

Collaborative Augmented Reality Tracking, Interaction, and Display for mobile game

Qiang Fu

August 18, 2016

INTRODUCTION

Background

Although Augmented Reality (AR) technology has existed for decades, it is by far one of the hottest tech topics in 2016. AR is hanging in there and gaining traction in flashy ways. AR is a technology which allows computer-generated virtual imagery to overlay physical objects exactly in real time. Unlike virtual reality (VR), where the user is completely immersed in a virtual environment, AR allows the user to interact with the virtual images using real objects in a seamless way. Azuma [1] provides a commonly accepted definition of AR as a technology which (1) combines real and virtual imagery, (2) is interactive in real time, and (3) registers the virtual imagery with the real world. As such there are many possible domains that could benefit from the use of AR technology such as engineering, entertainment and education.

Many early users who experienced AR technology mainly through the games, so game maybe the most interesting and efficiency channel to popularize the AR to the public. One example is Pokémon GO, which has been a huge phenomenon with gamers all over the world reliving their childhood through the AR game. Trending topics show how Pokémon GO has impacted people around the world; [6] even Michelle Obama is associated with it! The game has also raised discussion around topics like mental health, obesity and childhood, especially since gamers are being inspired to get out and explore new neighbourhoods on foot, and end up exercising more than they usually would, as they eagerly play the game to 'catch them all'. However, as an AR product, Pokémon Go just adapts location-based service (LBS) and basic vision-based tracking techniques in AR. What is the next tipping point for the AR application in mobile games?

For co-located collaboration Augmented Reality can blend the physical and virtual worlds so that real objects can be used to interact with three-dimensional digital content and increase shared understanding, which significantly enhance face-to-face collaboration. This is the technology that current mobile game could apply to improve the AR game development furtherly. This research focuses on the field of how collaborative AR application could be used in the mobile game industry based on previous collaborative AR studies.

Prior Work

Although single user AR applications were studied for decades, it was not until the mid-nineties that the first collaborative AR applications were developed. The Studiersube [2] and Shared Space projects [3] showed that AR could support remote and co-located activities in ways that would otherwise be impossible [4]. Since that time there have been some excellent examples of collaborative AR interfaces presented.

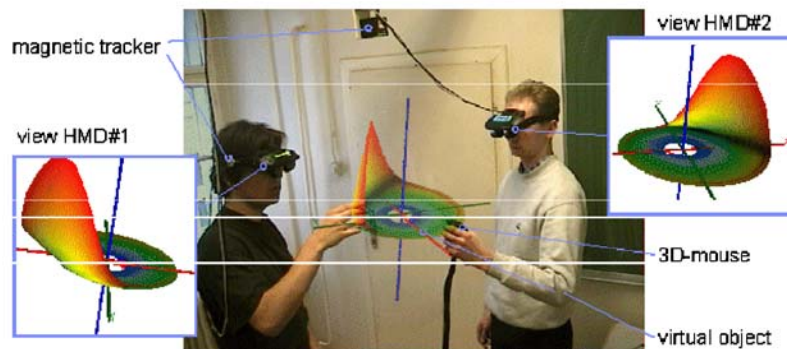


Figure 1: One of the first interfaces to show the potential of AR for face-to-face collaboration (StudierStube project). [2]

It was not until the mid-nineties that the first collaborative AR applications were developed. For co-located collaboration, AR can be used to enhance a shared physical workspace and create an interface for 3D CSCW [5]. In testing with the Shared Space application, users found the interface very intuitive and conducive to real world collaboration, because unlike other interfaces, the groupware support can be kept simple and mostly left to social protocols [5].

The StudierStube researchers identify five key features of collaborative AR environments:

1. Virtuality: Objects that don't exist in the real world can be viewed and examined.
2. Augmentation: Real objects can be augmented by virtual annotations.
3. Cooperation: Multiple users can see each other and cooperate in a natural way.
4. Independence: Each user controls his own independent viewpoint.
5. Individuality: Displayed data can be different for each viewer.

The value of these characteristics is shown by several user studies that compare collaborative AR interfaces to other technologies. Kiyokawa et. al. [8] have conducted an experiment to compare gaze and gesture awareness when the same task is performed in an AR interface and an immersive virtual environment. Similarly, collaborative AR interfaces can produce communication behaviors that are more similar to unmediated face-to-face collaboration than to screen based collaboration.

Augmented Reality techniques can be used to develop fundamentally different interfaces for face-to-face and remote collaboration. [8] This is because AR provides:

- Seamless interaction between real and virtual environments
- The ability to enhance reality
- The presence of spatial cues for face-to-face and remote collaboration
- Support of a tangible interface metaphor
- The ability to transition smoothly between reality and virtuality

Problem Definition

While it may be some time before AR technology becomes mature, there are many issues, both technical and social, that should be pursued in the meantime. One of the important aspects is creating appropriate interaction techniques for collaborative AR applications that allow end users to interact with virtual content in an intuitive way. More recently researchers have begun exploring how mobile AR platforms can be used to enhance face-to-face collaboration. In this case, how to combine these research with the mobile game development needs to be probed further, after all there are some of the limitations of current collaborative interfaces.

There are shortcomings with most current collaborative technology, especially when used to interact with spatial content [7]. In face-to-face collaboration, people use speech, gesture, gaze and non-verbal cues to attempt to communicate in the clearest possible fashion. However, in many cases the

surrounding real world or real objects play a vital role, particularly in design and spatial collaboration tasks. P

Aim

The main aim of the paper is to investigate the trend of collaborative AR technologies application and how to combine them together as well as the influence of mobile phone games on collaboration and social interaction of physically co-located players, instead of focusing on the collaborative AR itself. Evaluate the system performances, user interface performances and the usability of mobile phones for collaborative AR.

Research Plan and Methodology

The main method used in this research is to review previously published conference papers and other related material. In the rest of the paper, I first provide a comprehensive review of analyzing various tracking methods, interaction techniques and user interfaces in AR, which are very important areas for future research. Next, I present several research topics presented on the AR and games' combination. Then, I focus specifically on the important topics of AR tracking, interaction and display technology, discussing research developments, the main problems explored in the field and current and future AR game research directions.

Project Plan

	2016 Period 2					2017 Peroid 1					
Schedule (per month)	8	9	10	11	12	1	2	3	4	5	6
literature review											
1st Seminar											
establish develop environment											
develop fundamental functions											
research/program											
test											
write 1st draft thesis											
final thesis											
final seminar											

Figure 2: Proposal Research and Writing Timetable

REFERENCE

- [1] R.T. Azuma. A survey of augmented reality. Presence: Teleoperators and Virtual Environments 6:4, 355-385, 1997.
- [2] D. Schmalstieg, A. Fuhrmann, Z. Szalavari and M. Gervautz. 1996. Studierstube-An environment for collaboration in augmented reality. In CVE '96, 1996.
- [3] M. Billinghurst, S. Weghorst and T. Furness III. Shared Space: An augmented reality interface for computer supported collaborative work. In CVE '96, 1996.
- [4] L.S. Rodrigo Silva. Introduction to augmented reality. <http://virtual.Incc.br/~rodrigo/links/AT/node.19.html>.2003.
- [5] M. Billinghurst and H. Kato. Collaborative augmented reality. Communications of the ACM, 45:7, 64-70, 2002.
- [6] Amberā Cruz. Social media stats behind Pokémon Go's success. (2016). Retrieved from <http://www.pcworld.idg.com.au/article/604606/social-media-stats-behind-pok-mon-go-success.html>

- [7] Billinghurst, M., & Kato, H. (2002). Collaborative augmented reality (Vol. 45, pp. 64-70). NEW YORK: ACM.
- [8] Kiyokawa, K., Takemura, H., & Yokoya, N. (2000). SeamlessDesign for 3D object creation. *IEEE MultiMedia*, 7(1), 22-33. doi:10.1109/93.839308