Web-based Information System for Virtual Museum of Underwater Cultural Heritage in Turkey

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ABSTRACT
This paper presents a developed web-based information system using the data collected during underwater surveys conducted on the coastal region of Turkey. Divers from a variety of professional backgrounds collected data by keeping the archaeological artifacts in their original context. By collecting visual, geographical and descriptive data using structured datasheets, the artifacts are transferred into the digital domain. Through the analysis of these methods, an information system is developed aiming for the contribution of all interested parties in a collaborative manner. Combined with Google Maps, the database illustrates the initial technological steps towards the development of a virtual museum.

KEYWORDS: nautical archaeology, information system, digital heritage, Turkey Acknowledgement

Research aims

The research aim of this paper is to present a web-based information system, designed and implemented specifically for a future virtual museum of underwater cultural heritage of Turkey. We propose a web-based information system, which has the following objectives:

- complete digital archiving of raw data on nautical archaeology using *in situ* preservation

- open-content data entry and inquiry through open source codes.

- user-friendly visualization and communication of the sites information thanks to Google Maps

The information system combines the data collected during underwater surveys conducted on the Lycian coast of Turkey since 2007 using the non-destructive method of *in situ* preservation considered as the first preservation option by UNESCO during the Convention of Underwater Cultural Heritage in 2001. Our purpose is to highlight how this methodology of data collection and the information system specifically designed for this data can offer new possibilities for the storage, preservation and analysis of nautical archaeology especially for a model of virtual museum in Turkey.

Introduction

Cultural artifacts detached from their original context, are either transformed to a museum object, or when kept in their original place, they deteriorate caused by aggressive urban expansion and development, destruction caused by looting, and general neglect (Kalay, 2008). Similarly, underwater cultural heritage has been under escalating threat due to the extensive number of divers and underwater exploration techniques that gave rise to destruction of wrecks and immersed

sites (UNESCO, 2001). As opposed to remains on land, underwater environment offers ideal preservation conditions when the human intervention is prevented. Even without having to be removed from their original context, the underwater remains offer important clues about the past. Hence, we are able to transfer the underwater heritage into the virtual domain without disturbing the original context.

With the usage of digital technology in the heritage domain, a new genre of virtual space has emerged, namely the virtual museum, where digital collection and information are linked parallel to Malraux's vision of the "museum without walls" (Malraux, 1947). Not bound by physical constraints, the digital objects are housed and displayed in this repository (Parry, 2007). Consequently, practices at virtual museums have experienced a shift in the way this knowledge is acquired, preserved, researched, exhibited, and communicated.

Proposition

The idea was to propose an information system for underwater cultural heritage, which allows the analysis and visualization of the collected data through a collaborative method, an online system of data storage and sharing. By the help of three computer programmers, a tool was developed for the management of the data collected during the surveys conducted along the coastal line. Essentially an online database for systematic data collection, description, and interpretation, the system currently contains information on c. 700 finds through sketches, measurements, drawings, and photographic entries of individual finds, in addition to regional descriptions and observations made by divers. Combined with GPS locations of sites and findspots, the result of the integration of the database with Google Maps illustrates the distribution of the sites along the Lycian shoreline of Turkey. The process of gathering and recording data for the Virtual Museum has been interactive and continually increasing (Varinliolu, 2011).

Structure

The information system is an integrated, collaborative, open-content application with web-based client-server architecture. It was specifically designed and developed to serve multiple aspects of data collection conducted in the field surveys.

The following objectives were considered during the design and implementation of the information system, such as preservation, accessibility, user-friendliness, and integration. The extensive amount of data gathered during the field surveys were stored and preserved in this system. Allowing relations between entities, the database preserved the complex data relations that could be restored only in the digital domain. It was aimed that the system to be accessible by a wide range of interested parties, including archaeologists and divers, as well as the public. For this purpose, a web-based design has been developed. Following open-access and open-content neologism put forward by David Wiley (1998), describing the creative work that explicitly allows copying and modifying of its information by anyone, the content of the information system is available to the public. Moreover, the means of data entry and update were provided for the users to share information in a collaborative manner. During the design and development of the interface, the user-friendliness was emphasized by visual elements for comprehensive data entry and update interfaces. For an integrated system, the number of data fields was minimized to avoid duplicate and redundant data input. The system has provided and integrated framework, which gathers several aspects of archaeological research on a single platform. The spatial data, textual entries, photographs, sketches and drawings, typological observations as well as numerical measurements were included in the database.

System Architecture

The information system has been developed with a web-based, client-server architecture. All data storage is done on the server side, while data input and display are done on the client side. The server application works on a web server and is supported by a relational database management system (RDBMS) and the native file system for data storage and retrieval. The client application works on web browsers and communicates with the server application synchronously and asynchronously through the Internet. For mapping an external Internet Map Server such as Google Maps is used.

The information system used the software package called LAMP. A term originally put forward by Michael Kunze (1998), LAMP (Linux, Apache, MySQL, PHP) is an acronym for a set of software subsystems and components, named after the first letters of the Linux operating system , the Apache HTTP server, the MySQL database software and the PHP programming language. Depending on the operating system installed, WAMP is another alternative, working on Microsoft Windows operating system (Meyer, et al.). The information system has four structural elements: the web server, the web browser, information system programming and the database.

A web browser, internet browser, is a software application for retrieving, presenting and traversing information resources through the WWW. Client side application is fully XHTML 1.0 Transitional compliant and works on all major web browsers, independent of operating system and hardware configuration. Compatibility tests have been made with Mozilla Firefox, Microsoft Internet Explorer and Google Chrome web browsers on Microsoft Windows operating system.
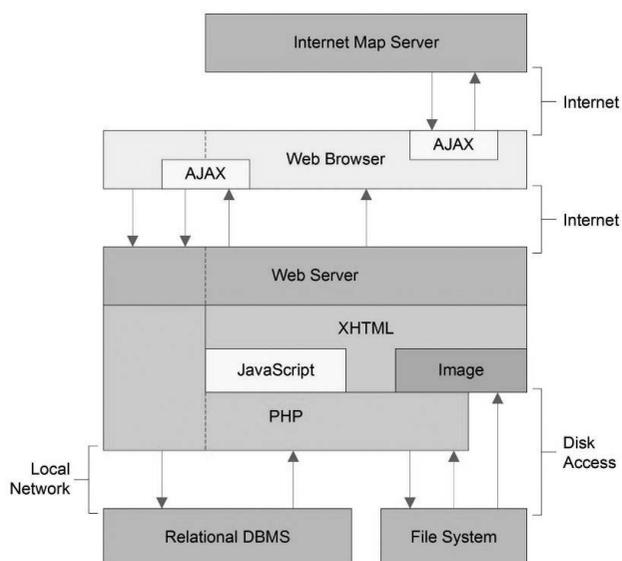
Fig. 1. System architecture programmed by S. Girgin.

A web server is hardware and software that helps to deliver content to be accessed through the internet. The hardware part houses the content, while the software part makes the content accessible through the internet. The server application of the information system works on Apache Web Server, developed using PHP programming language. PHP, widely used for web-based applications, is a general-purpose scripting language that is especially suited to server-side web development where PHP generally runs on a web server.

Client side application, user interface of the system, was prepared using XHTML (eXtensible Hypertext Markup Language) and supported by DOM (Document Object Model) Level 1 based, interactive JavaScript programming language. XHTML codes describing the user interface elements and behavior were generated dynamically by the server application. Similarly, graphical elements, such as icons, were either generated by the system or loaded from files stored in the native file system. In order to provide asynchronous data flow between client and server, AJAX technology has been utilized.

Programming libraries are mainly used to perform data visualization (i.e. mapping) and enhancement of user interface elements (i.e. Rich text editing). None of the programming libraries used for development are commercial, i.e. all libraries have licenses that are free of use. The database of the information system includes 18 data tables, which are organized in a relational structure. 16 of those tables were entered to the system through data entry forms. Hence, they are dynamic in size and number of records in the tables is growing within the life time of the information system.

The information system uses MySQL Database Management System for data storage and retrieval.

Being the most popular open source SQL database management system worldwide, MySQL has been selected primarily due to ease of use and widespread support. Among the data storage engines provided by MySQL, InnoDB storage engine supports relational database tables. Owing to relational database structure with foreign key constraints, all actions on records have been controlled at the database level and overall data integrity has been protected. Textual data is stored in universal Unicode UTF-8 encoding, which supports mathematical operators, and Turkish characters besides all other major alphabets used worldwide. Collations implemented in MySQL allow comparisons of characters sets to be done according to the rules of selected collation language. Hence, textual information can be queried and sorted property.

In order to display geographic information, the information system utilizes Google Maps. Owing to Google Maps' integration to the Internet, detailed satellite images for all the discovered sites during the survey are made available to the users of the information system. Although Google Earth has recently added zoom below the ocean and a view of the 3D bathymetry beneath the waves, Google Maps does not offer any bathymetric data to date. A custom-made dynamic map window gadget has been developed, which allows maps displayed on the user interface to be moved and resized freely for better navigation. The system also supports data entry in multiple coordinate formats.

System Components

The information system was composed of major components that are self-competent information systems on specific topics, which are closely linked to each other. Each component covers several record types and includes all data entry interfaces and database queries. These components were categorized as dive-logs including researchers/divers, sites, dive logs, findspots, find logs including measurements, photographs, sketches, and analysis/visual media such as drawings, images, notes (Fig.2).

In order to explain this highly complex database system, three major paths were defined. The first path was based on the dive logs, in which divers, findspots, measurements, photographs and sketches were linked. The second path followed the find and related information. Finds and the related findspots, photographs, sketches were linked to this system component. The third one, towards recording of the post-processed data, the images and drawings produced by the team members were linked to find system components.

Discussion

The information system has been developed with the objectives of preservation of the data gathered during
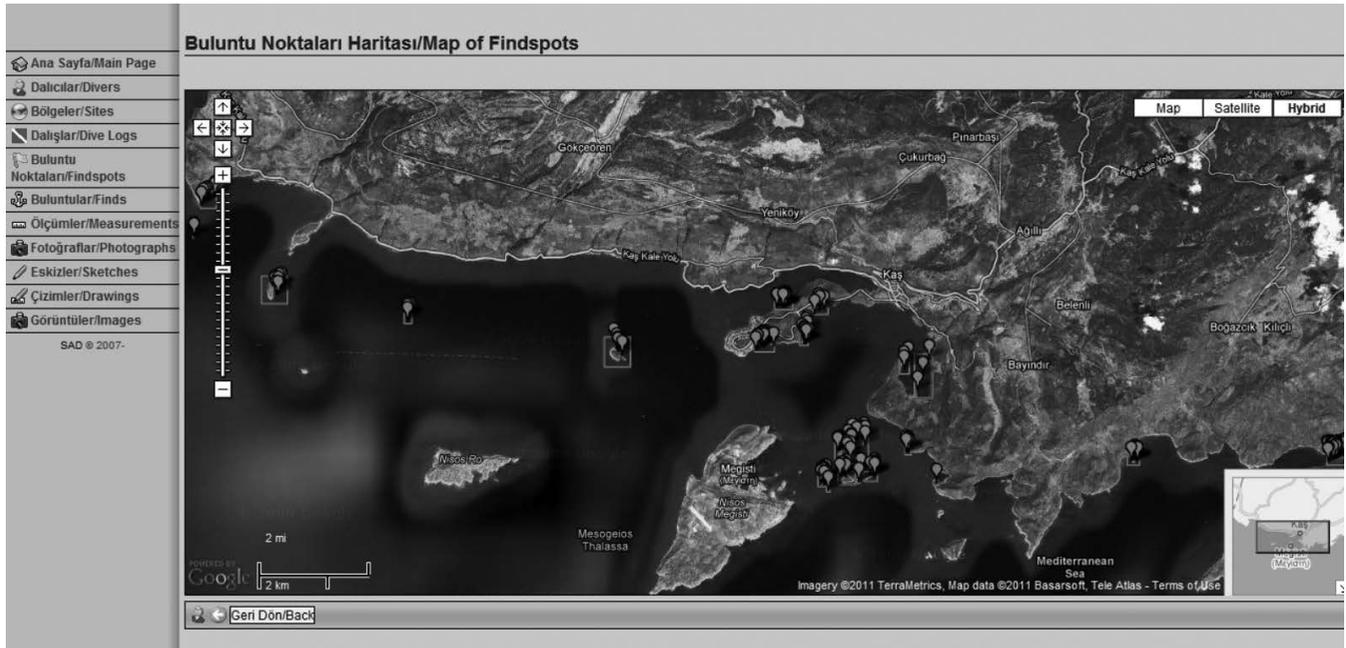
Fig.2. Interface of the information system.

field surveys, accessibility by the interested parties, the integration of multi-aspects of archaeological research under a single roof, and user-friendliness for the users. Composed of a database, visual media and mapping tools, the information system allows recording, storage and sharing data of c. 700 finds from 22 different sites. In comparison to conventional database systems used in archaeology, the information system developed makes it possible to manage all types of data related to underwater sites. As the system was not limited to any site, the user can do different kinds of spatiotemporal searches on the data, especially on Google Maps.

This information system is the first web-based collaborative and open-content platform for raw data of nautical archaeology in Turkey. In this respect, it is a pioneering and unique project for the preservation of cultural heritage in Turkey. Based on the analysis of the datasheets and later the database, this information system met the majority of the needs of archaeologists; hence the possibility of its use should be considered by the Ministry of Culture and Tourism in Turkey (MoCT), which aims to put a regulation similar to the currently available information systems into practice. Thus, the archaeological data collected during the surveys can be used to prepare an official underwater archaeological repository of Turkey. Although the components of the information system were designed according to the material remains found in Turkey, with little modifications, it can be adapted to other remains of material culture in different countries.

Following the creation of the information system, the next stage involves the interpretation of information through the feedback of specialized nautical archaeologists, as well as through the input of online contributors. Although this information system seems to be limited within the boundaries of collecting, storing and sharing data, it aims in future to integrate other disciplines at the interpretive stage, which is open to the general public. The system is an electronically distributed, online workspace, which provides the opportunity for the interaction of geographically distributed archaeologists and other professionals from related disciplines through the WWW. This model of information system enabled access to data for the shared input of educated and interested parties. Thus, this system in essence acted as an information retrieval system and provided a collaborative flow of information.

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