicates that the call time taken between secondary and main numbers ranges from 1101 to 2220 seconds.
3) The light green area indicates that the time of the call between the secondary and main numbers ranges from 2230 to 3000 seconds.
4) The blue area indicates that the time of the call between the secondary numbers and the main number ranges from 3210 to 4000 seconds.
5) The purple area indicates that the time of the call between the secondary and main numbers ranges from 4423 to 4440 seconds.
6) The dark green area indicates that the call time taken between secondary and main numbers is 5000 seconds or more.

Table V shows in detail the division of regions according to the duration of calls, and the colors and locations of the main number during these calls.

TABLE V
Most Call Time for Main Number

Most Call Time for Main Number			
Class Color	Call Duration	Secondary Numbers	Main Number Location (9647712262485)
	552 1100	9647811668899 9647714590105	Al-Shaab - Traders Street
	2220	9647502233446	Al-baldeyat-Bank Street
	3210	9647726788990	Adhamiya - Corniche Street - near Al-Numan Hospital
	4423 4440	9647813356128 9647801234567	Al-Zaytoun Street - near Al-Zawraa Park
	6780	9647512347645	Al-Mansour - Doctors Syndicate - near Asia Aseel Company
west Number of Call Duration (552) ghest Number of Call Duration (6780)			

Class Color						
Class Number	1	2	3	4	5	6
Call Duration	1-1100	1101-2220	2230-3000	3210-4000	4423-4440	>=5000

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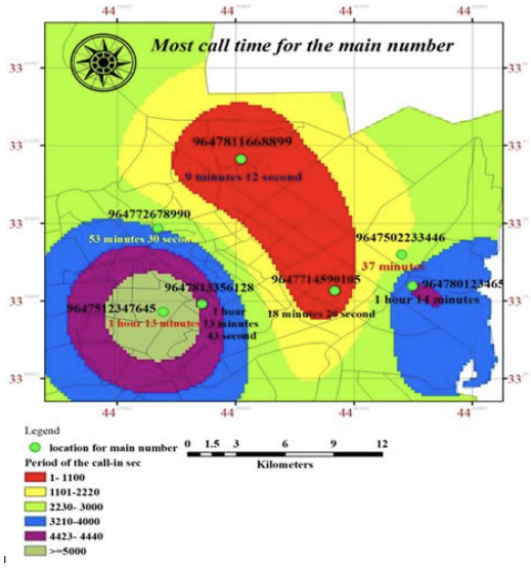

Figure 9: Most Call Time for Main Number

E. Tracking the Main phone Number Movements

In this part, a certain experiment for following up on the movements of the main phone number (the target) for one day. This is done through the location and time of the number as shown in Fig. 10. This process is often used as the last stage of tracing a specific person's phone number and it is considered one of the important stages of real access to the owner of the target number. In this part, World Street Map was used to show the details of the areas in a clear way that makes it easier for the analyzed person to track the phone number accurately and quickly.

Through the map, it is noted that the starting point for the movements of the main phone number (the target to be reached) starts from the area (Al-Baladiyat, Al-Masraf Street), and in (1/3/2021) at (9:10 AM), the target moves to the next location (Zayona Al-Rubaie Street) at (11:00 AM). The follow-up process of the target continues by moving to the site (Al-Karada, near the National Theater) at exactly the time (3:35 PM), the target moved from the Rusafa sector to the Karkh sector, specifically in the (Al-Bayaa) area at (6:22 PM), All these movements were monitored in one day on (1/3/2021). The target then moved to the next location, which is (Al-Mansour Al-Amerat Street) at (8:24 PM). The target remains in the Karkh sector, but it moves to another area (AL-Iskan) at (8:59 PM) on the same day (1/3/2021). The target continues his movements and moves from the AL-Iskan area to the area (Adhamiya, specifically near Al-Numan Hospital), and he was in this location exactly at (10:40 PM). Al-Adhamiya site is considered the last recorded site in the movements of the main number (the target) on the day (1/3/2021), at the dawn of the next day (2/3/2021) the holder of the number appears in the area (Palestine Street near Beirut Square), specifically at the time (1:26 AM). After that, the target settles in the Adhamiya area. It is the last point of his movements, specifically at (4:30 AM).

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Figure 10: Tracking the main phone number to target (for one day).

F. Further Discussion

Throughout the maps obtained via ArcGIS (especially the last map), the analyst exploits the stability and time of the target's presence at the last point to continuously follow the target. This stage is the last stage of analyzing the movements and communications of the main number. Through the stages and maps that were presented and discussed in the research project, a clear and accurate picture is formed which will benefit the recipient, especially the security service. It will facilitate their work in searching and monitoring important goals and enabling them to know good details about the identity of the owner of the target phone number, the locations of the secondary numbers connected to it, the times of the calls, the duration of the calls, and the most frequently called numbers. As a result, facilitating the task of catching the target and dismantling huge networks associated with it in an easy, simple, and fast way.

IV. CONCLUSION

In this paper, the process of analyzing and tracking a specific person's phone number is carried out by using the Kriging algorithm in the GIS program. The phone number is analyzed through specific steps depending on the time, date, and location of the calls. The steps of the analysis process are implemented using the GIS program. These steps are applied to the Baghdad administrative map used in the program. Baghdad map areas are divided into a group of multiple colors through the use of the Kriging algorithm depending on the data entered into the program (the duration of the call, the location of the main number during the call, the most frequent sites, the most connected numbers), these steps aim to reach the person holding the main number (the target) and dismantling its communication network easily and effectively. These steps have been applied in some different places and achieved success with a rate of 98% in the process of reaching the goals and dismantling networks like terrorism, kidnapping, drugs, and extortion networks. worth mentioning that during the analyzing and following up process, some problems can occur with a particular person's phone number for the following reasons: weak network, interruption of communication service, or closing of the target's phone number. This may lead to the loss of the instantaneous follow-up process of the target. Analysis of the mobile communication system using the GIS program provides clear and accurate results of the process of following up and monitoring the phone number of a particular person. The results give a clear graph of the movements of the main phone number, the places in which it is

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located, the number that it calls, and the longest time it takes during the call. The results of the analysis process directly aim to reach the number of the requested person or any number he called.

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CONFLICTS OF INTEREST

The author declares no conflict of interest.

REFERENCES

[1] Clark, M., Cell Phones as Tracking Devices. VValparalparaiso Univaiso University Law Reersity Law Review view Valpo scholar. Val. UL Rev., p. 1413, 2006.
[2] El-Rabbany, A., Introduction to GPS: the global positioning system.British and Congress libraries cataloging-in-publication data 2002: Artech house. 11.
[3] $Ng, K. - H.$ and W.K. Tang. The development of a personal mobile GIS. in 9th International Conference On Innovative Internet Community Systems I2CS 2015. 2009. Gesellschaft fÃŒr Informatik eV.
[4] Bhatia, S. and S. Hilal, Determination of Mobile Phone Tracking using Various Softwares. International Journal of Computer Applications, 2012. 53(17).
[5] Wan, X., An Android mobile GIS application for facilitating field work in the electric utility. journal HOGSKOLAN I GAVLE. 2014.
[6] Hanssen, ., Chapter-2 Position tracking and GIS in search and rescue operations, in Book Crisis Management-Theory and Practice. 2018, IntechOpen.
[7] Azad, M.A., et al, A first look at privacy analysis of COVID-19 contact-tracing mobile applications. IEEE Internet of Things Journal, p. 15796-15806,2020.
[8] Arikpo, I.I. and G.I. Osuobiem, A SOFTWARE TOOL FOR RECOVERING LOST MOBILE PHONES USING REAL-TIME TRACKING. International Journal of Advanced Research in Computer Science, 2020.
[9] Kunder, P.R., et al., The Real-Time Bus Tracking System. International Journal of Scientific Research in Science, Engineering, and Technology, p. 359-362,2019.
[10] www.latlong.net. place/Baghdad/Iraq 2022; Available from: https://www.latlong.net/place/baghdadiraq-12885.html.
[11] Esri, A., ArcGIS Online Will Change How You Think About Mapping and GIS. ArcNews Esri Summer, Vol. 34, No. 2, 2012.
[12] Goovaerts, P., Geostatistics for natural resources evaluation. 1997: Oxford University Press on Demand.