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A Proposed Framework for Smart Library Development Using Artificial Intelligence and Cloud Computing.

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Abstract - *Due to an inadequate information gap, poor verification of e-record collection, etc. There is a need for a smart library. With the advancement of information technology, libraries are becoming "smart libraries," which incorporate cutting-edge technologies such as artificial intelligence (AI), 5G, big data, cloud technology, etc.*

Infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS) are all examples of the kinds of services made possible by cloud computing, which is an internet-based, remote-driven, and service-oriented technology. Libraries can improve their services in many ways by adopting cloud computing with security certification, such as AWS certified security, which provides a higher level of protection for e-resources, lower costs for maintaining systems, more energy efficiency, and a more global online presence. This research aims to shed light on the general importance of smart library implementation on cloud computing via a systematic literature review (SLR). Five pieces of equipment must be in place before the smart library can be implemented: digital resources, internet service, thin client architecture, wireless access point, and a digital librarian.

The findings are used to propose a framework for an appropriate smart library. To sum up, it is suggested that libraries can be revitalised and kept relevant by adopting cloud-computing technologies, which will include them in the widespread Internet of Things (IoT) experience.

Key Words: *Artificial Intelligence, Cloud, Library, Information Technology, Thin Client, Wireless Access Point, and Internet of Things*.

1. INTRODUCTION

In the course of employment, an electronic document that offers evidence of an activity, transaction, or decision is received. [1] explained why it is of utmost importance to protect it as an evidence in accordance with the retention schedules that have been established by the institution an individual is working for. When this occurs, the electronic document is then considered an e-record and is required to be stored in a secure location within an official e-records system [3]. This process is done to ensure that authorized personnel may quickly access the document. In a scenario with digitized records, the stability of the record is put at a significantly greater risk due to the presence of security risks. Therefore, it is essential to keep in mind that electronic records are records that are stored in an electronic medium. Creating an electronic record, accessing the record, working with the record, storing the record, erasing the record, or transferring the record to a different medium all involve the use of a computer.

The National Archives of Australia (NAA) states that "word-processed documents, emails, databases, and photographs" are examples of electronic or digital records [1]. There are many different places that databases, hard drives, shared folders, email accounts, and other online services can be used to store electronic documents. Electronic records are a highly significant asset for ensuring that the institution is properly and efficiently regulated, and that it is accountable to its employees, students, and the university environment that it serves.

Electronic records enable decision-making easier, give evidence of university regulations, transactions, and activities, help the university stay organised, and provide support in the event of a legal challenge [2]. However, when a retrieval procedure is involved, it takes a longer time which disrupts the evenness of the administration and decision-making process. It also consumes time for the e-record manager as they hunt for that specific document, which is why there is a need for the security of e-records management. Information managers are adjusting their practices to accommodate the era of electronic information by gaining access to more resources that teach them how to handle and protect electronic records [3].

According to [4], poor records management is likely to result in information gaps, which lead to inadequate records and the loss of document legacy. On the other hand, ensuring that records are preserved in a suitable setting and can be easily retrieved whenever necessary is largely dependent on the quality of the records management system that is in place, such as an e-library [4]. Without effective record-keeping, it is exceedingly challenging to explain any choice that was made. In the absence of evidence that has been accurately recorded, illegitimacy and fraud are difficult to detect and cannot be dealt with appropriately.

In addition, a decentralised data centre can be formed in the register, and it can be extended to the electronic library to ensure good document management [5]. It is abundantly evident that the information in an electronic library may be managed through the utilisation of computer systems that choose the pertinent content to be collected, organise it, make it available to users, and preserve it for future use. E-library, in contrast to conventional libraries, can communicate with a significantly larger number of people, making them particularly useful in the context of academic institutions [5].

According to [6], "Digital libraries are used for many different reasons, but largely for the ease of accessing information." This is also affirmed by [7], who stated in their paper that "Digital libraries prove to be a meeting place for many subjects and disciplines such as information management, data access, library science, data systems, document management systems, internet, artificial intelligence, data processing, human-digital contact, and electronic security systems."

1.1 Background of the study

Librarians and information managers in different universities are increasingly becoming more concerned about the best way to effectively manage e-records so that they can meet the main mission of the institution to society and human cultural and scientific heritage. They also aim to use the available innovations to provide the information life cycle from creation to dissemination with more speed, scope, currency, efficiency, effectiveness, quality, and productivity [8].

Over the past 10 years, there has been a great emergence in the use of artificial intelligence in different domains such as fraud detection, phishing detection, facial recognition, etc. The impact of AI in the improvement of education from the student, lecturer, and management perspectives has been a major research interest among researchers over the past 5 years [8].

Research conducted by [8] shows that AI has been widely adopted and employed in education, especially by educational institutions, in a variety of ways. The authors concluded that instructors have been able to execute various administrative tasks, such as reviewing and grading students' assignments, more successfully and efficiently using these platforms, and have been able to improve the quality of their institutional activities. On the other hand, because the systems make use of machine learning and adaptability, the curriculum and content have been individualized and customized to meet the needs of the students. This has encouraged uptake and retention, which has improved the learning experience for students [9].

On a similar note, different authors have leveraged the advantages of cloud computing in the educational sector. They argued that using the cloud-computing technology with proper design of AI have better security performance over the traditional method of deployment [10].

The phrase "cloud" in cloud computing refers to a collection of networks, much like actual clouds, which are collections of water molecules. The user has limitless access to cloud computing capabilities whenever needed. Users typically prefer a mediator operator for the internet service in cloud computing rather than setting up their own physical infrastructure. Only the services that the users really used must be paid for [9].

To lessen the workload in cloud computing, the workload can be moved. Because the networks that make up the cloud carry a lot of the service load, running an application on local computers does not put a lot of strain on them. As a result, there is a reduction in the user's need for hardware and software [10].

The relationship is that e-records are available in the e-library [11]. If there is a security loophole in the library, it will greatly affect the provided documents. To properly mitigate the security risk, if a smart library that can easily track all the activities of the users and provide adequate security measures in real-time is developed, then the universities can be able to use the medium as a security backup when the need arises.

Since AI and cloud computing have been integrated in some university settings, if these technologies are properly used for development of the library, due to the security settings, these technologies will help to develop a smart library which will reduce the security holes pertaining to e-library.

1.2 Objectives

This research aims to present the best practice for proper security measure for an e-library. This aim gives rise to the following research objectives.

- Critically review the need for securing an e-library.
- Review the integration of AI with other technology for better library development.
- Present other required technologies for proper integration of AI-based proposed model into cloud computing.
- Development a smart library framework which integrates into the cloud computing infrastructure.

1.3 Scope of the study

Since the need for AI in the universities are increasingly of greater demand, secured smart library in academic institutions has been has been of major importance. They are concerned about how to effectively develop a smart library which can improve the academic settings and mitigate security loopholes in the institution with the aim of meeting main mission of the institution to society and human cultural and scientific heritage. The use of available innovations such as AI and cloud computing to provide the proper smart

library from creation to dissemination with more speed, scope, efficiency, effectiveness, quality, and productivity, is of important.

1.4 Significant of the study

As it controls records throughout their lifecycle, proper smart library aims to control the records and papers connected to corporate processes, transactions, and decision-making [11]. For a university to govern its management processes and make effective decisions, managing electronic documents is crucial. In general, a smart library encourages transparency and accountability while providing accurate information that enables an organisation to function successfully . However, if the security of this important asset is not properly addressed, a catastrophe could result; for this reason, the proper implementation of smart library which uses AI and integration into cloud computing is of importance in this digital age.

1.5 Research limitation

Although detailed roles of where AI and cloud computing can help in securing e-records will be documented. The work even proceeds with the expected framework of how the AI and other technologies can be integrated into cloud computing for better library system. However, this research does not develop the proposed model of this research.

1.6 Research questions

RQ1: What is e-records in the e-library?

RQ2: What is the ICT role for proper smart library system?

RQ3: Apart from AI and cloud computing, what other technologies can be integrated to make a library smart?

RQ4: What is the best way to develop the smart library framework which uses the advantage of cloud technology in the university settings?

1.7 Definition of technical terms

- **E-Records**

Any information created, used, and stored in a manner that a computer can only process is considered an electronic record. Email, documents, videos, text messages, backup tapes for disaster recovery, and information stored on portable media like memory sticks, BlackBerry smartphones, or PDAs are all examples of electronic records [12].

- **Library**

A library is a structure or room that houses collections of different records such as books, journals, and occasionally movies and music CDs that the public or members of an institution can use or borrow.

- **E-Libraries**

Digital environment which stores different forms of e-records for free or paid access.

- **Smart Library**

A smart library is an evolution of the hybrid library and the digital library.

- **Cloud Computing**

According to Microsoft, cloud computing is the distribution of computer services over the Internet ("the cloud"), including servers, storage, databases, networking, software, analytics, and intelligence. This enables faster innovation, flexible resource allocation, and scale economies.

- **Artificial Intelligence**

The idea and creation of computer systems capable of doing activities that would typically require human intelligence, such as speech recognition, visual perception, decision-making, and language translation, is known as artificial intelligence (AI).

- **Record Management System**

This area of management controls how organizations produce, acquire, store, use, access, and destroy records, whether they are in paper or electronic format.

2. Methods

This section provides a description of the methods that were used to collect secondary data for the study using the systematic literature review (SLR) to gain a comprehensive understanding e-records, e-library, and the implementation of smart library. The systematic literature review is a common evidence-based research method that entails a technique that is well-coordinated, comprehensive, and rigorous for the purpose of seeking or identifying relevant published literature with the goal of analysing them within the framework of specified research questions or hypotheses [13]. The systematic literature review is one of the most common evidence-based research methods. Even though the approach was initially developed for use in the medical sciences, it has now found widespread application in other disciplines, including business and cybersecurity [14]. Its transparency in the process of locating and selecting relevant literature or studies to review is one of the SLR's many attractive features; another is that the procedure can be reproduced. These and other features combine to make the SLR an extremely appealing tool to use [15]. This study employed the systematic literature review (SLR) methodology based on the format specified by [15], which provides a method that essentially includes three stages which are.

1. Planning
2. Conducting
3. Reporting

That is, the SLR is a straightforward approach of receiving input (research articles), processing it, and then reporting it (i.e., output). The extended version of the Preferred Reporting Items of Systematic reviews and Meta-analysis (PRISM-S) framework [14] was used as a guide in selecting the relevant peer-reviewed studies.

The Planning Stage

At this stage, keyword strings were formulated in line with the research questions raised in this study.

2.2.1 Database Search

According to [15], doing a literature review necessitates the utilisation of electronic databases as a primary research instrument. As a result of the fact that the databases contain citations and abstracts for research literature, the chances of obtaining pertinent research papers increased during the various electronic database searches that were carried out. This is because there is not a single database that can supply an exhaustive list of all the pertinent literature that one requires for review [16].

2.2.2 Inclusion Criteria

Inclusion criteria are used in the systematic literature review to consolidate the number of published studies to an amount considered reasonable by the author that would be sufficient for analysis [60]. There are five relevant criteria for including any article that was formulated, they are:

1. Type of publication.
2. Publication language.
3. Timeline (or period) of analysis.
4. Relevance of the publication.
5. Sector of analysis as shown in Table 2.1.

A rigorous effort was also made to access other published studies from the literature reviews and bibliographies of the selected study papers, if possible.

Table 1. Selection or inclusion criteria of the SLR study.

Code	Type	Inclusion criterion
CR1	Type of publication	Peer-reviewed journal, books.
CR2	Language of publication	English.
CR3	Timeline of analysis	From 2003 to 2022 (search was done in 2022).
CR4	Relevance	The article treats the relevance of e-records, e-library, threats, the ICT role of smart library, and the role of cloud computing in the integration.
CR5	Sector of the analysis	Education

Based on the first criteria (CR1) the study focuses on peer-reviewed articles and the published books. CR2 limits the publication language of the selection criteria into English language. Publications published between 2003 to 2022 were considered based on CR2. Moreover, publications that are relevant to the need for e-record in e-library, security challenges in this academic domain and how ICT can help in improving the system were considered.

Table 2*:* Shows the search strategy used to get the expected search per criteria.

Search text	Database result number	Included search
Role of e-records in e-library	62	33
ICT roles for university library system	22,700	18
AI and Smart Library	271,000	59
Cloud Computing and Smart Library	68,700	35

From the initial total of 362,462 articles found 362,317 were excluded based on these criteria. Then the remaining 145 articles were analysed in answering the research questions. The result is presented in the next chapter of the study.

1) **Search strategy**

Coupled with the inclusion criteria (Table 1) there was a thorough search of relevant literature using several generated keywords such as (Figure 1).

1. Electronic records at the library
2. The need for e-records
3. ICT and the smart library

Multiple databases were searched through the Google Scholar search engine (https://scholar.google.com) simultaneously. The following electronic databases were useful in providing literature for this study through Google Scholar; Academia, ScienceDirect, Emerald, and Elsevier. A manual search through the referenced list of studies was done to find relevant studies that might be useful to the author through analysis of the meta-data of search results from the database. The meta-data of selected articles are.

- Title
- Author(s)
- Date of publication
- Name of the journal

As shown in Figure 2.2, the flow process for the inclusion criteria is presented.

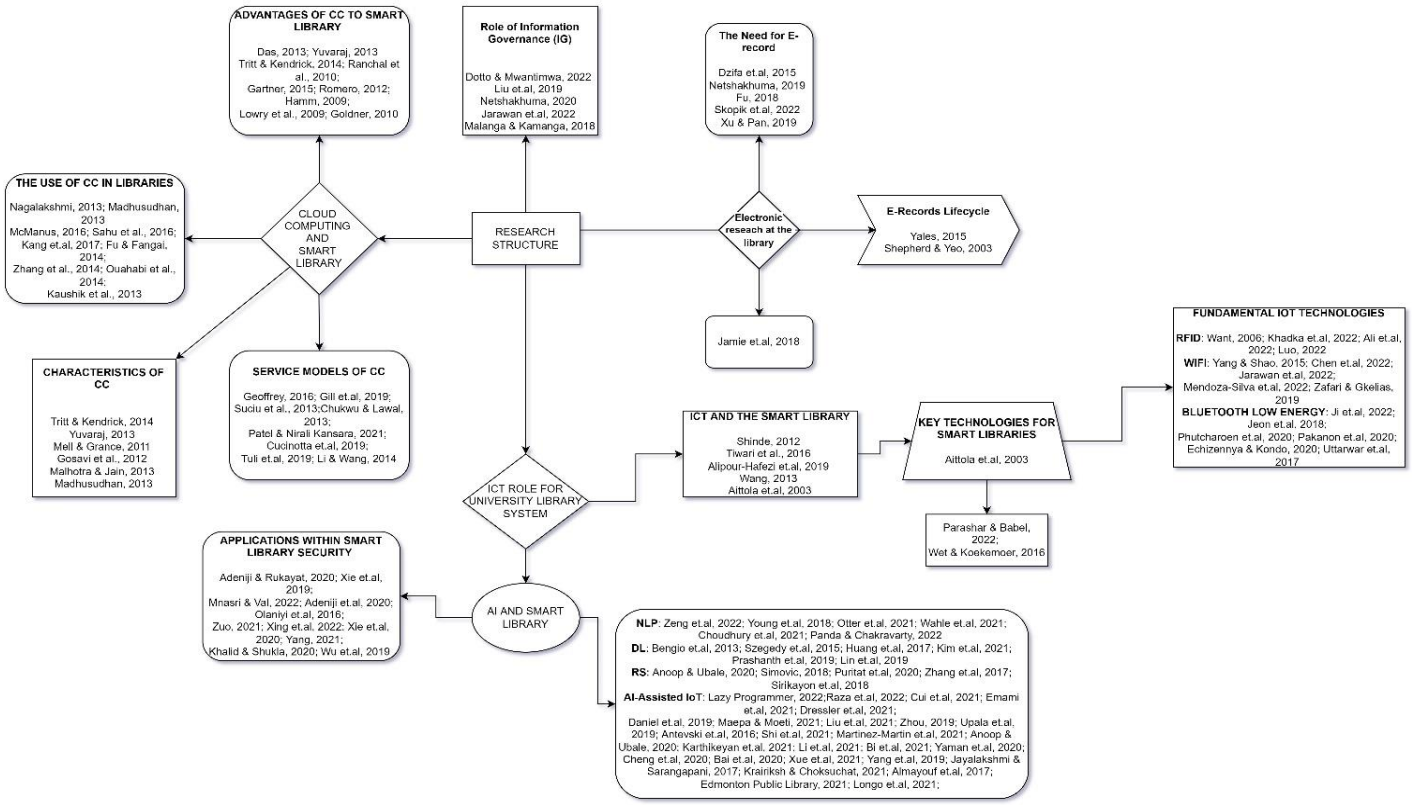

Fig. -1: Search Strategy.

2.3 The Conducting Phase - Data Extraction

Here the Google Scholar electronic databases were queried with the generated keywords. Wherever at least one of the keywords was found in the study from the database searches, the publication was read online or downloaded. The selected review articles would be screened for inclusion in line with the objectives of this study to maximise the veracity of the systematic literature review [18]. Downloaded studies were vetted based on pre-formulated criteria for inclusion. The initial number of studies was further trimmed to ensure that the article addresses the issues and research question formulated for the study. The initial search yielded 145 article results. After an initial analysis of the titles and abstracts, duplicates articles were removed. Then articles that did not meet the inclusion criteria were removed. After these activities, it resulted in the generation of a sample of 66 journal articles. The summary of keywords queried in the electronic search engines is given in Table 2.

Table 2*:* The number of research papers by search keywords.

KEYWORDS	NUMBER OF PUBLICATIONS
Electronic Records at the Library"	1
The Need for E-Records"	5
E-record Lifecycle"	4
Role of Information Governance (IG)"	5
ICT Role for University Library System"	2
ICT and The Smart Library"	5
NLP	6
DL	6
RS	5
AI-Assisted IoT	27
Total	***66***

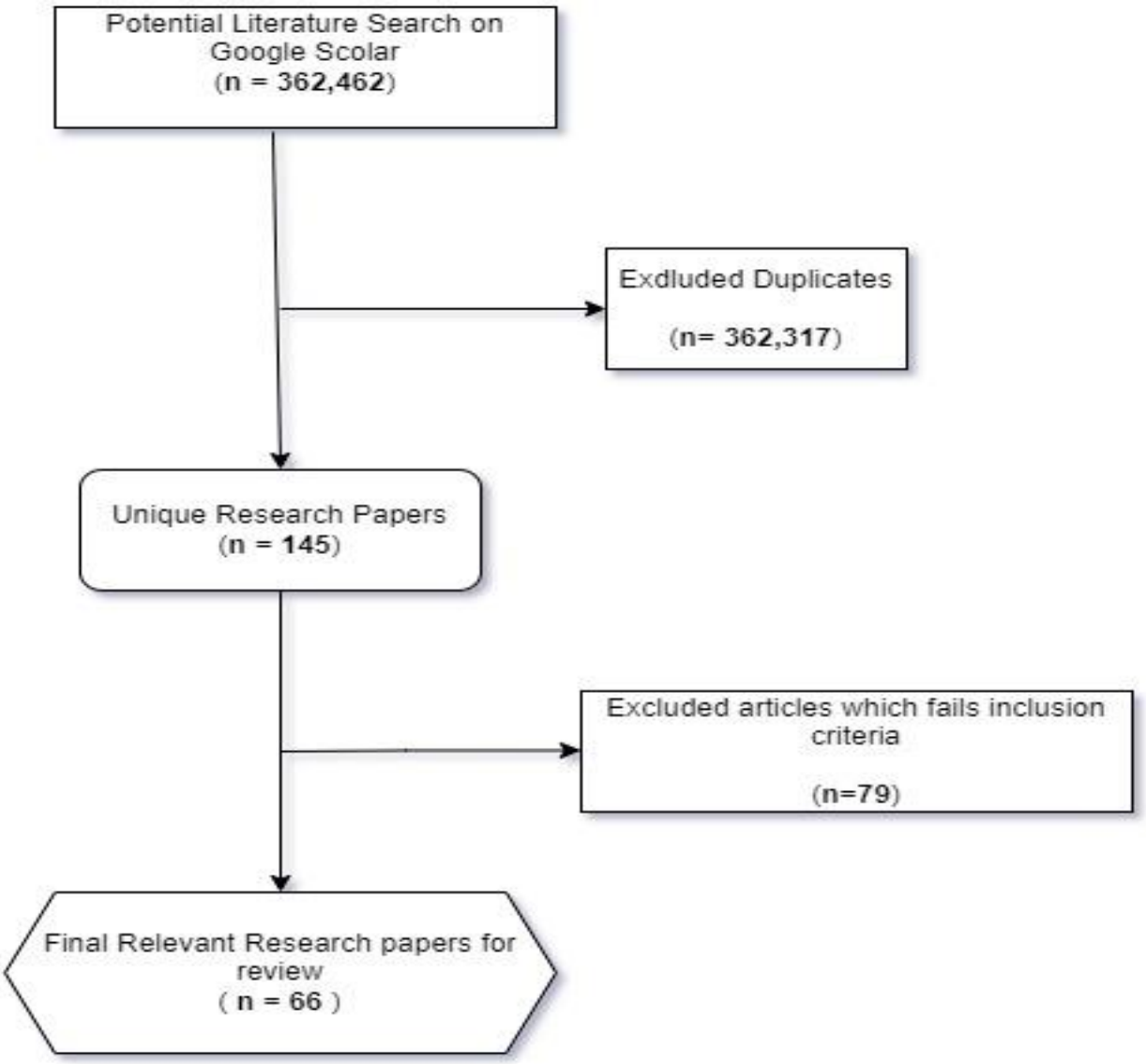

Fig. 2*:* The utilised systematic literature review flow process.

2.4 The Reporting Phase

This is the most important part of SLR. At this stage of the SLR process, the results of the analysis are reported to show whether it was able to provide answers and insight to the research questions - i.e., providing evidence that it achieved the study aims and objectives or not. This includes insights garnered from recommendations [19]. After analyzing the selected articles in this study, the results of how the research question was answered are reported and discussed in detail in the next chapter.

3.0 Implementation of Practical Work

3.1 Overview

For the four aims and objectives in this research, 5 research questions were posed. This research used a systematic literature review to identify and evaluate the need for a better smart library. The research starts with the role of e-records in e-library, the role of ICT in the e-library, how ICT can be used for a smart library, the impact of AI in a smart library, and the role of cloud computing in the smart library. The articles' search strategy in Figure 3.1 provides valuable data in the context of the aims of the study. This provides a holistic approach to understanding systematic approach towards the creation of the proposed framework which is discussed in this chapter.

Table 3*: Data gathering based on research questions (RQ).*

S/N	Research Question [RQ]	Relevant Review Article
1	What is e-record in the e-library?	[21,32,33,34]
2	What is the ICT role for proper smart library system?	[23,24,35,27]
3	Apart from AI and cloud computing, what other technologies can be integrated to make a library smart?	**RFID:** [36,37,38] **WIFI:** [38,39,40,37] **Bluetooth low energy:** [42,36,43,44] **AI-Assisted IoT:** [45,46,47,48,49,50,51,52,53,54,55,40,56,57]
4	What is the best way to develop the smart library framework which uses the advantage of cloud technology in the university settings?	[37,58,59]

The research questions raised were used as a basis for discussing the details of the findings.

3.2 RQ1: What is e-record in the e-library?

According to [29], electronic records are online-accessible digital files. Examples include e-journals, e-books, online databases in several digital formats, Adobe Acrobat documents (pdf), and Web Pages. However, according to [29], e-records are necessary even when the law does not require records to be kept permanently; records may be required to be preserved for an extended period in accordance with an established retention schedule. This explains why universities must discover a better method for securing a paper to digital information [60]. Others struggle with the difficulty of connecting documents to diverse forms and styles of business transactions

3.3 RQ2: What is the ICT role for proper smart library?

Based on the number of reviewed articles (12%), this seems to be the most important factor that can help to fix the challenges of e-records. According to the researchers, the major roles of the ICT are.

- It maintains a database by organising, storing, and retrieving files and media content, as well as gathering of other electronic materials, and provides digital services that are accessible from anywhere with a login.
- It is essential to the empowerment and education of citizens.
- Using proper technology, it can unlock all doors to knowledge while also maintaining the security and integrity of the university.

3.4 RQ3: Apart from AI and cloud computing, what other technologies can be integrated to make a library smart?

As documented in the research, AI and cloud computing plays an important role in the integration of smart library. However, these technologies rely on other technologies to function properly. The article in this research shows that:

- RFID
- WIFI
- Bluetooth low energy.
- IoT - are all important technologies to integrate a smart library.

3.5 RQ4: What is the best way to develop the smart library framework that uses the advantages of cloud technology in university settings?

To answer this research question, the author can divide the solution into the construction stage, which will cover the layout, the data centre construction, the interface system construction, and the integration with cloud computing.

3.4.1 Construction

For a smart library to work in such a way that mitigates the security risk of e-records, a systemic approach must be followed for proper construction. A smart service must utilise the intelligent services such as auto borrow machine, reading machine, cloud, enter read card system, smart bookshelf, WIFI, individual serve system, etc. Since there are many resources that can be available on the smart library, it is important to have an intelligent security system that will keep the smart library safe from loss of resources.

The scenario of smart library construction is of 3 scenarios, which are (Figure 1):

1. Intelligent device
2. Intelligent security and
3. Smart services

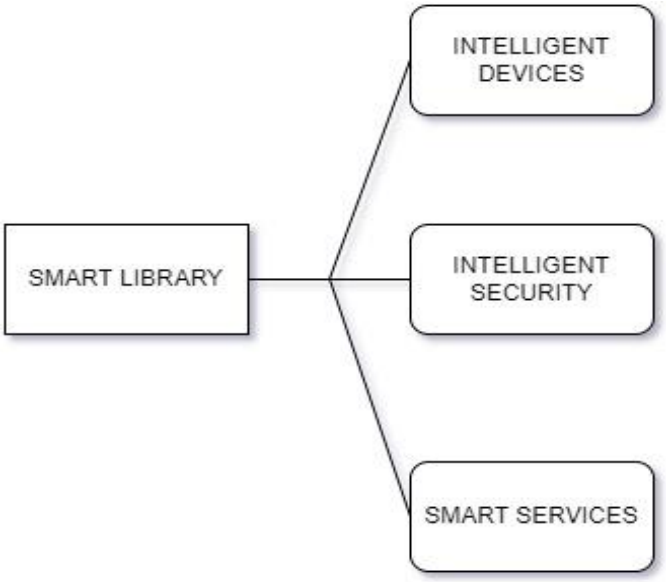

Fig. 3: Smart Library Content.

From Figure 3.2, the intelligent devices expected in the proposed smart library are listed. Through the intelligent gate system, big data about readers entering and exiting the library is collected. RFID is a kind of identifiable technology for non-touch object, the RFID number is assigned to each physical resource, so that it will become easier to manage.

An intelligent book controller is an important part of a smart library. Each book controller is the bottom of book information management, its main duty it is to manage the book and provide special information for the reader. If some books' position is wrong, it can be automatically corrected, it will be the source of the resources recommender engine [31]. At the same time, it is also a platform of exchange with readers. Book controller exchanges with the information centre via level-hub, construct an information net in the library.

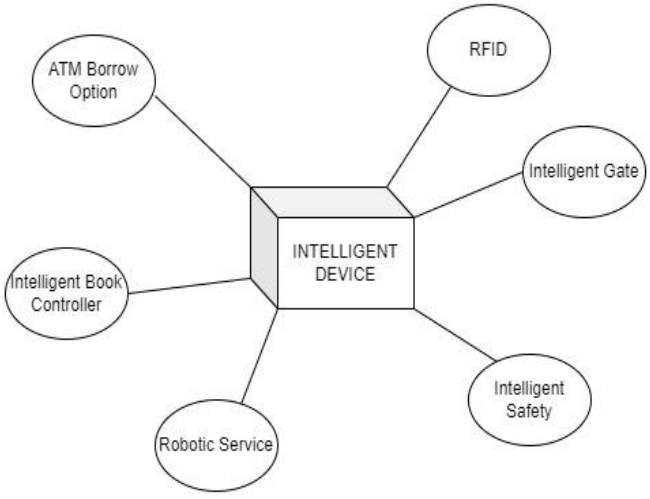

Fig. 3. Proposed Intelligent Device

The purpose of a library is to provide service, and smart service can help readers feel better using intelligent technology. In summary, smart services include serving students, staff, community readers, and disabled individuals. This will foster the institutional economic growth and maintain a collection record (Figure 3).

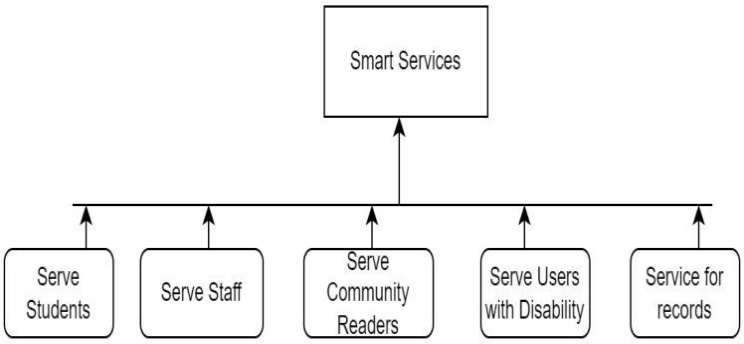

Fig. 5: Smart services Items for the working smart library.

3.4.2 Data Centre Construction

To build a smart library, a database that includes library documents such as books, e-books, journals, e-journals, e-resources, etc., and a service for target information resources, such as library members' information, university achievements, recordkeeping, and collections, are very important. All the services in the library are based on databases, so there is a need to construct more perfect data resources.

Figure 6 shows the relationship among the server object, devices, services, and database. A library provides services for readers when intelligent devices visit all kinds of databases. If there is no database, the devices will lose their function of service. Hence, it is the key point to construct a perfect data centre for the library. How to construct a big data centre is given in the scenario shown in Figure 7.

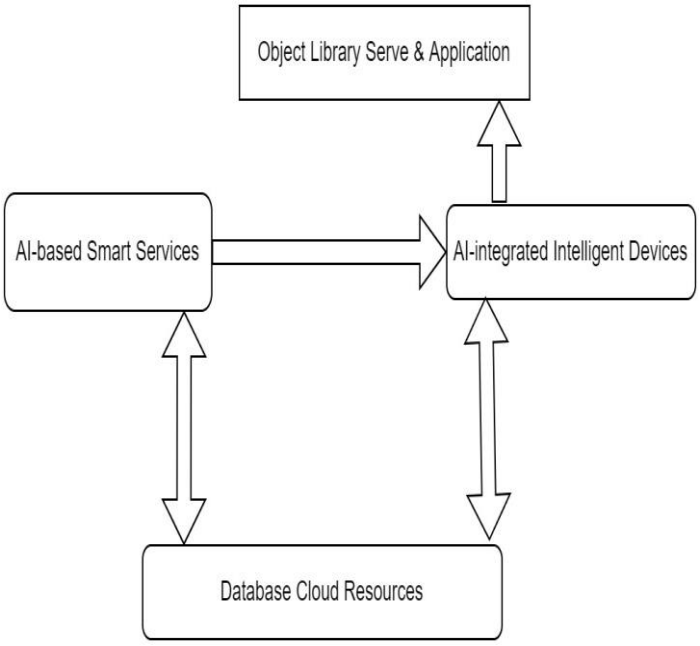

Fig 6. Database, intelligent devices, smart devices, and objects relationship.

A data centre can be divided into four sections: large physical data, e-resource data, reader information data, and special data [61]. In other words, what is available is known, who needs services is known, what their requirements are, and how to give them. The solution to these questions is the route of data centre construction. A database can be filled with four artificial and four intelligent devices. For instance, a book can be added to the physical big data either manually or by scanning its RFID.

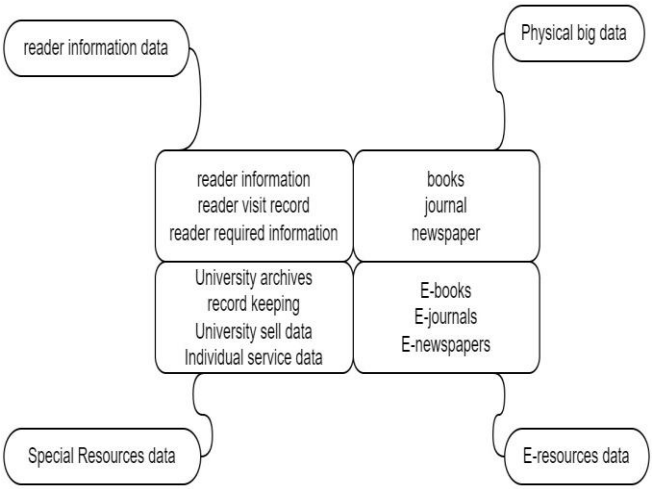

Fig 7: Smart Library expected data centre.

3.4.3 Interface System Construction

The reader, data centre, and interface system are depicted in Figure 8. Clearly, the interface system is the connection between the reader and the data centre. The library offers services via an interface system. The system maintains the data centre, which regulates all the complexity in the intelligent library, and delivers the required data to the reader. Important for the security of the proposed smart library are management systems such as an intelligent gate system and a system to prevent the loss of resources, among others.

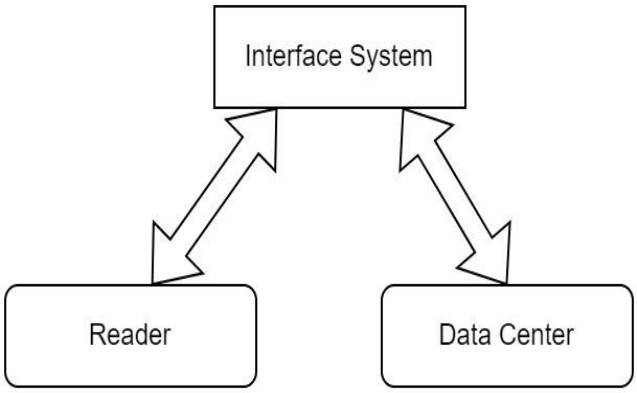

Fig 8. *Interface system interaction.*

The next chapter links the expected implementation of the proposed system with cloud computing.

4.0 Results and Evaluation

4.1 Overview

Intelligent libraries require high-speed Internet connectivity, wireless access points, thin client architecture, a digital librarian, and digital resources. These services are necessary for the construction of a cloud-based smart library. A smart library, as seen in Figure 9, is comprised of digital materials, Internet service, thin client architecture, a digital librarian, and wireless access points after the design proposed in section 2.4. Each facility displayed in the diagram must be evaluated for its value by the intelligent library that is proposed. The implementation of a smart library on cloud computing (CC) cannot progress if a required facility is absent or not in place.

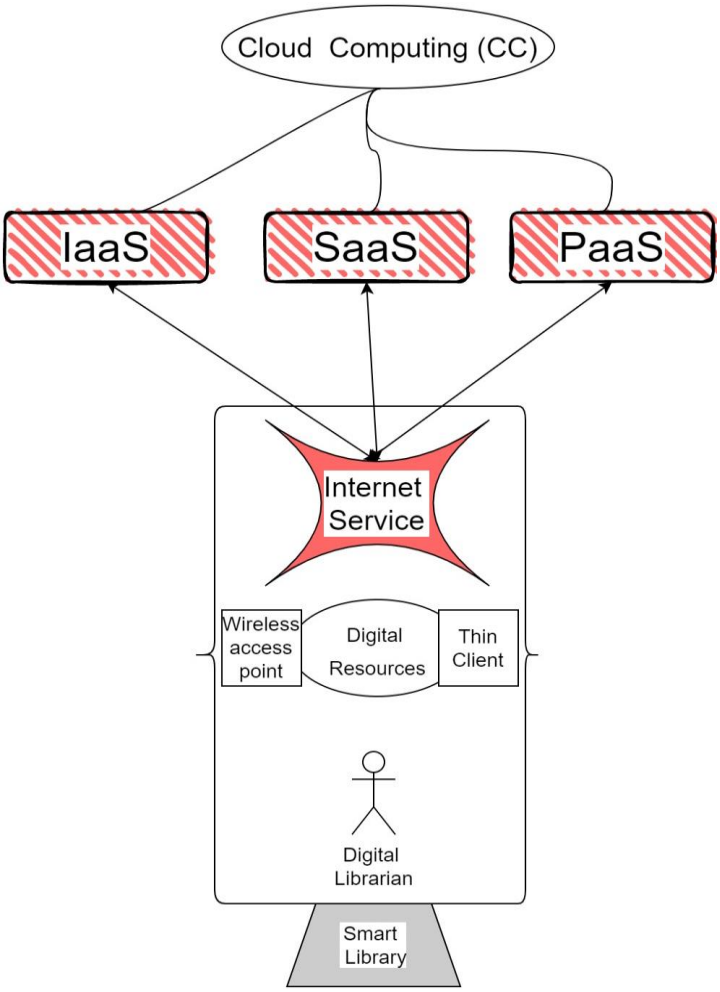

Fig. 9: Simplified View of the Proposed system.

4.2 Internet access

Cloud computing provides resources such as IaaS, SaaS, and PaaS on remotely accessible Internet-connected devices. Internet service is essential for the access, exchange, and distribution of resources among people from all over the world. The identification and selection of the best Internet service provider (ISP), the cost of bytes (in megabytes or gigabytes), the duration and the speed of the internet will have a substantial impact on the consistency of the quality of library services. Internet connectivity is required for the library to gain access to cloud computing resources. Access to all resources, including the operating system and applications, is dependent on the availability of an Internet connection; therefore, it is a technological factor that must be considered.

4.3 Thin client architecture

Thin client architecture cannot function without a server and thin client devices connected to a monitor (display unit). The thin client has a connected keyboard and mouse. This Server-client interaction requires a server with at least a 3.0 GHz processor, 16 GB RAM, a 4 TB hard drive, and Gigabit Ethernet (Network Interface Card-NIC) for faster, more robust, more efficient, and longer-lasting activities. Thin client architecture is a technology branch with multiple advantages. In addition to easing the centralization of vital functions, the technology can improve services and save money and energy. Thin clients immediately reduce IT support expenses, upfront purchase prices, capital costs, data centre space utilisation, licencing fees, and total administration and operational costs.

Using thin clients can also simplify the management of devices, apps, and digital resources.

Thin clients are safeguarded against the use of unauthorised software and the introduction of viruses, data cannot be transferred to a disc or saved elsewhere other than the server, and processing, management, and monitoring of the system are easily centralised.

In minimal time, systems can be virtually prepared, packed, and deployed. This suggests that thin client allows for the quick and flexible installation of systems with minimal effort or expert assistance. This will result in greater productivity and virtually universal access to library content and library-supported applications; a dynamic and flexible IT environment will produce stable and long-lasting information technology infrastructures. Establishing a thin client architecture in the library will aid in the successful implementation of cloud computing.

4.4 Wireless Access Point (WAP)

Cloud-based resources are accessible to users via the Wi-Fi infrastructure of the library. WiMAX routers are capable of transferring data at a rate of roughly 70 megabits per second across a range of 5 to 15 kilometres and can be positioned to provide 360-degree coverage. This would make it possible to develop a Wi-Fi network that extends beyond the library building. There are many benefits involved with placing a WAP in a library. Wireless access points are inexpensive to construct and maintain, increase productivity by decreasing the time required to attend to information accessibility, are adaptive and versatile due to their capacity to expand network signal for access beyond the surrounding area, and are user-friendly. Thus, wireless access points facilitate both the delivery of documents and the distribution of information.

4.5 Digital resources

The digital resources of the library are information resources that have been converted to digital format or acquired electronically. It is extremely beneficial for a library to have electronic forms of information to facilitate the usage of library resources by users.

4.6 Digital librarians

The deployment of cloud computing requires minimal staff. Managing Server/Thin client workstations and wireless access points requires the presence of at least two IT specialists with substantial experience in system installation,

networking, and Internet administration. IT personnel are responsible for monitoring usage flows and controlling authentication, authorization, and access (AAA). Even if open access is the standard for library information distribution, it is vital to institutionalise a measure of control over the use of library resources to optimise use, promote access, and avoid misuse.

4.7 Complete Proposed Framework for Smart Library

The complete proposed framework is shown in Fig. 4.2. As shown in Fig. 4.2, four separate layers must be included, which are the background layer, which is like an interaction layer that encompasses the social content, technological content, user access, librarian access, etc.

The next layer is the cloud layer, which stores the technological involvement of the core workability of a smart library as documented in section 2 of this research. Big data, data mining, artificial intelligence, and the use of Internet of Things are all stored in either of the available services, as shown in Fig. 4.1.

The Communication layer is the layer that enhances user-to-user, user-to-computer communication. As shown in the diagram, different forms of activities can be integrated in the perceptual layer, however, integration of the security system is very important in this smart environment as shown in the diagram.

Smart environments are the virtual environment that encompasses all the virtual infrastructure of the proposed library, whereas, smart building is the environment that encompasses the necessary electronic devices for the continuous functionality of the proposed smart library. An environment that encompasses all the activities in the smart library can be termed the smart city, as shown in Fig. 4.2.

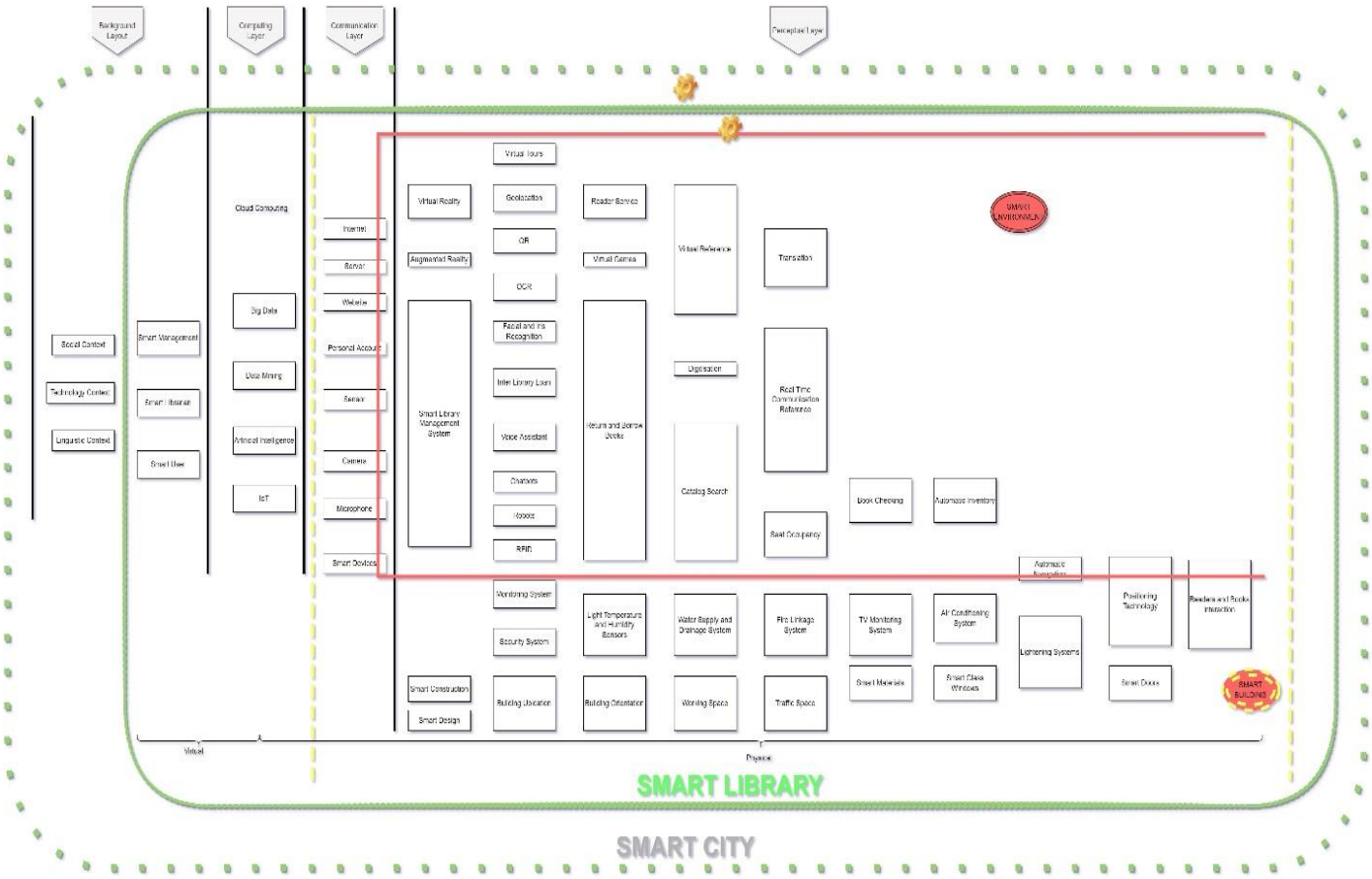

Fig. 4.2 Proposed Framework

5.0 Conclusions

Cloud computing is already an integral part of every ICT-related organization's daily operations. Integrating libraries with cloud computing technologies will transform libraries into intelligent libraries and optimise and improve library services in the information age. Cloud-based libraries are the world's newest type of e-Smart libraries. Every library must establish a cloud-based, updated information delivery infrastructure and a conducive atmosphere that effectively supports research, learning, and teaching due to the cloud's security advantages. In reality, libraries must revitalise and preserve their relevance by incorporating cloud computing technologies, which will make them part of the Internet of Things (IoT) experience that will soon dominate every sector.

Integration of the proposed methodology for actualization of smart library as discussed in this research can involve different technologies. For example, Wi-Fi can involve low level programming language such as C, for the AI related devices, Python programming language can hasten the development of such infrastructure etc. However, complete functionality of the proposed framework should be integrated using the application programming interface (API) which will eliminate any form of programming conflict.

This research has presented systematic literature review (SLR) on the need for smart library to counter challenges which can occur in the e-resources. The author of this paper has also carefully presented a framework which can be implemented for proper smart library functionality. However, development and proper testing has not been done, the author recommends the integration of the proposed framework as the future work.

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