

## Application of a content management system for bioinformatics websites

F. I. Sapundzhi\*, K. Cenov

South-West University "Neofit Rilski", 2700 Blagoevgrad, Bulgaria

Received August 01, 2019; Accepted October 29, 2019

Nowadays, the open source community develops many tools for building and maintaining web applications for interdisciplinary fields of science such as bioinformatics. The content management systems (CMS) are software tools to manage webpages and websites. CMS provide many of the basic needs of an informatics group. In this paper we present a CMS named KCS (Kristian Cenov System). The designed system is flexible, fast, multifunctional and easy to use. Many of the tools of KCS can be developed to support other research-specific activities - handling large biomedical datasets and deploying bioanalytical tools. KCS is designed to provide complete control of the website, ease of use, and easy adaptability to any type of website.

**Keywords:** software engineering, content management system, bioinformatics, internet, websites

### INTRODUCTION

CMS (Content Management System) is a software tool that plays the roles of publishing, editing, modifying, organizing, deleting, and maintaining content from a central interface. CMS is flexible and extensible and it is being taken as one of the most important Information and Communication Technologies (ICT) in managing information and knowledge. Many commercial websites use CMS and the users can easily develop specific element or full page without any hand coding [1,2].

A standard CMS consists of two parts: Content Management Application (CMA) that allows a user with confined expertise to manage the creation and editing of content without the need of a Web developer and the Content Delivery Application (CDA) that uses and compiles content for Website updates. The CDA portion of a CMS is essentially meant to replace a Website administrator in function. A typical CMS includes templates, a programming language, a dashboard and a database. A subsection of Content Management is the Web Content Management. A Web Content Management System (WCMS) is a program that helps in maintaining, controlling, changing and resembling the content on a webpage. The Content management system is working on the functional dependency between contents (collection), management and publication of final modified contents [3,4].

The most commonly used CMS applications or standalone tools are: *Document management systems* (DMS) for management of documents; *Groupware* - for managing collaborative projects in groups or teams (mailing lists, calendars, contact

lists); *Blogs* for publishing the text that commonly becomes the root of a discussion thread; *Forums* for discussing of thread management; *e-Commerce* - management of online sales and customers; *e-Learning* - management of curriculum materials and courses (LMS); *Image galleries* for management of image galleries; *Wikis* for collaboratively developed webpages and related content; *Portals* - tools that manage basic web portals [5].

Commonly used open-source website and content management tools are the following: Zope CMF [6], Ruby on Rails CMF [7], CakePHP CMF [8], MediaWiki Wiki [9], KnowledgeTree DMS [10], Drupal CMS [11], Joomla CMS [12], e107 CMS [13], Xoops CMS [14], Plone CMS [15], Moodle e-Learning [16], ATutor e-Learning [17], eduCommons e-Learning [18].

CMS are increasingly being used in bioinformatics research environments. Bioinformatics service providers may find that CMS can provide an attractive alternative for using expensive laboratory information management systems. The main objective of the developed CMS system is to enable more flexible, functional, faster and easier use by administrators, moderators, and generally by its users in biomedical informatics.

### MATERIALS AND METHODS

Several technological tools were used in the design of the KCS:

*HTML* (Hyper Text Markup Language) is a markup language that annotates text in a way that is syntactically distinguishable so that the computer can manipulate it. HTML is a set of markup tags used to describe web pages, where the tags separate normal text from HTML code.

\* To whom all correspondence should be sent.  
E-mail: sapundzhi@swu.bg

It is a combination of words and symbols which give instructions on how the document will be presented [19-25].

CSS (Cascading Style Sheets) is used to control the style and layout of multiple web pages all at once. Styles define how to display HTML elements. CSS overrides the default settings of the browser for interpreting how tags should be displayed, allows using any HTML element indicated by an opening and closing tag to apply style attributes defined either locally or in a stylesheet [19-25].

JavaScript is a client side scripting language designed to add interactivity to HTML pages. It is an interpreted language which allows the scripts to execute without preliminary compilation. It can be set to execute when something happens, can read and write HTML elements and change its content and properties. A JavaScript can be used to validate form data before it is submitted to a server [19-25].

PHP (Hypertext Preprocessor) is a widely-used open-source scripting language for web development and can be embedded into HTML. PHP offers several advantages: it runs on different platforms (Windows, Linux, Unix, etc.); it is compatible with almost all servers used today (Apache, IIS, etc.); it is free to download from the official PHP resource [19-25].

MySQL is a database server which is ideal for both small and large applications. It supports standard SQL and compiles on a number of platforms. It is free to download and use.

jQuery is a fast and concise JavaScript Library that simplifies HTML document traversing, event handling, animating, and Ajax interactions for rapid web development. jQuery is designed to change the way JavaScript is written [19-25].

## RESULTS AND DISCUSSION

A web-based CMS system called KCS (Kristian Cenov System) was developed. The designed system is flexible, fast and easy to use. The system is multifunctional - it allows adding styles and modules (news, chat, forums) and is also called engine system. Following diagram shows the working of KCS (Fig. 1).

The works which may be done on a KCS are presented in Fig. 2. KCS is built of various pages: Home Page and Control Center (Admin Panel). By modules of Home Page can be attached menus like the news menu, the latest forum topics, and more.

Registration Page consists of two modules: Conditions and Registration. Before registering, a user must carefully read the terms of the application, and after accepting them, the system redirects him to register. In Fig. 3 an application form with 5 required fields is presented: *username*, *password*, *password confirmation*, *e-mail address*, *security code*. The security code is used to protect against bots (web spiders) that make spam logs (or fake logins).

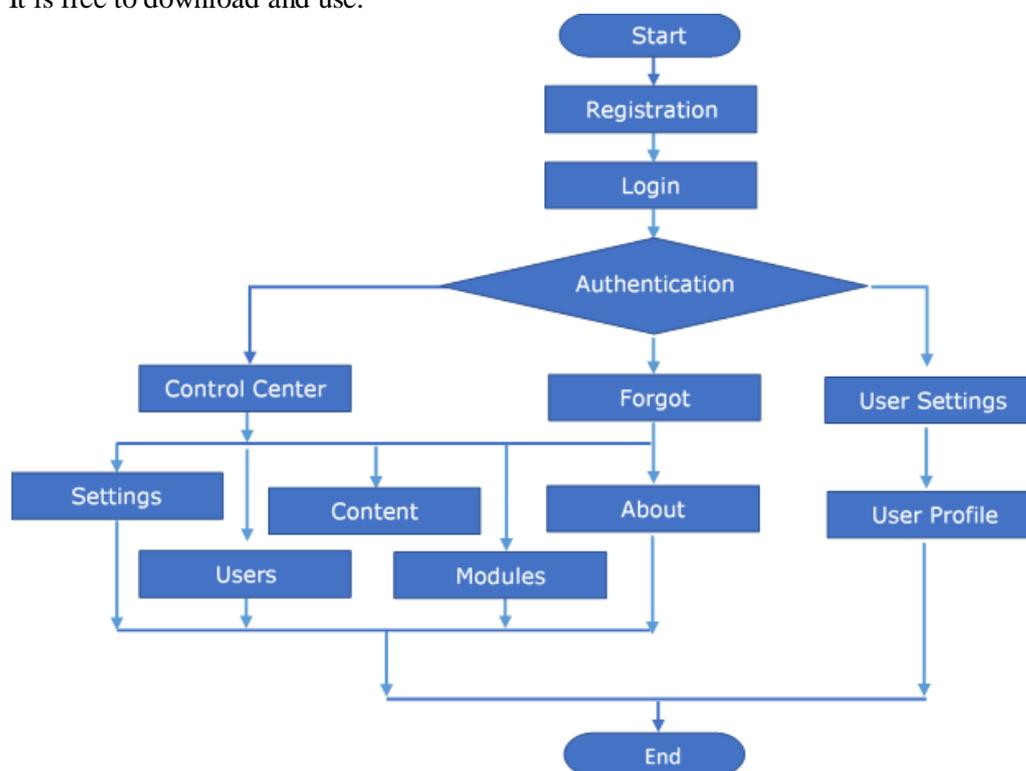


Fig. 1. System flow diagram of KCS.

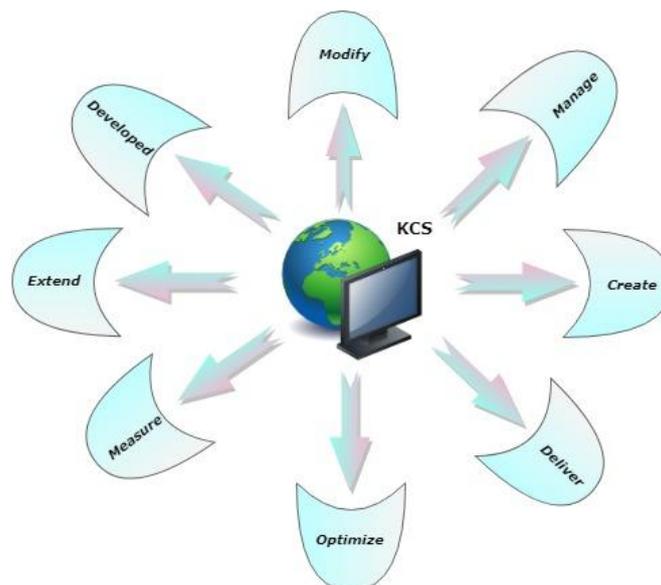


Fig. 2. The works which may be done on a KCS.

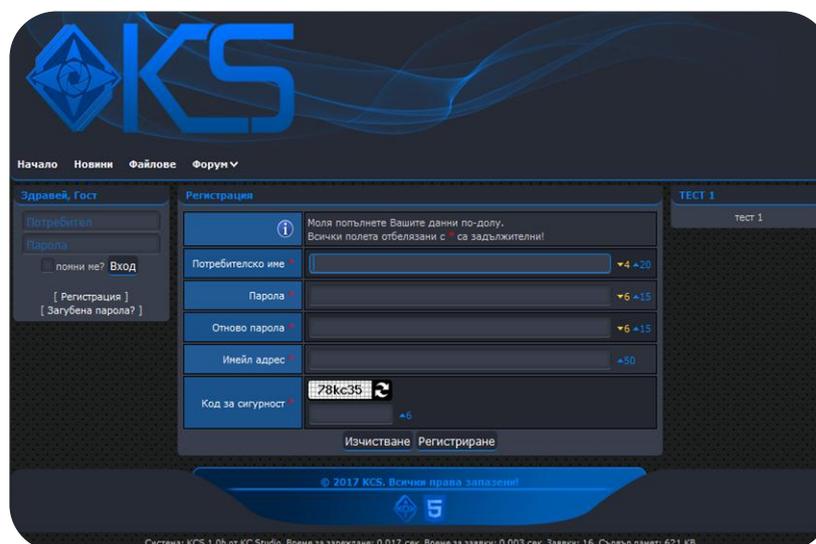


Fig. 3. Registration page in the KCS.

The *User Settings Page* is divided into two parts, where the second part is an addition to the first one and only applies to administrators and moderators. The user can add real name, change password, change or hide e-mail address. *Admin settings*. These are the same as User settings with the following additions: *User status* (activated, inactive or blocked), *Class* (Administrator, Moderator, User, or any other introduced by the Control Center) and *Rights* (access to Control Center, user manager, etc.) (Fig. 4).

*Profile*. This module consists of two parts: *User View* and *Admin view*. User Profile (User View) contains the following user information: username, real name, class, e-mail, registration date. User profile (Admin view) - an option added to edit the profile directly without having to log in to the Control Center.

*Control Center homepage* contains information about what you can manage through the Control Center. The settings are divided into 5 types: *Main*, *Registration*, *Information*, *Style* and *Language settings*.

*Main* - represents the main settings of the system. Through them, the administrator can change the name of the site and how it is displayed; choose a homepage and a class to link to it; close the site to *Moderator* or *Administrator*.

*Registration* - settings related to registrations. Through them, the administrator can turn on and off registrations in the application; includes and excludes validation (approval) of registration by an administrator; selects the default registration class; selects for each field of the registration form how many minimum / maximum symbols it should be; turns security code on and off (Fig. 5).

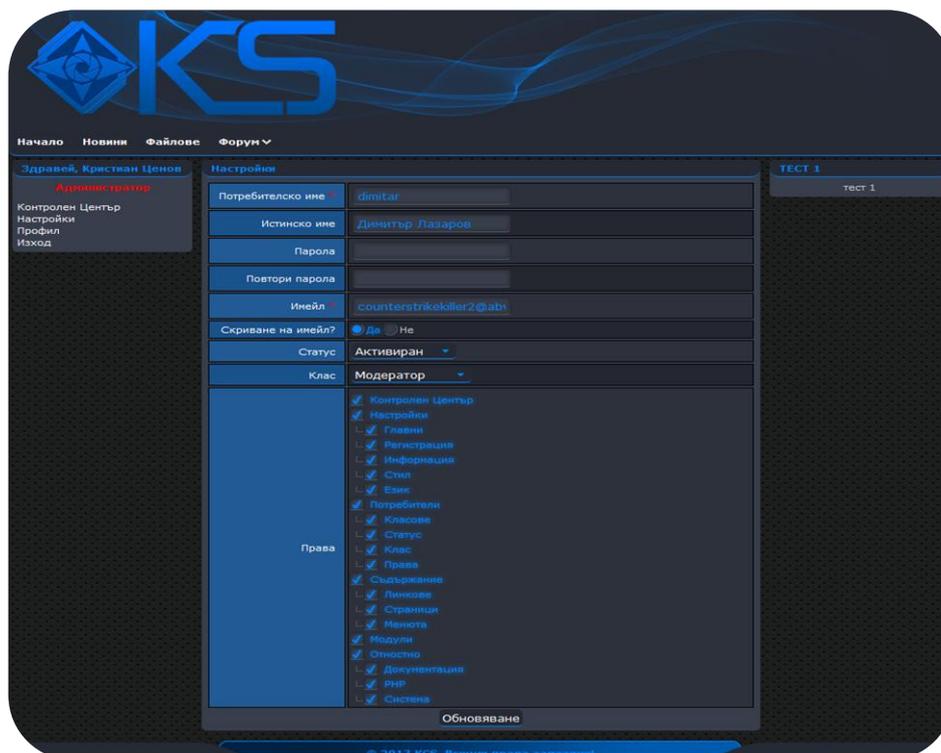


Fig. 4. User settings (Admin view).



Fig. 5. Settings (Registration) of Control Center module.



Fig. 6. Language and Style settings of Control Center module.

*Information* - through these settings, the administrator can choose what information to display at the bottom of the application: system information; time to load a current page; query execution time - the time during which queries are executed on a current page; number of requests - requests executed on a current page; memory server - the memory that the current page of the application uses.

*Style* - through this the administrator can choose the current style; add a new style directly from the application without having to connect to a server that hosts the system files; view style without choosing it as current; deletes a style (this does not apply to the main style because it is write-protected); sees information about each style - style name, version, creation date, author, skype or e-mail, author personal page, copyright.

*Language settings* - through them the administrator can add language; select the current language of the site; delete language; see information about each language - name, version, creation date, author, skype or e-mail, author's personal page, copyright.

*Manager Users* - through them the administrator can add, edit, delete, search and sort users. Sorting can be in ascending or descending order and is possible by ID, status, username, class, e-mail, date of registration.

*Manager Classes* - through the class manager, the administrator can add, edit, delete, search and sort class. Sorting can be in ascending or descending order and is possible by ID and class name (Fig. 7).



Fig. 7. Class and Link Manager of Control Center module.

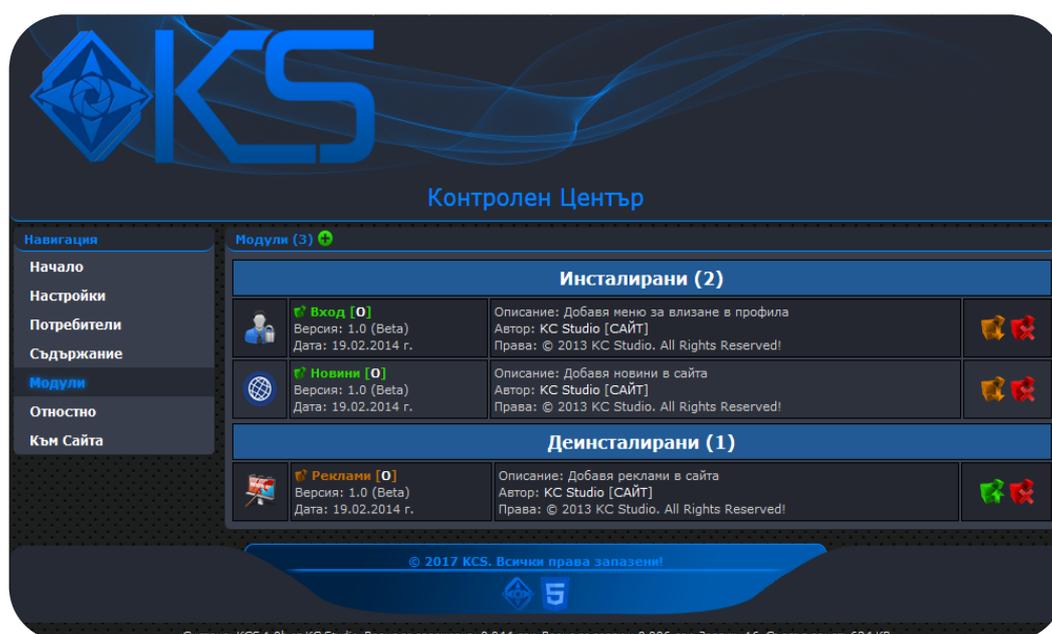


Fig. 8. Manager modules of Control Center.

*Manager Links* - links are the main menu of the system. Each link can have sub-links and each sub-link can also have sub-links, enabling the administrator to create his own navigation menu. Through the link manager, the administrator can add, edit, delete and arrange links (Fig. 7).

*Manager Pages* - through this, the admin can add, edit, delete, search and sort pages. Sorting can be in ascending or descending order and is possible by ID, status, style, page name, or page address.

The *Manager Menu* is divided into two parts with a button that switches between them (Home Page and Control Center). Through it the administrator can add, edit, delete, switch on and off menus; include on and off menu style; pin a menu to a specific page or move it to another area (Fig. 8). In the *Manager modules* they are divided into installed and uninstalled. Through them the administrator can add, install, uninstall, delete and set up a module. It contains information about module name, version, creation date, description, author, link to skype or e-mail address, personal page and copyright. *News Manager Module* - it is a module manager that is added by installing a module and allows managing a news module. Through it the administrator can add, edit or delete news.

CMS are becoming widely used in managing web content and provide a platform for construction of web-based tools that are easier to manage, more scalable and flexible than traditional home-built web tools [26-31]. CMS provide many of the basic needs of an informatics group. Many of the tools of KCS were developed to support other research-specific activities - handling large biomedical datasets and deploying bioanalytical tools. KCS was designed to provide complete control of the website, ease of use, and easy adaptability to any type of website.

## CONCLUSIONS

Content management systems are a powerful source of website and web content management tools. The developed KCS is more flexible, functional, faster and easier to use by administrators, moderators, and generally by its users. It will give an even greater advantage to the developed system than other CMS for biomedical informatics.

**Acknowledgements:** *This paper is partially supported by the National Scientific Program "Information and Communication Technologies for a Single Digital Market in Science, Education and*

*Security (ICTinSES)", financed by the Ministry of Education and Science.*

## REFERENCES

1. S. Caddick, *Nature*, **442**, 744 (2006).
2. J. Giles, *Nature*, **445**, 691 (2007).
3. <http://www.cms.co.uk/types/>
4. S. McKeever, *Industrial Management and Data Systems*, **103**, 686 (2003).
5. S. Phil, A. Dave, T. David, E. James. Content Management Systems (Tools of the Trade), Glasshaus, 2003.
6. <http://www.zope.org/>.
7. <http://www.rubyonrails.org/>.
8. <http://www.cakephp.org/>.
9. <http://www.mediawiki.org/wiki/MediaWiki>.
10. <http://www.knowledgetree.com/>.
11. <http://www.drupal.org>.
12. <http://www.joomla.org>.
13. <http://www.e107.org/>.
14. <http://www.xoops.org>.
15. <http://www.plone.org>.
16. <http://www.moodle.org>.
17. <http://www.atutor.ca/>.
18. <http://cosl.usu.edu/projects/educommons>.
19. J. Duckett, Web Design with HTML, CSS, JavaScript and jQuery Set. Wiley, 2014.
20. R. Nixon, Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5 (Learning Php, Mysql, Javascript, Css & Html5), O'Reilly Media, 2014.
21. L. Ullman, PHP and MySQL for Dynamic Web Sites: Visual QuickPro Guide, 4th edn., Peachpit Press, 2011.
22. L. Welling, L. Thomson, PHP and MySQL Web Development, 5th edn., 2016.
23. M. Eric, CSS: The Definitive Guide, O'Reilly Media, 3rd edn., 2006.
24. F. Sapundzhi, M. Popstoilov, *Bulgarian Chemical Communications*, **50**, Special Issue B, 115 (2018).
25. F. Sapundzhi, *International Journal of Online and Biomedical Engineering*, **15 (11)**, 139 (2019).
26. F. Sapundzhi, T. Dzimbova, N. Pencheva, P. Milanov, *Der Pharma Chemica*, **8**, 118 (2016).
27. F. Sapundzhi, T. Dzimbova, N. Pencheva, P. Milanov, *Bulgarian Chemical Communications*, **49 (4)**, 768 (2017).
28. F. Sapundzhi, T. Dzimbova, N. Pencheva, P. Milanov, *Bulgarian Chemical Communications*, **50**, Special Issue B, 44 (2018).
29. F. Sapundzhi, T. Dzimbova, N. Pencheva, P. Milanov, *Bulgarian Chemical Communications*, **50**, Special Issue B, 15 (2018).
30. F. Sapundzhi, *International Journal of Online and Biomedical Engineering*, **15(12)**, 88 (2019).
31. F. Sapundzhi, *International Journal of Online and Biomedical Engineering*, **15(11)**, 139 (2019).