CLONE CULTURAL PROPERTY:

NEW WAY OF CONSERVATION

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ABSTRACT: In modern society, we face a dilemma—while cultural properties must be safeguarded for preservation, there is also the need to display them to the public. To resolve this issue, the Tokyo University of the Arts (TUA) has developed a technology called "Clone Cultural Property" to create extremely accurate reproductions by combining art and scientific technology. Clone Cultural Property is new forms of art rather than simple replicas, combining state-of-the-art digital technology and traditional analog technology, in addition to integrating craftsmanship and artistic sensibility. The cultural properties that are reproduced are complete clones, using not only the same materials and textures but also recreating artistic DNA by including the cultural backgrounds and techniques used in the originals. The philosophy and technology behind Clone Cultural Property is useful in resolving the dilemma between the simultaneous need to preserve and exhibit cultural properties, while also serving as a method of perpetuating artistic culture. This novel technology enables us to preserve and display universally important cultural properties and it also has infinite possibility includes playing a certain role in tourism and cultural diplomacy.

1. INTRODUCTION

In modern society, we face a dilemma because while cultural properties must be safeguarded for preservation, there is also the need to display them to the public. Forbidding the public from accessing these properties is the easiest way to preserve cultural heritage and properties. However, they are important tourist attractions and are often expected to remain accessible to the public as valuable universal properties of humanity. While there is significant value in ensuring that archaeological objects or artworks remain open to the wider public, it is virtually impossible to balance the need to preserve and display them.

In addition, like the Great Buddha of Afghanistan/Bamiyan, which was destoroyed in 2001, valuable cultural heritage has been destroyed by terrorism or disappeared as a result of plundering, invasions, and conflicts. To ensure compatibility between protecing and displaying precious cultural properties is a long-standing issue all over the world.

2. CLONE CULTURAL PROPERTY

To resolve this issue, the Tokyo University of the Arts (TUA) has developed a technology called "Clone Cultural Property" to create extremely accurate reproductions by combining art and scientific technology.

"Clone Cultural Property," researched and developed by TUA, are the result of an aspiration to create a new form of art rather than simple replicas by combining state-of-the-art digital technology and traditional analog technology, in addition to integrating craftsmanship and sensibility. The idea is to minimize exhibitions of the original works in order to preserve them, while displaying works of similar, or perhaps even higher, quality by Clone Cultural Property.

In Japan, cultural properties have long been handed down by reproduction (mosha and mokoku) which inherits religion, studies, and techniques.

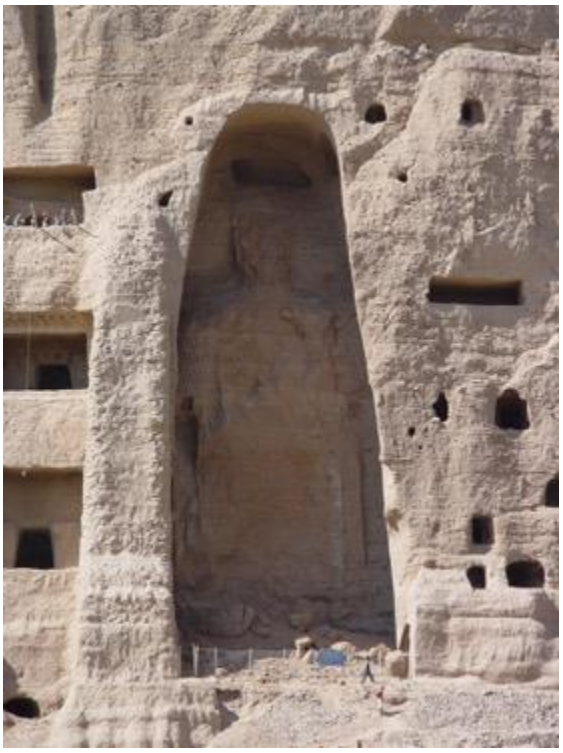

Figure 1: *The East Great Buddha (after destruction)*

The reproduction carry the religious or artistic values to the next generation in place of original cultural heritage whose degradation over time is inevitable. As a unique feature of Eastern culture, the reproduction is considered as a new art works which also contains the spirit and a source of inspiration for the creation through its reproducing artistic activity.

For example, the Horyu-ji Kondo mural paintings, dubbed the greatest Buddhist paintings and painted in the 7th century, were damaged by fire in 1949. The damaged murals were removed to a repository and what today's visitors see are reproductions completed in 1968 by printing photographs on specially commissioned Japanese washi paper and then adding color on top. Similarly, the Byōdō-in temple in Phoenix Hall, which has been the design on the Japanese 10 yen coin since 1959, is a national treasure built in the 11th century and listed as a UNESCO World Heritage Site and as one of the cultural assets of the former capital, Kyoto. There are paintings on the insides of the inner doors of Phoenix Hall, most notably paintings of the Buddha; the original art works, however, have been removed for storage, and reproductions painted in 1960s-70s are currently displayed in the hall. Similarly, famous Japanese shrines such as the Ise-jingu shrine and Nikko Tosho-gu shrine are periodically rebuilt and repainted, allowing shrine construction and painting techniques to be shared and passed down through the generations.

Figure 2: *Wall no. 6, Main Hall, Horyu-ji temple (destroyed by fire)*

Figure 3: *Reproduction, Wall no. 6, Main Hall, Horyu-ji temple (before destruction by fire)*

Figure 4: *1953 memorial year transfer (sengu) of the inner sanctuary of the Ise-jingu shrine (top: new sanctuary; bottom: old sanctuary)*

Figure 5: *Three wise monkeys, Tōshō-gū Shrine, Nikkō (Photo by Jakub Hałun, July 27, 2010)*

In Eastern, Wang Xizhi was a calligrapher active in the 4th century, during the Eastern Jin dynasty. He was highly respected for his calligraphy skills, both in China and Japan. His calligraphy works have been used as models since ancient times, not only in China but in Japan as well. However, none of his original works exist today. Many of his works have been handed down to our generation through elaborate reproductions. The degree of perfection in these elaborate reproductions is so high that they almost look as if they are genuine. The names of the persons who created the reproductions are unknown, as the reproductions have been passed down to us as calligraphic works by Wang Xizhi. In addition, the originals of the Gu kaizhi nüshi zhen tu silk hand scrolls painted by Gu Kaizhi in the fourth century and of the calligraphy works of Wang Xizhi have not survived, and the works exist only as reproductions housed at the British Museum. [1]

Figure 6: *Wang Xizhi Ritual to Pray for A Good Harvest (Xingrang tie), Princeton University Art Museum*

Figure 7: *Gu Kaizhi Nüshi zhen tu ('Admonitions of the Instructress to the Court Ladies') (Reproduction)*

A clone in scientific terms is defined as a group of organisms or cells, produced asexually from one ancestor or stock to which they are genetically identical. The cultural properties that are reproduced are complete clones, not only using the same materials and textures but also recreating artistic DNA by including the cultural backgrounds and techniques used in the originals. In this sense, these reproductions are not merely copies or replicas of cultural properties.

By conducting detailed research on original works, we are able to create Clone Cultural Property in which materials such as the paint, the support—dimples on the surface—and the brushstrokes are perfect imitations of the originals. However, the ultimate aim is not to create academically credible and valid replicas of the works but to impart culture and inspire people. When we create these clones, we always consider how viewers will feel when they see Clone Cultural Property and make

efforts to find ways in which we can impact them.

By creating Clone Cultural Property, we provide people with the opportunity to see the world's greatest works of art or clones of the same quality. To make clones widely available, we need to create accurate replicas using limited resources, and we were able to extensively reduce both time and cost by utilizing digital technology. Until recently, replicas were manually produced by craftsmen, with each work being slightly different and requiring an enormous amount of time and effort. However, cloning technology has resolved these issues.

2.1 CASE STUDY: THE MURAL PAINTING ON THE CEILING ABOVE THE HEAD OF THE EAST GREAT BUDDHA NICHE OF BAMIYAN

The mural painting on the ceiling of the East Buddha niche of Bamiyan: Climbing up the stairs in the remains leading to the top of the head of this gigantic East Buddha, there used to be a view of a ceiling painting representing the god of the sun and a panoramic view of the Bamiyan Valley from a balcony near the ceiling. However, in March 2001, this Buddha was completely destroyed, and now only a part of the right shoulder remains. It is no longer possible to feel the dynamic presence at the site, which can only be experienced from there.

In 2016, TUA decided to take on the challenge of reproducing the mural painting on the ceiling above the head of the East Buddha Niche of Bamiyan. This time, the reproduction was based on research materials and measured data and employed the latest digital technology and TUA's best craftsmanship.

RESEARCH, COLLECTION, AND COMBINATION OF IMAGES

Detailed photographs of the mural painting on approximately 15,000 medium format positive films, taken by Takayasu HIGUCHI's research team in the 1970s, are archived at the Institute for Research in Humanities, Kyoto University. 150 films with images of the mural painting were digitized in high resolution. After examining the digitized images, it became apparent that the resolution would not be high enough when the image capturing the whole mural painting was enlarged to its original size. A decision was then made to combine the photographs of the different parts of the painting to improve the quality. The mural painting consists of mainly three parts: the god

Figure 8: *Mural painting on the ceiling of the niche, seen from underneath the East Great Buddha*

of the sun riding a carriage with four horses in the center, and the sides decorated with royals, nobles, and Buddha figures of the East and West donners. The photographs of the three parts were combined to make one image. As it was painted on an arch-shaped surface, it was necessary for a research team in RWTH Aachen University in Germany (hereinafter referred to as "the German team") to adjust the distortions in the image using, as a reference, the development view created from the 3D data [2] after the destruction of the Great Buddha. The combined image was applied to the 3D data to confirm its position on the arched surface. The data measured by the German team was very useful in the reproduction process as it demonstrated that the blast did not completely change the shape of the ceiling.

By improving the quality of the digital image to the greatest extent possible, a few issues to be dealt with emerged, such as considering how to further improve the degree of perfection in the painting and the loss of quality caused by very high levels of image enlargement. However, it was possible to retain the charm of the original painting by retouching colors on the image printed at about 30% (area ratio) of the original size, supplementing images for the parts that had peeled off; and digitizing the photos taken again.

STRUCTURE OF THE MURAL PAINTING

The arch above the Buddha's head on which the mural is painted does not have a simple shape like a geometric pattern; it twists slightly and a large part in the center of the arch is dented.

Figure 9: *Connecting the three parts—sun god and east and west donners—using the development view created from the 3D data as a reference*

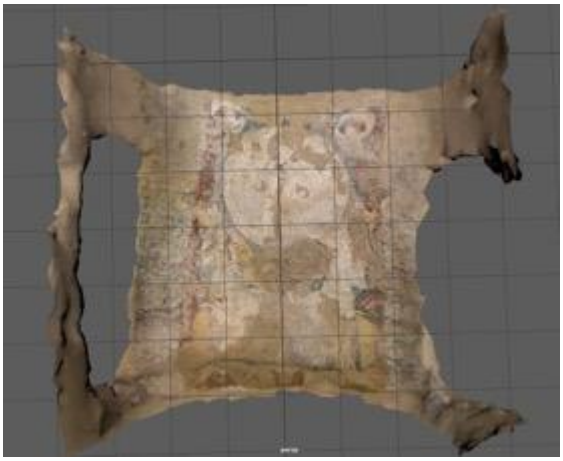

Figure 10: *Confirmation of the position by pasting the 3D data*

Figure 11: *Retouching colors on the mural painting printed out at about 30% (area ratio) of the original size*

As the reproduced mural painting would be lifted up to the ceiling for the exhibition, a high-density but light material that is easy to cut was used for the basic structure. Based on the German team's 3D data, the most suitable shape and structure to form the base of the arch were calculated in detail. In addition, delicate unevenness was reproduced based on the digitized photographs taken in the 1970s. To recreate the texture of the wall surface, displaced cultural properties, including mural paintings from Afghanistan that were being restored and preserved at the TUA, were used as examples. By conducting strict visual inspections and comparing samples repeatedly, a wall structure thought to be as close to the original as possible was finally created.

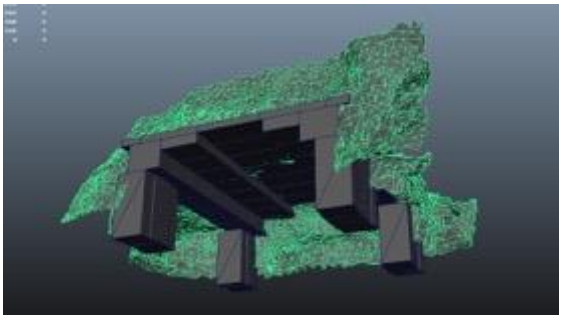

Figure 12: *Simulation of the application of the structure that will form the base in the niche using 3D data (provided by RWTH Aachen University)*

REPRODUCTION OF THE MURAL PAINTING

A high resolution image of the original size printed using an ink jet printer was pasted onto the aforementioned structure. Moreover, to create a texture similar to that of the original mural painting, retouching of the colors was done using the same mineral pigment materials such as lapis lazuli. The reproduction was completed by fully utilizing the artists' senses and skills developed over time at TUA and by synchronizing them with the spirit of the artists of the time.

An enormous amount of time and effort would have been required to reproduce the huge ceiling painting entirely by hand. The values of traditional Japanese "reproductions" that emphasize not merely copying but learning about the spirit of the original artists, as well as the use of modern digital instruments, enabled this reproduction to be created in a short timeframe, down to the very last detail that cannot even be seen by the naked eye.

The precious films left by those who had traveled with passion to the land of Bamiyan were revived using digital technology. We can only pray that the Buddhist paintings that traveled through the Silk Road in the very distant past and the reproduction of the mural painting to be installed in the niche above the head of the Buddha with the spectacular view of the valley will soon be returned to Bamiyan along with the Cultural Refugees. [3]

Figure 13: *Printing the mural painting on Japanese washi paper as the base layer*

Figure 14: *Attaching the printed Japanese washi paper to the structure of the niche*

Figure 15: *Retouching colors on the mural painting*

Figure 16: *Reproduced mural painting on the ceiling, seen from the same height as the head of the East Great Buddha*

Figure 17: *Mural painting on the ceiling of the East Great Buddha in Bamiyan: reproduction data based on the photographs taken in the 1970s*

Figure 18: *Mural painting on the ceiling of the East Great Buddha in Bamiyan: reproduction data supplemented with images from the Tokyo University of the Arts COI (Center of Innovation) Site (2016)*

3. CONCLUSION

Clone Cultural Property is just one way to preserve cultural heritage. However, we cannot only recreate the physical materials, but also the beliefs, artistic quality, and the attitudes that lie at the root of the works, to bequeath them to the next generation. This will deter the destruction of cultural properties during war and as acts of terrorism. It is a new method of advocating culture sharing and peaceful co-existence.

The philosophy and technology behind Clone Cultural Property is useful in resolving the dilemma between the simultaneous need to preserve and display cultural properties, and it also serves as a method of perpetuating artistic culture. This novel technology enables us to preserve and display universally important cultural properties, and it is expected to play a role in cultural diplomacy. It also offers infinite other possibilities. However, this project also carries the risk of flooding the public sphere with several replicated products. Therefore, we adhere to two strict rules. First, we collaborate only with original artwork owners. Second, we will transfer the technology to the government or other established institutions. We firmly believe that this project will form the basis for creating a prosperous world by supporting the concept of Clone Cultural Property created with artistic skill, while expanding the sphere of inspiration.

Tokyo University of the Arts has taken on the challenge of reproducing various cultural properties in the past. In 2013, we took on the challenge of reproducing the paintings on the outer sanctum walls of the Main Hall of the Horyu-ji temple—one of the world heritage sites that Japan is proud of. The mural paintings in the Main Hall of the Horyu-ji are a renowned set of Buddhist paintings in Asia, believed to have been painted towards the end of the 7th century. However, the mural paintings were damaged by a fire in 1949 and their artistic value was lost as a result. By integrating images of the mural paintings in monochrome photographs (glass plates) taken before the fire, reproductions by painters, records by art historians, and scientific analysis, we successfully reproduced all 12 mural paintings from the Main Hall of the Horyu-ji, which had the same size and texture as the originals, using the university's cultural property reproduction patented technology. During exhibition, it was possible for the first time in history to see full-scale reproductions of the mural paintings, to experience the space in the Main Hall before the destruction of the wall, and get a comprehensive sense of the value of the cultural property. In 2014, at the government of Myanmar's request, we created reproductions of the Bagan mural painting as memorial gifts for the participants of the ASEAN summit by using high definition photographs and 3D measurements.

The technology to produce Clone Cultural Property developed by us involves creating by hand, supported by digital technology, clones that are tangible "objects" that we can use to pass on our culture to future generations. It is not about exhibiting copies of original works. Art created by humans can only be reproduced by humans, and it is only through human hands that the authenticity of the original can be passed on. The new Clone Cultural Property, which is hybrids of traditional art and craft techniques and digital imaging technology, can be applied proactively to education programs and cultural diplomacy, sharing cultures of the world on a global scale.

Figure 19: *Reproductions of all 12 sides of the mural painting in the Main Hall of the Horyu-ji temple before the destruction by fire*

Figure 20: *Bagan Archaeological Area, Myanmar*

Figure 21: *A reproduction of the Bagan mural painting was handed over to the government of Myanmar.*

Figure 22: *Mural reproductions made by the Tokyo University of the Arts COI Site were exhibited at G7 Ise-Shima Summit (2016).*

4. ACKNOWLEDGMENT

Staff for the Reproduction of the Mural Painting on the Ceiling above the East Great Buddha Niche of Bamiyan

Supervisor

Masaaki MIYASAKO

Hidetoshi NAMIKI, Miki ASO, Yuichiro TAIRA, Kazuhiro MIHASHI, Yungko YU, Ryuji NISHIKAWA, Koji NOYORI, Bungo YANATORI, Rina HIRAO, Ikumi NAGAOKA, Tsubasa KOBAYASHI, Kotaro KUDO, Mariko SATO, Marina HOSODA, Rumi NAGAYAMA, Yuka ARATONO, Ryosuke IMAI, Sotaro SAWAMURA, Shohei SHIRAI, Aya SUMIURA, Shuntaro YOSHINO, Hao YUMO,Yuriko TERAMOTO, Yumiko HIRANO

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