Chapter 3.21
Human Communication in Collaborative Augmented Reality Systems

Kiyoshi Kiyokawa
Osaka University, Japan

ABSTRACT

The main goal of this chapter is to give characteristics, evaluation methodologies, and research examples of collaborative augmented reality (AR) systems from a perspective of human-to-human communication. The chapter introduces classifications of conventional and 3D collaborative systems as well as typical characteristics and application examples of collaborative AR systems. Next, it discusses design considerations of collaborative AR systems from a perspective of human communication and then discusses evaluation methodologies of human communication behaviors. The next section discusses a variety of collaborative AR systems with regard to display devices used. Finally, the chapter gives conclusion with future directions. This will be a good starting point to learn existing collaborative AR systems, their advantages and limitations. This chapter will also contribute to the selection of appropriate hardware configurations and software designs of a collaborative AR system for given conditions.

INTRODUCTION

The fundamental elements of augmented reality, such as head tracking and display hardware technologies, have matured sufficiently such that reasonably working AR systems are being produced in many application domains. An increasing number of researchers are therefore studying the human issues relating to AR, especially the impact of AR on human behaviors. The more computers become invisible and transparent to users, the more important this problem becomes. As an introduction to the following discussion, this section introduces fundamental issues related to collaborative AR systems.

Categories of Conventional Collaborative Systems

Since the advent of computers, networked computers have been used to support collaboration. In the 1960s and 1970s, however, computers were mostly used to exchange single-user activity among multiple workers. People gradually recognized the importance of the need for understanding how people work in a group and how technology could affect it. In 1984, Cashman and Grief organized a workshop on this issue and coined the term computer supported cooperative work (CSCW) to describe this common interest (Grudin, 1994). Since then, CSCW and groupware have been intensively investigated.

Collaborative systems are commonly classified into four types in two dimensions as shown in Table 1 (Rodden, 1991). One dimension is the form of interaction, and the other is the geographical nature of the users. Regarding the form of interaction, some tasks such as brainstorming require group members to cooperate in a synchronous manner, whereas other tasks such as group authoring mainly require independent activities followed by asynchronous discussion. Therefore, collaborative systems are either synchronous or asynchronous. On the other hand, regarding the geographical nature of the users, group members may be either distributed over the network (remote collaboration) or co-located in the same room (co-located collaboration). In the majority of AR systems, synchronous collaboration is supported in a co-located arrangement.

Augmented Reality as a Media for Collaboration Support

Characteristics of collaborative augmented reality systems are better understood by comparing those with networked virtual reality (VR) systems in a context of 3D collaboration. Table 2 shows a classification of 3D collaboration. Studies on networked virtual environments (NVEs) or shared virtual environments (SVEs) have begun in the 1980's. SIMNET developed by DARPA (U.S. Defense Advanced Research Projects Agency) was one of the first deployments in this regard. NVEs and SVEs support spatial activities and interactions among participants in a similar way as in the real world. As VR inherently implies that the synthetic environment is isolated from the real environment, NVEs are normally classified as remote systems even if the participants are co-located in the same room in the real environment. Although most of NVEs are synchronous systems, they can support asynchronous activities by providing, for example, a messaging system in the virtual environment.

Augmented reality technology has also been explored for years as another media to enhance collaboration. Figure 1 and Table 3 show a few typical applications and examples of collaborative AR systems. As Ishii, Kobayashi, and Arita point out (Ishii et al., 1994), seamlessness is a key characteristic of successful CSCW interfaces. Collaboration in collaborative AR systems is supported by the seamless nature of those interfaces. That is, co-located AR interfaces do not separate the communication space from the

Table 1. A classification of collaborative systems

	Synchronous	Asynchronous
Co-located	e.g., Face-to-face meeting	e.g., Co-authoring
Remote	e.g., Video conferencing	e.g., E-mail

Related Content

Flexible Crowd-Driven Decision Making in Times of Crisis

Mohammed Benali, Abdessamed Réda Ghomari, Leila Zemmouchi-Ghomariand Mohammed Lazar (2021). *E-Collaboration Technologies and Strategies for Competitive Advantage Amid Challenging Times (pp. 1-27).*

www.irma-international.org/chapter/flexible-crowd-driven-decision-making-in-times-of-crisis/280049

e-Research, a way of Learning Together?

Paolo Diviacco (2016). *Cultural, Behavioral, and Social Considerations in Electronic Collaboration (pp. 200-217).*

www.irma-international.org/chapter/e-research-a-way-of-learning-together/140711

Patterns for Effective Management of Virtual Projects: Theory and Evidence

Deepak Khazanchiand Ilze Zigurs (2006). *International Journal of e-Collaboration (pp. 25-49).*

www.irma-international.org/article/patterns-effective-management-virtual-projects/1945

An Approach to Feature Selection in Intrusion Detection Systems Using Machine Learning Algorithms

Kavitha G.and Elango N. M. (2020). *International Journal of e-Collaboration (pp. 48-58).*

www.irma-international.org/article/an-approach-to-feature-selection-in-intrusion-detection-systems-using-machine-learning-algorithms/261238

Impact of E-Collaboration Between Indian Banks and Fintech Companies for Digital Banking and New Emerging Technologies

Narinder Kumar Bhasinand Anupama Rajesh (2021). *International Journal of e-Collaboration (pp. 15-35).*

www.irma-international.org/article/impact-of-e-collaboration-between-indian-banks-and-fintech-companies-for-digital-banking-and-new-emerging-technologies/265267