3DPUBLISH: A WEB-BASED SOLUTION FOR BUILDING DYNAMIC 3D VIRTUAL MUSEUMS

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ABSTRACT:

Today museums around the world offer their content through two basic methods: a simple view of their artworks through a content viewer, or through a custom designed 2D or 3D virtual exhibition in which the pieces and the scene are static. This paper describes a 3DPublish tool which represents an alternative to these two static solutions thereby giving the possibility to dynamically manage a 3D virtual scenario (real or imaginary) and the artwork that composes it. This gives the user a most realistic experience through different exhibitions, using various added value methods like storytelling or virtual tours. 3DPublish will facilitate the museum curator's daily tasks and will improve the final results for 3D virtual museum exhibitions. This application was created as part of the Tourspheres project, whose challenge is to explore new measurement systems to reach a more valuable tourist behavior comprehension. But after the experience (presented in this paper as a case study) of creating a custom development for an exhibition for the Kubo Gallery in San Sebastian (SPAIN), the work focused on abstracting all processes to package the 3DPublish tool with the aim that it becomes a commercial solution.

1. INTRODUCTION

1.1 Context

For years, museums curators' efforts around the world focused on providing the public art collections digitally exploiting the latest advances in technology (Heath, 2005). To support these efforts, leading technological research efforts focused primarily on two sources: first the ability to scan the collections of museums through different techniques (3D scanners, high resolution photographs, assembly 360, etc.) (Hess, 2011), (Toylor, 2003) and the second source was techniques representing these works in virtual scenarios (real or imaginary) to make the visitor feel the physical sensation of being in a museum exhibition.

These static solutions were aimed at technological solutions, and provided valuable indicators such as the number of digitized works (Nóbrega, 2012), the type of digitized works (paintings, works in 3D, etc.), the similarity of a virtual scenario, or the amount of semantic information to organize the whole collection (Bonis, 2009). But this situation has changed.

In recent years the user experience in terms of education and entertainment has become the priority, even sacrificing technical advancement in some cases. This was in order to make the user more interested in museums and the cultural heritage they offered. Because this focus has shifted, the style, materials or location where artwork was created is not as important as the story associated with that work (Christopoulos, 2011) and what it represents in the context of an exhibition carefully created on a specific topic.

Furthermore, the current instability of the global economic situation makes many museums around the world discard the possibility of creating a virtual environment to deliver their presentations in an appropriate context (Dyson, 2010), and if they already have a virtual environment created, they cannot afford development to accommodate a new virtual exhibition. Despite this, creating virtual exhibitions is still a profitable idea because museums offering collections information and images on their web sites will not reduce visits to the physical museum, and will likely enhance interest in making in-person visits to the museum (Thomas, 2005). Recent initiatives such as Museums Analytics (Museum Analytics, n.d.) prove the strong correlation between any online activity and real visitation. In terms of profitability it is well known that the benefits of virtual museums contribute to visitation and are noteworthy as far as curators are concerned and in terms of documentation, conservation, research and exhibition (Sylaiou, 2009). 3DPublish allows museum curators to improve their usual processes more easily and therefore to improve their efficiency and profitability.

1.2 Project aims and scope

The 3DPublish main objective is to create a common framework to allow museum curators to create final exhibitions dynamically and independently of their start empty virtual scenario. This means that the curator has the ability to choose one 3D modeled scenario (real or imaginary) or use one of the basic available default scenarios provided by the application. So with 3DPublish the curator will not even need to have a modeled scenario to create a 3D virtual exhibition where a user can move and interact.

A secondary goal involves the ability to manage the contents of that scenario externally, feeding the application with different artworks in digital formats.

Once we have an empty virtual scenario and the artwork, the third goal is to give the possibility to position the artwork along the scenario, including the option to create new spaces (which do not exist in the base scenario) with new walls with different heights and thicknesses in which, of course, it will also possible to place artworks.

To improve the user experience, as related above, is also part of the project scope. Museum curator will be able to create different thematic exhibitions and visitor may choose load which one is more interesting for him. Each artwork may also be associated with an audio piece to complement the

information and create a storytelling. Finally the museum curator can create guided tours.

Many online web-based virtual museums have offline background processes for support. However, the entire 3DPublish project will be consumed through a web interface for both the museum curator and the visitors. 3DPublish will allow museums to increase their digital profile beyond a simple implementation of web-based 3D virtual museum with different kind of artwork using a system designed for the museums and tested with pilot studies in museums such as the Kubo Gallery in San Sebastian.

2.   SYSTEM DESCRIPTION

The application is focused on two different aspects: The part where the curator is responsible for the management and the part where the visitor just enjoys.

2.1   System Background, curator vision

Museums curators' work is very diverse. It consist of making the selection of an artwork to compose an exhibition, managing the space available to display these works, choosing where each work will be exposed, calculating the route each visitor will take and many other things. With 3DPublish, a museum curator will be able to do all this tasks from a single web interface solution based on tabs. It is designed in such a way to make all processes simple and intuitive, with the aim of allowing the curators' to work more dynamically and easier to create a virtual exhibition. It also allows the easier access for the public and for all potential visitors worldwide.

With the first tab museum curators´ find the artwork. Through various web forms they will be able to register, modify and delete artwork very easily. A work of art is composed of different metadata: title, author, year, technique, copyright, etc. and the most important, the administrator must upload a file to be linked to all this data. This file may be an image, video, presentation, or even a PDF document. The artworks could belong to a real exhibition or not, so curators will be able to create exhibitions with existing digitized real artworks, with just digital files or with a mix of the two types. The following image shows a new artwork registration form, within the upper tabs

Figure 1: New artwork creation form

The second tab contains the artists´ management, offering the possibility of registering a new artist, modify or delete it. The

metadata associated with an artist is data about his name, date of birth, life, etc.

With a third tab is the scenario tool. From here, the museum curators will be able to choose what works, which were previously registered, will be introduced in an exhibition. They can also manage exhibition space by creating new walls and moving them to find the perfect distribution. At the beginning the museum curator will always see an empty scenario for creating a new exhibition, but also old exhibitions can be loaded dynamically into the empty scenario if the museum curator wants to change anything. Museum curator will be able to save and load as many exhibition distributions as he wants. This feature is very useful for testing real exhibitions distribution before building them in the real life. The following image shows an empty scenario with 2 new walls and a work of art already in place.
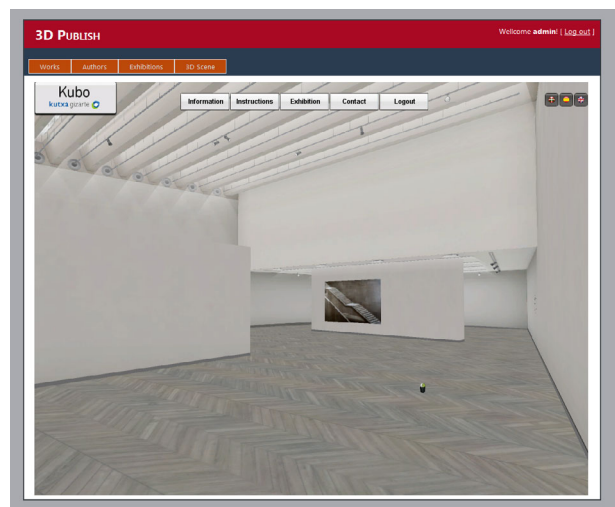

Figure 2: Creating new exhibition in an empty scenario

Finally the last tab is for managing exhibitions. Once the artworks and their authors have registered, and the distribution of the exhibition across the scenario is chosen, the museum curator can customize the exhibition by giving an informative description, a logo, creating defined paths through the exhibition, assign audio tracks to works as an audio guide or even storytelling, etc. From this tab, museum curator will also be able to choose which exhibition display for visitors by default and which ones will be public to be chosen by them. As always all through a web interface.

Thus, as we have explained, all the functions museum curator does every day are provided, and the creation of virtual exhibitions web becomes an easy and centralized process.

2.2   System Front end, visitor vision

Once the museum curator has published an exhibition, visitors can enter and enjoy it through internet. Entering museum virtual exhibition URL the visitor will see by default the empty scenario and it will load automatically the exhibition (data and associated artwork) which museum curator has marked as default. Once the content is downloaded the visitor can begin to walk through the virtual visit.

Visitors have several options to enjoy their visit. First they can see the exhibition information (subject, biography, etc...) And then they will be able to visit the exhibition through the virtual 3D scenario. The visitor could be a technological experienced user or not, and it is known navigation aids that are appropriate for experienced users may actually not provide a suitable level of support for inexperienced users and solutions that may improve the navigation performance of inexperienced users may not benefit experienced users beyond a certain degree (Walczak, 2007). Because of this, 3DPublish will allow visitors to visit exhibitions freely through all 3D scenario (instructions to move around the scenario will be displayed) or to do it through guided static paths defined by the museum curator. In both options, as showed in the picture below, each part of the exhibition displays information describing the work and its author.
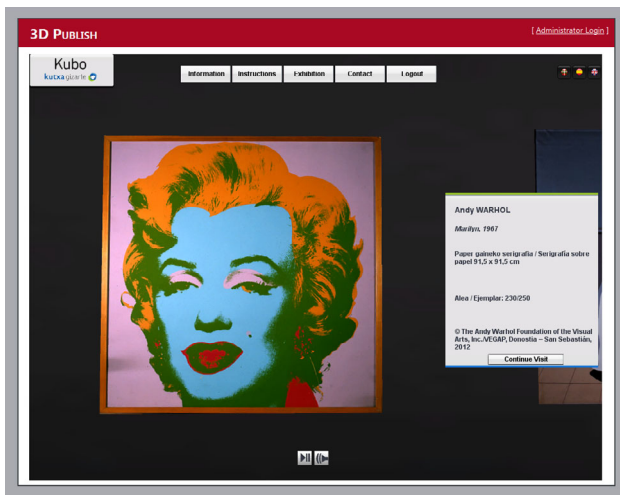

Figure 3: Visitor's view for artwork data

Each work may also have assigned an audio track, to complement the information provided on the screen, and can be used by the museum curator to create a story that describes the exhibition context and make the exhibition more interesting and educational, for instance, to students. Digital storytelling can help them to understand complex ideas, and introduce new contents (Yuksel, n.d.).

Another option is that visitors will be able to change museum exhibitions dynamically. This implies reloading the empty scenario and loading another exhibition with its works and corresponding distribution. So the user may have a complete historical view of the exhibitions hosted at the museum he is virtually visiting.

3. SYSTEM ARCHITECTURE

In this section the set of tools chosen to develop the project will be described. It is a technical explanation focused on the museum curator's part since the visitor portion is only the interface that displays all the processes of the server. Figure 4 illustrates the general layout of the 3DPublish application. Application core will reside in the web server and it has been programed in C#. Features associated with 3D scenario representation have been programed with JavaScript. The interactions between the different actors have been developed using REST services.

3.1 Content Management

The first feature 3DPublish offers is a content management system through a series of web forms. The file types this content manager supports were chosen because they are the most commonly used. For images, JPEG and PNG formats have been chosen, for video AVI format, for presentation PPT format and PDF format for documents. The museum curator may examine from 3DPublish web management any file of these formats that are on his computer and upload them to the web server. Once the file has been uploaded successfully, it is launched internally a conversion process to transform the source file to the final work which will finally be exposed in the exhibition.

For instance, AVI files will be transformed to OGG format (Waggoner, 2010) using ffmpeg2theora converser libraries. PDF files will have his data extracted (Wootton, 2007) into series of PNG images using Ghostscript libraries. And finally PPT files will be also transformed in a series of PNG files using Microsoft Office Microsoft.Office.Interop.PowerPoint libraries. The first 2 libraries are free and are compiled into separate files for use in any situation, but the libraries to transforming a PPT file need an office installation to be used. So the web server must have Microsoft Office installed with at least PowerPoint package, which means that the server will run a Windows OS. Finally the developers decided to use a Windows Server 2008, and the 3DPublish application will be accessible and runnable through IIS. Once the files have been processed correctly, they were placed in a Content server, which may be the same machine as the Web server.

Other data associated with a work of art and the author (including the reference to the file path transformed) will be stored in a database server. In this case it was decided to set up a MySQL server to store data.

3.2 Spatial Management

Once the files have been uploaded and processed, and are available in the content server, and authors and their works have been registered in the database server, the museum curator will be able to start building the virtual exhibition. He will start with an empty virtual scenario (real or imaginary) that has been previously decided and it will be displayed through the Unity 3D free engine. Inside 3D scenario museum curator will have different works (which have been previously registered), a selector for picking one by one and placing them in the different walls of the scenario. He will also be able to use a simple tool for creating new walls in empty spaces of the scenario.

Once the museum curator has finished creating the exhibition, he will be able to save the 3D scene. Internally this means that all new elements (artwork and walls) included on the empty scenario will be recorded in an XML file. There will be an XML file in the content server kept for each exhibition. It will also be created a new database record for this exhibition which will keep the creation date of the exhibition, a meaningful name and reference to corresponding XML content server.
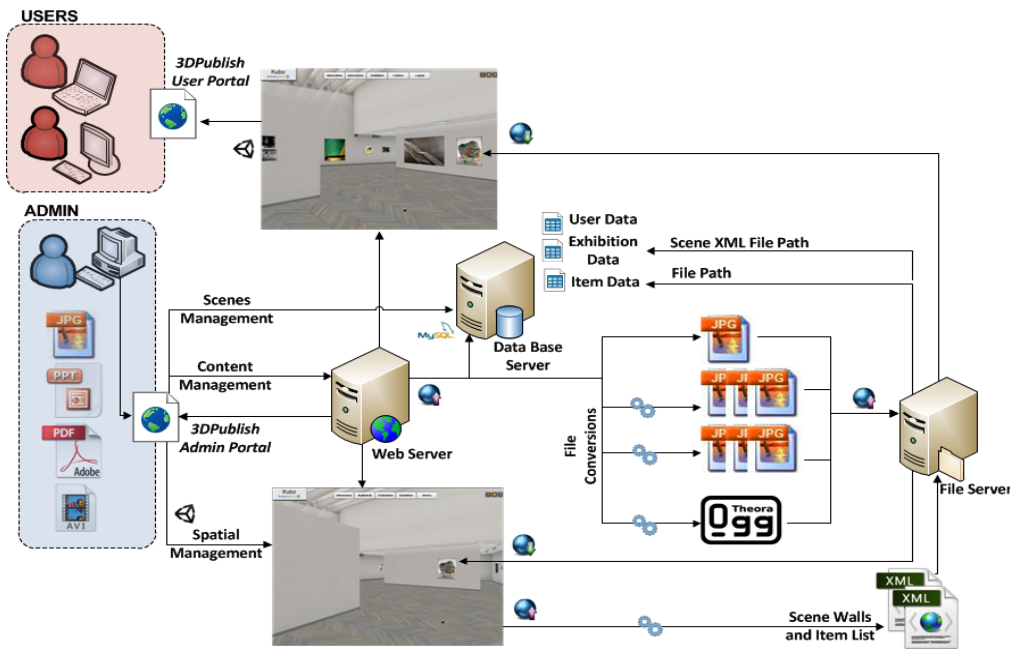
Figure 4: 3DPublish Architecture Diagram

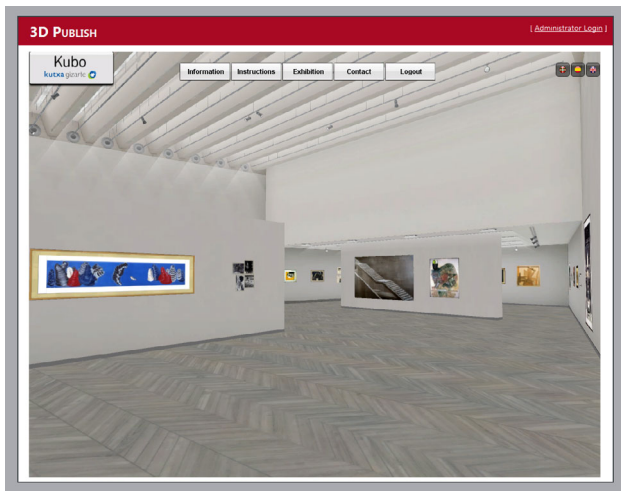The following figure shows the previously Figure 2 but with exhibition already finished.

Figure 5: Exhibition complete vision

3.3 Exhibit Management

When the museum curator has finished defining the exhibition he will then be able to begin the creation of added value, for instance assigning a logo and a description to the exhibition for visitors. This process implies updating the exhibition record within the database. For creating guided routes or associate audio to the artwork it is necessary to represent the tree of the XML exhibition file in a web form context. But thanks to this feature the museum curator will improve the exhibition defining a complete audio guide by assigning audio to every piece of the exhibition or even, as already related above, using these audio tracks for creating a storytelling context. Finally museum

creator will be able to create guided tours through the exhibition by choosing an order for works. All these features will be available as usual through web forms, with just two restrictions: the logo should be a PNG or PNG file, and the audio should be an OGG file.

On the other hand museum curator will be able to manage saved exhibitions, and for instance defining which the default exhibition for the visitor is, or selecting which saved exhibitions are public and because of this, ready to be chosen for being loaded in the scenario. Previously saved exhibitions could be deleted or remain unpublished too.

4. CASE STUDY OF THE KUBO GALLERY

As related above, 3DPublish tool born from Tourspheres project. In this project, the challenge was to reach a more valuable tourist behavior comprehension, so the visitor experience in a real museum space had to be complemented with the experience in a virtual space.

As responsible for creating this virtual space we realized that the museum curator usual processes for creating an exhibition in a real museum could be standardized and simplified for building virtual exhibitions in a flexible and intuitive way. And so, with the essence of a 3D game engine but simplified and oriented to creating virtual exhibitions flexibly, born 3DPublish. And, of course, the first exhibition that was created using 3DPublish was the virtual exhibition of the Kubo Gallery, a collection of artwork accessible from the museum website (Kubo Gallery Website, n.d.).

All the images of the virtual exhibition showed in this paper are the result of this collaboration included the following Figure 6 which shows the final result.
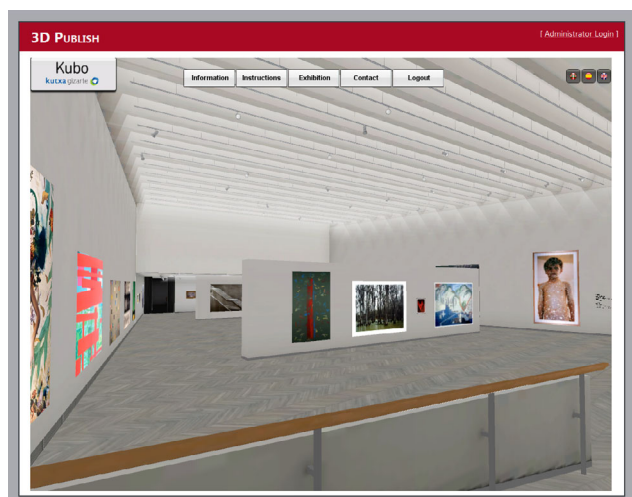
Figure 6: Kubo Gallery final result

5. CONCLUSIONS AND FUTURE WORK

We have presented in this paper a complete overview of the 3DPublish application. During the research process the developers found a gap in the virtual museum curator's daily work and because of this we have created this web-based application, with the ultimate goal of improving the processes of creation and museum maintenance of 3D virtual exhibitions. 3DPublish is the most complete option for creating virtual exhibitions based on a virtual (real or imaginary) empty scenario to make available final exhibitions for visitors, all through a centralized Web management processes oriented to the museum curatorial work.

From the work so far accomplished on this project, some new ideas for future development have emerged, to extend functions or improve the application. In the first place it would be beneficial to be able to work with additional image and video file formats. In addition to this, one of the more interesting improvements would be to allow 3D file processing in a streaming mode like the others file which represent artworks. Finally, to create a completely independent tool it would be ideal to be able choose a 3D complete virtual scenario for loading it in streaming mode in order to not rely on initial predefined scenarios to be put in the application compilation process. This means the scenario would be one more element in the content management of the application.

All processes involving the customization of the scenario elements will be also a great breakthrough. For example changing the color of a wall or his texture, move the lights position, etc. and all of these features, as always, on runtime through the website.

Many museums already have a content manager tool (online or offline) for their collections, such as The Museum Systems' TMS tool (The Museum System, n.d.), so it would be great to create an interface to use these collections or at least the metadata associated. In addition to this, it could be an important feature creating another interface for using Europeana public content.

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