CANKAYA UNIVERSITY

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# EFFECTS OF E-GOVERNMENT AND GIS TECHNOLOGY FOR DEVELOPING SERVICES IN EDUCATION SECTOR

## CASE STUDY: SCHOOLS IN KIRKUK CITY CENTER

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Title of the Thesis: **Effects of E-Government and GIS Technology For Developing Services In Education Sector Case Study: Schools In Kirkuk City Center**

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# ABSTRACT

## EFFECTS OF E-GOVERNMENT AND GIS TECHNOLOGY FOR DEVELOPING SERVICES IN EDUCATION SECTOR CASE STUDY: SCHOOLS IN KIRKUK CITY CENTER

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The field of e-government has become an important subject around the globe because it refers to the delivery of government services by means of technology to save resources and bring governments closer to their citizens and to the private sector. This study underlines how most e-government projects require spatial datasets to improve public services. Pertinent examples already found/extant in the literature are examined, and investigating schools locations in Kirkuk city are selected for the case study.

In parallel to the literature review, a study of the geographical distribution of schools is shown to be necessary such that land use for educational facilities occupies an unobjectionable part of the Kirkuk urban area, which in turn makes decision makers take this (land) use into account when the government is to establish city master plans.

This thesis presents how establishing a working GIS in the education services would improve e-government applications due to the fact that GIS tools and facilities improve flexibility and accuracy in the management of both spatial and non-spatial datasets. As the measurements recognized by the EU and UN show, e-government initiatives need to be prepared above accurate, clean, timely and controlled shared datasets. Therefore, establishing strong databases and making legislative changes to enable data sharing among government agencies are found to be the primary targets of both central and local governments.

The thesis shows that establishing a working GIS to provide services to students, teachers, citizens and decision makers in the education sector is technically feasible. However, the starting point ought to be collecting raw data from the field and ensuring that the data is updated in a timely manner, and not acquiring hardware and software. In so doing, Iraq can rank higher in international e-government measurement reports.

**Keywords:** GIS, spatial data, education sector, e-government, Iraq, Kirkuk

# ÖZ

**E-devlet ve CBS Teknolojisinin Eğitim Hizmetlerinin Gelişmesinde Etkileri Üzerine Bir Çalışma: Kerkük Merkezdeki Okullar**

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**Nisan, 2014,74 Sayfa**

E-devlet, teknolojiyi devlet hizmetlerinin iletilmesinde kullanmasıyla ve halkla, özel sektörle devleti yakınlaştırmasıyla küresel anlamda önem kazanmış bir konudur. Bu araştırma, birçok e-devlet projelerinin, kamu hizmetlerinin iyileştirmesinde, mekansal veriler kullandığının altını çizmektedir; literatürde ilgili örnekler işlenmiş ve Kerkük şehrindeki okul yerleri araştırma konusu olarak seçilmiştir.

Literatür taramasına parallel olarak, bu çalışma, okulların mekansal verilerinin çalışılmasını gereklilik olarak göstermiştir; öyle ki, Kerkük şehir bölgesinde eğitim tesislerinin inşaa yerleri tartışılmaz alan kaplamaktadır. Bu yüzden, şehir mastır planlarında, yönetimsel karar mekanizmalarında bunu göz önünde bulundururlar.

Bu tez, eğitim hizmetlerinde, çalışan bir CBS'nin e-devlet uygulamalarını ilerleteceğini savunmaktadır; çünkü, CBS, hem mekansal hem de mekansal olmayan verilerin işletilmesinde esneklik ve doğruluk sağlayan araçlara ve özelliklere sahiptir. AB ve BM tarafından tanınmış ölçümlerin gösterdiğine göre, e-devlet projelenin, doğru, temiz, kontrollü paylaşılan veriler üzerine kurulması gerekmektedir. Bu yüzden, sağlam veritabanları kurmak ve gerekli yönetimsel değişikliklerle devlet kurumları arasında veri paylaşımını sağlamak, merkezi ve yerel yönetimlerin birinci hedefleri olmalı bulgusuna ulaşılmıştır.

Bu tez gösteriyor ki eğitim alanında öğrencilere, öğretmenlere, vatandaşlara ve karar merkezlerine hizmet verecek, işleyen bir CBS kurmak, teknik açıdan olasıdır. Bunula beraber, başlangıç noktası, donanım ve yazılım temininden önce temiz veri toplama ve bu verilerin zamanında güncellenmesini sağlama olmalıdır. Bu sayede Irak, uluslararası e-devlet ölçümleme raporlarında daha yüksek sıralara çıkabilir.

**Anahtar Sözcükler:** CBS, mekansal veri, eğitim alanı, e-devlet, Irak, Kerkük

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# CHAPTER I

# INTRODUCTION

The revolution in information communication technologies (ICT) has resulted in changes in many aspects of people's daily lives around the world. These changes and developments have promoted the adoption of electronic government or e-government, in short; they have also changed how governments around the globe interact with their employees, citizens, agencies, businesses, and other stakeholders in many countries such as discussed in [1]. The field of e-government has become an important subject around the globe since it refers to the delivery of government services to citizens and business communities through the use of technology in order to minimize resource use and bring governments closer to citizens and the private sector. As the field is quite broad, there are many aspects to be considered in a comprehensive analysis. Managing demographic data, establishing links among governmental agencies for a shared database environment and amendments in law to clear privacy and security concerns are some examples of what e-government can do.

Due to the breadth of the field, we have narrowed our scope to concentrate on more specific subjects. In this thesis, we used the Geographic Information System, GIS, technology to collect, input, process, manage, report, analyze, and output geographical information and data that can serve students, teachers, employees and citizens in Kirkuk in the field of education as well as connect those separate elements in a way that local and central governments can follow and manage related information to set up and enhance e-government in Iraq. Additionally, we underline some hidden/not-so-obvious problems when we collect data and show how to address them in section 4.1; results of analyses of the collected data are given in section 4.2 and some examples of GIS being used in the field of education can be seen in section 2.10. In order for the reader to be able to follow the case study, the following section provides necessary background information about the education system in Iraq.

### 1.1 Background on the Education System in Iraq and Motivation

Prior to 1991, the education system in Iraq had a far better reputation in the Middle East than it does nowadays; however, the education system sector has suffered greatly following Iraq’s wars and years of international sanctions. In addition, the country’s ICT facilities and applications are weak and most teachers have either little or no ICT literacy, hence their basic inability to create a new generation of ICT literate students. However, delivering ICT in the education system in Iraq will help to overcome this problem by fostering greater ICT literacy among teachers, school principals, students, and Ministry of Education staff. This renewal of Iraq's educational system is vital due to the (inevitable) fact that Iraqi youth will be the main determiners of their country's future.

There are three authorities that control the education system in Iraq: local government educational authorities, which are responsible for kindergarten and primary education; the Ministry of Education, which is responsible for secondary education (general, vocational, and teacher training), including curriculum development; and the Ministry of Higher Education and Scientific Research, which is responsible for the administration of universities and the Foundation of Technical Institutes.

There are many reasons for the disadvantages that students experience in education in Iraq: these include difficulties or impossibilities of enrolment at a school and students not having a proper alternative educational provision. Moreover, if they are indeed able to enroll at a school, regular attendance is difficult or impossible. They find basic education difficult to acquire when they are at school due to fear and worries about not having effective teaching or additional support that some children need in order to learn, often attributable to a lack of textbooks, notebooks or other basic school equipment, disability, hunger or similar issues which impact on the individual child and his/her ability to learn as highlighted in [4]. In addition, such children appear to be receiving a substandard education due in no small part to the difficulties or failures in the educational system with its poorly developed and inadequacy of basic facilities at schools.

In order to enhance standards for all students so that they may benefit from education, each potential student needs a school nearby or within reasonable distance for access. In this way, the very first steps to provide basic education can be taken. One of the aims of this thesis is to show the importance of managing school resources and identifying potential places for new schools and how this can be achieved via GIS.

Iraq is divided into 15 educational regions, each under a Director General of Education, for the administration of primary and secondary education and the Directorate-General for Education. Kirkuk is one of these regions [2]. In the next section, we provide brief information on Kirkuk's demographic, geographic and educational position.

**1.2 Kirkuk**

Kirkuk is the fourth largest city in Iraq; the center of the province of Kirkuk located in northern Iraq, and is bordered by the Zagros Mountains to the north and the River Little Zab from the west and the Hamrin Mountain Range from the south and the river Sirwan from the south-west. Kirkuk has an ancient history estimated to go back more than 5,000 years. The Kirkuk city center coordinates are 35.46 degrees (35 degrees 27 minutes) North and 44.38 degrees (44 degrees, 33 minutes) East as shown in Figure 1. Kirkuk province is divided into four districts: the Kirkuk city center, Daquq, Debis and Hawija. According to a 2013 Department of Statistics report, the estimated number of residents is 1,585,468 people [3]; however, this number is not definite and so remains open to discussion.

The number of schools in the province of Kirkuk is 1,520 with 1,100 primary schools, 386 secondary schools, 52 kindergarten schools and some middle schools. There are 327,668 students attending these schools overall and there are 120,000 teachers providing education in Kirkuk. It should be noted that these numbers are estimates due to difficulties in acquiring reliable statistical data.

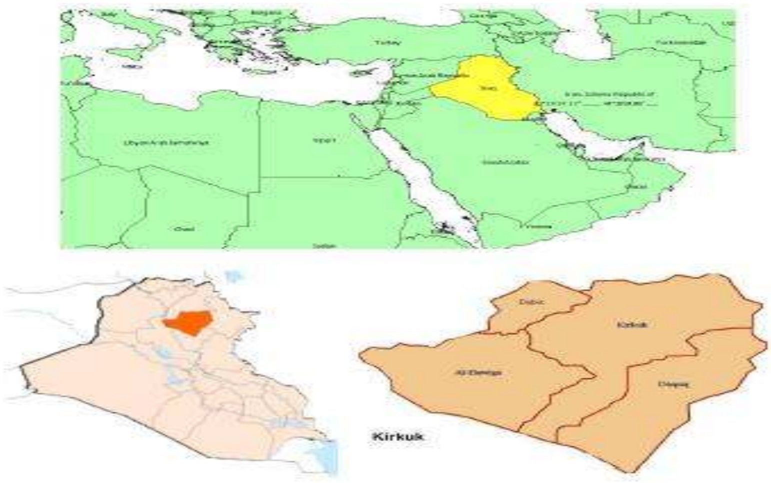



**Figure 1:** Map of Iraq And Kirkuk

### 1.3 Purpose and Scope

In this research, we study the distribution of educational services in the Kirkuk city center and how to produce distribution maps for schools based on multiple criteria such as the number of students per school and the number of teachers. Through this research, we aim to propose information systems to enable managers to select suitable sites for new school buildings and procure/obtain/acquire information about vicinities/sites/facilities to promote educational services. In addition, this study may be used to identify the efficiency of educational services by comparing school sizes and the number of school-aged citizens and create a geographic database of educational services as well as a new schools map through the optimal distributions of the resources.

E-government is the second fold of this study. We argue that investing on e-government initiatives will promote Iraq in such a way that repetitive work due to paper-based activities will be reduced, the quality of data will increase and governmental services will be provided far more efficiently and accurately. For this purpose, we study the basic principles of e-government in the second chapter. We also visit the initiatives and history of Turkey's and EU countries' attempts at e-government in order to understand and gain insight about what can be done in Iraq.

Compiling those two topics shows us that e-government programs enhanced with spatial data integration and separate GIS projects will improve standards for both the citizen and government in Iraq. Hence, the research question of this study is formulated thus:

"How can Iraq transform its paper-based government to electronic government and can Iraq initiate a reliable GIS in local governments to assist this transformation?"

As can be seen, the question is quite open ended; nonetheless, we approach the issue by selecting a case topic, namely education, to prove that setting up a GIS in local government in Iraq is technically feasible.

# CHAPTER II

# BACKGROUND AND LITERATURE REVIEW

## 2.1 E-Government

E-government can be defined as application of ICTs to enhance the delivery of government services in terms of improving service quality, and integrating government and its services for citizen, business, and other government agencies and enabling users to access government information in order to obtain services wherever and whenever they want (i.e. 24 hours a day, seven days a week) through multiple channels including the Internet.

E-government is not limited to putting government forms on government websites. It is about using ICTs to their fullest potential to provide services and information that is centered on the citizen. As the ICT has been proven to be an efficient way to conduct transactions between a government and its citizens and business communities as well as within the public administration itself, Nag argues in [5] that it brings many types of government services closer to citizens and, enabling the delivery of services to citizens and businesses on their terms and at their convenience, rather than following the logic of internal government structures.

E-government helps also to build (and occasionally regain) trust between government and citizens; ICT can enable citizen engagement in the policy process by providing transparency, therefore preventing corruption of a promoted, open and accountable government. A few examples of much-used services include payment of income and corporate tax, registration of new companies, application of personal documents such as passports and driver's licenses, and employment search services. An exemplar definition to the previous one is given by Gartner. The site has many electronic services [6]: "E-government is the continuous optimization of service delivery, constituency participation and governance by transforming internal and external relationships through technology, the Internet and new media." This includes government to government (G2G), government to business (G2B), government to citizen (G2C), and government to employee (G2E) as the types of service delivery [7].

### 2.1.1 Types of e-government delivery models

The primary goals of e-government can fall into four main groups: businesses, citizens, employees and other government and public agencies as shown in Figure 2. The electronic transactions and interactions between government and each group stated in Section 2.1 constitute the e-government web of relationships and the respective four main types of e-government service delivery.

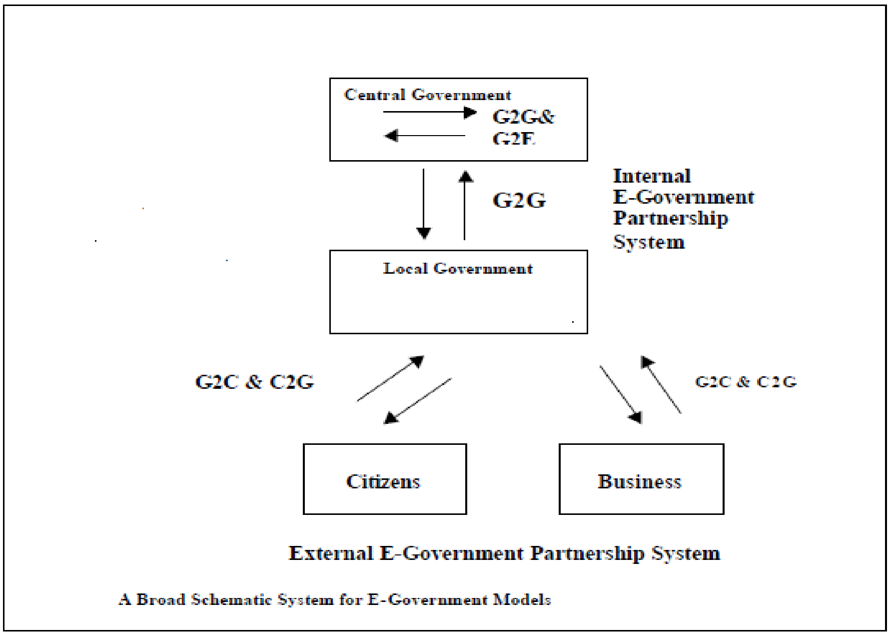



**Figure 2:** Types of E-Governments Delivery Models [7]

#### 2.1.1.1 Government-to-Citizen (G2C)

To provide public services online and to build trustable relationships between government and citizens, e-government applications can make government agencies talk and listen, hence continuously communicate with its citizens to participate in and improve public services [8].

Additionally, G2C allows citizens to access information and services conveniently, at any time, from any place, by use of various media (PC, Web TV, mobile phone or wireless devices) as shown in Figure 3; therefore, the primary goal of e-government is to serve the citizen and foster citizen interaction with government by making public information more accessible through the use of websites to reduce costs and time to complete transactions in government departments. It also enables and reinforces their participation in local community life. Examples of this include sending emails or contributing to online discussion forums; more examples are given on figures 3 and 4.

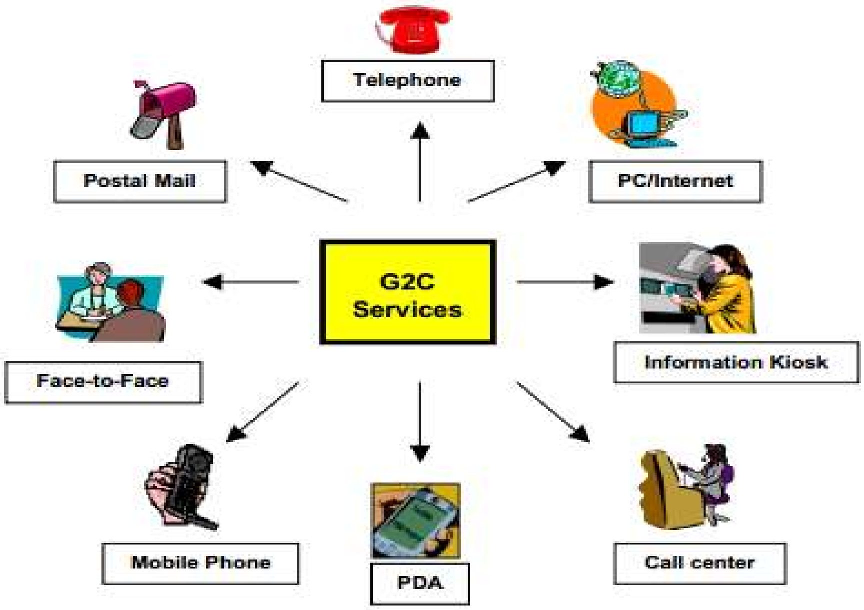



**Figure 3:** Multiple Channels of Access to G2C Services

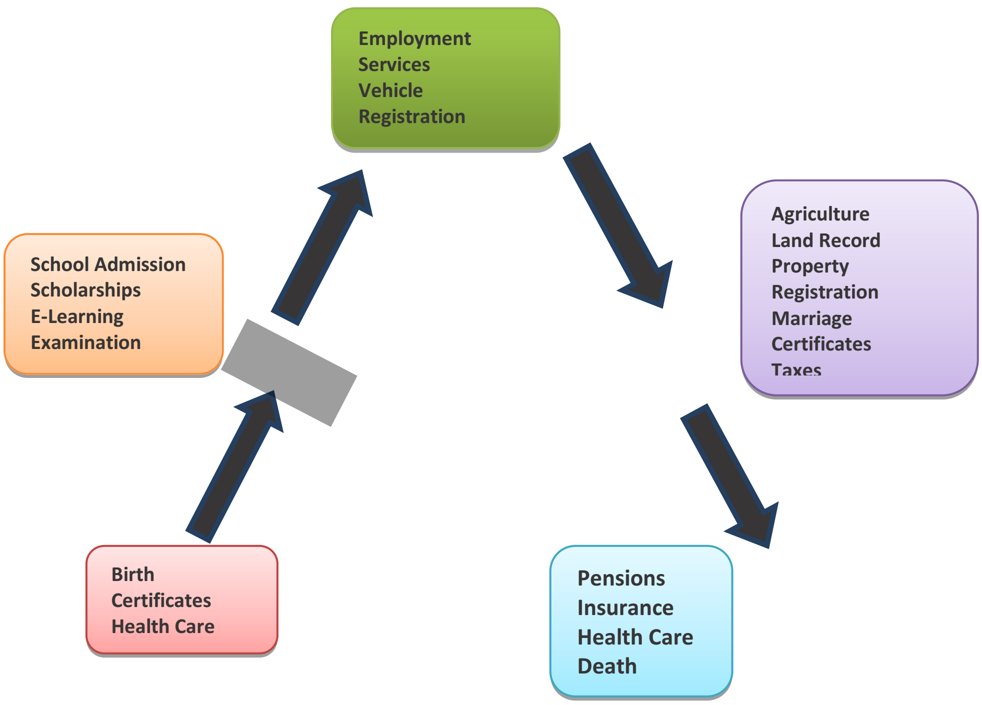



**Figure 4**: G2C Services

To sum up, the G2C model covers governmental services provided to citizens; most of such services can be offered on the World Wide Web. Popular examples include a citizen changing his address. When a person changes residence, he is obligated to inform the local authority. Additionally, he may be asked to inform many other places such as the police department, social security agency and perhaps local health centers. On the other side, a working G2C is expected to provide citizens a service through which they can inform the government online, e.g. through a website. Later, this updated information can easily be shared among relevant government departments. In this way, information need only be collected once to avoid any unnecessary duplication in government databases. Another benefit is that the citizen is not limited to a physical visit to a local authority and is therefore also not limited to reporting to a government office within a specific time period (e g. between 8:30 and17:00). Additional examples are found in Section 2.5.1.

#### 2.1.1.2 Government-to-Business (G2B)

The G2B model of e-government refers to online interaction between government and business. The government provides services through a network so that enterprises can apply for these services through digital platforms. It also includes transactional activities that allow users to do online business such as registration of a new company online, filing tax documents, renewing licenses, and public procurement [8]; for example, in public procurement services, if a government department requires to sell or buy something, they place an event on a specific website and the business sector attempts to bid for that procurement from that event. Additional examples are cited in Section 2.5.2. The G2B possesses intelligent activities enabling users to create online accounts and to personalize site contents and services. An example of such services can be seen in Figure 5.

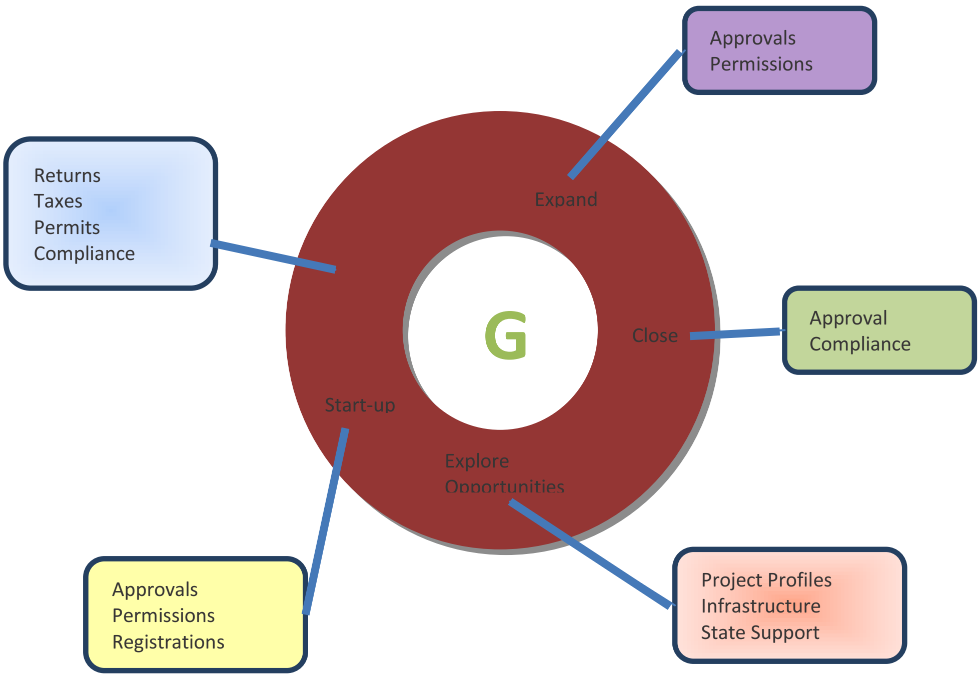



**Figure 5:** G2B services

### 2.1.1.3 Government-to-Government (G2G)

This refers to online relationships between governmental organizations (regional, national, and local governmental organizations) or with other foreign government organizations such as in EU. This online communication allows for the sharing of data and information between government organizations, departments and agencies [8]. For example, public hospitals can send birth certificates of new-born babies automatically to a tax agency or to police departments for registration. This can be done electronically using shared data between these organizations.

### 2.1.1. 4 Government-to-Employee (G2E)

G2E refers to the relationship between government and employees working under the authority of government. It is easy to confuse this group with G2C; G2E takes under its purview not only employees who are a government's own citizens but also non-citizen employees. Tracking tax records, health insurance and address registration are just some quick examples. Moreover, this is an effective way to provide e-learning and bring together employees to promote sharing of knowledge as well as giving employees the possibility of accessing relevant information regarding training and learning opportunities, benefit policies and the civil rights law [8].

### 2.1.2 E-Government Benefits

With the early success stories of the EU, there are several benefits for e-government programs that many countries are now seeking. Applying such programs in order to serve all partners in a country is climbing in the government agendas. These benefits include, but are not limited to, the following gathered from [9].

- Efficiency gains and cost reduction by using all expenditure/(spending) and income services online. This means lower processing costs in these activities while increasing efficiencies of government including processes and tasks.
- Increases in the quality of service that will be delivered to citizens and businesses as the time needed to provide such services can be greatly reduced. This can be achieved by providing self-service facilities over the World Wide Web. In so doing, services are not limited to the clerks at the counters. The online services offer fast and convenient transactions provided they possess user-friendly interfaces. Moreover, many citizens can have the same service at the same time online as the interface a machine and not human.
- Network and community creation: e-government aims to create an environment of interaction between all partners through the exchange of information on a network and in an integrated community. This will, without doubt, increase and motivate citizen participation in the digital transformation and reduce the digital gap.

### 2.1.3 E-government Measurement

The main objective of measurement is enabling countries to analyze progress in the field of e-government and to compare performance and development of the information within and between other countries.

In this research we will provide two metrics (?) of e-government initiatives as they are well recognized in the EU and/or UN.

#### 2.1.3.1 UNeGovDD Measurement

To compile the necessary information for a measurement, the UN has appointed its Division for Public Administration and Development Management (DPADM) of the Department of Economic and Social Affairs (UNDESA) to prepare a database. Basically, this database has been used to compile information to be used to create tools to compare, explore and analyze e-government data at global, regional, sub-regional and national levels. The reports are publicly accessible and visitors can find and sort e-government profiles of countries at the UN's website, http://unpan3. un. org/egovkb. The measurement index is based upon a four stage model [10]. It is beneficial to visit the model shortly in the following paragraphs.

**Stage 1 Emerging information services**

At this stage, it is necessary for government websites to link with ministries. Government departments and other branches of government for citizens can easily obtain online information on news in the national government and ministries [11]. At this stage, only information is provided without any user interaction.

**Stage 2 Enhanced information services**

Government websites deliver enhanced one-way electronic communication between government and service consumers. Downloading application forms to acquire government services is an example to governments at this stage. In addition, websites are expected to provide audio and video guidance, multimedia and multi-language options. Some limited e-services can be expected to submit requests for personal information or non-electronic forms which may be mailed to the service consumers registered address [11].

**Stage 3 Transactional services**

Government websites engage in two-way communication with their citizens, including electronic authentication of a citizen's identity, which is required to complete an exchange successfully. Additionally, government websites process non-financial transactions, downloading and uploading forms, e-voting, licenses, permits, filing taxes online and applying for certificates. They also handle financial transactions where money is transferred via a secure network to government [11]. Basically, at this stage all communication is carried out in the digital format.

**Stage 4 Connected services**

Governments at this stage have drastically changed how/the manner in which they communicate with their citizens. Services are now citizen-oriented rather than provider-oriented; i.e. citizens can log into an account to acquire services – they do not go to the service provider's site as services are now connected on the government side. Governments at this stage are proactive in requesting information and opinions from citizens using Web 2.0 and other interactive tools. This connectivity creates an environment that empowers citizens to be more involved with government activities in order to have a voice in decision-making [11] through citizen networks. More clearly, the citizen can log on, for examples to a government portal, through which he can see and use every service provided by the government. This differs from a citizen seeking the associated government website to find out which service he is looking for. To reach this stage, it is necessary for governments to make real-time connection of services and to use a central database as the services to be offered are not government-office-oriented but citizen-oriented; www.turkiye.gov.tr is an example from Turkey in Figure 6. Figure 6 shows how the user can log on in several ways: citizenship ID, mobile-phone password, electronic signature and citizenship electronic card.

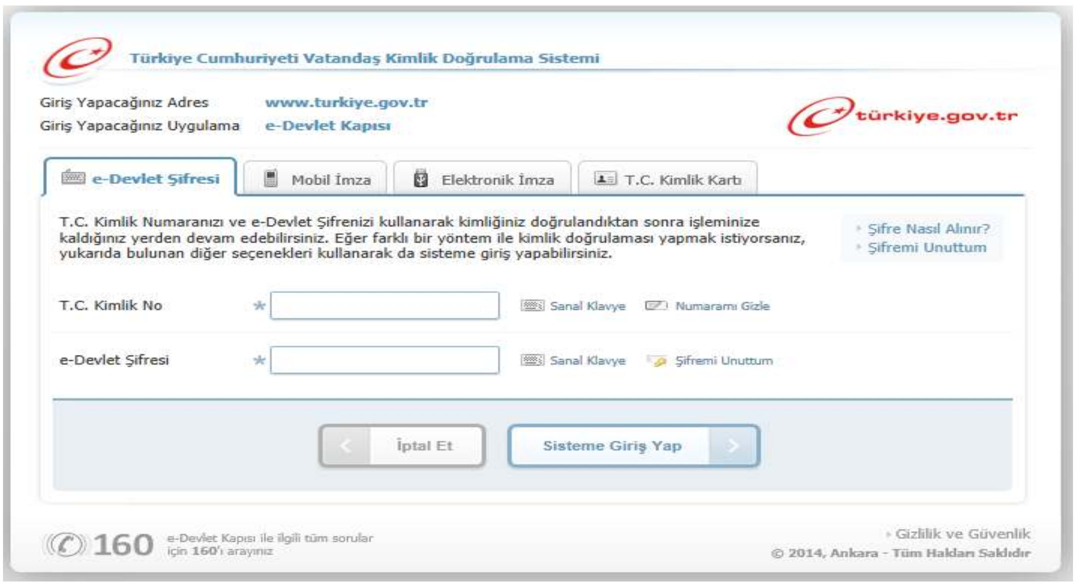



**Figure 6**: Turkey's E-government Portal Authentication Screen

#### 2.1.3.2 EU Measurement

EU countries measure the level of success of e-government initiatives through collaborative works provided by companies such as Capgemini (a French IT company), IDC (International Data Corporation), Rand Europe, Sogeti and Danish Technological Institute (DTi). The European Commission recognizes these works as e-government benchmarks in measuring public sector performance. Basically, the measurement body is informed by the European Commission and country representatives as to what is to be measured.

The benchmark uses a comprehensive ranking system to identify European countries that have implemented the most mature government services [12]. The measurement involves assessing the availability of 20 basic services (Section 2.1.4) and their sophistication by using a 5-stage model, similar to, but not identical with, the UNeGovDD (Section 2.1.3.1). The assessment is carried out on more than 10,000 websites at national, regional and local levels across the 32 participating European countries and it is executed by a multi-lingual team of researchers.

The analyses of online sophistication of 20 basic government services take the following elements as essential.

**Online sophistication:** By application, this is the extent to which government services allow for interaction and/or transaction between the administration and citizens or businesses. This measure covers 20 basic public services such as obtaining permits, online tax filing and enrolling in schools.

The online sophistication ranking assesses service delivery against a 5-stage maturity model: (1) information, (2) one-way interaction, (3) two-way interaction, (4) transaction, and (5) personal station automation. Figure 7 shows the level of online availability of (20) basic public services. The EU27+ score for this indicator in 2010 stands at 90% [12].

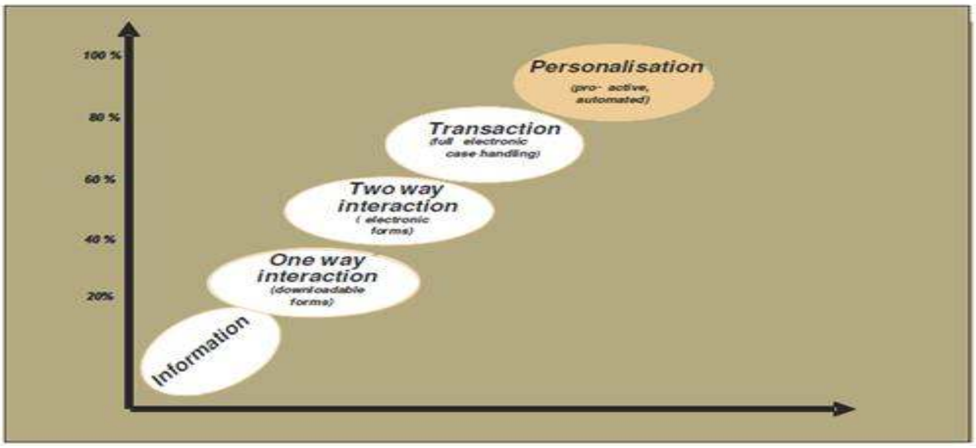



**Figure 7:** Five Stages Maturity Model

- **Information:** information on basic information on the organization and for services is available on the website.
- **One-way interaction:** downloadable forms are available on the website.
- **Two-way interaction:** online information exchange, for example, electronic official form uploading, online submission of examination results.
- **Transaction:** no paperwork, electronic case handling, decision, delivery, real-time response. For example: online bill payment.
- **Personal station:** no need for user to request services. For example, child allowance in Sweden is an automated social security service: when a child is born, the hospital sends the birth certificate to the tax agency for registration and the Swedish insurance agency pays the child allowance to the parents automatically.

**Full online availability:** the total number of basic public services that are fully available online.

Figure 8 represents the 5-stage maturity model of EU+ countries; as can be seen, they are, for the most part, at the fourth or fifth sophistication level, depending on the service in question with an average of 82% in 2010 [12].

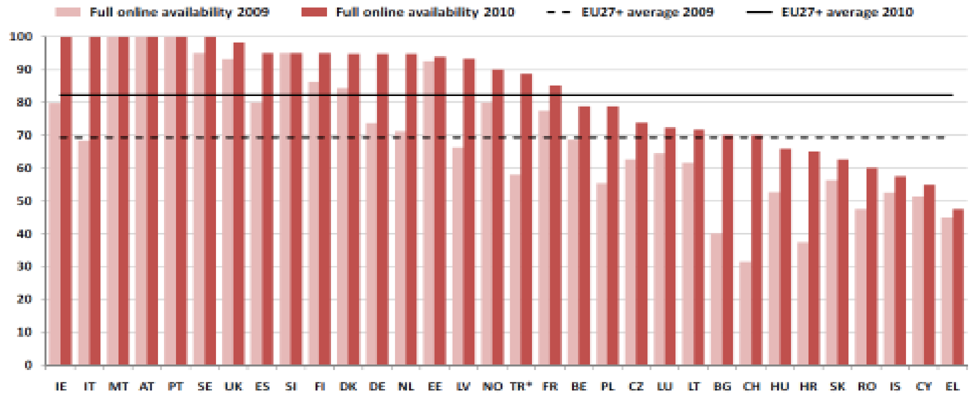



**Figure 8:** Full Online Availability of EU27+ in 2010

- **User experience of services**: the user-centricity and usability of e-government services. This indicator assesses the usability of 20 service websites as well as the extent to which they allow for monitoring of user satisfaction. This involves how much the online server's ease of use from user, there are five key criteria as regards user experience Figure 9, looked at 2010 benchmarking study [12].
- **Transparency of service delivery**: tracing and tracking of service provision, ability to use services in steps and indication of time duration for service completion.
- **Multichannel service provision:** Can we obtain the service by using alternative channels other than online, for example, a call center?
- **Privacy Protection**: Is there any privacy regulation concerning the user putting his private data on the website?
- **Ease of use:** Does the website have guidance such as an FAQ, demos, live support, and can the user add documents to applications and/or requests?
- **User satisfaction monitoring:** Is there some form on the website to monitor user satisfaction, feedback options and/or management of complaints?

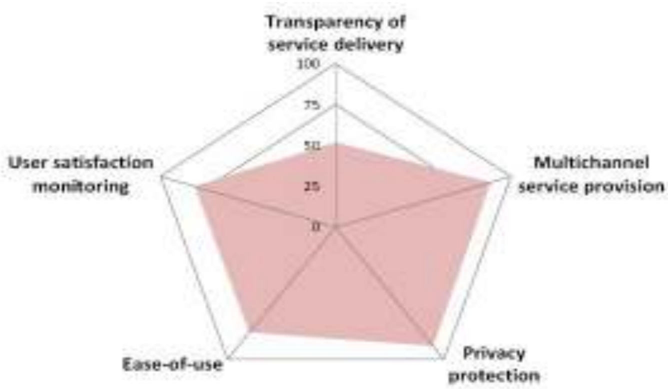



**Figure 9:** Five Key Criteria as Regards to User Experience

**Portal sophistication**: identifying the most mature, user-centric and personalized portals that provide direct access to a wide range of e-government services. This indicator is supposed to identify the most mature, user-centric and personalized portals that provide direct access to a wide range of e-government services. The indicator is comprises the following sub indicators/ measurement dimensions of the availability of the 20 services through the portal: a one-stop-shop approach, user-focused portal design and usability (Figure 10) [12].

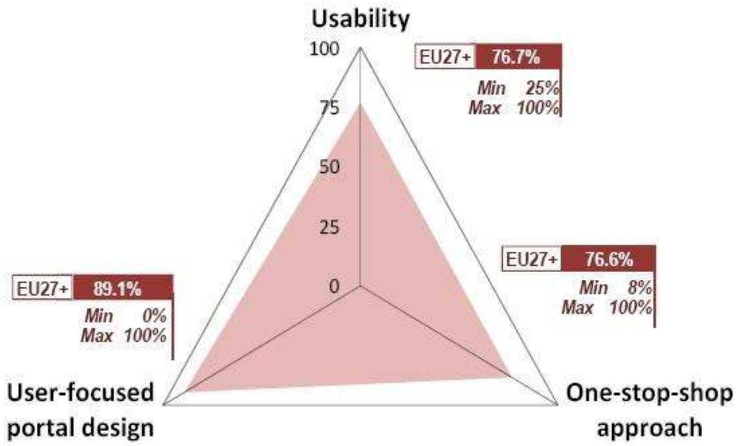



**Figure 10**: User Experience of Portals, EU27+.

Sub-national analysis: the 20 service metrics have been applied at NUTS, (Nomenclature of Territorial Units for Statistics) levels. This is to provide granularity of e-government performance across regional and local administrations.

### 2.1.4 Twenty basic e-government public services as defined by the EU

As we have discussed so far, e-government services are believed to bring positive changes to the way governments deal with businesses and citizens and consequently, the goals of these services are to save money and time, bring convenience to citizens and businesses with online transactions, online information acquisition and promote fair treatment among citizens and businesses. There are 20 basic public services that governments can transform on the digital platform hence pass to e-government as identified by the European Commission Directorate General Information Society and Media. Twelve of these services are to help citizens and eight of them are to serve businesses as we see in Table 1.

**Table 1:** E-government Services as Defined by the EU.

| Citizens | Businesses |
|---|---|
| Income Taxes | Social Contribution for Employees |
| Job Search | Corporate Tax |
| Car Registration | Registration of a New Company |
| Social Security Benefits | Submission of Data to the Statistical Office |
| Personal Documents | Custom Declaration |
| Application for Building Permission | Environment-related Permits |
| Declaration to the Police | value added tax (VAT) |
| Public Libraries | Public Procurement |
| Birth and Marriage Certificates | |
| Enrolment in Higher Education | |
| Announcement of Moving | |
| Health-related Services | |

**2.1.4.1 The twelve e-government services for citizens by the EU**

- **Income tax**: citizens should to have any means to pay tax electronically at any time; a government website is to have related information about all types of taxes and forms**.**
- **Job search services**: citizens can seek employment online. For example, if one is seeking employment, one is able to search through the related government website for availability. A job-seeker need not show up at a government office to submit documentation as all documents can be submitted online.
- **Social security benefits**:
  - **Unemployment benefits:** a social security benefit from government to assist low-income people financially [13].

- ○ **Child allowances:** money received by parents of newborn children from government. Requirements to receive this money vary from one country to another in the EU [13].
- ○ **Medical costs:** for this service, citizens pay the government monthly or yearly depending on the rules of the country. Citizens can acquire this benefit under health insurance schemes [13].
- ○ **Student grants:** governments provide students with grants for living and tuition fees in order to support education.

- **Personal documents:** the citizen can electronically send requests for his documents to obtain passports or drivers' licenses, instead of showing up at specific departments, waiting and standing in lines.
- **Car (Vehicle/Motor vehicle???) registration:** if a citizen purchases a new vehicle, he no longer needs to proceed to a car (vehicles?) registration office; he is now able to register a new vehicle online though the related government website. He is now able to submit any relevant documents about the new vehicle online.
- **Application for building permission:** citizens should be able to obtain construction permission by online submission. All and any relevant documents and information pertaining to the building should be received by the government website. The applicant can receive a response by e-mail if the government website provides transactional services.
- **Declaration to the police:** a citizen should be able to declare information to the police via the Internet [14]. This can include online theft declarations and databases of terrorists and organized crime groups, detection of vehicle theft offenders through the vehicles database, and of criminals through the criminal records database and an ability to access national information via a police network.
- **Public libraries:** the government should have a website through which the citizen can easily access and register to search for and place orders on books.
- **Certificates:** a citizen can submit his documents online on government website and request to obtain certification of birth, marriage or death.
- **Enrolment in higher education/university:** the government website should have information about a country's universities with course registration being provided by universities through student information systems. For this, universities can provide their own websites. Students can register or select courses online on the

university website without paper-based work as the processes can be completed digitally online.

- **Announcement of moving:** this pertains to announcing online one's change of address. If a citizen moves and changes his address, he need not proceed in person to the related office; instead he can inform the government electronically as discussed in section 2.2.1.
- **Health related services:** a government benefit that helps citizens to receive health services. For example, the government can have a portal website through which information about doctors and hospitals are provided. Patients can easily obtain appointments online or be informed about nearby hospital and pharmacy locations.

#### 2.1.4.2 The eight services for business

As we have already mentioned in section 2.2.1, these services are identified by EU countries [12] [14]; so, we continue the list we have started in the previous section.

- **Social contributions for employees:** this is a system of payment for social, medical and pension insurance of employed people. This payment is to be paid to those employees who are working in the public or private sector to acquire benefits in social and medical costs; and after retirement, he will receive monthly pension insurance money. This service requires information about/from??? the employee and the amount of money to be paid. Such information can be provided through digital platforms.
- **Corporate tax:** in a working e-government medium, submission of tax forms and payment can be performed electronically. Functionalities to follow-up status in the tax office check account balances and obtain information on regulations and updates via the Internet.
- **Registration of a new company:** an organization should be able to register a new company online and lodge any related documents electronically.
- **VAT (Value Added Tax):** VAT is a tax on the purchase price. It is a tax only on the value added to a product or service. Organizations or businesses should be able to submit and pay online.

- **Submission of data to statistical offices:** any data/information that the government is to collect should be provided to the government, electronically.
- **Customs declarations:** customs declarations can be submitted fully in an electronic environment.
- **Environment-related permits:** this pertains to obtaining online permission for issues related to the environment. If a business somehow impacts the environment, an environmental permit or application for exemption may be deemed necessary.
- **Public procurement:** that is, the procurement of goods and services on behalf of a public sector. A government website should provide to any candidates forms and information about public procurement requirements.

## 2.2 Geographic Information System (GIS)

GIS is a computer technology which is used to collect input processing, management, reports, analysis and output the geographical information, data and metadata for specific goals such as spatial data analyses. This definition includes the ability of the systems to introduce geographic information (maps, aerial photographs and digital photographs), metadata (contacts and tables), processing (removing errors), storage, and retrieval, analysis (spatial and statistical analysis) and display them on a computer screen or on maps and graphs or through websites. Moreover, it can help to answer questions and solve problems by looking at data on maps in a way that is quickly understood and easily shared [15]. In this section, we shall visit such analyses and management of spatial data.

### 2.2.1 The benefits of using GIS technology

GIS enables users to draw digital maps with multiple layers. Each layer can contain different schemes such as streets and roads or park areas. Users can easily hide or show any layer to obtain the best view on adopted maps for presentation and reporting.

Such systems help decision makers such that they provide necessary information to facilitate timely and proper decisions. Moreover, they enable users to make queries on geographic locations and display the results on a map. Such queries may be spatial or non-spatial as well as combined; e g., finding pharmacies that are opened 5 years ago and within 100 meters from a specific road.

As GIS can provide models of the real world, a robust data set can provide online and remote analyses; therefore, users can find information without the need for a field trip.

### 2.2.2 Components of GIS

GIS integrates five key components as shown in Figure 11:

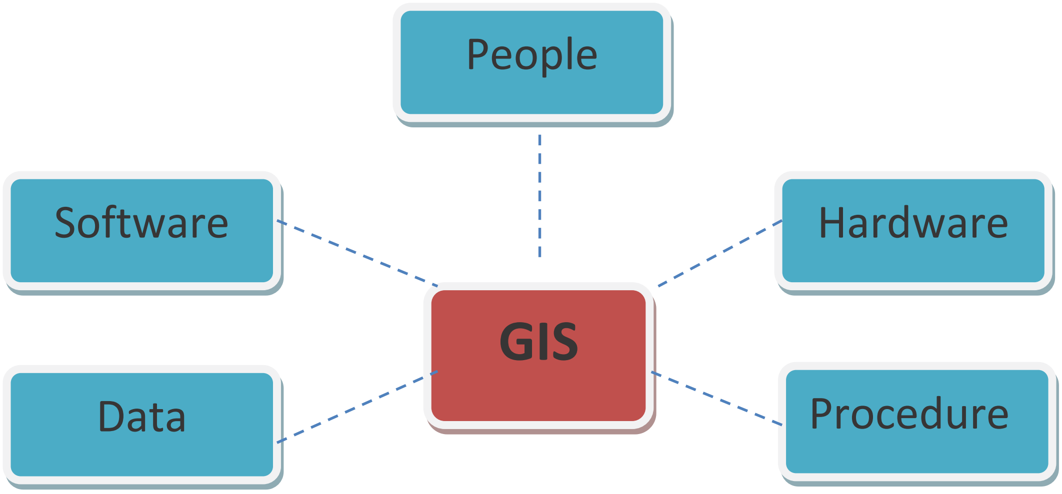



**Figure 11:** Five Key Components of GIS

**Hardware**: this is the computer on which GIS operates, with input devices used to enhance GIS performance such as a GPS, digitizer tablets and large scale scanners as well as output devices such as a screen and printer.

**Software**: GIS software provides the functions and tools needed to analyze, store and display both spatial and non-spatial data. The database components may already exist with the GIS, however, GIS software is expected to connect to external DBMSs. For example, MapInfo has its own database facilities; however, it can read and write data to and from Oracle. The tools can be used to support geographic queries, analyses and visualization.

**Data**: the most important component of a GIS is the data. There are two types of data that are handled by GIS. The first is tabular/ descriptive data that is stored in columns and rows in a database and can be linked to spatial data. The second is geographic/spatial data that consists of information about the relationships of entities in space, the locations, and relationships between geographic features and data that can be displayed as a map. GIS data can be collected in many ways such as from the field or purchasing from commercial data providers [16].

**People**: GIS technology without the people who manage the system and develop their applications is considered to have very limited value. Users of GIS may be technical specialists who design and maintain the system, or operators who use it to carry out daily routines/tasks such as entering data, running simple queries and preparing routine reports.

**Procedure**: the success of GIS operations depends on business rules and good implemented plans. For example, requirements as procedure to do if we want to select the best place to construct a new building, for example for a school or hospital.

### 2.2.3 Exemplar cases of GIS usage

In [17], we see the study on using GIS to assess the current situation of state school sites in elementary and secondary stages for girls in Mecca by representation of school sites on a digital map. In addition, this study shows the ability of the GIS to process multiple data from various sources, and combined with each other, using various statistical analyzes spatial and cast in one template to reach effective solutions by suggest to change some of these schools location or built a new schools according to planning criteria or social criteria to perform right decision. The researcher collected spatial data by using the Global Positioning System (GPS). GPS is a technology that provides users with positioning, navigation, and timing services. This system consists of three segments: the space segment, the control segment, and the user segment. An example is the U.S. Air Force that develops, maintains, and operates the space and control segments [18]. It can be used to determine the location of schools during field work and obtaining the correct coordinates in front of all school buildings. In addition, the researcher has acquired more than four maps of Mecca from different organizations in different formats. Information about population and population density, number of neighborhoods and subdivisions as well as area of Mecca were also collected. After the data collection, a database was created and ArcGIS software was used. Through spatial and statistical analyses provided by GIS, the study yields possibilities in constructing buffers around schools as compared with other schools. The comparison criteria are based on finding the nearest neighbor schools for girls in elementary and secondary stages, excluding unmanned geographical areas. In this research, the ability of GIS to process multiple sets of data from various sources has been underlined; in this manner, using various spatial and statistical analyses reports promotes decisions and detections of pattern distribution facilities in the municipalities.

Another example is reported in [19]; it is a study on using GIS techniques to draw new school maps in educational regions for primary and secondary schools in the Ain Shams province of Egypt. The aim of the study was to evaluate the distribution of appropriate educational regions on geographical maps for schools based on multiple criteria including number of students in the school, number of teachers and number of classes. The system helps operators to select an optimal site to build a new school and to obtain information about which area would receive the best education services. Benefits include identification of the efficiency of proposed educational areas by comparing sizes of schools and numbers of school-aged citizens education and to create a geographic database of these educational regions.

The first step of the research was data collection; this included spatial data such as school maps, a map of Ain Alsams province from Google Earth and metadata such as information about the number of schools, school names, school addresses, the number of classes in each school and the number of students. This information was acquired from the Ministry of Education in Egypt. The researcher exploited these data in the ArcGIS program to create a database. The importance of this project was to identify the most appropriate/suitable places to provide/reveive education services in potential neighborhoods. This provides advantages to those who wish to reside in a place with more suitable education services in addition to helping decision makers to identify any geographical areas which lack in educational services; such areas will be deemed suitable for construction of new schools.

Another study worth mentioning is reported in [20]. This study pertains to using GIS in a multi-criteria evaluation tool and using COM (Component Object Model) technology to solve site selection problems in Stowe, Vermont, USA. The researcher has identified the most suitable sites for a new school by using recreational facilities, proximity to major roads and proximity to already existing schools, topography and land use as criteria. GIS was employed to derive the criterion maps using five different data sets as shown in Figure 12:

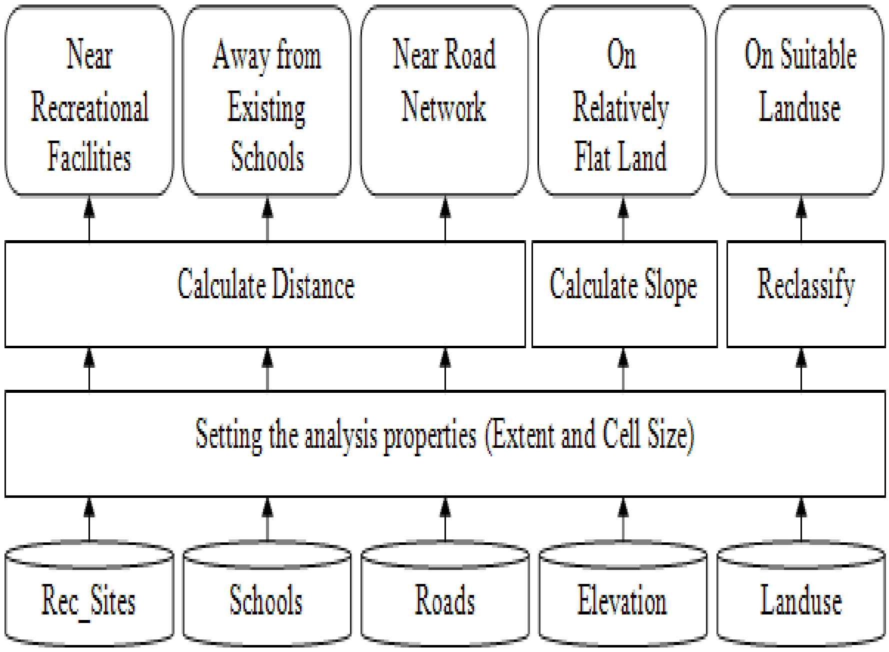



**Figure 12:** Five Different Data Sets

After preparing the standardized criterion maps, the other step is to identify the most suitable locations for the new school according to the predefined five criteria. In the work, it is stated that developing and using GIS-based multi-criteria evaluation tools for site selection is a complex process which needs well trained GIS developers and analysts to carry out. With some customization through macro languages, a toolbar in ArcGIS has been developed to overcome such limitations. This tool, using COM technology to achieve software interoperability, is the ability of two or more software components to directly cooperate and communicate in spite of their differences in interface and programming language.

In [21], the suitability of potential areas for schools is investigated. The researcher showed the most suitable criteria for the location of a new school in Negeri Perlis in Malaysia. A proposed site for educational facilities should not be a hill, swamp, flooding area or landslide risk. School sites must be far from industrial areas and have sufficient separation from unsuitable land, as a highway. Besides that, in order to avoid traffic jams and for the safety of children, the site must not be located along or near a main road. Moreover, road/path location is another important criterion in deciding on a site for new school in terms of mass transport and accessibility.

In [22], the researcher has showed that GIS is as a computer-assisted system for acquisition, storage, analysis and display of geographic data. However, data collection and database updating may pose serious problems due to some disadvantages such as high cost, low digital degree, and long time consumption depending on the source and registration format. On other hand, missing data may be accurately produced from the field with the help of GPS technology; in this manner, researchers are able to collect and update a GIS database. This technology is applied to the Zhalong wetland in China [22]. The related results showed that the data collection and database update of GIS based on GPS technology can orient changed areas rapidly and make the local database update more convenient and flexible.

Another example is from the Ministry of Education in Turkey, FATIH Project that covers employment of information technologies in primary, elementary and secondary schools to improve tools in the teaching-learning process [23]. The project includes supplying hardware such as providing each school with one multi-function printer and one document camera, interactive whiteboards, wired Internet connections for the classrooms and tablet computers to each teacher and student. Teachers receive training courses to eliminate computer literacy problems through the use of IT so that students receive correct information at the right time and easily share that information among themslves. The project's geographic decision support system was planned by Başarsoft company in 2013 [24]. The aim of this system is to produce fast and accurate information for the central government, hence the effective use of resources. In the construction of this system, developers required spatial and non spatial information on all schools as well as other resources to be reported on the map of Turkey as seen in Figures 13 and 14.

In this project, MapInfo/ MapXtreme software was used. The outcome of the first step of the project was the building of a digital map of Turkey with its regions and roads and the possibility of a search tool on the map. All schools in the Ministry of National Education of Turkey are placed on the map. Users have many options regarding the search of schools as shown in Figure13.

**Figure 13**: Search for Schools in Turkey

The user may also obtain information about each school such as school identity, name, address, number of classes, number of laboratories, contact information (landline and mobile telephone numbers, manager email address, fax, location, etc.) and building information as shown in Figure14.

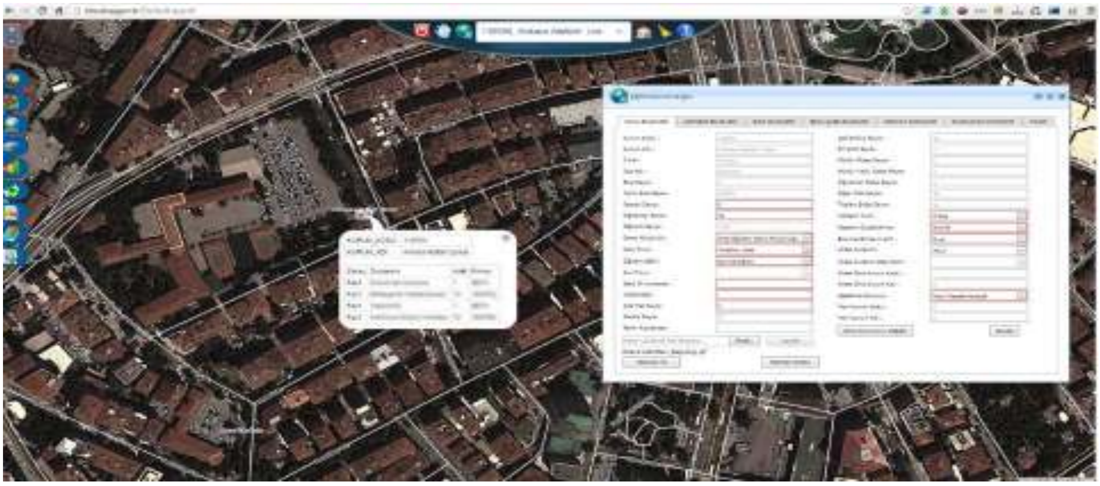


**Figure 14**: Information about each school

In addition, all data related to the school system can be displayed, updated and prepared as reports for analyses as shown in Figure15.

**Figure 15**: Preparation Static Reports

This project allows users to find the shortest path in order to access a school as shown in Figure16.

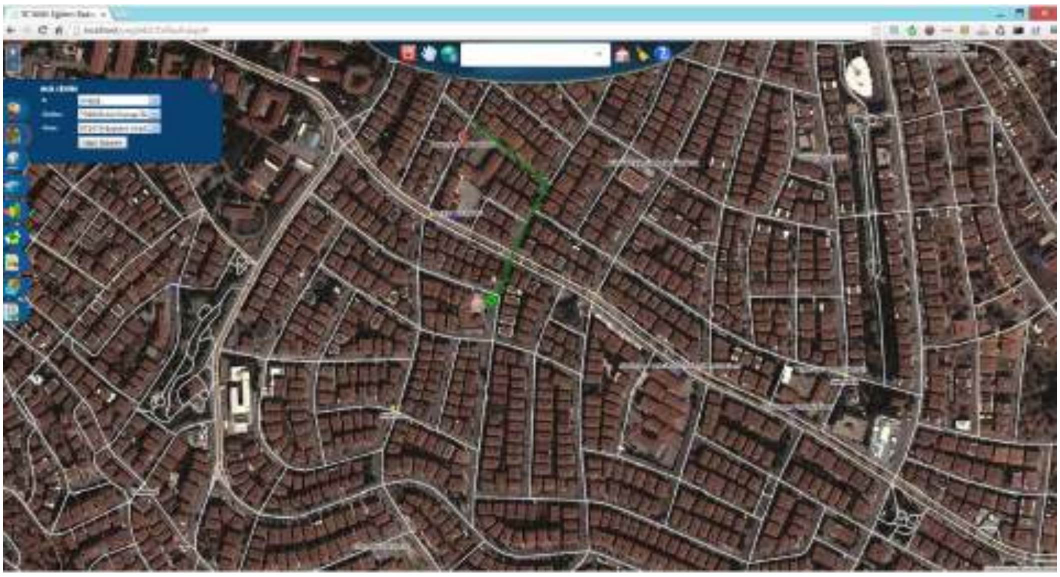


**Figure 16**: Map Showing the Shortest Path to a School

## 2. 3. Evaluation of the literature survey

As we show in the examples in section 2.2.3, researchers use different methods, criteria and technologies to collect data and to analyze it with ArcGIS software in order to obtain some desired results. Other GIS software products can analyze data and obtain results. Some of this software is free and non-proprietary i.e.

open source software with legal rights for users to have the freedom to run, change the code of the software. Most open source desktop GIS software can be installed on multiple operating systems, such as Windows, MacOS, and Linux. For example, KOSMO (http://www. opengis. es/) is one of the most popular open source desktop GIS (Java-based) applications. gvSIG (http://www. gvsig. com), which has been developed by the European GIS community, offers multiple language user interfaces; uDig (http://udig. refractions. net/) is also a popular Java-based desktop GIS software. GRASS (http://grass. osgeo. org/) Geographic Resource Analysis Support System is one of the oldest public domain GIS applications developed in 1985 by the U.S. Army Construction Engineering Research Laboratories. Also available are other open source software packages that can provide advanced GIS functions, such as web mapping services, advanced spatial analysis and spatial databases as in (MapServer (http://mapserver. org/), GeoServer (http://geoserver. org/display/GEOS/Welcome), Mapfish (http://mapfish. org/). In addition, there are some applications with spatial analysis programming tools and libraries such as STARS (Space Time Analysis of Regional Systems) (http://regionalanalysislab. org/idx. php/Main/STARS) [25].

In this research, we used MapInfo Professional with MapBasic software downloaded from (http://www.basarsoft.com.tr/download-tr) to analyze collected data and to evaluate output performances.

According to the examples visited so far, GIS technology has been employed to collect and analyze data to obtain locations of digital schools on the map as well as to acquire information about each school and to use the search capability to find the best areas for the construction of new schools. With this compilation, we can support our thesis that there are considerable examples in the literature to show that we can use GIS in managing schools in the Kirkuk city center. Such a system can provide detailed geographic information about school locations to serve citizens, students, teachers and decision makers in city and resource planning.

In this chapter we have covered electronic government initiatives and the importance of public participation as they are recognized as indicators of today's development criteria. Furthermore, we studied services to citizens and businesses that can be provided digitally. We have seen how interaction with government by making public information more accessible through the use of websites reduces the cost of services and increases accessibility; many citizens can have the same service at the same time and complete transactions in government departments online without any need of human interaction or necessity for showing up in person at a government office. Additionally, we have visited measurement techniques (section2.1.3) to evaluate and compare e-government transition of various countries. Furthermore, we have provided examples (section2.1.4.1) of those services to solidify basic public services that governments can transform into a digital platform.

As we have clarified in the first chapter, this thesis has two folds: e-government and GIS. GIS can serve e-government initiatives due to the fact that GIS applications are able to collect, input, process, manage, report, analyze and output geographical information. We have covered some of the examples in section 2.2.3 by using GIS in the education field; very briefly we have seen reports on success stories on school sites, selections on digital maps and possibilities of constructing buffers around schools which help making decisions about school vicinities and sites.

The following chapter presents some exemplar applications we have generated with MapInfo to provide tools that can be used to provide and manage geographic information about school locations to serve citizens, students, and teachers in the Kirkuk city center.

## CHAPTER III

## ANALYSES THROUGH EXAMPLES

### 3.1 Data Collection

In this research, we have collected data sets from many different sources. Basically, there are two types of data: spatial and non-spatial. We will look at those data sets in this chapter.

#### 3.1.1 Spatial Data

Maps showing all roads in Iraq and Kirkuk city obtained from the Directorate-General for Education Kirkuk (Figure17). Aerial photographs showing the Kirkuk city are from Google Earth. We were, however, unable to obtain the photos from the sources dues to the impossibility of finding the aerial map of Iraq and Kirkuk city. It ought to be noted that even if such a map were to have been found, the cost would have been considerable; therefore, we used a satellite map from Google Earth Figure 18.

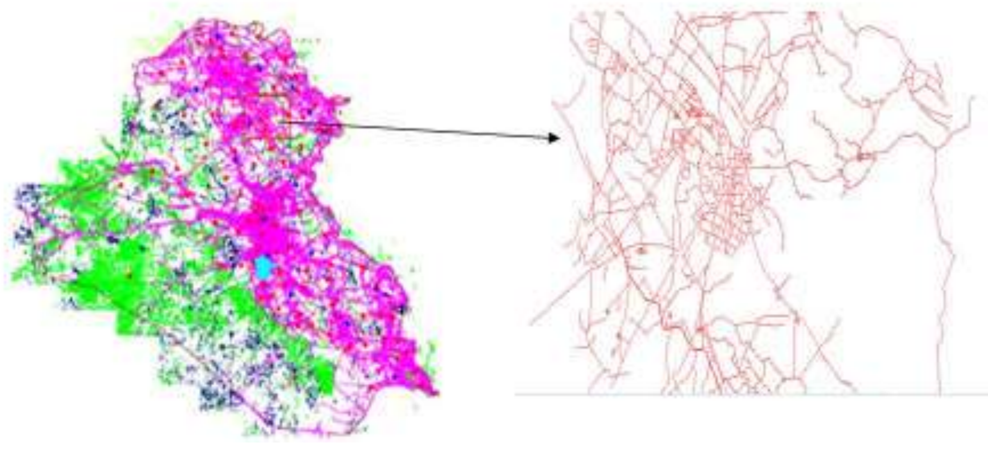


**Figure 17:** Iraq and Kirkuk's roads layer

**Figure 18**: Aerial Photographs of Kirkuk City

The imported satellite map of Kirkuk city center. We place the Kirkuk map layer over the Kirkuk road layer by selecting Table > Raster > Modify Image Registration; we select four points to place the Kirkuk map layer over the Kirkuk road layer for more details [27] p 41.

### 3.1.2 The text data

A screenshot of a Microsoft Excel file that contains information about schools in the Kirkuk city center, such as school name, location of school, type (primary or secondary), and coordinate of school is shown in Figure19. In addition, a Microsoft Access file that contains information about teachers at schools in the Kirkuk city center such as date of birth, place of birth, civil date, civil number, blood type, education, degrees of functional is shown in Figure20. These data sets are from Directorate-General for Education Kirkuk.

**Figure 19**: Spreadsheet Containing Information About Schools with Coordinates

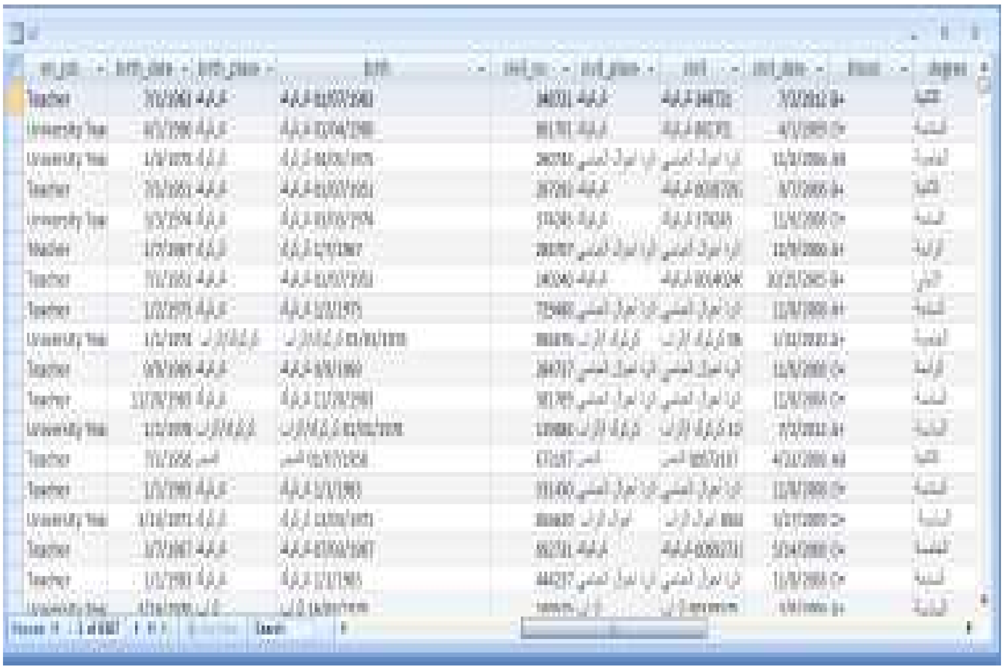


**Figure 20:** Database Table Containing Information About Teachers

## 3.2 Data Entry and Analysis

After collecting the data about primary and secondary schools (name, coordinators) in the Kirkuk city center from the General Directorate for Education in Kirkuk, we compiled them in a spreadsheet. To represent the location of schools in the Kirkuk city center, the GIS software, MapInfo Professional was used. (The researcher has attended lessons at Başarsoft Company to using MapInfo professional software.) we exported the schools location table to MapInfo Professional and we selected Table > Create Points to create points and represent the location of schools in the Kirkuk city center as a layer as shown in Figure 21.

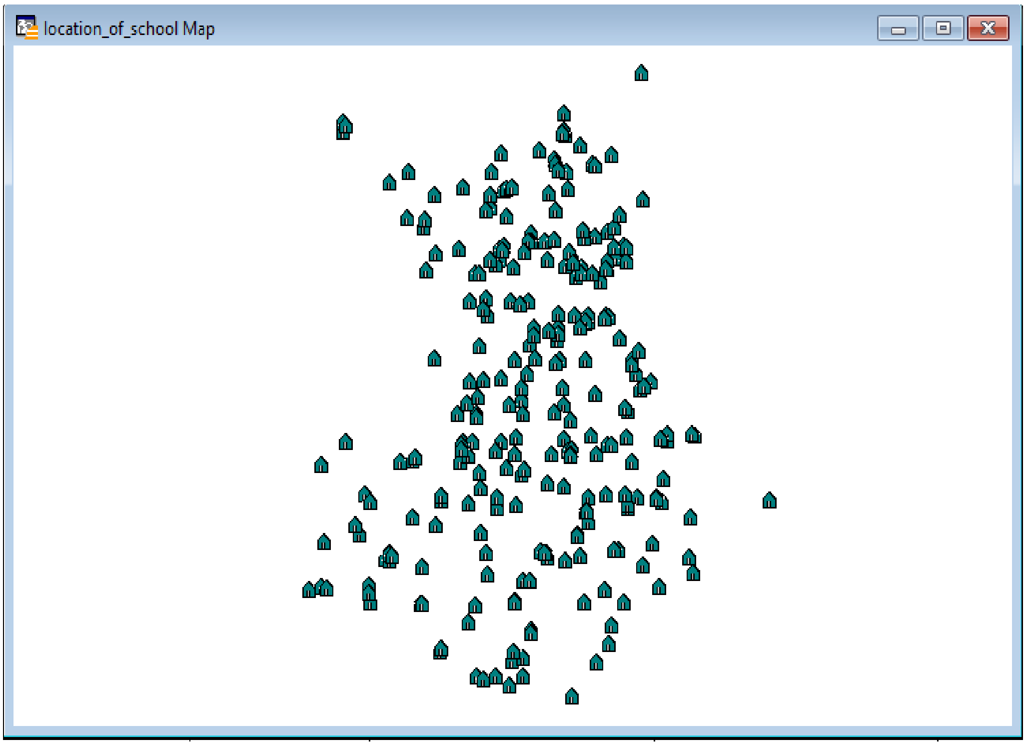



**Figure 21**: Schools Plotted as Layer on Map

We generated other layers as roads and regions. We have drawn these spatial data as we take the Google Earth view of Kirkuk as a reference (Figure 22).

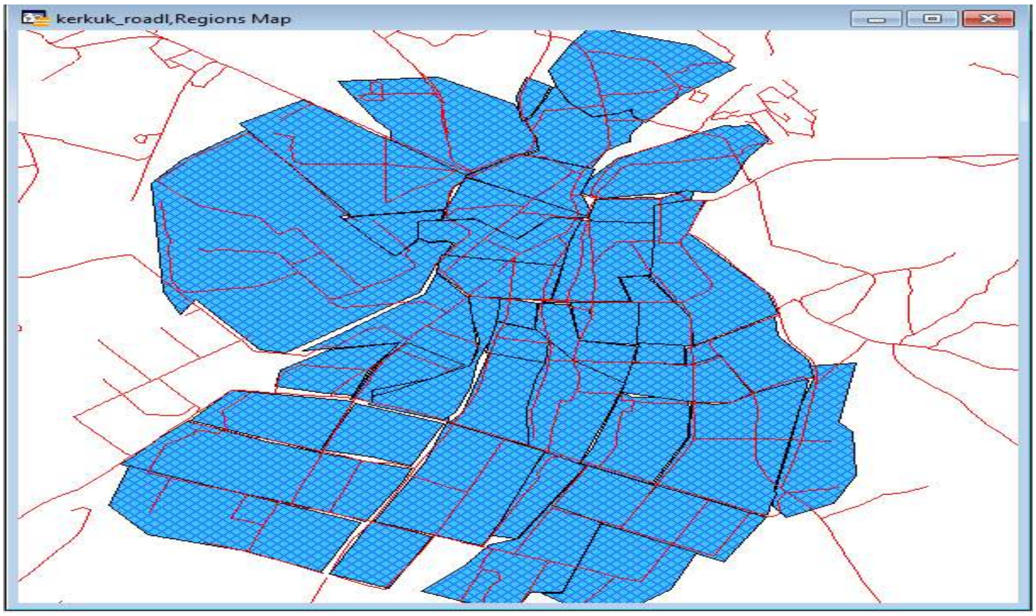



**Figure 22:** Kirkuk Roads and Regions

We saved a satellite view of Kirkuk that we obtained from Google Earth in JPEG format. We then placed this layer over the other layers (location of schools, roads, and regions) to give us a multilayer map of Kirkuk city (Figure 23).

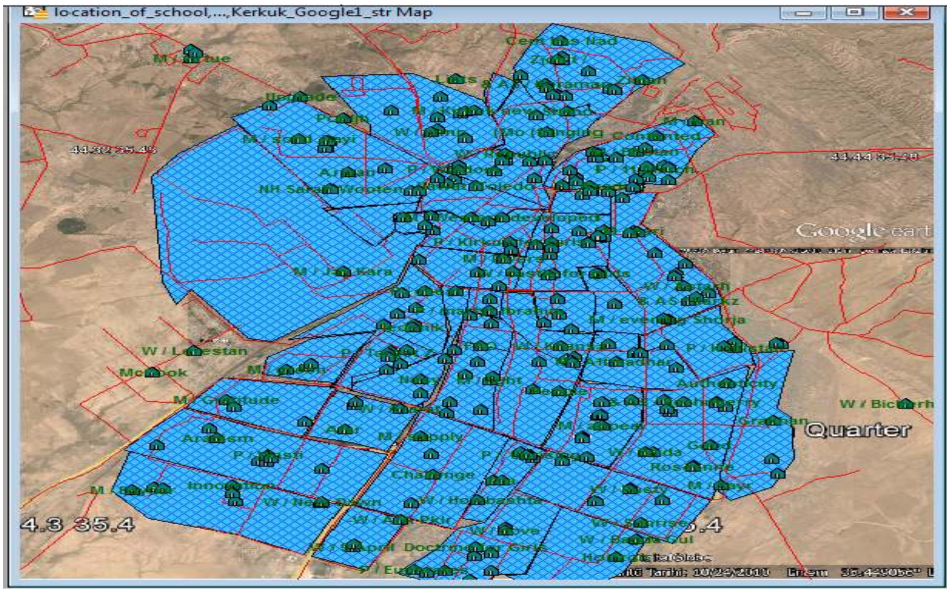



**Figure 23**: Kirkuk Map all Layers

### 3.2.1Thematic map

For the next step, we generated thematic maps of regions according to location of schools in each area, i.e. distribution of the schools. The colored map shown in Figure 24 presents the density of schools per region. This can serve as a decision maker to inform us as to school numbers, hence education facilities in each region as well as regions that need new schools i.e. should school construction be deemed necessary, the region in need is shown. Moreover, if further information about schools (such as student numbers, age of students, teacher numbers, or the competencies of the teacher in each school) is available, we can make a join between tables and produce thematic maps to obtain the distribution of teachers and students in regions as well as number of students and teachers in each school.

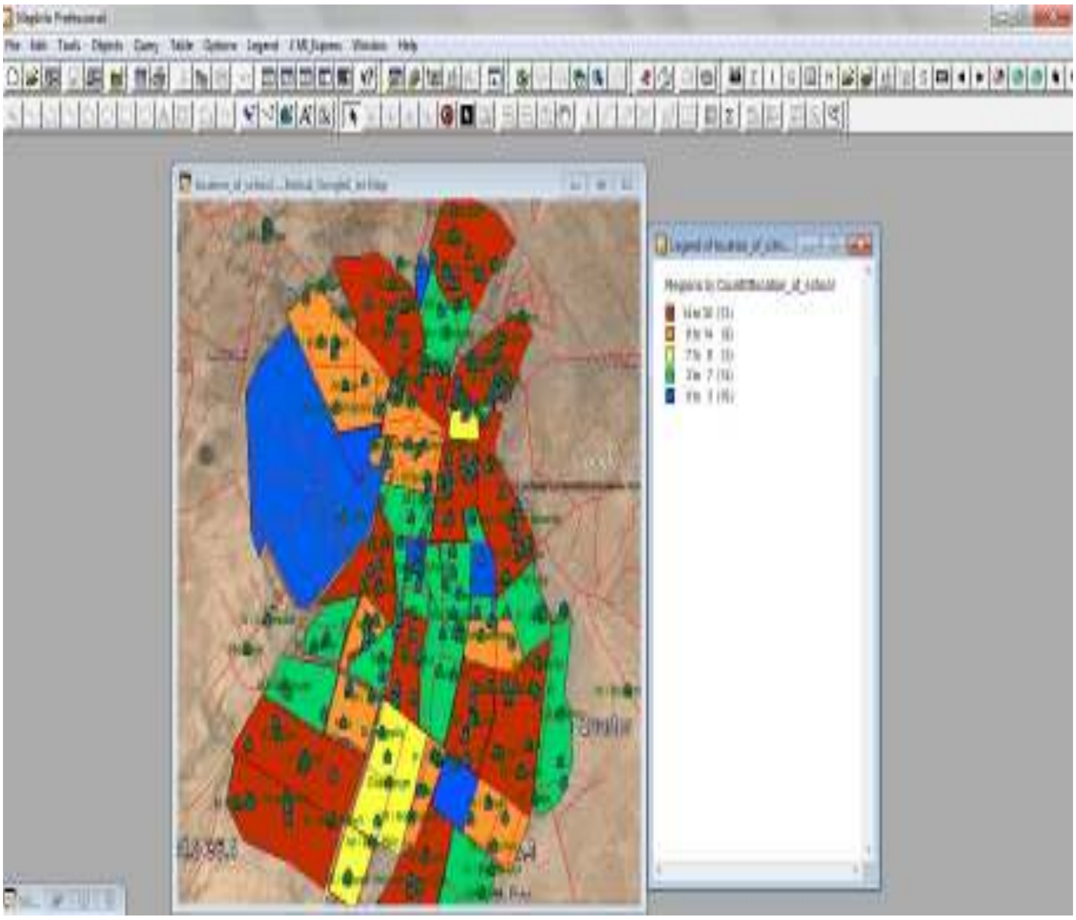


**Figure 24:** Thematic Map Regions Colored According to School Density

### 3.2.2 School search in an area

We have used MapBasic software which provides a development language for MapInfo Professional to write codes as shown in section 3.3.1. The tool in this section is employed/used to find the nearest schools around a given point. A partial view of the code is shown in Figure25. In order to run the application, we had to be certain that the MapInfo software was also running with the layers.

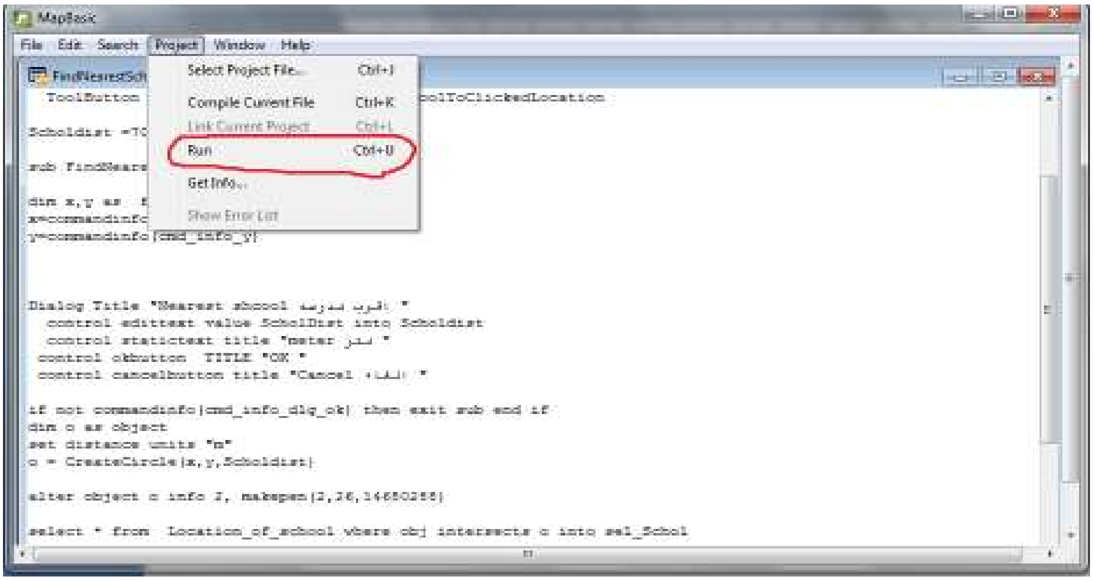



**Figure 25**: Code Written in Map Basic Software

After running the code, we switch back to the MapInfo software to observe a new tool button labeled FS (Find School) that we created by code.

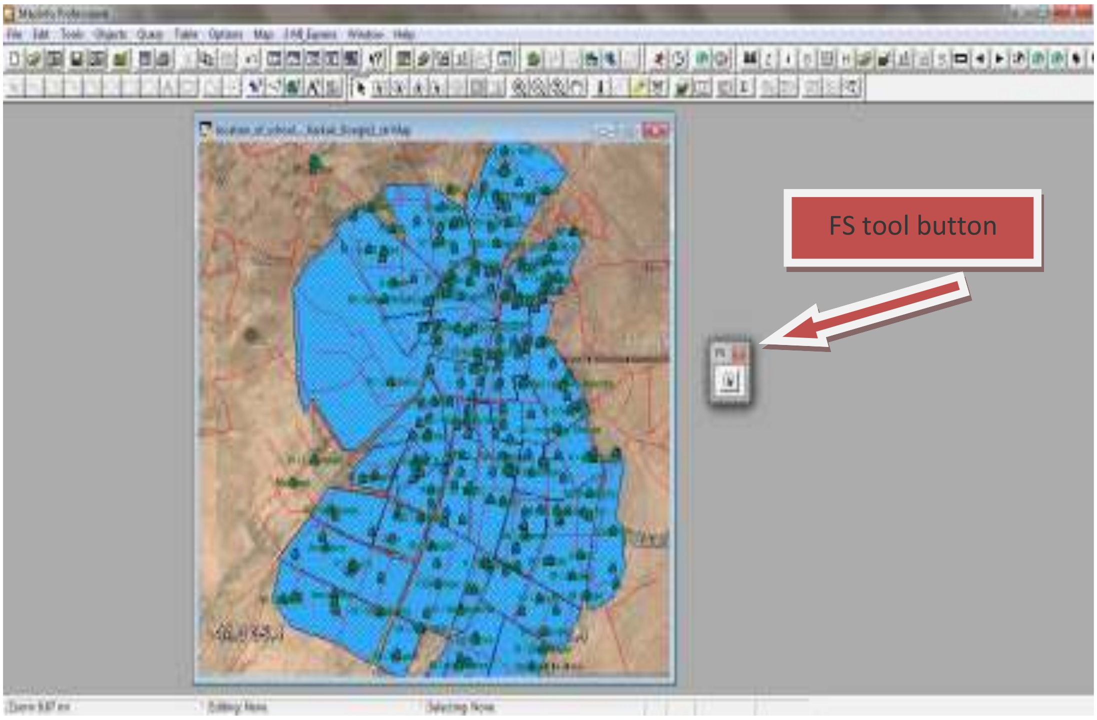



**Figure 26**: FS (Find School) button in Mapinfo Software

When the user presses on any point on the map, a window appears to enter the distance in meters for proximity. This is to be used for the radius of a circle inside of which schools are to be marked and highlighted. An example is shown on Figure 27 where the default distance, 500 meters, is entered.

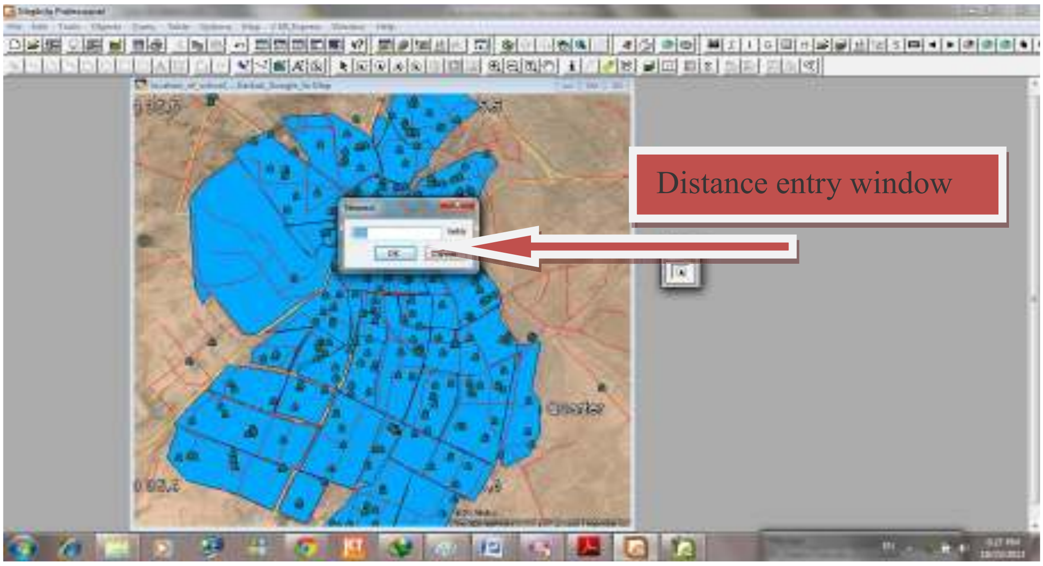



**Figure 27:** Distance Enter Window

After pressing the OK button, a purple circle around the selected point on map of the Kirkuk city center is drawn; schools within the circle are selected In Figure 28, another example is shown where 1500 meter around a random point is entered. A message showing the coordinates of the point and number of schools appears on the screen.

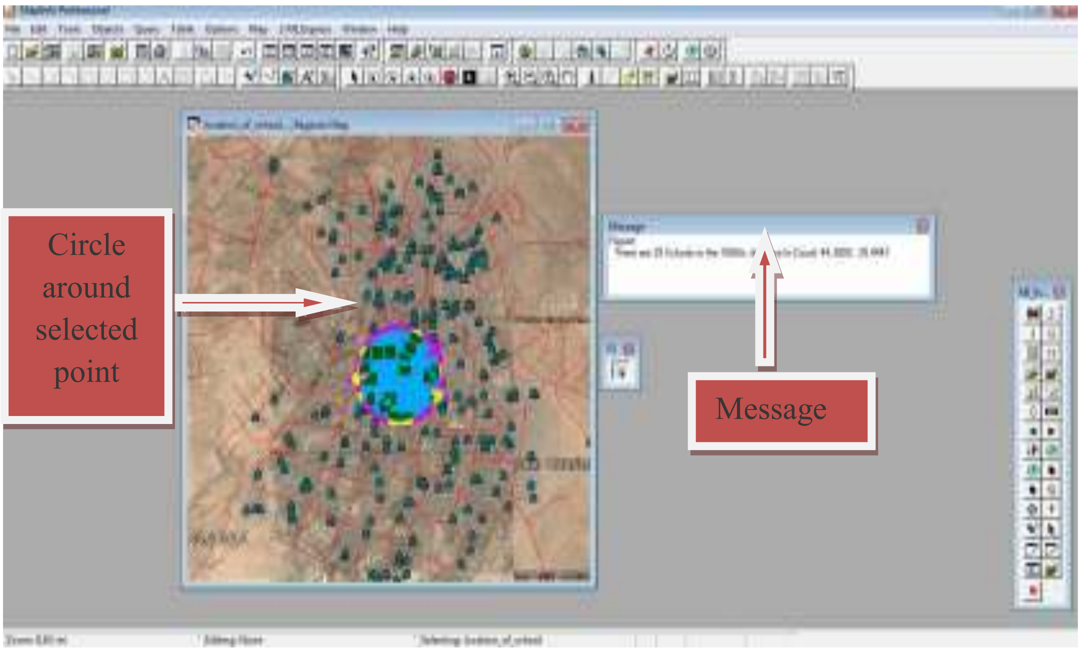



**Figure 28:** Buffer Circle And Message

### 3.2.3 Information tool

We can also show the information of selected schools by clicking on the info tool button in the main tool bar and we open a table that shows the information we collected about each school, such as name, type (whether it is primary or secondary), location of school, and school coordinator as shown in Figure 28. Such a tool would be useful not only for students and teachers but also for any citizen and decision maker who would like to obtain information on schools e g. the number of students and teachers in each school, along with addresses, number of classrooms, seats and whether schools are for boys or girls. The user can easily acquire such information about any school by selecting it on the map.

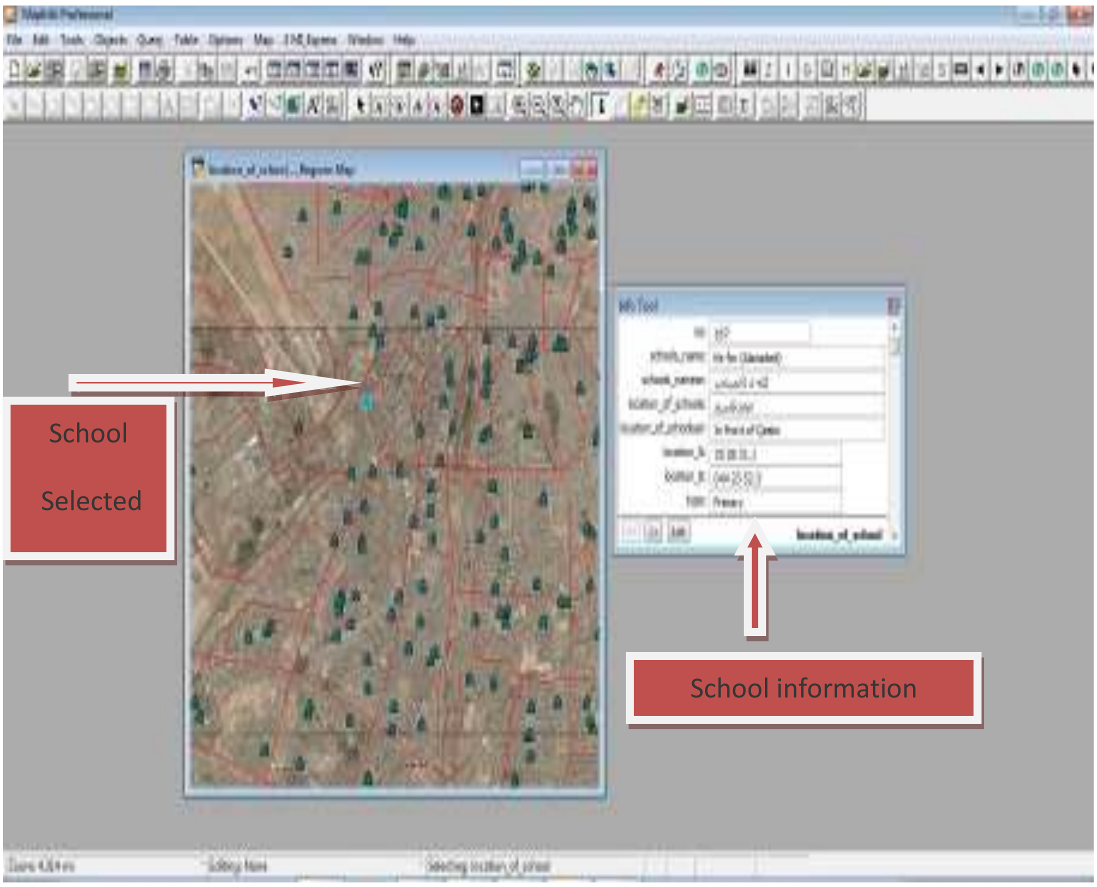



**Figure 29**: Info Tool

### 3.2.4 Nearest school to a region

Similar to the tool presented in section 3.2.2, we have created a second tool by using MapBasic; the code is presented in section 3.3.2. This tool is is used to find the nearest schools around any region the user selects. This tool can help managers when making decisions with regard to building, for example, a new secondary school in region A; however, there may already be secondary schools in region B, which is near region A; so, we have developed this tool to help decision makers by showing nearby schools according to the user-defined distance.

After running the code we wrote in MapBasic, we see a new tool button labeled SR (School, Regions) as shown in Figure 30.

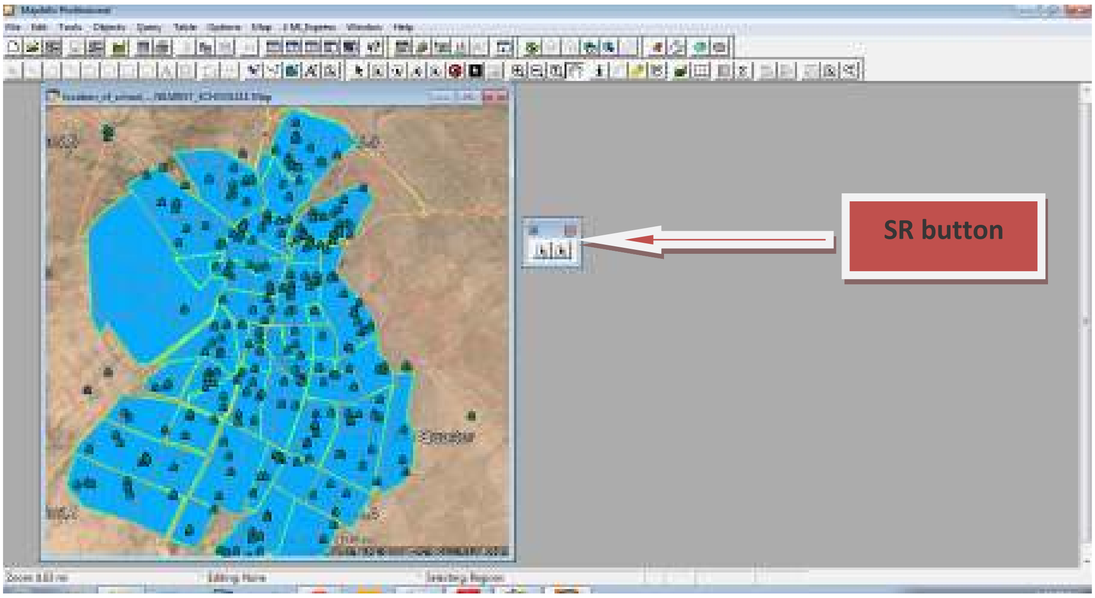



**Figure 30:** SR (Search in Region) toolbar

There are two differently-functioning buttons in this tool; however, they yield the same result: when the user presses on the first button, a window appears with the message “Please select a region from Regions layer” as shown in Figure 31.


**Figure 31:** Message Window for select a region

The user selects a region on the map and presses the same button to open a window to enter a distance around the selected point; the default distance is 500 (meters) as shown in Figure 32. In addition, if the user clicks the other button, a distance entry window appears without a select region message. When a region is selected, a window will appear in order for the user to enter a distance.

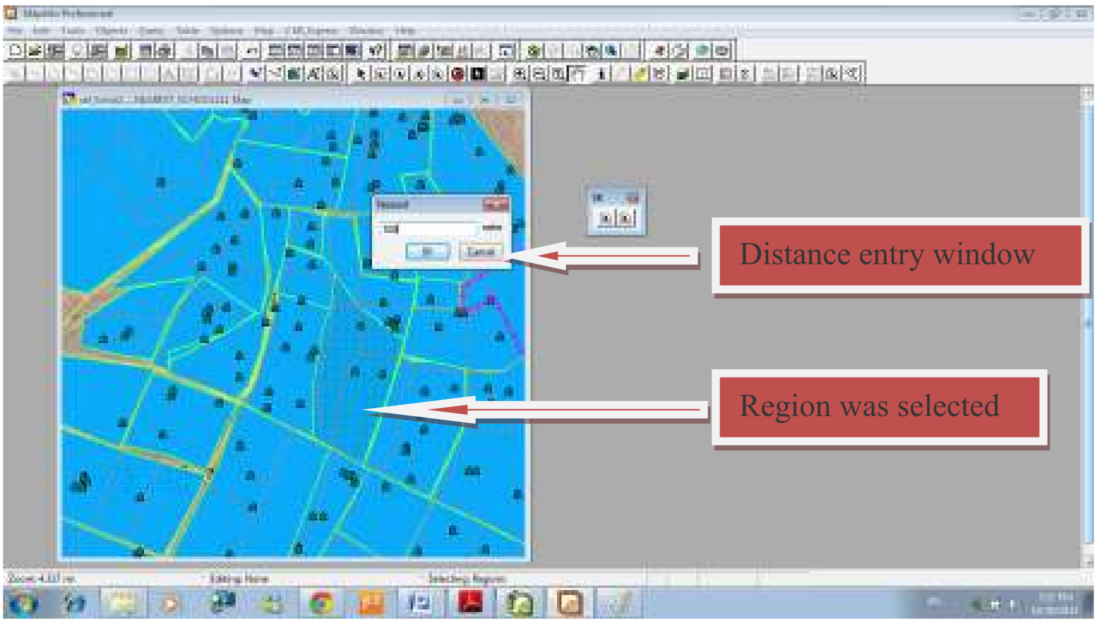



**Figure 32:** Changing Distance Parameter Dialog

For example, we enter 300 meters as the distance; the application draws a buffer around the selected region and shows two colors: the points in blue are schools already in the region, and the yellow points represent the schools outside the selected regions as shown in Figure 33. In addition, the user is given a report message for the name of the region, number of schools inside it, and the number of schools around it. Furthermore, we can obtain more information about each school by using the information tool as explained in section 3.2.3.

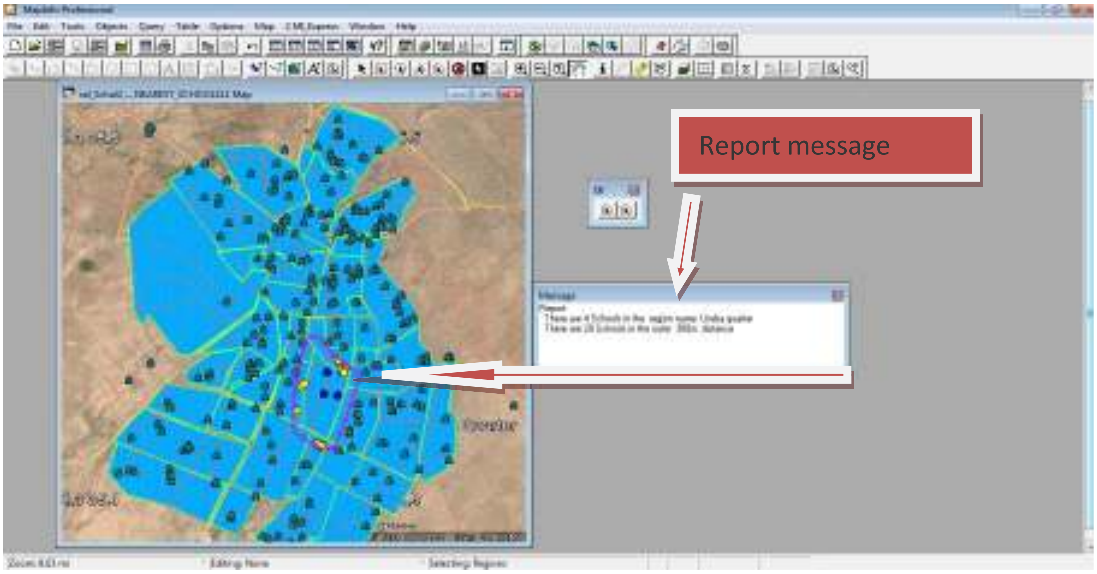



**Figure 33:** Schools shown with different color in area that selected

### 3.2.5 Nearest school to a point

This is third tool to provide ease the burden on decision makers. The code is developed in MapBasic and it is explained in section 3.3.3. This tool is used to find the nearest schools to the user selected point on the map.. In case there is more than one school in the vicinity, then the user can be provided with further information by using the information tool (section 3.2.3).

After running this code, the user sees a new tool button labeled NS (Nearest School), as shown in Figure 34.

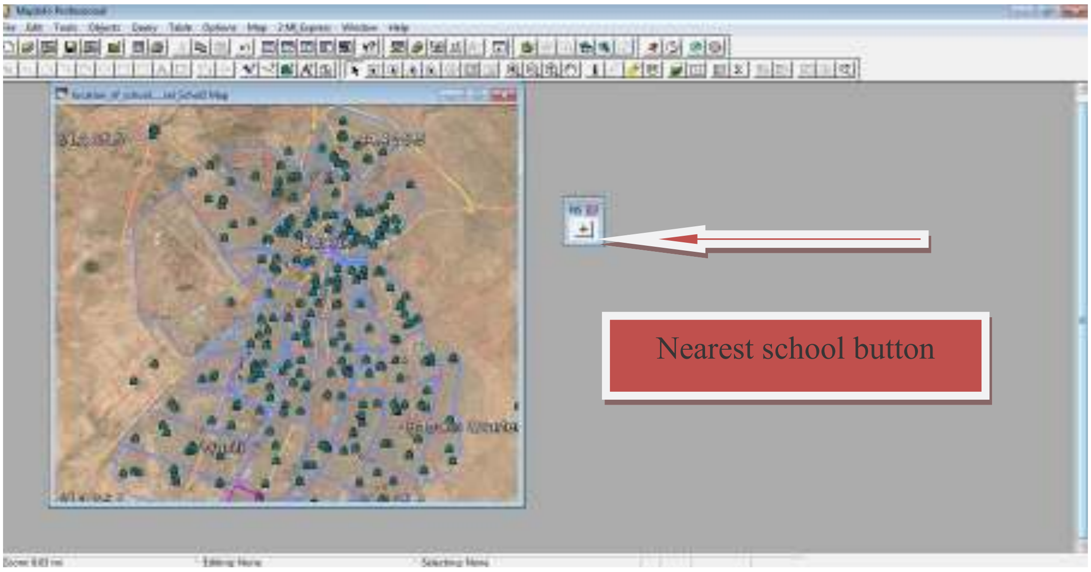



**Figure 34:** NS (Nearest School) button

When the user clicks the (+) button and selects a point on the map, a line is drawn between the point selected and the nearest school to that point as shown in Figure 35.

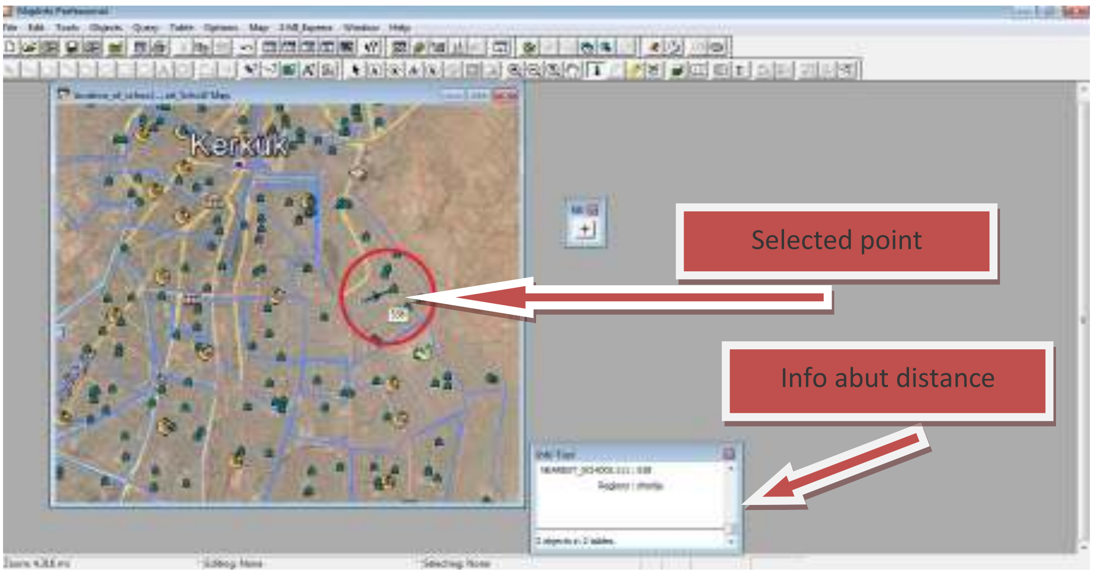



**Figure 35:** Line between Nearest Schools and Point Selected

There is a straight line drawn between points that are selected and the nearest schools with the distance between them shown in the Info Tool message window. In this application, we used straight lines for the distance due to our not being able to find a detailed road map of the Kirkuk city center.

### 3.3 Codes of the tools

In this research, we have used the MapBasic development language that allows programmers to create add-on tools for MapInfo Professional. Languages such as C, C++ and Visual Basic may also be used to create applications and MapInfo windows can be embedded in such applications. In this section, we explain the code for each tool we have presented so far in this chapter.

#### 3.3.1 Locating schools around a point

```
include "mapbasic.def"

declare sub FindNearestSchoolToClickedLocation
global Scholdist as integer
```

This code includes the MapBasic library and declares FindNearestSchoolToClickedLocation function and Scholdist as a variable.

```
Create Buttonpad "FS" as
  ToolButton icon 2 calling FindNearestSchoolToClickedLocation

Scholdist =500
```

This code is used to create a button pad, “FS” (Finding school), with a default value of 500 meters as shown in Figure 36.

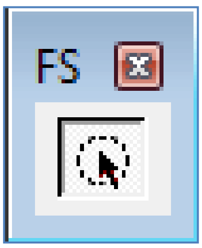



**Figure 36:** Find School (FS) button created by code

```
sub FindNearestSchoolToClickedLocation
dim x,y as  float
x=commandinfo(cmd_info_x)
y=commandinfo(cmd_info_y)
```

This procedure runs only when a user clicks the map because it is called by a tool button; clicking on this button generates the X and Y coordinates of the point.

```
Dialog Title "Nearest "
control edittext value ScholDist into Scholdist
control statictext title "meter"
control okbutton  TITLE "OK "
control cancelbutton title "Cancel "
```

This code creates the window titled “Nearest” for the user to enter a distance (Figure37).

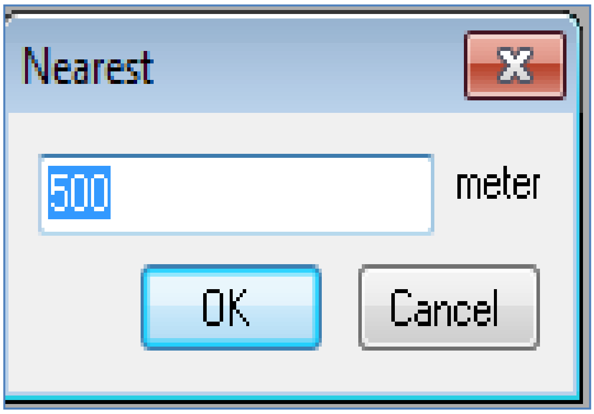



**Figure 37:** Nearest School Distance Parameter Entry window

```
dim o as object
set distance units "m"
o = CreateCircle(x,y,Scholdist)
```

This code is for creating a circle around the selected point on the map.

```
alter object o info 2, makepen(6,28,14680288)
```

This code is to create the shape of the circle and to color it purple.

```
select * from  Location_of_school where obj intersects o into sel_Schol

Print "  There are " + selectioninfo(sel_info_nrows) +
" Schools in the " + Scholdist + "m. distance to Coord: " + x + " , " + y
```

This code is for selecting the schools in the circle area and creating a report message to report the number of schools with distances and coordinates (Figure38).

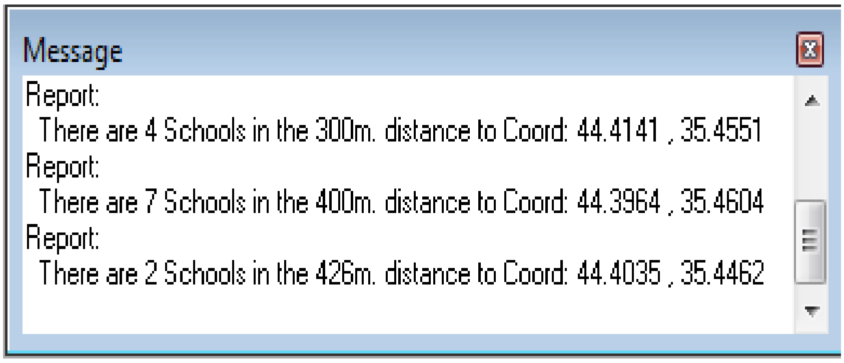



**Figure 38:** Nearest School Results Report window

```
dim tcosmetic as string
tcosmetic = layerinfo(frontwindow(),0,1)
delete from tcosmetic
```

This code is to delete previous circles and clear the map.

```
insert into tcosmetic(obj) values(o)
```

This code is to display the circle in ScholDist radius on the map.

### 3.3.2 Nearest schools around a region

```
include "mapbasic.def"
declare sub FindNearestSchoolToSelectedREgion
declare sub FindNearSchoolToSelectedREgionTool
dim Scholdist as integer
```

As we mentioned earlier, the first statement of this code includes MapBasic library. The second and third statements are to start and end the declaration. We also have a global integer variable, Scholdist.

```
Create Buttonpad "SR"  as
PushButton icon 3 calling FindNearestSchoolToSelectedREgion
ToolButton icon 3 calling FindNearSchoolToSelectedREgionTool
Scholdist = 500
```

This code is to create the "SR" button pad with two push buttons as shown in Figure 49.

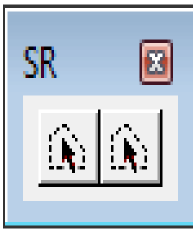



**Figure 39:** SR Button

```
if selectioninfo(sel_info_nrows) = 0
then note "Please select a region from Regions Layer" exit sub end if
if selectioninfo(sel_info_tablename) <> "Regions"
then note "Please select a region from Regions Layer" exit sub  end if
obj_reg = selection.obj
```

This code introduces a condition to create a message box to inform the user to select a region from the regions layer (Figure 40).

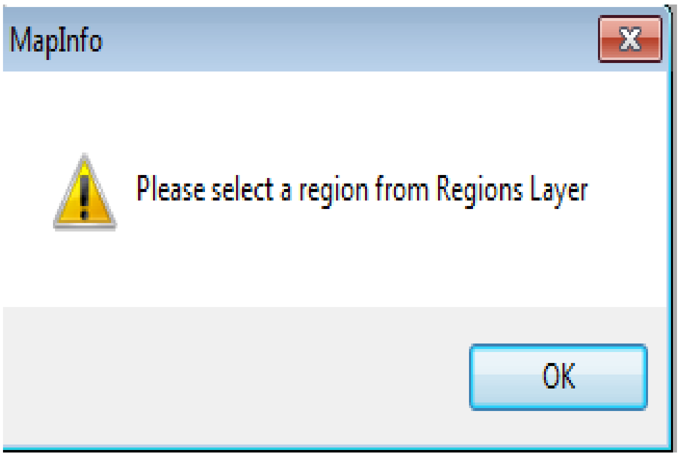



**Figure 40:** Warning Dialog

```
Dialog Title "Nearest"
control edittext value ScholDist into Scholdist
control statictext title "meter"
control okbutton
control cancelbutton
```

This code is to create the window titled "Nearest" to enter the distance and to create "OK" and "Cancel" buttons, same window shown before as in Figure 38.

```
if not commandinfo(1) then exit sub end if
```

This code is for if the "cancel" button pressed.

```
o = buffer(obj_reg,3,Scholdist,"m")
```

This code is to create a buffer area around the selected region.

```
select * from  Location_of_school where obj intersects o
and  not (obj intersects obj_reg) into sel_Schol noselect
select * from  Location_of_school where obj intersects  obj_reg into sel_Schol2 noselect
```

This code is for selecting schools inside an area that is buffered

```
add map layer sel_Schol
set map layer 1 display global Global Symbol (34,16776960,12)
add map layer sel_Schol2
set map layer 1 display global Global Symbol (34,255,12)
```

This code is for change the symbols and coloring schools that found in selected area as shown in Figure 41 below.

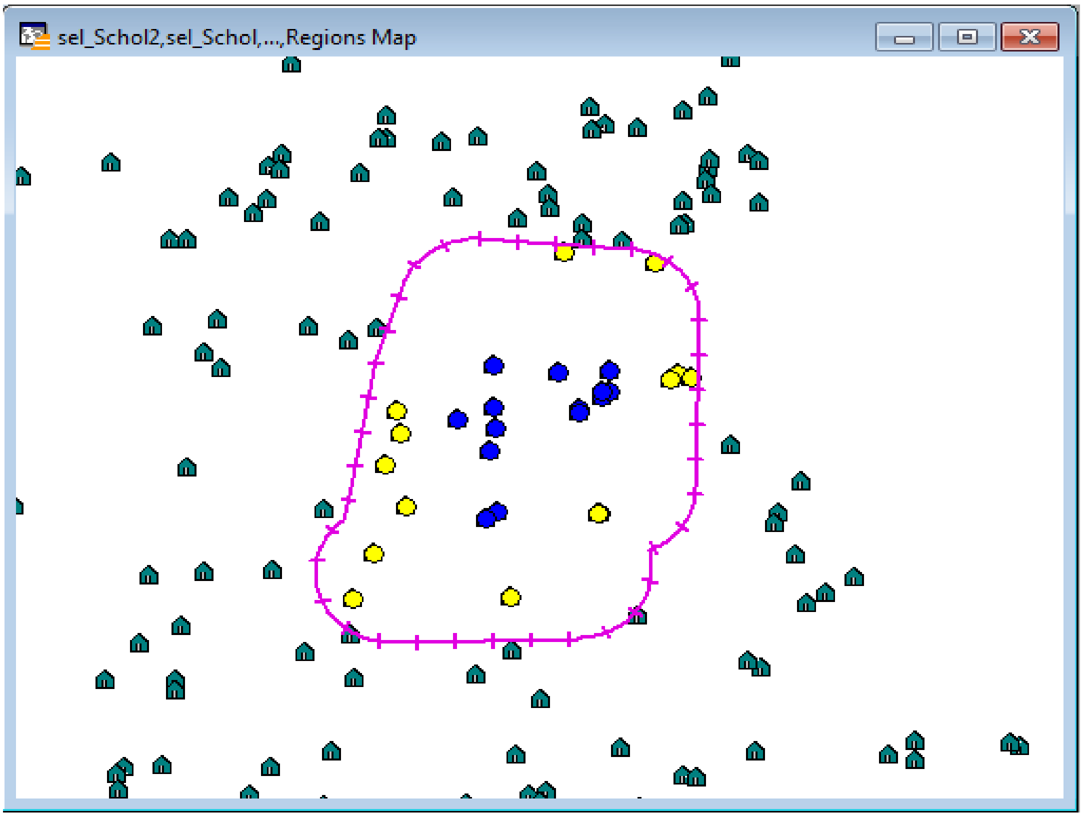



**Figure 41:** Coloring schools

```
Print "Report:"
Print "  There are " + tableinfo(sel_schol2,8) + " Schools in the  region name: "+selection.name
Print "  There are " + tableinfo(sel_schol,8) + " Schools in the outer  " + Scholdist + "m. distance"
```

This code is to create the report message showing the number of schools inside a region, the region name, and the number of schools outside that region according to distance, as shown in Figure 42.

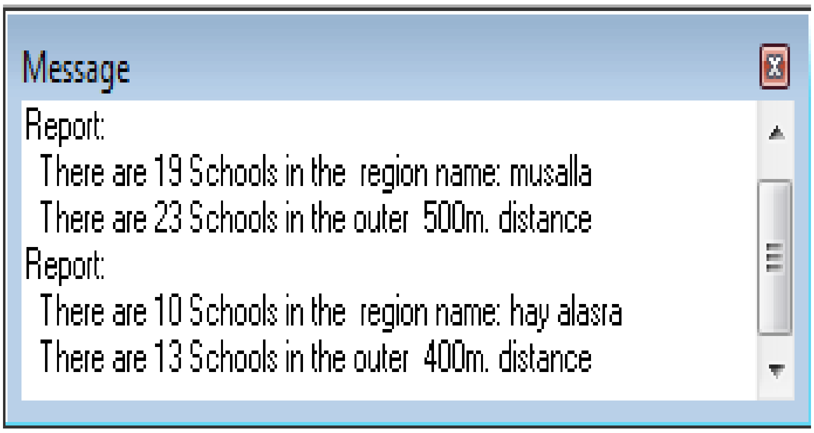



**Figure 42:** Report window

```
sub FindNearSchoolToSelectedREgionTool
dim x,y as float
x=commandinfo(cmd_info_x)
y=commandinfo(cmd_info_y)
select * from Regions where obj intersects Createpoint(x,y)  into selxx
```

The following code is to select a region around the clicked location on the map.

```
dim tcosmetic as string
tcosmetic = layerinfo(frontwindow(),0,1)
delete from tcosmetic
insert into tcosmetic(obj)values(o)
```

This code is to delete a previous buffer in the cosmetic layer on the map.

### 3.3.3 Nearest schools to a selected point

```
declare sub  NearestSchooltoClickedPoint
dim x,y as float
dim o as object

create buttonpad "NS" as
toolbutton calling NearestSchooltoClickedPoint
```

This code is to declare and create buttons as explained in the preview subsections.

```
sub  NearestSchooltoClickedPoint
x = commandinfo(1)
y=commandinfo(2)
o =createpoint (x,y)
```

This code is to create a point in the clicked location on the map.

```
delete  from NEAREST_SCHOOL111
nearest 1 from variable o
to location_of_school
into  NEAREST_SCHOOL111

update  NEAREST_SCHOOL111 set col1= objectlen(obj,"m")
```

This code draws lines between the points selected and the nearest schools on the map; it then deletes the last line and updates the NEAREST_SCHOOL111 layer.

### 3.4 Summary

In this chapter, we have presented the collected spatial and non-spatial data from various sources. We have also used this data in the GIS software to generate a digital map of the Kirkuk city center with roads, regions and primary and secondary schools. The purpose of collecting this data on a digital map is to show that enabling a working GIS in the Kirkuk city center is technically possible. Once it is achieved, users can see types of services that can be provided to citizens and decision makers in Kirkuk with the use of this technology. The GIS software, MapInfo Professional, also recognizes a development language provided by MapBasic to design tools for decision makers to facilitate querying spatial and non-spatial data, e g. deciding whether to build new schools in Kirkuk by knowing which regions have many schools as well as regions that need new schools. Another example is to find the nearest schools based on user-defined distances to a given point and/or around a region. Such services are simple examples that help students, teachers and other citizens to query schools in a vicinity and acquire information about these schools such as school names, locations of schools, types (primary or secondary). Therefore, it would stand to reason that more information and data would improve these services in order to help people not only in Kirkuk but overall in all of Iraq's provinces.

As shown in the (section 3.2.1) thematic map, we can color regions according to the distribution of schools. This means that when we see a different color, we will know the number of schools in each particular region. Whenever we have information about schools, student numbers, ages, teacher numbers, etc., more informed and better informed decisions may be made regarding the distribution of students and teachers by making thematic maps of this information.

Returning to the applications we have developed in this study, they are quite at intermediate level. Nevertheless, they support the idea that once the data is clean, we can start to manage the data and benefit from from that data. The examples presented in this chapter are as follows: the user can find schools near his place or any place he marks on the map; by using the "nearest schools" function around regions, we can support decision making in selecting new school locations in Kirkuk; by using the "info tool" function, the user can obtain information about schools.

# CHAPTER IV

# FINDINGS AND CONCLUSIONS

## 4.1 Findings

In this thesis, we revealed some potential problems that may hinder e-government initiatives in Iraq. One of the most remarkable is the data problem, including but not limited to the following:

1- No consistency in coordinate formats

The coordinates of schools are of different coordinate systems. This will necessitate conversion for use on the software. For example, coordinates in degrees minutes seconds (DMS) format such as 39 34 45.56 are converted to a decimalized degree system; for example to 39.553432 as shown in Figure 44. The formula is

1 degree = 60 minutes

1 minute = 60 seconds

From DMS to DD

36 degrees 30 minutes

= 36 + 30/60

= 36. 5 degrees

GIS software products can recognize the coordinates of formats; for example, we have seen that MapInfo Professional can make automatic conversions by Table > Maintenance > Table Structure for more details [27] p 37; however, this variety in the data sets can easily create problems for users who are not GIS literate.

2- E-government needs new technology and management in order to support transformation strategies that governments use to connect their organizations with each other and provide services to citizens and businesses.

3- The government of Iraq does not depend on technology to enhance government services in the lives of its citizens due to the 1990-2003 embargo as well as the wars that destroyed the Iraq Infrastructure, so this thesis comes to solve a part of these problems by using the GIS application in the field of the e-government services.

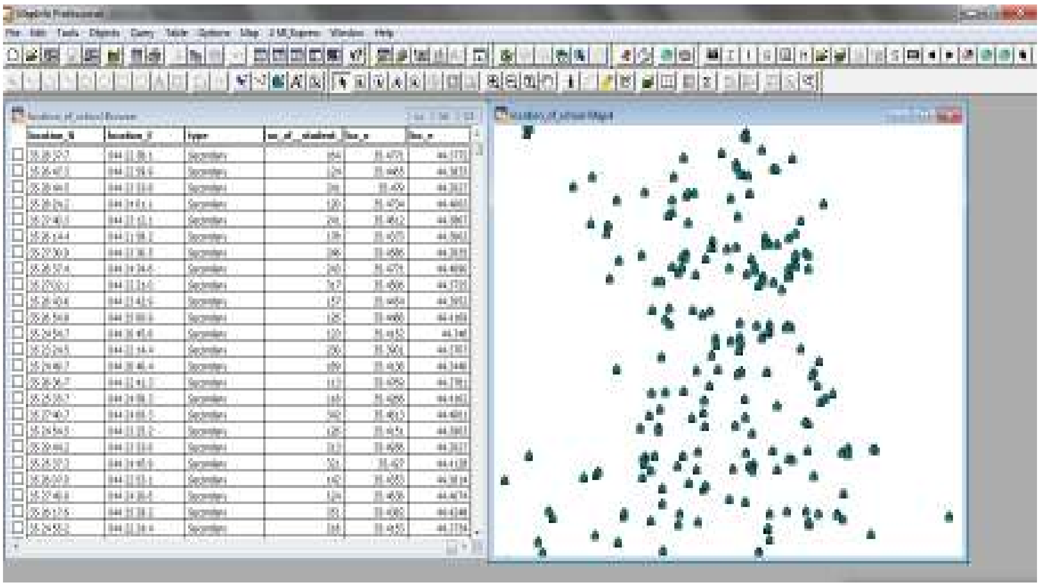


**Figure 43:** Schools locations after corrections

4- Data is not clean

Some school data are wrong; this fault shows itself when we plot schools ona map of Kirkuk Figure 44.

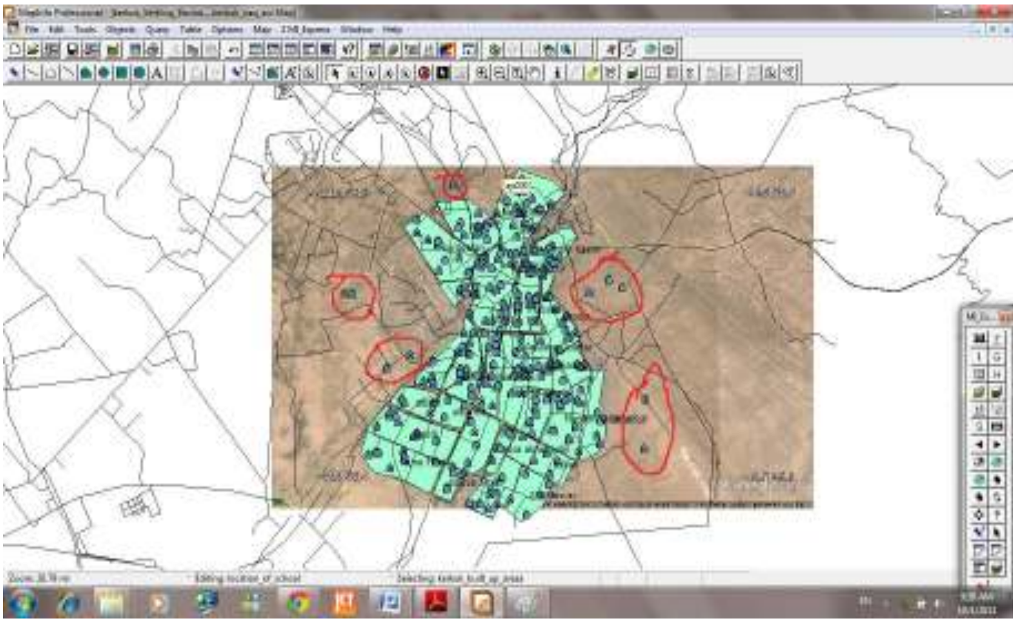


**Figure 44:** Incorrect School Locations

The quality of data about teachers and schools is poor. The data lack entries in student's number of each school, number of teachers in each school and number of classes.

5- In this research, due to the prohibitive pricing of the necessary map, we were unable to find a map from source showing the Kirkuk city center and the outlying regions; therefore, in order to solve this problem, we used Google Earth and MapInfo software together to draw region layers as shown in Figure 45; this layer is a reproduction (Figure 46).

**Figure 45**: MapInfo Software and Google Earth Together to Draw the Region of Kirkuk City

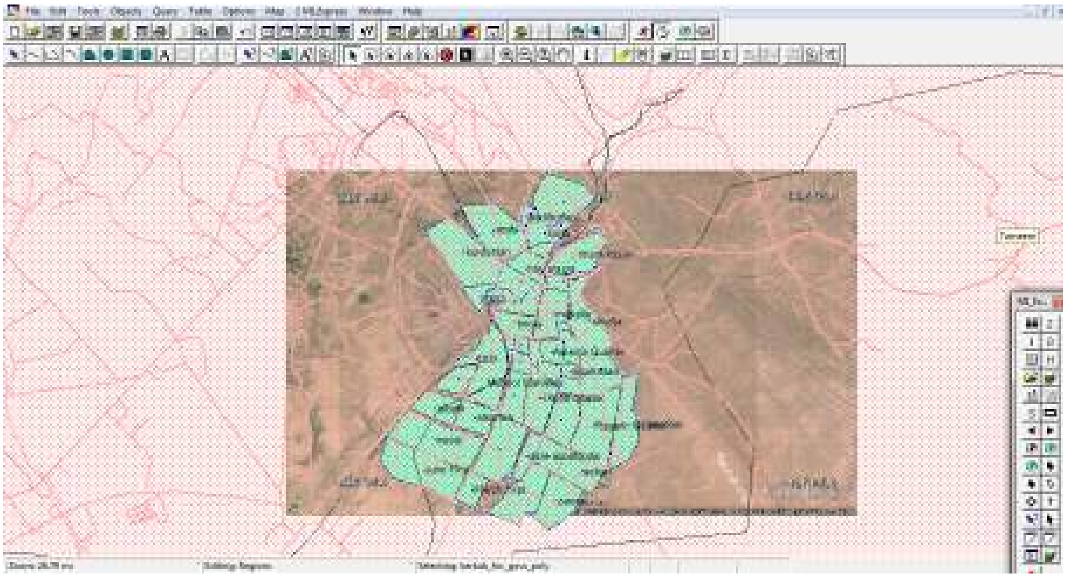
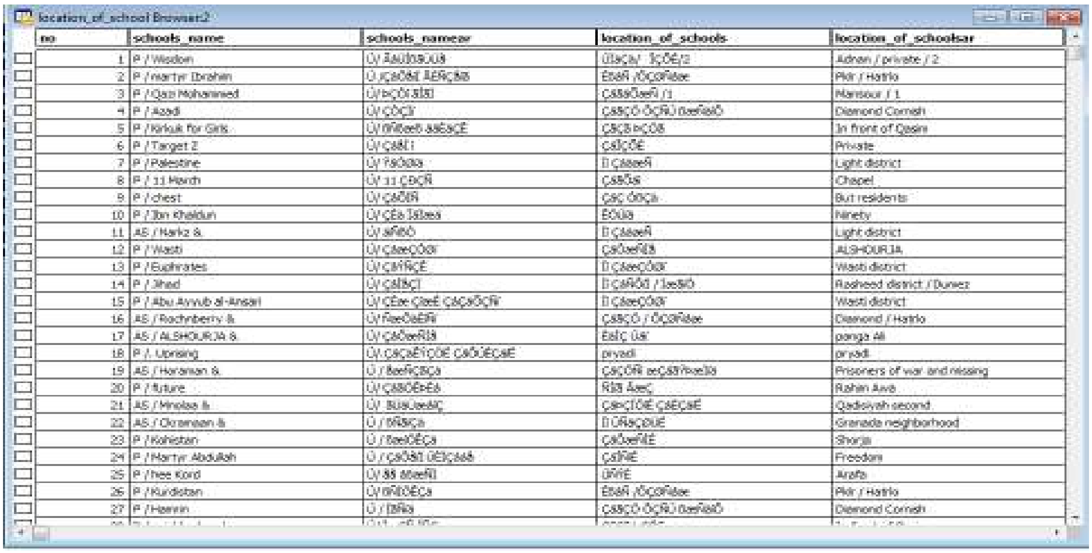


**Figure 46**: Kirkuk City Center Map with Its Regions

6- Solving Arabic Language Incompatibility

Another problem is due to the data in Microsoft Excel being in the Arabic language (names of schools, locations of schools); when we used this data in the MapInfo software, they appeared in the form of incomprehensible symbols. This problem was solved by changing the current language for non-Unicode programs to (Arabic) by following the steps; Start > Control Panel> Region and Language. As an automatic interpreter, we used Google Translator to translate this text data into English; however, the output was still far from satisfactory as shown in Figure 47.



location_of_school Browser2

| no | schools_name | schools_namear | location_of_schools | location_of_schoolsar |
|---|---|---|---|---|
| 1 | P / Wisdom | Ú/ ÃáÍßãÉ | ÚÏäÇä/ ÃåáíÉ/2 | Adnan / private / 2 |
| 2 | P / martyr Ibrahim | Ú /ÇáÔåíÏ ÇÈÑÇåíã | ÈßÑ /ÍÇÊÑÉ | Pkir / Hatrla |
| 3 | P / Qazi Mohammed | Ú/ ÞÇÖí ãÍãÏ | ÇáãäÕæÑ /1 | Mansour / 1 |
| 4 | P / Azadi | Ú/ ÂÒÇÏí | ÇáãÇÓ ÇáÑÜ ßæÑäíÔ | Diamond Cornish |
| 5 | P / Kirkuk for Girls | Ú/ ßÑßæß ááÈäÇÊ | ÇãÇã ÞÇÓã | In front of Qasim |
| 6 | P / Target 2 | Ú/ ÇáåÏÝ 2 | ÇåáíÉ | Private |
| 7 | P / Palestine | Ú/ ÝáÓØíä | Í ÇáäæÑ | Light district |
| 8 | P / 11 March | Ú/ 11 ÂÐÇÑ | ÇáãÕáì | Chapel |
| 9 | P / chest | Ú/ ÇáÕÏÑ | ÇåÇáí ÈÛÏÇÏ | But residents |
| 10 | P / Ibn Khaldun | Ú/ ÇÈä ÎáÏæä | ÊÓÚíä | Ninety |
| 11 | AS / Narkz & | Ú/ äÑßÒ | Í ÇáäæÑ | Light district |
| 12 | P / Wasti | Ú/ ÇáæÇÓØí | ÇáÔæÑÌÉ | ALSHOURJA |
| 13 | P / Euphrates | Ú/ ÇáÝÑÇÊ | Í ÇáæÇÓØí | Wasti district |
| 14 | P / Jihad | Ú/ ÇáÌåÇÏ | Í ÇáÑÔíÏ / ÏæãíÒ | Rasheed district / Dumez |
| 15 | P / Abu Ayyub al-Ansari | Ú/ ÇÈæ ÇíæÈ ÇáÇäÕÇÑí | Í ÇáæÇÓØí | Wasti district |
| 16 | AS / Rochnberry & | Ú/ ÑæÔäÈíÑí | ÇáãÇÓ / ÍÇÊÑÉ | Diamond / Hatrla |
| 17 | AS / ALSHOURJA & | Ú/ ÇáÔæÑÌÉ | ÈäÌÇ Úáí | ponga Ali |
| 18 | P /. Uprising | Ú/ ÇáÇäÊÝÇÖÉ ÇáÔÚÈÇäíÉ | pryadi | pryadi |
| 19 | AS / Horaman & | Ú / åæÑÇãÇä | ÇáÇÓÑì æÇáãÝÞæÏíä | Prisoners of war and missing |
| 20 | P / future | Ú/ ÇáãÓÊÞÈá | ÑÍíã ÂæÇ | Rahim Awa |
| 21 | AS / Minolaa & | Ú/ ãäæáÇíí | ÇáÞÇÏÓíÉ ÇáËÇäíÉ | Qadisiyah second |
| 22 | AS / Ocraneen & | Ú / ÃæÑÇãÇä | Í ÛÑäÇØÉ | Granada neighborhood |
| 23 | P / Kohistan | Ú / ßæåÓÊÇä | ÇáÔæÑÌÉ | Shorja |
| 24 | P / Martyr Abdullah | Ú / ÇáÔåíÏ ÚÈÏÇááå | ÇáÍÑíÉ | Freedom |
| 25 | P / hee Kord | Ú/ åí ßæÑÏ | ÚÑÝÉ | Arafa |
| 26 | P / Kurdistan | Ú/ ßæÑÏÓÊÇä | ÈßÑ /ÍÇÊÑÉ | Pkir / Hatrla |
| 27 | P / Hamrin | Ú / ÍãÑíä | ÇáãÇÓ ÇáÑÜ ßæÑäíÔ | Diamond Cornish |

**Figure 47**: Text Display Incompatibility for non-Arabic Regional Settings

7- There is considerable scope to research and develop projects in GIS applications in Kirkuk

As we have underlined in findings (4) and (5), there is a significant hole in the datasets of, for example, contact details of schools, number of students, name and competencies of teachers. In cases where such data is collected, more can be done for Iraq. For instance, thematic maps showing distribution of teachers over schools with their particular competencies can assist authorities in their decisions regarding human resources. Another example is having errorless and complete digital layers of roads to produce access maps to schools.

### 4.2 Conclusions and recommendations

As we see in the findings (Section 4.1), there are serious problems in data availability and cleanness in both spatial and non-spatial data types. For this reason, promising projects for Kirkuk should focus on collecting more information both from the field and government agencies and avoid any attempt that may cause variety in the data. The government should take serious steps in building unified maps of Iraq in cooperation with ministries such as the Ministry of Education, Ministry of Planning and the Ministry of Transport and Communications. Such digital maps should be sharable between/among those government agencies to build G2G services. We have seen in Chapter 2 that e-government initiatives rely on clean and complete data; otherwise, Iraq can lose large numbers/amounts of resources in hardware, software licenses as well as human resources. Such huge waste can make the public relectant to participate and support e-government projects. This is one of the major conclusions of this thesis.

In the remainder of this section, we make recommendations to overcome problems stated in the findings (Section 4.1). A good point to start with may be to educate school staff in order for them to be able to develop vision in providing clean and complete data to the Education Ministry (findings 3 and 4). Providing ID numbers as primary keys to the education staff in Kirkuk would also help to keep data clean. The Ministry of Education in Iraq has already applied to the International Computer Driving License courses for learning and awareness of all educational staff [26]. For the buildings with incorrect spatial data, field trips by GIS literates should be planned and they need to be equipped with GPS devices (findings 1 and 4).

Meeting with GIS vendors should be arranged to avoid any problem in advance; as finding 6 underlines, incompatibilities with the Arabic language can easily hinder any query in the datasets.

In addition, this work shows the benefits of using GIS to provide education services to anyone by drawing a buffer and findng schools information. Moreover, if teachers, students and schools are connected by school IDs, then it possible to make more analyses, for example; by showing on the map the schools without mathematics teachers. In addition, if population data for each person were available, then we can show the number of schools per population, or the number of schools per number of children, and for future if we had (0-6) age of children population, we could show which school is near to them.

Returning to the research question:

"How can Iraq transform its paper-based government to electronic government and can Iraq initiate a reliable GIS in local governments to assist this transformation?"

Our findings show that there will be considerable problems in establishing a working GIS that will support e-government in Iraq. Nevertheless, the literature shows that such problems are not insurmountable barriers; in spite of this, long term plans are needed in order to begin collecting and correcting spatial and non-spatial datasets.

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## APPENDIX A

## CURRICULUM VITAE

**PERSONAL INFORMATION**

Surname, Name: Adnan ABDULRAHMAN, Bashar

Nationality: Iraqi (IR)

Date and Place of Birth: 15 January 1987, Kirkuk

Marital Status: Single

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**EDUCATION**

| Degree | Institution | Year of Graduation |
|---|---|---|
| MS | Çankaya Univ. Mathematics and Computer Science | 2014 |
| BS | Kirkuk Univ. Computer Science | 2008 |
| High School | Al Walid High School Kirkuk | 2004 |

**WORK EXPERIENCE**

| Year | Place | Enrollment |
|---|---|---|
| 2009-2011 | Directorate General of Kirkuk Education | Programmer |

**FOREIGN LANGUAGES**

English, Arabic, Turkish

**Hobbies**

Sports, Movies, Computer, Photography