Providing Personalized E-Learning Content Services by Adapting to Multiple Feedback using Mobile Agents

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Abstract: Personalized e-learning services are becoming increasingly crucial for delivering quality content to subscribers. In open and dynamic environments, personalized e-learning services are essential, and emerging technologies such as web services and agents are playing a significant role in their development. User profiling is a promising approach to personalizing e-learning services, as it allows for the assessment of user profiles during the learning process. By collecting feedback from users and storing it in their profiles, the proposed system aims to provide efficient e-learning content services that can adapt to multiple feedbacks and cater to both individual and group users. Mobile agents are used for effective retrieval and distribution of learning content. The proposed system aims at providing personalized e-learning content services which can adapt multiple feedbacks and provides efficient e-learning content services to individual users and to group of users using mobile agents for effective retrieval and distribution of learning content.

1 INTRODUCTION

Personalization is important in today's service-oriented society, and it has proven to be critical for Internet and mobile telecommunications network service acceptance. Because of the widespread adoption of e-learning in all environments, scientific research in the field of adaptive and intelligent systems has been stimulated in order to provide high-quality services to e-learning end users. Adaptive and intelligent systems are those that meet the high demands for personalization of e-learning users. Personalization can determine a user's characteristics based on previous purchases, products, or pages viewed, or both. Adaptive and dynamic technologies are required. The traditional, static "One size fits all" approach provides all learners with a single set of learning resources. Because the conditions that determine which part of the educational material is appropriate for different learner characteristics were not described, learning contents delivered using this approach are not feasible. As a result, providing a personalized e-learning system that can automatically adapt to learners' interests and levels is critical.

User profiling is a promising approach to personalized e-learning systems that assesses a user's interests, levels, and learning patterns while they are learning. Based on the profile, a personalized learning resource could be generated to match the individual preferences and levels. Additionally, learners with similar interests and levels can be grouped, and one person's feedback can be used to guide information delivery to other members of the same group [13]. To ensure interoperability and scalability, the proposed system uses a service-oriented approach that encapsulates learning content within a web service, and all system components are implemented as web services.

The system is based on IEEE LTSA (Learning Technology Systems Architecture) and includes a chat room, a customized web browser, and a white board for information delivery. These comments can be used to determine the skill level and expertise of a user. These various feedback measures, such as reading time, the number of scrolls and prints, and the relational index on chatting history, will be combined by a feedback service. The collaborative filtering algorithm is used by mobile agents to deliver personalized information to learners by collecting user profiles that store user preferences and levels of expertise. Feedback can be tailored to individual users based on their characteristics, as well as to groups of users based on their shared characteristics.

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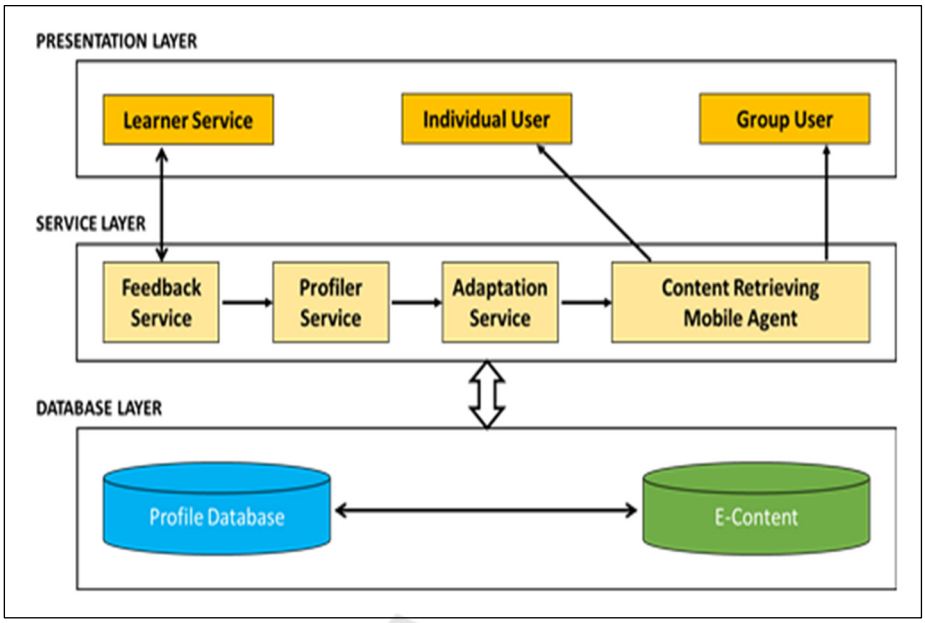

Figure 1: Architecture of the proposed system.

2 RELATED RESEARCH

As part of the related research, personalized service selection and personalization of an e-learning system are discussed. Also briefly discussed are e-learning services with agents, adaptive e-learning systems, and feedback adaptation.

Personalized Selection of Services: Users cannot be expected to browse all services until they find an adequate match, given the growing diversity of services. As a result, the task of service selection and composition must be supported by recommending a set of possible services or combinations from which users can then choose. Expanding the query for a service with preferences can essentially improve selection quality by excluding insufficient services.

Personalized E-Learning System: A personalized e-learning system is one that can adapt to the interests and levels of learners automatically. In order to infer user preferences, a feedback extractor with fusion capability is proposed. The user profiler collects user profiles, which store user preferences and levels of expertise, in order to deliver personalized information using the collaborative filtering algorithm. A personalized learning resource could be generated based on the profile to match the individual preferences and levels. When the learner interacts with the system, the feedback extractor extracts the learner's preferences and level of expertise and stores them in the user profile. The user profiler collects user preferences from the feedback extractor and provides learning content to the learner based on those preferences.

E-Learning Services with Agents: Victor Pankratius proposed a distributed, service oriented architecture for Web-based e-learning systems, as well as extensions to support software agents. The architecture's benefits and the use of intelligent software agents for distributed retrieval of educational content are also discussed. Nasir Hussain proposed an e-learning service-oriented architecture. The architecture is built with web service-based intelligent agents that allow users to consume each other's educational services in e-learning networks, enhancing the learning experience of individual learners, teachers, and authors through user agent interactions.

Adaptive E-Learning: The adaptation of e-learning content to provide personalized content to the user is known as adaptive E-learning. In the business world, a conceptual model is used to provide adaptive e-learning to employees' educational needs. It can be provided by adapting feedback and providing the user with personalized content. Feedback can be tailored at both the individual and group levels.

Conceptual Model for Adaptive E-Learning: A conceptual model is required for developing a personalized adaptive e-learning system in a business environment for identifying employees' educational needs from formal and semi-structured data and selecting an appropriate learning strategy based on that data. This model has been proposed as a general model for employees' continuous learning in a dynamic business environment (Trelepis and Stephanides, 2021).

Feedback Adaptation: A system is described that fulfils learning objectives by automatically selecting and integrating appropriate learning materials for a learner using web services based on the learner's initial knowledge, goals, preferences, and so on. Services appropriate to achieving a specific learning goal can be dynamically selected, composed, and invoked based on the learning goals as well as web services. Feedback can be tailored and personalization can be provided at both the individual and group levels. The concept of group adaptation implies that the system adapts feedback to common characteristics of a group of user

3 PROPOSED APPROACH

In this paper it is proposed that e-learning services are personalized by using multiple feedback measures and tailoring feedback to individual and group users via content retrieving mobile agents. Knowledge about a user derived from interactions with e-learning systems is stored in user profiles, which are then used to adapt and guide a learner through offered e-learning resources. The presented contribution introduces a scalable implementation architecture based on mobile agents. This platform is used to manage the execution of the various mobile agents that are used to support legacy e-learning systems. In addition, web services technology is used to enable communication and interoperability between mobile agents and e-learning systems. The proposed e-learning system architecture, depicted in Figure-1, consists of following three layers:

The Presentation Layer is made up of the learner service. The application interface is the learner service. In the service layer, the feedback service interacts with the learner service to collect multiple feedbacks from the learner.

The Service Layer consists of feedback service, profiler service, adaptation service, and content retrieving mobile agents comprise the service layer. The feedback service collects and stores multiple feedbacks from the learner service in the profiler service. The adaptation service will retrieve feedback from the user profiler service and adapt it. Based on multiple feedbacks stored in the user profile, the content retrieving mobile agents will deliver personalized information to individual users and groups of users.

The Database Layer is made up of the profile database and the e-content ontology. The profile database stores the user's preferences and level of expertise. The e-learning courses and contents will be saved in the knowledge base of e-content ontology. The e-content ontology database stores the courses that can be delivered to the user, such as software engineering, operating systems, C++, and computer architecture, among others. Some data sources are also saved, such as textbooks, notes, and tutorials.

The proposed system's operation is as follows: First, the feedback service will determine the learner's preferences, behaviour, and levels of expertise from the learner service. The feedback service will save current learner information in the user profile, such as preferences and expertise. The profiler service will extract user preferences and multiple feedbacks from the user profile and provide the collected information to the adaptation service. The adaptation service will process the various feedbacks and forward them to the content retrieving mobile agents.

By combining multiple feedbacks, these agents will retrieve content from the e-content ontology. Personalized information is stored in the profile database and delivered to individual users as well as groups of users who share common characteristics or a stereotype. Means tailored to each student and his or her unique (combination of) characteristics. Active users could receive immediate feedback in a brief format, while reflective learners could receive detailed elaborated feedback. The feedback could include references to the previous course (if the student has passed it) or the detailed explanation.

4 USER PROFILE DATA

The information gathered about the user can be saved in the user profile. These data are divided into two categories: static data and dynamic data. Static data are those that do not change during the interaction between the student and the system. The dynamic data are those that change as a result of the student's learning progress and system interaction.

The static data is divided into five sections: *Personal, Personality, Cognitive, Pedagogical, and Preference data* are included. The dynamic data consists of two data sets. They are *Student Knowledge data* and *Performance data*. Data is constantly gathered in order to keep an up-to-date record, and this data can be gathered from student-system interactions.

Multiple Feedbacks which are stored in user profile can be adapted to provide personalized e-learning service to the users. Individual Feedback Adaptation means that feedback is tailored to each student and his or her unique set of characteristics. The timing and manner of feedback delivery could be tailored to these individual characteristics. Traditionally, group feedback adaptation is performed on the basis of a group for stereotype model.

The primary goal of stereotype modelling is to model a group of users so that they can be adapted to as a group of users. Group adaptation is carried out in accordance with the characteristics of those groups. The parameters that characterize the user's personal preferences, interests, goals, habits, and mood are included in user preferences. Users may prefer some links or parts of the pages over others and this can influence the adaptation of the feedback in e-learning. For example, the user can prefer to receive feedback in a pop-up window.

5 CONCLUSIONS

The assistance Personalization is the ability to tailor a service to a specific user's needs. Personalization of services refers to tailoring services to a user's or a group of users' needs and preferences. Learners require personalization of e-learning services, which is especially important in open and dynamic environments. Because personalization is carried out with multiple feedbacks, the proposed e-learning services personalization by using multiple feedback measures will result in better performance. These multiple user feedbacks are stored in the user profile, which is a promising approach to personalizing e-learning services.

Previous research on personalization of e-learning services using implicit and explicit feedback has many drawbacks, such as user profile input, personalization using fewer measures, and personalization based on only pages browsed. These drawbacks are overcome by our approach, which employs multiple feedbacks for personalization and allows these feedbacks to be tailored to the individual user and group of users by delivering personalized e-learning content via content retrieving mobile agents. The agents and web services mobility makes the architecture robust, scalable, and efficient, and services can be provided to any legacy e-learning environment.

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