Virtual Reality as a Teaching and Scientific Dissemination Tool – First results

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ABSTRACT

Virtual reality has been increasingly widely used in teaching applications, various knowledge areas, and scientific dissemination. Based on this, a collaboration emerged between *Casa da Descoberta* the Federal Fluminense University's science museum, based at the Physics Institute, and MediaLab, a laboratory specializing in Virtual Reality content at the Computer Science Institute. The original objective was to incorporate a Virtual Reality environment into the museum, so that content from different areas of science is made available to any visitors, including scholars, which are the largest share of visitors. The project includes the installation of several Virtual Reality stations in the museum's physical space and the development of games within the scientific approach. Four games have already been developed and are available for first-playing tests presented in this paper.

KEYWORDS

Serious games, virtual reality, gamification, museum, science.

1 Introduction

Science centers play an important role in helping each individual to develop their full cultural potential, collaborating in the general education of citizens, and also helping to meet the perspective of permanent lifelong learning. In particular, science and technology centers, have enormous potential for motivating young people and the general public to enter the scientific culture.

However, these centers have always been limited in what they could offer to their public in terms of technology and interactive applications. Studies on Virtual Reality (VR) have gained prominence in several areas of knowledge and have a fundamental characteristic: the creation of a sense of presence [1-3]. Therefore, VR allows spaces such as *Casa da Descoberta* to cross these limits, expanding the community's scientific literacy leves. *Casa da Descoberta* receives approximately 8000 visitors a year between scheduled and spontaneous visits and is located at the Municipality of Niteroi, Rio de Janeiro.

This study is part of the Project "Virtual Reality as a Teaching and Scientific Dissemination Tool", approved by the Notice of the Applied Project Development Program (PDPA), created in partnership between the Municipality of Niterói, UFF, and the Euclides da Cunha Foundation (FEC). The Project aims to promote the acquisition of knowledge by society beyond university walls, seeking to show different areas of science and their relevance as research and application, while provoking an immersive enchantment for the sciences in VR. Also, to reach audiences of all different locations, ages, social classes, and degrees of education, increasing the levels of scientific literacy of individuals in general, seeking to arouse interest in lifelong scientific learning, while presenting innovative proposals from a methodological point of view in science teaching.

2 Objectives

Our objective in this XR Track is to present four gamified applications in VR that have been done over the past year. These

applications have a didactic purpose, in a playful and visually attractive way, for the dissemination of knowledge and for scientific dissemination itself.

3 Methodology

Applications were all developed in Unity for Meta Quest 2. For each of them, the environment was created using different techniques and types of interactions. Mechanics were developed using a pre-determined physic phenomenon. All applications were designed for users over 13 years old, following Portal Health and Safety Warning from the Meta Oculus recommendation documentation, and were designed a participatory design process with professionals from Computing and Physics.

4 Results

The four applications are resumed as follows:

1. “WindyVR”. Users not only have the chance to view a real marine conservation unit but are also able to get a windsurf sailing experience. The gamified activities focus on environmental issues and local cultural facts, besides teaching how to operate Wind-Surf equipment, as a haptic interface incorporated. The science concept involved is aerodynamics, and the application environment used Google Earth terrain depth map, enhanced by image editors tools, and pushed through Unity’s Terrain Tools to create a 3D model. Students hand-painted and surfaced each asset to match the style of the terrain. In this application, the controls and movement are essential with the hands over the rig and with the emerging visualization techniques of eye tracking.

2. “Rocks in Space”. It is a virtual environment of first contact with the phenomenon of gravity and how it influences the interaction with objects. When traveling through three different stars (Earth, Moon, and Mars), a player will be able to interact with space and throw objects at targets, in a playful way. When changing stars, players indirectly understand that it is necessary to adapt force movement, as gravity is the main science concept here. Earth is designed as a tutorial, so it contains fewer objectives to keep the player focused on their task. As the terrain resolution was too high for the device, the terrain size and height map resolution were optimized. The scientific concept involved here is Gravity.

3. “Cagarras”: This application is based on the Cagarras Islands, in partnership with the *Ilhas do Rio* Project team. The scenarios are, therefore, a digitized version of the real islands' digital elevation models (DEM) represented as a height map, imported as "obj" and adjusted to better situate the proportions that were already implemented. The seas, which represent much of the experience scenario, were produced employing a large flat mesh, with two maps of normals that move in opposite directions, generating a sensation of movement, in addition to the occasional ascent and random descent of some triangles of the mesh itself, to generate the sensation of waves. On top of each of the respective islands, there is the name of the island where you are flying over, serving as a guide for those who do not know the place. As a goal, hoops were placed throughout the scenario, as they intuitively instigate players to cross them. The player assumes the role of a bird and can see its arms digitized as wings in-game via IK (inverse kinematics).

4. “Lumin”. This is an exploration game where the visitor can learn, in an interactive way, how some species of fauna and flora behave in front of a light and explore concepts of luminescence. With a camera and a light, the player traverses a tropical island under rails, stopping at specific places to have the opportunity to photograph luminescent events. Each photograph generates points that are accumulated during a gameplay stream. The templates were purchased from the asset store and adapted for our use.

5 Conclusions

The evaluation of the games will be made through the observation of the degree of public satisfaction, and presence questionnaire. This implementation of a haptic interface in the WindyVR systems contributes to increasing user presence, and haptic feedback in the interactions [4, 5] will be further studied in detail. In addition, we hope to develop partnerships with schools and obtain feedback from teachers on how mediation has impacted student development in the classroom: improvements in learning; greater interest of teachers and students in the museum's areas of activity. We intend with this a constant and better direction of the search for the development of new content. We are sure this content production will provide a long-lasting partnership between the scientific dissemination of UFF, represented here by *Casa da Descoberta*, and the city hall of Niterói.

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