UML design model of the learner and the domain model in a dynamic adaptive hypermedia environment

A.BOUCHBOUA, R.OUREMCHI, F.MESSAOUDI, M.EL GHAZI

Laboratory of Transmission and Processing of Information
Department of Electrical and Computer Engineering, the Higher School of Technology, Fez
Sidi Mohamed Ben Abdellah University, Morocco
ahmed.bouchboua@usmba.ac.ma
rabah.ouremchi@usmba.ac.ma
faycal.messaoudi@usmba.ac.ma
Elghazimo@hotmail.fr

Abstract

A new generation of advanced learning systems must integrate new pedagogical approaches giving the learner an active role in learning, build his knowledge to give the possibility to integrate a learner-centered vision. The dynamic adaptive hypermedia systems in the field of distance education bring some solutions to these issues; their goal is to adapt the presentation of knowledge and help the learner navigate through the graph which includes all pages and links.

This work’s objective is to achieve the conception of a dynamic adaptive hypermedia system and implement its various models, and for that we are proposing an open-architecture for our system which is mainly composed of five main modules: the learner model, the domain model, the pedagogical model, the courses generator and multimedia database. [1] The first: the knowledge model. It is intended to identify relevant concepts and their relationships and provide an overall structure of the learning area. This model focuses on the development of a design environment for authors to produce pedagogical content dedicated to learners. [2]

1. Introduction

Pedagogical contents are generally presented to learners as a hypermedia called classic. This kind of hypermedia, presents the same pages and links to all learners, without taking into consideration their needs, preferences and knowledge on the contents they treat. So, links and unnecessary pedagogical content can lead the learner to a loss in his hyperspace and promote overloaded knowledge. Work on learner modeling put him at the center of learning process. One of their weaknesses is that they are not able to customize learning. E- Learning is more efficient when provided in the learning system, relevant information to personalize it and make it suitable to the student’s characteristics and preferences. Cognitive models become therefore not enough. Must be added the models containing cognitive, behavioral and psychological information, to make it a reachable system to heterogeneous population. For that, we should bring some adjustments to the system, to a threefold personalization of education, in the context, skills and prerequisites. This would allow a long term learning and in different contexts. So, we will place the learner as the main actor of the learning process and observe the system from his side, to give him the opportunity to manage himself his own self-knowledge.

We will present in this paper, our architecture system dedicated to distance learning. Then, we will detail the design study, using UML (Unified Modeling Language) and the proposed methodological approach for the realization of a simple dynamic adaptive hypermedia adapted to the needs expressed by concerned stakeholders.
present the cognitive state of the learner. It focuses on a prediction unit to predict the next concept that could be visited by students and also promotes the autonomy of the learner who has a need for feedback, to enable him estimating the effort it provides and those that remain to be provided. [3]

The third: is the learner model which allows taking into account the different characteristics of the learner, namely, personal information, needs, preferences, attitudes and skills. These parameters can be acquired by questionnaires that help detecting the learning style of each learner and monitored from the interaction of the latter with the system.

The fourth component: is the multimedia database. This database contains the concepts and documents to be presented to the learner, depending on the domain model [5]. These documents are characterized by attributes that help to identify those that should be presented to the learner.

The fifth and final component: called the courses generator, is considered as one of the most important parts in our system, because it connects different parts of the system defined above and allows us to offer a virtual hypermedia. Thus, pages and links will be built dynamically, taking into account the learning style and cognitive state of the learner. It allows, then, to restore, at some point, the concepts and links of a page and to display it. And so after having realized a first filter on the fragments in order to select those corresponding to the course given, it will be applied a second filter to select the fragments corresponding to the learning style of the learner to retain only fragments correspondingly adapted at the level of knowledge required.

Figure 1 shows the overall architecture of our dynamic adaptive hypermedia system.

3. Modeling of our dynamic adaptive hypermedia system

After studying the different needs and pedagogical aspects, within the Higher School of Technology of Fez (ESTF) and further to the analysis of the various elements and models of our system defined previously, we are going to dedicate this part to the abstract study, which allows the identification of functional needs expressed by the actors concerned, namely, the author who is the elaborator of the contents, the teacher who plays the role of a tutor and an assessor, a learner who is the user of the educational contents and the administrator.

The related actions between these actors are, on one hand, the identification including the identifier and the password for the access to the features of the system and on the other hand, the participation in the communications activity (Forums, Chat and Email). So
the consultation of the events declared in the hypermedia.

To reach the goals expected by our system, this modelling approaches four main parts which are the domain model, the educational model, the learner model and the administration part.

3.1. Domain Model

The concept of adaptation leans, for the generation of the on-line adaptive, adaptive educational contents broadcasted online, on the separation of the contents of the shape which will be presented, where it allows, and all the time, to choose the adequate concept to every learner and to choose the appropriate contents to the pages which will be presented in a separated way from the structure.

Furthermore, the observations made in academia shows, that uniformity in how to develop online learning environments that enhance the visibility of the training facilitates the management of educational content for the establishment and provide for learners an environment that encourages learning.

In most current hypermedia, the author is faced with the problem of multiplication of content sources; also, the results are often unsatisfactory, as regards the graphic and ergonomic adaptation of educational content to the needs of the learner and the institution.

In this context, our system can provide some solutions to these problems. It allows, in effect to:

- Adapt the content according to the needs of learners by a simple recreation of content while avoiding duplication.
- Facilitate the maintenance of the information through a logical multi-media publication, therefore, a single source of content and multiple media publishing products.
- Enrich the content, products with multimedia resources such as videos, flash animations, sound and images etc...
- Enhancing the educational content with assessment activities and exercises.
- Create compatible content with SCORM.
- Provide all training support structure and a uniform presentation graphic and ergonomic interface.
- Exchange-generated content with other institutions and between authors.
- Suitable for authors who wish to produce course content, simple and quick releasable.
- Allows you to create a documentary background scripted, structured, reusable and independent publishing format.
- Generates multiple media publication (paper, slideshow, SCORM) adapted to different contexts of use.

3.1. Structuring

The first step in developing the content is to cut the course grains. This allows structure and hierarchy, pedagogical content which is composed of a set of elements that can be defined as follows: [6]

- Teaching Module: the granularity of the upper structure of the educational content that can be associated to metadata used to describe content. That would facilitate course management and optimize research. It must have a Title giving indicators on the course content.
- Division: The division is the most encompassing content. It may contain learning activities such as assessment or it may also contain other divisions. A division must have at least a grain which is open by default in the division.
- Grain Content: The grain is a set of paragraphs composing a semantic unit. If the grain is long, it can be divided into recursive parties.
- Part: This is a set of educational blocks with a common educational goal. The use of parts suitable for prioritized over two levels content.
- Pedagogical Blocks: If the grain is short, it will consist of directly teaching blocks. Each block will be materialized in media.
- Pedagogical activity: It is a set of activities in which the learner interacts with a fixed-term educational content. It can be a learning activity or a valuation activity:
  - Learning Activity is the trainer proposed by default in a module. It cannot contain other learning activities and its structure includes one or several questions synthesis and general references.
  - Evaluation Activity: it contains only the type quiz questions. Its structure includes a modular feedback, depending on the score obtained on all exercises.

3.1.2. Scenario

The patterning step, cited above, is to cut content teaching units. Each of these units will then be scripted. This script is the second step in the process of realization of educational content available online.

It involves planning all educational activities such as learning activity or activity assessment in time and space, for a given population, taking into consideration the characteristics of learners (level, skills, ...), as it can make a clear correspondence between the different parts and elements of the content.

The diagram below helps to understand this correspondence, in general:
Fig. 2: Structure and scenario of the learning object

To better script our learning objects and to clarify the scheme, we detailed in the following figure, the main elements of the previous scheme.

Fig. 3: Detail of the structure of the learning object

3.1.3. Publications

Our system gives the possibility to the author at any time to publish educational content in multiple media of publication:
- Web support (HTML, SCORM).
- Support PDF Paper.

3.1.4. Use Case Diagram creation of pedagogical content

For the creation of pedagogical content, the author is responsible for developing its structure either by choice of a template and modify it later, or through the creation: step by step.

This development allows the creation of many elements, called, instructional module to teach the concepts, chapters and sequences that will be considered as basic units of content. Each author will be assigned to a workflow to validate or reject educational content. Therefore, we consider this workflow as a "system actor".

Fig. 4: Author's use-case diagram

3.1.4. Class diagram of domain model

Figure 5, below, details the various components of the domain model. This model focuses on the development of a design environment for authors to develop educational content dedicated to learners and can be adapted to various learning situations.
3.2. Learner Model

In our approach, the learner can be modelled first by his personal information, then, by his knowledge of the domain, and then, by his preferences, educational objectives and its interactions with the educational content. [7]

The construction of the student model is divided into two phases.

3.2.1. Initialization learner model Phase

- Filling out a form with personal information including the identifier of the learner and his password and his teaching career. This information will be stored in the user table.
- Reply to the questionnaire "ILS" to easily detect learning style according to the Felder-Silverman model [8].
- passing pre-test to define the initial cognitive state with respect to different concepts of educational content and decide on the structure of the learner own concepts.
- The results of the pre-test will be stored in the "response-learning" table, and then, follows the generation of records in the "cognitive map," table where are stored the cognitive state of the learner, for each concept of pedagogical content.

3.2.2. Update Phase

This phase allows to dynamically registering information indicating the degree of understanding of the learner’s cognitive level and in every part of educational content during the learning process; such information is the parameters obtained during its navigation course.

Our system allows: monitoring, supervision of the learner and the registration of all his tracks during his navigation on hypermedia and for the award of pre-tests and post-tests for each learning objective.

Updating the cognitive state of the learner is made in three steps:
- The generation of the records in the "interaction - learner" table following each learner interaction with the system.
- Calculate the new cognitive linked to the objectives and concepts of educational content state.
- The update of the cognitive map, as the new cognitive state of the learner in relation to each part of the course content.

3.2.3. Use Cases "learner"

After the registration and authentication phase, the system starts by identifying the learner. If this is the first use, the Felder-Silverman questionnaire will be presented, to easily detect his learning style.

Also, in addition to the common features of communication, learner mainly uses the system for consultation and educational modules to perform work. After reaching an expert level, it may propose course. They will spend subsequently in a Workflow.

The transition from one concept to another requires an evaluation. The student will be invited to answer multiple choice questions, single choice or open questions to determine if he understood the previous concept or not. When a learner chooses a course for the first time, the system will issue a questionnaire called knowledge to initialize the sub-model knowledge.

The system allows the learner to see its situation and its progress, during the learning process. It is also to be noted that the learner has the possibility to adapt the ergonomics of the interface assigned to it, the choice of the preferred language or to reshape the structure of the pedagogical content. Therefore, we propose an adaptive system as well as adaptable, so that the learner can change some characteristics of the system, to adjust it to his behavior.

The learner’s use-cases diagram illustrated in Figure 6, below, summarizes the tasks that the learner can perform on our system.
3.2.4. Class Diagram of learner model

This class diagram allows to manage learners and assign them to the virtual groups, to perform work, as it represents a package containing the objects relating to the learner, namely: the data which were intended to follow its activities and keep its traceability during a session of learning.

The general structure of the pedagogical content adapted to the profile of the learner will be chosen by this model. Who will also assign a learning style and a cognitive type for each learner.

4. Conclusion

Throughout this article, we have studied the various elements of the architecture of our system. Thus we explained the various features proposed by the system. We have also presented the detailed design of the proposed solution. In this context, we split the system into four parts: the domain model and evaluation; the pedagogical model; the learner model and finally the administration focusing on that of the learner and domain.

5. References


