An Agent Based Multilayered Architecture for E-learning System

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Abstract

E-learning refers to the way by which the learning content is provided by means of electronic technology. In a traditional E-learning system, there is only one layer and all agents and services are connected together. The architecture of the proposed E-learning system, in this paper, contains four tier layers. It is based on multi agent systems' paradigm. In this research we propose a novel method for updating content through Question-Answer between E-learners. We use sharable content object reference model (SCORM) for reuse and sharing the contents of the E-learning system. To achieve this, we have designed a system that applies various technologies, which guarantee various vital features for E-learning systems. These features include intelligence, distributed nature, adaptive attitude, interaction, accessibility and security. We have used multilayer modeling approach to provide flexible and light weight systems for E-learning environments.

Keywords

Multi-Agent system, architecture, E-learning, multilayer, modeling

1. Introduction

With the development of computer network and information technology, e-learning is developing quickly. Web-based learning environments are becoming very popular. E-learning refers to learning that is delivered or enhance via electronic technology. E-learning is defined as "the effective learning process created by combining digitally delivered content with support and services." [1] It is the instruction delivered electronically wholly by a web browser, through the Internet or an intranet, or through CD-ROM or DVD multimedia platform.

Intelligent agents can be defined as "software entities that satisfy four properties: autonomy, social ability, reactivity and pro activeness". Using intelligent agents in an e-learning architecture it is possible to obtain a personalized e-learning system adapted to the goals and characteristics of each learner [2]. The attributes of an agent are:

- Persistence: agents can run persistently without external command.
- Autonomy: agents can select the task and have the ability to decide the task priority without human intervention.
- Social ability: agent can communicate with other components via the agent language and cooperate to complete task.

Reactivity: agents can make corresponding reaction according to environment changing by perceiving the context.

Multi-agent system approach has been widely used in the development of large complex systems. Agents have many abilities such as the autonomy and social [3]. By using intelligent agents in an E-learning architecture it is possible to achieve a powerful system adapted to the needs and characteristics of every Learner [4].

Multi-Agent system is "the systems that consist of a number of agents, which cooperate with one another". They can in efficient way represent the problems that have multiple problem solving methods, multiple perspectives and/or multiple problem solving entities [5].

Multi-agent methodology has recently appeared as new tendency in modeling and development of learning environments [6]. The main reasons for this are the evolution of multi-agent technology itself and the fact that multi-agent methodology deals well with applications where essential issues, such as distance, cooperation among different entities and integration of different components of software, are found [7]. The flexibility and robustness obtained from multi-agent systems makes them suitable to be used in web environments.

In this paper, we introduce a multi-agent approach for design architecture of E-learning system.

2. The Proposed Architecture

In a traditional E-learning system, there is one layer and all agents and services are connected together. As depicted in figure 1, the proposed E-learning system architecture contains four tier layers and middle layer is based on Multi Agent System. Two layers for connection are used services (see circle between two layers in fig. 1).

This paper proposes a novel method for update content through Question-Answer between E-learners and this model using SCORM* [8] for reuse and sharing of E-learning contents.

2.1. Layers

Four layers existing in this model, namely Interface Layer, Middle Layer, Database Controller Layer and Database Layer.

Interface controller service is used to communicating between interface layer and middle layer. This service gets request from interface layer and if it is validation request send it to middle layer, after prepare the proper response in middle layer, this service send response to interface layer. Connection service is used to communicating between middle layer and DB controller layer. This service gets request from multi agent systems in middle layer and if it is validation request send it to respective agent in DB controller layer, after prepare the proper response in DB controller layer, this service send response to middle layer. Data access service is used to communicating between DB controller layer and DB layer. Data access service manage access (insert, select, update and delete) to databases.

2.1.1. Interface Layer

Users use this layer to communicate with system and this layer display user request accepted. In the learning process the user with two ways can get content in this layer:

- Manually select content
- Automatically select content by system

2.1.2. Middle Layer

This layer is used for confirm user requests, identification the user, determine access user, update content, select automatic content for user based on user performance, create and update the content by teacher or question-answer method and in summery manage the user request.

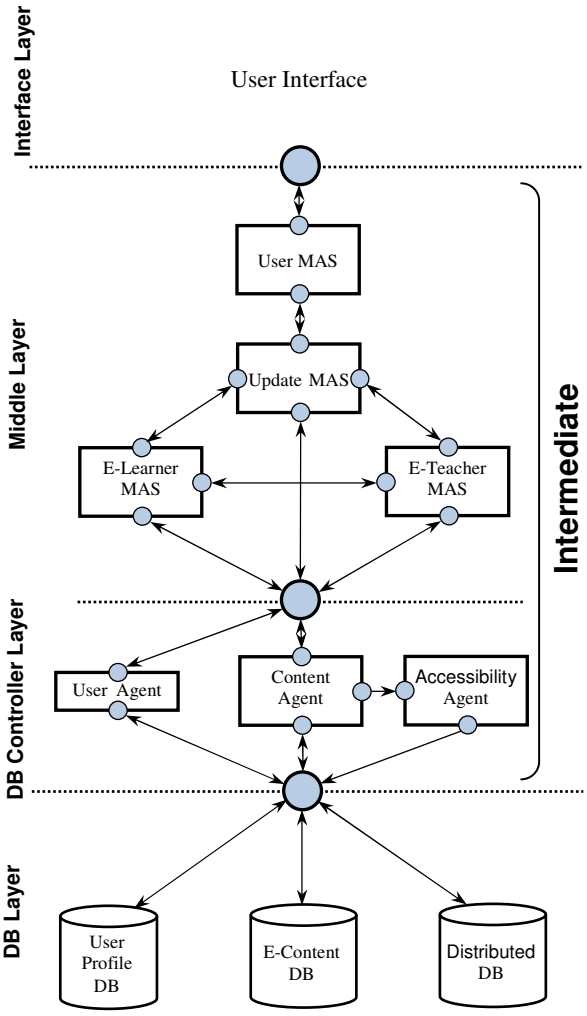

Fig. 1. E-learning architecture model.

2.1.3. DB Controller Layer

Database Controller Layer (DBCL) is a layer which provides simplified access to data stored in persistent storage in DB layer. This layer responsible for communicating with DBs, selecting previous layer requested contents and editing user information. This layer consists of three agents. User agent is used for identification of the user adding or deleting a user, saving the user performance and etc.

Content request received from connection service to content agent. Content agent delivered content need request (CNR) to data access service for searching in E-content DB, if CNR exist in e-content DB the access data service response this CNR to content agent. If CNR doesn't exist, data access service return false to content agent and this agent send SNR to accessibility agent, and accessibility agent contact with distributed DB through data access service then return this CNR or false to content agent. If we reach to CNR in this layer then it sends back to previous layer and else we send update request content to

* Sharable Content Object Reference Model

update MAS in middle layer and show to the user finding error on content.
There are some paths to find content in accessibility agent:

- Web service: web services are a distributed middle ware technology that uses a simple XML based protocol to allow application to send and receive data across the web [9].
- RSS based: RSS (Really Simple Syndication) allow users to get structured web information in a simple way, display changes in summary form and stay updated about news headlines of interest. In the e-Learning domain, RSS feeds meet demand for didactic activities from learners and teachers viewpoints, enabling them to become aware of new blog posts in educational blogging scenarios, to keep track of new shared media, etc [10].
- BDA: Dan Galea et.al [11] proposed Belief Desires Intentions that can search server knowledge bases in order to investigate the knowledge sub-graph until all knowledge items are given.
- CBR: O.R.Rishi et.al [12] present a methodology where using Case Based Reasoning, its provides student modeling for online learning in a distributed environment with the help of agents.

2.1.4. DB Layer

This layer consists of databases namely user profile DB, E-content DB and all distributed DB. In user profile DB we can store user preferences (preferences of the user means of the type of letter, the color, the icons, font and etc., that user prefers.), user performance (the means time user spend in each theory web page, for each exercise web page the mean punctuation obtained by the learner and the time spent to get the correct answer, for test web page the mean time spent to answer all questions and the mean punctuation obtained in the test web page) that performance agent evaluate it.

2.2. Multi Agent Systems in middle layer

2.2.1. User MAS

In this MAS is done any justification for information transmission, login, logout and create new session by Access User Agent (figure 2). Any user for login to system must be identified and for starting a work (like access to content) must be authorized by access user agent. Logout service automatically runs in the end of session or by user therefore call Update Performance Agent (UPA). UPA communicates with performance agent in Learner MAS or Teacher MAS to obtain user performance then UPA send update performance request to User Agent in DB controller layer for store user performance in user profile DB. All illustrated above managed by User Controller Agent.

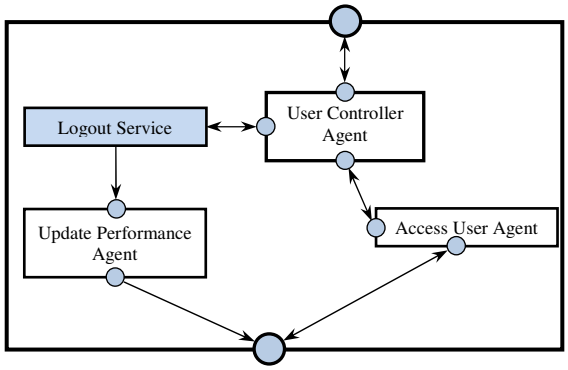

Fig. 2. User Multi Agent System.

2.2.2. Learning MAS

The Learning MAS appears from the general goal to maximize the course learning. The learning control agent communicates bi-directionally (asks for and receives information) with the Performance Agent, Practice-Exercise Agent, Question-Answer Agent, Reading Literature Agent, E-course Lecture Agent.
In figure 3 the Practice-Exercise Agent, Question-Answer Agent, Reading Literature Agent; E-course Lecture Agent is constantly waiting for the learning control agent to ask for content. When this occurs, they communicate with the performance agent to record the performance of the student in order to decide if he/she needs reinforcement. If e-learner needs some kind of reinforcement they elaborate a plan with the material that has to be shown to the student. In order to determine if the student needs reinforcement the performance agent will have access to a User Profile DB where the minimum requisites for each subject are stored (quantity of exercises to be initially shown to the student, how many exercises the student has to answer correctly, and in how much time, maximum time to correctly answer an exercise, etc.).

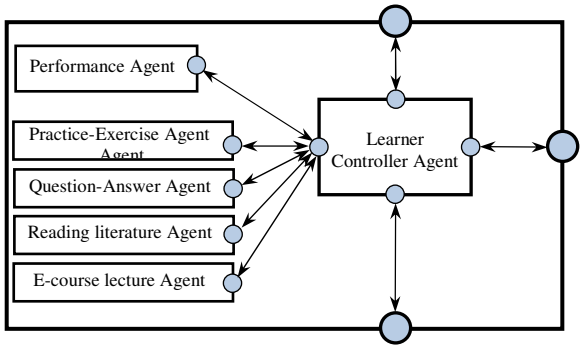

Fig. 3. Learner Multi Agent System.

2.2.3. Teacher MAS

This MAS communicate between teacher and system, create content and create exam by Exam Agent (it possible that create exam automatically based on E-learner performance). Teacher Controller Agent responsible for communication between Performance Agent, Exam Agent and its services. Performance

Agent store the time spend for exam creation and content creation and etc (figure 4).

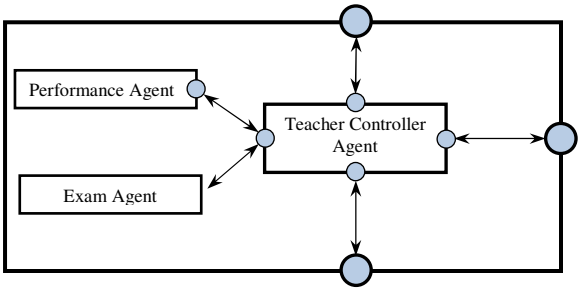

Fig. 4. Teacher Multi Agent System.

2.2.4. Update MAS

As depicted in figure 5 this MAS updates contents that produce by Teacher Update Agent (TUA) or Question-Answer Update Agent (QAUA)

A novel method for update content through Question-Answer between E-learners: it possible through bandied questions-answers between learners in forums or by massaging creating new contents. Firstly question-answer passed to QAUA then if its acknowledged by TUA, send it to Question Categorization Agent for categorize to proper content DB. Update Controller Agent responsible for communication between Teacher Update Agent, Question-Answer Update Agent, Question Categorization Agent and its services.

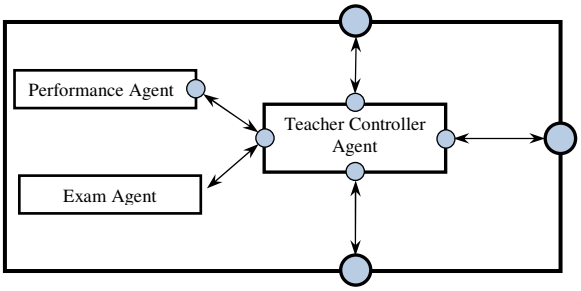

Fig. 5. Teacher Multi Agent System

3. Characteristics

There are several characteristics specific to E-learning system such as Interaction, Personalization, Adaptation, Intelligence, Interoperability, Accessibility and Security. [13]Most of existing E-learning architectures don't consider the entire feature in single system.

- Intelligence: Provide dynamism in E-learning and perform specific tasks on the behalf of members.
- Accessibility: Provide easy accessible to geographically dispersed content of the E-learning system.
- Interaction: Provide interaction environment to the users where object in the learning environment can be reality adjusted, modifies or manipulated to accord with user's performance. This enhances the learning process.
- Interoperability: Increasing important in reusing and combining learning elements in different ways to meet diverse learning needs and to create more adaptable learning systems.
- Adaptation: Provide adaptability functionalities in the E-learning system.
- Personalization: Provide a set of personalization functionalities such as personalizing learning plans, learning materials, personalized content management, learner model and learner plan.
- Security: Security consideration play an increasingly important role for distributed computing and it become an important challenge in order to insure that interested actors only have access to the right information at the appropriate time.
- This architecture considers all characteristics to enhance the quality of learning process:
- Interaction: through Performance Agent
- Personalization: through Learner MAS and its Performance Agent
- Adaptation: through User Agent in DB controller layer
- Intelligence: through all Agents and MAS
- Interoperability: through Content Agent in DB controller layer
- Accessibility: through Accessibility Agent
- Security: through Access User Agent

4. Conclusions

E-learning has become a part of education in recent times. In this paper we have presented our approach for the designing a multi-agent architecture of E-learning system. To achieve this we have designed a system that applies various technologies that provide features like intelligence, distributed, adaptive, interaction, accessibility, personality, security and used multilayer to provide flexible and light weight system E-learning environments.

The intelligent agent and MAS technology is an effective method in providing intelligent and personalized system.

We proposed a novel method for update content through Question-Answer between E-learners by using Update Multi Agent System. By using Accessibility Agent this model can work with SCORM for reuse and sharing of E-learning contents.

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