CHAPTER - 1

INTRODUCTION

1.1 Introduction

Libraries are highly vital in the provision of academic materials and support in research and learning at institutions of higher learning. The rapid growth and development of new technologies such as Artificial Intelligence (AI), Machine Learning (ML), Internet of Things (IoT), Blockchain, and Big Data or Virtual and Augmented Reality (VR/AR) have recently transformed library practices around the world. Every one of these technological advancements could increase user satiation by enhancing information retrieval, service personalization, automating mundane tasks, and providing secure access.

Like all other state university libraries in India, the libraries in Odisha also support educational and research activities of the University and Outside Communities. The state has 19 universities and these libraries serve a large number of students, teachers and researchers by providing books, journals, papers, and other digital materials. The transformation of a library from a mere book housing center to a contemporary knowledge center makes use of high end technologies and tools along with the use of online databases.

In Odisha, university libraries are slowly trying to embrace these technologies to upgrade their service offerings. However, with such changes, there seems to be insufficient information about the level of implementation and the resultant user satisfaction. Determining the current status and future technological needs can make a difference to what the libraries provide to their academic patrons. This study intends to determine the extent of the adoption of emerging technologies in university libraries in Odisha, the level of user satisfaction, and provide suggestions for enhancements.

1.2 Background of the Study

Libraries have always been the first to embrace technology to enhance user experience and service delivery. Manual cataloging, physical circulation of books, and personal reference services were the basis of traditional library service. The inception of Integrated Library Systems

(ILS) and Online Public Access Catalogs (OPAC) was the starting point when libraries began to automate their processes.

Recent technologies such as artificial intelligence (AI), machine learning (ML), Internet of Things (IoT), and Blockchain , RFID have started to change the way services are offered in libraries. Intelligent search and recommendation systems are made possible owing to AI, user behavior predicting analysis is made possible because of ML, IoT aids in the real time tracking of library materials, and secure decentralized systems are made possible for data through Blockchain.

In terms of Odisha, the university libraries are being compelled to update their services to satisfy the rising demand of techno-savvy users. Surprisingly, very little has been done to investigate how these technologies are being applied, or the effect of those technologies on users.

1.3 Statement of the Problem

Currently modern technologies are getting easier to access, numerous universities in Odisha face problems when it comes to integrating new services in their libraries. Inadequate underlying infrastructure, lack of skilled manpower, insufficient funding, and Development of new user friendly technologies directed to improve the dissatisfaction, are persistent problems that prevent the emerging tools from being used. Moreover, there is no systematic retrieval of feedback from users who have been serviced to ascertain to what level the available technological tools meet the user's needs and if they contribute to user satisfaction or not.

This study aims to explore the state of implementation of modern technology in state university libraries in Odisha with the intention of assessing the level of user satisfaction with the available digital services, and exploring the technological needs to enhance service provision. This study shall establish gaps between the expectations of users and the actual services rendered in order to suggest possible ways of replacing advanced technology. The findings of this study will form the basis for designing a comprehensive strategy to improve the quality of services, level of user satisfaction, and the performance of library systems in meeting the academic and research needs.

1.4 Need of the Study

University libraries in Odisha play a crucial role in supporting academic and research activities. However, with the rapid advancement of emerging technologies such as Artificial Intelligence (AI), Internet of Things (IoT), RFID, Machine Learning, Big Data, Mobile Technology, and others, user expectations have evolved significantly. Modern library users seek faster access, personalized services, and interactive platforms that traditional systems may not effectively provide.

Despite national and global progress in integrating such technologies into library services, many state university libraries in Odisha are still lagging behind in adoption and implementation. This gap impacts user satisfaction, resource accessibility, and overall service quality.

Therefore, there is a strong need to:

Assess the current status of emerging technology adoption in Odisha's university libraries.

Identify the challenges and barriers faced in technological implementation.

Understand the level of user satisfaction in relation to technology-based services.

Highlight the future needs and propose strategies for effective integration of modern technologies to enhance user experience.

1.5 Objectives of the Study

1.To identify the current status and types of emerging technologies adopted in university libraries of Odisha.

2**.** To identify user expectations and future needs regarding emerging technologies."

3 .To analyze the barriers and challenges they face while using the available technologies."

4. To assess the level of user satisfaction with the existing technological services provided by the libraries

5.To recommend future technological needs and strategies for enhancing user satisfaction in Odisha state university libraries.

1.6 Scope of The Study

Geographical Boundaries - This research will cover state university libraries in the region of Odisha, India.

Scope of Technology - The study will include all developing technologies such as artificial intelligence, machine learning, cloud computing, huge data, and digital libraries, among others.

User Groups: The study will focus on student who is users of the libraries ,only determine their views and satisfaction with the library services.

Scope of Services - The study will focus on library service areas of Information Retrieval and Access, Digital Resource Management, and inventory and asset management, user support, remote and mobile support, and smart environment services.

Time Scope: The study will determine the state of technology adoption at the present time and speculatively assess future technology requirements.

The confidentiality and anonymity of participants' responses will be maintained throughout the study.

1.7 Research Methodology

This research will use a **quantitative approach** to assess the current status and future requirements of emerging technologies in Odisha state university libraries, with a particular focus on user satisfaction. Primary data will be collected using**questionnaire Method**designed to gather relevant information from library users.

A **descriptive research design** will be employed to examine the extent of implementation of emerging technologies in relation to user satisfaction. This design is suitable for analyzing the availability, usage, and effectiveness of technological services in university libraries, and for identifying patterns, relationships, and areas of improvement.

The study population includes all 19 state universities in Odisha**.** A convenience sampling method was adopted to select a representative sample of university libraries that are more likely to provide relevant and rich data based on their infrastructure, size, and willingness to participate. From this population, 4 universities were conveniently selected for the study to ensure focused and meaningful insights into technology adoption and user experience.

The primary focus group of this study comprises library users, particularly PG students from the selected Odisha state university libraries.

Table 1.1 Total Population

Sl. No.	Name of the University
1	Fakir Mohan University, Vyasa Vihar, Balasore
2	Rajendra University, Bolangir
3	Madhusudan Law University, Cuttack
4	Ravenshaw University, Cuttack
5	Berhampur University, Bhanja Vihar, Berhampur
6	Khallikote Unitary University, Berhampur
7	Maa Manikeshwari University, Bhawanipatna
8	Dharanidhar University, Keonjhar
9	Center for Post Graduate Studies (CPGS), OUAT
10	Odisha University of Technology and Research
11	Rama Devi Women's University, Bhubaneswar
12	University Law College (Utkal University), Bhubaneswar
13	Utkal University, Vanivihar, Bhubaneswar
14	Vikram Dev University, Jeypore.
15	Maharaja Sriram Chandra Bhanjadeo University, Sriramchandra Vihar, Baripada(Main Campus)
16	Odia University, Satyabadi,puri
17	Shree Jagannath Sanskrit University,puri
18	Gangadhar Meher University, Amrut Vihar, Sambalpur
19	Sambalpur University, Jyoti Vihar, Sambalpur

1.7.1 Sample

Table 1.2 Selected Sample

Sl. No.	Name of the University
1	Sambalpur University, Jyoti Vihar, Sambalpur
2	Utkal University, Vanivihar, Bhubaneswar
3	Berhampur University, Bhanja Vihar, Berhampur
4	Gangadhar Meher University, Amrut Vihar, Sambalpur

The data collected through google forms inonline mode and analyzed or presented in Microsoft Excell in order to identify patterns, trends, and insights regarding the current state and future needs of emerging technology in university libraries.

1.8 Sheme of Work

The scheme of work describes the methodological design for the research, including its structure as well as the processes, activities and materials needed to complete it. The study is organized into the following chapters:

Chapter1: Introduction

In this chapter, the study topic is presented alongside the overview of the history and context, research problem, objectives, boundaries, significance, and an overview of the methods used in the study.

Chapter 2: Review of Literature

This chapter delves into the previously published literature on the use of new technologies in university libraries and their role in user satisfaction as well as presents arguments for the foundational premises of the research and identifies gaps in literature.

Chapter -3:Overview of Emerging Technologies in Libraries

This chapter focuses on concepts such as Artificial Intelligence, Machine Learning, Internet of Things, Mobile Technologies, Augmented Reality, Radio Frequency Identification, Big Data Analytics, Blockchain Technology and their description, function and services with respect to libraries.

Chapter -4: Profile of Selected University Libraries in Odisha

This chapter examines the profile of selected state university libraries in Odisha.

Chapter -5: Data Analysis and Interpretation

This chapter shall focus on analyzing and interpreting the result that came out of the data collected using thequestionaire,

Chapter-6: Findings, Conclusions and Suggestions

It presents the results, conclusions, and recommendations.

CHAPTER 2

REVIEW OF LITERATURE

A literature review serves as the foundation for any academic research by offering insights into existing studies, identifying research gaps, and framing the context of the present investigation. In the rapidly evolving landscape of academic libraries, numerous scholars have explored the impact of emerging technologies such as Artificial Intelligence (AI), Internet of Things (IoT), Blockchain, Big Data, RFID, Mobile Technology, and more on library services and user satisfaction.

This chapter aims to critically examine previous research related to the adoption, implementation, and effectiveness of these technologies in university libraries—both globally and within the Indian context. Special emphasis is given to understanding how these innovations contribute to improving library operations, service quality, and user experience. The review also highlights studies that address challenges in technology integration and strategies for enhancing user satisfaction through digital transformation in libraries.

Ali, F .etal. (2025): This study discusses the readiness for adopting artificial intelligence and emerging technologies in academic libraries in Pakistan, highlighting the challenges and opportunities presented by these technologies.

Oladokun, etal. (2024) investigate how new technology trends affect library operations and services. The authors offer a thorough examination of how technological developments have changed how libraries operate, the difficulties they have when implementing new technology, and the opportunities these developments present.

Andrew, D. (2024): Andrew explores the implications of blockchain technology in supply chain management, drawing parallels to its potential applications in library management systems. The research highlights how blockchain can enhance transparency, security, and efficiency in managing library resources, suggesting that libraries could benefit from adopting this technology to streamline operations and improve user trust.

Koumpouros, Y. (2024): Koumpouros reveals the potential of augmented reality (AR) in education, suggesting that libraries can use AR to create immersive learning experiences. The research highlights successful case studies where AR has been implemented in educational settings, encouraging libraries to explore innovative ways to engage users and enhance learning outcomes.

Mais, F., &Mezawy, S. A. (2024): The authors develop a model to improve maintenance management efficiency for service buildings, including libraries. The study emphasizes the importance of adopting modern management practices and technologies to enhance operational efficiency and reduce costs in library facilities.

Inamdar, Sayed Ahmed (2022)) in his study analyzed and explores the transformative impact of emerging technologies on library services and operations. The literature review highlights key technologies reshaping library management, user experience, and service delivery while addressing associated challenges and opportunities.

Lubanga and Mumba (2021) the field of research and development, creativity and innovation of the library are major points in a technologically driven world and are vital aspects of restructuring library services and products for efficient service delivery and optimum client experience. This study examined the importance of research and development, creativity, and innovation at the University of Livingstonia (UNILIA) library in the 21st century.

Saibakumo (2021) the long-term survival and support of academic libraries in the technological society depends on the expansion and upgrading of information services. In academic libraries, technological developments have pushed libraries to take allembracing, user-friendly, and technology-driven methods to delivery. This apparent gap appears to be filled by new technology. The study highlights the degree to which new technologies are understood, adopted, favoured and ready to be included in academic library operations in Nigeria.

Moruf and Dangani (2020) As information technology is becoming increasingly pertinent to academic institutions, librarians and other IT professionals need to master the technology which can be used in academic institutions, as developing digital expertise are fundamental in all academic curriculums. Their study not only discusses the rising trend in library technology

particularly in academic libraries but also examines the need to reflect and refocus on how technological developments are influencing their services further.

Funmilayo and Ayo (2020) attempt to determine the worldwide trends as well as a new library and IT technologies, so that readers may focus on them in particular for efficient library services. Moreover, the emerging technologies in library and IT services have led to the occurrence of several changes, as well as social expectations of librarians and information professionals.

Acharya, Hiremath and Lalasangi (2019) highlight the percentage of progress in the cutting-edge library. Then there are many modifications to the library and data benefits, as well as to the tasks and wishes of the library specialists to meet the customer data request in this period, according to the current advanced situation. Due to the ICT Impact, Digitization and library modernisation, another viewpoint has emerged in the field of LIS. It is recognised that computerised innovation in every sector and circle of life has created room for itself.

Llewellyn (2019) identifies innovative features of digital education, collaboration and cocreation in academic libraries, student experience and the design of learning spaces suitable for modern pedagogy have been found by the literature research. However, the author also examines the changing character of the academic library and the function of academic library professionals in the context of a broader transformation in society and higher education.

Chukwueke and Onuoha (2019) concluded that because of the many advantages it has to provide, ICT applications in libraries are of great relevance. The benefits include improved library services efficacy and efficiency, reduced access to information time, location and recovery time, conserving physical space for the library and so forth. In addition, several academic libraries are still not yet completely using these ICTs in their services despite their many benefits.

Hussain and Jan (2018) conducted a survey study on web 2.0 tool awareness. Their study's main goal was to determine the extent to which Islamabad, Pakistani university libraries use Web 2.0 technologies. The results show that web 2.0 technology activities pique the interest of young library workers. These technologies can be used to provide end users with the most recent and current information since social networking sites are more successful at selling library services in Web 2.0 applications.

Enweani (2018) outlined the different potential challenges that arise when university libraries are maintained in the current digital era. The article's primary themes, the evolving library landscape, and the need for effective university library management in the digital age were all emphasized. The study comes to the conclusion that university library administration must take immediate, creative action to address the numerous management challenges that these institutions face. Only then will digital university library administration yield the desired outcomes. The researcher employed a survey approach for this investigation, using a questionnaire as the main instrument for gathering data.

Inamdar, Sayed Ahmed (2022) investigated how new technology may influence library operations and services in the future. He noted important technologies that are changing how libraries function and interact with their patrons, including blockchain, cloud computing, augmented reality, artificial intelligence (AI), and the Internet of Things (IoT). The study emphasized how crucial it is to strike a balance between the development of technology and fundamental library principles like diversity, accessibility, and intellectual freedom.

Alcock, M. and Nemes, G. (2018) conducted a SWOT analysis on the impact of emerging technologies on libraries. Their study identified the strengths, weaknesses, opportunities, and threats posed by technological advancements in library services. They found that while technologies like AI and cloud computing can enhance efficiency, they also present challenges related to user privacy and equitable access.

Borgman, C.L. (2015) discussed the role of big data in scholarly research and library services. The study found that libraries are increasingly collecting vast amounts of data on user behavior and usage patterns. Big data analytics can help libraries improve service delivery, optimize collections, and anticipate user needs.

Mulimani, M.N. and Naikar, S. (2022) focused on the role of information and communication technologies (ICT) in teaching and learning. They argued that libraries must embrace ICT tools to support online learning, remote access to resources, and virtual collaboration among students and faculty.

K. R. Mulla and M. Chandrashekara (2010)conducted a survey of engineering college libraries in Karnataka on use of integrated library software. The survey provided an implicit view

of the professional experiences of the librarians in computerizing their house keeping operations. It is observed that 13.73 per cent of the engineering libraries are not automated for reasons which varied from library to library such as lack of computer facility, financial problems, lack of trained manpower and inadequate library collection.

Y. Srinivasa Rao's and B.K.(2009) Choudhury's case study of National Institutes of Technology (NIT) libraries in India on library automation facilitation concludes that computer in libraries automation makes the library system, resources, and services more attractive and interactive in helping libraries to meet users' expectations. To see the true picture of the provision of automation facilities among NIT libraries, this study has been conducted.

S. Dhanavandan's .etal .(2011) study on information communication technology infrastructure facilities in self financing engineering college libraries in Tamil Nadu find that the Autolib software takes the first position and Libasoft the second and in house prepared software takes the third position in the Review of Literature 45 utilization of the library application software. The digital library software (GSDLD Space software and Greenstaone software) are also use in few libraries. The possession of DELNET occupies the first position, INFLIBNET the second, ERNET the third, INDONET the fourth, and NICNET the last.

Seema Vasishta's (2009) study on roadmap for RFID implementation in Central Library, PEC University of Technology, Chandigarh gives brief idea about the emerging RFID technology, its importance in the library management system and its working. It describes the basic and optional components required for smooth working of the exercise. The aim has been to consider how to extend RFID applications to academic library keeping in view the shortage of funds and scarcity of supporting staff. The article illustrates a vivid picture about how RFID technology is acting as a boon for libraries thereby highlighting the key benefits of RFID like reliability, high speed inventorying, automated and materials handling

Kaling Borang's and Gautam Kumar Sarma's(2008) survey deals with application of ICT in two major academic libraries of Arunachal Pradesh i.e., Rajiv Gandhi Central University Library and North Eastern Regional Institute of Science and Technology (NERIST) Library. It discusses the status of library automation, different software Review of Literature 47 packages used for automation, OPAC, use of e-resources and the extent of their use in library operations of these

two libraries. This paper throws light on the problems and difficulties being faced by the library in applying ICT in the libraries.

Conclusion

The existing body of literature demonstrates a substantial exploration of the role and impact of emerging technologies—such as Artificial Intelligence, Blockchain, IoT, RFID, Big Data, and Mobile Technologies—on library operations and user satisfaction across global and Indian academic libraries. Various studies highlight technological trends, benefits, challenges, and implementation strategies in countries like Pakistan, Nigeria, and across different Indian states.

However, a critical analysis of the reviewed studies reveals a significant research gap concerning the specific context of university libraries in Odisha. Despite the rapid technological evolution and increasing user expectations in higher education, no comprehensive or dedicated studies appear to have been conducted on the adoption, implementation, and effectiveness of emerging technologies in Odisha's state university libraries. This absence underscores the need for focused research to assess the current status and future needs for technological enhancements aimed at improving user satisfaction in these institutions.

Addressing this gap is essential to inform policy-makers, academic administrators, and library professionals in Odisha about technology integration strategies that are both locally relevant and aligned with national and global best practices.

CHAPTER-3

Overview of Emerging Technologies in Libraries

Libraries have changed from mere physical spaces to advanced digital environments, which incorporate technologies to improve ease of access, effectiveness, and engagement. New technologies such as Artificial Intelligence (AI), Machine Learning (ML), Internet of Things (IoT), Virtual Reality (VR), Augmented Reality (AR), RFID, Blockchain, mobile technologies, and Big Data are earmarking a shift on how libraries function today. It helps in automating services, controlling resources, personalizing users' experiences, improving security and many more.

To meet the expectations of users for fast information retrieval, university libraries are applying these technologies for improvement on service delivery. AI-based chatbots help users with questions, deep learning algorithms help face recognition, IoT smart shelves help in effortless book inventory tracking, and mobile applications provide access to library resources from virtually anywhere. In the same way, Big Data assists in knowing the users' needs in the libraries, while Blockchain technology helps secure digital assets and business transactions.

This section explains the basic principles of these emerging technologies and their implementation issues in university libraries with particular attention to the use of new technologies aimed at enhancing the quality of services and consequently the satisfaction of the users.

3.2 Artificial Intelligence (AI) in Libraries

What is AI?

AI, or Artificial Intelligence refers to the emulation of human cognition in machines where they are able to analyze a given set of data, identify patterns, make a decision, and automate tasks. With the use of technologies such as Machine Learning (ML), Natural Language Processing (NLP), and Predictive Analytics, AI is able to increase efficiency and overall user experience in multiple fields such as libraries AI.

Uses AI in Libraries

AI is making a major impact in university libraries in regard to service delivery, automated processes, and personal attention to users. Some of the main uses are:

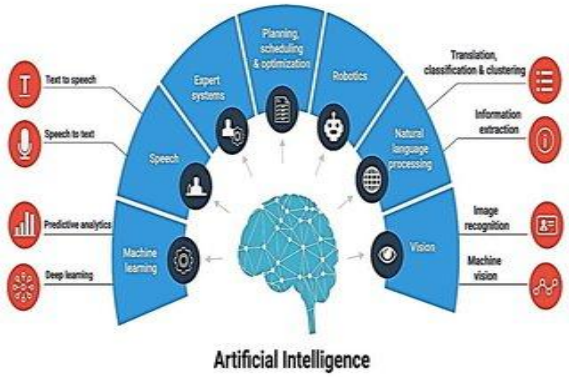

Figure:1.1 Artificial inteligence

Source:https://www.researchgate.net/publication/335661337_Applications_of_Artificial_Intelligence_in_Academic_Libraries

1. AI-Powered Chatbots & Virtual Assistants

Assist users in locating books, searching for research papers, and general queries.

Provide virtual assistance at all hours of the day and night which increases support service and lowers the burden on library assistance staff.

2. Automated Cataloging & Classification

AI systems automatically set out materials in correct order.

AI systems increase efficiency of tagging through enhancement and classification that makes the literature easier to locate through search engines.

3. Smart Search & Information

Machine learning and AI research make it possible for autonomous searching for needed information on the Web.

3. Tailored Book Suggestions

The AI uses the user's preferences and reading patterns to recommend useful books. Like the recommendation systems of Amazon and Netflix, these systems are also intuitive.

4. Research Assistance & Detection of Plagiarism

The AI tools like Turnitin helps in identifying plagiarized content in academic work. It helps researchers by analyzing pertinent research and providing the literature review pointers and important results.

5. Information Retrieval and Smart Searching

With the help of AI, the library's search engines can utilize Natural Language Processing, which permits users to issue requests in conversational terms. Provides correct and quicker results unlike conventional results which heavily rely on keywords.

3.3 Internet of Things (IOT)

What is IoT?

The Internet of Things (IoT) refers to a network of interconnected physical devices that communicate and exchange data through the internet. These devices, embedded with sensors, software, and connectivity, automate various tasks, enhancing efficiency and reducing human intervention. IoT is widely used in smart homes, healthcare, industries, and now, libraries, to improve resource management and user experience.

Applications of IoT in Libraries

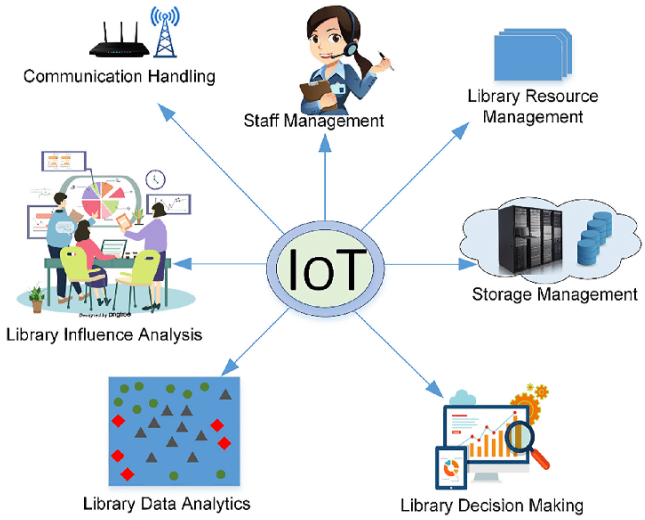

Figure:1.2 Iot work in Libraries

Source: https://www.researchgate.net/figure/Application-areas-for-IoT-in-libraries_fig2_355380026

1. Smart Shelving and Book Tracking

IoT-enabled RFID (Radio Frequency Identification) sensors help track books in real time.

Assists in locating misplaced books, reducing manual searching efforts

2. Automated Check-in and Check-out Systems

Self-service kiosks with IoT-based RFID tags enable users to borrow and return books without staff assistance.

Enhances operational efficiency and reduces waiting time for users

3. Environmental Monitoring for Book Preservation

IoT sensors monitor temperature, humidity, and light levels to protect rare books and manuscripts from damage.

Automated alerts notify staff when conditions need adjustments.

4. User Footfall and Space Utilization Analysis

Smart sensors track visitor movement and study space occupancy to optimize seating arrangements.

Helps in planning library layout for better user convenience and accessibility.

5. Security and Theft Prevention

IoT-based RFID security gates detect unauthorized removal of books.

Smart surveillance cameras enhance real-time monitoring and security measures.

6. Automated Library Maintenance

IoT-integrated smart lighting and HVAC (Heating, Ventilation, and Air Conditioning) systems help in energy conservation.

Reduces electricity consumption by automatically adjusting lighting and air conditioning based on occupancy.

3.4 Blockchain Technologies

What is Blockchain?

Blockchain is a decentralized, secure, and transparent digital ledger that records transactions across multiple computers. Each transaction, or "block," is linked and secured using cryptography, making the data immutable and tamper-proof. Originally developed for cryptocurrency, blockchain technology is now being used in various fields, including education, finance, healthcare, and libraries.

Applications of Blockchain in Libraries

Figure:1.3 Block chain technology d

Source:https://library.iitd.ac.in/arpit_2020-2021/Week%2016%20-%20Module%2040%20-%20PPT-%20Blockchain%20Technology%20and%20Its%20Application%20in%20Libraries.pdf

1. Secure and Transparent Digital Record Management

Libraries can use blockchain to store and verify digital records, such as membership details, borrowing history, and acquisitions.

Ensures tamper-proof records, reducing the risk of data manipulation or loss.

2. Decentralized Library Catalogs

Blockchain allows libraries to create a shared catalog system, enabling multiple institutions to maintain and access a unified book database.

Eliminates duplication of records and improves inter-library loan services.

3. Copyright Protection and Digital Rights Management

Blockchain helps protect intellectual property rights by recording ownership and usage rights for digital content.

Authors and publishers can track how their work is used and distributed.

4. Smart Contracts for Automated Transactions

Libraries can implement smart contracts for book borrowing, fines, and payments for premium services.

Automates processes, ensuring secure and transparent transactions without intermediaries

5**. Blockchain for Open Access and Scholarly Publishing**

Ensures authenticity and permanence of research articles and digital publications.

Helps prevent plagiarism and unauthorized modifications of research data.

3.5 Library Automation System

What is a Library Automation System?

A Library Automation System is a software solution designed to manage and streamline various library operations, reducing manual efforts and improving efficiency. These systems handle functions like cataloging, circulation, acquisitions, serials management, and user services through computerized processes. By automating routine tasks, libraries can enhance user experience, optimize resource management, and ensure seamless access to information.

Uses LibraryAutomation Systems in Libraries

Figure:1.4 Library automation system

Source:https://www.elibrarysoftware.com/what-is-library-automation.html

1. Automated Cataloging and Classification

Helps in organizing books, journals, and digital resources efficiently.

Uses standardized classification systems like MARC (Machine-Readable Cataloging) and Dewey Decimal System for easy retrieval.

2. Efficient Book Circulation Management

Tracks book check-in and check-out processes through barcode or RFID-based systems.

Sends automated reminders for due dates and overdue books, reducing manual intervention.

3. Online Public Access Catalog (OPAC)

Allows users to search and locate books in the library from any internet-enabled device.

Enhances accessibility by displaying book availability, location, and related resources

5. User Account and Membership Management

Maintains digital records of library users, including borrowing history and membership details.

Provides personalized recommendations based on user preferences.

7. Self-Service Kiosks and RFID Integration

Users can borrow and return books without library staff assistance using RFID-based kiosks.

Reduces queues and improves the overall user experience.

3.6 Mobile Technologies in Libraries

What is Mobile Technology in Libraries?

Mobile technology in libraries refers to the use of smartphones, tablets, mobile apps, and wireless connectivity to provide library services and enhance user experiences. It enables users to access library resources, search catalogs, borrow e-books, and receive notifications remotely, making library services more convenient and accessible.

Applications of Mobile Technology in Libraries

Figure:1.5 Mobile technology

Source:chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://library.iitd.ac.in/pdf/Mobile-Applications-in-Library-Services.pdf

1. Mobile Library Apps

Many libraries offer dedicated mobile applications that allow users to search the catalog, check book availability, renew borrowed items, and place reservations.

Provides real-time updates on new arrivals, library events, and due dates.

2. QR Codes for Easy Access

QR codes placed on books, shelves, or library posters link users to online catalogs, e-books, or additional digital resources.

Helps users quickly access bibliographic information, reviews, or multimedia content.

3. E-Books and Audiobooks on Mobile Devices

Libraries provide digital lending services where users can borrow and read e-books or listen to audiobooks via apps like Kindle, OverDrive, or Libby.

Eliminates the need for physical visits and extends accessibility.

4. SMS and Push Notifications

Libraries send SMS or push notifications for book return reminders, overdue notices, event updates, and library announcements.

Improves user engagement and reduces overdue penalties.

5. Mobile-Friendly Online Public Access Catalog (OPAC)

Mobile-responsive OPACs allow users to search, reserve, and access digital collections conveniently.

Ensures seamless browsing and interaction on smartphonesand tablets.

6. Augmented Reality (AR) for Library Navigation

Some libraries use AR-based mobile apps to help users navigate the library by showing directions to book locations and study areas.

3.7 Big Data in Libraries

What is Big Data in Libraries?

Big Data in libraries refers to the large volume of structured and unstructured data generated from library systems, user interactions, digital resources, and research outputs. This data includes borrowing records, search queries, user preferences, digital archives, and scholarly publications. Libraries use Big Data analytics to gain insights, enhance services, and optimize decision-making.

Applications of Big Data in Libraries

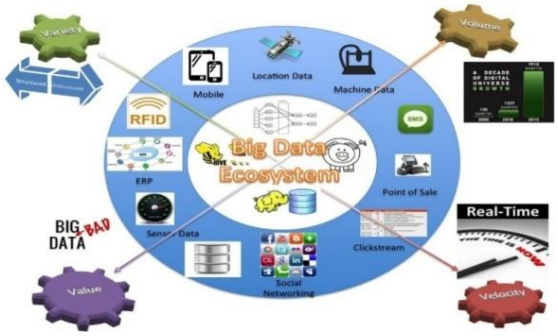

Figure:1.5 Big data in libraries

Source:https://bigdataanalyticsnews.com/big-data-use-cases/

1. User Behavior Analysis

Tracks borrowing patterns, search trends, and user preferences to improve collection development and personalized recommendations.

Helps in designing user-centric library services.

2. Optimized Collection Management

Identifies high-demand and underutilized resources, helping libraries make informed purchasing and weeding decisions.

Reduces unnecessary acquisitions and improves budget allocation.

3. Predictive Analytics for Library Services

Forecasts future trends in book borrowing, digital resource usage, and library attendance.

Helps in staff scheduling and resource planning.

4. Research Data Management

Organizes and analyzes vast amounts of scholarly articles, theses, and research data.

Facilitates data-driven decision-making for academic institutions and researchers.

5. Improved Digital Resource Accessibility

Uses Big Data algorithms to enhance the discoverability of e-books, journals, and online databases.

Ensures users can access relevant materials quickly.

6. Enhanced Security and Fraud Detection

Detects unusual activity such as book theft, unauthorized access, and plagiarism.

Protects sensitive user data through secure data management practices.

3.8 RFID In Libraries

What is RFID in Libraries?

Radio Frequency Identification (RFID) is a wireless technology used in libraries for automated tracking, identification, and management of books and library resources. It replaces traditional barcode systems with RFID tags, readers, and antennas, allowing for faster check-in/check-out, real-time inventory management, and enhanced security.

Services of RFID in Libraries

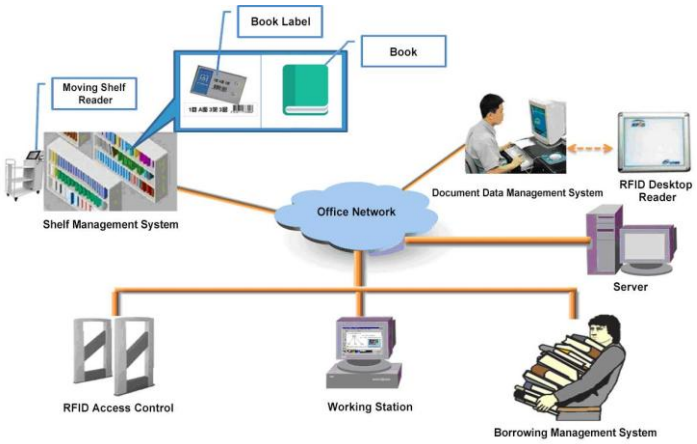

Figure:1.6 Rfid services

Source: https://www.elibrarysoftware.com/rfid-system.html

1. Automated Check-in and Check-out

Users can borrow and return books quickly by scanning RFID-tagged books at self-service kiosks.

Reduces the need for manual processing and saves time for both users and librarians.

2. Efficient Inventory Management

RFID enables real-time tracking of books, helping librarians conduct inventory checks faster and more accurately.

Missing or misplaced books can be easily located using handheld RFID scanners.

3. Anti-Theft Security System

RFID gates at library entrances detect unauthorized book removals by scanning RFID tags.

Enhances security and prevents theft without manual checking.

4. Self-Service Kiosks

Users can issue or return books independently using RFID-enabled self-service machines.

Minimizes waiting time and improves user experience.

5. Smart Shelving System

RFID-enabled shelves detect books placed in the wrong section, helping staff maintain an organized collection.

Users can also locate books easily using digital library maps.

6. Multi-Book Handling

Unlike barcodes, RFID allows multiple books to be scanned at once, making check-in/check-out faster and more efficient.

7. Automated Sorting System

Some libraries integrate automated book sorting with RFID, where returned books are automatically sorted into designated carts or shelves.

Reduces manual workload for librarians.

8. Integration with Library Management System (LMS)

RFID integrates with digital library software, providing real-time updates on book availability, due dates, and borrowing history.

3.9 Conclusion

The integration of emerging technologies in libraries has revolutionized traditional operations, transforming them into dynamic, user-centered information hubs. Technologies such as Artificial Intelligence (AI) and Machine Learning (ML) enhance service efficiency through smart search systems, predictive analytics, and virtual assistance, thereby personalizing the user experience. Internet of Things (IoT) brings automation and smart monitoring into physical spaces, improving resource tracking, environmental control, and energy conservation.

Blockchain ensures transparency, data security, and integrity in digital recordkeeping, licensing, and scholarly communications. Library Automation Systems streamline core library functions such as cataloging, circulation, and digital resource management, reducing human error and improving service speed. Meanwhile, Mobile Technologies extend the library's reach beyond its walls, allowing users to access services, receive updates, and interact with resources conveniently from any location

CHAPTER-4

Profile of the Selected University Libraries in Odisha

The academic libraries of state universities in Odisha play a vital role in supporting teaching, learning, and research activities. In the context of growing dependence on digital resources and emerging technologies, understanding the existing infrastructure and services of these libraries becomes essential for evaluating their current status and future needs. This chapter presents detailed profiles of the five university libraries selected for this study through purposive sampling.

Each profile includes key aspects such as the history of the university, library establishment and development, collection strength, staffing, ICT infrastructure, and the extent to which emerging technologies have been adopted. This chapter helps in understanding the institutional context, variations among libraries, and their readiness to implement modern technologies to enhance user satisfaction.

By exploring the individual characteristics and current practices of each university library, this chapter sets the foundation for the analysis and interpretation presented in subsequent chapters.

4.2 Selected University

4.1 Selected University

Sl. No.	Name of the University
1	Sambalpur University, Jyoti Vihar, Sambalpur
2	Utkal University, Vanivihar, Bhubaneswar
3	Berhampur University, Bhanja Vihar, Berhampur
4	Gangadhar Meher University, Amrut Vihar, Sambalpur

4.3 Profile of the University Libraries :

4.3.1 Profile of Sambalpur University Library:

4.3.1.1Brief History of the University

Established in 1967, Sambalpur University is located in Jyoti Vihar, Burla, Odisha. It serves as a premier institution for higher education in the western region of Odisha, offering postgraduate and doctoral programs across various disciplines, including science, humanities, and social sciences.

4.3.1.2 Overview of the Library

The central library of Sambalpur University was established in the year 1970 after three years of inception of Sambalpur University in 1967. It was named as Professor Bhubaneswar Behera Central Library in the name of fourth Vice Chancellor Professor Bhubaneswar Behera.The central library, a 3 storied building is spreaded over 27,450 square feet and comprises large reading rooms, textbooks section, reference section, periodical section, theses section and administrative sections. Resources of central library comprise of excellent collection of books, reports, journals, theses, and electronic resources. The holdings of the library consist of more than 1.5 Lakhs of books, 9000+ full text e-journals, 343 e-books, 16 online databases, and 14777 bound volumes. Through INFLIBNET e-ShodhSindhu Consortium, OSHEC Consortium and direct subscription to e-resources, the library provides access to wide variety of e-resources to its users for their teaching, learning and research assignment

4.3.1.3 ICT Infrastructure

The library is equipped with modern ICT facilities to enhance information access and retrieval. It offers internet services through 11 user computers connected to the university network, facilitating access to online journals and databases. Additionally, One PCs are dedicated to accessing the library's online/web catalogue.

Adoption of Emerging Technologies

Sambalpur University Library has embraced various emerging technologies to improve user experience:

E-Resources Access: The library provides access to a wide array of e-resources, including e-databases, e-journals, e-books, and e-theses. Notable databases include ProQuest, JSTOR, ScienceDirect, and SpringerLink.

Digital Library Services: Users can access digital resources remotely, facilitating research and learning beyond the physical confines of the library.

Library Management System: An integrated library management system is in place to streamline cataloging, circulation, and user services.

4.3.2 Profile of Utkal University Library

4.3.2.1 Brief History of the University

Established in 1943, Utkal University is the oldest university in Odisha and the 17th oldest in India. Located in Bhubaneswar, the capital city of Odisha, the university has been a pioneer in higher education, offering postgraduate and research programs across various disciplines.

4.3.2.2 Overview of the Library

The central library of Utkal University, known as the Parija Library, was established in 1946 in Cuttack and later shifted to the Bhubaneswar campus in 1962. Named after the first Vice-Chancellor, Professor Pranakrushna Parija, the library is housed in an impressive building spread over 28,000 square feet. It comprises large reading rooms, periodicals, references, manuscripts, documentation, textbook, and administrative sections. The library's holdings include over 2,00,000 books and 5,800 rare manuscripts.

4.3.2.3 ICT Infrastructure

Utkal University has placed significant emphasis on developing state-of-the-art ICT infrastructure. The campus is Wi-Fi enabled with 1 GBPS internet connectivity provided by BSNL. The Computer Centre, established in 1971, has been renovated with modern facilities, including servers, desktops, laptops, networking equipment, and peripherals. Two supercomputers (PARAM Savak) are also installed in the centre. Additionally, a language laboratory with 32 desktop computers and interactive tools has been established.

4.3.2.4 Adoption of Emerging Technologies

The Parija Library has embraced various emerging technologies to enhance user experience:

Automation: The library is fully automated using RFID systems and e-Granthalaya library management technology, facilitating efficient tracking and management of resources.

Digital Library: A state-of-the-art digital library annex has been established, featuring a 76-seat hall equipped with computer systems. Notably, 10% of the facilities are reserved for visually-challenged students.

E-Resources Access: Through the INFLIBNET e-ShodhSindhu Consortium and OSHEC Consortium, the library provides access to a vast array of e-resources, including over 119,000 e-books, more than 3 million e-theses, and 50,000 e-videos.

4.3.3 Profile of Berhampur University Library

4.3.3.1 Brief History of the University

Established in 1967, Berhampur University is located in Bhanja Bihar, Berhampur, Odisha. As a prominent institution in southern Odisha, it offers postgraduate and doctoral programs across various disciplines, including science, humanities, and social sciences.

4.3.3.2 Overview of the Library

The Central Library named as R.P. Padhi Library, was established in the year 1968 to meet the growing needs of the students, teachers, and research scholars. R.P. Padhi Library plays a vital role for disseminating different types of information resources and services to support the academic and research need of the user community. Library is functioning in two four storied building having four main sections. Currently, R.P. Padhi Library is having over 1,51,753 volumes of books and other resources like popul-ar Magazines, Print Journals, Theses and Reports in Science & Technology, Management, Humanities and Social Sciences. Besides these users of R.P. Padhi Library is accessing e-books, e-journals and other electronic reading materials through JSTOR, DELNET, EBSCO and Science Direct Database.

4.3.3.3 ICT Infrastructure

The library is equipped with modern ICT facilities to enhance information access and retrieval. Users have access to e-books, e-journals, and other electronic reading materials through databases such as EBSCO and Science Direct. Additionally, the library provides access to

JSTOR, a digital library of academic journals, books, and primary sources. Berhampur University is also a member of the Developing Library Network (DELNET), New Delhi, which offers networked library services and technical guidance to member libraries.

4.3.3.4 Adoption of Emerging Technologies

Berhampur University Library has embraced various emerging technologies to improve user experience:

E-Resources Access: The library provides access to a wide array of e-resources, including e-books, e-journals, and other electronic reading materials through databases such as EBSCO and Science Direct.

Digital Library Services: Users can access digital resources remotely, facilitating research and learning beyond the physical confines of the library.

Library Management System: An integrated library management system is in place to streamline cataloging, circulation, and user services.

4.3.3 Profile of Gangadhar Meher University Library

4.3.3.1 Brief History of the University

Established in 1944 as Sambalpur College, Gangadhar Meher University (GMU) was named after the renowned Odia poet Gangadhar Meher. Located in Sambalpur, Odisha, GMU has evolved into a prominent institution offering undergraduate, postgraduate, and doctoral programs across various disciplines, including arts, science, commerce, and management.

4.3.3.1 Overview of the Library

The central library of GMU, known as the Dr. Mayadhar Mansingh Central Library, was established in 1944 and renamed in 2020 to honor the eminent poet and former principal of GM College. The library serves as a pivotal resource center for the university community, catering to the information needs of faculty, research scholars, and students across various disciplines. It houses an extensive collection of over 116,671 books, subscriptions to 63 journals, and 15

magazines. The library also maintains a digital repository, including approximately 1,800 CDs/DVDs and other electronic learning resources.

4.3.3.5 ICT Infrastructure

The library is equipped with modern ICT facilities to enhance information access and retrieval. It is INFLIBNET-enabled and subscribes to PROQUEST, providing access to a vast array of e-resources, including e-journals, e-books, theses, and videos. A dedicated computer hall within the reading room facilitates access to these digital resources. The library employs the e-Granthalaya software for library management, and all books are bar-coded, allowing for efficient circulation processes. An Online Public Access Catalogue (OPAC) connected to the campus LAN enables users to search for library resources from any corner of the campus.

4.3.3.6 Adoption of Emerging Technologies

The Dr. Mayadhar Mansingh Central Library has embraced various emerging technologies to improve user experience:

E-Resources Access: The library provides access to a wide array of e-resources, including e-journals, e-books, and other electronic reading materials through databases such as PROQUEST.

Digital Library Services: Users can access digital resources remotely, facilitating research and learning beyond the physical confines of the library.

Library Management System: An integrated library management system (e-Granthalaya) is in place to streamline cataloging, circulation, and user services.

Wi-Fi Connectivity: The library interior is enabled with Wi-Fi connectivity, allowing patrons to access both offline and online resources seamlessly.

Meritorious Scheme: Extra library book service for meritorious students.

4.4 Conclusion

This chapter presented detailed profiles of Four selected state university libraries in Odisha—Utkal University, Sambalpur University, Berhampur University, Gangadhar Meher University,

and . Each profile highlighted the historical background of the university, the development and structure of its library, and the adoption of emerging technologies to enhance user satisfaction.

From the analysis, it is evident that while all selected libraries have made efforts to integrate modern technologies like e-resources, digital library management systems, and ICT tools, the degree of implementation and user accessibility varies. Some libraries, like those at Gangadhar Meher University and Ravenshaw University, have initiated specialized services (e.g., Braille library, online repositories), while others are still in the transitional phase of adopting comprehensive digital systems.

These profiles serve as a foundational understanding for the subsequent analysis of the current status and future needs of emerging technologies in enhancing user satisfaction, which will be discussed in the following chapters.

CHAPTER 5

DATA ANALYSIS AND INTERPRETATION

Data Analysis and Interpretation is a crucial component of any research study. It plays a key role in transforming raw data into meaningful insights that can drive conclusions and recommendations. To ensure clarity, ease of understanding, and effective communication of the data, researchers often employ various techniques such as rearrangement, tabulation, graphical representation, and summarization. These methods help in presenting the data in an organized and coherent manner, making it accessible for further analysis.

This chapter presents the analysis and interpretation of the data collected exclusively from students of Odisha State Universities through a structured, close-ended questionnaire administered via Google Forms. The purpose of this data collection was to understand students' perspectives on the current status, usage, and future needs of emerging technologies in their respective university libraries, as well as the impact of these technologies on their satisfaction and academic support.

The questionnaire consisted of multiple choice and check box-based questions designed to capture quantifiable responses. The collected data was systematically compiled and analyzed using basic statistical tools such as frequencies and percentages, and presented with the help of tables and charts for clarity.

The analysis in this chapter is organized according to key themes aligned with the research objectives: awareness of emerging technologies, frequency of use, satisfaction levels, perceived benefits, challenges faced by users, and expectations for future technological improvements in library services. This objective approach provides a data-driven foundation for drawing conclusions and making recommendations in the following chapters.

5.1 Profile of Respondents

This section presents the demographic profile of the student respondents who participated in the survey. Understanding the background of the respondents is essential for contextualizing their

responses and analyzing their perspectives on the use of emerging technologies in university libraries.

5.1.1 University Affiliation

The students were from different Odisha state universities. The distribution is as follows:

Table 5.1University Affiliation

University Name	Number of Respondent	Percentage (%)
Utkal University	16	21.92%
Sambalpur University	26	35.62%
Berhampur University	14	19.18%
Gangadhar Meher University	16	21.92%

5.1.2 Gender

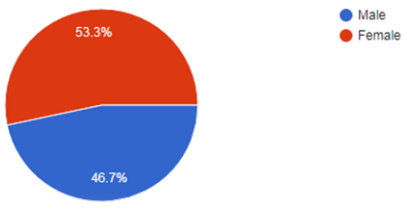

Fig:5.1 Gender

Gender Distribution of Respondents

The study included a total of 72 respondents who participated in the survey. Among these respondents, 38(53.3%) were male, and 34 (46.7%) were female. This demographic distribution indicates a fairly balanced representation of genders within the sample population, which contributes to the diversity of perspectives regarding the library services and emerging technologies explored in this research.

5.1.3 Department wise Respondents

Table 5.2 Department wise Respondents

Library and Information Science (LIS)	34	45.30%	1
Others (single or less frequent)	21	28.00%	2
Economics	3	4.00%	3
Sociology	3	4.00%	4
Pulmonary	2	2.70%	5
Odia	2	2.70%	6
Chitta Ranjan d...	2	2.70%	7
Botany	2	2.70%	8
Department of L...	2	2.70%	9
Biotechnology	1	1.30%	10
Total	**75**	**100%**	11

Fig:5.2 Department wise

The data includes respondents from four universities: Gangadhar Meher University (departments include Library and Information Science, MLIS, Commerce, Political Science, Economics, Zoology, Sociology, Earth Sciences, MBA, and Sanskrit), Sambalpur University (Library and Information Science, Chemistry, Physics, Mathematics, Statistics, Biotechnology and Bioinformatics), Utkal University (Library and Information Science, Commerce, English, Odia, Economics, Mathematics), and Berhampur University (Library and Information Science, Sociology, History, Chemistry, odia).

5.1.4 Semester of Study

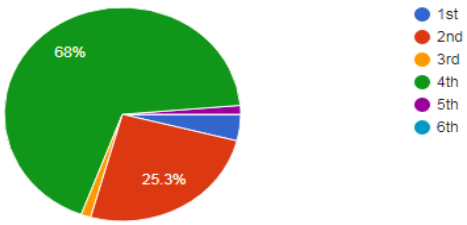

Fig:5.2 Semester wise

The majority of respondents (68%) were from the 4th semester, followed by 25.3% from the 2nd semester. Students from 1st, 3rd, 5th, and 6th semesters made up the remaining portion. This indicates that mid-level students were the most actively engaged in the survey.

5.1.5 Frequency of Library visits Per Week

Table 5.3 Frequency of Library visits Per Week

		Estimated Respondents	Rank
4	37.30%	28	1
5	16%	12	2
3	14.70%	11	3
6	12%	9	4
2	10.70%	8	5
0	6.70%	5	6
1	2.70%	2	7
7	0.00%	0	8
Total	**100%**	**75**	

Average Visits/Week (approximate):3.76 visits/week

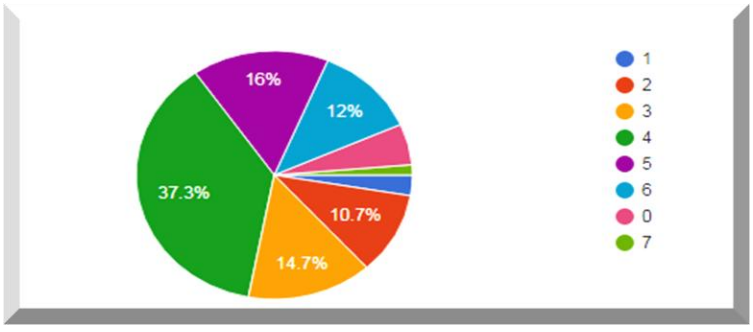

Fig:5.3 Frequency of Library visit

The data shows the percentage distribution of library visits. The majority of students (approximately 37.3%) visit the library 4 times per week, followed by 16% who visit 5 times,

and 14.7% who visit 3 times weekly, 10.7% 2 times weekly. This distribution highlights a moderate to high level of library engagement among students in Odisha State University Libraries.

5.1.6 Purpose for using the library

Table 5.4 Purpose for using the library

Purpose	Respondents	Percentage	Rank
Study	61	81.30%	1
Reading Book	47	62.70%	2
To use Internet	24	32.00%	3
To access newspaper/magazines	22	29.30%	4
Research work	21	28.00%	5
Borrowing books	21	28.00%	5
Using digital resources	21	28.00%	5
Assignment	16	21.30%	8
Photocopying services	14	18.70%	9

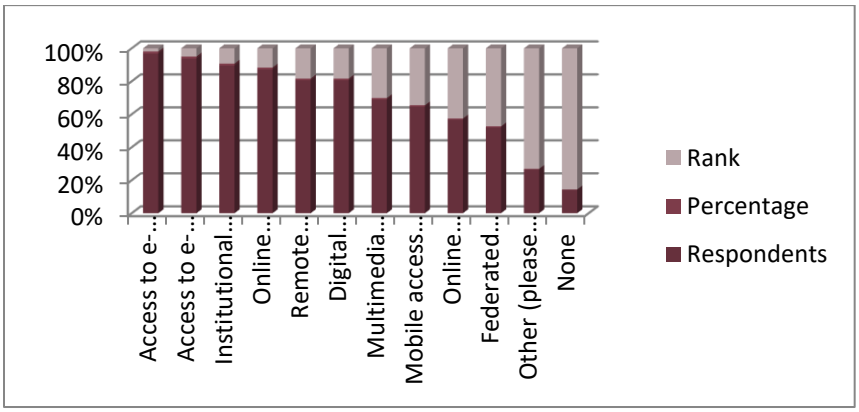

Fig 5.4 Purpose for using the library

The analysis of students' primary purposes for using the library reveals that the majority visit the library mainly for study purposes (81.3%), followed by reading books (62.7%). This suggests that the library is still strongly perceived as a traditional academic space. However, a considerable number of students also use the library for internet access (32%), accessing newspapers or magazines (29.3%), research work (28%), borrowing books (28%), and using

digital resources (28%), reflecting a shift toward more diverse and technology-driven needs. A smaller segment utilizes the library for assignments (21.3%) and photocopying services (18.7%).

5.1.7 digital library services

Table 5.5 digital library services

Purpose	Respondents	Percentage	Rank
Access to e-books	51	68.00%	1
Access to e-journals	38	50.70%	2
Institutional repository	29	38.70%	3
Online databases (e.g., JSTOR)	30	40.00%	4
Remote access to digital resources	22	29.30%	5
Digital newspaper and magazines	22	29.30%	5
Multimedia resources (audio/video)	16	21.30%	7
Mobile access to digital library	15	20.00%	8
Online question paper repository	12	16.00%	9
Federated search tools	11	14.70%	10
Other (please specify)	4	5.30%	11
None	2	2.70%	12

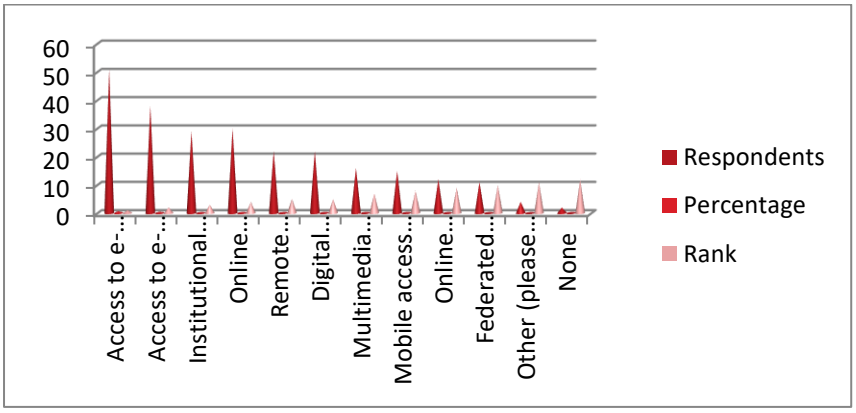

Fig 5.5 **digital library services**

The survey results reveal that the most commonly provided digital library service is access to e-books, reported by 68% of respondents, followed by access to e-journals, which is available in 50.7% of the libraries surveyed. Online databases such as JSTOR are offered by 40% of the libraries, while institutional repositories are accessible in 38.7% of cases. Services like remote access to digital resources and access to digital newspapers and magazines are each provided by 29.3% of the libraries. Multimedia resources, including audio and video materials, are available in 21.3% of the institutions, and 20% offer mobile access to the digital library. Less commonly

provided services include online question paper repositories (16%) and federated search tools (14.7%). A small number of respondents (5.3%) while only 2.7% indicated that their library does not offer any of the digital library services.

5.1.8 IoT-based services

Table 5.6 IoT-based services

IoT-Based Service	Respondents	Percentage	Rank
Smart library cards for automated check-ins	32	44.40%	1
Digital kiosks for searching books	24	33.30%	2
Smart shelves for book tracking	23	31.90%	3
None of the above	22	30.60%	4
IoT-enabled study room booking system	13	18.10%	5
Environmental sensors (e.g., smart lighting, temperature control)	10	13.90%	6

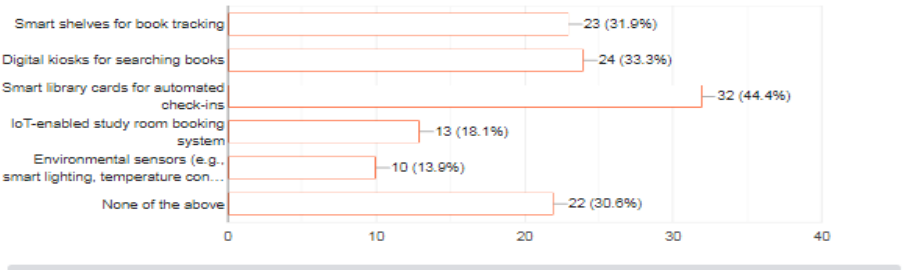

Fig:5.6 Iot based services

According to the data, the most commonly implemented IoT service is smart library cards for automated check-ins, used by 32 respondents (44.4%). This is followed by digital kiosks for searching books, available in libraries (33.3%), and smart shelves for book tracking, adopted by libraries (31.9%).Other IoT-based services include IoT-enabled study room booking systems, which are available in libraries (18.1%), and environmental sensors—such as smart lighting and temperature control—used by 10 respondents (13.9%). Notably, 22 respondents (30.6%) indicated that none of these IoT services are currently provided by their library.

5.1.9 RFID-based services

Table 5.7 RFID-based services

RFID-Based Service	Respondents	Percentage	Rank
RFID-based self-check-in and check-out	42	56.00%	1
RFID-enabled identity cards for user authentication	38	50.70%	2
RFID-based anti-theft security system	30	40.00%	3
Automated book return dropbox	24	32.00%	4
Real-time book location and tracking	18	24.00%	5
None of the above	18	24.00%	5
RFID-enabled smart shelves for inventory	12	16.00%	7
RFID-based access control to restricted areas	8	10.70%	8

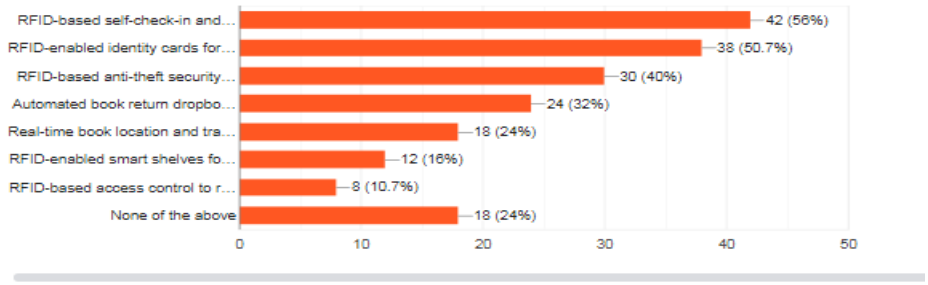

Fig:5.7Rfid based services

It displays which libraries have implemented Radio Frequency Identification (RFID) technologies. The most widely used service is RFID-based self-check-in and check-out systems, reported by 42 respondents (56%), followed by RFID-enabled identity cards for users, available in 38 libraries (50.7%). Additionally, RFID-based anti-theft security systems are in use by 30 respondents (40%), and automated book return dropboxes are offered by libraries (32%).

Other less commonly adopted services include real-time book location and tracking and RFID-enabled smart shelves for inventory, each used by 18 (24%) and 12 (16%) of the respondents respectively. The least implemented service is RFID-based access control to restricted areas,

reported by only 8 respondents (10.7%). Notably, 18 respondents (24%) indicated that none of these RFID-based services are provided in their library.

5.1.10 Library Automation System and there services

Table 5.8 Library Automation System and there services

Automation Service	Respondents	Percentage	Rank
OPAC (Online Book Search)	56	74.70%	1
Barcode/RFID Integration	32	42.70%	2
Automated Book Issue/Return	30	40.00%	3
Cataloging of Books	28	37.30%	4
User Login & Account Access	22	29.30%	5
Access to E-Resources via System	17	22.70%	6
Online Book Renewal/Reservation	16	21.30%	7
Usage Reports & Statistics	10	13.30%	8
Fine Notification System	9	12.00%	9
None of the Above	11	14.70%	10

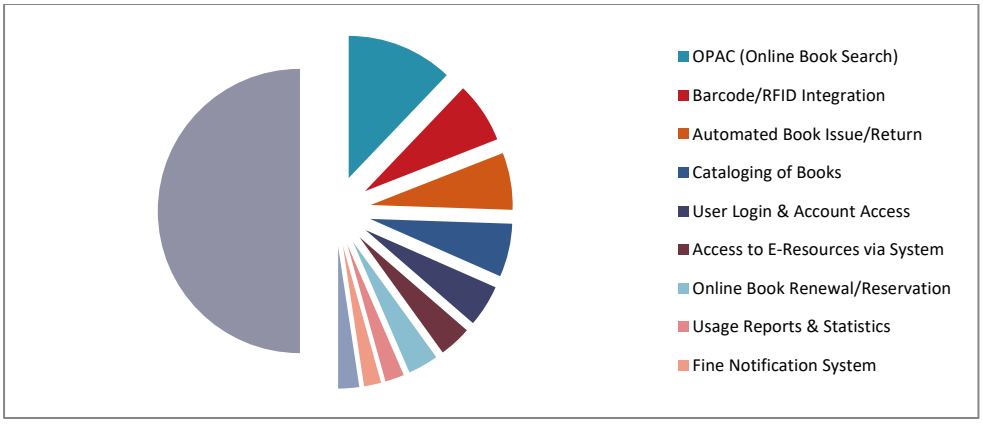

Fig:5.9 Library Automation System and there services

This data presents the functionalities available in library automation systems across various institutions. The most widely implemented feature is OPAC (Online Public Access Catalog or Online Book Search), provided by 58 respondents (74.7%), highlighting its foundational role in modern library systems. This is followed by Barcode/RFID integration, used in libraries (42.7%), and automated book issue/return systems, implemented by 30 respondents (40%).

Other notable features include cataloging of books (28 respondents or 37.3%), user login and account access (22 respondents or 29.3%), and online book renewal/reservation services (18 respondents or 21.3%). Access to e-resources via system login is offered by libraries (22.7%), while usage reports and statistics and fine notification systems are among the least provided, reported by only 10 (13.3%) and 9 (12%) respondents respectively. Interestingly, 11 respondents (14.7%) mentioned that none of the listed features are available in their library's automation system.

5.1.11 AI-based services

Table 5.9 AI-based services

AI-Based Service	Respondents	Percentage	Rank
None of the above	32	43.20%	1
Auto-suggestions in OPAC	30	40.50%	2
AI tools for research assistance	19	25.70%	3
Book recommendation system	18	24.30%	4
Personalized search results	17	23.00%	5
AI Chatbot for user support	15	20.30%	6
Smart alerts and notifications	13	17.60%	7

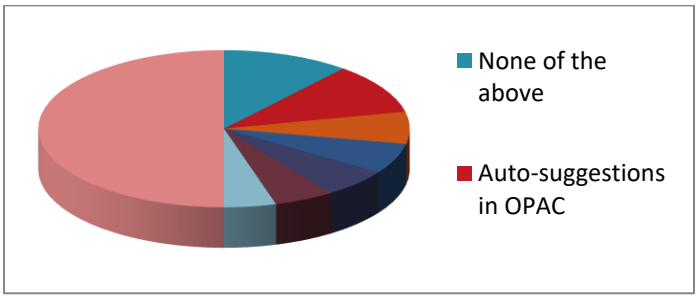

Fig:5.10 AI based services

This data Highlights the current implementation of artificial intelligence in library services. Among the various AI features, auto-suggestions in OPAC (Online Public Access Catalog) is the most commonly offered, reported by 30 respondents (40.5%). This is followed by AI tools for

research assistance (19 respondents or 25.7%), book recommendation systems (18 respondents or 24.3%), and personalized search results (17 respondents or 23%).

Less frequently implemented services include AI chatbots for user support, used in libraries (20.3%), and smart alerts and notifications, adopted by libraries (17.6%). Notably, 32 respondents (43.2%) stated that none of the listed AI-based services are currently available in their library.

5.1.12 Library bookmark app

Table 5.11 Library bookmark app

Services	Respondents	Percentage	Rank
Easy saving and organizing of resources	35	51.50%	1
Offline access to saved materials	27	39.70%	2
Synchronization across devices	19	27.90%	3.5
Sharing bookmarks with others	19	27.90%	3.5
Tagging and categorizing options	16	23.50%	5
None	11	16.20%	6

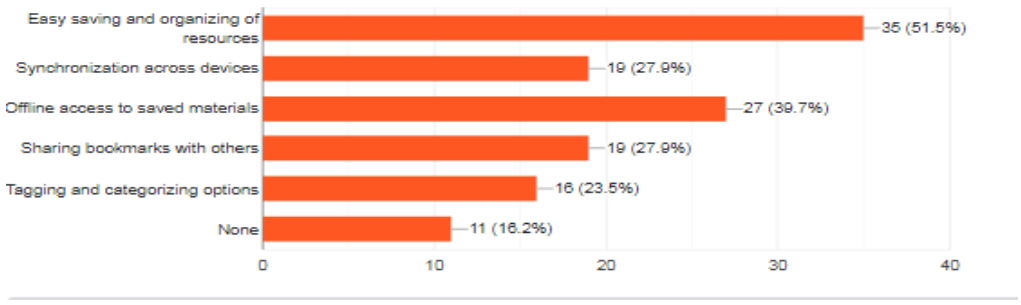

Fig:5.11Library bookmark app

This data reveals that most appreciated feature is easy saving and organizing of resources, selected by 35 respondents (51.5%), indicating the importance of streamlined access and personal archiving in library apps. Offline access to saved materials follows closely, with 27

respondents (39.7%), highlighting a strong need for availability without internet dependency.Synchronization across devices and sharing bookmarks with others were each chosen by 19 respondents (27.9%), showing that users value cross-platform continuity and collaborative features. Meanwhile, tagging and categorizing options were found useful by 16 respondents (23.5%), reflecting a moderate interest in organizing content by themes or topics. Interestingly, 11 respondents (16.2%) indicated that none of the

5.1.13 Augmented Reality (AR) services

Table 5.12 Augmented Reality (AR) services

None of the above	30	41.10%	1
Interactive library tours	22	30.10%	2.5
Virtual book previews (e.g., summaries)	22	30.10%	2.5
AR-based book search and location	18	24.70%	4
Real-time assistance using AR	15	20.50%	5
AR-enhanced educational materials	14	19.20%	6
AR for locating library sections/resources	12	16.40%	7

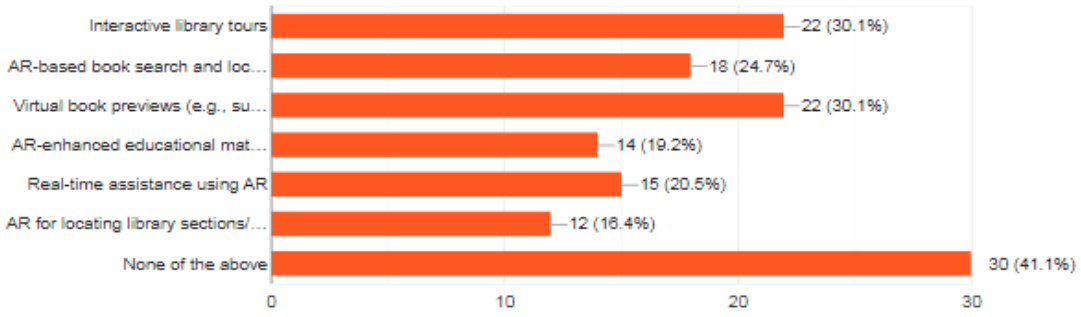

Fig:5.12 Augmented Reality Services

The data reveals that the most selected option was "None of the above," chosen by 30 respondents (41.1%), indicating that a significant number of libraries currently do not offer AR services. Among those that do, "Interactive library tours" and "Virtual book previews (e.g., summaries, trailers)" were the most common, each selected by 22 respondents (30.1%). "AR-based book search and location services" was provided by libraries (24.7%), while "Real-time

assistance using AR" was noted by 15 respondents (20.5%). "AR-enhanced educational materials" were available in libraries (19.2%), and the least common service was "AR for locating library sections/resources," with 12 responses (16.4%). Overall, while some libraries have embraced AR technology in various forms, a large portion has yet to implement these services.

5.1.14 Blockchain technology services

Table 5.13 Blockchain technology services

Services	Respondents	Percentage	Rank
None of the above	30	41.70%	1
Library record keeping	24	33.30%	2
Library card management	22	30.60%	3
Copyright and digital rights management	19	26.40%	4
User authentication and access control	18	25%	5
Inter-library loan and voucher settlement	15	20.80%	6
Transaction history of borrowed and returned items	13	18.10%	7

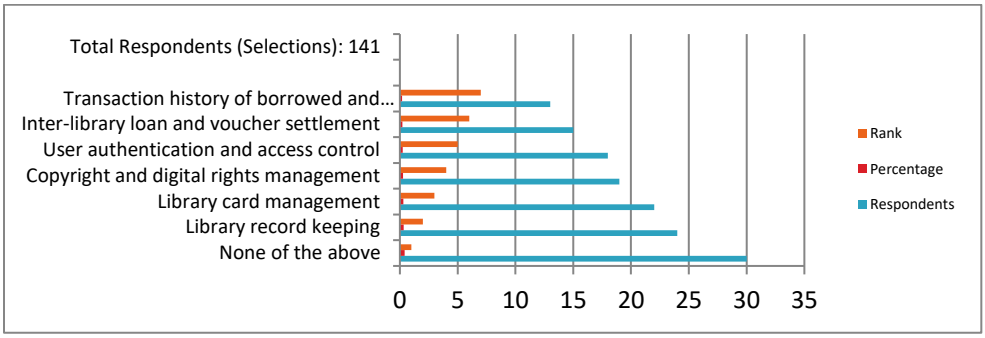

Fig:5.13 Blockchain technology services

According to this data The most commonly reported use was for library record keeping (33.3%), followed bylibrary card management (30.6%) andcopyright and digital rights management(28.4%). However, a significant proportion of respondents—41.7%—selected *"None of the above,"* indicating that many libraries have not yet implemented Blockchain

technology in any service area. Other less frequently adopted uses include user authentication and access control (25%), inter-library loan and voucher systems (20.8%), and transaction history of borrowed items(18.1%).

5.1.15 Big Data and Data Visualization services

Table 5.14 Big Data and Data Visualization services

Services	Respondents	Percentage	Rank
None of the above	30	41.70%	1
Library record keeping	24	33.30%	2
Library card management	22	30.60%	3
Copyright and digital rights management	19	26.40%	4
User authentication and access control	18	25%	5
Inter-library loan and voucher settlement	15	20.80%	6
Transaction history of borrowed and returned items	13	18.10%	7

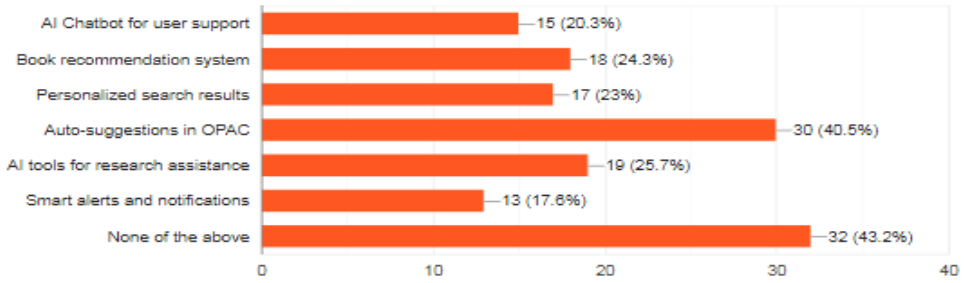

Fig:5.14 Big data and Visualization

The most commonly implemented feature is Auto-suggestions in OPAC (Online Public AccessCatalog), reported by 40.5% of respondents. This is followed by AI tools for research assistance (25.7%), book recommendation systems **(**24.3%), and personalized search results (23%). Features such as AI Chatbots for user support (20.3%) and smart alerts and notifications (17.6%) have seen lower adoption. Notably, 43.2% of participants indicated that none of these services are currently offered by their libraries. This suggests that while there is a beginning

interest in leveraging Big Data and AI tools for enhancing user satisfaction, a majority of institutions are yet to implement them.

5.1.16 Library's social media pages

Table 5.15 Library's social media pages

Services	Respondents	Percentage	Rank
New book arrivals and recommendations	28	39.40%	1
Event announcements and workshops	26	36.60%	2
Research tips and resources	26	36.60%	2
User engagement posts (e.g., polls, Q&A sessions)	20	28.20%	4
Success stories and user testimonials	15	21.10%	5
None of the above	24	33.80%	

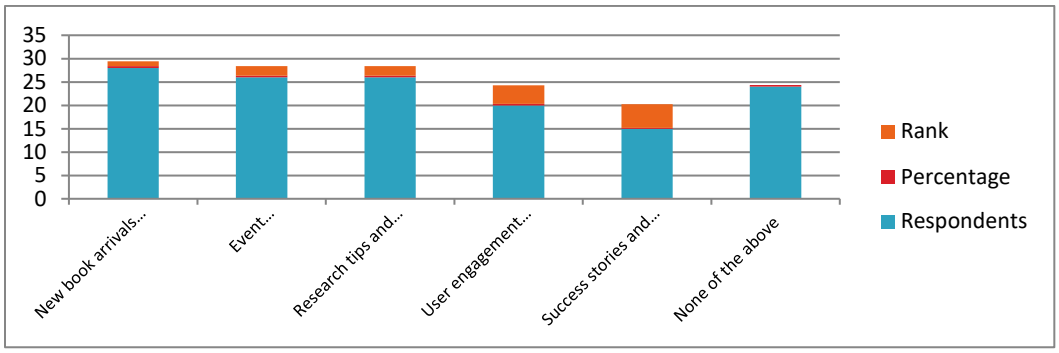

Fig:5.15 Library Social media pages

This data reveals that university libraries in Odisha are increasingly using social media to disseminate informative content. The three most commonly shared content types are new book arrivals and recommendations **(**39.4%), event announcements and workshops (36.8%), and research tips and resources (36.8%). These categories indicate a strong focus on academic engagement and resource promotion. User engagement posts such as polls and Q&A sessions (28.2%) and success stories or user testimonials (21.1%) are less frequently posted, suggesting that while informational updates are prioritized, interactive and community-driven content is still underutilized. Interestingly, 33.8% of respondents reported that *none of the above*

5.1.17 Barriers Facing while using Emerging technologies in library

Table 5.16 Barriers Facing while using Emerging technologies in library

Barriers	Respondents	Percentage	Rank
Lack of awareness or knowledge	34	47.20%	1
Insufficient training or guidance	34	47.20%	1
Lack of necessary infrastructure	34	47.20%	1
Limited internet connectivity or access	31	43.10%	4
High cost of implementation or maintenance	23	31.90%	5
Unavailability of technical support	15	20.80%	6
Privacy and data security concerns	18	25.00%	7
Low confidence or fear of using technology	13	18.10%	8
Technologies not user-friendly	13	18.10%	8
Lack of interest or perceived usefulness	9	12.50%	10
Language or accessibility issues	6	8.30%	11

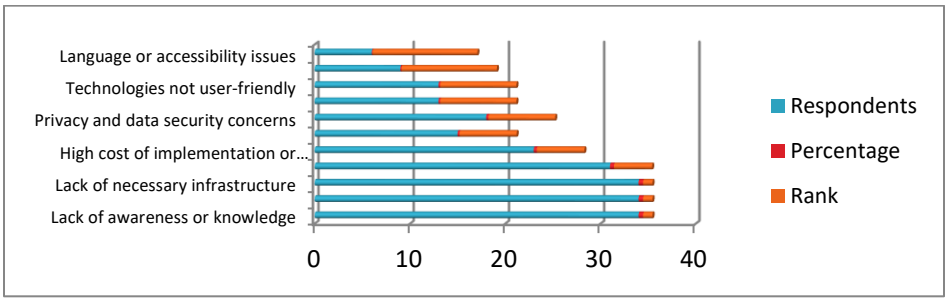

Fig:5.16

The most frequently cited barriers—each reported by**47.2%** of respondents—are lack of awareness or knowledge**,** insufficient training or guidance, and lack of necessary infrastructure**.** Additionally**,** limited internet connectivity or speed was reported by 43.1%**,** underscoring a significant digital divide. Other notable challenges include the high cost of implementation (31.9%) and privacy and data security concerns (25%). Less commonly mentioned, but still relevant, are issues like unavailability of technical support (20.8%), low user confidence**,** unfriendly technologies**,** lack of interest (ranging between 12.5%–18.1%), and language/accessibility issues (8.3%). This data indicates that beyond technological access,

5.1.18 challenges

Table 5.16 challenges

Challenges	Respondents	Percentage	Rank
Lack of technical support from library staff	30	41.70%	1
Limited features	29	40.30%	2
Technical issues	28	38.90%	3
Lack of updated systems or software	28	38.90%	3
Poor internet connectivity	24	33.30%	5
Complex user interface	21	29.20%	6
Errors or technical glitches	17	23.60%	7
Slow system response	12	16.70%	8
None of the above	5	6.90%	-

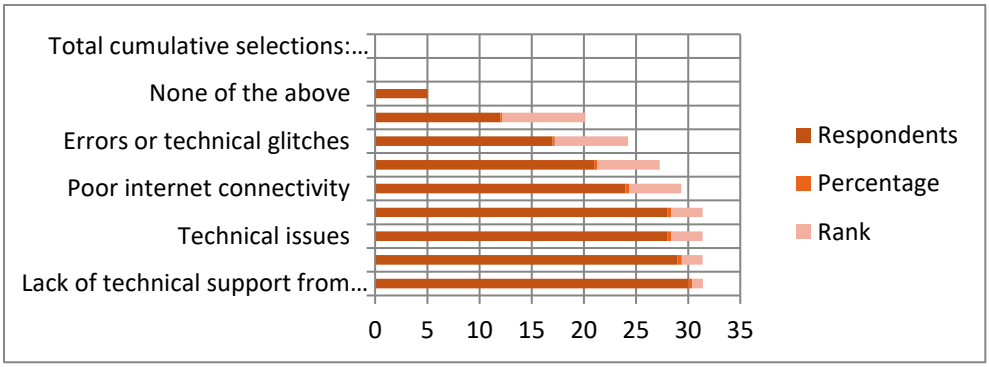

Fig:5.17 Challenges while using the services

The most frequently cited problems include limited features (40.3%) and lack of technical support from IT staff (41.7%), both of which significantly hinder the effective utilization of emerging technologies. Additionally, technicalissues and lack of updated systems or software were both reported by 38.9% of respondents, indicating outdated infrastructure as a major concern. Poor internet connectivity (33.3%) and complex user interfaces (29.2%) further contribute to usability challenges. Other difficulties such as errors or technical glitches (23.6%), slow system response (16.7%), and a small percentage indicating none of the above (8.6%) highlight the varied but consistent nature of obstacles.

5.1.19 Recommendation for Future Emerging Technologies

Table 5.16 Recommendation for Future Emerging Technologies

Emerging Technology	**Respondents**	**Percentage**	**Rank**
Artificial Intelligence (AI) for smart services	54	75.00%	1
Internet of Things (IoT) for smart library operations	41	56.90%	2
Library Automation System (e.g., Koha)	37	51.40%	3
Mobile Technology – for anytime, anywhere access	36	50.00%	4
RFID for fast self-check-in/checkout	29	40.30%	5
Blockchain technology for secure transactions	27	37.50%	6
Augmented Reality (AR) / Virtual Reality (VR)	23	31.90%	7
Data visualization tools for research & analysis	18	25.00%	8
Big Data tools for personalized services	17	23.60%	9
None of the above	2	2.80%	-

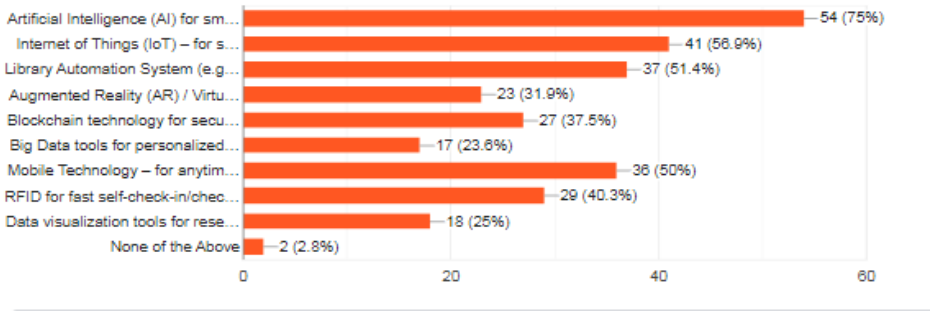

Fig:5.18 Recommendation for Future Emerging Technologies

The most highly preferred option is Artificial Intelligence (AI) for smart user services, selected by 75% of respondents. This is followed closely by Internet of Things (IoT) tools (58.6%), Library Automation Systems (51.4%), and Mobile Technology for anytime, anywhere access (50%). These choices reflect a growing demand for more intelligent, responsive, and mobile library environments.Other technologies also received notable interest, such as RFID systems for self-check-in/out (40.3%), Blockchain for secure transactions (37.5%), and Augmented/Virtual Reality for interactive experiences (31.9%). Less frequently chosen but still significant are Big Data tools (23.6%) and Data Visualization tools (25%) for enhancing research capabilities. Only 2.8% of respondents indicated *"None of the above,"*

5.1.20 Improvements through the use of emerging technologies

Table 5.16 Improvements through the use of emerging technologies

Faster and smarter information retrieval	43	60.60%	1
Easy access to digital resources	34	47.90%	2
Personalized recommendations and services	31	43.70%	3
Real-time tracking and management of library assets	35	40.30%	4
Interactive learning experiences	29	40.80%	4
Remote access to library services	25	35.20%	6
Enhanced security and data integrity	24	33.80%	7
Efficient self-service options (e.g., kiosks)	24	33.80%	7
Visual dashboards and analytics	19	26.80%	9
Seamless integration of print and digital systems	18	25.40%	10
More workshops/training on using these technologies	13	18.30%	11

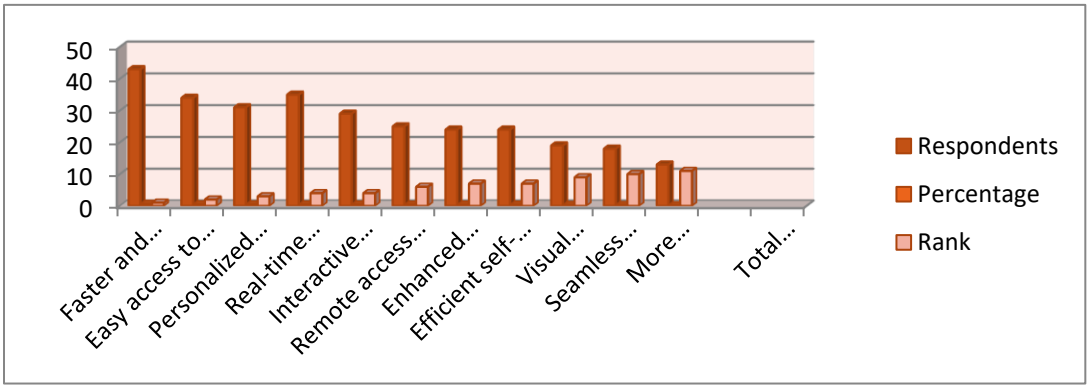

Fig:5.19 .Improvement through technologies

The data reveals strong user expectations for enhanced library services driven by technology. The top priority identified by 80.6% of respondents is faster and smarter information retrieval, reflecting a growing demand for efficient access to information. Other highly desired improvements include easy access to digital resources (47.9%), real-time tracking and management of library materials (49.3%), and interactive learning experiences (40.8%).Respondents also expressed interest in personalized recommendations (43.7%), remote access to library services (35.2%), and enhanced data security (33.8%), indicating that users expect not only convenience but also secure and intelligent library environments. Features like

visual dashboards and analytics tools (26.8%), integration of print and digital platforms (25.4%), and self-service options (33.8%) show a preference for user autonomy and a data-driven approach. Lastly, more workshops or training sessions were suggested by 18.3% of respondents, highlighting the importance of capacity building alongside technological upgrades.

5.1.21 Overall, satisficationwith the services

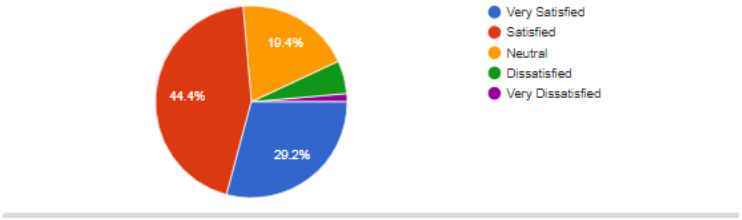

Fig:5.20 Satisfication of Services

Data show the largest segment, 44.4%, reported being satisfied, followed by 29.2% who are very satisfied, indicating that nearly three-quarters of respondents hold favorable views regarding the library's current offerings.

However, a notable portion of users expressed neutral (19.4%), dissatisfied (small green slice), and very dissatisfied (tiny purple slice) opinions, suggesting that while the services are well-received by most, there is still room for improvement.

CHAPTER 6

Findings, Conclusions and Suggestion

6.1 Introduction

This chapter presents the summary of findings, conclusions, and recommendations derived from the analysis of data and alignment with the objectives. The study aimed to assess the current status, challenges, user satisfaction, and future needs concerning the adoption of emerging technologies in state university libraries of Odisha. Based on data collected from selected university libraries and users, this chapter synthesizes the outcomes in relation to each objective and proposes actionable strategies to enhance technological integration and improve user satisfaction. The goal is to provide practical insights for policymakers, librarians, and university administrators to improve service quality, optimize user experience, and ensure that Odisha's university libraries remain relevant and responsive to changing technological trends.

6.2 Major Findings

Objective 1: To identify the current status and types of emerging technologies adopted in university libraries of Odisha.

Findings

- **The study identify that a significant portion of university libraries in Odisha have embraced emerging technologies .56%** use **RFID technology** for book tracking and issue/return services.
- Students reported that common technologies and digital library services areused ,which include e-resources (e-journals 50.70%, e-book 68%) .74.70% have introduced Online Public Access Catalog (OPAC) which accessible remotely
- Only **26%** have introduced AI-based services**,** such as aichatbots or recommendation systems.
- only 40% said mobile-based services were in use,.44.40% Iot based services used and 30.10% augmented reality services used
- Students also reported that the integration of advanced technologies like, Internet of Things (IoT), Augmented Reality (AR), and Blockchain is absent or at a very preliminary stage.
- University libraries still rely heavily on traditional library services due to limited digital infrastructure.

Objective 2: To identify user expectations and future needs regarding emerging technologies."

- About 75% of students emphasized the need for AI-based library access. 56% Iotservices , while 50% expressed interest in mobile technology.
- Around 40.30%respondents intrest to integration of RFID forselfcheckin check outvStudents highlighted a clear demand for upgraded digital infrastructure and user-centered tech services.
- Only 25% showed there interest to implement data visualization tools for research & analysis and 60% user Expect faster and smarter information retrieval with the various emerging technologies or 18.30 % respondents are recommend that more workshop /training on using these technologies

Objective3 :To analyze the barriers and challenges they face while using the available technologies."

Findings:

- Odisha state university libraries highlights several key barriers to effectively using the currently available technologies.
- A significant portion of users (47.20%) indicated that a **lack of awarnesss or knowledge** limits their ability to utilize digital tools and library technologies efficiently.
- Additionally, 47.20% insufficient training or guidance within librarymaking access to online resources inconsistent and frustrating
- And 43% respondents are facing limited internet connectivity or access
- Mainly 18.10% students expressed technologies are not user-friendly
- The main challenges is limited features or complex user interface revealed by 40 to 45% students

Objective 4: To assess the level of user satisfaction with the existing technological services provided by the libraries

Findings:

- The data show 44.4% user are satisfied with there existing technologies and 29.2% are very satisfied or19 % users are Neutral
- overall user satisfaction with current technological services is moderate.
- Satisfaction levels are lower among users who are more tech-savvy and familiar with emerging technologies in other domains.
- Small number of user are dissatisfied

Objective 5 : To recommend future technological needs and strategies for enhancing user satisfaction in Odisha state university libraries

Findings:

- Around 75% Usersrecommend Artificial intelligence for smart services
- More than 55% students are recommend to use of internet of things for smart library operations like smart library card for automated check ins
- Also 40% respondents are suggest that Rfid for fast self check in /check out and 37% users are suggest library should aquire block chain technology forn secure transactions
- Small portion of users recommend to adopt datavisualization tools and bigdata for personalized services

6.2 Suggestion:

1. Upgrade Technological Infrastructure

University libraries should invest in modern IT infrastructure including high-speed internet, cloud-based services, and smart library management systems.

Implementation of integrated library systems (ILS) such as Koha with cloud hosting can significantly improve service delivery and access.

2. Adopt Emerging Technologies

Libraries must progressively adopt emerging technologies like:

Artificial Intelligence (AI): For personalized recommendations and virtual reference services.

Mobile Applications: To provide access to library resources on the go.

Chatbots: For 24/7 user support.

IoT and RFID: For smart tracking of library assets and enhanced inventory control.

AR/VR: For interactive learning spaces.

3. Enhance Digital Literacy and Staff Training

Conduct regular workshops and training programs for library staff to familiarize them with emerging tools and software.

Incorporate continuous professional development as part of library management strategy to ensure technology readiness.

4. Promote User Awareness and Engagement

Libraries should actively promote their digital services and technologies through:

Orientation programs

Newsletters and posters

Social media and institutional websites

Encourage user feedback and involve users in technology evaluation processes.

5. Bridge the Expectation-Reality Gap

Conduct regular surveys and feedback collection to understand evolving user expectations.

Tailor services based on user needs, especially for tech-savvy students and researchers.

Implement user-centric designs in websites and mobile platforms to improve usability and experience.

6. Address Financial and Policy Barriers

Universities must prioritize funding for libraries under their digital transformation initiatives.

Seek grants from bodies like UGC, RUSA, and AICTE for implementing innovative library services.

Develop clear policies for technology adoption and digital resource management.

7. Create Strategic Plans for Technology Integration

Each library should develop a Technology Development Roadmap outlining short-term and long-term goals.

Include timelines, funding strategies, user needs analysis, and impact measurement indicators.

8. Foster Collaboration and Resource Sharing

Encourage inter-university collaboration for sharing e-resources, expertise, and best practices.

Join consortia (e.g., INFLIBNET, DELNET) to access shared digital content and reduce costs.

6.3 Conclusion

This study comprehensively examined the integration of emerging technologies in Odisha's state university libraries, emphasizing their impact on user satisfaction and service enhancement. Through an extensive literature review, institutional profiling, and user-based data analysis, it became clear that although these libraries have initiated steps toward modernization, the implementation and utilization of emerging technologies remain inconsistent and often limited in scope.

Key findings reveal that while tools such as RFID, Library Automation Systems, and access to digital resources are gradually being adopted, advanced technologies like Artificial Intelligence, Blockchain, IoT, and Big Data analytics are still in nascent stages or absent in most institutions. Users primarily depend on traditional services, with many expressing interest in more personalized, efficient, and tech-driven solutions. Barriers such as lack of awareness, insufficient training, outdated infrastructure, and poor internet connectivity significantly hinder full-scale technology adoption.

The research concludes that enhancing user satisfaction in university libraries requires not only the integration of cutting-edge technologies but also a robust strategy focused on training, infrastructure development, and user-centric design. Moving forward, it is essential that libraries prioritize scalable and inclusive digital initiatives to meet the evolving expectations of modern academic users. Institutional leadership and policy support are crucial to bridge the gap between existing capabilities and future needs, ensuring that university libraries in Odisha evolve into dynamic, technology-empowered learning hubs.

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