SERIOUS GAMES FOR DISSEMINATING THE KNOWLEDGE OF ANCIENT MANUSCRIPTS: A CASE STUDY

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Abstract

In this paper we present a Digital Serious Game set in a medieval alchemical laboratory, aimed at disseminating the ancient knowledge of medicine distillation contained in the famous Adam Lonicer's Kreuterbuch (1569) treatise. The application is based on interactive Virtual Environments and available on multiple visualization technologies, ranging from simple touch-based tablet up to immersive environments such as CAVEs or Oculus Rift. The game comes as the latest development level of a larger international multidisciplinary project meant to explore novel methodologies to raise the awareness about ancient books, in particular the collection of the Gunnerus Library of Trondheim, with a special attention to the public of youngsters.

Keywords

Libraries Archives, Virtual Environment, Immersion, Interaction, Learning, Digital Serious Games

1. Introduction

Virtual Reality (VR) is a complex technology, composed by several low-level technologies (like 3D graphics, robotics, etc…), able to recreate interactive environments wherein users can feel completely immersed on the scene. Nowadays VR is a mature technology in many respects and increasingly used in several application sectors because of its unique features in terms of immersion and interaction. Immersion is the physical feeling of being inside a virtual environment, generally obtained thanks to a set of interfaces that "surround" the user. Interaction instead is the level of capability of the user to modify the surrounding virtual environment receiving feedback to his/her actions. In order to achieve interaction the system must be able to react to unpredictable user inputs, i.e. it must be executed in real-time: it is not possible to pre-calculate the status of the system. Immersion and interaction both contribute to realize the sense of presence, i.e. the feeling of belonging to the virtual world. Immersion, interaction and presence are thus the three main properties of VR.

Immersive VR is characterized by the presence of all the three main properties, as opposed to Desktop VR which is a less immersive (but then again less expensive) experience. Interaction

and presence commonly depend on the complexity of the environment and on the implemented interfaces (Zyda M. 2005). High levels of immersion and interaction often require expensive or large devices hardly available to a mass audience, although the videogame market is pushing in this sense thanks to the increasing availability of low-cost devices (Carrozzino M., et al., 2012).

VR is more and more used in learning because it implies no need of any linguistic mediation between teachers and students. For instance, VR enables paradigm of exploration to acquire knowledge: a Virtual Environment might represent the context in which to simulate activities on which users are trained. Depending on the complexity of the resulting applications, this leads to Simulations (if the virtual experience has all, or most of the characteristics of a real experience) or to Digital Serious Game (DGS) if the virtual experience represents a well-defined subset of the real experience and the fruition is associated with a game paradigm. DSGs can exploit the potential offered by multimedia (and multi-sensoriality in VR systems) in terms of engagement and enables learning-by-doing paradigms: users can experiment in first person what they are learning. VR-based DSGs are learning instruments nowadays widely adopted, whose efficacy has been repeatedly presented in literature (Susi T., et al., 2007, Djaouti D., et al., 2011).

DSGs are classified using several criteria: by the type of the leaning content (scholastic, military, medical, professional, etc…), by the learning theory on which they are based (social, problem solving, cognitive problem solving, knowledge by exploration, …) or by the age of the target users (scholastic, academic, etc. - Ratan R., Ritterfeld U., 2009).

2. The project

In 2011 the Gunnerus Library of Trondheim, a university library of the Norwegian Science an Technology University (NTNU), started a series of activities aimed at disseminating the knowledge of its ancient collections. Interactive multimedia and Virtual Environments were identified as powerful means able to approach new users, especially young people, different than researchers. Grounded on this need, an international and inter-disciplinary collaboration among the Gunnerus Library, PERCRO Laboratory of Scuola Superiore Sant'Anna of Pisa and the Department of Computer Information Science of NTNU, Trondheim was (Carrozzino

M. et al., 2013) was implemented in the framework of the MUBIL[1] research project, ended in October 2013. The project has been structured into three different levels of development.

The first level of development has been named "Touch Book", i.e. a digital copy of a real manuscript/book placed in a three-dimensional context where users can see, zoom and browse the book's original pages, but also explore additional resources (such as transcriptions, translations or annotations) to improve the understanding of the content. As a case study, the Touch Book of the Lonicer's treatise on medicinal distillation (a book of the XVI century, among the most interesting owned by the Gunnerus Library) was implemented. The second step was the realization of the "Augmented Book", a similar metaphor enriching the Touch Book with images, 3D animations and other multimedia elements (fig. 1).
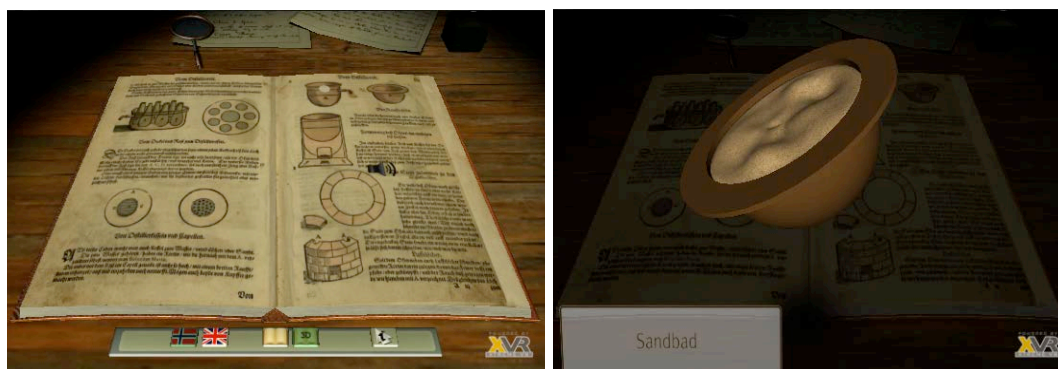

Fig. 1: The Augmented book

In order to realize this kind of applications, we decided to separate the "container" (the book application with all its features) from the content put inside (the text and the contained resources), described by an XML file. The container is an interactive application, realized by means of the XVR technology (Tecchia F., et al., 2010), that parses the XML file and visualizes the 3D book containing all the specified resources (fig. 2). This allows to easily realize new Touch/Augmented books presenting similar features and differing only in the resources. These applications can be run on desktop, tablet and Immersive Virtual environments (like Powerwalls , CAVEs or HMDs, in particular the Oculus Rift) and supports a wide range of interaction devices (mouse, joystick, MS Kinect, wand, etc.).
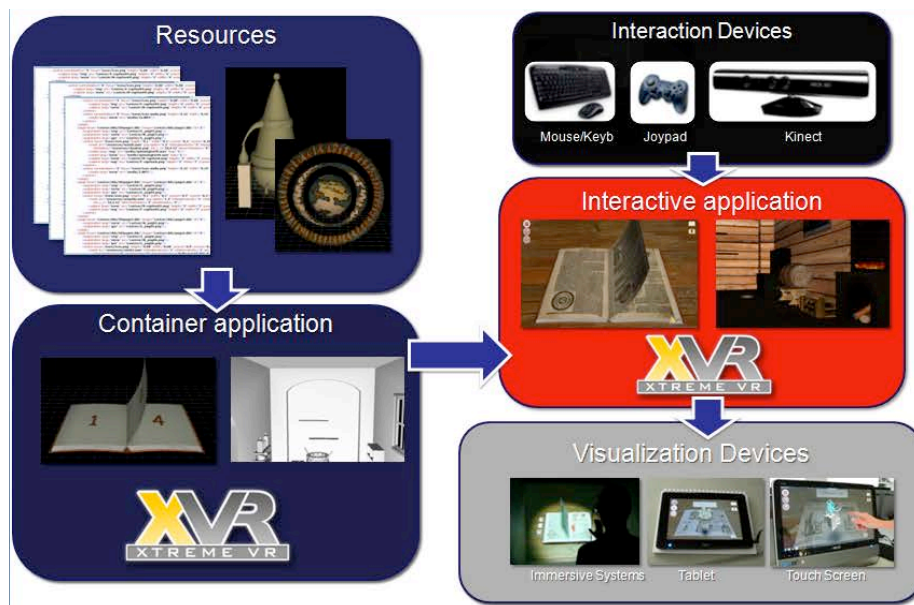
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[1] http://www.ntnu.no/ub/omubit/bibliotekene/gunnerus/mubil

Fig. 2 Architecture of the applications

The third level consists in the Virtual Laboratory, an application connecting the previous levels and allowing the users to apply the knowledge previously acquired in the experience with the Lonicer's treatise. The interactive application simulates an alchemy experiment in a Digital Serious Game structured like a point-and-click adventure game. As the previously mentioned applications, being the Virtual Laboratory based on the same underlying technology, it is adaptable to all the visualization and interaction devices previously mentioned, including the Oculus Rift (fig. 5).

3. The virtual laboratory

In this VR-based DSG, the user plays the role of an apprentice of an ancient alchemic laboratory, called by his master to distill a medicine. The procedure to realize the drug is illustrated inside the Lonicer's book.

Also in this case we used an approach based on a container (the application who interprets and regulates the information) and contents (the information). This enables the easy expansion of the game or the cost-effective creation of similar games. The architecture is based on a series of XVR libraries and an XML grammar used to define the resources needed by the environment and the relationship between the user's interaction and the defined objects.

The XML file describing the game presents configuration information, a set of resources (images, sounds, video, 3D objects) and finally the game mechanics, described using a set of different actions, divided by typology, conditions and reactions. These actions can be timers or interactions with scene objects. Game actions becomes available on top of "enabling conditions": if these are verified, the action can be executed. The execution can modify the aspect of the scene or generate a modification of the enabling conditions, causing the activation of another action. Using this system of enabling conditions, actions can have a progressive hierarchy but it is also possible to build an ordered sequence among then. Moreover, actions can be executed also in parallel.

At the beginning of the Lab game session, the user is asked to select the language (so far only English and Norwegian are available). The game than presents an introductive screen (fig. 3) resuming the game interface, with the alchemist's voice introducing the gamer to the interactive experience.

Fig. 3 The start screen

The user is immersed inside an alchemy laboratory of XVI century, with plenty of ingredients and tools (essential or useless) among which he/she will chose the ones needed to realize the drug. The essential steps to be accomplished are:

- Preparation of the furnace;
- Preparation of the ingredients mixture;
- Positioning of the mixture in the double boiler inside the furnace;
- Hermetic lock of the furnace;
- Refill of the furnace with embers;

- Management of the temperature and velocity of distillation.

Some of these steps are not sequential. For example, it's possible to start the furnace after the insertion of the water or prepare the mixture irrespective of the previous steps. In addition to the essential steps required for the creation of the drug, there are other actions not explicitly required but essential to proceed. For example no container with water is available, but there is a void container and a barrel from which the user can obtain the water. Similarly when the embers are finished, users can refill a fireplace using fresh coal so as to produce new embers (fig. 4 and fig. 5).

The game is provided with sounds that reward the correct actions and actions that advice for users mistakes (for example, a wrong choice of ingredients) and suggest to seek help if the user makes more than three mistakes. The help is provided by a copy of the Lonicer's book placed on a table (fig. 6).

To evaluate the temperature of the furnace, the user can observe the distillation velocity (which must be not too fast) or the quantity and the typology of the smoke produced by the combustion. The management of the temperature is made possible using different strategies: it is possible to decrease the temperature inserting clay plugs to the oven (which change the air inflow) or, vice versa, increase it removing these plugs or filling new embers inside the oven (fig.7).
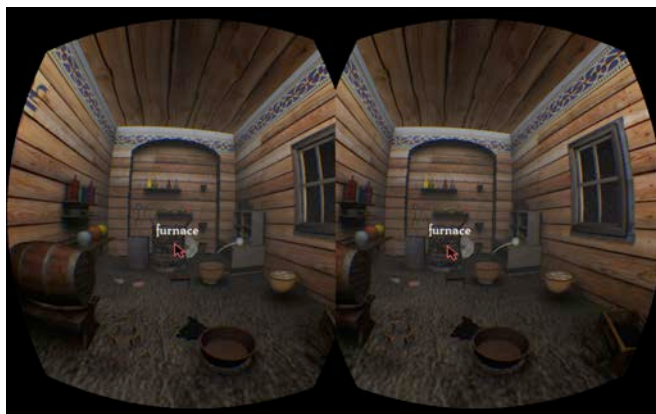

Fig. 4 First steps in the laboratory

Fig. 5 First steps using Oculus Rift

Fig. 6 The guide book

Fig. 7 Distillation

4. *Conclusions*

All the applications realized for the MUBIL Project are contributing to promote Gunnerus Library contents through public events. Furthermore, they are currently under test and evaluated by a group of users. In the next future these applications will be installed inside the NTNU Museum of Natural History and Archaeology connected to the library.

The Virtual Laboratory is designed on top of a generic framework allowing to extend the application to other experiments, this way enabling a more complete and engaging fruition of the Lonicer's treatise. Furthermore it allows also to realize completely different Serious Games aimed to different user targets or learning contents (Brondi R., et al., 2014).

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