Picture Transposition in an Immersive Virtual Representation for Work of Art Fruition in a Traditional Museum

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Abstract

In this work we present a Virtual Reality Platform for the presentation and the navigation of artistic paintings. We have investigated the employment of computer graphic technologies as an instrument for the "ri-presentation" of pictorial works.
A particular attention has been paid to the modelling aspects, to the performances constraints and to the architectonic design.
In the following we shall present some of the issues we encountered during the realization and we will discuss some of the design principles we adopted together with the constraints imposed by the system.

Introduction

The art is one of the most promising for multimedia and Virtual Environment (VE) applications. The potentialities offered by computer resources allow to quickly enlarge the information distribution but also, when carefully analysed, to enrich the fruition process. In this case, the artistic value of the produced operas should not be considered as an "alter ego" of the original work created from the artist. It should be considered as complementary and integrative work which does not substitute the original one.
The primary goal of this research application is to furnish a new vision for the existent artistic heritage. The Scientific American Magazine[1], in 1997, dedicated a special issue to this topics named "The Future of the Past".
Actually several works, dedicated to the representation of artistic work exist [2][3][4][5]. Rarely these works overcome the precise environment representation.
In the field of interactive art there are several works. C.Vasilakis et al. [6] in 1998 produced a digital three-dimensional reconstruction of the famous Velasquez's painting named *Las Meninas*. Such a work consists in a C.A.V.E. [7] like application allowing the users walking inside the Velasquez's opera. F.A.B.R.I.CATORS [8] in 1997 produced a Virtual Reality interactive journey into the Leonardo da Vinci's masterpiece *L'Ultima Cena*. In such a work, the visitor can visit in all its details the painting.

"Las Meninas" was an animated transposition of the original painting. It shows that the available instruments for computer graphics, besides the copy of the existing environments, allow the realization for new and animated environments which present an intrinsic potential value whenever used by an artist.
In this view, as future art frontier, it is possible to imagine multimedia and VE operas realized by "virtual craftsman". Such operas can be at the same time instrument for the exploration and the information which place the user in a proper surreal atmosphere.
In this work we investigate the employment of such technologies as an instrument for the "ri-presentation" of pictorial works. The existence of accessories info such as artist's sketches and period postcards allowed us the simplification of the synthesis work and to concentrate our efforts on a reduced set of problems.
In the following we shall present some of the issues we encountered during the realization and we will discuss some of the design principles we adopted together with the constraints imposed by the system. Actually the work has been completed and a proper fruition platform will be shortly placed in a dedicated room of the G.Fattori's Musem (Livorno).

Interactive Art

Namely the term *Interactive Art* indicates an artistic experience that does not present to the user a complete work but generates for the user and in the mind of the user a novel kind of experience. Such an experience presents the user as an active part of the opera fruition. In fact, the user can interact with the opera and manipulate it becoming, in such a way, the author of his personal artistic fruition.
In the case of Interactive Art, the user can be considered as an active part of the fruition experience. In fact, the user is not just an analysing subject but also he has an active part of the interpretation since the

system allow him to personalise the perception of the work.
In this case he will have an opera interpretation together with a proper (and personal) physical vision of the work which he can adapt conforming to his own interpretation.

The artist, with digital technologies, can create new artistic paradigms, new modes to involve the user in work of art perception.

The Macchiaioli 3D

Macchiaioli 3D is a Virtual Reality Station for the presentation of the G.Fattori[1]'s painting "*La Rotonda di Palmieri*".
The "Rotonda di Palmieri", (Palmieri's Round Terrace) Modern Art Gallery (Pitti's Palace, Florence),has been painted at Livorno in 1866. In this painting, a set of female subjects, placed below the Palmieri Bath awning, has been depicted behind the Romito's coast background {see fig.1}.
Macchiaioli 3D is an immersive VE based on the subject of the "Rotonda di Palmieri". It migrates from the Fattori's opera colours, themes and pictorial style.

Fig.1: La Rotonda di Palmieri

Moreover the 3D transposition from a 2D painting permits to view unknown particulars of the scenario that is represented in the painting.
Such details have been generated on the basis of period documents, artist sketches and on place measurements. A careful attention has been paid in order to achieve the maximum correspondence between the original painting and the synthesis environment. This will involve the user in such an environment that he can consider identical to that of the original painting.

The surreal atmosphere created in this way helps to improve the emotional participation and the user feelings.
The transposition work has been complicated by consistency problems. Sometimes the artist introduces into his work errors on the representation in order to focuse the user attention on one or more particulars. A careful analysis should be done since this distorsion can cause coherence problem in the reconstruction of the 3D model.
To flimsiness because of the reality represented in the painting is two-dimensional, in the female figures modelling process we have encountered the perspective flimsiness problem. Where the third dimension could be reconstructed like extrapolation of the perspective, this has been made. Where this was not possible, the information have been invented but maintaining the coherence with the reality represented in the painting.

For example in his "Rotonda" Fattori voluntary altered the curvature radius in order to achieve a wider scenery and a better balance among empty and full spaces. The scene designed by the artist has finally been complete with information external to the painting.

The environment which has been realized can be explored from the user by means of a joystick device. The system gives to the user a visual feedback by means of a large video screen as represented in Fig. 2. The user can move inside of the environment and change his proper viewpoint.

Fig.2: The user navigates inside the VE

Then, for the environment represented in the painting we are capable to reconstruct the 3D space (by extrapolation of the need information by the scene and with the aid of the perspective laws). Whereas, for the environment that is external to the painting there is the necessity to create or to reconstruct (like in this work) the real environment from which the painting scene has been inspired.

[1] G.Fattori (Livorno, 1825–Firenze, 1908); italian painter belonged to Macchiaioli style. Macchiaoli style gave enphasis to *macchia* pictorical tecnique.

Although the presented flimsiness can represent arguments on which the artistic critic of the conventional operas could reserve great remarks, this works does not regard the generation of a novel figurative art but on the contrary, it regards the development of a new paradigm for work of art presentation. This approach is an instrument to aid people to understand to the better the cultural heritage.

Environment Design

In order to proceed to the correct design of the environment elements, we have analysed a set of factors summarized in the following table:

1 Scene Model
2 3D Subject Model
3 Texturization
4 Lighting
5 Poligonalization
6 Levels of Details

An analysis of the painting scenario has been useful to define a surrounding environment that *could contain* the particulars placed in the original painting.
In this particular painting the environment was known. In fact, Rotonda di Palmieri is placed in a bathing establishment in Livorno; Livorno in '800 was a famous seaside resort. We have found some period documents, {see fig.3} which have allowed the reconstruction of the geometrical characteristics of the part of the VE that is not directly represented in the picture.

Fig.3: The original scenario

Because of the limits that are imposed by the geometrical complexity, we have chosen to reconstruct only some particulars: the Rotonda, the first part of the Palmieri bathing establishment and the building that worked like point for take a rest. We have modelled also the mountains to the horizon so that they reproduce the curves present in the painting.

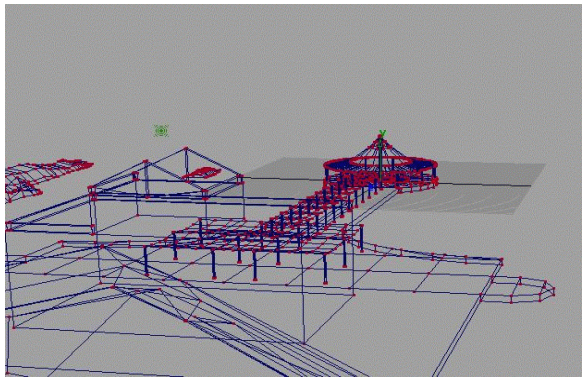

Fig.4: The environment reconstructed

For each female subject a dedicated analysis has been performed. The reconstruction technique has been oriented in order to achieve the lower number of polygons which is possible. In this way we have choose a compromise between the representation quality and the achievable 3D performances during the animation.

Each subject has been divided into three component groups:

- Head, hair, hat
- Body, arms
- Skirt

Each single group has been reconstructed in 3D for the visible part respecting the information contained into the painting. The missing part has been synthetically generated by means of software programs using a mirroring projection
In the original painting, all the female figures are placed of profile versus the viewpoint of the observer. Therefore in the construction process, the visible profiles and, by extrapolation, the relative three-dimensional shapes, have been created.
When the construction process for each particular has been finished, for example for the skirt, the same symmetric shape has been created; finally these two shapes have been merged and have formed the 3-dimensional object.
When the modelling process has finished, the figures have been placed inside the environment in order to recreate the same scene represented in the painting by the artist {see fig.5}.

The subjects and environment texturization has been achieved by sampling portions of the original painting. These samples have been used for covering the elements surfaces.

The VE has been realized in such a way that the pictorial characteristics of the author are reproduced in

faithful manner as far as is possible; the observer can emotionally participates by sensation that are generated by the surreal atmosphere. The goal that we have pursued has been to feel the user immerse in a painting in which he can travel.

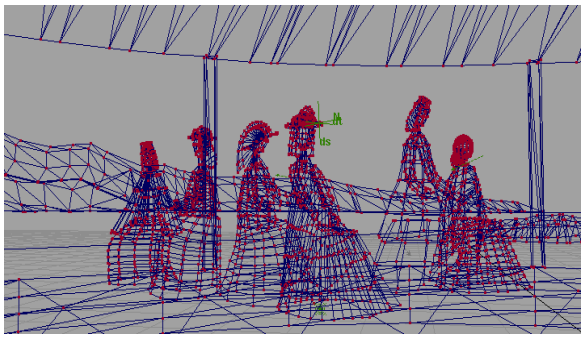

Fig.5: The figures placed inside the environment

To make this, we have created some textures using particulars sampled from the painting. These textures have been used to recover the objects that are placed in VE.

The environment actually makes us of a sparse light which make the whole environment lighted. We actually plan to insert mobile light sources in order to create suggestive shadow effects and day/night animations.
For a graphical displaying, it is necessary that each objects are expressed in polygonal shape, that is like a set of elementary primitives (which can be triangles or quadrilaterals) that are characterized by the vertexes and by a normal that specify the orientation in the space.
Once each object has been modelled by parametric curves, it can be transformed in the polygonal shape; this step is very important because each object has got a polygonal cost. It is necessary to make a balance between the number of polygons and the quality of the images. The female figures have been modelled in three-dimensional shape, with the same criterion.
In the environment modelling task, an advantage was that the objects were simple to construct because they were geometric shapes; whereas in the case of the reconstruction of the female figures, a process for reproducing to the better the original figures maintaining low the number of polygons, has been defined.

An automatic polygonalization phase has been added to the scene in order to reduce the environment complexity. In this way the VE is represantable on a medium class computer. The overall complexity is about 15000 texturized triangles.

Dynamical effects: the painting can be assembled by inserting the subject dynamically.

A dynamical treatment of the detail levels helps to improve the system performances. This treatment details the element descriptions whenever the elements are observed at such a distance which requires a better representation.

Fig.6: An environment scene

Display

The last step of the work has been the development of a user interface that allows a direct interaction with the VE. For this aim a tool that allows a visit in the environment by a joystick has been carried out by use of C++ language. This tool can run both on PC and IRIX 6.2 Silicon Graphics UNIX system. OpenGL, VRlib [9] and GLUT libraries have been used.

Conclusions

This work is related to the two-dimensional representation methodology, but it can be extended like immersive system by the use of proper devices.
It has presented the realization process of a Virtual Reality Station for works presentation. The fruition has made with alternative methods in respect to the traditional interaction that is proper of a classic museum.
The painting has been analysed in all its components for defining a possible interpretation that permits to avoid the problems that are described in section 3.
The application may be displayed on a great screen in order to give to several users at once the possibility of view the visit. The user can interact with a joystick.
The aim to introduce new interaction paradigms with the art is a research field very interesting and stimulating. By the use of the novel digital technologies it is possible to create new paradigms for the most complete work of art fruition.

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