إقرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

الدقة المكانية لبرنامج جوجل إرث في قطاع غزة

Positional Accuracy of the Google Earth Imagery in the Gaza Strip

أقر بأن ما اشتملت عليه هذه الرسالة إنما هي نتاج جهدي الخاص، باستثناء ما تمت الإشارة إليه حيثما ورد، وإن هذه الرسالة ككل، أو أي جزء منها لم يقدم من قبل لنيل درجة أو لقب علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى.

DECLARATION

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification

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الدقة المكانية في استخدام الصور الجوية في قطاع غزة في برنامج *Google Earth*

Positional Accuracy of the Google Earth Imagery in the Gaza Strip

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نتيجة الحكم على أطروحة ماجستير

بناءً على موافقة شئون البحث العلمي والدراسات العليا بالجامعة الإسلامية بغزة على تشكيل لجنة الحكم على أطروحة الباحث/ **محمد ابراهيم خليل حمد** لنيل درجة الماجستير في كلية *الهندسة* قسم الهندسة المدنية- البنى التحتية وموضوعها:

الدقة المكانية لبرنامج جوجل إرث في قطاع غزة

Positional Accuracy of the Google Earth Imagery in the Gaza Strip

وبعد المناقشة التي تمت اليوم الاثنين 08 رجب 1436هـ، الموافق 2015/04/27م الساعة الثانية مساءً، اجتمعت لجنة الحكم على الأطروحة والمكونة من:

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وبعد المداولة أوصت اللجنة بمنح الباحث درجة الماجستير في كلية *الهندسة*/ قسم الهندسة المدنية- البنى التحتية.

واللجنة إذ تمنحه هذه الدرجة فإنها توصيه بتقوى الله ولزوم طاعته وأن يسخر علمه في خدمة دينه ووطنه.

والله ولي التوفيق،،،

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DEDICATION

To the fountain of patience and optimism and hope.

To each of the following in the presence of God and His Messenger, my mother dear.

To the big heart my dear father.

To those who have demonstrated to me what is the most beautiful of life, my brothers and sisters.

To the people who paved our way of science and knowledge.

All our teachers distinguished.

To the taste of the most beautiful moments with my friends.

I dedicate this work.

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بسم الله الرحمن الرحيم

" نَرْفَعُ دَرَجَاتٍ مَنْ نَشَاءُ وَفَوْقَ كُلِّ ذِي عِلْمٍ عَلِيمٌ"

(يوسف 76)

ملخص الدراسة

يعتبر برنامج (Google Earth) من البرامج المتداولة عالميا بشكل واسع كما انه يتميز بسهولة الاستخدام بالإضافة الى انه مجاني وهو يدعم المستخدمين بالخرائط الجوية، وله العديد من الاستخدامات منها السياحية والتعليمية وكذلك التقنية. سوف يتم تطبيق هذه الدراسة على قطاع غزة بهدف قياس دقة البرنامج والى أي مدى يستخدم في مؤسسات قطاع غزة. في بداية الدراسة تم صياغة استبانة وتوزيعها على مجموعة من المؤسسات العاملة في قطاع غزة من أجل تقييم طبيعة المؤهل العلمي لمستخدمي البرنامج ونوع البيانات التي تستخدم في العمل ومدى حساسيتها ومن مستخرجات الاستبانة تبين أن هناك أكثر من 70% من الموظفين يستعينون بالبرنامج في العمل وإلى حد معين يستخدمونه في تحديد الاحداثيات وعمل القياسات، دون المعرفة بمدى دقة هذا البرنامج. فكان الهدف الاساسي من هذه الدراسة تحديد دقة هذا البرنامج، حيث تم أخذ مدينة خانيونس منطقة للدراسة وذلك عن طريق عمل مقارنة بين القراءات للإحداثيات من الخرائط الجوية في البرنامج مع قراءات الاحداثيات على الطبيعة باستخدام نظام GPS بعدد 40 نقطة موزعة في مدينة خان يونس. وتم استخدام نظام GPS لأنه يزود بالدقة المطلوبة في نظام الاحداثيات، ومن النتائج والمقارنات فإن معدل الخطأ في الاحداثيات الافقية للخرائط الجوية في برنامج (Google Earth) في منطقة قطاع غزة يساوي (39.24 m). وبالمقارنة مع معدل الخطأ في دراسات اخرى في مناطق مختلفة في العالم فإن هذا الخطأ يعتبر كبير وذلك يعزى الى التميز المكاني الضعيف لمرئيات (Google Earth) الخاصة.

وبالتالي فإن هذه الدراسة توصي بعدم استخدام البرنامج في منطقة قطاع غزة لتحديد الاحداثيات وينصح باستخدام البرنامج للاسترشاد والدراسات الأولية مع الاخذ بالاعتبار نسبة الأخطاء التي تم الحصول عليها في هذه الدراسة.

ABSTRACT

Google Earth provides an open source, easy to access and cost free image data that support map interest community. In this research a questionnaire distributed in several institutions in most of the sectors in the Gaza Strip in order to evaluate the qualification of users, type of data used in Google Earth and sensitivity of that type. The study finds that percentage of about 70% of the population use Google Earth in the field of work and to a certain extent population use the application in spatial data (coordination, distance…etc). However, this popularity of Google Earth is not an indicator of its accuracy. The aim of this research is to estimate the Google Earth horizontal positional accuracy in Khanyounis as a study area to evaluate this free source of data. This was carried out by comparing Google Earth measured coordinates of points with geodetic Global Positional System (GPS) receiver coordinates over sample of 40 check points located in Khanyounis area. Since GPS provides an accurate measurement of coordinates on the same ellipsoid as Google Earth, it was used to check the accuracy of Google Earth. Root Mean Square Error (RMSE) was computed for horizontal coordinates and was found to be 39.24 m. Which was very critical and disappointed to find such deference in accuracy between Gaza and the other world. So this study recommends that although Google Earth represents a powerful and attractive source of positional data, but it's critical to use it for studies otherwise for limited issues in Gaza Strip. In the Gaza Strip Google Earth should not be used in measurement of coordinates and when it's needed to use Google Earth in spatial data, it is recommended to use it in investigation and preliminary studies taking into account the scale of error computed in this research.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ANOVA	Analysis Of Variance
ASPRS	American Society for Photogrammetry and Remote Sensing
CIA	Central Intelligence Agency
CMWU	Costal Municipality Water Utility
DEM	Digital Elevation Model
GE	Google Earth
GEDTF	Global Elevation Data Testing Facility
GIS	Geographical Information System
GIS***	Geographical Information System
GPS	Global Positional System
IT	Information Technology
KSA	Kingdom of Saudi Arabia
MOPWH	Ministry Of Public Works and Housing
NASA	National Aeronautics and Space Administration
NGO	Non Governorate Organizations
RMSE	Root Mean Square Error
Sig	Significant
SPSS	Statistical Package for Social Sciences
SRTM	Shuttle Radar Topography Mission
UNDP	United Nation Development Program
UNRWA	United Nation Relief and Works Agency
WGS84	World Geodetic System of 1984

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

1.1 Scope

This chapter introduces a general background, problem statement, aim and objectives, brief research methodology as well as thesis organization.

1.2 Background

Google Earth is a virtual globe, map and geographical information program that was originally called Earth Viewer 3D, and was created by Keyhole, Inc, a Central Intelligence Agency (CIA) funded company acquired by Google in 2004. It maps the Earth by the superimposition of images obtained from satellite imagery, aerial photography and GIS 3D globe. Google Earth uses digital elevation model (DEM) data collected by NASA's Shuttle Radar Topography Mission (SRTM). The internal coordinate system of Google Earth is geographic coordinates (latitude/longitude) on the World Geodetic System of 1984 (WGS84) datum i.e., the same datum that used by GPS. (Nagi Zomrawi Mohammed, et al., 2013)

1.3 Problem Statement

Google Earth shows the earth as it looks from an elevated platform such as an airplane or orbiting satellite. The projection used to achieve this effect is called the General Perspective. This is similar to the Orthographic projection. Most of the high resolution imagery in Google Earth maps is the Digital Globe Quick-bird which is roughly 65 cm pan-sharpened (65 cm panchromatic at nadir and 2.62 m multispectral at nadir). Google is actively replacing this base imagery with 2.5 m SPOT Image imagery and several higher resolution datasets. (Nagi Zomrawi Mohammed, et al., 2013)

In Gaza Strip, Google Earth is widely used as a source of data especially after the recent war so there was a need to know exactly the accuracy of data image with reference to real data measurements.

1.4 Aim and Objectives

This thesis aims to stand on what extent Google Earth is used in Gaza Strip as a spatial data source. To achieve this aim, the following objectives are to be determined:

- Outline the degree of Google Earth using in Gaza Strip.
- Get the actual accuracy of Google Earth Image in Gaza Strip.
- How could the accuracy affect using this technique as a spatial image to support data in Gaza Strip?

1.5 Methodology

This study comprises five main stages of work as follows:

Stage I: Literature Review

This includes reviewing a number of international previous studies related to using Google Earth accuracy in spatial measurements as a free source of data. There are Two parts related to this topic; the first part presents the accuracy of data for locating the points, the second part shows the deference between readings in variable countries.

Stage II: Data Collection

The data of the research obtained from Municipality of Gaza, GIS Departments in several ministries, and mainly from questionnaires targeted to a number of public and private associations use this technique in Gaza Strip and other sources.

Stage III: Research Questionnaire

The main objective was to measure the scale of using the free source of Google Earth in Gaza Strip and for any kind of data it is used also, the sensitivity of the data. For this purpose descriptive analytical method is used. The data was collected by questionnaire that distributed randomly to ministries, municipalities, NGO organizations and private sector to achieve the results.

Stage IV: Field survey using GPS

To measure the accuracy for Google Earth it was needed to get an accurate data from a field using GPS technology by *Leica set type GS 15* taking 40 points in Khan-younis city as a study area.

Stage V: Conclusion and Recommendations

This stage summarizes the major findings and conclusion from the study, and consequently develop recommendations for interested and concerned authorities to use the findings.

Figure 1.1 illustrates the overall frame work of the proposed methodology.

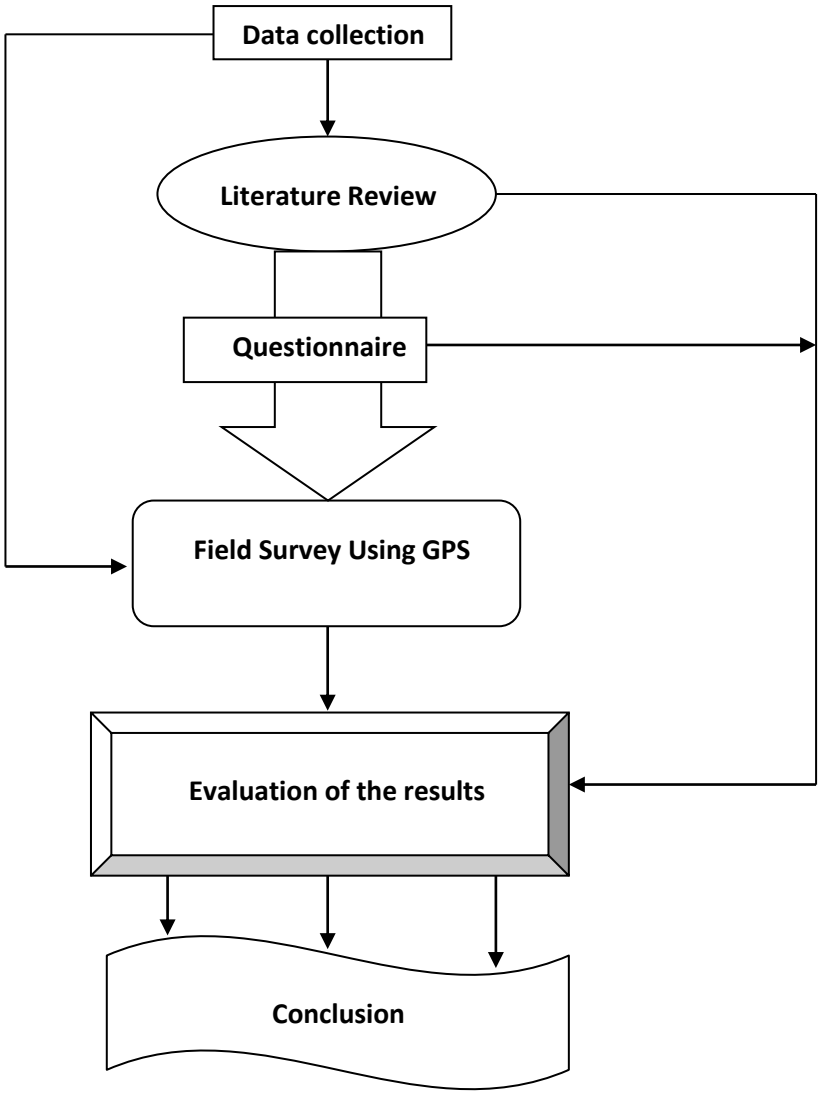

Figure 1.1: Methodology framework

1.6 Thesis Organization

This thesis includes seven chapters:

Chapter One presents the introduction chapter which involves scope, background, problem statement, aim and objectives and brief research methodology.

Chapter Two reviews briefly the literature related to the accuracy of data for locating the points in different countries, the deference between readings in variable countries, and the type of data taken from GE.

Chapter Three presents the methodology of research, which passes through five stages such as literature review, data collection, questionnaire with analysis, and GPS field survey with related analysis as well as conclusion and recommendations.

Chapter Four presents the questionnaire that was used in the study and the way it was designed, pilot study and data collection.

Chapter Five presents the questionnaire findings, descriptive statistics and analysis.

Chapter Six presents study area, field GPS survey, the Leica set type, accuracy of field data, Google Earth data, comparison between data and results.

Chapter Seven includes conclusion and recommendations

CHAPTER 2: LITERATURE REVIEW

2.1 Scope

This chapter presents a number of international previous studies related to using Google earth accuracy in spatial measurements as a free source of data. There are Two parts related to this topic; the first part presents the accuracy of data for locating the points, the second part shows the deference between readings in variable countries.

2.2 Google Earth Review

Google Earth (2009) is a virtual globe, map and geographic information program. It is a freely available program that superimposes imagery obtained from satellite and aerial photographs onto a 3D model of the world. The user's geographic data can be represented easily on Google Earth through the use of Keyhole Markup Language (KML) documents. These documents can be used to show points, paths, polygons and ground overlays. Plotting Surveying Data in Google Earth

The vertical aerial photographs used in Google Earth have been geo-referenced to align with the coordinate system. The process of geo-referencing involves identifying ground control points in the image for which accurate coordinates are available. A transformation is then calculated by computer software which processes the image so that it aligns to the ground coordinate system (Wolf and Dewitt, 2000). Mosaics are used to stitch many aerial photographs together. Controlled mosaics use rectified photos so that all of the photos are vertical and at the same scale. In mosaic assembly, image positions of common features in adjacent photos are matched as closely as possible. A plot of control points is used to match and constrain positions, similar to the technique used in geo-referencing. Uncontrolled mosaics simply match the image details of adjacent photos without using the ground control, which is quicker but less accurate in terms of the coordinate reference system. Semi-controlled mosaics have either no ground control or use photos that have not been rectified.

2.3 GPS Review

GPS is a satellite-based navigation system made up of a network of satellites that orbit the Earth twice a day and transmit information. For North America, there is a "constellation" of about 24 navigation satellites (called NAVSTAR) orbiting the earth

that is maintained by the U.S. military. The hand-held GPS unit picks up radio transmissions sent out by these satellites and uses them to triangulate a position on the ground. Differential GPS (aka "WAAS-enabled") is a feature available on some GPS units that uses ground stations on the Earth along with the satellites in orbit to calculate a position. Knowing the difference between the position of the ground stations and the satellites allows a correction factor to be used to calculate a more accurate position for the roving GPS unit (improving the accuracy of readings from about 50 feet to within 10 to 16 feet of the actual location).

2.4 Coordinate System Review

Coordinate systems enable geographic datasets to use common locations for integration. A coordinate system is a reference system used to represent the locations of geographic features, imagery, and observations such as GPS locations within a common geographic framework. Each coordinate system is defined by:

- Its measurement framework which is either geographic (in which spherical coordinates are measured from the earth's center) or plan metric (in which the earth's coordinates are projected onto a two-dimensional planar surface).
- Unit of measurement (typically feet or meters for projected coordinate systems or decimal degrees for latitude–longitude).
- The definition of the map projection for projected coordinate systems.
- Other measurement system properties such as a spheroid of reference, a datum, and projection parameters like one or more standard parallels, a central meridian, and possible shifts in the x- and y-directions.

2.4.1 Types of Coordinate Systems

There are two common types of coordinate systems used in GIS:

1. A global or spherical coordinate system such as latitude–longitude. These are often referred to what are map projections?
2. A projected coordinate system based on a map projection such as transverse Mercator, Albers equal area, or Robinson, all of which (along with numerous other map projection models) provide various mechanisms to project maps of the earth's spherical surface onto a two dimensional Cartesian coordinate

plane. Projected coordinate systems are sometimes referred to as map projections.

2.5 Previous Studies

(Nagi Zomrawi Mohammed, et al., 2013), estimates the Google Earth horizontal and vertical accuracy in Khartoum State so as to evaluate this free source of data. This was carried out by comparing Google Earth measured coordinates of points with geodetic Global Positional System (GPS) receiver coordinates over sample of 16 check points located in Khartoum State. Since GPS provides accurate measurement of coordinates on the same ellipsoid as Google Earth, it was used to check the accuracy of Google Earth. Root Mean Square Error (RMSE) was computed for horizontal coordinates and was found to be 1.59 m. For height measurement RMSE was computed to be 1.7 m. For the research purposes and to pursue the changes occurred while Google Earth images updated, it was noted that the positional accuracy was changed and improved, but the elevation is still as it were before update.

(Dr Kazimierz Becek, et al., 2011), reports on discrepancies in coordinates of objects as captured in Google Earth and their coordinates according to other data sources. In their project, the coordinates of the beginnings and ends of the central lines of runways well-visible in Google Earth were compared with the coordinates of the corresponding runways extracted from the Global Elevation Data Testing Facility (GEDTF). The results demonstrate that there are inconsistencies in the position data provided by Google Earth, and therefore caution must be exercised when using this service for certain purposes, such as navigation.

(Taro Ubukawa, 2013), tests the horizontal positional accuracies of five geospatial data sets of different scales in comparison with ALOS/PRISM imagery, which has a 2.5m resolution and an expected positional accuracy of 6.1 meters RMSE at nadir. The evaluation was done using Advanced Land Observing Satellite/ Panchromatic Remote-sensing Instrument for Stereo Mapping (ALOS/PRISM) scenes for 10 cities in different regions of the world. Root mean square errors (RMSEs) were calculated for control points in each of the 10 cities. RMSEs are a measure of the average deviation or distance of points in a candidate data set from their known positions on the ground, or in this case, from their know positions in the ALOS/PRISM imagery.

The RMSE for the satellite imagery represented in Google Maps and Bing Maps was 8.2 m and 7.9 m respectively, and for Open Street Map it was 11.1 m. Two small spatial scale data sets, Arc GIS ver. 10.1 World Roads dataset and Vector Map level 0 (evaluated for 9 cities) have RMSEs of 121.3 m and 838.3 m respectively. These RMSEs are less than the distance corresponding to 1 mm at the respective designated map scales. These results suggest that the RMSEs relative to the designated spatial scales for the data sets are reasonable. The research also shows that ALOS/PRISM imagery can be used for evaluating horizontal positional accuracy of different scale geospatial data sets.

(Paredes-Hernández, C. U. et al. 2013) states that Due to the popularity of Google Earth (GE), users commonly assume that it is a credible and accurate source of information. Consequently, GE's imagery is frequently used in scientific and others projects. However, Google states that data available in their geographic products are only approximations and, therefore, their accuracy is not officially documented. In this paper, the horizontal positional accuracy of GE's imagery is assessed by means of comparing coordinates extracted from a rural cadastral database against coordinates extracted from well-defined and inferred check points in GE's imagery. The results suggest that if a large number of well-defined points are extracted from areas of high resolution imagery, GE's imagery over rural areas meets the horizontal accuracy requirements of the American Society for Photogrammetry and Remote Sensing (ASPRS) for the production of "Class 1" 1:20,000 maps. Nonetheless, the results also show that geo registration and large horizontal errors occur in GE's imagery. Consequently, despite its overall horizontal positional accuracy, coordinates extracted from GE's imagery should be used with caution.

(Ashraf Farah and Dafer Algarni, 2014) test the horizontal accuracy of Google Earth where it is a virtual globe, map and geographical information program that is controlled by Google Corporation. It maps the Earth by the superimposition of images obtained from satellite imagery, aerial photography and GIS 3D globe. With millions of users all around the globe, Google Earth has become the ultimate source of spatial data and information for private and public decision-support systems besides many types and forms of social interactions. Many users mostly in developing countries are

also using it for surveying applications, the matter that raises questions about the positional accuracy of the Google Earth program. This research presents a small-scale assessment study of the positional accuracy of Google Earth Imagery in Riyadh; capital of Kingdom of Saudi Arabia (KSA). The results show that the RMSE of the Google Earth imagery is 2.18 m and 1.51 m for the horizontal and height coordinates respectively.

(Kazimierz BECEK and KHAIRUNNISA Ibrahim, 2011) are report on discrepancies in coordinates of objects as captured in Google Earth and their coordinates according to other data sources. In this project, the coordinates of the beginnings and ends of the centerlines of runways well-visible in Google Earth were compared with the coordinates of the corresponding runways extracted from the Global Elevation Data Testing Facility (GEDTF). The results demonstrate that there are inconsistencies in the position data provided by Google Earth, and therefore caution must be exercised when using this service for certain purposes, such as navigation.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Scope

This chapter presents the methodology of research, which is oriented into five stages; the first stage include literature review, the second stage presents data collection, the third stage displays questionnaire with its corresponding analysis, and the fourth stage presents GPS field work with its related analysis. The fifth stage outlines the conclusion and recommendation findings.

3.2 Research Methodology

This research aims to investigate the accuracy of Google earth in spatial data. In order to achieve the previous aim, the research passes through the following stages:

3.2.1 Stage I: Literature Review

The first stage include literature review which based on the primary data collected through reading and searching from related articles, books, website, and others. This stage presents a number of previous studies related to Google Earth and GPS. There are two parts related to this topic; the first part presents the accuracy of data for locating the points, the second part shows the deference between readings in variable countries.

3.2.2 Stage II: Data Collection

Data are collected through visiting a number of institutions and making interview with relevant professionals and specialists such as GIS Department in Palestinian Land Authority, Khanyounis Municipality and survey privet offices. Also, the data gotten from field survey using GPS and Google Earth Pro Final Full *Version 7.1.1.1871*.

The data assembled in this research can be organized into two categories as follows:

- Google Earth Pro Final Full *Version 7.1.1.1871*.
- Data collected from field (Khanyounis City as a case study using GPS)

3.2.3 Stage III: Questionnaire

The main objective was to measure the scale of using the free source of Google earth in Gaza strip and for any kind of data it is used also, the sensitivity of the data. For this purpose descriptive analytical method is used. The data was collected by questionnaire that distributed randomly to ministries, municipalities, NGO organizations and privet sector to achieve the results.

3.2.3.1 Sample size

The study population include employees work in GIS or survey departments in deferent institutions in Gaza strip. Equation 3.1 requires $\hat{p}$ as an estimate of the population proportion p (Triola, 2004)

When an estimate $\hat{p}$ is known: $$n = \frac{[z_{\alpha/2}]^2 \hat{p}\hat{q}}{E^2} \qquad (3.1)$$

Where:

n = Sample size required.

$z_{\alpha/2} =$ Critical value.

$\hat{p} = \frac{x}{n}$ Sample proportion of x successes in a sample of size n.

$\hat{q} = 1 - \hat{p} =$ Sample proportion of failures in a sample of size n, and

E = Margin of Error (usually 0.05 or 0.1).

3.2.3.2 Questionnaire Design and Content

A structured questionnaire was specially designed for the study and it consisted of two groups:

The first group: General data about the institution

The second group: Questionnaire points, that divided into 4 sections:

- About Google Earth as a program
- Google Earth usage in work
- Evaluation of the accuracy.

- Sensitivity of data

3.2.3.3 Statistical Analysis Tools

Data analysis made utilizing (SPSS 20). The researcher would utilize many statistical tools such as Frequencies and Percentile, Alpha- Cronbach's Test, Pearson correlation coefficients, One sample t test and One way ANOVA.

3.2.3.4 Questionnaire Results and Analysis

The aim of this part is to analyze the empirical data which were collected through the questionnaire in order to provide a real picture about usage of Google Earth. This chapter includes also the hypothesis testing.

3.2.4 Stage IV: GPS Field Survey

Based on data collecting, there are many steps should be performed to begin specifying the exact accuracy of Google earth in measurements. This stage can be organized into six categories as follows:

- Identification of study area
- Selection of GPS set
- Field measurement in the study area.
- Converting readings to global coordinates
- Using Google earth to locate same coordination
- Comparison between readings to get accuracy

3.2.5 Stage V: Conclusion and recommendations

This stage intends to summarize the main findings of this study through outlining the significant conclusion and proposed recommendations.

CHAPTER 4: QUESTIONNAIRE

4.1 Scope

This chapter presents the methodology of the study including research methodology, research population, the questionnaire that was used in the study and the way it was designed, pilot study, data collection, descriptive statistics, personal data analysis and hypothesis testing.

4.2 Questionnaire Methodology

The researcher targeted measure the scale of using the free source of Google Earth in Gaza Strip and for any kind of data it is used also, the sensitivity of the data. The researcher used descriptive analytical method, the data was collected by questionnaire that distributed randomly to people in the Gaza Strip to achieve the results.

4.3 Data Collection

Data collected through:

I. Secondary Data

The secondary sources in collecting data such as books, journals, and internet, documents and other literature related to the research are collected.

II. Primary Data

Primary data sources that are not available in secondary data sources by distributing a questionnaire, to study population in order to make measurement about the wide use and scale of sensitivity in the real field of use, the questionnaire survey seems to be most appropriate to collect data in the current study.

4.4 Population and Sample Size

According to equation 3.1, when $\alpha = 0.05$, $z_{\alpha/2} = 1.96$, $E = 0.1$, random sample is selected with size 100, and the questionnaire was distributed to the research population and 70 questionnaire papers are received with (70%) response.

$$n = \frac{[1.96]^2 0.182}{0.1^2} = 70$$

4.5 The First Group: General data

Research methodology depends on the analysis of data based on the use of descriptive analysis, by using the main program (SPSS).

4.5.1 Sample - institution

Table and Figure 4.1 show that (34.3%) from the sample UN agencies, while (52.8%) are for Governmental institutions and the rest (12.9%) for privet sectors such survey offices. This distribution is refer to an equal balance for the spread of each type of institution in Gaza Strip.

Table 4.1: Distribution of sample according to institutions

Institution	(n=70)	
	N	%
United Nation Development Program	11	15.7
United Nation Relief and Work Agency	13	18.6
Gaza Municipality	8	11.4
Khanyounis Municipality	5	7.1
Ministry of Public Work and Housing	9	12.9
Ministry of Agriculture	10	14.3
Costal Municipality Water utility	5	7.1
Privet Offices	9	12.9

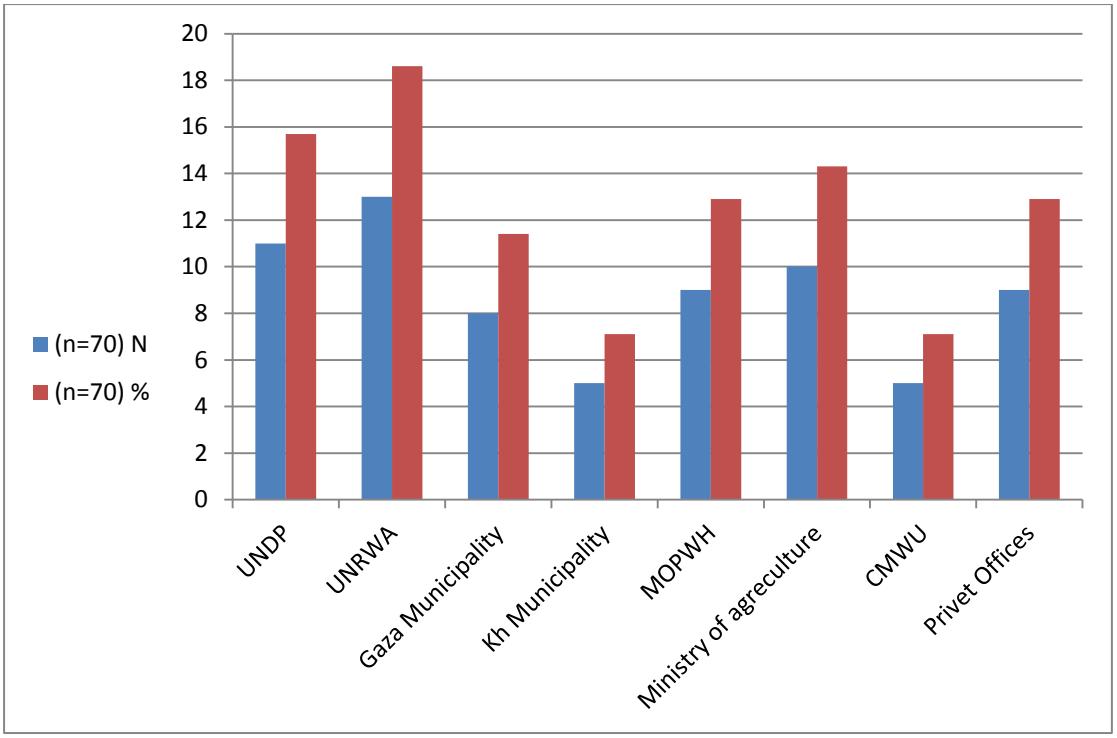

Figure 4.1: Distribution of sample according to institutions

4.5.2 Sample – Type of works

Table and Figure 4.2 show that the percent of each type of work is between 15% and 20% which indicate that there is equality approximately between deferent institutions

Table 4.2: Distribution of sample according to type of work

Field of Works	(n=70)	
	N	%
Buildings	39	18.7
Roads	41	19.6
Water & sanitation	33	15.8
Survey	36	17.2
Others	37	17.7
All of Above	23	11

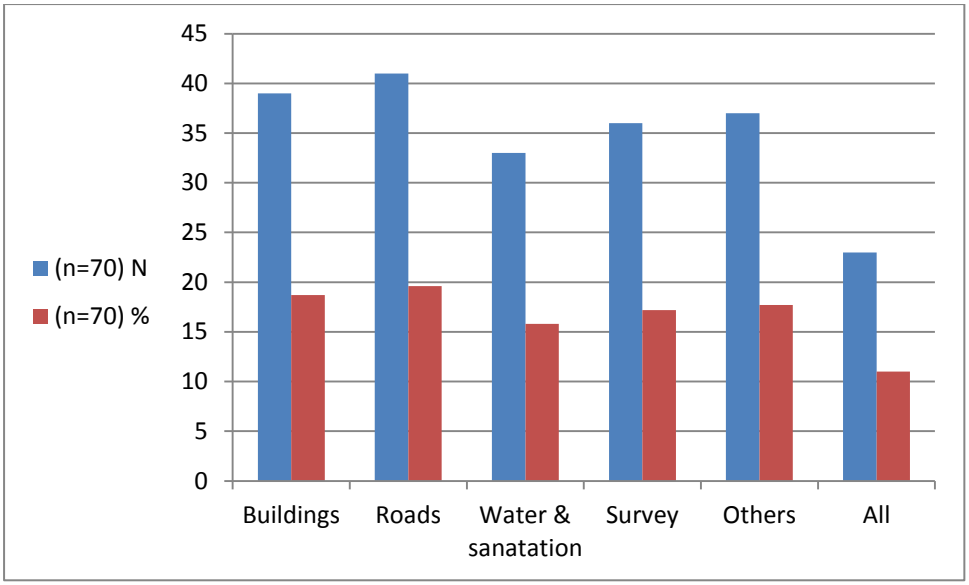

Figure 4.2: Distribution of sample according to type of work

4.5.3 Sample - experience

Table and Figure 4.3 shows that (15.7%) from the sample are (1-3 years) and (3-5 years), (24.3%) from the sample are (5-10 years) and (44.3%) from the sample are more than ten years. This means that the study sample is well distributed with respect to experience more and less than ten years.

Table 4.3: Distribution of to sample experience

Work experience	(n=70)	
	N	%
1-3 years	11	15.7
3-5 years	11	15.7
5-10 years	17	24.3
>10 years	31	44.3

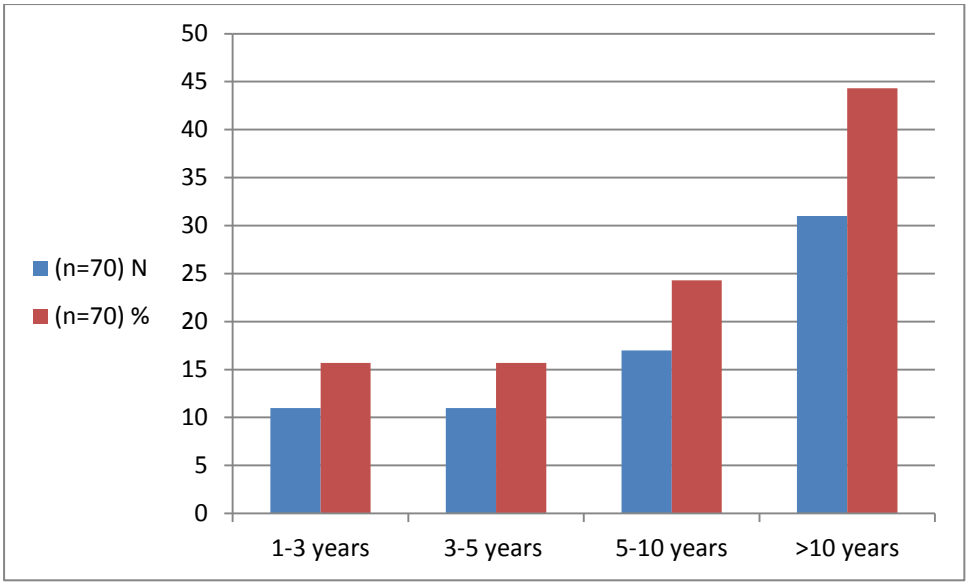

Figure 4.3: Distribution of sample according to experience

4.5.4 Sample - qualification

Table and Figure 4.4 shows that (7.1%) from the sample have (diploma degree), (62.9%) have (bachelor degree), (30%) have (Master degree), and (0 %) have (doctoral degree) It's clear that majority of employees have bachelor degree which is good that we need to evaluate with reference to direct users.

Table 4.4: Distribution of sample according to qualification

Education level	(n=70)	
	N	**%**
Diploma	5	7.1
Bachelor	44	62.9
Master	21	30
Doctorate	0	0

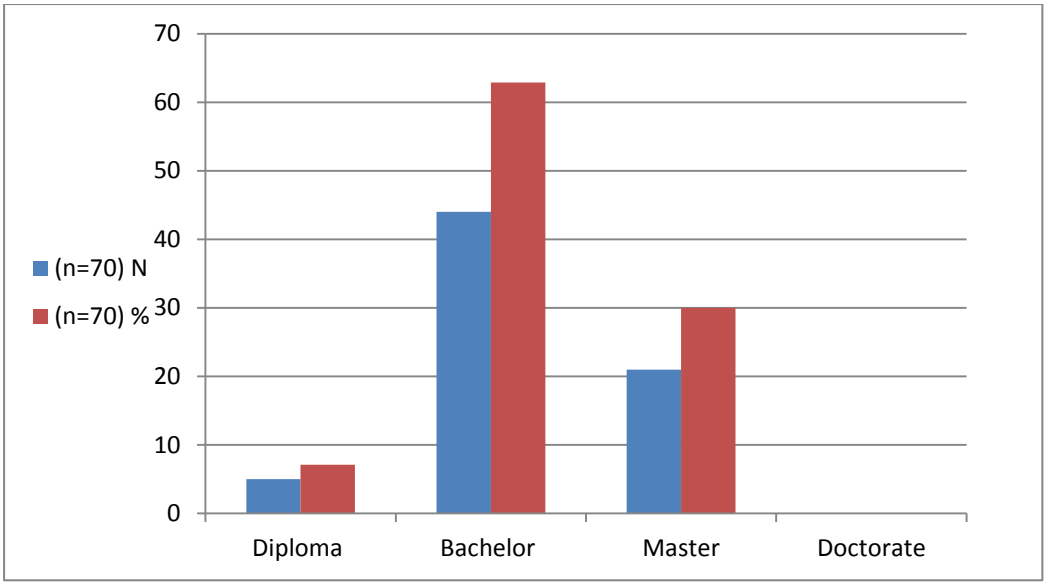

Figure 4.4: Distribution of sample according to qualification

4.5.5 Sample - Specialization

Table and Figure 4.5 clarify the distribution of specialization which clarify that the majority are engineers .

Table 4.5: Distribution of sample according to specialization

Specialization	(n=70)	
	N	**%**
Engineering	59	84.3
GIS	5	7.1
IT	2	2.9
Other	4	5.7

4.5.6 Sample – Position of employee

Table and Figure 4.6 clarify that higher percent 37.1 % for office engineer, then 25.7 for site engineer which indicate that there is a need for the accuracy to be known.

Table 4.6: Distribution of sample according to position

Position	(n=70)	
	N	%
Owner	1	1.4
Project manager	11	15.7
Site Eng.	18	25.7
Office Eng.	26	37.1
Others	14	20

4.5.7 Sample - Using Google Earth

Table 4.7 show that (75.7%) from the sample use the Google Earth in the work. This give you a good indication for the study

Table 4.7: Distribution of sample according to using Google Earth

Using G.E. Program	Control (n=70)	
	N	%
Yes	53	75.7
No	17	24.3

4.6 The Questionnaire Design

The questionnaire was designed in Arabic language, to be more understandable. An Arabic version were attached in Annex 1. Unnecessary personal data, complex and duplicated questions were avoided. The questionnaire was provided with a covering letter which explained the purpose of the study, the way of responding, the aim of the research and the confidentially of the information in order to encourage the respondents. A structured questionnaire was specially designed for the study and it consisted of two groups:

The first group: General data about the institution

The second group: Questionnaire points, that divided into 5 sections:

- About Google Earth as a program
- Google Earth usage in work
- Evaluation of the accuracy.
- Sensitivity of data

4.7 Data Measurement

In order to be able to select the appropriate method of analysis, the level of measurement must be understood. For each type of measurement, there is/are an appropriate method/s that can be applied. In this research, ordinal scales were used. Ordinal scale is a ranking or a rating data that normally uses integers in ascending or descending order. The numbers assigned to the important (1, 2, 3, 4, 5) do not indicate that the interval between scales are equal, nor do they indicate absolute quantities. They are merely numerical labels. Based on Likert scale it has the following**:**

Item	Very much	Much	Moderately	Little	Very little
Scale	5	4	3	2	1

4.8 Statistical Analysis Tools

The researcher would use data analysis both qualitative and quantitative data analysis methods. The Data analysis will be made utilizing (SPSS 20). The researcher would utilize the following statistical tools:

- Frequencies and Percentile.
- Alpha- Cronbach's Test for measuring reliability of the items of the questionnaires.
- Person correlation coefficients for measuring validity of the items of the questionnaires.
- One sample t test, to determine if the mean of a paragraph is significantly different from a hypothesized value 3 (Middle value of Likert scale).
- One way ANOVA.

4.9 Validity of Questionnaire

Validity refers to the degree to which an instrument measures what it is supposed to be measuring. Validity has a number of different aspects and assessment approaches. Statistical validity is used to evaluate instrument validity, which include criterion-related validity and construct validity.

4.9.1 Statistical Validity of the Questionnaire

Validity refers to the degree to which an instrument measures what it is supposed to be measuring (Pilot and Hungler, 1985). Validity has a number of different aspects and assessment approaches. To insure the validity of the questionnaire, two statistical tests should be applied. The first test is Criterion-related validity test (Pearson test) which measure the correlation coefficient between each item in the field and the whole field. The second test is structure validity test (Pearson test) that used to test the validity of the questionnaire structure by testing the validity of each field and the validity of the whole questionnaire. It measures the correlation coefficient between one filed and all the fields of the questionnaire that have the same level of similar scale.

4.9.2 Internal Validity

Internal consistency of the questionnaire is measured by a scouting sample, which consisted of 30 questionnaires through measuring the correlation coefficients between each paragraph in one field and the whole filed.

4.9.3 Structure Validity of the Questionnaire

Structure validity is the second statistical test that used to test the validity of the questionnaire structure by testing the validity of each field and the validity of the whole questionnaire. It measures the correlation coefficient between one filed and all the fields of the questionnaire that have the same level of liker scale.

4.10 Reliability of the Research

The reliability of an instrument is the degree of consistency which measures the attribute; it is supposed to be measuring. The less variation an instrument produces in repeated measurements of an attribute, the higher its reliability. Reliability can be equated with the stability, consistency, or dependability of a measuring tool. The test is repeated to the same sample of people on two occasions and then compares the scores obtained by computing a reliability coefficient (Polit and Hunger, 1985).

4.11 Cronbach's Coefficient Alpha

This method is used to measure the reliability of the questionnaire between each field and the mean of the whole fields of the questionnaire. The normal range of

Cronbach's coefficient alpha value between 0.0 and + 1.0, and the higher values reflects a higher degree of internal consistency. The Cronbach's coefficient alpha was calculated for each field of the questionnaire.

4.12 Internal Validity of the Fields

The researcher assessed the fields' internal validity by calculating the correlation coefficients between each paragraph in one field and the whole filed.

Table 4.8 clarifies the correlation coefficient for each Paragraph of the first field " About Google Earth program " and the total of the field. The p-values (Sig.) are less than 0.05, so the correlation coefficients of this field are significant at $\alpha = 0.05$, so it can be said that the paragraphs of this field are consistent and valid to be measure what it was set for except paragraph 3 which is not significant .

Table 4.8: Correlation coefficient of part "About Google Earth program"

No.	Paragraph	Pearson Correlation coefficient	p-value
1.	The program is available and easy to install	0.740	0.000*
2.	Considered an easy in use	0.757	0.000*
3.	It need training courses to able to use it	0.251	0.073*
4.	Last version of the program is easy to get	0.655	0.000*

* Correlation is significant at the 0.05 level

Table 4.9 clarifies the correlation coefficient for each Paragraph of the second field " Google Earth usage in work " and the total of the field. The p-values (Sig.) are less than 0.05, so the correlation coefficients of this field are significant at $\alpha = 0.05$, so it can be said that the paragraphs of this field are consistent and valid to be measure what it was set for.

Table 4.9: Correlation coefficient of part " Google Earth usage in work"

	Paragraph	Pearson Correlation coefficient	p-value
5.	It is widely used in most of work fields	0.831	0.000*
6.	Used for measuring dimensions	0.788	0.000*
7.	Used for measuring levels	0.565	0.000*
8.	Used for locating coordinates	0.515	0.000*
9.	For directions	0.782	0.000*
10.	Just used for get pictures as mandatory	0.577	0.000*
11.	Just to enter data inside the program	0.704	0.000*
12.	For other usage	0.831	0.000*

* Correlation is significant at the 0.05 level

Table 4.10 clarifies the correlation coefficient for each Paragraph of the third field " Accuracy in use " and the total of the field. The p-values (Sig.) are less than 0.05, so the correlation coefficients of this field are significant at $\alpha = 0.05$, so it can be said that the paragraphs of this field are consistent and valid to be measure what it was set for.

Table 4.10: Correlation coefficient of part "Accuracy in use "

	Paragraph	Pearson Correlation coefficient	p-value
13	While using it to get coordination it was clear that there is deference between Google data and the real data	0.469	0.000*
14	While using it to measure distance it was clear that there is deference between Google data and the real data	0.743	0.000*
15	Un clear display pictures in Gaza Strip is the main reason for less accuracy	0.278	0.046*
16	The available image from Google Earth is clear and could be used easily	0.353	0.010*
17	The images are old and couldn't be used always	0.469	0.000*

* Correlation is significant at the 0.05 level

Table 4.11 clarifies the correlation coefficient for each Paragraph of the fourth field " sensitivity of data " and the total of the field. The p-values (Sig.) are less than 0.05, so the correlation coefficients of this field are significant at $\alpha = 0.05$, so it can be said that the paragraphs of this field are consistent and valid to be measure what it was set for.

Table 4.11: Correlation coefficient of part "sensitivity of data"

	Paragraph	Pearson Correlation coefficient	p-value
18	The data used from the program are very sensitive	0.398	0.003*
19	The data could be got from other programs	0.777	0.000*
20	The program could be neglected because the data are not important	0.601	0.000*

* Correlation is significant at the 0.05 level

4.13 Structure Validity of the Questionnaire

The researcher assessed the fields' structure validity by calculating the correlation coefficients of each field of the questionnaire and the whole of questionnaire.

Table 4.12 clarifies the correlation coefficient for each filed and the whole questionnaire, p-values (Sig.) are less than 0.05, so the correlation coefficients of all the fields are significant at á = 0.05, so it can be said that the fields are valid to be measured what it was set for to achieve the main aim of the study.

Table 4.12: Correlation coefficient of the whole of questionnaire

No.	Field	Pearson correlation coefficient	p-value
1.	About Google Earth program	0.694	0.000*
2.	Google Earth usage in work	0.860	0.000*
3.	Accuracy in use	0.641	0.000*
4.	sensitivity of data	0.643	0.000*

4.14 Reliability Statistics

The values of Cronbach's Alpha for the whole of questionnaire. For the fields, values of Cronbach's Alpha were 0.809, This value is considered high; the result ensures the reliability of the whole of questionnaire. which indicates an excellent reliability of the entire questionnaire.

Correlation coefficients of all questionnaire are significant at α =0.05, so it can be said that the fields are consistent and valid to measure what it was set for. The values of Spearman-Brown is 0.719 with comparison with Pearson correlation coefficient which is 0.718.

The Thereby, it can be said that the researcher proved that the questionnaire was valid, reliable, and ready for distribution for the population sample.

CHAPTER 5: QUESTIONNAIRE RESUITS AND ANALYSIS

5.1 Scope

The aim of this chapter is to analyze the empirical data which were collected through the questionnaire in order to provide a real picture about the investigation of using Google earth in field of measurement in Gaza Strip. This chapter also includes the hypothesis testing.

5.2 Research Hypotheses

Hypothesis No. 1
"About Google Earth" is significantly significant at 0.05 level.
Table 5.1 shows the following results:

- The mean of paragraph No. 1 “The program is available and easy to install” equals 4.40 (88.0%), Test value = 10.728, and P-value = 0.000 which is smaller than the level of significance α = 0.05, The sign of the test is greater than much, so the mean of this paragraph is significantly greater than the hypothesized value 3. One concludes that the respondents are positive in the availability of the program and easy in use
- The mean of paragraph No. 2 “Considered an easy in use” equals 4.34 (86.80%), Test value = 15.032, and P-value = 0.000 which is smaller than the level of significance α = 0.05, The sign of the test is positive, so the mean of this paragraph is significantly greater than the hypothesized value 3. One concludes that the respondents agreed to this paragraph.
- The mean of paragraph No. 3 “It need training courses to able to use it” equals 2.13 (42.60%), Test value = -6.713, and P-value = 0.000 which is smaller than the level of significance α = 0.05, The sign of the test is low, so the mean of this paragraph is significantly less than the hypothesized value 3. One concludes that the respondents agreed that there is no real need for training courses.
- The mean of paragraph No. 4 “Last version of the program is easy to get” equals 3.06 (61.20%), Test value = 0.319, and P-value = 0.571 which is greater than the level of significance α = 0.05, The sign of the test is negative, so the mean of this

paragraph is significantly close to the hypothesized value 3. This indicates that there is difficulty somehow to get last version .

Table 5.1: Test values for "About Google Earth" part

No.	Items	Mean	Weight mean	t-value	P-value
1.	The program is available and easy to install	4.40	88.0	10.728	0.000
2.	Considered an easy in use	4.34	86.8	15.032	0.000
3.	It need training courses to able to use it	2.13	42.60	-6.713	0.000
4.	Last version of the program is easy to get	3.06	61.20	0.319	0.571

Hypothesis No. 2

Google Earth usage in the work is significantly significant at 0.05 level.

Table 5.2: shows the following results:

- The mean of paragraph No. 5 "It is widely used in most of work fields" equals 3.11 (62.20%), Test value = 0.704, and P-value = 0.485 which is greater than the level of significance $\alpha = 0.05$, One can conclude that paragraph not differ statistically on neutral degree (moderate degree).
- The mean of paragraph No. 6 "Used for measuring dimensions" equals 3.49 (69.80%), Test value = 3.051, and P-value = 0.004 which is smaller than the level of significance $\alpha = 0.05$, The sign of the test is positive, so the mean of this paragraph is significantly greater than the hypothesized value 3. One concludes that the respondents agreed to this paragraph.
- The mean of paragraph No. 7 "Used for measuring levels" equals 2.23 (44.60%), Test value =-4.831, and P-value = 0.000 which is smaller than the level of significance $\alpha = 0.05$, The sign of the test is negative, so the mean of this paragraph is significantly smaller than the hypothesized value 3. One concludes that the respondents disagreed to this paragraph.

- The mean of paragraph NO. 8 “Used for locating coordinates” equals 3.53 (70.60%), Test value =2.936, and P-value = 0.005 which is smaller than the level of significance α = 0.05, The sign of the test is positive, so the mean of this paragraph is significantly greater than the hypothesized value 3. One concludes that the respondents agreed to this paragraph.
- The mean of paragraph No. 9 “For directions” equals 3.55 (71.00%), Test value =3.455, and P-value = 0.001 which is smaller than the level of significance α = 0.05, The sign of the test is positive, so the mean of this paragraph is significantly greater than the hypothesized value 3. One concludes that the respondents agreed to this paragraph.
- The mean of paragraph No. 10 “Just used for get images as mandatory” equals 3.77 (75.40%), Test value = 4.879, and P-value = 0.000 which is smaller than the level of significance α = 0.05, The sign of the test is positive, so the mean of this paragraph is significantly greater than the hypothesized value 3. One concludes that the respondents agreed to this paragraph.
- The mean of paragraph No. 11 “Just to enter data inside the program” equals 3.23 (%), Test value = 1.137, and P-value = 0.261 which is smaller than the level of significance α = 0.05, The sign of the test is positive, so the mean of this paragraph is greater than the hypothesized value 3. But not significantly different. One can concludes that the respondents disagreed to this paragraph.
- The mean of paragraph No. 12 “For other usage” equals 2.90 (58.00%), Test value = -0.598, and P-value = 0.553 which is greater than the level of significance α = 0.05, The sign of the test is negative, so the mean of this paragraph is not significantly less than the hypothesized value 3. One can concludes that the respondents disagreed for used this program in other purpose.

Table 5.2: Test values for "Google Earth usage in the work" part

No.	Items	Mean	Weight mean	t-value	P-value
5	It is widely used in most of work fields	3.11	62.20	0.704	0.485
6	Used for measuring dimensions	3.49	69.80	3.051	0.004
7	Used for measuring levels	2.23	44.60	-4.831	0.000
8	Used for locating coordinates	3.53	70.60	2.936	0.005
9	For directions	3.55	71.00	3.455	0.001
10	Just used for get pictures as mandatory	3.77	75.40	4.879	0.000
11	Just to enter data inside the program	3.23	64.60	1.137	0.261
12	For other usage	2.90	58.00	-0.598	0.553

Hypothesis No. 3

Google Earth usage in the work is significantly significant at 0.05 level.

Table 5.3: shows the following results:

- The mean of paragraph No. 13 "While using it to get coordination it was clear that there is deference between Google data and the real data" equals 2.77 (55.40%), Test value = -1.693, and P-value = 0.096 which is greater than the level of significance α = 0.05, The sign of the test is negative, so the mean of this paragraph is not significantly and less than the hypothesized value 3. One can concludes that the respondents disagreed to this paragraph.
- The mean of paragraph No. 14 "While using it to measure distance it was clear that there is deference between Google data and the real data" equals 2.66 (53.2%), Test value = -2.429, and P-value = 0.019 which is smaller than the level of significance α = 0.05, The sign of the test is negative, so the mean of this paragraph is significantly less than the hypothesized value 3. One concludes that the respondents disagreed to this paragraph. This indicates that there poor knowledge about difference between Google data and the real data to measure the distance .
- The mean of paragraph No. 15 " unclear display pictures in Gaza strip is the main reason for less accuracy" equals 3.94 (78.8%), Test value = 7.397, and P-value = 0.000 which is smaller than the level of significance α = 0.05, The sign of the test

is positive, so the mean of this paragraph is significantly greater than the hypothesized value 3. One concludes that the respondents agreed to this paragraph.

- The mean of paragraph NO. 16 "The available picture from Google Earth is clear and could be used easily" equals 2.77 (55.40%), Test value = -1.693, and P-value = 0.096 which is greater than the level of significance α = 0.05, The sign of the test is negative, so the mean of this paragraph is not significantly and less than the hypothesized value 3. One can concludes that the respondents disagreed to this paragraph. This indicate that pictures from Google Earth is not clear and couldn't be used easily
- The mean of paragraph No. 17 "The pictures are old and couldn't be used always" equals 3.15 (63.0%), Test value = 1.134, and P-value = 0.262 which is greater than the level of significance α = 0.05, The sign of the test is positive, so the mean of this paragraph is not significantly greater than the hypothesized value 3. One concludes that the respondents agreed to this paragraph.

Table 5.3: Test values for "accuracy in use" part

No.	Items	Mean	Weight mean	t-value	P-value
13	While using it to get coordination it was clear that there is deference between Google data and the real data	2.77	55.4	-1.693	0.096
14	While using it to measure distance it was clear that there is deference between Google data and the real data	2.66	53.2	-2.429	0.019
15	Un clear display pictures in Gaza strip is the main reason for less accuracy	3.94	78.8	7.397	0.000
16	The available picture from Google Earth is clear and could be used easily	2.77	55.4	-1.693	0.096
17	The pictures are old and couldn't be used always	3.15	63.0	1.134	0.262

Hypothesis No. 4

Google Earth usage in the work is significantly significant at 0.05 level.

Table 5.4: shows the following results:

- The mean of paragraph No. 18 "The data used from the program are very sensitive" equals 2.94 (58.8%), Test value = -0.363, and P-value = 0.718 which is greater than the level of significance α = 0.05, The sign of the test is negative, so the mean of this paragraph is not significantly less than the hypothesized value 3. One concludes that the respondents disagreed to this paragraph. This indicates that data used from program is not sensitive.
- The mean of paragraph No. 19 "The data could be got from other programs" equals 2.79 (55.8%), Test value = -1.198, and P-value = 0.236 which is not significantly less than the hypothesized value 3. One concludes that the respondents disagreed to this paragraph. This indicates that respondents may have poor knowledge with other program related to same work of Google Earth
- The mean of paragraph No. 20 "The program could be neglected because the data are not important" equals 2.42 (48.4%), Test value = -3549, and P-value = 0.001 which is smaller than the level of significance α = 0.05, The sign of the test is negative, so the mean of this paragraph is significantly less than the hypothesized value 3. One concludes that the respondents disagreed to this paragraph.

Table 5.4: Test values for "sensitivity of data" part

No.	Items	Mean	Weight mean	t-value	P-value
18	The data used from the program are very sensitive	2.94	58.8	-0.363	0.718
19	The data could be got from other programs	2.79	55.8	-1.198	0.236
20	The program could be neglected because the data are not important	2.42	48.4	-3.549	0.001

Hypothesis No. 5

There is statistically significant level $\alpha = 0.05$ about **Google Earth, Google Earth usage in the work, accuracy in use and sensitivity of data** due to work experience.

To test the hypothesis we use the one way ANOVA and the result illustrated in Table 5.5 which shows that the p-value equal (0.024), (0.987), (0.045) and (0.285) respectively. which is less than (0.05) for knowledge of **Google Earth** and **accuracy in use.** While, the value of F test equal (3.449), (0.046), (2.887) and (1.301) respectively which is greater for knowledge of **Google Earth** and **accuracy in use** than the value of critical value which is equal (2.32), that's means there is statistically significant difference at $\alpha = 0.05$, about knowledge of **Google Earth** and **accuracy in use** due to work experience.

Table 5.5: ANOVA test due to work experience

		Sum of Squares	Df	Mean Square	F	Sig.
Google Earth	Between Groups	42.194	3	14.065	3.449	.024
	Within Groups	195.729	48	4.078		
	Total	237.923	51			
Google Earth usage in the work	Between Groups	6.324	3	2.108	.046	.987
	Within Groups	2028.926	44	46.112		
	Total	2035.250	47			
Accuracy in use	Between Groups	50.358	3	16.786	2.887	.045
	Within Groups	279.084	48	5.814		
	Total	329.442	51			
Sensitivity of data	Between Groups	17.759	3	5.920	1.301	.285
	Within Groups	223.033	49	4.552		
	Total	240.792	52			

Hypothesis No. 6

There is statistically significant level $\alpha = 0.05$ about **Google Earth, Google Earth usage in the work, Accuracy in use and Sensitivity of data** due to work education level.

To test the hypothesis we use the one way ANOVA and the result illustrated in Table 5.6 which shows that the p-value equal (0.924), (0.211), (0.895) and (0.197) respectively. which is greater than (0.05) and the value of F test equal (0.079), (1.559), (0.111) and (1.680) respectively which is smaller than the value of critical value which is equal (2.32), that's means there is no statistically significant difference at $\alpha = 0.05$, about **Google Earth, Google Earth usage in the work, Accuracy in use and Sensitivity of data** due to **qualification**.

Table 5.6: ANOVA test due to qualification

		Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Google Earth	Between Groups	.768	2	.384	.079	.924
	Within Groups	237.155	49	4.840		
	Total	237.923	51			
Google Earth usage in the work	Between Groups	131.880	2	65.940	1.559	.221
	Within Groups	1903.370	45	42.297		
	Total	2035.250	47			
Accuracy in use	Between Groups	1.485	2	.743	.111	.895
	Within Groups	327.957	49	6.693		
	Total	329.442	51			
Sensitivity of data	Between Groups	15.160	2	7.580	1.680	.197
	Within Groups	225.632	50	4.513		
	Total	240.792	52			

CHAPTER 6: MEASUREMENTS AND RESULTS

6.1 Scope

The aim of this chapter is to make a comparison between actual GPS observations and Google earth measurements in order to evaluate the accuracy of Google Earth in Gaza Strip.

6.2 Area of Study

Khanyounis Governorate is a part of the Gaza Strip. It is located in the south of the Gaza Strip, (Figure 1), bound by Deir al Balah to the north and Rafah in the south. It covers an area of about 111 km2 (about 31% of the Gaza Strip total area). According to the Palestinian Central Bureau of Statistics (PCBS, 2008, p.17), the population of Khanyounis in 2007 was 270,979 inhabitants (about 19.1% of the Gaza Strip total population). The built-up area occupies an area of about 17.57 km2 , while the agricultural lands cover an area of about 63 km2 . The area is generally flat with topographic elevation ranging from mean sea level (MSL) in the west to about 100 m above MSL in the east.

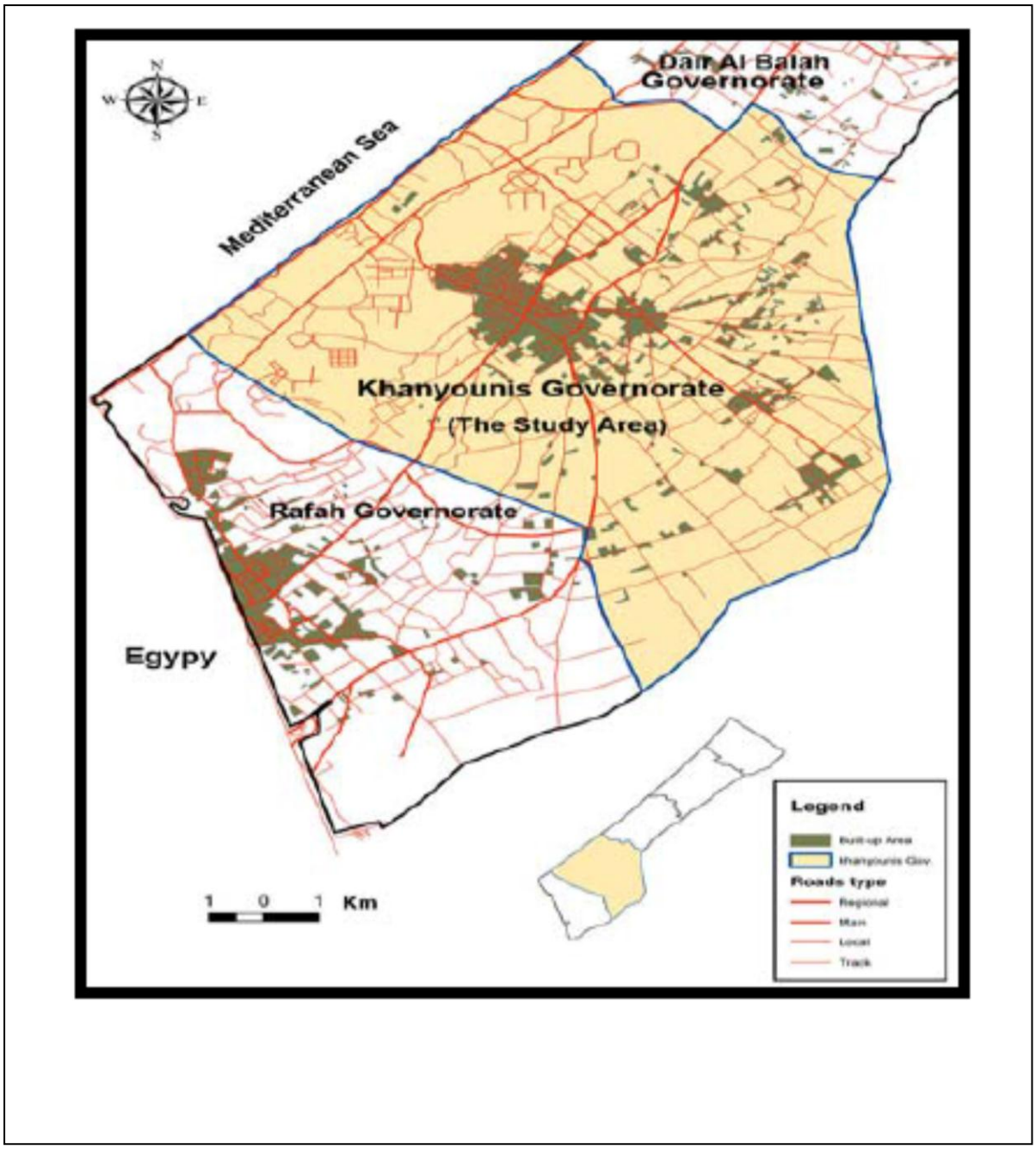

Figure 6.1: Khan-younis area located in Gaza strip

6.3 Field measurements using GPS

In this research the RTK GPS are chosen to observe the points in the study area to be compared later with Google Earth measurements in below this method and way of measurement also the accuracy will be describe in brief.

6.3.1 RTK GPS

RTK (Real Time Kinematic) surveying is a carrier phase, based relative positioning technique that employs two (or more) receivers simultaneously tracking the same satellites (Figure 6.2). This method is suitable when: (1) the survey involves a large number of unknown points located in the vicinity (i.e., within up to about 10 to 15 km) of a known point; (2) the coordinates of the unknown points are required in real time; and (3) the line of sight, the propagation path, is relatively unobstructed . Because of its ease of use as well as its capability to determine the coordinates in real time, this method is the preferred method by many users.

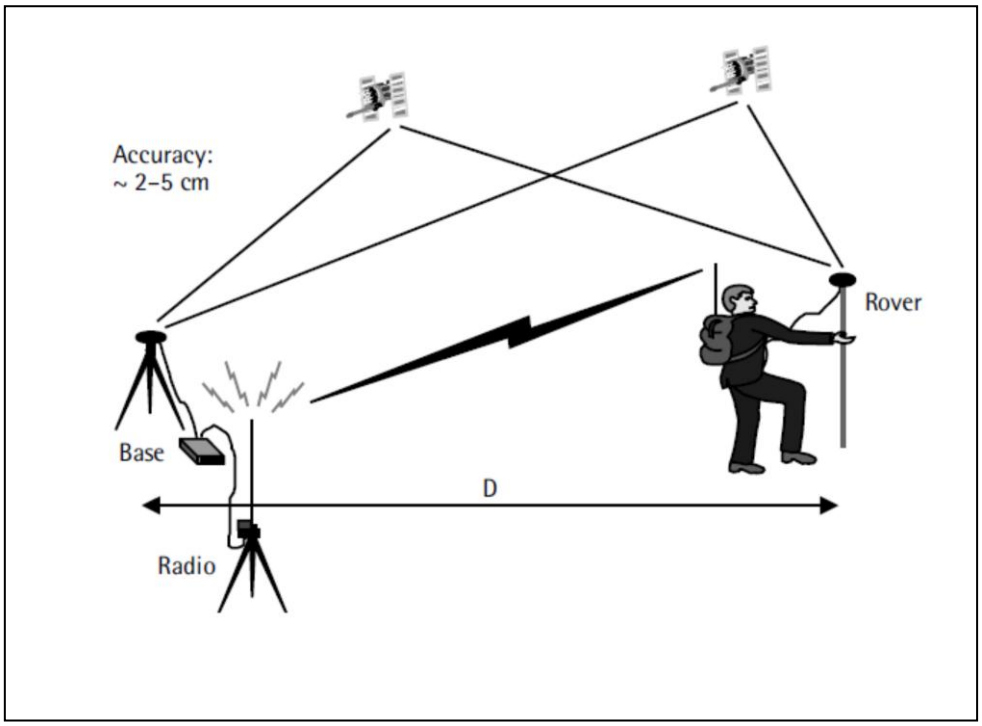

Figure 6.2: RTK GPS Surveying

6.3.2 Field GPS Observations

Using this method (RTK GPS), 40 field points are taken using *LEICA-GS 15* in Khan-younis area. The base receiver remains stationary over the known point (Khan-Municipality) and is attached to a radio transmitter (Figure 6.2). The rover receiver is normally carried in a backpack and is attached to a radio receiver. The base receiver measurements and coordinates are transmitted to the rover receiver through the communication (radio) link. The built-in software in a rover receiver combines and processes the GPS measurements collected at both the base and the rover receivers to

obtain the rover coordinates. The expected positioning accuracy is of the order of 2 to 5 mm. The computed rover coordinates for the entire survey stored and downloaded at CAD software for further analysis.

Figures (6.3) (6.4) illustrate the layout and distribution of check points in Khan-younis area.

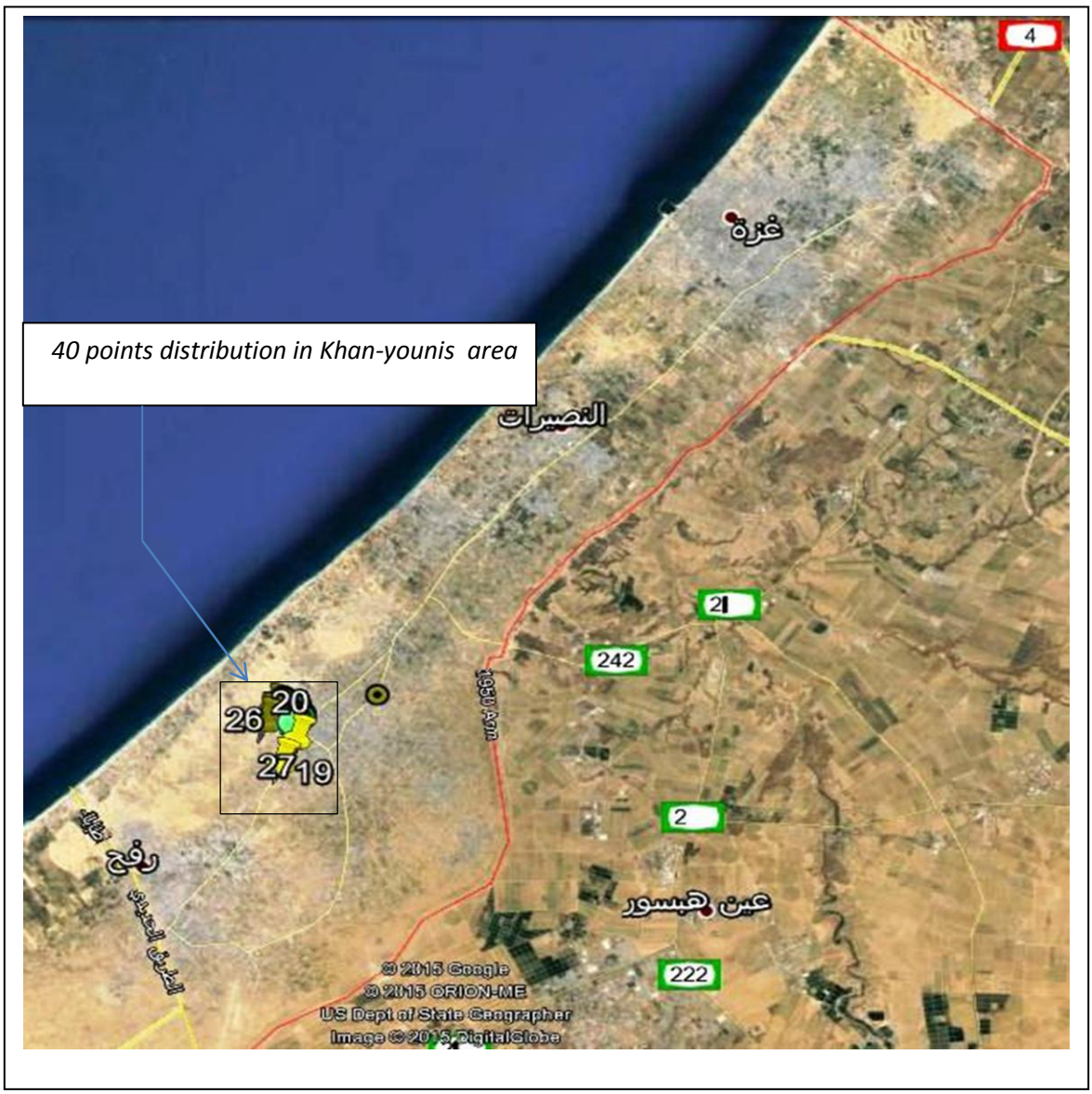

Figure 6.3 : 40 points layout in the Gaza Strip

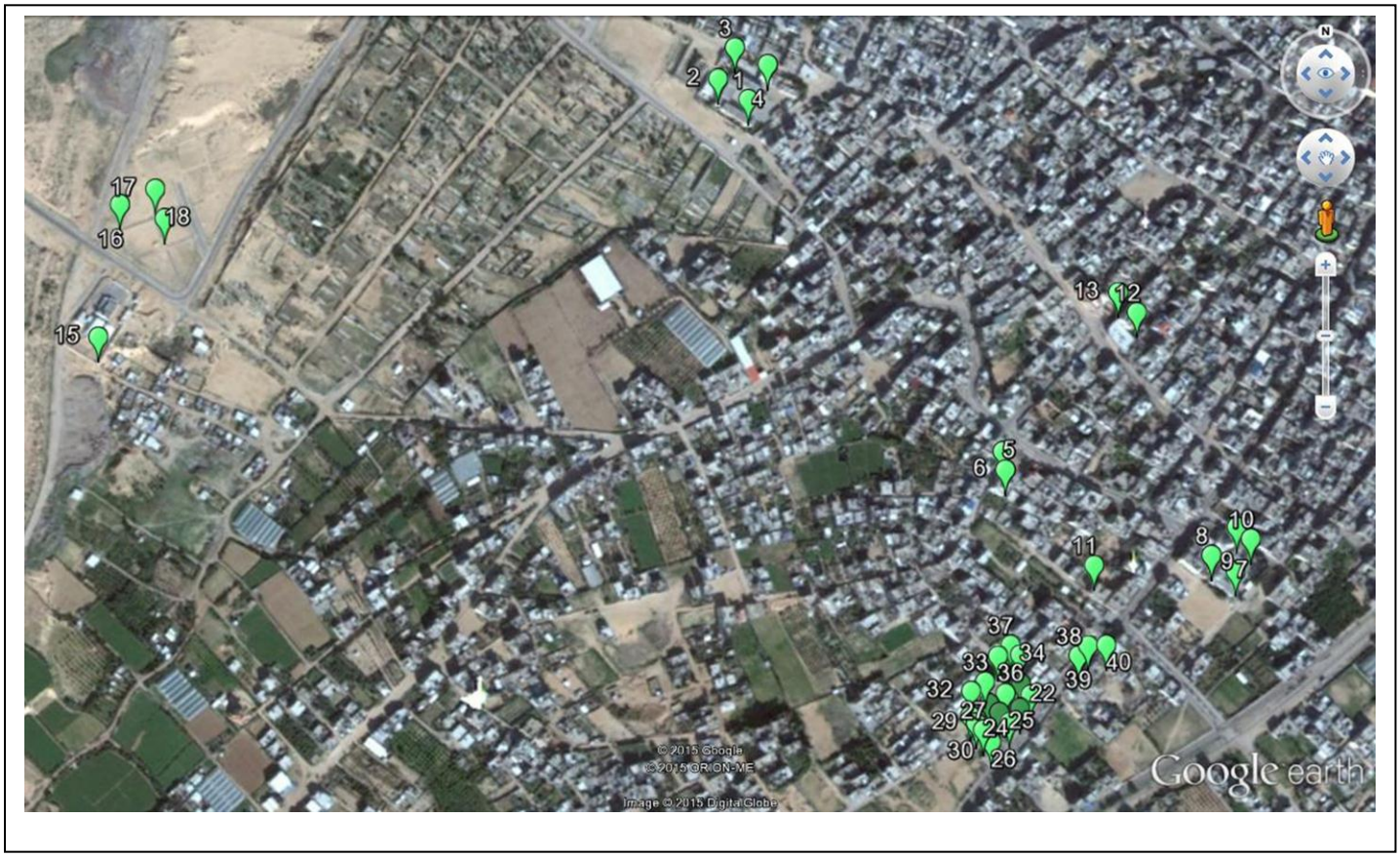

Figure 6.4 : Distribution of 40 points in Khan-younis area

6.3.3 Field GPS Results

The results for the points is shown below two points are excluded from the readings where the rest approved are in table 6.1:

Table 6.1: GPS Field Observations

No	GPS readings		No	GPS readings	
	Latitude (x) (m)	Longitude (y) (m)		Latitude (x) (m)	Longitude (y) (m)
1	82733.0877	83783.7265	21	83066.7064	83046.2507
2	82692.032	83812.2597	22	83066.7064	83034.156
3	82714.0017	83848.2552	23	83064.9384	83016.7385
4	82758.2082	83824.6811	24	83048.0766	83034.023
5	83044.2834	83338.9094	25	83051.3585	83000.7621
6	83047.4651	83315.7004	26	83030.2934	82977.4166
7	83337.6456	83186.0236	27	83021.6155	82987.0057
8	83309.4345	83206.0191	28	83042.5772	83010.4589
9	83342.6112	83245.9334	29	83014.5651	82995.5151
10	83359.241	83224.8188	30	83006.6867	83005.9991
11	83160.2482	83193.7469	31	83030.9818	83022.7777
12	83218.076	83510.3644	32	83005.2184	83037.1658
13	83196.6259	83534.1047	33	83023.0791	83048.8578
14	82193.1364	84010.2198	34	83060.0135	83085.2234
16	81936.5596	83659.9178	35	83043.4738	83071.2427
17	81982.8151	83676.4955	37	83049.0935	83095.4877
18	81996.4599	83639.9758	38	83138.9779	83080.7585
19	82405.0699	81917.2138	39	83152.0407	83094.0062
20	82940.3817	82841.7782	40	83174.2697	83095.9527

6.4 Google Earth Measurements

In this section the description of Google Earth in general, its use in measurement and the measurements for 38 points using Google Earth which was observed actually in the field (Khanyouis area)

6.4.1 Google Earth

Google Earth is a virtual globe, map and geographic information program. It is a freely available program that superimposes imagery obtained from satellite and aerial photographs onto a 3D model of the world.

The user's geographic data can be represented easily on Google Earth through the use of Keyhole Markup Language (KML) documents. These documents can be used to show points, paths, polygons and ground overlays. Plotting Surveying Data in Google Earth. The vertical aerial photographs used in Google Earth have been georeferenced to align with the coordinate system. The process of georeferencing involves identifying ground control points in the image for which accurate coordinates are

available. A transformation is then calculated by computer software which processes the image so that it aligns to the ground coordinate system (Wolf and Dewitt, 2000). Gaza Strip map in the Google Earth is not clear for users with comparison with other places all over the world, so this may affect negatively the accuracy of measurements.

6.4.2 Google Earth Measurements

Points (38) are observed in the field are now measured using (Version 7.1.1.1871) of Google Earth. Each point measured by zooming to the clear map as possible and the measure the coordination the below Table 6.2 clarifies the results.

Figures Below illustrate some points marked in the Google Earth to make the comparison.

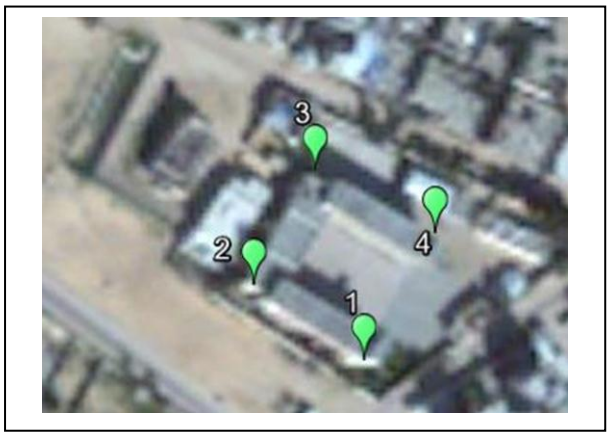

Figure 6.5 : 4 points in the school

Figure 6.6 : 4 points Garden & runway

Figure 6.7 : 4 points for a building

Figure 6.8 : 2 points factory

Table 6.2: Google Earth Measurements

Google Earth Measurement					
No	Latitude (ϕ)	Longitude (λ)	No	Latitude (ϕ)	Longitude (λ)
1	31.34271944	34.29350278	21	31.33609722	34.29709722
2	31.34295278	34.29310278	22	31.33596667	34.29722222
3	31.34330278	34.293325	23	31.33581667	34.29708611
4	31.34311111	34.29375833	24	31.33598333	34.29689444
5	31.33872222	34.29684167	25	31.33565833	34.29694444
6	31.33851667	34.29687778	26	31.33543889	34.2967
7	31.33736111	34.29995833	27	31.335575	34.29659722
8	31.33754167	34.29963056	28	31.33576944	34.29681389
9	31.33786111	34.299975	29	31.33565	34.29650556
10	31.337725	34.30015833	30	31.33573056	34.29643056
11	31.33743889	34.29805833	31	31.33586944	34.29667778
12	31.34029444	34.29865	32	31.33600833	34.29644167
13	31.34051944	34.29839722	33	31.33611667	34.29662222
14	31.34471389	34.28781944	34	31.336425	34.29708333
16	31.34153333	34.28516667	35	31.33631389	34.29679167
17	31.34170833	34.28563333	37	31.33653611	34.29695833
18	31.34137222	34.28575278	38	31.33641389	34.29785833
19	31.32587222	34.29022222	39	31.33652778	34.29798333
20	31.33423611	34.29580833	40	31.33653333	34.298225

These points in Table 6.2 are converted to the Palestinian coordinates system for the purpose of unifying the readings both in GPS and GE system as shown in Table 6.3.

Table 6.3: Google Earth Measurements

Google Earth measurements					
No	Latitude (x) (m)	Longitude (y) (m)	No	Latitude (x) (m)	Longitude (y) (m)
1	82769.16809	83794.04945	21	83105.16332	83056.92914
2	82731.31852	83820.2373	22	83116.93982	83042.35467
3	82752.78604	83858.87161	23	83103.84966	83025.82885
4	82793.84569	83837.27776	24	83085.76175	83044.45974
5	83083.24157	83348.19902	25	83090.22315	83008.38336
6	83086.49021	83325.37795	26	83066.75974	82984.2423
7	83378.59433	83194.83387	27	83057.10313	82999.41541
8	83347.56595	83215.11076	28	83077.90017	83020.80615
9	83380.63568	83250.26263	29	83048.44809	83007.80359
10	83397.95853	83235.02686	30	83041.38424	83016.79472
11	83197.85251	83204.94477	31	83065.03837	83032.00127
12	83256.76218	83521.1158	32	83042.69555	83047.587
13	83232.91267	83546.26252	33	83059.97729	83059.45774
14	82230.18752	84019.68938	34	83104.14097	83093.2852
16	81974.8129	83669.12165	35	83076.28282	83081.19353
17	82019.38294	83688.15567	37	83092.34678	83105.70362
18	82030.43841	83650.79154	38	83177.88414	83091.44576
19	82441.48923	81928.55523	39	83189.88376	83103.97625
20	82980.80278	82851.57375	40	83212.88715	83104.40299

6.5 Deference between measured and observed points

Differences between actual observed GPS coordinates of points and the Google Earth measured coordinates were computed as listed below in Table 6.3:

Table 6.4: Measurement of RMSE

No	ε_x (m)	ε_y (m)	No	ε_x (m)	ε_y (m)
1	36.080392	10.322951	21	38.4569	10.6784
2	39.286519	7.977603	22	50.2334	8.19867
3	38.784335	10.616414	23	38.9113	9.09034
4	35.637485	12.596657	24	37.6851	10.4367
5	38.958167	9.289616	25	38.8646	7.62126
6	39.025106	9.677548	26	36.4663	6.8257
7	40.948733	8.81027	27	35.4876	12.4097
8	38.131445	9.091656	28	35.323	10.3472
9	38.024478	4.329228	29	33.883	12.2885
10	38.717526	10.208062	30	34.6975	10.7956
11	37.604307	11.19787	31	34.0566	9.22357
12	38.686182	10.751402	32	37.4771	10.4212
13	36.28677	12.157819	33	36.8982	10.5999
14	37.05112	9.469582	34	44.1275	8.0618
16	38.253297	9.203848	35	32.809	9.95083
17	36.56784	11.660169	37	43.2533	10.2159
18	33.978505	10.81574	38	38.9062	10.6873
19	36.419328	11.341428	39	37.8431	9.97005
20	40.42108	9.795552	40	38.6174	8.45029
Linear Error				37.97	9.88386
Average linear Error				39.23533202	

Computing the Root Mean square (RMSE) - as an accuracy indicator - for plan-metric coordinates (X, Y) it was found to be 39.24 m.

This result shows that the shifting error in X direction about forth times that in Y direction. on the other hand, with some modifications this error may be fixed to be close as possible to the right location.

Another issue that Google Earth in Gaza strip can't be used as a source of accurate coordinates, because this error considered high in the coordinate system.

CHAPTER 7 : CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

Availability of data that make users in different disciplines in Gaza Strip use Google Earth in positional data extraction encourage to carry out researches in order to test and evaluate positional Google Earth extracted data. From the measurements carried out and results obtained above, it can be concluded with:

7.1.1 Conclusion from Questionnaire

1. The questionnaire was used to measure the scale of using the free source of Google earth in Gaza strip and for any kind of data it is used also, the sensitivity of the data
2. A structured questionnaire was specially designed for the study and it consisted of two groups, The first group: General data about the institution and the second group: Questionnaire points, that divided into 5 sections, about Google Earth as a program, Google Earth usage in work, evaluation of the Accuracy and sensitivity of data
3. The researcher assessed the fields' internal and structural validity by calculating the correlation coefficients between each paragraph in one field and the whole filed. The p-values (Sig.) are less than 0.05, so the correlation coefficients of all fields are significant at $\alpha = 0.05$, so it can be said that the paragraphs and the fields are valid to be measured what it was set for to achieve the main aim of the study.
4. The researcher used Alpha Cronbach's test, which indicate an excellent reliability.
5. One sample t test was used to determine if the mean of a paragraph is significantly different from a hypothesized value 3 (Middle value of Likert scale).
6. Users from deferent disciplines in Gaza Strip don't use deeply Google Earth in work specially in sensitive data because they don't have idea about the accuracy of the maps in this program.

7.1.2 Conclusion from the accuracy measurements of Google Earth in Gaza strip

1. Reliability of Google Earth extracted positional data can be supported by making some sort of field check.
2. Horizontal accuracy of Google Earth in Khanyounis area (Gaza strip) is about 39.24 m.
3. Google Earth represents a powerful and attractive source of positional data but it's critical to use it for studies just for limited issues in Gaza strip.
4. The low level of accuracy in Gaza Strip with comparison with other countries because:
   -Gaza Strip is maps resolution is very low.
   -Old maps are used in Gaza strip.
   -Political sensitive issues in Palestinian territories is one of the reasons.

7.2 Recommendations

As a result of this study, the following recommendations are depicted:

1. Restricted limitation for using Google Earth in positioning issues should be widely spread `in the deferent institution in Gaza strip.
2. In Gaza strip Google Earth should not be used in measurement of coordinates.
3. Follow up checking the accuracy for each new versions is highly needed because other researches prove that there is measured variance each version.
4. When it's needed to use Google Earth in spatial data (Gaza strip) it should be for investigation and preliminary studies taking into account the scale of error computed in this research.
5. Further studies to measures the accuracy of height in Google Earth is needed also.

REFERENCES

Ashraf Farah and Dafer Algarni. (2014). Positional Accuracy Assessment of Google Earth in Riyadh. Artificial Satellites, Vol. 49, No. 2 – 2014 DOI: 10.2478/arsa-2014-0008.

Ben van den Heever. (2012). Accuracy: Irrigation Design Software and Google Earth

CLOSSON et al. (2012). Salt-dissolution-induced subsidence in the Dead Sea area detected by applying interferometric techniques to ALOS Palsar Synthetic Aperture Radar images, ARTICLE VOL 23/1-3 - 2010 - pp.65-78 - doi:10.3166/ga.23.65-78

David potere. (2008), Horizontal Positional Accuracy of Google Earth's High-Resolution Imagery Archive, Office of Population Research, Princeton University. Sensors, 7973-7981; DOI: 10.3390/s8127973.

D M Stillman. (2009). Plotting Surveying Data in Google Earth.

Geo-community (2012), Conversion of Shapefile to KML, An overview of tools available, http:// spatialnews. geocomm. com / articles/ overview of kml conversion programs.

GPS Accuracy (2012), Gage mapping corporation http:// www. igage. com/ mp/ GPS Accuracy.

James Bolarinwa et al. (2009). Land Use Change Detection and Analysis Using Remotely Sensed Data in Lekki Peninsula Area of Lagos, Nigeria.

Kazimierz BECEK and KHAIRUNNISA Ibrahim. (2011). On the Positional Accuracy of the Google Earth Imagery.

Manal Omar. (1996). Shrinking of Dead Sea raises deep environmental concerns.

Martin Herold. (2005). Change detection and time series analysis –Lecture notes by Study sponsored by (RJGC)."

Nagi Zomrawi Mohammed et al. (2013). Positional Accuracy Testing of Google Earth. International Journal of Multidisciplinary Sciences and Engineering, VOL. 4, NO. 6, JULY 2013.

Reuma Arav, Sagi Filin and Yoav Avni, (2012). Monitoring changes along receding lake environments, Hydrographic Surveying.

Yuichi S. Hayakawa and Hiro'omitsumura. (2008). Accuracy assessment of Post-Processing Differential GPS Devices A Case Studing in Kaman and Hactitugrul, central Turkey.

Annex 1

Arabic Version of Questionnaire

The Islamic University – Gaza

Higher Education Deanship

Faculty of Engineering

Civil Engineering

الجامعة الإسلامية – غزة

عمادة الدراسات العليا

كلية الهندسة

قسم الهندسة المدنية

استبيان حول دراسة

تقييم استخدام برنامج (Google Earth) في مؤسسات قطاع غزة كمصدر للمعلومات

الفئة المستهدفة : المؤسسات الحكومية وغير الحكومية ومكاتب المساحة الخاصة.

الباحث

محمد إبراهيم حمد

الأخ الكريم.....حفظه الله

يعطي برنامج (Google Earth) بيانات عن جغرافية الأرض الطبيعية باستخدام الأقمار الصناعية، وانتشر استخدامه حاليا بشكل كبير جدا بحيث أصبح من أهم مصادر المعلومات التي تستخدم للاستدلال على مختلف البيانات من تحديد المواقع، توقيع ورفع الإحداثيات ، قياس المسافات وغيره من المعلومات الجغرافية. ولذلك كان لا بد من تقييم مدى استخدام البرنامج في مؤسسات قطاع غزة والتأكد من نوع المعلومات التي يتم الاستفادة منها ودقتها.

لذلك نرجو من سيادتكم الإجابة عن أسئلة الاستبانة بما ترونه مناسبا حيث تشكل هذه الاستبانة جزءا من دراسة للحصول على درجة الماجستير، مع العلم أن البيانات الواردة سوف تستخدم لأغراض البحث العلمي فقط.

فقرة (أ) : معلومات عامة عن المؤسسة :

اسم المؤسسة / الشركة : ----------

نوع الأعمال التي تقوم بها المؤسسة / المكتب: ☐ مباني ☐ طرق ☐ مياه ومجاري

☐ أعمال مساحية ☐ أخرى

عدد سنوات الخبرة لمن يقوم بتعبئة الاستبيان : ☐ من 1-3 سنوات ☐ من 3-5 سنوات

☐ من 5-10 سنوات ☐ أكثر من 10 سنوات

المؤهل العلمي : ☐ ثانوية عامة ☐ دبلوم ☐ بكالوريوس ☐ ماجستير

التخصص : ☐ هندسة ☐ GIS ☐ IT ☐ أخرى

وظيفة من يقوم بتعبئة الاستبيان: ☐ صاحب المؤسسة ☐ مدير مشاريع ☐ مهندس موقع ☐ مهندس مكتب

هل تقوم باستخدام برنامج (Google Earth) في عملك ☐ نعم ☐ لا

إذا كانت الإجابة بنعم فما هي نسبة استخدامك للبرنامج ☐ لا يمكن الاستغناء عنه ☐ في معظم الأعمال التي أقوم بها

☐ أحيانا ☐ نادراً

محاور الاستبانة	درجة الموافقة				
	كبيرة جدا 5	كبيرة 4	متوسطة 3	قليلة 2	قليلة جدا 1
المحور (1) : حول برنامج (Google Earth)					
البرنامج متوفر وسهل الحصول عليه من الانترنت					
يعتبر استخدام البرنامج سهل وغير معقد					
يحتاج البرنامج الى دورات تدريبية متخصصة حتى يتم استخدامه					
يمكن الحصول على اخر الاصدارات للبرنامج بسهولة					
المحور (2) : مجالات استخدام برنامج (Google Earth)					
يتم الاعتماد على استخدام البرنامج بشكل كبير في معظم مجالات العمل					
يستخدم لقياس الابعاد					
يستخدم لقياس الارتفاعات					
يستخدم لتوقيع ورفع الاحداثيات					
يستخدم لتحديد الاتجاهات					
يستخدم في الحصول على صور الاسترشاد فقط					
يستخدم في توثيق بيانات على نفس البرنامج					
لاستخدامات اخرى					

محاور الاستبانة	درجة الموافقة				
	كبيرة جدا 5	كبيرة 4	متوسطة 3	قليلة 2	قليلة جدا 1
المحور (3) : حول تقييم الاستخدام من حيث الدقة					
عند استخدام البرنامج للحصول على الاحداثيات تبين وجود فرق كبير بين نتائج البرنامج بالمقارنة مع النقاط في الطبيعة					
عند استخدام البرنامج لقياس المسافات تبين وجود فرق كبير بين نتائج البرنامج بالمقارنة مع القياسات على الطبيعة					
عدم وضوح الصورة في قطاع غزة هو السبب الاساسي في عدم دقة البيانات المستخدمة من البرنامج					
النسخ المتاحة ذات صور واضحة ويمكن الاستعانة بها					
الصور الموجودة قديمة و لا تفيد في استخدامه بشكل دائم					
المحور (4) : حساسية المعلومات المستخدمة					
المعلومات التي يتم استخدامها من البرنامج ذات حساسية عالية					
المعلومات التي يتم استخدام البرنامج بها يمكن الحصول عليها من برامج أخرى					
يمكن الاستغناء عن البرنامج لعدم أهمية المعلومات					