

Design and Implementation of an Effective Academic Web-Based Content Management System

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Abstract

In education, teaching and learning using Internet is one of the main important media for lecturers or instructors to provide teaching materials, post announcement, provide online quiz etc. AWCMS is a web-based system application developed to assist academics to create their personal profile and manage their course contents for teaching and learning purposes. Having this student-to-lecturer interface, the interaction between lecturers and students will be more effective and convenient. The research work comprehensive explained what content management systems is all about, its type and a review of work done in that area was carried out. The benefit of integrating this type of application in an educational setting was emphasized with a prototype design and implementation snapshots. The methodology adopted and utilized in this study is Structured System Analysis and Design Methodology (SSADM), using a 3-Tier application architecture.

Keywords: Academic Web-Based, Content Management, ICT

Introduction

The explosive growth of the World Wide Web has increased the technology for information dissemination. Besides that, the growth of software development becomes as important and the quick development tool for web development could assist non-IT user to use the web as communication medium. In education, teaching and learning; using Internet is one of the main important media for lecturers or instructors to provide teaching materials, post announcement, provide online quiz amongst others.

In today's global world, most educational institutions need a Web Content Management System (WCMS) to deal with higher volume of web content. Managing large web content is essentially important for an educational institution and requires some form of WCMSs.

As Harney (2009) posits "Increasingly, organizations are turning to WCMSs as a central

means of storing, managing, and editing all their web content including electronic documents, digital photography, audio, video and other forms of digital media". Given the increasing importance of web resources in higher institutions, the task of owning and managing a large website of higher education institution takes on a different meaning. Traditional web authoring programs do not often allow for a cost-efficient management of large institution website. Websites have become essential pedagogical tools in higher institution education. They are playing an increasingly integral role for delivery of academic, administrative, and student services. However, managing strategically and effectively the voluminous content of higher institution website may be a challenging undertaking. Many organizations have adopted WCMS to maintain a competitive edge.

A CMS is a computer program that helps users to publish, edit and modify the content as well as maintenance from a central interface (Boiko 2005; Rockley, et al 2003). One of its features is Web CMS which revolves around contents that are deployed on the Web. This feature allows non-technical users to control and manage a website with ease. The implementation of CMS is similar to that of other information systems and includes these steps: decision making phase, selection phase, development and implementation phase (TruongSinhand Chi-Trung, 2011). Mauthe and Thomas (2004), provide valuable insights into several aspects of content management, argued that content can be produced, altered, transmitted, consumed, and traded in parts or in its entirety. They suggest that content has two components: essence and metadata. *Essence*, in their view, is the physical representation of content in different forms and formats; it can be produced, stored, exchanged, transmitted or broadcast). On the other hand, *metadata* is defined as data about data. Metadata describes a content object considering different viewpoints, aspects, workflows, processes, and existing information models; it is essential to manage, search, find, and retrieve content whenever required.

Friedle (2003) defined Content Management as a discipline with the set of processes, technologies, concepts, and practices having to do with developing, collecting, managing, and publishing content. The author contends that a WCMS alone is not enough to solve the challenges of managing and maintaining Web content. He argues that successful content management starts with change management. Essentially, a WCMS has the power to make an institution competitive by facilitating content delivery on its website. It may empower content contributors as well as website users.

Problem Statement

In today's educational services advancement, there is need for a dynamic academic web content management system; a static departmental website is not desirable. The usual scenario is that department provides the desired information to the website administrators and they build the website section for the department as per the instructions. Any subsequent changes or additions to the website will require making a request for the same to the website administrators. This severely restricts the

flexibility and usability of the website for the department and its faculty members. It would be highly desirable if there were a system that could enable faculty members and students to engage in deeper academic activities by ways of real time updates of desired information on a departmental content management website on their own and whenever they want. This way, they can use the internet to communicate with the students much more effectively.

Objectives

The objectives of this study were to develop an effective Academic Web-based Content Management System for the Department of Computer Science, Nasarawa State Polytechnic, Lafia with the following benefits:

1. Increase productivity and performance amongst faculty and other staff of the department.
2. Knowledge sharing and transfer amongst staff and students through team work and collaboration.
3. Allows any of the users to update content without any technical expertise.
4. Make contents administration database driven.
5. Control access to information and guarantee feedback mechanism between faculty and students

Scope and Limitations of the Study

The design is using Department of Computer Science, Nasarawa State Polytechnic as a narrowed scope and it would also be limited by the following features; multilingual support and integrated language versioning, so also, payment system would not be incorporated into the design.

Literature Review

The history of web page content management in higher educational settings has developed from the use of websites as promotional tools and the development of distance learning courses in the nineties. Societal factors such as the greater integration of cell phones and technical devices into coursework (Cui & Wang, 2007) and campus life (Lever & Katz, 2007); generational shifts in communication behaviour (Vykoukalova, 2007); combined with trends towards web-based student services due to perceived greater accessibility (McNickle & Daniel, 2001); personalization and interactivity (Western Cooperative for Educational Telecommunications, 2002); as well as institutional factors such as the cost-effectiveness of web-based promotions.

Hoffer et al (2011) assert that “In the early days of the Internet, Web sites were often maintained by a small group of overworked developers; sites were often filled with outdated information and inconsistent layouts”. Indeed, Websites largely consisted of static hand crafted HTML code on convenient text editors (McKeever, 2003). Text, links, and a limited number of graphical images made up Web pages. McKeever (2003) provides a list of common problems which marked web pages:

poorly coded HTML code, broken tables, disconnected links, poor quality content and missing graphics. There has been a tremendous growth of web applications in the last decade. For example, there are sharp contrasts between the state of WCM in 1996 and 2002, as can be seen in Table 1.

Table 1: Evolution of WCM

<i>1996</i>	<i>2002</i>
* Static content	* Dynamic content
* Manual development of content to production	* Automatic development of content to production
* Simple architectures	* Multi-tiered architectures
* Tolerance to errors	* Lack of acceptability of errors
* Webmaster “bottleneck”	* Business user control

Source: McKeever (2003)

Table 1, illustrates the progression of content management from manual approaches to automation. Browning and Lowndes (2001) predicted the change from manual approaches to automation in website maintenance tools, when they compared the pre-millennial web and the post-millennial web. They argued that “The pre-millennial Web has been characterized by highly manual approaches to maintenance; the successful and sustainable post-millennial will have significant automation. One vehicle by which this can be achieved is the “content management

system” (CMS)”. The key tenet of this model is that with integration of information systems, “self-service authoring extends to the concept of ‘write once, re-use anywhere’, in which the Web is treated as just another communication channel along with email, word processor files and presentations. As websites became more complex, especially in the late 1990s, there was an urgent need for websites to accommodate higher volumes of content, more dynamic content, higher number of visitors, and increasingly complex supporting hardware and software. Effective content management tools were needed to handle the steadily growing content of websites. WCMS appeared to be indispensable tools to serve that purpose. As Rotella (2008) notes, “There are many useful technological tools for Web design and maintenance, but the advent of Web 2.0 and the interactive elements associated with it make Web content management systems (WCMS), also called content management systems (CMS), the most effective by far”. Therefore, as web technologies improved and matured, so did web content management systems. Today’s WCMS have become effective and efficient vehicles for web content delivery.

Types of Content Management Systems

According to Mullan(2012), when looking for a WCMS, a company should first determine whether their website will require a **basic CMS, mid-range CMS, or complex CMS**. These CMS can be categorized based on two different criteria which are either **Functionality or License**. Functionality identifies what goal each category of CMS is trying to achieve and which sector and platform is being used. There are four categories of CMS based on functionality. These are; **Web CMS, Enterprise CMS, Mobile CMS, and Component CMS**. Web CMS (WCMS) is one of the most popular types of CMS that involves the use of Markup languages for publishing, creating, storing and maintaining contents of a website. WCMS allows clients to take control over content, files, documents, and web hosting plans which are HTML-based depending on the system (Roebuck, 2011). Enterprise CMS (ECMS) is used by organizations for managing, organizing and sharing their large contents. These contents could be images, text, files et cetera (Rockley et.al 2003).

Component CMS (CCMS) focus on the creation of document from component parts. This includes graphics, links, a single word or even a complete paragraph of text. These components can be later reused within another document or across multiple documents. This guarantee that content is consistent across the entire document set. Each item of contents has its own life cycle which means that it can be managed individually or as part of a larger set of content (VasontSystem, 2010). Classification by license identifies if the CMS in question is free of use or not. There are two categories of CMS based on license; **Commercial or Proprietary CMS and Open Source CMS**. **Commercial or proprietary CMS** is a type of CMS that is owned by someone or a company and you need a permission or license in order to use it. In most case, even with the license, the license holders may still be forbidden to duplicate the CMS or make alterations to the application unless a more expensive /license is granted, (Wolfe, 2010). Open source literarily means source code availability. According to Raymond (1999), it suffices that the source code is publicly available and that it permits changes by users. OSCMS means a CMS that has the criteria of an open source. That is, OSCMS is a CMS that has its source code available for use or alteration by users or other developer community, as they like.

Drawbacks of an Open Source WCMS

Using an open source WCMS does not only have benefits; it also has distinct disadvantages. Arendt and Gerber (2009) argue that "Perhaps the greatest drawback of dispersed web editing occurs when owners do not take full ownership of their sites. In this case, the content can end up being stale or, worse, inaccurate. However, the area most affected by such problems has the ability to fix it." These are not the only issues with this model. Other issues include: (1) Lack of editorial review of content for grammatical or other writing errors; (2) Weaknesses in page layout and design, (3) Problems with image use and optimization, and (4) In some cases, issues with faulty coding (Arendt and Gerber, 2009). In view of these issues, it is imperative

that all necessary measures be taken into consideration before deploying a WCMS to manage the web content of an educational website.

Challenges to Effective Website Content Management

A significant challenge faced by web managers and others running university websites is identified by (Cox and Emmott, 2007). The large quantities of work produced by higher education institutions and increasing ability to edit departmental websites without specialized skills enabled by CMSs in many cases results in the decentralization of control over website content management. This can be highly problematic, in terms of consistency of navigation and user-experience and compliance with legal requirements with regards to copy-right and authorship.

As indicated by Cox and Emmott's (2007) survey, the most significant areas of concern raised by web managers within higher education institutions, in addition to lack of resourcing, were 'maintaining consistency with devolved content creation and currency of content'. While some web managers play more of an ambassadorial role, building relationships with the various departments, others negotiate the balance between centralization and devolved control over websites more aggressively; for example, by limiting training of departmental staff to more simple processes so that the central website team is required to maintain more complex procedures.

According to Ngoma(2011), it is suggested that a properly designed WCMS must support and be able to incorporate other web technologies (RSS, XML, SQL, DBMS, and DHTML) and new social media (such as Twitter, YouTube). Finally, it is important that schools and institutions consider the inherent benefits and shortcomings of a WCMS prior to its deployment. Centralization or decentralization solutions have their own challenges. In any event, data security must be salient feature of an effective WCMS. McGowan et al, (2013), concluded there is still a great deal to learn about web hosting and publishing issues and trends and the more general topic of web policy in higher education. Those case studies reflecting successful development, deployment, implementation, and maintenance of web policies can help model best practice.

Design Methodology and Architecture

Avison and Fitzgerald (1995) describe a methodology as a collection of procedures, techniques, tools and documentation aids which will help systems developers in their effort to produce a new information system. Methodologies provide a more systematic approach to software development, clearly defining tasks and giving greater management control, to avoid cost and schedule overruns (Avison & Fitzgerald, 1995). It is therefore essential that this study follows a methodology. The methodology adopted and utilized in this study is Structured System Analysis and Design Methodology (SSADM). SSADM is a widely used computer application development method in United Kingdom (UK) where it is originated and it is used as

a standard for many software developers in other countries of the world (Avison and Fitzgerald, 1995).

Description of Existing System

In an academic institution of learning, at the beginning of each academic semester, students register themselves at the academic division and department for documentation of their academic records. They do similar thing with corresponding course lecturers and tutors as the case may be. Finally, all the students submit their semester forms for course registration in their respective files at the department. This is the exact scenario of what is existing in the department of Computer Science, Nasarawa State Polytechnic, Lafia. Contrary to what is obtainable in higher institution of learning these days, where major departmental academic and other extra curriculum activities are computerized, with less paper work, instant information communication and dissemination with real-time faculty and students' engagements.

System Architecture Design for the AWCMS Application

Architectural design, deals with selecting the best way to structure or organize the programs with the aim of making it easier to read, understand, debug for errors and easy maintenance. The first phase of the software design is defining the software architecture. Software architecture is defined as a high level view of the system, the relationships among the subcomponents and their properties (Bellinaso, 2006).

The AWCMS application in this work applies the 3-Tier application architecture where the code for each area of responsibility can be clearly split away from the others as shown in figure 1.

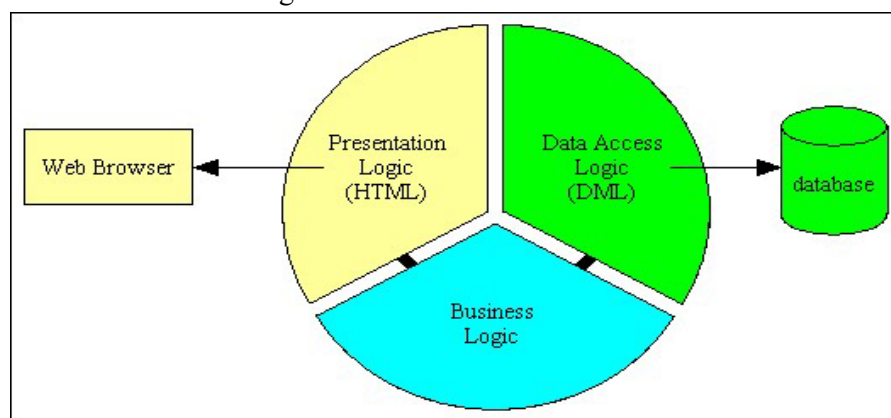


Figure 1: Three -Tier Architecture of the AWCMS Application

With this structure, it is easy to replace the component in one layer with another component without making any changes to any component in the other layers.

This structure also provides more reusability as a single component in the Business layer can be shared by several components in the presentation layer. This means that the business logic can be defined in one place yet shared by multiple components. In this architecture, the presentation layer has no direct communication with the data access layer-it can only talk to the business layer. The benefits of the 3-tier over other approach are reusability, flexibility, manageability, maintainability and scalability. The chosen architecture is translated into a High Level Application view as shown in figure 2.

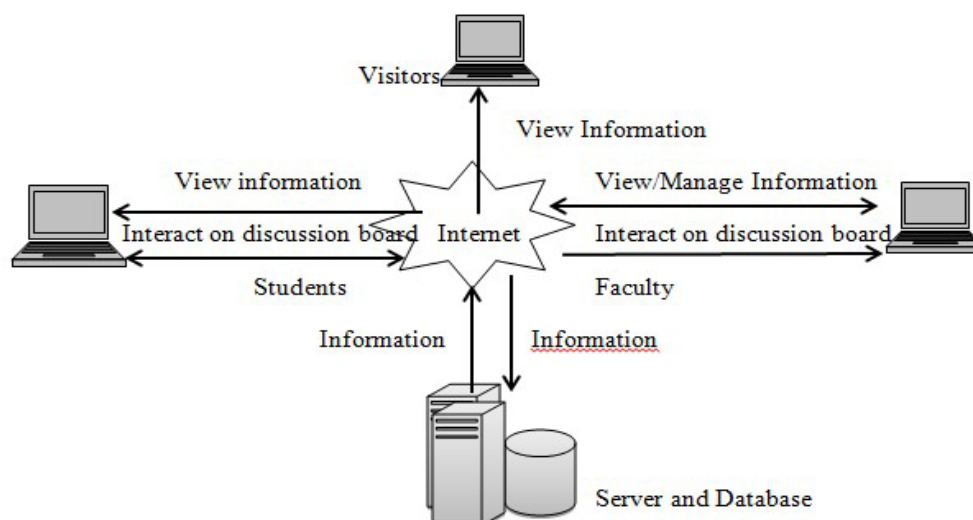


Figure 2: High Level Application View of the AWCMS Application

System Implementation and Evaluation

This section discusses the implementation stage of the software designed in this work which is described under the following sub-headings:

Choice of Development Environment

The application software developed in this work is tested in WAMP Server 2.5 installed on Windows 7 operating system platform. The programming language chosen for the implementation is JAVA using SPRING framework and IDE (Integrated Development Environment).

Also, in addition to JAVA which is used at the front-end for the core development, JavaScript, CSS were used for the Web user interface design. MySQL Database engine, a relational database management system (RDBMS) software was adopted as the backend in designing the databases in this research work.

Results and Discussion

Figure 3 to Figure 6 shows snapshots of the output for implementation of the designed Academic Web-Based Content Management System.

The Home Page

The interface in Figure 3 appears as the Home Page of the designed application after typing the appropriate URL on any available web browser.

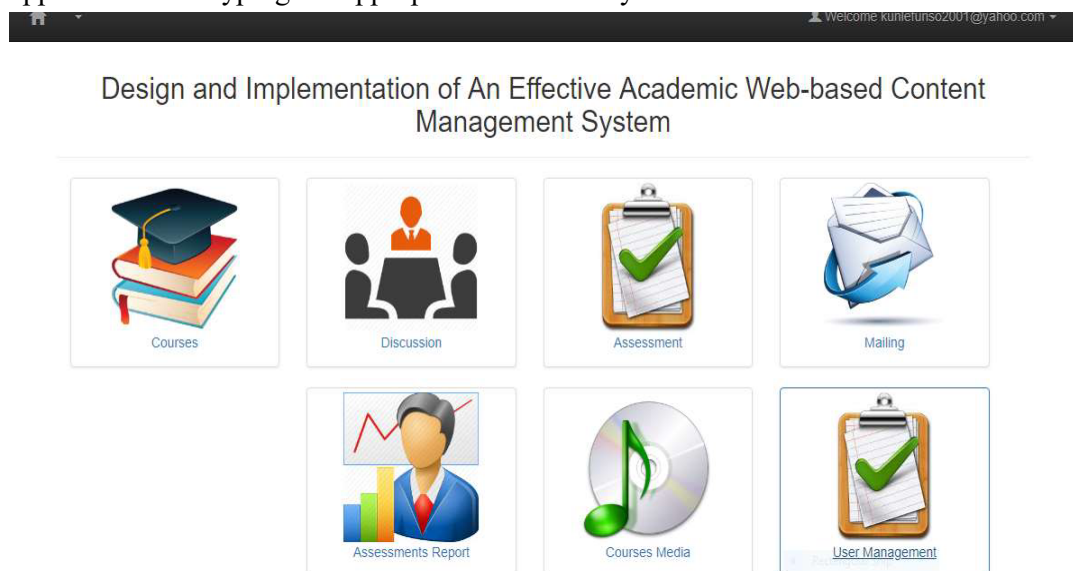


Figure 3: Home Page of the AWCMS Application

User Registration Page

The snapshot shown in figure 4 is an interface for a user to register to use the application.

Figure 4: User Registration Page

Course Media Page

The snapshot shown in figure 5, is an interface for Course Media for Faculty Users whom have registered their courses on the application to upload materials e.g Audio, Video, Text materials for students' users to download and make reference to accordingly.

Welcome kunlefunso2001@yahoo.com

COURSE'S MEDIA

Registered Courses

- Introduction to Systems Analysis & Design media
- Introduction to System Programming media
- Database Design media

Select a file to upload.

Media for Introduction to Systems Analysis & Design

No	Filename	Notes	Type
Add New Media			
File to upload		Choose File No file chosen	
Notes			
Add			

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Figure 5: Course Media Page

Assessment Report for Individual Student

Given in figure 6, is a snapshot of Assessment Report generated for Individual Student. The assessment is gotten through Student's Email address and it can be viewed by course listing in order to generate reports for each course taken by the Students.

5/31/2018

Assessment Report

ASSESSMENT REPORT

NASARAWA STATE POLYTECHNIC
P.M.B 109, LAFIA

Motto: Success Through Knowledge

Lecturer Details			
First Name:	Kunle	Last Name:	Funsho
Gender:	M	Email Address:	kunlefunso2001@yahoo.com
C-001- Mathematics			
#	Students	Assessment 1	
		10.0	
1	Ibrahim Abdulkadir	6.5	

Figure 6: Assessment Report Output for Individual Student

Conclusion

It is important to understand how a CMS impacts a number of different people and departments in higher education setting. Higher education institutions reap tremendous benefits from using a CMS, and more comprehensive preparation

will lead to a more successful implementation.

AWCMS, which target users, are lecturers, tutors and students are not only an interactive web platform but also a system that offers other useful web services as well. With the existence of AWCMS system, the target users can fully utilize the platform provided to them in a more convenient, time-saving and professional way, which will then increase the overall work performance. With this, lecturers and tutors will be able to gain as much benefits as possible from this system and simultaneously experiencing a great revolution in creating and managing their contents, thus giving a chance to target users to enjoy the features and maximizing the work performance for all academic personnel in Computer Science Department of Nasarawa State Polytechnic, Lafia.

Recommendations

This work on Design and implementation of effective Academic Web Based Content Management System is recommended for use because it would help the department to achieve greater academic transparency and drive efficiencies. In addition to scalability and ease of use, stability, portability and reliability are some of the non-functional requirements' features of the designed system.

Additionally, the full implementation of the designed application in the department of Computer Science of the Polytechnic will not only encourage the students of the Department to be more ICT compliant but would also serve as a medium and reference point for proper upgrade of their literacy level.

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