The Virtual Endeavor Experiment: A Networked VR Application

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Abstract

The SICMA (Scaleable Interactive Continuous Media Server—Design and Application) project has been part of the European Union's Advanced Communication Technologies and Services (ACTS) Program since the first call for proposals in 1995. The overall aim of the SICMA project is to design a scaleable server for the delivery of continuous multimedia information over a network to client computers.

The functionality of this server will be tested by a real-time Virtual Reality (VR) exhibition at The Natural History Museum (NHM) in London for three months from June 1997. A later trial will deliver a scaled-down version of the exhibition to a number of home users, via a video-on-demand provider. The VR exhibition will be based on the voyage of discovery to the South Pacific made by Captain Cook on the sailing ship *Endeavor*. Visitors will be able to freely move around a VR reconstruction of the ship containing various exhibits in the form of videos, pictures and 3D objects. The ship's cabins and all the exhibits will be fully narrated and integrated together to make a seamless but non-linear experience for the visitor.

Visitors reactions to the exhibition will be extensively monitored and evaluated. The Natural History Museum hopes that this unique experimental exhibition will provide an insight into the future of electronic outreach projects for the heritage industry. The overall budget of the SICMA project is about 6.5 MECU. The amount of the funding from the European Commission is 3.9 MECU.

Keywords

virtual reality exhibition, high bandwidth, video-on-demand, interpretation

The VR Exhibition

What is a Virtual Reality Exhibition?

The term Virtual Reality (VR) is used by many different people to mean many different things. A simple definition of a VR application might be 'a computer simulation that uses 3D graphics and devices to allow the user to interact with the simulation'.

The virtual *Endeavor* experiment will be displayed in two small darkened theaters. The images of the interior of the ship (see figures 1 and 2) will be generated by a computer with powerful graphics generating capabilities (a Silicon Graphics' Octane). They will be projected onto a curved screen, which will be approximately three meters wide and two high. There will be enough room in each theater for around ten people. In front and facing the screen will be a control panel, with a seat for one person. This person will be able to use the controls to move freely within the VR exhibition.

The graphics computer will generate the picture projected onto the screen in 'real-time'. This means that the picture the visitors see as they move around will be created by the computer as a result of the feedback it gets from the controls. Generating scenes like this in real-time is very computation intensive, and so an expensive graphics computer is required. In contrast, pre-generated scenes could have been used, on a much cheaper computer. However, the disadvantage of this is that the visitor would be confined to a fixed set of paths within the exhibition and would not be able to move around freely, which would not be a true VR exhibition.

The Advantages of VR for a Museum Exhibition

Virtual Reality is an exciting new medium for museum exhibit display, and the VR exhibition in development by the SICMA partnerships been designed to fully exploit the new possibilities afforded by it. The virtual museum project will allow the NHM to present material in a new, exciting and innovative manner, because VR has the following advantages over traditional methods of museum display:

- The visitors can explore exhibition spaces that the Museum could not physically build.
- The exhibits can be 'handled' and manipulated in a way that is not possible in reality.
- The visitors can move unconstrained by the laws of physics.

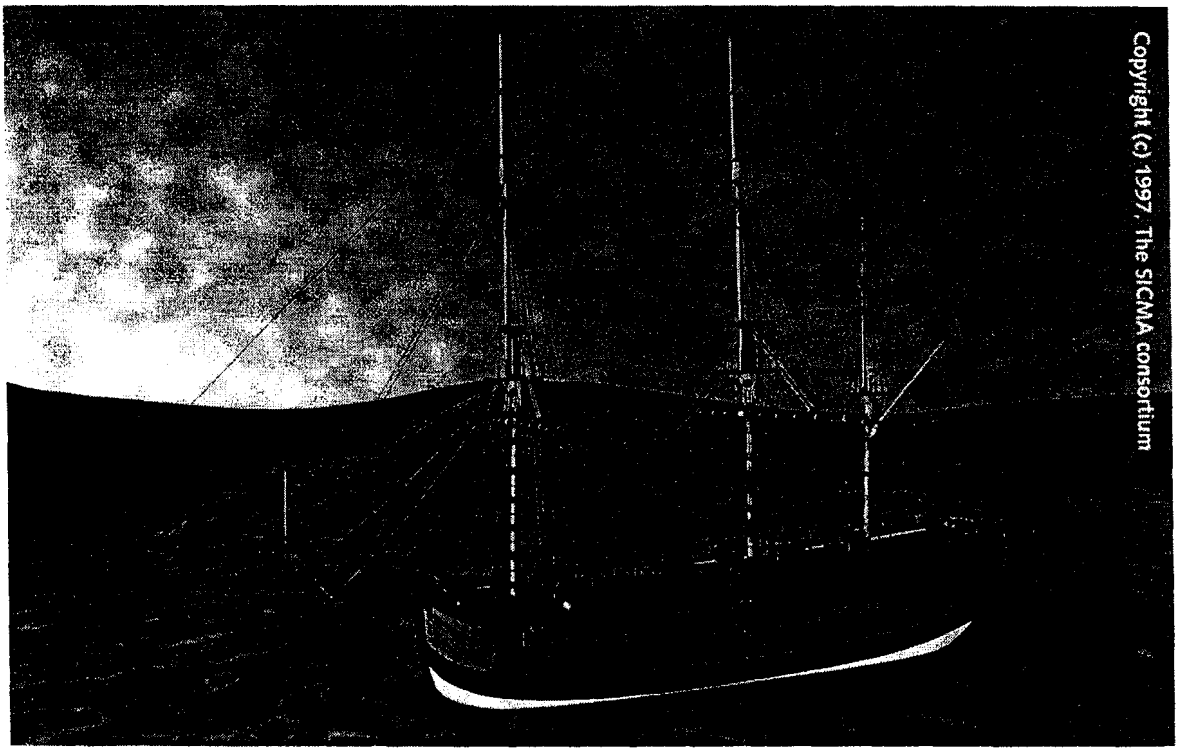

Figure 1: The Virtual Reality Model of the Endeavour

- The exhibits can be scaled to unlimited size (i.e. micro to macro).
- The exhibition space is unlimited.

THE DISADVANTAGES OF VR FOR A MUSEUM EXHIBITION

All content material needs to be in a digitized format.

- The exhibit material is limited to that which can (currently) be scanned using a 3D scanner:
- It must be smaller than a cube two meters on each site.
- It must not contain any transparent parts.
- It must not be too complex (no feathers, hair, hundreds of leaves, for instance).
- It must not be too shiny.

BASIC DESIGN PHILOSOPHY

When the design of the Virtual Exhibition started, it was decided that there were some fundamental principals that should be followed in its design. These were that it should be:

- **intuitive**—an instant understanding of the interaction requirements are needed by the visitor.
- **seamless and natural**—no windows apparent to the visitor, no menus, no desktop metaphor, etc.
- **consistent**—human/computer interaction studies show consistency to be a fundamental requirement of intuitive interactive systems. Buttons should be of a consistent appearance, function and location, for example.
- **durable**—the system should cope with the fact that many of the visitors will be using such a system for the first time, and that they may walk away from it at any point during the program.

Figure 2: Inside the Great Cabin of the VR Model

BASIC FEATURES

To meet the criteria mentioned above, we decided that the following basic features were required:

- **A short introductory video**—the application has a short introductory video which gives and overview of the story. This video is always shown when the reset button is pressed.

- **Reset button**—one of the two physical buttons is a reset button. This button restarts the application. It is set apart from the other button and is clearly labeled. Upon pressing this button, visitors are asked if they are sure they want to start from the beginning.

- **Automatic restart**—If the system receives no input from the visitor for a fixed period, the system automatically restarts itself. The length of this fixed period is adjustable, and has a default value of 120 seconds.

- **Hotspots**—areas in the gallery are defined as hotspots. These are associated with the objects on display and allow the visitor to change interaction mode by pressing the button ('interaction hotspots').

- **Interaction modes**—there are a number of different interaction modes. The normal mode is *movement,* which applies in the virtual gallery space. Other interaction modes are *video, picture* and *object.* Each object or entity in the virtual gallery space has an interaction mode associated with it.

- **Simple and consistent on-screen buttons**—All interaction modes, except movement mode, use a small number of buttons for interaction. These are always presented in a strip at the bottom of the screen. The right-most button is always the 'quit' button, which returns the visitor to movement mode.

- **A cursor**—All interaction modes, except movement mode, have a cursor in the shape of a hand with the index finger extended, as if going to press a button.

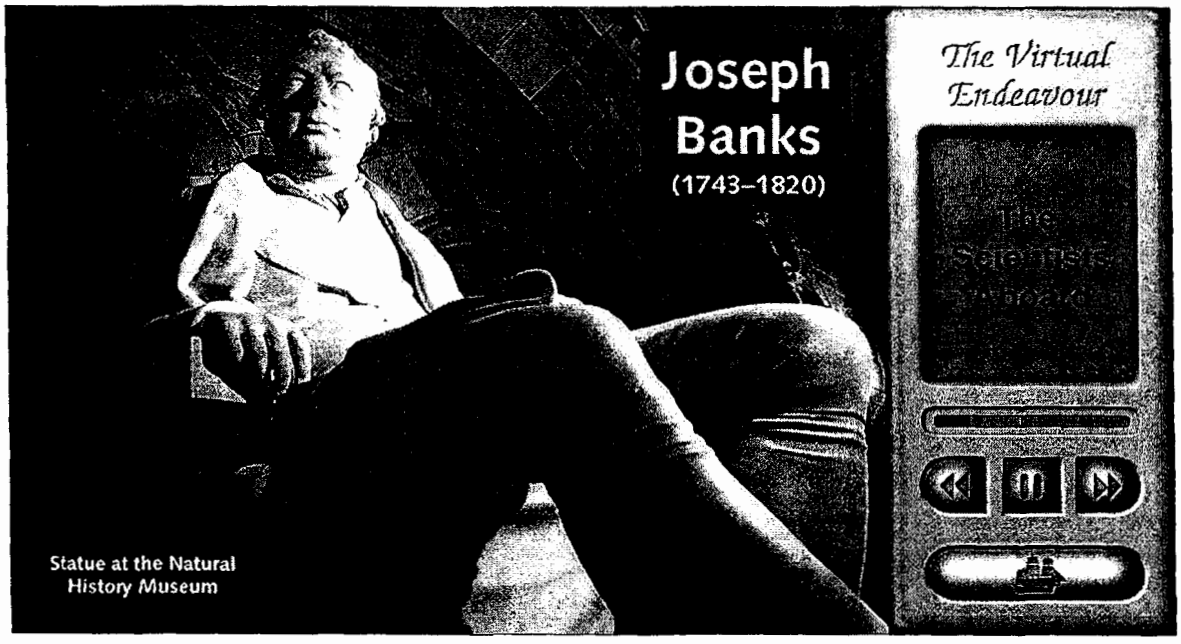

Figure 3: The Interface for Video Material ('video mode')

THE INTERACTION MODES

It was decided that three interaction modes would be enough to provide a simple interface to a wide variety of content. The modes were designed to operate separately from the 3D environment, since in order to press buttons the user needs a cursor, and there is no cursor in the 3D environment. In all modes a button with a ship motif quits the mode and returns the user to the 3D environment.

Video mode

In video mode (see figure 3) the visitor is presented with a video which starts automatically. A status bar shows how much of the video they have seen. We decided against giving the visitor the full range of video controls (pause, forward, rewind etc.), as the videos in question are all of less than two minutes in length.

Zoom mode

In zoom mode (see figure 4), the visitor can choose from a number of images, and can display the image at two levels of magnification. To zoom into the image, the user clicks on the image. Text describing the image is also displayed.

3D object mode

In 3D object mode (see figure 5) the visitor is presented with a 3D object which they can rotate by moving the cursor over the object. Whilst the visitor is viewing the object, an audio clip plays in which a narrator describes it.

THE PARTNERS

The principal European partners involved in the creation of the VR exhibition are:

ATELIER FÜR INFORMATIK UND ARCHITEKTUR (GERMANY)

This architecture company, with extensive experience in using computers to create computer models of buildings, created the VR model of the *Endeavor.*

3D SCANNERS (UK)

This small technology research company is creating a 3D scanner that uses a laser, video camera,

Figure 4: The Interface for Drawings and Charts ('zoom mode')

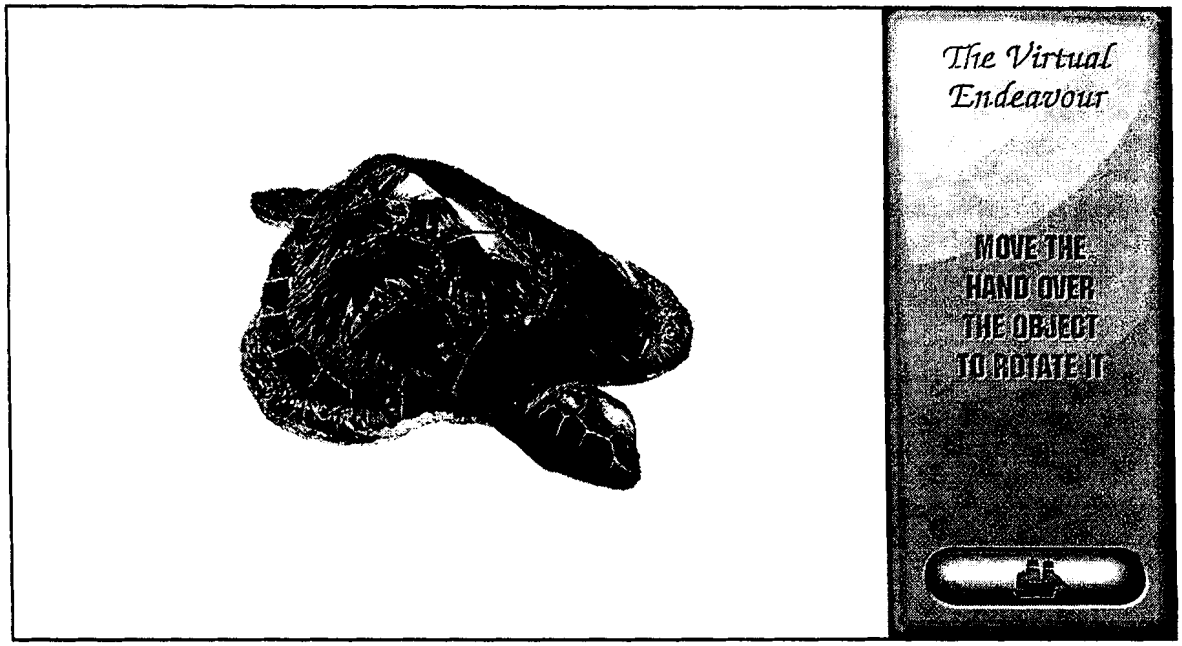

Figure 5: The Interface for 3D Objects ('3D object mode')

articulated arm and computer to create a texture-mapped 3D data model of an object. Objects scanned in this way are placed into the VR exhibition and can viewed by the visitor from all angles.

UNIVERSITY OF PADERBORN (UPB, GERMANY)

UPB are taking the data generated by the above two partners, optimizing it for real-time display, and creating the software necessary for the visitor to move around the exhibition and interact with the objects found there.

THE NATURAL HISTORY MUSEUM (NHM, LONDON)

The NHM is researching, designing and creating content for the VR exhibition. It is developing an evaluation protocol to gauge visitor responses to the exhibition, and will host the exhibition for three months starting in June 1997.

Table One shows a complete list of the SICMA partners.

Partner	Short Code	Country
Deutsche Telekom AG	DTAG	Germany
University of Paderborn	UPB	Germany
Atelier für Informatik und Architektur	AIA	Switzerland
Natural History Museum	NHM	UK
Gallo Romeins Museum Tongeren	GRMT	Belgium
3D Scanners	3DS	UK
Cap Gemini SpA	CAP	Italy
Multimedia Systems Center	MSC	Crete
Multimedia Systems Institute of Crete	MUSIC	Crete
Admit Design Systems Ltd.	ADS	UK

Table 1: SICMA Partner Institutions

THE EXPECTED OUTCOME OF THE EXHIBITION

The VR *Endeavor* exhibition is being treated by the Natural History Museum as an experiment into the possible future of electronic out-reach possibilities for the museum and heritage industries. Although the technologies being used in this project—high-bandwidth multimedia delivery over long distance networks, and real-time virtual reality—are currently leading-edge and very expensive, within the next five to ten years they are likely to become increasingly available to the family in the home. By creating this experimental exhibition The Natural History Museum hopes to evaluate the prospects for museum's to deliver this type of exhibition material into the home in the future.