Interchanging the Mode of Display between Desktop and Immersive Headset for Effective and Usable On-line Learning

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Abstract. In this new era of "untact", the on-line solutions for social gatherings and meetings have become important more than ever. In particular, immersive 3D VR based environments have emerged as a possible alternative to the video based tele-conferencing solutions for their potential improved learning effects. However, the usability issues stand in its way for it to be fully spread and utilized by the mass. In this poster, we study for another alternative, the mixed usage of desktop (or equally 2D video tele-conferencing) and immersive modes as necessary. The desktop mode is convenient for the user and allows the usual interaction in the most familiar way (e.g. note taking), while the immersive mode offers a more direct contact and interplay among the teacher and other learners. We conducted a pilot experiment comparing the user experience among the three modes: (1) desktop, (2) I3D VR/HMD and (3) mixed. For the mixed mode, we designed a flexible fixture for conveniently wearing/donning the head-set and switch between the desktop and I3D mode quickly. Participants much preferred the mixed mode usage due to the aforementioned advantages of bringing the bests of both worlds.

Keywords: On-line learning, Immersive 3D VR environment, Video based tele-conferencing, Educational effect, User Experience.

1 Introduction

With the advent of the COVID-19 and the era of "untact", the on-line solutions for social gatherings and meetings have become important more than ever. Most academic classes are now being conducted on-line mostly using the video tele-conference (VTC) solutions such as the likes of Zoom, Webex, Google Teams, and Microsoft Meets [4]. At the same time, there are much worries as to the educational effects of such classes conduct on-line in the long term [3]. As such, immersive 3D (I3D) VR on-line environments have emerged as a possible alternative [1]. I3D environments depict and decorate the classroom in picturesque 3D, and provides higher presence of

the lecturer and colleagues, natural interaction with one another, and some degree of physical manipulation of/with educational props/materials, i.e. an atmosphere and functions conductive to a better learning (at least for certain types of classroom learning (See Figure 1). Moreover, for large scale classes, due to the heavy network traffic, the video streaming of students is often turned off. I3D rendering of students as avatars is much less computationally and network-wise burden-some. In most cases, the I3D environment solutions offer both regular desktop and head-set modes. The true advantages of the I3D environment would be reaped with the use of head-set, however, the head-sets not only incur extra cost, but also are quite inconvenient and difficult to wear and use - they are heavy and stuffy; stereoscopic rendering will most likely introduce sickness; effective interaction is limited with the closed view unless a separate controller is used. Thus, in summary, despite the prospective advantages, these usability problem stand in the way of utilizing I3D solutions to their fullest effect.

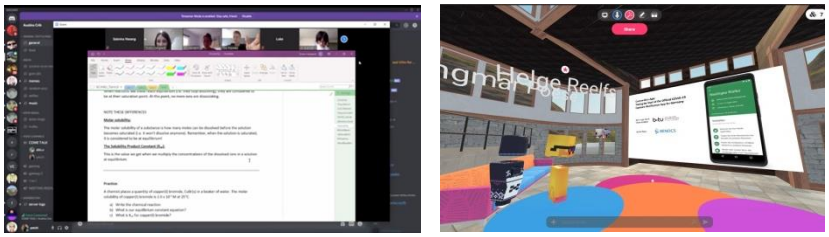

Fig. 1. Video tele-conferencing solution for classroom learning (left) and immersive 3D VR based environment – hubs.mozilla (right).

In this poster, we study for another alternative, the mixed usage of desktop (or equally 2D video tele-conferencing) and immersive modes as necessary. The desktop mode is convenient for the user and allows the usual interaction in the most familiar way (e.g. note taking), while the immersive mode offers a more direct contact and interplay among the teacher and other learners. We conducted a pilot experiment comparing the user experience among the three modes: (1) desktop, (2) I3D VR/HMD and (3) mixed. For the mixed mode, we designed a flexible fixture for conveniently wearing/donning the head-set and switch between the desktop and I3D mode quickly.

2 Related Work

Our study was inspired by the Hewlett Packard PC set-up, called the "VR snacking", which combined the PC with a VR station on a stand which made it easy to pick up, use, and the head-set back down. In this particular case, the computer aided design was the main application for which both desktop interfaces for the modeling activities and 3D immersive visualization were needed in the work flow [2].

Yoshimura and Borst investigated the desktop viewing and the headset viewing for remote lectures using the hubs.mozilla , a 3D immersive VR environment, for social

gatherings [1]. The comparative evaluation revealed that with regards to the presence/co-presence, usability and sickness, overall participants preferred to use the desktop and the head-set mode as needed. This study is similar except we have redesigned the head-set stand (e.g. vs. one introduced by [ref]) to fit the needs of on-line learning and assessed the user experience with regards to learning (vs. CAD workflow).

3 Head-set Stand Design

Figure 2 shows the head-set stand design. It was designed to be placed on the desk beside the desktop PC. Unlike the Hewlett Packard design, in ours, the headset is basically designed without detaching the headset from the stand most of the times (the option to completely detaching it is still available). This was to further remove the need to wear and un-don the headset. Instead, the user is to fit one's head to the headset on the stand. To make this process as easy as possible, mechanical joints were used to provide 3.5 degrees of freedom and adjust the position (height, limited degree in the right/left) and orientation (pitch/yaw) of the head set in a compliant fashion.

Fig. 2. The head-set stand design (left), and the illustration of mixed mode usage (right).

4 Pilot Experiment and Results

To validate the effects of our proposed bi-modal mode usage and associated design solution, we ran a small pilot experiment comparing the user perceived experiences among three modes of immersive 3D VR based on-line learning environment. Four participants (graduate students of age between 25 and 29) were recruited and instructed to view and use the hubs.mozilla I3D environment [5] to listen to a 5 min lecture in three different modes (presented in a balanced order): (1) desktop mode, (2) HMD/VR mode and (3) mixed mode. After experiencing the respective modes, the participants were asked to fill out a UX survey that assessed the (1) user's perceived learning effect, (2) general usability, and (3) immersion/presence/interest.

The survey results (Figures 3 – 5) revealed the mixed mode exhibiting a usability level similar to that of the desktop. However, user's perception of the learning effect

was greater with the use of I3D VR, either on its own or with the mixed mode. The VR/HMD mode was rated the lowest in terms of the general usability as expected due to the inconvenience of the head-set usage.

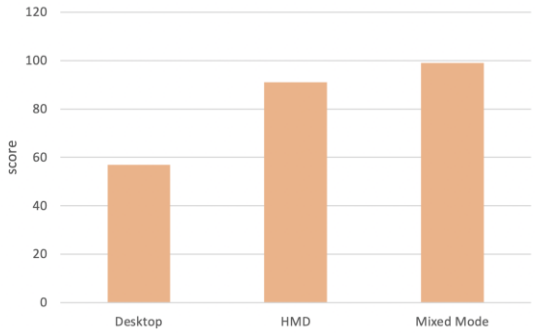

Fig. 3. The user perceived learning effects among the three modes.

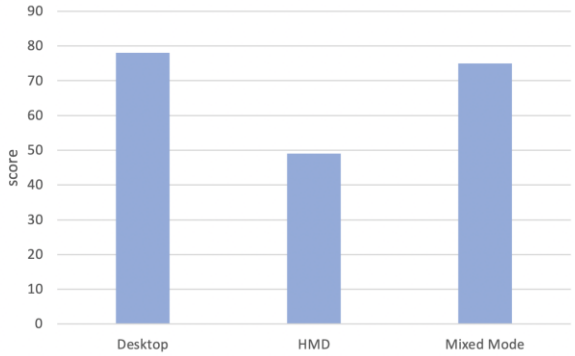

Fig. 4. The general usability among the three modes.

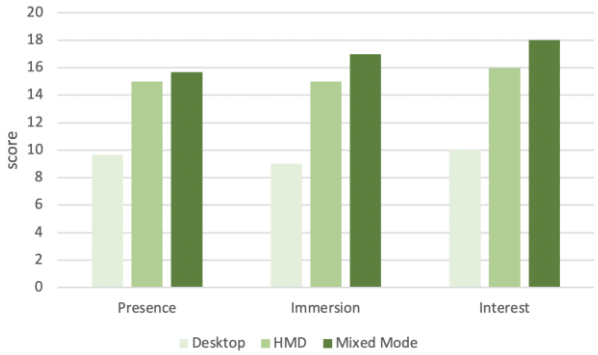

Fig. 5. Presence/immersion/interest levels among the three modes.

The post-briefings also reflected the general survey results: while the stand design and mixed mode helped users overcome the basic head-set only usability problem, subjects commented that immersive environment needed improvement in terms of not making any distraction with the non-essential objects within. There were interactive activities such as note taking needed across the three nodes, yet only practically possible in the desktop mode. There were subjects who felt disoriented in the process of switching between the desktop and VR/HMD mode.

5 Conclusion

In this poster, we conducted a comparative experiment to compare the educational effects and other associated user experiences of three different modes of on-line learning – (1) desktop only, (2) VR/HMD only and (3) mixed. The mixed mode offered the best balance for usability with the competitive learning effect as expected. Further design improvements must be further made to tailor it to the task of on-line learning (e.g. more movement flexibility and associated interactive activities. The experiment was only a small pilot one and the educational effects were only judged from the user's perception rather than through quantitative measures. We believe that the I3D environment will make more sense not just for lecture oriented classes but also for classes that require closer teacher-student interplay and 3D object manipulation (e.g. educational materials props).

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