SOFTWARE-AGENT ARCHITECTURE FOR INTERACTIVE E-LEARNING

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Abstract: Many universities worldwide have developed a variety of web-based e-learning environments, hoping to benefit from this new and fast spreading IT (Harasim, 2000). The main intention of this paper is to describe an e-learning model that would act as a prudent teacher to teach and test the aptitude of e-learners based on available knowledgebase. Here, we provide an overall view of the proposed model and then describe in brief about the purposes of different components of the model. This paper provides a visualization model named Web Online Force-Directed Animated Visualization (WebOFDAV) (Huang, et al, 1998) and also points out the implementation issues. The proposed model is designed to be compatible with any e-learning module designed according to the guideline mentioned in this paper.

1 INTRODUCTION

The development of the World Wide Web; which, no doubt, has made the world very small; and it has often led and is leading to significant changes in the ways in which things are done. Education is not an exception of that. It gives rise of web based learning; in other words, e-learning, which is now being used as a mean of learning in the web.

The pedagogy of on-line learning is still in it innovations, but it is already a useful tool and, if used well, can increase the range and excitement of learning. By realizing the growing trend towards e-learning, in this paper, we have proposed a flexible and interactive intelligent agent oriented e-earning model for teaching courses online.

The rest of the paper is organized as follows: Section 2 provides an overview of the proposed e-learning model, Section 3 focuses on the model components, Section 4 provides a visualization model of an e-learning lesson, Section 5 enlightens the implementation issues and Section 6 concludes the paper.

2 AN OVERVIEW OF THE PROPOSED E-LEARNING MODEL

Figure 1 in the following depicts the proposed e-learning model. It basically contains three parts:

- Agent Enabled User Interface (e.g., Intelligent Agent Interface)
- Interface With Application Software
- The Black Box

In the system we represent “Black Box” as the core of our entire system, which performs the main functionalities of the system. It gets the input from the agent enabled user interface and according to the users’ willingness it performs the operations. Users input are given to the black box and accordingly to the input, black box generates necessary control logics and signals to interact with the learner by means of an animating character agent that serves as awareness about the user to the black box for flexible and interactive lesson.

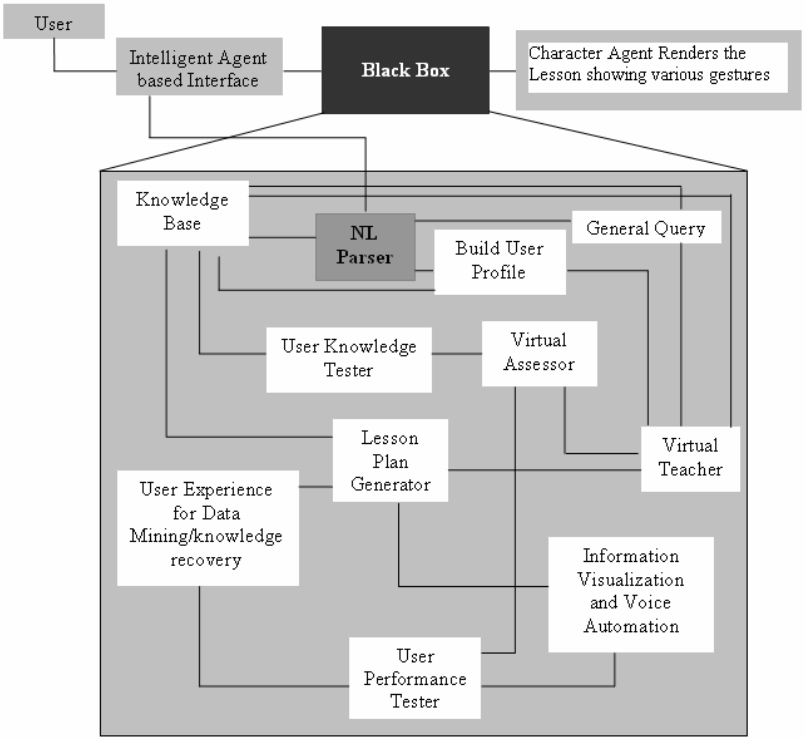

Figure 1: Model of the proposed intelligent agent oriented e-learning system

3 MODEL COMPONENTS

The proposed e-learning model consists of a number of model components. The users interact with the system through a character-agent enabled user interface (i.e., intelligent agent interface); at the core of the proposed e-learning model is the black box of major components of the proposed model.

3.1 Intelligent agent based interface

Input: Gets input from the User Interface with the help of character based intelligent agent. The input can be given in two forms either text or voice.

Output: Sends output to the knowledge base module. The output is a pattern that would be searched inside Knowledge base to retrieve appropriate knowledge key for knowledge retrieval by Virtual Teacher.

3.2. User Knowledge Tester (UKT)

The main role of User Knowledge Tester is to test the knowledge of a user. This is needed to develop both preconception and awareness of the users before starting and at the time of on going lesson.

Input:

1. User's request for test relevant to a particular level.
2. Virtual Teacher's request to load a test whenever a new user first interacts.

Output: User's answer script along with the question for assessment.

3.3. Natural Language (NL) Parser

This module parses the input of the user and bridges communication between the system and users to interact (by text or speech).

Input: The user input to the agent based interface (text or speech).

Output: The user profile (i.e., stating general user information) to be stored in the knowledge base.

3.4. Virtual Assessor (VA)

User knowledge and performance are two basic criteria by which Virtual Teacher can select the proper and suitable lesson module for the particular user. For this purpose Virtual Assessor assesses the user's knowledge as well as user's skill of performance with the help of UKT generated

questions and finally sends the assessment result (on 10 point scale) to the Virtual Teacher for picking up relevant lesson module having these three functions.

Function 1:
1. Gets the input from User Knowledge Tester.
2. Analyzes and evaluates the responses of user.
3. Sends back results to the Virtual Teacher to control the pace and style of teaching.

Function 2:
1. Gets the input from the User performance Tester (UPT) module.
2. Analyzes user's performances that servers as active awareness about the user.
3. Send back the result to the Virtual Teacher to control the pace and style of teaching.

Function 3:
1. Stores the correct answers of the questions from the Knowledge Base to assess the answers or actions of user.

3.5. Data Mining & Knowledge Discovery

While a user starts to take a lesson, this module opens up an eye to be aware of the user's interaction and records a profile based user's weakness and strength in terms of interacting with the learning environment or time taken to learn etc. Based on this information this module generates some case histories that help Virtual Teacher to control the pace and style of the selected lesson module.

Input: User's data from the User Performance Testing and Lesson Plan Generator modules.

Output: Some facts regarding a particular lesson module (e.g. most the learners are interested to topic C while spending much time on topic B etc.)

3.6. Knowledge Base (KB)

KB is the brain of the Virtual Teacher that guides to perform the correct operation. The functional modules KB can be represented as figure 2.

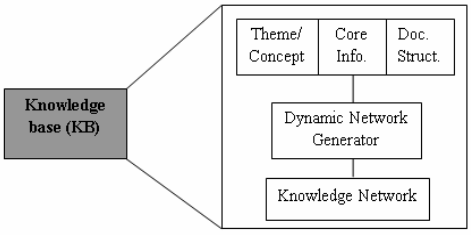

Figure 2: The inner view of the KB

In knowledge base the information is stored as a combination of theme or concept (i.e., the subject area), core information (i.e., the main information) and the document structure (i.e., how the document is structured, information about included visualizations and other related hyper documents etc.).

If a learner wants to learn a particular lesson, KB informs Virtual Teacher how to perform the teaching process by providing a knowledge key to load particular lesson module and then Virtual Teacher handles different user interaction and provides appropriate services.

Input:
1. From NL parser: Linguistic keyword (e.g. General Query about topic 'x')(I want to learn lesson x, etc)
2. From User Knowledge Tester: Command (e.g. load some questions to assess for level 'y')

Output:
1. Generates knowledge keys based on user's query/interaction with the Virtual Teacher.
2. It provides some clues to User Knowledge Tester (if necessary)

3.7. Lesson Plan Generator (LPG)

Mainly, Virtual Teacher interacts with this module to retrieve different lesson modules according to user's level and progress. LPG provides appropriate lessons to users by means of audio, video information rendered with a notion of keeping track of user's mental map while interacting with the lesson.

The format of each module is: **[Module Name, Level, Key Practices, Sequences, Audio Explanations, Video Demonstrations, Sample Questionnaires, Hints, Hyper document, Next Lessons, Previous lessons, Related Lessons].**

The modules are displayed by Information Visualization component with the help of Virtual Teacher.

3.8. Virtual Teacher

Virtual Teacher is associated with the LPG and plays an important role all through the teaching process. User's input is parsed by the NL Parser following some predefined grammars and passed to Virtual Teacher and then it sets a session for the user to assess the level. According to the assessment lesson modules to teach, for that particular level of user, is loaded.

3.9. User Performance Testing (UPT)

This module examines the user's performance soon after finishing a particular lesson. User Performance Tester at first tests the user based on some questionnaires related to the given lessons. It interacts with Knowledge Base module for preparing intelligent questionnaires. After completion of testing the user's performance it sends the answers script to Virtual Assessor to evaluate user's performance. It also gives information regarding the user about the test and lesson to Data Mining and Knowledge Discovery module.

3.10. Information Visualization

This component of the system accumulates the necessary information based on different lesson modules and visualizes the information for the convenience of user. The key role of this module is to automate interaction.
Input: Information about user interaction sequence necessary for providing visual aids.
Output: Provides visual aids to guide the lessons.

4 VISUALIZATION MODEL

We use the visualization model named *Web Online Force-Directed Animated Visualization (WebOFDAV)* (Huang, 1998) with slight modifications. This navigation approach helps the user; not only by providing a visual aid to guide the lessons journey, but also by preserving the user's *mental map* (Misue, 1995) of the view while the user interactively navigates the sections of lessons by swapping of views. This approach does not predefine the geometry of whole visualization at once; instead it incrementally calculates and maintains a small local visualization corresponding to the change of the user's focus. This feature enables the user to explore the current interest without requiring the knowledge of whole graph. This is a concept of *exploratory* navigation.

5 IMPLEMENTATION ISSUES

Implementation of the system puts emphasis on the design of the intelligent agent and the application interface, the structure of the knowledge base and the lesson generator and the formation of the virtual teacher along with other components. We have used some toolkits like CSLU (Schalkwyk, et al, 1996) to give an interactive interface to the users. The intelligent agent is built on Microsoft Agent Technology and Text to Speech APIs. The user knowledge tester component makes use of some predefined grammar. The knowledge base makes use of NLP parser. The virtual teacher component makes use of some predefined knowledge and currently loaded lesson module. The information visualization makes use of the WebOFDAV which reflects the concept of exploratory navigation.

6 CONCLUSION

We strongly believe that the proposed e-learning model of would be suitable to design and conduct any academic course online (for example application packages) and will definitely help the mass and naïve users of computer to learn lesson online (provided that the appropriate knowledge base and lesson modules are in place) in a very easy, interactive and flexible manner and such a system is under development phase.

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