DESIGN INFORMATION SYSTEM FOR AL-NAJAF INTERNATIONAL AIRPORT

ALAA FALAH HASSAN

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DESIGN INFORMATION SYSTEM FOR AL-NAJAF INTERNATIONAL AIRPORT

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Submitted by **Alaa Falah Hassan**

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This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

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ABSTRACT

DESIGN INFORMATION SYSTEM FOR AL-NAJAF INTERNATIONAL AIRPORT

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Presently, the development of technology plays an active role in all areas of life. Geographic information systems (GIS) can provide airport management staff with visual pavement information and act as a powerful analysis tool. Meanwhile, the spatial information managed by GIS can ensure the accumulation of valid attribute data regarding airport pavement. Based on the principle and general implementation process of GIS and the characteristics of airport pavement management, this project describes the implementation process of GIS in Iraqi airport planning and design. Airports are finding that an airport geographic information system (AGIS) can help them to better manage both air- and ground-side operations; in this project, the section on the ground was the subject of the case study, represented the AGIS used in building infrastructure layers of Al-Najaf international airport buildings and pavements.

Keywords: Geographical Information System, Airport Geographic Information System, AutoCAD, ArcGIS, MapInfo.

ÖZ

AL-NAJAF ULUSLARARASI HAVALİMANI İÇİN TASARIM BİLGİ SİSTEMİ

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GIS (CBS, Coğrafi Bilgi Sistemi), havaalanı yönetim personeli için, gözle görülebilir bir havaalanı yaya kaldırımı bilgisi ve güçlü bir analiz enstrümanı sunar. Aynı zamanda, GIS vasıtasıyla değerlendirilen mekansal bilgiler havaalanı yaya kaldırımlarının tutarlı verilerinin elde edilmesini de temin eder. GIS'in prensip ve genel uygulama süreçlerine ve havalanı kaldırım yönetim özelliklerine bağlı olarak, bu proje Irak havaalanı planlama ve tasarım GIS uygulama süreçlerini tarif eder. Mekansal varlıkları etkin bir şekilde organize edebilmek için, bazı katmanların özelliklere uygun olarak yerleştirilmeleri gerekir. Yukarıda söylenenler temel alınarak bir mekansal very tabanı oluşturulmuştur. Böylece, CBS yazılımının fonksiyon tasarımı; harita keşfi, harita konuşlandırması, mekansal sorgulama, haritanın render tarzı ve harita çıktısı da dahil olmak üzere sunulmaktadır. Neticede Havaalanları daha iyi bir şekilde hem hava ve hem de yer temelli operasyonlarını yönetmelerine yardımcı olabilecek bir Havalimanı Coğrafi Bilgi Sistemine (AGIS) kavuşmuş oluyolar. Bu projede örnek vaka

Anahtar Kelimeler: Coğrafi Bilgi Sistemi, Havaalanı Coğrafi Bilgi Sistemi, AutoCAD, ArcGIS, MapInfo.

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I would like to express my sincere gratitude to Assoc. Prof. Dr H. Hakan MARAŞ for his supervision, special guidance, suggestions and encouragement through the development of this thesis.

It is a pleasure to express my special thanks to my family for their valuable support.

I don't know where life will take me as I grow older, but one thing I know is that I will never be able to be a person bigger than my father. Thanks for everything dad.

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LIST OF ABBREVIATION

DEMs	Digital Elevation Models
GIS	Geographic Information System
WAC	Westralia Airports Corporation
ESRI	Environmental Systems Research Institute
CADD	Computer-Aided Design and Drafting
RTK	Real Time Kinematic
GPS	Global Positioning System
SQL	Structured Query Language
CAD	Computer-Aided Design
IGIS	Initial Geographic Information System
AGIS	Aviation Geographic Information System
SDA	Saddam Hussein Airport
UN	United Nation
AAAE	American Association of Airport Executives
IATA	International Transportation Association
ICAO	International Civil Aviation Organization
SITA	Société Internationale de Télécommunications Aéronautiques
EASA	European Aviation Safety Agency
ATC	Air Traffic Control
RFID	Radio Frequency Identification
AIPs	Aeronautical Information Publications
ICAA	Iraqi Civil Aviation Authority
TWA	Two- Way Alternate
DWG	Drawing database (vector) (AutoCAD - Drafix) (CAD programs)
CAM	Civil Aviation Management
IGIS	Interactive Geographic Information System

CHAPTER 1

INTRODUCTION

1.1. Background

In 2005, the Al-Najaf local government decided to build up a new airport in the city to promote religious tourism in the central and south of Iraq where many scared shrines spread away. Therefore, Al-Najaf local government started to allocate suitable best location in the suburbs of the city. The best site was chosen is in the east of the city at an old military air force base. This had been abandoned by previous regime, although all civil aviation infrastructure where almost available there. Nevertheless, local authorities recommended it as small civilian airport with many plans to develop it, in order to implement plans and projects to change the city to touristic center in the region, and transference station [1].

Therefore, when Al-Najaf airport started functioning faced many problems, of which an increasing number of flights and the infrastructure couldn't cope with. In fact, the apron capacity was just for four airplanes, meanwhile the arriving flights reached 150 with total number of 21125 passengers daily [2]. However, Al-Najaf Airport authority started putting together an ambitious plan to expand the apron capacity up to 14 airplanes at the same time and to build up new terminals, new hotels, and other relevant facilities [3].

To implement above premises, a lot of activities such as designing, building, ground and air control operation, maintenance must be executed efficiently beforehand. Therefore, to cover all these premises and sites of the airport it is required composing new systems, to replace old ones and consist of the following assets:

1- Asset of Geographical Information (AGI)
2- Asset of Maintenance Information (AOI)
3- Asset of Document Information (ADI)
4- Asset of Consumption Information (AVI)

Recent developments in the Civil Aviation Management(CAM) shows that neither the delivery nor the processing of changes are not optimal, and the(CAM) should formulate a comprehensive process system consisting of designs, building up ,maintenance, and back to design again .

At the present the information technology becomes as basic platform to every business unit weather it is big or small, particularly in the airport several department. Whereas a huge information and geographical data must be process, analyzing, sorting out, and finally store it. In additions, this data eventually provide real information for decision making by airport authority. [4].

It is evident that airport management also needs sort of computer systems to deal with every movable (aircraft, land service, air controls, arrival and departures…etc.) element within the air or in the ground to make sure that every things and safe control [5].

1.2. Objectives

The primary aim of this study is to design an information system capable of covering all components of the airport by using GIS software and other applications. GIS and related applications have enormous potential for helping researchers and airport managers to find out the geographic nature of the airport and the main airport facilities and to present clear ideas about the most important operations taking place inside the airport facilities.

This study additionally outlines the findings of the questionnaire and combines the work performed in the first part of the study. The survey demonstrates that available techniques and tips are of a dramatically general and bland nature and questionnaire. The Al-Najaf Airport terminal administration model “Ground Access to Airports: A Planning Guide” gives valuable data and a good introduction to the extent and nature of the issues that the airport faces.

The main aim of this study is to evaluate the issues that have a major impact on the construction of the new facilities. In doing this, a precise study was made of previous research works on airport expansion.

The previous analysis papers that explain expansion of airfields considered factors such as aircraft noise, land use, impact assessments, and decision-making processes.

However, it is obvious that these do not seem to be the sole problems or factors involved in an extension. An additional study of papers on similar issues points out other vital factors. A number of these factors are of value and therefore of economic advantage to the new project. Other factors are the protection and security of each flight operation and therefore concern construction personnel and instrumentation.

This study, when finished, will show the key factors that ought to be considered when planning the enlargement of the facilities at Al-Najaf International airfield; furthermore, it will examine the extent and impact of such development. Most significantly, it will help the manager of Al-Najaf airfield to understand the implications of finishing such a large project, while at the same time providing an analysis of work required in areas such as cost accounting and potential economic/future advantages of the project. The major problem of this research is establishing the wide scope of the pertinent factors that will be encountered in carrying out this project. One of the major challenges facing this research is that there are no maps, earlier research studies, or adequate elevation data for the area. Therefore, much research must be carried out first to acquire adequate information in order to be able to evaluate this plan thoroughly. This involves exploring and perhaps processing other sources of information, such as Landsat images and digital elevation models (DEMs) [6]. Processing these images and models as well as the existing data of local origin also involves using different geographic information system (GIS) programs and software. Another source of information involves sourcing and reading earlier literature that is related to this project. Taking these works into consideration, writing was of immense benefit to the investigation and analysis that need to be carried out in this thesis project. These sources of information were vital to this thesis, thus adding to the reliability of the outcome [7].

This study will eventually present an electronic master sheet to assist any specialist in this field in adding new developments when required because it contains the most important information regarding the optimal conditions for the undertaking of the development and growth of airports.

1.3. Related Studies

1.3.1. Australian Airport Gains Enterprise-Wide Access To Location Intelligence Tools

Perth Airport is one of the most important airports in Australia. It is Australia's fourth largest airport in terms of traveller movement. Between 2009 and 2010 it received 10.4 million passengers and a massive increase in passenger numbers is anticipated: the airport managers estimate that in 2029, about 18.7 million passengers will pass through the airport. Therefore, the airport managers decided to expand all terminals' utilities. The Westralia Airports Corporation (WAC) looked to accumulate more information regarding the airport's requirements, taking into account various security precautions, operations, client administration, and business and administration framework elements.

Perth Airport managers chose an intelligence solution, which was to use Environmental Systems Research Institute (ESRI) GIS and Dekho software, which was developed by ESRI's Australian branch. Based on ArcGIS, Dekho helped Perth Airport managers to integrate data from databases that contain the details of the region, including property and resource management. This product takes hand the Perth airport authority to handle information successfully through different airport offices, creating an efficient workforce through several to save time in real-time. Perth Airport authority has more plans for people to take advantage of the knowledge about airport area to improve its business processes and to better understand the nature of the different elements of the site. This project by the organization aims to manage the air station's resources and support procedures, reporting clearly about airport area, and to improve the application of knowledge of operational exercises through accessing diverse GISs [8]. Figure 1 shows Perth Airport aerodrome.

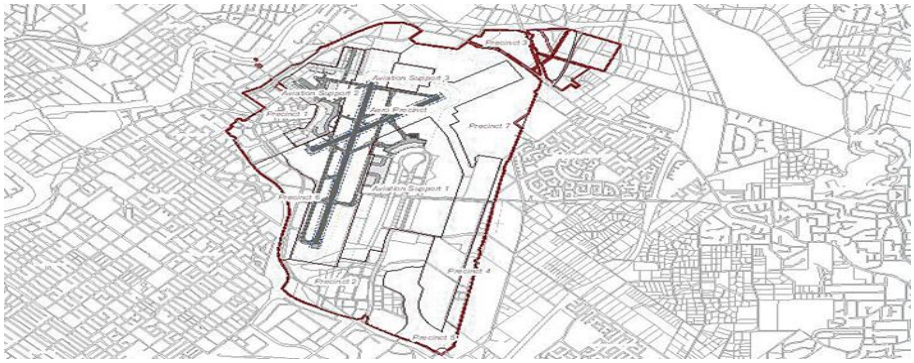

Figure 1 Perth Airport aerodrome

1.3.2. Albany International Airport, New York, Uses GIS For Pavement Management

Albany International Airport started work on a serious development plan in 1996, seeking funding from the state of New York to develop the airport using innovative methodologies. Considering the innovative methodologies, the aim was to achieve improvements in well-being and effectiveness.

In 2000, 1.44 million passengers flew from Albany International Airport, an increase of 22.5% on 1999. The key step was to create accurate maps of very high-asphalt destination areas through the use of graphics of the air station in the old design and electronic files supported in addition to the current plan and drafting (CADD) files given to the worker team, which had present big assistance to develop from new refinement by number of designer specialist staff working in the field. The company C.T. Male's GIS/GPS staff then utilized a Trimble Real Time Kinematic (RTK) GPS unit to confirm the drawings and gather key selections on the runways, taxiways, and aprons. The information was brought into ArcView 3.2 and changed over to a shape document group. The primary fundamental test was to bring all these different records into a typical direction framework. Managers at the airport used MicroPAVER's database to create an unusual database for the airport in the light of the fact that MicroPAVER's database consist of sequence modified parts. The system is the all-asphalt framework, for example, a set of boulevards or an airport. In this way, to help develop a computerized stock-take of asphalt, the MicroPAVER programming can get the GIS-empowered database to make differentiate reports, diagrams, charts, and assessment plans. To ascertain all asphalt segments, the characteristics of the area polygons were sent from ArcPad to the ArcView 3.2 plan. These plans were coded utilizing the same unusual techniques that MicroPAVER set up for its GIS reporting. And mean that ArcView 3.2 maps were presentation, demonstrating the date of review, the age of the asphalt in each segment, and the subtle elements in specific regions [9]. Figure 2 shows Albany Airport aerodrome.

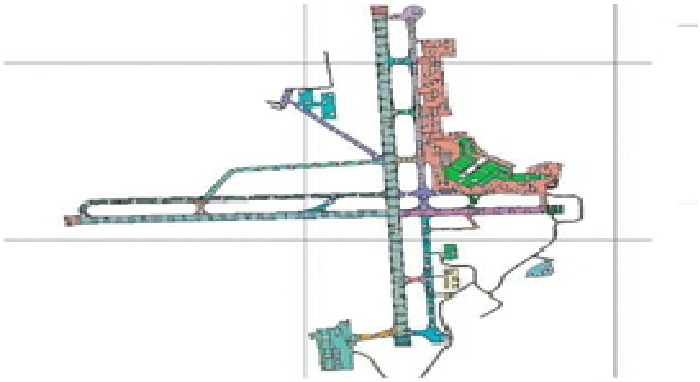

Figure 2 Albany Airport Aerodromes

1.3.3. Application of GIS/GPS in Shanghai Airport Pavement Management System

Managers at Shanghai Airport began a new plan to develop and modify pavement systems of Hongqiao and Pudong, which use GIS and GPS tools for operation and especially pavement estimate information digitally. All the subsequent data processing, analysis, and management can be done by the computer after the data are uploaded to the desktop for the storage and optimization of maintenance planning [10]. GIS capability also facilitates the programming and reporting of maintenance activities. This is often of special significance in aerodrome operations because any pavement maintenance activity must not cause unnecessary delays to aircraft operations. GIS offers a good tool to help in characterizing the airport pavement maintenance programming and planning analysis. Having tackled numerous planning difficulties featured by the aerodrome maintenance cluster, as well as assisting the directors in controlling the restricted permitted pavement maintenance, using GIS at Shanghai Airport helped to create new methods that took into account the best administration of the asphalt upkeep. Besides, utilizing this framework helps the specialists to have a much higher level of trust in the dependability of the information. The merging of GIS and GPS into a pavement management system has many benefits. By using a GPS receiver to get the exact coordinates of the specific location, all features can be located and transformed exactly. The integration between digital cameras and computers allows digital photos to be taken and stored with other relevant data attributes. Uploaded data are stored in a well-designed geographical

database, and complex queries and analyses were available for Shanghai Airport managers to optimize pavement maintenance. Furthermore, it is easy to generate the reports required by the customer through an SQL query engine [11]. Figure 3 shows Shanghai Airport aerodrome.

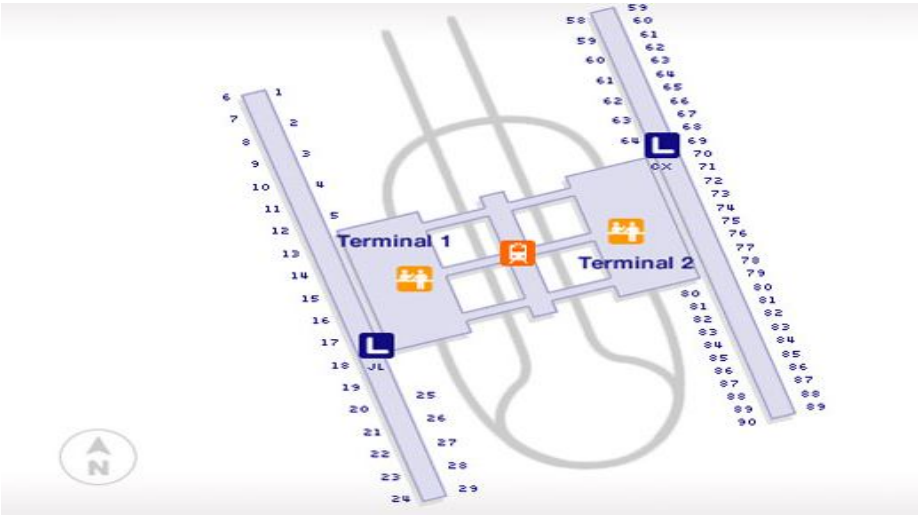

Figure 3 Shanghai Airport aerodromes

1.3.4. GIS for Airport Management – Orly, France

Airports around the world are faced with many significant challenges. As they grow in size, the need for improved ways and tools to manage areas directly impacts on the power to generate revenue. The infrastructure needed to support several buildings, runways, and accessibility is additionally under pressure to extend capacity. Meanwhile, energy, emergency, and urgent response functions should operate throughout these facilities. GIS will be used to increase efficiency, lower operation costs, and make sure crucial operations are managed properly and effectively. The first international GIS for aerodrome management was recently implemented at Paris Orly Airport to consider these problems and using GIS at the airport includes the following tasks:

1- terminal management
2- airport system
3- snow removal
4- tracking flight and noise pollution
5- security

6- traffic modeling
7- lease tracking
8- maintenance
9- environmental operations
10- emergency response

There are units that have several different ways of utilizing geographic technology; however few begin to specify the wide and varied use of GIS at intervals in airfield management and operations. Orly Airport itself could be an example, provide the airport volume and operations quality, wherever GIS present advantages in world airports [12]. Figure 4 shows Orly Airport aerodrome.

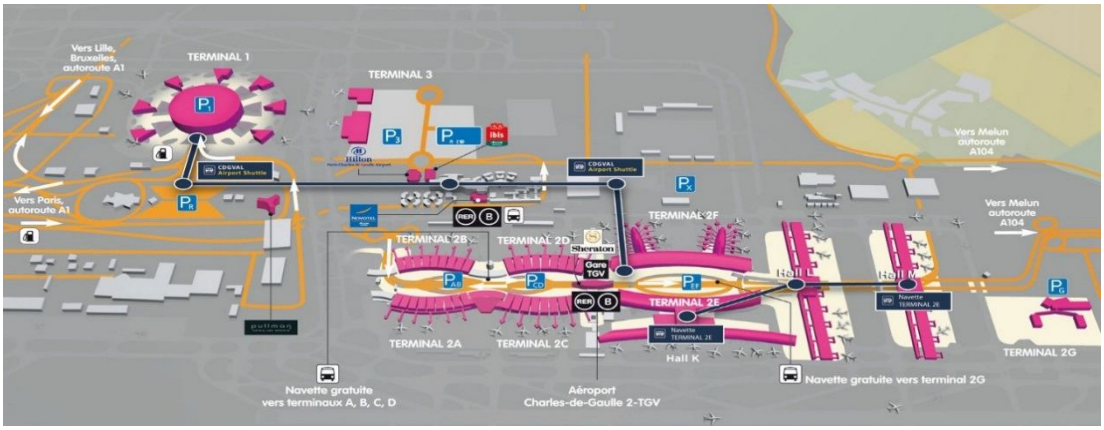

Figure 4 Orly Airport aerodromes

1.3.5. Design Ataturk Airport Information System by Using GIS

In Turkey, it is known that Ataturk International Airport is the biggest airport, which provides for 350,000 flights and 22 million travellers a year. It is conspicuous that such a so busy airport has a few issues to be considered in raising the standard of the administration for all the travellers and the staff at the airport. Also, in terms of the operation and security of the airport, it is so important that the airport management must be considerably qualify and self-relines. In addition, GIS technology provides a very clear airport image to the visitors, travellers and engineers in case of any information need for development. Airport data frameworks will be known as an operational GIS application. The most important aim of these frameworks is to improve the viability and power of the airport administration. Also, it ought to be

noted that outside data are not needed for these frameworks. The key target is to enhance the framework that indicates all components of the airport area and landscape units included. It is worthy noted that the profits made by efficient and highly evaluated GIS, airports, especially the will non airports, have utilized these frameworks to enhance and develop the managements and maintain required. The aerodrome GIS Committee has been designed by the American Association of Airport Executives (AAAE) which intends to qualify and instruct to become more specialized and maybe as GIS trainees on the future and also to deliver expanded GIS correspondence among airports. The GIS technology is presently found in a few fields and units, where it is considered a new sort of data examining and presenting systems. Needless to say that GIS as mean to reduce daily routine and minimize the issues that maybe tackled by the management [13]. Figure 5 shows Ataturk Airport aerodrome.

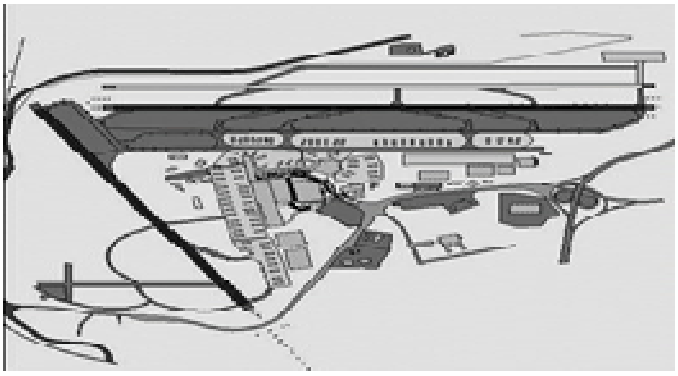

Figure 5 Atatürk Airport Aerodromes

1.3.6. Manchester Airport – Mapping Out the Future with GIS

GIS is powerful software, established and developed over several decades, that assists the transportation sector in predicting future growth. Manchester Airport has used GIS since 2001 and is one of the success stories as GIS has been used to develop its activities in order to predict future growth, to develop its business resources, and to help expansion based on planning. GIS software works throughout feeding information by third parties and the airport administration and presenting it into another format.

"*The primary role of Manchester's GIS software is to enhance passenger throughput and aircraft management.*" [14].

ArcView 3.2 GIS software was initially used at the airport. It uses maps and geographical data sets. It has the ability to analyses its own operational effect and the effect on the zone around the air terminal. Another version known as ArcGIS 8.3 was introduced later but with further capabilities such as spatial database engineering, and it is faster and more efficient at analyzing staff processes. ArcGIS 9.2 is used these days at the airport and has further operational and managerial capabilities. The airport GIS system is based on obtaining base maps from a local council that shows the land layout. Traffic data can be obtained from car park gates and congestion due to maintenance requirements. The capability of GIS exceeds expectations in terms of sound impact cause by airplanes landing/takeoff on neighboring and the other surrounding community. The overall capabilities of GIS are enormous, because it is widely used for several development projects such as city developments, predicting future growth for any airport, determining congestion, and so on [15]. Figure 6 shows Manchester Airport aerodrome.

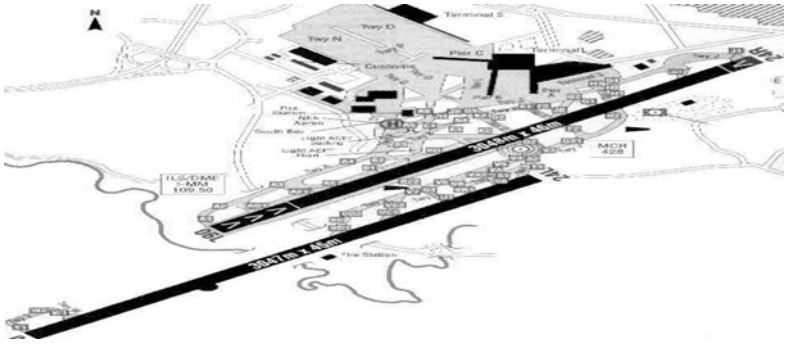

Figure 6 Manchester Airport Aerodromes

1.4. Organization of the Thesis

This thesis contains four chapters, which include all the necessary information about a design information system for Al-Najaf International Airport, methods, and applications used for analysis and design of the layers and data set.

1- Chapter 1 is an introduction to the history of Al-Najaf International Airport and how it is site was selection, number of flights, number of passengers, and important facilities, the objectives, and related studies.

2- Chapter 2 includes comprehensive overview of GIS, its importance and components, its usages and applications. Besides that the Iraqi airports and GIS, parts of airports, and the importance of GIS in airports are reviewed.
3- Chapter 3 deals with historical overview of Najaf airport and the methods used for gathering information and converting it from paper to electronic data by using AutoCAD maps which are used in GIS. Other programs are used to design an interface and to explain all the parts of this interface in addition to the code used in programming.
4- Chapter 4 is dedicated to the conclusions and future work.

CHAPTER 2

GEOGRAPHIC INFORMATION SYSTEM

2.1. History of GIS Development

Roger Tomlinson was the first known person how used the expression “Geographic Information System. Twentieth century advancements in photograph zincography allowed maps to be divided into layers, such as vegetation layer, water layer, and others. This was especially utilized for printing and drawing physical sites when all layers are inevitable arrange it would produce a clear image; otherwise alternatives would confuse the designer. In fact, the utilization of separate layers, with specified colors became major symptoms for GIS. This photographic methodology is not thought to be a GIS in itself, but merely maps and pictures without database to connect them [16].

Recently, Computer high technology developed by atomic weapon investigation prompted broadly useful technology for “mapping” applications by the early 1960s. GIS innovative technologies use advanced digital data, in-order to analyze various digitized data and to create new methods to be used in computer systems. Digitization is the most well-known strategy for information creation, where a hard duplicate guide or study arrangement is moved into a computerized medium through the utilization of a CAD system and geo-referencing abilities.

Due to the wide accessibility of more than one resource that is provided from both satellite and airborne sources, heads-up digitizing is turning into the fundamental route through which geographic information is processed. Heads-up digitizing specifically includes the following geographic information on top of the aeronautical symbolism rather than using the conventional system of following the geographic structure on a different digitizing table (heads-down digitizing) [17].

2.2. Geographic Information System

Although a lot of articles and literatures had been published, but many GIS subjects are still to be investigate. In this thesis the researcher tries to shed light on two aspects; the first is how to apply the GIS data in the AL-Najaf airport and the second how to relate all the events that may be taken place in the airport and converted to the GIS data, this can be described in Figure 7.

The GIS is one of the systems that enables and supports the decision-maker, to find the integral of the defined spatial data within its environment, as well as, it helps to analysis certain data on every physical location in the required area [18].

Nevertheless, GIS can be convert data into digital information for public users and also decision makers to discuss and suggest alternative resolutions which may face airport management [19].

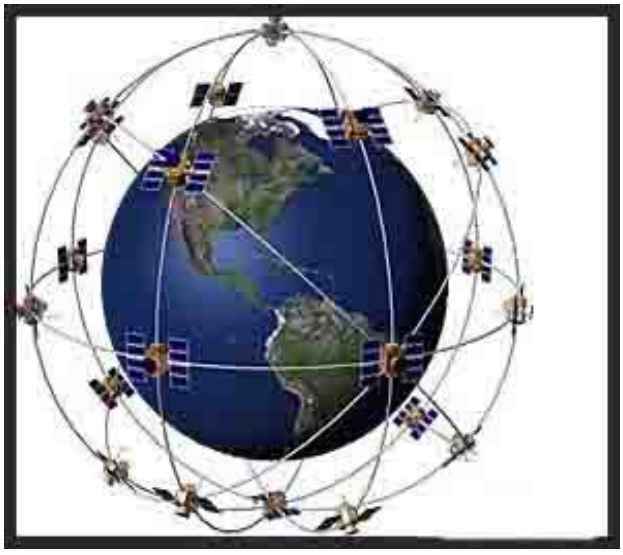

Figure 7 The position of satellites in their orbits

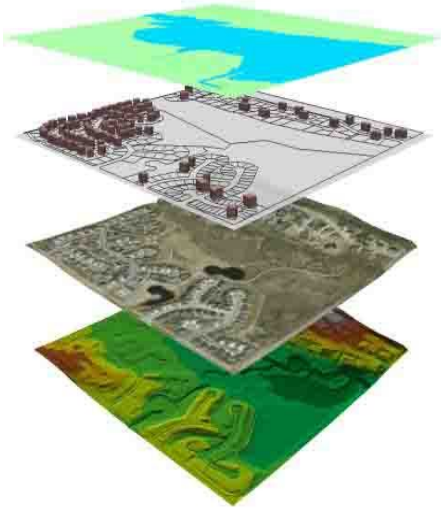

Figure 8 Map layers.

Therefore, generally speaking GIS can be utilized for collecting, analyzing, and introducing spatial information and stored in the GIS database. Spatial analysis of the information performed to create suitable data layers that can be added to consolidate a few guide layers into one, as demonstrated in Figure 8. Spatial information layers can be display on types of maps, reports, and graphs. GIS examination evolving

quickly, including logical devices such as standard compact facilities or discretionary apparatus sets and include add-ins or "examiners" [20].

However, this information provided originally by software suppliers such as business companies or non-commercial cooperative groups. In the meantime, GIS facilities new development tool and provided by the others. Also, some items offer software package, such as, programming language, scripting assistance, and/or exceptional interfaces programming for creating one's own exploratory analysis or variations. Some websites such as "Geospatial Analysis" and related books or digital books could provide a sensibly manual for the subject. And may create a new diminutions and perspectives to business service none (spatial intelligence), which commercials through Intranet freely, open access to geographic and interpersonal informatics organization. Geospatial intelligence depends on GIS spatial analysis to become a key component of security. So the GIS can be utilized as a part of numerous fields as shown in Figure 9.

Figure 9 Fields of application of GIS.

In addition, GIS enable clients to (collect, store, process, and test) spatial information on computer system. They give an electronic representation of data, which means the disruptions of those physical features and other ground natural sites [21].

A GIS reference which is providing elements of data that could coordinate among systems. These features can be classified into different layers and stored in GIS systems to facilities analysis visualization. Thus environment data and demographic

information land use climate changes and flooding can be analyzed and presented by GIS. Therefore various applications can produce and use various layers, such as attributes of list information, demographic data, natural and environmental information, streets, area use, waterway seepage, surge fields, can be displayed in GIS. Also, distinctive applications can create and use diverse layers.

Although GIS can save symbol data, which is explains information through the map saved independently database but eventually connected to them, and present assistance to check the spatial data and data symbol in same time. Nevertheless, GIS give help to the user to find the data symbol and link it with spatial data [22].

Therefore, GIS can relate geographically with different types of information to create maps and reports, allowing clients to (*collecting, managing, and translated*) area-based data in a structured and efficient way. Thus after (*collecting, sorting, and modifying*) data, GIS could present it as geographical information which based on certain requirement.

GIS systems are flexible and have high speed in update, analysis, and display. GIS can be gathering data from different resources such as images from satellite, aerial photos, maps, ground views, and GPS, which used commonly in GIS. Also, it is frequently use in service management such as electric sources, gas, water pipes, roads maps, telecommunication, storm sewers, and transmitter facilities of TV/FM, hazards analysis, and services of emergency [23].

The street network, tourism as shown in Figure10, topographic data, demographic data, and administration of local government boundaries are the typical data input.

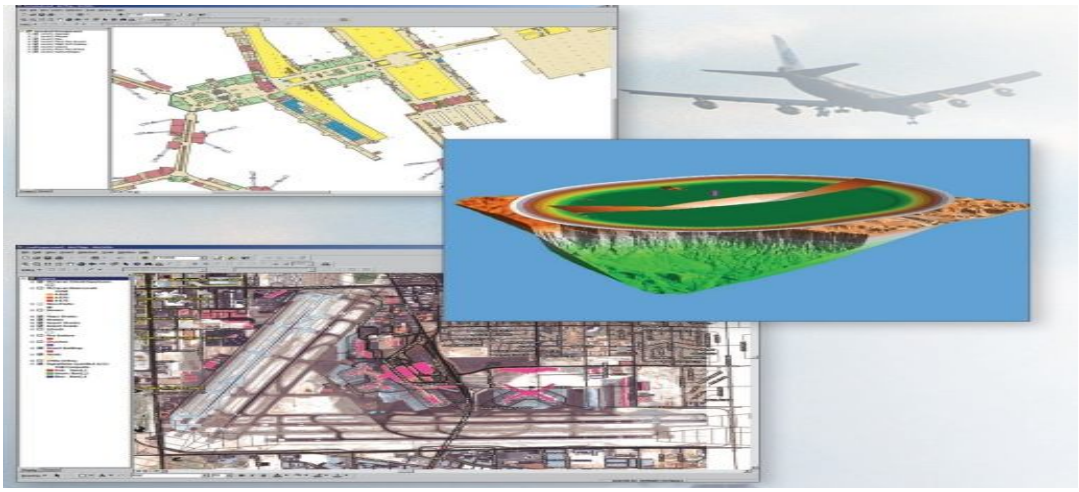

Figure 10 GIS in Tourism.

2.3 GIS Methods

GIS can be defined as a scientific way or group of methods or management to organize geographic data by using technological equipment. So, if we consider the three parts of the term separately, we find that "*geographic*" means everything related to maps, coordinates, the earth's surface, and so on, while "*information*" describes every detail and data arranged in a data set inside a database, connected to describe the geographic area, and the "*system*" shows the users or researcher the (H/W and S/W) that can be used to create a mix between geographic maps and information to be transformed from paper status to electronic status by using computers and other devices. Therefore, this developed science provides a representation of geographic information to the users or researcher in a short time and with high accuracy by using modern technology [24].

The huge continuous need for storage and processes to present complex data in the last 25 years has pushed most users and researchers to establish or develop new systems for storage to process spatial data by using technology, which represents in computer software especially one of the most important applications in computers. Recently, GIS has become the best and most useful tool in planning and management. GIS provides reliability and speed performs for a large amount of data in a short time and at low cost. GIS support researchers to make correct decisions when they want to resolve different kinds of problems. Finally GIS is considered the best tool for collecting and analyzing data obtained from different sources [25].

2.4. Maps and Spatial Information

The main method of identifying and representing the location of geographic features on the landscape is a map. Map is a graphic representation of where features are, explicitly and relative to one another. Map is composed of different geographic features represented as points, lines and/or areas. Each feature is defined both by its location in space (with reference to a coordinate system) and by its characteristics (typically referred to as attributes). Quite simply, a map is a model of the real world.

The map legend is the key linking the attributes to the geographic features. Attributes, such as the species by a forest stand, are typically represented graphically

by use of different semiology and/or color. For GIS, attributes need to be coded in a form in which they can be used for data analysis. This implies loading the attribute data into a database system and linking it to the graphic features.

For geographic data, often referred to as spatial data, features are usually referenced in a coordinate system that models a location on the earth's surface. The coordinate system may be of a variety of types. For natural resource applications the most common are:

- "*Geographic coordinates such as latitude and longitude, e.g. 56°27'40" and 116°11'25". These are usually referred to by degrees, minutes and seconds. Geographic coordinates can also be identified as decimal degrees, e.g. 54.65°.*
- *A map projection, e.g. Universe Transverse Mercator (UTM), where coordinates are measured in meters, e.g. 545,000.000 and 6,453,254.000, normally projection to a central meridian. Easting refers to X coordinates while Northing refers to Y coordinates*
- *All geographic shapes on the earth's surface can be symbolized as three fundamental sorts of shapes. Such as point, line, and aerial in GIS programming.*
- *Point shape: mean data exist when a shape is organized in a solitary area in space. Illustrations of point peculiarities include a correspondence tower, radio station, electricity site, and others.*
- *Linear shape: mean data exist when a shape's area is depicted by a string of spatial directions. Cases of straight information include streams, streets, pipelines, and so forth.*
- *Area shape: mean data exist when a shape is portrayed by a closed string of spatial directions. A zone shape is regularly called to as a polygon. This is the most widespread sort of data. Cases of polygonal information include forest stands, soil grouping ranges, regulatory limits, and atmospheric zones*" [26].

2.5. Data Accuracy and Quality

The nature of data hotspots for transforming GIS is becoming a regularly expanding concern for GIS programming specialists. With the stream of GIS applications on the business market and the fast programming of GIS innovations to take care of issues and put new terms for making choices, the accuracy of quality for GIS items is coming under closer examination. Much investment has been increased up as to relative mistake that may occur in GIS performance strategies. While project develop forward, and there are no rule have been yet appear in the GIS market, there are many stable recommendation can help to find mistakes, and guessing the quality of data resource [27].

2.6. Components of GIS Technology

A GIS in any association can only be successful with the provision of technology, data, association, methods, and structure of schema as GIS components. Also it can be seen as a software package in which the components are the different tools used to enter, manipulate, analyze, and output data. These important components can be described as follow:

- **Computer**: indicates to the hardware is the machine on which a GIS is executed. The product deals with a wide range of types of equipment, from primary machine servers to ordinary machines utilized as part of a stand-alone or machine system. GIS programming helps the capacities and instruments needed to include information and store geographic data [28].
- **Data**: Data is important and essential part in GIS. Geographic information, which consists of geographic shapes and attribute data. It is input data into a GIS utilizing a strategy called digitizing. This consists of digital features of geographic shapes, such as structures, streets, and district limits. Digitizing occur in many sections of any area, i.e., path, or boundary of geographic shapes where displayed on a computer screen by utilizing a checked paper outline as part of the foundation, or a delineated paper is connected to a digitizing tablet [29].

- **People**: The main part of a GIS is people whom use it. In the past, computers offered assistance for users, such as firms, schools, and organizations to buy. Therefore, GIS users increased dramatically in short time and exceeded those experts in this field. Today GIS is generally utilized by people in many various fields, such as helps people to improve their work, thereby making them more effective. Police use GIS to trace criminal acts and principal administrators at police headquarters use GISs to respond to crisis calls in general.
- **Methods**: A good GIS performance based on excellent plan and good designs for basic business and every organization have unique process. As in all organization have sophisticated technology, new devices must be utilized effectively, they are merged appropriately into the whole business procedure and operation. To do this appropriately requires not just essential improvements in equipment and programming but also the retraining and/or positioning of staff to use the new innovation in a suitable organization context. Failure to finish a GIS without consideration of a suitable organizational duty will bring about an unsuccessful framework [30].

2.7. Importance of GIS in General

GIS is an essential in general terms, because GIS in the present time important for government fields and private fields, so, GIS must be establish on correct condition to support geo-spatial technology. Therefore GIS provide integration between two parts m first image/map and geo-tagged and arrange it based on specific GIS. GIS can be redrawing the spatial distribution by using the feature (e.g., allocation of constructing or allocations of streets in a city, etc.), so, there are a relation between entities inside spatial distribution (e.g., allocation of constructing to streets or electricity system to emergency centers, etc.), and the association of numerous spatial variables in geographic space (e.g., in a region, a watershed, a country, or the entire earth itself). Thus, nowadays GIS systems help to create map visualization and design adjustable spatial of a data set, for example, information on population, movement, clients, monetary operations, beneficiaries, and so on, accordingly

permitting the production of population maps and costumer maps and their visualization [31].

Applications of GIS is necessary in many fields in countries and nation building and can help to achieve the benefits of advancement for the most needed people in the most needed areas by using a clear methods. Consequently, GIS can provide the strategies in a country by impacting on residents by making data accessible in a clear sort of guide and furthermore helping to fulfilled responsibilities and obligations of general administrative exercises. Applications of GIS put an important role in the scope of social administration as well as in zones of administration and national security to help in vital regions. In the meantime, GIS can also help organizations; by enable spatial resolution to support their organizations, exercises (either in private support of nation-building or in the proficiency of organizations). Population too can also benefit from GIS by reinforcing the mapping of their aspiration, demand, impeachment, and recommendations that help in business to provide national development. There is many firms brings data into the country and analyzing it to reach potential and quick procedure. Arriving at these objectives will be critically based upon the nature of choice-making at all levels: the request will be in exploratory, conceivable, and participatory choice-making that can convince society and improve personal satisfaction at all levels [32].

GIS plays an effective and extensive part in supporting choice-making methodology. Henceforth, the GIS concentrate on decision support and attention must be push to enhancing the nature of choice-making. GIS can be a significant differentiator for choice-making at all levels of administration and country building, whether in government, in ventures, or by population, state, or local-body levels, or for long-term arrangements or prompt choices. GIS concerns pictures and maps and must capture a host of spatial information representations of geo-labeled formative information tables, all of which include the "coordinated" GIS determined as Interactive Geographic Information System (IGIS) content for the country [33].

It must be realized that simply delivering the best satellite picture, best topographic maps, best forest maps, and so on is only a part of the issue dealt with by a GIS decision-support. Unless these are disappear with extensive volumes of government improvement information, the second half of the decision support is not covered.

Today, with such a promptly accessible and effortlessly usable "incorporated" GIS content not accessible in the country, our national decision-making procedure is constantly precluded from securing this essential differentiator and decisions that not only fail the advantages of the GIS approach but are also unable to try and gain the advantages that can be collected from the basic utilization of pictures and maps [34].

Structurally, the government is arranged in division – in this manner information accumulation and mapping are additionally sectorial – but what GIS can do is enhance data by incorporating these "sectorial systems" into a coordinated information framework. Such a "coordinated" GIS data set can be effectively super-imposed related to bringing new topographical information, and can bring a logical viewpoint of choices as well as help to take the right choice –alternatives down to general level. This will enable settling on better and good choices help to achieve manageable improvements with a participatory methodology.

Today, users need GIS-ready information help the user to access and use without too much difficulty (however pockets of GIS-ready information may be produced by some organizations in a particular task mode). Despite the high quality satellite pictures, amount of study and mapping in a type of topographic guide, forest maps, statistical information, and even picture information and so on, when arrange these things into a GIS-ready there are a little problem in structure still exists. Therefore, the prospective GIS user needs to put huge effort into arranging GIS-prepared information from these maps/pictures for decision support activity. Thus, often regardless the fact that a user needs to utilize GIS for decision-making, he or she may be demoralized by the huge mechanical "handling" one needs to perform, and for that could not use the scope of GIS to support his decision-making [35].

There is another major aspect that needs to be addressed to make GIS a part and parcel of the decision process. If GIS has to be embedded into a work or decision process, then it needs to be ensured that the GIS-ready data are constantly updated so that data are fully up to date for the governance process and usage. Further, there are new sets of GIS-prepared information that become conceivable with advances in GIS engineering, for example, maps on a 1:10,000 scale or bigger, and study the area possession once again information, territory information in 3D; underground stakes GIS information in urban communities, swarm-sourced information must be

protected, and guaranteed to protect GIS client and consistently enhances the GIS choice help benefits.

Empowering a wide utilization of GIS-based choice help additionally obliges a building approach environment for GIS far beyond the current arrangements and makes a “coordinating” and general arrangement structure [36].

While government has the Remote Sensing Information Arrangement 2011 for remote sensing pictures and the National Guide Strategy 2005 for use and spread of such is topographic maps, these basically refers to individual, but basic parts of these map consist of dispersal of pictures and topographic map. GIS is essentially more than basic pictures and SOI maps [37].

There are no meaning methods and terms for the extent of GIS activities that are important for the decision support – both GIS data and applications management collecting data and those applications use point 10 of viewpoint. Thus, there is a need for a careful GIS approach that overlaps the current pictures with plan definitions on topographic maps and additionally covers the scope of activities of a GIS and that would publicize and stimulate wide GIS use [38].

It appropriate to manage the GIS practice , under a legitimate focus that could be reliable and focus on keeping an eye on the mechanical GIS data, in the middle of various levels and methodological parts of a GIS. Immediately, every administration/division or customer component attempts to address to every unit in GIS activity, which is really, an engineering concentrated development and requires downstream geo-changing and GIS data for sorting out the GIS. Therefore, various exertions are being performed in maintaining the GIS information ability by every service/division and the same GIS information is constantly created and maintained by every service/office. This prompts large scale duplication and unnecessary effort, prompting huge national-level information disagreement in an unstained way. There is a requirement for a solitary Windows application for creating and maintaining the guide or picture and GIS data sets as typical GIS-prepared information for the country and for creating the GIS applications for services or offices. This would reduce the different exercitation and enable service/division and people can take advantages of GIS choice help [39].

From a worldwide point of view, GIS is becoming a basic ability that gives an innovative edge to countries. In today's changing world, countries that have a developed and dynamic arrangement of GIS would lead and outline courses in their national arena and in the global arena a long way ahead of those that utilize more customary types of data administration. GIS engineering is gaining basic importance in worldwide and multilateral systems, such as attending to cross-cutting issues in the environmental domain, waterways/seepage systems, as shown in Figure 11, fringes, environmental change, and even national security participation and border, especially as keeper supplies and frameworks are focused around the utilization of geospatial innovation. It is genuinely necessary to orchestrate a national GIS ability worldwide with its own specific GIS arranged data, satellite pictures, GIS applications, and GIS base. Along these lines, it is essential that the nation engage in GIS development with a data capacity that would not simply help bring the benefits of GIS to its own specific national efforts towards change but also give it an edge in the overall world. A national GIS will hence give that mechanical edge in the worldwide world.

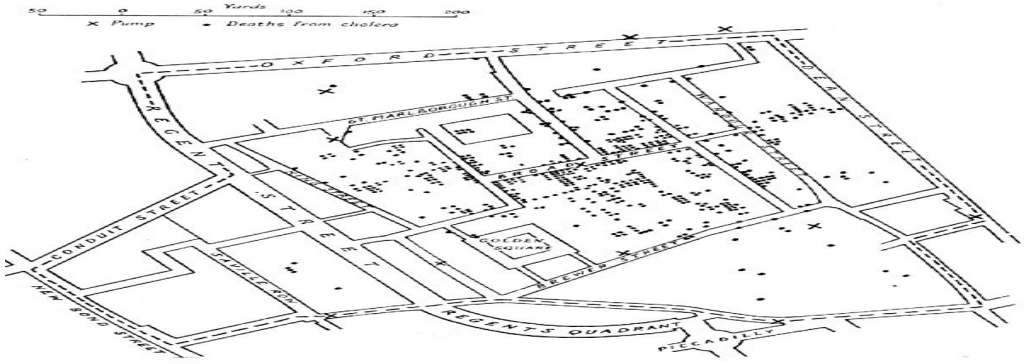

Figure 11 GIS Frameworks

2.8. History of airports in Iraq

According to statistics, in 1999 Iraq had a total of 113 airports, spread across small, medium, and large-sized airports, some military and others civilian. Some of these airports had unpaved runways while others were suitable only for helicopters. Some of the major airports in Iraq are described below.

1. **Baghdad International Airport:** This is the largest airport in Iraq and is located 16 km west of the capital Baghdad as shown in Figure 12. This airport name had the navigational symbol SDA, which has now changed to

BWG to symbolize the old name of the airport. This airport was built by French companies between 1979 and 1982, cost more than $900 million, and was designed for both civilian and military use, with a capacity of 7.5 million passengers annually [40]. Three major gates were built at the airport: Babylon, Nineveh, and Samarra; these names were changed after the 2003 invasion of Iraq to gates A, B, and C.

Figure 12 Baghdad International Airport

2. **Basra International Airport:** This is the second largest airport in Iraq after Baghdad International Airport. Built in the 1960s and developed and reconstructed in the 1980s, this airport was closed for a long time during the first Gulf War and in the second Gulf War during the invasion of Iraq in 2003. It was opened in 2005 for a Boeing 727 plane coming from Baghdad, the first plane to land at the airport after it reopened, and domestic flights between Basra and Baghdad began in the middle of 2005, as shown in Figure 13[40].

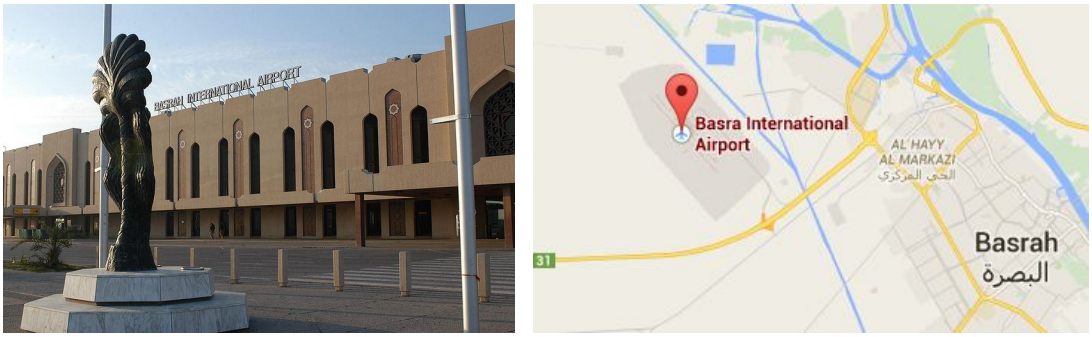

Figure 13 Basra International Airport

3. **Mosul International Airport:** This is the third largest airport in Iraq, built in the 1920s as a base for the British Army and converted to a civilian airport in 1992. It is located in the province of Nineveh, but the airport was later

developed in order to be recognized as an international airport globally, which was accomplished. After restoration work and development it was opened in December 2007 for the first trips to transport pilgrims to the Holy Land. This was achieved with the completion of all the procedures that were accomplished when the airport updated all technical conditions and was professionally transformed into an international airport ready to receive and provide services for all types of commercial aircraft. This high efficiency in the management of a prestigious institution such as Mosul Airport in operating flights to Iraq's neighboring countries enhanced the status of the city of Mosul. This helped in supporting the present and future economic advancement of the city. It has an air traffic control tower with new high-tech specifications and has more aeronautic development devices, as well as communications, making it stand out among airports that offer high quality navigation services in the Middle East [40].

4. **Al-Najaf International Airport:** The opening of Al-Najaf International Airport, from which return flights around the world can be taken, was officially carried out in the summer of 2008 [40] as shown in Figure 14.

Figure 14 Al-Najaf International Airport

5. **Erbil Airport.** This was opened in mid-2005 in the northern region of Iraq for trips to Turkey, Jordan, and some European countries as well as the Arab countries [45], as shown in Figure 15.

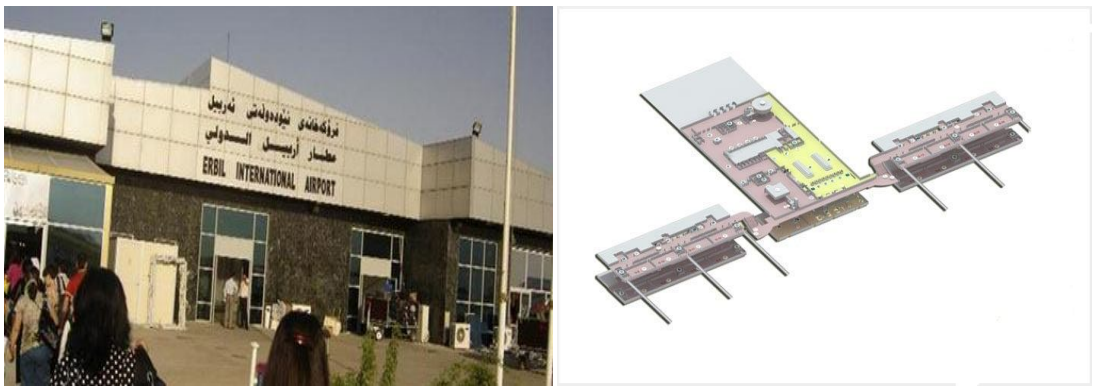

Figure 15 Erbil Airport

2.9. Airports and Airport Operations

The aviation fields are an important in transmission process. It is the physical site that transfer take ground place which control between the aircrafts in the air and land service [41].

According to the definition given by the United Nations, an airfield is a delineated space, on land or water (counting any structures, establishments, and gear) that is expected to be utilized either totally or in part or half for landing on and take-off from the surface.

Guaranteeing protected and secure flying is extremely exact and complex work and contains four principal parts:

1. Flying field operator
2. Airline
3. Movement control
4. Ground handling service

The following names most common agency that put rules and standardize for aviation around the world:

1. International Transportation Association (IATA)
2. International Civil Aviation Organization (ICAO)
3. Société Internationale de Télécommunications Aéronautiques (SITA)
4. European Aviation Safety Agency (EASA)
5. Euro Control

The main goal or objectives of support degrees of an airfield are:

1. Different sorts of entry end flights and helpful for helicopters
2. It can have just passengers or just freight activity

3. Centre point

The after effects of a support degree airfield on the surroundings are:

1. Positive impacts: regional improvement
2. Negative impacts: pollution, noise, and so forth.

The flying field limitation: the number of passengers and size of shipment that will be loading in specific period, and often measured in hours. Flying field classifications airports may be arranged in a number of ways:

1. Performed kinds
    1.1 Civil
    1.2 Military
2- Range
    2.1 Domestic
    2.2 International

2.10. Airport Parts

An airfield is split into the airside and components. Every part acts completely differently; however operations that are vital for safe and secure shipping are given particular consideration. On either side there are some measures to spot and monitor several stable or moving objects and other measures are taken by the staff according to the definitions given:

2.10.1. Fixed Parts in Airport

The stable parts (objects, items) in the airport are:

1.1 Runway
    1.1.1 Guard lights:
2.1 Landing direction indicator
3.1 Physical beacon
4.1 Light-weight capacitor discharge
5.1 Clip
    5.1.1 Holding position
    5.1.2 Flip pad
    5.1.3 Strip

5.1.4 Runway finishes safety space

5.1.5 Threshold

5.1.6 Stop approach

5.1.7 Shoulder

5.1.8 Markings

2. Apron

2.1 Craft stand

2.2 Outer parking position

2.3 At the terminal building:

2.3.1 Service roads

2.3.2 Frontage road holding position

2.3.3 Holding bay

2.3.4 Markings

2.10.2. Moving Parts in Airport

The moving parts (people, items) in airport:

1. People
   a) Passengers
   b) Permanent workers functioning at the airfield (e.g. ground handling workers, airline crew, airfield workers, etc.)
   c) Temporary workers entering the field
   d) Passengers' relatives, personal guests
   e) Official guests entering the airfield
2. Items
   2.1 Aircraft
   2.2 Ground support equipment
   2.3 Vehicles of staff and guests
   2.4 Individuals moving between terminal buildings
3. Buses
4. Train

2.11. Airport Functions

Aero plane terminal capacities are measured in close collaboration with carriers and functions. These are:

2.11.1 ATC Tasks on the Ground

1. Specialized instrumentation for methods and take-off operations (e.g. runways, taxiways, holding positions, secure strips, airside markings, and so on)
2. Ground navigation instruments and lights at the flying field
3. Air traffic controlling consists of:
    - 3.1 ATC
    - 3.2 Preparation for arrival
4. Flight and aircraft
    - 4.1 Flight planning
    - 4.2 ATC
    - 4.3 Air weather service (meteorology)
    - 4.4 Flight set-up
    - 4.5 Giving advice for the flight
    - 4.6 Final flight set-up coordination with the commander
    - 4.7 Operations control: required archives for operation
    - 4.8 Fuel needs
    - 4.9 Passenger list
    - 4.10 Shipment list
    - 4.11 Requirements for ground handling services
    - 4.12 Load sheet
    - 4.13 Captain's signature
    - 4.14 Aircraft ground handling
    - 4.15 Traffic control (not significant for this work)
    - 4.16 Terminal ground handling
    - 4.17 Travellers
    - 4.18 Baggage
    - 4.19 Cargo and Air Mail Handling

2.12. Integrated GIS with Airport

GIS is the best system to coordinate all stationary and moving components at an airport by checking, monitoring, and detecting their current locations and undertakings. For distinguishing, checking, and tracking the moving parts for terminal operations, the best present innovation is RFID. GIS conjointly allows joining of feature recordings and observations. Recognition of moving segments happens both in time and non-real- period, at reading point and consistently. RFID can be incorporated into GIS [42].

GISs, information technology (IT), and identification (RFID) can be utilized for explaining related track moving target by a confined building such as an aerodrome. Currently, GIS is utilized at the aerodrome for base administration and use ATC with new data to trace the vehicles inside aerodromes. The application not represent chase rider, packages, crew, and ground processing units incorporated into a run-of-the-mill GIS framework with RFID.

So by using GIS and related applications to study and improve Al-Najaf Airport's facilities and to make a solid structure for airport management when trying to build new buildings or rapier-pacific roads, GIS becomes an important part when any airport management in the world wants to expand an airport, because GIS provides easy-to-use multi-tools for researchers to support them in their work. Most managers of airports and construction companies started to use GIS not long ago, developed many applications to help them overcome many of the problems and obstacles, and found many solutions enabling them to finish rebuilding, repairing, or add new additions to specific locations within the airport. GIS was first applied to aeronautics around the 1980s and was used for the merging of navigation charts, route manuals, and aeronautical information publications (AIPs). Founded in 1990, a Dutch organization created an explanation system to see GIS; however GIS (ArcInfo) was utilized into command and maps in addition administration space to arrange the security and administration association. It might be only connected as a piece of a mixed media framework with further improvements such as footage, features, and sound in order to provide detailed information for the decision makers [43].

The landing strip framework administration utilizes GIS broadly for enlisting stationary items (e.g. property). The activity administration uses GIS with additional data (essential and optional measuring gadgets, GPS) for tracing aircrafts and runway vehicles at different period at the air terminal.

Nowadays, each primary runway contains a GIS considering the surface and/or airside:

1. Airspace management
2. Landing strip monitoring
3. Flight trace (ongoing)
4. Information about management
5. Offices and lease management
6. Runway layout outlining
7. Pavement, parking, and sign management
8. Utility and facility management
9. Noise monitoring and modeling
10. Ecological assessment [44].

Our national aviation system faces growing constraints on aerodrome capability and increasing prices for users through aerodrome delays. Growth in traveller traffic is expected to double at intervals of 17 years; nonetheless, the construction of new airports will not keep pace with the ever-growing demand. The monetary burdens on the Iraqi airlines' trade since, release have been well documented. In 1991, nearly all Iraqi airline companies lost money. Airport expansion and modernization under the federally funded aerodrome improvement programmed for aerodrome construction have decreased in the last 10 years, even if contributions to the aviation monetary fund have inflated. Consequently, airports compete among themselves to supply a better service at lower cost to the airlines for public transportation. The technique of jump forward at airports is aimed at boosting engineering, management, and decision-making by doing a stronger job of managing information. The introduction of a multiple-user, multiple-application GIS is one way to scale back prices and improve aerodrome capacity with scheduled airline traffic [45].

2.13. GIS Solutions for Airports and Aviation

Given the potentially dangerous nature of flights, particularly during take-off and landing, airports must stay in high level of performance at all times of the year, sometimes under challenging circumstances. Air terminal directors cannot bear the cost of long downtimes or unfavorable mistakes in execution. They must arrange and maintain their offices high performance and recognize potential reasons for mistakes well before a mistake happens. For a long time, air terminal administrators have used GIS to support their endeavors in preparing, operations, support, and security by including spatial data and visualization. GIS provides one kind of data and expository abilities that are not accessible in other data systems [46].

Business aerial shuttles and aviation authority controllers use GIS for airspace planning and directing applications and for office administration applications. Late upgrades to three-dimensional GIS help in airspace fields applications to be joined with geographic data from local environment, for example packages, area use, building heights, new developments, and altered landscapes around the air terminal. GIS programming considers a more noteworthy level of interoperability with other key programming apparatuses, for example machine-supported drafting (CAD) systems and social database administration systems. Clients can now exploit data captured by computerized aerial photographs, which can be input topographically, giving incredible foundation layers to mapping applications. Huge development in traffic has left numerous air terminal properties extremely short of space. GIS can be incorporated into property administration applications, enhancing precision and opportuneness in reacting to property data demands [47].

2.14. Airport Development

An airport is established in a particular situation not as an individual unit but as part of a network for the entire region or the country so as to ensure integrated long-range development. Before planning an airport, every detail has to be worked out in an orderly manner for a particular set of conditions, such as the potential air traffic originating in the vicinity, the number and types of aircraft that are likely to use the airport, its location with respect to nearby airports, whether it is going to be

used for commercial, diffuse, or mixed traffic, and the actual needs of the area at present as well as future anticipated requirements. On the basis of the proposed development of the region, an area airport plan or a master plan is usually prepared and the establishment of new airports or extensions and improvements of the old ones continue steadily according to the new needs. The master plan, which is a written and graphic documentation of a complete earlier analysis, the evaluation, the location, and so on, includes information about:

1. The evaluation of existing airport facilities
2. Anticipation of future facilities
3. The relative priorities of the component parts, so that only an appropriate type of airport is provided in any place [48].

CHAPTER 3

PROPOSED SYSTEM METHODOLOGY

3.1. Study Area (Al-Najaf International Airport)

Najaf airport is considered in the previous period, an air base set up by the Iraqi air force in 1980, but they are rarely used runway to fly. After the recommendations of the Iraqi Civil Aviation Authority was considered commercially airports in Najaf province.

According to standard rules and recommended practices cited by the International Organization for Civil Aviation in the design criteria in Iraq, it officially opened on 19 November 2008.

Al-Najaf Airport is located southwest of Baghdad at the intersection of latitude 31° 59.4' north and longitude 24.2° 44' east. The runway width was increased from 10.28 to 45 m with the construction of a shoulder width of 7.5 m to support the design of the aircraft in preparation for the expansion of the runway after the analysis of the geometric details in order to determine the real capacity of the runway to determine the requirements of the coverage of the (30 m) average for runways. It has also expanded the aircraft yard recently to accommodate more than 15 aircraft. A new system has also been installed, namely high-density lighting of the runway with an accurate indication of the corridor approach and lighting setups and indicators of wind direction on both sides of the runway. Runway markers and signs define the direction of the main runway from the point of entry of the airport to the passenger terminal and then to the runway and vice versa. When the airport is reached, there are administrative divisions and operations and the airport has a number of employees at the airport who are both Iraqis and foreigners.

There are 1550 employees in all the departments of airport. Currently contracts with the airlines at the airport in Najaf and international operating companies are listed as below:

1. Iraqi Airways
2. Taban Airlines Iran
3. Emirates Airline
4. Mahan Air
5. Fly Dubai
6. Turkish Airlines
7. Air Tours
8. Iran Air
9. Jupiter Flight
10. Wings Lebanon
11. Syrian lines
12. Jordanian Airlines (Royal Falcon)
13. Zagros Airline
14. Kish Airlines
15. Syrian Airlines
16. Al-Jazeera Airline
17. Royal Jordanian

There are 160 flights a day on average to and from Najaf and in peak periods this doubles, to up to 200 daily flights. The airport receives all airplanes, especially those from the national carrier Iraqi Airways, as shown in Figure 16, such as MD (88, 82, and 83), CRJ, B737, A320, A330, B767, A300, B747, and others. Generally speaking, airport activities are influenced by climatic conditions prevailing in the country (wind directions, temperature, and humidity) which are all climatic factors affecting aviation.

A Najaf Airport dimension is 3000 m in length and 45 m in width. This is the most prominent characteristic of the airport and compared it with other airports. The testimony from several airlines is that, when compared with international airports. At

the time of the Arab summit in Baghdad, the airports were shut down for two weeks, except for Najaf and Erbil.

Because of the closure of Baghdad Airport and the lack of staff operating in Najaf Airport, it was seen that there was a need to extend of the airport. In that period it was clear that the main problem that the airport was facing was the small apron with respect to the number of airlines operating at the airport, but now it started a project to expand the arena to accommodate to airplanes and added four aircraft positions. Now it has just started developing the passenger terminal to accommodate more arriving and departing passengers.

Future expansion of the airport is essential because the geographical location of the airport is important and other airlines will be landing, especially in the high season. AL-Najaf Airport received arrivals as shown in Figure 16 who may lock at the logo for first time immediately as shown in Figure 17. It is important to extend the airfield border as well as the development of services inside the airport and to revise the master to upgrade the airport and improve its performance.

Figure 16 Najaf Airport

Figure 17 Najaf Airport Logo

3.2. General GIS Concepts and Applications

General GIS are an electronic database administration framework that gives geographic access (capture, stockpiling recovery, investigation, and presentation) to spatial information. GIS gives an important support to structural architects for controlling and looking at the complex information normally needed in the configuration and examination forms.

Subsequently, structural specialists manage a large amount of GIS work, which permits structural designers to oversee and offer information with easy-to-understand reports and visualizations that can be investigated and conveyed to others. This

information can be identified both at task level and in its more extensive geographic setting.

GIS programming gives structural architects the schema for maintaining and sending distinguished information and applications during every part of the infrastructure depends on project lifecycle including arrangement and configuration, information gathering and administration, spatial investigation, development, and operations administration and support. This enables the instruments to collect resource to GIS applications and enhance ideas by giving architects, development foremen, surveyors, and investigators a single information source on which to work. Assemble all data makes easy to manage and organize the geographical data and CAD data, from dataset to screen and present assistance in analyze to make decision finally [49].

ArcGIS version 9.2 for Airport Application ArcGIS is a desktop GIS from ESRI. A GIS is a database that connects data to an area, permitting the user to see and dissect information in new and valuable ways.

A lot of firms have implemented GIS as kit for extension studies and configuration audits. Utilizing mapping information from the local environment, for example current roadway or route access to the airfield terminal grounds, airfield terminal asphalts, neighborhood stipulations, and ecological sensitivities, can fundamentally reduce the time taken to understand the complexities involved, especially for extensions of landlocked offices in realistic (Science for Changing World, 2013).

ArcMap is the place where present and investigate GIS data sets for any study territory, where allocate images, and make map formats for printing or distribution. A circular segment Map is likewise the application used to make and alter data sets.

A circular segment map displays geographic data as an accumulation of layers and different components in a guide. Normal guide components incorporate the information of map have many component ,the data in amp consist of layers, scale berm north arrow title, descriptive text, symbol, and so on.

3.3 Design of Information System

3.3.1 Data Collection

The researcher collected the data from multiple sources, particularly by several visits to the administration of AL-Najaf International Airport and mostly, to review all the processes that occur at the airport.

Researcher also studied all airport facilities to identify the components of the airport. For the components of each facility, a study was made for each building, in order to determine how many floors were in the building, and the most important services that were available in it, along with what each service provided to that building.

The researcher also explains the most important parts of the infrastructure of the airport and obtained the schemes of the airport. These schemes helped the researcher to identify all the parts of the airport and these parts are as follows:

1. Terminal
2. Runway
3. Apron
4. Service road
5. Taxi road
6. Electricity network
7. TWA

Also, the researcher obtained most of the important information from the Iraqi Civil Aviation Authority (ICAA) as shown in Table 1, which provided data schemes of Iraqi airports and private data on Najaf International Airport through which the researcher helped to transform the aerodrome maps to AutoCAD, one of the important programs that overlap with and match ArcGIS, as shown in Figure 19. These maps contain a lot of data that contributed to the design of a special system for Najaf Airport and served in the creation of a database integrated with the application of ArcGIS for the study of the most important queries when studying a specific part of the airport [49].

1	Aerodrome reference point coordinates and site	31°59'23.47" N, 044° 24'15.54" E
2	Direction and distance from city	6 km southeast of Al Najaf City
3	Elevation and reference temperature	32.9 m (103 ft.), 43.8 ºC
4	Geoids undulation	Not determined
5	Magnetic variation / annual change	03° 44'/04' E (Nov. 2007)
6	Aerodrome administration address Telephone / telefax / telex E-mail	Najaf Airport administration building +964 33334937 ops@najafap.comnajafops@yahoo.com
7	AFS address	ORNIYNYX
8	Types of traffic permitted	IFRFlight/VFR for landing

Table 1 Aerodrome Geographical and Administrative Data

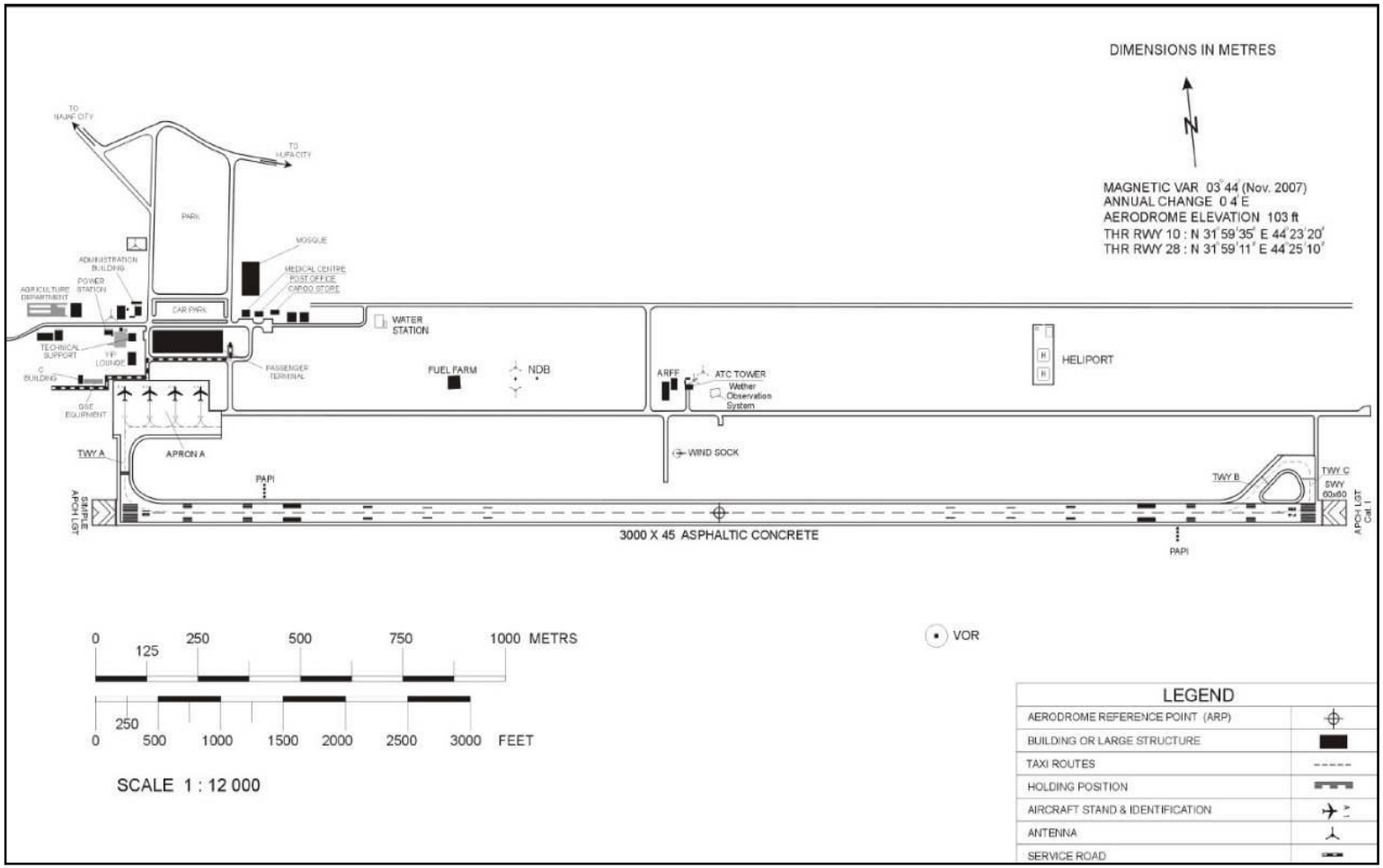

Figure 18 Al-Najaf international Airport / Acrodrome Layout

3.3.2. Organizing Data Using AutoCAD Software

Most of the maps that were obtained were not ready to be modified and there was an urgent need to act as the same maps were not entered properly by correct methods into computers. So, it was necessary to use software to improve these maps in order to make them ready for up-to-date data, to input important information regarding modifications, and to apply queries on the data set as shown in Figures 19 and 20.

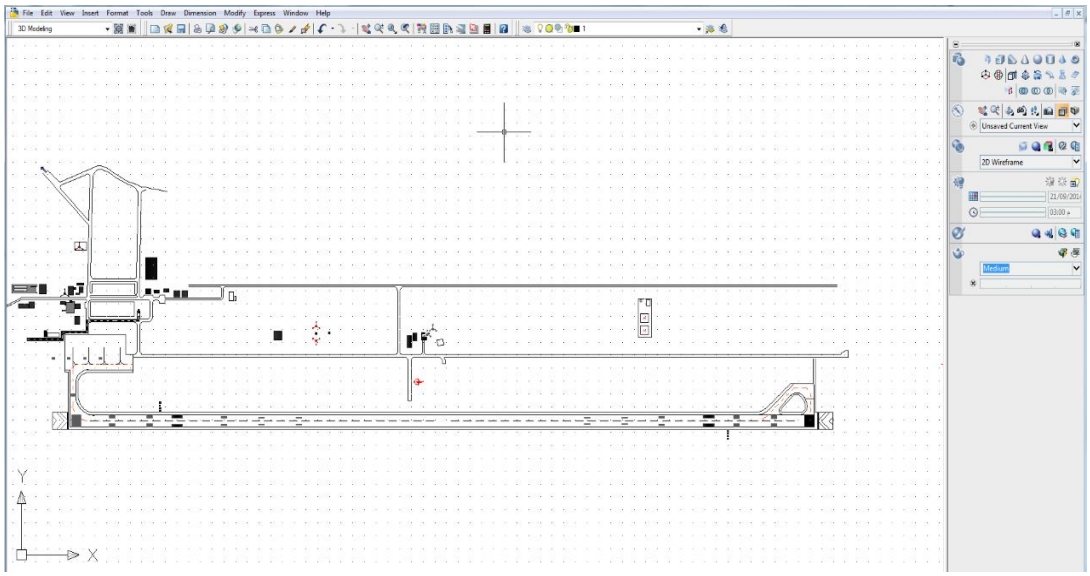

Figure 19 AutoCAD Airport Layer

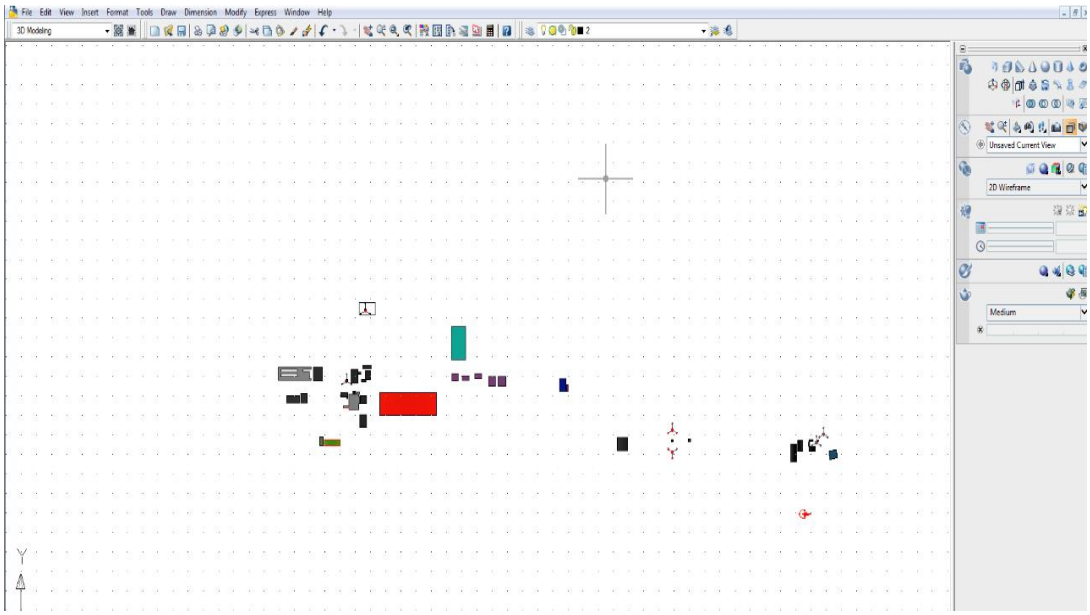

Figure 20 AutoCAD Building Layer

3.3.3. Convert AutoCAD Layers to Shape Layers

ArcGIS provides many of the characteristics and capabilities important for the harmony of AutoCAD with ArcGIS. ArcGIS contains many libraries or tools that help to create and convert layers of AutoCAD to layers of ArcGIS to an adjustable level, but the problem is that the researcher faced a lot of problems when collecting data from the current sources of the airport.

ArcToolbox, the most distinctive part of ArcGIS software, contains many tools that help to convert data from the DWG extension to the SHP extension. The data management tools library contains various kits such as classes in programming languages. One of the necessary kits is called “Features” and the features kit also contains many tools: “feature to polygon”, “feature to line”, and “feature to point” are responsible for converting AutoCAD layers to ArcGIS layers as shown in Figures 21 and 22.

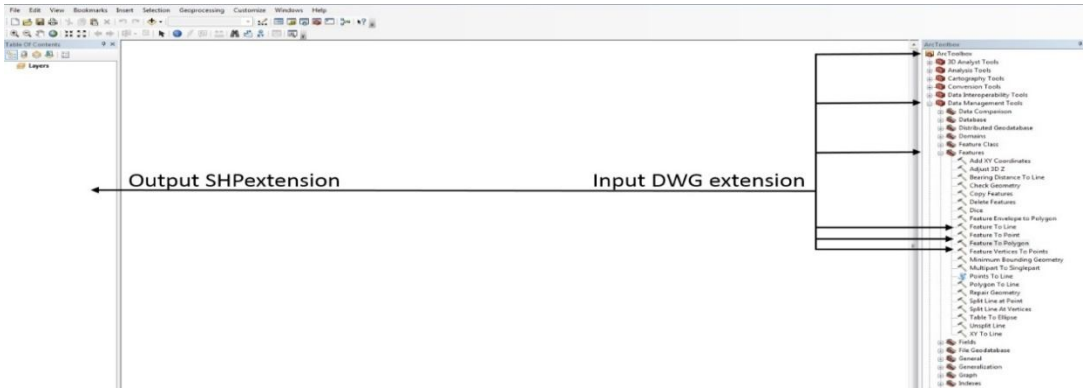

Figure 21 ArcGIS ToolBox

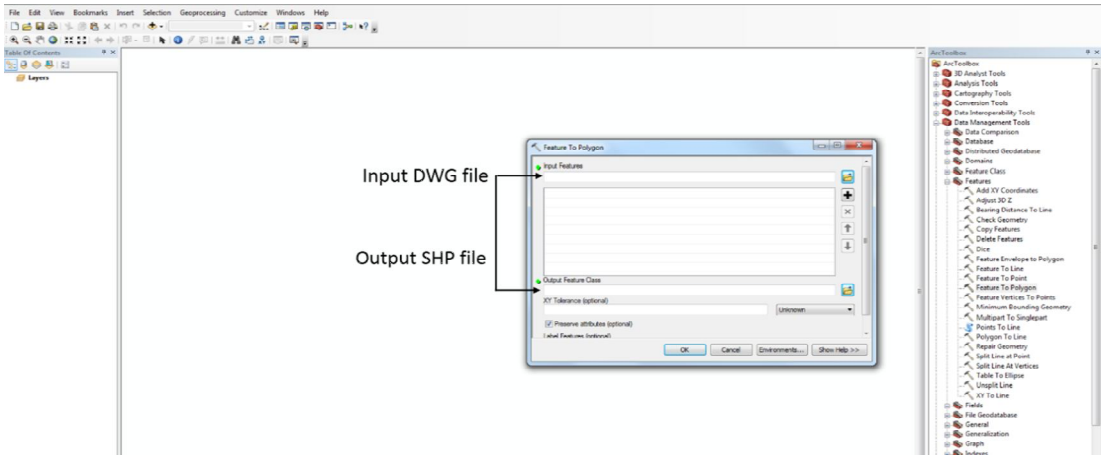

Figure 22 ArcGIS Feature to Polygon

After using the tools mentioned above, the result was as follows and the researcher took three layers as examples, as shown in Figures 23, 24, and 25.

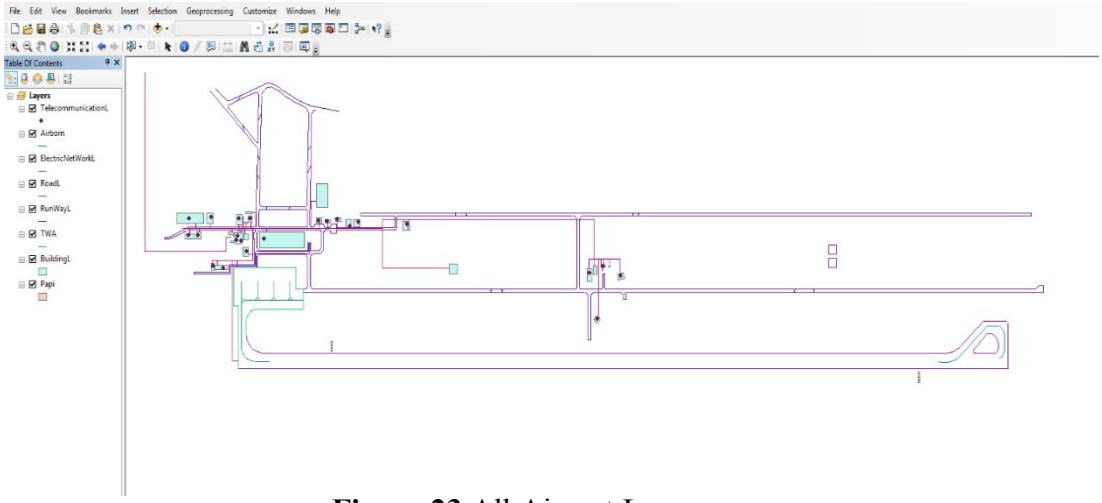

Figure 23 All Airport Layers

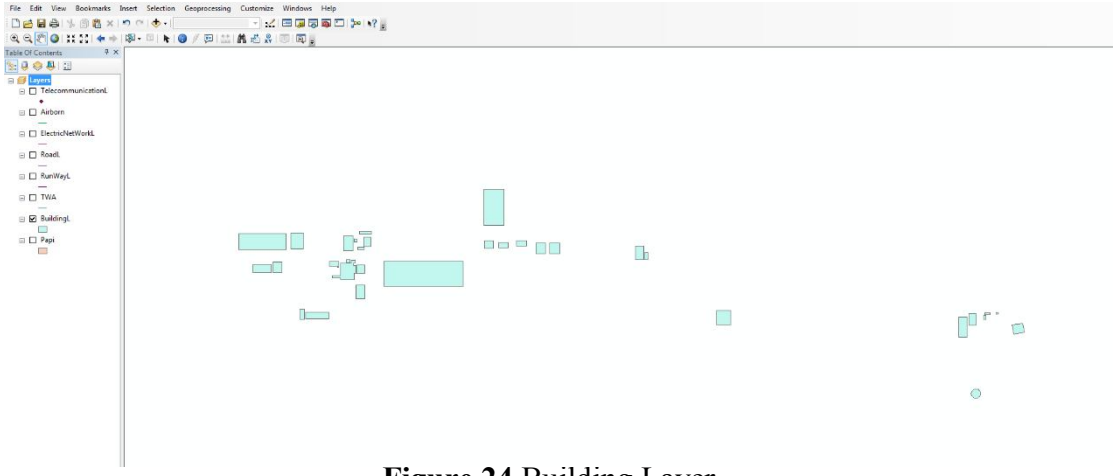

Figure 24 Building Layer

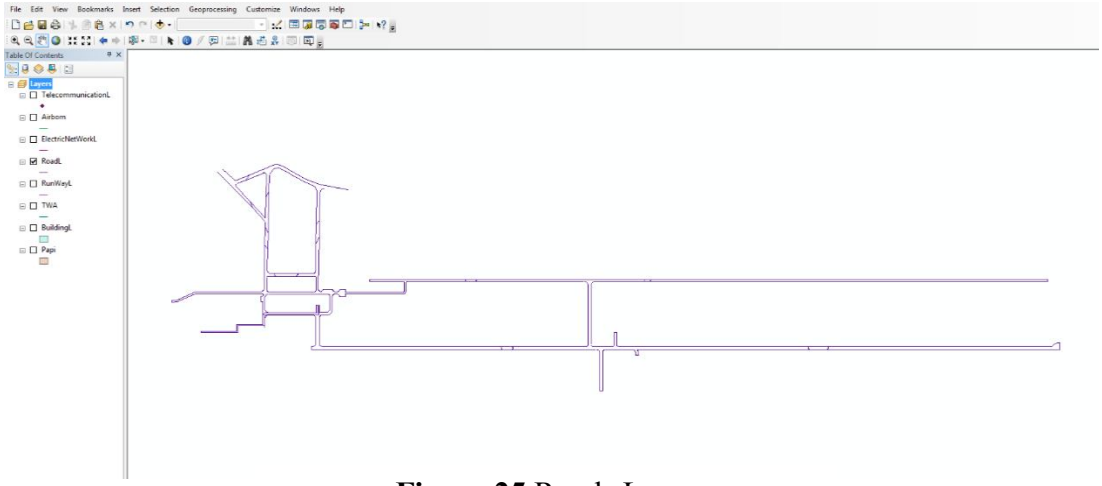

Figure 25 Roads Layer

3.3.4 ArcCatalog

The ArcCatalog application provides a catalog window that is used to organize and manage various types of geographic information for ArcGIS Desktop. The different kinds of information that can be organized and managed in ArcCatalog include:

1. Geo databases
2. Raster files
3. Map documents, globe documents, 3D scene documents, and layer files
4. Geo processing toolboxes, models, and Python scripts
5. GIS services published using ArcGIS Server
6. Standards-based metadata for these GIS information items and much more.

ArcCatalog was used in order to organize the data content into a tree view that one can work with to organize GIS data and ArcGIS documents and to search and discover data. As seen in Figure 26, ArcCatalog is used to:

- Organize the GIS data
- Manage the database schema
- Search for ArcGIS applications

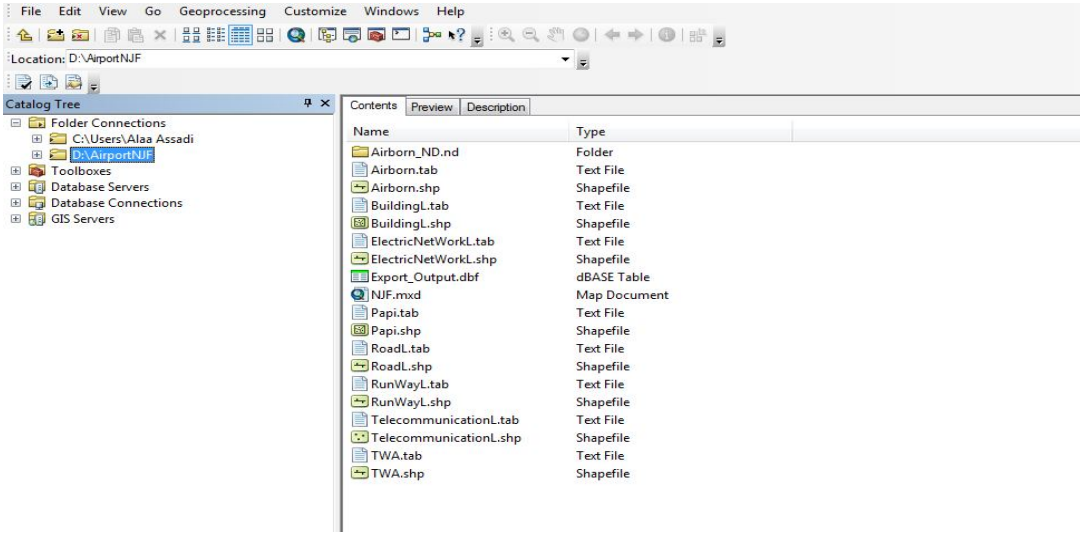

Figure 26 ArcCatalog Interface

3.3.5 Creation of Data Set for Converted Layers

When all layers are converted from AutoCAD to ArcGIS, it probably produces a random and unimportant database. So, the researcher delete most of them by using GIS assistance tools using library ArcToolbox and in this way all unnecessary records or fields can be deleted, as shown in Figure 27**.**

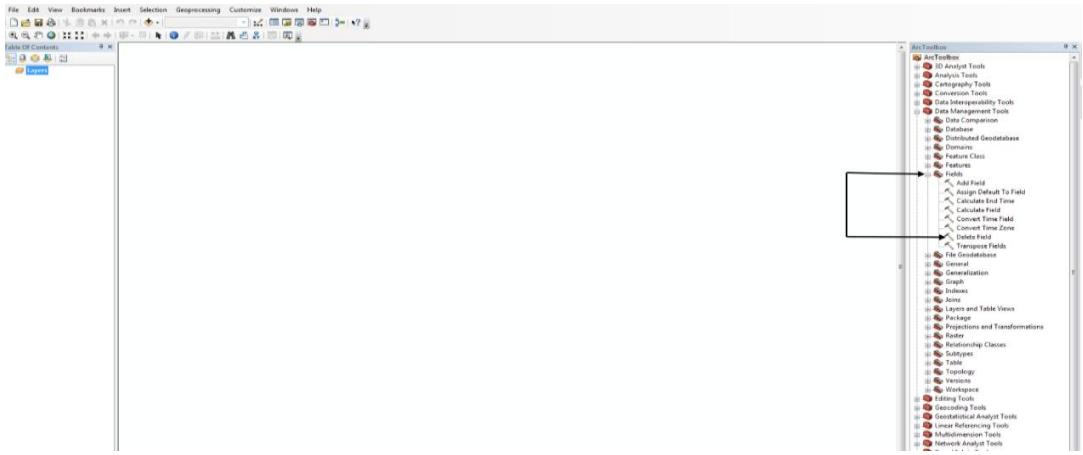

Figure 27 Delete Tools

The Editor Toolbar helped the researcher to create GIS layers and to modify the content by changing the layers' shapes or tabular data sets by using specific selection toolbar. It was used to add data to many records and fields inside this data set. The attributes table is a property used to show the data set and it is helps to add, delete, and modify data in the data set. Also, it helps in making a specific selection of shapes or points as shown in Figure 28.

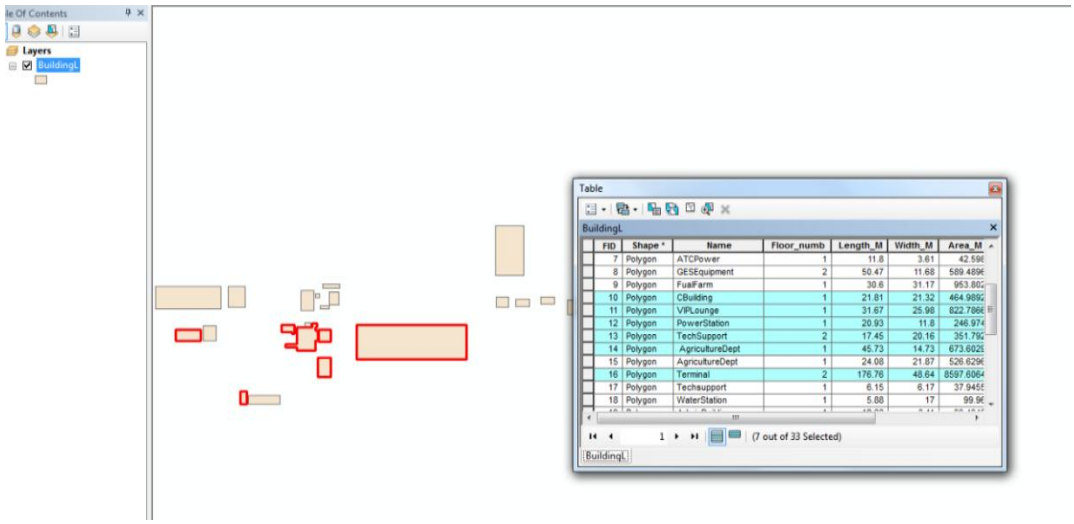

Figure 28 Specific Selections

3.4. Data Conversion and Application Developments

3.4.1. Data Conversion

After finishing all processes in ArcMap and finishing modifying and designing all layers and data sets, we open layers in MapInfo to convert shape files to Tab files (extensions of MapInfo files) to be able to program the interface for converted layers in MapInfo as shown in Figures 29 and 30.

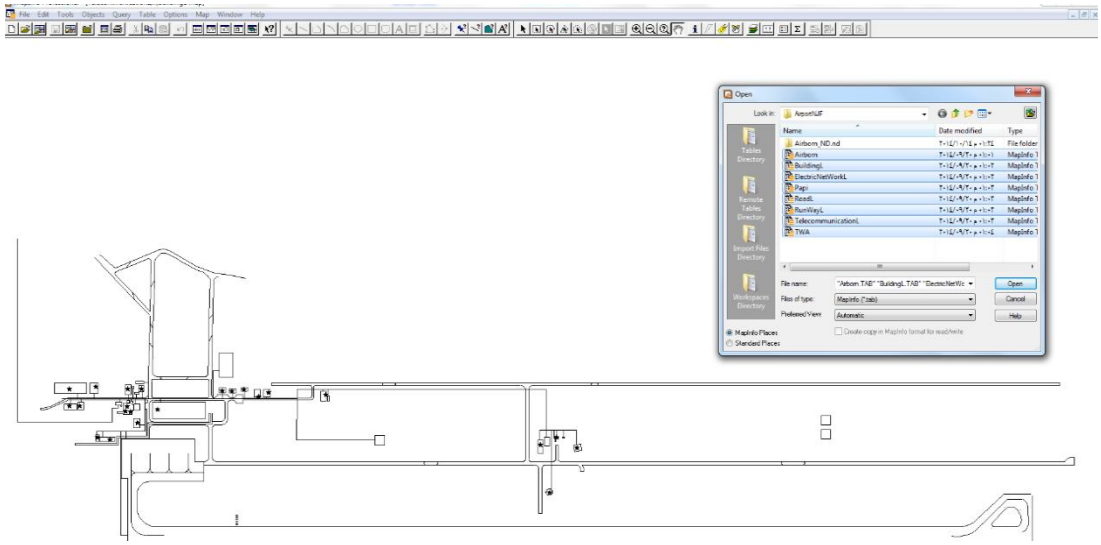

Figure 29 Converted Shape Files

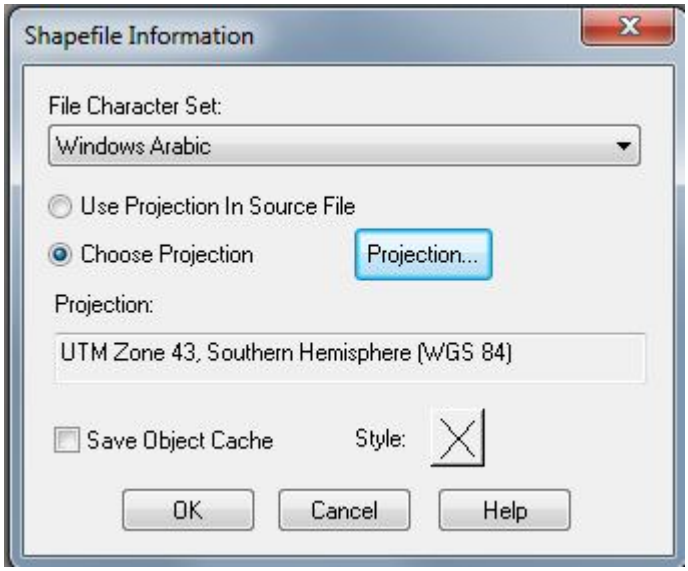

Figure 30 Specific Coordinate

Figure 31 shows mechanism of action of the program.

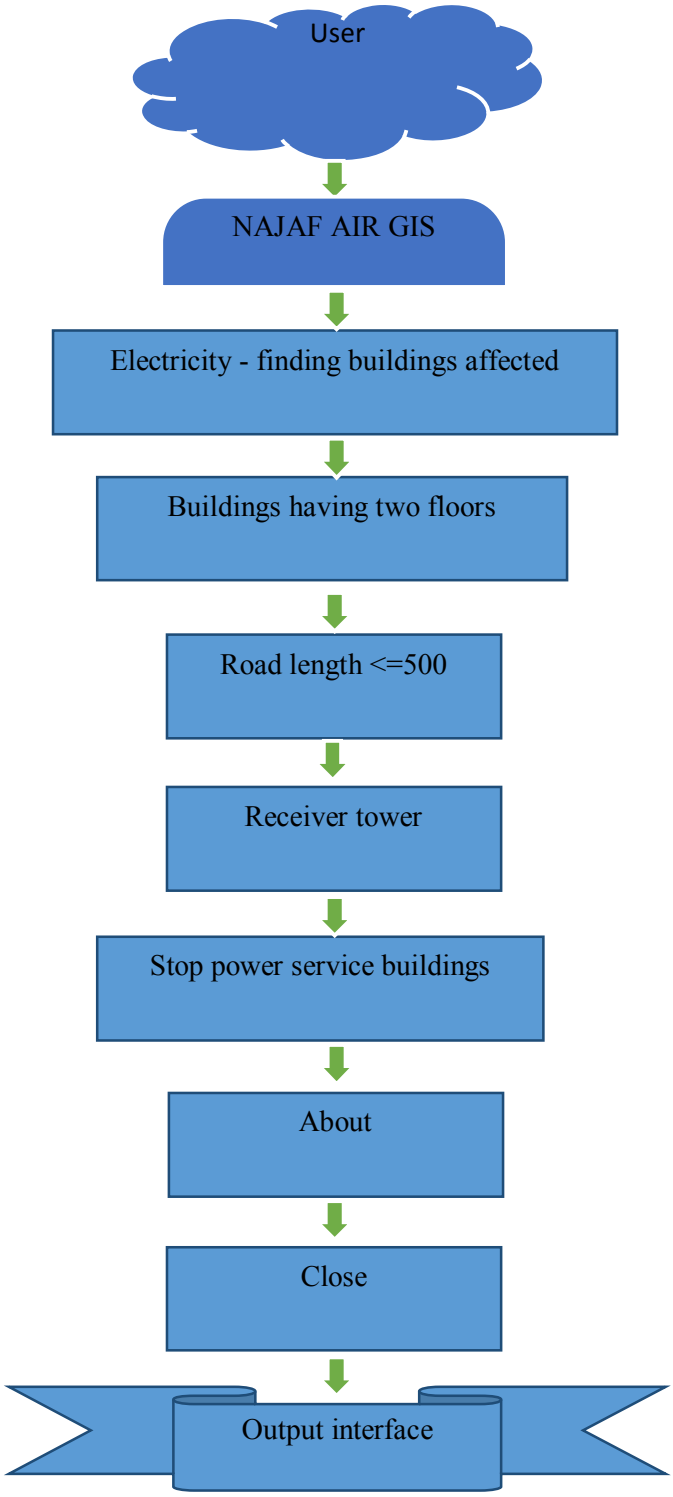

Figure 31 Application Scheme

When the application interface execute, it helps the users to browse the information according to their needs as shown in Figure 32**.**

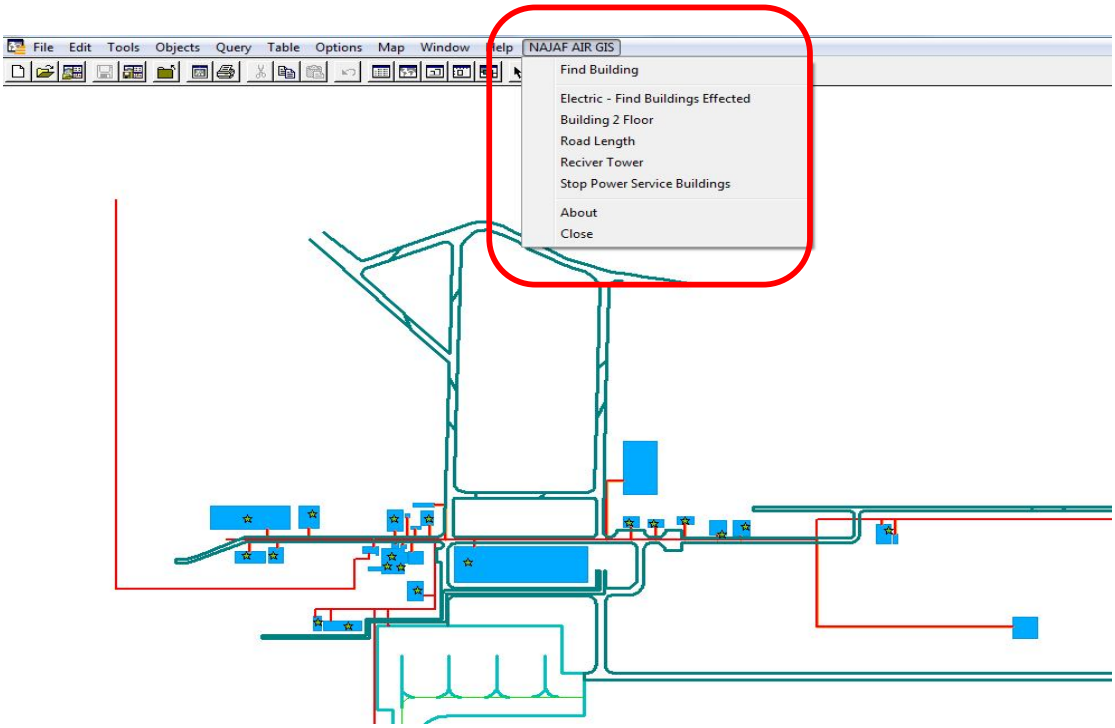

Figure 32 Application Interface

3.4.2. Selecting the Buildings

In this part of the application the first thing that a user will face is the specific buildings that have the most important facilities at the airport. There is a list containing the names of the buildings; when the user clicks on one of them it will appear on the map as shown in Figure 33**.**

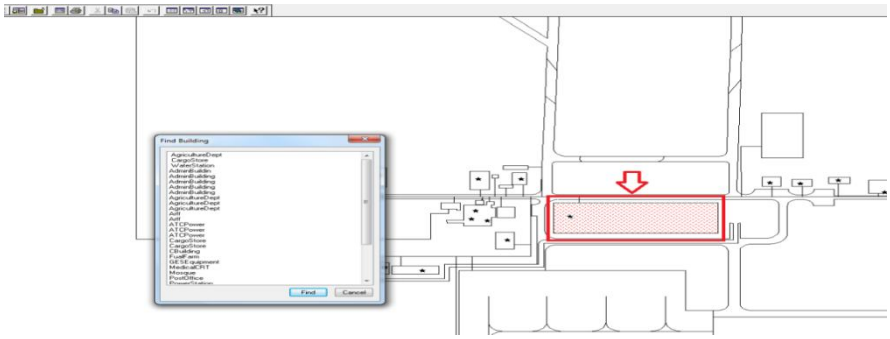

Figure 33 Output of Selected Building

3.4.3. Electricity – Finding Buildings Affected

This order is responsible for the electricity network and every line of the network connected and this option gives high flexibility to control the buildings and facilities during electric power feeding and to determine any buildings that must be cut off in case of problems. This process also gives the ability to find the buildings that consume the largest amount of energy to reduce electricity consumption as shown in Figure 34.

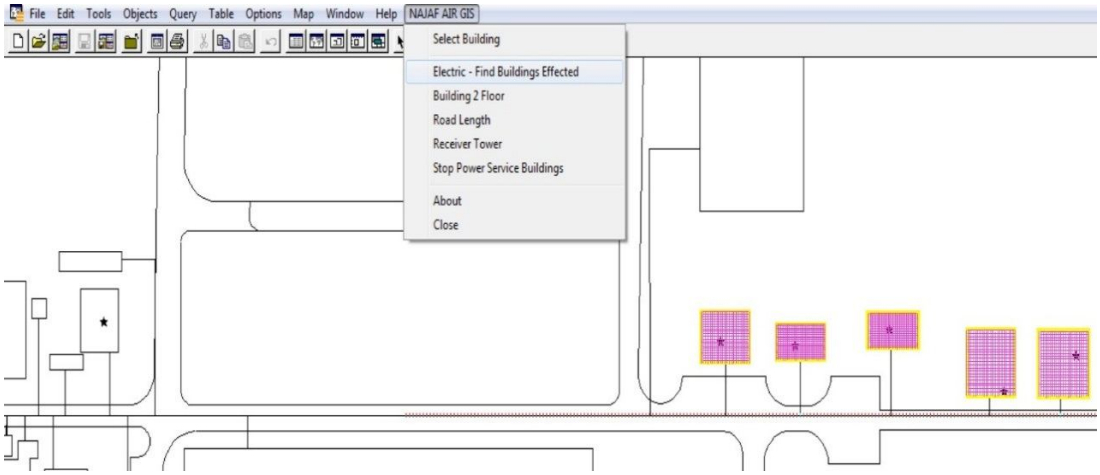

Figure 34 Finding the Buildings Affected

3.4.4. Number of Floors – Finding Buildings with Two Floors

The buildings are the most important facilities in the airport. Buildings vary depending on the size of the airport and air traffic density. Number of passengers will enter to the airport, for example, terminal arrival and departure lounges as well as measures for complete customs and immigration formalities and quarantine.

The building layer includes the buildings that in most airports, offices, and technical units serve the traffic, such as the unit meteorology and air traffic control units responsible for ensuring aviation safety. There are several existing buildings at the airport to service the aircraft life support, fuel, and maintenance. This program option helps users to find the buildings which have only two floors, as shown in Figure 35

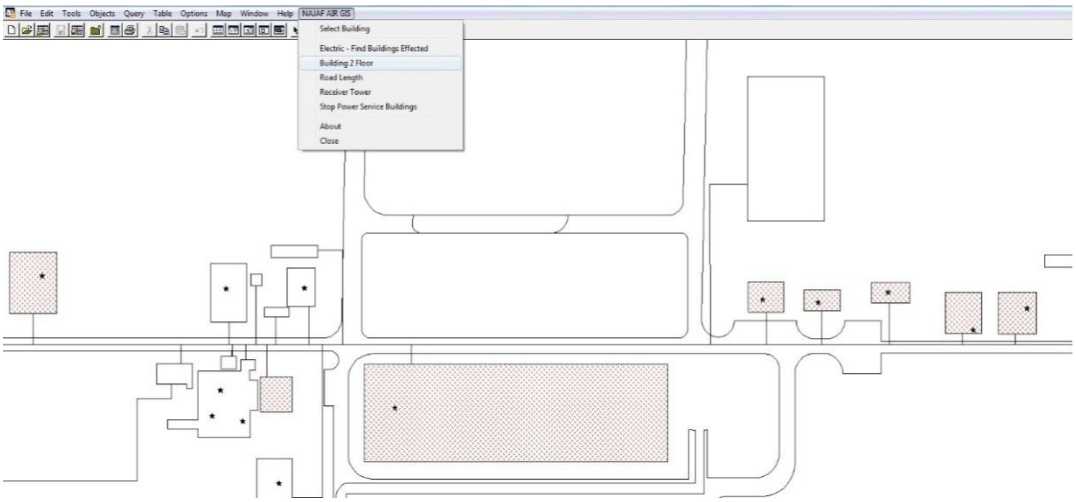

Figure 35 Buildings Having two Floors

3.4.5. Road Length

Roads are the lifeline of the airport, where most ground operations into the airport require specific methods and where there are several types of roads within the airport such as service and taxi roads that lead aero planes to the docking areas.

Therefore roads need a particular layout and specific specifications so as to avoid unnecessary accidents and intersections. This part defines the ways in which distances are minimized to less than 500 m and how to expand and maintain the road for frequent use as shown in Figure 36.

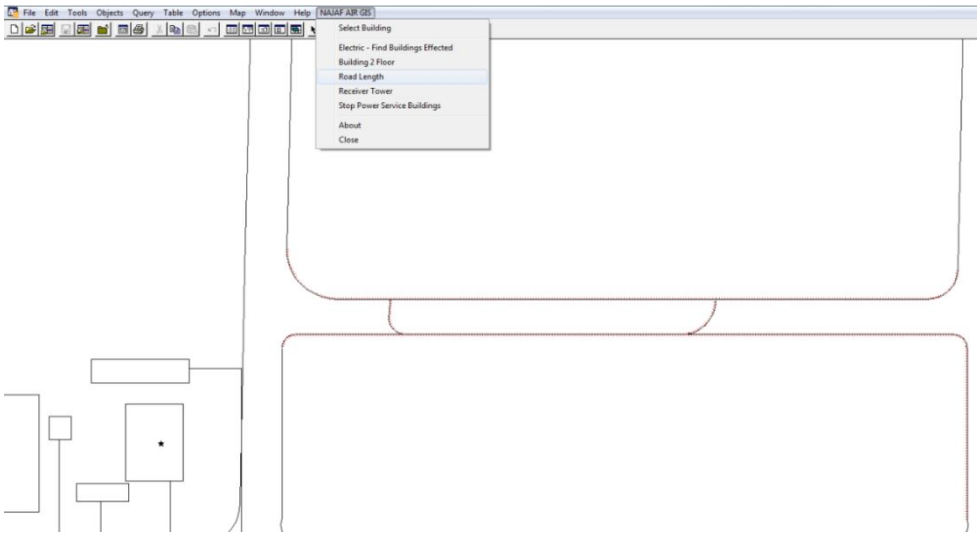

Figure 36 Road Shorter Than 500 m

3.4.6 Receiver Towers

This layer considers reception towers, which are the most important part in the process of communication between the parts of the airport and the synchronization between the different types of processes.

This option within the program helps identify constellation sites and if this were to be developed in the future it would be possible to take advantage of this feature to determine whether or not the towers work and the amount of information or the development of the towers, as shown in Figure 37.

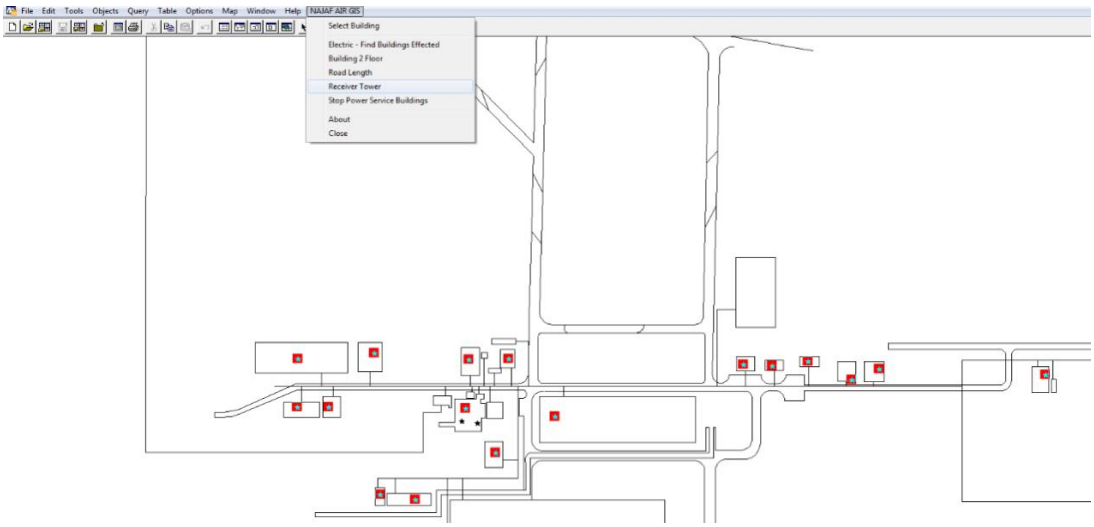

Figure 37 Receiver Towers

3.4.7. Stopping Power Supply to Service Buildings

This process of stopping the power for some of the buildings if certain problems occur helps the airport administration to control the electricity if it is to develop this part better, as shown in Figure 38.

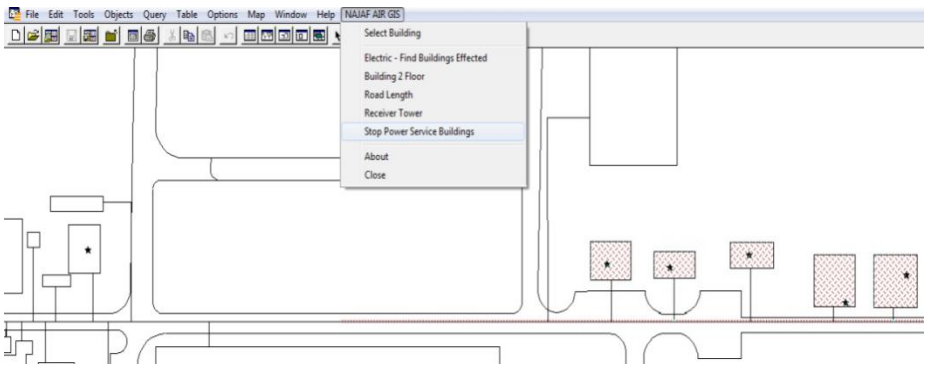

Figure 38 Stopping the Power

CHAPTER 4

CONCLUSIONS AND FUTURE WORKS

4.1. Conclusions

The conclusions to be concluded in this thesis can be summarized as follows:

1. Airport represent important facilities on the earth .So, for the accuracy and sensitively of landing and taking off operation, airport must stay in high level of performance all time of the year sometimes under challenging circumstances.
2. Airport management must use GIS technology in they work especially in planning maintenance, security and modeling operation because GIS have capabilities in analyze which not available in another applications and cannot be accurate by human.
3. GIS can support the detailed geospatial data about airport. This data will be used in local performance approaches and electronic notices to polite and flight deck airport moving map.
4. The main database of airport must up to date by using GIS information, imparting both basic security information (for example, runway end focuses or the area of navigational supports) and more secure for important information (for example, the area of an expansion on the landing strip). As well as giving clients current air terminal information, it will enhance air terminal and more effective audits of airport design overhauls.
5. The consequence of this study is a fantastic representation of the airfield utility including the airport structures. This permits coordination of the information in the GIS environment and provides information to the decision makers to help them make robust judgments regarding the new terminals, offices, and transportation infrastructure.

6. To compose the spatial elements successfully, a few layers are situated as per the qualities of spatial substances. The spatial database is made. At that point, the capacity configuration of the GIS applications use in map exploring, map locating, etc. That men style of map and output of map. .
7. The results were two maps; the first includes 11 layers and the other includes two layers. Each layer has information that describes the thickness of the subsurface.

4.2. Recommendations

Recommendations that can be drawn in this thesis can be summarized as follows:

1. It is recommended to use these kinds of kit or applications in master plan development of airports.
2. There are still various potential studies that could be developed to present a GIS-based wind rose that adequately decides the best way of a runway.
3. It is recommended that a detailed study of all types of joints in rigid pavement be made, including a study of the drainage system of the airport
4. It is recommended that all the maintenance activities be specified on the developed maps.

4.3. Suggestions for Future Works

It is recommended that a definite survey and subsurface utility verification effort to fully map and document subsurface utilities and structures. The data must be integrated with the existing GIS database store data on. The information must be incorporated with the current GIS database to fabricate 3D models.

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APPENDICES A

CURRICULUM VITAE

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EDUCATION

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B.Sc.	Al-Mustansiriya University, Computer Science	2006
High School	Al- Zubaidi High School, Haja, Yemen	2001

WORK EXPERIENCE

Year	Place	Position
2008– Present	Baghdad University Ibn-Rushed for Human Science	Teacher, Employee
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