Incorporating Information Technology in a Nigerian Learning Environment: the case for a Courseware Solution

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Abstract

One common phenomenon in the administration of pedagogy in a typical Nigerian educational setting is the use of traditional and manual methods in teaching and assessment of students at all levels of education leading to inaccuracy in student's assessments, delayed feedback on assessments, time wasting, inefficient use of paper resources, lack of privacy and confidentiality of records. In this paper, we developed a robust and simple tool that reneges on the power of technology in the administration and management of a course electronically. The solution developed not only proved robust and easy to use, but successfully improved student's cognition and desire to study, improved timeliness in assessment submissions, reduced delay in feedback, enhanced access to course materials, and improved student and staff use of Information and Communication Technology (ICT) in learning in Bowen University Iwo, Nigeria.

Keywords: *ICT, Pedagogy, Nigerian Education, Courseware, Traditional, Manual.*

1. Introduction

The recent developments in computer network technologies and the deployment of web based applications across the internet, have engineered a new paradigm to how information dissemination and teaching can be actualized in and outside of a traditional classroom setting. Many centuries before now, the use of slates, charts, flash cards, books, chalkboards, blackboards, and other forms of teaching aids dominated the administration of pedagogy. With the discovery of electricity came the use of devices such as phonographs, mimeographs, slide projectors and movie projectors as teaching aids [1]. However, the advent of the Worldwide Web (www) in 1990s, dramatically changed the way teachers and students communicated. Thus, bringing out a more advanced and efficient means of disseminating information and course related materials, as well as web-based discussion forums that enhanced student-teacher interaction [1]. The cognitive abilities of students no doubt improved as they are able to comprehend and assimilate information easily, retrieve more materials, and feel more organized with the use of technology [2]. Clearly, the benefits of technology in education could not be overemphasized.

Educational institutions all over the world particularly, developed countries have embraced the use of technology and associated teaching aids in the administration of pedagogy. These have been seen either in form of a Learning Management System (LMS) or a Course Management System CMS. However, in places like Africa, relatively few or no institution runs an LMS or CMS [3]. Hence, educators resort to traditional methods of teaching at all levels of education. These traditional methods have taken the form of teacher dictating, writing on the chalkboard, giving out notes to be photocopied, handing out assignments or quizzes verbally, conducting tests and exams using sheets of papers that are marked over a period of time, dispatching student's answer sheets weeks after marking, giving model or correct answers to tests and exam questions in class. This manual system of managing courses particularly in large classroom settings presents inefficiencies such as inaccuracy in student's assessments, delayed feedback on assessments, time wasting, inefficient use of paper resources, lack of privacy and confidentiality of records, abuse of manpower, stress in marking, too much dependence on paper work, inefficient use of storage space, and poor dissemination of information. In this paper, we addressed these challenges with the development of a robust, reliable, fast, efficient, effective and simple to use tool that reneges on the power of technology to administer and manage a course electronically in a Nigerian Institution of learning.

A Course Management System provides an infrastructure for the administration and management of a course

electronically [4]. A CMS is an online based infrastructure for the sharing of digitized information, teaching and the management of course curricular between teacher and student. The system provides the teacher with a set of utilities for distributing information on the web without any prior knowledge of programming [5]. In today's world of learning, several CMS solutions have been developed and commissioned for handling student's grades, taking tests, quizzes and exams, submission of assignments, providing quick feedback, tracking of student's course activities, enhanced information dissemination, and ease of access to course material. Examples of such systems include Blackboard, Angel, WebCT, eCollege, Moodle, and uPortal.

Blackboard Learning System is a CMS solution developed in 1997 as part of the Blackboard Academic Suite to provide educational instruction, communication and assessment [2]. The idea was a product of the vision to have a user-friendly interface by which educators could distribute module information, study guides and reference lists on the web. Blackboard as reported by Forbes.com Most Connected Campuses' List is being used by more than 70 per cent of colleges and universities in the US [6]. Furthermore, Blackboard brings to the fore increased availability as it can be connected to and from anywhere and anytime over the internet. With Blackboard, students have access to quick feedback on assessments, enhanced communication via discussion forums, email, announcement pages and virtual classrooms. Blackboard further displays course usage statistics enabling students to effectively manage their time [2].

Angel Learning Management Suite (LMS) is a customizable learning management system used for sequenced coursework [7]. Like other CMS solutions, Angel provides tools for course setups, learning sequencing, electronic file sharing, grading of students, creating and recording assessments, and tracking students' course usage. Angel LMS was developed in 1996 as a product from research work carried out at Indiana University – Purdue University Indianapolis. However, in May 2009, Blackboard Inc. acquired it.

Pearson's eCollege is Software as a service (SaaS) solution that provides eLearning Software and services to post primary and higher institutions of learning. Founded in 1996 as Real Education, Inc. in Denver Colorado, Pearson's eCollege administers and manages its online programs via its Pearson Learning Studio platform. Thus, creating a person centered learning environment that relies on a scalable, trusted, and advanced SaaS learning platform [8]

My Learning Space is an ideal and excellent social learning tool for any learning environment. Designed to enhance communication, collaboration, student assessment, discussion forums, reporting and knowledge-share, My Learning Space can be considered an integrated set of online tools [9]. Developed in the UK, My Learning Space focuses on the individual's capability as well as maximizing the strengths of the organization they belong to. Regardless of how My Learning Space is used, either as a single learning tool or in association with other learning platforms, it does provide a seamless, involving experience to produce results employing recent learning methods and practice [9].

uPortal [10] is the enterprise portal framework developed by and for the university community. As an open source based framework hosted by Jasig community, uPortal provides support for user customization, single sign-on access, web-based content, high level security, integration with standards-based authentication mechanisms and university applications [10]. With uPortal, users with multiple roles have access to dynamic and personalized page layouts. In higher institutions of learning today where open source CMS solutions have been deployed, uPortal comes top in the list [10]. Furthermore, uPortal can be deployed on mobile devices.

Moodle is an LMS that gives instructors the opportunity to set up their own web pages with dynamic courses that are accessible anytime, any day, and anywhere in the world [11]. Moodle was developed by the Moodle project based in Australia and is under the GNU General Public License (GPL). Using Moodle provides access to a single, robust, integrated and highly secured software that allows the user generate personalized learning environments. Just like other CMS discussed above, Moodle has the capacity to run online courses, it is customizable, flexible, scalable, and can be used anywhere and on any device. With an easy to use interface, Moodle provides strong support for teaching and learning, and is backed up by a strong team of developers [11].

This discourse continues with a look at the requirement analysis for the proposed system, the architecture, design and modeling, implementation and testing of the proposed solution, and finally, our conclusion.

2. Requirement Analysis

Requirement analysis involved the identification of functional specifications for our new product. These specifications we also referred to as user expectations which were considered relevant, detailed and measurable. We gave consideration to what features the expected solution was to have such that it effectively satisfied user request. Our solution was built with focus on the automation of all manual processes involved in the administration and management of courses in Bowen

University Iwo. Following is a description of the functional specifications for the CMS.

i. An administrative account for profiling students and staff to have access to the system. Also, grant access to administrator to set up course details.
ii. Student and staff proceed to register and activate their profile.
iii. Student and staff login with user id and password to be validated against database record.
iv. Access level to application granted based on user group information.
v. Students can download lecture notes, assignments and any other related material.
vi. Students can upload assignment modules, retrieve lost passwords, take online assessments, view announcements, and retrieve lecturer's feedback on submitted assessments.
vii. Lecturers can post new lecture materials, download submitted assessment modules for grading, return graded assessments for students download, send notifications to students, setup and activate assessment modules, and generate reports on students' performance statistics.

3. The Proposed System Architecture

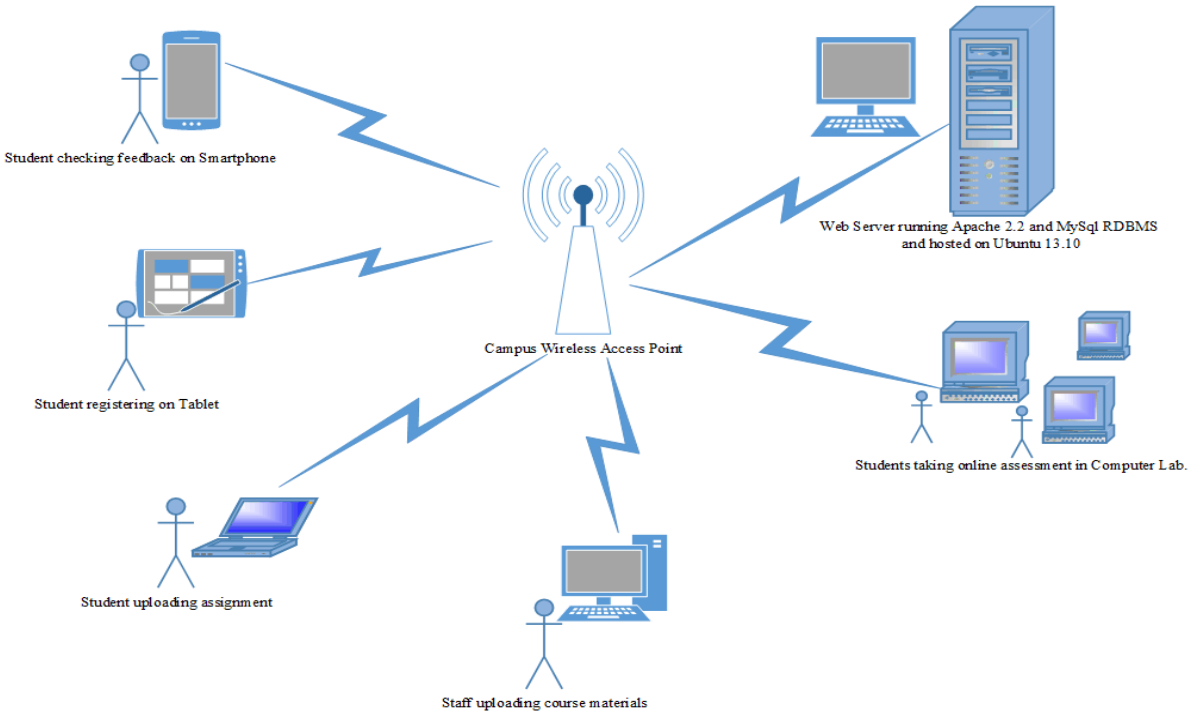

Fig. 1: System Architecture

3.1 The Importance of Smartphones

The role of communication and interaction in a learning process affects the outcome of the learning process [12]. In the recent past, the traditional role played by mobile phones (i.e., calling and texting) have dramatically transformed as a result of the introduction of Smartphones. Smartphones are fully featured mobile devices with capabilities for the installation of custom software, setting up of internet services and emails, large storage, running of multiple applications, faster speed, and portability [13, 14]. In a typical Nigerian setting, using a smartphone, a student is able to subscribe to a mobile internet service from a telecommunication provider. Hence, in the event of a breakdown or service failure from the campus-wide internet service, students can constantly remain connected to the internet for viable research activities. With the large storage on smartphones, it becomes easy and affordable to download course materials and related literature for offline access. While on the go, students are able to edit and submit course works as well as check their

emails and respond accordingly using the fast internet connection on their smartphones. In the classroom, understanding of subject related terms are enhanced as the students use the internet service on their smartphones to search for further information on terms. With extra utilities bundled in a smartphone, students can make recordings (audio or video) of lecture sessions; term projects carried out in the field, as well as stay informed with news updates. Knowledge sharing is improved as students can seamlessly communicate with another student and/or staff via chat forums. Despite the benefits of smartphones, Nigeria is yet to fully embrace the use of smartphones as currently; only 25% of mobile phone subscribers own a smartphone [15].

4. Design and Modeling

Software design is a creative process that involves the definition of methods, functions, objects and the general structure and interaction of code such that the software clearly meets user specification. Software modeling could further mean an abstract representation of a software design. Modeling focuses on software interface, its interaction with other software, and the relationship between software methods [16, 17]. Abstract languages or images are sometimes used to represent software design in a modeling context. Applying Unified Modeling Language (UML) considered the most commonly used language for software modeling [18]; we designed and modeled our CMS using Use case, Sequence and Activity diagrams to describe and communicate user requirements.

4.1 Sequence Diagram

Sequence diagrams otherwise called event diagrams, show how processes interact with each other and the manner in which they do. In a sequence diagram, we see the objects and the communication between objects in a timely fashion. Sequence diagrams reveal the objects and classes participating in a scenario, and the order in which communication is achieved between objects in order to satisfy the requirement of that scenario. Parallel vertical lines in a sequence diagram indicate objects that exit concurrently, whereas, horizontal arrows depict the information shared between the objects, and in the order they occur [19, 20]. Fig 2 shows a sequence diagram for the CMS.

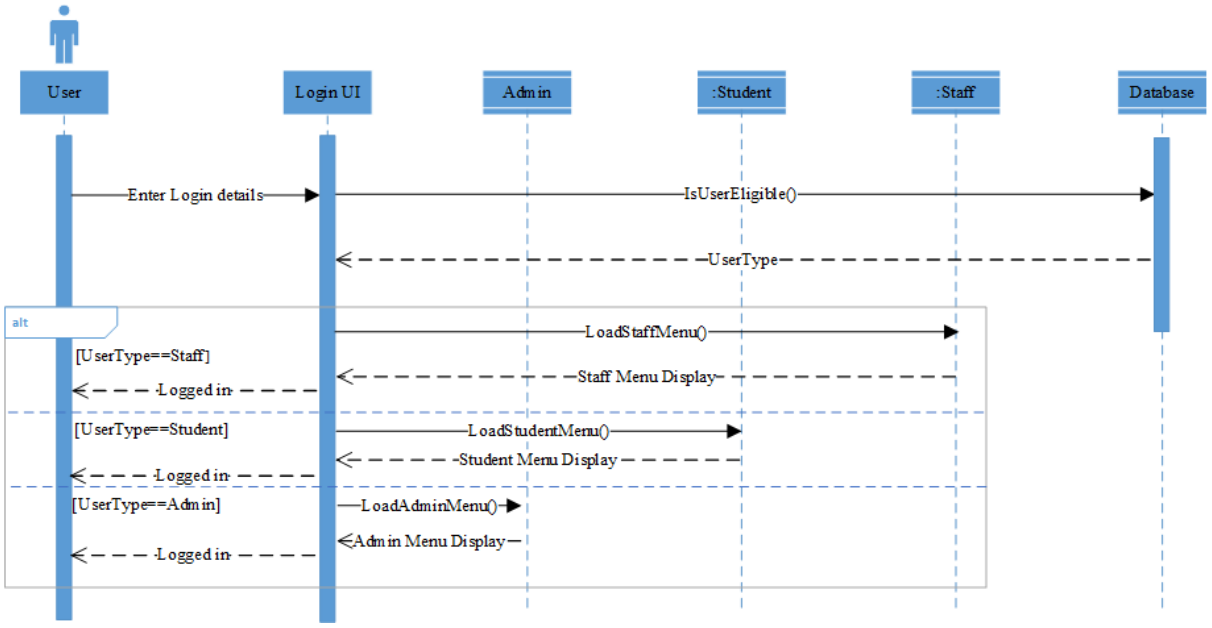

Fig. 2: Sequence Diagram for CMS

4.2 Use Case Diagram

The use case diagram shows the specification of the system. It does represent the activities performed by external entities and the system in order to satisfy defined goals [21]. Fig. 3, Fig. 4, and Fig. 5 show the use case diagrams for the staff, administrators and student as they engage the CMS respectively.

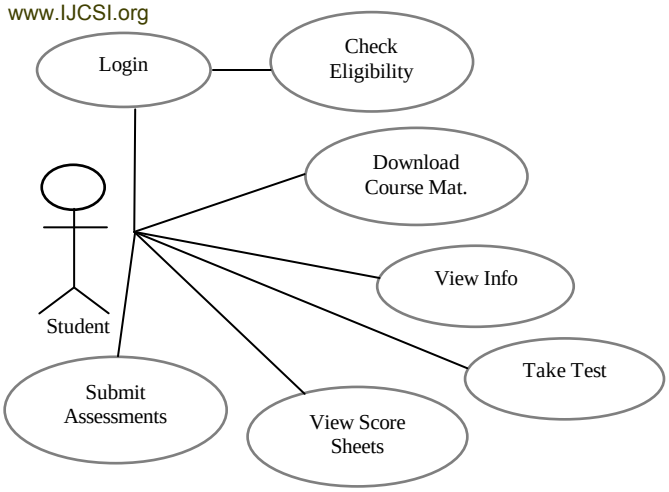

Fig. 3: Use Case Diagram of Staff engaging the CMS

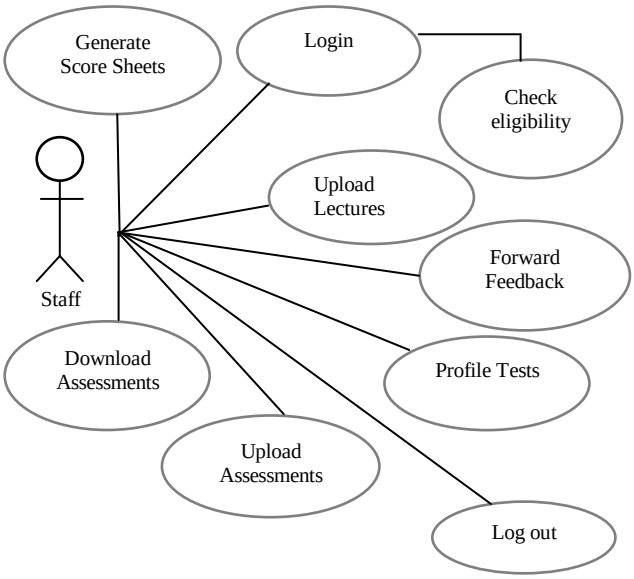

Fig. 5: Use Case Diagram of Student engaging the CMS

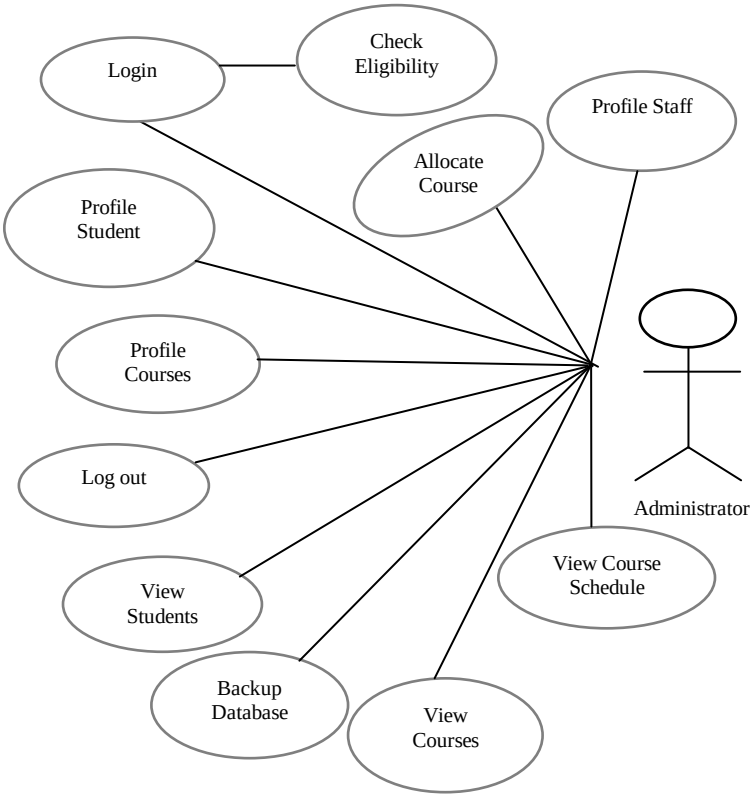

Fig. 4: Use Case Diagram of Administrator engaging the CMS

4.3 Class Diagrams

Class diagrams are pictorial representations of the detailed structure of a system. It shows the relationship between the classes and interfaces that build up the system. Fig. 6 shows the class diagram for our solution.

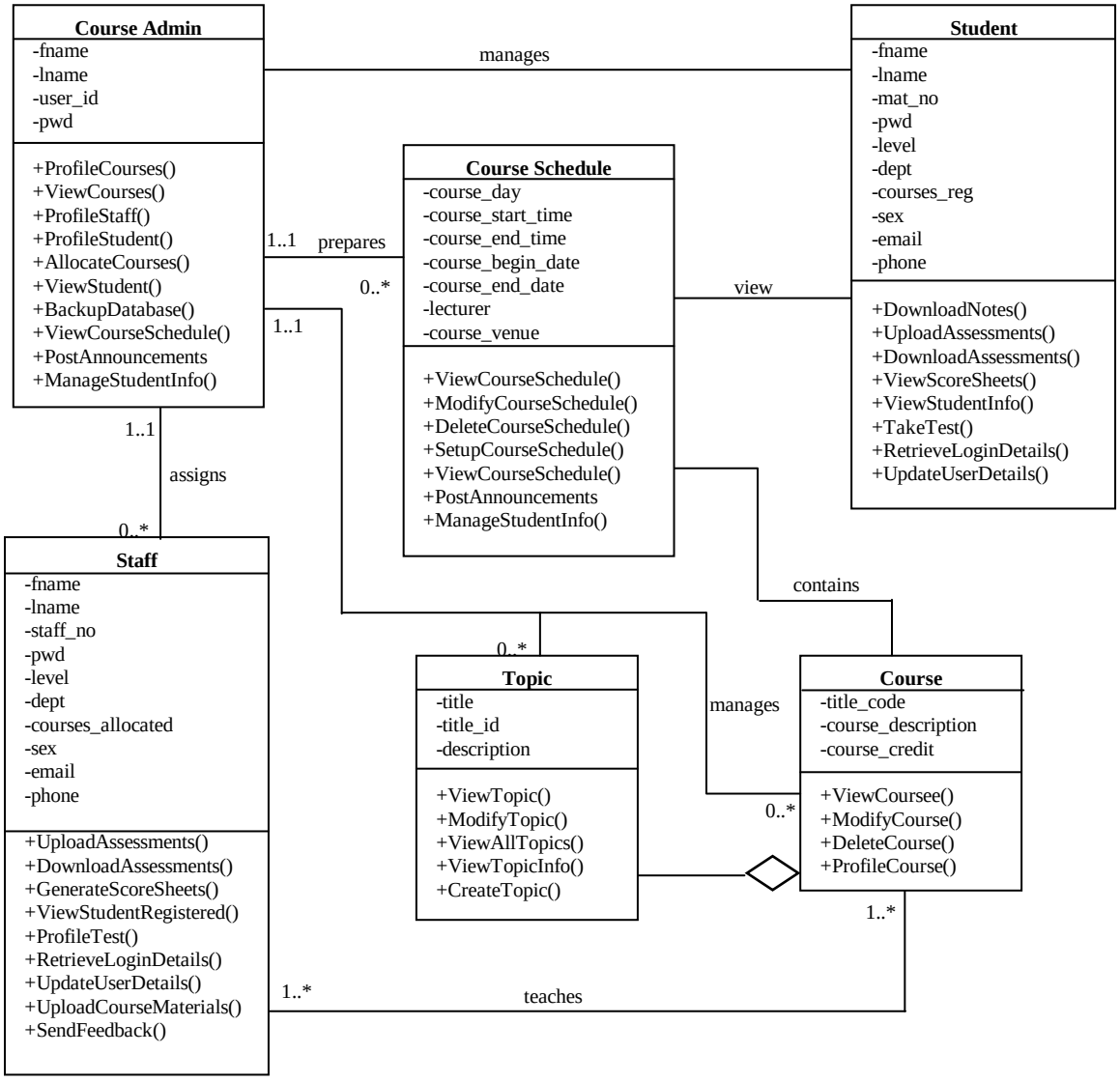

Fig. 6: Class Diagram for the CMS

4.4 Activity Diagrams

Activity diagrams show the general flow of control within a program. They can be seen as graphical representations of the algorithm or stepwise procedure in realizing a given task. In representing program flow, processes can be sequential, simultaneous or branched [22]. Fig. 7 shows the activity diagram of our solution.

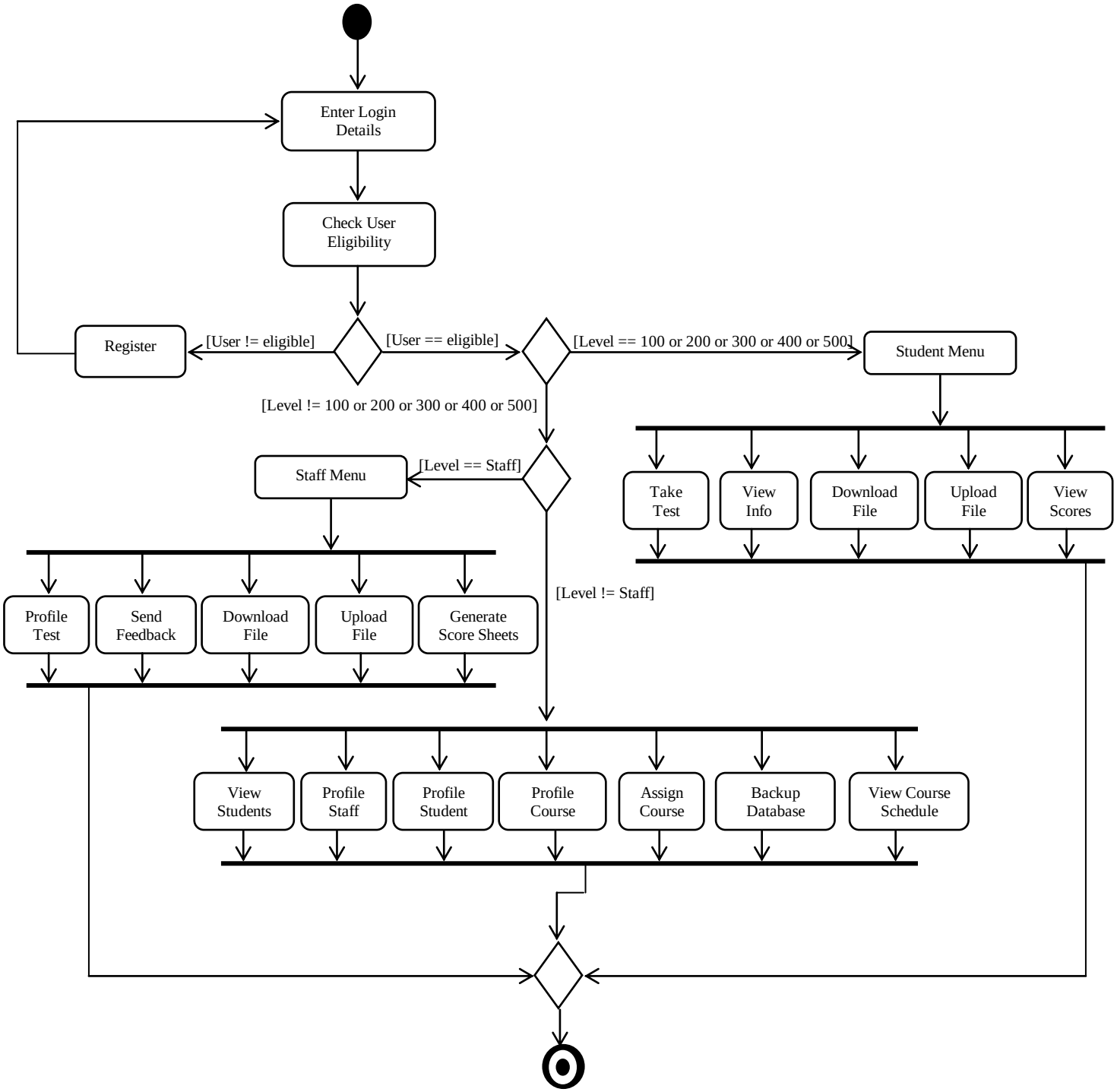

Fig. 7: Activity Diagram for the CMS

4.5 Interface and Database Design

The CMS is a fully web-based dynamic solution developed using the following programming technologies; HTML, Perl Common Gateway Interface (CGI), CSS, and JQuery, AJAX and SQL. The generation of standard web pages was done using HTML, with CSS providing style formatting. JQuery and AJAX were used in performing

input validation and in the display of message prompts to user. Perl CGI provided the Server Side Scripting support for the application and SQL provided the means for querying the database. As a web-based solution, the need for a web server to process client request and deliver the results back to the client was essential. Apache 2.4 was deployed on Ubuntu 13.10 OS to provide web server functionality. The CMS comprises a few static pages and several dynamic pages such as the homepage, registration pages, login pages, download menus, upload menus, announcement pages, password retrieval pages, online assessment menus, user profiling menus, assessment profiling menus, admin options, view score sheets and feedback generation pages. Fig. 8 shows the interconnection between web pages.

The data used at every stage in this application were stored in a database. The database was created using the MySQL relational database management system. MySQL Workbench provided the interface for administration and management of the database. However, the interaction between the database and the web pages was achieved via server side scripting (Perl CGI) and SQL. The database was named course_admin and comprised about 12 relational tables. Fig. 9 shows the design structure of the user_details table.

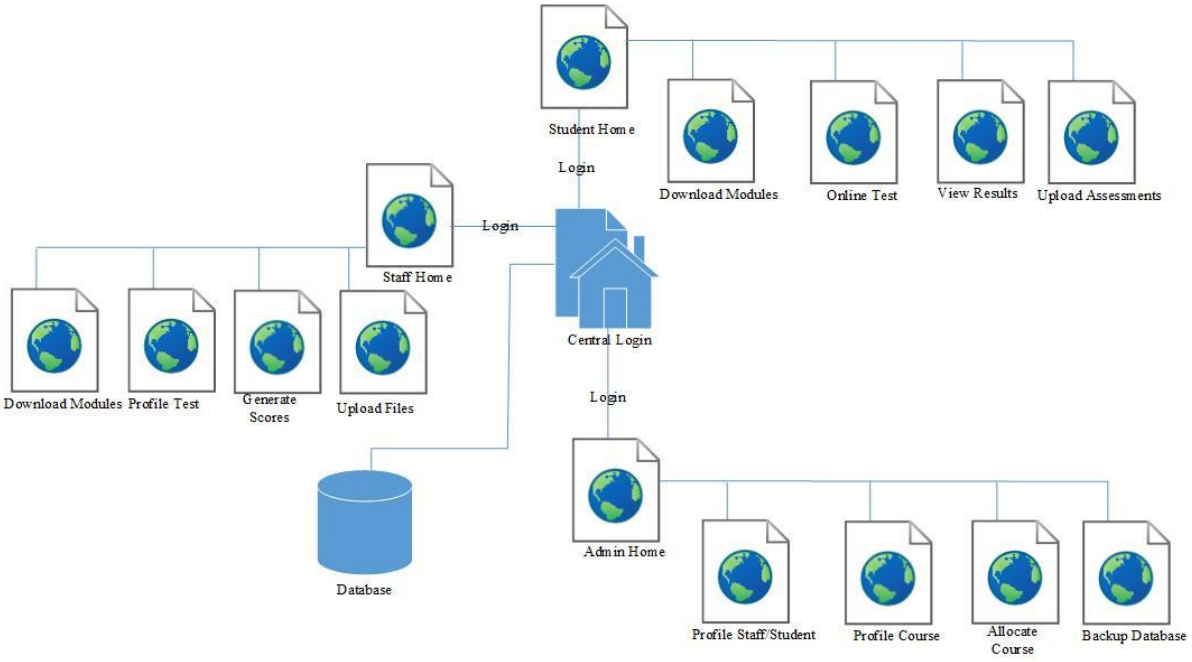

Fig. 8: Interconnection of web pages of the CMS

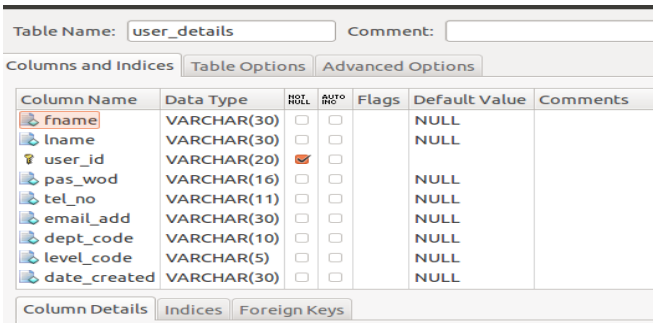

Fig. 9: User details table structure showing field names, data types and other constraints set

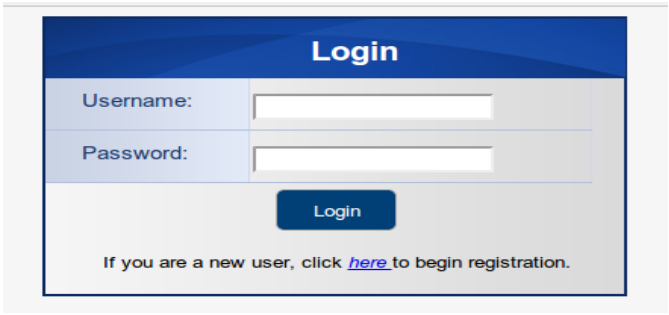

Fig. 10: Login page requiring user to enter user name and password or start registration

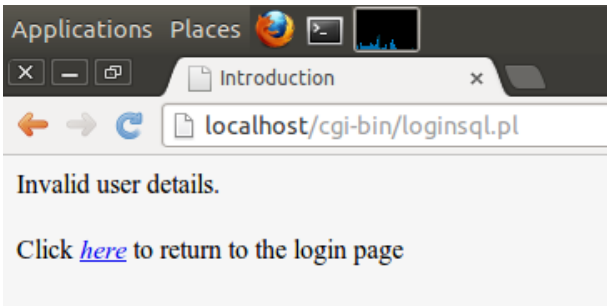

Fig. 11: Redirect page when invalid user entries at entered at logon

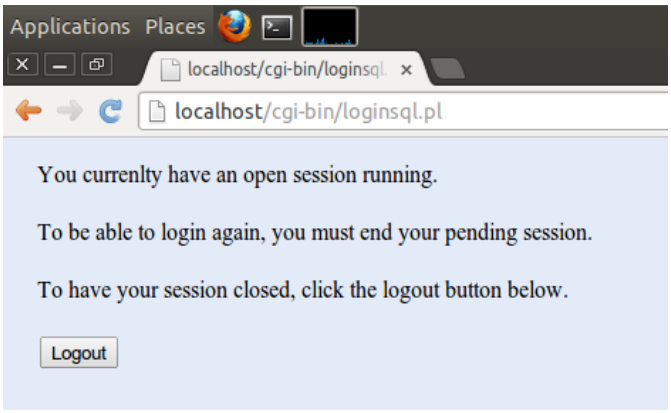

Fig. 12: Prompt for user to terminate any pending session before commencing a new one

5. Implementation and Testing

The department of Computer Science, Bowen University Iwo served as the case study for the implementation of this solution. However, prior to full implementation of the solution, the following tests were carried out;

i. Unit Test**:** This test involved certifying that each individual unit of the application that is, each web page executed independently of the other.
ii. Integrated Testing: This test involved certifying that each web page linked to another web page performed that action of linking appropriately.
iii. System Testing**:** This test involved a comprehensive check on the entire application to ensure that each individual unit having been integrated with one another could function as a whole without any failure. Here, we looked at the compatibility of the various units of the application with one another, to ensure they could interact with one another and shared the right kind of data between one another.
iv. Portability Testing: This test involved certifying the ease with which the application could be viewed from different browser windows. Initial tests were carried out using Mozilla Firefox and Google Chrome browsers. Further tests ensured that both Safari and Internet Explorer browsers could provide a seamless view of the application as well.

On successful completion of these tests, we further deployed this application on a web server hosted on the Wireless LAN of Bowen University Iwo. Access to a large

number of students and staff within the department of Computer Science was granted for the evaluation of the software. To login to the software, users were required to type on their browser URL the local domain name (citportal.edu).

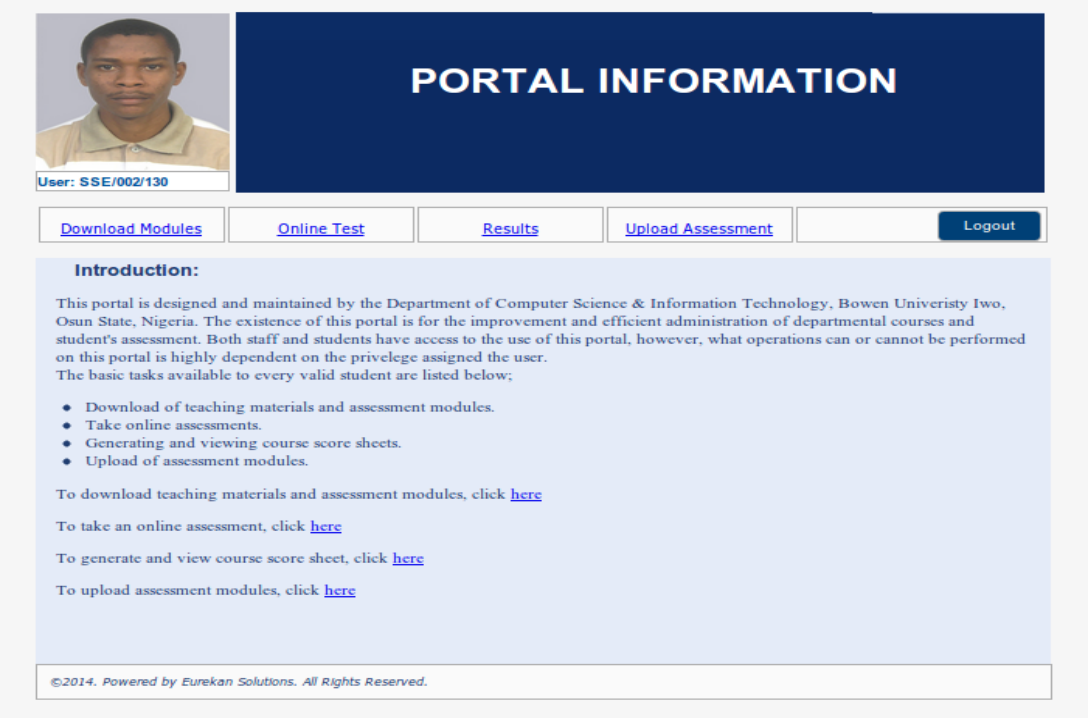

Fig. 13: Student home introducing portal and listing tasks available to student

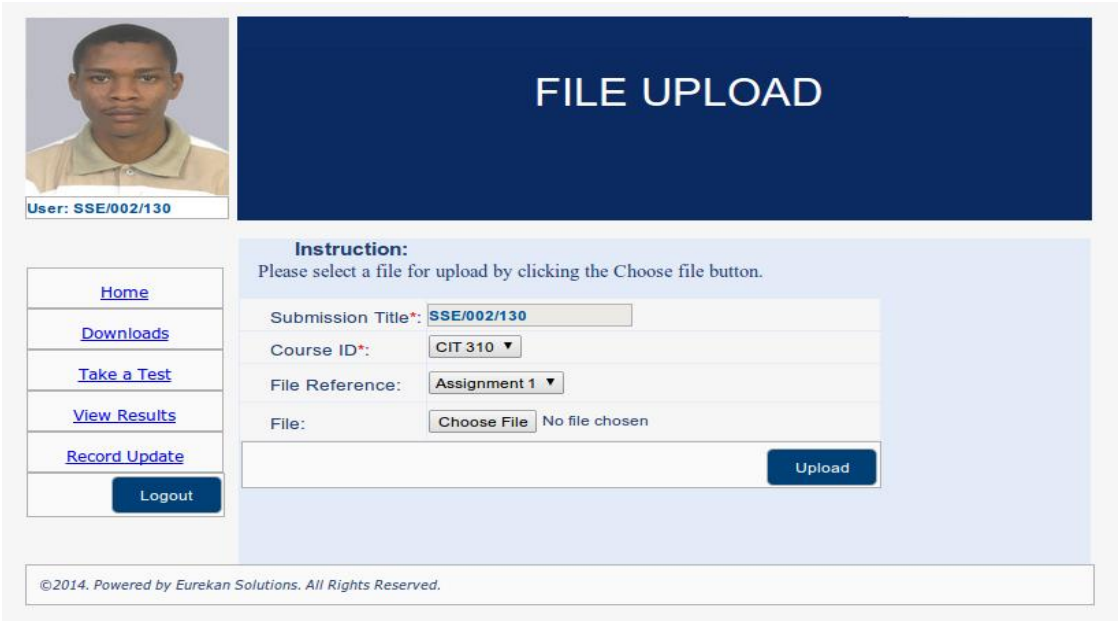

Fig. 14: Student menu for submitting course work

6. Conclusion

In this paper, we have identified some of the challenges confronting the efficient and effective administration and management of courses in Nigerian higher institutions of learning. We have also provided remedy inform of a robust and simple to use course management system that utilizes the power of technology in the administration and management of courses electronically in a Nigerian higher institution of learning. The software was deployed on the wireless LAN of Bowen University Iwo and tested by students and staff of the department of Computer Science. The outcome of the test showed that the use of technology in the administration and management of courses in Nigerian higher institutions of learning is a necessity that could improve students' cognition and desire to study. However, to fully maximize the power of this utility, there is the need to improve on hardware configurations and software technicalities so as to achieve maximum number of concurrent connections to the system. Also, in future work, we hope to introduce synchronous messaging forums, asynchronous discussion forums, student's course tracking and monitoring system, use of artificial neural networks and other forms of computational intelligence in grading students assessments.

7. References

[1] Buda, J., 2006. Course Management Systems. The Cultural Review, No. 28. [Online]. Available http://www.f.waseda.jp/buda/texts/cms.html (accessed 5.24.14).

[2] Patterson, D., 2004. Encouraging and Assisting Faculty Incorporation of Innovative Classroom Technologies, in: Proceedings of the 32Nd Annual ACM SIGUCCS Conference on User Services, SIGUCCS '04. ACM, New York, NY, USA, pp. 79–81. doi:10.1145/1027802.1027823.

[3] Unwin, T., 2008. Survey of e-learning in Africa based on a questionnaire survey of people on the e-learning Africa database 2007. [Online] Available http://www.gg.rhul.ac.uk/ict4d/workingpapers/elareport.pdf (accessed 5.24.14).

[4] Fredrickson, S., 1999. Untangling a tangled web: an overview of web-based instruction programs. J. ACM - JACM.

[5] Meerts, J., 2003. Course Management Systems (CMS) - EDUCAUSE Evolving Technologies Committee [Online]. Available https://net.educause.edu/ir/library/pdf/DEC0302.pdf (accessed 5.24.14).

[6] Jayson, S., 2006. Blackboard Breaks Through [Online]. Available http://www.fool.com/investing/small-cap/2006/05/09/blackboard-breaks-through.aspx?source=isesitlnk0000001&mrr=1.00 (accessed 5.24.14).

[7] ElateWiki, 2010. ANGEL Learning Management Suite - ElateWiki [Online]. Available http://www.elatewiki.org/index.php/ANGEL_Learning_Management_Suite (accessed 5.24.14).

[8] Pearson, 2014. About Us | Pearson eCollege [Online]. Available http://www.ecollege.com/about-us.php (accessed 5.24.14).

[9] MyLearningSpace, 2013. My Learning Space - Home [Online]. Available https://www.northlincs.net/ (accessed 5.24.14).

[10] Jasig, 2009. About uPortal | Jasig Community [Available].Available http://www.jasig.org/uportal (accessed 5.24.14).

[11] Moodle, 2014. About Moodle - MoodleDocs [Online]. Available http://docs.moodle.org/27/en/About_Moodle (accessed 5.24.14).

[12] Brown, T.H., 2003. The role of m-learning in the future of e-learning in Africa. Presentation at the 21st ICDE World Conference in June 2003, Hong Kong. [Online] Available http://www.tml.tkk.fi/Opinnot/T-110.556/2004/Materiaali/brown03.pdf (accessed 5.24.14)

[13] Mothar, N.M., Hassan, M.B.A., Hassan, S.B.H., Osman, M.N 2013. The importance of Smartphone's usage among Malaysian Undergraduates. IOSR Journal of Humanities and Social Science (IOSR-JHSS) Volume 14, Issue 3 (Jul. - Aug. 2013), PP 112 – 118 e-ISSN: 2279 - 0837, p-ISSN: 2279 - 0845.

[14] Klein, S., 2014. The Smartphone Revolution: could cell phones benefit students during school hours? [Online] Available http://whsbradford.org/the-smartphone-revolution-could-cell-phones-benefit-students-during-school-hours/ (accessed 5.24.14)

[15] TNS, 2013. Finding faster growth: New markets. Naviagting growth in Africa. [Online] Available http://www.tnsglobal.com/sites/default/files/whitepaper/TNS_Navigating_Growth_In_Africa.pdf (accessed 5.24.14)

[16] Fowler, M., 2000. UML distilled: a brief guide to the standard object modeling language, 2nd ed. ed, Object technology series. Addison Wesley, Reading, Mass.

[17] Gamma, E., Richard, H., Ralph, J., John, V., 1995. Design patterns: elements of reusable object-oriented software, Addison-Wesley professional computing series. Addison-Wesley, Reading, Mass.

[18] UML, 2014. Unified Modeling Language (UML) [Online]. Available http://www.uml.org/ (accessed 5.24.14).

[19] Yanic, I., 2007. UML Sequence Diagrams : A Quick Introduction [Online]. Available http://www.tracemodeler.com/articles/a_quick_introduction_to_uml_sequence_diagrams/ (accessed 5.24.14).

[20] Scott, A., 2013. UML 2 Sequence Diagrams: An Agile Introduction [Online]. Available http://www.agilemodeling.com/artifacts/sequenceDiagram.htm (accessed 5.24.14).

[21] Gemino, A., Parker, D., 2009. Use Case Diagrams in Support of Use Case Modeling: Deriving Understanding from the Picture. J. Database Manag. 20, 1–24. doi:10.4018/jdm.2009010101

[22] The Rational Edge, 2003. The Rational Edge -- September 2003 -- UML Basics Part II: The Activity Diagram - f_umlbasics_db.pdf [Online]. Available http://www.ibm.com/developerworks/rational/library/content/RationalEdge/sep03/f_umlbasics_db.pdf (accessed 5.24.14).

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