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Multi-Agent Architecture for Context-Aware Collaborative U-Learning System

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Abstract

The new technological advancements have made it possible to interact with computer systems and applications anywhere and anytime. It is important that the application, device and user are able to adapt to the current situation and environment. This paper presents the multi-agent architecture of context-aware collaborative u-learning system and the learning scenarios within ubiquitous learning environments that the system provides support for. It is composed of 3 layers. The application layer is composed of different agents which is called multi-agents. The mobile multi-agents are responsible for gathering the context information for u-learning. The component layer is composed of different components that support the mobile multi-agents in application layer. The physical layer is composed of different u-learning devices and sensors which are connected for context and physiological data gathering.

Keywords: *U-Learning System, Multi-Agent, Context-Aware*

1. Introduction

The term "ubiquitous learning environment" is from the term "ubiquitous computing", used to describe the moving of general computing off desktops and into many devices, to make computing available in all facets of everyday life. Handheld computers with Internet access, provide an opportunity for developers to explore and implement u-learning environments. The addition of the mobile component can extend the availability of the desktop environment, and exploit specifically mobile technologies for identifiable educational aims.

Educational Technology is always developing and growing, and this movement will persistently offer new and fascinating advances in our learning condition. Customary learning frameworks produced for laptop and desktop computers depended on remain solitary programming application or through sites and do not have the capacity to give a far reaching pervasive learning condition. A pervasive learning condition in view of early days cell phones do not have the preparing energy of note pads or mobile phones, low information exchange paces and limit. Along these lines the primary target of the exploration work is to build up an intelligent u-learning application in view of Web Services to encourage the ubiquitous learning. U-learning suites this life style by providing learning at any time and place. Increased access to learning environments is, of itself, a worthwhile educational goal. The following ubiquitous learning components have its own part in making learning "anytime, anywhere". The context-awareness, Global positioning System, Sensor, Wireless Technology, and Mobile Technology are the main components and discussed in succeeding pages. With the popularization of wireless networking and with the progress of mobile computing technology, the efficiency of handheld devices has been improved and more applications are possible. Combining handheld devices and U-learning will become an important way of learning in the future. The approach of u-learning has become a powerful way to deliver knowledge considering

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the increase in on-line users. U-learning is a new education concept by using the Internet technology, it delivers the digital content, provides a learner-orient environment for the teachers and students. U-learning can be defined as technology-based learning in which learning material is delivered electronically to remote learners via a computer network. U-learning could be seen as a professional level of education but with the advantages of lower time and cost. Some other advantages of u-learning include larger learner population, shortage of qualified training staff and lower cost of campus maintenance, up-to-date information and accessibility. In a typical u-learning environment the lecturers, students and information are in different geographical locations and are connected via the Internet. The u-learning promotes the construction of life-long learning opinions and learning society. u-learning is a broad concept and it consists with different types, namely Synchronous and Asynchronous e- Learning. Both methods have different characteristics and they use different methods to broadcast the learning materials. Asynchronous u-learning occurs when students begin and complete their training courses at different times according to their own schedule. Synchronous u-learning allows real-time interaction and raises a sense of community among learners. The security is very crucial in developing an u-learning system. Emerging standards for distance learning and education influence in a major way the development of u-learning systems. U-learning system must be secured against manipulation from the side of the students and also it protects user's privacy. E-learning includes numerous types of media that deliver text, audio, images, animation, and streaming video, and includes technology applications and processes such as audio or video tape, satellite TV, CD-ROM, and computer-based learning, as well as local intranet/extranet and web-based learning. Information and communication systems, whether free-standing or based on either local networks or the Internet in networked learning, underlies many e-learning processes. E-learning can occur in or out of the classroom. It can be self-paced, asynchronous learning or may be instructor-led, synchronous learning. E-learning is suited to distance learning and flexible learning, but it can also be used in conjunction with face-to-face teaching, in which case the term blended learning is commonly used.

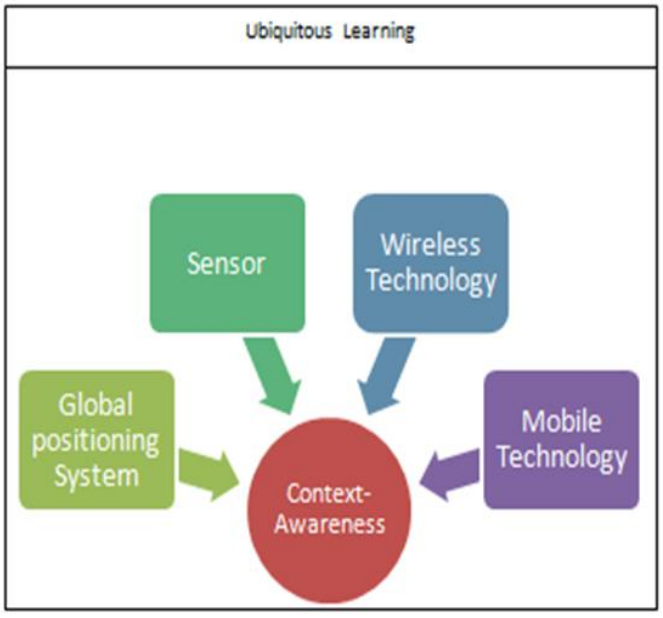

Figure 1. Ubiquitous Learning Components

2. Background of the Study

The background of the study includes the introduction of different learning strategies and technologies such as context-awareness and multi-agent system.

2.1. Context-awareness

Context-awareness means that one is able to use context information. A system is context-aware if it can extract, interpret and use context information and adapt its functionality to the current context of use. To capture context information generally some additional sensors and/or programs are required to transfer the context information to applications and for different applications to be able to use the same context information a common representation format for such information should exist. In addition to being able to obtain the context-information, applications must include some "intelligence" to process the information and to deduce the meaning

Context awareness is a property of mobile devices that is defined complementarily to location awareness. Whereas location may determine how certain processes around a contributing device operate, context may be applied more flexibly with mobile users, especially with users of smart phones. Context awareness originated as a term from ubiquitous computing or as so-called pervasive computing which sought to deal with linking changes in the environment with computer systems, which are otherwise static. The term has also been applied to business theory in relation to contextual application design and business process management issues. Context awareness is regarded as an enabling technology for ubiquitous computing systems. Context awareness is used to design innovative user interfaces, and is often used as a part of ubiquitous and wearable computing. It is also beginning to be felt in the internet with the advent of hybrid search engines. Schmidt, Beigl & Gellersen define human factors and physical environment as two important aspects relating to computer science. More recently, much work has also been done to ease the distribution of context information.

Recent developments on mobile devices and networks enable new opportunities for mobile learning anywhere, anytime. Furthermore, recent advances on adaptive learning establish the foundations for personalized learning adapted to the characteristics of each individual learner. A mobile learner would perform an educational activity using the infrastructure (e.g. handheld devices, networks) in an environment (e.g. outdoors). In order to provide personalization, an adaptation engine adapts the educational activity and the infrastructure according to the context. The context is described by the learner's state, the educational activity's state, the infrastructure's state, and the environment's state. Furthermore, each one of these states is described by its dimensions. Many examples illustrate the adaptation decisions.

2.2. Multi-agent System

A multi-agent system is a computerized system composed of multiple interacting intelligent agents within an environment. Multi-agent systems can be used to solve problems that are difficult or impossible for an individual agent or a monolithic system to solve. Intelligence may include some methodic, functional, procedural approach, algorithmic search or reinforcement learning. Although there is considerable overlap, a multi-agent system is not always the same as an agent-based model.

A multi-agent system is composed of multiple interacting intelligent agents. Multi-agent systems can be used to solve problems, which are difficult or impossible for an individual agent. In the following major characteristics of multi-agent systems are identified: each agent has just incomplete information and it is restricted in its capabilities, system control is distributed, data is decentralized, and computation is asynchronous. There is evidence in the literature that context-aware systems are a very active area of

research, from which context-aware multi-agent systems covers more than one third. Within this section, we focus on some relevant systems that have been used in real world experiments.

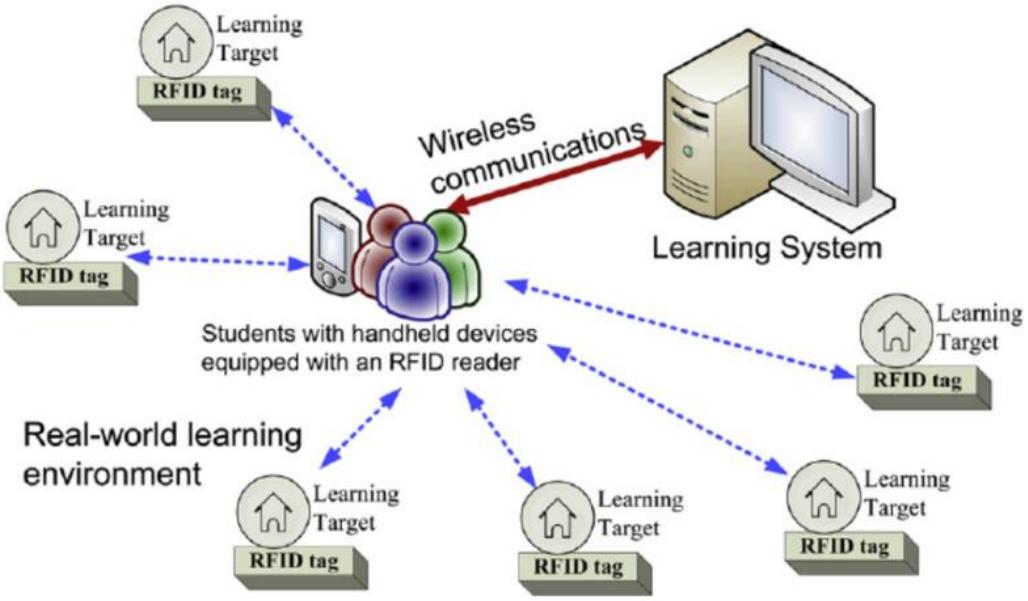

Figure 1. The Context-aware u-learning Environment [6]

New technological developments have made it possible to interact with computer systems and applications anywhere and anytime. It is vital that these applications are able to adapt to the user, as a person, and to its current situation, whatever that is. Therefore, the premises for evolution towards a learning society and a knowledge economy are present. Hence, there is a stringent demand for new learner-centered frameworks that allow active participation of learners in knowledge creation within communities, organizations, territories and society, at large. This paper presents the multi-agent architecture of our context-aware system and the learning scenarios within ubiquitous learning environments that the system provides support for. This architecture is the outcome of our endeavor to develop a system for sharing public interest information and knowledge, which is accessible through always-on, context-aware services.

Conveying learning materials whenever, anyplace is the objective supporting the omnipresent learning (u-learning) worldview. Customizing this u-learning courseware conveys a remarkable learning knowledge to every individual client. Personalization of learning content conveyance requires certain framework qualities; to be specific framework versatility, knowledge, client profiling and attention to client setting (organize, gadget, area). In this paper we depict the entre-pass framework which is a case of this new class of versatile u-learning framework. Entre-pass is intended to convey preparatory entrepreneurial preparing to people working inside little and miniaturized scale enterprises. Courseware personalization and student evaluation is accomplished utilizing a suite of community oriented BDI keen operators. At last, the aftereffects of our underlying pilot testing and the relating adjustments to the framework are exhibited.

Ubiquitous learning (u-learning) has turned out to be prevalent these days in training territory. The key component of u-inclining is that the learners are arranged in a setting mindful learning condition and they may not be aware of the learning procedure. This paper intends to build up the universal learning condition having the capacity to give the substance to the learners properly and adaptively. The created ULE comprises of a few inclining objects having the multi-operator engineering to accomplish flexibility. Each

leaning objects (LOs) comprises of three unique specialists planning together including an individual operator for keeping the clients' profiles and their noteworthy activities, a substance operator for choosing LO to the learners, and a portrayal operator for exhibiting the substance to the learners. Two observational examinations are directed in this paper including engineering and learning mode experimental investigation. For both experimental examinations, the learning effectiveness upgrade and understudies' fulfillment regarding usefulness and versatility are assessed. The outcomes demonstrate that the created ULE with multi specialist design can improve the understudies' learning productivity fundamentally for both individual and cooperative learning modes. Furthermore, the understudies fulfill their learning through the created ULE in the "fulfilled" level as far as usefulness and versatility for both observational examinations.

3. Collaborative U-Learning System Based on Multi-Agent Context-Aware

The collaborative u-learning system based on multi-agent context-aware utilizes different technologies to support the collaboration among the learners and teachers.
These are the following:

Context Awareness. Context awareness is defined complementary to location awareness. Whereas location may serve as a determinant for resident processes, context may be applied more flexibly with mobile computing with any moving entities, especially with bearers of smart communicators. Context awareness originated as a term from ubiquitous computing or as so-called pervasive computing which sought to deal with linking changes in the environment with computer systems, which are otherwise static.

Global positioning System. GPS is a space-based global navigation satellite system (GNSS) that provides location and time information in all weather and at all times and anywhere on or near the Earth when and where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United States government and is freely accessible by anyone with a GPS receiver.

Sensor. Sensors will be able to detect any changes in surroundings. Placed on adjacent to the object that will be used to recognized the presence of the learner; detect movement, light and *etc*. to relay context information. It is clearly identified through the above discussion that u-learning is not equal to “learning with u-computing technology”, which emphasizes not only the usage of wireless communications, but also the sensor technology (Hwang *et al.*, 2007).

Wireless Technology. Wireless technologies are also expanding their range of functions. Wireless communications are particularly useful for supplying data services to remote communities (and some urban areas) that do not have access to high-speed fi xed-line connections. The use of wireless technologies to support networks has been hampered by differences in standards, which have hindered interoperability across networks by different devices.

A multi-agent system is composed of multiple interacting intelligent agents. Multi-agent systems can be used to solve problems, which are difficult or impossible for an individual agent. In the following major characteristics of multi-agent systems are identified: each agent has just incomplete information and it is restricted in its capabilities, system control is distributed, data is decentralized, and computation is asynchronous. There is evidence in the literature that context-aware systems are a very active area of research, from which context-aware multi-agent systems covers more than one third. Within this section, we

focus on some relevant systems that have been used in real world experiments.

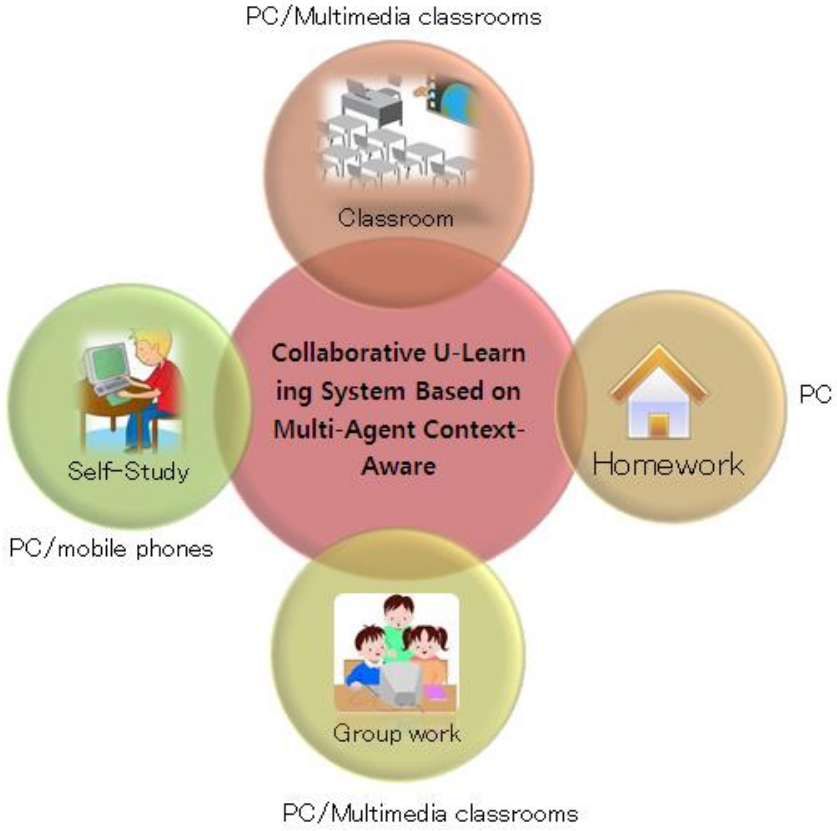

Figure 2. Collaborative U-Learning System Based on Multi-Agent Context-Aware

Figure 2 shows the u-learning environment. The u-learning module application for multicultural students can be access anytime, anywhere. This is connected to the remote data server which is the back-end of the system. The u-learning module application can be access in any device and OS platform.

The framework is composed of different layers. These are Application Layer, Component Layer and Physical Layer.

Application Layer is composed of different agents which is called multi-agents. The mobile multi-agents are responsible for gathering the context information for u –learning. Agents act in a certain degree of autonomy and independence in order to accomplish tasks without requiring the supervision of people or other agents. Agents acts as semi-autonomously, in the sense of several actions, such as exchange of information, collection of heterogeneous data concerning the context information for collaboration [5].

Component Layer is composed of different components that support the mobile multi-agents in application layer. These are group manager, knowledge system, component repository, context provider, security, resource repository, service container and dynamic binder. Each of the components has its own function.

Physical Layer is composed of different u-learning devices and sensors which are connected for context and physiological data gathering.

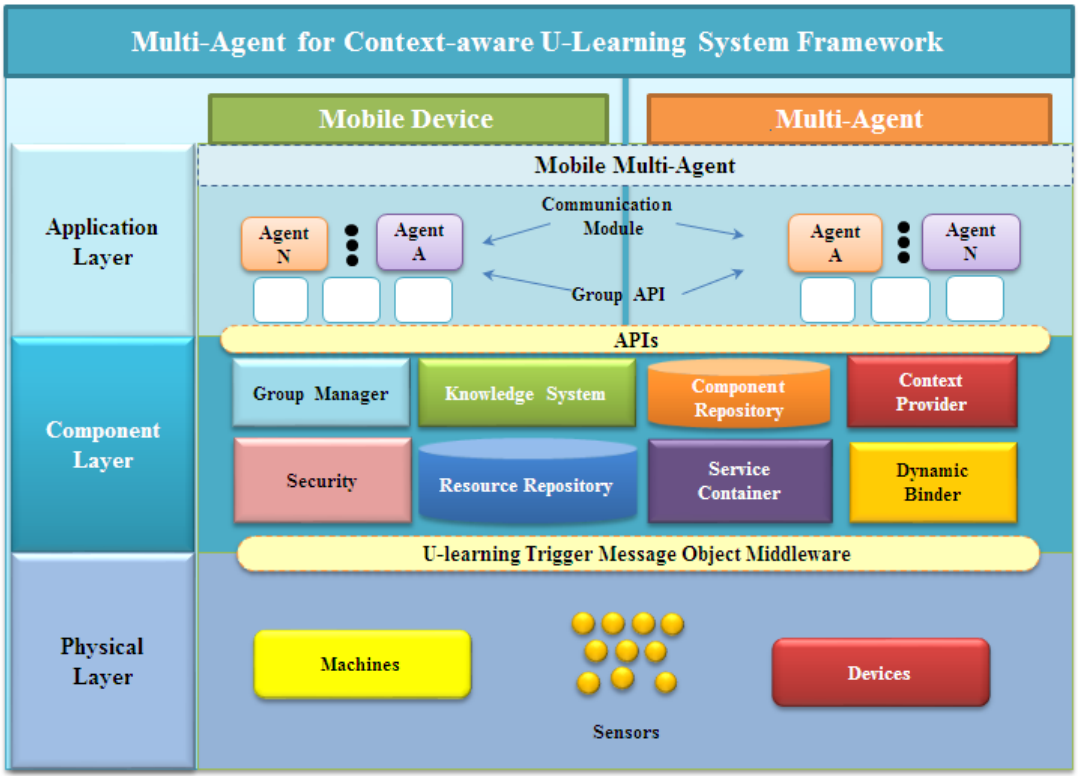

Figure 3. Multi-Agent Architecture for Context-Aware Collaborative U-Learning System

4. Conclusion and Future Works

In this paper, we designed a multi-agent architecture of context-aware collaborative u-learning system and the learning scenarios within ubiquitous learning environments that the system provides. The proposed multi-agent architecture for context-aware collaborative u-learning system is presented; it is composed of 3 layers. The application layer is composed of different agents which is called multi-agents. The mobile multi-agents are responsible for gathering the context information for u-learning. The component layer is composed of different components that support the mobile multi-agents in application layer. The physical layer is composed of different u-learning devices and sensors which are connected for context and physiological data gathering. The future works includes further study and testing.

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