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# **Towards A Framework for Designing Smart Library Management System Based on Mobile Cloud Computing**

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**ABSTRACT:** The concept of smart library system based on mobile cloud computing environment is becoming useful as many library users can afford their own mobile device that can be used to access and share e-resource remotely. These portable devices proportionally increase pressure on the network infrastructure of the library. In this paper, a smart library system based on mobile cloud computing environment in conjunction with a local server is proposed for Nigerian library system. The framework describes how users will be able to collaborate and share e-resources using their mobile devices on the cloud as an alternative source is provided via the local server to conserve network resource usage; the cloud storage provides scalable services and is accessible at anytime and anywhere.

**Keywords:** Smart library, mobile cloud computing, framework, e-resources

## **I. INTRODUCTION**

Library has been conceptualized severally by various authors. It is a physical or virtual resources environment for educational institution by providing information resources to support the overall academic activities of its institution or academic community.

According to [1] libraries are social institutions created to [1] conserve knowledge; preserve the cultural heritage; provide information; undergird and underpin education and research and serve as fountain of recreation.

For [2] libraries are “the foyer of living ideas that permeate and animate all aspect of national life.

Furthermore, [3] reiterates that librarians are an essential element in the educational system which is the society’s main arrangement for reducing costly ignorance, to those whose occupational function is the search for new knowledge to the solution of societal problems, the library is an indispensable source of information as they will have at their command a vast array of private, college, university, national, public, school and special libraries. The reduction of costly ignorance by libraries is achieved through the assistance they provide in the process of formal and informal education and in the direct assistance, they give to scholars and scientist in the extension of the frontiers of knowledge. In the past decades, access to information was usually in the library room and as technology advances, access is now made online.

In the recent times, library has undergone series of advancement from the traditional library to the modern library where contents are in digital form [4][5]. Today, modern libraries have changed the library’s perspective as advances in technology systematically changes mode of deploying and accessing information. According to [6], Library 1.0 offers a mono direction to information that mostly resides within the walls of the library and most library websites are static websites that provide no user interaction. Study by [4] revealed that streaming of video and audio media are applications that may be considered as the key features of Library 1.0. Furthermore, Library 2.0 moved the full suite of library services into electronic medium, offering bi-directional service sharing. With the advent of Library 2.0,



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Librarians provide information to users wherever they are and whenever they need information regardless of location and time of the day through various web 2.0 technologies such as Facebook, flicker, Pinterest, YouTube etc.

University libraries, as the most important academic and scientific research base, are responsible for providing information services for researchers. In the past, most libraries provide services based on their own library resources, thereby giving the librarians little option to consider or respond to users' demands. These days, university libraries in the developed world have embraced web 2.0 technologies, incorporating the dynamic and interactive nature of web 2.0 into library services leading to what is now known as Library 2.0. Some universities are moving ahead to adopt the library 3.0 based on web 3.0 technology to provide advance services and facilities to teaming users.

The increasing use of modern and advanced library technologies have advanced libraries. Libraries in the developing countries are short of such developments. Nigerian libraries in institutions of higher education have limited access to latest reading and study materials [7]. The development in smart, intelligent, mobile and wireless technologies have transformed the ways people access resources and services [8],[9],[10]. It is now easier to access library resources on move at anytime and anywhere with the help of mobile computing devices. Furthermore, smart library system can be built using the superiority and scalability of cloud computing and mobile technologies. The limitation of mobile devices such as storage space, processing speed and battery life span can be minimized with the deployment of cloud-based library system [8].

However, despite the increasing use of cloud-based services, there is a paucity of research on smart library system based on mobile cloud computing could be designed to enhances services delivery. In this paper, a smart library system based on mobile cloud computing environment in conjunction with a local server is proposed for Nigerian library system. The framework describes how users will be able to collaborate and share e-resources using their mobile devices on the cloud as an alternative source provided via the local server to conserve network resource usage.

The paper proceed as follows. Section two reviews the related works, section three proposed a framework for smart library system based on mobile cloud computing. The implication of the framework is discussed in section four, while section five discussed conclusion and further works.

## II. RELATED WORKS

Previous studies by [11],[12] on smart web were conducted to facilitate easy access to library materials via the internet. Some conducted their studies on static one-way library system while others provided a study on dynamic library access system. Few researchers deliberate on developing framework to digitalize the library system.

“KOHA [13] as an open source Integrated Library System (ILS) is the first open source library automation system based on cloud computing services targeted at small size public library and professional services”. Furthermore, [13] provided challenges in smart library system and management, suggesting that, although there are numerous approaches to address challenges facing the library using variety of ways, there is no standard in achieving the desired goal.

It was highlighted [14] that cloud computing and its applications in e-library Services as a model that promotes availability of resources and creates powerful distributed computing system with global reach and super computing capabilities. [14] further provided a schematic diagram of how smart library system can be achieved via Cloud computing. This study also discussed the advantage and disadvantage of adopting the cloud computing library system in Nigerian universities, mainly highlighting funding, technological gap and lack of power supply as impeding factors.

Accordingly, [15] developed a user interface for accessing catalogue for checking available resources. This request is passed to the system management tool, which finds the correct resources, and then calls the available services which retrieve the resources in the cloud. Monitoring and metering tools track the usage of the cloud so that resources used can be attributed, and the servers are managed by the system management tool.

Similarly, [16] developed a digital library based on cloud computing framework. The layers are divided into three, each perform certain function of running the system. The allocation of resources, virtualization and scalability are provided



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by authentic and monitored services. To understand the effectiveness of the resources allocation algorithm, they simulated the result and the utilization show satisfactory, however, they pointed out that security need grater caution.

Since mobile devices are available in addition to being affordable to most of the users, the tasks of deploying the necessary facilities to provide the desired services become a challenge and responsibility of the university libraries. Libraries in Nigerian universities have to provide an interactive information services with an up-to-date content to the users. But the libraries cannot afford to provide such services efficiently due to the expensive nature of required equipment and bandwidth. As such, most of the institutions in Nigeria seem to lack the required capacity to effectively deploy and sustain the library services with recent contents round-the-clock.

Smart library management system based on mobile cloud service that is flexible and scalable to support service delivery. This offer opportunities for library services to deliver a fast and scalable services to better security level for teaming users [17],[18].

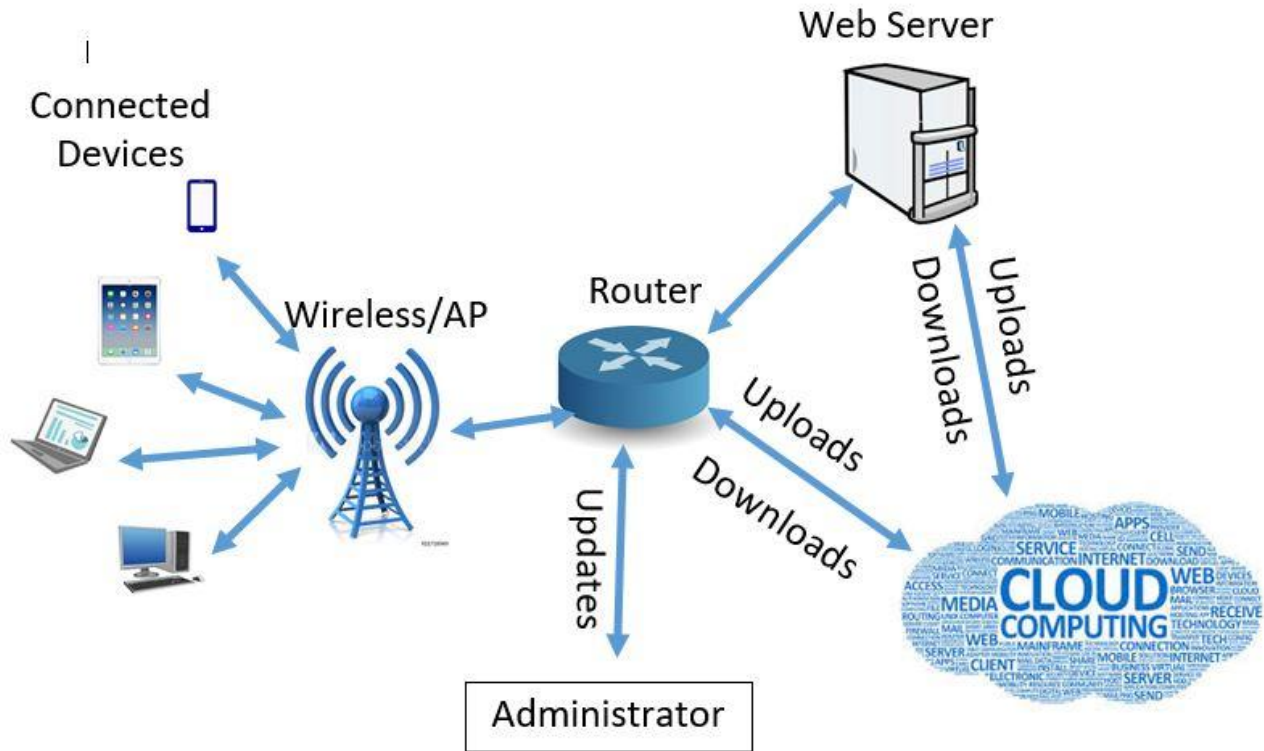
### III. PROPOSED SMART LIBRARY SYSTEM BASED ON MOBILE CLOUD COMPUTING

This paper presents a proposed smart library system based on mobile cloud computing. The framework will work in the presence of cloud server, in which the e-resource materials and other things are available in the cloud for guarantee of availability and security of the services all the time.

A local server serving as a database for the library resources situated in-house (locally); the local server operation is always active online but access information from the cloud library resources via Web services on routine basis for updates. The asynchronous update is based on hourly or daily routine as may be assigned by the Administrator. An intelligent router is placed as bridge between the client, the local server and cloud server. The purpose of the router is to direct client to the cloud library resources during uptime or redirect the user to the local resource in case of downtime. Nonetheless, the router can detect traffic and redirect some clients to the local server in the event that the network is overwhelmed by connected clients. Also, the router could be configured to direct certain traffics specifically to the local server and redirect others to the internet.

The adoption of cloud environment relieves the institutions of the need to acquire an actual costly server and resources (subscriptions based online databases) in order to install on a smart library platform, which are costly software applications needed for individual universities to run. Smart library resources could be placed in the cloud and distributed to other universities through collaboration as shown in figure 1. Every change in technology can be accommodated and updated in the cloud, which could also be applicable to all the universities hosting their services on the cloud and can be accessible via mobile devices.

**Proposed Framework Design**



**Figure 1: Proposed Framework for Smart Library System Based on Mobile Cloud Computing**

**Client (Mobile devices)**

Mobile application on cloud storage can be accessed via client devices which are also referred to as station. These are devices that has the capability to connect to wired or wireless network devices. For example, a station may be a laptop, a desktop PC, PDA, tablets or mobile phones. A client device may be fixed or mobile. These technologies allow user to access or request information from the web server through established connection on Access Point. The mobile devices allow user to access, share e-resources and collaborate with each other remotely.

**Wireless Access Point**

A Wireless Access Point (WAP) is a hardware device or configured node on a Local Area Network (LAN) that allows wireless capable devices and wired networks to connect through a wireless standard, including Wi-Fi or Bluetooth. WAPs feature radio transmitters and antennae, which facilitate connectivity between devices and the Internet or a network.

**Web server**

The primary function of a web server is to store, process and deliver web pages to clients. The communication between client and server takes place using the Hypertext Transfer Protocol (HTTP). Pages delivered are most frequently HTML documents, which may include images, style sheets and scripts in addition to the text content.

The Web Server will contain the databases/repositories which store all contents and information that are available and to be accessed by clients through their mobile devices. In that case, the database will be dynamically updated every time whenever any operation is performed in the cloud.



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## Cloud Storage

Cloud storage is a model of computer data storage in which the digital data is stored in logical pools. The physical storage spans multiple servers (sometimes in multiple locations), and the physical environment is typically owned and managed by a hosting company. These cloud storage providers are responsible for keeping the data available, accessible, and protected.

## Administrative Users

This segment of the framework is responsible for managing the entire system and provide security monitoring of the system. The administrator should be knowledgeable or have knowledge of the working of cloud-based services and the working of the server both locally and online.

## III. IMPLICATIONS OF THE PROPOSED FRAMEWORK

The implication of this framework is an effective service delivery through managing the limited resources available to libraries to deliver services to users within an area or environment while also making similar service delivery on the cloud to cater for all users within and outside the environment where the library is physically located. The role of the library in this case is to ensure the availability and sustainability of the cloud service, whereas internet service delivery to users could be handled by the library or the university or the users could use their independent source of internet service to access the e-resources available on the cloud. Thus, the implication includes:

1. Reduced traffic to the internet as e-resources are available through the local servers for library users with the immediate environment, which result to lower bandwidth usage.
2. In the event of downtime within the local environment of the library, users could have access to resources on the cloud using alternative internet sources such as using their internet enabled mobile devices.
3. Provide relieve for the librarian as service may rarely be completely down from both the local sources and the cloud sources.
4. Cloud source will provide more opportunity for collaboration with other libraries in distant location.
5. Service delivery will greatly be enhanced and improve user access to the library resources.

## IV. CONCLUSION AND FURTHER WORKS

For effective performance and resource utilization in the provision of interactive services in the Nigerian libraries, cutting down of Internet usage among the clients will reduce traffic and improve bandwidth utilization. The use of intelligent router to identify traffic, peak time or downtime and redirect the user to the alternative local server will greatly minimize disruption of service. The outcome will be an improved system that cut down cost and increase users' satisfaction.

In the future, a cloud-based mobile application will be developed that will implement the proposed framework in a typical Nigerian library system.

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