Step In and Out of the Dreams: Toward an Immersive and Interactive Virtual Experience of Dreams

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Abstract
This paper introduces the design of a creative work, using wearable and virtual reality technology, which can provide immersive and interactive dreaming experience simultaneously to a group of people. The design concept has been put into practice in the creative work: "Step In and Out of the Dreams". Also, we briefly introduce the WISE platform, a full-stack wearable hardware and software infrastructure developed by our team that facilitates this work.

Author Keywords
virtual reality; motion capture; wearable computing.

ACM Classification Keywords
J.5 [ARTS AND HUMANITIES]: Performing arts (e.g., dance, music)

Introduction
Everyone dreams. In dreams, people usually think that they have "real" somatosense and perception. As pointed out by [7], personal form of a dream indicates a macro-level consciousness and thus can be recognized as virtual reality (VR). Thus, the joys and sorrows in dreams were real at that time. Having a melancholy dream makes us cry while having a pleasant one makes us laugh. During the past few years, several projects and applications are conducted and have verified that VR is an effective way for constructing a

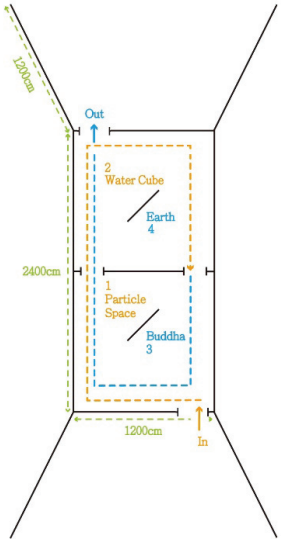
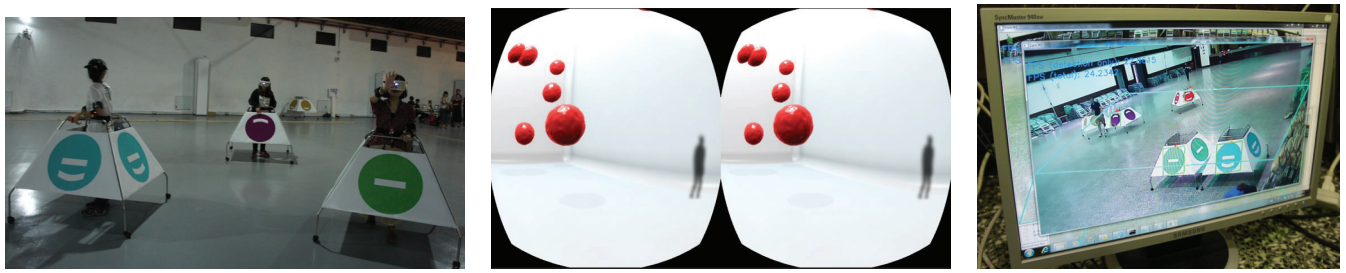


Figure 2: The floor plan of exhibition



(a) (b) (c)

Figure 1: (a) Our work provides immersive and interactive virtual experiences of dreams simultaneously to a group of people; (b) The dreaming view from the VR glasses; (c) Corresponding dreaming scenarios are presented to dreamers based on their positions.

new source of memories for users [8, 4]. In this light, this work utilizes wearable and virtual reality (VR) technologies to provide immersive and interactive dreaming experience. The overall experience consists of four immersive dreaming scenarios, where people are able to roam, just like they are dreaming (Fig.1a and Fig.1b).

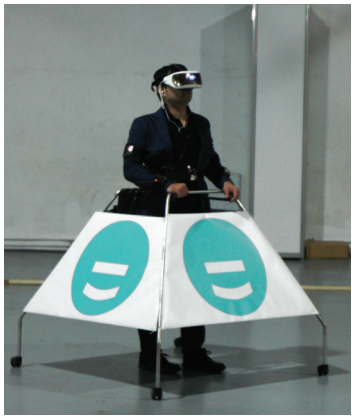
This work seeks to combine elements such as body perception, rhythm, movement, and position to construct an immersive and interactive virtual dreaming space. People experiencing the dreams can roam, cross, and interact within these vast spaces. In this work, the audiences, namely the dreamer, experiences a multi-dimension space, which is slowly shifting, inflating and cracking. They thus merge their bodies perceptions, rhythms, movements and positions into the virtual spaces (Fig.1c).

Design

Imagine that if self-consciousness is realized by putting one's brain in a high-tech urn, where all perceptions are fed by computers. That is to say, our conception of the world is, in fact, a compilation of signals sent to the brain. The reality we know is far from the truth, and everything we know is merely a projection from the brain. In this sense, the boundary between reality and virtuality is blurred. In the future, it is highly possible that one can upload consciousness to a virtual digital space [3], where the virtual body serves as a floatable container. The traversable souls can flow and transform freely among the connected containers. The concepts mentioned above inspired our work, which allows people importing their body perceptions, rhythms, movements and positions into the four virtual dreaming scenarios, including 1) the particle space, 2) the planet, 3) the water cube, and 4) the Buddha's head (see Fig.2). The dreamer can wander among the scenarios and interact with virtual objects freely. These scenarios are non-cohesive in order to reflect the fact that dreams are incongruous, discontinuous, and uncertain [6]. The design of visual arts and interactions of dreaming scenarios are detailed in the following subsections.

Transition gateway

Initially, the dreamer is in front of a gateway, which looks like noise signals. The transition between the scenarios occurs



(a)

(b)

Figure 4: The design of sliding carts: (a) outside view: the covering colored marker is used to identify the dreamer and her/his location; (b) inner view: a computer and an electric cell are attached on the cart.

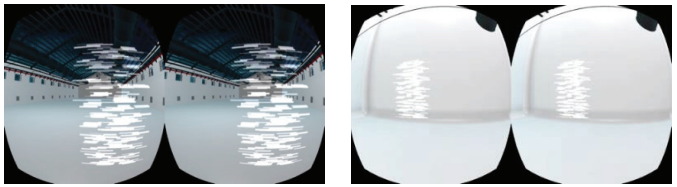
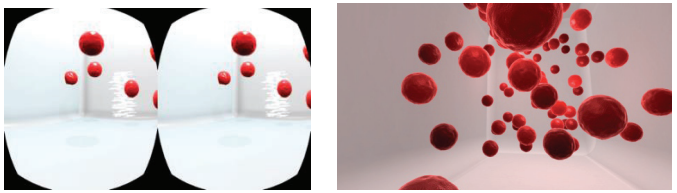


Figure 3: Transition gateway (glasses view)

when a dreamer passes through the gateway (Fig.3).

Particle space
The particles are constantly generated from the virtual walls (see Fig.5), and their locations are randomly determined by the computer. The dreamer can touch these particles; then the particles react by producing auditory feedback such as explosions or glass-cracking sound.

Planet
The planet appears in the center, with scattered meteorites around (Fig.6). The dreamer can move the meteorites away (the hand movements are detected by the wearable motion detectors). In our initial design, the planet is the earth. However, we decided to replace it with an unknown planet, since that our familiarity with the earth could lead



(a) (b)

Figure 5: Particle space: (a) glasses view (b) space view

(a) (b)

Figure 6: Planet: (a) glasses view (b) space view

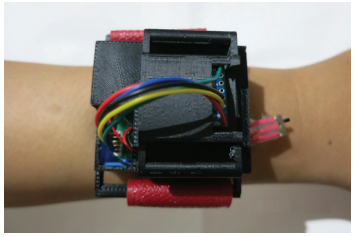
(a) (b)

Figure 7: Buddhaś head: (a) glasses view (b) space view

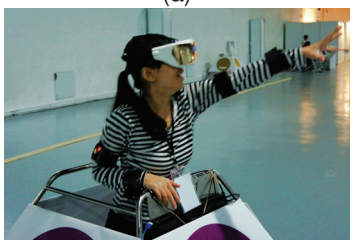
the dreamers to detach emotionally from the virtual reality.

Water cube
When the participants enter the scenario, they will first notice that they are just above the water and are continually sinking. If they paddle their hands downward, there will be visual feedback of floating up and auditory effects of paddling. (see Fig.8)

Buddha's head
The Buddha's Head rotates regularly and slowly when the dreamer first enters this scenario. If the dreamer touches the Buddha's head, it generates the visual and auditory effects.(see Fig.7)

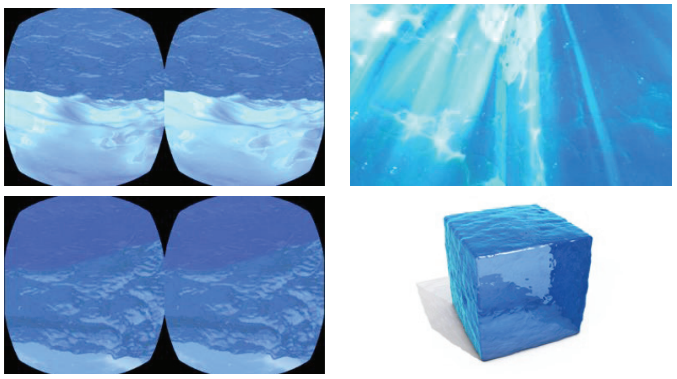


(a)



(b)

Figure 9: (a) A WISE item; (b) The performer is guiding the visual effects based on the WISE platform



(a) (b)

Figure 8: Water cube: (a) glasses view (b) space view

Companion dreamers
To avoid colliding with other dreamers, a dreamer is able to see the shadowed avatars of other dreamers. (see Fig.1b)

Audio arts
The original design of audio arts came from pure imagination. For instance, the particles exploding scene in the particle space sounds like shattering ice crystal. The "sinking" effects in the water cube scenario provide a sense of desperation. Therefore, to reinforce the feeling of oppression, we build thick and heavy sound effects in the environment. The ambient sound in the Buddha's head scenario is used to construct the atmosphere of caves, since that the surrounding view leads people to associate it with the Dunhuang frescoes. When approaching the Buddha's head, the dreamer hears sounds of animals. The animal sounds indicate the concept that perhaps animals are closer to the nirvana than humankind since they have pure souls. The intermittent music in the ambient sound is a reminder, saying that this is a dream. It is similar to the design of movie scores; they are absorbing and fascinating; nonetheless, they also accentuate that what we are seeing is not real. There should be no sound in the universe because the lack of medium. However, it is a dream; we imagine there are some electrons, particles, and energy in the universe. Based on this concept, we create the electronic sound effect in the planet scenario.

Implementation

As mentioned, this work is realized by combining animations, wearable devices, positioning system, and the WISE(Wearable Item Service runtimeE) platform [5]. The objective of WISE is to provide an open source (including hardware and software), low-cost, high performance and easy to use platform for wearable mix-reality creative arts. As shown in Fig. 10, this platform consists of a set of wearable sensors called WISE Items (see Fig. 4a), a set of protocol gateway devices called the WISE Coordinators, and a message bus called the WISE Broker. Figure 10 depicts the architecture of WISE. The WISE items are responsible for gathering motion data of the performers and transmitting to a WISE Coordinator via BLE (Bluetooth Low Energy) protocol in real-time. It is an integrated wearable module composed of an ATMEGA328P chip, an MPU-6050 posture sensor, a CC2540 BLE chip, and a 3.7V lithium cell. The battery is able to last for 10 hours if the message rate is set to 33 messages per second. Our research team also designs the covering case printed out by a 3D printer (see Fig. 9a). After receiving mo-cap data, the WISE Coordinators transmit these data to the WISE Broker, which is essentially an MQTT (Message Queue Telemetry Transport)[2] server, a lightweight and adaptive connectivity protocol widely used in the Internet of Things systems.

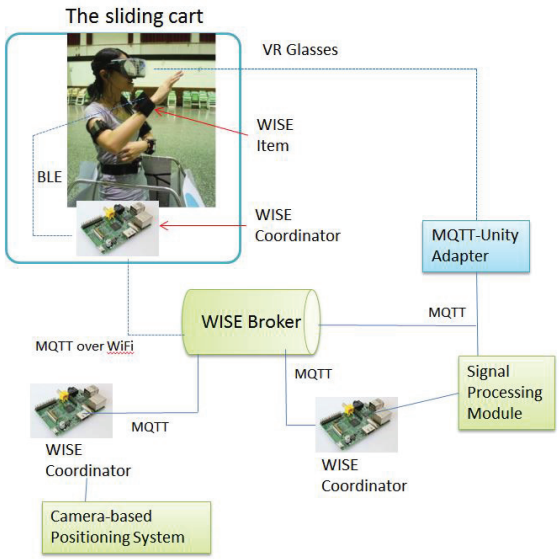


Figure 10: System architecture

The dreaming scenarios are rendered and manipulated based on the Unity platform [1] deployed on the VR glasses. The reaction rules are programmed as Unity plugins so that the objects in dreaming scenarios can react to the motion data streams coming from the MQTT-Unity adapter module. Signal processing and location detection software modules are installed in one of the WISE Coordinators by which the dreamer's locations and postures can be calculated quickly and then transmitted to the VR glasses via MQTT. Additionally, we developed a sliding cart to help a dreamer to explore the virtual scenarios safely. The cart is also used to put a laptop, the WISE coordinator, and the electric cell (Fig.9).

Execution and Reflection

Our work has been publicly demonstrated in Songshan Cultural and Creative Park (Oct. 17, 2015 - Oct.22, 2015), where totally 690 people experienced this work (Fig.11).

During the demonstration, many participants said that this is their first time to know that technologies can be combined to provide such a novel dreaming experience that they have never had before. After the virtual dreaming experience, people expressed their expectation of more scenarios and advanced multi-player interaction. Also, they advocated this exhibition to others. In the last few days of the exhibition, many people coming to this demonstration are encouraged by their friends or family. The responses from participants are summarized below:

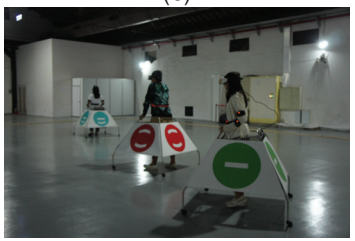
Comments related to the overall design: many people are interested in how the technologies are integrated to enable such an experience. They gave advises on the ways to interact with the virtual objects. Many of them suggested adding physical objects in the real environment, which can provide more tangible experience.

Comments related to the VR Glasses: many people stated that they had never thought of using VR glasses in this form. They discussed further applications with us and pointed out that they felt dizzy after wearing the glasses for a period of time.

The "dual viewpoints" as being an audience and a dreamer: the audiences can observe the participants from the outside of the area. Many participants reached out their hands and walked slowly forward. Audiences felt curious and wanted to know what have the participants experienced.

(a)

(b)



(c)

Figure 11: (a)The audiences that are going to experiencing this work; (b)A participant is wearing the equipments; (c) Multiple audiences that were experiencing and interacting in the dreams

Emotional resistance to the technologies: many people felt scared when they first came to the exhibition. Nonetheless, after seeing how the other participants interacted with it, they were willing to give it a try. Most of them considered it entertaining and enjoyable.

Summary

This paper presents the design, implementation, and execution of a creative work, Step In and Out of the Dreams, and the underlying technologies, the WISE platform. The VR technology was originally an indoor activity, such as games and medical treatment. With a novel way to combine wearable technology and VR, this work expects to bring individuals into group interaction and integrate them with physical space, allowing the participants to roam freely in illusive dreams. Currently, our work requires a centralized overhead camera for positioning. Our team is currently developing a new positioning system using trilateration based on BLE's RSSI signals so that the exhibition is more portable and is more robust to the lighting conditions.

Acknowledgements

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