A GLOBAL MUSEUM FOR E-LEARNING USE

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ABSTRACT

Nowadays a great amount of digitized material is available on the web. Many Museums are offering on line, full or limited access to their exhibits, accompanying them with useful knowledge in the form of metadata schemes. The development of these digital repositories can be utilized by a service that collects this information and offers modeled knowledge for e-learning use. The architecture behind this service utilizes the technology of the web services offering, on demand, knowledge from Museums' databases and an application that consumes them for e-learning purposes.

INTRODUCTION

According to the ICOM code of ethics, Museums have a particular responsibility for making collections and all relevant information available as freely as possible, having regard to restraints arising for reasons of confidentiality and security (ICOM Code of Ethics for Museums 2006).

To this mission, following the evolution of the internet as the primary communication and promotion channel and XML, many projects have been deployed from museums that digitized their exhibits and documented them with the knowledge that accompanies them in the form of metadata. In all these cases two were and still are the basic principles that museums have to confront to, syntactic and semantic interoperability of the content.

Syntactic Interoperability

Syntactic interoperability refers to the use of common language to the presentation of the data (the museums' exhibits in this presentation). The most used standard for metadata representations is Extensible Markup Language (XML) (World Wide Web Consortium (W3C) 2006). XML is a simple, very flexible text format designed to meet the challenges of large-scale electronic publishing playing an increasingly important role in the exchange of a wide variety of data on the Web and elsewhere.

Semantic Interoperability

Semantic Interoperability refers to the understand ability of the documented information for every other user or system that retrieves it. Semantic interoperability supports the integration of information offered from distributed resources. There exist several standards developed in order to help museums and other organizations to document their resources in a common (as possible as it is) way. These standards provide semantic definitions and clarifications needed to transform disparate, heterogeneous information sources into a coherent global resource for users searching for it over the Internet.

Based on the above interoperability principles and the most used standards, the proposed solution exploits the web services technology and architecture to create a global repository (one stop shop) for students, teachers, researchers and simple users interested to use museums material for educational purposes. The service offers on free basis, museums content with copyright issues and rights to be handled by the museums themselves. The advantage of the service is the minimization of administrative costs that for other subscription – based services are the main barrier to overcome.

The paper is structured in the following sections: *Section 2*, presents a theoretical overview of the related literature. *Section 3* describes the technology beneath the proposed service while in *Section 4* the proposed solution is presented. *Section 5* presents the results while *Section 6* is devoted to discussion and future works.

RELATED WORK

Similar work has been undertaken from the Art Museum Image Consortium (AMICO) and ArtsConnectEd. AMICO was a not-for-profit organization of institutions with collections of art, collaborating to enable educational use of museum multimedia. AMICO operated from 1997 to 2005 and its members had pooled

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their collective resources to create a digital library known as The AMICO Library™, which was a licensed digital educational resource available under subscription to universities and colleges, public libraries, elementary and secondary schools, and museums. It represented works in the collections of AMICO Members (AMICO 2005).

ArtsConnectEd is another relevant product of a partnership between the Minneapolis Institute of Arts and the Walker Art Center. The goal of ArtsConnectEd is to make arts education timely, engaging, interactive, and pertinent for both teachers and students of all ages. ArtsConnectEd offers a user-friendly Web site with access to the combined art collections, libraries, and archives of the Walker Art Center and The Minneapolis Institute of Arts (ArtsConnectEd 2005).

METHODOLOGY

The key point of the proposed service is that it is open to any Museum interested to participate in the network. There is no need for special integration in the central service that is developed to communicate with any Museums services are registered to its address book. The work that should be undertaken from the Museums is the development of a web service that will offer their documented information on their exhibits in a desirable form and the registration of this web service to the central application in order to be discovered and consumed.

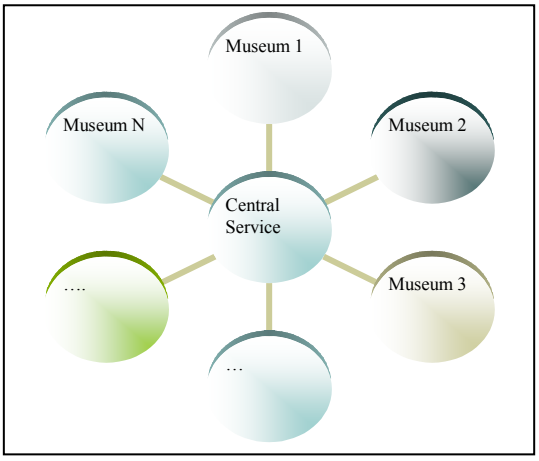

Figure 1: Museums network based on web services and interoperability principles.

Most of the Museums nowadays have the required infrastructure and specialists to support the provision of such a web service. The benefits from such a connection are expected numerous against the actual cost of the development of the web service. At the end these web services from several museums will form a growing knowledge grid performing a specific set of operations and will offer information for educational purposes to users request it.

The term Web services describes an important emerging distributed computing paradigm that differs from other approaches such as the Distributed Computing Environment (DCE 2005), the Common Object Request Broker Architecture technology (CORBA), and Java Remote Method Invocation (Java RMI) in its focus on simple, Internet-based standards to address heterogeneous distributed computing. Web services define a technique for describing software components to be accessed, methods for accessing these components, and discovery methods that enable the identification of relevant service providers. Web services are programming language-, programming model-, and system software-neutral (W3C Working Group Note 2004).

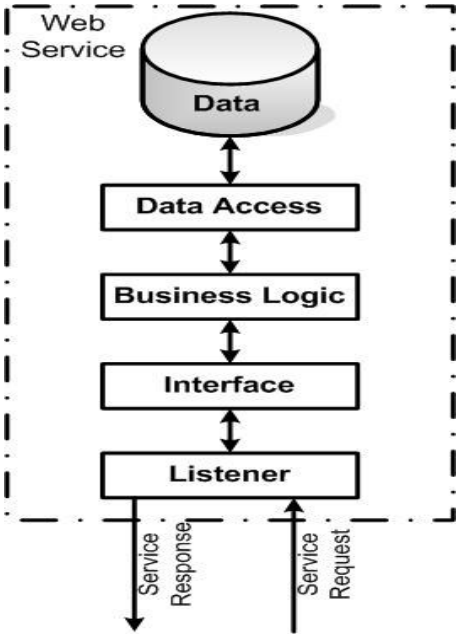

Figure 2: Description of a web service

Web Services interact with applications consuming them by exchanging messages in Simple Object Access Protocol (SOAP) format while the contracts for the message exchanges that implement those interactions are described via WSDL interfaces.

In order Museums to be able to register their web services to the proposed system, a Broker (server) will be set up to host the private Universal Description, Discovery and Integration directory (UDDI). Each Museum's web service should be registered to the UDDI directory in order to be published and reveal its functionality to the world. UDDI is an XML-based standard for describing, publishing, and finding Web services. Service consumers can then interrogate the broker to locate a required web service and use it to implement a request from a user. The proposed system will act as a service consumer and will access all the Museum's web services register to the UDDI registry.

The need for statefull web services is emerging for this specific type of application. The system has to be

informed, when contacting a Museum's web service registered in its private UDDI, if it's active or not, in order to know the time it has to wait before it returns an answer to the user requested information. For that reason a real time communication will be set up (in the form of parallel web services) in order each web service to continuously inform the system for its availability.

To successfully consume these web services XML/SOAP messages will be used for exchanging information with the main system. SOAP is a lightweight protocol intended for exchanging structured information in a decentralized, distributed environment (Gudgin et al 2003).

XML is the technology used with SOAP messages that form the requests and responses from a web service. A client invokes a web service by sending an XML/SOAP message, and then waits for a corresponding XML/SOAP response. Because all communication is in XML, web services are not tied to any one operating system or programming language and any Museum can build this web service on its current infrastructure.

The content of these messages should comply with the general known standard describing metadata CIDOC Conceptual Reference Model (CRM), now ISO/CD21127[3] which is a common used standard enabling information exchange and integration between heterogeneous cultural heritage relevant sources. Expanding CIDOC's structure with Learning Object Model's (LOM) metadata, a standard that specifies the syntax and semantics to fully/adequately describe a Learning Object, will help to make the identification of the most adequate information on museums exhibits more effective for the indented e-learning use.

PROPOSED SOLUTION

The central service (consuming the museums web services) will be able to offer the requested information about Museums' exhibits, their characteristics, their creators, the place that was found or created, their use, etc, and at the same time it will be able to filter this information for the audience it is addressed for. This filtering will use LOM's metadata scheme (age, difficulty, education, etc) to end to the adequate information that will present to the user. This information will be accompanied by the museum that offering it and any restraints arising for reasons of confidentiality and security.

The central service, to achieve the above described functionality, includes a smart search engine that will communicate with the web services subscribed to the services private UDDI registry. The results, from those "alive" web services will be presented to the user along with more information of the museum offering them. All the nodes described on the next diagram, which describe the architecture between each museum and the central service, communicate with each other through a Transmission Control Protocol/Internet Protocol (TCP/IP).

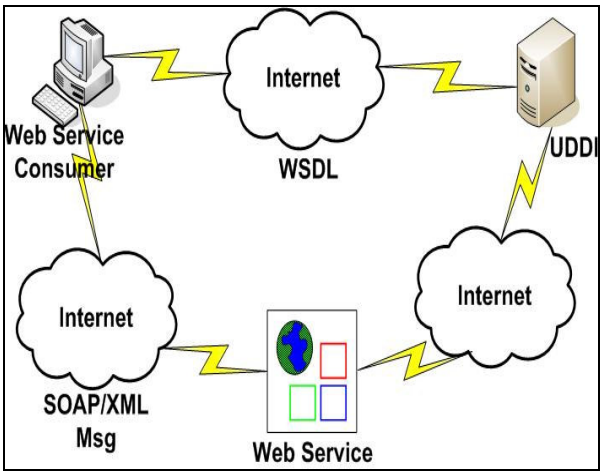

Figure 3: Description of the proposed architecture

The advantage of the described architecture is that the pool of available exhibits will grow rapidly as each new museum will join in. The simple steps the museums have to follow in order to develop and register its own web service to the service's UDDI are a promising factor for the viability of the service. Administration costs for the service, which are the most common barrier for similar projects, are minimized since the administrator needs to do not more than observing the successful integration of the new Museum's web services to the central system.

RESULTS

The proposed service is a great choice for many museums to communicate their content through larger channels (one stop shops) with small effort and expenditures. The service can be utilized and integrated in the portals of Organizations representing Museums (e.g. ECSITE European Network of Science Centers and Museums) to promote the exhibits of their members. The Web services infrastructures provide also to the Museums the possibility to use (offer) their own web services in many different ways (in their portals, in their local area's information portals, municipalities, Non Governmental Organizations (NGOs), tourist portals, etc). XML technology offers them also to upgrade, change or alter their databases without effecting the overall system's functionality.

DISCUSSION AND FUTURE WORK

Future work on the presented service is possible and necessary. Many additional services can be developed in the described infrastructure that will be based on the shared material. Such services that can we recognize are thematic excursions for school that are not going just to visit one Museum but specific exhibits in several

Museums, technological tourism, multimedia (images, Videos, 3d presentations) presentation of related exhibits that will accompany the original exhibits in the Museum's halls, etc.
Moreover the presented architecture can integrate the benefits of the Open Grid Services Architecture (OGSA) and OGSA-DAI. OGSA describes an architecture for a service-oriented grid computing environment for business and scientific use. OGSA-DAI is a middleware to assist with access and integration of data from separate sources via the grid
In any case, the exploitation of museum's material for learning purposes is an interested case that concerned and will concern many researchers in the future as the technology evolves and offers great additional opportunities.

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NIKOLAOS V. KARADIMAS was born in Athens, Greece and he graduated from Patra T.E.I. in 1995 with a Bachelor's degree in Electrical Engineering. He then received a Bachelor's degree with Honours in Electronic Engineering and a Masters degree in Computer Science from Glasgow Caledonian University, Scotland in 1997 and 1998, respectively. He also received a Masters degree in Distributed and Multimedia Information Systems from Heriot-Watt University, Scotland in 1999. Since 2002 he is a PhD candidate in National Technical University of Athens. Furthermore, since 2001 he is teaching Informatics in Hellenic Army Academy and New York College, since 2003 he is teaching in T.E.I. of Chalkida and since 2005 he is teaching in Technical NCO Academy, as well. He is a member of the Greek Chamber of Engineers, member of IEEE and member of IEE. His research interests are in the fields of Databases, Optimization Techniques, Geographical Information Systems, Decision Support Systems and Multimedia.

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