International Journal of e-Collaboration
Volume 12 • Issue 4 • October-December 2016

Towards an Automated Model to Evaluate Collaboration through Non-Verbal Interaction in Collaborative Virtual Environments

Luis Casillas, University of Guadalajara, Guadalajara, Mexico
Adriana Peña, University of Guadalajara, Guadalajara, Mexico
Alfredo Gutierrez, University of Guadalajara, Guadalajara, Mexico

ABSTRACT

Virtual environments represent a helpful resource for learning and training. In their multiuser modality, Collaborative Virtual Environments (CVE) support geographical distant people to experience collaborative learning and team training; a context in which the automatic monitor of collaboration can provide valuable and in time information, either for human instructors or intelligent tutor systems, about individual and group performance. CVE enable people to share a virtual space where they interact through a graphical representation, generating nonverbal behavior such as gaze-direction or deictic gestures, a potential means to understand collaboration. This paper presents an automated model and its inference mechanisms to evaluate collaboration in CVE based on the nonverbal activity of the participants. The model is a multi-layer analysis that includes: data filtering, fuzzy classification, and rule-based inference producing high-level assessment for group collaboration.

KEYWORDS

Collaboration Analysis, CVE, Expert Systems, Fuzzy Classification, HCI, Nonverbal Interaction

INTRODUCTION

Collaborative Virtual Environments (CVE) are a powerful setting for collaborative learning (Bratitsis & Demetriadis, 2013) and training (Peña & Jiménez, 2012), in which the apprentices can go through experimental and self-directed learning. CVE are shared virtual places and objects for multiple users to collaborate at a distance; a technology with a primarily visual and interactive interface in which the representation of information is achieved in a different way other media do, bringing remote people and remote objects together into a spatial and social proximity, and facilitating communication awareness (Wolff et al., 2008). On them, people interact with the virtual world and the actors in it, through a graphical representation, an avatar.

When people collaborate, interaction is performed through different communication channels other than words, that is, our nonverbal behavior that comprises most of what we do, except for the significance of the words (Patterson, 1983). In such a way that the avatar, as an embodied representation of the user in the CVE, aids conversation and understanding to the virtual space (Imai et al., 2000), adding nonverbal communication such as gaze-direction or by representing the pointing to a virtual object, deictic gestures.

DOI: 10.4018/IJeC.2016100102

Within this context, the automatic monitoring of collaboration in computer supported learning or team training, represents a resource for human or intelligent tutor systems in different ways such as creating the student or apprentice profile to adapt or personalize activities, to track the students' involvement, understanding the individual factors that influence the group and vice versa, measure of the participation equality or to understand the dynamics of the group (Foutsitzis & Demetriadis, 2013; Graham & Doore, 2015; Papanikolaou & Gouli, 2013; Reinig & Mejias, 2014).

In CVE, as computers systems, each performed activity can be bound to indicators through the users' log files, allowing collecting the whole phenomena data, including the avatars' performance and the situation of the virtual objects in it. Such logs collect dense data assemblies, enabling to infer high semantic indicators. In our proposed model, the raw data collected in the log files of the CVE is gathered and classified, throughout a multilevel mechanism capable to automate the production of high-level indicators; with the aim to automatically evaluate collaboration, based on the nonverbal behavior displayed by the participants through their avatars in CVE, as an alternative or a complement to the analysis of dialogue, just as if a human expertise had made such judgment.

RELATED WORK

Nonverbal behavior has been broadly studied in the real world and for the creation of artificial behavior in robots or animation (Breazeal, Kidd, Thomaz, Hoffman, & Berlin, 2005). However, there are few studies of the nonverbal cues people display in CVE through their avatars. In some cases, the developed CVE are focused on the automatic generation and scripting of nonverbal behaviors for autonomous agents; and in others on real-time interaction of human users with the primary goal to offer a tool that allows sending basic emotional nonverbal messages.

Guye-Vuillème et al. (1998) established the importance of non-verbal communication in face-to-face interaction and its conversion to an equivalent in virtual worlds, studying the advantages and disadvantages of complex embodiments. Using their Virtual Life Network (VLNET) they presented a solution that takes into account the practical limitations of input devices and social science aspects. Back then, their work exposed virtual environments as cold, dehumanized places, and with static avatars lacking emotions; while they stand out nonverbal communication as the most efficient way to communicate emotional content. About the use of avatars, Guye-Vuillème et al., (Guye-Vuillème, Capin, Pandzic, Thalmann, & Thalmann, 1998) recognized its importance as the means for the interaction with a virtual world and sensing various attributes of it. Also, that the avatar becomes more important in CVE because in addition, the avatar has crucial functions as: perception, localization, identification, visualization of others' interest focus, visualization of others' actions, and a social representation of self through the customization of the avatar.

According to Fabri, Moore & Hobbs (2004) emotionally expressive faces in avatars are beneficial for communication in CVE; and emotions can effectively be visualized with a limited number of facial features (they presented a set of exemplar facial expressions). Fabri, Moore & Hobbs argued about the insufficiency of existing distance communication media in terms of emotional context and means for emotional expression, and suggested overcoming this problem by enabling people to meet virtually in a CVE, engaging in quasi face-to-face communication via their avatars. All of which reinforce the importance of nonverbal communication between humans, which transcends the spoken or written word.

In 2005 Breazal et al. (2005) conducted an experiment where humans guided robots in order to explore the positive impact of non-verbal social cues and behavior, and also to illustrate how non-verbal communication helps to coordinate teammates' actions in collaborative activities. The robot's communication was verbal (explicit) and non-verbal (implicit). Their results showed that implicit non-verbal communication positively impacted the task performance with respect to team understanding and task efficiency.

Related Content

Human and Technology Leadership Roles in Virtual Teams

Ilze Zigurs and Terrance Schoonover (2008). *Encyclopedia of E-Collaboration (pp. 343-348).*

www.igi-global.com/chapter/human-technology-leadership-roles-virtual/12448?camid=4v1a