# DEVELOPING WEB-BASED 3D CAMPUS INFORMATION SYSTEM

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## ABSTRACT

Currently in GIS, it shows that many systems are available for web-based mapping and applications. However, the system that could handle 3D spatial data within web environment is hardly available. It is the aim of this paper to discuss the possibility of developing such system in 3D e.g. Campus Information System (CIS). In this paper, the datasets come from our own campus, i.e. University of Karabuk, Turkey that contains various objects such as road network, buildings, plants, lamp-posts, and other point-of-interests (POI) with Level-of-Details (LoD) 2. It is part of this paper to describe the designing and modeling of the approach towards 3D web information system for campus. We also plan to highlight some recommendation and future works for the work.

## 1. Introduction

Geographic Information Systems (GIS) usage has become widespread in diverse disciplines such as urban and regional planning, cartography, tourism sector, local governments and private sector. In general, GIS is a system of hardware, software, data, people, organizations and institutional arrangements for collecting, storing, analyzing and disseminating and presenting spatial and non-spatial information about areas of the earth (Chrisman, 2002).

There are many systems are available for the web-based mapping and applications in GIS. However, the system that could handle 3D spatial data within web environment is hardly available. In this study, we intend to create a web-based GIS Campus Information System (CIS) for the purpose of increasing the efficiency of planning in campus by data storing, analyzing, and querying.

Today, GIS-based CIS, have been used by many universities for different aims and purposes with different effective tools. This integrated system is formed by hardware, software, data and users for collecting spatial and non-spatial data within the university and its sub-units (both academic and

administrative). By using the systems, these spatial and non-spatial data can be transferred, stored, queried, analyzed, and presented to the decision makers.

The remaining of this paper discusses methods and approach for creating the 3D CIS in section 2, this section forms major discussion of this paper. Section 3 highlights conclusions and some recommendations for future work.

## 2. The Methodology

Developing CIS on CityServer3D involves several stages, including the following:

- Obtain data and Computer Aided Design (CAD) file of the whole campus area.
- Import CAD data into SketchUp software
- Gather footprints of buildings from CAD data and exported into SketchUp
- Extrude footprints and provide and determine the buildings measurement
- Optimize the photos taken (clearing unwanted objects, reduce the quality and size of the images)
- Texturing 3D buildings
- Design 3D campus area in SketchUp
- Convert .skp file into .gml for importing in CityServer3D
- Create interface for presenting on web

### 2.1 Data and Tools

As it is shown on Figure 1, Karabuk University campus is selected as a study area. It is approximately 4 km away from the city center and located on the south east of Karabuk.

*Figure 1: The study area of the project, Karabuk University, Turkey*

The data contains various information, such as:

- CAD file: consist of footprints of the buildings in the campus
- Info about measurements of the structures, e.g. heights, widths, and depths.
- Photos which shows all of the aspects of the structures taken in the campus

SketchUp software was used for creating 3D building and texturing. The building façades photos were then transferred for data processing in the Photoshop (for texturing). CityServer3D was used for designing 3D geodatabase of the area.

### 2.2 Designing and Modeling 3D Buildings

The footprints of the 3D models of buildings were obtained from AutoCAD files. Normally, CAD objects are not directly supported by the SketchUp. To handle for usage these CAD objects some conversion methods were used. Firstly, the CAD file was repaired and cleaned up from unnecessary point, line, polyline, and polygon. Then, the footprints and 3D of surface Google Earth are overlayed and imported into SketchUp.

In the next stage, 3D models of the buildings were generated by designing one by one on the footprints, and a lot of photos were utilized. In order to obtain very detailed structures of the façade, one of the best practice is to have a multi-aspect photo shooting as illustrated in Figure 2a. On the other hand, it is particularly emphasized on the corner snapshots to match all façade together *(Figure 3&4)*.

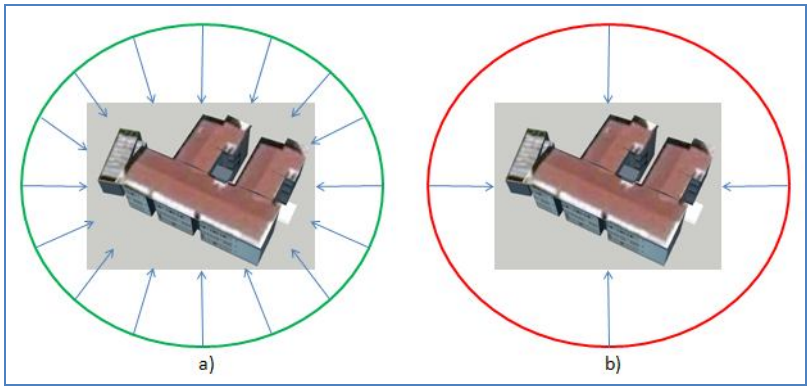


*Figure2: a – Multi-aspect photo shooting (Correct)*
*b – Four aspect photo shooting (Incorrect).*

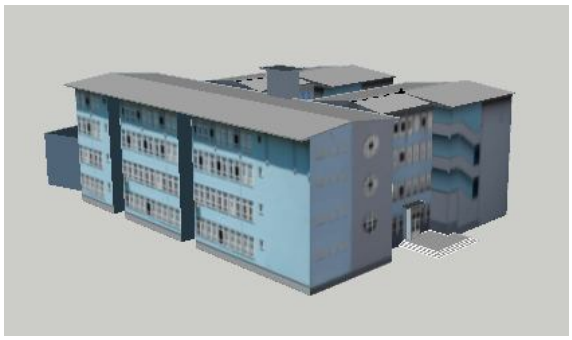

*Figure 3: The Faculty of Science*

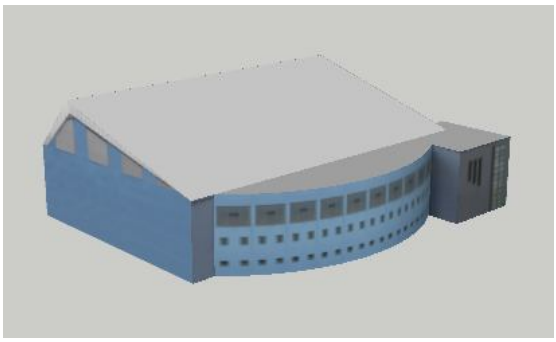

*Figure 4: The Gymnasium*

Façade texturing allows the realization of the buildings look like real objects on the terrain. Some of the captured photos could have some problems, such as obstacles (trees, cars, pedestrians, etc.) to the buildings appearance. To avoid of this kind of problem, photo editing is needed in image editor program. The photos also should have to be optimized in both aspect; file size and quality. On the other hand, designed models should have simple geometry to reduce file size too *(Figure 5)*. After the image and geometry optimization, the textured 3D models can be used effectively on the web to be loaded quickly based on GoogleEarth surface.

*Figure 5: Faculty of Technical Education and its Workplaces*

### 2.3 The Campus and CityServer3D

Our world is increasingly described by 3-dimensionally. 3D computer models play an important role in city planning, tourism, and knowledge transfer. The technology of the CityServer3D consists of a geo-database, a server with numerous interfaces for the import and export of the data and applications for the development of landscape models. An administrative software allows to process the data and the web viewer takes them by Internet onto the user's screen. In that case, whole campus system will be designed, textured, and input data in a SketchUp file. Then, this project should be transferred to CityServer3D by converting CityGML format.

CityGML is a common information model for the representation of 3D urban objects. Classes and relations for the topographic objects in cities and regional models is defined with the geometrical, topological, semantical and appearance properties.

CityGML format is beneficial for managing 3D city model as a multipurpose data source. External code list is a value defined by OGC for semantic modeling of objects by their type of class, function, usage, roof type, installation, material, and so on. On the purpose of importing 3D models into CityServer3D, it is required to convert 3D Sketchup models to CityGML format by using CityGML plugin for Sketchup. After that, models can be uploaded to CityServer3D (Alizadehashrafi *et al.,* 2011).

Behind the scene of CityServer3D, it is possible to access to the MySQL database using DDL (Data Definition Language) and DML (Data Manipulation Language) to define and manipulate the data directly *(Figure 6)*.

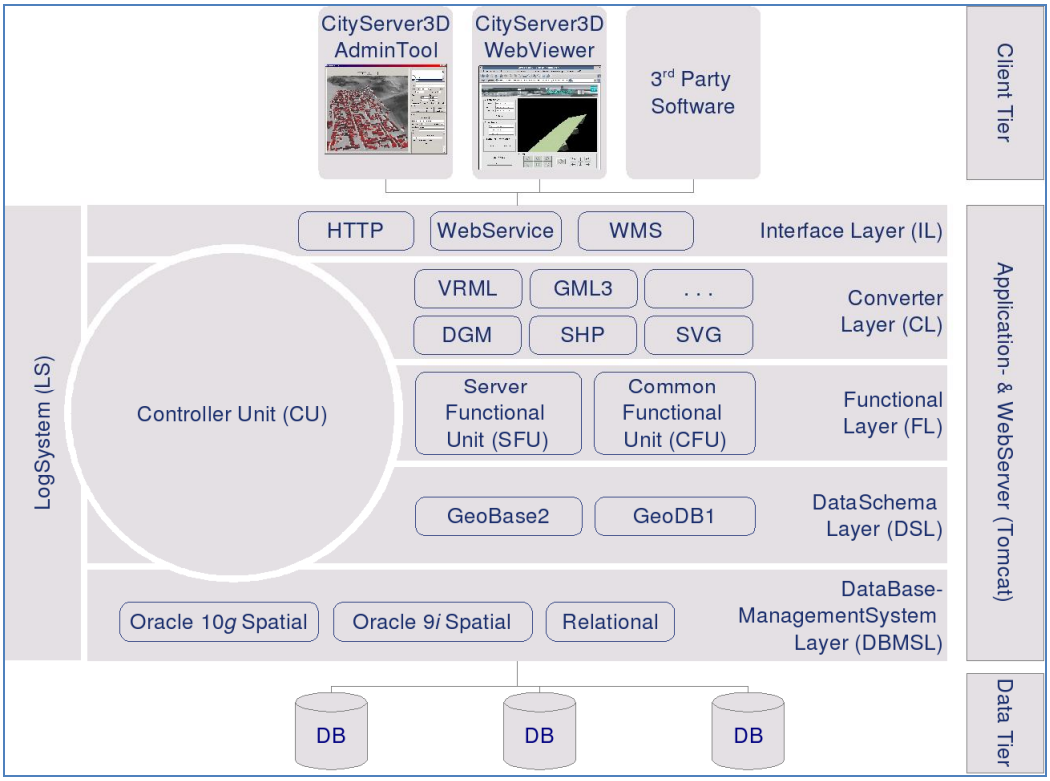


*Figure 6: Overall architecture of the CityServer3D system*

## 2.4 The System Interface on Web

To make the city models accessible and to provide mechanisms to manage content, two tools were integrated into the framework. Firstly, a web-based viewer, the WebViewer, gives the possibility to explore and visualize data stored in the system. Secondly, for the management of the database as well as for importing and exporting the geodata a dedicated client is provided for content administration. This tool uses the visualization and navigation functionality of the WebViewer as well as special data filters for data administration *(Figure 7)*.


*Figure 7: WebViewer of CityServer3D showing a 3D city model with LOD 1*

The WebViewer of the CityServer3D forms the interface between the user and the database. The WebViewer has standard technologies of the World Wide Web. The viewer works on any browser as long as it has java platform. Users can define any polygon by selecting area of interest on the map. When user clicks the interested area, the viewer and browser show the three-dimensional visualization of the selected area. In order to display 3D visualization on WebViewer, the viewer uses java3D technology. In a virtual universe the user can freely navigate through the area and objects. E.g., you can select buildings to get further information. The user interface is configured by XML files (Haist and Coors, 2005).

For managing the database as well as for importing and exporting the geodata, a special client is provided for content administration. This tool handles the visualization and navigation functionalities of the WebViewer. The most important function of the AdministrationTool is to consist of the import and export geodata in different formats. In order to support different formats, the AdministrationTool contains components that make a conversion of external data into the internal format possible. Presently, an exchange of SVG, SHP, VRML, raster-based, AutoCAD and GML3 files is realized.

## 3. Concluding Remarks

Although CIS's usage is very common, 3D CIS applications still doesn't prevail in the universities management tools (decision makers). This paper describes initial works on creating 3D web CIS, however, there are various aspects of 3D web CIS need to be addressed and investigated. This research attempts to investigate those mentioned aspects. We intend to carry out the initial works in the future. Definitely, the approach described in this paper can be used for real 3D web CIS e.g. by using a web-browser in any computer with an internet connection, many functions of this system can be used for the campus. Thus, it can be improved decision-making process by querying and analyzing functions in terms of taking into account a number of criteria.

Future work can be extended in many applications, for example, detailed 3D analysis can be done by defining every single part of the building. Also 3D network analyses can be integrated for the visitors of campus.

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