Introduction

In the past years there has been a continuous effort to develop applications that can be used for the effective management of archaeological sites and finds (cultural heritage). A custom integrated Cultural Heritage Management / Geographical Information System (CHM/GIS) application was developed using Microsoft.Net technologies and ESRI products. This was possible in order that archaeologists without extensive GIS training can geospatially reference archaeological resources without needing hours of extra training outside of their discipline. The system allows Cyprus’ Department of Antiquities (DA) staff in management of antiquities and the carrying out tasks according to archaelogical procedures. The particular application will be of major importance to the cultural heritage managers of Cyprus, allowing them to form a database and GIS that is able to refresh its geospatial database at regular time intervals an adapt of non-geographic data and integrating a customize database with a dynamic GIS that is able to refresh its geospatial database at regular time intervals. The particular research made possible to have a fully integrated application for the cultural heritage resources of Cyprus.

System design and implementation

The system implements common 3-tier architecture (data, application and presentation tiers). The system is accessible to researchers connected to the laboratory of geophysical sciences and archaeologists without extensive GIS training can geospatially referate, edit, delete, and query the existing cultural heritage records. The CHM/GIS application is bilingual (Greek & English). GIS component

The GIS component in the client application has two basic functionalities:

- Enables the user of the application to quickly associate their cultural heritage records
- Provides a context for the cultural heritage record and assist archaeologists in the understanding of the cultural heritage record.

Seamless integration is achieved through the utilization of ArcGIS Engine API and Net SDK. Typical and basic processing tasks such as creating, editing and querying existing cultural heritage inventory items can be accessed through a familiar user-friendly windows interface. The system is designed to operate as a client-server architecture that consists of the client application, and the GIS and web services application. The CHM/GIS application is application that is easily accessible to authorized users through the client application. The application was implemented with the Microsoft.Net framework utilizing ArcEngine API and ArcGIS.NET SDK. The system enables the user to add, edit and delete cultural heritage resource records. The application provides the user with the ability to create a record for the respective resource/ task (ancient monument, antiquity, archaeological survey, etc.) which will include the data as outlined by the DA and according to descriptions provided for each category of cultural heritage resource.

Client application

The client application of the CHM/GIS system with a single interface for the entire workflow of the department and its various users and their tasks, while the web application on the other hand provides an interface for the public to access the available cultural heritage data information in a geospatial context.

Concepts and requirements analysis

The Department of Antiquities (DA) of the Ministry of Communications and Works of the Republic of Cyprus internally catalogue all monuments in the territory. Each monument officially declared is published in the Cyprus Government Gazette and described according to the plots that occupies geospatially. Therefore the system uses this association to extend and identify cultural resources in a geospatial context. The DA has previously requested geospatial data according to the associated plots (sheet/plan/block/plot). These data are available locally and will be available through the local GIS system. Additional geospatial data not previously associated with archaeological resources are not available locally but will need to be available to users of the system. These data are provided remotely from Department of Lands and Surveys (DLS) as web services. There is also the likelihood that previous associated geospatial data becomes updated and current local copies consequently become outdated. Therefore, it is necessary to be able to synchronize data between local and remote services while maintaining the integrity of the data. In this case a process exists to verify and manage inconsistencies.

Synchronizing data between sources

Upon initialization the consistency between local spatial data and remote spatial data is checked as a background process. If the “business logic” cannot validate the spatial data on remote services it is likely that the spatial data has been updated and outdated local spatial data is then highlighted (Figure 7). There are separate processes available to administrators that may run synchronisation business on demand and create reports with outdated or newly selected cadastral plots to assist the offline process of request and acquisition from the DLS.

Figure 1 (left): Diagram describing the system architecture. Note remote users connect through secure Government Data Network (GDN).

Figure 2 (right): Aggregation of various sources all accessible from the client application. The separation of cultural heritage data and spatial data is integral to maintain the integrity of the data and fully utilise available features for verification and data management.

Figure 3: Graphical user interface (GUI) for cultural heritage management.

The CHM/GIS application is application that is easily accessible to authorized users through the client application. The application was implemented with the Microsoft.Net framework utilizing ArcEngine API and ArcGIS.NET SDK.

Typical and basic processing tasks such as creating, editing and querying existing cultural heritage inventory items can be accessed through a familiar user-friendly windows interface. The single interface provides concurrent access to centrally located data with a shared bibliography while also providing controls for data validation (consistent shared vocabulary and uniformity), concurrency (prevention of simultaneous edits) and versioning (edit history and timestamp stamping provided users).

Figure 4: The model displaying window for the GIS component from within the client application.

Figure 5: Process of selecting/associating spatial data based on cadastral information Sheet/Plan/Block/Plot.

Figure 6: All ArcGIS desktop print functionality is integrated into the application GIS component.

The environment provides the basic toolset to add value to the cultural heritage record. Additional feature layers supply topographic and cartographic information for reference. At the same time an advanced user is able to add data and save custom changes without affecting the integrity of the spatial data. Nevertheless, authorized users have the ability to visually associate spatial data to inventory items or cultural heritage records.

The feature layers use the local cadastral plot data along with dynamic queries to the cultural heritage database to geolocate the ancient monuments & movable antiquities in spatial context. A map based plot selection process assists the user to visually identify plots and select them to associate with the local cadastral plot data to a cultural heritage record (Figure 5). The map includes cadastral plot outlines, administrative units, geo-morphological and topographic features including Index Cassini and IGM models at different scales by default. The GIS component draws from both local GIS services, while utilizing queries across databases to present local data, and remote web services provided by GIS servers at the Department of Land and Survey. Every user has the ability to customize each client MXD so as to include any spatial data according to the plots it occupies geospatially. Therefore, the system uses this association to extend and identify cultural resources in a geospatial context. The Department of Antiquities (DA) of the Ministry of Communications and Works of the Republic of Cyprus internally catalogue all monuments in the territory. Each monument officially declared is published in the Cyprus Government Gazette and described according to the plots that occupies geospatially. Therefore the system uses this association to extend and identify cultural resources in a geospatial context.

Web Application

For web publication (Figure 8) a parallel system has been established replicating the main system but within a perimeter network (otherwise known as demilitarized zone (DMZ)). The geographical database and archaeological data base are replicated, securing the confidential data of archaeologists and site surveyors, according to internal policy, exposing only those plots of the first schedule and the monuments contained therein and antiquities approved for publication.

Figure 8: Detail info window of the ancient monument as displayed through the web application.

The background shows the into window of visually selected plot displaying list of ancient monuments.

Conclusions

The particular research made possible to have a fully integrated application for the cultural heritage resources of Cyprus. The system is capable of managing both movable antiquities and immovable monuments and all the diverse information regarding them by integrating a custome database with a dynamic GIS that is able to refresh its geospatial database at regular time intervals and by various authorized users.

The system promotes better management of the cultural heritage of Cyprus and accomplishes this by respecting and supporting the existing workflow while offering features and tools that simplify existing processes. It is the first time that a cultural heritage management solution aggregates such functionality and components, including the various heterogeneous data models and sources from GIS and web services into a client application with a visually intuitive environment familiar to the user thus allowing for the quick adaptation of non-experts into the geospatial context. The system allows also for the further development of its components and extension of its functionalities.

The particular application will be of major importance to the cultural heritage managers of Cyprus, allowing them to form a detailed archaeological cadastral that can be of help for the preservation of the monuments and the better organisation and planning of large scale construction works through the island. At the same time, the application plans to its users that will be capable of accessing an exhaustive inventory of the archaeological sites and the immovable monuments and finds of them, together with any related information and bibliography. Finally, the Web accessibility of the bulk of the archaeological sites will be of importance for the promotion and dissemination of the cultural heritage of Cyprus.