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Supervising Student Projects Using Content Management Systems

Milena Stanković, Milan Rajković, Petar Rajković, and Ivan Petković

Abstract: This paper explains the concept of web content management systems (web CMS) and presents a CMS called Centura, developed at the Faculty of Electronic Engineering in Niš. The way this solution can be used for supervising student projects is discussed in details. We also present the architecture of Centura, emphasizing the elements in the logical structure that can be used for adding new functionalities to the system, without changing the existing application architecture. Using this extension points, we introduce new behavior for standard elements, adjusting them to meet special requirements of student project management.

Keywords: Content management systems, project management.

1 Introduction

The expansion of Internet during the last decade has revolutionized the way people get and exchange information. The significance of the Web is shown in the fact that there is rarely an important institution without a Web site. Its fast growth has been followed by increased demands that Web sites have to fulfill, in terms of services and information they have to offer to the visitors.

The main problem that Web masters are facing nowadays is how to manage and update Web content in a timely manner. The larger an organization is, the harder it is to manage information on a daily basis, especially if the organization consists of many departments. This problem is especially critical for campus Web sites, where Web managers are challenged to meet user expectations in a highly decentralized environment with very limited budget. Courses and majors, academic programs, financial aid, tuition, and fees are the pieces of content most often named

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The authors are with Faculty of Electronic Engineering, University of Niš, Beogradska 14, PO Box 73, 18000 Niš, Serbia and Montenegro (e-mail: mstankovic@elfak.ni.ac.yu).

to be of importance to students browsing a university Web site [1]. Moreover, these sites have become the primary marketing tool for colleges and universities [2]. That is why having updated, pleasant looking and easy to use Web site is of great importance for these institutions.

The best solution of the site maintenance problem is to provide more control over the Web site to non-professionals. This way, people inside the organization can add or update Web pages according to their privileges, without a need for frequent Web master's interventions. Systems which provide this possibility are usually referred to as Web *content management systems (web CMS).*

Some of the main benefits of using a CMS are streamline and automate content administration, distribute content management and control, separation of content from layout and design and automate workflow management [3].

Considering the reasons listed above, the researchers at the CIIT laboratory at the Faculty of Electronic Engineering in Niš started developing a Web CMS called *Centura.* This is a general purpose CMS, that can be used for managing Web sites of medium sized organizations. *Centura* is still in the development phase, but the first test version has already been used for managing the site of the laboratory.

Although *Centura* is intended for wide range of organizations, its extensible architecture allows specializing for various purposes. Significant effort has been made in order to create a version of *Centura* that would be adjusted for educational institutions, covering all special requirements that exist in these environments.

One of the common features that an educational CMS should support is the management of student projects. The online tracking of a project development enhances the communication between students and teachers and brings more control to the entire process. This paper describes how *Centura* can be used for the supervision of student projects, and explains the benefits of using the CMS for managing this procedure.

The second part of the paper describes the main parts of the *Centura* CMS. The third part shows the architecture of *Centura,* emphasizing the elements used for the supervision of student projects. Finally, we explain the actual workflow defined for project management.

2 The Main Parts of Centura

Centura is written using PHP and JavaScript on the top of the MySql database. It is a general purpose CMS which consists of a *front-end*, that is basically a Web site that can be accessed by all users, and a *back office* (Figure 1) which is intended for the people who have the permission to create and manage content. Although *Centura* is a Web application, its reach client interface reminds of desktop applications.

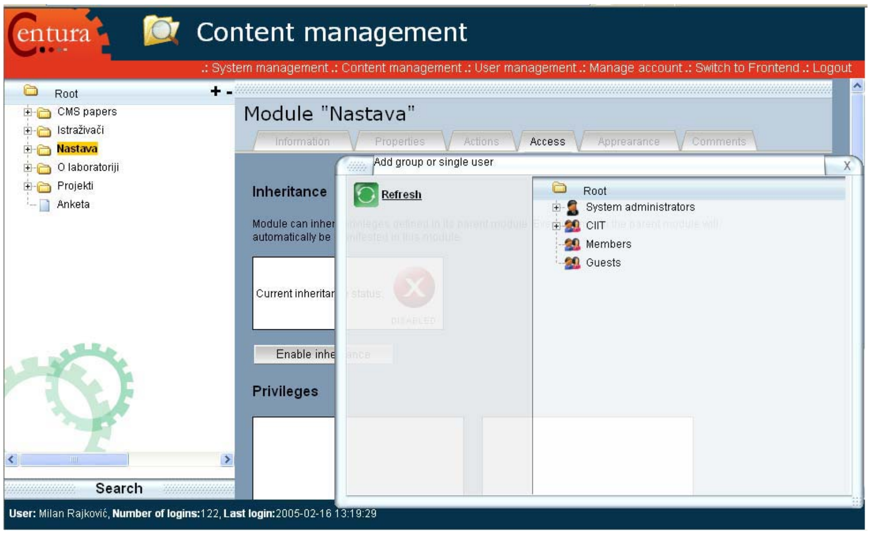

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Fig. 1. The back-office of Centura

The back-office provides the functionality for managing site content, users, settings and accounts.

The site content is hierarchically organized using the concept of *modules*, which are similar to folders in operating systems. Modules act as containers for other modules, binary files or items, but more importantly, they are used for setting the access permissions for users and groups. Basic access privileges are: *read*, *write*, *delete*, *publish and admin*, but some special-purpose modules can have other predefined privileges, which are a combination of the basic ones.

An item is the key concept of *Centura*, because it represents a Web page that will be displayed in the front-end. Items are XML structures which enable creating different types of Web pages like *articles*, *courses*, and *polls*. They are created and edited using an online XML editor which is also a part of *Centura's* back-office.

The CMS supports advanced user management and access control. Users are organized into groups which all have administrators assigned to them. Users and groups can be later attached to modules by setting the corresponding access privileges (Figure 1). The concept of the group administrator makes the user management completely distributed, where every group is controlled independently.

3 The Concept of Centura's Extensible Architecture

Considering the fact that a CMS represents an abstraction of functional requirements common to the majority of Web sites, it can not effectively meet special demands that users may have. That is why it is sometimes necessary to create a special purpose CMS that matches specific business rules.

With this in mind, authors of *Centura* created an architecture that is easy to extend. By inheriting from basic classes, new functionality can be added in order to adjust *Centura* for special requirements. As it has already been said, a lot of work has been done for the purpose of creating a CMS specialized for educational and e-learning sites. Figure 2 shows a class diagram with some of the basic logical elements in the system. Taking into account that these elements are hierarchically organized, we used the design pattern *Composite* to implement their recursive composition [4].

There are two points of extensibility in the architecture shown in the Figure 2. The first one is the *CModule* class. It is possible to create new types of modules by deriving from the *CModule* class. These new containers can define access privileges, workflow and their structure. They can also introduce predefined items, which are automatically added to the module after it is created. In this way it is possible to define a new behaviour for a module, which is more suitable for specific purposes. We introduced a new type of module for handling all the requirements of student project supervision, and implemented it using the *CProjectContainer* class.

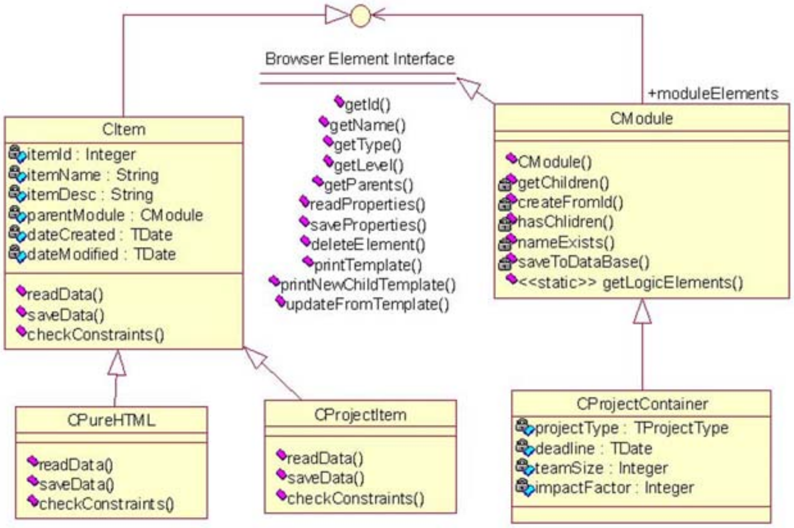


Fig. 2. A part of *Centura's* logical structure

The second point of extensibility is the *CItem* class. By inheriting from this class, new types of Web pages can be created. We used *CProjectItem* to encapsulate general functionality related to the pages that are used for managing projects.

Regarding the fact that items are stored as XML structures in the database, defining new types of items includes defining new XML schemas. Later in this paper, we will show an example of XML structure used for project items.

It is important to emphasize that extension of the current architecture is done during the design time, by the CMS development team. Further development of *Centura* includes creating an API which will allow third party programmers to develop new modules and items, suitable for their needs.

4 Managing Student Projects Using Centura CMS

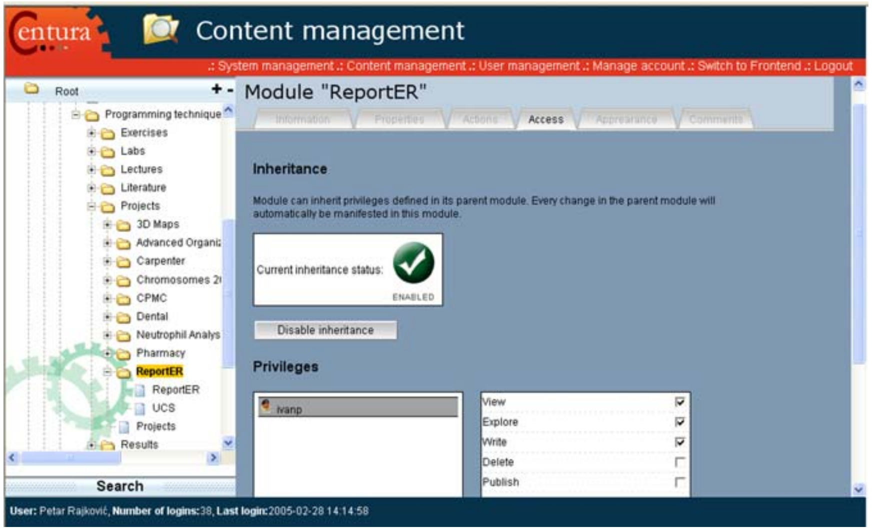
One of the most important characteristics of our educational content management system (CMS) is the ability to support the entire process of course management including management of student projects. When a module describing a course is created, a user has several options for defining its structure. The course module initially consists of the following sub modules:

- Lectures
- Exercises
- Labs
- Literature
- Results

The submodules named Lectures, Exercises, Labs and Literature include other submodules, articles and files, where the structure depends on their purpose. Professor has administrative privileges on each sub module created under the course module. On the other side, teaching assistants can access each sub module and administrate modules Exercises, Labs and Literature. In the module Lectures teaching assistants have only write permission, as well in the module Results. Students have access privileges for any kind of published material, and they can also send comments about each course's topics. The teaching staff has the privilege to create and administrate different polls, too.

Some courses have exams based on student projects. It means that students have to realize some technical, software or hardware system in order to complete their course. When a teaching professor decides to introduce projects in a course he or she should create a special submodule for that purpose. In our CMS this module is called *project container*. In the example shown on the Figure 3 the project container is named *Projects*. This module has all the functionalities of a common module, but also supports the workflow specific to the process of project supervision. Custom module of *Project* type has several specific properties:

- **project type** that defines the project workflow and dynamics,



Module "ReportER"

Inheritance

Module can inherit privileges defined in its parent module. Every change in the parent module will automatically be manifested in this module.

Current inheritance status: ✓ ENABLED

Privileges

View ☑
Explore ☑
Write ☑
Delete □
Publish □

User: Petar Rajković, Number of logins:38, Last login:2005-02-28 14:14:58

Fig. 3. The structure of the project container module

- **team size** that defines how many students will be assigned to each project and
- **impact factor** that defines the impact of the project in the final exam.

In our system for student projects supervision there are several project types, according to the specific course requirements. These project types are:

- Basic projects,
- Standard projects,
- Advanced projects

Different workflow is defined for each project type. Basic projects have simple, two steps workflow. On the other hand, standard projects have a more complex, five-stage workflow, and advanced projects full nine-stage workflow. Table 1 defines the workflow stages for each project type.

Students advance to the next stage of a project when they write specific documents and upload them to the server. The write permission, which is previously described, allows students to create specific articles and upload other necessary material. These specific articles are implemented as custom items inherited from *CProjectItem* class, shown in the Figure 2. An example of an XML item that represents a use–case specification document is shown on the Figure 4. Some fields (list of actors and list of use cases) are HTML enabled, so user can add graphical content (e.g. diagrams). When a document is uploaded or created it has to be validated first. This is done by a person who has the administrative privilege on the

Table 1. Workflow stages for different project types

Workflow stages	Basic projects	Standard projects	Advanced projects
System analysis	No	Yes	Yes
Use – case specification	No	Yes	Yes
Realization plan	No	No	Yes
Realization report	No	No	Yes
Test plan	No	No	Yes
Test report	No	No	Yes
Realized components installation	Yes	Yes	Yes
Documentation	Yes	Yes	Yes
Observations or white paper	No	Yes	Yes

module that contains projects. When document's property "valid" is set to active, it becomes public and can be accessed and viewed by each user with adequate access privileges. Valid document is locked for future changes, unless the administrator changes its state back to invalid. When all necessary documents corresponding to the specific project become valid, project is completed.

The main goal of the basic project realization is bringing some area of interest closer to students. This type of project is very suitable for courses (such are *Data structures*, *Compilers*, *Artificial Intelligence*) where students have to understand different types and classes of algorithms. Before the implementation starts, students get an adequate literature with detailed description of the problem. In some cases, the global view of solution methodology is provided too. After students have finished their projects they should write seminary paper with an overview of the problem and a description of implemented solution.

Duration of the basic projects is between two and four weeks. They are generally defined like projects for one student, and its impact factor on final exam is in range from 15 to 30 percent.

The standard project is a part of advanced courses beginning from sixth semester such are *Programming Methods*, *Database Design* and *Image Processing*. The purpose of this type of project is to prepare students for future work in specific area. During realization of these projects, students will face real problems and will have to complete many tasks and implement system response for many special cases.

Before the start of the projects, students get global project requirements and instructions how to organize their work. After that, they have to do system analysis and use – case model realization. Next steps are developing software, writing documentation and preparation of white or seminary paper. Completion of each workflow step is followed with uploading corresponded files and creating specific documents. These specific documents are based on templates like one shown on Figure 4. These templates are implemented like custom items.

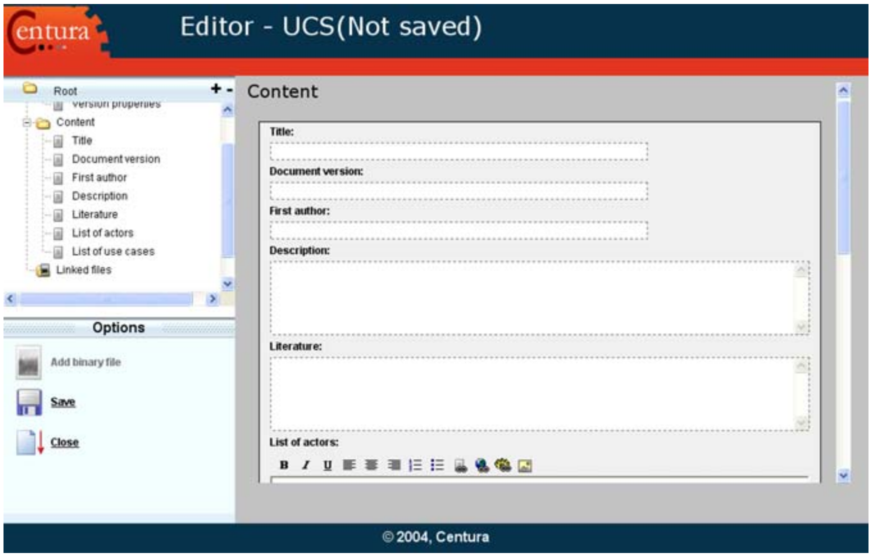


Fig. 4. Template for the use-case specification

The tasks for the standard projects are planned for two, extra three, students. The standard projects last from three up to nine weeks and bring impact factor from 30 to 60 percent. After the standard project is completed, the students have an additional week for completing documentation and writing a white paper. In some cases, when students realize a more complex project they do not have to attend written part of the exam.

The advanced projects are the most complex projects with the most complex requirements. The result of an advanced project should be stable software product that can be successfully installed on customer's computer or other electronic device. When we said "electronic device" that can be anything from microcontroller to smart phone or PDA. Result of the great majority of the projects is software for personal computers which operates under Windows or Linux environment. Students are encouraged to use both open – source and commercial platforms and developing environments according to their possibilities. Generally, there are no limits in choice of technology and platform for project realization, but open – source and cross – platform solutions are preferred.

Comparing with standard projects' workflow, the workflow for advanced projects is extended with another four steps. Those are *Realization Plan*, *Realization Report*, *Test Plan* and *Test Report*. The position of these workflow steps is given on

Figure 5. The main quality factor that is brought with advanced projects is strong insisting on testing and eliminating bugs as well as user – friendly interface.

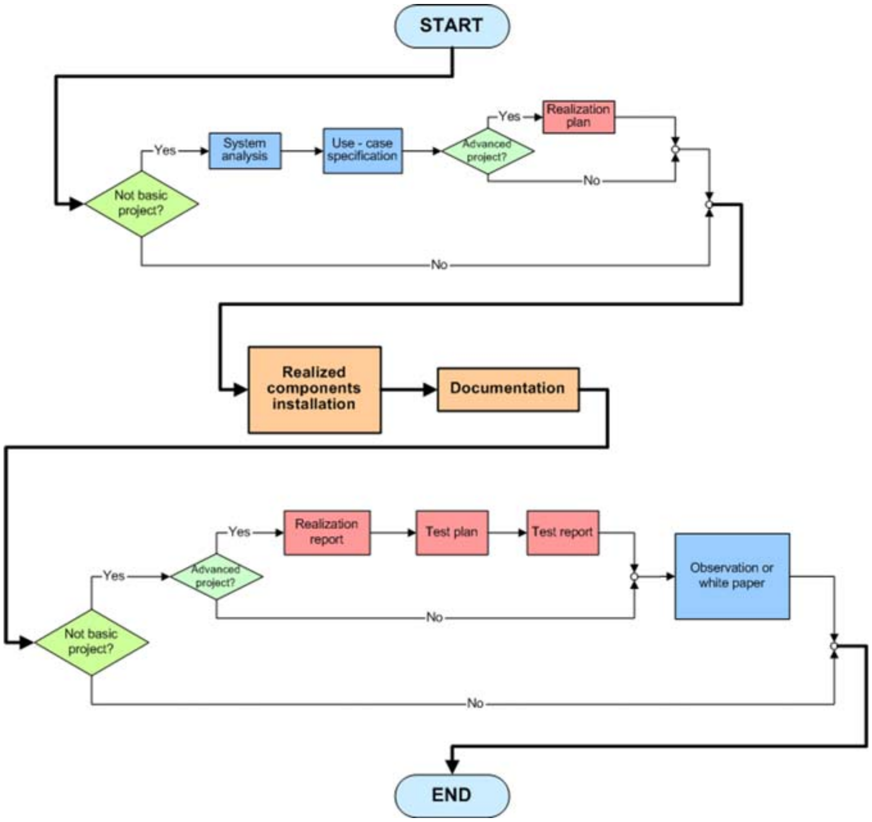


Fig. 5. Project workflow

As it has been noticed, the result of the advanced projects should be usable software and, in that sense, more working hours and more engaged students for single project are required. The standard team size for this class of projects is three students and a supervisor. The maximal number of advanced project's realization team members is limited on six persons. Those teams could be compounded both of undergraduate and postgraduate students and the project supervisor is teaching assistant or postgraduate student. The undergraduate students have at least ten weeks, usually twelve, to finish their advanced project. Upper time limit is fourteen weeks (full semester). Some advanced undergraduate students projects can last even more – twenty weeks or two semesters (one school year).

Also, students can take these long – term projects in order to complete two project – based exams, but this possibility is not so attractive to students. Impact factor of these projects is more than 60 percent, and realization of project from this category includes passing of written part of the exam. After finishing all necessary activities connected with project realization students have four weeks for preparing public presentation with software demonstration which is final part of the exam. Writing of the white paper for this project type is required.

5 Conclusion

In this paper, the process of student project supervision using content management system *Centura* is explained. The solution presented here, looks at the project management as a part of a more general activity of course management. This way, teachers have more control over the entire process than they would have using a simple organizing tool.

We also presented the underlying architecture of the CMS that enables adding new functionalities to the system, including defining special purpose projects or adjusting the workflow of the existing project types. Three basic project categories were explained in the paper in more details.

Although this part of the CMS is still in the development faze, we think that it will considerably improve the process of student project management, without bringing any significant overhead to the existing content management activities.

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