The Apprentice Gaze - AR Experience on Serralves Museum

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ABSTRACT

Project CHIC(Cooperative Holistic View on Internet and Content) aims to develop a set of digital platforms, based on open formats and interoperable technologies that promote and increase the dynamics of Portuguese media content creation. One of the platforms is a georeferenced augmented reality platform capable of interconnecting and retaining different sources of information and users, with the objective of providing an application capable of generating contextual information about heritage and tourism, specifically attributed to a user and a concrete experience. This article presents the development of three augmented reality experiences within the context of a museum.

CCS CONCEPTS

• Applied computing → Media arts  
• Human-centered computing → Mixed/augmented reality  
• Human-centered computing → Mobile computing

KEYWORDS

Art, Museum, Augmented Reality, Mobile Computing, Interactive Exhibit, Education

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1 The CHIC Project

The media sector is of fundamental importance in terms of economic development, job creation, and increased competitiveness. In this area, there have been three convergence trends in recent years that have anchored their development. The first one involves the convergence of a set of technologies based on traditional techniques of production and diffusion of content based on proprietary equipment, such as technologies associated with broadcasting, to another paradigm based on broadband Internet, services and the creation of open platforms to support them.

The second trend is the normalization and approximation of the dialogue between creatives and technologists. To this end, the entities of the national scientific and technological system have contributed to this, which has included in the curricula a set of objectives that leads to the multidisciplinarity of competences and the establishment of clear channels of communication between the creative and technological world.

Finally, the third axis focuses on the use of digital technologies as a way of preserving and enhancing cultural heritage, by creating new immersive approaches to interacting with it, by attracting new audiences and by preserving cultural heritage through the use of high-resolution formats and with high error tolerance.

Considering the sector actual situation, the opportunities and the challenges previously presented, one of the goals of the CHIC project is the development of a set of digital platforms, based on open formats and interoperable technologies that promote and increase the dynamics of Portuguese media content creation and its exchange between the different stakeholders of the associated value chain.

Within the scope of this project, one of the objectives is the development of a georeferenced augmented reality platform capable of interconnecting and retaining different sources of information and users, with the objective of providing an
application capable of generating contextual information about heritage and tourism, specifically attributed to a user and a concrete experience. This new platform for the dissemination of content in the area of tourism and heritage should allow work and provide different types of content, from articles (text) contextualized to virtual reality experiences and reality mix. After the development of the platform, the project is starting the testing phase. Different scenarios and contexts are being developed.

In this article, we will address the development of augmented reality experiences for the mobile platform in the context of a Museum Exhibit. These are the first steps in the development of content for interactive exhibits.

2 Context

The Serralves Foundation has a firm commitment to the world of Education. Using the Park and the Museum of Contemporary Art, the Educational Service develops a year-round set of activities for schools, children, young people, families, and adults. The Educational Service bases its activities on the natural, museological and architectural heritage of the Serralves Museum of Contemporary Art and its Park, in order to create closer and stronger ties with the community. New forms of cultural participation are therefore proposed, from the perspective of sharing interests, knowledge, and affections, in transversal approaches that span art, architecture, the environment, and citizenship. The Educational Service’s working processes are open and flexible. They aim to stimulate thinking and creativity, value reflective learning, foster dialogue and be potentially transformative. This program aims to engage with different audiences and contexts, through partnerships with schools, universities, associations, groups with special needs, among other institutions.

For the school year, 2018–2019 the Educational Service chose ‘ways of seeing’ as the theme for reflection. ‘Seeing’ can be analyzed from many perspectives: to observe, but also to perceive, to sight and to verify. Thus, we ‘see’ with the physical eyes as well as with those of the imagination. The exhibition features works developed by schools from pre-school education to secondary school from this subject-matter. The research team developed from the challenge presented by the Educational Service of the Serralves Foundation three experiences of augmented reality to promote reflection on the role and importance of the gaze in the contemporary society. It is intended that the project will have continuity with the aim to dedicate itself to works of the Collection of the Serralves Museum, whether the sculptures installed in the Museum park of varied artists such as Ângelo de Sousa, Alberto Carneiro, Claes Oldenburg and Dan Graham among others works in different artistic media belonging to the collection. The purpose of this partnership is to reflect and promote an in-depth knowledge and experience of the works belonging to the Serralves collection and to idealize new ways of relating art and technology in education.

3 AR Experiences

Based on the proposal of Serralves Foundation we have developed three experiences for the exhibition: Teletransporte do Olhar, Planeta Verde?, and Perspectiva do Olhar. The design of these experiences was done with the support of multipurpose game engine Unity [1], because of its IDE (Integrated Development Environment) which delivers very strong real-time rendering of digital objects. It can also be easily exported and compiled to all major’s OS’s (operating systems), i.e. Android and iOS. Since version 2017.2 it integrates the SDK (Software Development Kit) Vuforia Engine [2] that allows creating cutting edge augmented reality experiences. These software are not open source but they can be used for free under some circumstances, such as a non-profitable work.

Vuforia uses advanced comuter vision to recognize images (image target), objects (model object) and interact with spaces (ground plane, mid-air) in the real world [3]. An image target is the term used for images that Vuforia Engine can detect and track. Unlike traditional markers as QR codes or data matrix codes, image targets do not use specific black and white regions or codes to be identified. The Vuforia identifies and tracks the features that are embedded in the image itself. By matching these features with ones in a target database, it can detect and trigger an Augmented Reality (AR) experience as long the image target is partially in the camera’s field of view [4].

In the next sections, we will describe for each experience the concept, the developing of the idea and how it works.

3.1 Teletransporte do Olhar

In this work, we propose the user to experience a change of locations, to admire Plantoir sculpture, a work by Claes Oldenburg and Coosje van Bruggen and a landmark of the Serralves Museum, in other locations around the city of Oporto. Following the pitch made by Serralves Museum, we propose the idea of “tele-transport” the sculpture outside the walls of the museum into the city of Oporto by using AR (figure 1).

The user just needs to point a tablet with the mobile app into a surface (window) that has the image target on it, and the AR experience is immediately activated. As soon as the AR is triggered it creates a sort of “teleportation” that reveals an “impossible” situation. The user is able to see the sculpture in five different locations around the city. Each location is shown for 15 seconds and is on a constant loop. The experience was developed in three different steps: 3D model creation, shooting city locations, and implementation of the experience in the platform.

a) First, we evaluate photogrammetry as a method to recreate the artwork in 3D. Due to the reflexive nature and the size of the object, it didn’t work as good as we hoped, so we modeled it entirely from scratch using Autodesk Maya. The surface was divided into 3 objects and applied the box modeling technique to generate the entire modeling. With this workflow we had more control over the polygon count, aiming at real-time graphics application, ending up with 6438 polygons. After the modeling step, we opened the UV maps.
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properly to bake textures for the 3 objects. This was necessary in order to simulate a realistic material and its shadows enhancing the processing speed of the game engine. The final asset was exported in FBX format to be imported into a game engine.

b) Using the Kodak PIXPro SP360 which has a 235° Spherical Curved Lens we film all the locations in an almost spherical space. Thus, it results in the creation of depth and width so the 3D model could be implemented in post-production on Unity creating a space in which we could feel the tri-dimensionality of that scene. A complete 360° image is not needed as the user would be limited by is position on the exhibition and the window frame. As for the locations we chose iconic landmarks of the city Oporto, such as Aliados, Parque da Cidade, Casa da Música and Foz, to represent a variety of landscapes and environments on which the artwork would fit. We carefully framed the camera and studied various locations to achieve the best possible results in post-production and decided which of the final five locations and framings would be used to implement the 3D model during post-production.

c) As mentioned, Unity was selected for the implementation and to create the connection between the 3D model of the sculpture and the videos from the city. The videos were used as a render texture and applied in a 3D semi-sphere making the video reflect on the object and create a greater sense of depth and immersion. Then, the sculpture was integrated into specific points so it could blend within the video. After this, a script was created to roll the different videos with time cycles like an image carousel. Finally, we incorporated the content with Vuforia to create the augmented reality experience for a mobile device, and, every time the device captured our pre-designed image target it would trigger the experience.

As the user holds the tablet in his hands and points it at the image target, and as long as the camera keeps “holding” that target the experience keeps going. In the experience, the user can move forward towards the window, backward, right and left, up and down, and by tilting or panning the tablet the way it wants, he is able to see the tri-dimensionality of the scene presented. The user is invited to explore and can get close to the details of the sculpture, or the location surroundings, seeing himself immersed in an environment only made possible through this experience.

3.2 Planeta Verde?

On Planeta Verde? we aim to instigate a reflection about how our planet is being abused. By viewing it from a distance one can see the green of the trees and the clear blue of the ocean, but as the user approaches the image target with the tablet he can observe that there is almost no green because of deforestation, and in the ocean, thousands of white bottles of plastic are floating (figure 2).

a) This 3D model was created using 4 levels of detail (LOD). This technique is used in most 3D game titles and is known for decreasing the complexity of a 3D model representation as it moves away from the viewer or according to other metrics such as object importance. With regards to spreading the 3D models on the sphere surface, we used a scatter tool from MASH toolbox in Autodesk Maya. The first model described a planet full of trees, with a clean ocean. The second one we added some plastics on the ocean and cut some trees. On the third and fourth we have increased the ocean with plastic bottles and deleted almost all trees. We were then able to send to the game engine all these LOD information in just one FBX file, in order for them to be processed and loaded during the AR experience.

b) The implementation of this experience was based on the Teletransporte do Olhar, the difference, in this case, is the following: the 3D model had everything pre-defined in Maya like textures and lightning. So, on Unity it was created a LOD (Level of Detail) group, that would change the 3D object appearance in accordance with the distance between the camera device and image target. A small animation was added that would make the 3D object rotate endlessly in the X-axis to simulate the planet rotation.

c) Finally, the content integrated within Vuforia to generate the AR environment.

If the user starts the experience holding the tablet from a distance he can see the green of the trees and the blue of the ocean on Planet Earth, but as he approaches the image target there is almost no green as a result of deforestation, and in the ocean, thousands of white bottles of plastic are floating.

3.3 Perspectiva do Olhar

This particular experience was thought to answer to the challenge of creating new ways of seeing. ‘Seeing’ can be analyzed from many perspectives: to observe, but also to perceive, to sight and to verify. So, we envisioned a game where the user tries to find the right perspective in order to find the image of a human eye blinking (figure 3).

a) We used a video mask and motion graphics technique in order to produce this 3D model. First, we created a static grid of spheres using the MASH distribution tool inside Autodesk Maya. Then, we applied a transformation node to the distribution aiming at modifying the individual’s scale from the spheres. Finally, looking for creating an eye animation, we applied a human blinking video file to drive the spheres scale parameter. This work presented an interesting scale change, simulating the proposed animation of an eye. Once again, all spheres were exported as one FBX file containing the keyframes of scale, rotation, and position.

b) This experiment was the simplest in terms of implementation because most of the work was done in Maya, we just used Unity to import the 3D object and create a connection between the device and Vuforia to create the AR experience.

c) The user is invited to search in various and angles for the right perspective in order to find the image of an eye opening and closing.

4. Conclusion

The exhibition began in May 2019 and will end in September 2019. We are still in the process of collecting data and analyzing the whole process. The Educational Service of Serralves Museum has already invited us to collaborate in the academic year 2019-2020.
We are now beginning a new process of developing ideas and developing new proposals. Real-time graphics remain a bottle-neck with regards to the experience when dealing with different types of mobile devices. People carry distinct mobile operating systems and embedded graphics card which may limit the quality of the experience. Although we chose to pick a predetermined tablet device, the directions for art development, aimed at enhancing the exhibition, was hardware driven. Techniques such as low poly modeling and texture baking improved the overall performance.

**Requirements:**

Android Tablet with a pre-installed application (Provided by us)
Printed image targets (QR Codes) to be fixed on the wall (Printed by us)

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**REFERENCES**