A Computer Integrated Framework for E-learning Control Systems Based on Data Flow Diagrams

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Abstract: E-learning is currently considered as a valid and effective didactic methodology in courses at different levels such as high-school or university education, or net-based teaching. In scientific fields the adoption of e-Learning is more complex since courses have to include not only theoretical concepts but also practical activities on specific instrumentation. Over the past two decades, diverse research efforts have been made towards the personalization of e-learning platforms. This feature increases remarkably the quality of the provided learning services, since the users’ special needs and capabilities are respected. The idea of predicting the users’ preferences and adapting the e-learning platform accordingly is the focal point of this paper. This paper discusses different control systems in virtual educational system and highlights their properties. In conclusion, we derive data flow diagram (DFD) of a control system in e-learning environment designed to aid the managers for better control and decision making.

Keywords: E-learning Systems; Control Systems; Data Flow Diagram (DFD); Computer Integrated

I. INTRODUCTION

The advance in information technology creates a need and an opportunity to access a broad diversity of information at many places and at any time. Modern life also means that people have to be very careful with their time if interested in taking advances as offered by information technology. Consequently, the amazingly rapid development of technology during the recent years has the power to facilitate this call for web-based systems regarding information and knowledge, using computers to introduce e-learning systems [1-4]. The e-learning systems, which are able to satisfy the requirements of both novice and advanced users, are an area of interest which is always under the spotlight of research efforts. In this context, the user preferences should hold a primary role in personalization and should dictate the structure and functionality of the entire adaptive educational system [5, 6].

Embedded in a so-called User Profile, one of the issues that must be addressed is the prediction of the user preferences and, in general, the modelling of the user’s profile in terms of the user’s overall performance, content, and system/platform characteristics.

The field of e-learning systems has received significant research attention over the past few years. More specifically, numerous web-based learning systems [1-3] have been developed, aiming at being ubiquitously available and therefore facilitate a user’s learning by saving time. For such web-based learning systems, research has proposed different architecture approaches and the usage of distinct components to make up the architecture of the system and contribute to a system’s personalization. More particularly, in [7,8], it followed a similar pattern in the architecture, as using the Learner Model (User Profile), Adaptation Model (Adaptation Filter), Detection Mechanisms, Instructional Views (Display Engine), Content Domain (Lesson Plan) and Feedback, as the components of an architecture to realize an e-learning platform. Moreover, [5] use as Value-Added Services, Student Modelling Servers, and Topic Based Inference Agents as the main architecture components. In [9] context interpreter is used in addition to the typical architecture [8], as a component, which helps the “translation” of the context and automatically processes the “annotated content”. In [6] a layered model is used, using a more complex architecture consisting of the components conceptual model (Domain Model), goal and constraints model, User Model, Adaptation Model, and Presentation Model.

For comparing the e-learning system and traditional learning system, two comprehensive studies are illustrated. Mahdavi et al. [10] compared traditional system with virtual educational system statistically in Iran. In this way, by means of economical equations and statistical analysis, they illustrated a survey in depth. Finally, by means of hypothesis testing, they illustrated that the best option for educational system is the combination of both systems. Fazlollahtabar and Sharma [11] compared traditional engineering educational system with the e-learning engineering educational system on the economic dimension using hypothesis-testing approach in Iran. The comparison involved trend analysis and prediction based on costs and benefits of the two systems. Interestingly, the analysis revealed that the traditional system had greater advantage on the economic dimension. Several factors support the e-learning system despite the associated economic disadvantage. The final analysis provided results in favor of a blended system, which takes advantage of the traditional and e-learning systems.

Different studies have been worked out on cost optimization within e-learning environment. Mahdavi et al. [12] identified varied cost elements in e-learning educational system and optimized them by means of mathematical programming. Then they proposed an effective method to estimate the learning cost between any two skills of learner using the grey relational analysis. Mahdavi et al. [13] developed their previous study combining the grey relational analysis and a radial basis function network to estimate the learning cost between any two skills after identification of varied cost elements in e-learning educational system and optimization by means of mathematical programming. Fazlollahtabar and Yousefpour [14] applied the cost elements in the e-learning educational systems and proposed a combination of grey relational analysis and a radial basis function network to estimate the learning cost between any two skills. An integer programming method was employed to
demonstrate that it is possible to facilitate the acquisition of single skills by considering a set of useful compound skills.

Finding the optimal (shortest) learning path for user or tutor has been studied in different researches. Fazlollahtabar [15] applied a dynamic programming to find the shortest path for users in the e-learning environment. Since the learning parameters are qualitative, he used an analytical hierarchy process approach (AHP) to turn the qualitative parameters into quantitative ones. Fazlollahtabar and Mahdavi [16] proposed a neuro-fuzzy approach based on an evolutionary technique to obtain an optimal learning path for both instructor and learner. The neuro-fuzzy implementation helps to encode both structured and non-structured knowledge for the instructor. On the other hand, for learners, the neural network approach has been applied to make personalized curriculum profile based on individual learner requirements in a fuzzy environment.

Also Tajdin et al. [17] designed an assessment method based on real-time simulators. These simulators were able to facilitate education and play the role of virtual intelligent teacher referring to student capabilities by following the feedback mechanisms. This system, which was constructed by means of network and expert system, was contained a real-time simulator core that has an inference engine based on a hypothesis testing.

For analyzing users’ satisfaction in e-learning system, Mahdavi et al. [18] designed a heuristic methodology for multi-criteria evaluation of web-based e-learning systems based on the theory of multi-criteria decision making and the research results concerning users’ satisfaction in the fields of human-computer interaction and information systems.

Furthermore, many approaches have been used with regard to an e-learning system’s personalization in order to achieve adaptation. This is accomplished by using monitoring and evaluation methods during the learning procedure. For instance, it can be used as a student modelling server [5], explicit or implicit input by the user in the Detection Mechanism [8] or an adaptation filter, which “cuts” the implied unnecessary information for the user. Another method is used in [19], where it is shown that web navigation can be modelled by studying individual differences and behavioural metrics, using Latent Semantic Analysis (LSA) [20]. A user-based architecture of an e-learning system is presented in Figure 1.

Researchers and developers are making rapid improvements in the design and implementation of e-learning systems, resulting in continuous progress toward successful e-learning systems. In such environments a variety of architectures are designed and will be explained in the next section.

II. MANAGEMENT SYSTEMS IN e-LEARNING

Currently e-Learning is based on complex virtual collaborative environments where the learners can interact with other learners, tutors or the teacher. It is possible to give learner different synchronous and asynchronous services [21]. The former group includes virtual classrooms and individual sessions with the teacher or tutors. The latter group includes the classic didactic materials as well as Web-based seminars or simulations always-online [22]. These functions can be usually accessed by means of software platforms called Learning Management Systems (LMSs) [23], Training Management Systems (TMSs). A short description of those systems is as follows.

A. Learning Management System (LMS)

The LMS manages learners, keeping track of their progress and performance across all types of training activities. It also manages and allocates learning resources such as registration, classroom, and instructor availability, monitors instructional material fulfilment, and provides the online delivery of learning resources [24]. A Learning Management System is a large Web-based software application comprising a suite of tools that centralizes and automates aspects of the learning process through the following functions:

- register learners
- maintain learner profiles
- maintain a catalogue of courses
- store and deliver self-paced e-learning courses
- download e-learning modules and tools
- track and record the progress of learners
- assess learners
- track and record assessment results
- provide reports to management

Not all LMSs are fully Web-based; some administrative functions, like loading a new course might be executed through desktop applications. Since this limits flexibility, all LMSs should be migrated to fully Web-based implementations [24]. Some LMSs deliver additional functionality, for example, they can help:

- personalize content
- maintain job-based skills inventories
- identify skills gaps
- match staff to jobs
- manage compliance and certification
- manage classrooms and classroom resources
- track and report learning costs
- integrate Knowledge Management
- integrate live e-learning/virtual classes
- integrate collaboration tools
- support the whole learning value chain
- author content

In the same way that few users take advantage of word processor’s functions and features, few enterprises implement all the functions and features of an LMS.
B. Training Management System (TMS)

The TMS was around before the LMS. It’s a network application that manages and automates all traditional training activity. Like an LMS, it registers and tracks learners; however, the TMS assumes that all learning is face-to-face. It maintains catalogues of courses and classrooms, classroom resources and classroom events.

Its calendar function allows a trainer to book a classroom for a specific number of learners on specific dates and to book a projector, a flip chart, and any other resources she needs. Learners can then register for the course using an authorization code issued by their manager. The TMS allows the instructor to note in each learner’s personal records the sessions they actually attended. Behind the scenes, the TMS uses the authorization code to charge the cost of the course of the learner’s business unit.

With the arrival of e-learning, TMS vendors simply added a new module to manage what was to them just another learning resource online. When e-learning became more important, vendors changed the description of their product from TMS to LMS. Meanwhile new dot-com entrepreneurs were developing dedicated Web-based LMS applications that exploited the power of Internet technologies in ways the TMS-based systems couldn’t. However, it wasn’t long before prospective LMS customers asked the new entrepreneurs how they planned to handle classroom courses. The entrepreneurs simply added a TMS module to their LMS. Customers had to choose either a TMS with an LMS module or a LMS with a TMS module. That kind of confusion has dogged the market ever since.

III. DATA FLOW DIAGRAM

In this section, we propose data flow diagram related to the discussed control systems. According to the aforementioned explanations, the LMS and TMS systems are able to corporate many tasks in relation with student, teacher, and manager modelling in an e-learning system. In the proposed model, a process system is designed to get the information from the student and teacher, analyse them and keep the data for the management. In this system, the student may need the catalogues, lesson plans and so on. Also the students return their assessment of the learning system, do their registration, and track their educational condition. The teachers would provide the lessons and exam questions. The manager makes the decisions about acceptance or rejection of the registration and content of the lessons. The configuration of the primary system is presented in Figure 2.

![Diagram](image-url)

Fig. 2 The configuration of the primary system

Some details could be included in the primary system to cover the whole requirements of an LMS. In this complicated system, whole tasks of user/instructor modelling are being covered. Student would enter the system by registration or making his profile. After his registration is authenticated by the manager, he can be included in the process of choosing the courses, teachers and etc. Then the teacher gets the data from the user and analyses them for providing the necessary catalogues. The managers control and monitor all of the stated activities; whenever they face an inconsistency, they will reject the request and stop the process. All classes are recorded for being applicable in offline status. The reports of user and instructor are deposited in the data base storage. Teacher can assess the students through the homework and the online exams. When the teacher finds that the student is able to upgrade then the message is sent to the manager and manager would certify student’s upgrade. The data flow diagram is illustrated in Figure 3.

As it is obvious, the proposed system is capable to cover all functions of a control system to facilitate the educational goals via web. Also because of applying security controls, the system remains safe in the progress of user/instructor interactions. The advantages of the proposed learning management system include ease of use, being efficient from the security viewpoint, flexibility in choosing courses and teachers by students, availability, i.e. offline use is possible too, easy assessment, quick upgrade possibilities, simple monitoring system, and achievable implementation in any educational systems.

IV. COMPUTER INTEGRATED FRAMEWORK

Here, we design a computer integrated platform based on the proposed data flow diagrams. We divide the system to student profile, teacher profile and administrator profile. The description of the platform is given in the following sections.

A. Student Platform

In this section of the system, each student has his own web page as his profile. In his profile he finds his personal information as full name, entrance year, interests, research group, user name, password, etc. Another item presented in the students’ page is the courses. In this section the title of the courses, names of the professors, and other information about courses are presented. In offline class page a student can view the previous classes, which were recorded. Also, he can check the exam results. According to the time introduced in academic calendar, the student can attend the online classes. The configurations of the proposed platform for students are presented in Figures 4 – 9.

B. Teacher Pages

In this section teachers can insert catalogues of new courses that are viewed to students after administrator's confirmation. Different options and module are proposed for a teacher to insert a catalogue such as title, pre-courses, educational objectives, background, etc. Absent/present report is another capability of the teacher profile. The configurations of teacher section are shown in Figures 10 and 11.

C. Administrator

This section helps to manage courses and modules of the system. Facilities such as submitting new course, edit previous submissions, omit course, active courses, online/offline courses, class activity report, student evaluation
report are presented. Another section for administrator is security control options. Two of the specifications of the proposed CMS framework are the comprehensive security management and access control levels. Some facilities such as general setup, student activity control, student access level control, teacher access level control, student suspension, student activity observation are presented in this section. The configurations are illustrated in Figures 12 and 13.

Fig. 3 The data flow diagram of the proposed management system

Fig. 4 Student profile
Fig. 7 Notification for online classes

Fig. 8 Online classes
Fig. 9 Exam result

Fig. 10 Course catalogues

Fig. 11 Absent reports
V. CONCLUSIONS

The purpose of this paper is to explore management systems in e-learning educational system. Generally, for controlling and directing any system, management plays a substantial role. Management systems in distance learning are also significant in proposing a comprehensive learning system. In this way, Learning Management System provides properties of an educational managerial system, Training Management System concerns with special aspects of training. After explaining the tasks each of the management systems provides, we proposed the data flow diagram in an e-learning system which plays as a decision aid for the managers. Regarding to the representations of the proposed system, the efficiency, and functionality is illustrated. Consequently, a computer integrated platform is designed to support all aspects of LMS, CMS, and TMS. The specifications of the proposed platform indicate the capability and effectiveness of the framework.

REFERENCES


