A Major Challenge for Amplification Technologies - Designing Interactions for Social Spaces

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Abstract
The adoption of virtual and augmented reality (VR/AR) has recently become mainstream and in the foreseeable future, will eventually be adopted and used virtually anytime, anywhere. Seeing the current struggles and lessons learned from VR/AR, the social acceptance of Amplification Technologies is a major challenge moving forward. This paper discusses the concerns and factors that play a part in designing new input modalities and interaction mechanics that caters to public areas. We suggest the implementation of physiological sensing to complement subtle gestures as a method of unobtrusive interaction, as well as discuss the influence of culture and the concept of blending interactions towards social acceptance of Amplification Technologies based on VR/AR.

Author Keywords
Virtual reality; augmented reality; social acceptance; physiological sensing; subtle interaction

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Figure 1: Using the Google DayDream VR HMD in a plane.

Introduction

We've seen the first year of commercially available Virtual Reality (VR) systems and it seems Augmented Reality (AR) is just around the corner (e.g. HoloLens, MagicLeap). These are important enabling technologies for human augmentation and sense amplification. VR/AR is here to stay and has the potential to continuously grow until it is adopted by the masses akin to the adoption of smartphones. At this point of time, envisioning a future of people wearing a head-mounted displays (HMDs) while taking a stroll at the park or sitting in a bus may seem outrageous. However, most adoption of new technologies was never a pleasant thought. For example, in this day and age, almost everyone owns at least one social media account such as Facebook, Twitter, or SnapChat, usually more. However, in the past, the idea of having our images, videos, location and other details online and obtainable by others with an internet connection anytime seemed like a major violation of privacy and overall an unpleasant thought. That may persist until today for some individuals, but most of us have now accepted it as part of how we consume digital content, even if those concerns remain true. The same can be said for VR. Eventually, VR usage will be a common sight, and certain design considerations need to be fulfilled for this mass adoption. The contribution of this paper are the following: 1) Understanding the social acceptance of VR / AR adoption in public space, and the implications for amplification technologies, 2) the suggestion of physiological sensing as an input modality, 3) the definition of subtle interaction in the context of VR/AR, and 4) an illustrated taxonomy to show the relation between social acceptance and various forms of interactions mechanics.

Social Acceptance

Social acceptance can be defined in many ways. With relation to technology, it is often associated with the societally controversial technology. For instance, nuclear and cloning technology are often under heavy debate due to its controversial nature of usage, even though they can be highly beneficial under the right application. Social acceptance in this context refers to a point of which VR is already used everywhere. In such a scenario, VR requires new input and interaction mechanics to cater to that. Otherwise, current VR mechanics, such as reaching out to grab an object, would be obtrusive and even annoying for the people in the near vicinity. On the other hand, simple input methods like physical buttons on a controller is unrealistic and breaks the immersion, even leading to motion sickness in more severe cases. Therefore, the first step would be to understand what defines a social or public space. The primary assumption to be made is that all scenarios in public spaces means that the user is constantly surrounded by others who may or may not be using their own VR system. Such a space is all encompassing and can generally be separated to 2 task; sitting or standing/walking. We do not relate VR usage with more specific tasks such as performing sports or driving because such a usage would be unadvisable. For sitting, common scenarios for a public space would be in a train, taxi, plane, or a bench in a park as shown in Figure 1. These scenarios differ slightly in the sense of the proximity with the nearest person; generally, being in a train or plane has a closer proximity with others than a taxi or a park. For standing/walking, scenarios would generally be at a wider space like a park or shopping mall, or a constrained space like a train. This also leads to additional design considerations, namely safety. For

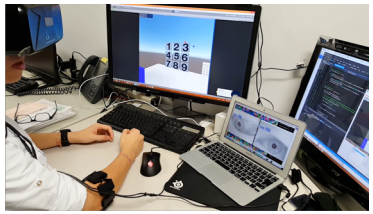

Figure 2: A multi-modal approach by combining eye tracking with electromyography (EMG) for subtle input

instance, standing in a train would require the user to be constantly holding a handle, which requires VR input to be hands-free.

Physiological Sensing

Concerning input mechanic, as mentioned previously, new input modalities needs to be introduced to cater to VR in a social space. We propose the use of physiological sensing as an input modality in this context [1]. The benefits are two-fold; it allows for an explicit input method that can be directly controlled, and an implicit output for feedback. Physiological data can be read through the electrical signals that we produce in our daily life such as eye activity, muscle movement, heart rate, and so on through well-placed sensors and careful calibration. Furthermore, the implicit nature of physiological data can also provide us information such as cognitive load, current emotion, mental state, etc. These sensing methods are subtle by nature; they do not require any obtrusive movements from the user and in some cases, is impossible to be detected. Eye tracking for instance, cannot be seen through a HMD, thus results in a user interaction that allows for both explicit control and even implicit feedback (where heat maps can be generated based on the user's fixation) [2,3]. However, care needs to be taken when implementing these sensing methods into interactions. Taking eye tracking as an example; it is suitable for selection in virtual space due to its cursor-like control, but since it lacks a method of activation, using solutions like dwell time or eye-based gestures causes strain to the user's eyes. A multi-modal approach illustrated in Figure 2 is an example that should be considered for these sensing methods to complement each other.

Subtle Interactions

For each of the desired sensing methods, careful considerations needs to be taken to implement them as user interactions. The concept of subtle interactions is fascinating by itself. VR interactions were always designed for the best immersion by requiring the user to perform actions that they would normally perform in the physical environment. However, with social acceptability taken into account, this adds a new dimension for interaction [4]. For it to be subtle, it will undoubtedly conflict with immersion. The more subtle an interaction is, the less immersive it becomes. Therefore, it is important to determine the right balance, and physiological sensing is meant to fix this issue. For example, utilizing muscle contraction on the forearm as a shooting mechanism is both subtle and realistic because it simulates the recoil of a gun that user induces themselves. Nevertheless, a comparison between subtle gesture and physiological sensing should be made to determine their usability in social space. These sensing methods are best utilized to complement subtle gestures in a way that allows both methods to contribute to an overall increase in social acceptance for VR in public.

Other Considerations

There are many factors to consider when dealing with something as wide as social acceptance for a new technology. This paper covers the proposal for new input and interactions for VR while considering the constrains of a social space. However, another factor that is worth considering is also the culture of the place. Certain countries or venues where these technologies are deemed as a violation of privacy will require further measures to be taken. For example, Google Glass has been banned from areas such as

restaurants or hospitals for fear of privacy violation. The second factor is taking subtle interactions a step further by introducing blended interactions. The concept of blended interaction takes subtle interactions a step further. For VR to blend into our everyday lives, activity recognition will allow a dynamic creation of interaction methods to suit the current physical task. For example, if the user needs to tie his or her shoelace, the current VR interaction can update itself to suit the user's task and blend in dynamically. We believe this seamless transition combined with physiological input can provide the illusion of virtual content that melts into the physical world. Figure 3 shows a taxonomy based on social acceptance and the nature of interaction for VR.

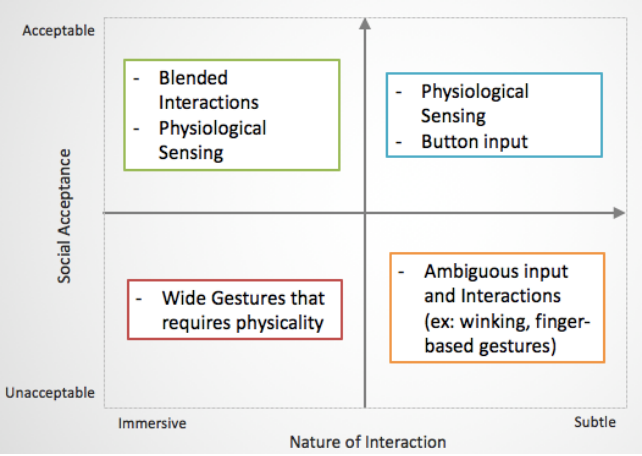

Figure 3: Taxonomy for VR interactions for social acceptance

Conclusion

Normally, the concept of social acceptance and subtle interactions are associated with wearable research [5], and has almost never been considered for VR use. These technologies, which can be considered as a form of "augmentation", will undoubtedly result in some negative responses when used in social spaces. This paper aims to change this for future implementation of VR, and to a certain degree, augmented reality (AR) to usher in a future of this technology being anywhere, anytime.

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