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From Image-Based to Immersive: Exploring Virtual Museums that enhance Accessibility and Forms of Museums

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Abstract

This paper delves into the evolution of museums in the Fourth Industrial Revolution era, where digital archives and virtual reality (VR) redefine the museum experience. Despite technological constraints, museums largely rely on image-based content, limiting their integration into the tech-driven society. However, the rise of virtual museums show diverse media programs from 3D presentations to interactive quizzes in order to enhance accessibility and education. Beyond institutional efforts, individual programmers contribute to using media platforms for broader accessibility. These advancements signify a promising pathway to engage diverse audiences and democratize cultural experiences within immersive digital environments. Moreover, this paper scrutinizes the challenges faced by museums in embracing the digital transformation including issues related to technological constraints, financial investments, and the need for specialized skills in curating digital content.

Keyword : Virtual Reality, Virtual Museum, Ubiquitous, Education, Individual programmers

1. Introduction

The Fourth Industrial Revolution, which has been actively developed through the interest of the whole society, was first introduced at the 47th World Economic Forum (WEF) held in Davos, Switzerland in January 2016. They defined as a term representing a new industrial era based on intelligent Information Communication Technology (ICT) and the next industrial revolution driven by artificial intelligence (AI), robotics, and life sciences [1]. In such a society, the prosumer society, where consumers participate in production activities, deepens and changes into a platform environment where consumers influence suppliers. Therefore, with the advent of the Fourth Industrial Revolution, the existing manufacturing industry is combined with new paradigms including digital technologies such as big data, Internet of Things (IoT), and AI and platform businesses, and has been transformed into an innovative paradigm that emphasizes consumer dynamics. This revolutionary change has ushered in the era of Museum 3.0.

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Various virtual reality (VR) technologies such as the establishment of digital archives based on big data, the emergence of exhibition spaces based on VR, and education through gamification have changed the form of museums and made it possible to access exhibition spaces not only in reality but also in a ubiquitous environment.

This transformation of museums is expected to expand the accessibility of public educational institutions so that it can provide opportunities to visit across class, geography, and age [2]. However, due to technological and economic constraints, most museums have tended to provide this information in the form of images, such as 3D indoor immersive map data. Of course, due to the type of museum that is centered on viewing, it was intended to induce an increase in visitors, but it has shown a tendency to be a supplementary means of the museum's website. Even in VR, the information delivery method of the past, which is centered on physical objects, is used, and it is not changing the form of the museum itself through the 4th industrial revolution. Therefore, it seems to be far from today's real society that is being commercialized.

A virtual museum is a digital platform that allows users to explore and interact with exhibits and collections from museums and galleries around the world. Virtual museums can take many forms, from simple online galleries to immersive 3D environments that replicate the experience of visiting a physical museum [3]. They offer many benefits including increased accessibility, the ability to reach wider audiences, and the potential to enhance learning and engagement with cultural heritage [4]. Recent studies have explored the potential of virtual museums to target specific audiences such as the MZ generation, older adults, and youth, and have suggested strategies for creating content that is engaging and effective [5][6].

Efforts to develop virtual museums are not solely undertaken by public institutions such as museums but individuals, particularly solo programmers, are increasingly delving into this domain. These independent programmers focus on ubiquity as their primary field of activity. For instance, when faced with limitations during the development process due to budget constraints or technical expertise, solo programmers seek support from visitors through donations and strive to enhance accessibility by utilizing media platforms like streaming channels. This approach opens avenues for expanding virtual museums by illustrating ways to enhance accessibility through new media. By citing examples from both overseas and domestic museums based on VR, this paper aims to explore the potential for broadening the scope of virtual museum experiences.

2. Virtual reality and museums

2.1 Virtual Reality

VR is an experience that takes place in a simulated environment through an interactive computer and is primarily a sensory experience that includes auditory, visual, and even tactile sensations. This concept of VR is also related to the concept of multimodality. Multimodal refers to the use of more than one mode of communication, such as image, gesture, sound, text, or voice, to create meaning. Therefore, a multimodal experience is a situation in which users interact with a certain information or system through multiple modes of interaction. This increases the sense of realism and allows visitors to immerse themselves in VR.

2.2 Emergence of Virtual Museum

Beginning in the mid-1990s, the application of VR technology in museum settings has been implemented in a variety of ways from CAVE systems to multimedia applications. The technology is mostly used for the digital reconstruction of lost sites and artifacts, but in recent years it has been applied to 3D galleries that allow 360 degree tours in a web browser [7]. This change is due to a shift in the core value of museums from ‘exhibit-centered to visitor-centered’ [8]. In the modern era, this movement has been transformed into a marketing and interactive act of identifying and researching visitors’ demands, needs, and preferences and reflecting them in planning. Through ubiquity, the way museums access and provide exhibitions and educational media is also being diversified to enhance the public’s cultural interest and response [9]. The dictionary meaning of ‘virtual museum’ is a museum that exists as information on a computer or television. The information of the artifacts is stored, and the user has the same experience as actually going to the museum and seeing the artifacts. Accordingly, virtual museums that utilize VR to directly interact with visitors and provide them with a simulated environment through computers and sensory experiences including hearing, sight, and so on.

VR is an experience that occurs in a simulated environment through an interactive computer and provides a sensory experience that mainly includes hearing, vision, and even touch. This concept of VR is also related to the concept of multimodality. Multimodal refers to the use of two or more modes of communication, such as images, gestures, sound, text, and voice, to create meaning. Therefore, a multimodal experience is a situation in which users interact with a specific information or system

through multiple modes of interaction. This experience increases the sense of realism and immerses the viewer in virtual reality environment (VRE).

2.3 Virtual Museums Examples

Virtual museums have proven to be effective in educational settings [10][11]. Moreover, the potential for using VR in education allows users to create their own virtual museums [12]. As museums embrace advancements in information technology, there is a growing trend of museums developing virtual spaces with their unique content [13-15].

Using virtual museums provides numerous advantages, such as accessibility to cultural heritage regardless of geographical location, interactive learning experiences, and the ability to explore historical artifacts in a digitalized and immersive environment. These platforms foster engagement and offer flexible learning opportunities for diverse audiences, including students, researchers, and enthusiasts, ultimately revolutionizing the way we interact with and learn from our collective history and heritage. Through examples of digital archives in domestic virtual museums, this paper is to discuss the forms and limitations of digital archives.

2.3.1 Streaming

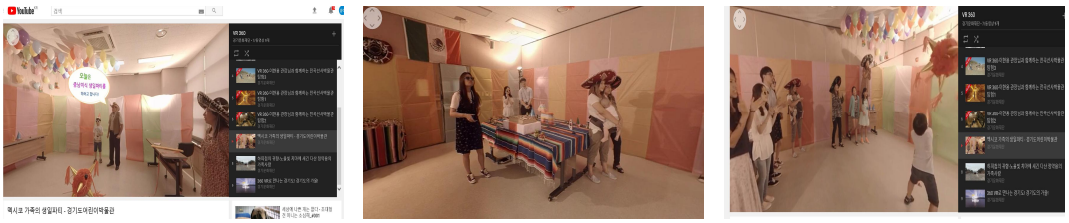
As shown in [Fig. 1], introducing features like section repetition and customizable content selection during streaming docent hosting enhances participant autonomy. This addition not only infuses gamification elements, thereby sustaining the interest of docents who might otherwise become disengaged, but also bolsters participants' comprehension of artifacts. Incorporating quizzes and arcade games contributes to a richer understanding of the exhibits while making the experience more interactive and enjoyable.

[Fig. 1] Nexon Computer Museum

As shown in [Fig. 2] and [Fig. 3], the Jeongokseon History Museum and the Gyeonggi-do Children's

Museum are guiding visitors to their respective exhibitions and experience programs through the streaming medium of YouTube. At the Jeongokseon History Museum, Director Lee Hwan-yong personally guides visitors through the museum's historical background, exhibition halls, and artifacts via a video focused on freely exploring the exhibits using OTG technology. On the other hand, the Gyeonggi-do Children's Museum offers an experiential program where the content and direction are vividly presented to visitors so that visitors can immerse themselves in the field. This approach includes the museum's internal space layout and outlining the program's progression for easy visitor navigation.

[Fig. 2] Jeongok History Museum

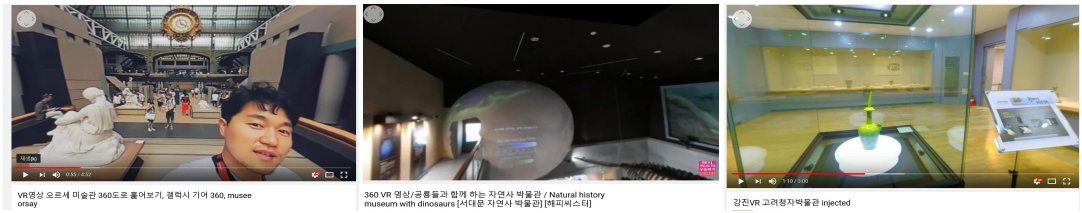


[Fig. 3] Gyeonggi Children's Museum

In 2016, Google Korea streamed content from the Natural History Museum in London, England, and the Natural History Museum in Berlin, Germany. As shown in [Fig. 4], these streams focused on specific artifacts, such as the Romaleo Saurus and Giraffatitan, in VR rather than providing panoramic views of the entire museums. The artifacts were accompanied by animation effects and docent explanations, enhancing visitors' understanding of these exhibits.

These instances illustrate how the once-challenging realm of VR has evolved, thanks to the integration of the Fourth Industrial Revolution, enabling its production by individuals. Hundred Creator's 360-degree tour of the Musée d'Orsay delved into the intricacies and methods of implementing VR post-filming. Meanwhile, as shown in [Fig. 5], Happy Sister's exploration of the Seodaemun Museum of Natural History and JinChul Hong's recordings at the Goryeo Celadon Museum showed the widespread accessibility and utilization of VR by the general public, particularly in capturing panoramic views of these museums.

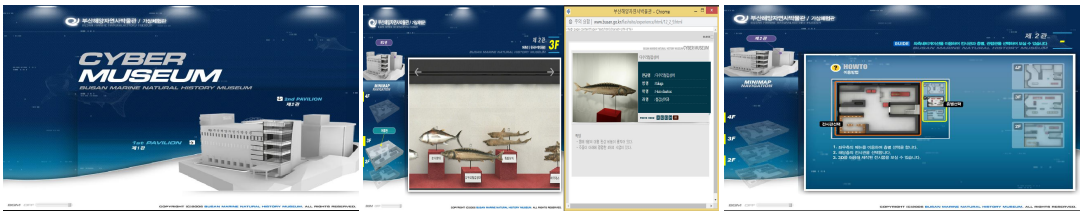
[Fig. 4] Google Korea



[Fig. 5] A single creator

2.3.2 3D VR

The 3D virtual reality setup replicates the actual exhibition hall so that it can allow participants to navigate autonomously using On-The-Go(OTG) technology. It also enables free movement and artwork selection. However, some digital archives rely solely on images and text, potentially leading to a monotonous experience that might disengage participants in the virtual museum.



[Fig. 6] Busan Museum of Natural History Museum

At the Busan Maritime and Natural History Museum, artifacts are also rendered in 3D within the exhibition space as shown in [Fig. 6]. Upon selection, a 360-degree view of the artifact alongside its appearance in the physical exhibition hall is presented to offer detailed information through textual content. This exemplifies an effective way of storing artifact information using digital archives.

Kunstmatrix adopts a distinct approach compared to other institutions by integrating direct

communication within the virtual museum. As shown in [Fig. 7], it allows users to send email directly to administrators for inquiries and suggestions about the artifacts, establishing an interactive communication channel.

[Fig. 7] Jinju City Museum of the Two Men in Jinju City

2.3.3 3D immersive indoor map data

3D immersive indoor mapping technology stands as one of the most extensively used technologies today. It can be exemplified by applications such as the Street View feature on maps. This technology is harnessed in virtual museums to enable users to explore the exhibition hall interiors via images and navigate through OTG-based movement controls. OTG is a technology that allows devices like smartphones or tablets to act as hosts, enabling connections with other USB devices such as flash drives, keyboards, or external hard drives without needing a computer as an intermediary. OTG functionality facilitates direct communication between compatible devices, enhancing their versatility and usability.

[Fig. 8] Google Artproject street view

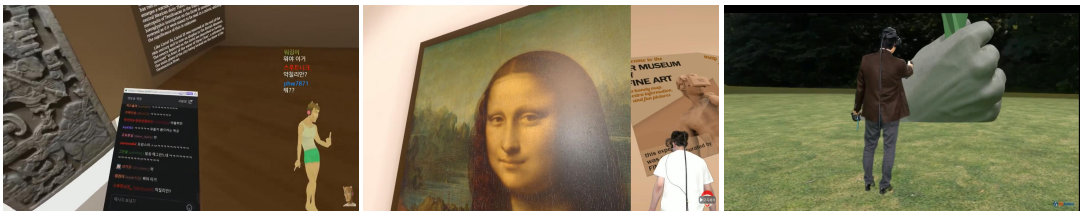
For example, The Google Art Project Street View is an extension of Google Street View that

specifically focuses on providing virtual tours of museums and cultural institutions. As shown in [Fig. 8], this feature allows users to explore the interiors of museums, view artworks, and experience the ambience of these cultural spaces from their computers or mobile devices. Users can navigate through galleries, zoom in on artworks, and access information about the artworks and the institutions hosting them. It offers an immersive way to engage with art and cultural heritage online.

2.3.4 VR game programs

The VR Museum of Fine Art represents an exceptional showcase of virtual reality to offer free access to anyone with a compatible VR device. Its funding model relies on visitor donations that show the immense potential of virtual reality in the realm of art appreciation.

As shown in [Fig. 9], this platform affords visitors an unprecedented opportunity to intimately engage with renowned masterpieces and it allows them to virtually touch and manipulate these artworks in ways impossible in the physical world. Through their devices, users can explore different angles and spaces, revealing aspects of the artworks previously hidden from view.



[Fig. 9] The VR Museum of Fine Art Game Program

In addition to textual information, the museum incorporates immersive sounds associated with the artifacts in order to enrich the overall sensory experience. Furthermore, its integration with broadcast channels like Twitch amplifies its impact, not only engaging direct users but also attracting audiences who experience the museum vicariously through live broadcasts. This dual audience approach enhances its reach and impact within and beyond the VR community.

3. Conclusion

The evolution of digital archives has transcended traditional limitations, ushering in an era where VR spaces redefine the museum experience. This shift allows participants to actively engage with digital archive and foster direct interaction and learning within a virtual realm. The convergence of IT

technology and multimedia not only introduces a novel experiential dimension but also ignites participants' interest, diversifies museum formats, and charts a new course for information acquisition.

This study has examined diverse media programs within virtual museums including 3D presentations, gameplay elements, interactive quizzes alongside the universally appealing images and videos. These findings illustrate the potential for virtual museums to offer educational content and digital archives inclusively. This approach signifies a promising pathway for engaging audiences of diverse backgrounds and ages and underscores the democratization of knowledge and cultural experiences within these immersive digital environments.

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