Development of a Mobile Platform for Library Information System

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ABSTRACT
Library is a room or building where books are kept and referenced. It is an area of multifarious activity on book management. Its major aim is to provide resources in the educational process. It is therefore important to enhance the services of the library especially the searching and borrowing services. To encourage many researchers in using library, its services to the community must be accessible, easy and available at all time. Hence, this paper is necessary to prepare a library data management platform whose services can be accessed by users using Android Smartphone. In this century, phone has become a ubiquitous tool. Consequently, its application and use in the library unit of every higher institution of learning cannot be overemphasized. This paper developed mobile library data management software for the Ambrose Alli University (AAU) library that will expedite the operations of the university library. Using a mobile phone, the system could show whether a book is available to be borrowed or not, book reservation and provide easy search of books. That is books can be searched with the option by title, author and ISSN. The software was developed using Android programming technology. Its full adoption by AAU library and other higher institution of learning will improve the data management operations in library system

Keywords
Library, Mobile Phone, Android Phone, Data Management, Mobile Library

1. INTRODUCTION
A library as a repository of knowledge that houses collections of books, reference reports, general reports, technical reports, periodicals, journals, conference proceedings, newspapers etc. Consequently, truth and knowledge can be found and acquired from the library through the aforementioned sources. The information content of any of the collections can be recorded as microfilms, audio tapes, microchips, and other materials traditionally kept in the library. The Librarian is charged with the responsibility of acquiring, organizing, maintaining and circulating the books and other library material through the various sections of the library for efficient use of the library by the users. The acquisition, cataloguing, bindery and circulation sections of the library undertake the acquiring, organizing, maintaining and circulation of the books/library materials respectively. When the library through the acquisition section acquires a book, its record is taken and accession number is given to the book after which the book will be sent to the cataloguing section of the library. Under this section, the book will be carefully studied and given catalogue number before it will be sent to circulation section of the library. The circulation section is responsible for circulation and distribution of books. The section also arranges the consulted books in the shelves. There are other sections like reference section which provides questions and bibliographic service and serial section where periodicals, journals and related materials are kept. The Library also houses special collections and operates circulation control in which books are lent to users. Libraries can be divided into categories by several types, which are academic libraries, corporate libraries, government libraries, private libraries, public libraries, etc.

The Ambrose Alli University Library is an academic library which assists in the provision of resources in the educational process. It supports the university curriculum and the researches of the university faculties and students. Presently, books transaction in the Ambrose Alli University Library is being done manually in most case; thereby, taking more time for transactions like borrowing of books, returning of books and searching of materials and books. Series of problems occur as a result of the existing inefficient library management system. Also, the university main library is housed at the centre of the academic core of the university as it appears in the master plan. At present, it is relatively far from the campus made up of the faculties of Arts, Education, Engineering and Technology, Management Sciences, Physical Science, Environmental Science, Law etc. This makes it discouraging for students to patronize the library when they do not find the books they needed after walking a long distance to the library. This paper has provided a better platform to solve these problems by developing a mobile library application through which every user of the library can search for the available books and make their reservation with android smart phone. This kind of system is needed and better than the web system since almost every student in the campus uses phones. This paper covers the implementation of a mobile library system for used in Nigerian Universities, using Ambrose Alli University Library as the case study that will run on Android phones for searching, reserving and monitoring availability of the library books.

2. RELATED LITERATURE
Library is regarded as the brain of any institution, of course many institution understand the importance of the library to the growth of the institution and their esteem users (students). The mobile library software is an application used for reserving library books, searching books in the library and monitoring books borrowed. It can be liken to a library management system which is used by the librarian to manage library resource whereas the mobile library application is used by the library users to access the library resources. Before the advent of computer in modern age there were different methods of keeping books in the library on shelves and each shelf was labeled in an alphabetical or numerical order, in which the categories of books available are arranged on different position on the shelves and as well are recorded on the library manuscript and when any book is to be referenced the manuscript is being referred. This help to know the position of such required book by the person that requested for the book. After the invention of computer, different researchers have

carried out various approaches on automated library system.
The first automated library system to be reviewed in this paper is the KOHA library management system. Since the original implementation in 1999, KOHA functionality has been adopted by thousands of libraries worldwide, each adding features and functions, deepening the capability of the system. With the 3.0 release in 2005, and the integration of the powerful Zebra indexing engine, KOHA became a viable, scalable solution for libraries of all kinds. LibLimeKOHA is built on this foundation. With its advanced feature set, LibLimeKOHA is the most functionally advanced open source Integrated Library System in the market today. The major setback of this Library System is that it is a web based which hackers could have the database hacked if strong security is not adopted. (www.koha.org).

Another automated Library System is the Capital's library software with the following benefits: Increases support available for staff and users in any modern library services provides efficiency, innovative system that's saves library time and improves the user experience.

In [1], a system was developed using KOHA Open source software to implement an updated database of books and other resources of the school of Chemistry Library in Bharathidasan University. The software was able to carry out the charging and discharging functions of the circulation section more effectively which provide various search options to know the availability of books in the library. KOHA is being said to be an integrated software system with all the required models for small to very large libraries [1].

The outcome of the system they developed has all chemistry library collections in single database, it gives the full control over the library collections and operations, faculty members can check the required books by simple modules, research scholars and faculty members can check the status of their borrowed books, they can get the complete details about the books for their further reading and research, data entry of the books can be done through the downloading of bibliographic details from the library of congress and other catalogues and the library system developed can share their data with various library and other department in the libraries. The limitations of this research are, lack of infrastructure facility, lack of environment support, lack of financial resources etc.

[2] developed a library management system which could be mainly used by member and staff of the library. The system allows members to search for books and reserve books through website so that they can save their time and cost to travel from one place to another to use the library. They can also use it to know what the book entails in the library. In the system developed, staffs can also be able to add news and also view reports with several criteria as well as add, edit and delete news. The system developed was aimed at allowing users to reserve books via online, to anable user borrowing books via online, implementing email technologies to the website, implementing SMS technologies to the system, designing a friendly graphical interface which would suit the users.

In the designing of the system, various modules were considered which are the:

i. Authorization and authentication module
ii. Member/staff module
iii. Search module
iv. Books maintenance module
v. News maintenance module
vi. Email module
vii. Report modules
viii. Publisher maintenance module
ix. Employee maintenance module etc.

The development tools used in the research are the Microsoft products like the Microsoft visual studio 2008 for the website development and ASP.NET with C# as the programming language having the Microsoft SQL server 2008 as the database. Mainly the software and hardware requirement used in this research were:

i. Operating system: windows 7 professional

ii. Database: MYSQL server 2008

iii. Development tools and programming language: Microsoft visual studio 2008 and VB.NET

iv. Processor: Intel core i2 duo CPU T7250 @ 2.00 GHz

v. Ram: 2 GB

[3] developed a system which is a library management software for monitoring and controlling the transactions in a library. In their study they came up with a Library Management System which was developed in java and mainly focuses on basic operations in a library like adding new member, new books, and updating new information, searching books and members and facility to borrow and return books. The system developed is an automated Library Management System, through the software user can add members, add books, search members, search books, update information, edit information, borrow and return books in quick time.

All the manual difficulties in managing the Library were rectified by implementing this software. The software which was designed can help users maintain and organize library making the software very easy to use for both beginners and advanced users The system requirement for the research entails how the library management system that was designed can be used in windows 98 Windows2000, Windows XP and Windows NT, supported for other platform such as Applet Macintosh and UNIX. The system was made to run on Windows 98 or Windows NT4.0 operating system and met the following hardware requirements.

i. For Windows 95 based computers, a 486 / 66 MHz or higher processor with 8MB

ii. For Windows 98 based computers, a 500/88MHz or higher processor with 32 Mb of RAM

iii. For Windows NT based computers, a 488 / 66 MHz or higher processor with 16 MB of RAM

iv. For Windows 200 based computers, a 700/850 MHz or higher processor with 512 MB of RAM.

At the end of his research the combination of all the web pages designed resulted in a web application named Library Management System, which works as online library. However could not work with a mobile phone since it is not a mobile application.

Problems and Challenges of Library Professionals in Developing Countries

New tools of information technology have absolutely changed the role & responsibilities of librarians. A number of studies have been conducted to explore the problems faced by librarians. This section reviews the studies conducted at International level in general and particularly in developing countries to investigate the problems confronted by the librarians.

A research on computer literacy skills of professionals in Nigerian University libraries concluded that most of the professionals do not poses high level of computer skill and their use of computer and technology is still maturing. They recommended that library management and leaders should organize and offer in-house computer training programs for librarians and enough computers should be provided in this regard [4].

[5] viewed library and information science education in developing countries. He concluded that computer programs in developing countries continue to suffer from lack of financial support by governments.

[6] reviewed the library education in Bangladesh. The study found that majority of institutions in Bangladesh do not have well-equipped computer labs or sufficient numbers of computers for students. Many institutions either have no library or inadequate collection of textbooks. Professional's status was also found very low, low pay scale and limited opportunities for promotion.

[7] found that there was no government agency to control, monitor and evaluate the school libraries activities. There was lack of awareness programs, budgetary constraints, inadequate space, inadequate library materials, lack of trained and skilled manpower and lack of appropriate government policy and lack of information literacy.

[8] investigated the computer skill among librarians in academic libraries on Ondo and Ekiti State in Nigeria. It was found the shortage of computers and computer skills among professionals. The study recommended that more attention and funds should be provided for training and procurement of ICT infrastructure in Nigerian University libraries. For computerization purpose, library administration should solicit funds and assistant from foreign agencies and foundations who are interested for the cause.

[9] searched out that in India there is non-existent of norms and standards for the education of librarians. Problems for Indian librarians discovered in his study were emergence of new Library Integrated System (LIS) schools, insufficient faculty strength, and lack of accreditation bodies, lack of proper library facilities, inadequate physical facilities, little attention for selection criteria, and lack of apprenticeship programs. Study suggested that the Government of India should play a leading role in promoting LIS education in India, by creating more job opportunities for LIS professionals and removing disparity in pay scales among LIS professionals.

In Iran, [10] concluded that librarians do not have traditional skills and sufficient background knowledge to meet the changing needs of their customers. They need to be empowered by new skills and information before going to empower their patrons. So there must not be a gap between librarian's professional and technological knowledge and their societies informational need that to be answered by librarians. Need for changing the syllabus of medical library and information science education in Iran was also felt.

Implementation Methodology

The design methodology used is the parallel method as a result of the fact that parallel methods support the use of the system side by side with the existing system in order to test for the system efficiency. Top down approach is used as well in the design because it allows the analysis of the system to be carried out one after the other. In this stage, the first goal was decided by task analysis. Next, the prototype of the system was analyzed. Then test was made on its usability and design with some design theories.

Implementation Tools and Platforms

i. **Android Studio:** is the official Integrated Development Environment (IDE) for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed especially for Android development. It is a replacement for the Eclipse Android Development Tools (ADT) as the primary IDE for native Android application development.

ii. **Android Virtual Device (AVD) Manager:** The AVD Manager is an emulator which simulated the functionality of an Android device running the Android OS. It allows developers to develop and test applications without the need of various real devices with different configurations. The emulator is a virtual mobile device running on your computer.

iii. **Java Development Kit (JDK):** The Java Development Kit is a software development environment used for developing applications, applets, and components using the java programming language. The JDK includes tools useful for developing and testing programs written in Java.

iv. **Gradle:** In Android studio, Gradle is a custom build tool used to build android packages (apk files) by managing dependencies and providing custom build logic.

v. **Personal Computer:** PC requirements to develop to develop the proposed system on Windows Os.

- Windows 7/8/10 (32- or 64- bit)
- Microsoft 3 GB RAM minimum, 8GB RAM recommended; plus 1 GB for the Android Emulator.
- 2 GB of available disk space minimum, 4 GB recommended (500 MB for IDE + 1.5 GB for Android SDK and emulator system image)
- 1280 x 800 minimum screen resolution

Programming language Used:

i. **Java:** Java is a general-purpose computer programming language that is concurrent, class-based object-oriented, and specifically designed to have as few implementation dependencies as possible It is intended to let application developers write once, run anywhere.

ii. **Kotlin:** is also a general-purpose programming language with static typing and type inference. Kotlin is designed to interoperate with java, and its standard library depends on the Java Class Library, but allows its syntax to be more concise.

iii. **SQLite Database:** SQLite is a open source SQL database that stores data to a text file on a device. Android comes in with built in SQLite database implementation. SQLite supports all the relational database features.

iv. **XML:** XML stands for Extensible Markup Language. XML is a markup language much like HTML used to describe data. In Android we use XML for designing our layouts because xml is lightweight language so it doesn't make or layout heavy.

System Development Approach

System development life cycle (SDLC) was adopted as the development methodology for this android software. It produces a consistent framework of tasks and deliverables

needed to develop this software. The SDLC methodology tracks a project from an idea developed by the user through feasibility study, systems analysis and design, programming, pilot testing, implementation and post implementation analysis, The development model used for the mobile library data system is the V-model which may be considered as an extension of the waterfall model, it offers a mean of making the development process more visible. The V-model represents a software development process (also applicable to hardware development) which may be considered an extension of the waterfall model. Instead of moving down in a linear way, the process steps are bent upwards after the coding phase, to form the typical V shape. The V-Model demonstrates the relationships between each phase of the development life cycle and its associated phase of testing. The horizontal and vertical axes represents time or project completeness (left-to-right) and level of abstraction (coarsest grain abstraction uppermost), respectively. The model is as shown in figure 1 below
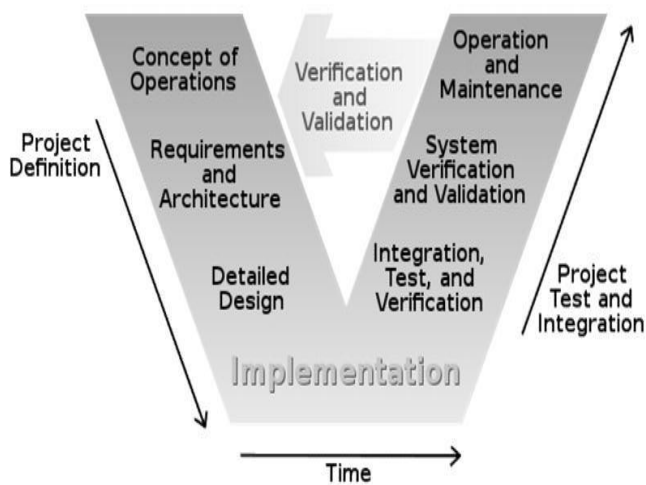
Figure 1: V-model

3. THE SOFTWARE ARCHITECTURAL DESIGN

The phase of the design of software architecture can also be referred to as high-level design. The baseline in selecting the architecture is that it should realize all which typically consists of the list of modules, brief functionality of each module, their interface relationships, dependencies, database tables, architecture diagrams, technology details etc. After the requirements have been determined the necessary specifications for the hardware, software, people and data resources and the information products that will satisfy the functional requirement of the system can be determined. The design serve as a blueprint for the system before these errors or problems are built into the system. Figure 2 and figure 3 shows the system architecture and flowchart respectively.
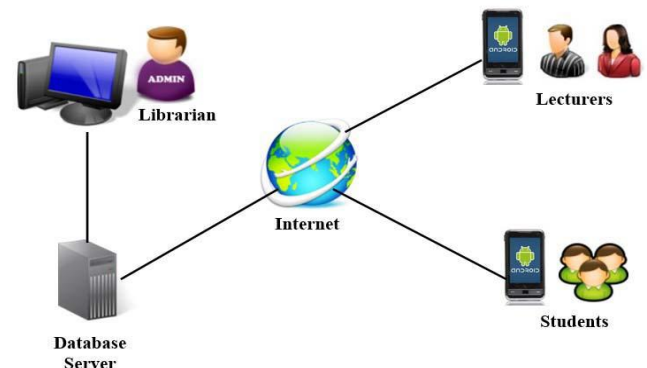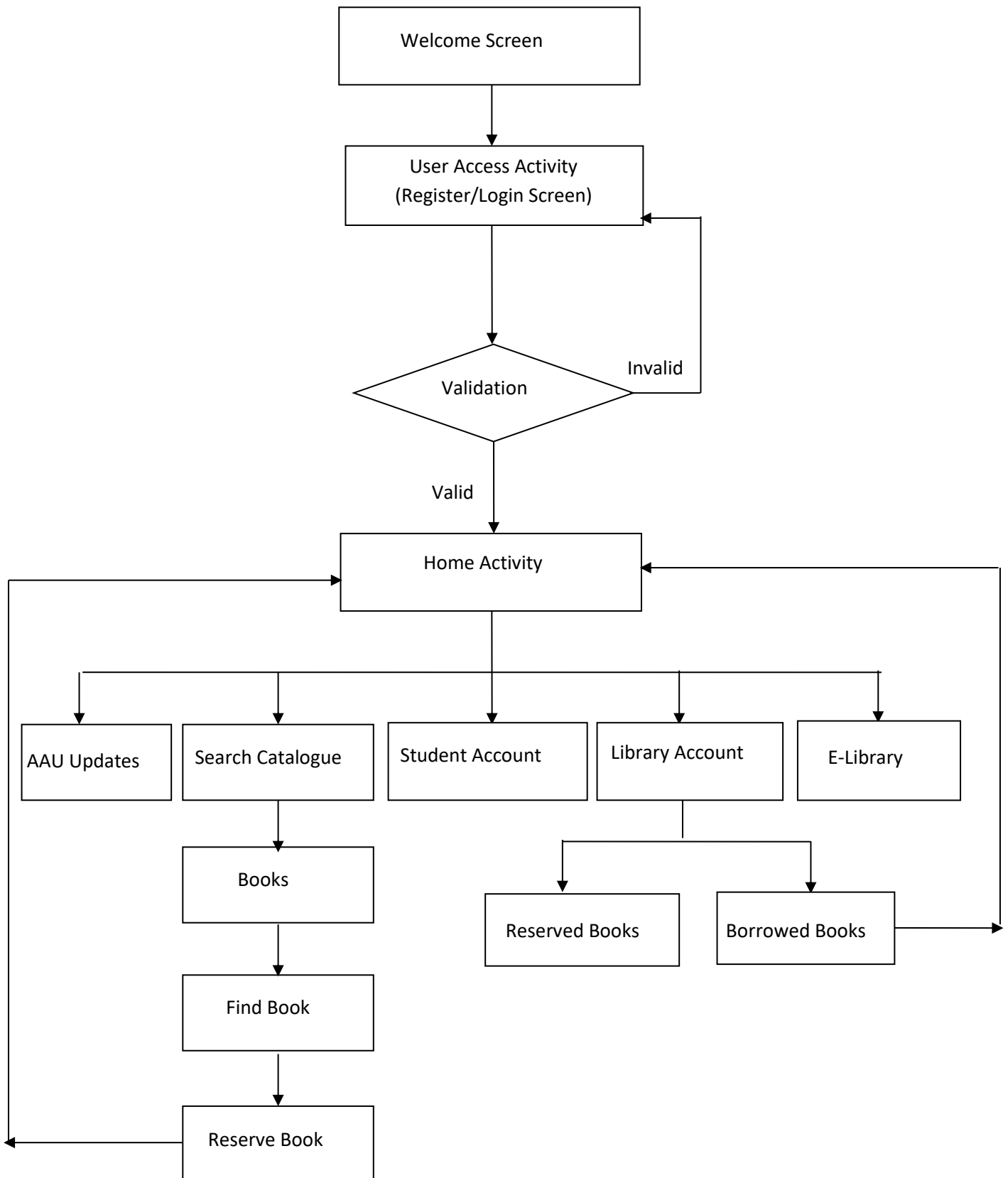

Figure 2: System Architecture

Figure 3. System Flowchart

4. BOOK SEARCH

User can search for book at the search catalog activity. First, he selects a search type which is either search by book title, serial or author, then type into the search box and finally clicks on the search button. The search operation data flow is as shown in figure 4 below.
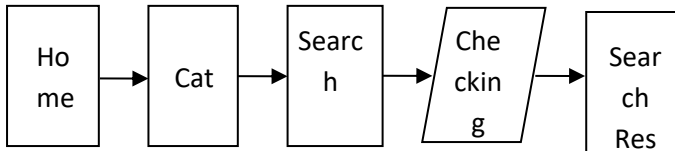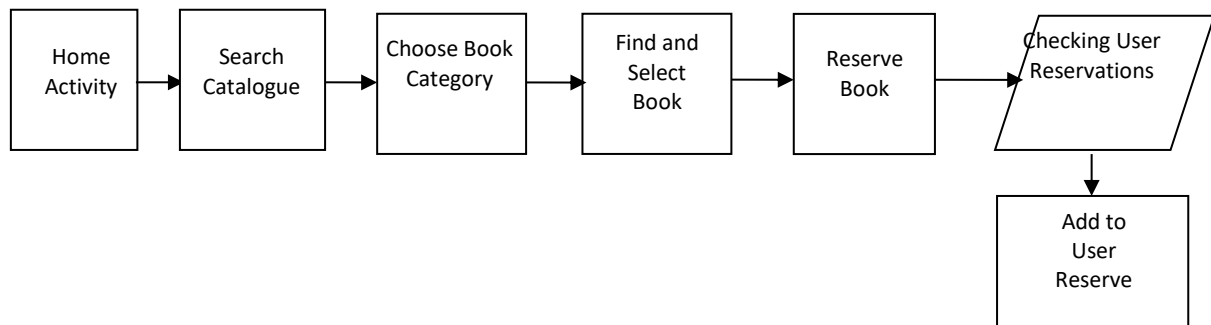

Figure 4: Dataflow Diagram for Book Search

Book Reservation

A library user is entitled to reserve a maximum of two books. To reserve a book, click on the search catalogue button, then select the name of the book category, find the book and select it. The search operation data flow is as shown in figure 5 below.

Figure 5: Dataflow Diagram for Book Reservation

5. EXECUTING THE SYSTEM

The system is easy to use. So, users need no special training before using the system. When the application is launched, the user is welcomed by a splash on the screen consisting of Ambrose Alli University Logo and welcome text. After which, the user is automatically taken to the login or registration screen where user can login account or register a new account. If login or registration is successful, the home screen opens up which present various activities users can perform with the application. The first output is the application icon as seen on the mobile phone of the user.
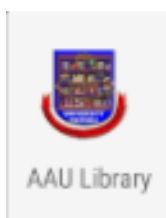

Figure 6: Screenshot of Application Icon

The Welcome Screen which is also known as the Splash Screen is the first screen that appears when the Mobile Library Application is launched by using the mobile library data icon as shown in figure 7 above. This screen consists of Ambrose Alli University (AAU) Logo.

Figure 7: Screenshot of Welcome Screen

User Access Screen

A library user can only use the application if he is registered, so the Access Screen has two option button which is the REGISTER and LOGIN button. The register option pops up a screen where a new user can create an account with matriculation number, first name and last name, department and password while the login option opens up a screen where a registered user can login to his/her account with his matriculation number and password. The screen shot for these screens are as shown in figure 9 below.
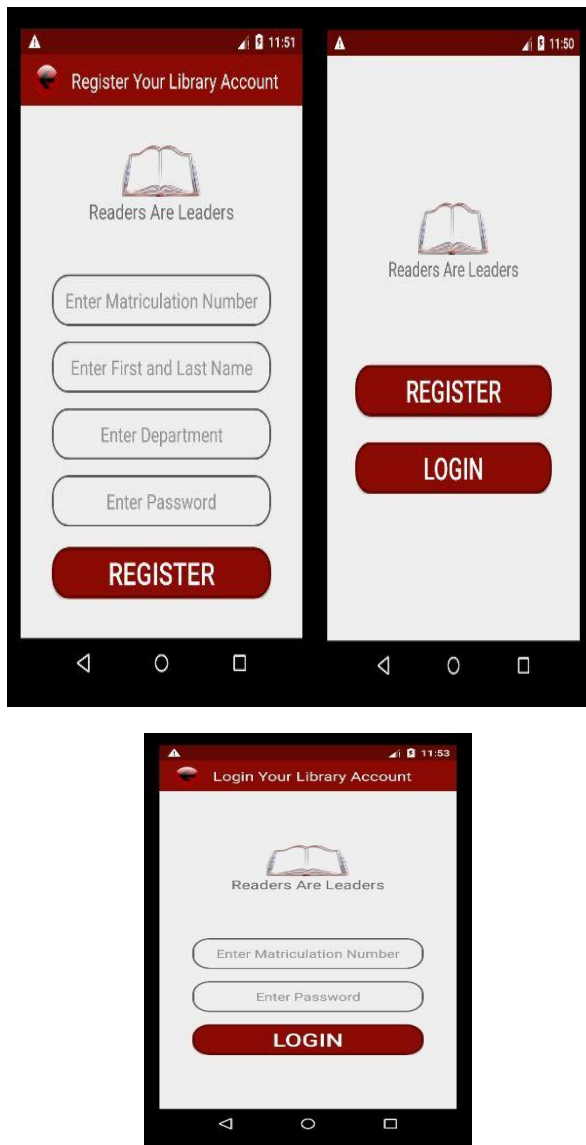
Figure 9: Screenshot of (a) Access Type Screen, (b) Register Screen, (c) Login Screen

Home Screen

The Home Screen is the screen that appears after a successful registration or login. The home screen has a collapsing interface. When it is not collapsed, it has a library image on the application bar while when it is collapsed, the image disappears. It consist of a library image, navigation button and five menu option that can be selected by users, namely: Catalogue, Account, Kofa, Updates and E-Library. Figure 10 shows the system home screen.
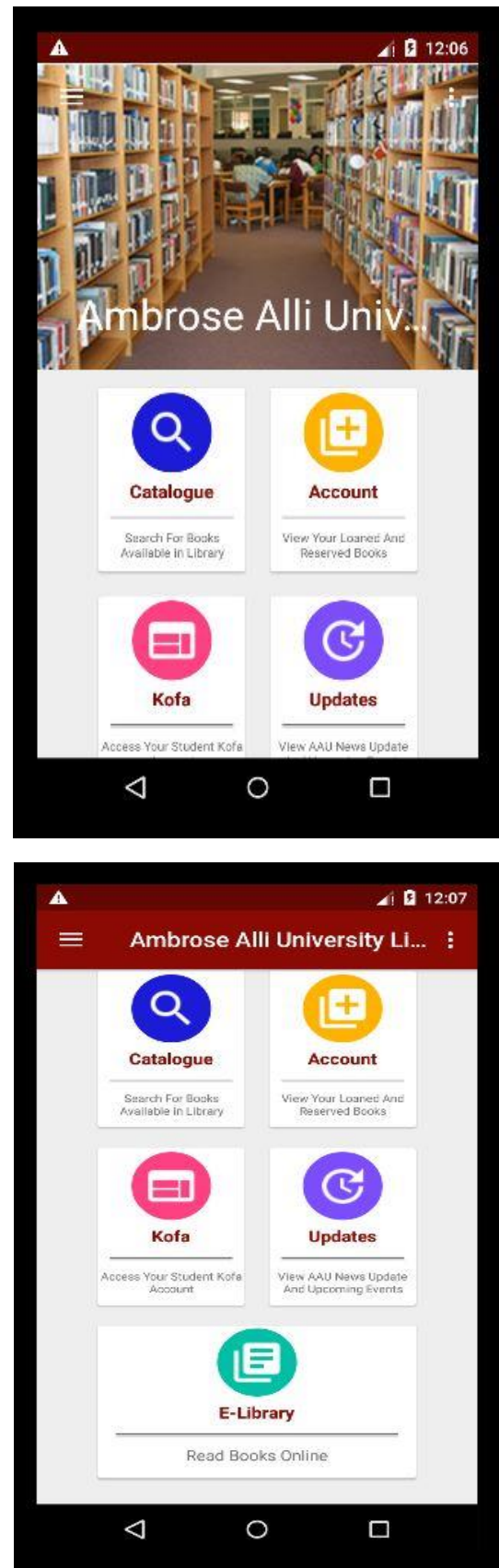

**Figure 10: Screenshot of (a) Home Screen (b) Collapsed Home Screen**

Navigation Screen

There are two navigation buttons in the mobile library application. One is at the left which pulls out a menu list with five menus namely: User, Home, Opening Hours, Librarian Office, About Library. The other is at the right; it pulls out a menu list with one menu which is the Change User menu. The navigation screen are as shown in figure 11.
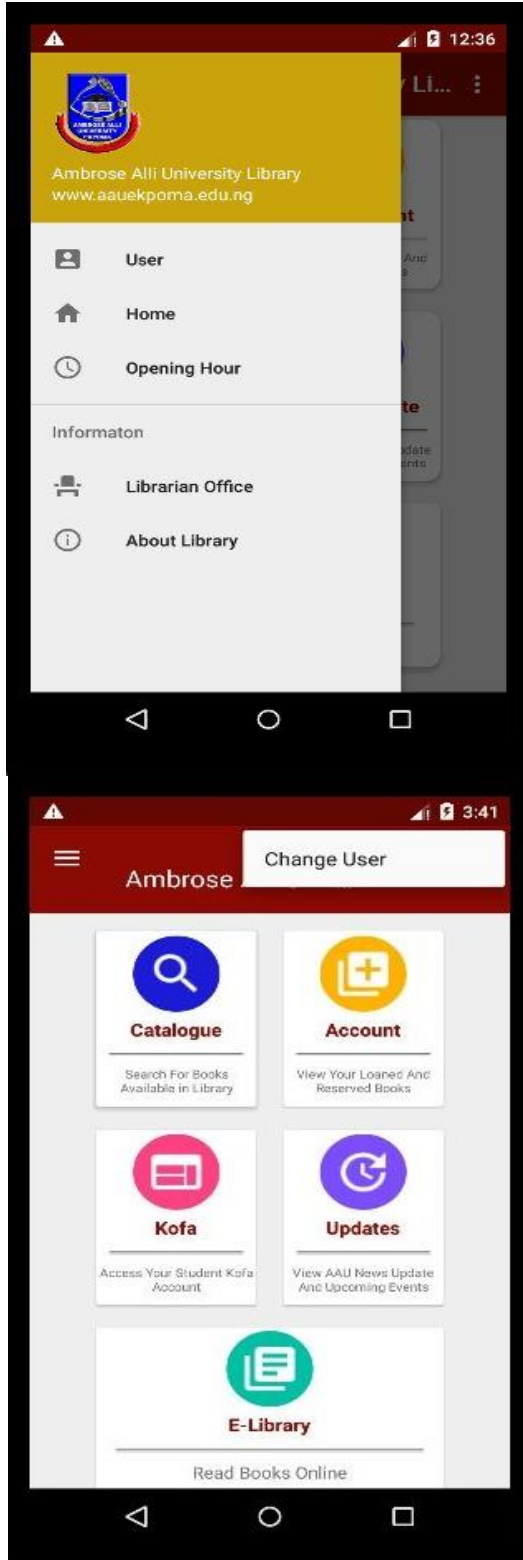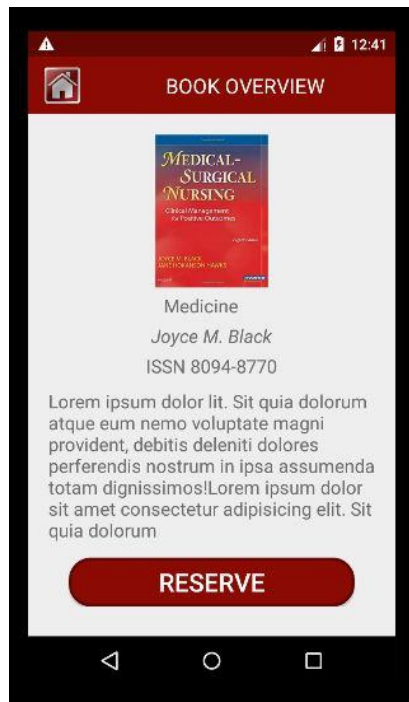
Catalogue screen

The Catalogue option on the Home Screen leads to three major activities as shown below. The first activity reveals the catalogue classification list of the library. The library catalogue is classified into: General Works, Education, Law, Engineering and Technology, Computer Science, Medical Science, Social Science, Mathematics, etc. The catalogue activity also has the search icon to open up the Search activity. The different section of the catalog screen are as shown in figure 12.
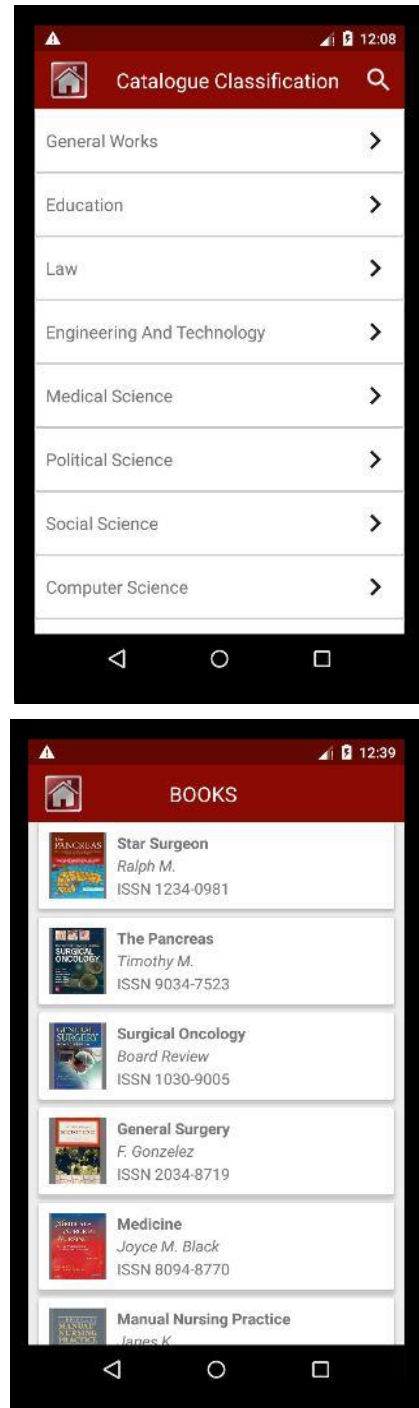
Figure 11: Screenshot of (a) Left Navigation Bar (b) Right Navigation Bar

Figure 12: Screenshot of (a) Catalogue Category (b) Books (c) Book Overview

Search Screen

The search opens up when the search icon on the catalogue activity is clicked. For a search to be done, one need to select a search type namely: title, author and serial number, after which type in the search depending on the search type selected and finally click the search icon. The system will look up the database immediately and load every book similar to the search and show it on screen as show below. The search screen are as shown in figure 13.
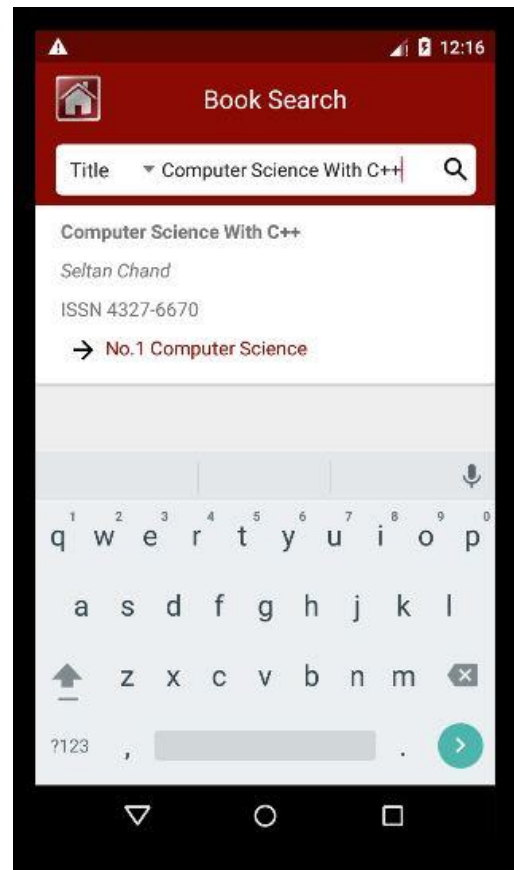
Figure 13: Screenshot of Book search

Account Screen

The account screen or activity is where a library user manages and monitors his/her library account. It has two buttons; the first which is CURRENT LOAN displays the details of the current book borrowed and show the numbers of days left for such book to be return. The second is RESERVATION. It shows the book a user has reserved and provides the user the option of removing a reserved book. The different account screen are as shown in figure 14.
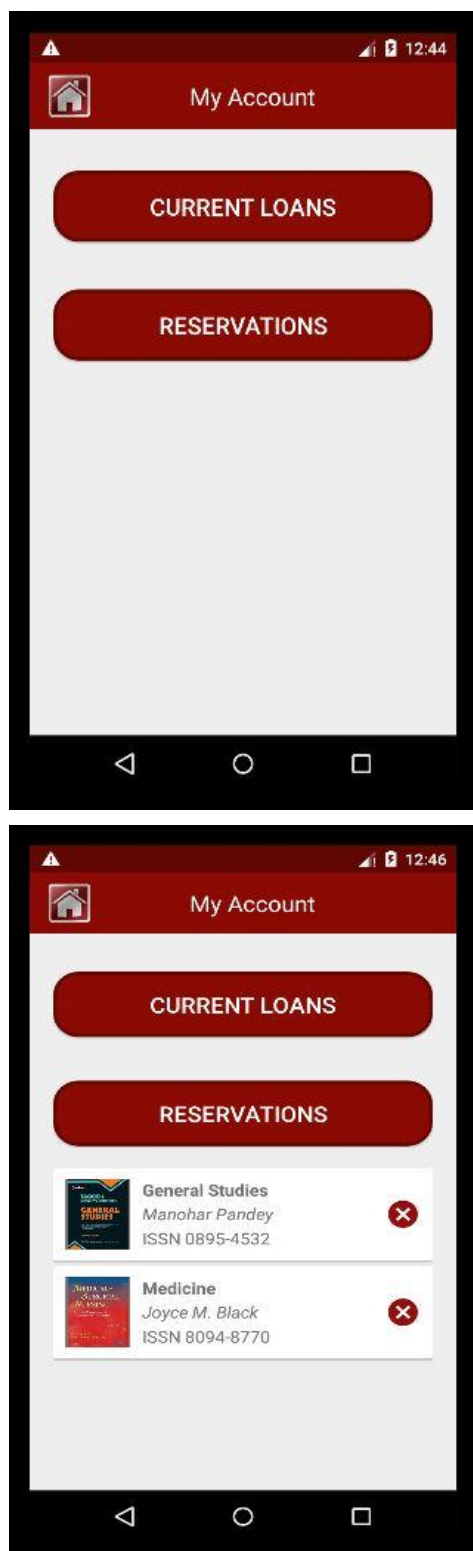
Figure 15: Screenshot of E-Library

6. CONCLUSION

The quest to make life easier and processing faster has led to computerization of various processes. Computer technology has transformed so many sectors especially the Educational sector in a very large extent. In an effort to foster technology driven education, this Mobile Library System has been developed to facilitates library in higher institutions of learning. Based on the experimental results it is concluded that:

    i.   Through android smart phone, library users can search for the materials available in Ambrose Alli University Library.

    ii.   This Mobile Library System can be used by library users to reserve books easily.

    iii.   This application helps to monitor the status of the books and monitor the deadline of borrowed books which will minimize delays in returning books or forgot the date of return of the book.

    iv.   It provides an e-library platform for students via mobile phone.

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Figure 14: Screenshot of (a) Account Screen (b) Reservations Fragment

E-Library

The mobile library system provides an additional platform where students can read books online for free. Through this platform, students have access to numerous educative books online. A sample of the e-library platform/screen is shown in figure 15.
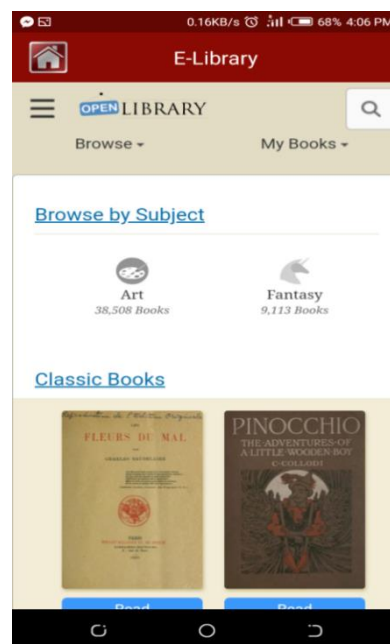
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