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Perception Change With Ubiquitous AR in Social and Individual Scenarios

Chloe Eghtebas
Technical University of Munich
Contact Author: eghtebas@in.tum.de

Abstract. AR will become ubiquitous and with it, many challenges emerge in a socio-technical context. Given the wide range of devices not all AR is made equal. From what the AR is technically capable of, to who is using it, and how it looks; there are different perceptions of different devices. From the heterogeneous landscape of AR, the social circumstances of informational inequality can emerge giving way to a social advantage or hierarchy. Furthermore, when AR becomes ubiquitous, it can be used to mediate perceptions of reality which can be applied in moderating communication in a multi-user environment [Mann (2002)]. In this Doctoral Consortium (DC) paper I motivate a vision, outline some challenges, report on progress already made and speculate the next steps in how to understand and direct the influence of perceptions to overcome, rather than increase the prevalence of social inequality.

Introduction

Augmenting technology is the original motivation towards pursuing technological advancements for better quality of life and to push the boundaries of humankind. Based on market trends of the ever evolving AR Head Mounted Display (HMD), from google glass, to Hololens, Magic leap, and new nReal glasses, we look at HMD's in particular which is a form of an augmenting technology that can reach

ubiquity. For ubiquitous AR to live up to its potential, it needs to overcome social reservations. Previous experience has shown that augmented reality HMD's are perceived based on their appearance and its user. In the case of google glass, users were observed to view the device as intrusive because of the camera [Hong (2013)] and also to have a different purpose based on the device color [Starner et al. (1999)]. Furthermore the perception of the device changes based on who is wearing the device, such as someone disabled [Profita et al. (2016)]. However, as AR and ultimately other augmenting technologies scale, there are social repercussions that have still yet to be understood, such as the informational inequality that can emerge giving way to a social advantage, that can ultimately impact the acceptability and quality of life of persons who could benefit from new technology.

Research Questions

The research questions are broken down in Figure 1 into the themes of social and individual settings looking against topics of perception of the Augmenting Technology and the interaction for the augmented technology.

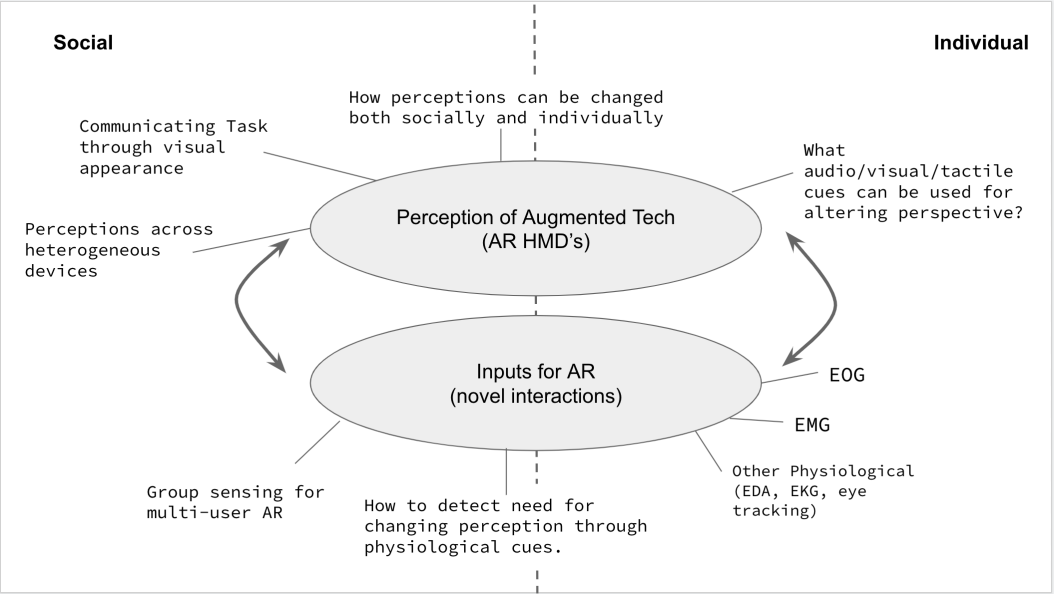

Figure 1. Figure shows the research questions with the themes of Perception Change of Augmented Technology and Interaction methods along the social and individual contexts.

RQ1: How perceptions can be changed both socially and individually?

The first series of questions address how can social and individual perceptions be changed. How can visual signals be applied to socially communicate the functionality of the device? If an indicator light or a physical covering of the camera, such as the trend for covering up laptop webcams, can be the most effective or if changing other aesthetics of the HMD's physical aspects could

communicate more benign intentions? Furthermore, when there are multiple-user settings with various AR displays, what are the telling capabilities or perception of capabilities that can lead to a social advantage? And on an individual basis, in what ways can an individual have their reality be mediated by certain audio, visual, and tactile cues?

RQ2: How to detect the need for perception change through physiological sensing in individual and group contexts? The second research areas looks towards understanding how to distinguish when to detect social versus individual physiological responses? Additionally, what devices (EOG, EMG, etc.) or fusion of devices can best detect a need for group mediated perception change?

Methodology

	Individual (I)	**Social (II)**
Perception Change (A)	1. Case study on when perception change can be applied. 2. Measuring physiological responses to successful perception change mediated by AR.	1. Augmenting Zoom: Perceptions and Asymmetric Encounters of Ubiquitous AR [√] 2. Follow up studies investigating different social roles and device capability. 3. How physical appearance change can signify device task.
Augmenting Interaction Methods (B)	1. Investigation into Natural Gestures Using EMG for SuperNatural Interaction in VR [√] 2. Novel interactions in AR (with physiological triggering)	1. Investigate social acceptability and perception of interaction method based on social role, device capability, and device appearance.

Figure 2. Figure showing the methodology and next steps..

Figure 2 shows the overview of the proposed methodology to address the research questions. The rows and columns represent the themes from Figure 1 and subdivide the research questions into categories. Each cell has the initial experiment or series of experiments to address the intersection of the corresponding themes in order for the research question to be answered.

Results

To go about answering our research questions, we built an initial social acceptability model, explored the three attributes of social perception, appearance, social role, and device capability, of the augmenting technology, and investigate interaction methods such as Electromyogram (EMG) for interaction and looked into Brain Computer Interface (BCI).

We started with an initial framework for generalizing the perception of all augmenting technologies Eghtebas et al. (2017b). This framework describes that

the acceptability is based of the individual cost or benefit versus the social cost or benefit and goes onto presenting different domains, such as education, law enforcement, sports, and business applications, which fall into a domain of these subsequent quadrants on the framework.

Next we looked at a specific augmenting technology, such as AR with ultra zooming capabilities [submitted waiting for results]. We developed a prototype to investigate the interaction and possible application and social concerns for such a super zooming device through qualitative interviews (n = 12). From the interview results, we identified themes around usability expectations, individual perceptions and preferences on privacy, and social permissions which we further investigated by a follow up survey of 100 participants. The survey varied social roles of who wears the zoom HMD across scenarios of the participant actively wearing the device, someone else wearing the device, and observing two people interacting with only one of them wearing the device and also the appearance of the HMD as a helmet, glasses, and futuristic contact lenses. The results showed that across all three scenarios, the contacts were perceived to have the highest advantage and the highest potential for misuse. These results address the research question, A.II.1, in the methodology Table 2.

Additional work has been done in looking into natural gestures for interaction in Virtual Reality (VR) which analyzed a series of gestures used to trigger a extendable abstract arm in VR [Eghtebas et al. (2018)]. Exploratory work has also been done on the interaction methods with BCI's which looked into the possible applications of BCI's and suggested criteria for integration of the calibration procedure of BCI's with the core application usage [Eghtebas et al. (2017a)].

Next Steps and Expected Contributions

Future work will be carried out by filling in the missing points highlighted in Table 2. Addressing quadrant A.I.1 and A.I.2, Electrooculography (EOG) will be used in conjunction with an AR HMD to understand which situations require AR mediated intervention as well as the model to detect physiological changes that indicate the needed intervention in a social group. Quadrant A.II.2 + 3 a follow up study from the survey results will look into varying the device capability to instead of just zoom also investigate other augmenting abilities (thermal, x-ray, other visible frequency spectrum, etc.) and investigate just how dominant the social role of the wearer is in understanding perception of acceptability of an AR HMD.

I plan to make contributions in understanding the social dynamics surrounding the likely ubiquity of AR HMD's and make design and implementation suggestions towards the usage of AR applications that are used in a social setting. Furthermore, I plan on highlighting the benefits of an augmenting technology, such as AR HMD's, for an individual in social situations while exploring ways that perception change can occur.

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