

Development of Mobile Access to FUTA Digital Library

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Abstract

Intellectual research findings and output of patent constitute a great impetus to national wealth creation and the development of the world at large. This can only be achieved through great access to a wealth of knowledge and experiences of past scholars that have contributed immensely to the intellectual bank. In the past, accessibility was only through entrance into a physical structure called “library” with books purchased with huge amount of money, arranged on a shelf. The advent of Information and Communication Technologies has made accessibility and sharing of the wealth of experiences by scholars much easier. This wealth of experiences could now be powered by organizations, government, institutions and even individuals. But this technology is also limited in wider global coverage due to lack of infrastructure and non-exploitation of standard ICT policies especially in developing countries like Nigeria. This paper develops a mobile platform that provides access and reuse of digital library to enhance academic findings and output of scholars in Federal University of Technology (FUTA), Nigeria.

Keywords: mobile computing, digital library, information, university

1. Introduction

The need for sharing and timely access to information in any community, especially in the academic environment cannot be over emphasized. This notion brought about the word “library” which comes from liber, the Latin word for “book”. A library is the physical collection of books and other information materials contained in it. The most important mission of a library is to collect, organize, preserve, and provide access to knowledge and information. In fulfilling this mission, libraries preserve a valuable record of culture that can be passed down to succeeding generations. Many contemporary libraries maintain collections that include not only printed materials such as manuscripts, books, newspapers, and magazines, but also art reproductions, films, sound and video recordings, maps, photographs, microfiches, CD-ROMs, computer software, online databases, and other media. In addition to maintaining collections within library buildings, modern libraries often feature telecommunications links that provide users with access to information at remote sites (Abegunde 2003).

People in many professions use library resources to enhance their work. People also use library resources to gain information about personal interests or to obtain recreational materials such as films and novels. Students use libraries to supplement and enhance their classroom experiences, to learn skills in locating sources of information, and to develop good reading and study habits.

The access to this information is somewhat limited, due to the location of the conventional libraries, the difficulty of checking through the library catalog to reference books, and sometimes the long queue of people (especially in academic settings) trying to borrow or return borrowed books might be another problem. In a bid to solving location problem, library materials are being moved to remote areas through vehicles such as trucks or buses by some library staff at certain days in the week.

The proliferation of technology has provided solution to these pressing problems. The first step to solving the problem involved the development of digital library in which library collections are stored in digital formats (as opposed to print, microform, or other media) and accessible by computers. Digital libraries bring about the integration, management and communication of gigabytes of multimedia data in a distributed environment (Bhargava *et al.* 1995). As a result of more technological advancement, various mobile devices such as PDAs (Personal Digital Assistant), mobile phones, iPod, and so on are now used to access information (ARL 2008).

Developing a platform for mobile access for FUTA digital library will promote greater and wider accessibility to wealth of knowledge and experiences and opportunities for sharing seamless information. In addition, the world is undergoing a transition from a paper to a digital economy. It is important for libraries in the developing world to take part in this changing scene. The rest of this paper is organized as follows. Section 2 gives an overview of library development, and related work. ICT, Mobile and Library Development, and some works carried out in the Nigerian context are reviewed in Section 3. Section 4 gives a description of the proposed mobile digital library system, while Section 5 gives the conclusion and direction for future work.

2. Overview of Library Development and Related work

Over the years, there has been tremendous development in the growth of library. Library can be traced back to the ancient times where documents were recorded in cuneiform, (a system of writing in which scribes (writers or copiers) cut wedges of varying size, shape, and depth into damp clay tablets), animals bones and on scrolls. This development can be grouped into conventional, digital, and mobile digital libraries, which are discussed below.

Traditional Libraries are libraries where the physical collection of books and other information materials are stored and in-housed by physical infrastructure such as buildings and managed by the staff or personnel. There are different types of traditional library, which are usually funded by governments or organisations, which include: public libraries, school libraries, college and university libraries, research libraries, special libraries and government libraries (Abegunde 2003).

With the advent of Information and Communication Technology, **digital libraries** emerged. A digital library could be described as the following: multimedia database, information warehouse, on-line information repositories, electronic library, operational image applications, imaging, World Wide Web (WWW) and Wide Area Information Services (WAIS) (Gladney *et al.* 1994). It is essentially an online collection of heterogeneous information, which are usually maintained by some digital librarian. It is seen as the electronic extension of functions users typically perform and the resources they access in traditional library. These information resources can be translated into digital form, stored in multimedia repositories, and made available through web-based services (Adewale 2007). Also, Borgman (1999) points out that the term digital library is used in at least two senses: In the computer science research community, digital library is viewed as content collected on behalf of users. In the library practitioner community, digital library is seen as an institution providing a range of services in a digital environment. While most of the digital libraries fall into the first category, the speculation about the future developments concentrates on versions of the second category. A digital library service is an assemblage of digital computing, storage, and communication machinery together with the software needed to reproduce, emulate, and extend the services provided by conventional or traditional libraries based on papers and other material means of collecting, storing, cataloguing, finding, and disseminating information (Gladney *et al.* 1994). Also, according to, Candela *et al.* (2007), “a digital library is an organization, which might be virtual, that comprehensively collects, and preserves for the long term, rich digital content, and offers to its user communities specialized functionality on that content, of measurable quality and according to codified policies”.

Continuous and rapid advancement in information technology and communication led to the evolution of the **mobile digital library** and is also expected to grow even more with the growth of the internet and information technology infrastructure. The term "mobile library" may be considered as all travelling or movable library activities in any format such as large enclosed trucks or vans or large motor vehicles equipped with shelves and a staff enclosure to visit rural districts or remote areas where there is no other library service at specific times on a certain day or days of the week (Nohema & Alfredo, 2003).

Mobile digital library which is the focus of this paper, can also be defined as a usable, accessible and user- friendly digital library system that is enhanced with mobile technology, in which users can easily have access to digital resources with their mobile devices, to add and create content to the digital repository by their mobile devices, therefore the name, “Mobile Digital Library”. For library (digital) to be mobile, it means it must be accessible anywhere and everywhere not minding the geographical location of the user, which is possible with the integration of mobile devices (such as laptops, notebooks, personal digital assistant (PDA), cell phones and other handheld devices) and technology. Internet enabled personal digital assistants (PDAs), cellular phones, and a wide range of mobile devices represent a novel and promising facet to exploit digital library resources.

A number of works related to the one presented in this paper are described below:

Bhargava *et al.* (1995) proposed architecture for providing mobile access to a digital library and the effect of different characteristics exhibited by the architecture. The work was part of a system under development at Raidlab in Purdue University in a research effort to address the impact of communications on digital libraries services.

The Athabasca University (AU) has implemented a comprehensive mobile library (M-library) website. The M-library system can auto-detect users' devices and bring them to the appropriately formatted version (mobile or desktop) of the site. It provides opportunities to increase the boundaries of anytime and anywhere learning for students (Yang *et al.* 2006). The architecture of their system is device independent. This was achieved through efforts to broaden the capabilities and flexibility of web browsers which separate the content from the format. An Extensible Markup Language (XML) is used, which enables the content to be specified and describes how it appears on various devices using XML Style sheet Languages (XSL). The web pages were programmed in PHP and mobile friendly HTML.

Hey *et al.* (2007) discussed a mixed research and design study to perform a needs analysis for the design of mobile engineering digital library infrastructure to support informal learning using mobile devices. The work presented twelve key needs areas at different levels of specificity that should be taken into account for the design of digital resources and mobile digital devices to be used in pre-engineering education and technology literacy activities. Based on this needs analysis, they also provided recommendations towards the design and development of an appropriate infrastructure to support the creation, sharing and utilization of digital resources to support informal learning about science and engineering using mobile devices.

Hahn *et al.* (2011) presented the results of collaborative planning among researchers from the University Library, the Department of Computer Science, and the Graduate School of Library and Information Science at the University of Illinois Urbana – Champaign. The plans articulated in the work are for applied research with handheld technology, leveraging the library's wireless infrastructures to produce a novel software application. The mobile software application enables library patrons to navigate the print collection as they search for items identified from the online catalog. Their proposed wayfinding software will enable library patrons to use their mobile devices to locate multiple service points within the library complex as well as libraries across campus. The project is based on WiFi fingerprinting, a technology for determining the position of a device in a building, even when GPS-based localization is unavailable.

3. The Nigerian Situation

The use of computers started late in Nigeria, but the growth in their use has been very remarkable (Ogunsola & Aboyade, 2005). Nowadays, computers have found its use in the universities, government departments and agencies, banks, commercial establishments, and industries in the country. The private sector is also not left out in this information technological revolution. The Universities in the country are now full of ICT enabled technologies. Many of them have Internet presence, with portals for e-registration, e-tests and other academic activities. According to Ogunsola & Aboyade (2005), the Federal Government of Nigeria and other international funding agencies are interested in the general development of ICT in higher education in Nigeria. This reflects in the establishment of the National Virtual (Digital) Library Project, by the Federal Ministry of Education. Funding agencies like Carnegie Corporation of New York are also interested in the Nigerian ICT development programme. The Corporation supported the establishment of scientific databases at the University of Ibadan, Nigeria.

According to a study carried out by Sulaiman (2010), Mobile cellular services made their first appearance on the Nigerian market in 1993 with a “national” service operated by NITEL and a smaller Lagos service operated by Mobile Telecommunications Services (MTS). The two firms, with a joint subscriber base of 12 500, provided voice services over an analogue E-TACS network, as well as basic value-added services such as voicemail and paging, from three switches in Lagos, Enugu, and Abuja. Later, in 1995, MTS closed its operations, and M-Tel emerged as NITEL's mobile service provider. In 2000, Econet Wireless Nigeria, Mobile Telephone Networks (MTN) and Communications Nigeria, joined the team. After 2000, several mobile service providers such as Glo, Visafone, Multilinks, Starcom have emerged, and more developments are taking place.

In spite of the technological advancements and development, there are still some barriers faced in the country, especially in the full adoption of ICT (Dhanavandan *et al.* 2008). Some studies reveal these. Ani *et al* (2005) investigated the adoption of ICT in University libraries in Nigeria. The major obstacles that influence effective adoption of ICT were found to be inadequate fund and limited electricity infrastructure. In a related study, Igun (2005) identified the challenges faced by the libraries and information centres in Africa in the establishment of electronic publishing. Their findings reveal that apart from information sources that can be downloaded online, acquisition of electronic books is not possible. Some of these barriers can be leveraged with the aid of mobile devices. For instance, some mobile devices, when fully charged can work for several days without electricity. Also, they are relatively cheap and affordable.

Efforts have been geared towards applying the mobile technology for learning activities in some Nigerian Universities. For example, Adagunodo *et al* (2009) developed a system for delivering examination results via the short messaging service (SMS) in a university. Recently in FUTA, Doyeni (2012) developed a mobile portal that allows learning contents to be delivered. Some Nigerian University Libraries have also received some benefits courtesy of MTN for the digital library development. Such Universities include Ahmadu Bello University, Zaria, University of Nigeria, Nsukka and University of Lagos (Abubakar, 2011). FUTA is yet to provide mobile access, hence the significance of the work carried out in this paper.

4. System Description

The mobile system is designed with the aim of enabling anywhere, anytime access to digital library materials. The administrative staff and patrons (staff and students) in different locations can access the system through the user interfaces provided. The system actually extends the functionalities of the existing traditional library and digital library by allowing remote and real time access to the library materials. This will motivate students to exploit the library facilities, which is part of their learning objectives.

4.1 System Architecture

The system architecture, as shown in figure 1, is built on three-layer architecture, which includes storage, business, and application layers. The storage layer is implemented using the file system, as managed by the SQLSERVER database tables. The business logic layer is where the system-specific functionality resides, including the Administrator Manager, User Manager, File Manager, Identity Generator and so on. The application layer consists of the interface to the system: the web user Interface, the layer at which users operates. The user interface of this system is web-based/mobile-based and therefore supports the client/server model as shown in figure 2.

4.2 Database Design

The mobile digital library System uses Microsoft SQL as the database management to manage the database and various tables used by the system. This database has four tables vis-à-vis the users table, book relation table, book reserve table and comment table. The users table is composed of the User name (surname, middle name, and last name), Matriculation Number, Age, Department, Registration date, User library code, and password.

4.3 System Implementation

The system is implemented to run on the windows platform and all other operating system with Internet capability. The system sits on top of the Microsoft.NET platform with Microsoft relational database management system (SQLSERVER), Microsoft Internet Information Server and ASP.NET web server technology. This approach of accomplishing various tasks developed in the system is described as follows:

- a. **Administrator's Module:** This module involves the interaction of the administrator with the system. The administrator manages the web-based aspect of the system. Here the first level of security is for administrative authentication and verification. To use the system, the administrator launches the web browser (e.g. Internet Explorer, Mozilla Firefox, etc), supplies the URL (Universal Resource locator) address at the address bar to display the "Home Page" as shown in figure 3. After logging in, he can perform these various operations:
 - i. **Register:** He can register new books by supplying the book title, the author(s), the book ISBN (International Standard Book Number) as shown in figure 4 and selecting the book category and the number of author, after which he submits to store it in the database. He can also register student (this is not compulsorily done by the administrator, as the student can also register through his/her mobile device).
 - ii. **Search:** The administrator can also search for the available books in the library as shown in figure 5. This is done by selecting the book category and by either supplying the book title or the book ISBN and click the search button, after which there will be response to show if the book is available or not. After these operations, the administrator can then logout.
 - iii. **View:** The view operation is made up of two sub tasks as shown in figure 6 -"All books" and "All comment", by clicking the "All Books" link, the administrator can view all the books that have been registered. Also, by clicking the "All comments" link, the administrator can view all the comments that have been posted by the mobile users.
- b. **The Mobile users' interface Module:** This module involves the interaction of the mobile users with the system. This is the mobile aspect of the system. The level of security is for users' authentication and

verification. This allows users to have access to the page in subsequent visits (this can only be after the user has registered) (see figures 8 and 9). To use the system, the user switches on his mobile device to launch the mobile Explorer. After his submission of the registration form, he will be a registered member and the system automatically generates a library code for him. This is useful for him to retrieve his password in case he forgets.

Search: This is done by selecting the book category and by either supplying the book title or the book ISBN and click the search button as shown in figure 9, after which there will be response to show if the book is available or not as shown in figure 10.

5. Conclusion

This paper presents a framework of the development of a system that provides mobile access to the library of the Federal University of Technology, Akure, Nigeria. The deployment of the system in FUTA and any higher institution of learning will enhance provision of services for wider accessibility to and usability of library materials. It will provide the opportunity for students to transform their daily events into meaningful learning opportunities that will complement their overall education. This reduces the stress of having to go through the physical library catalog, searching for available books and to provide real time access to available materials. Further work will include deployment of the system by some FUTA Staff and Students and evaluation of its performance.

References

- Abegunde, B.F. (2003), "Design and Implementation of FUTA Virtual Library", M.Tech Thesis, Federal University of Technology, Akure, Nigeria.
- Abubakar, B.M. (2011), "Academic Libraries in Nigeria in the 21st Century", *Library Philosophy and Practice*. Available at <http://www.webpages.uidaho.edu/~mbolin/abubakar.htm>.
- Adagunodo, E., Awodele, O. & Idowu, O. (2009), "SMS User Interface Result Checking System", *Issues in Informing Science and Information Technology* 6, 163-177.
- Adewale, O.S. (2007), "University Digital Libraries: Adaptive Personalized E-learning System, Yerimah Prints.
- Ani, O.E., Esin, J.E. & Edem, N. (2005), "Adoption of Information and Communication Technology (ICT) in academic libraries: A strategy for library networking in Nigeria", *The Electronic Library* 23(6):701-708.
- ARL (2008), "Mobile Technologies, Mobile users: Implications For academic Libraries", A bimonthly Report on Research Library issues and Actions.
- Awodele, O., Adagunodo, E. R., Idowu, O., Akinwale, A., Idowu, S., and Agbaje, M. (2009), "An Improved SMS user interface result checking system"
- Bhargava, B., Annamalai, M. & Pitoura, E. (1995), "Digital Library Services in Mobile Computing", *Sigmod Record*, 24.
- Borgman, C.L. (1999), "What are digital libraries, who is building them, and why? In Aparac T Saracevic T, Ingwersen P & Vakkari P (Eds). *Digital Libraries: Interdisciplinary Concepts, Challenges, and Opportunities*. Proceedings of the Third International Conference on Conceptions of Library and Information Science. Dubrovnik, Croatia, pp. 23-38.
- Candela, L., Thanos, C. & Borri, F. (2007), "The DELOS Digital Library Reference Model: Foundations for Digital libraries", Available at http://www.delos.info/index.php?option=com_content&task=view&id=345
- Dhanavandan, S., Esmail, S.M., Mani, V. (2008), "A Study of the Use Information and Communication Technology (ICT) Tools by Librarians", *Library Philosophy and Practice*.

Doyeni, O.A. (2012), “Development of a Mobile-Based E-Learning System”, *Unpublished M.Tech. Thesis*, Federal University of Technology, Akure, Nigeria.

Gladney, H.M., Ahmed, Z., Ashany, R., Belkin, N.J., Fox, E.A. & Zemankova, M. (1994), “Digital Library: Gross structure and requirements”, Report from a workshop of IBM Research Center.

Hahn, J., Twidale, M., Gutierrez, A., & Farivar, R. (2011), “Methods for Applied Mobile Digital Library Research: a Framework for Extensible Wayfinding Systems”, *The Reference Librarian*, 1541-1117, 52(1&2), 106-116.

Hey, J., Sandhu, JS., Newman, C., Hsu, J-S., Daniels, C., Datta, E., Agogino, A.M. (2007), “Designing Mobile Digital Library Services for Pre-Engineering and Technology Literacy”, *International Journal of Engineering Education*, 23(3), 441-453.

Igun, S.E. (2005), “ Implications for electronic publishing in libraries in information centres in Africa”, *The Electronic Library* 23(2):202-203.

Nohema, C. & Alfredo, S.J. (2003), “Mobile Access to Digital Library Resources”, JCDL Second Joint ACM/IEEE-CS Joint Conference, pp 184-185.

Sulaiman, S. (2010), “The State of ICT in Nigeria and its economic implications”

Yang, C., Tony, T., Rory, M., Mohamed, A. & Sherry, C. (2006), “The Athabasca University Mobile Library project: Increasing the Boundaries of Anytime and Anywhere Learning for Students”, Research Center, Athabasca University.

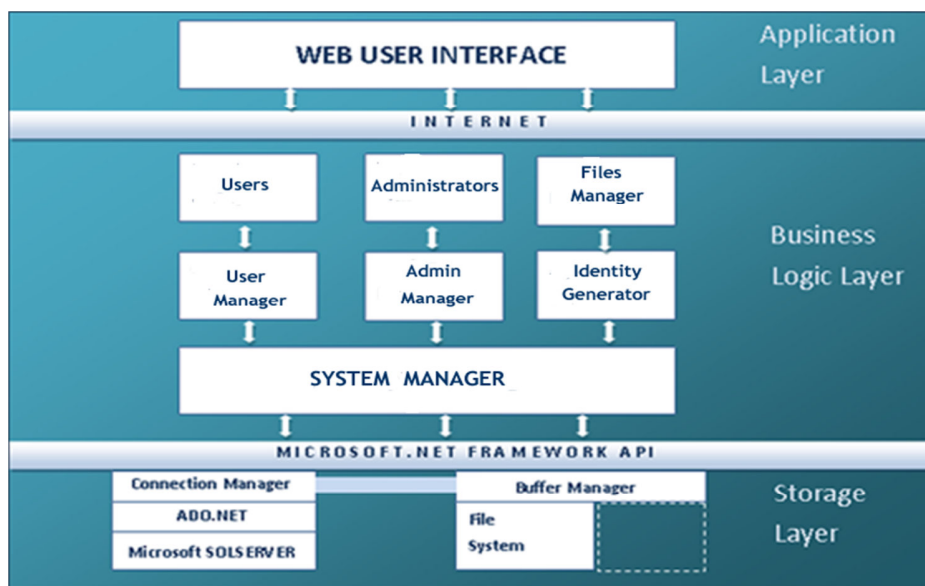


Figure 1. System Architecture

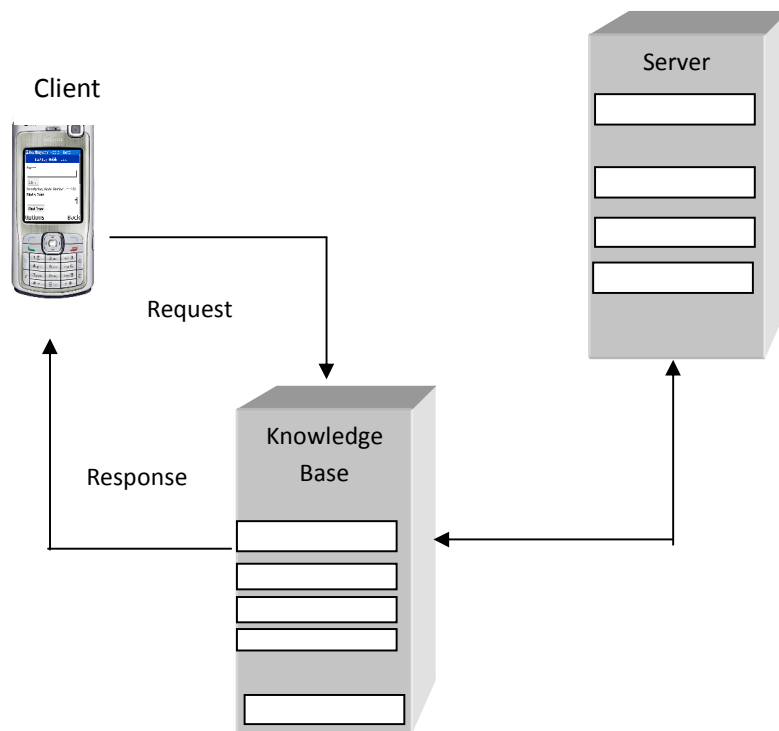


Figure 2. Client/server model of the User Interface




Login

The sharing of and access to information in any community, especially in academic environment cannot be over emphasized. This was why there are different types of libraries, (where collection of books and other informational materials are made available to people for reading, study, or reference) such as, public libraries, which serve all members of the general public; school libraries, which serve students and faculty through the high school level; college and university libraries, which serve students and faculty in higher education; research libraries, which serve the needs of advanced scholars; special libraries, which serve various organizations, industries, and governmental agencies; and government libraries, which serve governmental departments and agencies, and often the general public as well. Each type of library develops its mission statement, collections, services, and facilities to satisfy the needs of its particular clientele.

The access to this information is somewhat limited due to the location of the conventional libraries, the difficulty of checking through the library catalog to reference books, and sometimes the long queue of people (especially in academic settings) trying to borrow or return borrowed books might be another problem. In a bit of solving location problem, library materials are being moved to remote areas through vehicles such as trucks or buses by some library staffs at certain days in the week. The problem is yet to be solved because users have to wait for these certain periods before they can access the information they need.

The proliferation of technology has provided solution to these pressing problems. The first step to solving the problem involved the development of digital library in which library collections are stored in digital formats (as opposed to print, microform, or other media) and accessible by computers. As a result of more

Figure 3. Home Page



[Logout](#) [Administrator](#)

NEW BOOK REGISTRATION

Title
 I S B N
 Select Category Category
 Book Authors
 Select Number of Auhctors: 1
 Author 1

- ◆ Home
- ◆ Register
- ◆ Student
- ◆ Book
- ◆ Search
- ◆ View
- ◆ All Books
- ◆ All Comments

Figure 4. Book Registration page




[Logout](#) [Administrator](#)

SEARCH PAGE

Category: Autobiography
 Search by: Title ISBN
 Book Title

- ◆ Home
- ◆ Register
- ◆ Student
- ◆ Book
- ◆ Search
- ◆ View
- ◆ All Books
- ◆ All Comments

Figure 5. The search page



[Logout](#) [Administrator](#)

Title	Author	ISBN	Category	Status
COPING WITH COMPUTERS	HENRY C.LUCAS, JR.	0-02-919310-9	Science	Reserved
FINITE MATHEMATICS WITH APPLICATION	DAVID E ZITARELLI, RAYMOND F. COUGHLIN,	0-03-011292-3	Science	Available
COMPARATIVE PLANT ECOLOGY	J.P GRIME, J.G HODGSON, R. HUNT,	0-04-445685-9	Science	Available
MODERN NMR TECHNIQUES FOR CHEMISTRY RESEARCH	ANDREW E. DEROME,	0-08-032514-9	Select Category	Available
PHYSICAL SCIENCE	DEAN HURD, MYRNA SILVER, ANGELA BORNH BACHER, CHARLES WILLIAM MCLAUGHLIN,	0-13-700568-7	Select Category	Available
PRINCIPLE OF PROGRAMMING LANGUAGE	R.D TENNENT,	0-13-709873-1	Select Category	Available
STRUCTURING DATA WITH PASCAL	WILLIAM G MCAARTHUR, J. WINSTON CRAWLEY,	0-13-853060-2	Science	Available

- ◆ Home
- ◆ Register
- ◆ Student
- ◆ Book
- ◆ Search
- ◆ View
- ◆ All Books
- ◆ All Comments

Figure 6. All Books Page

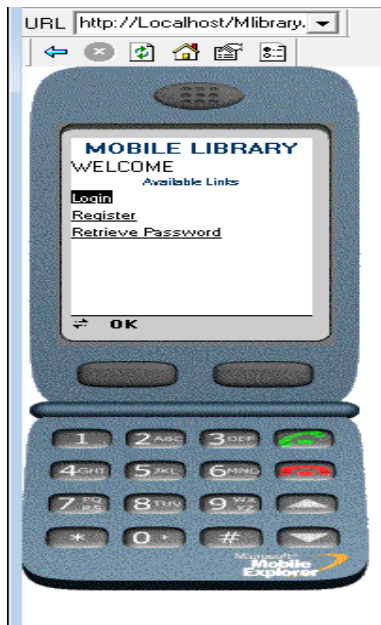


Figure 7. Home page for the mobile phone

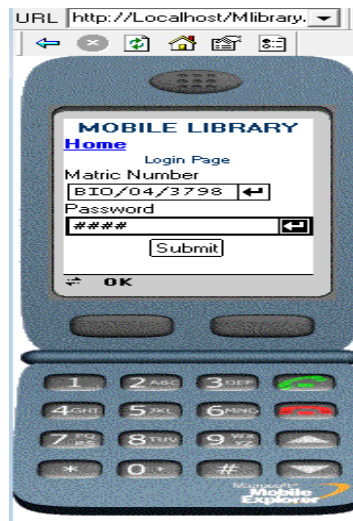


Figure 8. Login page

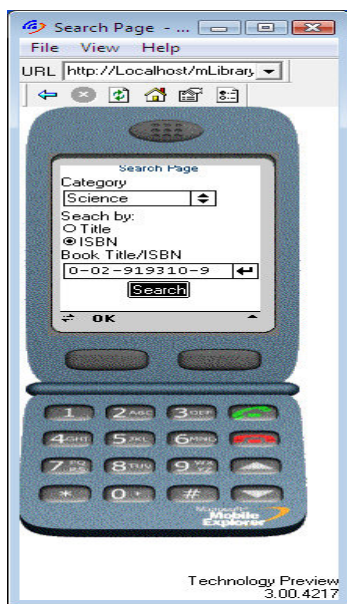


Figure 9. The Search page

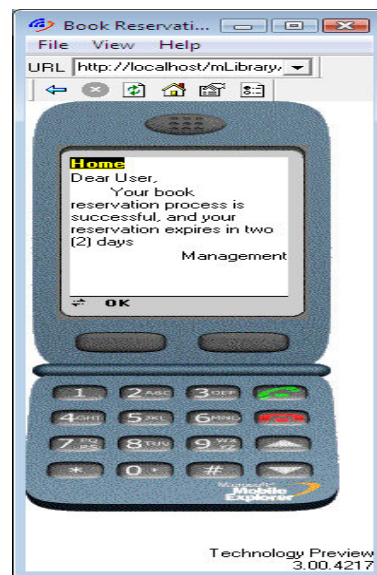


Figure 10. Response to Reservation operation

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