

DEVELOPMENT OF A KNOWLEDGE MANAGEMENT SYSTEM FOR A THEORETICAL ASPECT OF COMPUTER SCIENCE

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Abstract

The issue of getting, collecting and collating enough information for organizational and institutional use was a challenge in the past but now the table has shifted to the challenge of storing and managing the available information from loss. A lot of scholars have over-time written about knowledge management but not so much has been done to reduce knowledge loss. Being that a good number of individuals today really do understand how relevant knowledge is so the need for effective use of knowledge. This project tries to examine what knowledge is; the concept of knowledge management and tries to proffer a solution to the issue of loss or lack of knowledge. The system was design using Agile Development with Extreme Programming methodology, and the software tools used are Visual Basic 2013 for the front end, and have a database at the back end using MySQL. The result was the development of a Knowledge Management System for a Theoretical Aspect of Computer Science. It is a tool that stores tacit knowledge in a repository and makes it available for users who need it. Knowledge on a theoretical aspect of computer Science was stored based on their category and sub-category. The users apart from the administrator are the contributors who have access to add article, edit and delete their articles and the regular users who are just able to access the articles for the purpose of reading only. Articles here are lecture notes, journals, and textbooks.

Keywords: Knowledge, Management, Computer

Introduction

The importance of Knowledge cannot be over emphasized, knowledge is powerful and it is an important part of life. Knowledge is a powerful acquisition in life which when given to someone does not reduce. Knowledge is both practically and theoretically useful in all spheres of life. For this reason people devote themselves to the pursuit of knowledge (Gracia, I., 2009; Mamta, M., 2011).

The ability to manage knowledge is very important in today's knowledge economy. The creation and diffusion of knowledge has become increasingly important factors in competitiveness and comfortable living. While knowledge is increasingly been viewed as a commodity or intellectual assets, there are some paradoxical characteristics of knowledge that are radically different from other valuable commodities. These knowledge characteristics include the following:

- i. Using knowledge does not consume it
- ii. Knowledge is abundant, but the ability to use it is scarce
- iii. Much of an organizational/institutional knowledge walk at the door at the end of the day.
- iv. Transferring knowledge does not result in losing it (Kinnie, N. S., 2003)

This project proposes a way to effectively manage knowledge as regards the theoretical aspect of Computer Science. It is meant to be a system-based tool that should be able to house

as much theoretical knowledge as possible in order to make it available to individuals who may not have access to them by virtue of certain challenges in the selected scope of Study.

Literature Review

The question of defining knowledge has over time brought about a debate amongst philosophers which has led to different views as to what knowledge is. It is the capacity of people and communities to continuously generate and renew themselves to meet new challenges and opportunities (Jillinda, J. K, Karen, M. L., Sandra, L. J., 2000). A second view defines knowledge as a capability with the potential for influencing future action (Ferenc, F., Agnes, K., 2009). A third view defines knowledge as a condition of access to information (Robertson, M. 2000; Nyame-Asamah, F.,2009;). According to this view, knowledge must be organized in order to facilitate access to and retrieval of contents.

Over time, knowledge has been classified into two broad groups which are Tacit and Explicit knowledge. But some researchers make further distinction and talk about embedded knowledge.

- i. Tacit Knowledge: Tacit knowledge can be defined as skills, ideas and experiences that people have in their minds and are, therefore, difficult to access because it is often not codified and may not necessarily be easily expressed (Mamta, 2015). Tacit knowledge can be defined as knowledge that "is subconsciously understood and applied, difficult to articulate, developed from direct experience and action, and usually shared through highly interactive conversation, storytelling and shared experience." Tacit knowledge is the kind of knowledge that is difficult to transfer to another person by means of writing it down or verbalizing it (Augier, M., & T. V., (1999; Brain, C., Tim, B., Theresak, T., 2005). According to Business Dictionary, Tacit Knowledge is Unwritten, unspoken, and hidden vast storehouse of knowledge held by practically every normal human being, based on his or her emotions, experiences, insight, intuition, observations and internalized information. Tacit knowledge is acquired mainly through association with people, it is integral to the entirety of a person's consciousness, and it requires joint or shared activities to be imparted from one person to another. Effective transfer of tacit knowledge generally requires extensive personal contact, regular interaction and trust. The concept of tacit knowledge was introduced by the Hungarian philosopher-chemist Michael Polanyi (1891-1976) in his 1966 book 'The Tacit Dimension' also called informal knowledge.
- ii. Explicit Knowledge: Explicit knowledge also known as articulated knowledge is knowledge that can be readily articulated, codified, accessed and verbalized. It can be easily transmitted to others. Explicit knowledge "is more precisely and formally articulated, although removed from the original context of creation or use (McNiel, R., 2011; Mamta, 2015). Most forms of explicit knowledge can be stored in certain media. According to the business dictionary, explicit knowledge is knowledge expressed and recorded as words, numbers, codes, mathematical and scientific formulae, and musical notations. Explicit knowledge is also easy to store, communicate, distribute, and it is the knowledge found in books, on the web, and other visual and oral means.
- iii. Embedded Knowledge: According to P2P foundation, embedded knowledge is the knowledge which resides in systemic routines. Embedded knowledge refers to the

knowledge that is locked in processes, products, culture, routines, artifacts, or structures (Horvath 2000, Gamble & Blackwell 2001). Knowledge is embedded formally or informally; it is embedded formally such as through a management initiative to formalize a certain beneficial routine, or informally as the organization uses and applies the other two knowledge types. Embedded knowledge is found in manuals, rules, codes of conduct, products, ethics, organizational culture, processes, e.t.c. It is really important to note that while embedded knowledge can exist in explicit sources, it is not in itself an explicit knowledge.

A research by Nyame-Asiamah (2009) examines the contributions of knowledge management technologies including the web 2.0 for exploiting implicit knowledge. It proposes an integrated framework for extracting tacit knowledge in organizations, which includes web 2.0 technologies, organizational learning (OL), KM tools, and Community of Practice (COP). The outcomes of the paper indicate that Internet and Web 2.0 technologies have interesting prospects for creating learning communities where implicit knowledge can be extracted from people: The author proposes that organizations should design procedures and embed them in their Web 2.0 collaborative platforms persuading employees to record their ideas and share them with other members.

One very important point is that the above Knowledge Management tool provides a large support creating knowledge that was not previously known to a learning community. Once the knowledge is extracted and shared, the organization can then explore for knowledge diffusion. In this case, the departure or retirement of knowledge workers will not have a huge negative impact on the organization.

Knowledge Management

The concept of knowledge management was introduced in the beginning of 1990; ever since then so many definitions for knowledge management has emerged. Knowledge management is concerned with the exploitation and development of the knowledge assets of an organization with a view to furthering the organization's objectives (Rowley, 2000). Knowledge management is a systematic, organized, explicit and deliberate ongoing process of creating, disseminating, applying, renewing and updating the knowledge for achieving organizational objectives (Yon-Krogh, G. R.1996; Yu-N, A. C., 2000; Lisa, S. Z, 2002).

Knowledge Management has three basic elements i.e. generation of new knowledge, dissemination of the knowledge and application of the knowledge. Organizational culture, technological tools and human beings are the key elements required for managing knowledge more effectively for better education delivery in time phased manner (Paul, F., Anirach, M., Marjid, M 2003; Pienaar, H, 2003). With KM, higher education institutes are better able to increase student retention and better graduate rates, work to analyze the cost effective use of technology to meet more enrolment, transform existing transaction based system to provide information and compete in an environment where institutions cross state and national borders to meet student needs anytime/anywhere Namwar, Y.,& Rastgoo, A, (2013).

Related Research on Knowledge Management

Jillinda *et al.*, (2000) the authors in this paper believe that Knowledge Management is a new field and experiments are just beginning in higher education. Also discussed is the concept

of knowledge management applied in the corporate sector and how they might be applied in higher education, and whether or not higher education is ready to embrace them.

Also outlined are several new trends the authors believe will shape up the field of knowledge management in the nearest future. KM techniques in higher education can lead to improved academic and administrative services, and reduced cost. The authors of the paper also carried out a brief comparison between implicit and explicit knowledge, this concept helps to differentiate between e-business and knowledge management. In rounding up, the authors listed out the applications and benefits of knowledge management for strategic planning, administrative services, students and alumni service, and research process.

Rachelle, F. C Robert, F. C., Raymond, O.F., (2004) tried to explore various facets of the concept of Knowledge Management (KM). An attempt is made to bridge the gap between the common practices of KM and the hidden areas in organizations where knowledge cannot easily be captured. The authors also suggested that the concept of knowledge management has been around for so long a time, but most organization have only accepted it as a theory and have not put it into practice. Knowledge in this concept is information that is further refined to connect, compare, evaluate and act on information. The question is "How can faculty and administrators in higher education are motivated to share the knowledge gained from their experience"?

Faculty members fear the theft of their research ideas. Advances in technology make shared research ideas vulnerable to capture and unethical reproduction. Promotion and jobs security are functions of a faculty member's ability to generate original ideas, and apply them in unique ways. In such a case, knowledge can be thought of as a believe that is just justified and then internalized. Therefore, it can be lost, shared, or hoarded. The author having gained an insight into the study of knowledge management, hope to extend this survey by proposing a reward structure in colleges and universities that would make knowledge sharing an enhancement to promotion policies and job security.

Rowlet, J (2000, Torres, J 2007) suggest that Universities have two main roles: creating knowledge and disseminating knowledge. The main vehicle for creating knowledge has been research and the main vehicle for disseminating knowledge is teaching. But in this rapidly-changing economic world the traditional role of universities as providers of knowledge is greatly challenged.

According to the author, knowledge management can create an innovative relationship and link between work and education, contribute to the adaptation and assimilation of new knowledge with the existing one, help students to more closely match their talents with the current workplace demands, contribute to the re-connection of learning with experience, so that the curriculum can reflects real time, real place, and real problems.

The author suggests how learning can be assessed and controlled, and gives appropriate ways to monitor the increases and decreases in the knowledge assets embedded in the organization as part of future research, the author also suggest that a learning organization, based on knowledge management principles, moderates the learning of all its members both students and researchers and continuously transforms it.

Knowledge management is actually a strategy to enables people develop a set of practices to create, capture, share and use knowledge in advance. With the progression in the use of electronic base methods, teaching and training has become easier. In the same vain, a few techniques can be utilized to make learning more participative, interesting, goal-oriented,

and driving towards making innovative bent of mind. If knowledge management is properly applied to education whose underlying goal is to make people aware of skills, concept and competencies, it will help in enhancing the inbuilt competitiveness and transforming the budding managers into effective leaders.

There are a lot of theories on Knowledge management process in the literature but the one which unites them is taken as the basis for this methodology. In addition, examining these processes will also involve examining technological aspects, since this KM framework includes the process of storing and organization of knowledge and simultaneously analyzes if these processes are in progress and if organizations are using the actual technology. The methodology was designed to provide advantages. It begins with the inseparability of organizational aspects of knowledge management in educational institutions and application of knowledge management in educational process, so it examines both Knowledge Management levels, as opposed to other similar studies. Furthermore, it encompasses perspectives of teachers and students, and thus provides a clearer picture which is not affected by a subjective point of view of a specific and consistent group of respondents.

Knowledge Management System

According to Technopedia, a knowledge management system (KMS) is a system for applying and using knowledge management principles. These include data-driven objectives around business productivity, a competitive business model, business intelligence analysis and more.

Knowledge management systems refer to a class of information systems applied to managing organizational knowledge, (Augier, M. & T. V, 1999; Devonport, T. H& V. S 2001). Knowledge management systems are IT-based systems which are used to enhance the organizational process of knowledge creation, storage/retrieval, transfer, and application.

A knowledge management system is a specific combination of some subset of people, processes, and technologies concerned with identifying and leveraging the collective knowledge in a specific organization to help that organization compete (Pienaar, 2003; V, P, 2005).

It is important to note that not all knowledge management initiative rely on IT as an important enabler. But never the less, it can support KM in sundry ways. Examples include finding an expert or a recorded source of knowledge using online directories and searching databases; sharing knowledge and working together in virtual teams; access to information on past projects and learning about customer needs and behavior by analyzing transaction data (KPMG 1998a). I will be correct to say there is no single role of IT in knowledge management just as there is no single technology comprising Knowledge Management System.

Review of Knowledge Management Systems

Laal, M, (2011) discussed the issues involved in designing an information portal using XML-based tools. Traditionally, portals have been built using HTML-based tools but the use of XML provides offers several benefits, XML provides a way of efficiently aggregating, classifying, and presenting both unstructured and structured contents over the internets and similar networks.

According to the author there are new technologies that would enable the development, utilization, and implementation of knowledge management within an

organization. Enterprise portals actually facilitate, create, and allow an easier flow of knowledge within the organization. The enterprise portal is actually designed using XML-based tools to present, disseminate and store documents. The main difference between XML and HTML is in the area of their data handling capabilities; where XML structures the data as well as convey meanings about the data, HTML is only concerned about the representation of the data. There are other areas of research that can be pursued in order to give a better understanding on the use of portals for knowledge management in organizations.

Pienaar, (2003) suggests the factors that should be considered when designing and developing an academic portal. A Web portal can be defined as a Web site that aggregates an array of content and provides a variety of services including search engines, directories, news, e-mail and chat rooms. According to the author, portals have actually evolved to provide a customized gateway to information on the web. In the academic world, the move to the web includes internal administrative business functions as well as the core functions of teaching and learning. The scholar's portal would promote the development of and also provide access to the great number of the quality content on the web. The guidelines for the development of a portal for academics are formulated against the theoretical study and empirical research result. The result gotten gives indication of various academic activities that should be embedded in academic portal. Even though the internet and Web are supposed to play an important role on academics' task performance, it has actually been discovered that its impact is relatively limited. These aspects should be taken into consideration when designing and developing an academic portal.

V, (2005), in the Journal of Information Systems Education suggest that wiki is a group collaboration software tool based on the Web server technology. This paper examines the use of a wiki to facilitate knowledge management in an academic setting. The authors' findings suggest that wikis can support collaborative knowledge creation and sharing in an academic environment. Success in attempts to provide such support may depend on: familiarity with wiki technology, careful planning for implementation and use, appropriate class size, and motivation of students to engage in discovery learning.

Pienaar, 2003; Namwar, et al, 2008) suggest developing a generic Knowledge Management framework specifically adapted for higher education. Many academic institutions have been fully involved in the development and use of computer supported work systems and e-learning systems. However the sudden increase of teaching and learning material on the campus has posed some challenges. Those related to how the end user will use the systems effectively in their daily routine. Another challenge identified in this research is the method and technologies on how acquire, store, organize, disseminate, search, index and retrieve efficiently and successfully the available knowledge.

A framework mapping existing initiatives with knowledge management processes have been delineated. The author presents an innovative knowledge management for higher education. The empirical investigation aimed at understanding how the knowledge management works was perceived and encouraged by academic stakeholders. In this research there is no discussion on the involvement of new Knowledge Management systems for future needs. Only existing systems are involved and there is no discussion about sharing of the knowledge between the universities.

Namwar, et al., (2008) suggests that Weblogs are one of the popular technologies that have been developed in these years. The use of Web log will actually change the role of teachers/lecturers in the sense that teachers will no longer be represented by texts and materials but they will have to guide the students in this environments which will enable them do works themselves. One of the unique characteristics of Web log is that it can be used by professors to monitor and follow students learning process and it can also be used by students themselves. Using Weblog as a learning journal will enable students reflect on what they are learning, what they are reading, and what they are probably working on with colleagues. The tool also allows professors know how students are doing, what student's problems are, where they have difficulty in understanding, what the learning rhythm of the class is, etc.

The authors believes that students in higher education are not just dependent on classroom lectures alone, they have to work by themselves and probably with their colleague cooperatively but this is not easily achieved in a conventional classroom but in this new era by using new technologies like Weblog it is made easy and everybody can participate. In all weblog according to the author can bring about a significant benefit to learners by providing a forum where students can work and carry out activities in groups outside the conventional classroom environment.

System Analysis and Methodology

Analysis of Existing System

The existing system is the manual method of storing and retrieving knowledge such as paper printout or hand written materials. It will be tedious to maintain the records here and the human effort is kind of more here. This system requires extra care in preserving the acquired knowledge. Suppose the paper work comes in contact with water or other damaging substances. So it will be difficult to maintain the knowledge. The existing system is manual based and as such it is tedious, not reliable and data can easily be lost.

Analysis Proposed System

The proposed system contains the findings of the existing system and recommendation to overcome the problem and limitations of the present system. The aim of this system is to reduce the paper work and saving time to generate accurate output in terms of transfer of knowledge. The efficient reports can be generated by using this proposed system.

Some of the advantages of the proposed system include:

- i. It generates efficient output.
- ii. It is reliable.
- iii. It is actually a fast approach to storage and retrieval of knowledge.

Functional Requirement

The functional requirements of this system include;

- i. System will be able to capture user information such as their pictures, and bio-data.
- ii. The system will be able to store knowledge materials such as journals, lecture notes, textbooks, etc.
- iii. The system will be able to display knowledge materials for required used.

System Methodology

Extreme programming, a type of Agile development is the methodology used in the design of the system. The purpose for using the agile development is due to the fact that it focuses on streamlining the SDLC. Also, much of the modeling and documentation overhead is eliminated, instead face-to-face communication is preferred. Agile methodology is also useful in the development of systems with short time schedule and also system with unclear user requirements. There are several popular approaches to agile methodology but for the implementation for Knowledge Management System the Extreme Programming (XP) approach is used.

Extreme Programming begins with the user describing what the system needs to do. Then the programmer codes in small modules and test to meet the user need. Users are usually expected to be available to clear up questions.

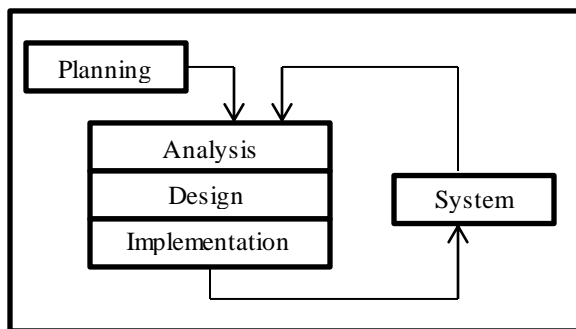


Figure 3.1 Diagram for Extreme Programming methodology

System Design and Implementation

System Design

The system adopted an application with an extended graphical user interface which is designed using Microsoft Visual Basic 2013. The user information is stored by MySQL which serves as a database located in the user's computer or server.

The logical design used includes entity relationship diagram, deployment diagram, Use Case diagram, and activity diagram.

The Class diagram for the Knowledge Management System is shown in Figure 4.1

Figure 4.1 identifies two elements of the system which are user and articles. The elements have a one-to-many relationship because a user can add multiple articles and also view multiple articles.

The user class has functions like login, logout, edit profile, change password, and view articles. The user class has two sub-classes which are *contributor* and *regular User*. The inherited classes contain all the properties of the parent class but the contributor has additional functions like add article, edit article and delete article. The article class contains just the save article function.

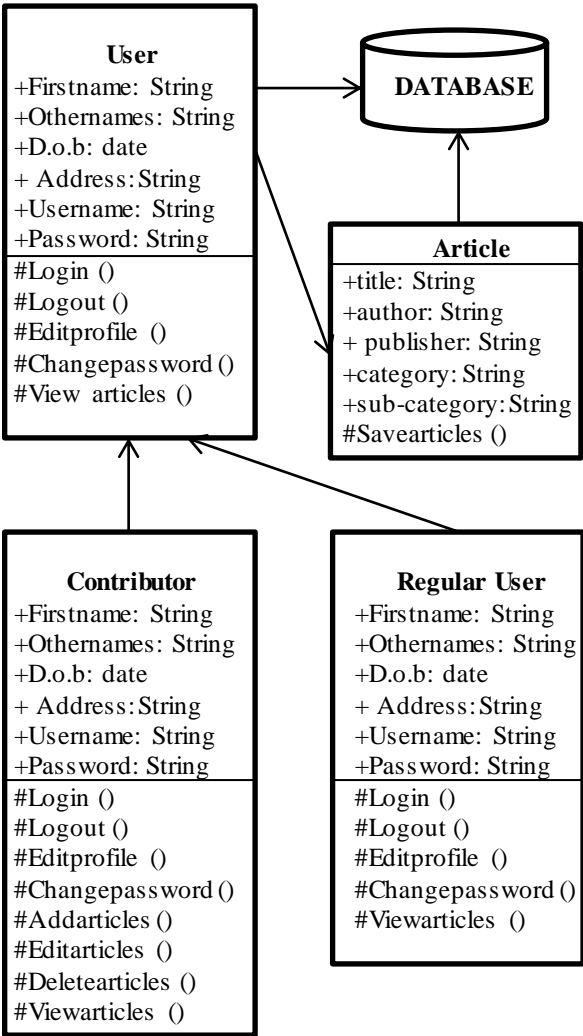


Figure 4.1: Class Diagram for Knowledge Management System

Below is the Use Case diagram for the

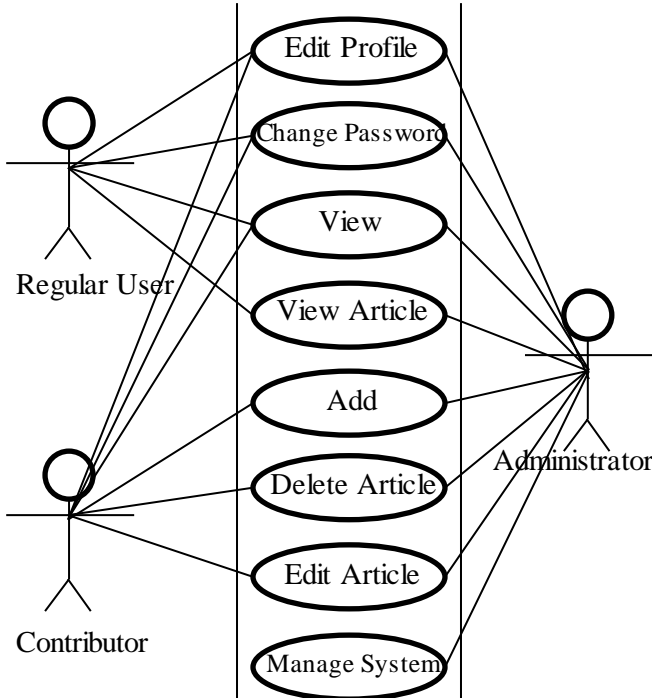


Figure 4.2: Use Case Diagram for Knowledge Management System
Below is the activity diagram for the system.

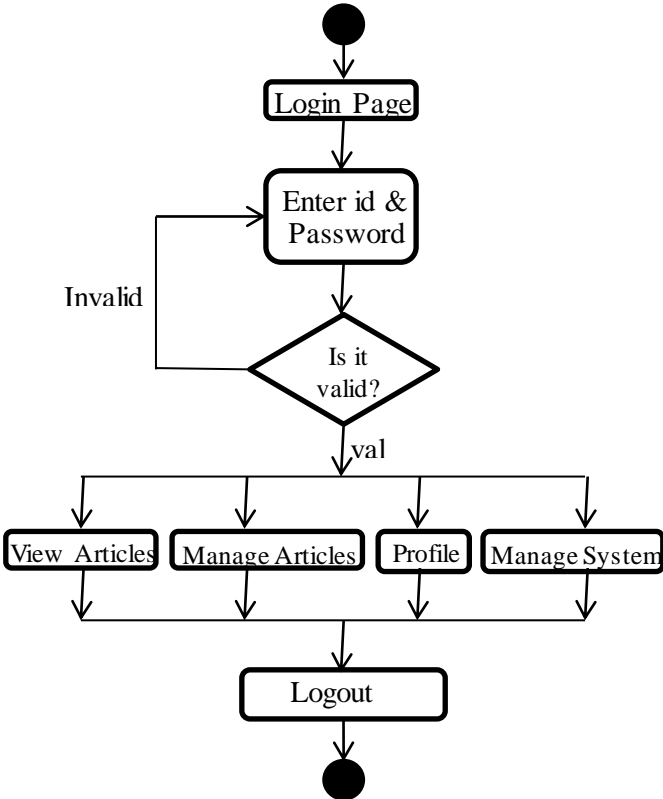


Figure 4.3: Activity Diagram for Knowledge Management System

Database Specification

User Table: This table is meant to create a login detail for the user.

Field	Data Type	Constraints	Description
Username	Varchar(10)	Primary Key	Admin username
Password	Varchar(20)	Not Null	Admin password
User Type	Varchar(13)	Not Null	The user specification that will determine the level of access.
Date Modified	Varchar(20)	Not Null	This shows the date the admin last logged in.

User Profile Table: To create a table that will store user profile

Field	Data Type	Constraints	Description
Username	Varchar(10)	Primary Key	Person's username
Surname	Varchar(50)	Not Null	User's surname
Other names	Varchar(50)	Not Null	User's other names
D.O.B.	Varchar(30)	Not Null	User's date of birth.
Gender	Varchar(6)	Not Null	User's gender
Address	Varchar(50)	Not Null	User's address
Country	Varchar(15)	Not Null	User's country
State	Varchar(10)	Not Null	User's state of origin
City	Varchar(20)	Not Null	User's city of residence
Email	Varchar(45)	Not Null	User's email address

Article Table: To create a table that will store all the knowledge materials

Field	Data Type	Constraints	Description
Serial No	Varchar(7)	Primary Key	The serial number of the knowledge material
Title	Varchar(100)	Not Null	The title of the knowledge material
Author	Varchar(50)	Not Null	The name of the author of the knowledge material
Publisher	Varchar(50)	Not Null	The name of the publisher of the knowledge material
Category	Varchar(50)	Not Null	The category of the knowledge material
Subcategory	Varchar(50)	Not Null	The sub-category of the knowledge material
Date posted	Varchar(30)	Not Null	The date in which the knowledge material was posted
Content	Varchar(2000)	Not Null	The content of the knowledge material
Status	Varchar(30)	Not Null	This shows whether a particular knowledge material has been approved by the admin.

At the end of the design phase, documentation describing the system control and backup is produced and made available for use in the next phase.

Development Process

This study was carried out using findings from past and present works. Getting there opinions and limitation to design a better system that provides solution to the existing problem of difficulty in transferring knowledge from knowledge-providers to knowledge-seekers especially in the theoretical aspect of Computer Science. This system is designed to allow knowledge-providers store as much theoretical knowledge as possible and also allow knowledge-seekers have access to unlimited knowledge especially in the Computer Science field. The system uses MySQL database to store all the knowledge.

System Requirements

The software requirements for the system include;

- i. Microsoft Windows 7/8/10
- ii. Microsoft dot Net Framework
- iii. MySQL server

The hardware requirements for the system include;

- i. Processor: Intel Pentium M or higher
- ii. Hard disk: 40GB or higher
- iii. RAM: 2GB or higher
- iv. Monitor: 14inch or higher

System Architecture

The system architecture comprises of both hardware and software components. The hardware component to be used for this system is a personal computer that will host the database and also run the algorithm. Some of the hardware components include;

- i. Operating system used; Windows 10 Enterprise (64-bit operating System).
- ii. RAM; 3.91GB
- iii. Hard disk; 561GB
- iv. Processor; Intel[®] Core (TM) i5 (2.20GHZ)

The software architecture consists of the application program and the database;

- i. Application Program: The application program is developed Using Visual Basic programming language using Microsoft Visual Studio 2013 as the development environment. Microsoft Visual Basic was chosen because of some advantages which include; easy to program. It has excellent database connectivity, it is robust, and it can run on the two most operating system platform (Windows and UNIX) and it also provides online support.
- ii. Database: The database consists of tables that stores records and it is implemented using MySQL database. This can also be migrated to any other relational database. The advantage of MySQL is that it is easy and it can store a very large record and requires little configurations

Implementation Tools Used

During the course of the research, the following tools were used, they involves both software and hardware requirements

Software Requirements

- i. Visual Studio 2013
- ii. MySQL

Hardware Requirements

- i. A Laptop

Program Modules and Interfaces

This system was design is such a way that each sub-system was design and tested separately and then they were brought together to function together. This system has three basic modules which are; Search Article Module, Add Article Module, Edit and Delete Article Module.

Search Article Module: This module allows users to search for any article available in the repository. The users can search using either keyword, Title of the article, the author, the category, or the sub-category of the article.

Add Article Module: This module allows the administrator and contributor to add up theoretical knowledge to the repository. Knowledge such as Journals, textbooks, articles, Lecture notes etc. Each addition must have a serial number which will be generated by the system, also added must be Author, Title, Publisher, and Date posted. The design interface is show in Figure 4.4 below.

Figure 4.4: Interface for Add Article Module

Edit and Delete Article Module: This Module allows the contributor who adds article to be able to edit and delete their own articles. And allows the administrator to edit his own articles and delete any at his own discretion. Figure 4.5 below shows the interface design.

Figure 4.5: Interface for Edit and Delete Module

Conclusion and Recommendation

Conclusion

In concluding, we will like to place a point that higher education institutions are readily in the business of knowledge, their in-depth activities are associated with both knowledge creation and as well as dissemination, and learning. This project has provided a tool that will ease off the application of these activities. The objective of this tool is to create a more user-friendly environment to enhance knowledge transfer.

One other very important point to note from this study is that Knowledge Management Systems provides huge support for both storing and dissemination of knowledge compared to the existing systems. Once one can reify hidden knowledge and share it, higher education institutions as well as organizations can further explore it for management and also spread it over a whole area. At this level the knowledge powerhouse begins to increase. We therefore need to give much credit to knowledge management system for readily giving room for group learning as well as continuous support to individuals and organizational transformation

Recommendation

We would like to recommend that;

- i. Being that knowledge transfer could sometimes be a challenge, more medium should be designed so that more individuals would be able to access available knowledge.
- ii. Also, the field of computer science is really wide, and a lot of knowledge is lost. As a result that, more tools should be designed in other to reduce the rate of knowledge loss.
- iii. A knowledge sharing culture should also begin in the early stage of a knowledge-provider's career, so that, he/she could be able to pass as much knowledge as possible before the end of the career.

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