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A Service Approach to Preserve the Heritage and Culture through Cloud Storage

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Abstract
This paper is aimed at proposing a service approach to preserve the rich heritage and culture of different countries and deploy these services in the cloud. The model (for e. g. bronze Idols and stone sculptures in India) maker's methodologies are represented as a service and are accessed by the intended client applications to reconstruct the heritages. These heritage services necessitate an intellectual middleware to integrate with the cloud. Service Oriented Architecture (SOA), which exploits the web services and XML technologies, will present an elucidation to meet the requirements. Web services provide a method for open and flexible interface between such distributed, heterogeneous heritage systems with loosely coupled service endpoints. The services may be in the form of 3D motion pictures of idols; ultrasonically detected images of stone sculptures; rock art pictures captured using laser sensors and thermal input devices. The availability of such services in cloud enhances the consumers who are fascinated in culture and heritage of a particular country to access them efficiently and reprocess. The proposed scheme promotes the global cultural exchange and bestows one a personal distinctiveness and a close tie between the countries and hence the preservation of culture and heritage of one country is endorsed.

Keywords: culture, cloud, heritage, intellectual middleware, service, SOA, xml..

Introduction

When a nation's progress is measured, the concept of self-reliance, self-sufficiency and national uniqueness comes as the core and the culture is referred as the origin of all the policies of a country like educational, social, political, medical or economical. The tactics of a nation's growth would therefore depend on the perception of the culture, the adaptation of its elements for political, educational and economic progress as well as its strengths for societal integration and maturity.

In this paper, a service approach to preserve the culture and heritage of a country is presented through cloud storage. The heterogeneous cultural heritages of different countries might be networked together to form a distributed heritage network. Heritage information will be an integration of various collections obtained from different countries such as many traditional arts and craft, ornaments, utensils, weapons, folk tales, temples, churches, mosques, monuments, idols, civilization, museums, libraries, festivals and histories. The above said heritage treasures need to be preserved with environmental protection and survival techniques as a cherished aspect of human development, as a connection to our past and as the indicator to our future. The conservation of knowledge is never a ravage. Processing and interpretation of huge amounts of diverse heritage data and interoperability are important issues in designing scalable heritage network architecture. The gathered data can be made accessible to the interested audience by a variety of means. For such applications, heritage networks could not operate as standalone networks; there must be an effective way for users to gain access to the data produced by the heritage networks. It is proposed to consider the cloud infrastructure as a solution. At present, the cloud system stresses an intellectual middleware that can be interoperable with different entities to fulfill the client application necessities. The Web services based SOA will present an affordable clarification to meet up the current demands.

This paper proposes a sophisticated middleware solution to the problem of integrating a heritage network of different countries designed as a heritage system into the cloud at a high abstraction level. The SOA is middleware which acts as an agent, translating application requirements into heritage configuration parameters and provides an abstraction layer between applications and the underlying heritage network infrastructure. In this paper, service-oriented programming model based on web services is presented for heritage applications. Here the communication between entities is carried out through Web Service Description Language (WSDL), in the form of xml messages and SOAP messages which again makes use of XML. Data provided by the heritage networks are represented as Services.

Service Oriented Technology is one of the promising technologies to build complex systems like a cloud system. While cloud systems tend to experience a number of potential advantages with the novel aspects of the Internet, the Internet has introduced significant security threats to cloud data. As the volume of users accessing the cloud data is also increasing heavily, the susceptibility of the data, which is an invaluable asset for any society, is also escalating proportionally. Here the service oriented heritage networks as designed above are integrated with cloud through a fastening proxy, acts as the Gateway, which takes care of the security credentials.

The paper is organized as follows: In Section 2, the related works are described, in section 3, the Service Oriented Heritage system architecture and integration architecture with cloud and its components are explained. The methodologies for reconstruction of heritage sources are depicted in section 4. Advantages/Applications of the proposed approach are discussed in Section 5. Lastly, it is concluded in Section 6.

Related Work

A project based on digitization of cultural heritages [1] in the form of geometric and photometric modeling is proposed leading to a cloud museum. The importance of preservation of heritage and culture is imbibed through game based learning [2] [3], hence the understanding of one country's richness goes unobtrusively in the young minds. Cultural heritage search engines [4] are available. Universeum [5] is a European network aims at the preservation, study, access and promotion of university collections, museums, archives, libraries, botanical gardens, astronomical observatories, etc. and it is open to heritage and museum professionals, researchers, students, university administrators and all those involved with university heritage. A heritage network [6] service is available in the UK.

An associative dimension of cultural World Heritage [7] sites is addressed. A case study [8] reveals that the cultural heritage conservation has been found to be a catalyst to fulfill a heritage tourism advantage. The evolutions of the concept of cultural heritage in West European states [9] were analyzed. Further, the authors also stated that, in the last decades of the 20th century, the term "heritage" was characterized by monument and cultural property and this development made it possible to recognize intangible cultural heritage, which was ignored for a long time, as heritage to be protected and safeguarded.

Reconstructing 3D geometry from photographs is a classic Computer Vision problem that has occupied researchers for more than 30 years and its applications range from 3D mapping and navigation to online shopping, 3D printing, computational photography, computer video games, or cultural heritage archival [13]. For nearly two decades, virtual reality (VR) technologies [10] have been employed in the field of cultural heritage for various purposes and guidelines for the development of VR systems for cultural heritage are suggested. A complete methodology to create a virtual exhibition system is explained, based on realistic high-quality 3D models of archaeological finds (reconstructed using a 3D Scanner and a high definition camera).

Online cloud has become the standard storage for photographs. Ever-growing numbers of photographs are uploaded to online photo sharing websites such as Flickr [20], Panoramio [21], and Picasa [22], every day from all over the world. Microsoft Kinect Fusion control libraries (firstly released in March 2013) allow using the device for 3D scanning and produce meshed polygonal of a static scene just moving the Kinect around and integrating the depth correction algorithm [23] and correcting the IR camera interior and exterior orientation parameters, the Fusion Libraries are corrected and a new reconstruction software is created to generate more precise models. The Authors [24] implemented cloud based architecture for accessing sensor networks. Similar approach is used in this presented work to collect the heritage information using sensors.

Proposed Heritage System

A. Service Oriented Heritage Networks Architecture

An advanced middleware solution to the problem of integrating a Heritage Network into the information system of an enterprise, such as cloud at a high abstraction level is proposed through the Service Oriented Heritage Networks (SOHN) gateway. A client application querying the data to the heritage network plays the role of service requestor. The model makers of idols and historical building structures across the world act as a heritage service provider. Then the transformation and mapping algorithm have to be used to transform the heritage data into a user friendly format for the internet accessing. The heritage data is obtained from various countries' model makers, which is in the form of heritage profiles-xml such as 3D motion pictures; ultrasonically detected images; pictures captured using laser sensors, thermal input devices and capturing the idol interiors using infra red thermo graphical methods. Service Oriented Architectural model for representation of heritage services is shown in Figure 1. The heritage data is obtained from various countries' model makers, which is in the form of heritage profiles-xml such as 3D motion pictures; ultrasonically detected images; pictures captured using laser sensors, thermal input devices and capturing the idol interiors using infra red thermo graphical methods.

A service is usable function that can be invoked by another component through a well-defined interface. Services are loosely coupled, that is, they hide their implementation details and only expose their interfaces. In this manner, heritage system client need not be aware of any underlying technology or programming language which the heritage service is used. The loose coupling between services allows for a quick response to changes. This results in a much faster adoption to the need of applications which makes use of heritage applications. The heritage system clients discover the service available in the heritage registry by service names and acquire the interface information by HSDL of the heritage services. Based on this information, the clients have a binding with the heritage service provider and can invoke services using Simple Object Access Protocol (SOAP). To facilitate orchestration and aggregation of services into heritage processes and applications, an eb-XML-registry may be used. The heritage-repository will provide a single view of all heritage services of different countries. The heritage services are published into the eb-XML registry using HSDL. The lists of services could be discovered and invoked by the heritage applications (client), using SOAP with heritage profiles-XML messages

B. Cultural Heritages as software

The heritage data, such as idol's image in the form of 3D motion pictures, ultrasonically detected images, images obtained through laser sensors and thermal input devices should be transformed into digital data. The dilapidated stone sculptures could be scanned using a 3D scanner and their internal structures could be analyzed using laser scanners and ultrasonic echo systems. The recorded information obtained through the above process could be offered as a heritage service and similar such data are acquired from different countries. They could be called as heritage parameters and they have to be converted into a web service. As, web services are application components that are designed to support interoperable machine-to-machine interaction over a network, such conversion of heritage parameters are necessary to deploy them as a web service. Hence interoperability is gained through a set of XML-based open standards, such as the Heritage Services Description Language (HSDL), the Simple Object Access Protocol (SOAP), and Heritage system Registry. These standards provide a common and interoperable approach for defining, publishing, and using heritage services.

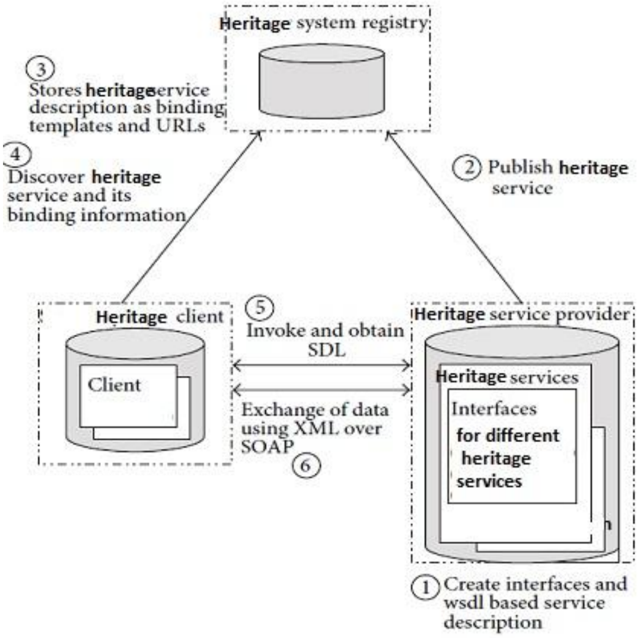

Fig. 1. Service Oriented Heritage Network Architecture

a. Methodology

Figure 2 shows the overall process of converting a captured image of idols into software. The input device could be a 3D scanner. Image transformation could be a semantic 3D reconstruction technique, where interpreted 3D models such as stone sculptures and bronze idols are reconstructed. The following methods could also be used: Multi-view stereo (MVS) [13] algorithms are able to construct highly detailed 3D models from images. They take a possibly very large set of images and construct a 3D plausible geometry. “PMVS”[14] is the open-source MVS software, which has been broadly used by artists. More recently, MVS software “CMPMVS” [15] were developed as convincing alternatives. The Multi-View Environment (MVE) is an implementation of a complete end-to-end pipeline for image-based geometry reconstruction, developed at TU-Darmstadt [16]. Open Multiple View Geometry (OpenMVG) [17] is an open-source library for computer-vision scientists, particularly besieged to the multiple view geometry community. The library is designed to provide an easy access to the classical problems in multiple view geometry, for example, feature detection/description/matching, feature tracking, and bundle adjustment. Acute3D [18] designs and markets the Smart3DCaptureTMsystem that allows the user to build high quality and resolution 3D models, where the applications range from cartography, architecture, defense, manufacturing, cultural heritage, and etc.. Pix4D [19] software converts thousands of aerial images taken by a lightweight UAV (unmanned aerial vehicle) or aircraft into geo-referenced 2D orthomosaics and 3D surface models and point clouds.

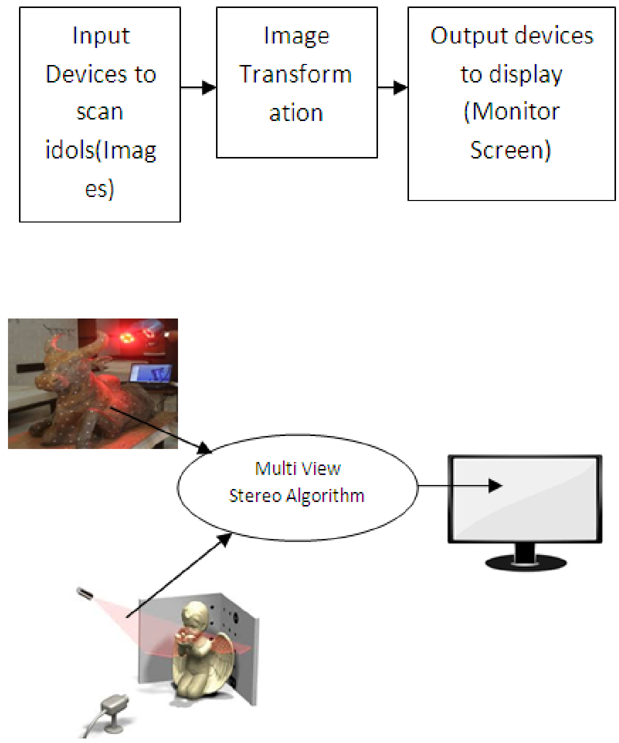

Fig. 2. Methodology to convert Heritage data as software

Image acquisition is the first significant step for triumphant MVS. The best practices for successful image acquisitions are: accuracy of the camera models, Image resolution, Image overlaps, Baseline, Number of images and Image quality. The success of MVS technologies has changed the entire shape of the 3D reconstruction industry by replacing laser range sensors, with image based solutions. As a variety of successful MVS algorithms presented high quality results in research, industrial applications followed with successful implementations of MVS for real products. Digital mapping is another process, in which MVS plays a crucial role. They provide immersive image-based rendering of famous landmarks all over the world, where MVS technique is used to reconstruct a geometric proxy for compelling image based rendering effects. MVS researchers [13] have started up

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successful 3D reconstruction. The explosion of cell phones and mobile devices equipped with cameras also lead to the capture of idols, rock arts, monuments etc., and these photos are a rich source of input data to the MVS, with the aim of reconstructing them.

C. Heritage profiles with XML

Using XML as a standardized data exchange format is a means to support more complex data management and heterogeneous heritage networks. XML representation of heritage data is essential for web service deployment. We could embed the heritage services which are available as images, with xml using the URL of the images captured. Moreover, XML is a key feature towards service-oriented heritage networks. Using XML in heritage networks encourages the interchangeability of different types of heritage models and systems. In this proposed work, heritage profiles are written in XML as given below, to be transported with SOAP request and response message.

<icon_url_base>http://Heritage. gov/heritage/images/fcicons/</icon_url_base>
<icon_url_name>nfew. jpg</icon_url_name>
<disclaimer_url>http://Heritage. gov/disclaimer. html</disclaimer_url><copyright_url>http://Heritage. gov/disclaimer. html</copyright_url>

D. Heritage system Registry

To facilitate orchestration and aggregation of heritage services into heritage processes and applications, registry (heritage repository) is used. To publish the heritage services, the eb-XML registry available with tomcat50-java web services developer package could be used. The HSDL files for heritage services should be used and the appropriate service bindings have to be set to register the services on the server. The heritage services of different countries are indexed in this heritage repository. Hence, through the heritage registry, it is possible to quickly locate the heritage services, one looks for. Through this response time of the proposed approach could be improved.

E. Heritage Cloud Architecture with SOHNA

Heritage networks collect information about the iconic model makers, but typically lack the resources to store and process the collected data over long periods of time. Cloud computing elastically provides the missing storage and computing resources. Specifically, it allows to store and access the collected heritage data effectively via Cloud-based services. Heritage resources do not have direct connection with cloud. Hence, a framework is necessary to manage the data from the heritage network. In this section, SOHNA architecture is extended to cloud by using fastening proxy which acts as a conduit between the two technologies. The Cloud architecture is shown in figure 3. In this architecture the fastening proxy would upload the heritage data to the IBM Blue mix Cloud. In the proposed architecture, the authentication of the message transmitted is taken care of in the fastening proxy module; the intended user (heritage client) is able to access the heritage data by performing a simple step of providing user name and password.

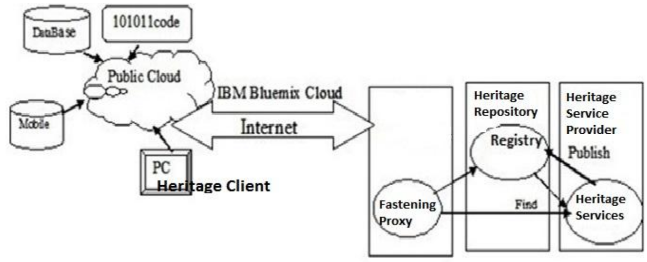

Fig. 3. Integrated Heritage Cloud Architecture with SOHN

Reconstruction of Heritage source

The main objective of the proposed system is that, it should be possible to reconstruct the heritage sources from the Cloud, a way to preserve them. Once the interested client accesses the heritage service of a particular country, if they are keen to reconstruct them, there are many techniques possible. One such technique based on [13] is explained here. Figure 4 shows the process of reconstruction of a heritage source, an idol. First two steps are completed before they are deployed in to the cloud.

- The first step is the idol is captured using the image acquisition process in all possible directions.
- The second step is captured images are subjected to camera calibration.
- The third step is 3D reconstruction.
- Finally, texture mapping is done to reconstruct the idol.

The last two steps are actually used in reconstruction.
A new approach of camera calibration based on the concept of silhouette coherence could be used [13] in the above process. For a given set of silhouettes and corresponding camera matrices, the silhouette coherence measures how likely is that a 3D object might have generated those silhouettes using the camera projection matrices. A comparison between a set of silhouettes are performed, and the silhouettes of the reconstructed visual hull using the camera matrices. If both the silhouettes and the camera matrices are correct, then the input silhouettes and the silhouettes of the visual hull will be exactly the same. A fast algorithm to measure the mismatch between both sets of silhouettes could be used. Camera calibration is performed as a mismatch minimization problem. The presented approach consists of exploiting feature points and silhouettes for the calibration step, and texture and silhouettes for the 3D modeling step.

Advantages of the proposed approach

Any country's cultural bequest is diverse. The proposed approach of preserving the culture and heritage of a country is articulated around the following major schema with an apparent and critical task for cultural heritage: artistic multiplicity and intercultural discourses are upheld. ; promoting culture as a mechanism for inventiveness in the framework of any country's Strategy for development and employment; promoting culture as a critical ingredient in the external relations of any country. But the above said agenda engrosses the recognition of policy makers and collaborative work of heritage managers, conservators and researchers of a country. This approach provides the international cultural and heritage exchanges.

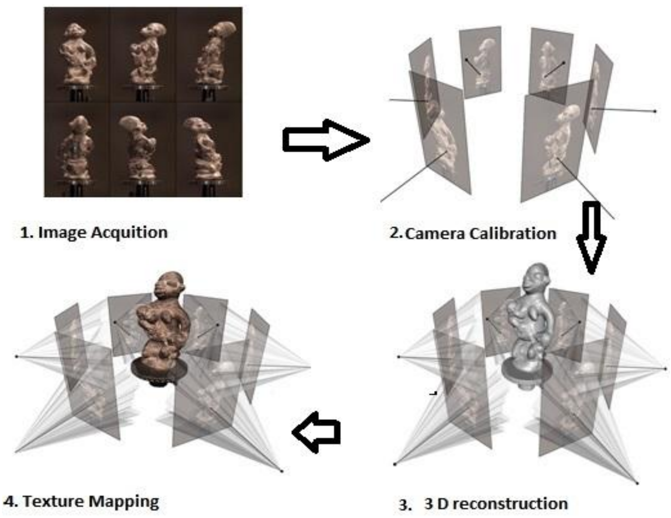

Fig. 4. Reconstruction process of an idol

The proposed approach may lead to the linkage of public and private research organizations across the Globe and research partners from universities, research centers, archeologists, museums to a Private Corporation to develop and apply the best technology and scientific know-how to the cultural heritage. Research has focused on solutions to preserve movable and immovable cultural heritage assets, such as artifacts and monuments respectively. This tangible part of the cultural heritage, together with the digital and intangible aspects, embodies a precious store of knowledge and treasure of significant historical and socioeconomic significance of a country.

Architectural beauty is good for the human brain. A relatively new area of neuroscience known as Neuro-aesthetics posits the theory that beauty in art and design makes people happy. Hence, when people study about art and culture, it improves their life span. We have distributed information about the culture and heritage which are available through Wikipedia and several web sites. The proposed approach will bring a unified integrated solution for interested model makers of idols and historical structures. The antique bronze idols and the idols made of herbal plants are getting looted and many such incidents are evidenced in newspapers [11] [12]. A five-and-half-foot tall Vishnu stone idol belonging to Pallava period and datable to the 9th century CE was stolen from a Vishnu temple in India. With this information the idol can be restructured and hence preserved using the proposed approach.

If the precious monuments are destroyed in natural calamities such as earthquake, strong tremor, tsunami and flood, they could be reconstructed within a short period of time, using the proposed method. Dilapidated idols and monuments could be restructured in any form such as miniature models or a very big massive structure of the replica could be reconstructed. Historic buildings are physical links to the past. It's not just about saving bricks, but about saving the layers and layers of information about the lives and those of the ancestors. Historically significant buildings contribute to countries, cultural and economic well-being, the vibrancy of street life need not be mentioned.

For example, if each and every stone of the Thanjavur big temple in India is visualized as 3D along with the study of material property and sturdiness, it is possible to replicate the Thanjavur big temple. A miniature model of the temple or a giant sized temple could be constructed. By this preservation is achieved and it will be a valuable asset for our future generation.

Cultural heritage could provide an automatic sense of unity and belonging within a group and allows the people to better understand previous generations and the history of where they come from. There is a scientific meaning for each and every structure of Indian temple. For example the tallest structure with vessels on the top in Hindu temples absorbs the thunder and withstands the lightening; hence the surrounding areas could be safeguarded. The property of such structures should be preserved and this information must be kept safe for reconstruction. With proposed approach, fewer building materials are required to refurbish old buildings, which reduce waste headed to landfill and the demand for aggregates grooving holes in the geography to supply the materials for new bricks and mortar. With readymade concrete technology such as precast concrete products, nothing is impossible to reproduce within short time.

Finally, since the heritage information is stored in a heritage registry/ repositories, recording this information in huge volumes of books, CDs are avoided. The models need not be kept in very large museums; they can be accessed virtually for reference from the heritage cloud which leads to Green environment.

Conclusion

The proposed paper started working on the service oriented paradigm as a medium for preserving the heritage network. Since MVS is being one of the most thriving fields of computer vision in the last decade, it could be chosen to reconstruct the high quality heritage images that are represented as heritage service. This solution is extended to heritage clouds offering heritage as a Service. The proposed architecture would enable the interested client applications of the particular domain to easily access and process large amounts of heritage data from various countries. A way to preserve the culture of one country is to record and store it for future generation. The proposed approach stored the heritage information virtually and hence preservation is accomplished. Further, it enabled the reconstruction of the required heritage sources. This approach would provide a scalable infrastructure for integrating heterogeneous heritage model services in cloud from different countries using a small set of powerful abstractions and further promotes a transnational cultural exchange.

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