MULTIMEDIA SUPPORTED GIS ON THE INTERNET CASE STUDY: TWO OTTOMAN FORTRESSES AND A CEMETERY ON THE DARDANELLES

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KEY WORDS: Multimedia, Internet, immersive, virtual reality, web programming, data acquisition, VRML, GIS, 3D

ABSTRACT:

The goal of this project is to combine advanced visualization techniques and Geographical Information Systems (GIS) to allow the viewer to be immersed in the data, therefore increasing perception and realism. Publishing Virtual 3D GIS application through World Wide Web (www) is another objective of the project due to cost-effectiveness and wide accessibility. This paper provides an overview of multimedia techniques, the web, and applications in GIS and mapping. The focus is on the concepts and principles of design for multimedia applications, particularly the incorporation of interaction and animation for the display of maps and their distribution through the World Wide Web.

1. INTRODUCTION

The cultural heritage is the most important evidences regarding the past society and each object of these has valuable information about the past. Unfortunately each valuable element of the historical structures has been vanishing day by day through time, nature, and human effects. Hence, some precautions are needed for protecting these historical structures from the corrosion and human effects. There are also two Ottoman Fortresses, called "*Seddülbahir*" and "*Kumkale*" on Dardanelles, Turkey in the same situation, however, the project team working with these monuments believes that the fortresses can be restored and protected only when it has been fully measured, documented and stored in proper historical information and management systems. (Güney et al., 2002)

It is with this larger, long-term goal that the team of surveyors, architects, historians and archaeologists began in 1997 to working together on the Survey and Documentation Project of "*Seddülbahir*" and "*Kumkale*". The project undertaken at the Division of Geodesy, Istanbul Technical University (ITU) and the Department of History, Koç University; to explore a development of a multimedia supported four dimensional (3D + time) information system to aid geographically-oriented the documentation of the two Ottoman fortresses of "*Seddülbahir*" and "*Kumkale*".

Having produced all topographic maps, architectural plans and historical information regarding the fortresses a base for GIS was began developing. Research and comparative analyses can be performed more effectively, accurately and visually with GIS. With this type of data system both the present situation of the fortresses and the condition of the fortresses in the past can be recorded and the architectural changes from the 17th century to the present day can be determined more efficiently. Natural, economical, social and political events, which have caused structural changes to the fortresses and surrounding buildings and environs, can be found out. (Güney&Çelik, 2003)

2. PRESERVING NECESSITY OF CULTURAL HERITAGE PUSH PEOPLE TO BENEFIT FROM INNOVATIONS

A map can be defined as an abstraction and a representation of reality and map features symbolize objects in the real world. There are long established techniques, patterns and symbols to summarize the real world via visual references. Historically, GIS has been used to automate what people did with maps and to help perform analysis that would be difficult, if not impossible, to do by hand. (Koehnen, 2002) In brief, a geographic information system is a tool that uses various forms of data as inputs to produce a map as an output. Because these maps are easier to understand than raw data, they can be used as a tool to communicate geographic information to a general audience. GIS is a great success in both areas, but as time goes on, the more expected things have come. Until recently, 2D maps have been the only format available to visually process geographic information. This is no longer the case because modern sensors, such as laser altimeter data, photogrammetric techniques and remote sensing, are providing a wealth of information that makes the third dimension possible in mapping. People wish to use GIS to manage data without being constrained by the inherit limitations of 2D maps. In fact, ones argue that including the third dimension is necessary to more accurately model the material world.(Moore and Dykes, 1997) Another recent change in mapping is how we distribute map data. The internet has brought GIS information and high quality maps to any internet user's web browser. So in effect, the two recent changes in mapping that have changed the science of GIS in recent years are internet distributed mapping and 3D visualization. Although much work has been done, and to be sure, more development is in 2D web mapping is to come, the next developments of distributed GIS will come in the form of 3D web mapping.

Advancement in technology and navigable 3D graphics has enabled cartographers to produce maps that are both interactive and animated maps, similar to most things experienced in reality. More recent developments in hardware and software capability and price have made three-dimensional output extremely affordable. People live in a 3D reality and the purpose of a map is to be an abstraction of reality; so the output of 3D GIS that can be both interactive and animated maps. The conventional 2D maps output by conventional GISs adequately represent functional data, but cannot represent visual data well at all. On the other hand, 3D maps do an excellent job of representing visual data and are also capable of handling functional data. The coupling of 3D GIS with interactive and animated output can only serve to further a map's ability to accurately depict geographic data. Current forms of output for 2D maps from GISs are many and include bitmap, pict, gif, and pdf formats. With the recent prominence of the World Wide Web as a medium for information exchange, gif and pdf formats, with cross platform compatibility, are particularly attractive. An attractive format is "Virtual Reality Modeling Language" (VRML) for distributing 3D GIS output. VRML 2.0 allows fully immersive environments, interactivity and real-time animation capabilities. VRML browsers work as plug-ins for common Web browsers and are currently available for most platforms.

In this paper an introduction to the 3D internet modeling language VRML\GeoVRML is provided and its usefulness to GIS people is explored. 3D modeling of geographic scenes presents opportunities of scientific exploration and visualization that are not possible in 2D. This paper shows how to create three-dimensional visualizations using commonly available and inexpensive tools. Objects can be queried and modified by the user and linked to underlying data, providing a GIS-like environment in three dimensions. The efforts at producing 3D visualizations of the cemetery, the fortresses and the surrounding areas focused on intensely to research, design and build a generic virtual environment and to describe 3D spatial representation of the historical objects with respect to the each other using VRML as a modeling language for the exploration the

historical background of living on that historical site.

Here, it is showed how to combine GIS-Visualization integration efforts with recent VRML work. The development of VRML models will allow users to interact with three-dimensional models via the World Wide Web. For these efforts, this means that users with a VRML browser will be able to interact with three-dimensional displays of spatial and terrain data sets.

3. METHODOLOGY

An application with interactive interface over the internet is introduced in this research to manipulate the historical information, recreate and visualize the fortresses and the cemetery. The application consists of three modules, the first for displaying a historical object by using virtual reality concept. The user accessed with WWW browser and walked around the historical place in the virtual environment. The second module is a geographical information system, which was applied to manipulate historical information. These two modules can be worked in the Internet and linked together with hyperlinks and JavaScript, Personal Home Page (PHP) in the WWW system. The last module applied the object-oriented virtual reality has just begun to develop. The security restriction is provided in the system, which allows only authorized person to manipulate databases and virtual reality information on internet.

VRML was chosen as a means of visualizing in 3D because it offers a platform and software independent file format. Its flexibility, ease of transfer and for the viewing options it allows users are the other specifications to select in 3D applications. Developed scripts provide that the user can easily interact with the 3D model, predefined walking or flying around and through it. It is also the chosen 3D format for the Web. There are many VRML browsers that can be used to view and interact with the model; although there is considerable variation in how well they render the models. The language, however, has the potential to describe the behavior of objects, provide links to other documents on the Web, represent interrelations that can be used to retrieve and visualize 3D spatial information and thus serve as an interface to 3D GIS. (VRML Consortium)

VRML files may contain references to files in many other standard formats. JPEG, PNG, GIF, and MPEG files may be used as texture maps on objects. WAV and MIDI files may be used to specify sound that is emitted in the world. Files containing Java or JavaScript code may be referenced and used to implement programmed behavior for the objects in your worlds. Script nodes can be inserted between event generators (typically sensor nodes) and event receivers. Scripts allow the world creator to define arbitrary behaviors, defined in any supported scripting language. The VRML 2.0 specification defines Script node bindings for the Java and JavaScript languages.

Aside from interactively positioning point of view, VRML allows the user to interact with 3D objects in a 3D world. The linkage (hyperlink) functionality has added to 3D model in VRML to enable the project members and users to retrieve the data regarding the historical object. The query capabilities on a 3D map about attribute data have been added the model. A standard web browser equipped with any one of many freely available “plug-ins” can become an interface into a three dimensional virtual reality. The best part is that high-quality VRML browsers are publicly available for free and work with high-quality web browsers that are also publicly available for free. (The Annotated VRML97 Reference)

A preliminary “Virtual Interface” has been developed using PHP, Java and JavaScript to interact with VRML worlds. The interface provides two-way communication between the user and the VR terrain, not only extracting positional information from the model but also allowing the user to move between viewpoints and select the view required. This preliminary interface has purposely not been embedded

within the VR space to emphasize the 2 dimensional links to the 3D environment, much as would be expected in using maps in the real world. VRML also allows 'Script nodes' by which the developer can add external programs (typically written in Java or Javascript) to extend its functionality.

VRML worlds are primarily defined by nodes that describe shapes, interpolators, sensors and scripts, linked by routes which pass messages between nodes. Most nodes are of predefined structure containing fields and events that describe their appearance and behavior; however the node set may be extended by use of prototypes and scripts. The VRML Script node provides a general purpose node for programming new sensors and interpolators for VRML whereby appearance and behavior of objects in the scene may be modified and defined. Script nodes contain references to the appropriate Java .class file to call when the script is initialized. The 'Virtual Interface' application opens via a 'ProximitySensor IsActive' field when the VRML file is launched. The script node enables events and nodes to be passed from VRML to Java (EventIn), commands to be sent from Java to VRML (EventOut) and the definition of fields in the VRML file to be used in the Java program. (The Annotated VRML97 Reference) Events, (such as mouse/cursor/keyboard combinations) can be sent from the VRML scene nodes where they are detected to Java programs that react correspondingly. The converse is possible too.

Once the all CAD drawings has completed and stored as DWG AutoCAD file format and imported into ArcGIS 8.x technology products. "3D Analyst", which is one of ESRI's ArcGIS 8.x extensions, has been used to create VRML output files for the historical site. VRML output obtained the integration of CAD and GIS technologies is of particular importance to the historical documentation with so many objects that are recreated in CAD packages due to standalone GISs lack the graphical capability and geometrical accuracy. In this project the approach to CAD/GIS integration is that CAD tools would be used to create, edit, and maintain graphical information. GIS tools would be used to model and analyze the data related to the geometrical information. The integration seems appropriate since both systems are meant to deal with spatial information. This output is stored in a data file external to the GIS, which is then loaded into a suitable VRML browser for viewing. The browser provides the functionality for the user interactively to explore the 3D model by "walking" and "flying". The user is unable to modify the model in the browser. Modification of the model requires going back to stage one, making changes to the 2D GIS database, and then generating a new VRML model. However, this output (being program generated) tends to be large and cumbersome, often unusable for web delivery. Once you get started, it's actually easier to create effective VRML representations yourself using much simpler tools. (With some guidance, a third-grader was able to create a significant VRML world in an hour using only a text processor.) The output becomes small enough and efficient enough to be of practical use for serving GIS data in three dimensions over the web.

4. Conclusion

This study is focused in the reconstruction of the fortresses of "Seddulbahir" and "Kumkale" and the cemetery of "Kumkale" in the virtual environment. This application helps the project members, architects, archeologist and art historian to centralize database, predicts the cultural heritage after recreation and provides history information for people who are interested in. Therefore, this study is very interesting for tourists and people who are trying to discover the past.

Another goal of the study is to show that high quality 3D data can be easily produced and viewed in a web browser format and that useful 3D online libraries of geographic data can be compiled. This goal was successfully achieved. It should be noted that VRML is a fairly large language and the possibilities of what can be built into the scene is really only limited by the

creators imagination. There are many things that could be added to these scenes to make them more interactive or informative.

This is the first part of the research for displaying and viewing a historical object by using virtual reality concept and a geographical information system, and these two modules can be worked in the Internet and linked together with hyperlinks and internet programming in the WWW system. In the research part, VR and OO (Object Oriented) are together applied to model the historical objects. An object oriented approach has many advantages such as objects are independent and reusable. Next step addressed for designing recreation using object oriented and virtual reality approach. Spatial database query is in which the development interface will include a geo-referenced multimedia resource base.

The historical scenario created in this research was derived from investigating of "life history of the fortresses". Historical documents, archaeological evidence, as well as imaginations were in dispensable in the completion of the work. The object oriented approach and GIS are tools for helping historians to investigate the best model and virtual reality is a visualization technique to present the model in 3D with navigator.

Many of the commercial GIS vendors are now realizing the possibilities of 3D GIS using virtual reality technologies. For example ESRI Inc. was launching a powerful 3D extension to their desktop GIS, ArcGIS 8.x technology – 3D Analyst extension.

Acknowledgement

It is due to the generosity of the Foundation Max van Berchem, the National Endowment of the Humanities, the American Research in Turkey, Leica Computer Systems and Technical Services and the Vehbi Koc Foundation that we were able to accomplish as much as we did over the past five years and all members of the *Seddulbahir-Kumkale* team give our sincere thanks to our sponsors. We would also like to thank the Turkish Ministry of Culture, the Director of Museums and Monuments and the Ministry of Defense for granting our team permission to research the sites of *Seddulbahir* and *Kumkale*.

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