Design of a Learning Management System for Small and Medium Sized Universities and Colleges

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Abstract - There has been recent trend towards the adoption of cloud-based Learning Management Systems (LMS). The benefits of cloud-based LMS systems include reduced costs and increased productivity resulting from sophisticated course development features, online course delivery, and anytime and anywhere availability of courses. Following the evaluation of a range of commercially available LMS platforms and their compatibility with our university information system, we have decided to develop our own LMS platform. This paper describes the design principles of the Parrot LMS platform and the main functions it supports.

Keywords: Information System Architecture, Cloud computing, e-Learning managements system, Education system

1 Introduction

Unicorn College (UC) is leading private university based in Prague, Czech Republic that offers Information Technology (IT) and Business Administration (BA) courses both to local and international students. For more than ten years we have been developing and improving our Unicorn College Information System (UCIS) that is based on the Unicorn Universe cloud platform and supports all business processes that are required for the day-to-day running of the college [1, 2]. The Unicorn Universe platform is a tool that supports the construction of applications from reusable components. All student related information, including student results, teaching materials, research projects and international internships is available online. Our students can access learning materials online, view their results, communicate with their classmates and lecturers, submit their assignments, and perform various other activities using the UCIS on a 24/7 basis. As the new generation of Internet savvy students enters the higher education system, they often find traditional methods of delivery of courses using lectures with a heavy assignment load difficult to adjust to. We have analyzed changes in the pattern of social behavior of our students over the last decade and our results indicate that while the students are spending increasing amounts of time online, they are devoting less time to university related activities [3, 4]. It can be also argued that as more student activities take place online, university education must follow this trend to remain attractive and relevant.

Using the UCIS as a platform for our courses we have been experimenting with various types of learning tools, including Interactive Textbooks, Podcasts, Nearpod, etc. for a number of years [3]. While our experience with using interactive learning platforms is still relatively short, it is evident that interactive classroom environment can make the learning experience more rewarding for the students and at the same time lead to improved learning outcomes. Our results indicate that the effectiveness of using an interactive learning platform varies depending on the type of course and on the attendance pattern (i.e. full-time vs. part-time) [5, 6].

We have been using various multimedia learning tools as standalone components; our plan is to integrate the LMS into most of our courses and at the same time to evaluate the effectiveness of interactive learning processes. We have been looking for a suitable LMS that is consistent with our strategy and objectives, and that adds value to our existing UCIS. We have evaluated several LMS products, including TalentLMS, WiziQ LMS, Adobe Captive Prime, Training-Online.eu, Blackboard, Moodle, and Haiku Learning [7, 8 and 9], but we could not find any system that matches our requirements, and consequently, we have decided to develop our own platform for creating and delivering courses for our students and external collaborators.

Our LMS platform called Parrot is designed to have enhanced security features and to be fully integrated with the UCIS system. As a cloud-based LMS solution, the advantages of the Parrot system include low start-up costs, accessibility, fast deployment, cost predictability, easy maintenance, scalability and customizability. The Parrot LMS will be initially aimed at small and medium sized universities and training organizations. New versions of the system will be designed to support a range of popular mobile devices, integrating the features of educational and training systems, and supporting the requirements of universities and other types of organizations involved courses delivery. In this paper we describe the Parrot LMS platform in sections 2, and give our conclusions and plans for future development of our LMS platform in section 3.

2 Parrot LMS Platform

Parrot LMS is a Course as a Service platform – a special type of a PaaS (Platform as a Service) for developing and delivery courses. The main design goal of the Parrot LMS is to create a cloud-based educational system that supports the development of a variety of courses that can be accessed...
by students and external participants. We have defined the following key requirements for the Parrot LMS platform.

1. Individual courses determine the structure of the learning blocks, topics and lessons. Lessons consist of explanations and prepared tests.
2. Students’ progress through individual lessons, answering questions and passing tests at the end of the lesson is managed by the system. Failure of the test indicates that the students do not fully understand the topic and results in repeating the study block or course.
3. Prior to taking the course, students may need to complete an entrance test.
4. During the course students may need to pass checkpoints.
5. At the end of the course students complete the final examination.

2.1 Parrot Application Structure

The Parrot platform is composed of two separate sub-applications: Parrot Business Environment Management (BEM) and Parrot Course (Figure 1). The Parrot BEM sub-application supports the central register of students, teachers, and other stakeholders and includes the accounting module; this sub-application will be implemented during the second phase of the Parrot platform development. Currently, we are focusing on the Parrot Course sub-application.

![Figure 1: The structure of the Parrot platform](image)

The sub-application Parrot Course is used to implement individual courses and allows teachers and course authors to create courses, and students to study the courses.

Figure 2 illustrates process decomposition of the Parrot course sub-application depicting the standard process flow.

- **Course initialization** process creates a new instance of the course that is prepared for content creation, but is not yet available to students.
- **Course content management** process supports the creation and maintenance of course content (for example, by adding lessons, questions, tests, etc.).
- **Course participant management** process performs student enrollment, withdrawal, suspension, etc.
- **Course study** process allows enrolled students to browse through the course structure and content and to perform various course activities (i.e. lessons, exercises, tests, etc.), manage their profile and track their progress.
- **Course archiving** process terminates the course, archiving and deleting the course instance.

2.2 Parrot LMS Terminology

Table 1 defines the Parrot LMS terminology used in this paper.

<table>
<thead>
<tr>
<th>Term/Definition</th>
<th>Description</th>
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<tbody>
<tr>
<td>Course</td>
<td>Course is a comprehensive unit of teaching (e.g. English 1st Year, Basic Physics for IT, etc.).</td>
</tr>
<tr>
<td>Block</td>
<td>Courses consist of Blocks; courses have between 1 and 9 blocks. Blocks are ordered units of teaching within the course.</td>
</tr>
<tr>
<td>Topic</td>
<td>Blocks consist of between 1 and 9 topics. Topics are ordered units of teaching within the block.</td>
</tr>
<tr>
<td>Lesson</td>
<td>Topics consist of between 1 and 9 lessons. Lessons are ordered units of teaching within the topic. Lessons include Questions.</td>
</tr>
<tr>
<td>Explanation</td>
<td>Teaching material for a lesson.</td>
</tr>
<tr>
<td>Question</td>
<td>Questions are clearly stated so that the corresponding answers can be automatically evaluated for correctness. Questions are of various predefined types.</td>
</tr>
<tr>
<td>Tutorial</td>
<td>Incorrectly answered questions from various activities are used to randomly generate Tutorials. Tutorials also contain about 30% of correctly answered questions.</td>
</tr>
<tr>
<td>Test</td>
<td>Tests consists from randomly generated questions from a particular component of the course. Test is set for the first or final lesson.</td>
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</table>
2.3 Business roles and Processes

There are five principal roles defined in the Parrot LMS platform. The **SysOwner** role allows users to create and initialize new instances of courses, and to delete existing course instances. The **Authorities** role is assigned to course owners. The **Executives-content** role allows users to manage (i.e. create, update, delete) course content. Courses can be managed using bulk administration (i.e. exporting or importing the entire course) or by administering individual parts of the course (editing lessons and questions). The **Executives-student** role allows users to assign students to a course. The **Student** role allows users to study the course, browse and view the course content, perform tests, carry out other activities such as manage their profile and track their progress.

2.4 Business Use Cases

We have identified set of business use cases (BUCs) within the processes of the Parrot Course sub-application. A sub-set of business use cases related to course content management process and to students is shown in Figure 3.

Identified BUCs allows course authors to import / export courses, define the course structure and to perform management of lessons, tests and questions. Test BUC involves configuration of tests (i.e. define the rules for question selection including number of question, range of topics, time limits, etc.). Students access courses through Course Portals; the Study Lessons BUC guides the students through the lessons, tests, exercises and checkpoints. A course or lesson can be rated by the students (Rate course and Rate lesson BUCs).

The final version of the Parrot Course sub-application will provide additional BUCs for course initialization, adding, removing and suspending students, and course activation.

Figure 3: A sub-set of business use cases of the Parrot Course sub-application

2.5 Technical Consideration

We chose Unicorn Application Framework (UAF) as the platform for the development of the Parrot LMS. Unicorn has recently released the UAF - a cloud-based, mobile-first IoT ready architecture that incorporates standard infrastructure services and allows application developers to focus on use cases that support business functionality [10]. UAF provides the environment for the implementation and deployment of uuApp (Unicorn Universe Application) – a component that implements a cohesive set of application functions designed to solve a specific user requirement.

The Parrot platform will be implemented as a uuApp. Based on the uuApp concept, each sub-application called uuSubApp will have its own application server (uuAppServer) and structured data store (uuAppObjectStore). The Parrot BEM sub-application is planned to be a single-instance application, so that one instance of the sub-application will be shared within the platform. The Parrot Course sub-application is planned to be a multi-instance application with each course implemented as a sub-application instance, using a multi-tenant architecture and micro-services.

3 Conclusions

Following the evaluation of a range of commercially available LMS platforms and their compatibility with Unicorn College Information System, we have decided to develop our own LMS platform. This paper describes the design of the Parrot LMS platform and the main functions it supports.

The expected benefits of the Parrot platform include reduced costs and increased productivity resulting from online course delivery for students and employees, anytime and anywhere availability of courses (ability to study the courses from the comfort of your home, or on your mobile device), and ability to replay any part of the course multiple times. Courses can be created on any topic delivering...
professionally developed and enjoyable content. Another important benefit of the Parrot platform will be its close integration with the Unicorn College Information System. Testing the various functions of the Parrot LMS platform within our university environment with the active participation of students and lecturers will undoubtedly accelerate the development of the platform, and give us confidence that the anticipated benefits of the cloud-based LMS solutions will be attained. We are currently working on detailed technical specification of the Parrot LMS platform and the first development phase which covers the Parrot Course sub-application.

4 References


