A Hybrid Content-learning Management System for Education and Access to Intangible Cultural Heritage

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Abstract: This paper presents an open and extendable platform that provides access to ICH resources, enables knowledge exchange between researchers and contributes to the transmission of rare know-how from their holders to the next generations. The platform is a hybrid Content-Learning Management system that permits the creation of new content of cultural heritage. It supports different user profiles for access, learning and analysis of the ICH, such as experts, learners, researchers as well as the large public. It is also supports the outcomes of sensorimotor learning functionalities of a game-based learning module. The platform integrates different modules based on multi-sensory technologies into an operating open-source content management system, which is enriched with a significant number of functionalities.

1 INTRODUCTION

The Intangible Cultural Heritage goes beyond the collection of monuments and objects that we inherited from our ancestors. It is related to knowledge and skills incorporated in human gestures that determine the identity of local communities and are expressed interalia through performing arts, traditional craftsmanship, rituals etc. The ICH doesn't only refer to the past, but also to the present and the future since it represents inherited expressions together with contemporary practices. ICH is inclusive since it characterizes the continuity of a knowledge whether it is practised, in the original community or in a different rural or urban region. It is also representative of the identity of the local community since it is recognized as heritage if it is considered as such by people that maintain it. Consequently, the preservation and transmission of the ICH is a worldwide challenge that is supported from the UNESCO, different Non-Governmental Organizations (NGO), experts, centres of expertise and research institutes. However, this knowledge has never been precisely identified in a way to be transmitted to next generations since it was extremely difficult to "capture the intangible".

2 STATE OF THE ART

During the last decade countries, cities, museums and cultural organisations in general, use digital technologies to provide access to cultural resources mostly through multimedia material such as videos, images, documents etc. The main goal of these initiatives is the digitization of tangible or intangible heritage and consequently its' collection and preservation. But in addition to the aggregation of cultural resources they aim to reinforce the accessibility to large public, stakeholders' engagement and sensitisation.

Important projects have been launched to propose digital platforms and provide access to this material such as Athena (Athena, 2011), ECHO - European Cultural Heritage Online Initiative (Echo-Cultural Heritage Online, 2014) , CAN (Collections Australia Network, 2011), and some private projects such as the Google Art Project (Google Art Project, 2013). These web portals provide access to paintings, music, museum objects, archives that have been digitized with the use of new technologies. Other platforms like the Cultural Heritage Connections Platform (Cultural Heritage Connection Platform, 2011) aim to connect experts and organisations in the field of international heritage cooperation and they serve as an interface for

information exchange and a documentation centre for projects.

One of the most important EU-funded project is Europeana (Europeana.eu, 2009), which is the most well-known portal for exploring the digital resources of Europe's museums, libraries, archives and audio-visual collections, thus offering direct access to millions of books, manuscripts, paintings, films, museum objects and archival records that have been digitised throughout Europe. From an architectural point of view, Europeana.eu constitutes a search engine and a database. It contains metadata integrated by providers and uses that database to allow users to search for cultural heritage objects, and to find links to those objects (Dekkers, 2011). To browse and search the objects and their links, different methods are used such as a timeline, a map Search, an openSearch API. The data is also made available as Linked Open Data, it is represented in the European Data Model (EDM) and the described resources are addressable and dereferencable by their URIs (Halshofer, Isaac 2011).

The goal of our hybrid content-learning management system is to go beyond the hosting of mere digitized heritage content and to propose an innovative platform for know-how preservation and transmission. The platform will permit the integration of heterogeneous resources of ICH into a single web based system, will give the possibility to all users profiles to realise a semantic browsing and searching exploiting ontological concepts. But it will also incorporate novel capabilities integrating multisensory technologies (motion capture, electroencephalograms etc.) in combination with enhanced viewing and playing possibilities, such as 3d visualisation and singing voice synthesis. I-treasures platform is not limited to one use case but it covers four different case studies such as a) rare singing knowledge, b) rare dancing knowledge, c) traditional craftsmanship, d) contemporary music composition. It will also permit a flexible integration of new form of ICH incorporated through pluggable modules. In the following section we present the architecture of i-treasures platform and the integration of the Content Learning Management System.

3 SYSTEM ARCHITECTURE

This hybrid system is being developed in the context of the i-Treasures FP7 European funded, research project. The aim of the project is to help preserve and spread intangible cultural heritage and rare

know how. It is a part of a larger system that entails data capture, feature extraction, semantic analysis, sensorimotor learning and finally training & education. Being a part of an ongoing research project only some components of the system have been implemented so far. The overall system architecture is shown in Figure 1.

The system consists of two main components with their subsystems. The first component is the Client Side Component (CSC). CSC can be the 3D Visualization module for Sensorimotor Learning desktop application, which is used for the capturing of the expert performances and the sensorimotor learning of the non-expert users or it can be the user's web browser which is used to navigate to the i-Treasures Web Platform. The CSC is a desktop application that integrates a set of modules that are responsible for the sensorimotor learning of musical, dance, singing and craftsmanship knowledge based on various types of sensors. Medium level features as well as high level metadata are stored in the digital repository that resides on the SSC.

The second component is the Server Side Component (SSC) which consists of the subsystems of the subsystems that reside on the i-Treasures server(s).The SSC is the web server that hosts the different subsystems such as the Content Management System, the Learning Management System, the Text to Song module and the Digital Repository which will be described in detail later on.
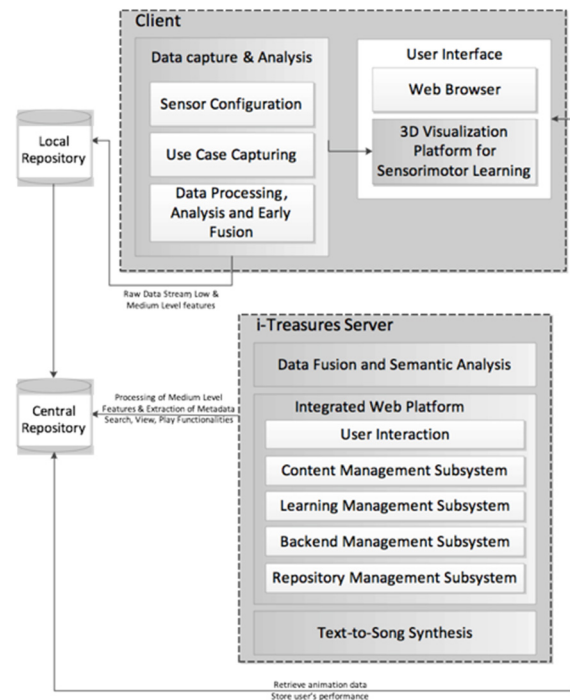

Figure 1: The overall architecture.

Additionally, it hosts the Data Fusion and Semantic Analysis module which extract high level metadata from the medium level features. We will focus on the SCS and especially the Content Management System (CMS) and the Learning Management System (LMS).

3.1 Server Side Component Subsystems - Content Management Subsystem & User Interaction

The Content Management Subsystem (CMS) is software written mainly in PHP that acts as the engine for generating dynamic web page content. It is also responsible for the management of users and their permissions. There are many CMS implementations, free and non-free. In this project is selected to use Drupal which is free and open source. Inside the CMS environment the user will be able to use the navigation menu in order to transit between the rich content (informative & educational) and the innovative tools that will be built for the needs of the project. Since the users will use the CMS as the gateway to all system features, this is the User Interaction subsystem. From the navigation menu the user will be able to choose to find out general/background information about various types of ICH, to explore the educational material stored in the Learning Management System and even download and practice the techniques of various ICH case studies through the 3D Visualization for Sensorimotor Learning module.

All the features of the CMS can be parameterized either from the preinstalled functions that are provided by Drupal or by the community contributed modules that extend functionality and parameterization and even the custom modules that will be built for the specific needs of Project.

3.2 Learning Management System

The Learning Management Subsystem (LMS) will facilitate along with 3D Visualization module for Sensorimotor Learning, the educational processes of the platform. It will be used to realize the Pedagogical Plans (that were developed for the purposes of i-Treasures) into Educational Scenarios. It is a system similar to the CMS but with an educational purpose. It provides the ability to a teacher to create online courses and enrich them with all sorts of educational material such as documents, pictures, videos and event quizzes that can be used for assessing the learner's progress.

A very useful education tool, is the learning path. The learning path is a series of chapters which can contain any kind of resources (html pages, multimedia content, text, image etc.) but additionally has the option to enable requirements. The learner that engages with a learning path, must complete successfully each step of the path, before advancing to the next one. At the same time, his progress on the path is monitored (time taken to complete the path, quiz scores etc.). This path can be exported to SCORM format and can be implement in different LM Systems. The LMS that is used in this project is Chamilo, an open source solution that is a fork of the source code tree of Dokeos which in turn is a descendant of Claroline, an LMS that's been around for over 14 years. One of the reasons for the selection of Chamilo is the simple user interface that incorporates yet not lacking at all in features against other popular LMS solutions and because it is based on a very mature source code tree that was originally built with a focus on stability.

3.3 CMS - LMS Integration

Because of the fact that the i-Treasures integrated platform relies on free and open source solutions to realize its web components that are independent of each other and designed to be standalone, there is a need to tweak them and build custom code in order to interoperate and provide to the user a seamless transition from one component to another. Towards this step, the first step is to develop a mechanism that will keep the user accounts, their details and their permissions in sync between the CMS and the LMS (through SOAP web services). Additionally, the user must be able to transit from the one system to the other without having to enter his/her account credentials more than once, in other words we developed an account synchronization (Figure 2) and single sign on mechanism (Figure 4).
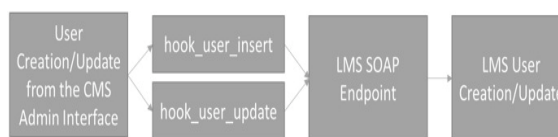

Figure 2: User Synchronization Process.

Also, there is the need for the user to be able to browse between the CMS and the LMS without needing to enter any credentials more than once. This is achieved by the Single Sign On module which is a Drupal module that implements a special code that is called by the hook_init() Drupal hook. This hook executes the code it contains every time a

page is rendered in the CMS. This code checks whether a user is logged in or not in the CMS. If yes, then a special cookie (SSO cookie) is crafted that contains the current user's email and Drupal Session ID. The contents of this cookie are encrypted in with shared key (shared between the CMS and the LMS) and the Session ID so as to prevent a malicious user from crafting this kind of cookie and gain unauthorized access to the LMS. In order for the LMS to know about this cookie and use it for authentication and authorization of the user that is already logged in the CMS, a special block of code was added to the appropriate default authorization function of Chamilo. This code checks for the existence of the SSO cookie and if found, it decrypts it to retrieve the contained user email and the Session ID. The session ID is used to verify that the decryption was successful and that this Session ID is indeed valid in the database of the CMS. After this verification, the user details corresponding to the decrypted email, are fetched from the LMS user database and the user is also logged in the LMS.
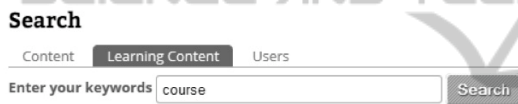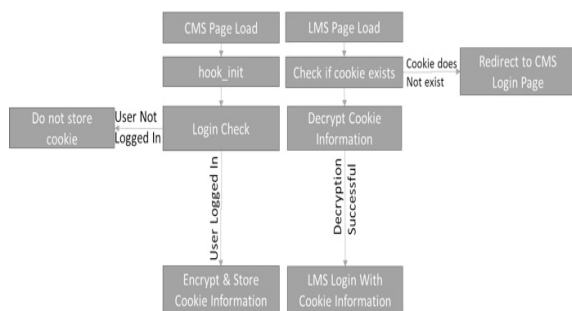

Figure 3: LMS Search Box.

Figure 4: Single Sign on Mechanism.

Additionally a search module is implemented on the CMS that will provide the ability to the user for a unified content search functionality. This module searches the content of both the CMS (nodes) and the LMS (learning path titles, learning path documents such as HTML or text files, course titles, course, descriptions/ objectives/ topics/ methodologies/resources) (Figure 3). Furthermore, there is the ability to display a "My Courses" block inside the CMS, where the user can see and directly navigate to the LMS courses that he/she is subscribed to. This happens with another custom made module that also uses SOAP web services for

the communication between CMS & LMS. This process is show in Figure 5.
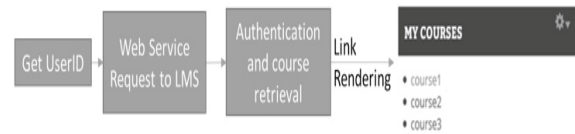

Figure 5: My Courses.

3.4 Sensorimotor Learning and LMS

Since the LMS is not aware of the Sensorimotor Learning (SML) process that will take place through the 3D Visualization module for Sensorimotor Learning, certain functions will be implemented that will read information about the users' performance during their SML sessions. After the user finishes playing the sensorimotor games the results of his session can be uploaded to the Web Platform and stored in the user's gaming profile. This communication will be done via RESTful web services and with the exchange of XML files containing the required data. The information will be stored at the platform and added to their profile so the teacher can have a detailed view of the learners' acquired skills during these sessions. More specifically and for this purpose we designed additional tables in the database schema that will be used to store the users Sensorimotor Learning performance such as remarks and comments about his performance as well as his/her final score. Furthermore, we have designed the implementation workflow of the LMS module that will present these results to the teacher. Another important point is that a common learning path for the sensorimotor game and the LMS activities will be proposed, accessible through the platform. Concretely it means that the learner can access the platform, do different learning activities and then pass through the same learning
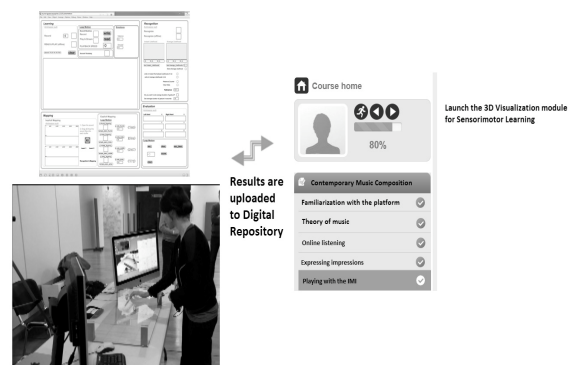

Figure 6: Sensorimotor Learning and learning paths.

path to the practical part with the use of sensors. This Sensorimotor Learning and LMS communication part is currently under development.

4 USER PROFILES

As mentioned the goal of i-treasures platform is to provide access to ICH resources and to contribute to the transmission and knowledge exchange of the rare know-how among different types of users. Therefore, three main types of user profiles are identified: teacher/expert, student and researcher.

4.1 Teacher/Expert's Profile

More specifically, teacher/expert has the ability to design and create educational learning scenarios, by using appropriate tools (i.e. online course creation, quiz creation, discussion forums, educational content creation, etc.) that the Learning Management System (LMS) provides.

4.2 Learner's Profile

The learner has the ability to attend the courses that have been uploaded to the platform by the teacher/expert. Apart from the use of LMS, the student can use the 3D Visualization for Sensorimotor Learning module, which will support him/her to learn, practice and master the different types of ICH. Finally, the purpose of the researcher to use this platform is mainly the semantic search capabilities that are provided.

4.3 Researcher's Profile

The researcher can use the digital repository in order to retrieve more accurate and relevant results to their queries. The semantic search is performed over ICH artifacts indexed according to metadata schemata.

5 EVALUATION

5.1 The Evaluation Framework

Figure 7 depicts an operational model hypothesising that the ICH platform design positively mediates the relationship between information provided by the ICH platform and its performance. The information construct in this pilot evaluating exercise comprised two subscales (i.e., purpose of website and quality of the informational content); the design construct comprised three subscales (i.e., accessibility, navigation, and interaction); and the performance construct comprised two scales (i.e., effectiveness and efficiency). Considering that the model refers to perceived constructs, it is further assumed that controls (e.g., users' gender, age, and level of education) may influence the information – performance relationship.
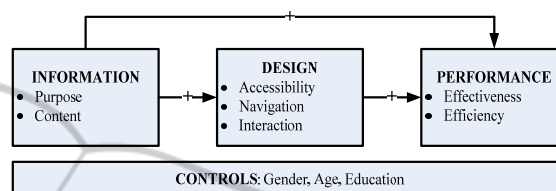

Figure 7: The Evaluation Framework.

5.2 Methods

Data for this evaluation exercise was collected in November 2014 by help of an e-questionnaire, which was completed by 54 students at the University of Macedonia – Greece, after having used the ICH platform. All items were measured on a scale ranging from 1 = not at all/very bad to 5 = very much/very good. Example of the items included: Purpose, 'How clearly the scope of the website is stated?'; Content, 'How accurate is the information provided?'; Accessibility, 'How easy is access to information?'; Navigation, 'How consistent is the appearance of the site between its parts?'; Interaction, 'Does the website provide potential alternative content presentation to users?'; Effectiveness, 'Does the website meet its objectives?'; and Efficiency, 'Does the website use the fewest possible resources to meet its objectives?'.

5.3 Estimation

Before estimation the survey instrument was examined with respect to construct internal consistency, construct validity, construct composite reliability, construct discriminant validity, and common method bias (Hair et al., 2008). To test the proposed framework the methodology of structural equations models, or latent variable models, was used via the estimating package of SPSS-AMOS. The estimated path diagram for the proposed framework is presented in Figure 8. The circles represent the related latent variables and the bold arrows indicate the structural relationships between

the corresponding variables. The numbers that are assigned to each arrow show the estimated standardized coefficients. All coefficients are significant, except those referring to the controls. The goodness-of-fit indexes confirmed the validity of the operational model (Chi-Square = 37.530, df = 32, p-value = 0.230, Normed-Chi-Square = 1.173, RMSEA = 0.058, NFI = 0.838, CFI = 0.970, GFI = 0.881) (Bollen, 1989).
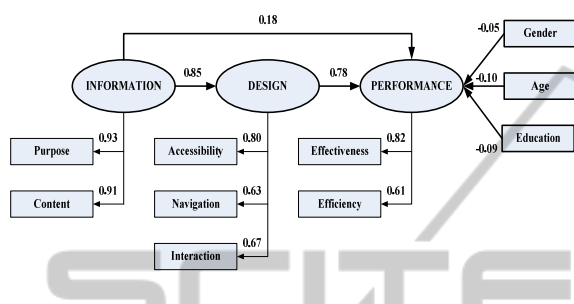

Figure 8: Evaluating Performance.

5.4 Findings

There are five major findings of this evaluation exercise. First, the purpose and content of the information provided by the ICH platform, as perceived by users, strongly influence performance. Second, the design of the platform, in terms of accessibility, navigation, and interaction, 'partially mediates' the information – performance relationship. Third, the 'unmediated path' that directly links information with performance has a low value, indicating that the design of the platform constitutes a correct and indispensable part of the platform. Fourth, considering that all structural coefficients (except those of the controls) are positive and have high values, it reflects the high quality of the ICH platform. Fifth, the personal characteristics of the users do not influence their perceptions about the performance of the platform.

6 CONCLUSIONS AND FUTURE WORK

Some limitations of the current version of the platform can be identified. For example a visitor without profile can not have access to the LMS and to certain functions such as the Text to Song or the advanced research. A key feature that is under investigation, is the ability for the SML sessions' results to be directly "injected" in a learning path session of the LMS. This will be useful in cases

where we would like to create a mixed learning path in the LMS, where the steps embedded in it, could contain both theory lessons and SML sessions. This means that a learner could be prevented from progressing through the learning path unless he/she successfully completes an SML session that is dictated by the learning path designer

7 ACKNOWLEDGEMENTS

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