

Designing Process of a GIS-based System for Historical Documentation

FIG Working Week 2004, Athens, Greece, May 22-27, 2004

**"...LIFE HISTORY OF THE FORTRESSES
STARTING WITH 'GEOHISTORY' RUNNING..."**

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Documentation Project of the Fortresses of "Seddulbahir" and "Kumkale"

The design and e-management of multi-participants, multi-purposes IT project

Multi-participants: each discipline in the contributes to the study with its science domain and expects different outputs rather than other science domains

Multi-purposes: the project has various puposes for the different level users such as decision makers, users, end-users

IT: Information Technology, data modeling, visualization, programming, etc.

If this is a project ...

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Documentation Project of the Fortresses of "Seddulbahir" and "Kumkale"

The Vision of the Project

is to model accurately the "life history of the fortresses" within a GIS project to determine more accurately and more efficiently the architectural changes from 17th century to the present day and to explore the natural, economical, social and political events, which have caused structural changes to the fortresses and surrounding buildings and environs.

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The Mission of the Project includes:

- modeling "GeoHistory" as a comprehensive 4D geo-processing model for historical documentation research with the help of historians in the project team defining the problems and expectations,
- developing "Temporal (4D) GIS (TGIS)" of the fortresses since "life-history of the fortresses" changed continuously over time,
- developing "Object-oriented GIS (OO-GIS)" of the fortresses to abstract the reality on a business model more effectively,
- developing "Virtual (3D) GIS (VGIS)" of the fortresses to allow the viewer to be immersed in the model, therefore increasing perception and realism,
- developing "Internet GIS (Web GIS) or distributed GIS" of the fortresses to publish GIS application through world wide web (www) due to cost-effectiveness and wide accessibility,
- developing "Integrated GIS" of the fortresses to utilize spatiotemporal object data model (ST-Object model).

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Based on the Vision and the mission of the Project

The system based on the vision and mission of the project was designed and the strategic plan of the project was produced due to the requirements and the phase of analyzing. Flow chart of the stages and timings were constituted upon the strategic plan or GIS development process. Management of the project is being realized on internet via web site of the project as an e-management.

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The Strategic Plan of the Project includes following stages:

- Making a project web site,
- Breaking the GIS project into its components,
- Data Modeling (database modeling and design),
- Nature of database, type of data, how stored etc. (database construction),
- Geo-Visualization,
- Publishing through Internet,
- Spatial Queries and Analyses,
- Integrating all components,
- GIS use and system maintenance.

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Project web site that has been developing website for managing the multi-participant GIS project over internet transforms a data source into communication hub and an analysis tool effectively for project members and users to share information about the project and discover the fortresses and historical background of them.

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SIS Model: *GeoHistory*

"**GeoHistory**" is temporal 4D (3D+Time) interactive GIS model with object-oriented approach based on multimedia application through Internet environment to model accurately and efficiently the life history of the fortresses. This model which is an application with interactive interface on internet to manipulate the historical information, recreate and visualize the fortresses and the cemetery consists of three modules:

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The components of *GeoHistory*

- **GeoHistoryRepository** which is a data modeling and database component of the GIS project.
- **GeoHistoryVirtualInterface** which is a visualization component of the GIS project and the user accesses with web browser and walks around the fortresses in virtual environment.
- **GeoHistoryQueryInterface** which is an internet component of the GIS project and the user manipulates and displays the system.

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The components of *GeoHistory*

Building 3D models, storing them and providing a user interface to visualize and manipulate them require new database and graphic technologies and robust programming languages. What is really needed is a model such that all data and functions can be accessed and manipulated in one seamless programming environment. "*GeoHistory*" is being implemented in order to build an open, seamless development environment. This paper will describe the design of "*GeoHistory*" and integration with its sub-components, such as "*GeoHistoryRepository*", "*GeoHistoryVirtualInterface*", and "*GeoHistoryQueryInterface*" and provide an efficient method of documenting historical structures.

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Spatiotemporal Object Data Model and Database Component : *GeoHistoryRepository*

The goal is to develop a SIS data model for a 3D historical documentation with spatial and non-spatial data under the same architecture and to implement a complete database system based on this data model.

A data model named "**GeoHistoryRepository**", which is an open ending object-oriented approach to GIS, is being designed for "*GeoHistory*", 3D interactive GIS model, as a means to integrate all the themes and provide the user with the ability to organize, update and display spatial, and attribute data according to the scientific and thematic domains. The scientific domains are history, art history, Ottoman history, archaeology, architecture, land surveying and geodesy over 3D base map provided by the Geodesy Division of Istanbul Technical University.

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Database component: *GeoHistoryRepository*



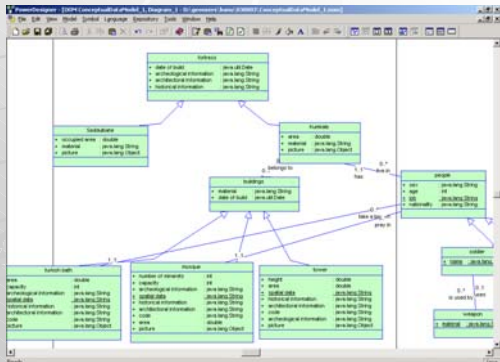
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Database component: *GeoHistoryRepository*



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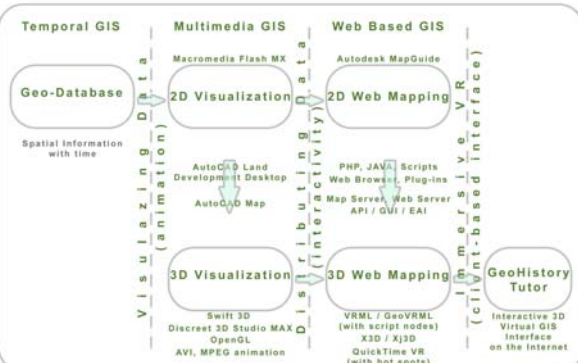
Visualization component: *GeoHistoryVirtualInterface*

"GeoHistoryVirtualInterface" is being developed as an immersive virtual reality environment to explore the productivity of the documentation of two Ottoman fortresses on the Dardanelles. The project team hypothesizes that the use of an immersive virtual reality interface to the GIS will allow investigators to easily perform complete and accurate spatial analysis of the data collected.

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 called "GeoHistoryTutor".

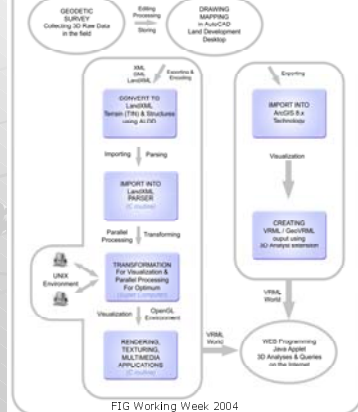
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Visualization component: *GeoHistoryVirtualInterface*



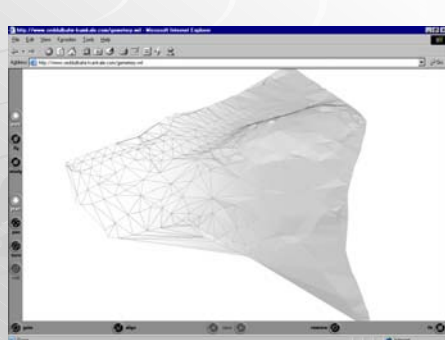
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Visualization component: *GeoHistoryVirtualInterface*



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Visualization component: *GeoHistoryVirtualInterface*



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Internet component: *GeoHistoryQueryInterface*

"GeoHistoryQueryInterface" module based on three tier client/server web GIS architecture is an interactive geo-query tool designed to promote the usage consisting of a large geo-database, "GeoHistoryRepository", with querying capabilities that includes the ability to output results in a map-based format using a GIS. This web-interface developed contains an application that enables query and extraction of the information belonging to fortresses and interactive mapping.

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The modules of "GeoHistory", "GeoHistoryRepository", "GeoHistoryVirtualInterface-GeoHistoryQueryInterface", is being linked each other with hyperlinks and internet programming like scripts of Java, PHP and worked together on web. Whilst the project has been successful in that it hides the size and complexity of the system behind an easy to use interface, the real success of "GeoHistory" has been the development of a GIS optimized for use over the Internet that integrates various technologies in a model. Once completed the integrated GIS of the fortresses can be used to discover the fascinating past of these historic structures, and to discover the present problems that face these cultural heritage sites.

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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.

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In developing the system, GeoHistory, the system providers are utilizing various visualization and interaction techniques, web and database technologies adequate for this specific GIS application of historical documentation. In addition, by evaluating its usefulness in its final field of application the providers hope to define techniques that could also be used in other GIS projects.

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