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Artana: Art and Knowledge about Anamorphosis

Shannon Dubreuil* Valentin Grillet† Nicolas Laurent‡ Jennifer Ling§ Eloïse Minder¶
Tristan Saliou‖ Alice Villafranca** Jean-Rémy Chardonnet††

Arts et Metiers Institute of Technology, LISPEN, HESAM Université, 2 Rue Thomas Dumorey, 71100 Chalon-sur-Saône, France

Abstract

For the 2022 IEEE VR 3DUI contest on the topic of "Arts, Science, Information and Knowledge – visualization and interactions", we present Artana, an immersive application proposing to explore anamorphosis in various interactive ways. Through an unexpected experience, the user is transported to a museum in which he/she will have access to the history of anamorphosis before being able to experience seven examples of them. A teleportation and a spinning wheel interaction techniques were implemented in Artana to ease interaction without altering the experience.

Index Terms: Human-centered computing—Human computer interaction (HCI)—Interaction paradigms—Virtual reality;

1 Introduction

At the intersection of arts, science and virtual reality, optical illusions represent fascinating phenomena. Anamorphosis is among these illusions that are interesting to explore, and can be well promoted by VR technologies. Anamorphosis is a distorted projection or drawing appearing normal when viewed from a particular standpoint, and/or using a suitable mirror or lens. The process, revealed in Renaissance paintings, is considered *"as a technical curiosity, but it also contains a poetics of abstraction, a powerful mechanism of optical illusion and a philosophy of fictitious reality"* [1]. The most famous painting featuring anamorphosis is "The Ambassadors", by Hans Holbein the Younger in 1533. This painting represents, on the bottom, a skull in a modified perspective; observers have to look from a particular position to see the skull clearly.

For the 2022 3DUI contest, we have created Artana, a virtual reality (VR) application dealing with anamorphosis. The application features two parts: the first one immerses users in a museum to explain the history of anamorphosis, and the second one consists in a room aiming to provoke wonder and surprise among users.

2 Theoretical Background and Rationale

Artists are known to be innovative, as they use every support they can to express creativity. Digital technology allows diversity in creation and provides different experiences. For example, teamLab[1] is an interdisciplinary group of artists, programmers, and engineers aiming to explore the relationship between the perception of the self and the world through digital art. Museums use also digital technology to spread and make art accessible to the most.

*e-mail: shannon.dubreuil@ensam.eu
†e-mail: valentin.grillet@ensam.eu
‡e-mail: nicolas.laurent_1@ensam.eu
§e-mail: jennifer.ling@ensam.eu
¶e-mail: eloise_jeanne_claude.minder@ensam.eu
‖e-mail: tristan.saliou@ensam.eu
**e-mail: alice.villafranca@ensam.eu
††e-mail: jean-remy.chardonnet@ensam.eu

[1] https://www.teamlab.art/

Figure 1: Left: room of unexpectation. Right: museum room in Artana.

In digital art, VR is an important medium. More than a simple screen, VR technologies provide immersion and interaction with virtual scenes. Art in VR invite users to participate in or interact with the artwork, involving to be able to navigate freely in a three-dimensional environment [5]. Numerous VR experiences in visual arts are already available [7], however, as far as we know, not on anamorphosis. The mathematical principle of anamorphosis is indirectly present in VR. Anamorphosis is used for example to visualize panorama's creation, or alternative conceptual models for the pictorial construction of VR panoramas [4].

Beside proposing a novel artistic experience, Artana aims also to teach users how anamorphosis works in an entertaining way. Past work has shown the effectiveness of learning by doing in VR [8]. VR engages indeed users in an entertaining and exciting way increasing retention of information [6]. We have developed the contents of Artana based on this theory. Through different interaction methods, users manipulate elements to create or visualize anamorphoses.

3 Artana Functionalities and Interactions

We have created a virtual world, under Unity3D and displayed in an Oculus Quest 2 HMD, pleasing to the eye and consisting of two different scenes: a room of unexpectation (Fig. 1 left) and a museum room (Fig. 1 right). The different interactions implemented within Artana are summarized in Table 1.

3.1 Navigation

To switch from one room to another, we implemented a virtual elevator. Users can choose the room by pressing the corresponding button in the elevator. The switch from one room to another is not instantaneous to give the feeling of a real elevator.

For locomotion inside each room, we use a standard teleportation technique to facilitate navigation and avoid the well-known occurrence of cybersickness. We have however added the following functionalities to the standard technique:

- fading for smooth scene changes and to avoid abrupt teleportation, as past work has shown a spatial disorientation effect implied by teleportation [2]
- use of parabolic targets
- orientation of the view of the next location after teleportation, using the Oculus right joystick controller (Fig. 2); although past work has shown that such feature could degrade user

Figure 2: Left: teleportation with view orientation and parabolic target. Right: the spinning wheel interaction.

Table 1: Summary of the interactions in the real and virtual worlds, with the corresponding technologies used.

Real world	Virtual world	Technology
Button press on the controller	Oriented teleportation	Index Trigger and joystick
Viewpoint change	Anamorphosis	Head movement
Hand movement	Elevator movement	Collision of the controller on the virtual button
Hand movement	Local teleportation (for the tree artwork, see below)	Collision of the controller on the virtual object
Button press on the controller	Spinning wheel in the museum room	Grab Trigger Remote

experience [3], we decided to implement it to further counteract spatial disorientation effects.

The changes we have brought allow a better VE experience by increasing plausibility illusion [9].

3.2 The spinning wheel interaction

The spinning wheel is a new interaction that we have implemented in the museum room to provide users with entertainment on the history of anamorphosis. Users have to match the information displayed on the walls with the corresponding paintings by spinning a virtual wheel. The wheel sticks to the paintings when the correct answers are found. To implement it, we adapted the OVR Grab and OVR Grabbable scripts provided with the Oculus Integration package, defined the wheel as a Rigidbody in Unity3D and included colliders around it used to detect whether answers are correctly found. To force the wheel to only rotate around the vertical axis, we froze its translations in all directions, as well as rotations around the horizontal axes. The collider's positions were carefully chosen, since the Rigidbody does not use the pivot point of the object but a calculated gravity point.

3.3 The 3D anamorphoses showroom

The main room of Artana presents the variety of representations allowed by anamorphosis to provide an unexpected experience. Users can navigate and discover the following artworks: (i) an arch sublimated by the art of Darel Carey, (ii) an illusion of reflection in the water, (iii) a tree with the hanging sphere anamorphic technique in which users can locally teleport from one place in the tree to another and experience anamorphosis when getting close to the tree, (iv) the discovery of a frog through a cylindrical anamorphosis, (v) two conical anamorphoses, (vi) several anamorphoses in perspective, and (vii) a 3D vortex illusion mat (Fig. 3).

For each representation, users have to find the right viewpoint to see the objects without any perspective deformation. Thanks to this search phase in which users change their posture, the playful aspect of the application is achieved.

Figure 3: Examples of anamorphoses.

4 Discussion

We have successfully created a realistic environment with the addition of a cylindrical mirror illusion. However, given the hardware we chose to use and its limited power, we had no choice but to bake the mirror, meaning that users cannot see themselves into it in real time. Hence, one improvement would be either to change the headset for a more powerful one, or to find lighter algorithms.

We have also developed interaction (navigation and manipulation) techniques with the objective to be the easiest to use for the most without altering the experience anyhow. However, we are aware that the spinning wheel interaction and the oriented teleportation technique may still lack intuitiveness. One improvement could be to add more indications for each technique, so that users quickly understand what to do and do not focus on the interaction technique rather than on the content of the application.

5 Conclusion

We have created an immersive application to bring enjoyment and teach anamorphosis. This application is composed of two rooms, a museum and a 3D anamorphosis showroom. Users are free to move from one room to another, by using an interactive elevator. The museum room brings knowledge about the history of anamorphosis, while the showroom features seven examples of anamorphoses.

A spinning wheel interaction was implemented to add a playful aspect for finding the right painting information. To navigate inside each room, an oriented teleportation was applied to avoid any cybersickness occurrences while maximizing usability.

Though functional, Artana needs to be evaluated, not only on interaction usability, but also on the learning-by-doing aspect related to anamorphosis, which will be the focus of future works.

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