THE DIGITAL MUSEUM: CHALLENGES AND SOLUTION

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Abstract—**This article discusses the development of digital curation in cultural expression applications, such as museum and art gallery, focusing on the user experience perspective. The use of digital technology has improved the production process in conventional museum and art gallery and has greatly facilitated the interaction between viewers and collections. Although the concept of digital museum has attracted a lot of attention in the past decade, there remain many challenges to be addressed. In this paper, we discuss current progress in the development of digital museum and identify important factors that affect its successful deployment.**

Keywords: digital museum, digital curation, semantic web, argumented reality, user experience

I. INTRODUCTION

From time immemorial, the way traditional museum exhibits are only limited to leading the audience into showrooms to view the original artworks, however, due to the limitations of factors such as exhibition space, venues, and schedules, the total numbers of direct contacts with exhibits are in the minority. For instance, the National Palace Museum (NPM) of Taiwan, which contains more than 650,000 domestic and foreign antiquities, has continuously increased its collections by purchasing or accepting donations of artifacts. The entire collections will take over 30 years to exhibit if each exposition is run for three months at a time [1]. A museum would seem like an antiquity warehouse, which is inapproachable and distant. Moreover, since the antiquities belong to all citizens, the traditional museum has a predicament where owners cannot freely acquire information about their properties.

According to the statutes of International Council of Museum (ICOM), a museum "is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, research, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment" [2]. Hence, an important role of a museum is to make its heritages become a part of our life, much like the functions of a library. Based on this aspiration, the digital curation of a museum has become a common pursue in both the academic and public sectors.

Technology and societal impact play a complementary role to each other in museum digitization. The value and function of cultural heritage are realized through knowledge sharing and exchange of idea. Hence, the focus of the digital museum should be on the visitor's experience rather than the technology itself. However, without the aids of advanced technology, such goal cannot be materialized effectively. Therefore, the challenges involved in the creation of digital museums can be divided into two dimensions: the use of technologies and the enhancing the user experiences.

In the past, the technical dimension has been the primary focus. Issues ranging from the imaging and digitization of artifacts to data management have been extensively researched [3–6]. It is true that a successful digital museum requires a good technology; it is also true that the success cannot come without considering the cultural heritage sharing aspect. There are, however, very few studies on the later, particularly on the area of user experience.

In this article, we focus on the aspect of user experience and describe strategies that help to enhance a visitor's on-site experience in a museum through digital technology. We discuss how the use of technology can improve the production process and increase the communication and interaction between viewers and collections in museums and art galleries.

II. THE CHALLENGES OF DIGITAL CURATION IN THE MUSEUM

Virtual Museum versus Physical Museum

The museum digitization movement has been ongoing for over a decade since the beginning of the 21st century. The term "digital curation" first emerged in an academic seminar convened by the Digital Preservation Coalition and the British National Space Centre in London on 2001 to discuss the improvement of the Open Archival Information System Reference Model (OAIS) standard and the knowledge sharing of digital curation in various fields [7]. However, the huge advancement of information technology has turned the digitization process to become more progressive and diversified. Accordingly, the virtual museum has become a platform where museum connect with their clients outside the museum building. Many well-known museums have committed to create their virtual environment by either putting the digitized information onto their web pages or pre-recording their tour guide through portable devices, such as the Collection Database (Compass) of The British Museum [8]; the virtual museum of The Louvre on the iPhone [9]; and The

Metropolitan Museum of Art's Timeline of Art History [10]. The common feature of these efforts is that the information can be received by the visitors quicker and easier without time and space limitation.

Although the development of museum seems to benefit from the application of digital technology, digitization of the museum has also brought with it some disadvantages. For example, the physical museum is becoming more isolated and functionless without visitors participation; meanwhile, the audiences are also losing the opportunities for sharing and communicating their viewpoint with others. From the user's point of view, the digital museum is not to replace the traditional museum; conversely, the digital information should complement the physical museum. Carol has found from her interview survey that the traditional value of museum has been unintentionally eroded in the process of museum digitization [11]. She argued that the physical museum has an irreplaceable status in people's minds. Hence, the aim of museum digitization should be focus on filling the gap of the physical museum.

According to Coulter-Smith, the constitutions of social communication and art collections have been hampered by the operating patterns of galleries for a long time [12]. Cultural institutions should function as a learning environment [13]. As museum experience should be done on physical place with genuine objects, the enhancement of user experience in the physical museum, such as how to improve the communication by considering the interactive factors has attracted much effort.

The Development of Museum User Experience

User experience has been considered as an indispensable factor by academic researchers and curators in museum digitization in recent years. According to Beer, museum visitors spend less than one minute on each collection in on-site [14]. Thus, how to captivate visitors by extending the time of art appreciation and enhancing their knowledge by adopting various machineries has become a new branch of research in digital curation. As Gurian pointed out, the physical museum will be blended with technological element in the near future [15]. Some research results have suggested that, the museum experience can be boosted by an interactive and immersive environment [16]. Consequently, it can be expected that the traditional method of masterworks' description will be replaced by other methods that enhance the sensory impact and the real experience of the visitors. Based on this concept, the discussion of user experience can be divided to several aspects, the facets of visualization, personalization, interaction with education, and repacking. These key elements may offer visitors with a valuable experience and help improving communication between viewers, curators, and museums.

III. CURRENT STRATEGIES

Analyze the challenge and limitation of digitization for providing the best viewing experience is a crucial step in the development of digital curation. In the implementation of digital museum, the relationship between people and collections is more important than the compilation itself. Therefore, in relation to the aim of digitization of collections and the problems being faced, this section will discuss the current development of the user experience in the museum

setting and offer the possible strategies for the future achievement.

Visualization (Casual information visualization)

The characteristic of visualization is the keystone of user experience in the field of the digital museum. Previously, visualization systems were mostly exploited in the professional field as an overview provider through complex technology-based interface and interaction [17]. For example, The Solid Software Xplorer (SolidSX), which is a Windows tool of creating the high-resolution image structures for users to understand and examine the applications that are designed by any type of .NET languages; and Crime mapping, which is a map adopting by law enforcement agencies (LEA) for showing and analyzing different crime models.

However, the situation has been changing over the last few years. The concept of Casual Information Visualization (Casual InfoVis) has been noticed by the digital curation community. Casual InfoVis is designed for audiences who do not have special qualifications or only visit museums casually [18]. The view of this insight comes from the edification of other information systems, social visualization and artists' visual works. The difference between Casual InfoVis system and traditional InfoVis can be due to differences in user population, usage pattern, data type as well as goals. The information can be illustrated by using computer-mediated applications [17].

Casual InfoVis can be described as a rudiment of utopia in the cultural organization. However, the implementation and outcome of this concept still relied on the integrating of different components such as interactive interface, database and personalized framework. With the progress of digital museum development, the developers and curators should keep this notion in mine in order to assess the visitors' behavior effectively for providing the best solution.

Personalization

The function of personalization is one of the fundamental components for the achievement of digital museums. Proper use of this concept could not only provide curators with better opportunities to understand the needs of visitors, but also cultivate their potential devotion. As Riecken pointed out, personalized attention is a way of "building customer loyalty by establishing a one-to-one relation" [19]. In addition, personalization may also reduce the financial pressure in the operation of museum management. Many studies have found that the budget of a museum has become less rely on government support. How to use the limited resources to connect with audiences has become the major concern [20]. For instance, museums could optimize the tour paths to attract visitors by using personalized technologies; or choose the most popular collections for exhibition via repackaging.

In order to accomplish this objective, there are a number of projects in museum personalization. CHIP (Cultural Heritage Information Presentation), which is an interdisciplinary research project between information technology and museum masterpieces created by CATCH (Continuous Access to Cultural Heritage) program of NWO (The Netherlands Organization for Scientific Research) in Netherlands [16]. It creates a pre-visit experience for allowing visitors to build a

personal tour path by rating collections online, as well as offering a chance to review the collections which are of interest to them after they finished the on-site visit. The Piggy Bank Project, a sub-work of Simile project directed by the MIT Libraries and MIT CSAIL, is presented as a Firefox extension for user to collect digital contents from separate websites, then combine them together for further references [21]. In spite of each project providing diverse features, the most noteworthy feature of these projects is their integration of the Semantic Web.

The personalization of item can be implemented by using highly semantic module. According to Tim Berners Lee, the Semantic Web is an extension of the web based on the fact that machines can better comprehend the metadata by giving a well-defined meaning to information. In the context of digital museum, the Semantic Web is evolving from being museum dominance towards user centered collaborative filtering. The materialization of which could be involved in several modules, including Resource Description Framework (RDF), a data model that is used to carry a variety of metadata between resources [22]; Web Ontology Language (OWL), a language that is clearly expressed in terms of proper nouns and the relationship between these terms [23]; Friend of a friend (FOAF), a way of self-discretion adopted by XML and RDF that could make the connection between each individual in the Web [24]; Simple Knowledge Organization System (SKOS), a language that is designed by RDF Schema for sharing and demonstrating controlled vocabularies [25], as well as Cidoc CRM, which is announced by Comité International Pour La Documentation (CIDOC) that particularly focus on the museum of cultural heritage [26].

Although the Semantic Web seems to be a beacon for the museum personalization, it still has some potential drawbacks need to be overcome, such as the issues of privacy, data security and immature ontologies. It is due to the fact that the role of Semantic Web in the museum context is to provide a way of analyzing and understanding human behavior while separating irrelevant personal details of the users. The questions of how to maintain information as a personal resource without privacy and security concerns, and how to define the ontology have become important issues for the future.

Interaction and Education

Formerly, museum exhibitions tend to comprise of actual objects with limit explanations, which are always written by curators or reviewers on the panels beside the objects or pre-record in the audio hand-held device as a personal tutor during the visit. However, such styles of presentation has many negative aspects, such as creating distance between visitors and the objects, not educational, as well as make people feeling more isolated as they do not have the opportunity to communicate with each other about the objects that they are interested in. Spasojevic and Kindberg pointed out that the expectation of museum exhibitions should be blended with extendable visiting experience, and appropriate interaction with real objects [27]. Coulter-Smith also reinforced the importance of interactive activities, which can lead arts into our lives by building a bridge between visitors and artworks [12]. Therefore,

the capacity of the museum should be like a "multi-dimensional educational institution," where a visitor can retrieve the information for references, and approach the additional resources of the artworks like in a tutorial. In relation to these aims, some techniques have been proposed to enrich the constituent of an interactive museum, such as the Web-based construction, Virtual Reality (VR) or Augmented Reality (AR).

Augmented reality (AR) is an extension of VR system that could intermingle actual with virtual environment for real-time interaction [28]. The implementation of AR may work towards filling the gap of traditional museums which do not offer enough interactive stage for visitors and artifacts. Some studies have been aimed at the application of AR to museum interaction. For instance, the project of Flypad developed by The Mixed Reality Lab (MXR) in the University of Nottingham for a controversial arts center called The Public in England. This project endeavored to enhance the condition of interactivity by using the technique of AR, which allows users to control their avatar by operating different control panels, and to further improve the user experience [29]. Another example is the undertaking of the virtual showcase, which is a translucent display system using AR. It was first introduced at Vienna University of Technology in Austria, followed by the advance pattern, which was announced at Laval Virtual 2011 by the ESIEA engineering school in France [30]. The ambition of this system is to lay emphasis on the interaction between visitors and physical artifacts and break the barrier between virtual and actual museums by integrating the AR technology into a traditional museum showcase format.

In summary, the technique of AR might be a strategy to reach the goals of interaction and education in the physical museum. Unfortunately, on the embodiment of personalization, the pre-experience and after-experience of the visit are not contemplated in these systems. Thus, in order to strengthen the entire journey of the museum visitors, the association of the personalized feature should be taken into account in the development of the interactivity process in the future.

Repackaging

According to the statistic of Museums and Art Galleries Market Report from HighBeam Business in American, most of the cultural funding is decreasing across the United States in the twenty-first century. During this period of economic depression, the Smithsonian, the world's largest museum and research complex in USA, has reported that 29 percent of visitors vanished in just seven months [31]. In this period of budget tightening, the capabilities of information interchange and data repackaging are important consideration for museum digitization. The ability of data repackaging should be considered at the early design phase in the digitization process. Re-combinative collection may bring additional revenues to a museum in various ways. For example, flexible resources could increase the opportunity of art commoditization to bring additional revenue for cultural organizations, as well as to achieve the goal of marketing to attract visitor. As the social anthropologist Mary Douglas and Baron Isherwood mentioned, the significance of goods is the ability to become representatives of social status, symbol or glory [32]. With the change of economic situation, more and more artwork will be

converted into goods in the future. The interchangeable data can reduce the production costs by reusing existing components.

The solutions of repackaging involve a number of techniques, which have been suggested over different discussions. One important consideration is migration, which allows data to move freely between different platforms for cross-platform sharing. Next, the ability of transformation is another important feature. The digital information should facilitate easy format change for it to be recombined and reused with other items. An example is FBX, which is a file format used by the majority of 3D software such as MAYA and 3DS MAX for transferring their projects to other applications.

Repackaging has raised the issue of quality control. Giaretta suggested that the result of multiple file conversion should be paid more attention before the information is transformed [33]. Thus, how to make sure that the converted information is identical to the original and whether the health status of the file is available for long-term preservation will be a critical topic of deliberation in the future.

IV. CONCLUSION

Successfully addressing the challenges in digital museum development could not only promote its growth in this high-tech era but also boost the societal value of cultural heritage. This article provides some insight to the development of digital museum from the user experience viewpoint. A clear understanding of the different factors affecting user experience can provide guidelines to assist curators and scholars in structuring a viable framework. Although much effort has been devoted to the digital museum development, there is still much work to be done. For example, a personalized system will need to confront the issues of privacy and the usage efficiency in the physical museum; then interactive mechanism might disregard the influence of personalization; and a flexible data format will need to deal with the issue of quality control in different platforms. Hence, how to address these issues will be a crucial task in this emerging area.

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