P – Learning: Personalized e-learning using Semantic agents

Dr.M.Thangaraj, Mrs. S. Vanathi, Mrs.M.chamundeeswari

Abstract— **P-learning an agent based Personalized e-learning is an efficient education method, developing in a fast manner. Multi-agent system is one of the emerging trends in computer science. It can provide new solutions to very complex and restrictive system. In recent days, the application of multi-agent systems is spreading in almost every field though e-learning is also gaining its benefits. Personalization in e-learning has drawn more and more attention. E-learning has provided us the capability of providing quality education to masses without restricting them to specific time or place. We have lots of different existing systems, but most of them are lacking all the features like personalization, intelligence, accessibility and security in one single system. The purpose of this paper is to illustrate the advantages of using intelligent agents to facilitate the location and customization of appropriate e-learning resources and to foster collaboration in e-learning environments.**

Index Terms— **E-learning, Semantic Web, Agents, Personalization, Recommendation**

I. INTRODUCTION

With the boom of computers and the Internet, E-learning, as an efficient and effective education method, has drawn more and more attention from researchers and practitioners. It is now possible to provide customized learning for different learners to meet their personalized requirements. Many international organizations and standardization bodies are engaged in development of new approach to achieving personalization in today's distributed E-learning environment[1]. Most researchers focused on the issues of how to provide intelligent functions in the E-learning system and mainly considered how to construct E-learning systems and improve the technologies and learning tools. Some researchers were aware that learning materials could be a major factor in the E-learning world but gave little considerations on learner profile. For instance, [2] discussed how to build knowledge driven personalized E-learning system with less specification for user profile data.

E-learning system not only supports teaching and learning, but also provides some intelligence interaction among the collaborative team members [2]. The upcoming agent based technology is widely used because it helps to

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design complex system with less effort. Multi agent system makes a great change in the society for the reason that the conventional education system required the presence of both the student and the instructor at the same time, same place and at the same interval of time, which is somewhat hard to manage every time [3 and 4]. In addition to this, it is also true that in this competitive world with increasing popularity and newly emerging technologies, people find less time for traditional method of study. Though the concept of learning with the help of tools and technology is being followed since the last decade, still an appreciable number of intelligent learning systems are being developed and proposed, but most of the developed systems suffer the limitation of security and efficiency in terms of complexity [5, 6, and 7]. In order to build an intelligent system, that removes these limitations of existing systems, we propose a system that is secure and user friendly. The security of the system lies in an abstraction layer between the user and the system and encryption of data transferred. The proposed Multi Agent Based educational system takes the personalized status of the learner into consideration and accordingly provides the study material. It also provide the means for a student and teacher to connect remotely and hence make the process of teaching and learning more effective, powerful and easily accessible The organization of paper is as follows.

Agent Technology is one of the most promising technologies for dealing with distributed collaborative environment [8]. Agents are the software program which work on behalf of human to carry some task which has been delegated to it and take their own decision according to the requirement [9]. The various properties of agents make them more suitable to environments where human intervention is very high. In such an environment the agent technology is suitable, because agents are capable to doing things on behalf of human being, and by the use of agents technology, we can solve the challenge in much better way. The various characteristics of agents [10,11 ,12 and 13] Autonomy, Heterogeneity, Proactive, Reactive, Communication, Dynamism, Social ability, Collaborative Behaviour that enhance the efficiency**.**

A multi-agent system (MAS) is a system in which multiple autonomous agents work together to achieve a common goal by using its own local information [14]. The key principal of Multi-Agent system is that each agent is pursuing its own local goal and interacts with each other to attend the global goal [15].

II. RELATED RESEARCH

Here, the related research review presents on ontology-based personalized systems in e-learning domain used for selecting appropriate learning resources.

[1] User interests are the main feature of the user's profile, it indicates background information of user like topics of interest, familiarity with the query topic, preferences etc. This can be represented in the form of semantic structures enhanced with the use of ontologies.

[2] The way users identify quality (observation) defines their satisfaction level. Personalization ontology-model defines user perception, the concepts in ontology represent user's application specific purposes (Goal) and properties in ontology establish relationships between these concepts.

[3] An ontology-based representation is richer, more precise and less ambiguous. It provides an adequate grounding for the representation of learning course-material to fine-grained user interests.

[4] The semantic based personalization in e-learning environment is based on learner's prior knowledge, learning style and performance aspects of the e-learner.

[5] Proposed ontology based dialog system called OWL-OLM, for acquisition of user knowledge and to analyze the current state of the user's knowledge according to the needs for a particular course of user's preference.

[6] Proposed personalized e-learning system based on Item Response Theory (PELIRT) to provide adaptive learning which consists of two parts, the front-end part is for managing communication with learner and recording learner behavior. The back-end part is to analyze learner ability and select suitable learning materials for learner based on estimated learner ability.

In the E-learning world, learning resources and learners are the two most important key components. Learning resources can be made up of learning objects each of which is a self-contained chunk of learning that fulfills a single, affirmed learning goal [16]. Learning objects can be grouped into larger collections of content and be used in the multiple contexts for multiple purposes. These characteristics make the learning content changeable according to different customized requirements [17]. Learning objects make personalization of leaning content possible. The learner profile, which maintains learner information, plays a decisive role in building personalized learning content. Many organizations have proposed learner profile design models. Among them the most well known are IEEE PAPI [18] and IMS LIPS [19]. IEEE PAPI contains six categories of information such as: personal, relations, security, preference, performance, and portfolio information. Similarly, IMS LIPS provides a structure for storing identification, qualifications, accessibility, activities, competencies, goals, interests, transcripts, affiliations, security keys, and relationships. Both of them describe general learner information without considering how it affects the learning resources in form of learning objects.

We take advantage of the concept of the learning objects and extend the IEEE PAPI for development of personalized e-learning systems. The extended design model captures richer information that is able to facilitate intelligent discovery of learning objects. This will ultimately contribute to the development of personalized E-learning systems.

1. **Architecture of an intelligent system for personalized e- learning**

The main objective of our paper is to propose a secure and interactive agent based architecture for e-learning environment. The highlight of this system is to provide

the knowledge according to the student personalized status, ease of use and security against unauthorized access and manipulation of data. The Modified architecture of IRS-EEE (Fig. 1) is based on the semantic structure, promises a powerful approach to satisfy the E-learning requirements with Intelligent Agent . This Semantic architecture of E-learning embrace four Agent such as User Agent (UA), Planning agent (PLA), Content Management Agent (CMA) and Personalized Agent(PA).
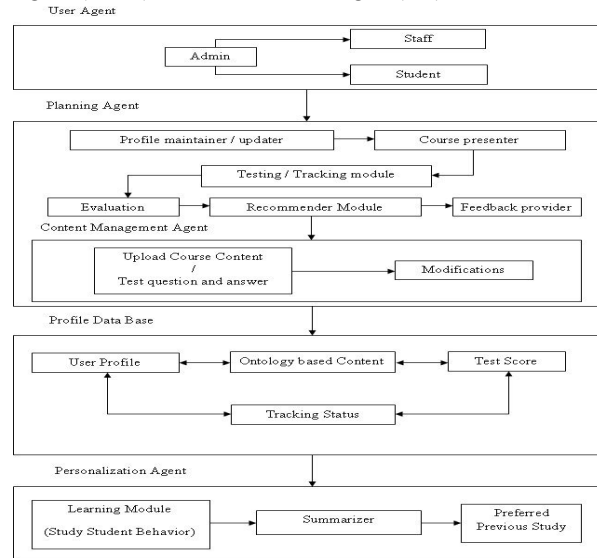

2. **User Agent**

This agent has three roles; they are Admin, learner and Staff. This learning system completely functions around the users. The entire scheme as well as its functions differs according to the role selection. Every user has its profile that is updated as and when the changes happen. The responsibility of ADMIN is to monitor user's profile, content updating, assessment of outcome, learner's performance and Tracking the performance of the entire System. The function of the Staff that consist of many works such as preparing, presenting the content, adding and updating the content, questions, conducting and correcting tests, maintaining and accessing test scores etc. The concepts in a particular topic are included by the staff based on that topic. Before including the concept, the topic or course factors would be attached. Then the staff would affix the content details to those topics. Before introducing the content, the type of the content format is specified. This system supports multi content format (ppt, ppt with audio, video). After including the attributes of a particular concept or a topic the instructor include the content details in one of the format. This type of work flow would be iterated by the instructor to complete the entire concept or sub-concept details. Then questions for every concept of the block will be included.

The learner is the next stage user. The content of a particular concept or sub-concept is observed and learned by the learner. An effective learning environment is provided with the help of ontology and sub-ontology based concepts. In addition, the chapter and the contents are classified into blocks of related concepts. The blocks are mapped as ontology and the related concepts within blocks are mapped as sub ontology. In this context, the learners go for an assessment before beginning to learn a concept known to be

pretest.The learners are allowed to undergo an assessment, again when the concepts are completely learned by the learner. Then the assessment upshots will be evaluated and they carry out to the CML, component part of tracking. The Fig illustrates the work flow of the Learner.
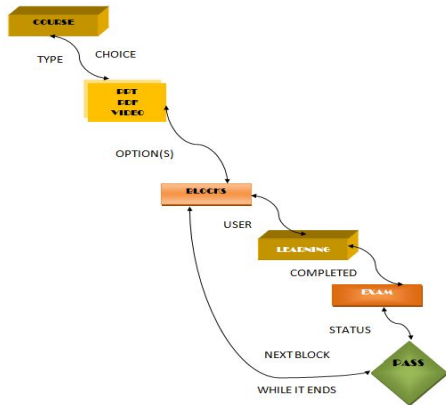

3. Planning Agent

This second Agent , Planning Agent provides Course Admin Service. This has testing like pre-test (before learning course content) and post -test (after learning course content), assessment of the test performance and permitting back tracking services whenever necessary. It also interlinked with Content Management .

The function of the Profile maintainer will maintain all the related information about the learners, staff etc. Whereas, updater keeps track of the consistency of data by proper updating process.

The Course Presenter Module presents the content in terms of course content outline, corresponding content and its concept map. While the learning process is going on, the status of the learner is stored in the database by Testing / Tracking Module. The learner is allowed to a block to verify their indepth knowledge in that block and block test is conducted. On the basis of the result the recommendations are given. If the result is above threshold value then the learner allowed to access next block otherwise switches back and made to read again.

Once the student has finished all the blocks, final post-test is offered and the results are compared with pretest to assess the improvement of the user and the skills of the user by the evauation module and test results are updated in the table. The Student feedback will be fed into our recommender system in turn it will recommend the teacher to improve the content if it is the learners need and at the same time this system provides the facility to give feedback about the performance of the learner by the staff.

In this paper the recommendation is given to the learner depends upon the value of their performance. The flow of decision is shown in Figure.
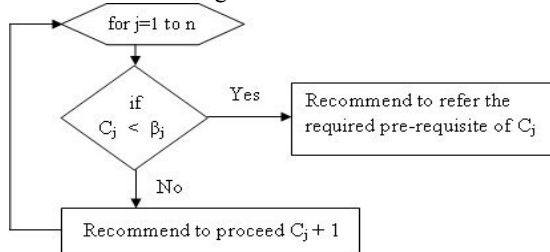
Pesonalized e-Learning system finds the poorly learned and well learned concepts among n number of concepts of every student and suggest the students to repeat it if necessary that is the score of the student in that particular concept (C_j) is less that the threshold value (β_j).

4. Content management Agent

This Agent displays the Course Content of the course of interest. This Agent facilitates the learner through multimodal presentation including Power Point, visuals and etc.

CMA displays the course content prepared based on SCORM, (sharable content object Reference Model) Standard. Course presenter presents and preserves the hierarchical course structure with their semantic relationship between the concepts like " is part of ", " is subtopic of " ," is pre-requisite of ". Content of a course is delivered with corresponding concept maps which express the interrelations of the sub-concepts of the selected concept .

5. Resource Agent

The Resource Agent consists of database components of user contain all the required information about learners, staff and admin. This agent maintains the databases with users' profile, ontology based content, test score and Tracking status of the every learner. It contains two databases Profile Data base and Content Knowledgebase. Profile Data base is used to store all the information about the student like learning style, educational qualification, name, age and etc. and also store information about tutor like name, Area of Interest etc. The actual course content will store here in Content Knowledgebase in an organized format.

Personalization Agent :

Personalization agents should be able to select learning materials and optimize schedules for individual learners based on cognitive style, personal preferences, and accessibility needs in addition to prior knowledge anddesired knowledge. Personalization agents should accommodate learners with a wide range of skills and backgrounds; allowing learners who are strong in one area to move ahead quickly, while other learners obtain extra assistance.

Personalization agents continuously monitor individual learners progress and use of materials. Learners rate the usefulness of learning materials provided to them and answer questions to assess their understanding of the subject matter being taught. This information is used to determine the usefulness of materials for teaching specific topicsas well as to update the individual lesson plan as the learner interacts with the system.

The user profile contain information about

- Personal information describes the user natural feature and is represented as <name, telephone, address, reference, e-mail, postal address>.
- Security information is about the user's authority to use the system and is represented as <user name. password>.
- Relation information describes the relationship between the user and the other users and is represented as <is teacher, is student, is administrator>. The system can provide different functions for different users.

➤ Performance information records the user performances as <learner ID, content ID, recoding-date-time(time begin, time end), complete percentage, total time accumulate, score>. This category is used to record the user's actions. When the user uses the system, the user actions and his/her study history will be recorded, so the system can get the necessary data to decide his/her next learning content. For example, if the record shows that the user already completed all the learning units but the score is very low, the system may find those knowledge points that the user did not grasp and assemble relevant learning objects to form a new learning unit for the user. In this category we add the complete percentage value to tell the system the study status.

➤ objective information is an important category which can reflect the user's subjective sensation and is a key factor during the process of constructing personal learning materials. The goal information is represented as <new start(complete a knowledge point, complete a unit, complete a course, complete a subject), continue last study>. In this category, we pre-define two values. User selection will determine the system procedure. If the user selects 'continue last study', the system will call the previous record and select the learning material based on it. If the user selects 'new start', the system will not consider the user action history and will continuously ask the user's goal. Obviously this category plays an important role in our personalized E-learning system.

6. Proposed Algorithm

The following Personalized E-learning Algorithm (PeLA) used in the proposed system depicts the flow of logic. The list of parameters used in the algorithm are listed in Table.

Parameters used	Explanation
cID	concept ID
sID	student ID
alt	actual learning time
elt	expected learning time
ca	correct answer
wa	wrong answer
nqs	number of questions
ua	Unanswered
n	number of concepts
C_j	score of jth concept
B_j	Threshold value of jth concept
noblks	number of blocks
nocs	number of concepts
nmbuser	number of users

This algorithm Pe-LA use CBeLA [20] (Concept Based E-learning Algorithm) to improve the learner's knowledge. Prior knowledge of any concept is one of the most important factor that influences the performance of the learner. The learning progress of a student should be assessed after completing each concept. Each concept has four associated parameters: Correct Answers (CA) , Wrong Answers (WA), Expected learning time (elt) , Actual learning time (alt).

Each concept in the ontology based content has any of the three associated states such as unknown, known and wellknown. Following equations are helpful to calculate the values

unknown $\Leftarrow$ If (alt > elt) &&(ua+wa>=ca and ca<= β_j) (1)

known $\Leftarrow$ ((elt <=alt) && (ca> β_j and ca<= 2*β_j) (2)

wellknown (elt <=alt) && (ca>2*β_j) (3)

Based on this tracking process [12], the system evaluates the student's progress and suggest to make a revision of that module or to continue the sequence.

Algorithm PeL(Personalized e-Learning Algorithm)

Input : alt,elt,ca,wa,ua, β_j, noblks, nocs.

Output : Recommendations based user level of interest and performance.

Create profile for each user

For I=1 to nmbuser

{

Call CBeLA

If (uid >1 && exist concept) then

Update recommend list from userprofile based recently viewed concept

Update user profile with Cid,Uid, view time

}

This algorithm is used to monitor individual learning within a course and the usefulness of specific learning objects. Agents can be used to generate learning progress reports against predefined goals and can document learning efficiency as well as learning effort. This should allow organizations to manage their e-learning programs to provide the materials and courses that are of the greatest benefit to the organization / learner. The ability to measure the impact of the organization's e-learning program is another important benefit of implementing an agent-based e-learning system.

Evaluation and Experimental Results

This implemented system Pe-L is built on windows 7 professional environment using Intel core2dual processor with 1 GB RAM and also 250 GB HDD and developed in visual studio .net 2008 environment using asp.net and SQL server 2005 is adopted to be the database. For this study , Bachelor of Science in Computer science , Programming Language course content was taken as a dataset and the learners are the students of Bachelor of Science in Computer science from different colleges which are geographically distributed Learners from urban, semi-urban and rural colleges are participated in this study.

This work is tested with these limitations/assumptions such as:

1) Learner should have knowledge of computers.
2) Learner should learn at least one concept without break.
3) Too many repetitions to be avoided.

4) Staff should have thorough knowledge on the course content.

Once the learner enters into Pe-L he/she has to sign-in and enter their profile. The admin approved the learner .The learner selects the course. Select his learning preference/learning style (ppt, ppt with audio, video). If the learner is beginner he /she is permitted to view the content in sequential order. The course content is presented as they prefer for the medium and advanced level. . After suspicious learning of the concepts in each block, a question set is given. Using the result of the block test, the concepts within that block are categorized as unknown, known and well-known. Then the recommendations are given as per the algorithm discussed earlier. After completing all the blocks, post-test is conducted to measure the knowledge improvement in the domain and the efficiency of the system. While learning the concepts the actual learning time is observed and recorded to compare with the average expected time, as it's the important data to assess the learner [14] and updated in the user profile.

Personalized Agent continuously monitor and update the user behavior to profile. If the learner enter the same concept yet again , then personalized agent get the concept from the profile based on the time that he /she recently viewed .

The evaluation for E-learning includes assessment of learner, evaluation of the instruction and learning environment. Assess the learner is a continuous process. Outcome of the assessment is used to update learner level and to append course material are dynamic.

7. Performance analysis

The study of evaluation approach was organized on different subjects of the same branch, to retrieve concerned learning materials. The retrieved contents are ranked based on their similarities to the given query and concerned subject. The proposed system is analyzed through the calculation of information retrieval metric "precision" to measure its performance. Experiment is performed through Intranet and using local college database as Data-set for learning materials. Precision and recall are the two standard statistical measures for calculating performance of information retrieval models. Precision indicates the capability of system to retrieve the relevant items. Personalization time: Time to retrieve any information depends on the type of search engine, size of data set , relevancy between query and do user history and re-ranking algorithm used. The effectiveness of Agent based learning is shown in the following graph.
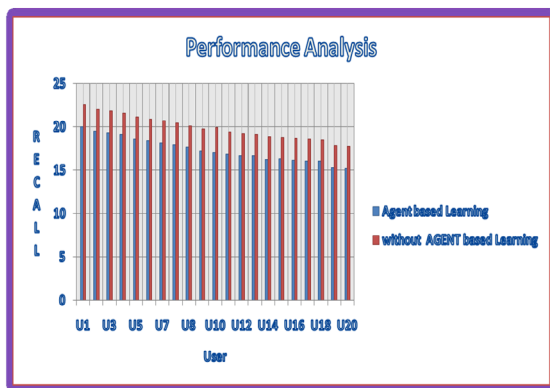
The analysis shows that the outcome of the learner is high in Agent based Learning. The above graph shows that there is considerable improvement in precision with the use of proposed system to compare with direct search approach. Accessing the required content without waiting, motivates the learner and improves continuous learning. The quickness measured between the Agent based system and other system is compared in the following graph shown below.
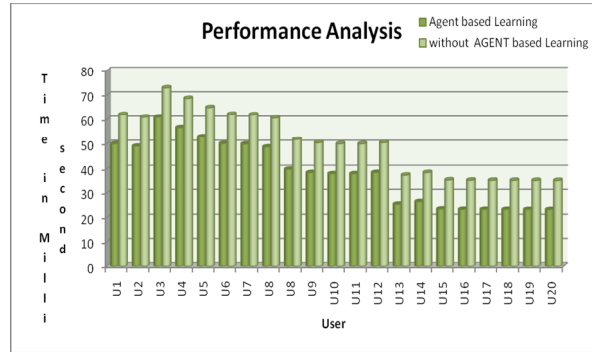
The results of the above graph shows the Agent based learning encourage the learner's perception by providing the content in a fast manner.

CONCLUSION

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.

In this paper we have discussed different agents, their properties, interaction among different agents and their usage in an e-learning environment. We have proposed a new architecture for Multi-Agent e-learning system. The main focus of the system is to enhance the security level and reduce the complexity of system interaction at the user level. In this system, we have introduced an Agent layer in the form of web portal that hides the complex details of system working from the end user and henceforth leads to easy handling of the system.

The proposed ontology based learner-model is aimed to simulate learner Domain specific preferences and Educative support preferences for Personalized accessing of learning materials in e-learning domain in the future.

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