Chapter 1
Automatic Approach to Evaluate Collaborative Interaction in Virtual Environments

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ABSTRACT

Virtual environments for multi-users, collaborative virtual environments (CVE), support geographical distant people to experience collaborative learning and team training. In this context, monitoring collaboration provides valuable, and in time, information regarding individual and group indicators, helpful for human instructors or intelligent tutor systems. CVE enable people to share a virtual space, interacting with an avatar, generating nonverbal behavior such as gaze-direction or deictic gestures, a potential means to understand collaboration. This chapter presents an automated model and its inference mechanisms to evaluate collaboration in CVE based on expert human rules of nonverbal participants' activity. The model is a multi-layer analysis that includes data filtering, fuzzy classification, and rule-based inference producing a high-level assessment of group collaboration. This approach was applied to a task-oriented session, where two participants assembled cubes in a CVE to create a figure.

INTRODUCTION

Nowadays Collective Virtual Environments (CVE) are an intense setting for cooperative learning (Bratitsis & Demetriadis, 2013) and training (Peña & Jiménez, 2012), in which adherents can experience exploratory and self-coordinated learning. CVE enable sharing virtual places and objects, by allowing the integration of numerous participants to team up as groups; an environment with a visually-profuse

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and intuitive interface in which information is managed in newfangled ways, bringing remote individuals and objects together into a spatial and social vicinity, and encouraging correspondence mindfulness (Wolff et al., 2008). In there, individuals cooperate within a virtual world and the players get a graphical representation as an avatar.

At the point when individuals team up, cooperation is performed through various correspondence channels other than words, that is our nonverbal conduct that involves the greater part of what we do, aside from the importance of the words (Patterson, 1983). Such that the symbol, as an embodied representation of the user in the CVE, aids conversation and understanding in 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.

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, measuring 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 computer 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 from 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. This is either an alternative or a complement to the analysis of dialogue, just as if a human expertise had made such judgment.

This chapter is organized as follows: "related work" section includes a review of previous efforts regarding the collaboration analysis, as well as the case for CVE; the "technological support" section focuses on featuring the technology-assets involved in this study; "modeling collaboration analysis" section is aimed at defining the analysis model throughout fuzzy logic and knowledge-based systems; "applying the model" section is devoted to providing evidence regarding model's operation. Finally, sections "conclusion" and "questions for discussion" close the present proposal including some remarks about the operation of the model and its possibilities to operate in some other contexts.

This work is an enhancement of a previous study developed at (Casillas, Peña & Gutierrez, 2016).

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 a real-time interaction of human users with the primary goal to offer a tool that allows sending basic emotional nonverbal messages.