A VR Multimodal Interface for Small Artifacts in the Gold Museum

Pablo Figueroa*
Universidad de los Andes, Colombia
Juan Borda†
Universidad de los Andes, Colombia
Diego Restrepo‡
Universidad de los Andes, Colombia
Pierre Boulanger§
University of Alberta, Canada
Eduardo Londoño¶
Museo del Oro, Colombia
Flavio Prieto‖
Universidad Nacional de Colombia

ABSTRACT

The Gold Museum, in Bogotá, Colombia, displays the largest collection of pre-Hispanic gold artifacts in the world and it has been renovated recently. With funds from the Colombian Government, we have created a multimodal experience that allows visitors to touch, hear, and see small artifacts. Here we present a description of this demo, its functionality, and technical requirements.

1 INTRODUCTION

The collection of Pre-Hispanic artifacts at the Gold Museum [1] in Bogotá, Colombia, is a unique example of the highly advanced skills and artistic achievements that aboriginal people in Latin America accomplished. It has more than 3000 gold artifacts, pottery, and other pieces that were used in the daily lives of peoples before the fifteenth century.

With funding from the Colombian government, we are developing applications that show the potential of new technologies for the discovery and appreciation of small artifacts. Initially, we are developing multimodal experiences both at the Web and at the Museum, in order to have a closer experience with some of the pieces of this collection. This demo shows a prototype of the multimodal experience that visitors will have at the Museum. It uses technologies such as 3D visualization, haptic feedback and sound reproduction in order to provide visitors a closer experience with 5 selected pieces from the current exhibition. We hope that these technologies encourage visitors to know more about these and other pieces.

2 THE INTERFACE

The main menu shows which pieces are available for closer exploration by means of flags on top of the Museum's map. Users can select an artifact and use two different tools: one for cleaning and restoring and the other for weighing. After a certain period of time the system starts again in the main menu, in order to limit the time that each visitor can spend with this tool.

The restoration activity depicts objects with a shiny golden surface covered in some parts by oxidized metal. Users can inspect an object from any angle, and clean it by touching with a haptic device. We provide a rotation widget that generates a Hooke's Law force on the haptic device when it is in proximity, and whose intensity and direction affects the rotation speed of the associated artifact. The object's shininess is generated by a GLSL shader with varying degrees of surface reflection and color, and dust is a texture on top of the object. By reading texture coordinates at the moment of contact it is possible to switch between the rusty texture and the actual object's color. This restoration process is close to what curators do when cleaning objects in detail, and this is explained to visitors by audio while they are interacting.

Another activity that users can perform in this application is to weigh artifacts. The purpose of this activity is to show users how some objects are heavier than others, even when their sizes would hint the contrary. For this purpose we developed a virtual two-pan balance that has an object on one pan and no object on the other. The user can push down on the empty pan to reach an equilibrium, and feel a force proportional to its actual weight.

3 SOFTWARE DESCRIPTION AND SYSTEM REQUIREMENTS

This application uses the H3D API for its implementation. H3D is an extension of X3D with support for haptic devices that combines XML descriptions with python scripts in order to allow developers to create rich haptic experiences. We have created an implementation that tries to efficiently use H3D by creating X3D prototypes[1] for interface elements like the rotation widget, the two-pan balance, and menu flags. Other, more simple prototypes, are used to instantiate scanned geometric data in different parts of the application. Another simple yet very practical prototype is one that scales and moves the whole scene according to the haptic device we are using at a certain moment.

We work with a Phantom Omni and a Novint Falcon, both with different workspace volumes. We produce a 3D visualization by means of a CRT monitor and shutter glasses.This prototype lets us explore the same scene with any haptic device, performing device position calibration and scene scaling in each case in particular. Although H3D can be used under Linux, we have just used our system under Windows XP with a GeForce NVidia card and 1GB of RAM.

4 EARLY RESULTS

Our current setup allows users to interact with both a 3D visualization and a haptic device in the same space. We have periodically shown parts of this application to visitors of our lab during the last 4 months, and we have collected some general usability information that helps us to tune our system. In general, the use of the haptic device has to be explained to visitors prior the interaction, and there are some differences of use between the two haptic devices that we plan to tackle in the near future.

5 INTRODUCTION TO COLIVRI

Colivri (Co-Laboratorio en Interacción, Visualización, Robótica y Automatización)[2] is a collaborative effort between Mechanical, Electronic, and Computing Engineering in order to create a space for research in the fields of Human-Computer Interaction, Visualization, Robotics, and Automation. We are currently 9 faculty members from different research groups that share a common theoretical background in fields such as Euclidean Geometry, Computer

*e-mail: pfiguero@acm.org
†e-mail:jua-bord@uniandes.edu.co
‡e-mail:dieg-res@uniandes.edu.co
§e-mail:pierreb@cs.ualberta.ca
¶e-mail:elondola@banrep.gov.co
‖e-mail:faprietoo@unal.edu.co

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[1] Currently, Some technical limitations in H3D related to prototypes and python scripts forced us to create a mechanism for instantiation of such prototypes before execution.

[2] It is also a misspelled version of Colibrí, or Hummingbird in Spanish.

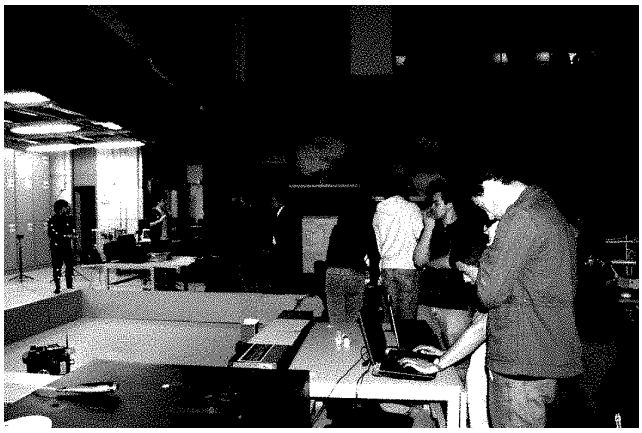

Figure 1: Colivri's Main Area

Graphics, and Computer Vision, and we develop projects in the intersection of these fields. After one year in our new installations, we are running 4 externally funded projects and we have active involvement of about 30 PhD, MSc and undergrad students.

This lab was created due to the increasing requirement of multidisciplany teams for development of applications in fields such as Mixed Reality, Simulation, and Computer Vision, and the potential of such applications in the future. Our installations were designed inside the new Engineering Building of Universidad de los Andes, with start-up funds for equipment from the University. We pursued an open, multi-functional space that allows several configurations in order to fulfill our goals in research, teaching, and consulting.

6 Current Facilities

Figure 1 shows a picture of our current installations during a demo session. The main area has about 200 m^2 and it currently holds two main facilities: a tiled display of 9m wide by 3m in height and our lab for collaborative robotics. Beside these, we also have a Phasespace system for motion capture, a custom built 3D table, a 3D haptic desktop, and two custom built simulators for a boat and a car. Our second level has a small conference room and desks for students in research projects. The small conference room has capabilities of both a Geowall and an Access Grid node, and we are using it to perform enriched teleconferences with our international research partners. Beside these elements we have low cost cameras, projectors, HMDs, input devices, and a 3D scanner, in order to cover most of the interests of our Faculty, and allow developments in the fields we are interested. So far we had a visitor Faculty from Canada, we are expecting another one from France, and we are looking potential collaborative efforts with other international labs.

7 On-Going Projects

Some of our on-going projects include the following:

- An internally funded project in order to support 3D visualization in our tiled display, with color and geometric blending of images. We expect to obtain an image of up to 6000 by 2000 pixels per eye.
- An internally funded project for a software infrastructure for MR application development. We would like to support a smooth transition between MR hardware setups and for this reason we are developing a visual programming environment with code generation capabilities that will allow novices and experts to create MR applications.
- A government funded project on Virtual Heritage, for multimodal exploration of small pre-hispanic artifacts, in collaboration with Universidad Nacional de Colombia and University of Alberta.
- A government funded project on Scientific Visualization, for heterogeneous and collaborative interaction over a virtual wind tunnel, in collaboration with EAFIT University (Colombia) and University of Alberta (Canada).
- A government funded project on Telecontrol of machinery, in collaboration with Universidad Nacional de Colombia and Tecnológico de Monterrey (Mexico)
- A government funded project on Edutainment with Maloka (A Colombian Science Center)

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Acknowledgements

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[1] Banco de la República, Colombia. Museo del oro. http://www.banrep.gov.co/museo/eng/home.htm, 2008.