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TECHNOLOGICAL ADVANCEMENT OF ACADEMIC LIBRARIES IN 21st CENTURY

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ABSTRACT:

This article focuses on the current and future of academic libraries in the 21st century with the integration of technology. It examines the role of technologies like RFID systems, website development, automation, digitization, database management, e-resources, and e-readers in reshaping library services. The article highlights the transformative impact of these technologies on library operations, user experiences, and the evolving role of librarians. This comprehensive analysis underscores the necessity for libraries to adapt and innovate, ensuring their continued relevance and effectiveness as academic libraries. It also anticipates the future of academic libraries, particularly with the introduction of AI, GIS, and IoT.

Keywords: library, automation, artificial intelligence, internet of things, RFID, OPAC, database, digitization.

INTRODUCTION:-

The 21st century is characterised by the rapid change of traditional businesses into the digital one. The information and communication technology (ICT) revolution has brought a number of major developments for education institutions. This includes applications, devices, systems, and networking components that enable modern computing. This implementation is not far from academic libraries.Technology is the cornerstone of libraries in the twenty-first century, helping them to meet the demands of their users. Libraries have traditionally been tasked with gathering, cataloguing, preserving, and protecting items so that future generations can utilise them. However, the contemporary library makes use of technology to provide its patrons with information services around the clock. As needed by providing tools for resource access, assisting with research, encouraging cooperation, and promoting information literacy, libraries in the twenty-first century are essential to education and research. They act as hubs of knowledge, enhancing the academic and research endeavours of students, faculty, and researchers. The main aim of 21st-century libraries is to define the growing role of academy libraries in supporting education and research in an increasingly digital and interconnected world. 21st century libraries will interrogate and widely understand the effect of technological advancement in libraries, which includes computational collections, online catalogues, data analytics, and virtual research aids.

REVIEW OF LITERATURE

Asemi, A., & Asemi, A. (2018), This study introduces the possibility of applying AI approaches to library systems and surveys applications of AI in information science and libraries. Librarians' tasks, including cataloguing, indexing, information retrieval, reference, and other tasks, have benefited from the use of intelligent systems. They used exploratory factor analysis (EFA) as a starting point to determine which AI approach categories are most useful in library and information science (LIS). AI is also useful in many other fields, like robots for libraries, machine translation, and speech recognition.

Bayani, M. et.al. (2018) , This study suggests an implementation strategy for transforming traditional library systems into intelligent online library systems by utilising the Internet of Things. Through the use of small sensors and RFID tags, the Internet of Things makes it possible to connect a physical object like a book or other text typologies with real-time communication technology. Among the desired outcomes of using IoT tags are the tracking of labelled items geographically and the continuous real-time monitoring of books. These IoT features enable the implementation of an online library supply chain and its integration with other technologies. **Hoy et al. (2017)** founded blockchain technology that is comparably updated and efficient in order to store online transactions, which are tamper-resistant. By discussing many applicable fields of blockchain, they emphasised implementing blockchain in the fields of medicine and libraries. He gave a proof of concept about the implementation of the bitcoin framework to tackle digital rights management and access control issues in libraries and educational institutes.

Jotwani (2013) analysed the resources and services of the Indian Institute of Technology's library. The study was on e-resources, ICT applications and services, and the growth of digital libraries. The study explores that ICT plays a key role in satisfying user requirements in IIT libraries. The author suggested in his paper that libraries at IITs will move towards the next level of technology upgrade, including the application of cloud computing, to modify and advance their resources and services. Which has been achieved by modern libraries. **Saults, L. et.al.** (**2011)**, the library bought ten Kindles and stocked them up with free classic literature in anticipation of launching a test experiment, which proved to be quite helpful, especially for the reader services staff who would be answering any questions from the children. The ten Kindles were then updated with the e-books. It was required to connect to the Wi-Fi or utilise the USB cord that came with each device in order to upload the e-books to the Kindles. A barcode was attached to every Kindle and connected to this record. **Veeramani & Vinayagamoorthy (2011)** surveyed to "evaluate the use of information technology (IT) in academic libraries in Kuwait". The study explored that IT mostly helps to provide information within time and assists in accessing databases without time limits. The importance of information libel lies in its accessibility and utilisation by users for productivity and decision-making.

According to Cholin (2005), a review of information technology applications in different university libraries in India that provide effective access to resources available within universities Also discussed is the role of the INFLIBNET Centre in the overall development of university libraries through the UGC-Infonet E-Journals Consortium.

OBJECTIVE

The study aimed to identify the impact of employing new technologies in libraries. To provide a comprehensive overview and critical analysis of the current state of technology adoption in libraries. This paper attempts to explore the possible advantages and difficulties of coming technologies while highlighting the effects of current technologies on user experiences, information management, and library operations.

RESEARCH METHODOLOGY

The study applied the descriptive method through content analysis of a literature review with the most important and related published English language. This paper is concerned with technologies and their use to enhance the efficiency of the library. A detailed literature study and analysis are part of the process needed to write an article on library technologies. First, a systematic search of academic databases, journals, and reputable sources is conducted to gather relevant studies and articles. These sources are then critically reviewed and categorised according to themes such as databases, automation, library websites, and future technologies. The paper synthesises the findings, identifies trends, assesses the impact on library services, and examines the challenges and opportunities.

SCOPE AND LIMITATION

The article concentrates on a range of technologies and their effects on users, library services, and new trends. Examples of these technologies include automation tools, digital catalogues, library management systems, and upcoming AI tools.It has certain limitations, like the unavailability of adequate material, the possibility of bias in the selection of sources, the speed at which technology is developing, and the difficulty of updating knowledge. It's also important to consider length restrictions, generalisation potential, and ethical issues.

Technology trends in academic libraries:

Modern library means a combination of various terms like computers, internet, websites, digital resources, automation software, web-based services, RFID, CCTV, databases, OPAC, e-resources, and many more. The invention of computers and the internet dramatically changed the working of libraries, which changed manual methods into computerised ones. In traditional libraries, librarians were exhaustively managing physical card catalogues, tracking inventory manually, assisting patrons, managing circulation manually, and providing them only with paper-based resources. With computers and the internet, tasks like circulation and digital databases Automation and digitization have freed librarians from routine library operations and enabled them to focus on higher-value services like research guidance and information literacy instruction, which enhances the overall working of academic libraries of the century.

- **Library automation:-** In the 1960s, very few libraries started using computers to manage their collections. Earlier, the focus was on automating cataloguing and circulation processes effectively. The 1980s and 1990s integrated library systems (ILS) combined various library functions into a single software and acted as a hub of library housekeeping operations. As the internet spreads throughout the globe, ILS manages cataloguing, circulation, and patron services, often integrating digital resources and online catalogues. Over time, library automation software like KOHA, Evergreen, Sierra, SOUL, and Libsys has continued to evolve, incorporating advanced features like RFID technology, self-checkout, and interlibrary loan management, thereby enhancing the overall functionality and accessibility of libraries. The future of library automation will be improved AI-driven search and recommendation features for patrons, enhanced data analytics, and greater compatibility with other formats. Automating libraries results in resource management, improved user access, and streamlined library housekeeping operations. However, some difficulties of library automation include the higher cost of implementation and staff training, as well as concerns about the security and privacy of users' data.

- **Web OPAC/Online Catalogues:** Online catalogues, also known as OPACs (Online Public Access Catalogue), originated in the late 20th century when libraries began to adopt digital technologies. The transformation of traditional card catalogues to online catalogues marked a significant shift in how libraries managed and provided access to their collections, which enhanced the depth and breadth of available materials. Web OPAC enables remote access with powerful search features, including keyword searching, advanced filters, and relevance ranking, making it easier for users to find relevant materials. These advanced search and discovery tools make it easy to access the relevant material in less time. They

make possible access to library collections, place holds,allow users to check availability, renew items, and access digital resources. Patrons can check the real-time availability of items, reducing the need for physical searches in the library. Examples: Library of Congress Online Catalogue: https://catalog.loc.gov/vwebv/searchBrowse: In this library, users are allowed to access a vast collection of online resources, such as e-books and online databases. Using online catalogues has some drawbacks; users who are not familiar with digital technology may find OPACs challenging to use. While providing convenience, it reduces direct interaction with library staff.

- **Database:-** A library database is a collection of information that stores and manages a wide range of materials available in a library, such as books, journals, magazines, multimedia items, and other resources that are searched online. Libraries purchase subscriptions to databases so users can search, locate, and access library materials efficiently on a variety of subjects. Users can access the e-resources through computers or mobile devices at any time and from anywhere. It solves the problem of distance and time. Whether a library's catalogues are online, in print, or linked with its management system, users can access them all. The databases have been categorised according to their user base, content, and intended usage. Typical categories for library databases are open-access, reference, and academic databases. Some of the library databases are WorldCat, ProQuest, JSTOR, and Scopus. ProQuest: It gives access to scholarly and research resources on topics like science, technology, social sciences. JSTOR: https://www.jstor.org/ JSTOR is a digital platform that gives access to academic journals, books, and primary source materials in electronic form.

- **Interlibrary Loan:-** Interlibrary Loan allows users of one library to access materials from another by sending a request to the library. The service gives library users access to resources beyond their local library's holdings. In this process, two or more libraries mutually agree to share their physical resources and share online catalogues with each other. The technologies used to develop interlibrary loan facilities at the library include integrated library management systems, online union catalogues, ILL management software, and digital document delivery systems for electronic materials. These technologies work together to streamline the process of borrowing and lending materials between libraries, enhancing resource accessibility for patrons.

- **E-mail services/IM and SMS:** The use of email services, instant messaging (IM), and SMS (short message service) in libraries has its roots in the late 20th century. Adapting these technologies in libraries gives more user involvement, helps meet changing needs and expectations, improves resource management, increases time returns, and enhances customer satisfaction. Email and SMS services inform users of their book issuance and return dates. This helps users avoid late fines and makes sure that the library's materials are available for other readers promptly. This service also informs users of the availability of reserved books for pick-up via email or SMS. Users can receive alerts regarding fines accrued due to late returns, which encourages timely returns and helps in revenue collection for the library. Libraries use email alerts to keep users informed about the latest acquisitions, upcoming events, and other important updates. IM or chat services allow users to ask questions or seek help with their research needs remotely. Users may get more individualised notifications, reminders, and suggestions from these services in the future based on their past usage and personal preferences.

- **Library website and FAQ:** Library websites like any other websites are developed and maintained by IT experts. The website may have started out internally, been created by the library's in-house IT staff, or been contracted out to web development firms. For all things library, the website acts as a one-stop shop. Its modern technology, easy navigation, and user-friendly style all work to enhance the user experience. From any place with an internet connection, users may quickly access the library's digital resources, including databases, e-books, and e-journals, through the website along with information about the catalogue, policy, and contact details.. It helps promote library events, programmes, and special collections, increasing community engagement. It also facilitates communication between library staff

and users through features like contact forms and chat services. Example: the website of IIM Ahmedabad. https://library.iima.ac.in/

- **FAQ Section:-** It covers a range of common queries and provides clear, concise answers about library policies, services, and resources without needing to contact library staff, saving users time and reducing the need for phone or in-person inquiries to seek information from the library. In a library, users try to find answers to several frequently asked questions (FAQs). They may ask questions about the process of obtaining a library card, whether computers and Wi-Fi are available or not, how to suggest new purchases for the library's collection, how to request specific books within the library's operating hours, knowing the library's operating hours is essential, and how to access ebooks and digital media on personal devices. FAQs are designed to help users navigate the library's services and resources effectively.

- **RFID:-** Traditional barcodes were superseded by RFID (Radio-Frequency IDentification) technology in libraries. Integrated circuits, antennas, readers, middleware software, and a variety of materials that may be affixed to objects as RFID tags are used to create RFID technology. The tags have an antenna for connectivity and a microchip for data storage. The middleware is designed to facilitate communication between the reader and the ILS, as the systems rely heavily on it. Tags can be found on media and inside library materials. It simplifies processes, lessens the workload of employees, and facilitates quicker material check-out and return. The high level of accuracy with which this system tracks inventory lowers the possibility of mistakes in shelving and cataloguing and also improves security by having security gates and alarms that self-activate or deactivate in response to unauthorised material removal. Shorter wait times and self-service kiosks enhance the customer experience. Libraries can find missing materials and do inventory audits with ease. RFID systems require periodic tag and equipment replacements in addition to ongoing maintenance. Due to the high expense of tags, scanners, and system integration, only a small number of libraries are having difficulty deploying RFID. Libraries must, however, handle privacy issues and make sure that staff members are properly trained to utilise new technology.

- **Current Awareness Services (CAS):** CAS are essential tools for individuals and organisations willing to stay informed about new arrivals and trends in their areas of interest. These services offer a personal approach to information dispersion, allowing users to specify their preferences, sources, and delivery frequency. CAS originates from the need to manage and customise the flow of information in the digital era. In the future, advancements in CAS are likely to include even more sophisticated AI-driven content curation, real-time updates, and integration with emerging technologies like augmented reality and virtual reality to provide immersive and interactive information experiences for users.

- **Digitization:** The process of digitising involves converting tangible objects into digital representations, such as books and manuscripts. Libraries that have gone digital can now have several users view the same content at once.It gained prominence due to libraries and cultural institutions recognising the need to preserve and provide widespread access to their collections. Preservation of available materials, enabling their remote access, and enhancing the searchability and discoverability of resources are the main aims of digitization. It faces certain challenges like the cost and time associated with digitization, the potential loss of certain aesthetic qualities of physical materials, and copyright and intellectual property rights-related issues. The future of digitization technology is likely to improve automation through AI and machine learning for more efficient and accurate digitization. Digitization needs various technologies, like high-quality scanners, Optical Character Recognition (OCR) software for text recognition, digital storage solutions, and metadata standards for cataloguing and search. Libraries use a variety of digitization software to convert physical materials into digital formats. One popular digitization software example is Adobe Acrobat Pro, which is widely used in libraries for scanning, optical character recognition (OCR), and creating PDF files. It provides tools for enhancing scanned images, converting scanned text into searchable and editable formats, and organising digitised content.

- **Kindle:-** In November 2007, Amazon created and began selling the Kindle brand of e-readers and electronic book readers. These gadgets are mostly used for reading electronic books and other content. The distinctive E-ink display technology used by Kindles resembles the appearance of printed text on paper, making them highly readable even in direct sunlight and easy on the eyes. Kindle allows customers to download electronic books, periodicals, newspapers, and other digital goods. These devices have features like built-in illumination, waterproofing, and support for audiobooks. They have gained popularity among readers because of their portability, ease, and digital library features. Kindles in libraries give users easy access to e-books through the library's digital lending system; users can borrow Kindle e-readers. E-books can be checked out by patrons for a predetermined time, after which they are automatically returned. The price of installing Kindles in libraries can differ. It covers the cost of buying Kindle devices, e-books (which would require a licence), and ongoing maintenance. With only one lightweight gadget, Kindle users may carry and access a sizable library of digital books. Not all books are available in digital format, and there are restrictions on sharing and reselling e-books. Future Kindle readers will probably have even more sophisticated screens with longer battery lives, such as colour e-ink.

Challenges faced by academic libraries when adopting new technologies

Academic libraries face a variety of obstacles when implementing new technologies. These obstacles can differ depending on the particular technology being implemented and the institution's particular circumstances, but some typical obstacles include:

- Low budget: Because new technology is expensive to acquire, implement, and maintain, 90% of university libraries have limited funding. Consequently, making an investment in new technology might be difficult.
- Training and development: Some workers could have trouble adjusting to the new technology, and there might be costly and time-consuming opportunities for them.
- Interoperability: It can be difficult to seamlessly integrate new technologies with outdated gear, software, and databases; this may call for outside help or specialised development.
- Data security and privacy: Sensitive user data is frequently handled by academic libraries. Adopting new technology may lead to worries about data security and privacy, necessitating careful planning and regulatory compliance.
- Accessibility: In an academic library context, it is essential to make new technology accessible to all users, including those with impairments. Technically speaking, achieving accessibility compliance can be difficult and may demand additional resources.
- Vendor Lock-In: Some technologies might have this restriction, which would make switching to different approaches challenging in the future. This may reduce flexibility and raise overall expenses.
- Evaluation and Selection: Finding the best technology may be a difficult and time-consuming process. To make sure that the chosen technology is in line with the library's strategic goals, a cross-functional team is frequently involved.
- Obsolescence and Sustainability: Technology develops quickly, and what is cutting-edge now can become outdated in a few years. Libraries must make plans for the future of technology and think about how to deal with eventual obsolescence.
- The digital divide makes it difficult to guarantee that all users have access to new technologies, particularly when some may lack the required hardware or internet connectivity. Academic libraries have a civic duty to address the digital gap.

Future of the libraries

- **Blockchain:-** Blockchain is a method of storing data that makes it difficult or impossible for the system to be altered, hacked, or controlled. Blockchain technology's future sphere lies in the field of libraries in order to safeguard user and patron records, improve user privacy, and facilitate research paper data. It is anticipated to bring about a significant revolution. The use of private and public keys, an encrypted authentication technique that protects user privacy, is a fundamental aspect of blockchain technology. Because it is difficult to convert the public key into the private key, privacy is ensured. Privacy is guaranteed since it is hard to turn the public key into the private key. It is really feasible to query and inspect the contents of each block because just the public key is kept with them. There is now a limit on how much may be encoded in a block. More complex data links as well as information in formats other than PDFs, images, audio, and videos that weren't previously connected to blockchain will be possible as the technology advances. This will be an essential part of libraries since it can authenticate and preserve digital artefacts that may be used in place of tangible assets (like contracts or 3D models).

- **Artificial Intelligence(AI):-** The concept of artificial intelligence initially surfaced in the middle of the 20th century, when scientists began developing computer programmes to simulate human thinking. These days, AI is frequently employed to improve goods and user experiences across a wide range of businesses, including libraries. Artificial intelligence (AI) systems are computer programmes that can learn, solve problems, reason, and understand language. These programmes are meant to resemble human cognition. It will provide more precise search results, offer customised services, automate time-consuming tasks, and offer 24/7 customer support. Significant barriers include worries about privacy, the need for robust data protection, and the potential for job displacement for certain library tasks. AI systems could also need regular upkeep and upgrades. Future libraries will see a dramatic transformation thanks to AI-powered search engines. Even if users don't use specific terms, they will still be able to discover what they need thanks to contextual and semantic search. AI will examine user preferences and behaviour to provide tailored suggestions. For instance, it can provide recommendations for books, articles, or other resources based on a user's historical borrowing behaviour and interests, making it simpler for users to find new materials that suit their preferences. AI can also track the popularity and consumption of different resources, which aids in making decisions about the addition, deletion, or extension of the library's collection. Automating the digitization of physical materials will heavily rely on AI.

- **Chat bots:-** Chatbots in libraries will be automated conversational agents that assist users with a wide range of activities, such as answering questions, providing research guidance, and offering information about library resources and services. They can analyse user input, recognise intent, and provide relevant responses. Many are integrated with databases and library catalogues to retrieve real-time information. These AI-powered tools enhance user engagement, improve accessibility, and offer 24/7 support, helping libraries deliver efficient and personalised assistance to their patrons while freeing up staff for more complex tasks. They improve user engagement and accessibility. Limitations may include chatbots not understanding complex or context-specific queries. They lack the personal touch of human interaction. Implementation and maintenance costs can be considered.

- **FAQ versus chatbot**

  FAQs (Frequently Asked Questions) and chatbots are both technologies used to provide information and support to users, but they differ in their approach and functionality. Here are the key technological differences between FAQ and chatbot services:

Features	FAQ (Frequently Asked Questions)	Chatbot
Nature of Interaction	FAQs are static databases of knowledge.	Conversations may be dynamic
Information Retrieval	Users must manually search for their queries, and predetermined information is used to generate the responses.	Based on the user's input, they can offer tailored replies.
Response Time	Users may quickly get answers by searching for pertinent FAQs, however these prepared replies may not address any particular questions.	Chatbots respond quickly to user inquiries and customise their replies to fit their individual needs.
Automation and Intelligence	FAQs do not change as user behaviour does. They lack the capacity to develop over time and learn new things.	The replies of chatbots may be continually improved by interactions. They can make suggestions,even carry out activities on the user's behalf.
User Engagement	The only user interaction is confined to looking up and reading static FAQs. There isn't any direct interaction with the user.	Users are actively engaged in talks via chatbots. They can give follow-up information, clarify inquiries, and keep users engaged.
Scalability	It can take a lot of work to create and manage FAQs. If they aren't updated frequently, they could become obsolete.	Chatbots may respond to a variety of user inquiries and are scalable.To include fresh information or address new inquiries, and simply update.

- **Robotics:** The use of robotics in libraries is an outgrowth of the continuous advancements in automation, digitalization, and artificial intelligence. Robotics technology has developed over many years. Robotics is being used by libraries to modernise their operations and enhance services. They may also be trained to participate in interactive learning exercises or give tours, which makes libraries more interesting and accessible to visitors. The use of robotics in libraries supports the goal of the library to provide access to knowledge and resources by streamlining processes and generating novel interaction possibilities. They may offer round-the-clock assistance, freeing up library professionals to do more difficult jobs. Robotics can also benefit those with disabilities. There may be issues with privacy and security, especially if robots are used to gather or keep personal information. High launch costs and ongoing maintenance expenses might be quite detrimental. Some clients could view robots as scary or would prefer to interact with people. Robot librarians may remove books from shelves or storage facilities using robotic arms or a conveyor belt system. Users can order certain books or other products using a predefined interface or the library's online catalogue. The robots can be taught to investigate the library's architecture using sensors, cameras, and mapping technology. They have the mobility to go between shelves, locate, and take the appropriate book. Some robot librarians have interactive displays and can converse. Users can interact with the robot to enter their requests, ask for directions, or learn more about the library's offerings.

- **Geographic information systems (GIS):** Libraries can effectively identify and organise structural data, such as maps and geographic references, thanks to geographic information systems (GIS). Users can analyse maps, satellite photos, and geographic data for a range of purposes by having access to geospatial databases and mapping tools. GIS makes it possible to add location-based services that help library users locate books and resources inside the building, frequently using mobile applications that offer interior navigation. By organising seminars, projects, and educational initiatives centred on GIS, such as community mapping, environmental education, and cultural heritage preservation, libraries may interact with local communities as well.

CONCLUSION

In summary, the dynamic integration of technology into academic libraries has brought about revolutionary developments that have improved user experiences and efficiency. With the advent of AI, GIS, and IoT technologies, more innovation is promised in anticipation of the future. Academic libraries must change with the times in order to continue being important in the digital era.

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