The Optimization by Using the Learning Styles in the Adaptive Hypermedia Applications

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ABSTRACT

This article addresses the learning style as a criterion for optimization of adaptive content in hypermedia applications. First, the authors present the different optimization approaches proposed in the area of adaptive hypermedia systems whose goal is to define the optimization problem in this type of system. Then, they present the architecture of their proposed system. The first step involves choosing a learning style model. The selection of this style is done by using a dedicated questionnaire answered by a learner. Then a modeling of the learner is completed based on his learning style. Finally, content that is to be presented to the learner is managed by a content generator module, depending on the model of the learner. Built on methods and techniques proposed for modeling and adaptation, the adaptive hypermedia system based on learning styles provides optimized adaptations. The authors’ approach has been experimentally validated and the results are encouraging.

KEYWORDS

Adaptation, Adaptive Hypermedia, Learner Model, Learning Styles, Optimization

1. INTRODUCTION

The presentation of information in hypermedia relates to an area that is much researched and discussed. Hypermedia systems have become very popular thanks to the facilities they offer learners accessing information. The systems are designed to promote the acquisition of knowledge through a set of documents in the form of nodes (text, images, sounds, and animations) connected by links (Tircot, 1994). This offers a set of paths among the data for each learner to choose from (Brusilovsky, 2001). Adaptive hypermedia systems have the ability to change their characteristics according to their perception of the learner’s goals, personal characteristics, preferences, and knowledge (Brusilovsky et al., 1994). Thus, adaptive hypermedia systems are designed to align the content of hypermedia documents with user profiles. For this purpose, they use one or more models to represent knowledge and have one or more adaptation strategies.

The objective of adaptation is to provide the user with relevant information and to present it in an appropriate manner at any time (Fischer, 2001). In hypermedia applications, many adaptations can be found for a single learner. In this sense, the most appropriate information means the information that has been best adapted for a learner. The aim of our research is to provide the most appropriate information for a learner at any time, according to his learning style.
2. EXISTING ADAPTIVE CONTENT OPTIMIZATION APPROACHES

In this section, we present the optimization problem in the field of adaptive hypermedia applications. We base our presentation on the study of some adaptive content optimization approaches to compare with our proposed solution.

2.1. GAITS Approach

GAITS was one of the first educational hypermedia systems using genetic optimization algorithms. Supervised education techniques are used, the teacher assigns an educational goal for each student before training begins (Quafafou, 1993).

In order to provide optimal educational content, the tutor interacts with the learner using predefined dialogues. These dialogues consist of a header and a body. The header contains the preliminary knowledge required to use this dialogue as a candidate of the current lesson, a learning level, and a learning strategy to present the lesson. The body represents the educational material that defines the interactions (exhibition, question / answer, games, etc.) (Mock, 1996).

2.2. Approach by Ant Colony

Several research studies have used algorithms ant colonies (a class of evolutionary algorithms recently proposed for difficult optimization problems). The goal was to track the learner when navigating through the links courses and study his footsteps.

With a simple decomposition of content in sections and units, the ant colony algorithm could solve the problem of guiding users on their path. The main mechanisms used in this algorithm is the propagation of information (the effectiveness of the teaching of content units, relevance of bows, and the tendency of users) accumulated by the system through user navigation between units content. This information’s communication mechanism described the operation mode of the ant colony. The objective of this switching device is to guide the user to the most consistent unit. (Haddi et al., 2008).

Another approach consists to assimilate the user as the ant (Dahbi et al., 2014). Modeling content in the form of a directed graph allows applying this algorithm. Each node of the graph represents a concept, each directed arc represents the opportunity to spend this concept to another. The user can then be assimilated to an ant looking for the best way to achieve the goal, passing the tests related to the final lesson of this course. The best way forward is built gradually through the pheromone left by the user throughout its course, failures and successes. Such approaches are used for groups of users by recording track of users during navigation in the set of content.

2.3. Optimization by Adjusting the Presentation of a Hypermedia Document

In (Bruno and Philippe, 2001) an algorithm for adjusting the presentation of a hypermedia document was proposed. The purpose of this algorithm is to best satisfy the requirements of a hypermedia document author. The problem is modeled as a minimum cost tension problem in a graph and an algorithm based on compliance method (out-of-kilter) for the minimum cost flow problem has been proposed.

According to the algorithm presented in (Bruno and Philippe, 2001), the variety of components that make up a document (audio, video, text, image, etc) make the animation a complicated problem. These documents are composed of multimedia objects with presentation times must be adjusted to satisfy a set of temporal constraints which reflects the unfolding of the animation proposed by the author. But for its constraints are satisfied, the author must accept some flexibility regarding the ideal duration of each object, the non-explicitly expressed time is completely prohibited.

To estimate the quality of adjustment, cost function is introduced for each object. If the object remains at its ideal duration, the cost is zero, otherwise it is positive and it increases as the adjustment moves away from the ideal. This generally translates in practice by a convex function of cost. In
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