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Overview of Design and Implementation of Library Circulation Model: A Case of Lagos State University Library

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ABSTRACT

The beauty of Library operations is not only in the ability to provide needed and useful materials containing information for the community, but also to be able to make them accessible to the clientele as and when needed, which is what circulation is all about. The objectives of the study were, to analyse the existing information system in LASU Library circulation section, design an information model for circulation section of LASU Library, and implementation of the designed library circulation model. The implementation tools used were, HTML (the Hypertext Mark-up Language), CSS (Cascading Style Sheets), Java Script, Jquery, and Mongodb. The architectural design used was the unified modelling language (UML) which is a general-purpose modelling language in the field of software engineering and provide a standard way to visualize the design of a system. The model will increase the effectiveness and efficiency of the activities carried out at the circulation unit of LASU Library. At the end of the study, recommendations are provided for the smooth run of the designed circulation model.

Introduction

The word library is derived from the Latin word "Liber" bearing the meaning "a book" and French word "LIBRAIRE" bearing the meaning "book seller shop; the home of book" in Sanskrit (Khanna, 1994). In the ancient period library was presumed just as a store house of the books, only aim of which was to preserve the rare books. However, in the present era, the aims and objectives of libraries are going to cover wider scope and are being adjusted in accordance to necessity also. According to Ranganathan, a library "a public institution or establishment charged with the care of a collection of books, the duty of making them accessible to those who require the use of them and the task of converting every person in its neighbourhood into a habitual library goer and reader of books" (Krishna, 1991). Thus a library is regarded as a public institution, which is also expected to convert the potential readers into actual readers. According to Srinivasa et al (2010), Library is a fast growing organism. The ancient methods of maintaining it are no longer dynamic service for the clientele, application of modern techniques has become absolutely indispensable. A properly computerized library will help its users with quick and prompt services.

The advancement of science and technology has made a tremendous improvement in the lifestyle of the society today. It has affected almost all walks of life. Especially, the magnetic words, Information Technology has been chanted in all corners of the global arena and incorporates in organizational,

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managerial, developmental and marketing sectors. The services rendered with the help of Information Communication Technology (ICT) are faster and more effective. Libraries are not exempted from the impact of the Information Communication Technology. The implementations of ICT in the library and Information Centres have made a tremendous improvement in the management of these centres. This has made the library more users friendly and has increased the efficiency of the library professionals. (Ajay et al 2014). Information technology (IT) has revolutionized and made life easier by different types of applications. In light of the rapid changes in the use of information technology, there are many tools and techniques and systems that have been produced and invented. Information technology is a combination of computer technology and telecommunications, which makes it possible for systems and new products to be developed to help people at work, in education and at home. In the modern world, many processes may take place at the same time and in place so that there is a need to integrate all the processes, and create paperless environments and also to ensure efficient management tasks. The purpose of the integration of computer -based systems to help increase market share and making it very easy for customers to use. Computer systems are increasing demands that are being made by customers and for those companies that are not directed to the computerization is bound to lose because of the intense competition and efficiency resulting from computing. Library computerization is now gaining importance necessitating the establishment of profession-wide standards. Comprehensive studies of library computer systems world over include discussions of machine-managed acquisitions, cataloguing, serials control, circulation and bibliographic services. (Liaquat and Mukhtiar 2016). According to Venus, (2012), technology has become as the culture among the stakeholder in all walks of life due to the reach, the cheaper cost, multiplication, virtual reality and easy to use. Automation is an immense process for any system including higher education and institutions. Higher academic libraries across the globe were the fore runners in integration of data bases of resources and end user and integrating for effective approaches. Hence the current concepts of digital presence of various business and social practices existing in the web as the outcome of automation and mechanization that was taken place in early eighties and nineties of the previous century in libraries and other institutions. He further opined that Library Automation refers to the use of computers to serve the needs of library users. The operations of a library get a quantum jump with the introduction of computers. The computers help to provide fast and reliable access to the resources available in the library as elsewhere. The application of computers in the library operations avoids repetitive jobs and saves lot of labour, time, speeds up operations, increases use of library resources. Computers are not only used as a tool for processing the data, but also for data storage and accessing.

There are several types of libraries existing in the society to serve the needs of the society. Some of the most popular types of libraries are: Public libraries, National libraries, Special libraries, Academic libraries, School libraries, College libraries, University libraries. Libraries attached to school, college, university or an institute of learning is known as academic libraries. They exist to support the goals of their parent organizations. Variety of libraries has variety of purpose to serve their readers. Academic library has also such purpose. It assists education research, teaching and learning of the academic community. The Lagos State University Library as an academic library commenced operations in November, 1984 in accordance with the Edict that set up the University like all University libraries. The circulation section of Lagos State University (LASU) Library automated to the level of providing services to today's patron who are information technology savvy. Having observed the existing manual system thoroughly, the existing system is still facing handful of challenges which indicate that it is time to automate the system. The objectives of this study were to design and implement a library circulation model with analysis of the existing information system in LASU Library circulation section, designing an information model for circulation section of LASU Library and implementing the designed library circulation model.

Methodology, Concepts and Results

Information system has been defined in terms of two perspectives: one relating to its function; the other relating to its structure. From a functional perspective; an information system is a technologically implemented medium for the purpose of recording, storing, and disseminating linguistic expressions as well as for the supporting of inference making. From a structural perspective; an information system consists of a collection of people, processes, data, models, technology and partly formalized language, forming a cohesive structure which serves some organizational purpose or function. The functional definition has its merits in focusing on what actual users -from a conceptual point of view- do with the information system while using it. They communicate with experts to solve a particular problem. The structural definition makes clear that IS are socio-technical systems, i.e., systems consisting of humans, behaviour rules, and conceptual and technical artefacts. An information system can be defined technically as a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision making and control in an organization. In addition to supporting decision making, coordination, and control, information systems may also help managers and workers analyse problems, visualize complex subjects, and create new products. Components of information systems include; Resources of people, Hardware, Software, Data and Networks.

Libraries procure documents for readers. The documents should be put to maximum use. The first two laws of library science advocate that the readers should get books to meet their information needs; and every book in the library should be used by the readers. The circulation desk is staffed by trained staff in order to handle circulation system and answer other queries of the readers. An efficient circulation section aims at ensuring

maximum use of library materials by the users. It does so by adopting proper procedures, systems for charging and discharging and maintaining relevant records. For a circulation system to be functional and effective, it must address charging and discharging of materials timely and with ease, show the eligibility of a borrower to enjoy the facility, facilitate overdue alert and notices of return, work out overdue fine when overdue books are returned, provide for the reservation of books in high demand and keeping statistical records of discharged books and registered users.

Circulation desks officers in the library perform multivarious duties which include but not limited to those identified by Wikipedia (2012) are Lending materials to Library users, Checking in materials returned, Monitoring materials for damage and routing them to appropriate staff for repair or replacement, Trouble shooting circulation technology, i.e. Library circulation software, scanners, printers etc., and Collecting statistics on Library use, i.e. patron transactions, material checkouts, etc.

In every Library, there are ways through which users are admitted and granted access to the resources therein. These vary to some extent from one Library to the other. This discussion borders on the ways by which Lagos State University's Library carries out the user registration. The university community comprises various categories of users who are registered under terms relating to their categories. These categories of users include: Staff, Students (undergraduate and postgraduate) and External Users (Researchers). After registration, you will be issued a library ticket that admits you into the library to have access to its resources and services. Registration is done at the beginning of the season for the students. To renew your library registration, you need to produce your old library ticket, payment receipt(s) and confirmation of your studentship by your faculty officer.

Library services are extended to external users/researchers who are neither student nor staff of the university. This group is required to come to the library with an introduction letter from their institution or company. Their registration is done at the Reference Librarian's Office, after which a temporary pass that expires with the time frame applied for is issued to the researcher. To replace a lost Library ticket, you will be required to write an application, attach a police report or an affidavit with (two) 2 other passport photographs to the Readers Services Librarian. After due consideration of the genuineness of the claim of loss, the Readers Services Librarian reserves the right to approve a replacement of the lost ticket or reject the application. As the custodian of the records of patrons, the responsibility to absolve them of any indebtedness rests with the circulation section. This implies that, before any graduate, retiree or severed or late staff can be cleared to collect certificate or entitlement as the case may be, the records of the Library must be checked to declare them not guilty of indebtedness concerning Library property which falls under the jurisdiction of the circulation section. The circulation desk keeps and maintains the statistical records of the following Library services involve books borrowed, register of full time and part time students, register of staff, cleared Graduates and overdue books. The statistical records help the librarian to know just how popular a book is and who has had it. This term is used interchangeably with lending or loans. It refers to the loaning out of Library resources particularly books to users who require them outside the walls of the Library.

Libraries formulate policies that guide their operations. Like other Library operations, charging, renewal and discharging of Library stock are guided by certain policies in order to enable the Library provide timely and efficient circulation services and prevent loss of materials. Among the policies of the Library relating to charging, renewal and discharging registration with the Library is a prerequisite for the eligibility of a user to lend Library materials. The category of a user determines the number of books he/she can borrow, the length of time he/she qualifies to keep the borrowed material in his/her custody. At the expiration of the lending period (date due), the borrower is expected to return or renew the material in his or her possession and that materials to be borrowed must be in good condition and must similarly be returned in good condition etc.

At the circulation desk, books are reserved if there is request for it. Books are sometime recalled from borrowers shelving. The records that are kept at the circulation desk include: users' registration cards, pink cards and borrower slips. These are filed in trays in ways that facilitate easy and quick access for the staff. Each of these is filed as discussed below.

Users' Registration Cards are cards that show data of registered users. They reflect details about the patron in relation to their name, address, department, course of study and school among other details. They are filed first, according to department in alphabetical order and under each department; every registered patron's card is filed alphabetically by surname. Pink cards are attached to each processed Library book and it contains the relevant bibliographic details of the book. Provision is made for date due stamp on the card to enable the circulation desk monitor defaulters. They are filed chronologically by accession number irrespective of the date due on them.

The Library uses the Newark system in the loaning out of its materials whereby book slips are in the custody of the Library and dispensed to borrowers as and when the need arises, as against the Browne style which dispenses borrowers' slips to users pending the need for them. In other word, in the Newark system, the Library holds the book slips and gives them to borrowers when they want to borrow materials, while the Browne system gives them to users in anticipation of the need for them. The book slip is issued to a user at the circulation desk at the point of borrowing a book(s) so as to capture details of the book(s) and that of a user who wants to borrow from the Library. The slips, when completed are filed behind the registration card of the borrower.

Types of Circulation Systems include, **c**ard System in which two cards are used – one card is for the book known as book card and the other is for the user or borrower. This card system is commonly followed by libraries. The two card systems are as follows: Newark system and Browne system. According to Rach (2016),

Newark circulation system is the most widely used manual system. It is simple to use for both borrowers and staff and is suitable for both small and medium-sized libraries. The system requires no expensive equipment. There are two variations, self-charge, which requires borrower participation and staff-charge with no borrower participation. When a library uses a self-charge method, borrowers remove the book card from the pocket and write their names and identification numbers or other required information on the first available blank line. The borrower gives the book card to the circulation attendant, along with a library card or other form of identification. The staff member verifies the identity of the borrower and stamps the due date in book and on the book card. Kumar (2001), illustrates that in the Newark system, the user is issued with a borrower's card. Details regarding the borrower's name, address, registration number, date of expiry, signatures of the borrower are given. In addition, columns for due date, date returned are given. A book card with the details about the book (call number, name of author, title, accession number) along with the columns for the due date, borrower's name or signatures and registration number are put in the blank pocket inside the book cover sometimes the column for the name/signature is omitted. A date label is pasted inside the book on the fly leaf (a page facing the book or front card board cover of the book) call number, accession number, date of release, along with the rules for overdue charge and columns for the due date given.

Browne Circulation System was devised by Nina E. Browne. It involves the following steps:

i. For charging, the book card is removed from the book and placed in the borrower's ticket which has her/his name, address and registration no. /ID no.
ii. The borrower's ticket with book card is filed under the date by the call number.
iii. The due date (date on which the borrower is supposed to return the book) is stamped on the due date slip and the charged book is given to the reader.
iv. When the book is returned, the due date/issue date is checked from the due date slip. The book card with the borrower's ticket is taken out from the date guide card in the charging tray. The due date/issue date is cancelled on the due date slip and borrower's ticket is returned to the reader. The book card is inserted into the book pocket.
v. If the book is returned after the due date, overdue fine is calculated, the reader is asked to pay the overdue fine

Blatchford (2009), noted that when libraries began lending their stock, they needed systems to keep track of the books. There were many and varied systems, depending on the size of library and community it served. From the early years of operation through until the late 1950's the library used the card-based Browne system. The borrower exchanged one of their borrower cards for the books they wished to take away. The book was stamped with the return date and the cards filed in date order to be retrieved when the book came back. The systems were cumbersome and time consuming. As loan volumes increased, libraries looked toward automation to improve their efficiency. Ranganathan (2006), talks about the Browne system as a method where each volume in the library has a small book ticket in the form of the pocket, put inside the pocket formed at the bottom of the date label by folding it over and pasting down the edges. The ticket gives the call number of the book, accession number, its author and title. Each borrower is provided with as many reader tickets as the number of volumes he is entitled to have a loan at a time. This ticket is of a size that can be presented into the book ticket. Carr (2000), noted that the charging system which are in vogue during the latter part of the nineteenth century expressed a variance of view point and the differing library police. He noted that this when he made his report on charging system 1889. He started that a notable distinction is usually apparent in charging systems of libraries, dependents upon whether the book or the taker is given precedence in the records. He found that some libraries keep simple accounts (either by ledger or slip) in which the leading factor is the book number, other emphasized the name or number of the taker when filing the entry. He noted that a few libraries keep a double or triple entry system in which the book and the taker are of equal importance. Brown (2001) noted that the ledger system was used in the history of libraries, and described its use in the early monastic libraries. Books lent were entered in a Bevis Librium or register which appears to have correspondent with some of the varieties of modern ledgers or day books. At the annual distribution, which was also stock-taking, these register entries would no doubt be marked off and fresh entries made of the new borrowers and the so-called "two-book" system, to find that in the Carthusian monasteries the issue of two books at a time was permitted. Dewey (2000), noted that the ledger system in his days, a simple blank book has the date at the top of the page, a left-hand column for the reader' numbers then columns for the book numbers. These lines are filled as the books are issued and they can be charged very rapidly, as only two numbers of reader and of book have to be charged. It is must faster than a ledger system where the page must be found for each entry. A column at the right is filled with the date of return. Unless this day-book is posted to a reader's or book-account ledger, nothing can be found except by knowing the date. In this respect it is no worse than the common slip arranged entirely by dates. Newburgh (2000), used a charging system of a "noel sort" one ledger with borrowers in the common form supplemented by another, where the number of the book is given at the left and the number of the page of the person who has it out follows. By reference to any number it is seen whether the book is in, or if out, who has it. It is the slip system put into the ledger form. The ledger system proved useful to the Sunday school's library, according to Shute who described the plan he devised.

The Strength of the Manual Circulation System

Edoka (2010) stated that the main public service point is the circulation desk or loans desk usually found at or near the

entrance of a library. It provides lending services and facilities for return of loaned items. Renewal of materials and payment of fines are also handled at the circulation desk. Circulation staff may provide basic search and reference services though more in depth questions are usually referred to the reference librarian at the library reference desk. The circulation desk is in most cases staffed by library support staff instead of professional librarians. Williams (2001), explains that the method used for issuing out information materials is crucial, it must be in position to leave behind full detail of the borrower and the book(s) issued on loan. This information helps in recalling of required and overdue information material. The methods applicable in libraries are register method, one card system, two card system (Browne or Newark) and automated issue system. Overdue, the books borrowed by the borrower have to be returned on or before the due day stamped on the due date slip. If the book is not returned on or before the due date, the book is known as overdue. It should be noted that overdue books create an impact on the regular circulation of books. Therefore, according to Lance (2004), overdue is actually a control measure implemented with the help of the policy by collecting overdue charges and sending a reminder to borrowers. However, much as overdue charges are an effective measure to control overdue in the library, most academic libraries with this policy do not regularly practice it due to tough opposition from users who are in most times students. Reminder as an aspect of overdue is an important activity in circulation management since most borrowers forget to return the books and few do not take the responsibility of returning the books.

The Challenges of the Manual Circulation System

Anusha (2012), notes that library circulation challenges include; loss of library materials, poor accessibility by users and servers at the circulation desk, poor tracking system, failure to return borrowed material by users and delay to return loaned or borrowed material among others. Adams (2010), stated that there are challenges brought by both the changing nature of information access and the phenomenal impact of ICT on libraries have been considerable for a small library with limited resources and affiliated to the premier distance learning institution. Anusha (2012), noted that librarians often struggle with logical consequences when students' faculty or families are delinquent in returning materials, return them in worse conditions than when they were checked out, or fail to return them at all. With limited budgets, school library programs can ill afford consistently large losses which unfortunately tend to be preserved. Library users should also be encouraged to develop excellent lifelong library borrowing habits. How then can librarians factor accountability into the mix and still preserve library resource? Rach (2008), noted that Newark system makes it difficult in determining if a patron has over-dues or other lost items which should prevent them from being able to borrow more material, slow and difficult processes for determining the circulation status of a given item.

According to Rach (2008), the following are limitations of manual circulation system

i. Limited information access point because creating duplicate records to increase points is time consuming and costly
ii. Slow and difficult processes to determining the circulation status of a given item
iii. The potential for misfiled records
iv. No means of easily providing users with list of items they have currently charged
v. No means by which library users can be informed of pending due dates
vi. Provision of only the most rudimentary statistics because of the time involved in manually compiling detailed information
vii. Difficult in determining if a patron has overdue or other lost items which should prevent them from being able to borrow more materials

Pitukwerakul & Prom Wong (2010), readers need real time feedback information about the library collection and tradition centred manual system cannot render that services which is a problem.

Automated Circulation System

In an automated circulation system, the manual system of operation is replaced with computer based system of operation. In this system, the library has web based catalogue which shows the collection e.g. books, journals, etc. and their availability in the library; besides the record of registered users of the library is also available on the computer. This is all maintained through integrated library management software. There are many advantages of using an automated circulation system. The catalogue displays what the library has and users can access it from anywhere. The users can easily check their "accounts" to find out what has been issued to them, books which are overdue and can renew the books. In an automated circulation system, there is no need for the library to issue and maintain borrower's cards or tickets. Every member requires a single card with a unique identification number (such as library membership number) to be used by the software to access the member database. The multiple borrowing facilities are also controlled by the software.

The circulation module performs the following activities:

i. Handles activities of lending, return, renewal, and putting on hold, sending reminders
ii. Controls the following – circulation type, location and status, user database, profiles, privileges, computation and payment of overdue fines, lost books, etc.
iii. Has additional features like import, export, backup and restore functions for the database, inventory, generates different kinds of reports e.g. usage statistics, lesser

used books, heavily used collection; supports interlibrary loan.

iv. Has an option to generate and print bar coded Identity cards (ID). KOHA Library Management System is an example of automated circulation system

Impact of Automation on Circulation Activities

Technology has helped to enhance the library system; library operations such as circulation, cataloguing, acquisitions, and serials have changed significantly due to technology. Circulation control is often the first activity a library considers automating. In addition to loan transactions, an automated circulation system can perform the following tasks: tracking of circulation materials, checking for excessive number of books checked out, detecting delinquent borrowers, printing out overdue notices, printing out fine statements, enabling rapid access to location or status of items, preparing statistical data of circulation activities, and providing a multiple branch libraries network support. Omekwu (2010) stated that the duality operates in traditional and technological paradigms, explaining that the technological paradigm…. Is not limited by time and space but rather seamless, dynamic, interactive and integrative and that Information and Communication Technology (ICT) is the engine that creates the seamless, dynamic, interactive and integrative capacities and possibilities. ICT is a broad term that covers wide range of technologies. It is the convergence of computers, communication and microelectronic-based techniques.

System Analysis and Design

Systems development or product development across the globe has two major components: Systems analysis and Systems design. System design is the process of defining the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements. Systems design is therefore the process of defining and developing systems to satisfy specified requirements of the user. The purpose of the design is to meet the user's specification of the system software, determine flexible system alternatives that will achieve the recommended result and make optimum use of the hardware, software and other processing resources that may be used in implementing the solution. But before this can be done, we must thoroughly understand the old system and determine how computers can best be used to make its operation more effective. System analysis is the act, process, or profession of studying an activity (as a procedure, a business or a physiological function) typically by mathematical means in order to define its goals or purposes and to discover operations and procedures for accomplishing them most efficiently (Merriam-Webster dictionary). System analysis is the study of a system and its component as a prerequisite to system design. It is very essential that the new system should be free from any iota of errors, that's why it's important that the system analysis should understand the weakness of the current system and strive to alleviate it. The analysis stage describes the process of collecting and analyzing facts in respect to the existing operations, procedures and systems in order to obtain a full picture of the situation prevailing so that efficient and effective computerized system may be designed and implemented if proved feasible.

System analysis and design relates to shaping organizations, improving performance and achieving objectives for profitability and growth. Analysis specifies what the system should do. Design states how to accomplish the objective. The emphasis is on systems in action, the relationships among subsystems and their contribution to meeting a common goal. However, proper system analysis aims at devising strategies in which the conceived system takes its shape. System analysis will help the system designer to first have prior knowledge of the existing manual system, its strengths and weaknesses, and how it can be replaced by a computerized system which will help in ameliorating the challenges of the manual system. The reality of designing and implementing a model coupled with its mandate to meet the users' requirement is encapsulated in the clarity and proficiency of the system analysis phase. It is noteworthy that an excellent system analysis invariably leads to an excellent system design.

Existing System and its Problems

We need to understand how the existing system works in the manual process so as to analyze, design and implement it using computer. The existing system of library management system involves lots and lots of paper work. The system involves that all library user details will be taken on a white and black method. To borrow book from a library a borrower information is being taken for every registered user and can actually sign out for return of the book once he/she is completed. Having the overview knowledge of the existing system, Every service has its attendant challenges which are appreciated by the operators or providers of such services. Circulation transactions are therefore not exempted from challenges relating to the service provided. These challenges include but not limited to the following:

a. The pressure of work during the period of students' registration creates avenue for avoidable errors like improper and or incomplete documentation
b. Filling errors occur when a user's registration card is filled under a department different from his or hers, which often times occur during registration period
c. Harassment of circulation staff by some clientele who deliberately refuse to understand and comply with relevant Library rules.
d. Failure of some students to register with the Library within the stipulated time and their desire touse the Library as their registered colleagues thereby causing unnecessary stress
e. Loss of book or pink cards (either deliberately removed or it fell off) prevents charging out of such books as and when the users need them

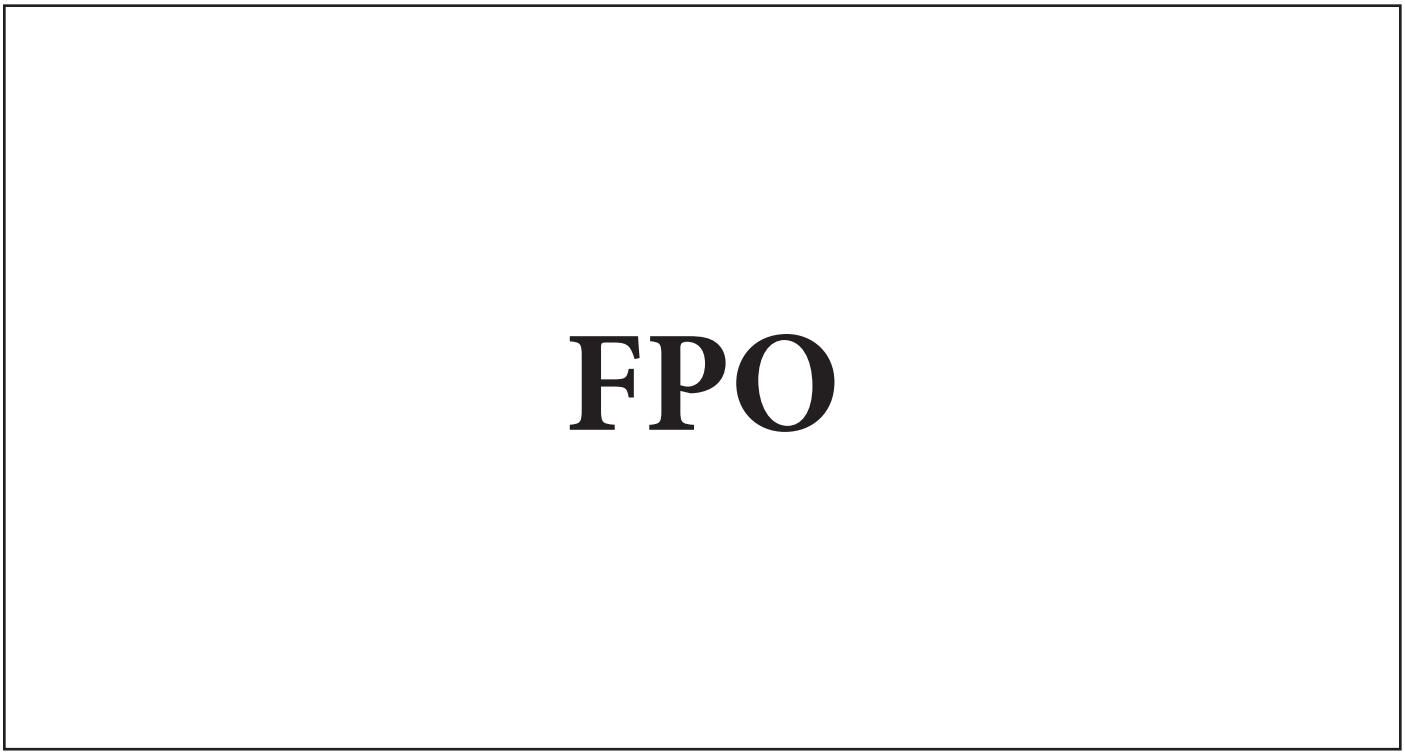

Fig 1

f. Loss of Data: A lot of paper works are needed for the safe keeping of the details of books borrowed by a registered user.
g. Time Wasting: User time are wasted as a result of searching for a book that has been borrowed by a user whose record cannot be traced on the paper records.
h. Error Prone: The existing system of operation is prone to error.
i. Tedious: It is tedious because it must take a routine
j. Processing Speed: The processing speed is very low resulting into low output.
k. Loss of Library materials: Since charging and discharging of books and other library materials are done manually, if record of the library material borrowed is lost, the material itself will be very difficult, if not impossible to retrieve back.
l. Inadequacy of personnel: In an academia, libraries are expected to welcome new users at every session, which means library users are increasing from time to time. Unfortunately, library staff are not increasing thereby leaving the librarians with the challenge of having more work with lesser hands.

Description of the Proposed System

Book Circulation is the main service provided by this library to its members, i.e. the student, teachers, staff of the Lagos State University, Ojo. In addition, private and temporary membership is also provided to the readers. Book circulation includes lending of books from general collection and offers lending for use inside the library from the text book section reference section and serials section. An automated circulation system should be able to:

i. Check that each borrower is registered and is eligible for service
ii. Keep track of borrowed items
iii. Keep track of circulation statistics based on borrower and item type
iv. Indicate the availability of items
v. Show when an item is due for return
vi. Notify borrowers and staff of overdue items
vii. Automatically calculate overdue fines
viii. Reserve items
ix. Support self check-out
x. Process transactions quickly and accurately
xi. Perform other tasks as needed by the local library

There are different stages in the process of this proposed system. These stages are listed as follows:

a. Home page
b. signup/login page
c. Main activity page
d. registration of library users
e. collecting and keeping of statistical records
f. charging and discharging of library materials
g. book reservation
h. Selective Dissemination of Information (SDI)

Advantages Of Proposed System

Certain merits have been associated with the proposed system which enhances the design of the system. Some of which are stated below:

i. There is no loss of data.
ii. Time wastage is greatly reduced.
iii. It is less error prone, its mistakes are minimal
iv. It is not tedious or stressful.
v. It has very high processing speed.
vi. It is free from biasness (all users are served equally).
vii. It provides an immediate form of response to every user.
viii. It facilitates easy learning.

System Design

System design is the process of defining the elements of a system such as the architecture, modules and components, the different interfaces of those components and the data that goes through that system. It is meant to satisfy specific needs and requirements of a business or organization through the engineering of a coherent and well-running system.

Systems design implies a systematic approach to the design of a system. The process is systematic wherein it takes into account all related variables of the system that needs to be created—from the architecture, to the required hardware and software, right down to the data and how it travels and transforms throughout its travel through the system. Systems design then overlaps with systems analysis, systems engineering and systems architecture.

The Functional Specification produced during System Requirements Analysis is transformed into a physical architecture. The architecture of the system is discussed below

Use Case Diagram

The use case diagram is used in presenting the system requirements of any proposed system. A use case is a realistic descrip-

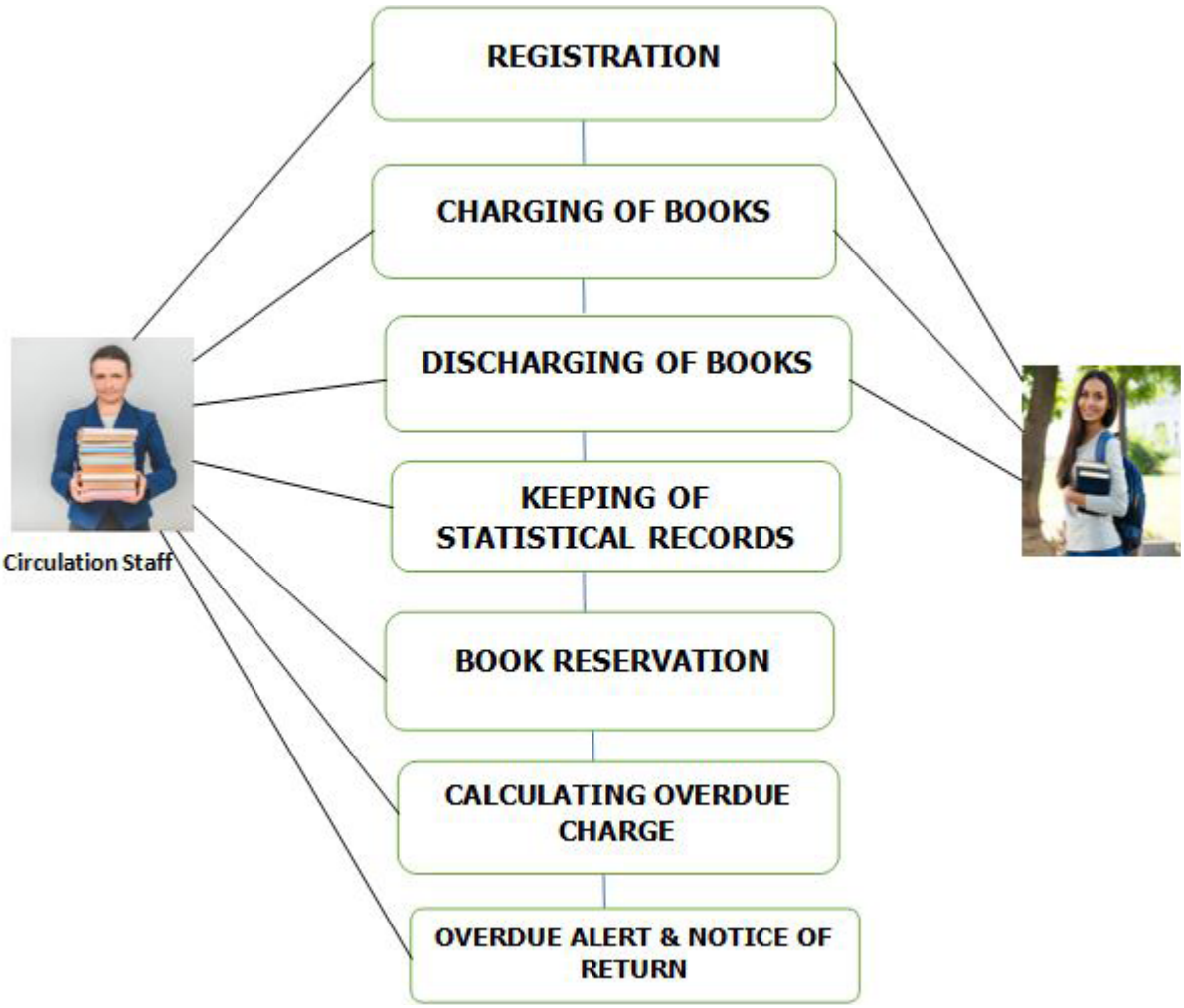

Fig 2 Block Diagram of Library Circulation Model

tion of the workflow of the system and it is used to explicitly describe the intentions and actions of users. The use case diagram, which present the system requirements are used to show how the proposed system work in practice.

System Architecture

The software architecture of a program or computing system is a depiction of the system that aids in the understanding of how the system will behave. It serves as the blueprint for both the system and the project developing it, defining the work assignments that must be carried out by design and implementation teams. The architecture is the primary carrier of system qualities such as performance, modifiability, and security, none of which can be achieved without a unifying architectural vision. Architecture is an artifact for early analysis to make sure that a design approach will yield an acceptable system. By building an effective architecture, we can identify design risks and mitigate them early in the development process. The architectural design used is the unified modeling language (UML) which is a general-purpose modeling language in the field of software engineering and provide a standard way to visualize the design of a system. Furthermore, UML is not a methodology. It is a modeling language, and it can be used to define diagrams and the meaning of these blueprints. A method is an element which will take things a bit further. It will be responsible for defining the processes that must be followed to create the software. It will also organize both the diagrams and tasks. The architectural design is divided into three subsystems namely;

User interface subsystem

System kernel

Output subsystem

i. User interface subsystem

This is an interface that allows users to interact with the system through graphical icons and visual indicators such as secondary notation. That is it is the interface through which the interact with the system, registering and login to the system, choosing the activity they which to perform.

ii. System kernel

The system kernel is the core of the system. It is responsible for running the program and providing secure access to the machine's hardware. The kernel also decides when and how long the program would run. The system kernel is the subsystem by which all processes that are not visible to the users are performed.

iii. Output subsystem

This is the subsystem where all reports about operations carried out are generated for the system and to crosscheck and view or print when needed.

Software Implementation and Documentation

The purpose of System Implementation can be summarized as follows: making the new system available to a prepared set of users (the deployment), and positioning on-going support and maintenance of the system within the Performing Organization (the transition). At a finer level of detail, deploying the system consists of executing all steps necessary to educate the users on the use of the new system, placing the newly developed system into production, confirming that all data required at the start of operations is available and accurate, and validating that business functions that interact with the system are functioning properly. Transitioning the system support responsibilities involves changing from a system development to a system support and maintenance mode of operation. This chapter discusses the implementation of library circulation model, as well as the functions, features and composition of both the front end (that the user interacts with) and the back end (which is hidden from the user).

Implementation Tools Used

HTML and CSS

HTML (the Hypertext Mark-up Language) and CSS (Cascading Style Sheets) are two of the core technologies for building Web pages. HTML provides the structure of the page, CSS the (visual and aural) layout, for a variety of devices. Along with graphics and scripting, HTML and CSS are the basis of building Web pages and Web Applications. HTML is the language for describing the structure of Web pages. HTML gives authors the means to: Publish online documents with headings, text, tables, lists, photos, etc. Retrieve online information via hypertext links, at the click of a button. CSS is the language for describing the presentation of Web pages, including colours, layout, and fonts. It allows one to adapt the presentation to different types of devices, such as large screens, small screens, or printers.

JavaScript

JavaScript is a dynamic computer programming language, it is most commonly used as part of web browsers, whose implementations allow client-side scripts to interact with the user, control the browser, communicate asynchronously, and alter the document content that is displayed. It is also used in server-side network programming with frameworks such as Node.js, game development and the creation of desktop and mobile applications.

JQuery

JQuery is a cross-platform JavaScript library designed to simplify the client-side scripting of HTML. JQuery's syntax design makes it easier to navigate a document, create animations,

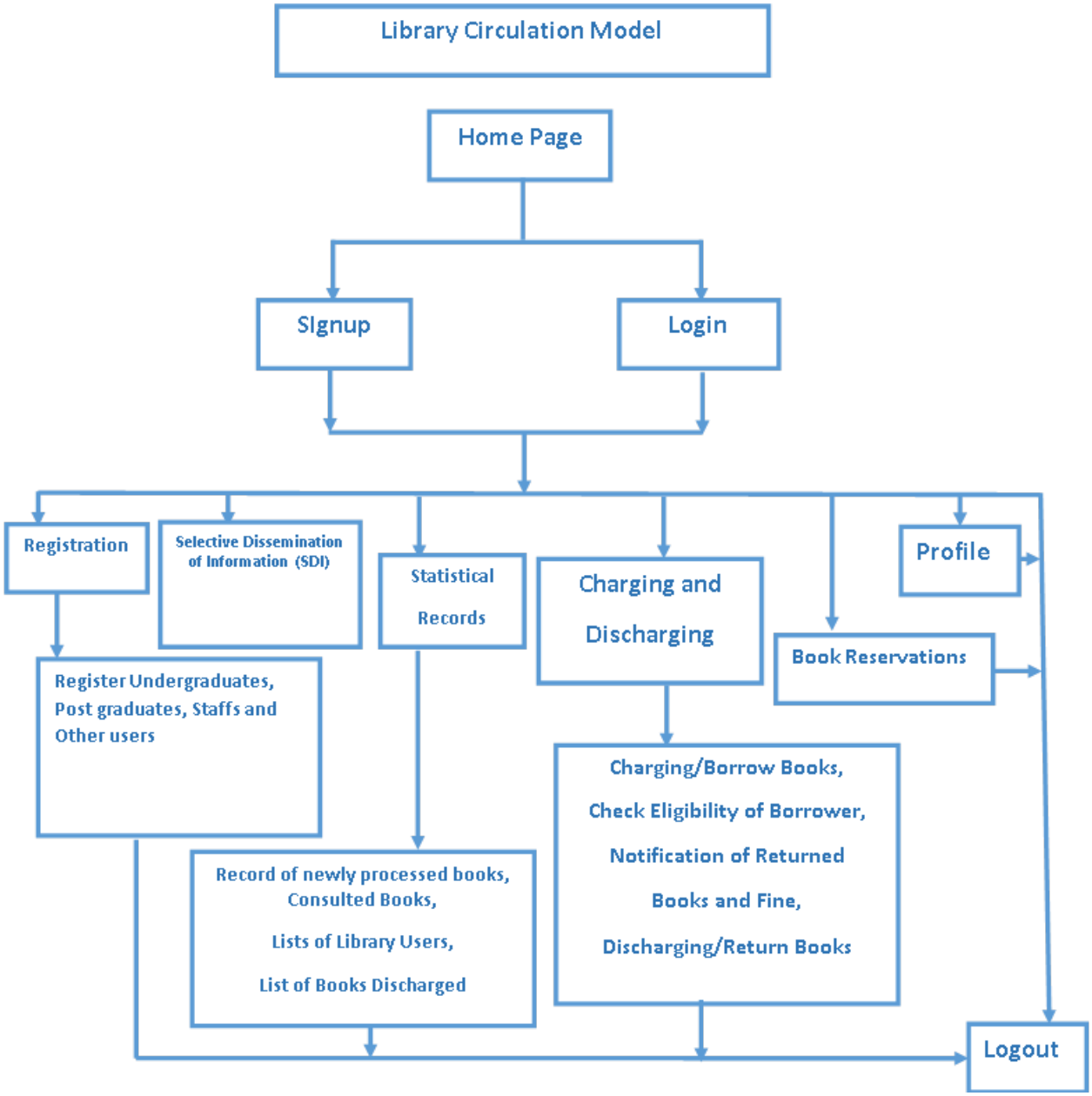

Fig 3 System Architecture of Library Circulation Model

handle events, and develop Ajax applications. JQuery also provides the capabilities to create plug-ins on top of the JavaScript library. This enables me to create abstractions for low-level interaction and animation, advanced effects and high-level, theme-able widgets. The modular approach to the JQuery library allows the creation of powerful dynamic web pages and web applications.

MongoDB

MongoDB stores data in flexible, JSON-like documents, meaning fields can vary from document to document and data structure can be changed over time.

The document model maps to the objects in your application code, making data easy to work with Ad hoc queries, indexing, and real time aggregation provide powerful ways to access and analyze your data. MongoDB is a distributed database at its core, so high availability, horizontal scaling, and geographic distribution are built in and easy to use

MongoDB is free to use. MongoDB possess these characteristics:

i. High availability through built-in replication and failover
ii. Horizontal scalability with native shading
iii. End-to-end security

iv. Native document validation and schema exploration with Compass
v. Management tooling for automation, monitoring, and backup
vi. Fully elastic database as a service with built-in best practices

Requirements of the System

The system emerging from this project have both hardware and software requirements. The reason for these requirements is because the system needs both the physical and non-physical components to be efficient and deliver an effective experience when in use. The hardware requirements include the following:

a. A main memory device (RAM) of appreciable speed and size, preferably, a speed not less than 1.8GHz and a size not less than 3.0GB.
b. A secondary storage device of equally appropriate size.
c. A processor of an architecture of not less than 16bit bus.

The software requirements include:

a. The platform on which the system will be implemented- the Operating System.
b. A Database Management System to which queries will be sent.
c. Any internet browser that supports HTML 4.0 or later
d. Internet Information Service (IIS)

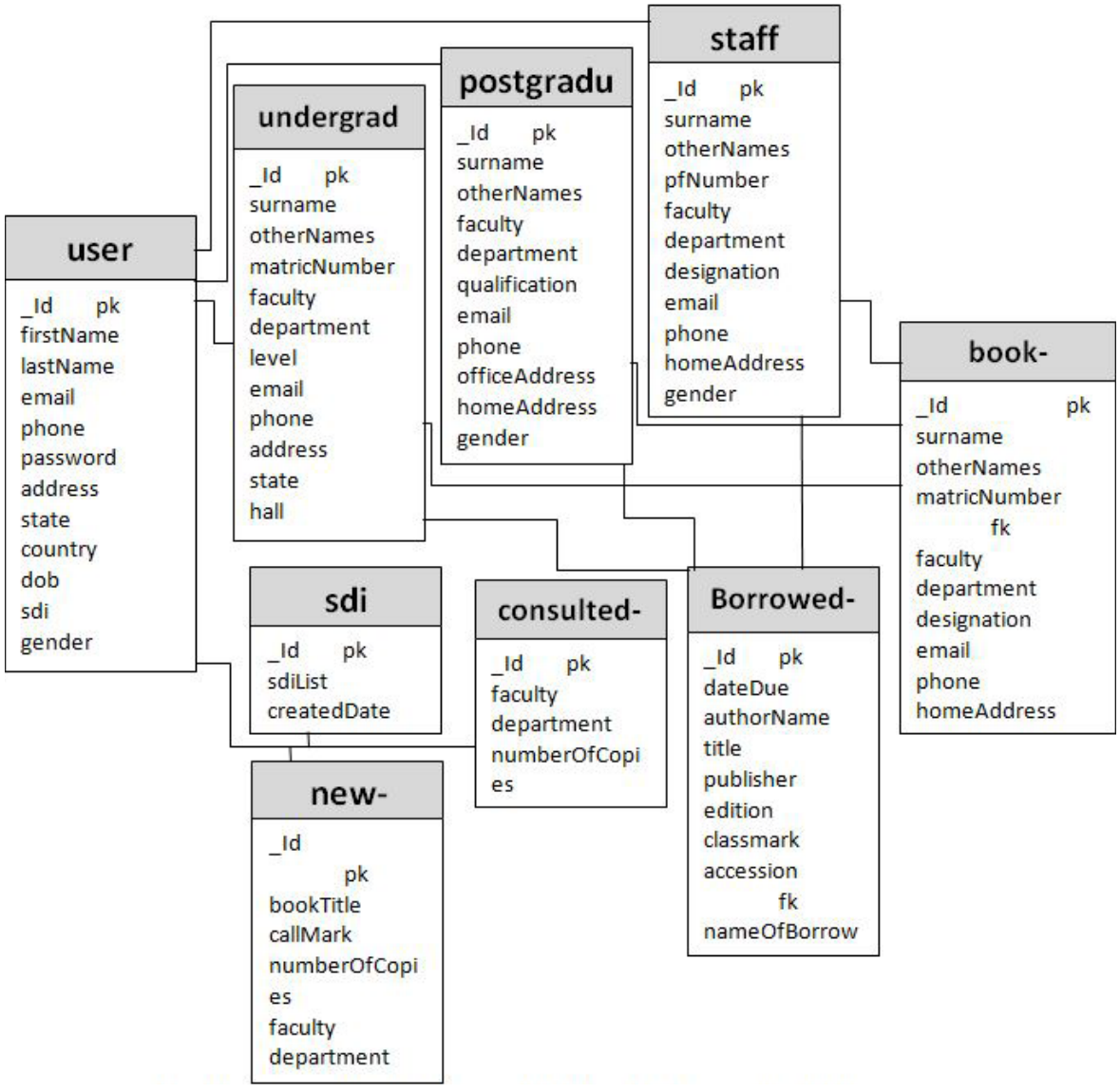

Fig 4 Structure of the Database and Relationship between the Tables

Implemetation Hierarchy

A human-built system with complex behaviour is often organized as a hierarchy. For example, a command hierarchy has among its notable features the organizational chart of superiors, subordinates, and lines of organizational communication. Implementation hierarchy systems are organized similarly to divide the decision making responsibility.

Each element of the hierarchy is a linked node in the tree. Commands, tasks and goals to be achieved flow down the tree from superior nodes to subordinate nodes, whereas sensations and command results flow up the tree from subordinate to superior nodes. Nodes may also exchange messages with their siblings.

This system consists of the following pages:

a. Home Page
b. Login/ Register page
c. Choose Activity
d. Logout

System Testing

System testing is a critical aspect of Software Quality Assurance and represents the ultimate review of specification, design and coding. Testing is a process of executing a program with the intent of finding an error. A good test is one that has a probability of finding undiscovered error. The purpose of testing is to identify and correct bugs in the developed system. Nothing is complete without testing. Testing is vital to the success of the system. In the code testing, the logic of the developed system is tested. For this, every module of the program is executed to find an error. This is the test conducted on a computer integrated system to evaluate the system's compliance with it specified requirements. The system testing determines how the entire system as a whole can be relied upon. The proposed system has been tested with real life data and information each program module has been tested with appropriate data to ensure it work as expected.

System Documentation

Documentation is an overview compilation written by the programmer of the software program, describing as details all the processing as details all the processing involved during the developmental process before making it available. Program documentation is a written description of what each module of a program does and the inter-relationship between them.

System Maintenance

This is very important as it improves the life span and efficiency of the program. A computer system consultant should be called in on regular basis to perform a routine check on the computer system. General cleaning of the external parts of the computer and other preventive routine should be carried out daily such as antivirus update.

Conclusion

This study identified various problems associated with the existing system of LASU library circulation system. The inadequacies of the existing system to meet certain objectives give room for the development of a suitable system. The new system will meet the expectation of the designer in that it is more efficient and effective compared to the existing system because the circulation desk, as the public relation section of the Library, plays a frontline and pivotal role in promoting its image. Through this section, Library operations are made accessible to the general public. Therefore, due to the sensitive nature of this section it requires competent man power and information communication technology facilities to operate it. The new system is evident in the reduction in terms of time of operation and quality of output from the system, and other benefits. In an effort to foster technology driven service in LASU library circulation unit, this library circulation model has been designed to manage all the operations in the unit such as registration, charging, discharging, etc. In conclusion, from proper analysis and assessment of the designed model, it can be safely concluded that the system is an efficient, usable and reliable library circulation model. It is working properly and adequately meets minimum expectations. The new system is expected to give benefits to library users and staff in terms of efficiency in the usage of library system if well implemented. The designed system if implemented will reduce the pressure of work during the period of students' registration and eradicates avoidable errors like improper and or incomplete documentation. Irrespective of any make of the software, whether commercial, open source or in-house, there should be provision for web based services. It is recommended that the Librarians should use all the advance technologies which can reduce the gap between users and library resources for enhancement of the library services. Finally, there should be computer training for Library staff especially the circulation staff in order for them to be able to operate the designed system effectively.

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