

Widening Access to Intangible Cultural Heritage: towards the Development of an Innovative Platform

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Abstract. The paper discusses around Human Computer Interaction aspects of advanced learning systems. It underlines the added value (in terms of widening the learning possibilities and enhancing the learning experience) of designing the system itself only after having carefully taken into account the users' requirements regulating the interactions between the learners and the technological environments. In doing so, it offers the view of what has been done in the EU project i-Treasures, which focuses on Intangible Cultural Heritage (ICHs) and investigates whether and to what extent new technology can play a role in widening the access to the underpinning rare know-how, and possibly sustaining its transmission / passing down to next generations. The project can be regarded as exemplar since it instantiates a very peculiar situation where HCI aspects are deeply affected by the fact that the i-Treasures technological system foresees the massive use of cutting edge sensors.

Keywords: Cultural Heritage Education, Intangible Cultural Heritage, Human Computer Interaction, Learning Management Systems, Educational platforms, Accessibility, Usability.

1 Introduction

In recent times, cultural heritage education has encountered digital technology [1-2-3] and ICT technologies are increasingly becoming one of the pillars of teaching and learning interventions in the field of cultural heritage [4].

Actually, a variety of digital tools exist that can support Cultural Heritage Education. In a very rough categorization, we can distinguish among:

- Virtual Museums (VMs) i.e. those ICT-based environments that support the virtual visit (via the Internet, on-site, through standalone applications) of past and present cultural heritage artifacts and expressions (e.g. the Scrovegni Chapel¹, Giza 3D²),
- Domain specific Serious Games i.e. those gaming environments aimed at supporting the learning of cultural heritage related issues (e.g. APA game³) and

¹ http://www.padovanet.it/salamultimediale/index_english.htm

² <http://giza3d.3ds.com/index.html#discover>

³ http://www.youtube.com/watch?v=yDZe_r3QQug

- More complex digital systems that are not only oriented to information delivery (so to merely support the acquisition of knowledge), but are also aimed at supporting the passing down/transmission of specific know how (so to also support the acquisition of specific competences and abilities).

In the following, we will mainly focus on this last category of tools. It is particularly specific of the field of Intangible Cultural Heritage (ICH) which, according to UNESCO [5] encompasses all those “*practices, representations, expressions, as well as the knowledge and skills (including instruments, objects, artefacts, cultural spaces), that communities, groups and, in some cases, individuals recognize as part of their cultural heritage*”.

The above mentioned three different types of ICT tools potentially supporting Cultural Heritage Education also instantiate different types and/or levels of interaction between the software and the user [6]. Virtual Museums (VMs)⁴ use cutting edge technologies and allow an in-depth view of cultural heritage artifacts but, from the HCI viewpoint, often they only offer limited possibilities, mainly oriented to having an exhaustive view of the objects themselves: choosing the item to focus on, zooming in and out, watching them from multiple perspectives etc... Fig.1 shows two screenshots from the Virtual Museum on the Giza pyramids where the users are allowed to make a virtual visit to the Giza archaeological territory⁵



Fig. 1. 3D views from the GIZA 3D Virtual Museum

Some more sophisticated and educationally oriented VMs [7] also allow conducting immersive experiences (e.g. Etruscanning⁶) by also offering the possibility to carry out personalized paths and to customize the view of CH objects. The possibility of customizing the learning paths is also shared by most Serious Games specific of the domain of Cultural Heritage; such tools, by relying on basic game mechanics offer educational experiences where the interaction between humans and the software is

⁴ A specific network of excellence about Virtual Museums has been co-funded by EU in 20010. In the network web site <http://www.v-must.net/> relevant examples can be found and specific features of VMs are detailed

⁵ GIZA 3D by Dassault Systemes <http://archeomatica.it/ultime/visita-virtuale-delle-piramidi-di-giza> and <http://giza3d.3ds.com/index.html#discover>

⁶ <http://v-must.net/virtual-museums/vm/etruscanning-3d-2011-2012>

larger and more advanced. Fig 2 shows a screen shot from the APA game⁷, a Serious Game, set in the 13th century and oriented to inform about the life in the Roman Bologna.



Fig. 2. Screenshot from the APA game

In this paper we focus on the third category of tools mentioned above, namely those aimed at supporting the passing down/transmission of specific know how and we discuss how some issues related to Human Computer Interaction in this specific area can be tackled. This is done by referring to the i-Treasures project which is aimed at designing and delivering an integrated platform supporting the transmission of some expressions of intangible cultural heritage.

2 The i-Treasure Project: An Overview

I- Treasures is an Integrated Project co-financed by EU under the ICT theme (Information and Communication Technologies) of the FP7 (7th Framework Program) which has just started in 2013 and will conclude its activities in four years. It makes an in-depth use of cutting- edge ICT and sensor technologies to sustain the passing down and transmission of ICH in the fields of dancing, singing, music composition and craftsmanship.

The ultimate and main outcome of i-Treasures will be “*an open and extendable platform providing access to ICH resources, enabling knowledge exchange between researchers and contributing to the transmission of rare know-how from Living Human Treasures to apprentices*”. This means that the project aims at going far beyond the simple ICT-enhanced dissemination and the mere digitization of cultural contents;

⁷ The game is developed by CINECA, CNR-ITABC and Fraunhofer Institute see <http://www.v-must.net/vm-blog/apa-game-short-presentation>

it, rather, aims at analyzing and modeling the different ICHs thus supporting the learning of the rare know how behind them and its passing down to new generations.

In particular, in I-Treasures relevant and detailed information on the different artistic expressions recognized as ICHs are obtained from expert performers and researchers in the field and, based on this information, key aspects and features of this ICH are “captured” by using advanced ICT and sensor technologies.

As examples: 1) as to singing the specific vocal emissions are analyzed by tracking the vocal tract of the singers during performance; 2) as to dance, body motion, posture and movements are detected, coded and registered by means of advanced motion capture techniques; 3) as to pottery hand gestures are tracked and coded. A thorough process of modeling the available data is then carried out by relying on advanced Semantic Multimedia Analysis techniques.

This process allows shaping and directing the learning process of apprentices (also through avatars assuming the role of virtual exemplar performers). Learners are exposed to multi-modal and multi-sensory learning experiences, carrying out individual trials and receiving appropriate feedback, so to reach increased levels of competence in an easier, more direct, quicker and effective way [8-9].

The envisaged learning process is, thus, expected to take the learners beyond the concept of “learning by imitation” and will allow them to:

- acquire relevant conceptual information in different formats (audio, video, narrative, etc...),
- view in details the performances of expert artist (and this can be done by each student at his own pace following personalized paths)
- put oneself to the test, carrying out individual trials, receive appropriate feedback (in different formats e.g. audio or video as well) and hints so as to be able to adjust individual performance and reach increased levels of competence in an easier, quicker and more direct way.

The entailed innovative learning/teaching process is strongly based on innovative technologies and tools. Of course, it is not meant to substitute but rather to complement the traditional learning/teaching methods and actions; the traditional role of teachers is not diminished or set aside but rather safeguarded and valued thanks to the provision of new educational tools and related innovative teaching methodologies.

3 HCI Issues in i-Treasures

In the i-Treasures platform users are supposed to interact with the system in order to:

- Learn basic (and, eventually, detailed) information about the specific ICH, (understanding cultural background, viewing/listening to performances, etc...)
- Acquire the ability to perform in the specific ICH so to be enabled to act themselves as performers (thus gaining both theoretical and practical competences)

While the first objective can be easily pursued using traditional online learning methodologies (be they individual, collaborative, based on guided searches or self-

regulated approaches...) the reaching of the second objective is strongly dependent on the use of cutting edge combined ICT and sensor technologies.

If we look at the i-Treasures project from an HCI perspective we must, then, acknowledge that it instantiates a very peculiar situation where the innovative use of multiple sensors plays a major role and, thus, also affects relevant aspects of Human-Computer Interaction. Actually two different types of sensor-based learning processes take place in the different phases of the project:

- One that “goes” from humans to the computer (the capturing via sensors and the modeling of relevant aspects of entailed know how so that the computer is able to master and reproduce it, where the computer learns from humans)
- One that “goes” from the computer to humans (the passing down of the know how acquired by the computer to the actual apprentices/learners, where humans learn from the computers and sensors help the computer interpreting and assessing human performance)

In both cases, the use of sensors is key to the reaching of the intended results: from the one hand, (by tracking experts’ performance) they enable the computer to acquire the information needed to model correct behavior and, from the other, they intervene in the learning process (by tracking the students’ performance) so to allow the computer to assess the apprentices’ performance, in order to fine tune feedbacks and exercises.

In both cases, again, the sensors mediation/interference highly affects relevant aspects of the interaction between humans and the system.

Summarizing we can say that the i-Treasures platform supports both traditional and sensors-based learning actions: it makes an extensive use of sensor technology to support learning but also foresees a variety of more “traditional” learning actions (i.e. typically those related to the acquisition of general and specific information /knowledge on the topic). In an HCI perspective, the interaction between humans and the computer is both mediated or not by sensors.

The basic possible different learning paths (and therefore different types/levels of interactions between the users and the system) can, then, be represented as follows:

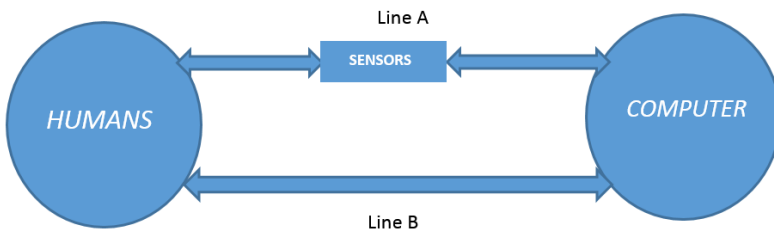


Fig. 3. I-Treasures learning paths in an HCI perspective

Line A represents the sensor mediated path from humans to the computer and vice versa while Line B represents the traditional interaction between the computer and humans and vice versa.

4 HCI Requirements/Solutions in i-Treasures

The i-Treasures project has the main goal of widening as much as possible the access to intangible cultural heritage and of fostering its knowledge, learning and transmission. In this light, while designing the i-Treasures platform, a User Centered Design (UCD) approach [10-11] is being adopted and specific attention is devoted to properly managing all the HCI issues involving the actual relationships between human-users and the system, with the final aim to make the i-Treasures platform easily accessible, comprehensible and useful to the largest possible audience.

Based on these considerations and taking into account the peculiarities of the i-Treasures project (mainly related to the massive use of sensor-mediated learning techniques), during the initial phase of requirements elicitation, a set of detailed requirements for the HCI aspects of the i-Treasures system and platform has been defined.

Ease of use, Multilingual, Personalized and Universal Access are established as pillar-requirements for the system and the platform [9].

Within the consortium it is, in fact, felt as mandatory that the platform could offer equal access opportunities to all users, including those with disabilities, provide relevant interaction facilities to any kind of learner and that different paths could be followed according to the users' specific needs.

Among the non functional requirements, (i.e. among the properties of the system architecture or, rather, the standard "built in" features instantiating how the system is supposed to be), we particularly focused on both "Accessibility" (i.e. features guaranteeing the actual possibility to access and use the system to a variety of users with different abilities) and "Usability" (i.e. general aspects involving the effectiveness, efficiency and satisfaction of use of the system).

As to Accessibility attention has been particularly devoted to "the degree to which the platform and related tools are actually available/can be used by as many people as possible", including people with functional/sensory disabilities such as vision, hearing impairments etc... Requirements in this area should mainly comply with existing accessibility legislations [12].

As to Usability [13], attention will be devoted to the general clarity of the system and in particular, following Nielsen & Loranger [14], to its overall quality in terms of: 1) promptness with which users learn to use something, 2) efficiency they attain while making use of it, 3) how easy it is for them to remember how to use it, 4) how error-prone it is and, finally 5) the level of satisfaction that they attain from using it

The platform will also take into account a wide set of functional requirements, among which all those involving the sensors mediation (as per line A).

The definition of the functional requirements carried out, as said above, during the initial phase of the project, has entailed a complex procedure, which is fully described in Pozzi et al. [9]. As to the specific requirements regulating the Human Computer Interaction issues, they can be basically distinguished into the following categories:

- Sensors-specific requirements, regulating the interaction among human-users and sensors and vice-versa (e.g. Requirement n° 8: *Sensors should not affect or hinder performance and vice versa*)

- Learning-specific requirements, regulating interactions with the LMS Learning Management System (e.g. Requirement n° 18: *The educational platform shall adjust lessons/difficulty levels according to students' characteristics and abilities*)
- Environmental requirements, regulating interactions of the human users with the environment, including both physical objects and places (e.g.: Requirement n° 5: *The system shall adapt to the place where the performance happens*)
- Inter-human actors requirements, including partner-performers in the case of group activities, (e.g. Requirement n° 4: *The system should detect physical interactions among performers in a group*)
- Content-dependent interaction requirements, regulating the interactions of the users with the system but strongly dependent upon the relationship with the specific contents of the learning activities (e.g. for the specific content area of dance related learning processes. Requirement n° 34B: *The platform shall visually highlight the student's mistakes*). In this line, the system design will particularly focus on feedback provision issues; actually, feedback represents a key HCI aspect in all learning systems but in the i-Treasures case, it is vital, being at the very core of the overall educational approach adopted.

In the light of the the requirements defined above, we can acknowledge that the i-Treasures platform will be designed and developed by taking into account the seven basic principles of Universal Design set by the Center for Universal Design at North Carolina State University⁸, namely:

- Equitable use -The design makes the system useful and marketable to people with diverse abilities.
- Flexibility in use -The design accommodates a wide range of individual preferences and abilities.
- Simple and intuitive -The design is oriented to make the system easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
- Perceptible information -The design allows the system communicating necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
- Tolerance for error - The design minimizes hazards and the adverse consequences of accidental or unintended actions.
- Low physical effort -The design entails that the system can be used efficiently and comfortably and with a minimum of fatigue; this principle was partially extended to include due limitation to cognitive efforts.
- Size and space for approach and use -The design of the system foresees that appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

⁸ http://www.ncsu.edu/ncsu/design/cud/about_ud/udprinciplestext.htm

5 Conclusions and Future Work

The paper has briefly discussed around the issue of widening access to Cultural Heritage Education by means of innovative ICT tools. In doing so, it has first casted a glance to the different types of digital resources available for the scope. It has, then, focused on Intangible Cultural Heritage expressions and, drawing on the i-Treasures project, it has also outlined some ideas about the relevant HCI aspects that can contribute to ease access to dedicated resources, increase usability and make more effective the entailed learning processes. The main peculiarity of the i-Treasures project is an in-depth and massive use of cutting edge sensors for supporting learning and transmission of the rare know how behind Intangible Cultural Heritage expressions. The paper has looked in-depth at these aspects, by outlining some Human Computer Interaction related issues and challenges, which take into account the mediation/interference of sensor in the dialogue between the users and the computer systems. In the light of the requirements defined in the first phases of the project (which still is in its initial stages), an attempt has been made to produce a categorization of HCI related requirements for innovative learning systems encompassing the use of multiple-modal sensors. During the following phases of the project, field experiences and demonstrations will be conducted and HCI aspects will be explored in practice so to possibly allow revising and updating the existing list of requirements.

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