ABSTRACT

The application of ubiquitous technologies in the improvement of education strategies is called Ubiquitous Learning. This article proposes the integration between two models dedicated to support ubiquitous learning environments, called Global and CoolEdu. CoolEdu is a generic collaboration model for decentralized environments. Global is an infrastructure designed to create ubiquitous learning environments. Global provides software agents that perform tasks common to ubiquitous learning processes. By extending these agents or adding new ones, a system can be specialized to support ubiquitous learning environments. The CoolEdu/Global integration created a collaborative and decentralized ubiquitous learning environment. The resulting environment was evaluated through a simulated scenario dedicated to explore its functionalities. The results were encouraging and showed the potential of deploying the environment in real situations.

Keywords: Collaborative Environments, CoolEdu, Decentralized Environments, Ubiquitous Computing, Ubiquitous Learning

INTRODUCTION

Approximately 20 years ago, Weiser (1991) introduced the concept of Ubiquitous Computing predicting a world where computing devices would be present in objects, environments and human beings themselves, interacting naturally with the users without being noticed. Ten years later, Satyanarayanan (2001) reinforced this concept.

In recent years, the evolution of technology has enabled ubiquitous computing, as mobile...
devices become smaller and more powerful. Moreover, the advent of wireless communication technologies has enabled devices to access services anywhere and anytime. Additionally, the increasing adoption of Location Systems (Hightower & Borriello, 2001; Hightower, LaMarca, & Smith, 2006) has been stimulating Location-Based Services (Vaughan-Nichols, 2009; Dey, Hightower, Lara, & Davis, 2010) and Context-aware Systems (Baldauf, Dustdar, & Rosenberg, 2007; Dey, 2001).

Education, as well as other areas of knowledge, makes use of these new technologies to improve their practices and approaches. The application of these technologies in improving education strategies gave rise to a research front called Ubiquitous Learning (Barbosa, Hahn, Barbosa, & Saccol, 2011; Ogata, Yin, El-Bishouty, & Yano, 2009; Rogers, Price, Randell, Frase, Weal, & Fitzpatrick, 2005; Yang, 2006).

Ubiquitous Learning refers to learning supported by the use of mobile and wireless communication technologies, sensors and location/tracking mechanisms, that work together to integrate learners with their environment. Ubiquitous learning environments connect virtual and real objects, people and events, in order to support a continuous, contextual and meaningful learning. A ubiquitous learning system can use embedded devices that communicate mutually to explore the context, and dynamically build models of their environments. It is considered that while the learners move with their mobile device, the system dynamically supports their learning by communicating with embedded computers in the environment. The opportunities made available by the context can be used to improve the learning experience.

This article describes the research effort to integrate two models related to ubiquitous learning, called CoolEdu and Global. Both models were developed in the University of Vale do Rio dos Sinos (UNISINOS). CoolEdu is a collaboration model for decentralized environments. Global is an infrastructure designed to create ubiquitous learning environments. The CoolEdu/Global integration created a collaborative and decentralized ubiquitous learning environment.

The text is organized into four additional sections. The next two sections describe the integrated models. After, a section discusses the integration and an experiment conducted to evaluate the resulting environment’s functionalities. Finally, in the last section, we draw some conclusions and plans for future work.

THE GLOBAL MODEL

Figure 1 shows the architecture of Global. In the center there are six software agents, which are supported by four components represented by APIs The agents offer a set of features for learning support. Each instance of Global runs on a device, and the absence of an agent compromises only the features that rely on it. The following paragraphs describe the agents and components.

Communication between agents is articulated by the Connectivity agent, and uses messages in the FIPA-ACL standard FIPA (2013). In the exchange of messages between agents of the same instance, i.e., when agents operate on the same device, the Connectivity agent performs a direct delivery to the recipient. In exchanges of messages between agents of different instances, the agent is in charge of finding the best way to deliver the message. This requires the agent to choose one of the available proxies that have access to recipient agent device and send the information through this proxy to the Connectivity agent of the message recipient’s instance.

The Context agent treats contexts in Global. Contexts are pieces of information used to characterize the situation of a participant in an interaction (Dey, 2001). Global defines two sets of context characteristics: Environment and Relationship. The environment characteristics are collected by monitoring the environment, such as the position in space and time (e.g., a context can be defined as a region linked with a specific time interval). The relationship characteristics, in turn, can be used to group users,
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