Towards Facilitating Communication Between the VR User and the Bystander

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ABSTRACT

The usage of immersive head mounted displays (HMDs) in co-located collaborative settings, creates situations whereby one person is in virtual reality (VR user) and the other in the real world (bystander). To increase awareness between these two collaborators, I propose to investigate (a) how the bystander can derive meaning from the VR users interactions, (b) how this information may be used to communicate with the VR user, and (c) which methods are effective for doing so. My research is valuable for practitioners and designers who are creating virtual reality experiences for mixed collaborative settings.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**;

KEYWORDS

Virtual reality; Co-located Collaboration; HMD

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Sidebar 1: I propose to investigate how co-located collaborators, whereby one is very an HMD (user on the left) and the other is in the real world (bystander on the right), can effectively communicate with each other, while balancing the HMD user's level of presence.

INTRODUCTION

My interest is focused on interactions with head mounted displays (HMDs) in co-located collaborative settings, whereby one person, the HMD user, is interacting in VR and the other person, the bystander, is in the real world. This creates an imbalanced collaboration scenario, as the bystander is fully aware of the real world, while the VR user is partly aware of the real world and ideally, fully immersed in the virtual world. To lessen the lack of balance between these collaborators, I investigate (1) how the bystander can be made aware of the VR interactions (e.g. gestures), without it being a threat to the VR user, and (2) how communication between these two different collaborators, for example in form of interruptions, can be effectively designed. The latter touches on a highly discussed topic in VR research, as interaction with a real world bystanders affects the presence of the VR user, which is one of the main quality measures for VR experiences.

This research offers an opportunity for the HCI community to understand how HMDs can be integrated into collaborative settings by designing user centred VR interactions, not just for the main VR user but with the bystander in mind.

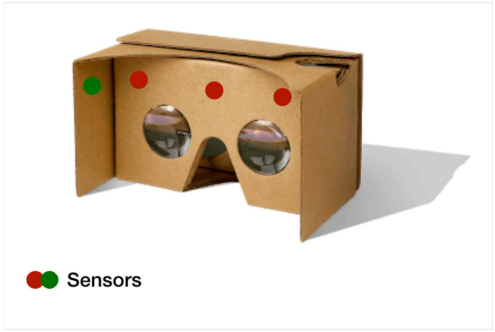
RELATED WORK

When used in a collaborative setting, co-located bystanders are given, whether they are passing by or constantly in the room. Unlike the majority of technologies, where bystanders have a visual insight into the interactions of the user (e.g. desktop), the vision of HMDs, as self contained-devices without a keybaord and external screen, does not allow for this. Although, this promotes privacy and security for the VR user [5], it decreases awareness of the VR users' interactions, which collaborators for example use to derive opportune moments for interruptions [6]. Based on prior work by Heath and Luff [7], we suggest that interactions may be designed in such a way that they create meaning for the bystander and not solely for the user of the HMD.

Furthermore, fostering communication (e.g. in form of interruptions) between the VR user and the bystander remains a challenging topic, as shown in prior work, which states that VR users' awareness of the real world negatively affects their presence in VR [10] - a main quality measurement for a successful VR experience. Although, we agree that communications affect the presence of the VR user negatively, they are unavoidable in a co-located setting (e.g. in form of interruptions) [9] and necessary if HMDs are to be successfully integrated into the worklplace. Thus, our research aims to create awareness for bystanders on how to engage collaborators using such a device, whilst maintaining a balanced presence for the VR user.

RESULTS OF PILOT STUDY

Sidebar 2: Multiple solutions used the traffic light system to display availability.



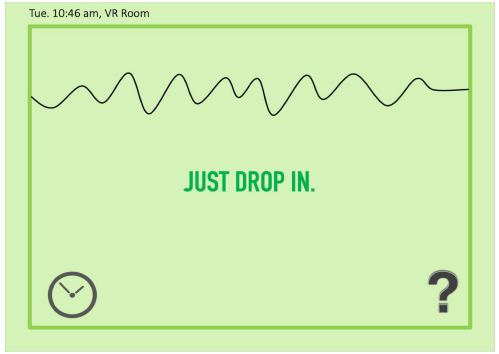


Figure 1: One solution was to provide an external screen which tracks physiological data of the VR user to display availability and cognitive load.

PILOT STUDY

To understand the design space of information that may be displayed on the surface of the head mounted display to the benefit of the bystander, we completed a pilot study at our institution. The goal of the prototype was to (1) provide information to the bystander that would support the bystanders decision making process on when to interrupt or not and (2) that would increase social acceptability of the HMD by providing additional information to the bystander.

As part of a tutorial at our institution, we asked groups of students (N=24) to create low-fi prototypes that display VR Users availability or status to the bystander. Students without prior experience of high end VR technology, were given an introduction to the HTC Vive and its controllers. Students formed five groups and each one was provided with multiple card board head mounted displays (HMDs) to facilitate the low-fi prototyping process. First, they had to complete an hour long ideation session, whereby they had to come up with as many ideas as possible on what they thought would be beneficial information for the bystander. In the second session, they had to create prototypes that would capture how the information may be displayed. This was followed by a testing phase, whereby each group tested their prototypes with five users and two VR experts. Next, they did a second iteration of their prototype based on the user and expert feedback. Examples of prototypes are provided in sidebar 2 and figure 1.

CONCLUSION AND DISCUSSION

We believe that the surface of the HMD is unused space that may be re-purposed for the benefit of the bystander. Additionally, our study showed that adding hardware to HMDs may be another approach to solve for the lack of communication between the bystander and HMD user.

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