

# VIRTUAL EXHIBITION BUILDER

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**Abstract:** Virtual visits on the Web are an important means to publicize a museum collection and attract visitors. Software applications for building virtual exhibitions, in addition to being tools to create content for virtual visits, may help the staff of a museum to conceive and mount exhibitions. This paper presents the Virtual Exhibition Builder, an interactive software tool aimed at the creation of virtual exhibitions, given a 3D model of the exhibition space in an X3D file and a set of information about the artworks that are to be exposed. The development of this tool involves inputs proposed by museum experts.

## 1 INTRODUCTION

Museums located around the world are open to remote, on-line visitors through the World Wide Web, spreading their collections and attracting visitors to the museum itself.

Offering 3D virtual exhibitions may provide a sense of immersion inside the exhibition space and allow free navigation. They require the creation of the virtual model of the exhibition space and the placement of the artworks inside it. The latter task should be performed by museum experts, which seldom include information technology specialists. Thus an interactive tool for assisting the placement of artworks in selected locations, besides being useful to create virtual exhibitions, can also be quite a valuable auxiliary tool to mount a new exhibition.

Some tools have been proposed to help a museum curator to conceive and mount an exhibition (Hrk, 2001; Wojciechowski, 2004; Katalabs).

In previous work (Semião, 2008), an application was conceived aiming to support the creation of virtual exhibitions by the museum curator. It was based on Web3D technology (Web3D), generating 3D environments in X3D. This prototype had some limitations and to overcome them, a new version of the tool with additional features was implemented (Gomes, 2010). This tool was presented to museum experts to get advice about the functionalities that

should be provided and, as a result, it was updated taking into consideration their observations. This paper presents this revised version, called Virtual Exhibition Builder: in section 2 are referred the opinions given by museum experts; section 3 describes the application; and in section 4 are drawn conclusions and is indicated the future work.

## 2 INPUT FROM A MUSEUM TEAM

The new application was presented to the director of the City Museum of Lisbon Town Council and to her team. Throughout the year, this museum presents several temporary exhibitions, along with its permanent collection.

The functionalities of the new application comprised: the selection of the surfaces that could exhibit artworks; the placement of 2D and 3D artworks and removable structures, such as dividing walls to dispose paintings or plinths to display 3D objects; the refinement of previously built exhibitions; the creation of an X3D file with the resulting virtual exhibition.

All members of the museum team considered that this kind of tool can help them to prepare an exhibition. It can be used to try different approaches to arrange the artworks within the exhibition space. Afterwards, these preliminary proposals can be discussed both among the elements of the team and with the authors of the artworks.

It was concluded that photorealistic images are not an important issue in this stage, since the main concern is to decide about the harmonious arrangement of the artworks. Therefore, the ability to dispose and simulate light sources is not required.

The tool preserves the relative dimensions of the artworks and of the exhibition space which is a significant feature according to the team.

The creation of virtual exhibitions to be available on the Web was also considered an interesting functionality.

They proposed some new features, namely, to provide a new kind of removable structure that simulates the limits of a glass case to cover 3D artworks, giving a better perception of the available space. They also suggested that simplified models of 3D artworks could be a reasonable approach to speed up the preparation of temporary exhibitions. Besides improving the application's performance, they avoid the time consuming task of creating detailed 3D models.

It was noticed that navigation in 3D space can raise some problems in achieving the correct position of the user. This can be corrected by defining viewpoints at key points allowing the user to move among them.

### **3 VIRTUAL EXHIBITION BUILDER**

The development of this tool was initially guided by the basic concern of producing a platform to assist museum teams, most probably non-informatics, to prepare an exhibition and create a virtual exhibition. Moreover, it was intended to be used for different physical spaces.

Since mounting the exhibition involves selecting artworks and associating each one with the surface where it will be exposed, one of the problems arising for the generic treatment of any exhibition space is the need to automatically add to the description of the exhibition space, modelled in X3D format, the capacity to choose these surfaces. In the case of X3D this process involves touch sensors in areas that can become suitable for the placement of objects. Furthermore, it is necessary to store all the information about the structure of the virtual exhibition model and all amendments in order to support future alterations. To achieve this goal it was conceived a conversion mechanism that transforms any X3D model of an exhibition into a generic, geometric description enabling a uniform treatment of any scene.

The following subsections present the

architecture of the application, its basic features and the user interface.

#### **3.1 The Architecture of the Application**

The architecture of the application is based on a modular design in order to allow easy implementation of new features.

The functionalities of the application are split into multiple edit modes. An edit mode is an independent unit, associated with a specific action that can be undertaken, such as, adding a 2D artwork, adding a 3D artwork, adding a removable structure, creating a viewpoint. It has the capacity to change the scene in some particular way and record these changes on the X3D file that stores the final virtual exhibition.

The articulation with each module is done through well defined interfaces that contain the necessary methods for the application's workflow, such as switching edit mode, saving the current logical state or obtaining the graphical user interface associated with the edit mode. Through these interfaces, the application core can glue everything together without relying on the implemented modules.

There is an abstract implementation of a module for the generic placement of objects, which includes all the common features concerning object placement. For each specific type of objects that can be added to the scene, a derived module of this abstract module is implemented, taking into account the particular characteristics of the object.

Information about the artworks is stored in a database integrated into the application, using SQLite. Although it would be more interesting to link the application to existing databases, this solution would certainly raise compatibility issues due to the lack of standardization in museums databases. Solving these issues would require some implementation specific knowledge, which is not desired in this application. Moreover, as stated by the experts of the museum, when dealing with the conception of temporary exhibitions, it is a more reasonable approach to use a database separate from the one that contains the museum collection.

The elementary steps the user must take in order to build a virtual exhibition are: load a X3D model with the rooms of the exhibition space; select surfaces adequate to display artworks; place and adjust the artworks in those surfaces; optionally define specific viewpoints to help navigation around the exhibition; export the new X3D model. These features will be detailed in the next subsection.

The application is implemented on Java SE 1.6 and uses Xj3D API 2.0M1, which builds and

handles the scene graph. To access and modify the contents of this graph the methods of the SAI (Scene Access Interface) Web3D standard are used. We resorted to Java3D API 1.3 for some phases of the geometric processing. The graphical user interface is built on Java Swing.

### 3.2 Basic Features

**Standardization of the Scene Geometry.** Despite being a well-defined format, X3D allows multiple internal representations for the same visible result, due to the wide variety of nodes that exist to describe the geometry of an object. Thus, analyzing an X3D scene when we do not know its creation process poses major difficulties for interpreting its geometry in an easy, complete and correct way. To overcome this difficulty, we devised a process that does not change the initial description of the scene but adds a new definition of its geometry, which contains the information necessary to add new objects to the scene.

This abstraction layer of the initial scene geometry is composed of a set of invisible surfaces which are placed in the top of the original geometry. Each surface is a flat area characterized by a single normal vector and comprising an arbitrary number of adjacent triangles. All the modifications done to the scene, including the addition of touch sensors or the highlight of surfaces, are done in this layer, leaving the original scene completely untouched.

**Selection of Surfaces.** Before starting the placement of art objects, the user must explicitly choose which areas are suitable for placement. This selection can be interactive, choosing suitable surfaces one by one or using pre-defined filters. These filters examine each surface and decide whether it should be selected and can also be combined and used to perform the inverse operation, that is, to reject surfaces instead of selecting them.

At the current development stage, there are: an area filter that selects all the surfaces that have a certain minimum area; and a normal filter that selects the surfaces whose normal satisfy the conditions imposed by the user.

**Placement of Objects.** To allow extending the type of objects that can be inserted into the scene, we defined a set of basic parameters that characterize an object and give support to the generic mechanism of object placement: the bounding box; the base of contact with the surface where it is placed; the normal vector of this surface (corresponding to the face or the visible volume of the object); and the orientation of its upper edge.

After selecting the object to be inserted into the scene, the previously chosen surfaces become selectable and the user must pick one with the mouse. The centre of the contact surface of the object is placed on the specific surface point selected with the cursor. Then the object can be rotated, its position can be adjusted or can also be placed on another surface.

2D artworks are stored as images in the database, along with additional information about the piece. One of the characteristics stored in the database is the physical dimensions of the artworks, so they are displayed using the correct scale.

3D artworks are stored as X3D models. A simplified representation can be built based on the physical dimensions and a single image of the artwork. In this case, a parallelepiped is placed in the scene—and the image of the object is applied as texture to all faces. In Fig. 1 there is an example of two different representations of the same 3D artwork.

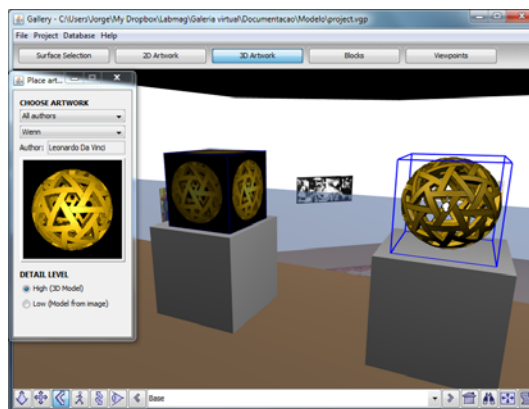


Figure 1: Two alternative representations of the same artwork are shown.

In addition to artworks, it is also possible to add removable structures, like dividing walls or plinths. For this purpose the user can place in the scene parallelepiped objects, choosing their size and colour. Once placed in the scene, the areas that compose the surfaces are also considered suitable for the placement of artworks and can be chosen in surface selection edit mode.

**Viewpoints.** X3D allows the definition of pre-defined positions for the user, called viewpoints, which are associated with a direction of sight. To support viewpoint definition interactively, the application is capable of automatically obtaining the position from where the user is looking at the scene and allows the user to define that view as a viewpoint.

**X3D Exhibition File Generation.** The X3D file containing the description of the virtual exhibition is produced through a process where each edit mode independently writes its changes to the output file. The file containing the original scene graph is modified using the DOM (Document Object Model) interface provided by Java API for XML processing. Note that the changes made to the original file are mostly addition of new nodes, not modification of existing ones.

**Exhibition Re-Editing.** To make adjustments to a virtual exhibition previously built, the X3D file resulting from its construction does not have all the required information. Hence it is necessary to know which objects were introduced in the initial scene.

To enable the re-editing of virtual exhibitions, a mechanism was designed based on a set of auxiliary data structures that store information about all objects added to the scene. The contents of these structures can be saved in a file - called the state file - which reflects the current editing state of a scene.

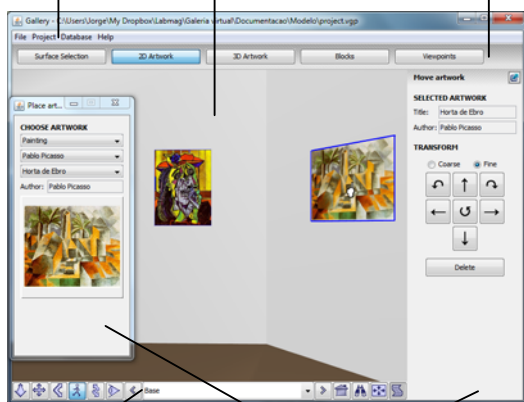
### 3.3 User Interface

The user interface is composed of two sets of elements: one is shared by all edit modes while the other depends on the active edit mode.

The shared elements are split into three different zones (Fig. 2): (1) the menu bar, with common options like file save and file load; (2) the edit mode switch buttons and (3) the 3D browser, including the display area and the navigation bar.

The edit mode dependent options (4) are displayed in two lateral panels, which can be detached from the main window, as shown in Fig. 2, or hidden in order to maximize the 3D display area.

(1)Menu bar (3)Display area (2)Edit mode switch buttons



(3)Navigation (4)Edit mode specific options

Figure 2: User interface for 2D object placement.

The added objects in the 3D scene are highlighted using coloured bounding boxes whose visual appearance indicates if they belong to the active edit mode, if they are selected or if the cursor is over them, as shown in Fig. 1. The selectable surfaces also display similar behaviour, but using colour overlays to achieve the different appearances.

## 4 CONCLUSIONS AND FUTURE WORK

We have presented an interactive tool - Virtual Exhibition Builder - for building virtual exhibitions. This tool aims to assist museum teams in the initial stages of mounting an exhibition. In addition, the resulting virtual exhibition can be shown through the Web for diffusion purposes.

The development of this tool received input from the experience gained in a previous work and was designed in order to overcome its limitations. This tool was presented to specialists from a museum and several improvements were introduced afterwards.

Future developments include the creation of printed layouts of the surfaces, with artworks annotated with the distances between them and the floor; the ability to change the colour of the exhibition surfaces; the projection of videos on surfaces; the reproduction of music depending on the site that is being viewed at the time; the capability of displaying in the scene details from the selected artworks, such as title and author, in order to provide more information to visitors at the virtual exhibition.

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