Information Landscapes for the Communication of Ancient Manuscripts Heritage

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Abstract — **Ancient manuscripts are an important form of heritage and knowledge which is conventionally hard to disseminate to the general public because of restrictions due to the need of physically preserving the original tomes from the wear and tear of time and man-made damages.**

The MUBIL project involves museums, libraries and ICT academy partners with the aim of developing a consistent methodology enabling the use of Virtual Environments as a metaphor to present manuscripts content through the paradigms of interaction and immersion. This paper presents the results of MUBIL research applied to the case of an ancient travel journal written by the Norwegian scholar Lilienskiold presented under the form of Information Landscape (IL). In ILs information is distributed onto several ideal planes enabling the access to the book content in different ways: digitization of the original pages, transcriptions, 3D animations, explanatory movies, audio narrations, excerpts of text, glossary entries and 3D models, explored with a guided navigation or in a free interaction mode, all concur to the realization of an enriched experience which is expected to become an important aid to the communication of this undiscovered heritage.

Keywords—Museums; Manuscripts; Virtual Reality; Information Landscapes

I. INTRODUCTION

Cultural heritage institutions such as museums or libraries play an important role in informal education and learning, and to this purpose they are increasingly encouraging a larger and more direct involvement of the public.

Virtual exhibits [1][2], 3D reconstructions [3], multi-modal interactive Virtual [4] or Augmented Reality [5] interfaces and other cutting-edge technological solutions are more and more commonly used to establish novel activities that convey information for knowledge construction, acquisition and integration.

Many recent studies have investigated the benefits of VR-based tools in museum learning activities [1]. In particular, when dealing with youngsters, it can be observed that gaming activities motivate students to interact and to be engaged throughout the learning process in a way that is meaningful for them [6]. Learning by playing has proven to leverage students' experience with the learning context and increase the educational effectiveness [7].

The Gunnerus Library, instituted by the Norwegian Royal Society of Science and Literature in 1670, hosts a collection of rare and ancient manuscripts which constitute a valuable patrimony related to the historical culture of the whole Europe.

This important form of heritage and knowledge is conventionally hard to disseminate to the general public because of restrictions due to the need of physically preserving the original tomes from the wear and tear of time and man-made damages. Web delivery of digitized copies of manuscripts is an important resource allowing a potentially unlimited access to such heritage which, however, remains often limited to specialists.

It is therefore valuable to investigate novel means to make such content more appealing in order to involve a larger audience.

II. THE MUBIL PROJECT

The MUBIL project, participated by the Gunnerus Library of Trondheim, Norway, the Norwegian University of Science and Technology NTNU (Norway) and Scuola Superiore Sant'Anna (Italy), aims at exploring the role of ICT tools in learning through the lens of mixed environments at museum-archive visits and at investigating novel design models for activities that can support learning adapted to school programs.

MUBIL involves museums, libraries and ICT academy partners in order to develop a consistent methodology enabling the use of Virtual Environments as a metaphor to present manuscripts content through the paradigms of interaction and immersion, evaluating different possible metaphors.

Fig. 1. Excerpt from the Lonicer's Manuscript

The first developed prototypes are related to two books belonging to the historical archives of the NTNU Library Gunnerus branch, selected based on their peculiar content and their suitability to be presented through interactive virtual representations.

The first one (Fig. 1) is a treatise on medicinal distillation, written by Adam Lonicer (1528-1586). The second book is a travel itinerary, written by an aristocrat from Bergen, Hans H. Lilienskiold (1605-1703), describing his trip to Europe in 1670. The two books are rather different not only because of the topic they address, but also in the type of content. The first book is full of wonderful illustrations referring to objects, tools, plants, animals, etc. It was almost natural, therefore, to conceive a VR-based experience where the book is transformed in a kind of 3D pop-up book (Fig. 2).

Fig. 2. Lonicer's augmented book

This prototype concept, which we have defined *augmented book* [8], preserves the physical shape of the book as such: the 3D environment is basically an ancient desk on top of which is placed the 3D model of the book which can be browsed with natural gestures (different interaction devices, ranging from traditional mouse/joystick to touch-screens or Kinect are supported). On each page a set of relevant hotspots, commonly spatially referenced in correspondence to the illustrations, are placed and can be interactively selected. Upon selection, a 3D model of the related object pops-up from the book and floats

above it, with an accompanying audio narration explaining the tool and its functionalities. Although the user can access this application also on normal PCs/notebooks, it is better experienced through immersive stereoscopic visualization systems such as CAVEs or Powerwalls. Additional layers of information relate to transcriptions and translations of the original text, explanatory labels, audio, sounds, movies and real-time 3D animations.
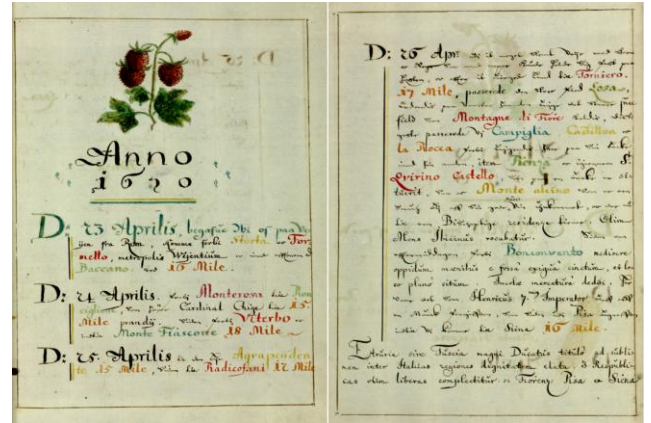

Fig. 3. Excerpt from the Lilienskiold's Manuscript

The second book, instead, presents a very different layout (Fig. 3). Being it a travel journal, the manuscript is mostly made up of text with a few illustrations. Although the augmented book concept is adaptable to all books, as the application is conceived in order to easily separate container and content, this metaphor is not suitable to all books, Lilienskiold's journal being an example. We needed a way to emphasize the text without turning down the opportunity to enrich the content with the typical elements of virtual environments which commonly trigger a better involvement of users and make them enjoy the experience. For this kind of books, we identified Information Landscapes as one of the most suitable representation metaphors.

III. INFORMATION LANDSCAPES

Virtual worlds are not always the simulation of real ones. In Virtual Reality many levels of abstraction may exist and the represented environments can range from realistic to totally abstract digital scenarios. Among the latest, Information Landscapes [9] are a noteworthy example.

The term "Information Landscape" has been coined by Muriel Cooper [10]. ILs are virtual environments where a set of information entities (text, sounds, images, 3D models etc.) are represented in the 3D space with a well determined spatial organization and opportune connections.

The first notable feature distinguishing Information Landscapes from conventional VEs is that in ILs the most important virtual entities are the text surfaces, which also constitute the main portions of the virtual space which the user is enabled to interact with.
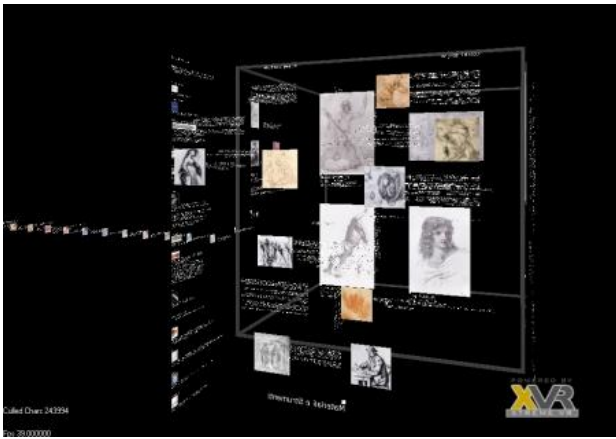
Fig. 4. Example of Information Landscape

David Small [11] used the metaphor of *constellation* in order to indicate the visual effect generated by one of the possible bunches of text represented in an IL, observed by a natural distance at the beginning of the navigation (see Fig.4).

The aim of an IL is not to exactly represent the reality, but rather to go with the user through a path of knowledge inside a completely abstract world. Inside an IL, information is presented in a layout commonly designed to present semantic significance, allowing the user for an immediate interpretation of the presented concept. The IL is conceived to bring users directly inside information, so that learning originates from their exploration of that world.

User interaction with the landscape can be completely free or take place through a constraint navigation activated by links, which allow readers to follow a pre-defined interpretation of the logical structure of information. In ILs links are very similar to hyperlinks, i.e. they allow to connect two entities; the main difference is that the connection is not instantaneous: IL links are implemented by means of viewpoint movements pre-defined by the landscape author (through customized parameters such as trajectory, time of traversal etc.). This means that additional semantic significance can be associated also to links, as following a link is not just a teleportation but rather a travel.

Another difference with traditional hypertexts is that ILs allow to constantly keep the vision of the context where a specific information is placed and, through the free navigation metaphor, they enable a real "non-sequential" rather than a "multi-sequence" approach.

Designing an Information Landscape means to follow a process that is articulated in five stages:

- Design of a script/storyboard

- Identification of the information entities

- Design of the layout

- Connection between the entities (linkage)

- Customization of the user interaction

In order to facilitate the user exploration, interaction, understanding and search of information, it is needed to carefully identify and organize the objects and the related layout; access to information must in fact be as simple and intuitive as possible.

The first two stages are more conceptual; the third stage can start from a free-hand draft but must be finalized with the *IL Author* software application. This Integrated Development Environment, whose first version has been developed in 2003, has been redesigned from scratch to address some of the functionalities needed by the Mubil IL and to cope with more general exigencies to which the support was lacking in the previous version. This software offers two main functionalities: the *editor*, enabling the design and the construction of the landscape, and the *viewer*, which allows to verify step-by-step the final result and each introduced modification.
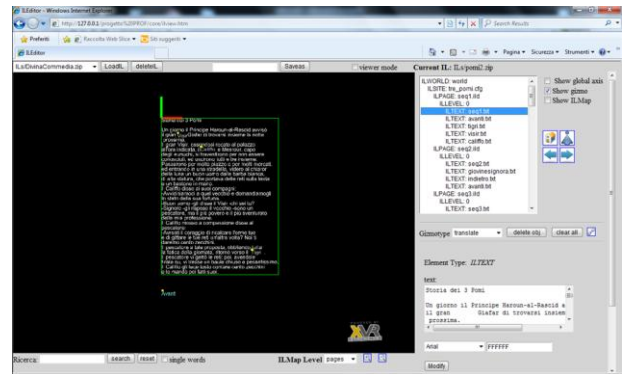

Fig. 5. A screenshot of the web-based IL Author window

IL Author can either run as a stand-alone application or as a web-based application allowing to cooperatively work on a shared landscape and to centralize storage and usage of resources. The software (Fig. 5) presents a WYSWYG interface; at the center of the screen the current layout of the landscape is shown in a real-time 3D window using the XVR [12] technology. By default the window shows a simple template constituted of one single text element, i.e. the sentence "Hello World by IL Author". This IL can be used as a starting step for the creation of any other landscape; otherwise it is possible to load an existing IL. On the right of the 3D window, a panel shows a list containing the hierarchical structure of the landscape. An IL is composed of a root node (ILWorld) which can contain one or more sites (ILSite) each composed of one or more pages (ILPage). Pages can be organized into several levels of detail (ILLevel) that are shown depending on the distance between the viewer and the page. Each ILLevel can contain objects of different type: text, images, video, sounds or 3D models. Below this panel the interface presents the property panel, allowing to modify the properties of the selected node (position, orientation, content, color, etc.). The spatial properties of objects (position, orientation and scale) can alternatively be modified directly inside the 3D window through a series of graphical gizmos. Other commands permit to edit, rename, delete and add objects.

One of the most important steps is the creation of links, as they constitute the particular strength of this kind of virtual environment.
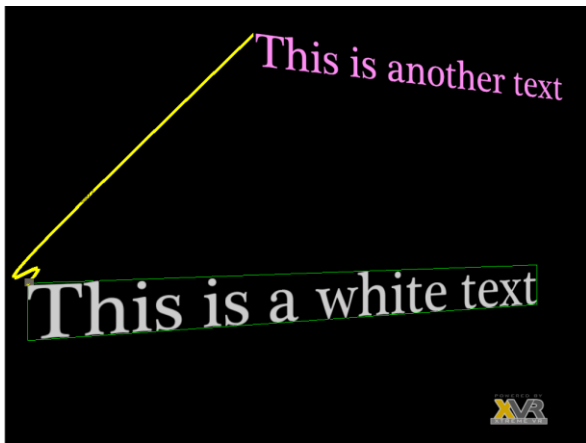
Fig. 6. An example of link between two IL objects

Creating a link is as simple as clicking on the two objects that must be connected. Once the link has been created, a curved thick line (Fig. 6) connecting the objects is visualized. By clicking this line it is possible to modify parameters such as the target position that the camera will reach at the end of the movement (in relative coordinates w.r.t. the target object reference system), the curvature, the speed of the animation etc.

The editor includes also a search box in order to assist the author in the retrieval of a given text information. The viewer mode does not include many of the elements of the described GUI, being limited to what is actually needed for the exploration of the landscape, i.e.: the 3D window, the search box and, optionally, a 2D map of the landscape - useful when dealing with large landscapes which might cause readers to get lost in free navigation - which uses a particular color code to identify the height of the elements and therefore provide hints related to their 3D spatial localization. As any other XVR-based application, ILs can be viewed either with a plugin for the Internet Explorer web-browser or with a stand-alone executable.

IV. AN IL FOR THE LILIENSKIOLD MANUSCRIPT

The Mubil IL (Fig. 7) focuses on the transposition of an ancient travel journal written by the Norwegian scholar Lilienskiold, born in Bergen in 1650. When he was 18 he started his Grand Tour to Europe which consisted in visits to several countries, including Italy. After coming back home he wrote a book describing to this experience, one of the chapters being dedicated to the town of Pisa.

Fig. 7. Entering the Lilienskiold IL

In part for this reason (it constitutes an ideal bridge between the two countries involved in the project), in part for its content (the Lilienskiold IL is centered on the metaphor of a trip from Norway to Italy, and the original book presents many information which lend themselves well to serve this purpose) this manuscript appeared to be the ideal choice to implement the IL concept. ILs in fact allow to enrich and deepen information not only related to the text itself but also to a wider context. As a matter of fact this IL includes also information related to the author and his historical period, as well as a glossary of the most relevant terms referenced in the text.

The IL design has been iteratively addressed. First of all a draft storyboard was agreed together with the design of the information layout in terms of placement in the space, type of content (audio, video, text, 3D objects, etc.) and interaction design.

The first version was devoted only to information extracted from the original text. Excerpts of the book text were placed around a plane onto which a map of the town of Pisa has been applied, together with images and 3D models of the most relevant points of interest of the town described in the book. For instance, in correspondence to the Cathedral Square, 3D models of the Church, the Bell Tower, the Baptistery and the Monumental Cemetery have been introduced, together with Lilienskiold descriptions of the monuments (Fig. 8).

Following the first beta edition, it was decided to improve upon this version on different levels. Being text the main component of an Information Landscape, particular care was put on the choice of the font. The first version presented a "standard" white serif font on a black background, as in most of the previously developed ILs; this is mostly due to the fact that this combination strongly emphasizes the metaphor of a constellation of words floating like stars in a nightly environment. From a more practical point of view, it offers a very good readability and reduces the need of having many complementary elements in the background. However the general effect proved to be too abstract; while in Information Landscapes this is commonly not a drawback, in this specific case we wanted to have something more deeply connected with the physical substance of the book. Therefore we opted for a yellow-earth background and a black text, more directly associated with the pages of the real book.

Fig. 8. Pages of text in the IL environment

This association has been even more strongly highlighted with the introduction of an additional layer of information, metaphorically represented as a new platform connected with the first one by a floating staircase, containing the digitization of the original book pages (Fig. 9). A further level is represented by the glossary, also represented as a platform on a different plane, containing detailed explanations of terms referenced in the original text to which they are linked.

Fig. 9.   The platform with the original book pages

As far as the user interaction is concerned, this IL can be navigated in two main modes: free exploration, where users can freely move inside the virtual environment by means of mouse/keyboard, or guided navigation. The guided mode provides a more structured storytelling, carefully designed in the storyboard, and fully exploits the mechanism of linking typical of Information Landscapes. Each item, in fact, can be linked to another item placed inside the same environment; when a link is selected the virtual camera automatically moves smoothly so as to face the object targeted by the link. So far, the implemented metaphor is based on simple mouse clicks (or other equivalent supported devices such as joystick, keyboard, touchpad etc.) which trigger two different behaviours: right-clicking on an item activates a camera animation bringing to a close-up on the item itself, whilst left-clicking on an item triggers the camera to follow the link (if any: as in hypertexts, an object can be linked by many items but at most to one item) enabling a close-up on the linked item. The two modes are present at the same time, so it is possible to follow a chain of links and, at a given time, to proceed autonomously. In order to prevent users from getting lost, a navigation history mode is available, bringing the camera close to the latest visited links. The Information Landscape Engine has also been improved in order to fully support immersive devices such as CAVEs and Powerwalls, and in order to support the insertion of multimedia elements such as videos, music and 3D audio.

The first visible item of the Lilienskiold Information Landscape is actually a video animation acting as a presentation of the subject and showing a character (meant to be Lilienskiold himself) riding a horse and travelling from Bergen to Pisa. The audio track describes the purpose of the IL and some basic information about the author and the manuscript. Following the link starting from this item an image representing the coat of arms of the Lilienskiold family is reached, which below presents the text "Coat of Arms" in turn linked to the corresponding entry in the glossary. Navigating the next object, an image extracted from the original book is presented along with a link to the corresponding digitized page placed in the original book platform. Therefore since the beginning the user is gradually introduced to the interaction and the visualization metaphors of Information Landscapes and, at the same time, to the topic of the book. From here on, the user can follow the steps of the author's travel discovering Pisa.

All the book excerpts, presented as pages of floating text, are written in the original language, i.e. Norwegian. However, each of these pages presents in the bottom a button triggering the playback of an accompanying audio narrating the same passage in English. Page by page the most important sights of Pisa are described: Piazza dei Cavalieri, the University, the Church of Santo Stefano, the Cathedral Square, the Church of Spina and many others. Each of these elements is accompanied either by a stylized 3D silhouette onto which the element picture is mapped or by a proper 3D model.

The last sequence of the landscape (Fig. 10) is dedicated to the ancient city walls and is placed on the map close to the channel bringing to the sea. The object is linked to the first object of the central platform allowing, therefore, to restart the route from the beginning.

Fig. 10. An overview of the main IL level

V.   THE EVALUATION FRAMEWORK

The main research frame of the Mubil project is to investigate different modes of interaction between new groups of users and the historical collections of the NTNU University library. Through a user centered research approach we focus on the creation of an educational landscape of digital humanities for our institution. The interactive and immersive character of the proposed virtual environment is expected to reinforce the active participation in knowledge seeking activities at the Mubil lab. Users are invited to interact with the collections through hands-on tasks and subject specific assignments prepared by their teacher in advance in collaboration with the lab. The visits to the Mubil laboratory are the observation field of our research. The students are invited to cooperate and perform certain tasks in groups, in a blended environment of a physical laboratory installation and an immersive virtual environment. The main research frame

and the tasks of this knowledge course are introduced to them before and during their visit. A focus group has already been invited to three successive visits to evaluate the lab applications. During those visits we collect our primary and secondary data by using mixed methods as:

1. Pre and post tests
2. Video recording of student performance during the lab-visits.
3. Preparatory Field notes, visit observations and interviews of the participants.
4. The curriculum products, the student reports and the evaluation of the teacher.

The final applications will be completed by October 2013 and the lab visits will continue with testing the lab concept throughout 2014. An analysis of the data will be conducted through 2014 and a series of publications has been planned. The project has been presented in several major conferences and has already established a website, a Facebook page and a blog page. A neutral partner from the Museum sector will also be invited to observe and evaluate the overall architecture in 2014.

The third partner at NTNU, Department of Computer and Information Science (IDI), is providing the project with the software expertise needed to test and evaluate the augmented board and software application under the supervision of Prof. Letizia Jaccheri. The IDI provided already the project with an arena for testing the dissemination objectives and the communication strategies.

Mubil was the stakeholder in a course offered during the spring semester 2012 by the NTNU University at the level of master studies. The course is called Experts in Team and is offered to all masters students of our university. Students work in interdisciplinary groups developed various dissemination ideas and four student reports. Their involvement and ideas helped the project to test its research questions in an academic forum and brought new ideas to the virtual design strategies.

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