A CONTEMPORARY STANDPOINT ON THE RELEVANCE OF SIMULATED INTELLIGENCE IN MUSEUMS AS CULTURAL HERITAGE ESTABLISHMENT

By

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Abstract

The paper seeks to look into the integration of Simulated or Artificial Intelligence (AI) and emerging technologies which has initiated a paradigm shift in museums and cultural heritage institutions, redefining their operations, preservation methods, and audience engagement strategies. This paper presents a comprehensive contemporary perspective on the multifaceted applications of AI within these contexts. It explores the transformative roles of AI in artifact analysis, enabling precise restoration and conservation through advanced imaging and predictive modeling. The integration of virtual reality (VR) and augmented reality (AR) offers immersive, interactive experiences that enhance educational outreach and accessibility, breaking down physical and cognitive barriers to cultural heritage. Furthermore, the utilization of data analytics provides ambience for visitor friendly behaviour, facilitating personalized experiences which optimizes the exhibit design management and considerations of ethical standards; data privacy, the digital divide, and the potential loss of traditional curatorial roles. These have been cursorily examined to provide a balanced viewpoint on the technological advancements. This paper highlights best practices and innovative approaches that exemplify the potentials of AI and emerging technologies to revolutionize the cultural heritage sector. The study concludes with a forward-looking discussion on future trends and the ongoing evolution of museums and cultural heritage sites in the digital age, emphasizing the need for continuous adaptation and ethical stewardship in leveraging these powerful tools for cultural preservation and education. Thus, recommends continuous training and professional development for staff to bridge skill gaps and ensure effective use of technology.

Key words: Artificial Intelligence, Museum, Cultural Heritage, Augmented Reality

Introduction

The digital revolution has profoundly impacted numerous sectors, thus museums and cultural heritage institutions are no exception. The advent of Artificial Intelligence (AI) and other emerging technologies, such as virtual reality (VR), augmented reality (AR), and data analytics, has offered unprecedented opportunities to transform these institutions. Artificial intelligence is being lauded as the "future". There is untapped value to be unlocked across sectors looking for their commercial, scientific and educational potential. With machine, learning tools and insights have become more accessible than ever before. Regarding the broader applications of AI, we must admit that creative robots are already creating paintings, writing screenplays and composing music. Stephen Hawking predicts that computers will outpace humans with artificial intelligence within the next century Ciecko, (2017). Artificial intelligence and its place in museums If scathing media coverage and scathing talk about politics are any indication, AI will shape people's lives for years to come. From breakthroughs in medicine to improving spam filters, applications of artificial intelligence and machine learning are growing every year. In the museum sector, A.I., presents a range of opportunities, from new patterns of engagement with collections to institutional advancement initiatives and beyond.

The concept of the virtual museum appeared for the first time in 1947 by the scientist Andre Malraux, and the virtual museum is defined as a group of digitally recorded images of historical, scientific or cultural importance that are accessed through electronic documents. The virtual museum offers an unconventional method for communicating with visitors using flexible tools sensitive to user needs and interests. The virtual museum takes different forms depending on the museum display scenario, where the museum is presented in a three- dimensional

The virtual museum presents the museum collections through the web, the Internet or the personal computer. Technological developments that have emerged as areas of critical importance make it possible to use sophisticated tools to provide customized interfaces for creating virtual museums, to design a virtual museum exhibition in many ways, Milgram, and Kishino (1994) used information vectors to build, acquire and integrate knowledge. New types of interfaces, interaction technologies, and tracking devices are developing at a rapid pace and can be integrated into multimedia VR and interactive AR interfaces. Exhibits are intended to be more dynamic and interactive rather than static in nature and authoritative to create a more realistic approach and enhance the experience of virtual visitors.

The main features of the online interactive exhibition are:
Multiple contexts so that the user can connect to the gallery in a seamless manner

Good instructional design
Proactive learning contexts
Good balance between learning and entertainment
The absence of pages full of texts to interfere with the learning experience

Photography technology
Virtual museums need high-resolution images in order to provide as much information as possible about the virtual exhibits. It relies on the resolution of digital and traditional high-resolution images. Images produce very large files that are difficult to manage and transfer over networks due to their reliance on bandwidth availability. The strategy adopted to counter this problem is image servers that use a Russian doll imaging architecture

and give the user opportunities for expansion and interaction, because the multiple resolutions of the image are stored in a single file and make it possible to gradually transfer the image. FlashPix and then JPEG2000 are two image formats that introduced a new concept of imaging architecture. It also allows storing metadata

This image format is used by various museums such as Talagala,(1998).Some Flash Pix features are certified by the JPEG2000 image format which also has progressive image portability and scalability and some new features that fill in the gaps of metadata insertion and content protection Content of previous standards for digital media encryption. The advantages of the image format have been extensively investigated in research or work and the JPEG2000 format has been adopted by cultural institutions (Sylaiou, *et al.,* 2004).

3D Web Galleries

Internet technologies have tremendous potential to provide virtual visitors with ubiquitous access via WWW to the museum's virtual environment. The increasing efficiency of Internet connections (ADSL) makes it possible to send important media files relating to artifacts to virtual museum exhibits. The most popular WWW visualization technology includes 3D Web that offers tools such as VRML and X3D, which can be used to create an interactive image Virtual Museum TheWeb3D Consortium contains standards for realtime 3D communication and the most important standards include: VRML97 and X3D. Since 1997 it has been VRML97 which stands for Virtual Reality Modeling Language. Technically, as a 3D interchange format that defines most of the commonly used semantics found in today's 3D applications such as hierarchical transformations, light sources, viewpoints, geometry, animation, material properties, and mapping. VRML is also defined as a simple, cross-platform language for publishing three-dimensional web pages as well as to provide the technology needed to integrate three dimensions, and transform texts into multimedia into a coherent form. When these types of media are combined with scripting languages and the capabilities of the Internet, a whole new type of interactive application becomes possible. Hence, this makes the presentation of virtual exhibitions possible, the visualization usually consists of dynamic web pages combined with 3D VRML models (Liarokapis, *et al.,* 2004)

This can be enhanced with other multimedia information (such as movie and audio clips) and used remotely via web protocols (HTTP). A more 3D graphics format, Collaborative Design Activity (COLLADA) defines an open standard XML schema for exchanging digital assets between various graphics software applications that may store their assets in incompatible formats. One of the main advantages of COLLADA is that it includes more advanced physical functions such as collision and friction detection (which is not supported by 3D Web).

The most powerful technologies that have been used in museum environments include OpenSceneGraph (OSG) and a variety of 3D game engines. OSG is a high-performance, cross-platform, open source 3D graphics toolkit, used by museums (Calori,*et al.*,2005) to create more powerful VR applications, especially in terms of immersion and interaction since it supports text, video, audio, and 3D scenes in a single 3D environment.

On the other hand, 3D game engines are very powerful and provide superior visualization and physics support. Serious games are a new concept and allow the collaborative use of 3D spaces that are used for learning and teaching purposes in a number of educational fields. The main strengths of serious gaming applications can be generalized as in the areas of communication, visual expression of information, mechanisms of cooperation, interaction and entertainment. Both technologies (OSG and 3D game engines) compared to VRML and X3D can provide highly realistic and immersive museum environments, but they have two main drawbacks. First, they need advanced programming skills in order to design and implement custom applications. Secondly, they do not have support for mobile devices such as PDAs and 3G phones.

Virtual reality exhibitions

Virtual reality is a simulation of a real or fictional environment created in 3D through digital technologies that are visually tested and provide the illusion of reality. Over the past few years, modeling software has become affordable and the cost of building virtual environments has decreased dramatically, fueling new application areas such as virtual heritage. For example, low-cost, highly interactive VR experiences for museum visitors can be created on the basis of standard hardware components (a relatively low-cost computer with a cheap graphics accelerator, touch screen, and sensor, for example an inertial cube), and some application software and browser plug-ins. Virtual reality applications can be used by distributed groups of a large number of players, and are immersive and interactive. In a virtual reality environment, participants are immersed in a completely artificial world but there are different types of virtual reality systems, which provide different levels of immersion and interaction. Heim believes that weak virtual reality can also be characterized by the appearance of a three-dimensional environment on a two-dimensional screen (Heim, 1993). In contrast, powerful virtual reality is the complete immersion of the senses, which includes immersion screens and tracking and sensing technologies. Common visual displays include head-mounted displays and polarized holographic glasses while inertial and magnetic trackers are the most common positioning and guidance devices. As far as sensing is thought, a 3D mouse and glove can be used to create a sense of control in a physical space. Kivotos is an example of a highly immersive VR environment, a virtual reality environment that uses the CAVE® system, in a room measuring 3m by 3m, where the walls and floor act as projection screens and in which visitors embark on a journey thanks to stereoscopic 3D glasses. As mentioned earlier, virtual galleries in a web browser can be visualized in the form of 3D galleries, but they can also be used as a standalone interface (not within a web browser).

In addition, there are a number of commercial virtual reality software tools and libraries, such as Cortona, which can be used to create fast and efficient virtual museum environments. However, the cost of creating and storing content (3D exhibitions) is too high for medium and small-sized museums that represent the majority of cultural heritage institutions. An overview of the tools and methods is available.

Augmented reality exhibits

It provides museum visitors with an enhanced experience by visualizing, interacting with, and navigating museum collections among artifacts, or even by creating museum exhibits in an augmented reality environment. Virtual visitors' Virtual artifacts can be placed anywhere in the real environment using either sophisticated software methods (... computer vision technologies) or specialized tracking devices (Inerti-a Cube). Although AR exhibition is difficult to achieve, it offers more advantages to museum visitors than Web3D and VR exhibitions. In the Augmented Reality Museum Gallery, virtual information (usually 3D but can also be any type of multimedia information, such as text or image information) is displayed on video frames captured by the camera, giving users the impression that virtual culture artifacts already exists in the real environment, Macariu, and Iftene.,(2018). Through human computer interaction techniques, it can Users carefully examine virtual artifacts by tactile manipulation of data (tags) or sensors (using pressure gloves). This "augmentation" of the real-world environment can lead to easier access to museum information and enhance the impact of the museum exhibition on virtual visitors. The automated tour guide system uses augmented reality technologies for an interactive virtual exhibition and can superimpose meaningful audio on the real world based on the user's location, providing the advantage of enriching visitor experiences.

The Meta-Museum Guide System is based on augmented reality and artificial intelligence technologies which provide a communication environment between the real world and cyberspace to make the most of the museum's archives as knowledge base (Mase, *et al.,* 1996). Moreover, AR has been experimentally applied to allow visualization of real objects that are incomplete or broken as they were in their original state by overlaying missing parts.

The ARCO system provides customized tools for virtual museum environments, ranging from the digitization of museum collections to the tangible visualization of both museum and antique exhibits (White *et al.*, 2004). ARCO has developed tangible interfaces that allow museum visitors to visualize virtual museums in 3D Web, VR, and AR environments sequentially.

Mixed reality exhibitions

Mixed Reality (MR) is based on a combination of virtual reality, augmented reality, and the real environment. According to Milgram and Kishino's Virtual Reality and Real and Virtual World series, objects are presented together on a single screen with a visual representation of real and virtual space. 3.6

Touch the method of touch and feel involves the shape and texture that the observer feels when exploring a virtual object. The Haptic touches make it possible to achieve the extension of visual presentations to make them more realistic, useful and attractive to visitors. The Phantom device is used inside the museum allowing visitors to touch and feel the virtual reality.

Phantom is a desktop ground robot that allows simulating the contact of one finger with virtual objects through a pointing device (such as a pen), as it detects collisions with virtual objects, simulating the sense of touch.

Use of mobile devices in museums

Mobile devices represent a wide range, including cell phones, personal digital assistants (PDAs), and tabloids. Improvements over the past few years in optics, processing power and ergonomics have begun in a number of museum applications.

Negative effects of the use of artificial intelligence in the field of Museums and heritage

Bias: since AI algorithms are created by humans, they can have internal bias by those who intentionally or unintentionally inserted them into the algorithm. If the AI algorithms are built with bias or the data in the training sets, they were given to learn from is biased, it will produce biased results. This reality could lead to unintended consequences like the one seen in the discriminatory recruitment algorithms and Microsoft's Twitter chat bot becoming racist. As companies build AI algorithms, they need to develop and train responsibly.

Loss of certain functions:

While many jobs will be created by AI and many people expect a net job increase or at least expect the same amount to be created to replace jobs lost thanks to AI technology, there will be jobs that people do today that machines will take over. This will require changes to training and educational curricula to prepare the workforce of the future as well as helping current workers transition to new jobs that will take advantage of their unique human capabilities.

Transformation of the human experience:
If AI takes on menial tasks and allows humans to drastically reduce the amount of time they need to work, the extra freedom may at first glance seem like a utopia. However, in order to feel that their lives have a purpose, humans will need to direct their newfound freedom to new activities that give them the same social and mental benefits that their job used to provide. This may be easier for some people and communities than others. There are likely to be economic considerations, too, when machines take over the responsibilities that humans used to pay to do. The economic benefits of increasing efficiencies are quite evident in corporate profit and loss statements, but the overall benefits to society and the human condition are a bit more ambiguous.

Global regulations:
While our world is becoming a much smaller place than ever before due to technology, this also means that AI technology that requires new laws and regulations will need to be defined between different governments to allow for safe and efficient global interactions. Since we are no longer isolated from each other, the actions and decisions regarding AI in one country can negatively affect others very easily. We are already seeing this happen, with Europe adopting a strong regulatory approach to ensuring approval and transparency, while the US and China in particular are allowing their companies to apply AI more freely.

Accelerated Hacking:
AI is accelerating the speed of what can be achieved and, in many cases, beyond our ability as human beings to follow through. It can be thorny to detect nefarious actions as phishing, handing viruses into software and taking advantage of AI systems because of the way they see the world before the damage is caused.

AI Terror: Likewise, there may be a new form of AI-enabled terrorism to deal with: from the expansion of autonomous drones and the introduction of robotic swarms to remote attacks or disease transmission through nanobots. Our law enforcement and defense organizations will need to adapt to the current potential threat. This will take extensive human time and thorough examination to determine the best way to prepare for the future with more applications of AI ensuring that even though there is potential for negative interaction with further adoption, they are minimized as much as possible.

Conclusion

The digital revolution has profoundly impacted numerous sectors, and museums and cultural heritage institutions are not left out. The era of Artificial Intelligence (AI) and other emerging technologies, such as virtual reality (VR), augmented reality (AR), and data analytics, presents arrays of opportunities which can transform these institutions various types of virtual museums. The range of classifications like the imaging technology, 3D Web, VR, AR, MR, touch and mobile devices are personal aids which museums can exploit as possibilities of new media to analyze and respond in different ways to visitors. This will offer intuitive interaction with the displayed content and provide an entertaining and educational experience. Virtual museums avail many benefits as they make better museum curators, enhances seamless of documentation, preservation, research and exhibition. In virtual museums, the ability to preserve and disseminate cultural information more efficiently and with cost-effective approach using innovative tools and methods become more attractive to varied group of visitors and can promote enduring information about museum exhibitions while offering improved display of artifacts with aid of emerging technologies. This sits well with various groups of end-users such as career professionals, students and tourists alike who can benefit it as it meets their recreational and educational needs.

Recommendations

Based on contemporary perspectives and findings, as well as to optimize the application of AI and emerging technologies in museums and cultural heritage institutions, it has become imperative to propose:

Development of Strategic Partnerships:

Museums should collaborate with technology companies, academic institutions, and other cultural organizations to leverage expertise and resources. Partnerships can facilitate the development and implementation of innovative technologies, ensuring their effective integration into museum practices.

Invest in Staff Training and Development:
To fully realize the potential of AI and emerging technologies, museums should invest in the training, retraining and development of their staff. This is to meet the demands of the use of new technologies, as well as fostering a culture of continuous learning and adaptation.

Prioritize Ethical Standards:
Establish clear ethical guidelines for the use of AI and emerging technologies. This includes ensuring data privacy, addressing potential biases in AI algorithms, and respecting intellectual property rights. Museums should engage with stakeholders to develop and implement these standards.

Enhance Digital Infrastructure:
Invest in robust digital infrastructure to support the adoption of AI and emerging technologies. This includes upgrading hardware, software, and network capabilities to ensure seamless integration and operation of advanced technological tools.

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