An Adaptive Learning System Based on Ant Colony Algorithm

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Abstract*— One of the most important emerging requirements of the learning is adaptation to learner's needs. Adaptive learning will permit improvements in the current scenario. It suggests courses adapted to results, behaviors, preferences, tastes of learners. In the present paper, we have proposed an approach based on the Ants colonies' optimization algorithm. This helps to recommend a learning course. It adapts to fit in the best manner into learner's profiles. The approach is helpful in improving both the learning achievement and learning efficiency of individual Learners. Learners with different attributes may locate learning objects (LO) which have a higher probability of being suitable. A web-based learning approach was created for learners to find the learning objects more effectively. We propose an attribute based ant colony system to help learners find an adaptive LO more effectively.

Index Terms*— adaptive learning, ant colony, learning object, learning style, learner

I. INTRODUCTION

Information and communication technologies, particularly the internet, have prevailed this last decade our everyday life, personal's as professional's. E-learning sites are increasing because of the interest which they bring: time, transport and accommodation saving, use flexibility, interactivity etc. Since few years, a new current is interested to adapt pedagogic contents to learners. Hence, it will be most appropriate to offer a tailored contents, and more adapted courses based on preferences and learners abilities. In the reality, most learners cannot find most suitable pedagogical objects because each one has different attributes and each learner has different characteristics. The establishment of the learning path for learners was certainly not a new approach, but learner's characteristics and their learning behaviors lead to the elaboration of adaptive systems. Kolb, Felder and Silverman indicated that students learn in different manners:
some of them learn best when visualizing contents, others when listening…etc. Thus, a learning style can be considered as a general predisposition to process information, in particular manner. Learning styles have to be considered when elaborating the dynamic learning environment. Our approach is different from many existing models and brings some contribution, especially when using Ant colonies (adaptive courses) for optimization.

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The following sections include: the literature review of the related studies, a description of our designing system, an introduction to optimization algorithm, some screenshots, and finally, the concluding remarks of the study.

II. RELATED STUDIES

There has been a keen interest of researchers in the field of adaptive learning for almost a decade now. Most approaches consider the learner profile for adaptive learning. Adaptation provides better learner satisfaction and that too coupled with the ant colony optimization algorithm improves learner's experience of the system. Consider the Table I below; here we note down the various algorithms and methodologies used in similar systems. In attribute based ant colony system various attributes of the learner and learning object are taken into consideration. Learners have attributes such as knowledge level, media preference etc. Similarly learning objects can be for a distinct learner as well as in different formats. All the systems take into account different characteristics into account and deploy separate algorithms for searching of learning objects.

TABLE I
EARLIER WORK

Sr. No.	**Algorithm/Methodology**	**Author**
1.	Attribute based Ant Colony System	Yang et al.
2.	Learning Objects and Methods of Adaptive Hypermedia	Ruiz et al.
3.	Style based Ant Colony System	Wang et al.
4.	Multi –agent systems with SCORM and WEB ontology	Yaghmaie et al.

III. ACTUAL DESIGN OF THE SYSTEM

The system known as Ant Colony System is used to generate profiles of three kinds of users: administrator, teachers, and students. Each one has its own rights and privileges and functionalities. The administrator has all the privileges like creating new users, modifying existing users, editing profiles of his own as well as other users of the system. He can perform search on the data repository as well as view database information.

Teachers first need to register with the system and afterwards upload data into the repository. Students on registering with the system can search and access materials according to his choice.

When a learner for the first time registers with the system his preferences are taken as input into the system and user level of knowledge is judged and choices are stored into the database. The content generator who through his three modules (profiling and filtering) allows dynamic adaptation of pedagogic contents based on learner's profiles.

A. Profiling Module

One distinctive feature of any adaptive system is the user model that represents essential information about each learner. This model integrates characteristics of learning style, the most relevant using several models proposed such as apprentice, beginner, intermediate, and expert. Educational contents of a model are partitioned on elementary units into various kinds such as audio, video, text, pdf etc.

B. Filtering Module

Filtering allows learners looking for learning to be able to profit of what has been already found and used. Filtering module is charged of comparing the newly searched content with the previous search results, to suggest him the most appropriate learning content. This important step allows recommendation time optimization in the case where similarities among learners population set exists.

IV. USING THE ANT COLONY ALGORITHM FOR OPTIMIZATION OF SEARCH

After the learner enters a search term in the box, the system uses this algorithm for faster search and optimization of search results accordingly. This Meta heuristic is inspired from collective behavior of storing, and path tracking observed within ant's colonies. Ants communicate indirectly through dynamic modification of their environment (pheromone's trail) and build by a solution to one given problem by taking on account their collective experiences. The ant colony optimization (ACO) algorithm is inspired by ant colonies behavior to search the shortest path. The proposed algorithm is as follows:

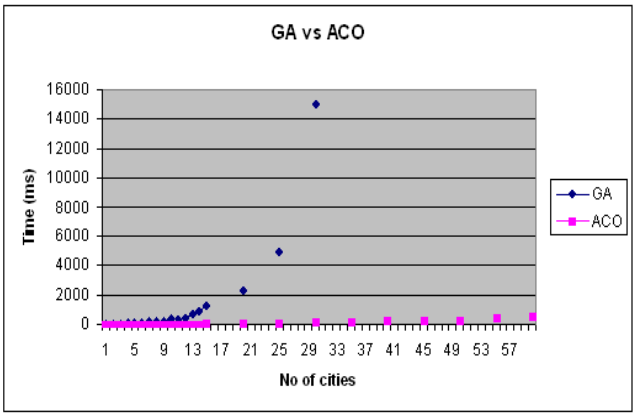
Procedure ACO algorithm
Set parameters, initialize pheromone trails
While (termination condition not met) do
Solution construction
Location search
Pheromone update
End
End ACO algorithm

The ant colony system (ACS) is a particular algorithm of ACO which is based on agents that simulate the natural behavior of ants, develop mechanisms for cooperation, and assist them in using experience (Dorigo & Gambardella, 1997) to find the shortest path between a food source and the nest. The ants lay pheromone and heuristic information to mark trails. As the paths are visited by other ants, some of the trails may be reinforced and others paths may be allowed to evaporate. Pheromone trails can be observed via the number of ants passing through the trail. When there are more pheromones on a path, there is larger probability that other ants will use that path, and therefore the pheromone trail on such a path will grow faster and attract more ants to follow (so called positive feedback).

The probability $P_{ia}(t)$ for an ant to reach the destination I $\epsilon\{1,2\}$

$$P_{ia} = \frac{(t_s + \Phi_{is}(t))^a}{(t_s + \Phi_{is}(t))^a + (t_s + \Phi_{il}(t))^a} \quad (1)$$

Graph 1 below depicts the comparison in performance of ant colony algorithm with other generic algorithms.



Graph 1

V. APPLICATION

ANT COLONY SYSTEM has been implemented with C# and MS SQL SERVER 2005. The educational web based application contains three actors, to know: Learner, Author/ Teacher and Administrator. Learner is prompted with a questionnaire, in order to determine his or her profile. The learner preferences are then stored into the database for future references. The following figures describe the process of adaptive searching and learning objects recommendation.

Fig. 1 below represents the user login page. Depending on the user privileges various tabs are enabled for a particular user. The user authentication is done at this position itself.

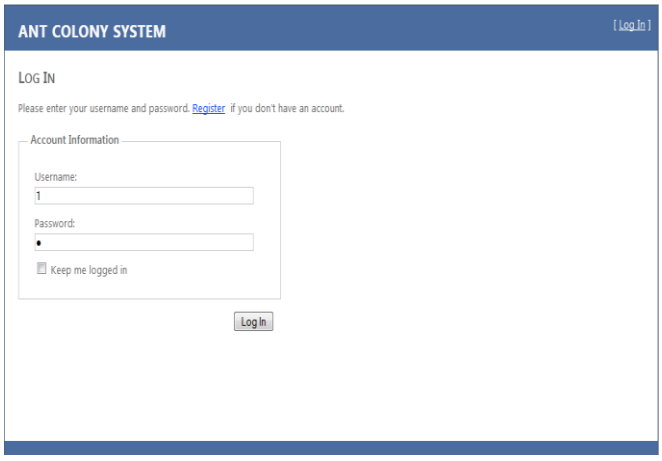


Fig. 1 Login Page

Fig. 2 below shows the search window, showing the search results for the string in selected drive of the computer. User has the choice of selecting files of a particular type from the check boxes in search and then opens the files in the inbuilt editor or player. As shown in Fig. 3, shows the new user account creation page. Once we open a file after searching, the path gets stored in the database with the corresponding user name. Fig. 4 below shows the paths stored in the database. We have the choice of removing redundant paths from the database. This has to be done manually.

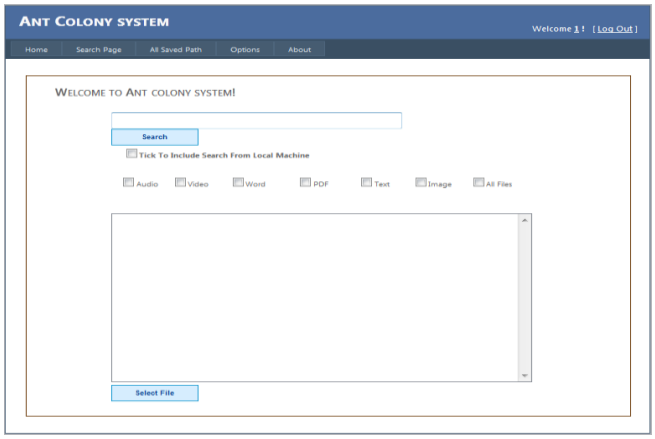


Fig. 2 Search Page

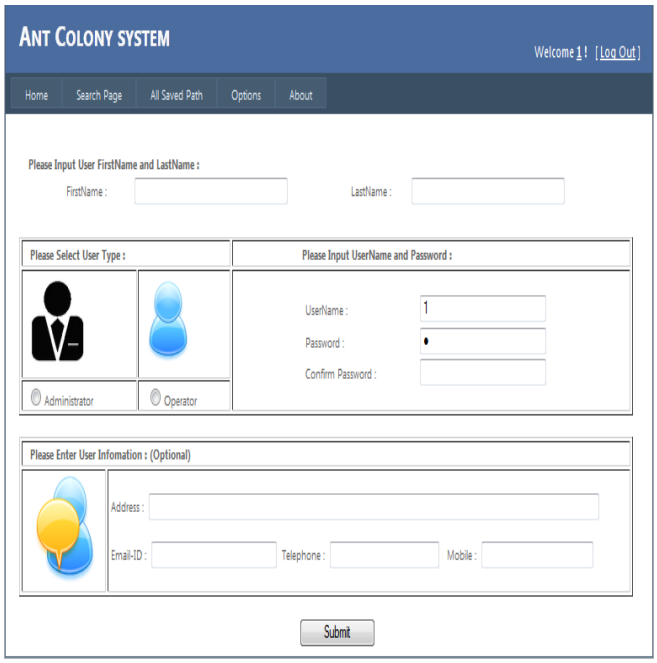


Fig. 3 User Account Page

Fig. 4 Database Paths

VI. CONCLUSION

In this paper, we propose an adaptive learning platform, ANT COLONY SYSTEM, which takes personalization information into consideration, including individual educational level and learning styles.ANT COLONY SYSTEM is an environment that can assist teachers to develop courses and provide learners with suitable educational objects to improve their learning performance. In this work, we used a method based on ant colony algorithm. Ants Colonies Algorithm remains a fine tool to solve combinatory problems. Data sharing on pheromones is the highlight of such technique, where each search comes over to enrich the collective knowledge. Its implementation, learner's domain knowledge level and learning objects attributes can provide an adaptive solution to learners. The experiment conducted by us is only at its beginning. Now, we work to optimize all parameters, the first results will be discussed in our future work. E-learning implementation of the same would be particularly beneficial and liberating especially for student with disability**.** Use of multiple algorithms for generation of better learning paths can improve this implementation and provide more accuracy. Collaborative filtering would provide an added advantage to the current implementation.

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