A Pratibha Spandan's Journal

CONFLUENCE OF KNOWLEDGE
(A Multidisciplinary International Peer-Reviewed/Refereed Journal)
ISSN 2320–5237 | Volume 13, Issue 02, February 2026 (Special Issue)
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EMERGING TECHNOLOGIES IN LIBRARIES: APPLICATION OF MOBILE TECHNOLOGY TO ENHANCE LIBRARY SERVICES

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ABSTRACT
Libraries are adapting new tools and techniques to store and also to retrieve information systematically. The increasing use of Information and Communication Technology (ICT) in academic libraries, changing nature of libraries from traditional to digital, availability of resources in various forms and formats have made a great impact on development of the academic libraries. Libraries are adapting new tools and techniques to store and also to retrieve information systematically. The use of mobile computing devices such as smart phones is rapidly increasing in the population. Libraries can serve better services to their users by embracing the growing capabilities of mobile technology. They can promote and expand their existing services by offering mobile access to their websites. This paper highlights about the emerging technologies in libraries and discusses the application of mobile technology in libraries to enhance the library services.

Keywords: *Mobile Technology, M-Libraries, Cloud Computing, RFID, Artificial Intelligence, Machine Learning*

INTRODUCTION

Academic Libraries are changing drastically in the modern world because of changing technology, e-publishing, and new ideas about library services and products. Libraries are adapting new tools and techniques to store and also to retrieve information systematically. The increasing use of Information and Communication Technology (ICT) in academic libraries, changing nature of libraries from traditional to digital, availability of resources in various forms and formats have made a great impact on development of the academic libraries. The use of mobile computing devices such as smart phones is rapidly increasing in the population.

Mobile Technology has transformed many aspects of our lives: how we work, how we communicate, how we study and how we play. At present, the total of around 904.51 million mobile users, as per latest data released by Telecom Regulatory Authority of India (TRAI), have excellent connectivity across regions. The dominant mobile network providers are Airtel, Tata DoCoMo, Vodafone, Idea Cellular, Reliance Communications and state run BSNL/MTNL.

Mobile technologies are rapidly growing and they have played an important role in the management of relations between people in social, economic and in everyday life (Goh, Kim, Lavanya, Kim, & Soh, 2006). Libraries are mastering the mobile Web to bring patrons a new set of services. They are offering information about library services and collections, providing access to library catalog search, portable exhibit information, subject guides, e-journals, and library hours, all formatted for the small screen (Kroski, 2007).

The Indian educational system is developing. It is changing from d-learning (distance learning) to e-learning (Electronic Learning) and now from e-learning to m-learning (Mobile Learning) and it will be the next great task. M-learning will bring about a paradigm shift from the Old methods of education delivery, and integrate ICT as an essential component in every days learning.

Academic library professionals need to acquire such knowledge and skills as the library and information profession is a highly IT influenced profession.

EMERGING TECHNOLOGIES IN ACADEMIC LIBRARY

- Cloud Computing
- RFID Technology
- Mobile Technology
- Artificial Intelligence & Machine Learning

Cloud Computing

"Cloud computing is Internet-based computing, whereby shared resources, software, and information are provided to computers and other devices on demand through the Internet"

The combination of servers, networks, connection, applications and resources is defined as 'cloud'. Cloud computing is a comprehensive solution that delivers IT as a service. It is an Internet-based computing solution where shared resources are

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provided like electricity distributed on the electrical grid. Computers in the cloud are configured to work together and the various applications use the collective computing power as if they are running on a single system. With Cloud Computing users can access database resources via the Internet from anywhere, for as long as they need, without worrying about any maintenance or management of actual resources.

RFID (Radio Frequency Identification) Technology

Radio Frequency Identification (RFID) technology changed the concept of security around the world. RFID is a generic term that is used to describe a system that transmits the identity of an object or person wirelessly, using radio waves. RFID allows an item, for example a library book, to be tracked and communicated with by radio waves.

The antenna enables the chip to transmit the identification information to a reader. The reader converts the radio waves reflected back from the RFID tag into digital information that can then be passed on to computers that can make use of it.

Artificial Intelligence (Ai) and Machine Learning (ML)

Artificial intelligence (AI) and machine learning (ML) have brought about a significant change in the world of modern libraries, turning them from passive repositories of knowledge to intelligent centers for information gathering and sharing. By streamlining procedures, improving search capabilities, tailoring user experiences, and providing insightful data on user preferences, the integration of these technologies has had a significant influence. This section examines the ways in which artificial intelligence (AI) and machine learning (ML) have become disruptive technologies, transforming library systems through information retrieval, recommendation systems, predictive analytics, and cataloging.

Automating Processes: By automating repetitive chores, AI and ML are simplifying library operations and freeing up human resources to work on more complex projects. Artificial intelligence (AI) systems can now effectively handle tasks like cataloging, metadata tagging, and sorting, decreasing the need for human labor and improving overall operational efficiency. Libraries can strategically manage resources thanks to automation, which maximizes staff productivity and time.

Enhancing Search Capabilities: It can be difficult to find pertinent search results in traditional library catalogs. By comprehending context, semantics, and user purpose, AI-powered search engines enhanced with machine learning algorithms can improve search capabilities. The utilization of Natural Language Processing (NLP) approaches facilitates more accurate and intuitive search functions, resulting in expedited information retrieval and access.

Personalizing User Experiences: By customizing suggestions and services based on previous behavior and preferences, AI and ML allow libraries to provide each user with a personalized experience. By recommending pertinent books, articles, or other materials based on user interactions and borrowing history analysis, user pleasure and engagement are increased. Customization creates a feeling of community and motivates patronage of library resources over time.

Recommendation Systems: Personalized suggestions are generated by AI-driven recommendation systems that examine user behavior, preferences, and patterns. These systems make recommendations for pertinent books, articles, or other materials based on the user's past usage or expressed interest in. This greatly improves discoverability and motivates people to delve deeper into a wider variety of content.

Predictive Analytics: Predictive analytics is made easier in libraries by AI and ML, which helps with resource allocation and decision-making. Libraries can foresee trends, enhance collection development, and distribute resources efficiently by examining historical borrowing patterns, user demographics, and circulation data. By using data-driven strategies, library services can be adjusted to meet changing customer needs.

Information Retrieval: Information retrieval in libraries has been completely transformed by sophisticated AI algorithms, especially deep learning models. Libraries today serve as intelligent ecosystems that adjust to the needs and interests of their patrons, going beyond simple physical repositories. Applications of AI and ML are not only increasing search efficiency and automating procedures; they are also improving user experiences and offering priceless insights that enable libraries to provide better services to their communities.

Mobile Technology

Wireless technology and mobile phones are becoming an integral part of everyday life and are changing the ways we connect and interact with the world around us. Mobile technology has brought outstanding changes in various fields and particularly in education. People are using devices like laptops, mobile phones, tablets, e-readers, iPods, PDAs, handheld gaming consoles etc., They are now also being used to access e-mail, search the Web, Video chat, interact and discus on social media, and play games etc.,

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With a growing number of people accessing the Internet from their pocket PCs and mobile phones, libraries are investigating ways to deliver their services to mobile phones and other small-screen devices so that their patrons can access them any time anywhere. This can be as simples as sending text message alerts about reservation becoming available or overdue books or as complex as digital reading room, which allows readers to access full eBooks and journal article through their library's subscriptions on any mobile device. There services have collectively become known as 'M-Libraries', a shortening of the phrase 'Mobile Libraries'.

Fig 1: Difference in view of Standard & Mobile Optimized Websites.

APPLICATION OF MOBILE TECHNOLOGY IN LIBRARIES

A mobile application is software written for mobile devices that performs a specific task, such as a game, calendar, music player, etc. In the mobile realm, we frequently come across terms like Native app or Web app. Libraries can better serve their users by embracing the growing capabilities of mobile technology. They can promote and expand their existing services by offering mobile access to their websites and online public access catalogs; by supplying on-the-go mobile reference services; and by providing mobile access to e-books, journals, video, audio books, and multimedia content.

Mobile Web in Libraries

Mobile libraries are libraries that deliver information and learning materials on mobile devices such as smart phones, personal digital assistants (PDAs), Tablet phones and iPods to allow access by any one from anywhere and at any time.This will result that the library services and information in the library are able to be accessed anywhere and any time using these mobile devices.

The following services may be offered in mobile phones.

- SMS alert services

  Following are possible ways to send SMS from libraries

  - ✓ Few Library automation software's provide option to send SMS alerts for reserved items, due items to users. For example, Libsys 0.7 & E-granthalaya
  - ✓ Plug-ins integrated with library email system to enable email to SMS messaging.
  - ✓ To send SMS to collect the requested books
  - ✓ Reminding the user if, book is due in his/her account; informing user about the exact fine.
  - ✓ Acknowledging the user about renewal of a book.
  - ✓ Users may request the opening hours/ Holidays of the library via SMS.
  - ✓ News and event reminder service via SMS.

- Electronic Resources with Mobile Interfaces

  Mobile interfaces are webpages that are graphically adjusted for smaller screens. The Mobile Access webpage has a list of mobile interfaces and apps in all subject areas. Mobile apps are software that is downloaded to your smartphone or tablet.

  Mobile interfaces offer a variety of databases and digital resources such as e-Books, e-Journals, e-databases, dissertations, images and article databases. These collections can either be downloaded from the library websites on user's own mobile devices or libraries lend mobile devices with the collections already on them. A large collection of audio books both free-and subscription-based services are available for download and also transferable to mobile devices.

  Most of the e-book publishers provide 24x7 accesses to the library subscriptions from any internet terminal within the campus, as well as on mobile devices, such as iPods, Android devices, and Kindle.

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Example:

- ACM Digital Library has a mobile app for both iOS and Android devices.

  www.dl.acm.org
- IEEE Xplore Digital Library

  www.m.ieee.org
- WorldCat connects to the collections and services of more than 10,000 libraries worldwide.

  www.worldcat.org/m/

  Librarians are required to become familiar with mobile technologies, and work with vendors and IT experts to ensure that e-collections of their libraries are mobile-friendly.
- Library guide

  Libraries can give users the best of library guide information such as library use guide, question answering service, and library statistics delivering rich content in a way that works best for users. If users have questions and want to contact the librarian for help, they can get a fast response from the library via the mobile device and find the appropriate information needed.
- Suggest a purchase

  Librarian can receive the suggestions from the users sent via mobile phones. In such cases users need not to visit the libraries and write the requirements in a register.
- Mobile AVOD system

  The mobile Audio and Video on Demand System (MAVD) enables users to Listen/Watch Audio and Video contents of the library's AVOD system on the mobile devices through Bluetooth, Wi-Fi or 3G. The MAVOD system has licensed videos, English Language Learning Programs, and lectures/speeches delivered.
- Location of the library

  Users might be provided with virtual tours of the library sections and their services.

  For instance, Library of Congress provides an application prepared for the iPhone users which gives a virtual tour of Library of Congress that mirrors the main reading room, the great hall, the bible collection etc.
- Library Virtual/Audio Tour

  Library users, who don't have time or inclination to attend an on-site workshop, can get access to library tours on their mobile devices. Audio/ virtual library tours can be produced fairly quickly, inexpensively, and could reduce the amount of staff time spent helping new users to orient themselves in the library and explaining the facilities available. It can easily be provided both as downloads from the library website and on mobile devices.

  Libraries even can provide audio tour of a library. For example, University of Limerick library, Ireland provides audio guidelines to the library users (University of Limerick Library, 2012).
- New Title Preview

  Mobile gadgets can be used to disseminate the information about newly acquired documents which are of irrespective of forms.
- QR Codes on Mobiles

  A QR code is a matrix barcode readable by smart phones and mobile phones with cameras. They are sometimes referred to as 2d codes, 2d barcodes, or mobile codes. On most phones purchased in the United States, one must download a free app (application) in order to read the QR code, although some phones have one preinstalled. QR codes can hold much more information than a regular barcode. The information encoded in a QR code can be a URL, a phone number, an SMS message, a V-card, or any text.
- Wi-Fi - Internet Access

  Mobile phones are available with 3G facility.

  Libraries can offer wi-fi facility to access electronic information sources.

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- Catalogue search

  Library catalogue: Libraries can provide their catalogue on the mobile devices. University of Cambridge has made a provision to search the library catalogue from the mobile device. The service can be viewed by accessing the URL - http://www.lib.cam.ac.uk/mob/#menu

- Journal finder: Library Journal Finder provides access to full text journal, magazine, and newspaper content as well as links to titles held in print. For instance, American University library has providing option to search journals through mobile phones. The URL for this service is http://www.library.american.edu/mobile/get_article.html
- Reference service: Library users can ask librarians anything through the live chat and texting with mobiles. The reference services can be provided with the help of sending and receiving SMS. Immediate feedback is also possible from the user's side.
- E-readers. Despite being available for decades, the general public has only become aware of e-readers in the last 5 years, primarily due to the popularity of Amazon's Kindle and Barnes & Noble's Nook.
- Electronic textbooks. One of the next great digital frontiers being tackled is that of academic texts. E-readers and tablets have new features that allow students to highlight and add annotations to the text, just as they would with paper texts. They give students the capability to link to additional information.

Some of the Publishers Offering Database through Mobile:

Publisher/Database	Mobil App.
1. American Chemical Society	iOS and Android
2. American Institute of Physics	iOS
3. All EBSCO host databases	iOS and Android
4. Elsevier	iPhone and Android
5. Gale Cengage	iPhone and Android
6. PubMed medical database	iPhone apps and Android app.

ADVANTAGES OF MOBILE APPLICATIONS FOR LIBRARY SERVICES

- It improves access to library collection and services for audiences, wherever they are, whether onsite or anywhere else in the world.
- Helps in equipping staff to champion and drive the development of mobile services to improve access and productivity.
- Modernizes the library brand to reflect relevance, accessibility and innovation.
- Creates opportunities for learning.

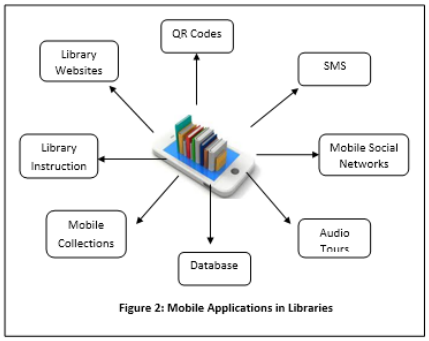

Figure 2: Mobile Applications in Libraries

Mobile Websites

In addition to mobile applications, some companies and organizations develop mobile versions of their web site that are better optimized for viewing on mobile devices.

Encyclopedia Britannica Mobile: http://i.eb.com

MedlinePlus Mobile : http://m.medlineplus.gov

WorldCat Mobile : http://www.worldcat.org/m

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Creating Mobile Web sites, OPACs and applications

Name of the Applications	Purpose	Mobile Compatibility	Provider/ URL
Android Developers	Resources for creating Android applications. Includes developer guide, tutorials and videos.	Android Phones	http://developer.android.com
AirPac (Innovative Interfaces)	Library catalog. Includes features such cover images, integrated library locations with Google Maps software, request and renew items, and more.	All web enabled phones	http://www.iii.com/products/airpac.shtml
Boopsie	Specializing in public and developer Matthew Leak outlines one way to create an iPhone-friendly version of a web site.	All web enabled phones	http://www.boopsie2.com
MobilePress	Mobile press is a free plug-in for word press blogs which will automatically transform you blog into a mobile version which such a device is detected.	All web enabled phones	http://wordpress.org/extend/plugins/mobilepress/
Library Anywhere	Creating and sold through Library Thing, Library Anywhere is a mobile catalog for any library. Includes mobile web an apps for iPhone, Blackberry and Android.	All web enabled phones	http://www.librarything.com/forlibraries
MobileTuts+	Tutorials for all mobile developers, regardless of platform. Topics include techniques for building mobile apps and mobile web sites	All web enabled phones	http://mobil.tutsplus.com
MoFuse (Mobile Fusion)	Build a mobile version of an existing web site or blog with the MoFuse content management platform	All web enabled phones	http://mofuse.com
Zinadoo	Users can add ready-made widgets such as guestbook's, email, call me and feedback forms as well as RSS feeds.	All web enabled phones	http://zinadoo.com

M-Library services using Mobile Applications

Name of the Services	Purpose	Mobile Compatibility	Provider/ URL
Mobile Online Public Access Catalogues (MOPACs)	Libraries are providing access to their OPACs via mobile-optimized websites. The New York public library mobile beta site supports a mobile. MOPAC and allows users to browse library locations and hours.	All web enabled phones	http://m.nypl.org
Mobile Applications	Some libraries have developed mobile applications for smart phones. The District of Columbia Public Library.	All web enabled phones	http://dclibrarylabs.org/projects/iphone/
Mobile library instruction	Offering library instructional materials and resources via mobile platform. Ex: East Carolina University's "Research First Aid" is a series of podcasts for library researchers on the go.	All web enabled phones	http://www.ecu.edu/cs-dhs/lauuslibrry/researchfirstaid.cfm
Mobile Collections	Third party content providers are partnering with libraries to deliver audio books, e-books, audio language courses, streaming music, films, images and other multimedia that can be used on mobile devices. *Example:* overdrive service support for Blackberry smart phones.	All web enabled phones	http://www.overdrive.com
Duke Mobile	Duke University has created a free iPhone application called Duke Mobile.	All web enabled phones	http://itunes.apple.com/app/dukemobile/id306796270?mt=8
SMS Reference	Some libraries are offering "text-a-librarian" services ideal for simple questions that can be answered with brief response.	All web enabled phones	http://www.library.yale.edu/science/text,sg/html

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Library Short Message Service (LSMS) Notifications	Many libraries use SMS for a variety of purposes, including notification for items available for pickup, due date reminders, information on availability of library materials, provision of call numbers and locations and others.	All web enabled phones	http://cpl.org/?q=node/12258

CONCLUSION

Mobile Technology has transformed many aspects of our lives: how we work, how we communicate, how we study and how we play. Mobile Web library services transcend time restrictions. It facilitates patrons transcend spatial limitations, allowing them to enjoy the services provided by the library without having to go to the library and 24 hours a day using with their mobile phones.

Academic libraries need to create mobile applications that serve as customizable interface and ensure full and flawless access to all library resources and services. Librarians should seek faculty on their campuses who are developing or using innovative tools like those described here and begin experimenting with them in partnership with faculty and students. Mobile devices can offer more opportunities for students to be actively engaged in their learning and to fully participate in the social nature of learning. These developments show how libraries can adapt to a world that is becoming more and more digital, from increasing user interaction to guaranteeing the longevity of digital resources. Academic library professionals need to acquire such knowledge and skills as the library and information profession is a highly IT influenced profession.

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