

Designing and Studying Social Interactions in Shared Virtual Spaces using Mobile Augmented Reality

Rishi Vanukuru
rishi.vanukuru@colorado.edu
ATLAS Institute,
University of Colorado Boulder

Jayesh Pillai
jay@iitb.ac.in
IDC School of Design, IIT Bombay

Amarnath Murugan
amarnath2105@gmail.com
IDC School of Design, IIT Bombay

Ellen Yi-Luen Do
ellen.do@colorado.edu
ATLAS Institute,
University of Colorado Boulder

1 INTRODUCTION

Most immersive virtual event platforms enable users to spatially interact with one another using two broad types of modalities: Computer-based Virtual Reality, or Immersive Augmented/Virtual Reality using head-mounted devices. The ubiquity of personal computers means that computer-based VR is much more widely available, however, users miss out on the rich spatial experience that Immersive AR/VR headsets provide—devices that few people have access to today. Large-scale immersive virtual event platforms deal with this trade-off by allowing participants to join using whatever modality the device they have is capable of (such as Mozilla Hubs [7]). Mobile AR is a promising modality that can provide an interactive spatial experience to a larger number of remote participants. While there are virtual event platforms that incorporate Mobile AR to some extent [10], a systematic exploration of the possible interactions in Mobile Social AR would be useful in identifying scenarios where this modality is most suitable. To that end, we have developed a mobile application that enables participants from around the world to socially interact with each other in shared AR spaces (Figure 1A). The activities in the application have been designed to explore different types of group communication, and various spatial interaction techniques. By studying how users navigate these communication-interaction configurations, we hope to understand the contexts in which users feel present and immersed in Mobile Social AR. At the workshop, we seek to gain feedback about our ongoing research on collaborative interactions in Mobile AR social spaces, and begin a conversation about the place mobile devices have in cross-modality virtual event platforms.

2 RELATED WORK

Recent research in the field of Social VR has explored the overarching ideas of self-representation [4] and group dynamics [6, 13], as well as more context-specific implementations [5, 9]. In the case of Social AR using head-mounted devices, researchers have also investigated the effects of avatar representation [14] and interaction techniques [1] on presence and collaboration. Mobile AR has been studied as a tool for co-located social experiences [2, 12], and as a means for spatial referencing between remote pairs of users [8]. However, there has been limited work that explores its use in remote social situations involving larger groups, where issues

of Mobile AR interaction techniques, avatar representation, and presence are intertwined.

3 SOCIAL INTERACTION IN MOBILE AR

Our goals for this project are to 1) create a prototype to demonstrate a range of possible interaction scenarios in Mobile Social AR, and 2) to use this prototype to investigate how people interact with each other, and with digital content, in such shared spaces. We aimed to cover a range of group configurations, based on their size and communication dynamics. Using mobile AR for long periods of time is likely to cause fatigue in users, and so we chose short social experiences to implement in our prototype. These were: 1) **Party Mode**: Users can have small parties around a virtual cake (Figure 1B), 2) **Parlor Games**: Simple word games that can be played in large groups, 3) **Pictionary**: Users draw pictures on a shared whiteboard while others guess what is being drawn (Figure 1C), 4) **Chess**: Pairs of users can spatially move the digital pieces on a shared chessboard, 5) **Jenga**: Multiple users can take turns at removing a piece from a stack of blocks in a manner that does not cause it to collapse (Figure 1D), and 6) **Spatial Puzzles**: Users collaboratively solve puzzles where individual pieces need to be arranged to form 3D shapes (Figure 1E). We now discuss these activities in the context of the underlying communication and interaction configurations that they are meant to represent.

3.1 The Communication-Interaction space

- (1) **Group Size**: We designed activities specifically meant for pairs of users, as well as activities that could accommodate larger groups of up to ten people (*Parlor Games*, *Spatial Puzzles*).
- (2) **Group Dynamics**:
 - **Turn-taking**: We included activities with pairwise turn-taking (*Chess*, *Jenga*), many-to-one communication (*Pictionary*), and one-to-many communication (*Parlor Games*).
 - **Collaborative versus Competitive**: Some activities required all users to work together (*Spatial Puzzles*), groups of users to form teams and compete (*Pictionary*), and individuals to compete with each other (*Chess*, *Jenga*).
 - **Open-ended activities**: While games are good activities to motivate a group of people to interact, we also

