The Use of GIS and Handheld GPS Integration for the Preparation of Quick Plans

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Abstract

All kind of data is the important component of a GIS studies. The data which will be used for GIS works is mostly provided from an digitized maps, existing paper maps, areal photos or satellites images. Nowadays the data from GPS can be used to make plans and maps of the studied area and the GPS data can be converted into the GIS environment more easily. GIS and GPS integration systems have some useful applications for the rapid preparation of plans and maps of small areas. This paper will try to explain GIS-GPS integrated systems and give applications during the preparation of Eskisehir Industrial Area plans and Gundogan-Bodrum Touristic Area plans.

GIS and GPS Integration

Definition of GIS

The glossary of GIS books generally describes the GIS as "An organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information" (Anon, 1990). Every interested person can find different GIS definitions which might be useful for their purpose. Each data for GIS must have geographic reference value and identify the location of it on the ground. Many users have been using computers for manipulation of spatial data since 1960s. During the 1980s, advances in computer hardware, particularly processing speed and data storage, catalyzed the development of GIS software for handling spatial data. GIS is filling a very real need in the face of the rapid growth of digital spatial data in a wide application fields, from social to technical studies (Carter, 1994).

Definition of GPS

In recent years the availability of global positioning system technology has permitted convenient, inexpensive, and accurate measurement of absolute location (Campell, 1996). GPS, another increasing useful form of GIS technology, was initially developed by the U.S. military but now widely used for both military and civilian applications around the world, often in conjuction with GIS (Bernhardsen, 2002). GPSs have the

capability to integrate image data with field data. Global Positioning System (GPS) refers to the group of 24 geosynchronous satellites owned and maintained by the U.S. Department of Defense (USDOD). Each satellite with atomic clocks in it and each satellite transmits a unique signal that is received by a GPS receiver on earth. There is also a high precision quartz clock in a GPS receiver is calibrated to a satellite's atomic clock via information imbedded in the GPS signal. Each GPS receiver on the earth generates same code at the same time as satellite, this property which GPS has the ability to measure the time difference between the signals transmitted and received. It is known that these radio signals travel at a constant speed, 299,460 km/s in the atmosphere. So, it is possible to locate the precise location of the standing point with the GPS, for the intersection of four spheres with the known distance between a GPS receivers and GPS satellites as radii. Theoretically a minimum of four distance measurements is needed to find the precise X, Y and even Z location of the given point on the ground. These GPS satellites have launched on six different orbit around the world, and each orbit has four satellites. It is possible to see at least four satellites on the ground at any time.

Methodology

Integration of GIS and GPS for the preparation of quick maps and plans have described in this study. The integration methodology with hand held GPS receiver is used to check whether it is good enough for collecting GIS feature's attributes.

Studied Area

Two different areas were selected as the studied areas. The GIS and GPS integration method was applied for these areas. One of the areas belongs to industrial area and the other is touristic area according to land use classification. Industrial area of Eskisehir, which is located in the middle of Anatolia was selected as for the preparation of quick plan of industrial area (Figure 1). The second area, Gundogan, located in the north part of Bodrum is selected for the preparation of quick touristic plans (Figure 1).

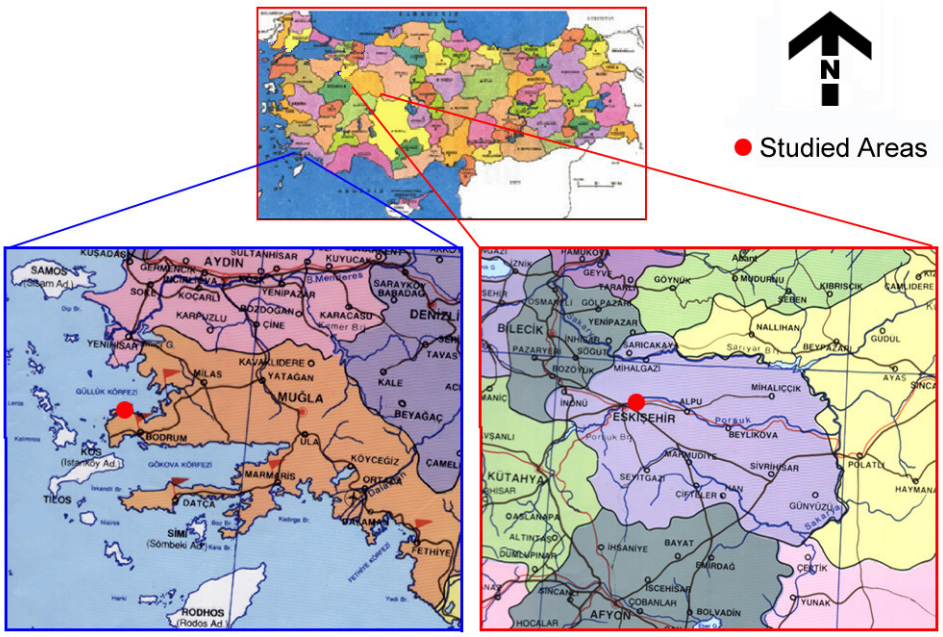

Figure 1 Location map of the studied areas (Gundogan-Bodrum at the left; Industrial area of Eskisehir at the right).

Equipment, Software and Data Collection

The Global Positioning System (GPS) has become an essential tool for GIS users. It is very easy to use, portable and can locate the feature within millimeters to 10 meters by using sophisticated to handheld GPS receivers respectively.

Low cost, Magellan 315 type handheld GPS is used for collecting GPS data (Figure 2). There is a wide variety of free and low cost software packages on the market, allows data communications between GPS receivers and your computer, including full data editing and storage options. GPS TrackMaker is one of them and it is used in this study.

Figure 2 Low cost handheld type GPS is used for this study.

More than 50 waypoints were collected at the Gundogan touristic area. The waypoints were collected while walking. The UTM coordinates of the waypoints were recorded in the GPS and the attributes of the hotel, restraurant and private site were obtained at the same time. More than 100 waypoints were collected in the Industrial Area of Eskisehir. The waypoints were collected by car. Factories and common utility buildings were selected as feature class. Type of factories and common utility buildings are the attributes of these feature classes.

Preparation of Maps and Plans

The waypoints which define the feature classes were collected for industrial and touristic areas. Registered Landsat ETM satellite image was used as background for Gundogan touristic area (Figure 3). Types and categories of factories are selected as

the main attributes for industrial site. Hotel classes and restaurant types were selected as attributes for tourist site. All the collected waypoints were imported in the GIS GeoMedia Pro software and it is seen that there is a good match between the collected GPS waypoints and registered satellite image (Figure 4).

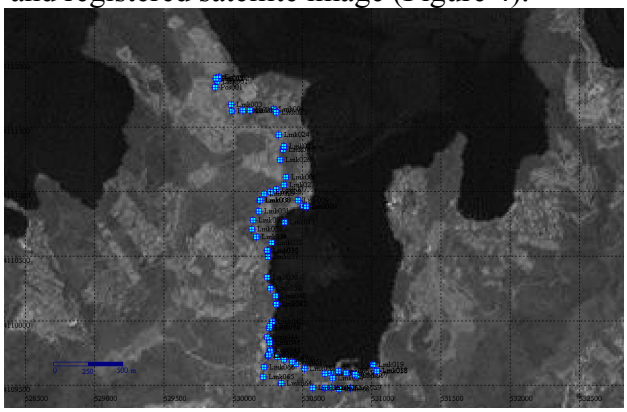

Figure 3 Collected waypoints of touristic locations as feature classes on the satellite image of Bodrum region.

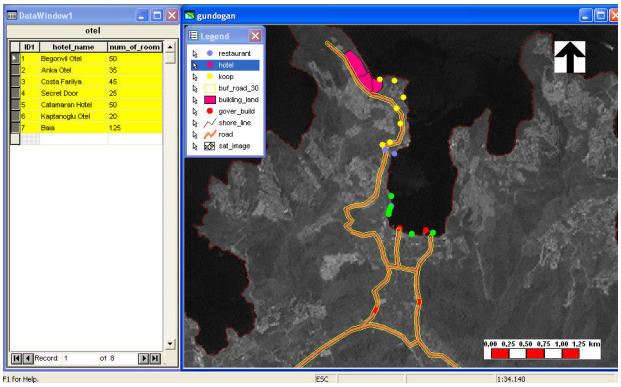

Figure 4 Selected feature classes in the GIS environment.

The waypoints which were collected from the industrial area were overlaped on the aerial photograph and satellite images (Figure 5). Aerial photograph and satellite images were registered to the UTM coordinates before overlaping operation (Figure 6).

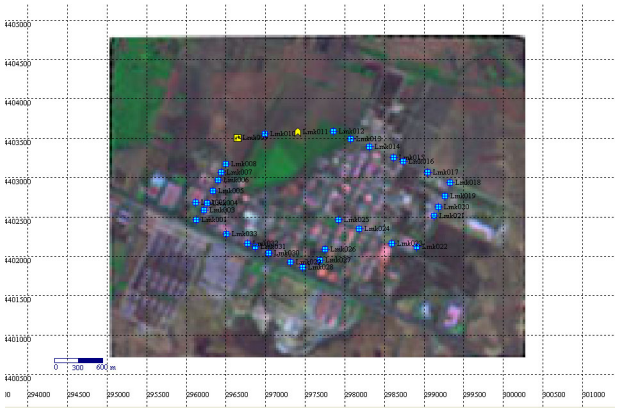

Figure 5 Collected waypoints as feature classes from industrial area on the satellite image.

Figure 6 Selected feature classes of the industrial area in the GIS environment (aerial photo is used as registered background).

At the end of these two applications it is seen that, good match was reached between the background registered images and the collected GPS data. Non-graphic data which are the attibutes of the touristic places and factories were prepared in a simple database environment and jointed with the graphic objects.

Results

At the end of these studies it is seen that, the collected waypoints by using handheld GPS receiver can be used for rapid data collection. These data have the ability to transfer rapidly from the GPS environment to the GIS environment. The maps and plans which are obtained by using handheld GPS and GIS softwares can be used effectively for getting information, querrying and analysing the feature classes.

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