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Full Length Research Paper

Interactive web-based campus information system

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Data can be stored accurately, up-to-date and in a complete sense while it is possible to correlate to certain data and present them for sharing thanks to the facilities brought in by the technology of geographical/urban information system. Being at a significant position in terms of transitioning into the age of information, universities are among the top institutions where information is utilized most efficiently. Assessing and updating present information and drawing out new information out of them is inevitable in order for those institutions to develop. Therefore, it is highly important for universities to set up systems based on information technologies. The scope of this study covers usage of the ArcGIS software to collect graphical and attributes data that belongs to Erciyes University which are to be transferred into the computer environment, stored, examined, analyzed and presented to users in the form of documents and reports. The structures were converted into three-dimensional form using the ArcGIS SketchUp extension and the SketchUp Pro software to carry out modeling of buildings which were selected as examples maintaining similarity to the actual structures. The system was tested through spatial inquiry and analysis process and the obtained results were probed on. The ArcGIS Server software was utilized and offered to the use of users on the Internet platform.

Key words: Geographical information system, campus information system, WebGIS, database design.

INTRODUCTION

Today, information has become rapidly accessible because of technological advancements. It is inevitable for the educatory institutions, where the basis of information is formed, to pioneer at the point of presenting information (Chrisman, 2002; Özyavuz et al., 2009). In this context, presenting to the user information on institutions which are able to access information constitutes one of the most primary steps. Computers and electronic communication stand out as important components in terms of making information available (Geymen et al., 2008; Tiryakioglu et al., 2004). The computer environment is employed so as to ensure faster flow of information in the rapidly developing world. Geographical information systems are a part of this trend (Topay et al., 2003; Karaş et al., 2005). Geographical information systems (GIS) are computer-based systems that enable users to collect, store, process, analyze and present spatial data (Folger, 2009; Cete et al., 2010). If we take universities as the most important institutions to inform societies, it becomes clear that universities should also be the platform where information should be utilized most efficiently today. This is why evaluating, updating and drawing new information out of the current information at hand forms the conditional basis in order for universities to conduct planning, develop and perform education activities in the best manner possible (Yomralıoğlu, 1999).

In addition to containing information such as university topographies, land use and natural characteristics, as well as health services and landscaping the campus information system is an information system that is capable of accessing statistical information regarding education or distribution of students over departments and faculties, and aims to ensure that administrations make rapid and sound decisions on all types of planning services about education, personnel management, facility management and the university's future (Ölgen et al., 2004; Kumar, 2011; Tarhan et al., 2006). Also existing many systems are available for the web-based mapping (WebGIS) and applications in GIS. However, the system that could handle 3D spatial data within web environment is hardly available (Kahraman et al., 2011). These Web-based systems are formed by hardware, software, data and users for collecting spatial and non-spatial data

within the university. These data can be transferred, stored, queried, analyzed, and presented to the decision makers. WebGIS has many technical advantages. Data can be maintained and be updated in a centralized location or be integrated with many sources on broad spectrum platforms. A web-based map can be used both privately and publicly (Aydinoglu and Yomralioglu, 2002). The end-user software is an easy and cheap web browser, not an expensive and complex GIS program. The web browser provides a much more dynamic map tool than a static map display (Aydinoglu and Yomralioglu, 2003).

This study will concentrate on how the basic infrastructure of a campus information system should be and was carried out by designing and implementing an exemplary campus information system. Data entered into the system was correlated, 3D designs were devised, examinations and analyses were carried out and data was rendered available in the web environment using the ArcGIS software.

RELATED WORK

Currently, many universities raise funds in various way to start construction of Campus Information System Project (Liu and Li, 2011; Hunt et al., 2010). One of these projects began in the middle of 1990s in University of Jiaotong in China. This project has occurred mail system, office automation system, education management system e-card system and other information application systems in university (Qu and Huo, 2012).

The Campus Computing Project was first started in 1990 at the Claremont University in America (Qu and Huo, 2012). The Project is the largest continuing study of the role of information technology in American higher education (http://www.campuscomputing.net/page/kenneth-c-green-director). The national studies of this project have collected lots of qualitative and quantitative data to help inform faculty, campus administrators, and other interested in the use of information technology in American colleges and universities (Qu and Huo, 2012).

The University of Calgary in Canada has the smart campus projects. To help students and visitors easily find their way around campus, the university developed an interactive room-finder application using institutional spatial data. Users can input the building name and room number they wish to find, and the application generates a detailed map showing the floor plan with the desired room highlighted. From a risk management perspective, the university has also used ArcGIS to enhance public safety. Using a current model of the campus and incorporating up-to-date floor plans, emergency preparedness and evacuation plans were developed (ArcNews, 2012). University of Ningde Normal and Hunan City University in China virtual campus are studied based on 3D modelling, image processing and database, such as using 3D MAX to create 3D model and putting on the texture image, and redeveloping specific function by ArcGIS spacial analysis and C#, so as to perfect the function of the system (Zhanga and Huang, 2012).

In summary, for constraints of history and technology, and the drawbacks and internal deficiencies of management systems, current information systems could not adapt no management and service requirements, restrict to develop the university (Qu and Huo, 2012).

TASKS PERFORMED

Study area

Erciyes University, which has been selected as the study area, has been founded in 1978 and today it serves with its totally 16 faculties, 4 higher schools, 7 vocational higher schools, 7 institutes, 5 departments, 19 research centers and Gevher Nesibe Medicine Faculty Hospital with 1350 beds (Geymen and Bostanci, 2012). In addition to the Medicine Faculty Hospital; Cardiovascular Disease Hospital, Organ Transplantation and Dialysis Hospital, Oncology Hospital, Children's Hospital and Bone Marrow Transplant and Stem Cell Treatment Center are the most important health institutions. The university is located on 494 ha of land, 59 ha of which is closed area. In the selected campus area, there are two noise sources, one of which is the traffic noise from the roads while the other is students' density for 41.000, administrative and academic staff for 5.000 as well as the patient and visitors of the hospitals (Figure 1). It is observed that the traffic and human density is higher particularly, in the hospital area and bus stops (www.erciyes.edu.tr).

Creating graphical data

A 2011 Ikonos satellite image, large scale topographic maps, various thematic maps digital boundaries maps, 1/50000 environmental plan, 1/5000 Campus Master Plan, Digital Elevation Model maps generated by the Kayseri Metropolitan Municipality are all used as data sources in this study.

Graphical data of the project area was derived from the maps provided by the Municipality of Melikgazi in NetCad format. Building, road and height information was converted initially into the Drawing Exchange Format (DXF) layer and then into the Esri shapefile (SHP) format using the ArcGIS software. Attributes data about the building and road layers was updated and made examinable. A numerical height model was formed out of the available height data, using functions of the 3D analysis module of the ArcGIS software (Esri, 2008).

Inclusion of non-graphical (Feature) data into the project

Cadastre maps and attributes data were obtained from the Directorate of Land Registry, Directorate of Title Deed and Kayseri Metropolitan Municipality. Building data like building names and floor information was added in the attribute table of the related layer. Missing buildings information within the campus area were found out and the database was updated.

Database design

Decisions were made as to which geographical data element (point,

Figure 1. The study area of the project, Erciyes University, Turkey.

line, area) would be taken as a reference in order to classify the feature data required for the Campus Information System of Erciyes University and which features would be necessary to find out. Table and attributes data were arranged in line with the classifications set forth in the ArcCatalog software taking into consideration numerical or text forms of information. Attention was paid to ensure that each chart contains a key and non-repetitive data. Upon forming the charts and determining key areas, inter-chart entity-relationship diagrams were created.

Feature charts of faculties, administrative units, social and sportive facilities, dormitories, banks, markets, residences and car lots were correlated with vector data using the 'join' command. Charts of clubs, cafés, restaurants, computer laboratories, conference halls, departments and department laboratories were correlated using the 'relate' command. Photographs and panoramic views of structures present within the project area were linked to the project, which was formed in the ArcGIS environment, through hyperlinks in order to enhance with further visual quality.

RESULTS

Campus maps can be queried both locally and via the web in an interactive manner, and various graphical as well as verbal as data can be obtained as part of the Campus Information System which is developed on the ArcGIS 9.3 platform. Obtained data was then rendered available and analyzable in the web environment. The main framework of the interactive pages of the system's web module was established with the assistance of the 'WebGIS SVG' add-on, a macro that is run on ArcGIS, thus boosting availability.

Preparation of data for availability in the local environment

Queries for each layer on the interactive maps are enabled. Detailed information can be accessed through viewpoints. A general idea about the campus can be inferred by examining the camera views of characteristic campus points, classrooms and rooms. When viewpoints are clicked on, realistic panoramic views of each respective point can be viewed and rotated 360° (Figure 2).

Noise levels in the morning, at noon and in the evening can also be monitored at 50 metering stations established within the campus through the Campus Information System. A noise map is produced using these values on the basis of the noise measuring level appropriate for geostatic interpolation methods. Figure 3 shows the noised map modeled between 8 and 9 o'clock in the morning using the Inverse Distance Weight (IDW) method.

Transportation data provided by the Metropolitan Municipality of Kayseri was integrated to the established campus information system. Thus students were enabled

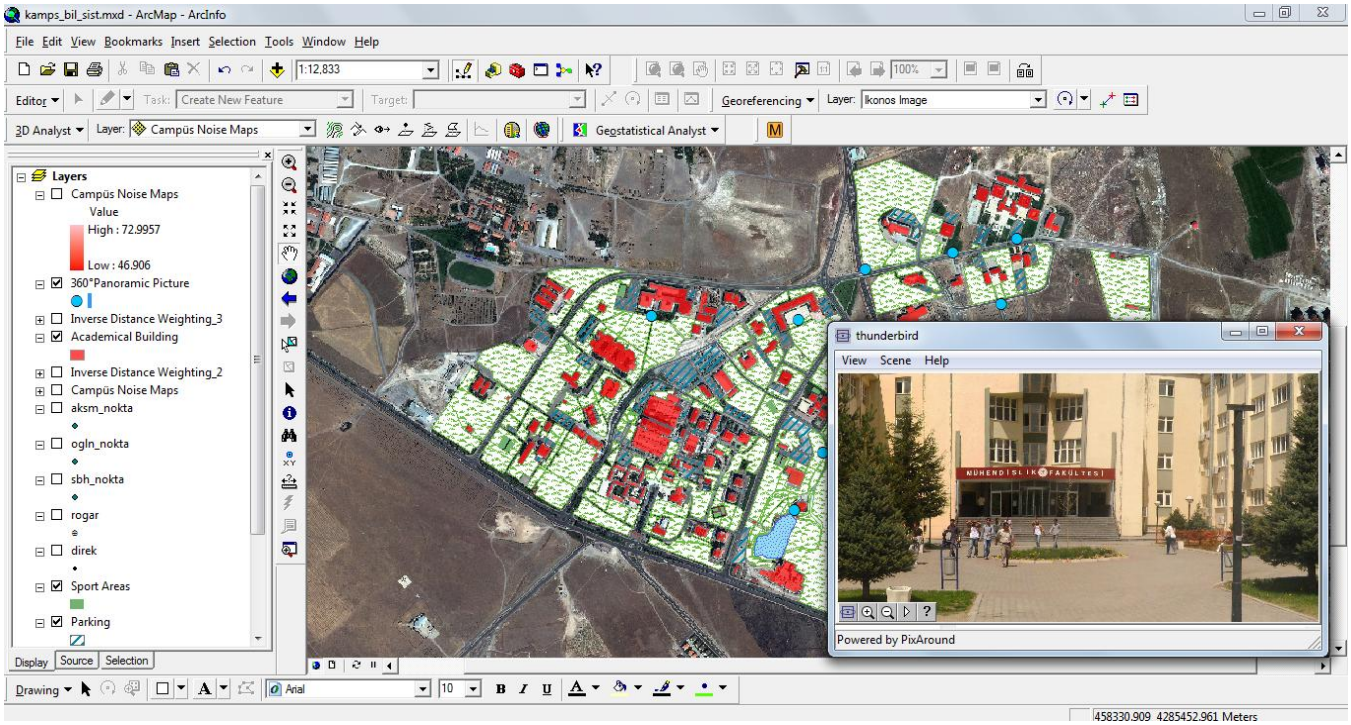

Figure 2. Preparation of a database in the local environment.

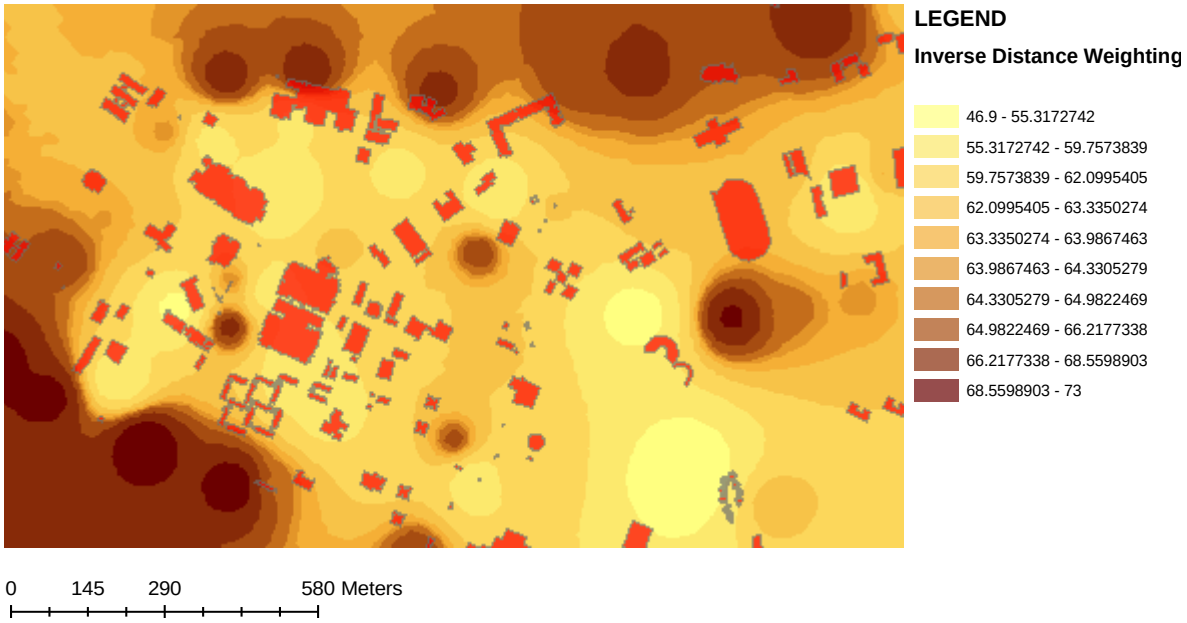

Figure 3. Morning time noise map of the campus area modeled using the IDW method

to travel to the campus area easily from all districts of Kayseri. Departure times and routes of buses can be checked through the system (Figure 4). Cooperation is sustained between Erciyes University Department of Computer Engineering and the Metropolitan Municipality of Kayseri to optimize transportation data.

Presentation of data via the Internet

By using communication between ArcGIS software and languages of Internet Explorer web-based designs for spatial data can be made (Geymen, 2010). By saving the result page that is obtained as index.html and index.svg

Figure 4. Bus stops and routes displayed to provide information on transportation to the campus area by bus.

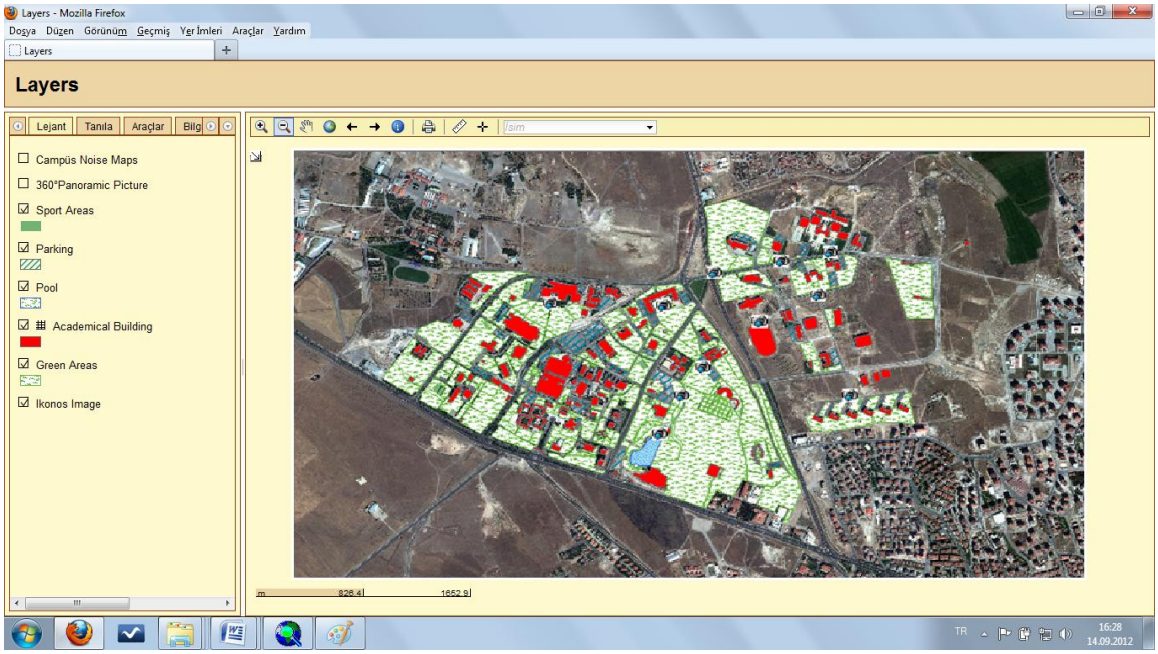

Figure 5. Graphical and feature data presented via the Internet.

the design can be monitored (Figure 5). Raster data can be saved in GIF or JPEG format, vector data and text objects can be saved in SVG (Scalable Vector Graphic) format (Geymen, 2006).

SVG format, in addition to being a graphic file format that gives the opportunity to zoom in, zoom out, pan without loosing the attributes of cartographic data in web media, it is a web language developed based on XML (Ferraiolo, 2004). It provides the use of high quality graphics for the users. It zooms out the dimensions of the files so much and it provides quicker opening of data within the browser. SVG, at the same time, supports attribute data. These data are saved as XML file within the project. These data are called by different methods within the web page. By making selection on the graphic object with mouse, by monitoring all attributes of graphic

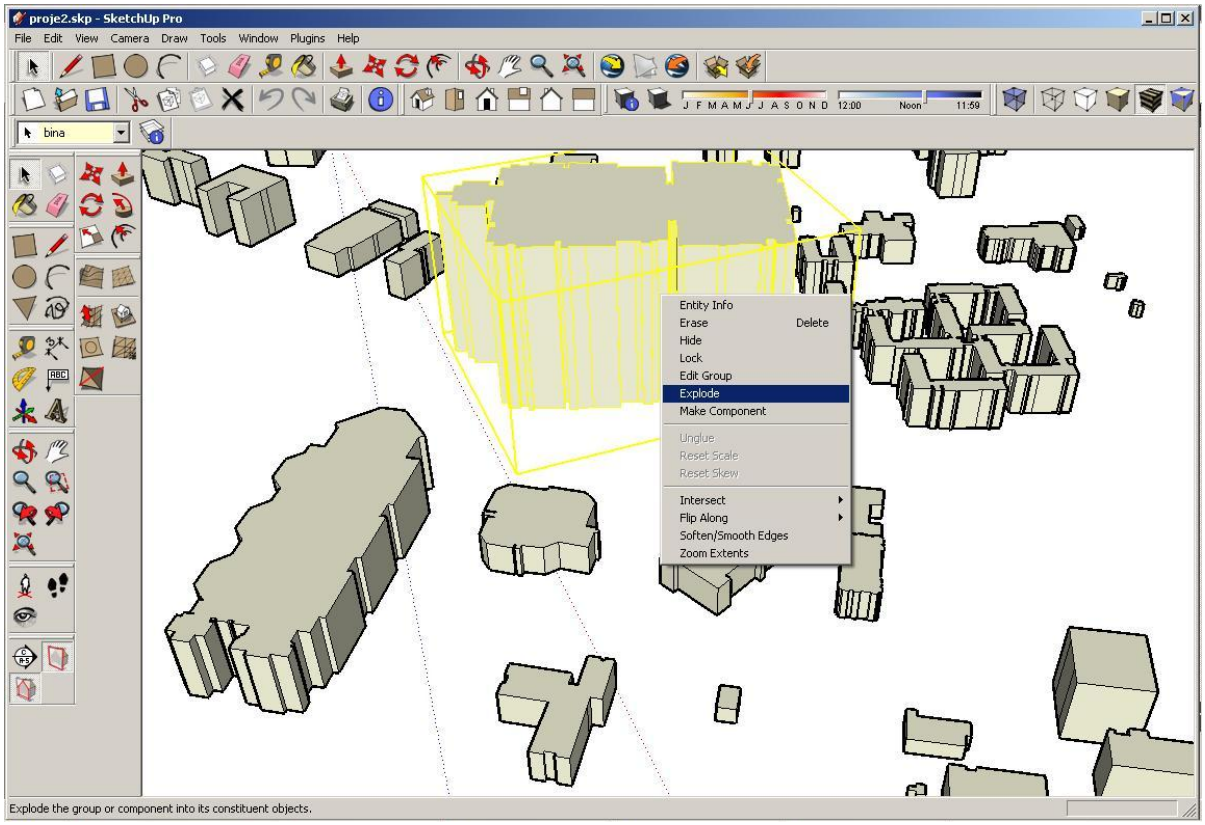

Figure 6. SketchUp general view.

object or making inquiry, attribute data for graphic objects can be monitored within web page (Chris and Jackson, 2004).

SVG button interface is added to prototype software for obtaining resultant files by operating the system. By operating this button, index files are generated. Visiting this index page, all query and analysis processes that can be performed in the ArcGIS software can be accessed in the Internet environment. Here, the user is able to choose components like layer, scale, logo, distance and site information, which she desires to see on the webpage (Geymen, 2006).

Texturing and rendering structures in 3D

Following inclusion of graphical and non-graphical data in the project, a 3D Triangulated Irregular Network (TIN) model of the land was produced by utilizing contour lines. IKONOS satellite view of the project area was used on the TIN in order to enhance the sense of realism. Buildings can be rendered in 3D with the help of the ArcScene module. Texturing of the buildings was performed using the SketchUp add-on of ArcGIS and the SketchUp Pro software. SketchUp is a 3D modeling software that was designed for architects, engineers, movie makers, game developers and users present in almost all fields where 3D modeling is employed (http://tr.wikipedia.org/wiki/SketchUp). The texturing process started upon selecting the buildings to be rendered in 3D with the ArcGIS SketchUp add-on using the 'Select Features' command and transferring them to the SketchUp software. Initially, the 'Explode' command is implemented on the building to be textured (Figure 6). After selecting the picture to be textured, the picture is adapted to the surface (Figure 7). Once this process has been completed, the 'Export' command is used and the picture saved in the 'ESRI multiPatch (.mdb)' format (Figure 8). The obtained stream is then converted into the Keyhole Markup language Zipped (KMZ) format and exported into the Google Earth Program (Figure 9). The 3D view of the Engineering Faculty is shown on Figures 6 to 9. One can enter the indoors of the faculty and take a virtual trip on this model.

DISCUSSION

An information technology aided campus information system should be developed to enable universities to provide a better service. Erciyes University campus is almost like a city in terms of its location, size, and numbers of students and staff. Therefore, a campus information system should have the features of a city

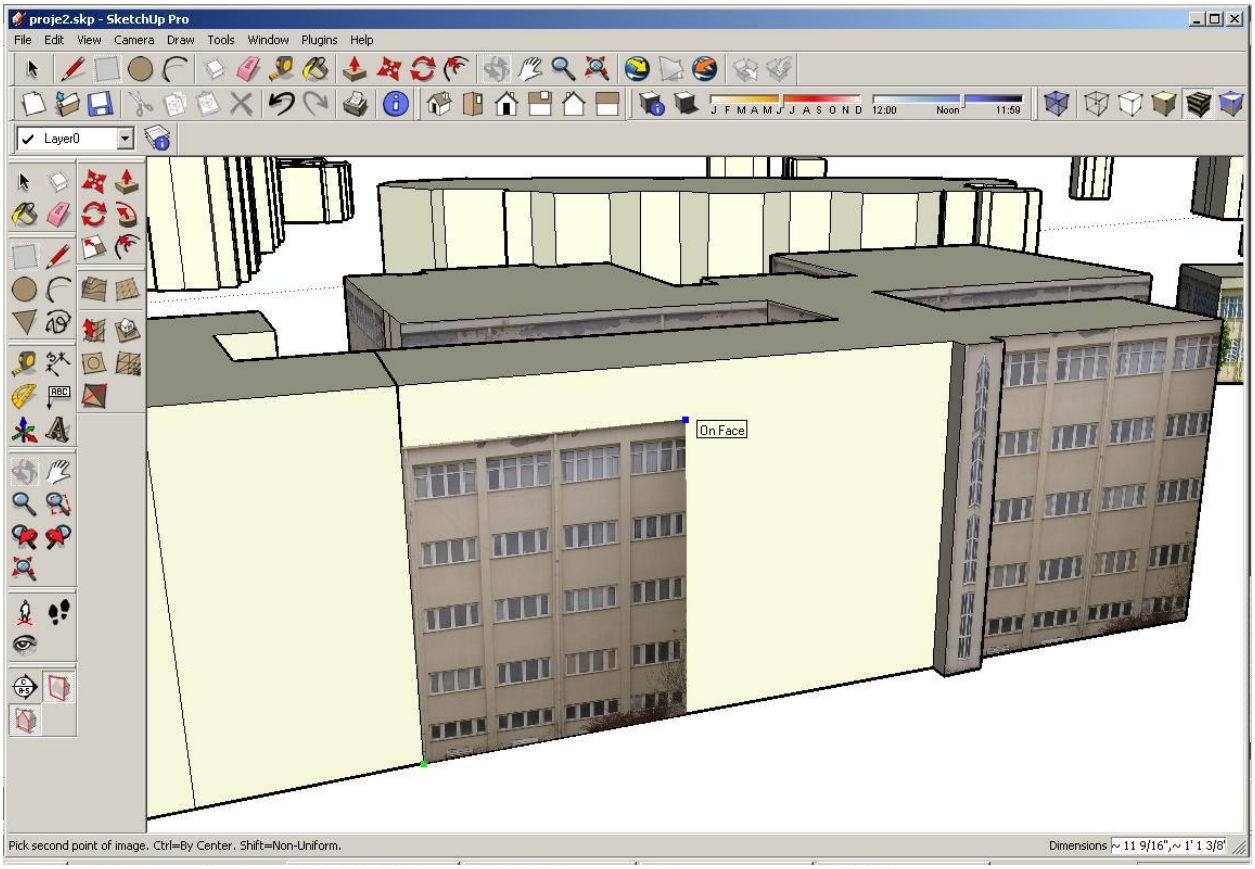

Figure 7. Process of texturing the buildings

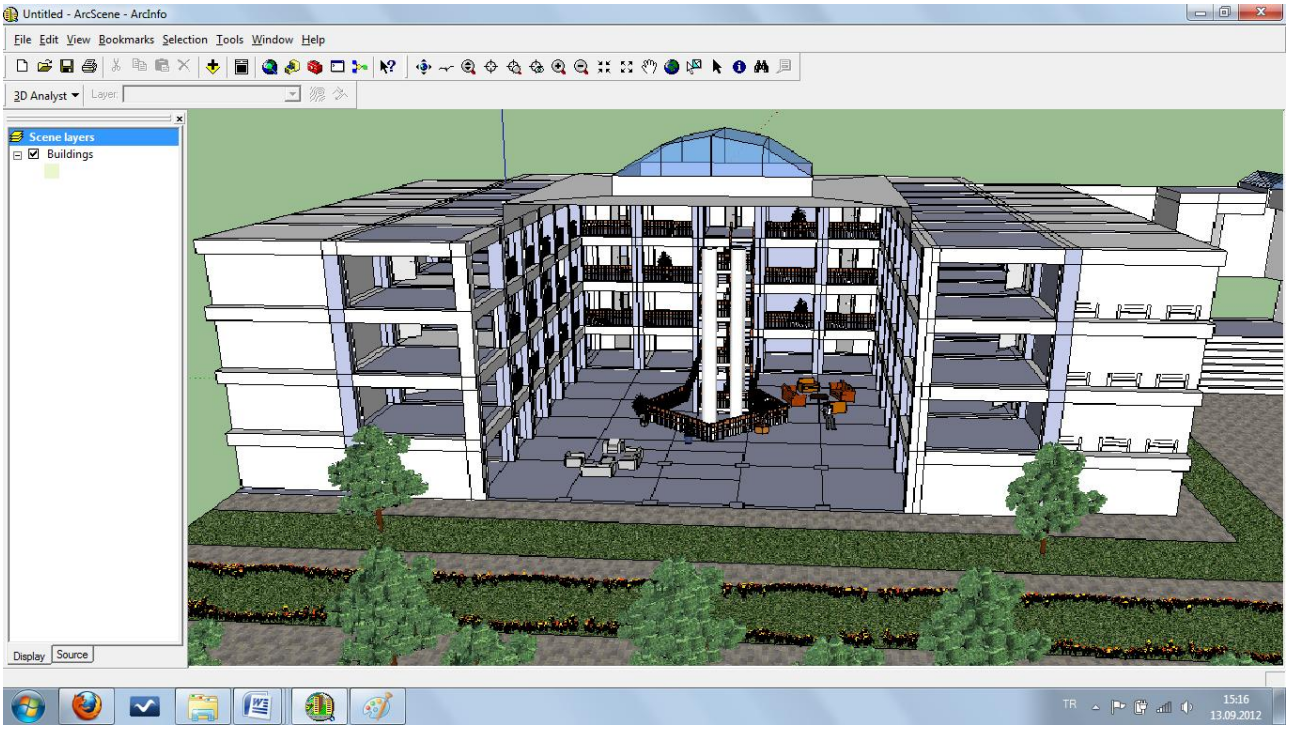

Figure 8. 3D structures after being added to the project.

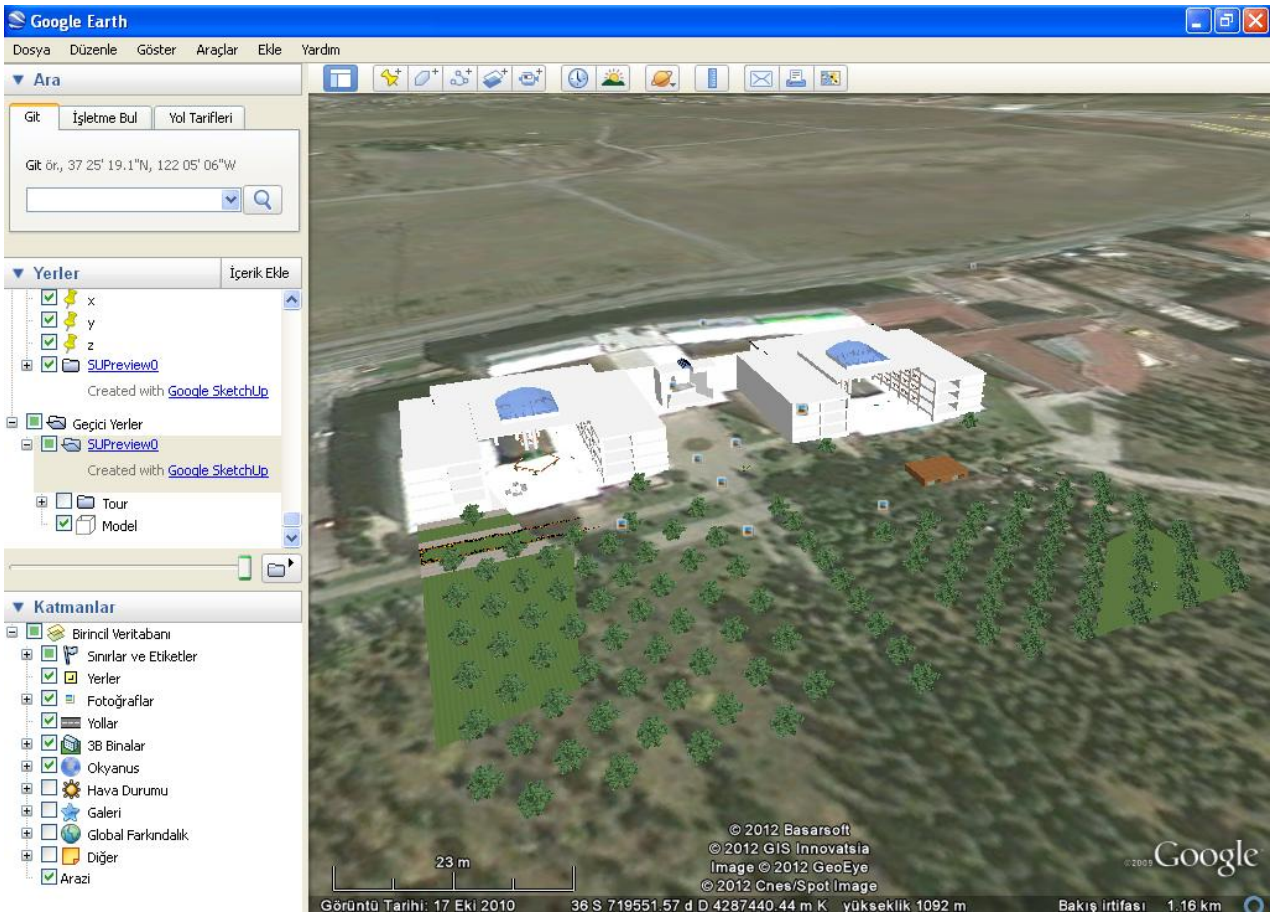

Figure 9. Viewing 3D structures in the web environment.

information system as well. Erciyes University is a university that is constantly developing. Such development requires extensive monitoring by the university by means of GIS technology. If the construction of education, administration and service buildings and continually increasing student numbers are taken into consideration, the importance of the study will be better understood.

In our case, the existing maps of areas of use have been updated and arranged in such a manner that they may be examined and analyzed in order to provide samples within the scope of this study. Furthermore a database of the buildings has been formed for 3D display. Users will have the chance to make visual tours within the buildings and obtain information by virtue of such a system. By developing the information system, first of all academic and administrative staff and students within the campus, as well as off-campus users, will be provided with many opportunities. Accessibility to information through such a system will be improved while the increasing academic and administrative units and changing staff numbers will ensure that users within the campus will be able to reach this information quickly.

Off-campus users will have the chance to rapidly access visual and numerical information regarding the staff and physical status of the university. In order to ensure that the system achieves full success, recording data accurately will be the main priority, as the entire examination and evaluation to be made depend on such data.

Conclusion

The university campuses function literally like a city in themselves in terms of their spatial sizes, structures and numbers of students and personnel. Therefore, a geographical campus information system should bear the characteristics of an urban information system too.

In this sense, data of various natures was compiled together and it was made possible to examine graphical and non-graphical data in a broad manner. A 3D application was practiced on the Campus Information System of Erciyes University and exported to the Internet environment additionally with rendering many buildings successfully.

Considering these facts, it is of critical importance to find out and analyze the audience and their needs during the process of forming a database. This decision to be made during the project preparation process has a direct impact on data collection and processing steps, which come later on in the project. The Campus Information System of Erciyes University was designed as an information system that is open to constant updates, user-friendly for both trained and untrained users, and capable of responding to all needs of users and carrying out analyses.

As the significance of geographical information systems gets recognized, the field of use is bound to expand. However, the rapid advancements in technology will enhance GIS with new aspects, making it more user-friendly and visually satisfying.

Future work could be extended to include many other applications. 3D representations of the faculties in the campus area could be made at several levels -of-detail. Also, new software tools for processing semi-automated CAD building models and user interaction tools could be developed.

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