FÁTIMA REVISITED: AN INTERACTIVE INSTALLATION

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ABSTRACT

Three very young shepherds, on May 13, 1917, reported seeing "*... a lady even brighter than the sun*...", floating a meter or so in the air, near an old oak tree, when they were pasturing their little herd in *Cova da Iria*, Portugal. The story of *Our Lady of Fátima* has remained one of the most remarkable odes in Portuguese folklore. It is, beyond the religious event in itself, a key episode in the official history and culture of the Portuguese people. It is a day celebrated every year; more among the faithful believers, but also in the media and even as a political catchphrase, widespread, recognized and celebrated, including by the Vatican and several Popes. In this paper, we present two multimedia installations where the central figure is Our Lady of Fátima, following two main ideas: (a) a "door" opens up the possibility to access multiple space-time experiments, and (b) we try to reach into the Portuguese imaginary surrounding the appearance of Our Lady of Fátima, using a female archetype suggesting a "sacred apparition". Both installations use a Microsoft Kinect sensor to detect the presence of a viewer for triggering the start of the narrative, followed by recognizing different movements of the viewer(s), *e.g.*, moving left, right, forward, backward, etc., to create different flows in the presented narrative – even at some point changing the face of Our Lady of Fátima with the face of the viewer. Both installations use similar hardware and software concepts, except that the first one uses a Rear Projection solution where the narrative is presented by the image of Our Lady in real size and the second uses a Hologram.

Keywords: Interactive Installation, Digital Art, Computer Vision, Film, Hologram.

INTRODUCTION

On May 13, 1917, three children, *Lucia de Jesus dos Santos* (10 years old), *Francisco Marto* (9 years old) and *Jacinta Marto* (7 years old), reported seeing "*...a lady even brighter than the sun*…" on an oak tree a meter or so high, when pasturing their little herd in the *Cova da Iria,* Portugal. This was the initial story of Our Lady of Fátima, following her appearance in this hamlet at the centre of the typical rural Portugal, in the early years of the 20th century. This was and still is, one of the most remarkable odes in folklore and sacred literature, with a large sanctuary built in her behalf [1].

In the literature there are several interactive installations that integrate art, technology, image, film and volumetric sensors [2, 3, 4], with also analytic frameworks to evaluate such interactions in public installations (see e.g. [5]). In this paper we propose two installations, where the central figure is a "holy spirit"- like figure that tries to recreate the sacred apparition of Our Lady of Fátima. Both installations use a Microsoft Kinect sen-

sor to detect the presence of a person to trigger a narration. Different actions of the spectators (*e.g.*, moving left, right, forward, backward, rising the arm, *etc.*), create different interactions in the narrative, including changing the face of the interlocutor with the face of the figure. Both installations are similar except, one uses a Rear Projection solution where the narrative is presented by a figure in real size (1.70m height) and the second uses a Hologram (0.30m height).

In the following Section it will be presented briefly the Our Lady of Fátima history, followed by a brief explanation of the Rear Projection and Hologram techniques. The next Section consists details both the hardware and software used, including how the films were prepared and the interaction with the Kinect was implemented. The final Section concludes with a small discussion.

OUR LADY OF FÁTIMA HISTORY AND PROJECTION TECHNIQUES

On May 13, 1917 a little before noon, three children were prayed the Rosary, as it was their custom, as it was said, they were building a small stone house (seemingly on the site where today stands a Basilica [1]). All on the routine of a bucolic setting: 3 children, a small herd, the backdrop of a rural country, sparsely populated and undeveloped.

The most consensual reports speak of the emergence of a sudden bright light, announced by a thunder. The little shepherds decided to seek shelter; however, soon after, a new pulsing bright light emerged, and this time even more intense. The surrounding area was inundated by a bright glow and by a distinguished apparition on top of a small holm oak (which is currently a sacred place, near where the Chapel of the Apparitions is [1]): "…*a lady even brighter than the sun*, *from whose hands hung a white rosary*…".

The Lady told the 3 children that they had to pray a lot and offer unreserved devotion to faith. The Lady then invited them to return to *Cova da Iria* during five consecutive months, always on the 13th of each month and always at the same hour – when the sun reaches the highest point in the sky. And so it was, the children returned, and the apparition of Fátima returned to *Cova da Iria* on the 13th of June, July, September and October (the exception was August; the apparition took place in a place called *Valinhos,* this probably because, on this day, the children had been taken to *Vila Nova de Ourém*.

Of course, since its first appearance, the story told by the little shepherds spread widely. According to historical reports, in her last appearance, on 13th October, there were present about 70.000 persons to receive the Lady, and in this last appearance the Lady said she was the *Lady of the Rosary* and that there, at the *Cova de Iria*, should be erected a chapel in her honour. For more details and illustrations about the story see [6, 7].

Knowing the story of Our Lady, two projection techniques presented suitable for the installation: (a) *Rear Projection* (back-projection) is a technique well known and widely used [8], as it consists in a projector positioned behind a screen casting a reversed image of the background or scene. This requires a large space to project (nevertheless, this can be minimized by using ultra-short-distance projectors), as the projector had to be placed at a minimum distance from the back of the screen, with the screen requiring a special retention surface [8]. The great benefit of this technique is that all the projection (and interaction) equipment can be completely hidden behind the screen, greatly increasing the belief that the user is interacting with a "sacred apparition".

(b) *Holography* is a technique for recording interference patterns of light which can generate or display images in 3D (three dimensions) [9]. Sometimes, a hologram is also defined as a photographic image that appears to have depth. In this case, holograms work by creating an image composed of two superimposed 2D pictures of the same object seen by different reference points. The use of slightly offset reference points is designed to mimic the image interpreted by the human brain, which likewise receives a distinct, slightly offset image from each eye that the brain combines into a coherent 3D image [10]. One of the most common techniques to generate holograms is called the *Pepper's Ghost* [11]. In its basics, it uses a large piece of glass at a 45º angle to the audience and special lighting techniques for showing the audience a combination of light passing through from behind the glass and light reflecting off the glass, at a 90º angle from the line of sight, creating the illusion that the reflected light appears from nowhere. The holographic effect is actually an object or image hidden from the audience and reflected off the screen. Spotlights with dimmer controls can alternately illuminate the area behind the glass or the area off the side. One light is turned up while the other was turned down, in such a way that the total light intensity was nearly constant. The best effect was achieved by using dark backgrounds. An example applied to the theatre and holography illustrating the entire length of the technique can be found in [12]; for the mechanical engineering parts see [13]. In the prototype used for this paper we used a very thin acrylic sheet (for a more realistic result a Mylar polyester film can be used) in a 45º angle over a monitor (27”). The best benefit of this technique is that the spectator can interact with the installation as a 3D “sacred apparition” that is floating in the air, while also viewing all that is happening in the background and around the figure.

THE INSTALLATION

The installation has two fundamental key ideas behind: one, where a door would be a possibility to access multiple space-time experiments, and the other, condensing the Portuguese imaginary as the female archetype as a sacred apparition, known as the appearance of Our Lady of Fátima. The second idea was imposed immediately as more impactful, which reinforces the belief that, even given the provision of advanced technological instruments, archaism survives and overlaps as the dominant reference.

Having Our Lady of Fátima history as background, we propose two installations: The first, with the dimensions of a real person with around 1.70m. In this installation the story is rear-projected into an acrylic with a film retention, suspended around 0.5m from the floor, representing a “time-space” door, and uses a projector of around 3000 lumens. In the second installation we use a hologram, currently still a prototype installation that allows holograms around a maximum of 30cm height. Both installations share the same storyboard, differentiating only on the projection technique. The spectators, like the shepherds, are the visionaries of today. Generically, the story fades from a black background with a sputter until the holy figure appears. The sputtering sounds were mentioned in all the texts at that time, *e.g.*, “*…tinnitus, as of horseflies in a jar…*” or “*…the crackling…*”. So, it is also introduced the mist and thunder said to have been heard in the apparition. In parallel, the sound of a heart beating seemed ideal to delineate the appearance of the Virgin, as well as a church choir to reinforce the “divine ambience”. The entire storyboard in general shares several key elements like the movements of the figure’s hands and arms, head and eyes, seemingly launching the unexpected, in an aura

of mystic awe; also a message is spoken from front to back, both fussing and frightening. A music from Robert Ashley, "Automatic writing" also goes along with the story.

All films (images) were purposely white saturated and flicker from time to time (see Figure 1, and the *Film Production* Section) – this was to convey a bit the impact that the shepherds had. In Figure 1 (left), it is shown a frame from the film used in the Rear Projection installation, and on the right, two frames tested on the holographic installation. As soon as any spectator passes by, the story and interaction starts, i.e., the presence of a spectator, triggers the storyboard (see Fig. 2, top block). The installation is then ready to interact with the spectator near it. In summary, there are six main interactions (see Fig. 2). If the spectator:

(a) moves/walks from left to right in front of the installation: the holy figure looks very fast to the right executing some movements and sounds; after the interaction, it returns to stage (e);

(b) moves/walks from right to left in front of the installation: similar to a), but now it looks to the left, *etc.*;

(c) moves the arms (e.g. rising them in an prayer gesture): The figure makes several movements, e.g. looks to sky, to the left and right, open-close arms, etc., accompanied with different sounds. This interaction finishes to stage (e);

(d) moves closer to the installation: the face of the spectator is automatically segmented (cropped from each frame acquired in real time from the user) and overlapped with the one from the figure. When the spectator moves away, this overlapping finishes, returning to stage (e);

(e) was still for some time: in this case there are 3 interactions that occur in sequence, depending on how much time the spectator remains still. (i) The figure was still, only sound changes. After a while if the spectator keeps still, (ii) the figure makes some movements like it was "speaking" with the spectator and (iii), the same as in ii), but different movements and sounds.

(f) moves away: the figure also moves away, and all the images and sounds from the installation disappear, until a new spectator was presented.

FILM PRODUCTION

The film production was made in a Chroma-key studio to ensure the absence of spatial references and facilitate the post-production. The main concern was the angle of view since the subject (Fátima) should occupy all the field of view. Plus, the shot had to be vertical to fit a human size projection. In these sense, it was used a full shot to insure the complete view of the subject. The illumination was made with three light sources: two key lights (to attenuate the relationship between shadows and light) and one backlight (to facilitate trimming). It was also used a smoke machine that created artificial fog and helped create a mystic atmosphere.

Concerning the post-production, it was developed into two distinct aesthetic experiences: The first one involves the subject in a heavenly aura characterized by overexposure while the second one clearly cuts the subject giving a greater degree of image definition and a greater sense of closeness. It was also added a dropout effect, characterized by a small loss of data in the image. This effect refers to something that happened in the

past (and simultaneously in the present) from the age of the older tapes, dating to the analog era. However the effect is not just aesthetic – it creates a jump cut that will facilitate the assembly of the different parts of interactivity.

The sound was thought to create additional stimuli to image. Sound effects and sound track have the ability to create audible conjunctures and appeal to the spectator's immersion into the narrative, against a compliant and passive attitude. According with Gilles Deleuze [14], images and sounds no longer need to be based on movement, nor in a temporal linear sequence of past, present and future. So the sensory-motor sensations, time indirect representations, tend to be replaced by exclusively visual and audible conjunctures, namely the *opsign* and *sonsign*, time direct representations.

Figure 1 - Left, one frame used in the film for the Rear Projection installation, and right two different frames used in the films on the holographic installation.

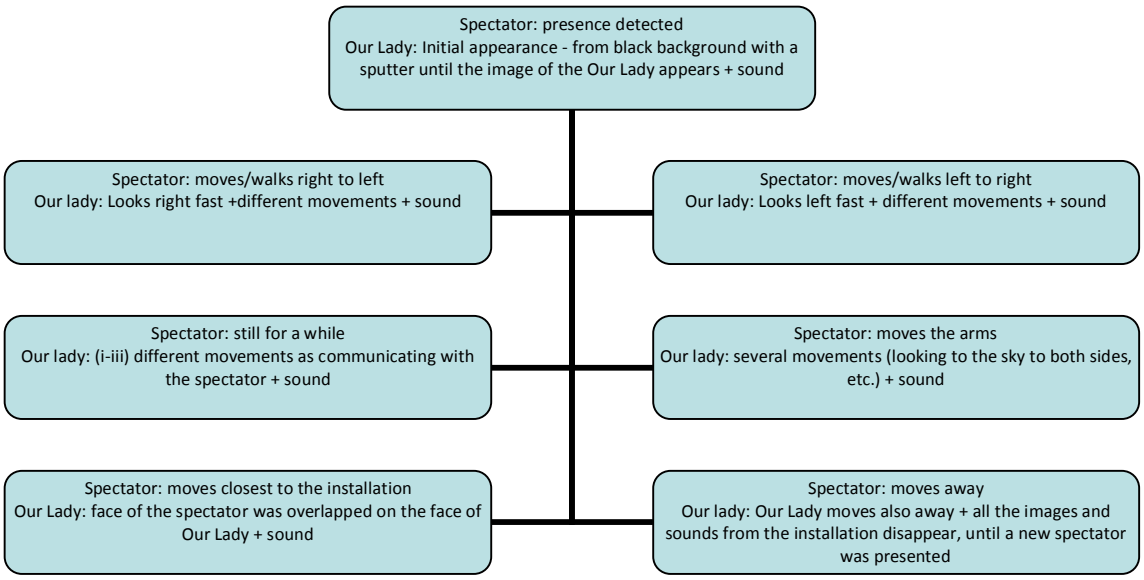

Figure 2 - Block diagram of the installation interactions.

KINECT INTERACTION

Kinect [15] provide us three main streams to our interaction stages: RGB, which was in our case used to extracted a spectator face, Depth, which was also used to extract a spectator face and was implicit called by Kinect to track users, and Skeleton tracking, which was where we rely to detect if and how many spectators were interacting.

We start building a list of spectators based on the Depth and Skeleton information, which has the following purposes: it contains the currently tracked spectators, identified

by ID, ordered by who was first detected and various information in different times about tracked joints (see Skeleton [15]). The list was also capable of knowing how many spectators had been near the installation for statistical purposes. Once a spectator was detected by Kinect this was added to the list alongside its current position, which will be used to check if he/she has moved and in what direction has he/she done so. In another hand, if that spectator or any other that was currently on the list stops being tracked by Kinect, he/she is removed from the list. If the list is empty, and a spectator was found, the initial film was played, at which it will never play again unless all active spectators exit Kinect field of view, shutting down the installation. Once this intro was played the installation will have a different reaction based on what the user did (Figure 2).

As already mentioned in a previous Section, the spectator interacts with the installation based on his/her position relative to its previous tracked position and it also takes into account movement of his/her hands. Continually, the first spectator current position was compared to its last position, to know if and in what direction has he/she moved. Was considered that a spectator has moved if he/she was at least 0.5 meters away from its last tracked position, verifying then in what direction has he/she moved. For this we use the values returned by Kinect, that returns a position based on a three axis coordinates system (x, y, z), where x was the distance in meters the spectator was from the Kinect in the horizontal plane in a perpendicular direction of where Kinect was pointed, y was the distance in meters the spectator was in a vertical plane from the Kinect and z was the distance in meters that the user was from the Kinect in the horizontal plane in the direction that Kinect was pointed (for more details see e.g. [15]).

To know in which direction a spectator has moved the following procedure was implemented: (a) Obtain the current position of a spectator, (b) compare it with the last tracked position of that same spectator, and verify if the absolute difference of each coordinate was greater than 0.5 meters. If that comparison is true for a coordinate, then the spectator has moved in that axis triggering the next step. (c) A spectator has moved left if the subtraction between the current x position and the last tracked x position is negative, otherwise he has moved right. A user has moved up if the subtraction between the current y position and the last tracked y position is positive, else that user has moved down. The same for z position, being negative for forward, positive for backwards. (d) Once this was computed, the spectator joints (see [15]) and skeleton positions are updated (tracked) to be used in the next loop for the next comparison. Depending on what happened, the installation triggers a different reaction (see Figure 2).

Two more cases must be stressed: First, in case the spectator has moved closer to the installation, his/her face will be extracted. For this Kinect SDK [15] does most of the job. (i) We pass to the SDK the spectator ID we want to extract the face, in which we will get a points cloud regarding to various points of the face. These points were returned by the Kinect, which includes various points of the contour of the extracted face among other points such as mouth, eyes, nose and eyebrows. (ii) With the contours point was built a Boolean polygon that was used as a mask to extract the face by simply applying it to the RGB image returned by Kinect. (iii) Both the mask and the RGB image were then cropped in order to obtain smaller images that are easier and faster to work, that were afterwards (iv) brightened up to match Our Lady “skin tone”, which was done by adding up a constant to each pixel of the RGB image, and resized to fit Our

Lady face. (v) Finally, the face can now be placed over Our Lady using a pre-known location of the image.

The second, was how to interact with the installation using gestures. In this case, a praying gesture (can be any gesture) was triggered if a spectator joins his/her hands at the level of the shoulders. To detect this, we (i) check in the spectator skeleton in the top of the list for 2 conditions: (ii.1) If the spectator hands are closer than 10cm of each other and (ii.2) if the hands are closer than 30cm from the shoulders centre. If this was the case, (iii) is incremented a frame counter by a constant k (k=2) otherwise that same counter is decremented (k=-1). This counter will reflect how many frames the spectator have actually been performing the gesture. Note that k cannot be lesser than 0, and if the $k > 40$, than the spectator was considered to be performing the praying gesture.

Figure 3 shows some examples of the two installations working. On the left the Rear Projection installation, and on the right the holographic installation using the movie built on the basis of the rightmost image in Figure 1. The images are shown in grey to focus the attention of the reader to the installation not to surrounding background.

Figure 3 - Examples of the Rear Projection (right) and Holographic installation (left).

DISCUSSION AND CONCLUSIONS

We presented two installations that use a Microsoft Kinect sensor to allow user interaction with a holy figure representing *Our Lady of Fátima*, with both installations following the same storyboard. We argue that the "mystic" effect created by both installations was able to tap into the Portuguese folklore and imaginary surrounding this chapter of Portuguese religious history. Both installations so far were only presented in the University Campus, nevertheless it was concluded that despite the holographic installation attracting more curiosity from the public, spectators preferred to interact with the Rear Projection installation – this was expected due to the different dimensions of the installations.

In the future, with the final version of the holographic installation (not the prototype shown here), both installations will be presented at the same time in the same environment for a long period (around one week), and a more comprehensive evaluation, using specialized frameworks to evaluate public installations [5]. More conclusion will be taken from the different impacts of the installations, with a follow-up interview to each spectator.

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