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Perception of Digital Restoration and Representation of Cultural Heritage -Focusing on Simulation and Simulacra

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Abstract: *This paper focuses on the recent trends in digital implementation technology and its relationship with cultural heritage restoration. Cultural heritage consists of tangible and intangible elements, including monuments and folklore cultural assets. The utilization of digital restoration and visualization techniques offers boundless possibilities beyond mere technical reproduction, shedding new light on the historical characteristics and values of humanity. Such research is regarded as an essential output that captures the profound social, cultural, and economic significance of cultural heritage. Digital restoration, reflecting Jean Baudrillard's concept of 'Simulacra,' serves as a crucial tool to reinterpret past civilizations based on historical evidence for the public. Through this process, profound insights can be gained from various fields such as society, economy, art, religion, and lifestyle. This approach signifies that the digital restoration transcends its mere technical aspect and helps in understanding its academic significance.*

Keywords: Cultural heritage; Representation; Restoration; Simulacra; Simulation.

1. Introduction

Cultural Heritage Administration's "Cultural Heritage Protection Act" aims to "preserve cultural assets to inherit the national culture and by utilizing them, it contributes to the human cultural development and promotes the cultural improvement of people." The definition is "artificially or naturally formed national, ethnic, or global heritage with great historical, artistic, academic, or scenic value," and the protection object refers to tangible cultural properties, intangible cultural properties, folk cultural properties, and natural monuments [1]. The investigation results for lost cultural properties on the Cultural Heritage Administration data are about 197 items, including national treasures(2), treasures(22), historic sites(4), national intangible cultural properties(1), national folklore cultural properties(4) national registered cultural properties(12), municipal intangible cultural properties(3), municipal tangible cultural properties(63), municipal monuments(3), municipal folklore cultural properties(8), regional registered cultural heritage(1) and cultural properties data(74) [2]. The loss of cultural heritage due to unexpected natural disasters, war, fire, theft, neglect, and damage decreases historical values and threatens the loss of national sentiment or the identity of the region or country [3]. Examples include the unexpected fires of the national treasure "Sungnyemun Gate, Seoul" at the southern main gate of Hanyang City Wall, built during the Joseon Dynasty, and the historic building "Naksansa Temple". Restoration of cultural heritage through the application of digital technology means representation with digital data and is a sustainable data preservation method suitable for present timeliness. It also forms a close relationship with building digital archives or virtual reality representation technology, which is a realistic alternative in terms of utilization, and the value of public use is limitless. For centuries, humankind has benefited from various cultural value-raising effects through efforts to change human life more efficiently and through the economic utilization of the supply and demand of inventions earned by imagination. So far, digital implementation technology using computers has been mainly used in entertainment cultures such as games, animations, and movies with production methods such as shape, movement, and compositing effects under the proposition of simple imitation and reproduction.

However, this study contains a more generalized meaning that digital application technology can be used as new media, such as restoration and presentation of cultural heritage based on history. The argument is an interpretation of existence, in line with the premise of presentation that it must have sufficient reasons and grounds for existence around the "principle of sufficient reason" [4] of Gottfried Wilhelm Leibniz (1646-1716). In the dependent perspective on the difference of Gilles Deleuze (1925-1995), the critical explanation of presentation is a quadruple of shackles. It specifies the precondition of representation, which its root, including "identity in the concept," "confrontation in the predicate," "similarity in judgment," and "similarity in perception," exists as the difference of ratio cognoscendi, ratio fiendi, ratio essendi, ratio agendi. It is a relevant example of understanding the internal function of maintaining the essence of cultural properties [5].

Therefore, the point of this study is to explain that perception of digital restoration and representation can replace the absolute essence. The results produced in the digital restoration process of cultural heritage are not just technical external reproductions but are significant values as inherited originals of original thinking based on Jean Baudrillard (1929-2007)'s simulation and simulacre view. In addition, in the process of restoring lost data using digital technology or searching for a "sustainable preservation method," a significant relationship can be understood that the actions of "restore" and "represent" in the category of digital technology use are based on simulation and simulacre.

2. Theoretical Background

In the digital culture of modern society, real facts are adapted according to such intentions, and modified messages are delivered. Such a phenomenon is a Hyperreal [6] that exerts more influence than real, following the view of Jean Baudrillard (1929-2007). In addition, to combine the meaning of "restoration" and "representation," represented reality, which is much more exaggerated than the true nature of the restored original, is integrated with the consumer's needs. Such an argument in a study by Jin-Wook Kim (2022), digital reproduction technology is evolving enough to represent everything humans imagined in mythology. Also, if the exhibition value of films in the age of mechanical reproduction has been noted, the healing value of films in the era of digital reproduction can be noted [7]. To understand his argument by comparing the concepts of "restoration" and "representation," it is worth paying attention to the purpose of the word implying and the possibilities earned by ripple effect or experience of how positive or negative results after the action will affect various fields of modern society rather than the performance criterion of the action. The meaning of restoration is to restore to its original state, and its nature can be interpreted as a part of the representation. It includes reconstructing the past culture, meaning that the original image is estimated and restored from the damaged remains and relics found in ruins. It is appropriate to understand representation as the total recovered sum, and the linguistic meaning is 're-presenting'; in terms of lost cultural properties, representation has the representativeness of the original. In the study of Chang-Rae Kim (2012), the linguistic meaning of representation was interpreted as duality, which is "re-präsentieren" and "Vertreten" of the original expression [8]. In the mural found at the Lubang Jeriji Saléh Cave in the Kalimantan region, east of Borneo Island, figures of wild livestock believed to be 51,000 years old were depicted [9]. Such a discovery suggests that humans imitated nature and represented it in the process of expressing notable materials that existed at the time in murals. In terms of cultural heritage, it is a discovery that obtains more value than the original, which can infer the essential lifestyle of the time. This phenomenon can be recognized as a dual concept of historical facts and representation transferred from the cultural heritage finally encountered. In restoring cultural heritage, the meaning of representation and restoration is not an argument for discourse, such as Plato (375 BC)'s "essence of idea compared to caves" [10] or that the artists' subjects at that time were the result of imitation. In a paradoxical sense, the representation of cultural heritage also includes the purpose of the archaeological aspect that it is restored after an in-depth analysis of meanings of the original purpose through data analysis such as estimation through photos, literature, and similar data left after the original was lost. Therefore, the finally restored cultural heritage can be carried out as a representation of the original can be understood in the case of "Sungnyemun Gate, Seoul," where the original essence continues. It is the oldest wooden structure remaining in Seoul after it was first built in the 7th year of King Taejo (1396-1398). It was expanded on a larger scale in the 30th year of King Sejong (1448) and the 10th year of King Seongjong (1479), dismantled and repaired in 1961-1963, and recently restored after the fire of Sungnyemun Gate (2008.210) for five years and two months, and it is still very much loved by the public [11]. This reason is proof that it represents the existing essence in terms of the influence and ripple effect on society of the meaning and essence derived from the philosophical

implications of representation after several restorations. Therefore, evaluating it as human efforts to find and preserve historical values is sufficient. There are many other studies that can find cases of the inheritance of cultural heritage, its significant value as an original, sustainable preservation methods, restoration, and representation through the use of digital technology or public utility.

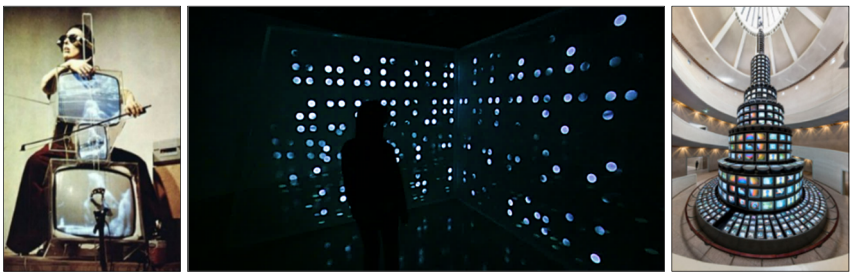
Table 1. Prior Research on Cultural Heritage

Researcher	Research area	Subject	Characteristics
J. H. Jeon, K.D. Kim (2018) [12]	The value of utilization rather than the value of preservation.	Seodaemun Prison.	Cultural Prototype Contents Using Virtual Reality.
W. T. Jeong, J. I. Han (2017) [13]	Archive and resources.	Arirang.	DB construction and information center at the national level.
E. G. Seo, H. J. Park (2019) [14]	Archive Exhibitions using Archival Contents.	Heritage records.	Archive exhibition strategy of archival culture.
I. G. Rossau, M. M. Skovfoged, J.J. Czapla, M. K. Sokolov, K. Rodil (2019) [15]	Tripartite Digitization Model (TDM) and digitization of traditional furniture manufacturing technology.	Intangible Cultural Heritage.	Safeguarding traditional craftsmanship using virtual reality.
C. J. Nwabueze (2017) [16]	Copyright and Data Authenticity in the Digital Preservation of Heritage.	OAPI, African Intellectual Property Organization.	Copyright and Authenticity of Digital Heritage.
K. T. Yim (2017) [17]	The Flow and Current Situation of Cultural Heritage Archives in Japan.	Cultural Heritage Archives in Japan.	Digital Archives.

It is true that after the first study of photography began in 1839 by French chemist Joseph Nicéphore Niépce (1765-1833), it had a significant impact on the photography of French painter and technician Daguerre (Daguerre, Louis Jacques Mandé, 1789-1851) as a sensational tool humans invented for representation, and British philosopher William H. Fox Talbot also discovered photography, a complete representation tool. However, each is photography strictly designed in its own way and can be seen in the context of the identical action of representation of the human desire to capture shapes that exist in nature. Compared to the traditional paintings depicted by artists so far, it is a representation tool designed according to a very technically meaningful hybrid method. In other words, the conceptual solidarity between the "Daguerreo type," a clear image expression method, and the "Calo type," which makes photography easy to capture the world of an existing form, [18] is an advanced method that can be seen as the beginning of human archival culture and technological representation. After, George Eastman (1854-1932) produced a Kodak camera for the public, so anyone was exposed to a virtual expression method that could easily capture important moments of life in a still image. Such study results are used as evidence for us to easily see the records of 100 years ago in photographs and understand the reproduced reality and the lifestyle of the time. The steady development of these technologies is still bringing significant changes to the future of art. It is easy to understand the concept of performance of digital restoration through technological convergence such as generation, correction, compositing, and printing of images or 3D data by authoring tools and equipment control technology based on more advanced imaging equipment, computers, and programming.

Digital implementation technology is based on the organic interaction of 'artistic imagination and engineering concept,' and the common ground is creativity in pursuit of novelty [19]. The study of Sungook Hong (2014) investigating the "multidimensional interaction between art and technology," states that Nam June Paik (1932-2006) developed a unique performance, convergence of artistic and scientific imagination in the first Video Art exhibition with cellist Charlotte Moorman (1933-1991) and philosophy about it [20]. Even though it was happening in the analog era at that time, Figure 1 (b) work laid the foundation for present media art with the attempt to insert heterogeneous things. His philosophical thinking, accelerated by technology, could

relate aesthetic experience and entertainment, economic value and value as popular art, easily mediating knowledge, experience, and emotions [21]. In other words, it opened the road for a change in concept from "appreciating" traditional methods to "experiencing and communicating" popular art and attempt at natural industrialization. Figure 1. (c), Yiyun Kang's intuitive perspective screen work <Gates>, at the Chosun Ilbo's 100th anniversary Hangul Special Exhibition, tried to express the current and future of Hangeul, starting with the formative principle of the moment of "ㄱ" (the first letter of the Korean alphabet) [22]. It interprets the ergon nature in the frame with logic intended for the roots of homeostasis and consistency, and imagination introduces parergon emotions outside the frame into the screen. It can be interpreted as an effort to inherit the essence of cultural heritage and reproduce it in a different medium. In other words, the concept is to create groundbreaking media art that bridges the essence of tradition with the human imagination aimed at a hyper-futuristic perspective. The results from the analog era should be materialized in various public experiential creations. This concept underscores that the restoration and reproduction of cultural heritage should be perceived as part of the same endeavor.



(a) (b) (c)

Figure 1. (a) Charlotte Moorman, Nam June Paik, <TV Cello,1963>, Acrylic, wood, bass string, 3 CRT monitors, silent, white and black single-channel digital video analog tape (phone), 170×92×95cm [23]; (b) Nam June Paik, <The more the better,1988>, video installation, 4-channel video, color, sound, 1,003 monitors (6", 10", 14", 20", 25"); steel structure; laser disk (1,850×1,100×1,100) [24]; (C) Yiyun Kang, <GATES, 2020>, projection mapping installation, 05:06"

Artists and inventors imply that art is the act of creating something from nothing when pursuing a new creation of original ideas. However, there is a personal difference in creative activities as they are methods of approaching creative activities according to the artist's rationalized motives based on metaphysical or physical experiences predicted in various environments. In other words, natural imitation can be involved in the process. Humans fantasize when they pursue wishes that are somewhat far from reality in human life, whether by themselves or others. The reality of fantasy is certain to be fiction or illusion. However, the comparison object of reality that humans are trying to escape will be decorated in and out of a posteriori and a priori spaces of reality and fantasy by relative standards, and it is often closer to a priori judgment. It is because it is deeply related to the justification faced in the process of the digital restoration and representation of historical relics and relics that humankind has not speculated and verified, and it faces the critical problem of maintaining the essence that can contain the original meaning. To clearly describe this thought, looking at the problem of a priori perception prior to the background of posteriori knowledge or experience, the argument of Byong Deok Lee (2010) in the study "A priori justification based on epistemic analyticity" that states 'it is enough to justify this proposition with knowledge of proposition alone,' [25] restoration and representation have their own identity, meaning that judgment based on prior knowledge can also result from the accumulation of posterior experiences.

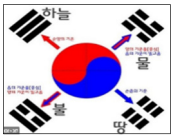
In Plato's (BC 375) writing, "The Republic," he argued, all artistic creating is a form of imitation of nature [26]. In other words, the artist's work was described as the result of the motivation and illusion that existed in the dream. However, it takes work to agree, looking at his philosophical thoughts on a standard for the restoration and representation of the cultural heritage of modern society. It is because, based on the study of Byong Deok Lee (2010), the accumulation of ephemeral experiences can be seen as reflecting the meaning and emotions for prior judgment at the same time. The context of viewing the meaning of reproduction as a positive reproduction process raises the possibility that the act of reproduction can gain positive influence and power on the public regarding the restoration and reproduction of cultural assets in Walter Benjamin (1936)'s claim that

the existence of the original is a prerequisite for a sincere concept [27]. In other words, the meaning of reproduction is interpreted from the perspective of reproduction in that it acts as an inevitable evolutionary process such as society, politics, culture, and technology rather than understanding it as an act. In addition, the difference between reproduction by art and imitation means the object itself is always at a close distance, and the reflection of timeliness that conforms to the trend of the times cannot be ignored.

It is necessary to deeply understand Jean Baudrillard's view of derivative reality that the justification of results restored and represented is more real than reality. The origin of the word "simulation and simulacre" [28] can be described as images, portraits, statues; models; idols, gods, figures, reflections, visions, hallucinations, ghosts, spirits, and more, and Plato's idea is needed to be understood first. The basis for his dichotomous world view enables to understand the idea in the dimension of visible and intelligible [29]. Idea, which was described as the metaphor of the cave, was stated as the essence and absolute truth [30] and the artists' creation is an illusion and an imitation of nature. The nature of the idea that forms the basis of Plato's simulacra encompasses logical, empirical, epistemological, and axiological concepts [31]. Logically, this idea connects to sub-concepts, overarching concepts, and parallel concepts. Empirically, it serves as the foundation for objects' existence, with beauty in things derived from the idea of beauty itself. Plato's philosophy categorizes entities into visible, which can be sensed, and non-visible; the latter, being intangible emotions, are perceived spiritually. Axiologically, the essence of the ideal is abstract, residing in both phenomenal space and ideological reality. This implies that the contradictions inherent in the artists' reality of the time were elevated as topics, reinterpreted, and the concept of Simulation used symbols and imitations to derive the outcomes of Simulacra.

For the Example of Simulacre appearing in modern society, the concept can be understood in [Table 2]. Simulacre Example. (a) The Heart Symbol has various examples, including the shape of the human heart, the color of blood, the shape of the woman's buttocks, which is the origin of life that supported humankind, the shape of the red apple cut in half, and the expression of love. It is hard to find a clear origin. However, the current heart shape is recognized as a meaning of love regardless of the country and race.

Table 2. Simulacre Example

Classification	Public Perception	Simulation	Simulacre
a) Heart Symbol	Symbolizing the intangible mind as tangible.	The human heart symbolizes emotions and the mind, the shape of a woman's buttocks, and the origin of life: Symbol of love.	
b) Statue of Liberty (Liberty Enlightening the World)	Desire for freedom from oppression and irrationality.	The pursuit of possibilities related to freedom is a symbol of the desire for liberation.	
c) National Flag of Korea	Diagrammatic symbol of the existence of a nation.	It became a representation of national identity. (Geon: sky, Gon: earth, Gam: Water, Yi: fire)	
d) Candlelight Vigil	Culture of protest seeking fair rights.	Established as a culture that advocates irrationality and human rights, it has become an icon of the global human rights movement.	

(a) Naver, papeterie; (b) Naver, Go Guides; (c) naver, images; (d) Milwaukee independent, Article.

(b) The State of Liberty is a statue presenting liberation that was given as a present by France to celebrate the 100th anniversary of the United States' liberation in the course of numerous wars, slavery, and political and industrial transformation in the 18th and 19th centuries. (c) The Taegeukgi is a national flag that represents the existence of the Republic of Korea, and those who do not know its existence recognize it as a representative symbol of Korea. (d) The meaning of candlelight vigils has changed from violent protests calling for democratization to a protest culture with gentlemanly behavior as cultural citizens and is now a global perception that has become an expression of democracy, contradiction, and human rights movements.

Jean Baudrillard's philosophy of simulacre described it as an identical duplication without the original [32]. There is a paradoxical meaning that a reproduced duplication of the original through the process of simulation becomes an independent original with a self-existence regardless apart from the original. Simulation insisted on the continuity of four stages by consisting of the representation itself as a whole with simulacre, and the stages are as follows. *"1) it is the reflection of a profound reality; 2) masks and denatures a profound reality; 3) it masks the absence of a profound reality; 4) it has no relation to any reality whatsoever: it is its pure simulacrum"* [33]. It is relevant to the purpose of establishing a meaningful value as the original in which the natural thinking of the essence and the appearance needs to obtain a firm justification for restoring cultural heritage or representation containing its original meaning. The categories of "Simulacre and Simulation" can form the basis for the research problem that restoration and representation itself for the forming of cultural heritage can be recognized as an original with independent meaning, form, and pattern by the Simulation process. While early capitalism aimed at increasing production, late capitalism was restored and commercialized in a virtual space as a result of analyzing social phenomena and structures simultaneously entering a consumer society. The image needed in modern society means that it is represented and utilized according to commercial preferences, and the argument is that the distance between culture and consumers is seen as a "relationship of curiosity" as evidenced by reality in the book "La Societe de consummation: ses mythes ses structures" [34].

Additionally, there exists a demand for a method to restore and represent digital data a preservation technique appropriate for the original or contemporary timeliness lost due to the reinterpretation of Simulacrum. The validity of this study lies in its innovative approach towards the restoration and representation of digital data, utilizing rigorous methodological analyses to ensure the robustness and replicability of the results. [Figure 2] illustrates the process of presenting a restoration of digital cultural heritage and the significance of the presentation by reconstructing it based on Jean Baudrillard's perspective, a 4 steps continuity where truth and experience form a simulacrum representation of the simulation itself. The reliability and validity of this process have been ascertained through consistent testing and refinement, signifying a substantial advancement in the preservation and restoration of cultural heritage in the digital era.

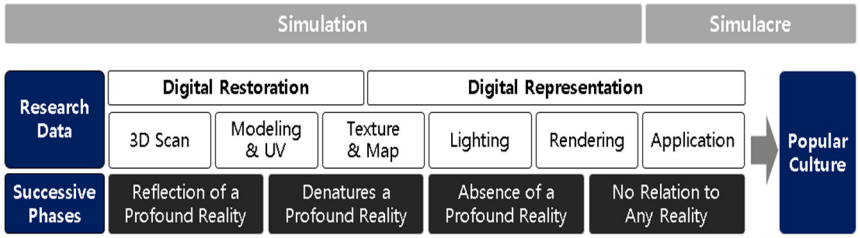


Figure 2. Restoration and Representation Process

Therefore, this paper aims to delve into the concept of the simulacrum by integrating "restoration" and "representation" through the application of digital technology, aligning with the needs of consumers. The objective is to acknowledge cultural heritage as a valuable and unique preservation method that is sustainable. In the context of the digital cultural era, cultural heritage garners importance as a readily accessible resource that can be disseminated in a virtual space.

The methodology of this research, as depicted in [Figure 2], is structured into four stages of 'successive phases,' leveraging Jean Baudrillard's perspective as explored in the theoretical background. These successive phases encapsulate technical processes such as 3D data scanning, Modeling & UV, Texture Mapping, Lighting, and Rendering, all of which were executed following conventional CG production protocols. From a technical viewpoint, the research was designed around the pre-production planning phase, the production phase, and the post-production phase, which encompasses data combination and modification. The principal authoring tools utilized in this research were a 3D scanner, Maya, Blender, Z-brush, and Photoshop.

3. Awareness of Digital Restoration and Representation as Simulacre

The start of rationalism in Western culture heralded the emergence of capitalism from the fall of feudalism. It means that the early Industrial Revolution focused on rational organization of production rather than blind profit-seeking, which is a capitalist orientation. After that, capitalism's full-scale start and maintenance have been required to meet mass production according to demand and the abundance of various consumer preferences, such

as politics, society, culture, and economic activities. That is the characteristic of modern capitalism that we feel. The areas related to culture and art also experience many changes, facing innovations, such as photography in the process of image generation and expression, which has maintained a unique creative before. The invention of photography, which can describe moments of characters and backgrounds, developed in great significance in human history and can be seen as the point where the term, the restoration or reproduction of the characteristic forms or appearances of that time, becomes a realistic keyword. The fact that the concept of reproduction and imitation of technology confronts the identity issue of the original can be seen as an innovation in terms of critical philosophical awareness. Reviewing the chronology of events closely related to simulacre and simulation, it should be noted that the development of digital technology allowed computer graphics to be incorporated into movies as well as photography. In addition, modern society is in the accelerating stage of technology that transcends the limits of recognition capability of the human five senses, such as innovative changes in fast data sharing technology, methods using the internet, and the display method using Head Mounted Display (HDM) and virtual reality (VR) containing hyper realistic image expression. In particular, these technologies provide virtual environments in areas such as education and simulation with content in the form of play culture, going beyond the limitations of artistic expression. Therefore, the restoration concept deviates from the literal meaning and serves as another original that embodies an actual environment beyond substance.

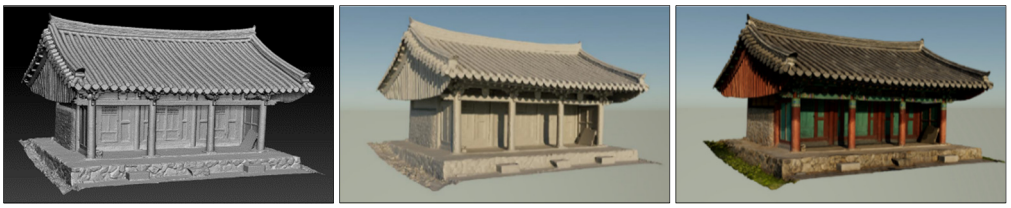
Artists and inventors have in common that their act is a discovery from particular motivation. It is in the same context as what Plato (BC 375) indicates in his writing that the aspect of an artistic act is classified into three: "uses, makes, and imitations. [35]" For example, the production process of the Mucheomdang House was digitally restored and reproduced according to ‘successive phases’ of the four steps of [Table 3].

Table 3. Successive Phases of Mucheomdang House

	Reflection of a Profound Reality	**Denatures a Profound Reality**	**Absence of a Profound Reality**	**No Relation to Any Reality**
Successive Phases	Historical meaning, Application of existing shape.	Converting of digital data and establishment of system.	Restoration of lost parts.	Digital reproduction including shape, aspect, meaning and more.

[Figure 3] is a restoration into digital data containing 3D Modeling & Texture with data scanned by digital technology to preserve the existing Mucheomdang House (Yangdong, Gyeongju). The technological realization of restoration is similar to that of simulation, and it is undoubtedly a completely independent digital entity, and the public is aware of historical identity and nature from the result of reproduction.

The discussion of the results is predominantly centered on issues related to technical visualization implementation. In the case of inanimate objects, it is highlighted that the implementation can be continuously updated using validated data or photographic information from the existing physical object. Thus, when compared to the original images, we can observe a visually similar appearance.



(**a**) (**b**) (**c**)

Figure 3. Mucheomdang House (Yangdong, Gyeongju): (a) 3d scan; (b) Digital Restoration with 3D Modeling & Texture(simulation); (c) Digital Representation Example(simulacre)

The restoration procedure of cultural heritage is an imitation combining the cases of historical research. It can be seen as reproducing the original through technological reproduction using digital authoring tools. It is to help understand the fundamental concept of simulácrum interpreting in terms of “logical, empirical, epistemological, and axiological” through Plato (375 BC)’s ideological theory rather than providing the clue to

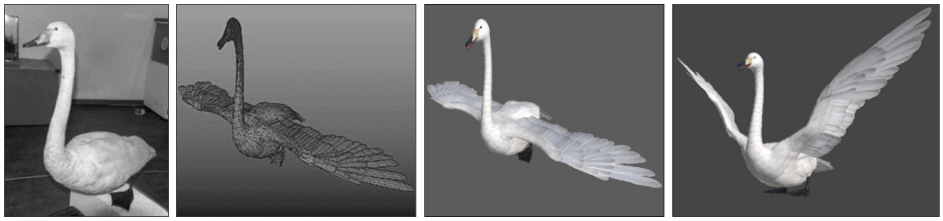
problem-solving. The production process of Whooper Swan was restored and reproduced using digital authoring tools according to the 'Successive Phases' of four steps of [Table 4].

Table 4. Successive Phases of Whooper Swan

	Reflection of a Profound Reality	**Denatures a Profound Reality**	**Absence of a Profound Reality**	**No Relation to Any Reality**
Successive Phases	Application of characteristics of form of stuffed animal.	Converting of digital data and establishment of shape.	Digital restoration of lost parts.	Digital reproduction including shape, aspect, meaning and more.

It will be helpful to understand Walter Benjamin (1936)'s explanation of the argument mentioned above that "the existence of the original is a prerequisite for a genuine concept. [36]" In addition, it cannot be denied that the essential conditions of creation exist within the fundamental frame of imitation mentioned in the "formation as a creation and reproduction, the embodiment of creation and reproduction (2021)" by Song Jin-won and Ahn Byung-hak, which imply mimesis [37], voice, and act imitation theory [38].

It shows that the argument also includes the action of imitating and symbolizing data by the intervention of experiences accumulated inside humans when restoring the form of stuffed birds in [Figure 4]. Whooper Swan. There are no issues regarding visual similarity when implementing the visual aspect of a living organism. However, when integrating animation actions, there is a lack of naturalness. Nevertheless, as the focus of this research is on visual exterior visualization, the issues related to motion will be resolved in future research.



(a) (b) (c) (d)

Figure 4. Whooper Swan: (a) Taxidermied & 3d scan; (b) 3D Modeling; (c) Digital Restoration with 3D Modeling & Texture(simulation); (d) Digital Representation Example(simulacre)

To justify the restored and reproduced results discussed in the theoretical background, reliance was placed on Jean Baudrillard's perspective of a derivative reality that is more real than reality itself. The production process of Crane was restored and reproduced using digital authoring tools according to the 'Successive Phases' outlined in [Table 5].

Table 5. Successive Phases of Crane

	Reflection of a Profound Reality	**Denatures a Profound Reality**	**Absence of a Profound Reality**	**No Relation to Any Reality**
Successive Phases	Application of characteristics of form of stuffed animal.	Converting of digital data and establishment of shape.	Digital restoration of lost parts.	Digital reproduction including shape, aspect, meaning and more.

Additionally, elements such as size, structural form, material, color, and texture of the 3D model were restored using a grid comparison method based on original measurements. This process also encompasses the imitation and symbolic representation of data, a task influenced by the accumulation of human experiences, particularly evident in the restoration of the form of the stuffed birds shown in [Figure 5]. The visual similarity of the restored form is a usable result in digital content.

(a) (b) (c) (d)

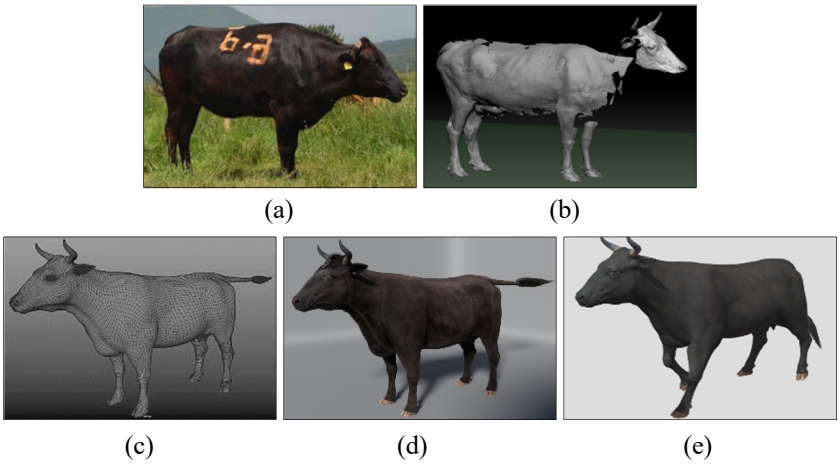
Figure 5. Crane: (a) taxidermied & 3d scan; (b) 3D Modeling; (c) Digital Restoration with 3D Modeling & Texture(simulation); (d) Digital Representation Example(simulacre)

Crane, the characteristics of birds are moving creatures, and basic form and aspect information was adopted from data such as photographs and stuffed animals. In addition, in the case of animation, it was finally restored through the inference process of basic pose and motion using the motion pattern data of birds with similar body structures. In terms of preserving the data of existing individuals, digital restoration aligns with Plato's concept of imitating nature, adhering to Benjamin's concept of authenticity - the notion that while an original's 'aura' can never be fully reproduced, the restoration process should remain as faithful as possible to the original. This process, involving imagination and imitation, was digitally revived and replicated using digital authoring tools following the four Successive Phases outlined in [Table 6].

Table 6. Successive Phases of Jeju Black Cow

	Reflection of a Profound Reality	**Denatures a Profound Reality**	**Absence of a Profound Reality**	**No Relation to Any Reality**
Successive Phases	Application of characteristics of form of real object and stuffed animal.	Converting of digital data and establishment of shape.	Digital restoration of lost parts.	Digital reproduction including shape, aspect, meaning and more.

[Figure 6]. Jeju Black Cow, the artist's extremely subjective judgment, acts in the restoration process of the stuffed original. In addition, it is the basis of virtual reality, which means a vast transcendent act of pursuing a fantasy that is close to reality.



(a) (b) (c) (d) (e)

Figure 6. Jeju Black Cow: (a) Material reference; (b) 3d scan from taxidermied; (c) 3D Modeling & Texture; (d) Digital Representation example(simulation); (e) Digital Representation of Animation Data(simulacre).

In the aesthetic idea based on Plato's philosophy, the meaning of imitation is classified into involvement (methexis), similarity (homoiosis), and identical (paraplesia) [39], and it can prove that subjectively embedded memories about imitation (mimesis) are necessary conditions implicated in artistic activities. In the case of [Figure 6]. Jeju Black Cow, the digital data conversion process of stuffed animals cannot be considered perfect in the results reproduced in the artist's imagination and expert's historical evidence compared to the actual form or pattern.

However, in comparison with Jean Baudrillard's philosophy of simulacre, it defines that identical reproduction without the original can have full potential as another form of the original.

[Table 7]. Jeju Horse, it is commonly called "Jeju pony," and, is also called "Guahama" or "Thoma", which means that it is a horse that can pass under a tree due to its short height. The restoration of the form exhibits sufficient similarity. However, there are various technical implementation issues related to the treatment of surface texture, such as color and material. In particular, the problem of implementing animal fur exists due to the limitations of the authoring tools and subtle differences in the visual perception process.

Table 7. Successive Phases of Jeju Horse

	Reflection of a Profound Reality	**Denatures a Profound Reality**	**Absence of a Profound Reality**	**No Relation to Any Reality**
Successive Phases	Application of characteristics of form of stuffed animal.	Converting of digital data and establishment of shape.	Digital restoration of lost parts.	Digital reproduction including shape, aspect, meaning and more.

[Figure 7]. Jeju Horse is a medium-sized horse with a size of 117cm for females and 115cm for males and it has a gentle personality and a healthy constitution, so it has strong immunity and survival against diseases. The color of the fur is mostly brown, reddish brown, gray, and black, and its characteristic is that it has a unique body shape with a low front, a high back, and a long body length, which is distinctly smaller than other horses. Therefore, the restoration and expression of cultural heritage based on simulacre should be interpreted as a realization of a virtual idea through the artist's imitation and reinterpretation. In addition, digital figuration of intangible, tangible cultural heritage is newly reproduced into those with independent meaning and aspect through the process of simulation. The restored data holds more meaning than the real, and it can be seen as the present original in which the actual object is simulated. The restoration of the object's form offers sufficient similarity. Nonetheless, careful attention is necessary when handling surface attributes such as fur, impurities, and discoloration. Moreover, meticulous modifications based on data analysis are required.

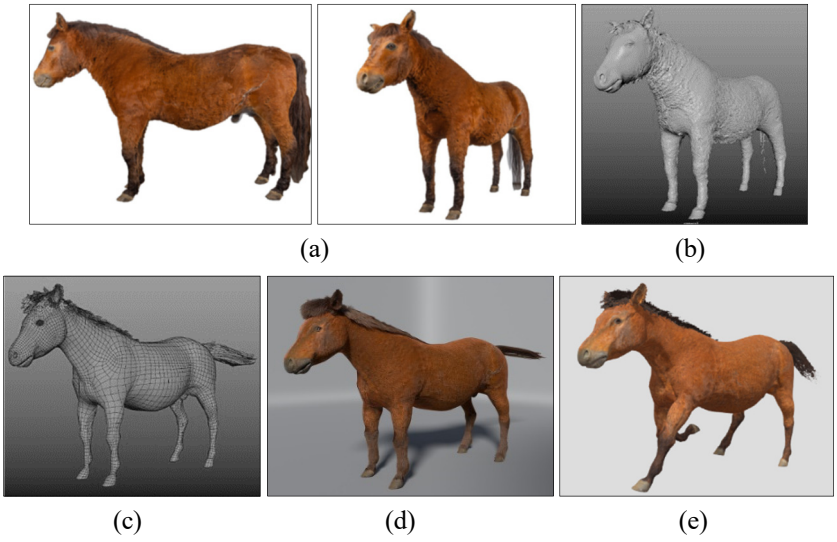


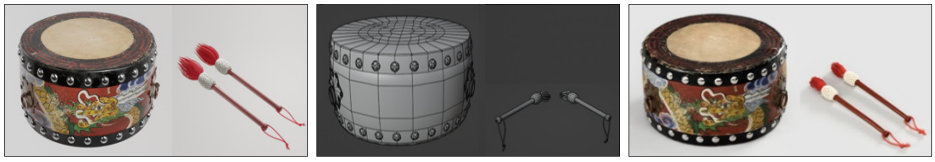
Figure 7. Jeju Horse: (a) Material reference; (b) 3d scan from taxidermied; (c) 3D Modeling & Texture Digital Restoration; (d) Digital Representation example(simulation); (e) Digital Representation of Animation Data(simulacre).

In restoring and reproducing traditional Korean instruments, this study is divided into artificially produced reproduced instruments and original instruments after excavation, in the case of [Table 8]. Dragon Drum was digitally restored and reproduced using digital authoring tools according to the four aspects of 'Successive Phases' presented as a real traditional musical instrument.

Table 8. Successive Phases of Dragon Drum

	Reflection of a Profound Reality	Denatures a Profound Reality	Absence of a Profound Reality	No Relation to Any Reality
Successive Phases	Application of characteristics from real object, photograph.	Converting of digital data and establishment of shape.	Digital restoration of lost parts of original.	Digital reproduction including shape, aspect, meaning and more.

As shown in [Figure 8], the Dragon Drum measures 40.5 cm in diameter, 23 cm in width, 33.5 cm in length, and 25 cm in circumference. It was digitized using photographic data of the original instrument. The restoration of traditional instruments presents challenges due to the variety of materials used, including wood and leather, and devices to secure the leather. Understanding the type of varnish applied to the material and how it is used is particularly important when dealing with textures. While the similarity to the original is quite high, there are differences in the handling of reflective materials on the surface and the treatment of damage due to prolonged use for a more realistic representation.



(a) (b) (c)

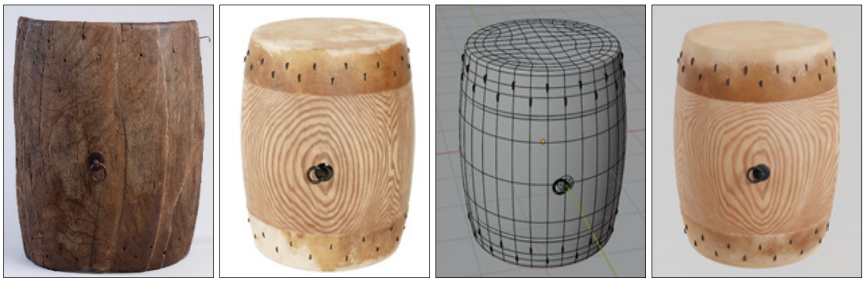
Figure 8. Dragon Drum, (a) Pictures of Original Instrument; (b) 3D Modeling & Texture Restoration(simulation); (c) Digital Representation example(simulacre).

The drum, which measures 34cm in diameter and 51.2cm in height, is the oldest known drum in Korea and is believed to date back to around the 9th century. It was digitally restored and reproduced using digital authoring tools, following the four steps of 'Successive Phases' as outlined in [Table 9].

Table 9. Successive Phases of Drum

	Reflection of a Profound Reality	Denatures a Profound Reality	Absence of a Profound Reality	No Relation to Any Reality
Successive Phases	Application of characteristics of reproduced instrument shape.	Converting of digital data and establishment of shape.	Digital restoration of lost parts of original.	Digital reproduction including shape, aspect, meaning and more.

The traditional instrument shown in [Figure 9]. Drum was unearthed in 2005 at Yeonji in the Hwawangsanseong Fortress in Changnyeong.



(a) (b) (c) (d)

Figure 9. Drum, (a) A drum excavated from Hwawangsanseong Fortress in Changnyeong (Images courtesy of the National Gimhae Museum); (b) Reproducing Instrument by Handcrafting; (c) 3D Modeling & Texture(simulation); (d) Restoration example(simulacre).

As recorded in the "Veritable Records of King Taejong," the Hwawangsanseong Fortress, where the drum was discovered, was constructed in 1410, during the 10th year of King Taejong's reign. The instrument was restored and reproduced by estimating data for the missing parts, using literary research, 3D scanning, and 3D data application [40]. This approach was based on the fragments in Figure (a), discovered during the excavation. In this study, the instrument was digitally restored based on the reproduced versions, and the actual form was recreated using grid mapping, taking into account the size, material, and texture for 3D modeling.

The main challenge encountered in creating the final product lies in the detailed handling of materials needed for aesthetic surface treatment. Realistic portrayals of leather, wood, metal attachments, and indications of damage or scratches from prolonged use can lead to a more authentic physical representation.

4. Conclusion and Implication

This study posits that the perception of digital restoration and representation, in line with contemporary timeliness, can substitute absolute essence. The results obtained during the digital restoration of cultural heritage weren't simply technical reproductions of shapes, but were grounded in Jean Baudrillard's theory of Simulation and Simulacra. It was considered that the inherent essence carries significant value as the inherited original. Furthermore, Baudrillard's philosophy insists on the continuity of four steps, forming the representation of the simulacra itself, which are as follows: *"1) It is the reflection of a profound reality. 2) It masks and perverts a profound reality. 3) It masks the absence of a profound reality. 4) It has no relation to any reality whatsoever: it is its own pure simulacrum."*

Therefore, in terms of digital restoration and representation of cultural heritage, 1) reflection of meaning and purpose based on literature and archetypes; 2) realistic application of digital implementation technology; 3) restoration of lost archetypes; 4) The potential for digitally reproduced heritage to replace archetypes constitutes a pure simulacrum. The implications of these research findings, in terms of theoretical and digital implementation, are as follows.

In theoretical studies, reviewing the meaning and functional behavior of imitation, reproduction, restoration, and representation provides a basis for understanding the thesis. Imitation can be viewed as reproduction via the intervention of a universally recognizable experience in the creative process. It is challenging to dismiss the possibility that certain functional acts may be identical among the external duplicating processes, which form the restoration process. Restoration is an act of returning a form or aspect to its original shape through symmetrical analysis and historical evidence of the damaged parts of valuable antiquities and relics. This property can be interpreted as a part of the representation of the whole. In other words, it encompasses the reconstruction of past culture, meaning that the original image is estimated and restored from the lost remains and relics found in ruins. Representation should be ideally understood as reinvention, the sum of the restored whole.

In terms of digital implementation, the innovative function of digital restoration technology grants access to scientific production methods that are easy to visualize in 3D and correct. The convenience of digital technology aligns with public-friendly social norms and offers the advantage of being able to digitally restore the real world to simulate situations that cater to the public taste. In the past, computer graphics implementation technology was primarily focused on the simple restoration of shape. However, its utility in modern society can be combined with artificial intelligence and virtual reality, based on IT. In the process of restoring cultural heritage, there are ample reasons to virtualize tangible and intangible cultural properties in the historical sense through literature surveys and historical research, thereby advancing them into a meaningful industry.

The results of this study primarily focused on a literature review regarding the theoretical persuasiveness of the restoration and reproduction of tangible cultural heritage. Ultimately, while the restoration and reproduction of cultural heritage are based on historical facts, it is also essential to consider the demands imposed by current timeliness. Furthermore, in this process, the restoration of some heritage assets was achieved using digital technology. The criteria for this were established through the four successive phases from Jean Baudrillard's basic concept of Simulation and Simulacra. In the case of intangible cultural properties, they are invisible, such as a theater play, dance, music, or craft technique. Here, the person who possesses the technique becomes the subject of designation. Building on this digital evolution, a notable development is the emergence of the 'Digital Actor' [41], often equated with terms such as Avatar, Digital Human, and Virtual Influencer. The term primarily pertains to the use of avatars in games or the substitution of film characters. Throughout the paper, it is consistently referred to as a Digital Actor. As its prevalence continues to grow, there's an evident need to further refine technological production methods and to more comprehensively integrate lifelike appearances and motions that mirror human

behaviors. An ideal representation of a digital actor might be historical figures, meticulously recreated using empirical data and advanced simulation techniques. Such virtual reconstructions have promising applications in movies, dramas, animations, games, advertisements, and education, encapsulating a detailed portrayal grounded in simulacra. The entertainment industry has already begun showcasing such virtual personalities, with notable figures like <Rozy>, <Jane>, and <Reah>.

However, the process of restoring cultural heritage relies on factual data from human history, but some aspects are communicated through oral and unverified methods, making it challenging to precisely restore the origin or justification of the data in the survey and research process. Moreover, the production process involved in digital restoration may incite social discord if the intended meaning and purpose are utilized for different aims, necessitating societal standards for the appropriate restoration of cultural heritage.

Hence, the limitations of this research are twofold. First, there is an insufficient amalgamation of historians and scholars related to the content. The necessity for improved communication within a structurally enhanced environment may usher in a more superior era of convergence. Second, cultural heritage serves as an excellent example of establishing national and ethnic identities, and its outcomes can form the foundation of a digital cultural powerhouse through extensions like education and the provision of virtual environments. From this standpoint, future research will delve further into the structure and applicability regarding how tangible and intangible heritages can influence cultural, educational, and economic ripple effects.

Conflicts of Interest: The authors declare no conflict of interest.

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