Smart Library Infrastructure: Challenges and Issues

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Abstract

This paper mainly emphasizes the Smart Library (SL)concept, SL architecture, SL design development, management, services, smart security assistance, usefulness, and related concepts discussed at length. This article discusses the challenges and issues in the Smart Library system information processing, retrieval, and service-related questions. As this paper was a concept paper, the thoughts presented here were entirely on the personal perspective of the authors, which were drawn based on available published literature on the study. Smart library infrastructure offers many benefits and opportunities for libraries, it also presents several issues and challenges, as discussed in this study.
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Keywords
Smart Library; Smart Library Infrastructure; Internet of Things in Library; Big Data; Data Mining.

Electronic access
The journal is available at www.jalis.in
DOI: 10.5281/zenodo.8359510

Journal of Advances in Library and Information Science
ISSN: 2277-2219 Vol. 12. No.3. 2023. pp.174-183

1. INTRODUCTION

Libraries have evolved significantly, from their origins in ancient civilizations to their current form in the modern era. Recent information and communication technology developments, especially the Internet and the web, have significantly changed information generation, distribution, access, and use. Literature has been utilized as a source of printed information for centuries; publishers were essential in creating printed information. Users are using printed information sources, either by buying them or using them through libraries, even though distributors, booksellers, and especially libraries have played a significant role in the diffusion of knowledge for hundreds of years. With the arrival of computers in information processing around four decades ago, the situation began to shift, and there has been a tremendous transformation in the last few years.

The first use of computers in information management opened the door to new ways of accessing and utilizing information, allowing for the creation and availability of e-indexes to collections, e-databases of journal articles, conference papers, and so on. In this new era, people may access electronic databases of locally developed and remotely available information resources in addition to using printed information resources. Over time remote online information search platforms have become an aspect of how we seek and utilize information. These platforms haven't replaced libraries. Rather, improved access, to information by leveraging technology in communication and data processing. Afterwards, libraries transitioned their card catalogues into catalogue databases, eventually evolving into public access catalogues (OPACs) allowing local and remote access. Another notable transformation in information storage, retrieval and sharing came with CD ROMs. Significant databases emerged on this platform making distribution and access much easier. Users can access sources of information such, as bibliographic and non-bibliographic databases from their locations, such, as libraries or offices. Although CD-ROM databases became an obvious competitor of online search services, they did not replace them. As a result, end-users had more choices for access to information — publishers continued to publish printed as well as electronic information resources on CD-ROM and/or in the form of electronic databases for local and remote access. Dictionaries, encyclopedias, and many other information sources appeared in more than one format — print and electronic.

In most cases, people had to buy information sources or go to libraries to use them for free or upon fee payment. This situation continued till the appearance of the

Internet and especially the web. Within ten years or so, the web has tremendously impacted all aspects of our life, especially concerning the generation, distribution, and use of information. Modern libraries are becoming more digitally oriented, providing patrons with more online resources and services. With new technologies such as IoT, AI, and Big Data, intelligent libraries are emerging as a new trend, providing patrons with a more personalized, efficient, and interactive experience.

2. REVIEW OF LITERATURE

The review of literature is an essential component of any research study. During the study, the researcher attempted to review more related literature on the chosen topic.

Jadhav, D., & Shenoy, D. (2020). This article explores the incorporation of technologies, like data mining, artificial intelligence the Internet of Things and voice driven search in libraries. The aim is to transform libraries into libraries. It raises questions, about what defines a library and how we can gauge its level of smartness. To answer these questions, the article reviews literature and identifies five key elements and fifteen sub elements that contribute to a librarys smartness. A based model is then developed based on these elements and sub elements to calculate the index of a library. To demonstrate the usability of this model it is applied to evaluate the level of smartness in an library located in South Asia. Vito Albino, Umberto Berardi & Rosa Maria Dangelico (2015). This paper uses an approach based on a thorough literature review of pertinent studies and official documents of international institutions to explain the meaning of the word "smart" in the context of cities. It also identifies the key features and characteristics of a smart city. Reviewing the various urban smartness metrics demonstrates the need for a common understanding of what smart cities are, what makes them unique, and how they stack up against more conventional cities. In a few smart cities, initiatives and performance metrics are also noted. Aittola, M., Ryhanen, T., & Ojala, T. (2003). This paper describes Smart Library, a location-aware mobile library service demonstrated in the University of Oulu's main library. On a PDA, the service provides map-based access to books and collections. Smart Library is a completely software-based solution that can be installed on top of a WLAN to provide wireless Internet access without additional hardware. Smart Library was preferred over traditional shelf classification for finding books in a user evaluation with over 30 patrons. Following user feedback, the main library integrated Smart Library into their standard customer service.

Kwok, S.K., et al. (2008). This paper describes the RFID system's development and library usage over time. Traditional library operations require significant time and human labor to complete warehouse management tasks like book tracking. It has been discovered that RFID technologies can improve library operations, particularly in the processes for checking in, checking out, and stocking books. Mobile devices have also gained popularity as tools for increasing productivity because they make real-time data and information more accessible in the workplace. This paper describes an accessible mobile Smart Library System (SLS) with RFID functionality for streamlining library operations.

Aslam, Sana & Sonkar, S.K.. (2019). This paper states that the library will provide better services to library users. In India, smart libraries combine hardware and software with various opportunities for smart users. The living space of the library will be an inside lab where the researchers, students, and staff can develop smart technologies and collect data regarding the study's purpose. Modern services can also provide smart library users furniture, building, lighting, cooling, heating, Internet, smart library card, etc. The reason behind making smart libraries is the greater use of new equipment and interactive communication in the library.
Cao, G., Liang, M. and Li, X. (2018) The focus of this article is to conceptualize the concept of smart libraries and propose a holistic approach for developing smart libraries that aligns with current practices and cutting-edge technologies. This study clarifies the smart library concept by aligning it to the three main dimensions of smart libraries (technology, service, and human). It provides strategic principles such as infrastructure integration, service construction, and human learning. It outlines guidelines and directions for public and academic libraries wanting to become smart.
Tran Van Hong and Et.al. (2021) The article discusses how science and technology have evolved, and how improvements in information and communication have created new possibilities for public libraries to change. Libraries have advanced significantly in both operation and development scales with the application of advanced technological achievements. Virtual and intelligent libraries have replaced traditional libraries. Libraries typically link together, share, and use the same collections in order to improve information resources in a "infinite way," create equal opportunities in accessing and utilizing information for every user, save money, and prevent waste. To share intangible information resources with all users worldwide without any issues or barriers, public libraries need innovative models in their thinking, technology, and operating methods. Gupta Sungkur, Y., M. S. Ozeer, A., & D. Nagowah, S. (2021). This paper

describes how an IoT-based smart library system was implemented on a university campus. The system uses analytics and machine learning to identify trends and make predictions. The paper includes a presentation of the system prototype.

Gul, S. and Bano, S. (2019) This paper discusses the cutting-edge and ground-breaking technologies that create smart libraries. The new generation of libraries, known as smart libraries, combines smart technologies, smart users, and smart services. The research confirms that smart libraries get smarter as new smart technologies emerge, improving their operational efficiency and user satisfaction. Smart technology implementation in libraries has closed the gap between the services provided by libraries and the constantly shifting and conflicting needs of people. Borgman (2000b, 40) suggests that the very first research-based definition of digital libraries appeared in 1992, when the term 'electronic libraries' was used to describe what is now known as digital libraries. Incidentally, that definition was given by Borgman herself (Borgman, 1993) and was included in a report by Fox also in 1993. Since then, many definitions of digital libraries (variously called digital libraries, electronic libraries, and virtual libraries) have appeared in the literature. While reviewing these definitions, Borgman (1999) notes that 'In general, while librarians concentrate on digital libraries as institutions or services,but researchers (who typically have backgrounds in computer science and/or engineering) focus on the content gathered on behalf of user communities..' So, two different schools of thought, one emphasizing the 'enabling technologies' and the other the 'service aspects' of digital libraries, may be noted in the literature. The articles appearing in two special issues of the Journal of the American Society for Information Science (2000a; 2000b) provide excellent accounts of digital library research, especially in the USA, but none focus on digital library services per se. In his editorial (2000), Chen emphasizes access to information and suggests the various methods, tools, and techniques that facilitate improved access to information in digital libraries. The Stanford digital library research team characterized a digital library as a cohesive assembly of services built upon a variety of material collections, with some of these collections potentially residing outside the direct purview of the organization offering the service, but still contributing to its function (Reich and Winograd, 1995). Libraries in India have a long history, but there has been a renewed focus on modernizing and digitizing library services in recent years. The government has implemented several initiatives to improve the infrastructure and services of libraries in India, including the National Mission on Libraries (NML) and the National Digital Library of India (NDL).Under NML, the government has been upgrading and modernizing existing libraries and building new ones in areas lacking library facilities. The NDL is an ambitious project to digitize a vast collection of books and other materials from libraries across India and make them available online. This will create a wealth of knowledge and information accessible to people across the country, including those in remote and underprivileged areas. Despite these efforts, libraries in India still face some challenges. For example, many libraries lack the necessary infrastructure and resources to implement digital technologies and staff members may not be trained to use them effectively.
Additionally, the libraries in India face the same issues as smart libraries, such as funding, security, maintenance, and staying current with changing technology. Furthermore, access to the library and its resources is still limited for many people, especially in rural areas, and library facility usage is relatively low compared to other countries. This can be due to a lack of awareness and understanding of libraries' services and resources a lack of access to transportation and other logistical issues. The Indian library system is undergoing modernization and trying to catch up with technological advancements. However, still, there's a long way to go to fully achieve the smart library infrastructure and make it accessible to all citizens.

While the term "digital library" enjoys widespread usage in academic literature, a fresh concept, the "hybrid library," emerged within the realm of digital library research in the United Kingdom. A hybrid library is characterized as a facility in which digital and print information resources coexist, seamlessly integrated into an information service that can be accessed both locally and remotely. Numerous researchers anticipate a continued prevalence of hybrid libraries, envisioning a future where traditional libraries harmoniously merge with evolving digital counterparts. Pinfield et al. (1998) comment that The hybrid library, which uses both electronic and paper-based information sources simultaneously, is situated between the conventional and the digital libraries. According to Rusbridge (1998), a hybrid library combines various technologies from various sources and integrates systems and services in both the print and electronic environments. He continues, " The hybrid name library is intended to reflect the transitional state of the library, which today cannot be fully print nor fully digital."'

3. THE SMART LIBRARY CONCEPT

The concept of a smart library refers to using technology to enhance library functionality and user experience. This includes using digital tools to improve the organization and accessibility of information and technology to automate specific processes and improve efficiency. Some critical elements of the smart library concept include: (i)Digitization: Smart libraries use digital technologies to make information more widely accessible, such as online catalogues and databases. (ii) Automation: Smart libraries use technology to automate tasks such as check-out and check-in of materials, freeing up staff time for more value-added activities. (iii)Personalization: Smart libraries use data analytics to understand patrons' needs and preferences and to personalize services accordingly.(iv)Accessibility: Smart libraries use technology to make information and services more easily accessible through mobile apps and self-service kiosks.(v)Collaboration: Smart libraries use technology to improve the cooperation and communication between libraries within the same institution and across different organizations.(vi) Interactivity: Smart libraries use technology to create more engaging and interactive learning experiences through virtual and augmented reality and 3D printing.(vii)Smart space management: Smart libraries use technology to optimize space and resources through automated book sorters, self-service returns, and other equipment.

3.1 Definition of Smart Library

A smart library is a library that uses technology to enhance its services and improve the user experience. This can include using digital tools to improve the organization and accessibility of information and technology to automate specific processes and improve efficiency. The main goal of smart libraries is to provide patrons with easy access to the information they need, when and where they need it. Smart libraries also use technology to create a more efficient, responsive, and user-friendly environment that encourages patrons to use the library's services and resources. This can include RFID (radio-frequency identification) technology for tracking and managing library materials, mobile apps for library patrons to access information and services, self-service kiosks for accessing information and reserving materials, and 3D printing, virtual and augmented reality technology for more engaging and interactive learning experiences.

3.2 How helpful is the Smart Library?

Smart libraries can be beneficial in several ways, such as:

(a) Improved access to information: Smart libraries use digital technologies to make information and materials more widely accessible, such as online catalogs and databases. This can make it easier for patrons to find the information they need, regardless of location.

(b)Personalization: Smart libraries use data analytics to understand patrons' needs and preferences and to personalize services accordingly. This can help patrons get the most relevant and valuable information and resources.(c) Increased efficiency: Smart libraries use technology to automate tasks such as check-out and check-in of materials, freeing up staff time for more value-added activities. This can help increase library operations' efficiency and improve user experience.

(d) Better space management: Smart libraries use technology to optimize space and resources through automated book sorters, self-service returns, and other equipment. This can help make the best use of limited space and improve the overall user experience.

(e) Improved collaboration and communication: Smart libraries use technology to enhance the cooperation and communication between libraries within the same institution and across different organizations. This can help increase knowledge-sharing and resources and improve the overall user experience.

(f) More interactive and engaging learning experiences: Smart libraries use technology to create more engaging and interactive learning experiences, such as through virtual and augmented reality and 3D printing. This can help make learning fun and interactive and improve the user experience.

(g) Overall, the smart library can be a powerful tool for improving access to information, personalization, efficiency, and collaboration. This can help make the library more responsive to its patrons' needs and help ensure it remains relevant and valuable in the digital age.

4. SMART LIBRARY ARCHITECTURE

4.1 Green Library

A green library is a library that incorporates environmentally sustainable practices into its operations to reduce its environmental impact and promote sustainability. Some examples of sustainable practices that a green library might implement include:

- Energy efficiency: Green libraries may use energy-efficient lighting, heating, and cooling systems, as well as renewable energy sources such as solar panels.
- Water conservation: Green libraries may use water-efficient fixtures like low-flow toilets and faucets to reduce water usage.
- Recycling and waste reduction: Green libraries may have recycling and composting programs and implement practices to reduce paper waste, such as double-sided printing.
- Sustainable building design: Green libraries may incorporate environmentally sustainable design principles into their building design, such as using natural lighting and materials from renewable resources.
- Sustainable procurement: Green libraries may prioritize purchasing products and services with a lower environmental impact, such as those made from recycled materials or produced using sustainable manufacturing practices.
- Green transportation: Green libraries may promote the use of alternative transportation options, such as cycling or public transit, or may provide facilities for parking bicycles and electric vehicle charging stations.
- Green procurement and collection development: Green libraries may consider environmental impact when procuring materials and may focus on acquiring electronic resources and e-books, which have a lower environmental impact than traditional print materials.

Overall, the goal of a green library is to minimize its environmental impact, promote sustainability, and educate its patrons about the importance of environmental stewardship.

4.2 Smart Library Design

The design of an intelligent library is an important aspect that considers the different functions and spaces within the library, as well as the needs of the patrons. Some key elements of smart library design include:

- ***Reception and circulation****:* The design of the reception and circulation area should be welcoming and easy to navigate, with clear signage and self-service kiosks for checking out materials. Reading areas should be comfortable and conducive to reading, with good lighting and comfortable seating. Study areas should be prepared to provide a quiet and focused environment, with various seating options, including tables and carrels. Technology areas should be designed to provide access to the latest technology, such as computers, tablets, and 3D printers.
- ***Children's rooms****:* Children's areas should be fun and interactive, with age-appropriate materials and activities.
- ***Special collections****:* Special collections, such as rare books or archives, should be designed to provide a secure and controlled environment to preserve these materials.
- ***Meeting and conference rooms****:* Meeting and conference rooms should be flexible and adaptable, with the latest technology for presentations and video conferencing.
- ***Staff areas****:* Staff areas should be functional and efficient, with good lighting, ergonomic furniture, and ample storage space.
- ***Accessibility****:* Smart library design should consider the needs of patrons with disabilities, providing easy access and appropriate accommodations.

Overall, the smart library design should combine an efficient and functional structure and a comfortable and welcoming environment that encourages patrons to use the library's services and resources.

4.3 Smart Library Services

Smart library services use technology to enhance library services and resources and improve the user experience. Some examples of smart library services include:

- Digital catalogues and databases: Smart libraries use digital technologies to make information more widely accessible, such as online catalogues and databases. Patrons can access these resources remotely and search for specific materials or information.
- Self-service kiosks: Smart libraries use self-service kiosks to allow patrons to check out materials, reserve resources, and access information quickly and easily.
- Mobile apps: Smart libraries may offer mobile apps that patrons can use to access library services and resources, such as searching the catalogue, reserving materials, or renewing items.
- RFID (radio-frequency identification) technology: Smart libraries use RFID

technology to track and manage library materials, making it easier for patrons to locate and check out materials and for staff to manage the collection.

- Digital collections: Smart libraries may offer digital collections of e-books, audiobooks, music, and videos, which patrons can access online.
- Online research tools: Smart libraries may offer online research tools, such as databases and e-journals, that patrons can use to access scholarly information.
- Virtual and augmented reality experiences: Smart libraries may offer virtual and augmented reality experiences, such as 3D printing, which patrons can use to explore and interact with digital content more engagingly and interactively.
- Online learning resources: Smart libraries may offer online learning resources, such as tutorials, webinars, and MOOCs, which patrons can use to learn new skills and knowledge.
- Chatbot and AI-powered services: Smart libraries may use the chatbot and AI-powered services to assist patrons with their queries and to suggest relevant resources based on their interests.
- Overall, smart library services use technology to make information and resources more easily accessible and to provide patrons with a more efficient and user-friendly experience.

4.4 Smart Library Security & Assistance

- Smart libraries use technology to improve security and assistance for patrons and staff. Some examples of smart library security and service include:
- Security cameras: Smart libraries may monitor the library and deter criminal activity.
- Access control systems: Smart libraries may use access control systems, such as RFID-enabled library cards, to control access to certain areas of the library and to manage the check-out and return of materials.
- Fire and safety systems: Smart libraries may use fire and safety systems, such as smoke and heat detectors, to protect the library and its patrons in the case of an emergency.
- Emergency alerts and notifications: Smart libraries may use emergency alert systems to notify patrons and staff in the case of an emergency, such as a fire or natural disaster.
- Assistive technology: Smart libraries may provide assistive technology, such as speech-to-text software, to help patrons with disabilities access library services and resources.
- Wireless network: Smart libraries may offer wireless networks, which patrons can use to access the internet and library resources on their devices.
- Remote access: Smart libraries may provide remote access to library resources, allowing patrons to access digital materials outside the library.
- Security software: Smart libraries may use firewalls, antivirus, and intrusion detection systems to protect against cyber-attacks and protect patron's personal information.

  Overall, smart library security and assistance operate technology to enhance the safety and security of the library and its patrons and to provide patrons with the necessary resources and support to access library services and resources.

4.5 Internet of Things (IoT) Based services.

IoT (Internet of Things) based library services use connected devices and sensors to enhance the services and resources offered by a library and improve the user experience. Some examples of IoT-based library services include:

- Smart Shelving: IoT-enabled smart shelves can automatically track the movement of library materials, notifying staff when a book is returned or when stock is running low.
- Smart Lighting: IoT-enabled smart lighting systems can adjust the lighting in the library based on the time of day, occupancy, and other factors to save energy and improve the patron's experience.
- Smart Space Management: IoT-enabled sensors can be used to track the use of different library areas, such as study rooms, meeting rooms, and technology areas. This information can be used to optimize the use of space and resources.
- Smart temperature and environmental control: IoT-enabled sensors can monitor and control the temperature and humidity in the library, ensuring that the environment is comfortable for patrons and that materials are protected from damage.

- Real-time location tracking: IoT-enabled devices can be used to track the location of patrons, staff, and library materials, making it easier to locate resources and manage the flow of people in the library.
- Smart lockers: IoT-enabled smart lockers can provide patrons a secure, convenient way to store their items while using the library.
- Smart Book Return: IoT-enabled smart book return machines can allow patrons to return books and other materials by scanning the barcode or RFID tag, and the device will automatically sort the books by title, author, and genre.

IoT-based library services use connected devices and sensors to enhance the library's services and resources and improve the overall user experience. These technologies can help to increase efficiency.

4.6 Cloud Computing

Cloud computing is a technology that allows libraries to store, manage and process data remotely through the Internet. Smart libraries can leverage cloud computing to improve their services, efficiency, and accessibility in several ways:

- Remote access: Smart libraries can use cloud computing to allow patrons to access library resources remotely from any location with an internet connection.
- Digital collections: Smart libraries can use cloud computing to store and manage extensive digital collections, such as e-books and audiobooks, and make them available to patrons through the cloud.
- Online research tools: Smart libraries can use cloud computing to provide patrons access to online research tools and databases, such as e-journals, that are stored and managed remotely.
- Backup and disaster recovery: Smart libraries can use cloud computing to keep backup copies of their data and systems so that they can be recovered in the event of a disaster.
- Collaboration and communication: Smart libraries can use cloud computing to improve the cooperation and communication between libraries within the same institution and across different organizations.
- Automation and analytics: Smart libraries can use cloud computing to automate specific processes, such as check-out and check-in of materials, and to process and analyze data to understand patrons' needs and preferences.
- Cost savings: By outsourcing these functions to a cloud provider, smart libraries can use cloud computing to reduce costs associated with managing and maintaining hardware and software infrastructure and energy consumption.

Cloud computing can help smart libraries to improve their services and make them more widely accessible and efficient while reducing costs.

4.7 Data Mining

Data mining is extracting useful information and insights from large data sets. In libraries, data mining can analyze various data types, such as circulation, patron usage, and collection data, to better understand patrons' needs and preferences and improve library services.

Some examples of how data mining can be used in libraries include:

- Collection analysis: Data mining can analyze the library's collection data to identify popular and in-demand materials and underutilized resources. This information can be used to make informed decisions about collection development and acquire new materials that interest patrons.
- Patron analysis: Data mining can analyze patron usage data, such as circulation data, to identify patron behavior and preference patterns. This information can be used to personalize services and resources and to target marketing and outreach efforts.
- Space management: Data mining can be used to analyze data from sensors and cameras to track the use of different library areas, such as study rooms, meeting rooms, and technology areas. This information can be used to optimize the use of space and resources.
- Resource usage and impact: Data mining can analyze data from digital resources, such as e-books, to understand their usage and impact. This information can be used to make informed decisions about resource acquisition and evaluate library services' effectiveness.
- Chatbot and AI-powered services: Data mining can train chatbot and AI-powered services to understand patrons' queries and suggest relevant resources based on their interests.

Data mining is a powerful tool that can help libraries to gain valuable insights into patrons'

needs and preferences and to improve their services and resources accordingly.

4.8 Big Data

Big data refers to the large and complex data sets generated by various sources, such as digital resources, social media, and sensor networks. Big data can improve library services and resources by providing valuable insights into patron behavior and preferences.

Some examples of how big data can be used in libraries include:

- Collection analysis: Libraries can use big data to analyze the usage of their collections, such as books, e-books, articles, and videos, to identify popular and in-demand materials, as well as underutilized resources. This information can be used to make informed decisions about collection development and acquire new materials that interest patrons.
- Patron behavior: Libraries can use big data to analyze patron behavior, such as circulation data, search queries, and social media activity, to identify patterns in patron behavior and preferences. This information can be used to personalize services and resources and to target marketing and outreach efforts.
- Space management: Libraries can use big data from sensors and cameras to track the use of different library areas, such as study rooms, meeting rooms, and technology areas. This information can be used to optimize the use of space and resources.
- Resource usage and impact: Libraries can use big data to analyze usage data from digital resources, such as e-books, to understand their usage and impact. This information can be used to make informed decisions about resource acquisition and evaluate library services' effectiveness.
- Chatbot and AI-powered services: Libraries can use big data to train chatbot and AI-powered services to understand patrons' queries and suggest relevant resources based on their interests.

Big data can provide libraries with valuable insights and intelligence to improve their services and resources and to better understand their patrons' needs and preferences.

4.9 Robot Assistance

Robot assistance in libraries refers to using robots or autonomous systems to assist patrons and staff in various library tasks.

Some examples of how robots can be used in libraries include:

- Book retrieval: Robots can retrieve books from stacks and shelves, making it easier for patrons to access the needed materials.
- Circulation: Robots can be used to check books in and out, reducing the need for staff assistance and allowing patrons to check out books on their own.
- Cleaning and maintenance: Robots can clean and maintain the library by vacuuming the floors and dusting the shelves.
- Guiding and Assistance: Robots can guide patrons in finding their way around the library by providing directions to specific areas or resources.
- Security: Robots can patrol and protect the library by monitoring suspicious activity and responding to emergencies.
- Chatbot and AI-powered services: Robots can be integrated with chatbot and AI-powered services to assist patrons with their queries and suggest relevant resources based on their interests.
- Digital services: Robots can provide digital services such as printing, scanning, and 3D printing.

It's worth noting that while robots can be used to automate specific tasks and improve efficiency, they are not yet capable of replacing human staff in most libraries. However, technology is advancing rapidly, and robots will likely play an increasingly important role in libraries in the future.

5. CHALLENGES & ISSUES IN IMPLEMENTING SMART LIBRARY ARCHITECTURE

Smart library infrastructure uses technology to enhance library functionality and user experience. Some challenges and issues that may arise include:

- **Funding:** Implementing new technology can be costly, and libraries may struggle to secure the necessary funding.
- **Training:** Staff and users may need training on using the new technology, which can be time-consuming and expensive.

- **Integration:** Integrating new technology with existing systems and processes can be challenging and require significant technical expertise.
- **Accessibility:** Technology can be a double-edged sword, as it can make information more accessible to some while creating barriers for others, such as those with disabilities.
- **Security:** With increasing data being stored and shared electronically, libraries must ensure their systems' security and patrons' privacy.
- **Maintenance:** New technology often requires regular maintenance and updates, which can be costly and time-consuming.
- **Keeping up with changing technology**: Library technology is rapidly evolving, and libraries must stay current with new trends and innovations to remain relevant.
- **Evaluation of effectiveness**: Measuring new technology's significance and determining whether it provides value for money can be challenging.

6. CONCLUSION

Smart library infrastructure refers to using technology, such as IoT, AI, and cloud computing, to enhance the services and resources offered by a library and improve the user experience. Smart libraries are designed to be more efficient, interactive, and personalized, providing patrons with various services and resources.

Smart libraries can include smart shelving, smart lighting, real-time location tracking, smart lockers, and IoT-enabled temperature and environmental control. They also have digital services such as e-books, online research tools, and digital media production tools. In addition to these technological advancements, smart libraries include maker spaces and hubs, providing patrons access to technology and tools that support creativity, innovation, and hands-on learning.

As technology advances, libraries are expected to continue integrating new technologies and services to improve the user experience and make information more widely accessible. Libraries are becoming more than a place to borrow books; they are becoming centers of knowledge and learning, community engagement, and creativity.

In India, library development has evolved, with a focus on preserving religious texts in ancient times, expanding to support research and education during the colonial period, and increasing access to books and information to the general public in the post-independence period, and now becoming more digitally oriented with the advent of new technologies.

While smart library infrastructure offers many benefits and opportunities for libraries, it also presents several issues and challenges, as discussed in this study.

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