Development of a GIS Based Information and Management System for Cultural Heritage Site; Case Study of Safranbolu

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Key words: Safranbolu, Cultural Heritage, 3D Modeling, GIS, Thematic Map, Web Server, Photogrammetry

SUMMARY

Documentation of the cultural heritage sites is extremely important for monitoring and preserving them. Turkey has many cultural heritage sites originating from the first human settlements in Catalhoyuk and Alacahoyuk and civilizations such as Byzantine, Seljuk and Ottoman. 3D modeling and digital recording of historical buildings in several locations of Turkey have been conducted and still continuing. The nine cultural sites in Turkey are included in the protection list of UNESCO as cultural heritage and one of them is the city of Safranbolu. In this study, outcomes and further studies of a research project related to study area was discussed in details.

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1. INTRODUCTION

Cultural heritage sites of countries present very much emphasis for various ways e.g., tourism, publicity of country, economical gains supply. It is not only important having cultural heritage, but also to protect and revitalization of these sites. Turkey is considerably reach country in term of historical settlements. But it is very important to document all these settlements in details and reconstruct them according to their original structures especially for the sustainability (Unal, 1998; Yesilcicek, 1995). Traditional Turkish Architecture was constructed according to their life style during the history. It is possible to examine traditional Turkish houses back to 17th century and they can be differentiated according to their room arrangements, multi layered, roof type and structural techniques (Gunay, 1981).

Safranbolu is the one of the most outstanding example of the traditional Turkish Architecture and also unique itself in terms of conservation of the human settlement in their authentic environmental motif up till now. The historical buildings built with a spectacular architectural knowledge reflect and brings the existing custom and culture from past to present. There only 1120 works of arts among the countless cultural arts have been taken to conservation (Akcin et al, 2005). Even though the history of the city is considerable old and has many different civilizations it reflects the economic richness of the Ottoman Empire. Currently the city became almost an open air museum and very popular destination for both natives and foreigners (Aksoy and Kus, 1998).

The cultural heritage sites of countries are to be protected and will be kept for next generations. UNESCO (United Nations Educational, Scientific and Cultural Organization) helps the countries on this matter by taking the important sites into the list of world cultural heritage sites. Such an action draws public attention in the particular country as well as in the world's community. Sustainability of the site and presenting the heritage in its original form can be provided by well documenting the interested area (Kulur and Sahin, 2008). UNESCO has put the historical Safranbolu settlement into the world heritage list in the year of 1994 and its natural entity has been well conserved throughout all the years up to now (URL 1). In Turkey, 9 historical areas are under protection of UNESCO including Safranbolu historical city. Safranbolu is the one of the most outstanding example of the traditional Turkish Architecture and also unique itself in terms of conservation of the human settlement in their authentic environmental motif up till now. In this study outcomes and further studies of a research project related to study area which is supported by the Turkish National Research Center (TUBITAK) is discussed. The basic aim of the project is development a GIS based information and management system for the city of Safranbolu. For his purpose, all registered

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historical buildings are assigned with the database. In the further steps of the project, 3D models of selected building which are registered as historical monuments will be realized using different data comes from different sources and then obtained results will be published and distributed via internet by a web-based information system designed during the study.

After collecting cadastral information, land register and all historical information, related to the buildings, will be collected, reliefs of the selected buildings will be extracted using terrestrial photogrammetric technique. After construction of 3D modeling of the building a GIS based database will be designed. In this database, there will be 3D models, locations, historical information, cadastral and land register data of the selected buildings together with the other data related to buildings collected during the study. Using this system, all kind of spatial and non-spatial analyses will be realized and different thematic maps for the city will be produced.

The aim of this study is build an internet based information system for the documentation of the old part of the city of Safranbolu. For this purpose, digital data from different sources with different resolutions are brought together in GIS. With the study, all the constructions in Safranbolu will be recorded permanently and architectural features of them will be integrated to information system. In this way, this study will be reference for future studies. In addition, by the help of internet which is the fast way to reach the information and knowledge, the study will be help to increasing the number of tourists reaching the data much more and easy way and increase in the cultural heritage tourism.

2. STUDY AREA

The city of Safranbolu has been selected as the study area in this project. It is located in the inner part of the Western Black Sea Region (Figure 1). The city's historical roots in the Ottoman Empire date back to the 13th century. Safranbolu has a remarkable wooden culture and has characteristics of Turkish structure art to date. Many Turkish wooden and stone structure art examples can be traced in fountains, roads, walls, Turkish baths, mosques etc. in the old section of the city (Ergin, 2003). The city of Safranbolu contains well-preserved items of many civilizations (Roman, Byzantine, Seljuk and Ottoman). It is a city which preserves all its values, monuments, sites, groups of buildings, and an historic shopping area. There is a great homogeneity between these elements. It is a typical Ottoman city that has survived to the present day. Safranbolu was placed in the world Cultural Heritage list by UNESCO in appreciation of the successful efforts in the preservation of its heritage as a whole. The city has deserved its real name for its cultural houses. It also displays an interesting interaction between the topography and the historic settlement.
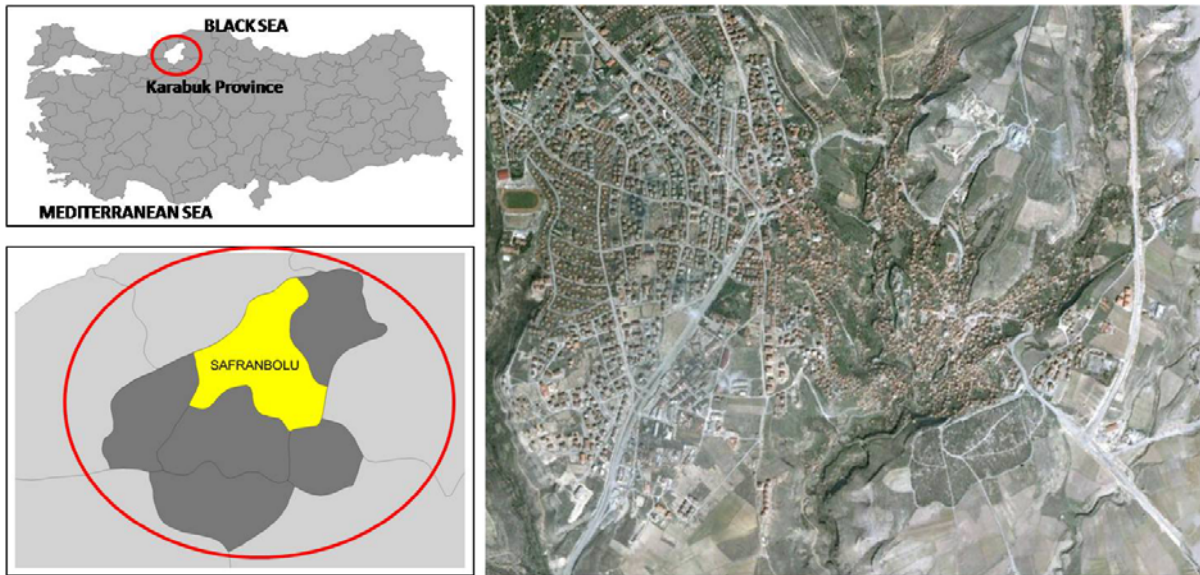
Figure 1. Location of the study area

Safranbolu consists of four distinct districts - the market place area of the inner city, known as Cukur (The Hole), the area of Kirankoy, Baglar (The Vineyards), and an area of more recent settlement outside the historic area. The city has about 2000 traces that are being protected in the natural tissue as an expression of the historical and cultural wealth. Rock Graves, mounds, Caravanserai and Turkish Baths, The Old Mosques, Shopping Districts, Water Vaults, Fountains, Tombs and Historical Houses are some of the traces that have survived.

Figure 2. Different views of the historical buildings of Safranbolu (Ergin, 2005, Gunay, 1998).

Figure 3. Different cultural examples of Safranbolu

Safranbolu has won its first fame with its buildings that have a traditional and special architecture. These houses are wonderful architecture samples that show Turkish society life of 18th and 19th centuries. These splendid houses which carry the effects of crowded family structure, economic wealth and local climate properties are defined as "five sided architecture" because of their roofs.

Safranbolu houses are the buildings with 2-3 floors, 6-8 rooms, balconies, and lots of windows in every room. In these buildings; esthetical use of stone, unbelievable quality of woodwork, ornaments of wall and ceilings, pools inside the houses, stairs and door knockers (URL 2). In Figure 3 different cultural examples are given.

The interested area is chosen from a part of Safranbolu which includes the area of the inner city. This area includes a lot of the old architectural buildings such as Cinci Caravanserai, Cinci Turkish Bath, Clock Tower, The Old Government Building, The Old Jail, Koprulu Mehmet Pasha Mosque and Izzet Mehmet Pasha Mosque etc.

3. USED DATA AND METHODOLOGY

In this study, 1/1000 scale digital cadastral maps of the Safranbolu obtained from the city municipality is used as the main topographic data. The vector map of the old city part and contour lines of the same part of the city are given in Figure 4.

In the study, stereo pair of IKONOS satellite sensor data of Safranbolu is also used to support the existing maps. The images was rectified by ground control points chosen from the 1/5000 scale maps. Since present the image was used only as backdrop image and in the further studies these images will be used to extract the height information of the historical buildings lie on the study area. A realistic 3D textured model of study area with IKONOS pan sharpened image is given in Figure 5.
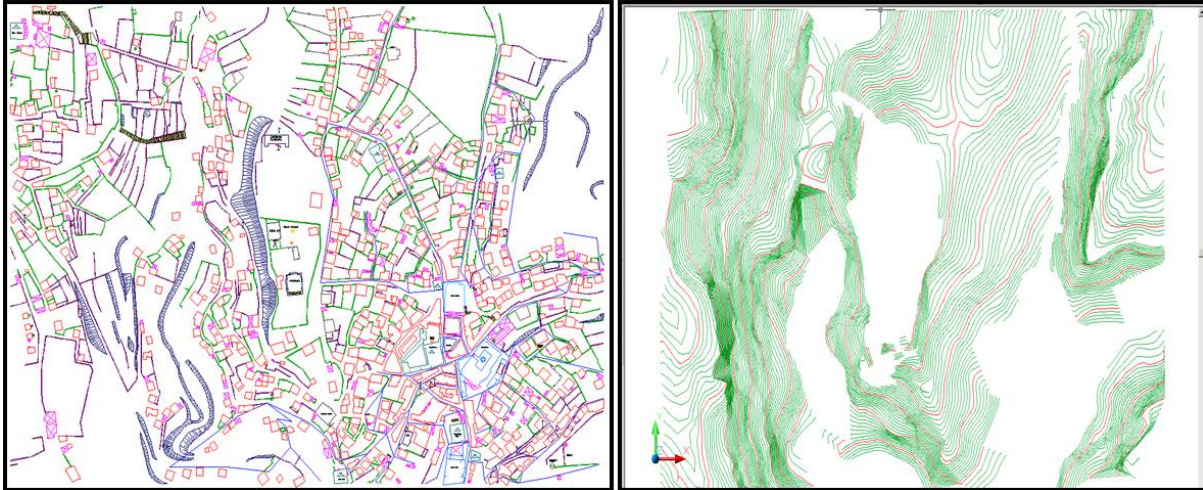
Figure 4. 1:1000 scaled the present time map and the contours of the study area


Figure 5. Textured model of study area with IKONOS pan sharpened image (Marangoz, et all., 2006).

4. TERRESTRIAL PHOTOGRAMMETRIC WORKS

The terrestrial photogrammetric works are another step of the project. The inner city includes lots of architectural buildings such as Cinci Caravanserai, Cinci Turkish Bath, Clock Tower, The Old Government Building, The Old Jail, Köprülü Mehmet Pasha Mosque and İzzet Mehmet Pasha Mosque etc.

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In the study several different digital cameras were employed to record the images of the historical buildings for the further photogrammetric studies which is going to be used for extracting the 3D information of the building which also be used in the modeling step. Calibrations of the cameras were realized before the image taken process. In the study also a digital camcorder was used to record the buildings. Some of the obtained photographs and video records will be available via internet after the project finalized.

As a simple example of the four facades of the Dagdelen Mosque obtained from the photogrammetric process is given in Figure 6. A realistic model of the selected historical buildings will be realized and presented via internet at the latest step of the study.
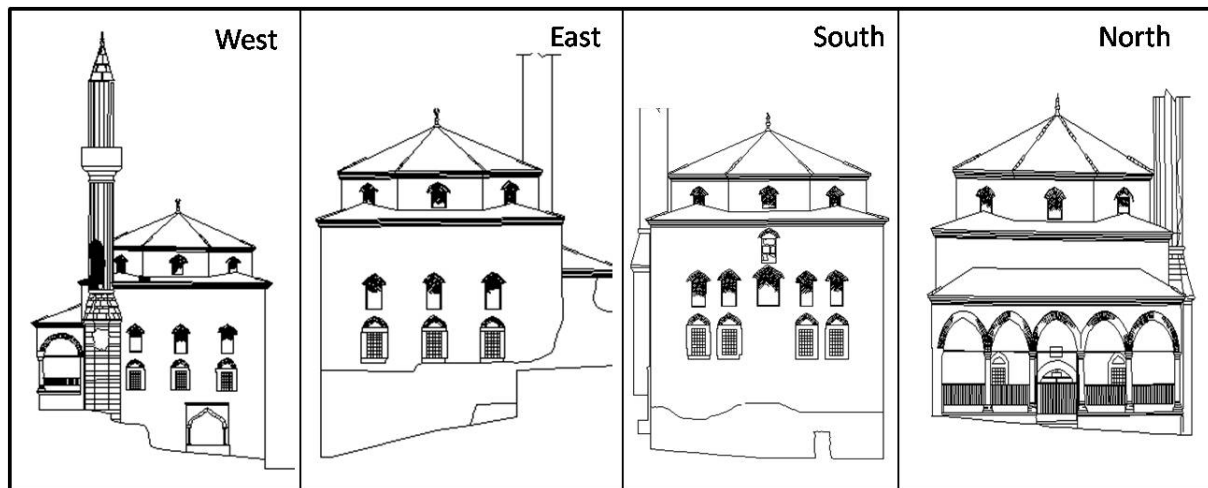
**Figure 6. CAD drawings of the four facades of the Dagdelen Mosque.**

Together with the graphical documents such as architectural drawings and other semantic information about the houses have being collected and stored in a design GIS database and all the related information stored in a GIS environment will be presented at the end of the study.
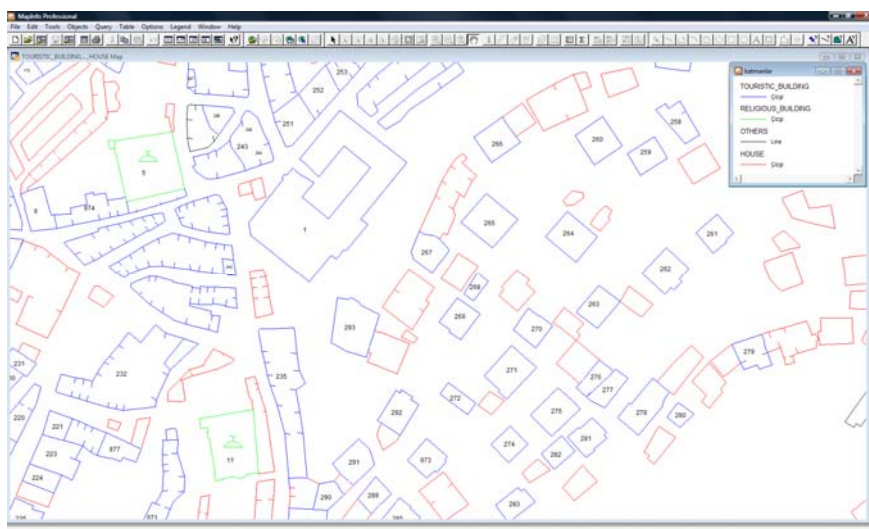
5. GIS MANAGEMENT

This is the main part of the project which is still under process. At the beginning a relational database was established. In this database, historical structures have been located at the center and all related (current and historical) information of the building were collected. The collected large amounts of data were added to database after the filtration process. Due to more than one record of the same structure, sometime it was difficult and time consuming to select the correct data of the structures. The database was designed as flexible format for the possibility of the new types of data might be reached during the study. Apart from historical structures, old roads were also considered in the data base design step.

As mentioned before 1:1000 scaled topographic map is used as the main graphic data for the project. In Figure 7, according to their status classified graphic data of the small part of the

project area can be seen. In this figure the buildings are classified as registered or unregistered building. The term of "registered" also indicated that the buildings are under protection. In Figure 8, the buildings are classified according to their usage such as religious buildings, touristic buildings, house and others. Related information was added to these layers after the topology of these separated layers were realized. Produced CAD drawings of some buildings were also associated with the related structures. Graphical documents such as architectural drawings and other semantic information about the structures are collected and will be presented in a GIS environment in the further steps of the project.
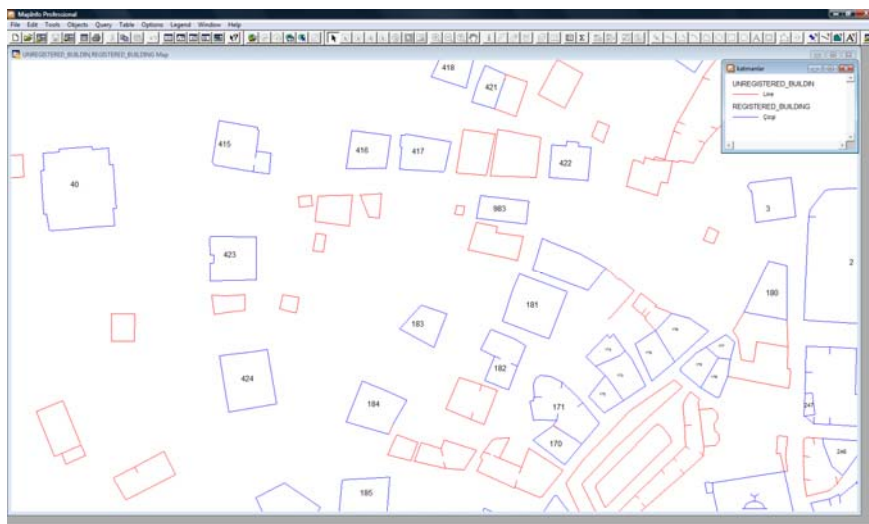
Figure 7. Building layer classified according to registration status.

Figure 8. Building layer classified according to indented usage.

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6. CONCLUSIONS

Turkey has a lot of historical cities and areas under different threat and they should be restored as soon as possible. During these relief or restoration studies the mapping step is certainly needed and the time is another important phase. Safranbolu has been included in the "List of World Inheritance" by UNESCO in 1994 and as a world city because of its success in protecting its natural heritage is just an example in Turkey. Recording analysis, protection and revitalization of cultural heritage sites are being undertaken by different approaches.

This study is given some outcomes of the project of a case study for digital recording and 3D modeling. The 3D models of the structures are significantly important both obtaining sufficient information about the buildings and better visualization of them. Especially a realistic model determined by texturing will be helpful for the users to better understand the structures. The related height information of the historical structures will be produced using a stereo pair of the high resolution satellite imagery and obtained data will be helpful for the modeling and presenting of the whole selected building in 3D via internet using established GIS.

In the next step of the project, all data (photos, videos, architectural drawings etc.) and models (3D and VRLM) related to selected historical building will be presented on the internet. By this way many visitors will have a chance all over the world to visit one of the cultural heritages of Turkey and they will also have the opportunity to make different queries about the Safranbolu. Similar studies oriented for modeling and preserving of the cultural heritage sites should be encouraged and supported by the decision makers. It was seen that, based on the extracted results, development of an information and management system for recording analysis, protection and revitalization of cultural heritage sites of Safranbolu can successfully undertaken and integrated to the GIS environment.

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