The 10th International Symposium on Virtual Reality, Archaeology and Cultural Heritage VAST (2009)
K. Debattista, C. Perlingieri, D. Pitzalis, and S. Spina (Editors)

The Blue Gold Exhibition: A Multimodal Installation for Small Artifacts

Pablo Figueroa[†1], Eduardo Londoño[3], Pierre Boulanger[2], Flavio Prieto[4],

Mauricio Coral[1], Juan Borda[1], Felipe Vega[1], and Diego Restrepo[1]
[1]Universidad de los Andes & Bogotá, Colombia
[2]University of Alberta & Edmonton, Canada
[3]Museo del Oro & Bogotá, Colombia
[4]Universidad Nacional de Colombia & Bogotá, Colombia

Abstract

The Blue Gold exhibition is the first result of an international collaboration for preserving digital copies of small artifacts from the Gold Museum in Colombia. It is currently open to the public with three complementary installations and it offers both multi-media and multi-modal experiences to visitors. In particular, it is possible to touch and observe in 3D small artifacts by using a commercial haptic device and a stereo display. This paper discusses issues associated to project organization and development, technologies used for data processing, our redundant approach for dealing with technology limitations, and the challenges associated with the creation of a multimodal exhibition. We report our early experiences and future challenges with these types of exhibitions.

Categories and Subject Descriptors (according to ACM CCS): I.3.7 [Computer Graphics]: Three-Dimensional Graphics and Realism—Virtual reality I.3.8 [Computer Graphics]: Applications—I.3.6 [Computer Graphics]: Methodology and Techniques—Interaction techniques J.5 [Arts and Humanities]: Fine arts—

1. Introduction

The Gold Museum in Bogota is Colombian's main institution for preserving, researching, and exhibiting the most representative pieces of Colombian's pre-Hispanic past, specially artifacts made of gold. Pre-Hispanic civilizations such as Muisca, Tairona, or Sinu produced beautiful garments, musical instruments, and working tools in which they showed their knowledge of goldsmithing and handcrafting of several materials. In total, the Gold Museum contains about 33.000 objects made of gold, and 20.000 other objects made of stone, pottery, wood, and textiles.

During this project, we started a process of creating virtual heritage content by gathering digital information from a representative set of 12 artifacts with 3D scanners, high resolution cameras, video cameras, and high quality microphones. Our initial goal was to capture as much information as possible during the short period of time (one week) we had access to those artifacts. The Blue Gold Exhibition is the first public manifestation of such process, in which we try to offer visitors a set of interactive experiences allowing them to be closer to the selected pieces, either at some special installations in the Museum or through the Internet.

In order to do so we created three installations, one available through the Internet, one available through a computer room at the Museum, and finally, a special multi-modal booth at the Museum with haptic and stereo display capabilities. By using these installations, digital replicas can be observed with high level of detail from several points of view. One could also hear their sound when they are hit with a virtual stylus, observe them in stereo, and touch them using a commercial haptic device. All these interfaces create for the museum participants a much closer encounter with artifacts, and a new way to observe and interact with them.

2. The Project

Blue Gold is a government funded project that began in 2008 with the participation of 2 Colombian and one Cana-

† pfiguero@uniandes.edu.co

dian universities, and the sponsorship of the Gold Museum in Bogota. The project's main goal is to provide high quality, Colombian based content through the Renata [Cor08], a dedicated network connecting various colombian academic institutions and high speed academic international networks such as Geant in Europe, Clara in Chile, or Internet-2 in the United States. Renata sponsored several projects that will create interesting content for researchers in Colombia as well as for the rest of the world. The Gold Museum is one of the finest pre-Hispanic museums in the world, and for this reason the creation of digital replicas of selected pieces in its collection is of great interest. Although the main goal of heritage preservation is important in its own right, we wanted also to explore novel multi-modal interfaces that may allow visitors to virtually manipulate and explore virtual proxies of real artifacts. Some artifacts have interesting features that usually remain hidden from casual visitors such as their weight or sound that could now be explored through this multi-modal interface.

Our team included archaeologists, experts in 3D scanning, and experts in novel interfaces. Although the Museum's willingness to collaborate, strict access rules to gold artifacts and limited time (one week for scanning) were issues to consider from the beginning of the project.

Our first task was to select a 12 representative artifacts to be digitized. We decided to limit the size of the artifacts between 1 and 17cm to guarantee that we could digitize them using available 3D scanners. We also decided to digitize artifacts with a variety of materials, functionality, and cultures. Figure 1 shows the selected artifacts which are:

Figure 1: *Selected Pieces for this Project.*

- A woman that was modeled in bee's wax and then cast in gold, then decorated with hammered pendants to enhance the shining power of the metal, considered the vital power of the sun.
- A Tolima pendant in the form of a jaguar mixed with insect features and powers (between 1 and 700 A.C.)
- A stone bell from the Tairona culture (between 900 A.C and 1600 A.C.)
- A Nariño region bell (between 600 A.C and 1600 A.C.)
- A gold based jaguar from the Calima culture, used as a lime container for the coca ceremony (between 200 B.C and 1300 A.C.)
- A small object in the form of a skull from the Tumaco culture, made of gold and platinum (between 700 B.C. to 350 A.C.)
- A disc from the Urabá region, which was probably used as decoration for a stick used in the sacred consumption of coca leaves
- From the swampy area in the north of the country and the Sinu culture, a golden heron that was used as decoration of a chiefly staff (between 200 B.C. to 1600 A.C.)
- A gold based cover for a snail shell, which was probably used as a trumpet for ceremonies (between 200 B.C and 1300 A.C.)
- A ceramic vase from the Cauca region, probably for holding sacred liquids (between 150 B.C and 900 A.C.)
- A Muisca culture ceremonial raft, one of the masterpieces of the Museum (between 600 A.C and 1600 A.C.)
- A small rattle

The following sections describe the technologies we used to digitize the artifacts, the data processing we had to accomplish, and the installations that are part of the Blue Gold exhibition.

2.1. 3D Digitizing Technologies

For the process of digitizing the artifacts, we only had one week to do the job. Since we had access to three scanning technologies (a Faro/Kéon digitizing arm, a Minolta scanner, and a NextEngine scanner, shown at Figure 2) we decided to share the same room allowing for easy transfer of artifacts between digitizing stations and parallel digitizing work. We also used two high definition cameras with a homemade mounting system for capturing stereo images and to reduce reflection problems (Figure 3). Using a directional microphone, we also captured the sound signature of selected artifacts as they got hit by a stylus. A video camera was also used for documenting people's work flow. This will later on allow us to understand the digitizing process in action to evaluate the efficiency of the work flow.

Figure 2: *Scanners in our Capturing Process.*

Because of the limited time allocated for digitizing artifacts, we performed numerous digitizing mockup sessions with physical replicas from the Museum, which allowed us to fine tune the work flow. In total, we were allowed to only have 6 technicians inside one of the Museum's vaults for that

one week, with 3 members of the Museum staff performing all artifacts' manipulation and doing constant supervision.

Figure 3: *Our Setup for High Definition Cameras.*

2.2. Data Processing for Optimal Content Production

In order to create the content for the installations in Blue Gold, we performed the following tasks:

- We processed the high resolution pictures in order to eliminate undesirable shadows from the surroundings and the hardware setup. These pictures were used to create a 360° view
- We reduced the polygon count of the highest resolution 3-D model (2.6 M triangles) to a specified count (20K triangles) in order to guarantee real-time (min. 10 Hz) display performance on two graphic platforms we have available for this installation. The polygon reduction was performed by Rapid Form using a high-performance hierarchical polygon reduction algorithm. These reduced models were then used by a X3D based viewer for the website and for the haptic installation
- We manually stitched high-resolution textures to some selected 3D models to improve visual quality without having to increase the polygon count. We are currently working on an automatic version of this texture registration process but due to technical difficulties it could not be ready before the exhibition at the museum. Figure 4 shows two of such pieces. Since other objects are made of gold, we created in each case an artificial material that mimics their original color. Figure 5 shows how these reproductions look.

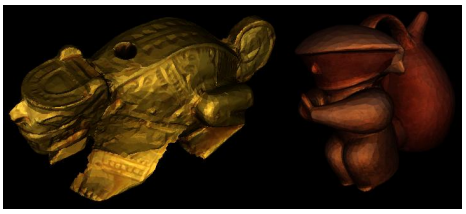

Figure 4: *3D Models with Manually Stitched Textures.*

2.3. Project Installations

The Blue Gold Exhibition consists of three main installations: a web site, a multimedia application, and a multimodal installation.

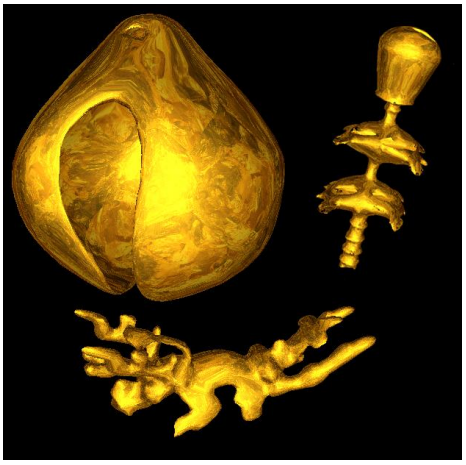

Figure 5: *3D Models with Artificial Gold Material.*

The web site in Blue Gold allows visitors to observe details of six artifacts in the Museum. It is possible to see each artifact from different viewpoints, see high resolution images, and view simplified 3D models. There is also textual information associated to each artifact that describes its location in the Museum and its historical origin. Figure 6 shows screen-shots of such web site †.

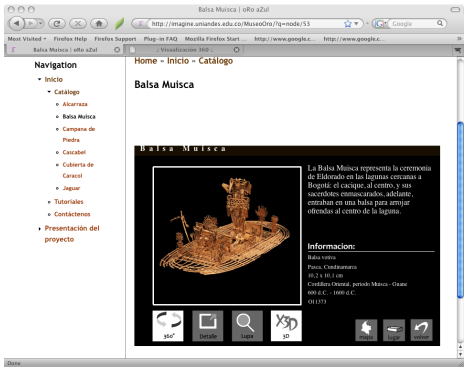

Figure 6: *The Web Site of the Blue Gold Project.*

The multi-modal experience is another way to present the same information as the one in the web version. In this case, the interface was targeted to a computer room inside the Museum. Visitors interact with a robust interface based on a track-ball and a button. Since it is Museum's policy to have just one digital installation per computer our multimedia installation can not be turned off.

Finally, we developed a haptic and stereo visualization installation that allow visitors to touch, observe in stereo and

† Available at http://imagine.uniandes.edu.co/MuseoOro.

hear some of the digitized pieces, as shown at Figure 7. All interactions in this installation are mediated by a low cost haptic device such as the Sensable's Phantom Omni. This setup co-locates both interaction and visualization in a space that contains the virtual artifacts. Even though the input device is not located in the exact position where the virtual pointer appears, visitors feel that they are touching the virtual artifacts as if it was real. In this application, visitors can select which floor they want to visit, and the system shows which artifacts are available at each floor. Object selection is performed by pushing a door with the haptic device. Once an artifact is selected, it is now possible to see it from any point of view, or to perform two activities: weighing or cleaning. A detailed description of this interface and related work are mentioned in [FLB*09].

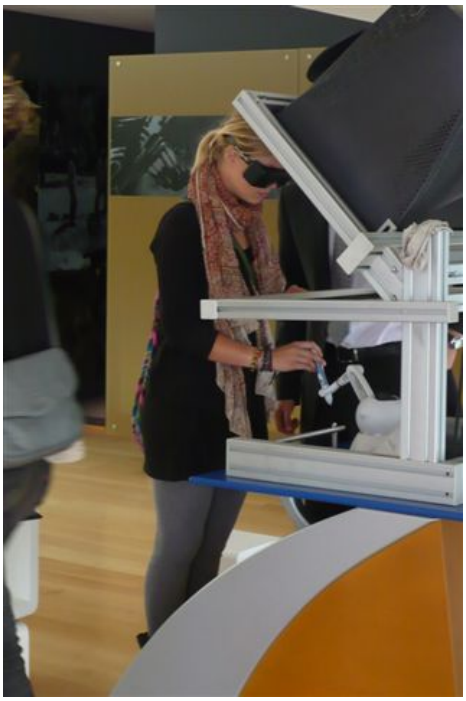

Figure 7: *The Haptic Installation of the Blue Gold Project.*

3. Early Lessons

We divide lessons in three categories: preproduction, development, and deployment. During preproduction, we decided to take advantage of the fact that we had access to several 3D scanning devices and we managed to capture a good set of data. Although the data size and precision far exceed what is required for the Blue Gold exhibition, the models created are of archival quality and can be used for more precise displays and interfaces as technology advance. In practice, the most limiting resource in our case was time with the pieces.

Our main challenge in development was time, since we had just six months. For this reason, we had to leave the process of automatic stitching of textures for subsequent work, and concentrate on compelling tough fast results. Technologies such as Quicktime VR for 360° views, X3D for 3D visualization, H3D for haptic visualization, and RapidForm for object's simplification were very valuable in this endeavor. However, standard visualization techniques create artifacts in simplified models, such as some apparent cracks in the ceramic vase of Figure 4. Another important lesson is how different types of information are better suited for different display technologies: high resolution pictures look better in high resolution displays, and not so well in our autostereoscopic display, due to the reduced resolution. This is one of the main reasons why we created several complementary installations which allowed us to emphasize on different aspects of information visualization.

Finally, the deployment of these interfaces have been very rewarding and have opened new doors for future developments. Since computer literacy of visitors varies widely, it is difficult to design an interface that invites them to explore and interact as if they had an object in their hand. Despite the fact that we developed our haptic installation in three cycles with over 300 people testing them, we still have place for improvements. Equipment and software APIs are also challenging, since they still lack the resilience, sturdiness, and reliability to be left without supervision. For example, we discovered that a guide is still required in order to facilitate the use of the haptic installation to visitors, and reboot the installation if it gets into an undesirable state.

4. Conclusions and Future Work

The Blue Gold exhibition is the first result of our very successful international effort that creates virtual heritage around the collection of the Gold Museum in Bogota. Three complementary installations have been created allowing visitors to learn and to explore in more detail selected pieces, to see them closer, and to touch them with haptic technologies. This exhibition allowed us to explore novel ways to interact with high quality reproductions of small artifacts, and new ways to relate the virtual experience with the real-physical world. We plan in the future to fully use this information (especially the 3D models) in order to create more compelling experiences for museum visitors, and to address the needs of experts in these artifacts.

References

[Cor08] CORPORACION RENATA: Red nacional académica de tecnología avanzada. http://www.renata.edu.co/, 2008.

[FLB*09] FIGUEROA P., LONDONO E., BOULANGER P., PRIETO F., CORAL M., BORDA J., VEGA F., RESTREPO D.: Interaction with replicas of small pieces: Using complementary technologies to maximize visitors' experience. In *Proceedings of the 10th International Symposium on Virtual Reality, Archaeology and Cultural Heritage VAST (2009)* (2009), Eurographics.