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TOWARDS DEDICATED SOFTWARE TOOLS TO ASSIST THE CREATION OF VIRTUAL EXHIBITS

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Abstract

As consequence of the technology expansion of recent years, people are nowadays seeking digital interactive experiences. Museums need to understand and embrace this change by creating digital interactive exhibitions that are culturally guaranteed by the institution authority and, at the same time, can be more appealing for the general public. Amongst the new softwares available to this purpose, 3D engines are some of the hardest to handle for people not coming from the Information Technology field, creating a technological gap between the museological space and the third-millennium public's expectations that results in a lower lever of enjoyment for the public. With the support of Unity3D, one of the most famous and reliable VR-ready 3D engines, a suite of tools called Muse-Tools was developed to reduce this gap by extending the engine's editor functionalities to provide museums curators with enough tools to plan both real and virtual exhibitions without relying on expert programmers or artists.

Keywords

Virtual Museums, Digital Heritage, 3D modelling, Unity, Virtual Environments, Interactive Museums, Digital Humanities

1. *Introduction*

The unpredictable spread of technology we have seen in the last two decades, together with the simplification of software interfaces, has revolutionized the way digital worlds are perceived and used by the mass. This social change was made possible not only by the reduced costs of hardware production, but also by expanding the range of possible fields in which digital tools are used. Some museums have already started to show a practical interest in these new technologies, providing the visitors with a more immersive experience, but unfortunately so far the broad spectrum of contexts in which Virtual Heritage has been used has only reached a small percentage of its potential, mainly due to the lack of dedicated tools that museums can use to create their own products.

In order to move from the old static idea of museums as mere collection of objects to a new concept of museums as open digital organizations, institutions need specifically-designed programs to facilitate the digitalization of their own environments as much as digital humanities experts that will help them using those assets in the most profitable way.

Being the creation of dedicated software to humanities research a very recent approach, very few technologies have been created with the specific purpose to plan cultural heritage exhibitions in a virtual space, and almost none of them has reached a broad audience yet.

In this paper we describe Muse-Tools, a new suite of tools specifically developed to help curators to recreate realistic spaces in a 3D environment with a high degree of realism. The suite can be used to produce user-oriented applications, giving museums a dedicated tool to produce the interactive digital contents they need to engage the third-millennia audience. Additionally, such a tool could drastically drop the costs of planning real exhibitions. Elements such as lights, objects, supports and materials could be tested in a visually-rich virtual environment with almost no costs, increasing the curators' control over the final result with potentially infinite testing possibilities and no danger for the artefacts.

2. *Theoretical Background*

An important shift of paradigm took place at the end of the 80s, when the old idea of museums as mere collections of objects shifted to a modern concept of museums as public institutions responsible for producing and sharing information (Pearce, 1994; MacDonald & Alsford 1989, 1991; Alsford 1991; MacDonald, Karp, Kreamer & Lavine, 1992). This change was motivated not only by the curiosity that emerging technologies such as the internet were arousing in the media and the academic environment, it was also demonstrated that for a general public, information was even more important than the object itself. According to several researches, if no significant connection could be built between the object and the viewer, the interest will drop and visitors will likely not pay enough attention to it. (Treinen, 1996) With this newer conception of museums coming forward, a new definition of museum was proposed in 2007 by the International Council of Museums (ICOM), describing a museum as *"A non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment.*" (ICOM, 2007).

If such a definition can be considered complete and exhaustive, defining what a Virtual Museum is has proved to be a harder task because of the many different meanings and areas this new concept is associated to. A sense of general confusion was evidenced by Bruno (Bruno F., Bruno S., De Sensi, Luchi, Mancuso & Muzzupappa, 2010), which specified how the "Virtual Museum" definition is used to describe two distinct types of VR technologies, one referring to the reconstruction of a pre-existing museum, and the other one representing virtual environments that are not related with any real-world space or reconstruction, two very different products that can be developed with the same techniques, but that represent different entities.

As it clearly appears from this distinction, a long series of applications can be categorized under the name of Virtual Museum, such as virtual environments running on web browser, Advanced Reality applications running on a personal smartphone or even mustimiedia kiosks. Without a clear distinction of roles it is hard to find a homogeneous comprehensive definition, and surely we cannot consider as exhaustive the many ones proposed so far. In 2010 Carrozzino and Bergamasco (2010) proposed a new categorization method of VR technologies for museums, based on levels of immersion and interaction rather than their applications, from a starting level of a totally detached scenario displayed by a 2D monitor to a fully immersive environment such as the CAVE. While being a good solution to distinguish different environments belonging to the virtual world, a fully shareable definition of a Virtual Museum is still missing.

2.1 Virtal museums as tools to solve old problems

Despite a common shared definition of virtual museums is still lacking, many studies that autonomously categorized themselves under this label were performed, showing how Virtual Museums could significantly increase the visitor's experience by providing new solutions to older problems while not creating any disaffection or counterproductive effects on the museum itself, as feared by many museums' curators (Pierdicca, Frontoni, Zingaretti, Sturari, Clini & Quattrini, 2015).

Virtual museums have also the capacity to tackle the problem of detached experiences that many users have lamented about. Several experiments were conducted to understand what level of interactivity and customization users would expect from future museums, from which it emerged that the majority of people would demand more interactive applications, with the possibility to be challenged during the visit, and even showed the necessity to be guided by a room attendant while visiting an exhibition. (Pagano, Armone & De Sanctis, 2015; Choi & Kim, 2017).

This problem can be easily handled by Virtual Museums by using pre-defined avatars that could guide the users, interact with them, and function just like a professional guide with no drawbacks of sort. In fact, as shown by several studies (Reeves & Nass 1996; Krämer, Tietz & Bente, 2003; Gratch, Wang, Okhmatovskaia, Lamothe, Morales, van der Werf & Morency 2007), people react to virtual humans in much the same way they react to real people, increasing their level of awareness and making custom experiences more enjoyable for different types of audience (Robles-Ortega, Feito, Jimenez & Segura 2012; Katz & Halpern, 2015; He, Li & Shang, 2016).

2.2 From 3D scanning to User-Oriented applications

A first overview of the "Virtual Heritage scene", as it was recently defined (Koller, Frischer & Humphreys, 2009), was given in 1997 (Forte & Silotti, 1997), when the first 3D representations of objects with artistic interest were modelled by hand. In 1998 the first significant results in automatically converting real artistic objects to 3D models were achieved by "*The Digital Michelangelo Project*", where a joint force of Stanford University and University of Washington scholars was able to digitalize 10 different statues from the Italian artist Michelangelo in over two years of work. The project was the first one to be conducted on a large scale, and it pointed out several critical points of such a task, including the huge costs of moving laser scanners and handling raw data outputs. (Levoy et al., 2000) Since that work several other projects were able to produce better results with smaller impacts of said critical points: in 2003 a 3D reconstruction of the original Parthenon obtained by merging laser scansions from reproductions was created (Stumpfel et al, 2003), and in 2004 another Italian team (Callieri et al, 2004) successfully evidenced invisible damages on Michelangelo's David computing effect of physics, time and dust exposure by using a three-dimensional model.

As direct consequence of refining these techniques, an increasing number of scholars has pointed out the importance of using them to improve the way museums make their contents available to public. In 2008 University of California in cooperation with other institutes started a project to create a Virtual Museum of the Chinese Han dynasty (Forte, dell'Unto, Di Giuseppantonio Di Franco, Galeazzi, Liuzza & Pescarin, 2010). In 2010 a team from the University of Tokyo started a MEXT founded project about augmented reality in museum explorations, mixing VR with real objects during the museum exploration (Hirose & Tanikawa, 2010). In 2014 a team from Ritsumeikan University in Japan, went another step forward, recreating a whole moving scene: in their project they collected data about the traditional Yamahoko Parade in Kyoto to build a VR system able not only to show the parade in its own real context, but also to make the users feel like they were participating in it (Li et al, 2014).

In almost all of these projects the involvement of the museum personnel is commonly limited to a loose/tight side-to-side cooperation with the technical people in charge of designing and developing virtual exhibits, as this task usually involves hard ICT skills (such as programming) not commonly owned by non-technical users. We envisage that a more direct involvement of curators in the design of the virtuals space could lead to the creation of richer digital exhibits more homogeneously related to the real exhibits hosted by the same museum. However this would require the presence of software tools specifically aimed to this purpose and accessible also for users that, in principle, do not necessarily own specific ICT skills.

3. Questionnaire

Being the purpose of the project to create a suite of tools to help museums curators develop their digital spaces, it was important to have an estimate of the average curator's ability with computers, what their experience with Virtual Museums and Virtual Reality was, what they would they expect from such a tool, if they thought it could be useful to improve their daily tasks and if they would be willing to use it in their daily activity. For this reason an online questionnaire was created and shared amongst museums curators. The structure was subdivided in six different sections, each one containing a list of multiple choices questions and, in some cases, a non-mandatory open question regarding specific fields. This solution was adopted for two main reasons, the first one being the ability to perform better statistical analysis on schematic results, and the second one being that those types of questions are faster to answer and easier to understand for the audience. The questionnaire was sent by email to over 350 museums curators, and received 63 answers back.

3.1 Results and discussion

On average, the answers followed our expectations. Most of the curators, regardless of their age, gender, role or previous experiences, have expressed a total detachment to new technologies, and many of them replyed by email asking whether if we wanted their IT experts to answer our survey, as they were more qualified than them. The profile of current curators is representative of an individual who has a high degree of instruction and at least ten years of experience working with museums and exhibitions, but that, in general, has just vague hints of the possibilities offered by new technologies, especially VR-related ones. Data coming from the questionnaire is particularly significant as it evidences three main critical points:

- **Experience:** museums curators have demonstrated to have poor familiarity with modern digital technologies. When asked to evaluate their knowledge of specific software, almost none of them had ever heard of 3D engines, and only less than 10% of them had ever used Photoshop or any other graphic software. Results were even worse in relation to AR/VR hardware, with over 90% of them rating their experience 1 on a scale from 1 to 10. Moreover, more than 50% of them had no familiarity at all with touch screens, not only in the context of museums, but in everyday life as well.
- **Value**: when asked if they were willing to pay for a virtual museum, 73% of curators answered no, but when asked if they were willing to use their own personal devices to enhance a museum tour, over 84% of them answered yes (Fig. 1). In other words, museums curators consider virtual tours as not worth any money, but they would love to use them. As unexpected as it was, this data was strengthened when users were asked to evaluate some general definition of museums: according to the interviewed subjects, Virtual Museums cannot have the complexity of real objects, and museums are bounded to physical items, even as a pure showcase of objects that carries no information with itself.

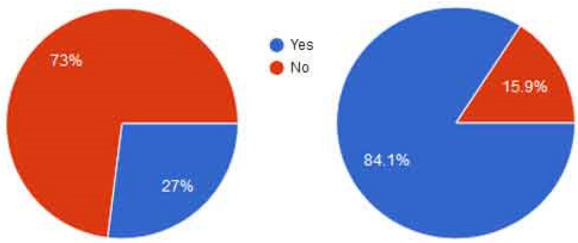

Fig. 1: Number of curators willing to pay to visit a Virtual Museum on the left, and number of curators willing to use a personal device on the right

- **Preconceptions:** the only open question in the survey asked what curators believed to be the biggest problems for the museum visitors. Many aspects were mentioned, from the poor illumination to overcrowding, but most of the answers verted on the rudeness and poor knowledge of the staff. While this problem can easily be solved with digital tools, curators tended to discard them. As already seen above, digital avatars could be used in many contexts to provide the visitors with customized data with no information loss or emotional detachment, but when asked to rate the usefulness of Human-looking avatars in a possible virtual museum, the relative majority of them voted 1 on a scale from 1 to 10 (Fig. 2). This idea is probably due to preconceptions, as many curators are concerned that digital objects, no matter what their use is, can distract the public by reducing the time spent observing a specific artefact.

These problems are all indicators of a homogenous trend. The vast vajority of the consulted museum curators seems to be anchored to the old idea of museums as preservation spaces and showcases of objects, perceiving technology as something unnecessary and somehow disturbing. It is important for the future of museums to force curators to abandon preconceptions to look at what data is telling, accepting the presence of technology in future exhibitions.

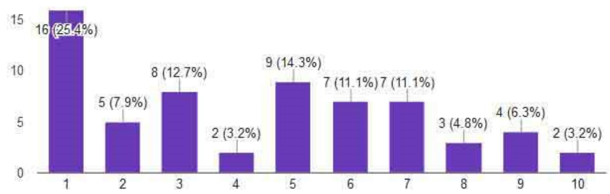

Fig. 2: Curators interested in using Human-Looking avatar guides

4. Muse-Tools

Creating a sotware tool for such a specific audience presents some unique challenges: as shown by the survey, curators are still reluctant to adopt new technologies in their daily workflow, and in order to avoid a certain failure it is important to create something they would feel comfortable with. However, when it comes to simplification, the risk of over-doing it is always present. Being the objective of this project to be functional for both old-generation curators, such as those who are representative of the traced profile above, as much as for technology experts working in museums and people that had familiarity with computers and modern technologies, it was extremely important to design a very friendly User Interface (UI) without giving up any possible important functionality.

The idea to realize the tool from scratch was considered in early stages of the project, but with the declared purpose to build a tool with possible real world applications, it was very clear that scripting it from scratch would have taken an unrealistic amount of time. The best solution to produce satisfying results in the time frame we had was therefore to integrate the suite with some other existing software that could provide enough quality while respecting all the requirements listed by the project's specifics. After several tests with the most common 3D engines available on the market, it was decided to create and distribute the suite as AssetPackage for Unity3D, the popular game engine developed by Unity Technologies. Unity comes with a very simple and intuitive UI, presenting a visual authoring interface that enables composing even complex 3D scenes, and their associate features,

Moreover, it is intrinsically structured to be used also by people with no programming experience and allows a high degree of customization and extensibility. Also, thanks to his modular structure, it allowed the final Muse-Tools users to decide what components they wanted to use without the need to import them all. Each single designed feature was implemented as a different component that could be used without relying on any other, and almost for each one of them an Editor script was created to simplify the component's UI and override the default mouse behaviour to perform complex operations without noticing the user.

The relationship between videogames and education is a relatively recent topic, but many studies are already showing how interactive and recreational environments could be exploited to improve people's learning processes. The urge to rebuild modern museums structures to fit a modern audience will make the need of using new technologies a priority in the next years, and refusing to take inspiration from what has proved to be not only an incredibly catchy activity but also a possible informative source for people could influence the gap between the new generations and culture. There is therefore no shame to take advantage of a well-established market to explore the possibilities that modern technologies offer to further improve the way human heritage is perceived. Moreover, modern videogames, regardless of the platform they are built for, provide a visual standard that will be unavoidably used as comparison for whatever virtual space museums could be able to build. Regardless of the concept of gamification and serious gaming, the videogames industry can offer museums those tools that they so desperately need.

4.1 Features

By following the suggestions coming from the experts asked in the questionnaire, five independent components were developed for the suite, which extend the functionalities of the Unity built-in editor to cope with the needs involved in the task of designing a virtual exhibition:

RoomBuilder: the Unity authoring environment allows to load existing 3D models of any kind, including of course architectural models of building interiors. However it does not offer any simple feature to create such environments inside the editor. The RoomBuilder extension allows to create and handle building structures, giving users the highest possible degree of freedom while creating building features such as walls, fixtures, floors and the roof. The system is based on a visual-node interface: users can create and position any amount of nodes within the scene and connect them with each other; once they are satisfied with their model they can click the "Create walls" button to generate the corresponding meshes and GameObjects (Fig. 4). After that, they can further modify the scene by adding doors and windows, dragging them around and resizing the structure as they want.

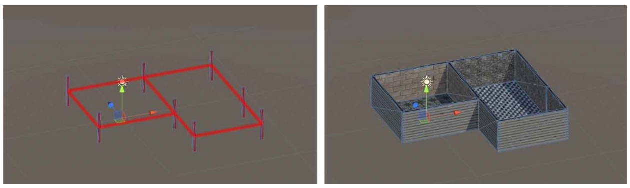

Fig. 4: On the left, the structure as seen by the users, with the nodes standing straight and the red links between each other. On the right, the builing created by the algorithm.

All modifications are performed in real time inside the Unity Editor by using a complex system of dynamic parametrized mesh processing functions that handle the geometrical data (vertices, triangles and UVs) behind the scene in a non-destructive way. By design, users only have to deal with some basic nodes positioning, and without any modelling or programming skill they are able to recreate complex buildings by themselves. It is worthy to notice that all components are textured and tessellated room by room, each internal space (and the external perimeter) uses a different unique material, and each room can be customized to show different environments with different properties.

SunPos: the SunPos component is responsible for handling a directional light that behaves like a sun within the scene. Once it gets attached to a GameObject, it creates a new directional light that gets positioned according with basic geographical informations such as the time of the day, a location on Earth expressed in geographic coordinates, and whether if summer time is in place or not. This light automatically becomes the main directional light, providing an immediate feedback within the scene (Fig. 3).

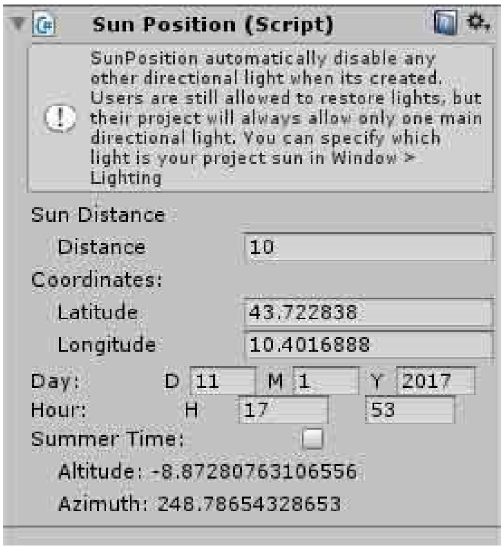

Fig. 3: SunPos user-friendly panel

Ruler: According to the questionnaire, precise and consistent measurements are the highest priority amongst the curators while creating an exhibition, and the Ruler component has the purpose to fulfil this task by making measurements easy, fast and precise in a 3D environment. The entire component is based on a list of coordinates that store the positions users want to measure. Each position is connected with the next one in the list, it is therefore not possible by design to cross multiple points with each other if not by creating a new instance of the component. Users can always modify those positions both by moving them using the corresponding handlers inside the Scene Tab and by changing their values from a custom inspector designed for this operation. The system is built upon a global settings panel that can be found on top of the Unity main menu. Users can easily modify the scale and proportions of their scene from there, and changes will instantly be applied to all the Ruler instances.

InfoTable: the InfoTable system is designed to simplify the process of creating AR labels and to substitute old museums labels in a VR context. The system allows users to create datasheet for any possible object within the scene, providing two different types of visualization: one with a full-screen pop-up sheet, with a customizable background, that can be triggered by pressing a keyboard button, and an Advanced Reality floating text that can be put everywhere within the scene, with custom fonts, colours and dimensions. The InfoTable system was designed to contain and save data such as title, period, author, current owner, current location and description of an object, but it can be extended to display custom fields.

HumProjector: the HumProjector component is in charge of simulating the behaviour of a simple projector within the scene. Unity already contains a Projector component that can be downloaded from the Standard Asset package, but it does not calculate any light occlusion while projecting onto a surface, which could cause some confusion amongst the non-experienced users. While still being a very effective solution for many scenarios, it was unlikely for curators to understand its default behaviour; it was therefore decided to implement a custom script to be placed alongside the standard component so that their combinations would produce a more realistic looking situation. The component has three rendering options named “texture”, “multiple textures”, and “video”, that determines whether if the content type is a single texture, an array of textures to be changed within the application at runtime, or a movie texture to be played like a standard video file. Optionally, users can apply a secondary texture to add an ageing effect by simply ticking the “Ageing Effect” field in the inspector. For aesthetic purposes only, users can also dynamically change between two different projectors models and three different types of screen.

Combined together, all these components extend the default functionality of Unity by giving non-experienced users specific tools that can be used for the purposes discussed before.

4.2 3D Models

Being the purpose of the suite to make curators independent from external figures, it was important not only to give them instruments to create the museum, but also an extensive library of items to fill it. For this reason, Muse-Tools contains a library of assets complete with textures and associated materials. Assets are divided in two main categories: the first one contains general assets like showcases, book holders, books and lights that can be used both in testing and releasing environments, as they are general models built from scratch that are not linked with any museum in particular and can be handy even for user-oriented applications; the second section instead contains specific assets such as statues, Egyptian columns, a crucifix, cannons, coins and several other assets that are digital representations of real objects and therefore can be used in testing environments only and not redistributed. These assets cover only a small part of what can be displayed in a museum, but they should be enough to simulate a wide range of possible situations, giving curators enough objects to test their environments without recurring to other sources. Almost all the developed assets can be easily customized in size and appearance in order to ensure the widest flexibility of the library.

The entire process of creating those assets followed the standard pipeline used by digital experts to create 3D models for videogames. While displaying a single scanned mesh of an artwork can be done even with millions of polygons on screen, an environmental scene with rooms, different light sources, textures, normal maps and animations need a totally different approach. When creating an asset it is extremely important to know from the beginning what its position will more likely to be, its approximate scale, and how important it will be in the scene to reduce their impact on the scene. The following list will describe in details what assets were created and the process that it was used for each one of them:

- Labels and emergency lights: of all the assets, labels are simplest ones, as each one of them is simply obtained by applying a PNG image to a standard plane. By tweaking Unity default material to make it accept the PNG transparency, the result is a plain label with no depth that could be used to decorate any surface. Those types of labels are well known to people therefore, despite not being "really" 3D, it will be likely for anyone not to take any particular attention to it; viewers' brains should automatically associate the meaning to the shape without any conscious and mindful input. Also, a set of two different emergency exit lamps has been created, one for each direction that could be used to indicate the fastest evacuation route to take even in dark spaces.

- Coins: a total of five different coins were created for the suite. All coins have the same base mesh, composed of a small cylinder with a big radius and a very short distance between the two faces. Each one of them has a unique texture that represents a unique material, plus some variations on the theme to represent different historical periods.

Fig. 5: The same book with three different colors. Same mesh, same material, same textures, different results.

- Books: books are probably some of the most various items that can be found in the world, and creating even a smaller sample would surely leave off something a museum could be interested in. In total, six types of books have been created, all being a modification of the same standard shape, with different measures and a unique albedo texture for each one of them. Four books come with a predefined colour, ready to be positioned in the scene without any effort, while the other two come with grey-scale general textures to make it easier for the users to add an overlapping colour by tweaking the material. All books' covers come with a texture and an associated normal map, while a different material with a plain texture and no normal map was used on the pages (Fig. 5).

- Fixtures: a total of three doors and three windows was created, with the addition of a door frame that can be positioned on every door space left open while adding a door. Of the three doors, two of them are basically the same model, with the exception of a glass window positioned on one side, while the third one can be used to create a multiple adjacent doors scenario and it is also the only one that does not come with a handler and a locker. All three windows have the exact same size in terms of external structure, but unlike the doors, they all come with three different types of decorations. A basic UV-Unwrapping was done, but no specific material is assigned.

- Lights: All the lights created and distributed with the project are meant to be simple representations of what a light-emitting object can look like in a museum, and they are no real Unity light emitters. Unsurprisingly, lights in Unity are components just like anything else, and to have realistic emitting lights users will have to autonomously add these components to the imported meshes by themselves. A total number of eight lights was created: two small recessed lights that can be put at the bottom of a shelf to light something displayed at least 10 centimetres from them, two circular downlights that can be placed on any plain surface to simulate both a point and a spotlight, one neon light with two cables that can be hanged from the ceiling, two spotlights, one with a cylindrical shape and one with a conic shape, and one last big spotlight attached to a black metallic support. All lights have only a single metallic texture and a high metallic value set in their materials, with no normal map or ambient occlusion of sort.

- Showcases and supports: users can find several furnitures and supports that can be used to simulate glass showcases, tables, book holders, poles with cordons, a baseboard and even some dark metallic hooks to simulate how any artwork would look like if fixed to a wall. A total of nine different showcases was created, with various dimensions and shapes to fit the biggest possible range of contents, some of them being as tall as an average human being and wide enough to fit a sarcophagus, and some of them being small enough not to be able to contain a medieval helmet if not scaled up. All showcases come with a range of materials that include light and dark wood, metal and plastic, normal maps, but no ambient occlusion. Amongst the supports, users can find the aforementioned baseboard, a square white simple table, metallic poles with a red hemp looking cordon, two chairs, two dark metallic flat supports that can be used any type of object, and two different book supports that can display different book shapes.

Fig. 6: 3D model of an orthodox cross. The model comes with five different textures, named "Albedo", "Normals", "Ambient Occlusion", "Specularity" and "Emission"

- Cross: While not being the most common artwork, it was decided to create a medieval cross because of the level of complexity such an object would have in terms of appearance. The model is derived by a two-dimensional Orthodox iconography of the crucified Christ that was imported in Blender and upon which the shape was modelled after. To transform the image in a texture, we made use of CrazyBump, a utility able to derive different types of maps (such as normals, ambient occlusion, diffuse, emission and specularity) just from one coloured image. Once the 3D model and the textures were imported in Unity, an associated material was created and its settings were minutely tweaked in order to faithfully represent the real gold refraction when painted on wood (Fig. 6).

Mosaic: the so called Mosaic asset is the exact representation of a Roman mosaic found in Cyprus several decades ago and recently restored. In order to introduce variation in the environment, the basic texture was mixed with some dirt effects and cut to increase its ageing level. The obtained result was then passed to CrazyBump to generate the other textures, from which only normals and ambient occlusion were used. The final 3D object is composed of four basic meshes: besides the plain oval mesh used to show the mosaic, a sandy background was added to create variation, a marble structure to be used as showcase was build following the mosaic shape with a semitransparent glass placed on top of it.

Paintings: Like boos, paintings are amongst the most common artworks in the world. It was therefore difficult to find a representative sample that would satisfy each possible type of audience. For this reason, the selected paintings are not based on their historical period but more on their appearance, in fact they are all presenting different features in terms of colours and chromatic appearance, making them useful in different contexts. The process to create these paintings was the same for each one of them: once the main albedo texture was downloaded from a license-free resource, it was imported in Blender, where a pre-built mesh was already unwrapped. Once the mesh was scaled to match the painting original size, the model was saved and the process repeated. With the exception of two famous portraits that have an external frame, all paintings share the same background texture and no frame was applied.

Egyptian artworks: the Egyptian artworks were the last objects to be created and were all designed with the final demo in mind. They are composed of three different columns, three papyri and a giant stone that could be independently placed within the scene without affecting the others. All three columns have approximately the same height and size, but they differ very much in their appearance. In fact, all of them are based on different set of textures created in Photoshop by mixing several Egyptian wall-paintings available online with a basic limestone texture, complete of normal maps and a soft occlusion. The papyri are instead more similar to labels; all three of them are simple planes with a different scale and a unique PNG texture applied above. The last element, the lion stone, was directly obtained by modifying an existing Egyptian rock carving picture and applying it on top of a custom mesh. Being the original work complete and undamaged, some damages were artificially added in Photoshop, giving it the impression of being the remaining part of a bigger wall.

5. Project in action: the demo

When the questionnaire was created, it was hard to get in touch with enough curators to have a significant amount of answers, and there was no possible way to ask the same people to perform complex and long user studies for the suite if over 80% of them didn't even answer a ten minutes survey. We therefore decided to present the potentiality of Muse-Tools with an interactive demo, created by using all the described features, plus some standard Unity techniques to bake the lights. The demo consisted in a full explorable Virtual Museum with four rooms, plus an external open space that is used to demonstrate the possibility of abstracted Virtual Reality in combination with human heritage exhibition. Each room was characterized by a unique theme that was reflected not only by the artefacts on display, but also by a dedicated wall texture, floor tiling, and the way lights were calibrated.

The first two rooms, named "Egypt" (Fig. 7) and "Classical Period", are part of the same instance of RoomBuilder, created with a .3 meters walls width and 4 meters walls height, the other two rooms, named "Cross" and "Middle Ages" are instead part of a second instance of RoomBuilder that uses the same walls width but is only 2.2 meters tall. A third instance was actually used to create the open space called "Outdoor", but in this case the relative walls were hidden, to give users the impression of an open space.

5.1 Demo Discussion

To achieve the visual result shown by the demo, several different skillsets had to be put in use to obtain state-of-the-art graphics, and it was soon realized that it is unlikely for a single museum curator to ever be able to recreate such a work by himself if not by spending an impractical amount of time studying, which is exactly what this project was trying to avoid in the first place. When museums will understand how precious those technologies could be for them, they will have no choice but to create heterogeneous teams to produce the best possible applications. Figures such as Architects and Engineers can cooperate with UI Designers, 3D Artists and programmers, and under the guidance of museum curators, they will be able to produce those high-quality digital contents that is almost impossible to create by one single person.

Despite this consideration, all the expected features that emerged from the survey have been successfully implemented and most of them were put on use while creating the demo, as soon as the code will be reviewed, the suite will be released under a free license. It is very likely for a tool such as RoomBuilder to be appealing not only for virtual museums, but also to all those people who will need to quickly edit and test closed spaces. In the same way museums could benefit from using pre existing tools, it is possible for other fields to incorporate some museums-dedicated tools such as this suite and many others that could be developed for with the specific purpose of making better digital museums.

6. Conclusions

The purpose of Muse-tools was to make curators independent and to give them something they could use to recreate reliable virtual spaces, but while the practical aspects of the project can be considered fulfilled, it has also demonstrated that the existing gap between museums curators and new technologies cannot be filled without the help of new categories of professionals that can understand what museums are, but that can also use modern tools to enhance them.

In this context the role of Digital Humanities experts becomes more important than ever. In the forthcoming future museums will be forced to open their spaces and to the use new technologies in their exhibitions, and professional figures able to tightly cooperate with curators, providing ICT expertise and, at the same time, owning a deep knowledge of the museum world, will be essential. The old idea of a museum container is no longer up with the times and it can easily become counter productive: the appeal of a static space is slowly falling, and new technologies such as Virtual Museums – in their broader sense – can help filling the still existing gap between the public expectation and the cultural offer.

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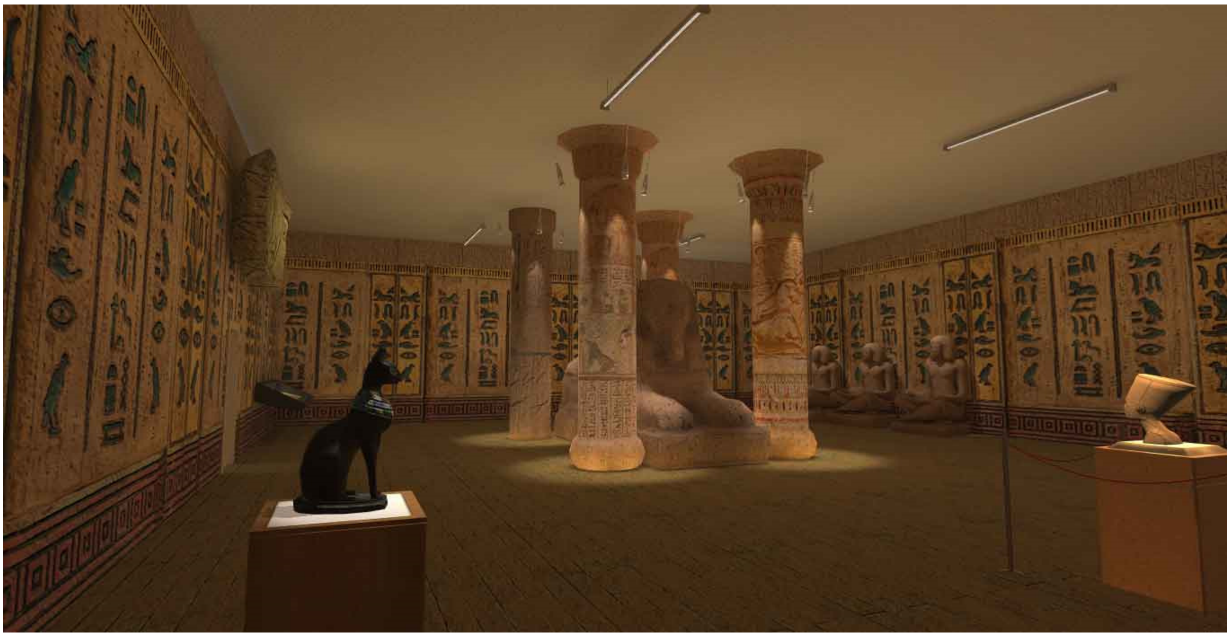

Fig. 7: The Egyptian room. A small sphinx is positoned at the center of the room, with a copy of the Nefertiti bust in front of it.

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