# MOBILE GIS APPLICATION IN URBAN AREAS AND FOREST BOUNDARIES: A CASE STUDY

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**ABSTRACT:**

Data is one of the most important components for GIS. It is accepted as a principle element of GIS by specialists. Both data collecting and updating are highly significant and difficult for GIS. Global Positioning System (GPS) is one of the most efficient data collection methods for GIS. It is possible to obtain high-accuracy location data through GPS. As a result of development in location determination areas and wireless communication systems, GIS users can access the map or information via internet and also simultaneously share the collected data in the field. Mobile GIS is a mobile system which is integrated GIS and GPS on a portable computer. Trimble GeoXT was used as a mobile GIS device for this study. It contains mobile sub-meter GPS receiver and a handheld computer.

Population of Turkey is about seventy millions and 25 percent of this population has been living in Istanbul. In addition, Istanbul has large forest areas. It is inevitable to set up new settlements due to the fact that population of Istanbul has been continuously increasing. As a result of this, the forest areas have seriously been threatened. Therefore, it is very important to determine the forest areas, the build areas and to observe them with GIS.

Cekmekoy city was selected as the study area due to the fact that it is one of the little open areas for built in Istanbul and has large forest areas. Web-based GIS was designed and applied utilizing from satellite image and 1/1000 scaled vector data of previous years. Afterwards, data relevant forest and built-up areas is updated and determined by the Mobile GIS device which is integrated with Web-based GIS.

## 1. INTRODUCTION

Data is one of the indispensable components for GIS. Data collection is required the time and cost in GIS. There are different data collection methods in GIS. Nowadays, data must be dynamically collected in field due to increase usage of GIS. Thus, making a decision and spatial analyst are applied during the data collection.

GPS is one of the most practice data collection methods. As a result of removing of the selective availability (SA) error in 2000, accuracy of the absolute location determination is sub 10 meters in GPS (Mintsis, 2002). In addition, it is about ± 3 meters while using the WAAS and EGNOS systems now (Hunter, 2002). It is possible to get the accuracy about ± 50 centimetres in case of using the DGPS method (Trimble, 2004).

Urban applications of GPS mapping systems include mapping transportation and utility infrastructure. Streets and highways are digitized by driving along the roads while recording the GPS positions. Road conditions, hazards, and areas that need repairs are entered as attributes for use in inventory and GIS programs. Other urban applications include mapping and recording land parcels, zones, public works, street features, and factories. GPS helps in mapping electrical, telephone, water, gas, and sewer lines. Items like manhole covers and fire hydrants are mapped as points with associated attribute information (Trimble, 2002).

Mobile GIS integrates three essential components; GPS, rugged handheld computers, and GIS software (Trimble, 2006). The term "Mobile GIS" can be defined as an integrated software/hardware framework for the access of spatial data and services through mobile devices via wire line or wireless networks." Wireless GIS" is a subcategory of mobile GIS technology that focuses on the wireless networking capability of mobile GIS services. There are two major application areas of mobile GIS.

- Field-based GIS, which focuses on GIS data collection, validation and update (spatial and attribute).
- Location-based services (LBS), which focus on business-oriented location management functions such as navigation, street routing, finding a specific location or tracking a vehicle (Solyman, 2005).

Use of mobile computer has quickly increased. Mobile computers are used as personal digital assistant (PDA). In addition, it is also used for data – collection, data – updating, and data – editing processes in GIS.

Data collection and updating processes in field were difficult in past. Firstly, collected data in field was being added to map with sketch. Afterwards, in result of checking them, they were manually transferred to GIS. As a result of this, GIS analysis and decision-making were late due not to be up-to-date GIS

data. Nowadays, the mobile technology provides directly collecting the digital geographical data through mobile computers. Data has timely been transferred the database in applications on account of implementing data collection and evaluating processes in field. As a result of accessing the up-to-date data and correct location information; analyze data presentation and decision-making processes have been applied rapidly (Montoya, 2003).

Mobile GIS provides the advantages such as

- Collecting the correct, rapid and up-to-date data,
- Using the digital map and satellite images in field,
- Executing real time navigation in field,
- Implementing the spatial analyst in field,
- Accessing the presented map on the internet,
- Sending the collected data by wireless communication (Yomralioglu, 2004).

Remote sensing is another significant data collection method for GIS. Nowadays, it is possible to get the up-to-date data by satellite images. One of the major functions of GIS is its analysis of changes between two or more layers of geographic data. In remote sensing, change detection is the process of the identifying differences in the state of an object or phenomenon by observing it at different times (Singh, 1989).

Both Remote Sensing and GPS are indispensable data collection methods for GIS. According to the aim of creating GIS, the appropriate data collection method should be decided.

This study considers data collection methods such as Remote Sensing and GPS in GIS. Furthermore, it presents the information about the usage of Mobile GIS in forest boundaries and urban areas.

## 2. THE STUDY AREA

Cekmekoy city was selected as the study area which is one of the most important settlement areas of Istanbul due to the fact that it has the dense forest areas and built-up areas. Therefore, current situation of the city has continuously changed. However, the forest areas of the city have been threatened. Moreover, data collection and data updating are necessary to create the sustainable GIS in the city. The study area is given in Figure 1.

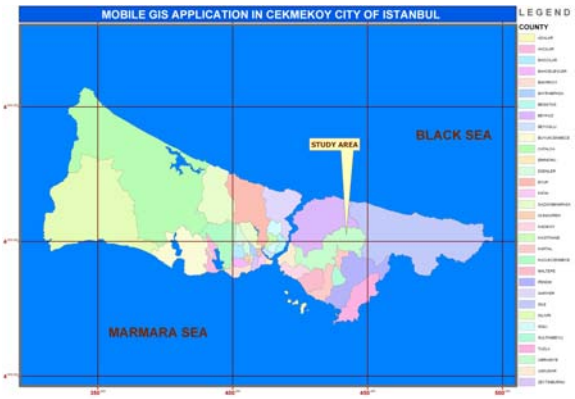


Figure 1. The study area

## 3. METHODS FOR MOBILE GIS APPLICATION IN CEKMEKOY CITY

IKONOS satellite image of Cekmekoy city in 2004 and its 1/1000 scaled vector data of previous years were used for this study. Finally, collected up-to-date data by Mobile GIS device was integrated with web-based GIS.

Designed layers and its attributes are given in table 1 for this study. Furthermore, Arc GIS 9.1 (GIS), Arc IMS 9 (Web-Based GIS) and Arc Pad 7 (Mobile GIS) software were used to create the system.

| Layer Name | Geometric Type | Attributes |
|---|---|---|
| Building | Polygon | ID, Name, Site Name, Update Date |
| City Block | Polygon | ID, Block Type |
| Forest Boundary | Polyline | ID, Forest Name, Name and Surname (Responsible for updating), Update Date |
| Cekmekoy City | Polygon | ID, District Name, Authority |

Table 1. Designed layers and its attributes for this study

Trimble GeoXT was used as mobile GIS device which consists of GPS receiver, handheld computer and installed Mobile GIS software. It is given in Figure 2.


Figure 2. Mobile GIS device used for this study

## 4. RESULTS AND DISCUSSIONS

Satellite images and Mobile GIS device are significant for sustainable GIS. Satellite images provide only geographical data for GIS. However, Mobile GIS device enables both geographical and non-geographical data for GIS. Particularly, it helps in Urban Information System (UIS) applications.

The block is appeared as a free block in IKONOS satellite image in 2004. It is given in Figure 3. However, last situation of the block has been determined as the site block named “Agaoglu My Country Site” by the Mobile GIS device in 2006. In field, its shape area was determined about 153240 square meters by the device. The block has been built up in 2006. It is given in Figure 4.

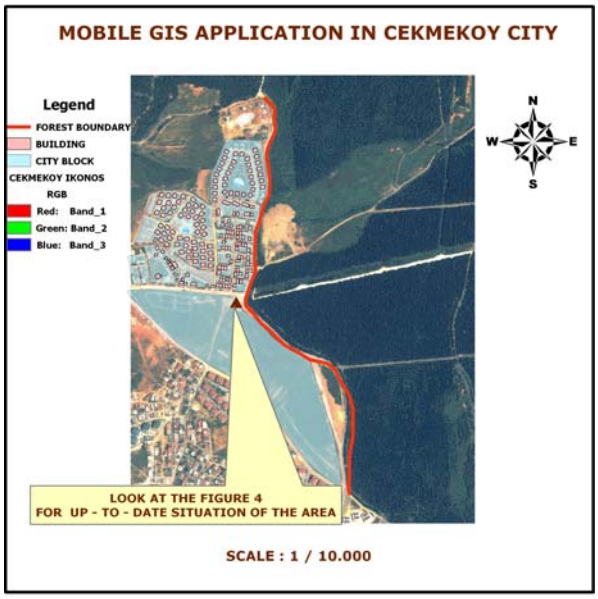


Figure 3. Situation of the block in IKONOS satellite image in 2004


Figure 4. Up-to-date situation of the block in 2006

Forest and the built-up areas are next to each other in Cekmekoy city. The boundaries of them have constantly been determined due to change the situation of the city. In the study area, the boundary of the forest area is determined by the Mobile GIS device which is integrated with web-based GIS. Its shape length is about 1540 meters. It is given in Figure 5.

Urban Information System (UIS) is an effective tool for municipalities to control social, cultural, physical and economical activities and to offer well-qualified service. These activities are essential for UIS. Providing sustainable UIS is as important as creating the UIS.

Existing buildings in the system (Buildings Gokdeniz Villas of Cekmekoy) has been confirmed in the field. Additionally, non-geographical data such as site name, building name and updating date related to them has been determined by Mobile GIS device and integrated with web-based GIS. It is given in Figure 6. Due to the fact that the applications similar to this study support UIS, Mobile GIS is a significant tool for UIS.

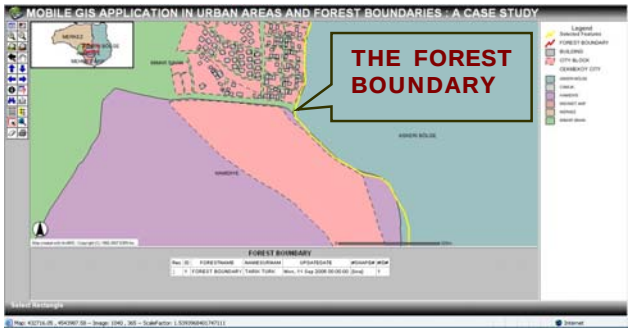


Figure 5. Presenting in web-based GIS of the determined forest boundary in the study area

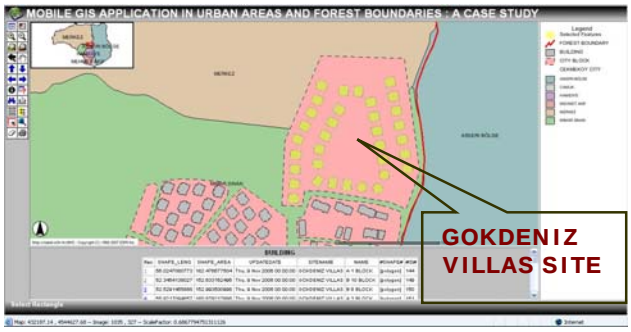


Figure 6. Query the buildings belonging to the site via web-based GIS

## 5. CONCLUSIONS

Mobile GIS has been used in various applications by many different disciplines. By empowering field personnel with the responsibility of data acquisition, editing and verification, Mobile GIS applications have the capability of bringing field and office activities into a collaborative environment that can further improve productivity, reduce costs and minimize project completion timeframes. Making the technology truly effortless and natural to use should empower new communities of users, thus increasing the value of the software and databases being built now and in the future by government and the private sector (Hunter, 2002).

As a result of developing in information technology and increasing of the investments in the field, it is certain that Mobile GIS will be an alternative technology for classical GIS applications and used efficiently by people.

Nowadays, Mobile GIS has commonly been used in UIS applications. It helps acquiring geographical and non-geographical data in the field. Besides, it is an important tool for facilitating the people life in case of integrating with web-based GIS.

This study presents the information about the mobile mapping, web-based GIS and integrating of them.

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