

# 3D GIS EXAMPLE IN HISTORICAL PENINSULA OF ISTANBUL

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## ABSTRACT:

During the recent years, the developments in the computer technology industry significantly contributed to the Geographical Information Systems (GIS) to be inside of our daily life. Today's GIS is easier and more helpful to the user community. The user profile of GIS can vary from a tourist who is seeking a destination by using navigation systems in a foreign city or an expert working on urban planning of governing a mega city. These examples can be increased with different examples for different professions and aims. The current usage of the systems shows us that GIS is highly recognized and information systems sophisticated projects with Geographical tools are highly ranked in the top list of decision makers. Developing computer technologies are progressively contributed to computerized information systems are much more use than they were ever before. Since the recent developments, in the computer technology visualization is gaining more importance and getting more effective for the professionals who deal with the information systems. As a result of the developments, new technologies such as virtual reality, 3D GIS, urban modelling...etc, are currently in development. In this paper the use of visualization techniques for GIS are studied and an application has been carried out in the historical area of Istanbul.

## 1. INTRODUCTION

A three dimensional (3D) model facilitates the study of the real world objects it represents. A geographic information system (GIS) should exploit the 3D model in a digital form as a basis for answering questions pertaining to aspects of the real world. With respect to the earth sciences, different kinds of objects of reality can be realized. These objects are components of the reality under study. (Pilouk, 1996).

This paper aims to present the integration of the components sharing some common aspects in a 3D model which can be used in visualization, simulation and planning for tourism, navigation, architecture, cultural heritage and city planning. This integration brings related components together, minimizes redundancy and uncertainty. Since the model should permit not only the representation of known aspects of reality, but also the derivation of information from the existing representation, the design of the model is constrained so as to afford these capabilities. Tourists are searching on the internet, virtual maps and guide books.. etc in order to explorer touristic place where is the touristic area of the city. Also people use GI systems which is several of them are two- dimensional and are not so much impressive about visualisation. The paper discusses this problem with special virtual 3D city models.

Some of the areas that will benefit from these 3D GIS capabilities are Urban Mapping, Landscape Planning, Architecture, Archaeology, Automatic vehicle navigation, Environmental sciences, etc.

### 1.1 General Information

Until today, GIS remain one of the exciting tools to manipulate geospatial data. Systems offered by various vendors are growing in terms of functionalities and all of these systems are basically two-dimensional (2D) based and at the most just able

to manipulate another data layer like contours or heights to the existing datasets or layers. Having this system around means we have 2.5D based GIS. Now, GIS users are getting more complex datasets and need to manipulate these datasets and generate information as we perceived in the real world, i.e. in 3D environment. This environment provides much better understanding of the geospatial pattern and phenomena, either in small or large scale areas (Abdul Rahman, 2006).

In this paper the represent of 3D GIS is more visual and interesting for people who are interested in GIS. In the poster, the designing approach of 3D GIS will be explained and discussed. Building 3D models are helpful to contrast the situation and position of the structure in different time epochs.

### 1.2 Methods

Geographic information is represented by a series of geographic datasets that model geography using simple, generic data structures. GIS includes a set of comprehensive tools for working with the geographic data. As real world is represented by visualization models in the GIS, geo visualization gains significant importance for parts of the system. Geo visualization is about working with maps and other ways of the geographic information, including interactive maps, 3D scenes, summary charts and tables, time-based views, and schematic views of network relationships.

Section 2 looks into the experiments about the working area, information about using programs, using data's and visualization. Section 3 describes the city models with giving information about using programs while the web base GIS and future plans will be discussed in Section 4. Finally, the conclusion and some further works in Section 5.

## 2. EXPERIMENTS

In this section gives some detailed information about the data which are used during this application this application, software's, application area and visualization techniques with respect to the experiments.

### 2.1 Data Set

Data is the most important component for Geographic Information System. While data is admittedly a necessary component of GIS, it provides the maximum return when its definition includes support for specific priority applications, an enterprise data architecture, and integration with transaction-based systems. Basing data requirements on application requirements can greatly reduce the length of time before your GIS begins providing tangible results. A comprehensive enterprise data architecture designed for incremental implementation will facilitate integration with existing transaction-based applications, as well as reduce the scheduled time for achieving benefits from GIS. Centralization of data coordination, the enterprise data architecture, and standards (including metadata) can facilitate maintenance by departments who update information for which they are directly responsible. Data can be described as different observations, which are collected and stored. Information is that data, which is useful in answering queries or solving a problem. Digitizing a large number of maps provides a large amount of data after hours of painstaking works, but the data can only render useful information if it is used in analysis.

The data used for this three dimensional geographic information system have been currently provided by GIS office of director in İstanbul Metropolitan Municipality. These data then were transferred to the worldly most used and preferred programme Arc GIS 9.2 which had been prepared by the firm ESRI. Necessary information about this programme will be given in the programme that will be used. Also the urban conservation plan for the historical peninsula which had been prepared by this institution was provided on the Internet. Fig 1

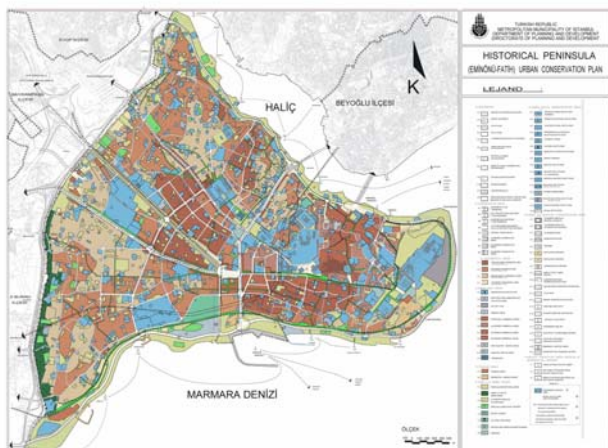


Figure 1 : Historical Peninsula Urban Conservation Plan

### 2.2 Using Software

The current version of the Arc GIS 9.2 software is used in the project in order to prepare a GIS with all data's which are going to create three dimensional visualisation. The Arc GIS 9 release includes a geo processing environment that allows execution of

traditional GIS processing tools (such as clipping, overlay, and spatial analysis) interactively or from any scripting language that supports COM standards. Although the most popular of these is Python, others have been used, especially perl and VBScript. Arc GIS 9 also includes a visual programming environment called Model Builder that allows users to graphically link geo processing tools into new tools called models. These models can be executed directly or exported to scripting languages which can then execute in batch mode (launched from a command line), or they can under go further editing to add branching or looping.

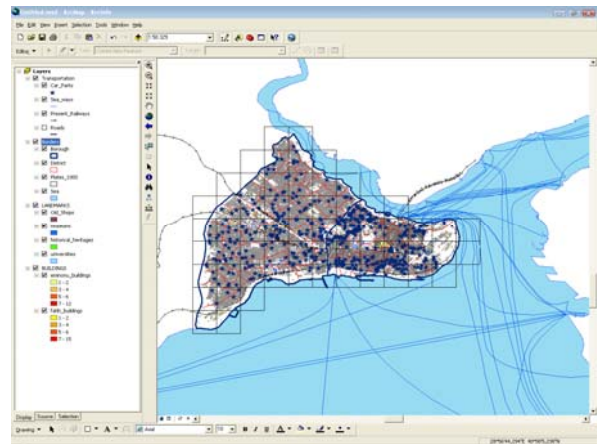


Figure 2: A view of Arc GIS 9.2 with all datas

### 2.3 Historical Area

Istanbul is one of the most famous historical city in the world with full of memories. During the centuries the city hosted as the capital of Rome, Byzantium and the Ottoman Empire with as an interesting center for the world owing to its natural beauties. In addition to the historical structures which are the heritage of these cultures. The city was built as a highly important city of the Roman Empire in the year 330 and named Constantinople. After Rome was divided into two parts as the Eastern Rome and Western Rome, it was made the capital of the Eastern Roman Empire. When the Ottomans conquered Byzantium in the year 1453, Istanbul was converted into the capital of the Ottoman Empire. Many historical works of art showing traces of these empires have survived until to day. The obelisks belonging to the Roman period, which were used as ornaments of the public square Sultanahmet, are still maintained in their original places today. The reason of the choosing the historical peninsula of Istanbul, which is the district named Eminönü, has been included in the capital of culture for 2010 and was chosen by UNESCO and constitutes one of the liveliest regions of the central area.

The historic city of Istanbul is situated on a peninsula flanked on three sides by the Sea of Marmara, the Bosphorus and the Golden Horn. It has been the capital of three great empires, the Roman, Byzantine and Ottoman empires, and for more than 1,600 years over 120 emperors and sultans ruled the world from here. No other city in the world can claim such a distinction.

### 2.4 Visualization

Visualization is any technique for creating images, diagrams, or animations to communicate a message. Visualization through visual imagery has been an effective way to communicate both

abstract and concrete ideas since the dawn of man. Examples from history include cave paintings, Egyptian hieroglyphs, Greek geometry, and Leonardo da Vinci's revolutionary methods of technical drawing for engineering and scientific purposes.

Visualization involves visualization software technology for the viewing and manipulation of 3D models, technical drawing and other related documentation of manufactured components and large assemblies of products. It is a key part of Product Lifecycle Management. Product visualization software typically provides high levels of photorealism so that a product can be viewed before it is actually manufactured. This supports functions ranging from design and styling to sales and marketing. Technical visualization is an important aspect of product development. Originally technical drawings were made by hand, but with the rise of advanced computer graphics the drawing board has been replaced by computer-aided design (CAD). CAD-drawings and models have several advantages over hand-made drawings such as the possibility of 3-D modeling, rapid prototyping and simulation.

The 3D Visualization area has also had significant progress in the visualization of landscape and city models. Over the last couple of years there has been an emergence of operational web-based solutions for the visualization of very large landscape models. There are ongoing developments that focus on streaming a very large number of 3D Objects such as cities and enabling high-performance 3D visualization on mobile devices. (Kraak, 2002; Nebiker, 2001)

### **3. 3 D CITY MODEL**

#### **3.1 Google Earth**

Google Earth displays satellite images of most inhabited regions of Earth allowing users to visually see things like houses and cars from a bird's eye view. The degree of resolution available is based somewhat on the points of interest, but most land (except for some islands) is covered in at least 15 meters of resolution. Las Vegas, Nevada and Cambridge, Massachusetts include examples of the highest resolution, at 15 cm. Google Earth allows users to search for addresses for some countries, enter coordinates, or simply use the mouse to browse to a location.

Google Earth also uses digital elevation model (DEM) data collected by NASA's Shuttle Radar Topography Mission (SRTM). This means one can view the Grand Canyon or Mount Everest in three dimensions, instead of 2D like other map programs/sites. Since November 2006, the 3D views of many mountains, including Mount Everest, have been improved by the use of supplementary DEM data to fill the gaps in SRTM coverage.

Many people using the applications are adding their own data and making them available through various sources, such as the BBS or blogs mentioned in the link section below. Google Earth is able to show all kinds of images overlaid on the surface of the earth and is also a Web Map Service client. Google Earth supports managing three-dimensional Geospatial data through Keyhole Mark up Language (KML).

Google Earth has the capability to show 3D buildings and structures (such as bridges), which consist of users' submissions

using Sketch Up, a 3D modelling program. In prior versions of Google Earth (before Version 4), 3D buildings were limited to a few cities, and had poorer rendering with no textures. Many buildings and structures from around the world now have detailed 3D structures; including (but not limited to) those in the United States, Canada, Ireland, India, Japan, United Kingdom, Germany, Pakistan and the cities, Amsterdam and Alexandria. In August 2007, Hamburg became the first city entirely shown in 3D, including textures such as facades. The Irish town of Westport was added to Google Earth in 3D on January 16th, 2008. The 'Westport3D' model was created by 3D imaging firm AM3TD using long-distance laser scanning technology and digital photography and is the first such model of an Irish town to be created. As it was developed initially to aid Local Government in carrying out their town planning functions it includes the highest resolution photo-realistic textures to be found anywhere in Google Earth. Three-dimensional renderings are available for certain buildings and structures around the world via Google's 3D Warehouse and other websites.

#### **3.2 Google Sketch Up**

Sketch-Up is a 3D modelling program designed for professional architects, civil engineers, filmmakers, game developers, and related professions. Sketch up may also be used to design buildings to be displayed on Google Earth. It was designed to be more intuitive, flexible, and easier to use than other 3D modelling programs, which are often difficult to learn.[1] Several features allow designers to play with their designs, unlike what is possible in other 3D CAD programs. It is marketed as an easy-to-use conceptual tool with a simple interface. A well known feature in the SketchUp World is the 3D Warehouse. Users can use their Google Accounts to upload models, and then browse the 3D Warehouse for many components and models.

Some of its key features and uses include:

- A "smart" drawing cursor (inference) system that allows users to draw 3D objects using a 2D screen and mouse.
- Simple massing study capability via "push-pull".
- An interactive Heliodon, or sun angle simulator.
- Ability to animate camera and sun movements.
- Models can be individually colored with an assortment of solid colors, textures and materials.
- Interoperability with Google Earth.
- Simplicity of use over other modeling programs for children, amateur artists, and hobbyists

### **4. RELATED WORKS**

According to the steps of processes; with the Arc Map programme which enables the data being used to be arranged, first of all, the present positions of these data were determined, the data being divided into three parts as periodic, spacious and linear were examined, saved within separate layers in the programme, with the Arc Catalog programme the used data were put into a Personal Geo database with the extension mdb and the coordinate system as ED50 was arranged for all the data, for the data divided into layers the symbologies applicable in Arc Map programme were determined and the necessary process to make visual was carried out, for the data of buildings by using the techniques to make visual within the programme

separate coloration processes were carried out according to factors, the data whose symbologies had been determined were turned into three dimensional data with the additional software Export to KML Extension V.2.3, were saved as KML format which is an extension of Google Earth programme, for the three dimensional projection of the land and the buildings on it the Arc Scene programme which is also another software of the firm ESRI was used, finally the buildings within the historical peninsula on which all these processes had been applied were transferred as KML format to Google Earth programme which is one of the most popular and useful programmes these days. In the Figure 3, there is a section of the three dimensional model made with this programme.



Figure 3 : Represent of the 3D model on Google Earth

The three dimensional geographic information system formed in the historical peninsula along the borders of the city Istanbul was presented on the Internet. Moreover, the models of Ayasofya, Sultanahmet Camii and obelisks at the hippodrome which had been prepared in the Google Sketch Up programme were integrated into Google Earth programme. In the Figure 4, there can be seen the new positions of the historical works' three dimensional models prepared in the Sketch Up programme.



Figure 4 : Represent of the all the project area on Google Earth with 3d buildings

#### 4.1 Web Base GIS

Another significant area of 3D GIS research is devoted to Web applications. The Web has already shown a great potential in improving accessibility to 2D spatial information (raster or vector maps) hosted in different computer systems over the Internet. The first attempt to disseminate and explore 3D data, i.e. VRML, appeared to be rather "heavy" for encoding real geo-data due to the lack of a successful compression concept. Despite the drawbacks, the language became a tool for research visualisation. Researchers could concentrate on data structuring and analysis and leave the rendering issues to VR browsers offered freely on Internet. GeoVRML (VRML extended with geo-nodes) and Geographic Modelling language (GML) are another promising opportunities for representing 3D data on the Web. Based on XML concepts, GML provides larger freedom, flexibility and operability than VRML. (Zlatanova, 2002).

The Web has already shown a great potential in improving accessibility to 2D spatial information (raster or vector maps) hosted in different computer systems over the Internet. 3D data were not even transferable over the Web until five years ago. The first attempt to disseminate and explore 3D data, i.e. VRML, appeared to be rather "heavy" for encoding real geodata due to the lack of a successful compression concept. Despite the drawbacks, the language became a tool for research visualisation. Researchers could concentrate on data structuring and analysis and leave the rendering issues to browsers offered freely on Internet. The research on spatial query and 3D visualisation utilising VRML has resulted in a few prototype systems (Zlatanova 2000). GeoVRML (VRML extended with geo-nodes) and the new standard X3D (<http://www.web3d.org/news/x3d/>) are among promising opportunities for representing 3D data on the Web. A key goal of the X3D standard is definition of interoperable, light-weight components for 3D Web and broadcast applications beyond VRML 97. (Zlatanova 2002)

The Open Geospatial Consortium Web Feature Service Interface Standard (WFS) provides an interface allowing requests for geographical features across the web using platform-independent calls. Web Coverage Service(WCS) describes discovery, query or data transformation operations. Web Map Service (WMS) produces maps of spatially referenced data dynamically from geographic information. With the Web Feature Service, Web Coverage Service and Web Mapping Service standardized components for the access to 2d, 2.5d, and 3d data have been specified by the OpenGIS Consortium (OGC). Thus, application programs and web clients can fetch the needed spatial data via openinterfacesand create appropriate 3d visualizations. (Almaiera and Kolbe, 2002)

#### 4.2 Future Plans

Here, future users would like to have information of a particular object in a certain regions or areas in a split of seconds, very accurate, and easy to access either standalone or Web/Internet solution (Hunter and Tao, 2002). Although theoretically, the spatial modelling of objects could be extended to multi-dimensional (nD), the computing visualization systems only permit up to 3D environment. This section attempts to highlight some possible research works that could lead to the future GIS or ubiquitous GIS. This is the future trend of GIS where every component in GIS like data collection, data manipulation, data basing, and visualization were done seamlessly and they are highly dependent on mobile computing environment.

Although theoretically, the spatial modeling of objects could be extended to multi-dimensional (nD), the computing visualization systems only permit up to 3D environment. This section attempts to highlight some possible research works that could lead to the future GIS or ubiquitous GIS. The author believe that this is the future trend of GIS where every component in GIS like data collection, data manipulation, databasing, and reporting (and visualization) were done seamlessly and they are highly dependent on mobile computing environment. We have seen several research groups are working on this direction e.g. GeoICT Lab, York University, Toronto, Canada; GIS Section at TU Delft, The Netherlands, and Fraunhofer Institute (IGD), Darmstadt, TU Berlin, Germany.etc. (Abdul Rahman, 2006).

## 5. CONCLUSION

With this study we are going to show where the best places to visit and go shopping are as well as what the real situation of the historical peninsula is with the 3D visualizations of the buildings. Therefore, we are able to show the cultural and historical places of historical peninsula with the 3D based land neighbourhood. Also, users will be able to make a cyber travel on the land with using all the functions of Google Earth. This will give a good, enjoyable meeting with the landmarks on historical peninsula. In addition to this, the system will have a good chance to show the land with this realistic 3D visualization to the visitors.

The author believes that in next generation of the world GIS will have a true 3D GIS in near future with all the standards.

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- Historical Area: <http://english.istanbul.gov.tr/>
- X3D : <http://www.web3d.org/news/x3d/>

