# Using Serious Games for Intangible Cultural Heritage (ICH) Education: A Journey into the Canto a Tenore Singing Style

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Abstract:     Serious games are being increasingly adopted to sustain teaching and learning in a variety of educational fields (school education, etc.); the cultural heritage field does not make an exception, especially as far as tangible heritage is concerned. More recently, even in the field of ICH, games have started to be used to allow learning of intangible cultural expressions or traditions (Yilmaz et al. 2015). In the frame of Intangible Cultural Heritage (ICH), ITD-CNR has developed the "Canto a Tenore game", a mixed 2D/3D adventure game, aimed at supporting learning of the basics of this rare singing style, which originated and is still practised in Sardinia (Italy). The idea behind the game is to involve the player in an engaging journey, where s/he has to help the main character, who is currently living abroad, to find his roots in Sardinia. The comprehensive integration of contents in the gameplay, as well as the immersive nature of the 3D environments, allow the user to learn the basics of the Canto in an engaging way. In this paper the authors discuss the main strong points, challenges and criticalities of adopting such technologies.

## 1   INTRODUCTION

In recent years, the growing potential of technologies has started to be exploited in the Cultural Heritage field. Tangible artefacts, as well as intangible heritage expressions, have been digitized with the scope of safeguarding them and making them available for a wider public (Sotirova et al., 2012). These efforts have allowed the creation of large and important repositories, like Europeana, but, also, many Cultural Heritage institutions such as Galleries, Libraries, Archives, and Museums (or GLAM) have started making use of digital resources.

From digitized records to 3D models and applications, technologies are opening new opportunities for Cultural Heritage exploration and fruition: nowadays users can browse digital repositories and see images of artefacts, can visit virtual museums (Styliani et al., 2009) or interact with treasures of the past through virtual reality (Gaitatzes et al., 2001). Recently, the adoption of cutting-edge technologies, like sensors and 3D modelling, have also made the digitization and modelling of Intangible Cultural expressions possible (Yilmaz et al., 2015).

Among technologies, a further step ahead has been taken by digital games and in particular serious games (namely games developed with an educational purpose) which offer fun and engaging experiences during which the user is motivated to keep interacting with the game and therefore its contents (Mortara et al., 2014). Moreover, games are recognized as an appropriate media for both tangible and intangible expressions, considering that they are grounded on several elements – among which interactivity, adaptivity and narrative (Prensky, 2001) – supporting an interactive and situated experience (Bontchev, 2015).

Considering all these aspects, ICTs open up interesting possibilities in the field of Cultural Heritage education. As Ott and Pozzi (2011) state, ICTs allow personalized and inquiry-based approaches, where learners can discover at their own pace and not just "being taught". Moreover, they support situated learning experiences, since learners can use multiple devices and networks, while they are exploring environments (pervasive and ubiquitous learning). Last but not least, technologies give the possibility of supporting informal learning opportunities, namely outside a formal education setting. Therefore, institutions like Museums for example, now have the capacity to involve visitors of all ages in interesting and meaningful learning experiences.

Serious games present additional advantages in terms of learning experience: besides supporting constructive, experiential and situated learning, they are able to promote self-regulated learning and collaboration among learners (Dagnino et al., 2015).

Starting from these considerations, in the framework of the i-Treasures project (Dimitropoulos, 2013) a serious game has been developed about Canto a Tenore. The game has the scope of introducing the basics of Canto a Tenore in a playful and engaging way.

Canto a Tenore is a four-part form of polyphonic singing that is orally transmitted and practised in the central areas of the island of Sardinia in Italy.

A Canto a Tenore choir is composed of four singers with different roles: a soloist (the " boghe" ), who sings the text of a poem, and three accompanying voices ("su bassu, sa contra and su mesu boghe") who support the soloist usually using nonsense syllables (Pozzi et al, 2013). This tradition is fairly well-known and appreciated in the area in which it is spread, but not outside Sardinia and even less around the world. In 2005 it was included in the "Representative List of the Intangible Cultural Heritage of Humanity".

In the following, first of all the i-Treasures project is described, in order to give an idea of the context in which the game has been developed. Afterwards, a short introduction is provided to serious games in cultural heritage. Then, the game development process is presented and discussed, so as to highlight the main challenges encountered.

## 2 THE i-TREASURES PROJECT

With the UNESCO convention (UNESCO, 2003) the safeguarding of Intangible Cultural Heritage has become clearly a priority. Several initiatives have been carried out with this aim, also involving technologies, but most of them were aimed at creating digital archives or inventories of materials, with documental purposes. This effort, which is certainly a starting point, will otherwise have limited impact.

The i-Treasures project is an Integrated Project co-financed by the EU under the ICT theme of the FP7th; this project has the scope of going beyond the current attempts at safeguarding ICH through technologies and going towards ICT-enhanced dissemination and not the mere digitization of cultural contents. The i-Treasures project is developing "*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*" (Dimitropoulos, 2013). With this platform, the project aims to provide new contents and learning opportunities by analysing and modelling the different ICHs and making this specific knowledge available through innovative tools and in structured educational paths (Dagnino et al., 2016).

I-Treasures makes use of cutting-edge ICT technologies in order to capture "hidden" experts' knowledge in a number of cultural expressions in the fields of dancing, singing, music composition and craftsmanship.

Using a multi-sensor technology (e.g. 2D/3D optical sensors, inertial sensors, ultrasound sensors, microphones, electroencephalograms, etc.) the data related to the basic features of the cultural expressions considered were captured, then analysed and merged so as to identify specific patterns (e.g. postures, gestures, audio, affective states, etc.) in ICH performances. These data serve as input to create 3D models of the performers and use them for teaching and learning purposes: recognizing the great potential of games, the project introduced innovative game like applications aimed at teaching sequence of the steps or sounds of different cultural expressions (Yilmaz et al., 2015).

Moreover, in the project framework a game aimed at delivering theoretical information and developing listening competences in users has been developed: the Canto a Tenore game.

## 3 SERIOUS GAMES FOR CULTURAL HERITAGE

The use of games in Cultural Heritage was first explored by Anderson and colleagues (Anderson et al. 2010) and recently sketched by Mortara and colleagues (2014), and Bontchev (2015). While the first two contributions are specifically oriented to serious games, the third includes both entertainment and serious games.

As for entertainment games, Bontchev (2015) highlights the existence of some titles belonging to the group of documentary games, like "*History Line: 1914-1918*" (developed by Blue Byte in 1992) or "*Great Battles of Rome*" (developed by Slitherine Strategies in 2007), that are able to realistically represent historical events like battles or wars. Moreover, he highlights that other popular games, despite being developed for fun purposes, are able to convey accurate information. Among them, he presents the example of the "*Assassin's Creed II*"

game, which includes a number of key elements proper to virtual heritage applications (Granström 2013) and is able to represent the Renaissance period in Italy with great accuracy and realism.

As for Serious Games (SGs), Anderson et al. (2010) describe the following categories:

a) Interactive Virtual Museums - virtual museums incorporating exploration and specific tasks (e.g. quizzes, reassembling tasks) and b) Prototypes and demonstrators – games that are based on 3D technologies to reconstruct historical sites.

Applications like "*ThIATRO*" (Froschauer et al. 2011) belong to the first category. This is a 3D virtual environment, where the player acts as a museum curator, having to collect paintings from different museums in order to prepare an exhibition.

Applications like "*Roma Nova*", an SG based on the "*Rome Reborn*" model (Vourvopoulos 2013), belong to the second category. This game is conceived to support exploratory learning by immersing the learner/player in a virtual environment; the main aim of the game is to help the player learn, by interacting with autonomous characters in a cultural heritage environment, different aspects of history through their interactions with a crowd of virtual authentic Roman avatars.

In addition to these two categories, Bontchev (2015) identifies another two categories:

c) Games for acquisition of cultural knowledge and intangible heritage (for cultural skills and language training) like "*Second China*", a web - based multimedia repository and an island in Second Life designed to mimic cultural and visual aspects of China (Henderson et al., 2008) and "*Icura*" (Froschauer et al. 2010) in which the player learns about Japanese culture and etiquette;

d) Social tagging and knowledge acquisition games – games conceived to encourage players to submit cultural information about cultural artefacts. Among these, "One-Up" is a multi-round mobile app game in which players score points for submitting single-word tags (Flanagan et al. 2013).As for the game type, according to Mortara et al (2014), in the field of CH, SGs of different kinds have been adopted: from trivia, puzzle and mini-games to mobile applications for museums or sightseeing, (e.g. '*Muse-US*' (Coenen et al. 2013), '*Tidy City*'[1]) to simulations (e.g. the '*Battle of Waterloo*'[2]), to adventures and roleplaying games (e.g. '*the Priory Undercroft*', Doulamis et al. 2011).

The Canto a Tenore game presented in this paper can be included in the third category cited by Bontchev (2015), i.e. games for acquisition of cultural knowledge and intangible heritage, since its aim is to spread the Canto a Tenore tradition. It is worth saying that the game appears to be innovative in the field since, to the best of our knowledge, the existing games are more oriented to cultural awareness, rather than to presenting specific cultural expressions.

As for the game type, it clearly belongs to the category of adventure games, since the player is immersed in the main character's search for his origins.

In the following, the game is described, with particular attention to the design process that is clearly a core phase in the development of a game. All the aspects considered in this phase are presented and discussed.

# 4 THE CANTO A TENORE GAME

As said above, the Canto a Tenore game is an adventure game in which the player/learner acquires a basic theoretical knowledge, as well as some listening skills, in this singing expression, by helping the main character, Andrea. Andrea is a young man living in Argentina, who has a very limited knowledge of his origins until he finds an audio tape belonging to his grandfather (containing the recordings of a group of men singing a cappella) and a picture (where his grandfather appears in a group of four people, apparently singing together). Andrea decides to find out more about his origins and starts his search for possible relatives in Italy.

In the following, the game is described, according to the guidelines and principles adopted in i-Treasures to develop all the games of the project (Yilmaz et al. 2015), namely in terms of: 1. Pedagogical aspects; 2. Game structure and 3. Score and performance evaluation (Dagnino et al., 2015).

## 4.1 Game Design

### 4.1.1 Pedagogical Aspects

In line with the literature in the field (Habgood, 2007; Ulicsak and Wright, 2010) the contents related to Canto a Tenore are totally integrated in the gameplay, because the information needed by the player/learner to solve the mystery of Andrea's origins are strictly intertwined with the information about the Canto a Tenore itself.

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[1] http://totem.fit.fraunhofer.de/tidycity
[2] http://www.bbc.co.uk//history/british/empire seapower /laun ch gms battle waterloo.shtml

Therefore, while the declared scope of the game is to find out where Andrea's grandfather was born and whether his relatives are still alive, this objective can be reached only by learning about Canto a Tenore singing. In this way, the player doesn't feel forced to read or listen to singing excerpts, as everything is functional for him/her to solve the game.

Being conceived for youngsters and adults with no previous knowledge of Canto a Tenore, the educational objectives of the game are related to knowledge acquisition and listening competence development, while singing competences are not addressed. At the end of the game the player is expected to have acquired a basic knowledge of Canto a Tenore and to have developed basic listening skills.

A map of the contents to be addressed in the game was drafted with the help of a group of experts in this cultural expression and then the contents distributed in different scenes of the game, so as to be balanced and well-integrated into the narrative and the gameplay. In particular, the theoretical knowledge, mainly related to the historical, geographical and technical aspects of this singing tradition, is delivered through dialogues with the game characters and information retrieving by the main character. Listening competences are trained through listening tasks, aimed at highlighting the main characteristics of this singing style (e.g. the features characterizing the four voices, the different forms of the chant and local variations).

While theoretical knowledge is mainly delivered during the first two scenes, the listening tasks are proposed in the second and third scenes.

In the game the main educational strategies are active (Bonwell and Eison, 1991) and experiential learning (Kolb, 1984), as the player is called on to find and elaborate information to proceed with the game.

Assessment does not imply separate quizzes or tests, but knowledge and skills are assessed through tasks that are perceived as part of the game (the player writes e-mails and a diary at the end of each scene).

Feedback about correctness is provided immediately: the e-mails and the diary are structured as "fill in the blank" tasks, therefore, when the player makes a mistake in his/her text, the system corrects him/her by pointing directly to the resource where the correct information was originally given.

As for the advances in the game, when the player takes a wrong decision, one of the other characters intervenes to help him/her to change his/her mind.

### 4.1.2 Game Structure

As for the general organization in scenes/sessions and the rules guiding the progression from one to the other, The Canto a Tenore game is structured in two main scenes and is placed in two different locations: Argentina and Sardinia. The transition between one scene (location) and the other is done through videos, explaining what the following expected steps are.

An introductory video is also included, to introduce the player to the game plot and to make him/her aware of the scope of the game.

Score and performance evaluation.

The Canto a Tenore game is mainly conceived as a game to be played individually and – as such - doesn't include any mechanism oriented to competition or collaboration.

In this game the player's motivation is expected to be boosted by the solution to the enigma of Andrea's grandfather.

Besides, since the game was mainly conceived as a non-formal or informal learning experience, the player's progress is not evaluated in the strict sense, but s/he gets feedback about the correctness of his/her answers and decisions. As said above, feedback is provided immediately after each task (emails and note writing or decisions taken at crossroads) thus helping the player to find the correct answers or to make correct decisions.

## 4.2 Game Development

The development of the Canto a Tenore Game was carried out using a rapid prototyping approach: several prototypes were developed before reaching the final stage. Initially the game was conceived as a 2D application, but in order to make it more appealing and interactive it was developed with both 3D and 2D scenes, using the Unity3D platform[3].

In the three-dimensional scenes the user can guide Andrea in his exploration of the environments (Figure 1).The two-dimensional scenes are used for Andrea's interactions with other characters (Figure 2) or where the user has to assess his/her knowledge of information collected during the game, in the form of e-mails or notes (Figure 3).

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[3] https://unity3d.com

Figure 1: A 3D scene in which Andrea explores the city of Buenos Aires.



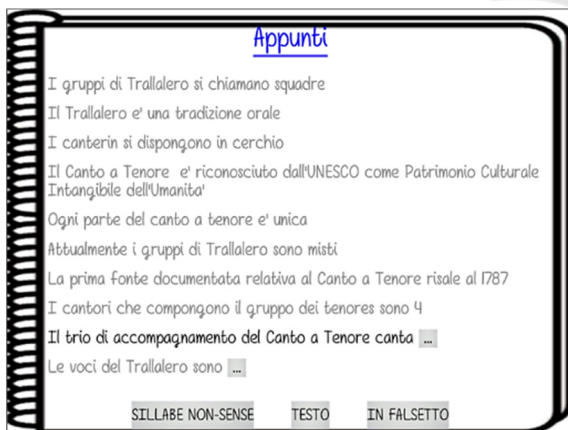Figure 2: Andrea interacts with the music school teacher.



Figure 3: Andrea's notes.

The interactions between the three-dimensional objects and the management of the user interfaces are implemented using scripts written in C# language.

A great effort was applied to manage the graphic aspects of the Canto a Tenore Game. Indeed, to accomplish the three-dimensional view, some standard assets directly downloaded from the official Unity asset store site have been joined with some assets created ad hoc for this game. In particular, the main character of the Canto a Tenore Game is a combination of the outputs given by Autodesk 123D Design, to develop the main structure of the 3D object, Adobe Fuse CC, to manage the animations of the character, and Sculptris Alpha 6 to create the facial expressions.

To create the 2D textures, which represent the main features of the dialogue interactions and of the educational and interactive aspects inside the Canto a Tenore game, a combination of Adobe Photoshop and Adobe Illustrator was used to build the whole images and some particular details of the scenes.

### 4.3 Main Challenges in the Canto a Tenore Game Design and Development

The process of designing and developing the Canto a Tenore game posed several challenges mainly at design level.

The first is related to the objectives and contents of the game. It is worth saying that, like many other traditional cultural expressions, Canto a Tenore is not formally taught. Aficionados and apprentices acquire knowledge about it and skills spontaneously listening to the performance of singers and speaking with them.

Therefore, the objectives and the contents were necessarily agreed with experts depending on the potential users of the game. This required consistent interdisciplinary work involving experts in cultural expressions, educational technologists and developers.

Secondly, in order to avoid a detachment between the contents to be addressed and the game itself, as sometimes happens in educational games, great effort was put into conceiving tasks and integrating them in the gameplay. Indeed, every learning task is functional to progress in the game: information is given in the form of clues and assessed in the form of notes (having a notebook is quite common even in commercial games) or decisions to be taken; the scope is to avoid the player feeling s/he is being taught or assessed with quizzes or something similar, that can hamper the flow.

Last but not least there was a challenge linked with the game development. SGs usually face the limit imposed by a low budget; compared to commercial ones, they are often perceived as less

appealing at graphic and interface level. The same issue was faced for the Canto a Tenore game: the game needed ad hoc drawn assets (the main character, the Sardinian village, etc.) not allowing us to use just the ones already available on the Unity website. Therefore, as said above, the small developers' group put a consistent effort into preparing the 3D and 2D assets with the limited resources available. This effort resulted in fairly good quality characters and environments that of course don't reach the level a player can find in a commercial game but were considered satisfactory.

# 5 CONCLUSIONS

Several authors have clearly stated that digital games, and in particular SG, *per se* present important advantages that make them useful tools in the specific field of CH. As highlighted by Mortara et al. (2014) and Bontchev (2015), in recent years, the development of games also in the area of ICH has been increasing; this may certainly be due to the advances at technological level. In this contribution, the process of design and development of an SG for ICH education was presented. This game appears to be innovative in the genre, because it is oriented to teaching about a specific cultural expression and not languages or traditions. In the paper particular attention has been paid to the guidelines followed to produce a sound product at educational level, at the same time, to provide the user with a playful experience. Following these guidelines faced the design group with several challenges that were briefly discussed.

Future research would be of course advisable in the field, so as to exploit the potential of games to develop meaningful applications, especially in the area of Intangible Heritage.

## ACKNOWLEDGEMENTS

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