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The effectiveness of HMD-based virtual environments through 3D camera for hotel room tour

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Abstract: Many of hotel customers obtain information from hotel websites to find the best alternative. One of the crucial information for the choice is spatial/visual information of hotel rooms. However, hotel website provides photographs only showing representative room features that may not be sufficient to give a full understanding of hotel room to customers. HMD-based 3D virtual environments (HVE) created by 3D camera could improve customers' experiences of hotel rooms by providing full virtual tours of hotel rooms. However, to the best of our knowledge, whether HVE can adequately provide similar customers' perception on spatial/visual information remains unproven as physical hotel rooms. The present study thus aims to verify how similar and reliable information on physical hotel room HVE provides to hotel customers in comparison with hotel website with 2D photograph and display-based 3D virtual environment. For this purpose, this study conducted a comparative experiment to investigate perception of three environments. As a result, the study found that HVE is more effective to provide spatial/visual information as similar as an actual hotel room. In addition, HVE increases customers' perceptions towards the reliability of information, the quality of hotel room and intention to book.

Key words: Virtual Reality, Head-mounted Display, 3D camera, Virtual tour, User perception

1. INTRODUCTION

As the importance of Online Travel Agencies (OTAs) has been growing, most of hotels provide room photographs on their websites, which help customers check rooms before making a reservation. However, these photographs are usually not sufficient to give full information on hotel rooms to customers. Such lack of information could give rise to customer's perceived gap in room features such as space layout, furnishing between online photographs and the actual rooms. The perceived gap could lead to customers negative impression (e.g. disappointment and dissatisfaction) on the hotel.

The recent technology, 3D camera, in this regard has a potential to mitigate the perceived gap by creating realistic virtual environments. 3D camera captures visual (e.g., color and texture) and spatial (e.g. dimensions and locations) data of a physical space in an accurate and instant manner. The captured data are then uploaded to a cloud server for processing, computing and generating virtual environment, thereby providing consistent information between the virtual environment and physical environments [1,2]. This technology supports a walkthrough function through which customers can navigate and gather further information in the virtual environment [3,4]. The generated virtual environments are usually experienced through display on computer screen or Head-Mounted Display. With the advancement of immersive virtual reality technologies, HMD-based 3D virtual environments (HVE) draw more attention in recent years. Indeed, studies in diverse fields proved the usefulness of HVEs [5-7] and some of hotels are recently employing HVEs in their hotel website.

However, whether HVEs can adequately represent physical hotel environments for providing similar customers' perception on room features remains unproven. To address the gap, this study aims to evaluate how similar and reliable the obtained information from the experiences of the three environments (i.e., hotel website with 2D photographs (HWP), display-based 3D virtual environment (DVE) and HVE) are to actual hotel room. For this, we created a virtual hotel room using 3D camera and conducted an experiment to compare perception on spatial/visual information of three environments. Since this study is an on-going project and only small number of subjects participated in the experiment, a preliminary analysis result is presented in this study.

2. RESEARCH METHOD

2.1 Experiment setting and participants

A hotel room of Hotel ICON in Hong Kong was selected as a test-bed. The hotel room involves regular hotel room facilities such as a television, a toilet, chairs, a desk, a bed, closet and both natural and artificial light. A room description page of the hotel website was used for the experience of HWP. A Matterport 3D camera was used to capture the hotel room and then create a virtual environment for the experience of DVE and HVE. The created virtual environment was uploaded to the hotel website instead of 2D photographs for the experience of the DVE. Participants then used a mouse to move and look around and draw/draw back curtains in the virtual environment. Lastly, Samsung Gear VR was used for experience of the HVE. Figure 1 shows 3D scanning of the Hotel room and the experiment. For the experiment, ten participants were recruited by advertising through a poster at the Hong Kong Polytechnic University. The participants have been rewarded a gift coupon for their participation. The participants were undergraduate and graduate students at the Hong Kong Polytechnic University from the ages of 18-22 years old. Six of them are man and rest of them are women.

Figure 1. 3D scanning of the hotel room and the experiment.

2.2 Experiment Procedure

Before the start of the experiment, participants read and signed a consent form for agreeing participating in the experiment. Then, they were given a training tutorial on how to use Samsung Gear VR and how to navigate in the HVE. A within-subject study was designed for this experiment. Participants experienced three environments (i.e., HWP, DVE, and HVE) for two minutes respectively in a random order. After all the experience of the three environments, participants walked and looked around the actual hotel room to evaluate how similar and reliable the obtained information from the experiences of the three environments were to the actual hotel room. Each participant was asked to perform three comparative evaluations on room features as shown in Table 1: the actual hotel room (baseline) versus HWP, DVE, and HVE. In addition, questions regarding intention to book and the reliability of the obtained information from the experience of three environment were also asked.

Table 1. Hotel room features for comparative evaluation.

Hotel room features
Cleanliness of guest room (bedding, carpet, furniture, etc.)
Cleanliness of bathroom
Space layout of guest room

Window view of guest room
Size of guest room
Size of bathroom
Interior design of guest room (furniture, interior accessories, etc.)
Room facilities (Air conditioning, electronic appliances, safety box, etc.)
Bathroom amenities (presence of bathtub, shower booth, etc.)

3. RESULTS AND DISCUSSION

Because of the limited number of participants, this study only presents the mean values of each question of room aspects of the three environments. The analysis results are shown in Figure 2. As expected, the results show that the HVE provides more similar spatial/visual information to the actual hotel room compared to DVE and HWP. Although DVE shows higher similarity than HVE to the actual room in a few room features, they are confined to the room aspects of bathroom. In case of 'Window view of guest room', we think ease of viewing through window at various angles using mouse may affect the results.

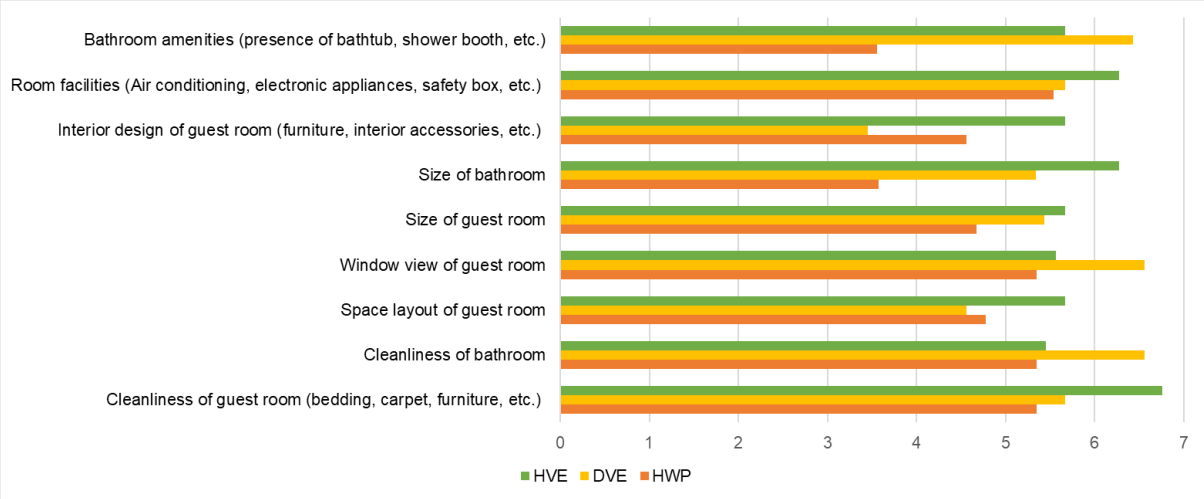

Figure 2. The results of perceived similarity on spatial/visual information between an actual hotel room and three environment

In addition to the perceived similarity, the results of the preliminary analysis indicate that participant felt HVE and DVE more trustworthy in terms of the obtained information from the experience as shown in Figure 3. Similarly, participants feel more positive on intention to book and the quality of the hotel room in HVE and DVE. Although these findings were not derived from the statistical analysis, mean differences of variables of rooms features are distintive.

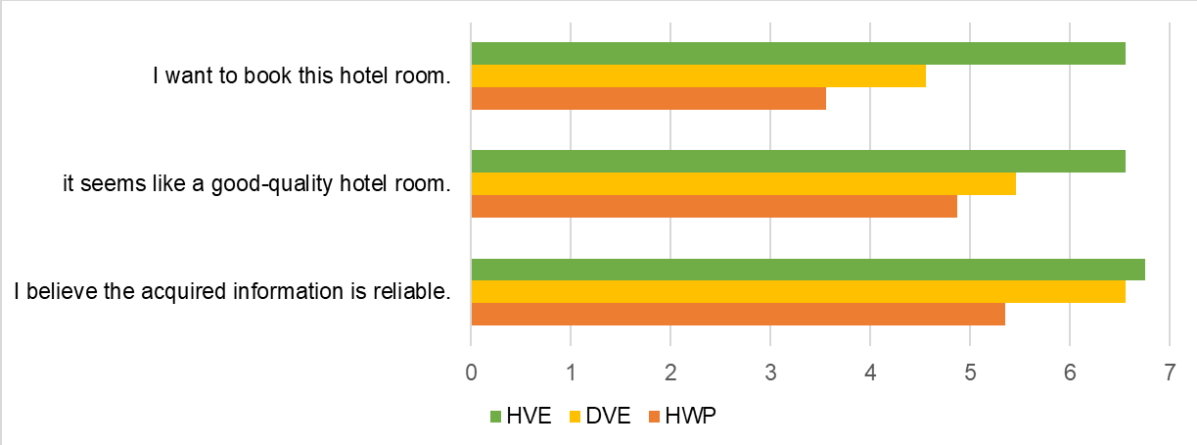

Figure 3. The results of intention to book and reliability of the information

4. CONCLUSIONS

This study conducted an experiment to compare perception of three environments (HWP, DVE, HVE) and then to verify the feasibilities of whether HVE can be used for inspecting hotel rooms online. The main outcomes of this study are that HVE is more effective to provide spatial/visual information as similar as an actual hotel room. In addition, HVE increases customers' perceptions towards the reliability of information, the quality of hotel room and intention to book. These results provide the potential of online room inspections using HVE to hotel business. Furthermore, this new practice of using 3D virtual technologies can thus develop new communications between hotels and customers within the hotel industries. The survey in this study is, however, based on a small number of participants. In addition, the results were obtained from subjective questions. To address this issue, further studies are required using various psycho-physiological sensors that objectively examine participants' emotion and engagement with larger number of experiment sample.

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