Labyrinth 3D. Cultural archetypes for exploring media archives

(Article begins on next page)

12 January 2025

iris - AperTO

Labyrinth 3D. Cultural archetypes for exploring media archives

SCHOLARONE™
Manuscripts

Labyrinth 3D. Cultural archetypes for exploring media archives

Since the advent of the World Wide Web, online media archives have changed their audience from a restricted number of professionals and amateurs to the general public. This shift is not without consequences: if, on the one side, it represents an important opportunity for archives to engage in a dialogue with a larger audience, on the other side it advocates novel forms of access that go beyond the highly specialized models underlying traditional access tools. In this paper, we propose to use 3D graphics for designing novel tools of exploratory search in cultural heritage archives. Our approach has been deployed as an online virtual environment where the user can navigate the meaning relations over the items in the archive. Targeted at cultural heritage, the application, called here Labyrinth 3D, relies on the use of cultural archetypes to inform the conceptualization of the archive and the creation of the virtual environment, with the goal of engaging the user in the exploration of the archive through the creation of personal paths.

Keywords: media archives, 3D environments, exploratory search, cultural heritage, archetypes

1. Introduction

In the last decades, the advent of the Wold Wide Web has led public institutions and private actors (the latter also known as creative and cultural industries - CCI), to publish their media archives online, dramatically increasing the range of cultural contents that are available to the general public. Online digital archives innovate the access of cultural resources (Bolick, 2006, Haskins 2007, Beer & Burrows 2013), advocating new forms of curation and access to cope with what has been called the "data deluge", generated by the digitalization process and the advent of born digital data (Hey and Trefethen 2003, Beagrie 2008). The rich variety of online imagery, text, and other

resources raise new challenges to the traditional paradigm of archive access, stimulating novel and interactive methods that culminate with the emergence of "archive inspired" creativity. For example, the artist Shimon Attie (Popescu 2012) creates multimedia art installations where archive materials such as film footage and pictures become part of an immersive audience experience; similarly, the work "Were the house still standing", designed by a multi-disciplinary team of artists, photographers and sound designers, is a multimedia installation about the Holocaust, which incorporates archival recordings and images into a poetic storytelling (Katz and Quin 2012).

As noticed by Chen et al. (2005), the openness of digital archives implies the coexistence of different user perspectives over the archive contents, ranging from the historical and archaeological stance to the iconographical and cultural one. In order to support multiple perspectives in the access to the archives, Chen et al. propose the insertion of an explicit "abstraction layer" into the architecture of the digital archive, to acknowledge the relevance of the conceptual models employed by the users in the interpretation of the archive contents.

In this paper, we join Chen et al.'s notion of abstraction layer with the paradigm of archive-based creativity by proposing "cultural archetypes" as conceptual tools that support the construction of personal paths through digital archives. Inspired by the research in iconology (Van de Waal1974, Warburg and Birnk 2008), literature (Highet 1949) and narratology (Thompson 1955), we employ the term 'archetype' to refer to a conceptual core set at the intersection of narrative motifs, iconological themes and classical mythology. Common examples are the archetypes of "journey", " labyrinth", and "hero": deeply rooted in collective consciousness, as stated by C. G. Jung (1981) and enforced by the practice of imitation in Western Culture, these archetypes possess

the unique capability to create a multiplicity of links over heterogeneous resources

within shared, unifying conceptual models.

In our proposal, the cultural archetype motif deploys an online exploratory

environment through the selection of one virtual archetype that inspires the design of a

graphic dynamic interactive interface, and the organization of a number of archetypes -

collected after the study of the archive -, for the design of the user interaction. In

particular, the graphic interface is a realization of the well known archetype of the

labyrinth, introduced by the myth of the Minotaur but retrievable even in contemporary

culture (e.g., J.K. Rowland's Harry Potter's novel about a "goblet of fire", where a

tournament is partly held in a hedge maze) and spanning distant geographical locations

(from, e.g., Cnossos Palace in the island of Crete to the city of Reims in France, where a

well-known labyrinth is represented in the cathedral). As surveyed by Kern (2000),

different realizations of the archetype of the labyrinth span worldwide across ages,

ranging from the representations provided by ancient civilizations all across Europe to

the mazes created in the last century, with mirrors and hedges, for entertainment (for

example, the well known hedge maze in Hampton Court). The virtual environment, that

we will term Labyrinth 3D in this paper, has been designed with the goal of supporting

the archetype-based exploration of media archives: the user is immersed in a 3D maze,

where the locations, corresponding to archive items, are connected through pathways

created dynamically, following the meaning relations that are inferred automatically in a

computational ontology of archetypes. Turning point after turning point, the user

decides where to direct her/his exploration, based on her/his curiosity about the

categories of the archetypes ("character", "story", "action", "object", "place", and

"epoch") represented in the ontology. As she/he advances in the maze, following

personal choices driven by the preferences for the archetypal category, a path emerges, connecting distant items,.

This paper is structured as follows: after describing the motivations and requirements accounted for in the system design (Section 2), we illustrate the sources of inspiration that informed its design (Section 3) and how they eventually shaped the implemented system (Section 4). The description of the system abstracts from technical details to focus on the user experience, that we describe through a navigation example. An account of the feedback received from the audience (Section 5) and the conclusion end the paper.

2. Background motivations and functional requirements

The digital convergence that has recently affected the access to cultural heritage and the distribution of media objects brings content producers and consumers to share and generate contents, working alongside the traditional paths of cultural markets and education (Jenkins 2006). In the access to cultural heritage, digital convergence has favoured the development of digital platforms, such as online museums and cultural websites, aimed at encouraging the approach of the general public (consider, for example, the well known Europeana web portal[1]). Notwithstanding the disruptive potential of the convergent culture, however, the access to digital media archives is still largely based on keywords and/or tags, through which the users can filter contents to find what they need. Personalization and integration with social networks have been exploited to innovate the relationship of the archives with the audience, but the basic access paradigm has not changed yet. Rather, the research has focused on the design of

---

[1] www.europeana.org

effective search tools, integrated by personalization and recommendations, without affecting the general framework depicted above, which is based on formally specified queries. As a result, a change of paradigm in archive exploration has not been accomplished yet: the access to online archives still relies, in most cases, on the metaphor of the traditional archive, where a collection of physical items are described in a catalogue by subject, title, etc., and the access to them is obtained by searching various indexes implemented on the catalogue. A search in a digital archive normally returns a list of relevant objects (books, pictures, videos, etc.), without an explicit representation of the meaning relations over them, with the exception of from spatial and temporal representations such as maps and timelines. The advent of the Semantic Web can compensates for this lack, but the complexity of relations encoded in the formal languages of the Semantic Web may exacerbate the presentation issues. Pioneering attempts have been made at using different type of conceptual categories to describe archive contents: for example, the Agora project (Van Den Akker et al. 2011) describes artworks in terms of the historical events they refer to; the Decipher project relies on a story ontology to support the creation of "museum narratives" (i.e., story-based collections of artworks) by curators (Mulholland et al. 2012). The access to digital collections, however, still relies on traditional metaphors that replicate a physical equivalent, such as the archive or the museum.

Our proposal relies on three main premises.

The first premise concerns the inadequacy of search based tools to the needs of the general public, recently pointed by Hall (2014): in most cases, people approach an archive without a specific set of items in mind - or, even worse, without a specific set of constraints to form their queries. According to Hall, access tools should specifically support the exploration of the archives by the users: the notion of *exploratory search*

(Marchionini 1996), characterized by serendipity, is especially suitable to the needs of non professional users, who approach an archive without any specific search goals in mind, but with the simple desire to explore its contents. In our proposal, the key to the access is the notion of archetype: this notion provides an explicit *abstraction layer* for archive access, open to the creation of personal paths through the contents, and identifies the specific archetype of the labyrinth to devise a spatial metaphor for supporting the exploration task in a virtual space.

The second premise concerns the tradition of organising cultural artefacts along thematic categories based on their historical, geographical and iconographical features, whose importance is emphasized by the multidisciplinary perspective of digital convergence (Trant 2008). This practice not only underpins the use of timelines, maps, and advanced visualizations in online digital archives, but brings with it the established use of spatial layouts to convey categories. Consider, for instance, the use of spatial layouts in cultural spaces, such as exhibitions and museums, to create thematic sections and paths (Hillier & Tzortzi 2006). Our approach adapts this paradigm to the exploration of archives: we propose an especially designed, virtual environment that the users explore to access the contents of the archive through the archetypal visual metaphors of the labyrinth, with the causal and associative relations over the contents represented by a maze of physical connections.

The third premise concerns the use of visual technologies, employed in today's applications that range from video games to edutainment and installation art, and capable of providing immersive, engaging user experiences (LaViola & Keefe 2011). The use of 3D for data visualization relies on the process described by Manovich

(2011), by which the properties of the digital medium, through the use of specific

software for editing, sharing, and analyzing digital data, shape the actual content to be

conveyed: 'all 'properties of digital media are now defined by the particular software as

opposed to solely being contained in the actual content' (p 30). However, these

properties by themselves do not ensure the reception of the intended conceptualization:

as argued by Ziemkiewicz -Kosara (2008), based on their empirical studies, the choice

of the visual metaphor is crucial to communicating a conceptual model to the users, that

goes beyond the properties of the medium. Moreover, Rieber & Noah (2008) show that

a carefully designed balance of visual and game elements in educational applications

provides a more effective transmission of the notions to the users. Here, 3D

visualization is put to use for engaging the audience in the exploration of data through

the archetypal element.

3. Inspirational works

The conceptual model encoded in Labyrinth 3D is inspired by the notion of

cultural archetype, set at the intersection of categories of prominently narrative nature,

namely character, story, action, object, place, and epoch. Stories provide an effective

conceptual model for mediating between the user and the description of the cultural

artefacts, thanks to the relevance of narrative cognition for the transmission of cultural

values (Bruner 1991). The content of visual artworks, in particular, can often be

described in terms of some narrative situation, i.e., a basic template where a character is

depicted in the intentional act of doing something, using some instrument, as part of the

achievement of some goals that characterize her/him. An example of the role of

narrative templates in iconography is provided by Iconclass (Van de Waal, 1974), a

thesaurus of subjects employed to classify art objects according to their iconographic

content: with more than 4000 occurrences of story-related categories, Iconclass includes

specific categories of narrative nature, such as classical mythology. The reference to

narrative entities, then, is not limited to visual artworks, but extends across media and

genres, ranging from music to novel (Almén 2003, Ryan 2004), further propagated by

the practice of remediation (Bolter & Grusin 2000).

A notable reference is provided by Warburg 's Mnemosyne project (1929). The

core of the Mnemosyne project (Warburg and Birnk 2008) is a set of iconographical

archetypes (a pictorial atlas, or *Builderatlas*), described through tables (*pathosformeln*)

where different images are collected to describe some kind of archetypal concept. For

example, table 4 of Warburg's Builderatlas, which describes the topic of the relationship

between gods and mankind, combines two classical heroes, Prometheus and Phaeton, by

virtue of their challenges to the gods. Despite the intrinsic limitations posed by the

historical, cultural, and political factors that affected Warburg's selection of subjects

(Bruhn 2000), the approach of Mnemosyne to the exploration of culture can be seen as a

precursor of the paradigm of "exploratory search" advocated by the advent of online

cultural heritage archives.

Figure 1

Figure 1: *Pathosformeln* from Warburg's *Builderatlas* (www.engramma.it).

Similarly to the Builderatlas, where the juxtaposition of iconographic references

suggests implicit relations among artefacts across ages and media, in Labyrinth 3D the

user navigation is driven by an archetype that associates artefacts of different type,

represented by digital objects. The exploration obtained through the archetypes

leverages the sparseness and multiplicity of the meaning associations yielded by the

archetype along each category (character, story, action, object, place, and epoch) to

provide serendipity to the user navigation.

In particular, the archetype of the labyrinth, deeply rooted in Western Culture

(Kern 2000), lends itself well to conveying the many-to-many relations among the

cultural heritage objects established by the collection of archetypes employed in the

projects, thanks to its graph-like nature (Rosenstiehl 1971, 1988). The metaphor of the

labyrinth trades off the use of spatial layouts for orientation against the unpredictability

of the environment that characterizes it, providing at the same time the immediacy of

use that is typical of well-known environments. In Labyrinth 3D, the representation of

the physical layout of the space, usually employed as a tool to orientate the user (i.e.,

with top down views and maps), is employed in a first-person view to create a sense of

disorientation. However, disorientation here is not without a purpose, since it acts as a

stimulus for the user to discovery, in a serendipic way, the heritage treasures hidden in

the maze, and to consider (or even re-consider), the relations over them. Differently

from maps, the exploration in Labyrinth 3D takes the form of a subjective, creative

experience so as to provide a sense of enactment as the walk of the user through the

maze proceeds.

Despite the inner organization of the archetypes into categories, the nature of the

archetype belongs to the realm of *liquid design*, in the sense established by Novak since

his first theorization of liquid architectures (1991). As exemplified for the aural domain

by the installation "Allobrain", described by Thompson et al. (2009), the use of today's

immersive 3D technologies enables the creation of liquid architectures into virtual

environments where users "create their own trajectories" through the object domain. In

Labyrinth 3D, the fluid nature of the notion of archetype does not enforce curatorial,

predetermined "visit paths", but lets trajectories through the archive emerge from the

interaction of the user with the virtual environment. The metaphor of the labyrinth, then,

is also visually characterized by fluidity (Deleuze 1983), thanks to the plurality of

perspectives it creates onto the domain of observation.

4. Labyrinth 3D

In this section, we describe the implemented environment Labyrinth 3D[2], where

the archetype of the labyrinth gives shape to the 3D virtual immersive environment and

a set of cultural archetypes, each organized along the categories "story", "character",

"epoch", "object", "action", and "place", mediate the user exploration of a repository of

media resources. Briefly, the 3D environment consists of a virtual labyrinth that

contains digital representations of the items in the archive, linked by pathways that

represent the archetypal similarities among them. Targeted on the general audience, the

project aims at encouraging the users to explore the media repository, as a way to

promote personal cultural enrichment and cultural heritage dissemination. Labyrinth is

not targeted on a specific type of heritage or media: the assumption underlying the

project is that cultural archetypes, due to their pervasive nature, can be employed as a

compass to help the user navigate heterogeneous repositories.

4.1 Design and User Experience

The setting of the environment is inspired to the classical hedge maze, with

architectural elements that are intended to remind some distant but not well specified

past, so as to prepare the user to the appearance of disparate and temporally distant

---

[2] url omitted for blind review

items. This choice was due to the constraint posed by the heterogeneity of the items in

the archive, which share connections with the same archetype though being different for

appearance, style, epoch, etc., and for its similarity to the "gothic" genre usually

featured by the maze games many users are familiar with. Maze games, originally

characterized by 2D graphics, like Atari's Pacman[3], are a well-established genre,

recently proposed in 3D graphics with bestselling titles such as Imangi's Temple Run®[4]

(one of the most downloaded apps for iPhone in 2013[5]) or PlayFirst's Dream Chronicles

®[6].

In Labyrinth 3D, the floor is partly tiled, partly covered with grass, reminiscent

of a deserted location that is seldom visited, so that the user gets the feeling of

undertaking a solitary journey in an abandoned area - as the accidental, sparse,

somehow "lost in memory" nature of the connections induced by the archetype

suggests. The environment includes two types of elements, namely nodes and pathways

connecting the nodes. Pathways differ in length and form: some are shorter and let the

user catch a glimpse of the destination; some are longer and bend, so that their end is

not visible before the user gets near the end. Small differences in the visual appearance

of the nodes and pathways embellish the environment, serving at the same time the

function of allowing the user to remember the elements visited so far, useful in case of

backtracking (without Ariadne's thread!), or in case the user finds her/himself in a

---

[3] http://en.wikipedia.org/wiki/Pac-Man

[4] http://www.imangistudios.com

[5] Josh Constine (January 15, 2012). "Mobile Game Design: How Evil Monkeys Chased Temple
Run To App Store #1". TechCrunch. Retrieved May 18, 2015

[6] http://www.playfirst.com/games/view/dream-chronicles

location that she/he has already visited before - a not unusual situation in mazes that is

purposely allowed for by the design of the environment.

Nodes include nodal spaces, where artworks are located, and crossroads, where

the path splits into different directions. Nodal spaces contain a media item representing

the artwork (an image, a sound file, a video clip or a text excerpt), which is either a

digital equivalent of the artwork or some accompanying documentation (e.g., the cover

of a book, the poster of a film), with connections categorized according to the reference

archetype. Crossroads serve the function of splitting the chosen category into single

artwork relations: in graph-like representations, in fact, only one-to-one relations can be

directly encoded, while many-to-many relations need an intermediate node to connect

them with each other via a set of one-to-one relations.

Figure 2

Figure 2: The template for nodal spaces in Labyrinth 3D: notice the doors and the low
balustrade in the middle.

Fig. 2 illustrates the basic template for nodal spaces: a low circular balustrade,

reminiscent of a sacred enclosure, is situated in the middle area, open in several points

so as to provide an affordance inviting the user to step into the inner part of the space,

where the artwork (missing in the figure) is situated. The space is surrounded by a wall,

with doors opening on different pathways. Each nodal space has a fixed number of

doors: depending of the actual number of categories by which the artwork in the node is

connected with the other artworks, some doors may be hidden by greenery.

The user navigation starts from an artwork, situated in a nodal space: the user

must choose one of the doors posited on the edge of the node, each labelled after the

name of a different category - among the ones acknowledged by the conceptual model of the archetype: story, character, object, action, location, and epoch. Pathways are symmetric, so they can be walked both ways. The user is free to explore the labyrinth, going back to previous locations as many times as she/he wishes. The design of the navigation was inspired by the paradigm of *constrained navigation* (Burigat and Chittaro 2007), with the aim of making it affordable also to non-expert users of 3D applications. This approach constrains the user to move in the 3D space according to simple, pre-defined paths and movements - instead of letting her/him move freely in the space. Navigation controls are provided by circles of lights posited on the floor, that the user clicks to be transported to the exact location of the circle. Smaller circles are posited in front of the doors leading to the pathways, and along the pathways. Larger circles mark the presence of artworks in the middle of nodal spaces: when one of these circles is clicked on, a layer appears where the title of the work and an accompanying image are displayed, and a media item can be viewed or played (depending on its type). A button labelled "More information" makes a further layer appear, with information about the artwork (artist, age and a short text, see Fig. 3). Small circles of light appear inside the navigation controls when they are clicked on, so that they can be distinguished from the controls that have not been clicked on yet, eventually forming a sort of "red thread" that marks the path made by the user so far. The metaphor of the red thread, aimed at improving self orientation, is also enforced by a small console, posited in the lower part of the screen, that shows the list of the artwork nodes visited by the user: by clicking on a node in the list, the user is brought back to that node. The console also contains buttons for ending the session and turning off the sound. Notice that, differently from standard virtual environments, the interface does not contain a map displaying the user position: rather, the orientation is entirely committed to the

navigation controls, as described above, and to the sequence of visited artworks reported in the navigation console.

In order to make the experience more engaging and to counterbalance the lack of commitment provided by a non-directed navigation, we introduced an explicit element of *gamification* in the interaction: when the session begins, the user is challenged to reach a "target node" through the archetype traversal. When the user reaches the target node, or when he/she decides to exit from the maze, the session ends and the user is shown with the statistics about her/his own performance (number of visited nodes, elapsed time, backtrackings), which provide an incentive to come back to the installation to improve one's own performance.

4.2 Production

Labyrinth 3D was part of a larger project about the use of Semantic Web techniques for multimedia publishing, the Labyrinth project, jointly conducted by an academic partner, i.e., the research team of the University of (omitted), a media partner, i.e., a small publishing company, and a software company; a 3D agency was hired by the consortium to develop the application. The project, aimed at creating a web based platform for navigating semantically annotated media archives, included both a web based, hyper-textual interface, and the 3D interface described here, Labyrinth 3D, developed as an app for Mac and Windows. The university team included a project manager, a new media expert, an interaction designer, and a knowledge engineer.

The production workflow assumed by the project addressed a typical scenario of the publishing industry. Publishing companies collect huge archives of references and media items, sometimes as the result of editorial services, more often aimed as part of their content editing workflow (formally described by Hardman et al. 2008). These archives represent significant assets of the company since, after they have been

collected, they often become again an input to the editorial processes by inspiring the

ideation and development of new editorial products, such as monographs and series.

Thanks to their availability in digital format, then, they can be seen as potential editorial

products themselves. The archive collected by the publishing company for the project

concerned the topic of the labyrinth and it included 200 items, selected with the goal of

having different media types represented in the archive (text, pictures, sounds and

movies). Given the archive, a set of relevant archetypes were identified through the joint

work of the publishing professionals and the new media experts, and modelled in a

formal ontology: beyond "labyrinth", "hero" and "journey" were chosen for their large

spatial and temporal coverage. Finally, the 3D application was designed and developed.

In September 2014, we conducted an evaluation of Labyrinth 3D, described in the next

section.

The core of the system is the Archetype Ontology (AO), which represents the curatorial

view on the archive embedded in the 3D installation. The ontology, designed and

formally encoded by the knowledge engineer, contains the representation of a set of

archetypes and describes how the artefacts represented in the archive are associated

with them via the categories that provide the dimensions of archetype description,

namely "story", "character", "object", "action", "location" and "epoch". By the end of

the project, the ontology contained 38 stories, 40 characters, 30 actions, 39 locations, 19

objects and 40 epochs, distributed over the three archetypes. A description of the

ontology can be found in Damiano and Lieto (2013). The process by which the items in

the archive are put in relation with the archetypes is conducted in a semi-automatic way,

starting from their metadata, following the procedure described by Damiano et al.

(2015). The metadata annotation of the archive is conducted via a form-based web

interface following a standard metadata schema; when the items in the archive are

uploaded to the system, their metadata are searched for connections to the archetypes by automatic reasoning processes. Finally, the set of resulting connections are checked for wrong connections and possibly corrected by a human expert. Notice that the reasoning process generates not only trivial connections, derived from archetype elements that are explicitly mentioned in the metadata of each artefact, but also more subtle connections, derived from the inner structure of the archetype conceptual model, such as for example, the relation between story and episodes. As a result, a curator may decide to discard some of the connections found by the automatic reasoning software, but also she/he may find unexpected, yet plausible, connections.

The 3D maze is not built statically: rather, it is created step by step while the user advances through the virtual environment, as the result of her/his choices. So, during the visit, the maze literary emerges from the archetypes stored in the ontology, with unpredictable configurations that depend on the interaction with the user and on some random elements embedded in the design. For example, when the number of the connections for an artefact exceeds a given threshold[9], a maximum number of connections to be displayed are randomly selected. For these reasons, should the user use the system in different times, she/he would find her/himself in consistent, yet different mazes, achieving a new experience every time.

4.3 Navigation example

In order to exemplify the functioning of the 3D labyrinth, we resort to a navigation example, conducted by using the "labyrinth" as the reference archetype (thus doubling

---

[9] Currently set to 7 to comply with the known limitations of working memory (Miller 1956)

the role already covered for the spatial layout). Consider the artwork

"Minotauromachia", a painting by Pablo Picasso (Figure 3[10]).

Figure 3

Figure 3: Start nodal area, Minotauromachia by Pablo Picasso, Spain ("Spagna" in
Italian) 1935.

The screenshot in Figure 4 represents the first step of the interaction: the user is

posited in the nodal space that contains the painting and is surrounded by a set of doors.

The doors represent the categories that connect it with other artworks, as encoded in the

ontology. Following the conceptual model of the archetype, each door is labelled after a

different category, in order to mark that the artworks reachable through that door share

one of more features with the current artwork in the given category (one character, one

or more places, two stories, etc.). Pointing and clicking on the small circle posited in

front of the door leads the user through a pathway to the next node, which can be a

nodal space or a crossroad.

Figure 4

Figure 4: Doors from start nodal space, labelled according to the archetype categories
(character or agent, place, epoch) by which it relates to the other artworks.

In Figure 4, a partial view of the start nodal space can be seen, with doors for the

"character" category (here, labelled as "agent"), the "location" category (labelled as

"place") and the "epoch" category. Taking the door marked as "agent" (character), the

---

[10] The metadata of the artworks are in Italian for presentation reasons.

user is brought through a pathway to a crossroad with doors leading to a set of artworks that exhibit the characters of "Theseus" and/or the "Minotaur" (Figure 5). Notice that, since there are more than one artworks displaying the characters engaged in the Minotauromachia (such as, e.g., paintings, ancient coins, etc.), a crossroad is needed to fork the path into several branches to the single artworks, so to maintain the principle "one node, one artwork". From here, if the user chooses the door surmounted by the title "Teseo uccide il Minotauro" (Italian for "Theseus killing the Minotaur", centre of Figure 5), she/he will walk through a pathway to the nodal space which contains the artwork with the same title, i.e., an ancient Greek vase representing Theseus in the act of killing the Minotaur (Figure 6).

Figure 5

Figure 5: Crossroad for the category "character": the titles of the related artworks are written over the doors (in Italian). From left to right: Ancient coins discovered in Cnossos ("monete rinvenute a Cnosso"), Theseus killing the Minotaur ("Teseo uccide il Minotauro"), The frescos of Villa Imperiale in Pompei ("affreschi della Villa Imperiale a Pompei").

Figure 6

Figure 6: A Greek vase depicting Theseus killing the Minotaur, unknown creator ("anonimo"), Greece ("Grecia"), 5th century B.C.

Backtracking to the initial nodal space (the one containing Picasso's Minotauromachia) and choosing a different door (i.e., a different category) from this nodal space, the user can take a different path: for example, by choosing the door

labelled as "objects", i.e., artworks related with the same object as the current artwork

(e.g., Ariadne's ball of thread), the user gets to the crossroad represented in Figure 7:

notice, for instance, the door to the 17th century Italian painting entitled "Il filo di

Arianna" (Italian for "Ariadne and the thread", on the right of Figure 7).

Artwork by artwork, the user makes her/his way through the maze, enjoying the

artworks she/he comes across in a serendipic journey through ages and locations, until

she/he eventually gets to the target, or presses the button "Exit" posited at the bottom of

the interface. At any time, the user can go back to a previously visited artwork by

clicking on the dots in the bar posited in the navigation console, labeled as "Stations"

(bottom of figures).

Figure 7

Figure 7: crossroad for the "object" category (after backtracking to the initial nodal

space, Figure 3) with doors to different artworks. From left to right: Theseus killing the

Minotaur ("Teseo uccide il Minotauro"), Sleeping Ariadne ("Arianna dormiente"),

Ariadne and the thread ("Il filo di Arianna").

The overall path made by the user in the example navigation can be seen in Figure 8.

Figure 8

Figure 8: Schema of the user navigation in the example, interleaving nodal spaces and

crossroads.

5. Meeting the audience

In September 2014, we carried out an evaluation of the Labyrinth 3D, in order to gather information about the users' liking of the application and preferences about its use. In the occasion of a scientific dissemination fair open to the general public, small groups of 3 to 5 people, chosen among the attendants, were given a demo of Labyrinth 3D. After a short introduction to the application, the users were asked to choose a path in the labyrinth from an initial random node, with the experimenter clicking on the navigation controls corresponding to the current user's choices. This procedure was motivated by the fact that, given the high inflow of visitors, we decided to exclude the usability of the interface from the evaluation, in favour of a more coordinated execution of the testing protocol.

The users were generally enthusiastic about the application, with teachers and young adults especially attracted by the potential applications of the virtual environment for didactic and dissemination goals. Users tended to read carefully the information displayed about the single items, reasoning aloud about their connection with the archetype and with the previously visited artworks. Some users explicitly asked to interact directly with the system and were allowed to do it, thus enabling the experimenters to make ethnographic observations about their navigation. The ethnographic observation showed that navigation was generally easy: the users were able to understand the use of the controls (the lit circles posited on the floor) to move from a location to another, with some problems only at pointing at the distantly located circles, which were too small due to the 3D perspective. Some users uttered their bewilderment at finding themselves in a node they had already visited, but were ready to accept the explanation that this is typical of labyrinths.

The preliminary evaluation was conducted on a corpus of 51 media objects, which included images, text excerpts and video clips, described according to 3

archetypes (labyrinth, hero and journey). After each session, users were asked to answer

individually a short written questionnaire in an anonymous form. The questionnaires

were collected in a separate area by different experimenters.

The questionnaire was designed to test the acceptance of the 3D environment, its

immediacy of use and its appeal for the average media users, in order to assess the

achievement of the design goals of the application, i.e., stimulating the users to navigate

the repository through an engaging experience. Inspired by the notion of participatory

design in heritage (Smith and Iversen 2014), we tested some specific design choices,

such as the setting of the labyrinth and its use for different purposes. To do so, we asked

the users to express preferences about the appearance and use of the application, aimed

at gathering information for the design of similar applications within the framework of

Labyrinth 3D.

The questionnaire included 7 questions. Question 1 grouped 6 sub-questions,

aimed at investigating the general **acceptance** of the application: by using Likert scales

(with 5 points from -2 to +2, mapped onto values from 1 (-2) to 5 (+2) in the subsequent

data analysis), we asked testers to what degree the application was:

(1) intuitive

(2) interesting

(3) engaging

(4) useful

(5) appealing

(6) straightforward to use

Then, through multiple answer questions, we asked the testers to indicate their preferred

devices (Question 2) for using the application (tablet, pc, smartphone, etc.) and to

indicate what use (Question 3) they envisaged for the application (teaching,

entertainment, cultural dissemination, etc.). In order to investigate how the users

perceived the application, we also asked the testers what types of applications were

similar to the proposed application (Question 4), with alternatives ranging from didactic

media (encyclopaedia) to cultural dissemination (museum) to entertainment (video

games). Finally, we asked some specific questions about the acceptance of the metaphor

of the labyrinth and of the visual design. In particular, we asked the testers (Question 5)

to select adjectives to describe the 3D labyrinth (with positive and negative polarities:

"confusing", "intriguing", "ordinary", "challenging", "playful" and "unpleasant"), then

we asked them whether they liked or disliked the proposed setting, ancient ruins

(Question 6), and what alternative settings they would like to have implemented

(Question 7) through multiple choices that proposed a range of locations typically

associated with cultural heritage: historical palace, modern building, museum building,

etc.

41 testers took part in the evaluation, males and females, with ages ranging from

10 to 67 years old. The results were encouraging under all perspectives, i.e. the

acceptance of the application, its immediacy of use, the understanding of the metaphor

of the labyrinth and the suitability of the setting. The average value of the answers to the

questions concerning the acceptance was 4.5 (Question 1, subquestions i to vi, all 5

point Likert scales), with "interesting" as the highest average value (4.7) and

"straightforward" as the lowest average value (4.32), indicating that the application was

appealing but its use was not entirely clear, an indication for future redesign. The

average values collected for Question 1 are illustrated in Table 1.

The remaining questions revealed further details about the users' perception of

the application for what concerns its goals and uses. As for the preferred device for

using the application, the "PC" was the most frequently selected choice (25 users),

followed by "tablet" (17) and "smart phone" (17), indicating the wish of taking

advantage of the navigation experience in a separate session from other activities,

through a device that fosters immersion. As for intended use (Question 3) "cultural

enrichment" was the most frequently selected choice (31 users), followed by "teaching"

(18 users). The "video game" and the "encyclopaedia" (Question 4), were not

surprisingly the most frequently selected choices (18 and 14 users) of similar

applications - since Labyrinth 3D was designed with the goal to disseminate cultural

contents with an immersive, game-like interaction style in mind. The labyrinth

environment (Question 5) was perceived as "intriguing" by 31 users, but "challenging"

or "playful" only by 13 of them, showing that only a few users perceived it as overtly

arduous or tended to catch only its playful side. Finally, most users (31, 75.6%) liked

the proposed setting. The most preferred alternative settings (Question 7, multiple

choice) were the museum and the library (15 users each), in line with the reception of

the content as cultural indicated by the answers to Questions 3 and 4.

The results described above, although influenced by the fact that the testers were

selected among the users who showed more interest about the application by

approaching the demo booth, show a good acceptance of the installation and of the

design choices and goals underlying it. In particular, the users seemed to perceive the

application as a tool for teaching cultural notions to self (cultural enrichment) or others

(school teaching) and find it similar to video games, but they don't perceive the

entertainment as primary (since this option was selected only by 9 participants). As

confirmed by the ethnographic observation, these results reveal a strong interest for the

installation, which, prompted by the language of 3D, extends also to the cultural

contents to embrace the goal of cultural dissemination.

6. Conclusion

This paper has proposed the use of 3D graphics for designing novel tools of exploratory search in cultural heritage archives. The tool is an online virtual environment where the user can navigate the meaning relations over the items in the archive. Targeted at cultural heritage, the application Labyrinth 3D employs the cultural archetypes to inform the conceptualization of the archive and the creation of the traversal paths, engaging the user in the exploration of the archive.

The use of 3D graphics in cultural heritage is usually aimed at the visualization of objects and locations, existing or reconstructed, as a support to study and dissemination activities. Relevant examples span from private initiatives (such as, the well known Google Art Project[11] and Arounder[12]) to public research and educational projects (see, e.g., the animated 3D reconstructions of the ancient city of Rome and of Roman villas described by Dylla et al. 2008 and Rua and Alvito 2011). These approaches are characterized by the use of visualization for reconstructing locations and objects that do not exist anymore, or for superimposing to existing locations and objects new interactive functionalities, making them available to users in a remote modality.

The work presented in this paper radically departs from this approach and differentiates from the works mentioned above since, in our approach, the 3D representation is not employed to reconstruct real environments, but as a tool to convey meaning relations through a visual environment. The works surveyed above focus on the modelling and reconstruction of real environments, while we see the virtual environment as an experienceable substitute for the relations over the objects in an external domain, represented by the media archive, gathered and organized into a set of

---

[11] www.google.com/culturalinstitute/project/art-project

[12] www.arounder.com

cultural archetypes. In our approach, the user is immersed in a virtual, maze-like

environment that embeds a cultural heritage archive, where she/he actively explores the

archetypal meaning of the items in the archive, finding her/his way through the archive

in a personal way.

Labyrinth 3D relies on the assumption that the use of shared conceptual models,

the cultural archetypes formally encoded in the system as computational ontologies,

together with the pleasure of exploration and enactment brought by the (itself

archetypal) environment, can work in favour of the user engagement. We have

illustrated the inspiration and goals that informed the design and implementation of the

system, bringing a creative component into the user experience, acknowledged by the

positive impact on the audience.

On the edge of the transition of the Web to the paradigm of Linked Open Data,

which makes the need for generalized access models to networked contents even

stronger, the scalability of the system, which relies on formal ontologies and automated

reasoning, confirm its innovation potential for the design of novel access tools to

cultural heritage archives that literally bring the user into the core of the archive.

References

Almén, B. (2003). Narrative archetypes: A critique, theory, and method of narrative analysis. Journal of Music Theory, Duke University Press, pp. 1-39.

Beagrie, N. (2008). Digital curation for science, digital libraries, and individuals. International Journal of Digital Curation, Digital Curation Center, 1(1), pp. 3-16.

Beer, D., & Burrows, R. (2013). Popular culture, digital archives and the new social life of data. Theory, Culture & Society, Sage, 30(4), pp. 47-71.

Bolick, C. M. (2006). Digital Archives: Democratizing the Doing of History. International Journal of Social Education, 21(1), pp. 122-134.

Bolter, J. D., Grusin, R. A. (2000). Remediation: Understanding new media. Mit Press.

Bruhn, M. (2000). The Warburg electronic library in Hamburg: A digital index of political iconography. Visual Resources, Taylor a& Francis, 15(4), pp. 405–423.

Bruner, J. (1991). The narrative construction of reality. Critical Inquiry, 18(1), pp.1–21.

Burigat, S., & Chittaro, L. (2007). Navigation in 3D virtual environments: Effects of user experience and location-pointing navigation aids. International Journal of Human-Computer Studies, 65 (11), 945-958.

Chen, C. C., Wactlar, H. D., Wang, J. Z., & Kiernan, K. (2005). Digital imagery for significant cultural and historical materials. International Journal on Digital Libraries, Springer, 5(4), pp. 275-286.

Damiano, R., and Lieto, A. (2013). Ontological Representations of Narratives: a Case Study on Stories and Actions. In Proc. of CMN, CEUR series, vol. 1096, pp. 76-93.

Damiano, R., Lombardo, V. and Lieto, A. Visual metaphors for semantic cultural heritage. In Proc. of Intetain 2015.

Deleuze, G. (1983). Cinéma 1-L'image-mouvement. Minuit.

Dylla, K., Frischer, B., Müller, P., Ulmer, A., & Haegler, S. (2008). Rome reborn 2.0: A case study of virtual city reconstruction using procedural modeling techniques. Computer Graphics World, 16, 25.

Hall, Mark M. (2014). From Searching to Using: Making Sense of Digital Cultural
        Heritage Collections, In Proc. of The Search is Over! Exploring Cultural
        Collections with Visualization.

Hardman, L., Obrenović, Ž., Nack, F., Kerhervé, B., & Piersol, K. (2008). Canonical
        processes of semantically annotated media production. Multimedia Systems,
        14(6), Springer, pp. 327-340.

Haskins, E. (2007). Between archive and participation: Public memory in a digital age.
        Rhetoric Society Quarterly, 37(4), pp. 401-422.

Hey, A. J., & Trefethen, A. E. (2003). The data deluge: An e-science perspective. In
        Grid Computing. Making the Global Infrastrcutre a Reality, F. Berman, G Fox
        and J. Hey (eds.) Wiley.

Highet, G. (1949). The classical tradition: Greek and Roman influences on
        Western literature. Oxford University Press, USA

Hillier, B., & Tzortzi, K. (2006). Space syntax: the language of museum space. In A
        companion to museum studies, Macdonald, S. (Ed.), (pp. 282-301). John Wiley
        & Sons.

Jenkins, H. (2006). Convergence culture: Where old and new media collide. NYU press.

Jung, C. G. (1981). The archetypes and the collective unconscious (No. 20). Princeton
        University Press.

Katz, Robert, and Douglas Quin (2012). "Were The House Still Standing: Maine
        Survivors and Liberators Remember the Holocaust: Digital technology and new
        media as a means of storytelling in creating an imaginative template to preserve
        Holocaust testimony." In The Holocaust and World War II: In History and In
        Memory, Edited by Nancy E. Rupprecht and Wendy Koenig, Cambride Scholars
        Publishing

Kern, Hermann. Through the labyrinth: Designs and meanings over 5,000 years. New
        York: Prestel, 2000..

Rieber, L. P., and Noah, D. "Games, simulations, and visual metaphors in education:
        antagonism between enjoyment and learning," *Educational Media International*,
        Taylor and Francis, vol. 45, no. 2, pp. 77–92.

LaViola, J. J., & Keefe, D. F. (2011). 3D spatial interaction: applications for art, design,
        and science. In *ACM Siggraph 2011 Courses* (p. 1). ACM.

Lev Manovich, The language of New Media, The Mit Press, Massachusetts Institute of
        Techonology.

Lord, P., Macdonald, A., Lyon, L., & Giaretta, D. (2004, September). From data deluge to data curation. In Proceedings of the UK e-science All Hands meeting, pp. 371-357.

Manovich, Lev. "Media after software." Journal of Visual Culture 12.1 (2013): 30-37.

Marchionini, G. (2006). Exploratory search: from finding to understanding. Communications of the ACM, 49(4), pp. 41-46.

Miller, G. A. (1956). The magical number seven, plus or minus two: some limits on our capacity for processing information. Psychological review, 63(2), 81.

Mulholland, P., Wolff, A., & Collins, T. (2012). Curate and storyspace: an ontology and web-based environment for describing curatorial narratives. In The Semantic Web: Research and Applications, Springer Berlin Heidelberg, pp. 748-762.

Novak, M., 1991. Liquid architectures in cyberspace. In: Benedikt, M. (Ed.), First Steps. Cyberspace.

Popescu, D. I. (2012). The 'Defamiliarising'Aspect of Art about the Holocaust: New Curatorial Strategies of Display. Holocaust Studies: A Journal of Culture and History, 18(1), pp. 102-118.

Rosenstiehl, P. (1971). Labyrinthologie mathématique. Mathématiques et Sciences humaines, 9, 5-32.

Rosenstiehl, P. (1988). Labirinto. Enciclopedia, Einaudi.

Rua, H., & Alvito, P. (2011). Living the past: 3D models, virtual reality and game engines as tools for supporting archaeology and the reconstruction of cultural heritage–the case-study of the Roman villa of Casal de Freiria. Journal of Archaeological Science, 38(12), pp. 3296-3308.

Ryan, M. L. (Ed.). (2004). Narrative across media: The languages of storytelling. University of Nebraska Press.

Smith, N. S., Knabb, K., Defanti, C., Weber, P., Schulze, J., Prudhomme, A., Kuester, F., Levy, T., Defanti, T. (2013, October). ArtifactVis2: Managing real-time archaeological data in immersive 3D environments. In Proceedings of IEEE 19th Int'l Conference on Virtual Systems and Multimedia (VSMM 2013).

Smith, R. C., & Iversen, O. S. (2014). Participatory heritage innovation: designing dialogic sites of engagement. Digital Creativity, 25(3), pp. 255-268.

Thompson, J., Kuchera-Morin, J., Novak, M., Overholt, D., Putnam, L., Wakefield, G., & Smith, W. (2009). The Allobrain: An interactive, stereographic, 3D audio,

immersive virtual world. *International Journal of Human-Computer Studies*, *67*(11), pp. 934-946.

Thompson, S. (1955). Myths and folktales. Journal of american Folklore, pp. 482-488.

Trant, J. (2008). Curating Collections Knowledge. Museum Informatics: People, Information, and Technology in Museums, 2, 275.

Van de Waal, H. (1974). Iconclass: an iconographic classification system (Vol. 2). North-Holland.

Van Den Akker, C., Legêne, S., Van Erp, M., Aroyo, L., Segers, R., van Der Meij, L., and Jacobs, G. (2011, June). Digital hermeneutics: Agora and the online understanding of cultural heritage. In Proceedings of the 3rd International Web Science Conference (p. 10). ACM.

Warburg, A., & Birnk, C. (2008). Der Bilderatlas Mnemosyne (Vol. 2). Akademie Verlag.

Ziemkiewicz, C., & Kosara, R. (2008). The shaping of information by visual metaphors. Visualization and Computer Graphics, IEEE Transactions on, 14(6), pp. 1269-1276.

Tables

Table 1: The liking of the application by the users, through Likert scales (values 1 to 5)

SYSTEM PROPERTY	AVERAGE VALUE	STANDARD DEVIATION
intuitive	4.35	0.72
interesting	4.7	0.57
engaging	4.41	0.74
useful	4.48	0.61
appealing	4.5	0.74
straightforward	4.32	0.68

Figures

Figure 1: *Pathosformeln* from Warburg's *Builderatlas* (www.engramma.it).

Figure 2: The template for nodal spaces in Labyrinth 3D: notice the doors and the low balustrade in the middle.

Figure 3: Start nodal area, Minotauromachia by Pablo Picasso, Spain ("Spagna" in Italian), 1935.

Figure 4: Doors from start nodal space, labeled according to the archetype categories (character or agent, place, epoch) by which it relates to the other artworks.

Figure 5: Crossroad for the category "character": the titles of the related artworks are written over the doors (in Italian). From left to right: Ancient coins discovered in Cnossos ("monete rinvenute a Cnosso"), Theseus killing the Minotaur ("Teseo uccide il Minotauro"), Frescos from Villa Imperiale in Pompei ("affreschi della Villa Imperiale a Pompei").

Figure 6: The Greek vase depicting Theseus killing the Minotaur, unknown creator ("anonimo"), Greece ("Grecia"), 5th century B.C.

Figure 7: crossroad for the "object" category (after backtracking to the initial nodal space, Figure 3) with doors to different artworks. From left to right: Theseus killing the Minotaur ("Teseo uccide il Minotauro"), Sleeping Ariadne ("Arianna dormiente"), Ariadne and the thread ("Il filo di Arianna").

Figure 8: Schema of the user navigation in the example, interleaving nodal spaces and crossroads.
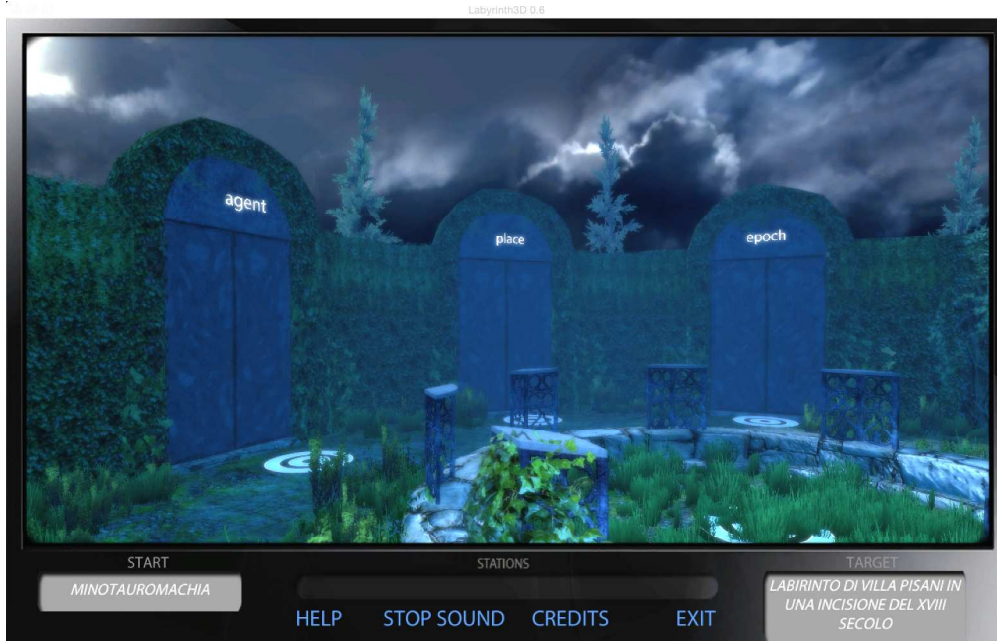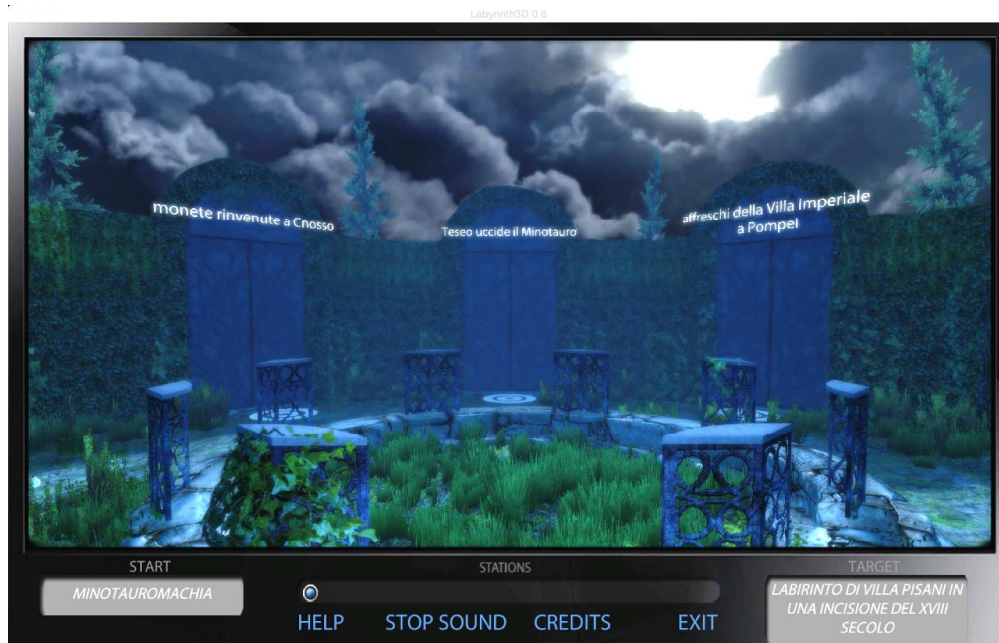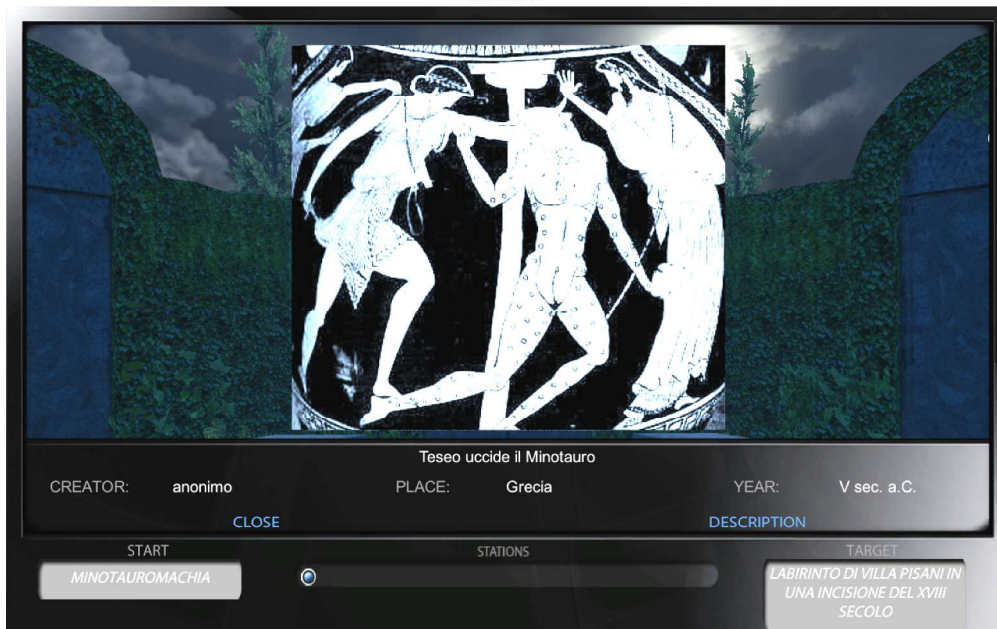
299x197mm (72 x 72 DPI)
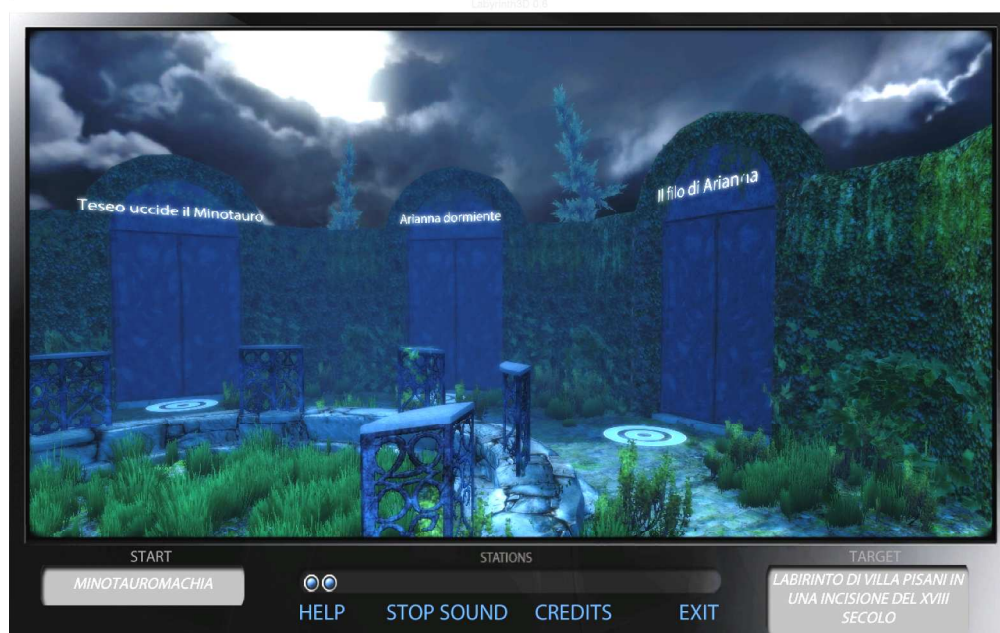
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

225x141mm (72 x 72 DPI)

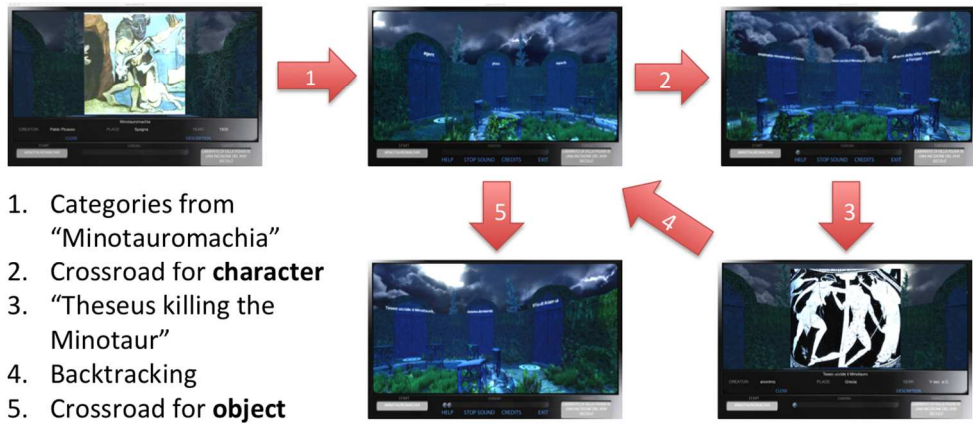451x289mm (144 x 144 DPI)

451x289mm (144 x 144 DPI)
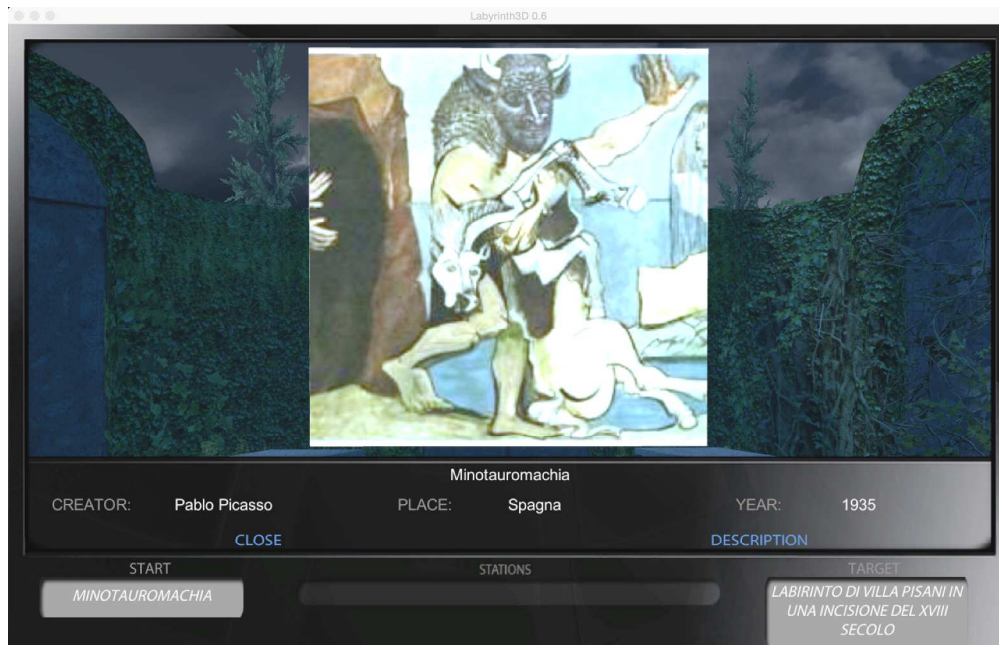
451x289mm (144 x 144 DPI)

451x289mm (144 x 144 DPI)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

451x289mm (144 x 144 DPI)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1. Categories from "Minotauromachia"
2. Crossroad for **character**
3. "Theseus killing the Minotaur"
4. Backtracking
5. Crossroad for **object**

492x216mm (72 x 72 DPI)