Current Role and Applications of Artificial Intelligence (AI) in Museums of India

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Abstract

Artificial Intelligence is the intelligence possessed by the machines under which they can perform various functions with human help. With the help of A.I, machines will be able to learn, solve problems, plan things, think, etc. Artificial Intelligence, for example, is the simulation of human intelligence by machines .It has a wide array of applications in the fields of medicine, marketing, finance, security, and museology as well. A few of those practices are currently being observed in India, and they are helping to preserve our culture, roots, and traditions, thus passing them on to future generations. Not only that, AI has also helped in gaining insights by detecting certain patterns that were not exactly visible to the human eye. In this article, we will discuss the current role, influence, and future scope of the applications of AI that have been deployed in Museums of India. The use of AI in various functions of a museums like, documentation, display, preservation, interpretation and communication etc. is also discussed. How the museums are using AI in security and risk assessment is also a point of consideration.

Keywords: Artificial Intelligence, Human Intelligence, Documentation, Preservation, Risk Assessment.

1. Introduction

In an economic environment characterized by permanent and rapid technological evolution, successful organizations are the ones that are able to adapt their processes and activities to change. Whenever we think 'Museum', what comes to mind are high ceiling and silence where you walk holding your breath while looking at skeletons of the past or large towering paintings with ceremonial portraits.

However in the recent past, the museums are undergoing enormous changes in space time and display and technology innovation has become a topic of significant interest among museums and has dominated the discussion in many museum conferences, workshops, and seminars. This is probably because innovation, if applied correctly, can help museums to achieve their organizational mission more effectively and efficiently.

The technological innovation consists of adopting new technologies to be applied to products, services or production processes. The technological innovation is the means through which museums can offer people an active visiting experience. Museums these days are not only about showcasing artifacts but with the technological interventions like artificial intelligence, 3D models and HD displays, museums in India are reinventing themselves.

Artificial Intelligence has been there for decades but with the new age getting their hand on big data, the growth has been exponential. Like other fields, it has impacted museology and museums too. It's here with some notable opportunities and can make

museums better and more sustainable. Before diving deep into the examples of how the museums in India are using AI to improve their institutions, here are some key areas like audience engagement, creating and managing database, visitor's insight and museums security, virtual reality (VR) and augmented reality experiences to note where AI is going to make a significant impact.

Considering the changing trends in technological advancements in different functions of museums, the present research was conducted to study the use of Artificial Intelligence in museums. Prime Minister's Museum and Parliament Museum, New Delhi, Victoria Memorial Museum, Kolkata, INTERWOVEN, Bengaluru and Vedshala Ujjain were considered to assess in the areas of technological innovation in management, visitors experience and organizational innovation. Some other museums, where use of AI have been done in to its functioning also taken in to account.

2. Aims and Objectives

  i. To explore the use of Artificial Intelligence (AI) Technology in Indian museums.

  ii. To study the effect of such technological advancement on visitors.

  iii. To explore the types of AI and its use in museums.

  iv. To study impact and scope of the AI technology used in various Indian museums.

  v. To promote awareness of advance technologies like AI in Indian museums.

  vi. To study the advantages and disadvantages of using AI in museums.

  vii. To analyze the mechanism of technological advancement in Indian museums.

  viii. To suggest about future technological advancement for benefits of museum to compete in market.

3. Literature Review

Rani, S. et.al. (2023) pointed out that AI and computing technology are currently being used to facilitate access to collections, tour guidance, and educational activities while emerging technologies show promise for providing even more immersive and personalized visitor experiences.

Suroto, P.Z., et.al (2020) are of the view that innovations in museums have begun in several developed countries. In Louvre museum, the use of technology has been done by using audiovisual media in several types of collections. One form of technology use in an art performance with exhibition- based is also done in a mall in Jakarta, called Galeri Indonesia Kaya. The form of innovation carried out in this art exhibition uses the artificial intelligence method. Artificial intelligence assists to emphasize the creation of intelligent machines that work and react like humans.

Varitimiadis et al. (2021) present a detailed analysis of the use of chat bots in the specific context of museums over a large sample and conclude with a proposed architecture for the implementation that takes into account the specific cases and knowledge types that museums require.

Bologna Museum is using an AI system to track visitors and understand how they look at artworks but also socializing patterns. This helps plan better exhibitions but also might improve the safety of museums (Charr, 2021).

Bughin et al. (2016) argued that utilizing a data-driven approach to decision-making leads to better results when compared with the intuition/experience-driven approach.

Theil, S. et.al. (2023) explained that artificial intelligence is becoming an increasingly important topic in the cultural sector. While museums have long focused on building digital object databases, the existing data can now become a field of application for machine learning, deep learning and

foundation model approaches. This goes hand in hand with new artistic practices, curation tools, visitor analytics, chatbots, automatic translations and tailor-made text generation. With a decidedly interdisciplinary approach, the volume brings together a wide range of critical reflections, practical perspectives and concrete applications of artificial intelligence in museums, and provides an overview of the current state of the debate.

4. Methodology

The present study was conducted by visiting the museums of Delhi, M.P. and Kolkata and the observations were documented by personal observations and by discussing with the staff of the museums. The use of AI in Visitor's Experience and museum management was particularly discussed and observed. To study and understand the use of AI and its different types and application of AI in museums, the secondary sources like journals, books and websites were explored and presented the details in the paper.

5. Use of AI in Different Areas of Museums

As per definition of museum given by International Council of Museums (ICOM), the museum has to perform certain functions. They may include collection, documentation, preservation, display and communication, research and education. The visitors may experience the visit of museum in different ways. The overall experience and engagement of visitors depend up on how effective the communication process of museum is.

With the advancement in technologies especially with the introduction of AI, the overall functioning of the museum and visitors' experiences has changed a lot. The use of AI in museums of India especially in science museums has been discussed here:

5.1 Audience Engagement:

"A Museum should never be finished, but boundless and ever in motion" (Goethe)

With COVID-19 bringing the world down to its knees, several industries were impacted. One of the institutions that were most impacted is Museums. The pandemic forced the experts to think of ways to preserve and promote natural heritage and culture. The search ended up with AI. It has helped enhance museums not only within but also outside the physical spaces of the museums. The technology in museums today can now aid a visitor in real-time, being a guide and a partner simultaneously. A simple example of such a practical application would be a chatbots (Recuero, V.N.et.al.2019, Kim, H.J. et.al 2022, French., A. et.al.2019 and Jain,V. 2023).

5.2 Creating and Managing Databases:

AI has now started aiding museum curators in creating and managing digital archives. With machine and deep learning techniques, it is now much easier to access and store historical records and artifacts. With such tedious tasks being automated, the curators can turn their creativity into reality.
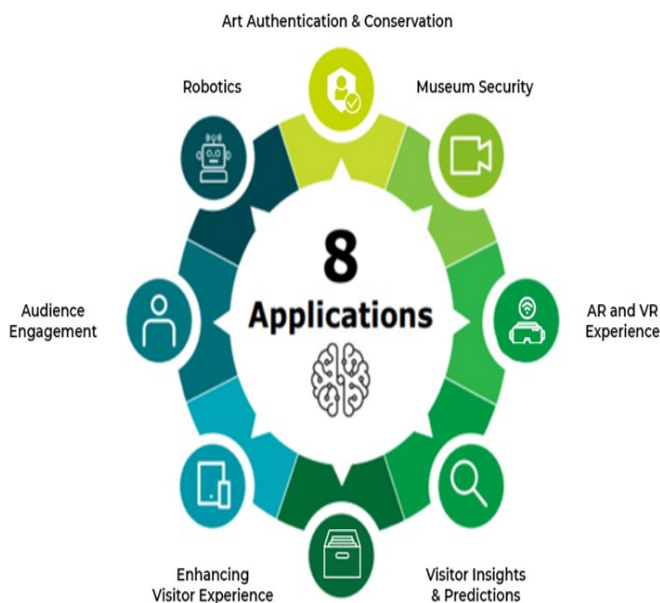

Figure 1 Archives & Data Management

5.3 Visitor Insights and museums security

Predictive tools in museums can help generate visitor behaviour and insights and draw patterns from them. Such insights can be a valuable tool in tailoring events and exhibits, improving storytelling, etc.

5.4 VR and AR experiences

The world's prominent business tycoons are fighting to create deep and indulging metaverse for their respective audiences. Museums can be lit by such indulging technologies, too. While the input cost might be high for them, the output would create unforgettable experiences too. It would allow the users to interact and explore museum collections and historical sites like never before.

These were some of the areas in which AI had had a significant impact in recent times. It's time for us to know what the buzz is about and how it works.

AI is a machine's ability to demonstrate human-like qualities such as reasoning, learning, planning, and creativity. AI enables technical systems to sense their environment, deal with what they perceive, solve issues, and act to attain a certain goal. The computer receives data already prepared or obtained by its own sensors, such as a camera, processes it, and then responds. AI systems can adjust their behavior to some extent by analyzing the consequences of prior acts and operating autonomously.

As the buzz surrounding AI has grown, manufacturers have scrambled to promote how their goods and services use it. Frequently, what they refer to as AI is really a component of technology, like machine learning. AI necessitates a foundation of specialized hardware and software for developing and training machine learning algorithms. Although no single programming language is synonymous with AI, Python, R, Java, C++, and Julia all offer popular characteristics among AI engineers.

While certain AI technologies have been available for more than 50 years, significant advancements in AI have recently been made possible by increased processing power, the availability of vast amounts of data, and the development of novel algorithms.

Artificial intelligence has gained international attention and is thought to be essential to the digital transformation of society. Although significant changes are anticipated from future applications, artificial intelligence is already present in our daily lives.

6. Types of Artificial Intelligence (AI)

Most artificial intelligence apps currently in use were developed using a certain kind of machine learning algorithm. But in the past ten years, artificial intelligence (AI) has grown exponentially thanks to the advancement of artificial neural networks, which enable machines to process information like that of the human brain. Based on the functionality and capabilities, classifications have been developed within these breakthroughs to make it simple to identify the type of AI we are working with:

6.1 Narrow AI

Because it can function on the intended task it has been educated on, it is sometimes known as weak AI. AI, in any other form, is essentially theoretical. Widespread instances of artificial narrow AI are Chat GPT from Open AI and Alexa from Amazon.

6.2 General AI

Another name for it is powerful AI. As of right now, generic artificial intelligence (AI) is a theoretical idea that can complete a new work using an original method without the assistance of a human by using lessons learned from the past. To put it another way, it's artificial intelligence that can match human potential.

6.3 Super AI

It goes by the name of artificial super intelligence as well. It is more intelligent than humans because it can reason, think, learn, and form judgments. Such artificial intelligence is capable of feeling human emotions, as well as having desires and beliefs. An example of artificial super intelligence in fiction is Ultron, who appears in Marvel's Age of Ultron.

6.4 Reactive Machine AI

AI systems known as reactive machines are memory less and created with a single, highly specialized purpose in mind. They are limited to using the data that is currently accessible since they are unable to recall past results or choices. Reactive AI is based on statistical mathematics and can generate seemingly intelligent outputs by analyzing large volumes of data.

6.5 Limited Memory AI

Unlike Reactive Machine AI, this type of AI can remember prior events and results and track specific objects or situations across time. Limited Memory AI may use facts from the past and present to choose the best course of action for achieving a desired objective. However, while Limited Memory AI can use past data for a limited time, it cannot store that data in a library of past experiences for later use. Limited Memory AI can increase its performance as it learns from additional data.

6.6 Theory of Mind AI

Theory of Mind AI is a functional subset of General AI. Though an unreached kind of AI today, AI with Theory of Mind functionality might comprehend the thoughts and feelings of other beings. This understanding may influence how the AI interacts with those around it. In principle, this would enable the AI to imitate human-like interactions. Because Theory of Mind AI can deduce human motives and reasoning, it will tailor its interactions with individuals to their own emotional needs and goals. Theory of Mind AI would also be capable of understanding and contextualizing artwork and writings, which current generative AI technologies cannot do.

6.7 Self-Aware AI

Self-aware AI is a type of functional AI class for applications that require advanced AI capabilities. Self-aware AI, like the theory of mind AI, is entirely theoretical. If ever realized, it would be capable of comprehending its own internal conditions and qualities, as well as human emotions and thoughts. It would also have its own feelings, desires, and beliefs (Martinez, R. 2019)

7. Application of AI in Museums of India

Artificial intelligence has a wide range of applications in the field of Museums and Museology, including robotics, image analytics, natural language processing, deep learning, machine translation, social media analysis, etc. Many museums of India upgraded themselves as per requirements of Artificial Intelligence. Victoria Memorial Museum is the finest example of the same (Figure 2)

Figure 2 Victoria Memorial Museum, Kolkata (upgraded to International Standards of AI)

7.1 AI Connections Table

One of the most popular examples in the field of museology is the AI connections table present in the Henry Ford of Museum American Innovation. The AI connections table present in the museum gives the visitor a privately curated experience by correlating and uncovering the stories between innovations and the collections present across the

museum. For example, during a museum tour, the chief curator displayed how a cell phone, a trowel, and a lathe from the Industrial Revolution are all connected, opening a plethora of insights to the visitors and adding to their excitement (Figure 3). The platform has been called more AI-informed rather than AI-driven. As the museum continues to improve and enhance its collection, the table will continue to grow, thus providing visitors with a unique experience almost every time (Weili, S., 2022).
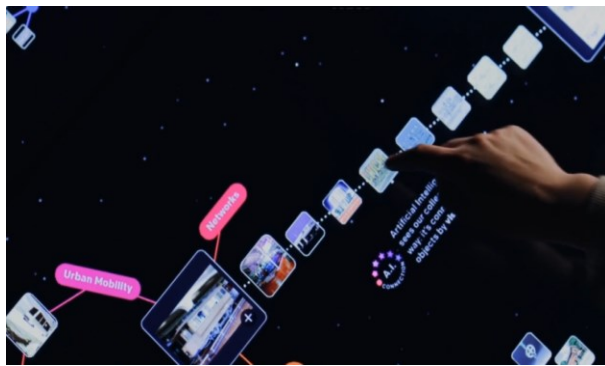

Figure 3 AI Connections Table in action

Following are some of the applications of AI in the field of museums and museology in India:

7.2 Pradhan Mantri Sangrahalaya, aka PM Museum

India's Prime Minister Narendra Modi inaugurated Pradhan Mantri Sangrahalaya on April 14, 2022. The museum is known for capturing the essence of all the Indian prime ministers the country has seen since Independence, including Jawaharlal Nehru, Indira Gandhi, H.D. Deve Gowda, Lal Bahadur Shastri, Rajiv Gandhi, and others. The museum has been digitized to attract the youth and bring them closer to the nation's history of prime ministers. To do so, Gurugram-based next-gen startup Tag-bin and other technology partners have played a significant role in incorporating advanced technologies like AR/VR and AI/ML to provide users with a defining experience.

The startup worked on curating content available for different prime ministers over the course of 2 years. Using the content, they have made some interesting installations, like a handwriting robot that uses image processing techniques to write a personalized message from the Prime Minister in their handwriting using a robotic arm. Also, the museum has a 'Selfie with Prime Minister' zone, which lets you take a realistic selfie sent directly to the visitor's email. The selfie also uses a helicopter setup and an immersive screen, sensors, and motion controllers to provide an enhanced and genuine experience from the selfie.

Lastly, they have incorporated an 'India at 2047' feedback wall, which is used to collect visitor data – i.e., how they visualize India in the year 2047. The idea is to incorporate these ideas in framing future policies for the government that will govern the country (Bharti, T. 2021, Naik, A.R. 2022)

7.3 Navachara Kaksh – AI-enabled gallery

The room of new ideas or the Navachara Kaksh, which was inaugurated by President Pranab Mukherjee in 2015. The gallery in the museum has been setup as a collaboration of Rashtrapati Bhavan and Intel India. Many innovations present in the gallery come from Indian students.

In July 2023, President Droupadi Murmu inaugurated the Navachara, which is now an enabled gallery in the Rashtrapati Bhavan and exhibits six innovations that help you gain insights into the Rashtrapati Bhavan (Team, O., 2023).

7.4 MuseSkop – Ajiabghar

MuseSkôp is an AI-driven journey for the visitor that provides them with a beautiful and unique combinative experience of mobile, web, and AI technologies. It's an interactive way to provide physical objects with an augmented layer of digital content. To dive into this immersive experience, users don't need to download any app either. They must scan the QR code simply, and a web-based app will launch on the mobile browser. Later, the

camera screen will provide an intro and instructions to guide visitors and enable them to see embedded digital content. One can simply focus on specific objects and swipe through different carousels to explore more and uncover further insights. The app is based on AI-driven image classification, which has been trained or landmarks points on artworks (MuseSkop).

7.5 INTERWOVEN: Museum of Art and Photography

It is a result of the collaboration of the Museum of Art and Photography in Bengaluru and Microsoft. INTERWOVEN is a platform that uses Microsoft's Azure Custom Vision and AI Text Analytics. The platform helps in revealing the hidden patterns that connect the artworks at MAP to other artworks present within the institution as well as with other global partner institutions like the Metropolitan Museum of Art in New York, Smithsonian in Washington, DC, and V&A in London.

To put it in simple words, one might start their journey using INTERWOVEN through an artwork in India and might find themselves how it connects to an artifact or an artwork in Washington DC's Smithsonian. The institution has also partnered with Accenture Labs to provide users with a unique chatting experience with MF Husain (Murali,D. et.al. 2023, Husain, M.F. 2023,INTERWOWEN Website).

7.6 Vedshala Museum – Ujjain

The Vedshala Museum in Ujjain is working on enhancing the visitor's experience using AI. They have built a comprehensive database, digitizing its collection, which can be easily accessed through the website and mobile apps. Multilingual support is provided in these databases, virtual tours, and augmented reality experiences to help the user know more in their preferred language (Chatterjee, A. et.al. 2024).

8. Findings

AI can be incorporated across the spectrum; from visitor experience to behind the scenes, and the technology can come in many forms. Current AI use for operations includes visitation forecasting and understanding collections by using machine vision to help recognize, classify, or pattern images. On the public side, AI offers many unique opportunities to engage visitors. In 2018 the world was introduced to Pepper, a humanoid robot developed by the Smithsonian. Pepper answers visitors' questions and tells stories using voice, gestures, and an interactive touch screen (Ambrose, T. & Paine, C. 2019).

AI also offers visitors the potential to interact with historical figures .Data clean-up, data classification, automated chat bot, membership & fundraising, identifying subject matter, sentiment analysis, text/character recognition etc. Virtual Reality, Augmented Reality and Holography have been incorporated in display of objects and viewing experience of visitors. The museums of India like Pradhanmantri Sangrahalaya, Parliament Museum, Navachara Kaksh – AI-enabled gallery, MuseSkop – Ajiabghar, INTERWOVEN: Museum of Art and Photography, Vedshala Museum – Ujjain are using AI technology to improve their visitor's experience in different areas of the museum. Some museums are using AI in security of the museum.

9. Conclusion

AI, at the current pace, will impact a wide variety of fields and almost everyone across the globe. Its potential in the fields of medicine, banking, defense, analytics, etc., is unmatched. In the past few years, it has started impacting the field of museology, too. From chat bots to sentiment analysis, from image classification to pattern identification, AI has many opportunities to explore. However, before indulging in the gloomy clouds of AI, museums have to think of operational impact first. Well-researched and well-planned

investments can have a significant effect, thus driving people to learn more about museums.

As we advance, examples like the ones mentioned above are going to be a regular occurrence and AI is going to touch every corner of our country in some way or another. It can not only improve audience engagement and interaction, but will also help in securing the historical artifacts, creating databases, archives, visitor insights and immersive technological experiences with Virtual Reality and Augmented Reality.

With AI evolving every day, museums across the globe are developing new ways to increase audience interaction too. India, being a center of culture, creativity and genius minds, shouldn't lag behind in this race, progressing in creating a safer, ethical and educational future for the generations to come.

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