

Dokodemo Door: A Doorway to Alternate Realities

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Abstract: We present "Dokodemo Door", a system which brings the users to alternate realities by a simple interaction of opening the door. In our system, a door, which is usually a bridge between physical mediums, acts as an interface for seamless transitioning between alternate realities. Alternate realities could be from a remote venue, which brings about the experience of telexistence, or could be from a recorded past reality, which brings about the illusion of past events happening in live. The visual component of the alternate realities is presented to the users in immersion through a head-mount-display. The users are able to experience a blended reality of the live reality and the alternate realities through interaction with the door.

Keywords: substitutional reality, telexistence, door interface, illusion

1. INTRODUCTION

We live in a fascinating and vast world. We humans have always sought ways in order to travel to and experience every part of the world. The ambition of exploring the world led to the development of more and more efficient means of transportation, which allows humans to be able to physically travel to remote places in a timely manner. Aside from physically travelling, researches in the field of Telexistence, such as TELESAR V [3], while one of the main goal is to allow humans to telexist to hazard places, provide the experience of existence in remote places to the users without actually travelling by using surrogate robots and providing cross-modal feedbacks to the users. However, perhaps the most magical experience of actually being in remote places is illustrated by a technology from a cartoon, Dokodemo Door, which allows one to open the door and instantly travel to any place in the world.

The reality at a remote place, which we give the term remote reality, can be considered as one kind of a broader term, alternate reality, which refers to realities aside from the actual reality which is around us. Alternate realities can be experienced in systems such as CAVE [2], such as in the context of a virtual reality, which may provide realistic cross-modal feedbacks so users would actually feel the alternate realities as real. However, to achieve a true immersion in the alternate reality experience, we have to consider the transition between actual reality and alternate realities so users cannot distinguish when actual reality ends and when alternate reality starts.

This kind of seamless transition between actual reality and alternate realities are studied in researches in the field of Substitutional Reality [5], which is to substitute in an alternate reality seamlessly, so the users do not detect that the sensation feedbacks are actually from a synthesized alternate reality.

In our system, we design the seamless transition through the



Figure 1. A doorway to alternate realities.

use of the door (Figure 1). Door can be considered as a perfect interface for transitioning between alternate realities because for us humans, we consider the door as a mean to divide and connect two physical mediums. We aim to expand this philosophical definition to a more abstract level, by using the door as an interface between realities and provide the experience of Dokodemo Door.

2. RELATED WORK

Connecting experience between actual reality and alternate realities seamlessly and logically is suggested by the Substitutional Reality (SR) System [5]. The SR system constructs the alternate reality from the past by recording with a panoramic camera. The SR system focuses on creating a seamless transition from present to past, so users would regard that past events are actually taking place in live reality. Therefore, the system has a venue restriction that actual reality and alternate reality have to be at exact same place. Our system builds on the SR concept to include embodied interaction during the transition, and aims to provide a seamless transition between realities beyond past reality to include also remote reality by using the door as an interaction interface.

Using door as an interface for connecting two remote places

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Figure 2. Stereoscopic video see-through HMD.

is designed in a project, “Europe, It’s Just Next Door” [4]. The project places doors in major cities of Europe, and users are able to open the door to see a door-size video screen which streams video from a door in another city, thus connecting two remote places through the door. However, the alternate reality in this project is fixed in the doorframe and lacks full immersion. Our system immerses users fully in the alternate realities.

3. DOKODEMO DOOR

Our system consists of a head-mount-display (Oculus Rift Development Kit), two cameras (Microsoft Lifecam Studio), two wide-angle lenses, a wireless headphone (Sony MDR 10-RBT), a normal physical door, and a potentiometer. Our design of Dokodemo Door can be categorized into how are actual reality and alternate realities experienced by the users, and how to transition between realities using the door.

3.1 Alternate Realities

Dokodemo Door is an interface between actual reality and alternate realities. We provide cross-modal feedbacks in the visual and audio sensations. To achieve a truly immersive experience of the alternate realities, we use a HMD, which can completely immerse a user in the reality in the HMD.

In order to see actual reality while wearing the HMD, we modified the HMD to be a video see-through one by attaching two cameras (Figure 2). Two cameras are needed to provide a

stereoscopic image. The HMD has a horizontal field of view of around 100 degrees. The two cameras have a diagonal field of view of 75 degrees, and have an aspect ratio of 16:9. The formula for calculating the horizontal field of view from a diagonal one is:

$$W = \frac{rD}{\sqrt{1+r^2}}$$

where W is the horizontal field of view, r is the aspect ratio, and D is the diagonal field of view. The two cameras are calculated to be around 65 degrees in the horizontal field of view. Two wide-angle lenses, which increase a camera’s field of view by a scale of 1.5, are used to further enhance the field of view of the cameras to be around 98 degrees, which is close to the field of view of the HMD, in order to keep the visual object perception as close as possible to normal sensation.

The alternate realities, which the users experience when the door is opened, can either be pre-recorded or streamed. For simplicity, we use a panoramic video camera (Point Grey Ladybug 5) to pre-record videos at various places with the door (Figure 3). The users are able to view the alternate realities constructed from the panoramic videos freely, as the built-in sensor of the HMD tracks their head orientation so the view of the panoramic video is synchronized with head orientation.

3.2 Transition

Transitioning between actual reality and alternate reality occurs as the users open the door. As the users are about to open the door, their field of view in the HMD is completely filled by the door. Therefore, we can achieve seamless transition by synchronizing both the position and color of the actual door, as viewed from the see-through HMD, and the recorded door, as viewed from the recorded alternate reality, so the substituting of actual reality by the alternate reality is unnoticeable by the users. As the door is opened, the users are immersed in the alternate reality, but the door-opening interaction is in actual reality. Therefore, we have to synchronize the recorded alternate reality with the actual interaction between the users and the door, for example, if the user opens the door to 45 degrees, then the door in the alternate reality should also be opened at 45 degrees. We fix a potentiometer to the door’s hinge to measure how much the door is opened (Figure 4). The potentiometer in our system is a logarithmic one, therefore we have to calibrate and map the potentiometers values to be linear by sampling the values at a 10-degree interval of door open from 0 degree to 90 degrees. We can then synchronize the recorded alternate reality video frame with the door open degree to be displayed to the users.



Figure 3. Recording alternate realities.

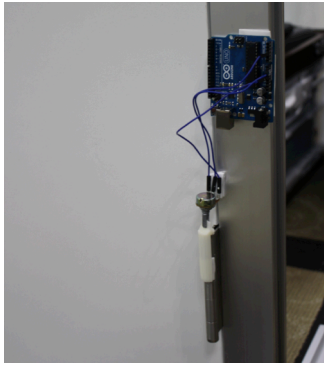


Figure 4. Potentiometer measures door-open degree.

4. DISCUSSION

4.1 User Experience

The user is able to experience a blended reality of actual reality and alternate reality by using Dokodemo Door. The point is that every time the door is closed and opened, the door connects to a different alternate reality. The alternate reality experience, if constructed from a recorded reality at a remote place, brings about experience of telexistence (Figure 5). If we choose to record the reality at the exact same location where the users are going to experience Dokodemo Door, then the illusion of past events happening in live can be provided, similar to original SR system. Furthermore, we can construct the alternate reality from a cyber reality synthesized by a computer, then we can connect real world with the virtual world through the door (Figure 6).

Our system was demonstrated at a closed event (Figure 7). Around 20 participants experienced our system. We observed many valuable reactions and feedbacks from the participants. For example, participants were fascinated that they could open the door to remote venues and are able to totally immerse by looking around in the remote places. The illusion of past reality happening in live is also effective. We pre-recorded a past reality at the demonstration venue, and participants' reaction to past reality is observed as they tried to dodge a ball being

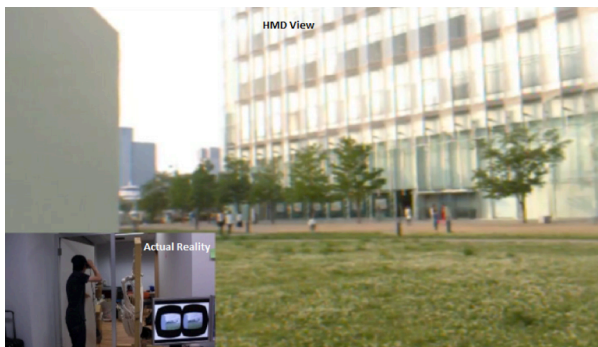


Figure 5. Experiencing remote venues using Dokodemo Door

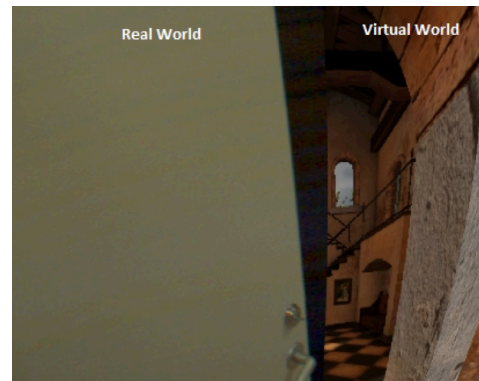


Figure 6. Dokodemo Door connects real world and virtual world.

thrown at them in past reality. A interesting phenomenon is that when we recorded the remote realities, we also recorded a dummy hand when opening and closing the door. Therefore, when the participants experience the remote realities, they could actually see a hand on the doorknob. One user actually perceived that to be own hand. This phenomenon suggests that superimposing a body image in alternate realities could increase immersion, and is also a demonstration of the visual-haptic rubber hand illusion [1] in an alternate reality.

4.2 Limitation and Future Work

Our system transitions from actual reality to alternate reality completely as the door is about to open. Therefore, if during the transition the user looks away from the door so that the door does not fill the entire HMD view, then the transition would not be seamless because we can synchronize the actual door and alternate reality door for seamless transition, but we cannot synchronize different background environment in alternate realities. A future work is to track the doorframe so that during the transition, only the area enclosed by the door is alternate reality. A second limitation is that since we construct the alternate realities from recorded videos, users are restricted from walking from original spot because viewpoint of recorded video cannot change. A solution is to also record a movement in the video through the door, or use streaming live.



Figure 7. Dokodemo Door demonstration.

5. CONCLUSION

Dokodemo Door is an interface between alternate realities. Transition design in alternate reality systems is crucial to a truly immersive experience. We choose door to provide a seamless, logical transition because doors have always been considered as a mean to divide and connect mediums. In our system, users are able to experience a blended reality of actual reality and alternate realities as they interact with the door. Dokodemo Door experiences include existence in remote venues, illusion of past events happening in live, and connection between virtual world and real world. We are looking to explore how Dokodemo Door can achieve innovative alternate reality transition and immersion.

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