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Utility of Digital Technologies for the Sustainability of Intangible Cultural Heritage (ICH) in Korea †

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Abstract: The importance of preserving intangible cultural heritage (ICH) for sustainable development has been widely acknowledged by the international society. Various forms of cooperation have taken place to prevent deterioration and destruction due to its inherent characteristic of 'intangibleness'. Public engagement, however, has largely been excluded from the system in spite of its significance in safeguarding ICH by inducing people to be trained as successors. In this respect, this paper discusses and emphasises the necessity of public engagement in safeguarding ICH. To this end, it suggests the use of digital technologies to create museum content to encourage public involvement with and learning about ICH. Focusing on ICH in Korea, digital exhibitions on *Jultagi* and *Daemokjang* utilising virtual reality technology are proposed. The ultimate aim of this article is to contribute to the sustainability of world ICH for humanity through digital exhibitions.

Keywords: intangible cultural heritage (ICH), digital technology; digital museum; South Korea; Jultagi; Daemokjang

1. Introduction

In recent years, international communities and NGOs (non-governmental organisations), such as UNESCO (United Nations Educational, Scientific, and Cultural Organisation) [1] and ICOM (International Council of Museums) [2], have acknowledged the significance of safeguarding intangible cultural heritage (ICH). Unfortunately, however, ICH is at risk of deterioration and degradation due to its inherent characteristic of 'intangibleness' and the effects of globalisation and social transformation [3]. Because ICH is not a tangible preserve, it cannot last without the direct intervention and transmission of human beings, such as an individual act or a collective custom. If a sufficient number of successors and their training are not secured, the tradition cannot be properly transmitted and it is inevitable that it will vanish. In order to cope with these threats and promote its sustainability, states and international institutions have cooperated. National governments have introduced policies and systems to take care of ICH within their countries, and international organisations specialising in protecting ICH have been established. These activities, however, need to deal with the issue of inclusiveness—the relationship between ICH (and its holders and successors) and (inter)national governments and organisations is highlighted, whereas public engagement is marginalised in spite of its importance in safeguarding ICH. This is problematic; public understanding of ICH is essential in that it improves an individual's quality of life and in that the organisations in charge require people's support and approval in order

to execute their budget assigned to safeguarding ICH. Also important is to provide the opportunity for experience and participation to the public in order to secure sufficient personnel with the potential to be successors. In this respect, it is of significant importance to provide opportunities for the public to learn what ICH is, why it should be protected, and to actually engage with them. Museums are suitable places for people to learn about and experience ICH, as they are institutions that preserve the tangible and intangible heritage of humanity and exhibit it for the public interest. Digital technologies can be applied to museum exhibitions to contribute to the public understanding of ICH by attracting their attention, increasing accessibility to ICH, and enabling immersive experiences that seem almost like reality, in which the users can feel and interact with multiple senses.

Since the late 1990s, scholars and practitioners in cultural studies and industry began to show interest in the field of ICH. Many suggested the potential of utilising both/either digital technologies and/or museum exhibitions to facilitate safeguarding cultural heritage (see Karp (2004) [4], King et al. (2016) [5]). UNESCO (2003) defined the basic concept of ICH and declared the necessity of safeguarding it [3], whereas ICOM held its general conference under the theme of 'Museums and Intangible Cultural Heritage' in 2004 to discuss museums' roles in safeguarding ICH [6]. Kono et al. (2009) explored issues regarding ICH in terms of intellectual property and ownership [7], whereas Stefano et al. (2012) provided case studies about safeguarding ICH in different countries [8]. Case studies were mainly conducted with regard to Chinese heritage (see Song et al. (2019) [9]; Lin, Q. (2018) [10]). With regard to safeguarding ICH using digital technologies, Pietrobruno (2013) explored videos on ICH uploaded on video-sharing websites such as YouTube in relation to UNESCO's efforts to safeguard ICH. She discussed the possibility of social media as the new digital archive for intangible heritage [11]. Alivizatou (2012) studied the role of museums in preserving ICH [12].

In the meantime, a number of articles have discussed the concepts and cases of digital exhibitions and museums. In general, Park (2014) defined the concept and role of digital museums [13], whereas Lee (2016) went further to emphasise the importance of digital technologies to enhance the social functions of museums [14]. Recent studies have suggested the idea of adapting state-of-the-art digital technologies such as virtual reality, augmented reality, three-dimensional printing, and media façade for museum content (see Bruno et al. (2010) [15], Mortara et al. (2013) [16], Lee (2018) [17]). Butnariu (2019) discussed the development of eHeritage and studied the case of the Dacian Dracon flag [18]. Naguib (2013) studied museums that construct ICH regarding migration and diaspora [19]. In practice, there have been attempts to digitise cultural contents including ICH. For instance, in Korea, the Cultural Heritage Administration (hereafter CHA) has utilised 3D scanning for a number of forms of cultural heritage and has provided their images for 3D printing and modelling along with 3D video clips through an online website [20]. In the same vein, Intangible Heritage Digital Archive provides open resources on intangible heritage in various forms such as video clips and oral records [21].

Although the research above successfully pointed out the importance of ICH and digital exhibitions, few have discussed why public understanding is significant in preserving ICH and how technologies can be utilised to create digital exhibitions on ICH in relation to public understanding. In this sense, this paper explores the possibility of digital technologies being applied to museum content on ICH in order to promote its sustainability through better public understanding. The article begins with exploring the idea of ICH, focusing on the case of UNESCO and the South Korean government as examples of measures of safeguarding ICH in the world. Then, the paper defines the role of museums in terms of public engagement and safeguarding ICH. The importance and necessity of public understanding and engagement in safeguarding ICH are discussed further. Also, the idea of utilising digital technologies is explored. It is relevant to safeguarding ICH because they, especially the immersive realistic media that combine virtuality and physical experience, enable the public to directly taste the training process of intangible heritage education, thereby raising understanding and interest. The convergence between the two ideas is presented in the next section by suggesting possible vrtual reality exhibitions on *Jultagi* and *Daemokjang*, two of Korean ICH. The paper concludes with tentative questionnaires for ICH holders and successors, engineers and technicians, and the general public who

would have experienced the virtual reality (VR) programmes. The questions are designed to evaluate the "educational", "technical", and "inducing" effects of the programmes. The ultimate aim of this article is to suggest the potential utility of digital technologies for safeguarding ICH and to encourage an interdisciplinary conversation on the topic.

2. Theoretical Background

As seen from the literature review, the idea of developing museum content on ICH utilising digital technologies has not been widely discussed. Rather, research on ICH, museum studies and practices, and digital technologies have been conducted separately. This section is devoted to exploring the concepts and possibility of utilising digital technologies to promote sustainability of ICH. It is followed by proposals for digital exhibitions on ICH in Korea in the next chapter.

2.1. Intangible Cultural Heritage (ICH)

UNESCO is a prominent international body that leads global cooperation in the fields of education, science, and culture to promote the sustainability of humanity. One of their major concerns includes cultural heritage. At first, its priority was focused on tangible cultural assets such as "Greco-Roman sites, medieval cathedrals, Renaissance palaces, Egyptian and pre-Columbian monuments, or Chinese and Indian temples", largely overlooking the value of intangible heritage. Since the early 1990s, being inspired by the Korean and Japanese systems for protecting intangible cultural assets, UNESCO's concerns and activities began to encompass the intangible with regard to cultural heritage, taking a "more holistic and inclusive understanding of heritage". A series of relevant measures and projects have taken place: the Recommendation on the Safeguarding of Traditional Culture and Folklore in 1989, the Living Human Treasures programme in 1993, and the Proclamation of Masterpieces of the Oral and Intangible heritage of Humanity in 1997 [12] (pp. 32–33). Finally, in 2003, it declared its purpose to recognise and preserve ICH as "a mainspring of cultural diversity and a guarantee of sustainable development" through the Convention for the Safeguarding of Intangible Cultural Heritage. It explains what ICH is as follows:

> The 'intangible cultural heritage' means the practices, representations, expressions, knowledge, skills—as well as the instruments, objects, artefacts and cultural spaces associated therewith—that communities, groups and, in some cases, individuals recognize as part of their cultural heritage. This intangible cultural heritage, transmitted from generation to generation, is constantly recreated by communities and groups in response to their environment, their interaction with nature and their history, and provides them with a sense of identity and continuity, thus promoting respect for cultural diversity and human creativity. . . . compatible with existing international human rights instruments, as well as with the requirements of mutual respect among communities, groups and individuals, and of sustainable development. [3]

The organisation states five categories of ICH: (a) oral traditions and expressions; (b) performing arts; (c) social practices, rituals, and festive events; (d) knowledge and practices concerning nature and the universe; and (e) traditional craftsmanship. It explains that as ICH plays a key role in maintaining cultural diversity, it enhances social cohesion, and helps individuals develop a sense of identity and belonging within a culture. As for intercultural relationships, it facilitates communication between and respect for different cultures [3]. Despite its value and importance in human life, ICH has been facing the danger of disappearance due to its innate 'intangibility', meaning that it requires deliberate efforts and measures to be preserved and transmitted. Furthermore, globalisation involving the movement of populations, development of technology, popular culture, and urbanisation has further reinforced the risk of disappearance of ICH [12]. Against the threats of deterioration and destruction, UNESCO has put forth substantial efforts to safeguard ICH by raising international awareness of the significance of ICH. The organisation established the Lists of ICH and the Register of Good Safeguarding Practices

to take appropriate measures to "keep them alive". As of December 2018, 508 forms of heritage and practice are enlisted in the lists. Furthermore, UNESCO is working on various projects in cooperation with other related organisations while educating and providing capacity building programmes to its member states in order to safeguard ICH [3].

As briefly mentioned earlier, UNESCO's activities were inspired and encouraged by the Republic of Korea, which is one of the pioneering countries that has given insight to the world with regard to the value of ICH for humanity, providing legal frameworks to safeguard them [22]. The country suggested the 'Living Human Treasure System' to UNESCO in 1993 to raise international awareness of ICH and the holders and successors; Korea also hosted the ICOM 2004 General Conference in Seoul, the capital city, under the theme of 'Museums and Intangible Heritage' [23]. These efforts are rooted in its long history of recognising and protecting ICH within its legal system at a national level. Since 1962, the government has taken care of national cultural heritage according to the Cultural Heritage Protection Act which defined ICH as follows:

> Among intangible cultural heritage which has been passed on throughout many generations, referring to those falling under any of the following items: traditional performing arts and arts; traditional skills concerning crafts, art, etc.; traditional knowledge concerning Korean medicine, agriculture, fishery, etc.; oral traditions and expressions; traditional ways of life concerning food, clothing, shelter, etc.; social rituals such as folk religion; traditional games, festivals, and practical and martial arts. [24]

Focusing specifically on intangible heritage, the Act on the Safeguarding and Promotion of Intangible Cultural Heritage aims for creative inheritance of traditional culture through preservation and promotion of ICH to encourage cultural improvement [25]. It states that the Administrator of the CHA is in charge of the designation of national ICH and its holder(s), and specifies that the CHA may provide financial aid and privileges to the holder(s) for artistic, technical, and scientific research; discovery of successors; successor training and activities for transmitting ICH; and documentation of the heritage [26]. Thanks to this well-organised system, Korea has succeeded in safeguarding heritage that would have otherwise disappeared [22] (p.11). As of November 2018, 140 instances of heritage are under governmental care and are getting support as national ICH [27]. The categories of national ICH and examples of each type are shown in Table 1 below. Table 1 shows seven categories used to classify the types of national ICH in Korea, but some of them are partly overlapped. This is because 'culture' itself is a very broad and abstract concept, encompassing almost everything in human civilisation, making the categorisation to be used only for the sake of convenience.

Table 1. National intangible cultural heritage in Korea.

	Category	Total	Examples
a	Traditional performing arts and arts	46	Jongmyo Jaeryeak (1964), Yangju Byeolsandae Nori (1964), Pansori (1964)
b	Traditional skills concerning crafts, art, etc.	53	Gatil (1964), Najeonjang (1966), Hansan Mosijjagi (1967)
c	Traditional knowledge concerning Korean medicine, agriculture, fisheries	-	-
d	Oral traditions and expressions	-	-
e	Traditional ways of life concerning food, clothing, shelter, etc.	7	Joseon Wangjo Gungjung Eumsik (1970), Munbaeju (1986), Myeoncheondugyeonju (1986), Gyeongju Gyodong Beopju (1986)
f	Social rituals such as folk religion	18	Eunsan Byeolsinje (1966), Yeongsanjae (1973), Jongmyo Jerye (1975)
g	Traditional games, festivals, and practical and martial arts	16	Namsadang Nori (1964), Ganggang Sullae (1966), Gangneung Danoje (1967)

When classifying ICH, in addition to the taxonomy suggested by the UNESCO and the CHA of Korea on the basis of the characteristics of each genre, ICH can be divided into two types according to the nature of holders and successors: the first type is the common knowledge and practices shared among a large number of members of a group, which is passed on to a number of individuals in younger generations in the same group. These are plays and festivals that can be easily learned and enjoyed together. For example, Ganggang-sullae is widely practiced in the southern part of the Korean peninsula. Any woman from her teens to fifties can easily learn to sing and dance and participate in the play. The second type is special knowledge and skills that only few living humans treasure, or the holders possess; the skills and techniques of living human treasure is transmitted to a very small number of successors through strict education and training of apprenticeship. It is made up of special and complex techniques that require intense training for at least three to five years to learn and practice. As these forms of heritage are transmitted from a few holders to a small number of successors, not from a large group of an older generation to a group of a younger generation, the ICH will vanish unless there are enough successors to acquire the knowledge and skills from the older generation of initiators. It is necessary, therefore, to put deliberate effort into recruiting successors for the latter type more actively than the former type.

The organisations in charge—the UNESCO and the Korean national government—do take measures to provide due protection and support for ICH and the people who preserve and transmit it to the next generation. What can be inferred from this system is that it prioritises the relationship between the organisations and the specific ICH with its holders and successors. The close ties between the two parties, however, exclude the general public from the system naturally and inevitably. The UNESCO and South Korea are just two examples of bodies that rule out the public from measures to safeguard ICH; this is a commonplace in the world as a whole, not to mention the countries and cultural institutions that are passive in safeguarding ICH. This marginalisation is, however, problematic because public understanding is necessary in the process of preserving and safeguarding ICH. The significance of the issue can be analysed in two dimensions. On one hand, ICH enables people "to choose a full, satisfying, valuable, and valued way of living together" with a sense of identity and belonging to the cultural community that it creates, which is the fundamental and essential reason for safeguarding ICH in the first place [7] (p.34). This applies not only to those who perform the arts and skills or have the specific knowledge and transmit it to future generations; it also goes for the general public within the cultural community who enjoy the heritage, watch traditional arts performances, or use the products created through traditional craftsmanship, for instance.

On the other hand, there is also a more realistic and practical reason why public engagement is necessary. The knowledge and skills shared only by a small number of people require transmission from holders to successors; lack of successors means its disappearance. This is where public education is needed; once more people get to know more about the value of ICH and why ICH deserves national protection, there would be more people interested in being trained as a successor themselves. Even if they do not go that far, the public would agree with governmental support for the holders and successors; after all, the government requires public support to execute its national budget for safeguarding ICH and promoting its sustainability. Furthermore, a beneficial cycle would be created as the public becomes interested in and enjoys ICH, which leads to even more governmental support, followed by further development of cultural heritage. In this sense, public understanding and engagement are vital in order to promote its sustainability, and it is required to encourage the public to be interested in ICH and to learn how meaningful it is to have such ICH in one's culture.

2.2. Museums and ICH

According to ICOM, the current definition of a museum is an institution that "acquires, conserves, researches, communicates, and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment" [28]. Although now the definition involves "intangible heritage", this was not the case during the early stages of development of museums.

The theme or major concern of museums has gradually shifted and expanded over time. Upon its foundation in 1946, the organisation limited the content of museums to "artistic, technical, scientific, historical, or archaeological material". It continued to focus on the "material evidence" of humanity (ICOM, 1974; 1989; 1995; 2001) until the organisation finally included both "tangible and intangible heritage of humanity and its environment" to its definition of museum content along with tangible heritage in 2007 [29]. This demonstrates that, although the major focus in the early days of the development of the museum was on material objects, now museums, according to the definition of ICOM, shed light on the value of ICH along with material objects in a more traditional sense.

In the Museoin, the very first museum that originally served as the temple of the Muse in ancient Greece, performing arts were offered to the goddesses during the ceremony [30]. It was after the Industrial Revolution in the 18th century that people became interested in folk and traditional cultures in earnest. Facing the "break between past and present, [and] the separation between the old and the new" due to rapid modernisation, peasant culture and tradition or ways of life received more attention by those who tried to keep "the past alive". This awareness was followed by new kinds of museums, such as the open-air museums, which included not only conventional buildings and villages but also traditional lifestyles and cultures in a more inclusive sense, and ecomuseums, which focus on the close relationship between place and local identity [12] (p.19).

2.3. Museums and Digital Technologies

There is limited opportunity for modern people to enjoy or to experience ICH in general. Due to the weakness of being handed down by a small number of holders to similarly a small number of successors, the transmission of ICH is not included in the formal school curriculum. In addition, it is recognised as a high-level culture that can be understood or enjoyed only with prior knowledge, which makes the public feel disconnected with ICH. As a result, the general public does not know much about ICH, and does not have much interest in safeguarding ICH. Therefore, it is needed to increase the number of people who are interested in experiencing ICH and are likely to participate in the training and education as successors in the future. This is where public education is needed to promote its sustainability, and the museum is a suitable place to this end.

In the meantime, there have been shifts in the roles of museums. In the early stages of the development of museum studies and practice, the institution was mainly regarded as a space for storage; after all, Mouseion was a place to keep various sorts of paintings and sculptures dedicated to the goddesses after rituals. Through the medieval and Renaissance period, it evolved into a place to exhibit relics, spoils of wars, and arts. With the opening of the Ashmolean Museum in 1683, public museums, in a true sense, began to show interests in public education and engagement [30] (p.7). Nowadays, being a place where people can learn about history, culture, and other subjects through exhibitions, museums provide individuals with a wealth of information in diverse fields. On the basis of the people-focused and audience-centred perspective, museums are encouraged to offer information in a way that benefits users and audiences, not in a way that satisfies the organisation [14] (p.70).

In regard to these new roles of museums, digital technologies can be utilised to enhance museum experience. The birth of virtual museums enabled the public to appreciate the object and find out more information about it through online websites without having to visit the museum physically. Furthermore, digital technologies maximised the educational value of museum exhibitions. Recent emphasis on edutainment indicates that while the end of an exhibition should be educative and informative, the process of learning should be fun and dramatic [30] (p.90). In other words, education should not only be a serious and grave ritual; it should also be entertaining and engaging. Digital technologies are a good means to reinforce the edutainmental aspects of museum practice in several ways: the application of digital technologies simply and easily draws public attention; it enriches visitors' museum experience through the visual impact and abundant information provided by digital media; it allows hands-on experience and enhances interactivity in museums, thus reinforcing educational effects; and it appeals to the younger generation in particular who are familiar with utilising

digital technologies and are willing to do so. Overall, digital technologies enable audiences not only to appreciate the objects but also to actually feel and experience them through communication and interaction within a comfortable and enjoyable setting that increases motivation for learning and its durability [31].

So far, various digital media have been utilised in museum exhibitions, and studies on digital exhibitions have been published. Google Arts and Culture have cooperated with museums around the world to provide virtual tours with 360 degree views inside the museums [32]. The Digital Discovery Centre at the British Museum employs various digital technologies to facilitate exhibition viewing and to provide activities mostly for young people [33]. The American Museum of Natural History developed a smartphone app called Explorer that automatically recognises the visitor's location within the museum and provides information on objects in front of the user in various forms such as text, sounds, and movie clips through augmented reality [34]. In the case of Korea, there have been several exhibitions that utilised high technologies; for example, in <Renoir exhibition—Scent of A Woman> at BonDavinci Museum, Galleria Foret, visitors could visit Renoir's studio in virtual reality [35]; in <Kimhongdo Alive: sight, insight> at the War Memorial Korea, the landscape painting of Mt. Keumgangsan by Kim was displayed in vivid media art [36]. However, exhibitions that utilise high technologies are mainly temporary ones, and the technologies are, at best, largely used for pop-up events simply meant for attracting public attention. Digital media used in other, more common, exhibitions are rather simple and one-way technologies such as digital kiosks, mobile devices, and virtual museums.

In the era of the Fourth Industrial Revolution, however, state-of-the-art technologies display potential for improving museum exhibitions even further and for becoming a major part in the storytelling of an exhibition. Claus Schwab (2016) explained that the Fourth Industrial Revolution is a technological revolution in which different disciplines of studies from the Third Industrial Revolution, including digital, biotechnology, and physics, converge and are interconnected to create a giant leap forward in terms of technological advancement [37]. Newly developed and upgraded technologies empower individuals to use one's imagination and creativity. Virtual reality (VR) is regarded as one of the primary technologies in the Revolution, along with augmented reality (AR), three-dimensional printing systems, Internet of Things (IoT), big data, artificial intelligence (AI), and cloud computing. These technologies have been widely applied on museum activities including exhibitions. Some of the examples are listed in Table 2 below, along with actual use in museums in Korea. These examples prove the potential utility of digital technologies museums, thereby enabling the discussion on developing digital exhibitions on ICH.

Table 2. Examples of technologies in the Fourth Industrial Revolution [38,39].

Technology	Functions	Examples of Usage
Virtual reality (VR)	To create an environment that is extremely close to reality, stimulating the user's senses and enabling the user to experience 'virtual reality' where s/he can interact with objects within the virtual reality with the help of devices	<Renoir exhibition—Scent of A Woman> at BonDavinci Museum, Galleria Foret, Korea
Augmented reality (AR)	To enable a user to interact with virtual objects in reality	<Dinosaurs AR Zone> at National Science Museum, Korea
Three-dimensional printing	To create three-dimensional objects and to enable small quantity batch production	Creation of clothes and accessories at Daegu Textile Museum
Internet of Things (IoT)	To embed communication systems in computer objects to connect and communicate with/between objects with intelligence	Smartphone app using Beacon technology for Seoul Museum of History
Big data	To collect and manage data on a large scale, providing databases for artificial intelligence's machine learning	Big data analysis on Hangeul (Korean language) by National Hangeul Museum

Table 2. *Cont.*

Technology	Functions	Examples of Usage
Artificial intelligence (AI)	To express, infer, and manage knowledge, realising smartification in various service environments	"QI", an AI robot with IoT function introduced in the National Museum of Korea
Cloud computing	To enable a user to work online on the basis of server system, regardless of time and place	VR museum based on cloud computing platform for Gongju National Museum

2.4. VR Exhibition on ICH

Given the utility of digital technologies for exhibitions, the nature of each technology should be considered in order to select appropriate one for each ICH experience programme. When planning an exhibition on ICH, VR technology is effective as it allows the audience to try tasks that cannot easily be experienced in the real world, and it increases users' immersion by synthesising the body's movement with the system that is displayed on the screen. According to Milgram and Kishino (1994) [41] and Kstov (2015) [40], mixed reality (MR) technologies can be listed along a continuum on the basis of a specific standard. One way to line them up is to compare the degree of virtuality or reality of the environment [41]. As described in Figure 1, at one end of this virtuality continuum is the real environment, and at the other end is the virtual environment in which the user is completely disconnected from the real world. In the middle of the continuum is a series of MR technologies: the first one close to reality is AR technology that overlaps virtual images on reality, thereby augmenting reality; closer to the virtual reality is augmented virtuality (AV). At the far end is VR, which is composed of (semi-)immersive VR that immerses the user further into the virtual world. Technologies such as CAVE (Cave Automatic Virtual Environment) system weaken the sense of reality and enhance virtuality.

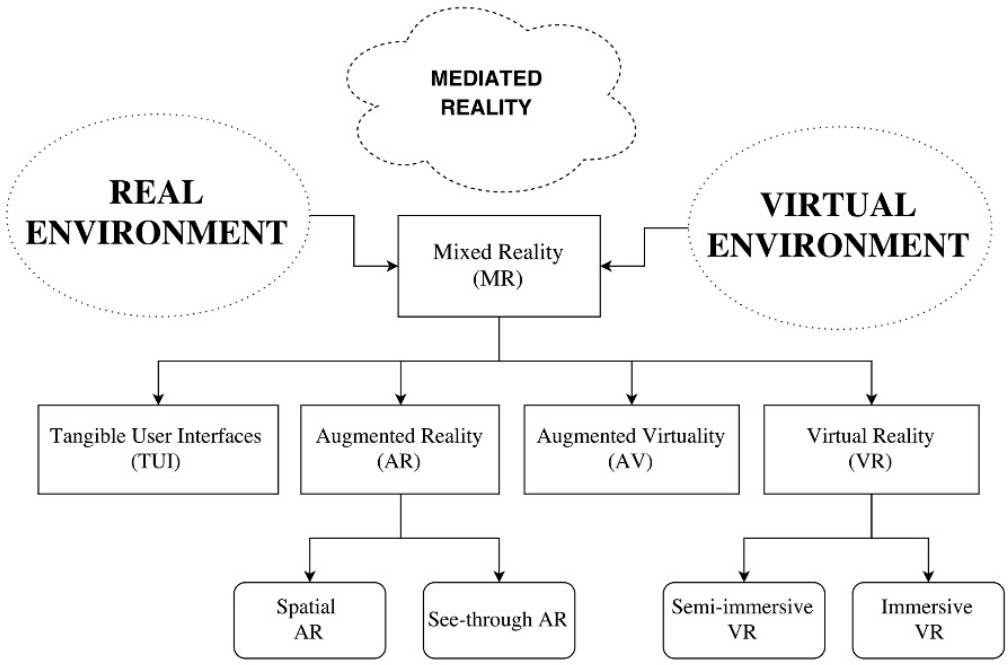

Figure 1. Virtuality continuum (Kostov, 2015) [40].

Among various MR technologies, the immersive VR technology with a head-mounted device (HMD) is suitable for digital exhibitions on ICH. First of all, it reduces the constraints of time and space as it realises a whole virtual world within the system. To try the ICH in reality, one needs certain environment with necessary clothing, equipment, and an ICH holder who can train the person. When using VR technology for ICH exhibition, however, one does not need to prepare them as

they are already prepared within the virtual system. Also, wearing a HMD, the user is completely immersed into virtual reality. On the screen of the HMD, the user is able to see him/herself wearing the costume, holding the tools, and being trained by the virtual holder. The system recognises the user's movement and changes its display accordingly. This raises immersion and presence that makes the user keep focused on the programme. The sense of reality is much higher compared to the CAVE system that exposes the gap between the real self and the virtual character on the screen. Thus, the use of VR technology would dramatically increase the user's concentration on and immersion into the exhibition, resulting in active participation and considerable educational effect [42]. Furthermore, VR programmes can easily be copied to be used simultaneously in many places, while HMDs and wearable devices are small enough to move around. This especially benefits culturally disadvantaged people, those who are not used to having the opportunity to enjoy exhibitions either because there were no exhibitions in the nearby area or because they were not able to move due to physical obstacles. In this sense, if VR technology is applied to digital exhibitions on ICH, a wider public will be able to experience and interact with ICH in the digital world in an easier yet more interactive and engaging way, which further enhances educational effects. In fact, VR contents that allow users to experience traditional culture already exist. For example, "Beat the Beats" is an immersive experience programme with media technology developed by 4TheVision. As seen from Figure 2, users could not only indulge into a Korean traditional music performance but also actually try playing musical instrument along with a band in the virtual environment. The users who tried out the programme commented that playing traditional Korean musical instruments in virtual reality was indeed a "great experience" and "very nice" [43].

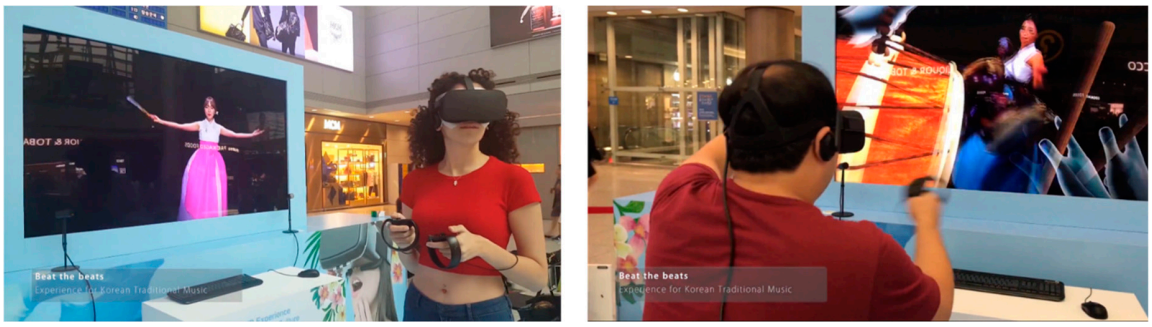

Figure 2. "Beat the Beats".

Digital technology, such as VR, is particularly appealing to the general public who do not know or are not interested in ICH. The technology in itself is enough to provoke curiosity of the public and to lower the entry barriers. It enables an immersive experience and lets people gain training from the virtual living human treasure. Once properly digitised and programmed, the holder's performance or educational programme, led by the holders and certified successors, can be copied and distributed almost infinitely. This means that the wider public is able to learn directly from the ICH holders through the VR programme, regardless of the imbalance between supply (number of holders) and demand (number of individuals who would like to learn from holders). The technology enables specialised one-on-one training through interactions between the user and the holder. Furthermore, the content becomes far more persuasive and impressive when the actual holder appears in the programme; the importance of ICH within its culture and necessity to safeguard it are further emphasised when it is explained by the actual holder, compared to when a text is read. Also, the experience of getting trained by the holder is more interesting than public training or education programmes led by unaccredited performers. Overall, VR experience arouses users' interests in and respect for ICH.

3. Proposal on ICH Exhibition Utilising VR Technologies

3.1. Jultagi

Jultagi was designated as Important Intangible Cultural Heritage in 1976 by the Korean government and enlisted in UNESCO Intangible Cultural Heritage in 2011. As shown in Figure 3, it is a kind of traditional performing art of tightrope walking that an aerialist performs, doing acrobatics, singing, and dancing. Tightrope performance exists in other cultures on the globe. However, what differentiates Korean Jultagi from other tightrope tricks, besides its long history and refined, showy skills, is that the performer not only does acrobatic tricks but also interactively communicates with and entertains the audience. The performers actively engage with the audience, talking with them, letting them intervene in the course of the performance, ultimately changing its content. As it is often performed at conventional markets and in regional festivals, Koreans are easily exposed to the traditional performance, which allows them to strengthen their identity as Koreans. Also, the active communication not only makes the event more entertaining but also enables the viewers to have the indirect experience of flying in the sky and feeling the sense of freedom. Today, the Committee for the Preservation of Tight-rope Walking and Kim Dae-Gyun, the only official holder, are responsible for the preservation and transmission through apprenticeship and public education.

Figure 3. *Jultagi* [44].

To realise Jultagi as a VR exhibition, a hand controller and a block where the user stands are needed. The hand controller, in virtual reality, will appear to be a hand holding a folding fan that an aerialist uses in a performance. The fan was originally used to keep one's balance high up in the air; but in this programme, where the user does not need to exert much effort to maintain their balance, the fan will add realism to appear as if they actually are a Jultagi performer. The block may be made of either plastic or wood, but should be high enough to build stairs with several steps on both ends and long enough so that the user can come up the stairs from one end, walk along the block, and come down the stairs to the other end. Also, it should be covered with a sponge-like material so that the user would feel like the ground, or the tightrope in virtual reality, is shaking and moving, feeling the elasticity of the rope and slight dizziness of walking on it. The user's safety should be guaranteed by setting cushions besides the block and providing the user with safety pads.

The overall system architecture is described in Figure 4. The server collects and recognises data which is reflected on the screen on HMD (Head-Mounted Display) with visual and audio effects. Based on these effects, the user chooses an option by pressing button on the HMD or moves the body. The data regarding location, height, balance, etc. is recognised by the wearable device and sent to the server, which, then again, is parsed and reflected on the screen.

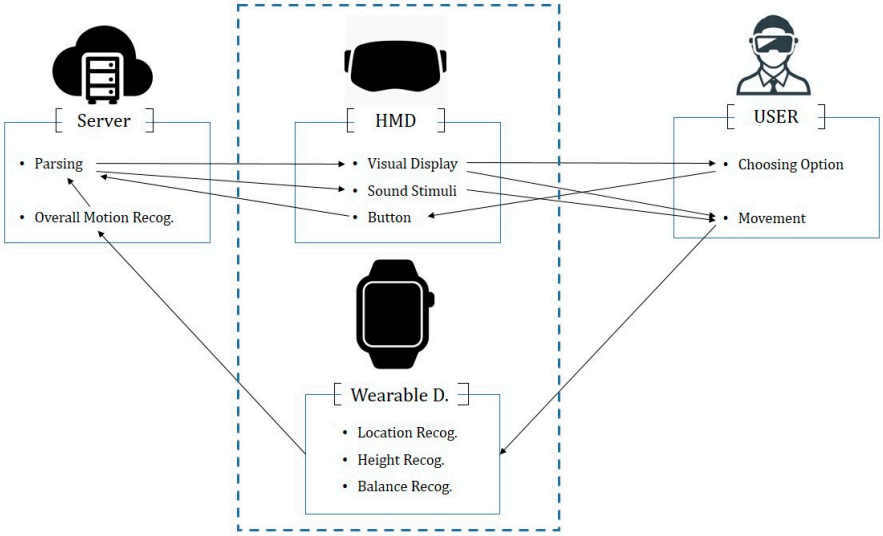

Figure 4. System architecture. HMD: head-mounted device.

The simple version of scenario diagram is elaborated in Figure 5. The programme begins as the user puts on the HMD, where virtual reality unfolds in the monitor. First, the VR video is played where the holder appears to explain Jultagi—about what it is, its history, its meaning in the broader cultural context, the necessity of preserving the heritage, and so on. Then, he demonstrates how to perform Jultagi and teaches the user basic skills from the very beginning. The user follows the holder's lead to imitate the movements. As interaction is available in the VR programme, and is the essence of this whole programme, the holder provides one-on-one training and corrects the user's movements. After learning the basic skills for some time, the VR setting is changed to a stage where the user can actually perform Jultagi. Beside the user is a tightrope which, in reality, is the block that the user can climb up to via the stairs. On the tightrope—or the block in reality—the user looks down at an assistant clown, musicians, and the crowd on the ground. As the user moves on the tightrope, the musicians begin to play traditional Korean music, which they can hear through the speakers on the HMD. The user can try acrobatic movements, including jumping and walking back and forth, without the worry of falling down from the rope. It is critical to adapt the user's point of view while actively moving so that the user can identify the location within the virtual reality and feel that the user is actually walking and flying in the air, feeling the thrill and excitement. During the experience, characters in the virtual reality may speak to the user either by voice through the audio system or by text on the screen; the user can communicate with them either by speaking out loud or by choosing options on the screen. Depending on the user's choice, the people in the virtual reality may respond to or intervene in the conversation through laughing, joking, or commenting. As the user reaches the other end of the tightrope, they slowly come down the stairs and take the device off on the ground and the video ends.

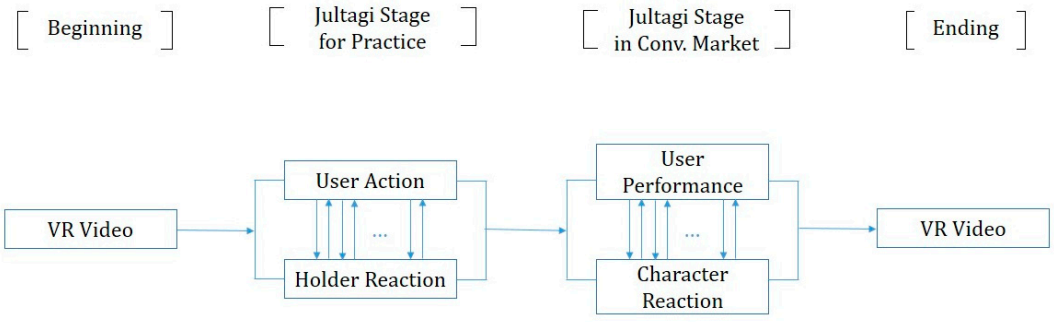

Figure 5. Scenario diagram.

The above scenario can be organised into three steps: (1) learning Jultagi, (2) experiencing and training Jultagi, and (3) performing Jultagi. Implemented images of screen plays and explanations are discussed below.

Step 1: Learning Jultagi

The brief images and scenario of Step 1 is described on Figure 6 and Table 3. In this first step, the VR programme begins with the explanation by the Jultagi holder about the heritage. As the user puts on the HMD, the holder appears to explain about the history and cultural value of Jultagi. He also demonstrates the movements slowly so that the user can grasp the basic idea what Jultagi is and how to move one's body. It is a one-way lecture where the holder explains and the user listens. Detailed screen plays, (re)actions, and required technologies are listed below.

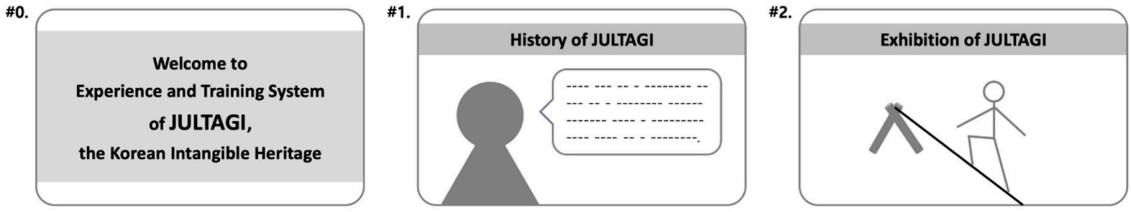

Figure 6. Step 1. Learning Jultagi.

Table 3. Scenario on the VR exhibition on Jultagi, Step 1.

Scene	Screen Play	User's Action	Reaction and Interaction	Required Technologies
Beginning (Scene #0)		User puts HMD on.	The VR begins.	HMD, screen display
Scene #1	Jultagi holder (virtual character) appears to explain the history and value of Jultagi.	User listens to the brief introduction.		Audio and visual impacts
Scene #2	Holder performs Jultagi in a slow version.	User chooses points of view to watch the performance from various angles.	System adjusts points of view	Hand controller, focusing

Step 2: Experiencing and Training Jultagi

The user tries out the movements in *Jultagi* after closely observing the holder's tricks. The user provides one-to-one feedback and training on the movements in the beginning level. The set of user's movement and the holder's reaction, or feedback, is repeated several times until the user properly performs each movement. The interaction between the user and the virtual holder is more highlighted in this phase. Figure 7 and Table 4 describe the screen images and scenario of Step 2.

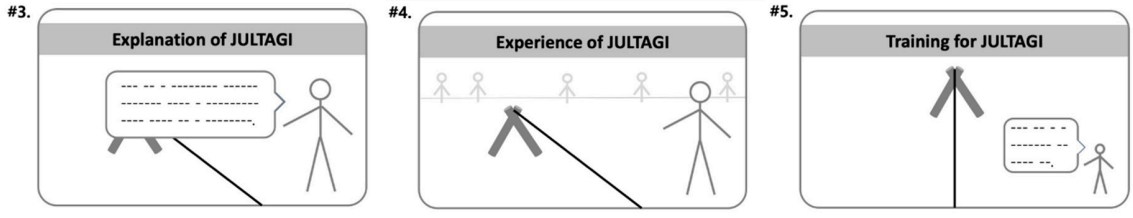

Figure 7. Step 2. Experiencing and training Jultagi.

Table 4. Scenario on the VR exhibition on Jultagi, Step 2.

Scene	Screen Play	User's Action	Reaction and Interaction	Required Technologies
Jultagi stage for training (Scene #3~5)	Holder shows how to keep his balance, and demonstrates skills (e.g., Kochagi (stretching one's leg towards nose), Chaeksangdari (cross-legged sitting)).	User follows the movements step by step.	Wearable device recognises the locations and positions of arms and legs. Holder corrects the user's movements.	Hand controller, wearable device with gyro sensor, motion recognition.

Step 3: Performing Jultagi

The user finally gets the opportunity to perform Jultagi in front of the virtual audiences. On the rope, he tries out the actions and tricks as he wants. Here, he moves on the rope, performing the tricks he learned from the holder he practiced before. He communicates with the audiences back and forth while performing on the rope. Communication and interactions are the essence of this whole VR programme. In addition, the user can display his originality and creativity regarding the ICH on the rope. The screen images and scenario is briefly explained in Figure 8 and Table 5.

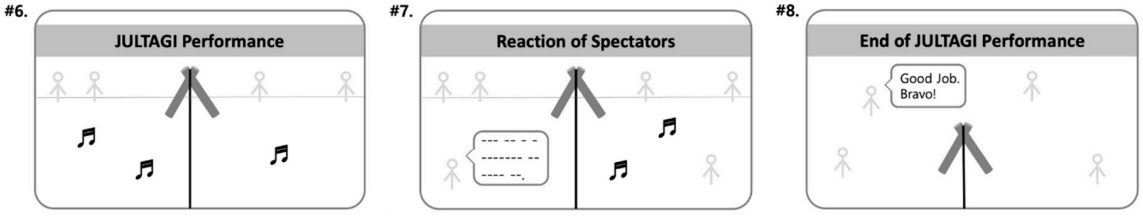

Figure 8. Step 3. Performing Jultagi.

Table 5. Scenario on the VR exhibition on Jultagi, Step 3.

Scene	Screen Play	User's Action	Reaction and Interaction	Required Technologies
Jultagi stage in a conventional market (Scene #6)	User stands next to the rope, surrounded by virtual characters (assistant clown, musicians and the crowd).	The climbs up the stairs, and begins to move forward, trying out the tricks.	The wearable device recognises the user's location and position. The point of view is adjusted as the user climbs up the rope and moves forward on the rope.	adjusting point of view wearable device with gyro sensor, audio impact, focusing
Scene #7	Characters clap, cheer, and speak to the user.	The user responds by answering or by moving his/her body.	The wearable device recognises the user's location and position. The point of view is adjusted as the user climbs up the rope and moves forward on the rope. The user and the audience communicate back and forth.	wearable device with gyro sensor, audio impact, mic
Ending (Scene #8)	At the end of the rope.	User slowly comes down the stairs and takes the HMD off.	The VR ends.	

As seen above, the use of digital technologies allows the user to have immersive and exciting experience on the tightrope. The wearable device recognises the user's movements and locations, which is reflected on the screen play; this improves the presence and immersion so that the user feels as if he/she is actually performing the ICH. The communication and interaction between the user and the virtual characters are essential and fundamental in this programme, which is also realised through digital technologies. It provides the users with the opportunity to learn how to do acrobatic movements and to display his/her artistry and creativity in the programme. While learning through experiencing the programme, the user realises that Jultagi is more than just acrobatic movements and tricks, it is a kind of comprehensive performing art that consists not only of aerial stunts but also of music, jokes, and two-way communication with the audience. The user may understand one feature of traditional Korean performing arts, including Jultagi, is the active communication and interaction between the performer and audience that blurs the distinction between the two, allowing the audience to affect and change the course of the performance. Through this experience, users are attracted to learning more about the heritage itself and moving on to further exploration of the world of Jultagi and possibly other intangible heritage.

3.2. Daemokjang, Traditional Wooden Architecture

Daemokjang was designated as Important Intangible Cultural Heritage in 1982 and enlisted as UNESCO World Heritage in 2010. Daemokjang refers to two concepts: traditional wooden buildings and the master craftsman who takes care of the maintenance, restoration, and reconstruction of these

buildings. The artisan is responsible not only for planning, designing, and constructing the buildings but also for managing and supervising the assistant carpenters. Daemokjang as ICH refers to the former concept of traditional wooden architecture. So, in Figure 9, the people processing wooden blocks are Daemokjangs. Constructing Daemokjang requires artistic creativity with scientific knowledge on nature and technological abilities to recreate the tradition. Due to their wealth of knowledge and refined skills, these artisans were given governmental positions during the Koryeo and early Joseon periods in the past. The skills and knowledge of Daemokjang are universally acknowledged for their traditional beauty and practicality, as seen from the designation of Changdeokgung Palace and Bulguksa Temple as UNESCO World Heritage Sites. Regarding transmission, three holders and two successors are officially acknowledged [45].

Figure 9. *Daemokjang*.

For the programme, two hand controllers, one for each hand, are required, which appear as tools to process wood in the programme. The virtual reality begins as the master craftsman appears to explain Daemokjang. He explains the principles of processing different woods and shows how to do it, which is followed by the user's activity in trying out the skills. Just like in the Jultagi programme, the artisan gives comments to the user and provides professional training to educate them. Then, the setting changes to an actual Daemokjang working space where other craftsmen and carpenters are processing wood besides the user in virtual reality. Here, the user plays the role of an assistant carpenter following the lead of the master craftsman. The user can decide which part of which building to work on among a selection of famous Korean wooden buildings. Upon choosing which activity to try, the artisan gives a demonstration on how to process the wooden pieces. The user follows the artisan's guidelines to make building materials of wood using hand controllers; the user can choose an option from cutting, trimming, carving, and chiselling, and then move the controllers to process the wooden piece in the virtual reality. While working on the wood, the user listens to the sound effects of processing the wood, which adds realism to the experience and enhances the presence of the user. When all the materials are prepared, the artisan shows how to assemble these pieces to complete the chosen structure. In this phase, texts appear on the screen to explain about principle of using wooden joints to put bigger pieces together to create the "joint that lasts for thousands of years" [45]. Also, the user may try these skills to create their own building or structure, displaying artistic ability and creativity. The scenario is briefly explained in Table 6.

This experience is unique in that users can build their own wooden architecture in the middle of a city without having to go to the woods to get materials and to secure empty space to process the materials. Although it all happens in virtual reality, users may actually feel like they have become traditional architects who have considerable knowledge and skills to deal with wood in traditional ways. While being trained by holders, processing the wooden materials, and assembling them into

architecture, the users learn from ancestor's wisdom—they understand the principles of wooden construction and learn about the simple yet wise use of wooden pieces. Furthermore, the experience enables the user to display their artistic abilities. Although they can only choose from the provided options, the users are able to mix and match the options, leading to the recreation of tradition. This allows users to explore the potential and future of the heritage.

Table 6. Scenario on VR exhibition on Daemokjang.

Scene	Screen Play	User's Action	Reaction and Interaction	Required Technologies
Beginning		User puts HMD on.	The VR begins.	HMD
	Daemokjang holder (virtual character) appears to explain the history and value of *Daemokjang*.	User listens to the brief introduction.		Audio and visual impacts
Work space with holder	Holder explains and shows how to process woods to create components for traditional Korean buildings.	User watches the movements and learns how to move the hand controllers.		Audio and visual impact
	Holder gives one-to-one training on each skill to process materials (e.g., cutting, trimming, carving).	User uses hand controllers to follow the movements.	System recognises the movements. Holder gives one-to-one training on how the user should move hands and arms.	Hand controller, motion recognition
	Holder demonstrates how to join the components.	User follows the movements step by step to join the components to complete a structure.	System recognises user's movement. The material is completed accordingly. Additional training by the holder is given.	Hand controller, motion recognition
Work space with other workers	The scene changes to the work space where other craftsmen and carpenters (virtual characters) are working with raw materials.	The user watches and hears them working on their parts.		Audio and visual impact
	Options appear on which part of which building to work on.	The user chooses which part of which building to work on.	Holder appears to give directions on how to process the raw materials.	Hand controller or HMD button
	Raw woods and tools are provided.	User moves hand controllers to process the woods.	The material is processed accordingly. Holders give directions on the user's movements	Hand controller, motion recognition
	Holder gives directions how to join the materials.	User moves hand controllers to join the components.	The components are joined accordingly. Texts explain the principles and fundamentals of joining them.	Hand controller, motion recognition
Work space alone	Tools and raw woods are provided.	User creates one's own structure by processing and joining the materials.	The components are processed and joined accordingly.	Hand controllers, motion recognition
Ending	The holder and other carpenters give (positive) evaluation on the user's performance.	The user takes off the HMD.	The VR ends.	

4. Conclusions

To summarize, there has been worldwide cooperation and national efforts to save ICH, which have mainly focused on the relationship between the supporting organisations and the ICH holders and successors, overlooking the importance of public involvement. The critical fact is, however, maintaining a steady number of successors through increased public engagement is vital to sustainably transmit the tradition to future generations. In this respect, this paper shed light on the importance of public engagement in ICH and suggested the use of VR technology to realise exhibitions on ICH. VR is suitable to this end, as it allows the general public and beginners of ICH to try experiencing ICH regardless of the time and space limitations. Proposals of VR exhibitions on Jultagi and Daemokjang are given as examples to demonstrate how VR can be effectively applied on ICH contents. It is true

that the scenarios are rather simple and basic and that they lack empirical evidence because they have not yet been realised. Rather than being conclusive, however, this paper provokes thoughts and encourages readers to think about the potential utility of digital technologies for the sustainability of ICH. The actual realisation can be done through interdisciplinary studies that cross borders between the field of humanities and engineering. This paper is also meaningful in that it encourages conversation between the two fields to promote the sustainability of ICH.

Digital exhibitions have almost infinite potential to contribute to safeguarding ICH. First of all, exhibitions employing digital technologies such as VR enable digital heritage transmission of ICH, which is the fundamental part of promoting its sustainability. VR technologies allow one-on-one training with a digitised actual holder on the basis of active interaction and immersion. Rigid and detailed digitisation of actual holder's performance provides appropriate resources for beginner's training. Regardless of the lack of supply of educators, the general public can get training from the human heritage through VR while enjoying it but not noticing they are actually 'learning'. They may also naturally realise that ICH is worth protecting. This experience may result in the audience getting interested in the original heritage itself, which may encourage them to explore more about it. The future successors and holders of ICH may be there among those who experienced ICH through a VR exhibition. Indeed, in the scenario of the VR programme for Jultagi, it was demonstrated that VR technologies along with other digital devices, such as the wearable device and the HMD, allowed the user to have a more thorough experience. The user could communicate and interact with the virtual characters back and forth. The user could also feel a stronger presence and immersion thanks to the synthetisation within the system through adjustment of movements and points of view. The digital technologies improved the quality of ICH transmission training and lowered the barrier for beginners.

Despite of its strengths in education and training of the general public, digital exhibitions on ICH do have limits and need further improvement. First, the simple experiential VR program is not suitable for training the future successor beyond the beginner level. This is because the knowledge, skills and abilities of human cultural properties should be passed on to those successors only through direct contact and education. Looking on the bright side, this implies that digital technology will not replace human cultural assets with robots or software, and thus the authenticity of the ICH education process will not be damaged. Another issue is that transforming ICH into museum content may be regarded as taxidermy, not a way of keeping it alive. This is because ICH possesses its true value when it is maintained and performed within its culture and community among the people, not in a sheltered environment. Furthermore, the true value of ICH may be degraded if the entertaining aspect is emphasised excessively. Also, it has to deal with the issue of cost due to the high-priced VR facilities and programme development. Unless extensive study is conducted and carefully designed, VR exhibitions may degenerate into "expensive furniture" [5] (p.83). Likewise, it is crucial that technological defects such as friction and dizziness in current stage are improved and cost less for better user experience.

Also, various approaches should be explored in order to maximise the efficiency of digital technologies applied on ICH exhibitions. To begin with, collaboration with the actual heritage holders is suggested in order to deliver the authenticity of the actual heritage; the holders may give a demonstration to the public on a regular basis or lead education and experience programmes to teach the participants how to create or perform the heritage. The content of exhibitions may be affiliated with school education so that it encourages the active participation of students. The technologies used in digital exhibitions may be diversified to enhance the educational effects. Augmented reality and media façade are useful technologies to increase the sense of immersion while big data may be used to customise the programme for individual visitors. More 'traditional' technologies, such as social networking systems (SNS), may be used to promote the exhibitions to the larger public. More interests and efforts should be made in order to improve digital exhibitions and to encourage public involvement so that it can contribute to the safeguarding of ICH for humanity.

5. Discussion

Systematic evaluation is necessary to improve the quality of VR programme as this kind of programme has not yet been realised widely. Feedback from the holders and successors as well as engineers are mandatory. Holders and successors are at the very core of this whole transmission system, which authorises them to evaluate whether the programme is effective in educating and training the general public, contributing towards making the ICH more authentic and sustainable. The engineers and technicians are to try the programme themselves so that they can see whether the technologies are rightly used to enhance the presence and immersion within the programme. They are the ones who understand what needs to be improved and how it can be improved. Feedback from the general public who have tried out the programme is also essential. Questionnaires can be useful to get the opinions on how the people felt and thought about the programme on the basis of the grades and descriptive answers they give to each question. The questionnaire is intended to evaluate the programme regarding (1) educational effects, (2) technical effects, and (3) inducing effects. The tentative list of questions with regard to the Jultagi programme follows:

(1) Questions on "educational effects" are to see whether the programme is effective in teaching the general public by giving relevant information about Jultagi and ICH in general.

- (1-1) Do you think the programme rightly included explanations on what Jultagi and ICH in general are?
- (1-2) Do you think now you know more about Jultagi and about ICH in general after trying the programme?
- (1-3) Did the programme explain the importance of preserving ICH in detail?
- (1-4) Do you agree with the importance of preserving ICH as explained in the programme?
- (1-5) Would you recommend your friend to try this programme in order to learn about Jultagi and ICH in general?

(2) Questions on "technical effects" are to see whether technologies are properly applied on the programme and are helpful to enhance its educational effect.

- (2-1) Was VR technology helpful in understanding what Jultagi and ICH in general are?
- (2-2) Did the technologies encourage you to get interested and involved in Jultagi and ICH in general?
- (2-3) Do you think the VR programme on Jultagi is helpful if you actually try Jultagi in reality?
- (2-4) Do you think the technologies were properly used to make the virtual environment feel like reality?
- (2-5) What are the strengths and weaknesses of the VR programme on Jultagi when compared to the actual Jultagi training led by living human treasure in reality?

(3) Questions on "inducing effects" are to see whether this pre-level participatory programme encourages actual education of transmission run by living human treasure in reality.

- (3-1) Do you think this programme give people a taste of what Jultagi and ICH is?
- (3-2) Do you think this programme would encourage people to get more interested in Jultagi and ICH in general?
- (3-3) Are you more interested in exploring ICH yourself now compared to before?
- (3-4) Do you have plans to participate in experiential programme run by the living human treasure?
- (3-5) Do you have plans to get actual transmission training to be a successor?

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