Web Based Cultural Heritage Inventory System

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Abstract

Ethiopia is endowed with magnificent Cultural Heritages. Cultural Heritages are the result of creativity of mankind and have scientific, historical, cultural, and artistic values. Cultural Heritage Inventory allows to safeguard and manage priceless Cultural Heritages. However, Cultural Heritage Inventory in Ethiopia is in its rudimentary stage. As a result, the vast majority of the country heritages are inaccessible, undeveloped, and endangered for illegal trafficking.

The Web Based Cultural Heritage Inventory System Project is initiated to study the problems related to a Nation Wide Cultural Heritage Inventory system and come up with a software prototype that can tackle the cultural heritage inventory problems.

Attempt is made to study in depth the cultural heritage inventory work flows with particular interest on the field work. Literature review is made on filed work scenarios. The current system analysis is made by conducting qualitative study. Data collation is made through semi structured interview with purposefully selected Heritage experts at ARCCH. Secondary source data are consulted in similar systems surveys and GIS technology review is conducted. Through comparative analysis, existing system analysis is made. A Rational Unified Software Engineering process is used to produce architectural goals specification and the architectural documents. Object Oriented Programming is used to develop a prototype.

We identified the modality of Heritage Inventory field work as sedentary. We specified the architectural goals of the system and based on driving quality attributes, we proposed multi layer server client architecture for the implementation of the system. For interoperability, web services are proposed. The architecture incorporated web service for interoperability and Geographic Information System (GIS) for distributed heritage management. We developed a prototype that tires to avoid difficulties related with cultural heritage inventory.

Keywords: Heritage Inventory; GIS; Field Mobility; Client Server Architecture

1. Introduction

One cannot think of the modern world without software. E-government has become the order of the day. We cannot think of accountable and efficient public services without the application of software. The application of computing in various fields has brought increase in productivity, improvement in quality of service, and accuracy in collection and processing of data. This is not an exception in the cultural field and in particular in Cultural Heritage Inventory. Cultural Heritage Inventory is characterized by a data intensive activity that is carried out on the field. The application of computing in field work is increasingly narrowing the gap between a field work and an office and allowed in acquisition of sound field data, its effective management, and enrichment of the field work experiences.

This paper attempts to address the problem of Cultural Heritage Inventory as a field work from the perspective of software engineering. The software engineering methods followed to examine the problem area and come up with a working prototype are discussed. The functionalities of the prototype are presented.

2. Background

Ethiopia has recognized the benefits of knowledge economy and has embraced e-government. The government has introduced e-government policy. A functional model is developed to implement the policy. The functional model is

expected to tackle the problems in public sector services and make accessible government services and information to the public. One of the components of the model identified is Public Interface Applications (PISAs). Community and Public Interest Services are group of applications identified under this component and one of which is Cultural Heritage Inventory System [1].

Ethiopia is known for the vast richness of her Cultural Heritages. The Research and Conservation of Cultural Heritage (ARCCH) is a government body responsible among others to carry out a scientific registration and supervision of Cultural Heritages. However, the existing manual registration system is inefficient, expensive, and unmanageable to carry out the Cultural Heritage Inventory [2]. Lack of adequate information of Cultural Heritages has made the protection and preservation task inadequate and incapacitated the Cultural Heritages Development effort and hampered tourism development.

In Cultural Heritage Inventory process, the huge task of registration and data collection is done in the field. There are studies that have been carried out on the application of mobile computing in a field study. The studies identified three modalities in a field study based on user mobility and the associated use context. According to Kristoffersen and Ljungberg [3], the three modalities of mobility are wondering, travelling, and visiting. The field work mobility study is important to determine the type of technologies to be used and the software to be developed.

3. Objectives and Research Methodology

The general objective of the research is to come up with a working prototype that facilitates the field work in Cultural Heritage Inventory. To obtain in-depth understanding of the problem, qualitative research design has been adopted. Data collation is carried out by preparing semi-structured interview. Purposeful sampling technique is used to select ARCCH‘s experts that are engaged in Cultural Heritage Inventory and six of the ARCCH Heritage Management experts, managers and database administrators are approached for interview. Secondary sources such as reports and manuals are consulted. Review of related theoretical and empirical research literature is conducted with special focus on Geographic Information System, Web technology engineering methodology, architecture, and computing in field work context. Comparative analysis is used to understand the problem area and test driven development is used to develop and test the prototype. The research is mainly concerned on Cultural Heritage Inventory in the field work. However, it attempts to address software engineering issues related to usability, multimedia data collection, spatial data capturing, data visualization, presentation, and diverse data management. The system is believed to be beneficial in caring out efficiently and accurately the cultural heritage inventory. It will be applicable for day-to-day activities of experts that are engaged in cultural heritage inventory at ARCCH and regional cultural bureaus.

4. Software Requirement and Architecture

Based on the current system analysis conducted at ARCCH, the major activities of the Cultural Heritage Inventory field work are related to observation, measuring of artefacts, and recording of their observation. The cultural heritage field work modality is categorized as sedentary where experts spend some time in a given place to do inventory. Experts on the field collect heterogeneous data. Back office standalone inventory system has been identified whereby the field work data is entered.

A survey of similar systems reveals that inventory systems are web based. Given the heterogeneity of data to be collected, the systems have functionality to manage video, image, text, and spatial data. Most of them integrate Geographic Information System (GIS) to manage the spatial data. The various functionalities provided by the system allow users to update, view, edit, and search inventory data based on assigned privileges. XML and web service is the chosen functionality they implement to interoperate with other systems. Some systems are developed with Open Source and others with proprietary software. GIS allows not only the day to day management and maintenance of heritage site but also natural and cultural resource spatial distribution and inventory assessment. It also enables

identification of assessment of potential threats to cultural resources [4, 5, 6].

GIS technology is now matured enough to be applied in mobile environment. Mobil GIS as it is known allows for capturing of spatial data on the move using wireless application protocols. Web or Internet-GIS is a distributed system that works in networked computers in order to integrate, disseminate, and communicate geographic information across the internet [7, 8]. Web based GIS is identified as the technology to be implemented in the system.

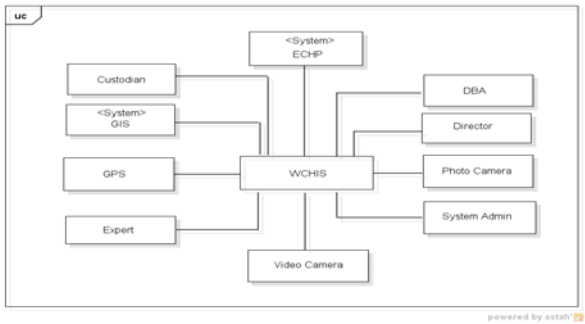

Figure 1: WCHIS Context Diagram

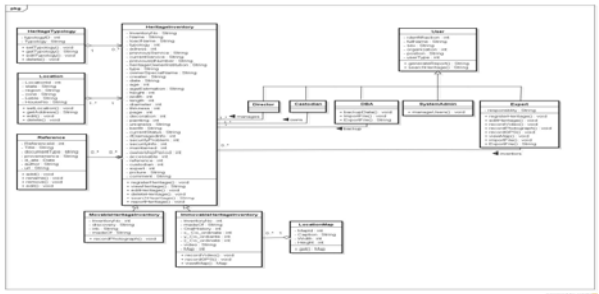

Figure 3: Class Diagram of the System

The data diagram that is mapped to the class diagram and which depicts the association between the relational tables is shown in Figure 4.

Fifteen sequence diagrams are used to describe graphically the sequence of interactions among architectural elements. The hardware and communication interface and the quality attributes of the system are specified. High level quality attributes are identified which are related to performance, interoperability, robustness, usability, maintainability, and security. Based on this requirement, the system architecture is designed. To develop the system architecture, the architecture of

Through in-depth analysis of the current system and survey of similar systems, the requirements of the systems are identified. The system context is defined as shown in Figure 1 and the functional and non functional requirements are specified.

Thirteen use cases are identified that are related to Heritage Inventory, Spatial Data, video, pictures capturing, user management and interoperability as shown in Figure 2. They are prioritized and their use case scenarios are prepared.

Structure of the system in terms of objects, classes, attributes, operations, and their associations are identified as shown in Figure 3.

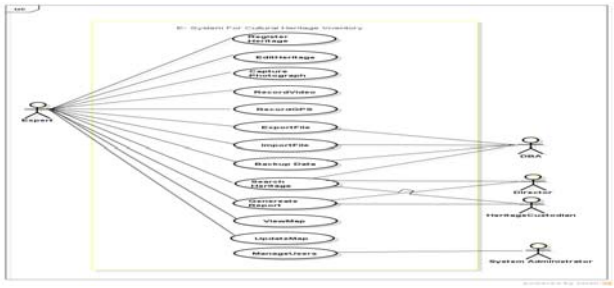

Figure 2: WCHIS Context Diagram

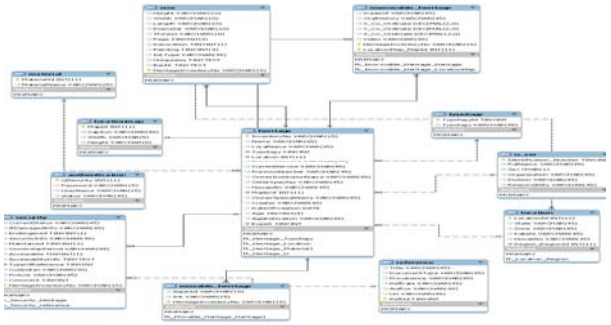

Figure 4: Association between relational

two similar systems is examined and well proven architecture styles and techniques are consulted.

Based on examination of the architecture of two similar systems, i.e., Ethiopian Cultural Heritage Project and Cultural Heritage Inventory Management System (CHIMS), the client server architecture is identified as the proper architecture pattern to be used. Taking into consideration the special requirements of WCHIS, a multi-tier client server architecture is chosen to be the architecture of WCHIS.

WCHIS's client server architecture pattern is separated into different layers with clear interface of communication between the layers. The data and

presentation services are loosely coupled which favours modifiability. The processing task can be shared between the application logic and the database server which improves the quality of service and enhances performance. Interoperability is supported using web service. It is scalable and allows integration of spatial and non spatial data. The multi-tier client server architecture of the system is depicted in Figure 5.

The system is designed based on open source technology as shown in Figure 6.

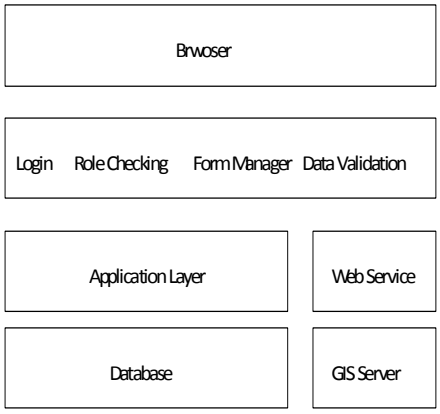

Figure 5: WCHIS System Architecture layers

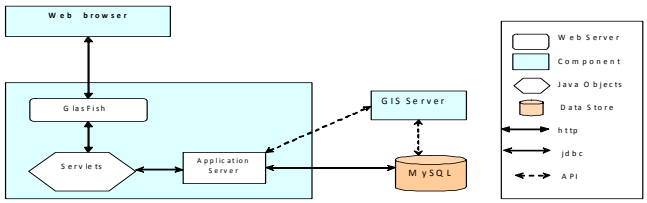

Figure 6: WCHIS System Design

5. Prototype

The development of the WCHSI system has followed the Object Oriented (OO) software development method. The method is chosen because it allows reusability and maintainability. The OO design and development is realized using the de facto standard Object Oriented Unified Modelling Language. Java programming language is used for the implementation of the system. The advantage of writing code in Java is that it is Object Oriented Programming language that allows maintainability, reusability, and portability.

The prototype has login page (Figure 7), movable and immovable heritage page, user admin, and report page. Users of the system need to log on to the system. The system allows users to gain access to pages based on their privileges. The user admin page allows the management of new and existing users. The system admin has access to the admin page. The system admin may grant, change or revoke user's access to the system.

The main work bench of the system is the movable and immovable Heritage Inventory Page. It is organized in such a way that a series of pages are prepared for registration of the inventory data. The user navigates through the pages to register the inventory data. Users are provided with the appropriate links that allow them to view previously registered data and make the appropriate updates. Figure 8 shows one of the series of pages opened by users to do registration.

Figure 7: Login Page

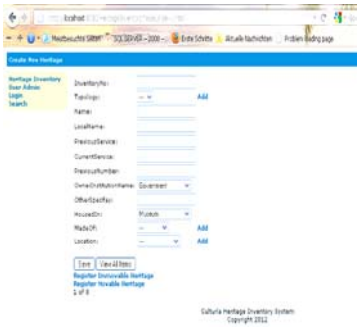

Figure 8: Inventory Page

Figure 9: Search Result Page

The prototype allows users to register heterogonous data, view the data when necessary, and make the appropriate updates. The prototype runs on Glassfish server on a web browser and at the back end supported by MySQL. The prototype search page as shown in Figure 9 and the user admin page shown in Figure 10 are some of the pages that demonstrate the look and feel of the application.

Figure 10: Search Result Page

6. Conclusion and Recommendation

Cultural Heritage Inventory in Ethiopia is in its rudimentary stage. In order to appreciate the problems and come up with alternative solution, a literature review is made, qualitative study is employed, and system analyses document produced. Based on the current system analysis, related systems survey, and GIS technology review, the architectural goals for the new system are specified. Analysis of candidate architectural models is undertaken and multi layered client server architecture is proposed. The architectural views of the system are designed and object oriented programming is used to develop prototype of a Web Based Cultural Heritage Inventory. In ARCCH's strive to align ICT with its business process, the automation of the inventory process at a grassroots level should be given due attention. The research demonstrated what can be achieved using low cost open source technologies.

Given the federal government structure and the strong stake the regional governments have in the Cultural Heritage Inventory, they need to manage their local heritage data. Thus the system needs to work in distributed database while the central database is located at ARCCH. As future research, distributed database design and implementation issues taking into consideration the available IT infrastructure need to be addressed.

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