Chapter 12

CAFCLA: A Framework to Design, Develop, and Deploy AmI-Based Collaborative Learning Applications

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ABSTRACT

Ambient Intelligence (AmI) promotes the integration of Information and Communication Technologies (ICT) in daily life in order to ease the execution of everyday tasks. In this sense, education becomes a field where AmI can improve the learning process by means of context-aware technologies. However, it is necessary to develop new tools that can be adapted to a wide range of technologies and application scenarios. Here is where Agent Technology can demonstrate its potential. This chapter presents CAFCLA, a multi-agent framework that allows developing learning applications based on the pedagogical CSCL (Computer-Supported Collaborative Learning) approach and the Ambient Intelligence paradigm. CAFCLA integrates different context-aware technologies so that learning applications designed, developed, and deployed upon it are dynamic, adaptive, and easy to use by users such as students and teachers.

1. INTRODUCTION

In recent years there has been a technological explosion that has flooded our society with a wide range of different devices (García, Tapia, Alonso, Rodríguez, & Corchado, 2011). Moreover, the processing and storage capacity of these devices, their user interfaces or their communication skills are improved day by day. Thanks to these advances, we are currently surrounded by technology that has changed our habits and customs (Jorrín-Abellán & Stake, 2009). All this has caused the apparition of new fields such as Ambient Intelligence, whose main objective is to simplify the use of technology to improve people’s quality of life (Tapia, Abraham, Corchado, & Alonso, 2009).

Education is one of the areas in which Ambient Intelligence presents a greater potential as it pro-
vides new ways of interaction and communication between individuals and technological systems (Scardamalia, Bereiter, McLean, Swallow, & Woodruff, 1989). The usage of Information and Communication Technologies (ICT) has been present in educational innovations over recent years (Scardamalia, Bereiter, McLean, Swallow, & Woodruff, 1989), modernizing the traditional transmission of contents through electronic presentations, email or more complex learning platforms such as Moodle or LAMS and fostering collaboration between students (Collaborative Learning) (Gómez-Sánchez et al., 2009). Beside the use of those general-purpose tools in education, other tools that make more specific use of technology have appeared. This applies to those that make use of Context-aware information and ubiquitous computing and communication, fundamental parts of Ambient Intelligence (Traynor, Xie, & Curran, 2010).

Mobile Learning has become the umbrella under which new ways of learning have emerged, including areas such as Mobile Computer Supported Collaborative Learning (MCSCL), based on traditional CSCL, Context-aware Pervasive Learning or, more recently, Location-Based Learning (Roschelle, 2003). There are several approaches proposed by the scientific community in these research areas which share a common element: the use of mobile devices and wireless communications (Roschelle, 2003).

The inclusion of context-awareness in educational scenarios and processes refers to Context-aware Learning (Laine & Joy, 2009), a particular area of application of Context-aware Computing (Dey, 2001). Moreover, the ability to characterize and customize the context that surrounds a learning situation at a certain time and place provides flexibility in the educational process. This way, learning does not only occur in classrooms, but also in a museum, park or any other place (Bruce, 2009), obtaining ubiquitous learning spaces. Thus, there is an extensive literature that addresses the problem of this kind of learning, highlighting those works that attempt to solve contextual information acquisition and providing data to users (Chen et al., 2007; Martín et al., 2010). The use and integration of different technologies and the approach to specific learning activities characterize these solutions. However, the complexity of understanding and use of the technology and solutions in the aforementioned works does not allow a wide use of them. In addition, the use of intelligent management techniques is another lack in the reviewed works. In this sense, the ability to operate in a distributed way, predict, adapt and anticipate the users’ actions provides a dynamic personalization of the learning process that benefits and improves the acquisition of knowledge by students (Traynor, Xie, & Curran, 2010).

This paper presents a conceptual multi-agent framework aimed at designing, developing and deploying AmI-based educational scenarios. Teachers are able to characterize the context where the learning activity will occur through the creation of a world model in which locate data collectors (e.g., sensors), identify and characterize areas of interest (e.g., paintings in a museum), etc. Moreover, the collaboration between students and the customization of the information available is also provided and can be integrated in the activity design. The framework is supported by a multi-agent architecture that provides intelligence to the learning process by helping to manage the activity, all the communications involved, the context-awareness and the collaboration between students and teachers. In addition, developers and technicians benefit from the Application Programming Interface and the formal schemas provided by CAFCLA.

The following section describes the background and problem description related to the presented approach. Then, the main characteristics of CAFCLA are described: what kinds of activities are covered, how the context of the activity can be defined, who the users are, which activities are implemented by the framework, and how the multi-agent architecture and the context-aware