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Yun, Hwang Rok
Graduate School of Design,
Kyushu University
yunhr61@gmail.com

Kim, Dae Woong
Faculty of Design,
Kyushu University
dwkim@design.kyushu-u.ac.jp

Ishii, Tatsuro
Faculty of Design,
Kyushu University
tatsuro@design.kyushu-u.ac.jp

A Study of Digital Media Art Utilizing the Contents of The Architecture Cultural Property

Digital video expression using Projection Mapping techniques at Mojiko station

Abstract
This research is about creating contents about the origin and history of Mojiko station using Projection Mapping one of the new digital media techniques, and designing video expression and evaluation in order to develop a new genre of Projection Mapping. We investigate the characteristics of recent various Projection Mapping creations expressed in each purpose and method, then we test Projection Mapping through experimentation and propose the process of using cultural property as a material for contents and a way to develop contents using cultural property and validate the outcome. In order to perfect the techniques based on this research we think it is important to clarify how to develop the contents of Projection Mapping and techniques by testing them and experimenting under various conditions.

Keywords: Digital Media Art, Projection Mapping, CG

1 Introduction

Recently three-dimensional Video Projection as well as augmented reality, which consists of video and 3D objects projected on a display, they are both developed. The hardware and video contents using both technologies attract attention.

By making objects which do not physically exist look as if they were in existence, we aim to fuse real space and virtual space, contributing to the improvements of the entertainment and artistry of the contents. In particular, Projection Mapping is proposed as dramaturgy by CG images and lighting. This technique enables projector art that combines the real and virtual to be finished by programming the structure and dimensions to precise measurements and projecting CG images and lights. [1][2]

This research is about creating contents about the origin and history of Mojiko station using Projection Mapping one of the new digital media techniques, and designing video expression and evaluation in order to develop a new genre of Projection

developments for contents of diverse cultural relics, historic

sites and cultural assets and developing a new genre of Projection Mapping.

1-1 Research background

Architecture is a subject with complex meanings. Sometimes, it is evaluated as public art beyond one for human convenience. Currently, there are cultural assets with the traces of history at Mojiko Retro in Kitakyushu City. Architectural heritages, in particular, among cultural properties are ones that show cultures and histories best, which reflect the images of each period well. Architecture has characteristics of each country, but the flow of the recent world architecture homogenized in external aspect. In addition, the present world shows complex multi-cultural characteristics along with each country's own culture, and among them, young generations are losing the meaning of historical and cultural identities. Based on this phenomenon, using the contents of cultural heritages with cultural and historic values is considered as a nice opportunity of increasing people's interests in and values of the cultural heritages that are being forgotten. In addition, it is expected that a secondary effect by which the meaning of architectural heritages through works become more educative and corresponding values.

1-2 Purpose of research

This research is about creating contents based on the origin, history and image of cultural architecture heritage using Projection Mapping one of the digital media techniques. First we investigate the characteristics of recent various Projection Mapping creations expressed in each purpose and method, then we test Projection Mapping through experimentation and propose the process of using cultural property as a material for contents and a way to develop contents using cultural property and validate the outcome.

2 Projection Mapping

2-1 Projection Mapping

In modern projection technology, slide projectors were popularized in the 20th century, in the 21st century projection image expression rose explosively by increasing popularity of computers and digital projectors. The developments of computer graphics enabled us to project images easier by the developments of digital projectors. Projection Mapping was born in the process of the developments of projection techniques. It has the exact same form of “projecting images onto something” as the former projection techniques. However, the major difference is to project images onto three-dimensional and textured surfaces. The definition of Projection Mapping by Projection Mapping Association Japan (PMAJ) is an imaging technique synchronizing objects (real) with images (virtual), which is not simply projecting images or computer graphics on the screen or a plane, but projecting them on a building, 3D structure or artifact with a projector. Images created with former projection techniques have only the virtual side of images. The screen is the only real object and projection medium to capture images. Viewers were limited to two-dimensional virtual images.

On the other hand, Projection Mapping can even represent three-dimensional impressions and a special feeling as if objects that cannot move were actually moving, objects look more realistic, different expressions stood out by giving casting light and shadows of the images as well as utilizing information such as parts and irregularities that the object has. It enables us to enjoy not only images projected but also objects that are being projected onto. The fantastic and illusive visual expressions can make audiences feel like the objects move, change shape and glow by itself with the moves and changes of the images[3]. Figure 1 shows a schematic diagram of Projection Mapping. Projection Mapping enables complex expressions including the representation of the surrounding environment combining seeing a real object and watching images.

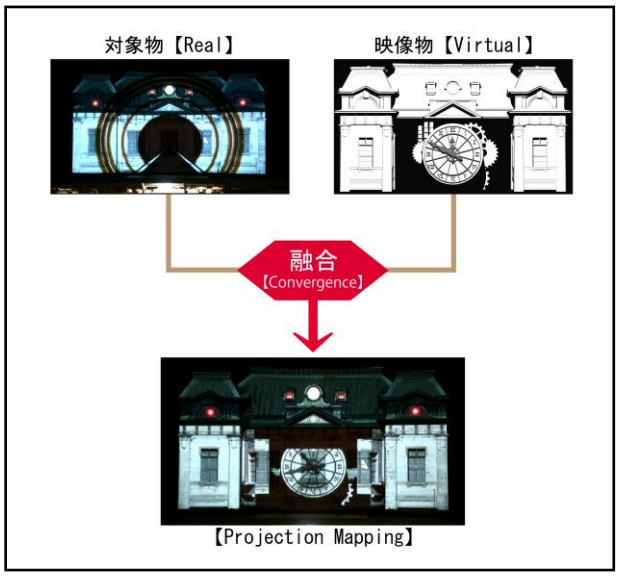


Fig.1 Projection Mapping conceptual diagram

2-2 Projection Mapping cases

We investigated the case of existing Projection Mapping works while we created our work. Expression methods of Projection Mapping have been diversified. It is categorized into several types such as the methods of projecting onto buildings, projecting onto rooms and passages, projecting as stage direction, and projecting onto shaped objects.

2-2-1. Method to project onto buildings

This Projection Mapping at the Ralph Lauren building in London. (Figure 2)The images were projected onto the large Ralph Lauren buildings. It shows off the images effectively with the color of the building and characteristics of the shape. Projection Mapping onto buildings varies from large buildings like those of Ralph Lauren to relatively small buildings. We create a CG model with the same scale based on the blueprint of a building, and produce the images for the projection surface that has been selected in advance. As with outdoors, it depends on ambient lighting, weather, positions of the building, and the situation around them. A high number of high-intensity projectors need to be prepared depending on the

size of the building. This can be extensive work in many cases. This large-scale Projection Mapping has been used by advertizing companies.

Fig.2 <<Ralph Lauren>> Projection Mapping

2-2-2. Method to project onto rooms and passages

In 2011, the German Projection Mapping expert group Mr. beam announced 360 degree three-dimensional Projection Mapping new technology as a testing form. This test video "living room" is directed as the furniture and the carpet placed in the room change as time goes by.[5] The living room is different from Projection Mapping methods of projecting images on the surface of buildings that they used to project onto and now it focuses on small objects such as furniture. It points out Projection Mapping as a space direction of projecting the images onto an area and an entire passage. Viewers can experience the images as a space, it makes them feel as if the virtual and real were fused.

Fig.3 <<Living Room>> Projection Mapping

2-2-3. Method to project as stage direction

Projection Mapping as stage direction is used on a stage like a live performance and fashion show. It has benefits such as the radical change of the stage and atmosphere with one image as well as decreasing spending except screen installation and projectors. In recent years, as depth sensor-based device technology such as Microsoft Kinect, media art such as open Frameworks and processing, open source programming environment for interactive contents, game engine such as Unity have spread explosively, see media art used by these equipment.

Some Projection Mapping are applied with these techniques. In the music video of American artist Nosaj Thing's song "Eclipse blue" by Manabe, Projection Mapping has been done interactively applying the people by image processing the approximate shape of a human with a depth sensor. As it receives the shape of the human in real time, the images move to the dance. It brings on a strange impression that cannot be brought with video synthesis by post-production as it combines the human and the images on the spot.

Fig.4 <<Eclipse Blue>> Music Video

2-2-4. Method to project onto Sculptures

"Polygon playground" is an interactive video installation produced by WHITE void as a "large scale interactive lounge" at the SMUK fest music festival in Denmark. According to their website, they made a large-scale polygon object glow that offers room for up to 40 people at a time using 360 degree Projection Mapping. An additional sensory system detects people's positions[6].

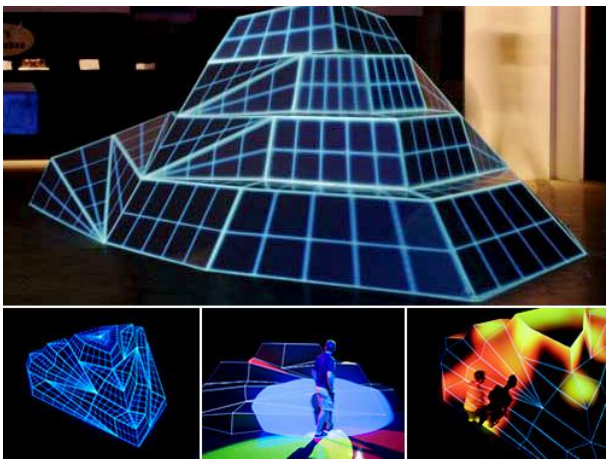


Fig.5 << Polygon Playground >> Projection Mapping

As described above Projection Mapping has various types and ways to produce change depending on projection objects, surrounding environment, and equipment.

It is important to have a clear vision before starting to work on a project. Mechanism of Projection Mapping is so simple that the object is changed from a screen to a three-dimensional object, but as projectors emit light to the object theoretically it can project any three-dimensional object. Therefore, when an object changes it can widen the range of expression. The potential is attractive as a research subject, to explore unseen Projection Mapping is valuable artically as we explore the possibility of media, especially video. To derive the common characteristic from the above cases of Projection Mapping, advertisements of companies, products, events and disposable Projection Mapping, so we focus on expressive space to fuse both objects (real) and video (virtual) that Projection Mapping has, and propose a way to develop contents with the origin and

history of cultural property without existing Projection Mapping and explore the possibility of a new genre for Projection Mapping using appropriate contents and elements of design.

3 Work Production

Existing Projection Mapping can be classified by whether the object of projection is “static or dynamic, and the video is either interactive or non-interactive.” This study will produce a work with the static technique which is most often used among the existing Projection Mapping methods. Since a static object is one that is not moving such as a building or furniture, an interactive device is not specially necessary for the production of projection images. The characteristic of the Projection Mapping of a static object is a method of pre-rendering[1] for the object is not moving. Figure 6 shows a brief diagram of the flow of the projection images: This is to trace one object at a time and produce images fit with the traced data.

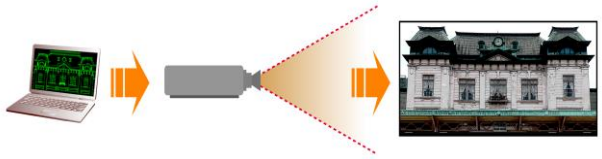


Fig.6 Static target Projection Mapping flow

3-1 Summary of the projection object

We selected Mojiko station located in Mojiko, Northeastern Kitakyushu as the cultural asset for which contents will be produced. Mojiko station is a bisymmetrical, Neo-Renaissance style, two-story wooden building constructed in 1914.

Fig.7 "Mojiko station" important cultural properties

Remaining intact as it had been built, it was designated as an important national cultural asset first as a station building. In the station, there are various historic assets such as basins which have been used since before the war and a fountain where people can wash their hands, etc. In this study we selected Mojiko station as the object of projection because of its historic value designated as one of Japan's important cultural assets and because the station will enter a preservation and maintenance project from September 2012 to March 2018, it would be the very building from which residents or tourists could reflect on memories. In addition, the contents of the work were produced using subject matters related to the history of Mojiko station [7].

3-2 Production process

As briefly described above, the Projection Mapping of a static object is described with an example of Projection Mapping at Mojiko station was carried out on December 24, 2011. It is a Projection Mapping by making contents with the value and historic materials of the station building which is just as it was in the old days. Generally, Projection Mapping uses pre-rendering movies. The flow of production is as follows in Figure 8.

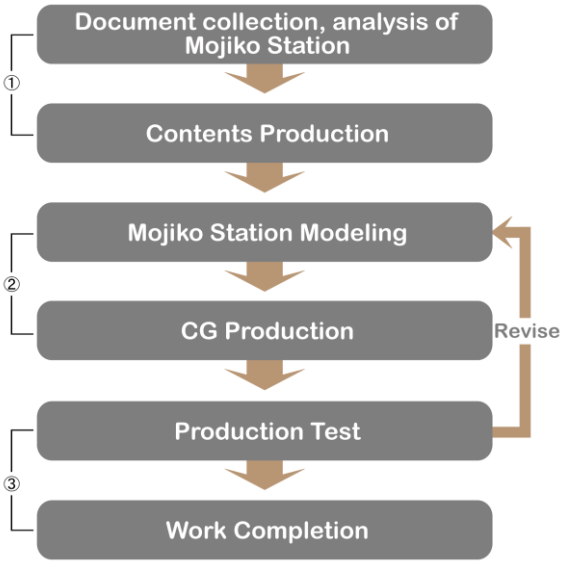


Fig.8 Production process to static target

The flow of production is shown below.

① Trace the shape of Mojiko station. This includes the method of making data the shape as it is using a 3D digitizer or measuring and tracing numerical values from Photographs. In this study we will trace them using the former and in the traced data, the images of Mojiko station should accurately overlap with the Station Building when projecting images.

② Produce images based on the traced data. Since in this study we produce the images with the Pre-rendering movie production technique, use Adobe After Effects or Autodesk Maya, etc. to produce images.

③ Conduct an image projection test in the field if the prepared free rendering movies exactly match with the

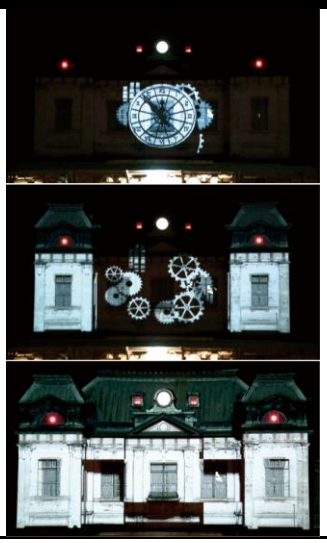
[1] Pre-rendering is the process in which video footage is not rendered in real-time by the hardware that is outputing or playing back the video. Instead, the video is a recording of the footage that was previously rendered on a different equipment (typically one that is more powerful than the hardware used for playback). Pre-rendered assets (typically movies) may also be outsourced by the developer to an outside production company. Such assets usually have a level of complexity that is too great for the target platform to render in real-time.

actual Mojiko station. If they do not match, trace correction is necessary, and if the images exactly match with Mojiko station and there is no problem of their movements, they are complete [8].

3-3 Contents

Use Mojiko's specialties such as rickshaws, banana characters, a train and historic materials as the contents, then produce them so that they can make the audience who visit Mojiko station feel the charms of the station. The concept of the production is Projection Mapping digital image expression using attractive images such as Mojiko's unique retro images which induce the audience's emotional changes or romantic Mojiko's night view images. The flow of the stories of the image expression is as follows in Figure 9.

Scene. 1

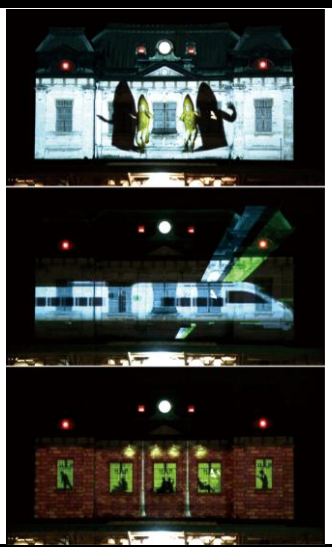


・Clock makes a ticking noise
・Clock will begin to sound mad
・A wall of Mojiko station protrudes and goes down

Scene. 2

・Graphic Image direction
-The outline of the station is replaced by various colors
-A ball exits from the window and falls from the top
-A picture moves to the rhythm of BGM on a wall
・A wall of Mojiko station protrudes and goes down

Scene. 3



・Banana man character appearance
・A train runs backed by the night view of Mojiko Retro historical district
①A train departs from Mojiko Station
②A train runs and is replaced by various backgrounds
③A train arrives at Mojiko station
・Darkness falls
・Time passes by at night in Mojiko

Scene. 4

・A snowy image falls slowly from the top
・Christmas ambience image
-Direct it with a candle, illumination, ribbon

・Fireworks direction
-Merry Christmas message
-Romantic MOJIKO message

Fig.9 Contents

3-4 Correction process of projection target

In Projection Mapping, we construct a 3D virtual space a computer and carried out a simulation test in the same environment as reality to deliver stereoscopic visual effects to the audience. We then grasp the shape of the projected object and the positions of the projector and audience's viewpoint in advance and distribute each of them in the virtual space on the computer. Then we carry out projection texture mapping of the rendering images obtained from the audience's viewpoint on the object in the virtual space in the same condition and obtain the position of the projector and the rendered image. Projecting the image obtained this way in the actual environment as the simulation makes it possible for 3D Projection Mapping. (Figure 10)

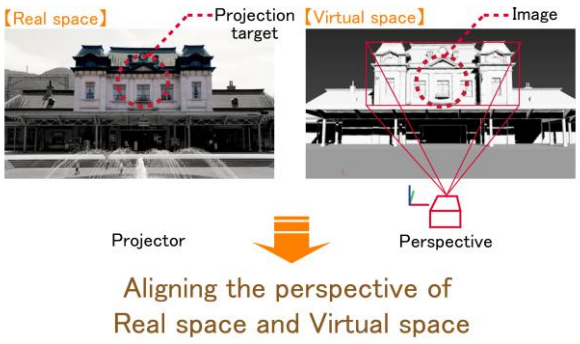


Fig.10 Aligning the perspective of real space and virtual space

3-5 Video production

It is common to project images using a projector on a flat screen. Projection Mapping projects them onto a three-dimensional structure rather than a flat surface, and the point is to make it look like a 3D motion. The method of production is first to select an object and accurately measure the shapes of the selected object or sculpture. And then, produce an image to project based on the data. To construct a 3D virtual space, we use mental-ray software that is broadly used to produce video contents such as films or games to construct the scenes of the necessary modeling and lighting. We also use a mental-ray rendering engine for rendering.
Finally, Adobe After Effects is used for adjusting styles or synthesizing the work. Using the images based on this image producing technique can realize the effect of direction by Projection Mapping. (Figure 11)

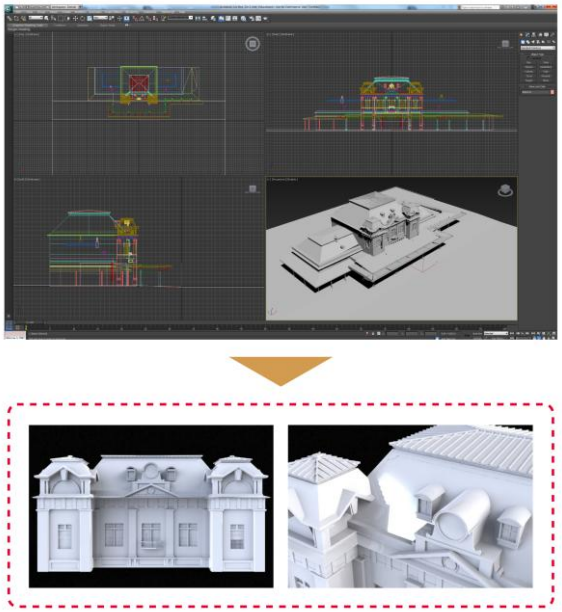


Fig.11 Video modeling

3-6 Structure of the System

In this study we installed a system like Figure 12. Panasonic PT-D7700 was used, which is a projector supporting Full HD resolution with brightness of 7000 ANSI and contrast of 1300:1. The projection image and sound effect (BGM) was controlled by portable switcher “Any Cast Station.” The system in this study is characterized by installing two workstations and projecting images simultaneously to prevent the images from halting in their projection.

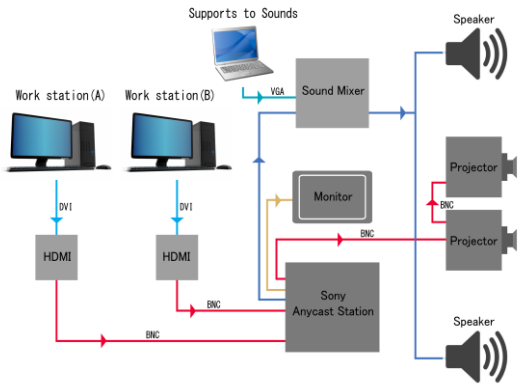


Fig.12 Structure of the System

In addition, two overlapped projectors were used so that the system can respond to the brightness of the surroundings at the place of projection.

4 Experiment Overview

This chapter is about the detailed experiment of the production and design of Projection Mapping. The experiment took place twice on December 2nd, 2011 and December 20th, 2011. The first one took place at a sports field at Graduate School of Design, Kyushu University and the second one took place at the field of projection object (Mojiko staion).

4-1 Experiment 1

In the first experiment, we checked the distance between a projector and the projection object , the size (height x width) of the surface of the projection object (Mojiko station) , brightness of a projector installed with the number and width of video. We installed the equipment based on the blueprint of the projection object and the size we investigated in advance. The distance between the projector and projection object is 66.8m. The height and width of the projection object is 13m and 20.6m. This is one of the important initial steps for accurate matching of the projection video and projection object in the process of projection mapping. We prepared high-definition(1920*1080) still photograph images and short videos and had an experiment to test performance brightness of the projector. As a result, we didn't have any problem with the size of the surface of the projection subject but found out that the brightness of the projector is not enough. The reasons could be the brightness of the surrounding environment, the performance of the projector, the image of the created contents etc but in this case we discovered it is because the brightness performance of the projector is not sufficient. As a solution to this problem, using a high performance projector is the fastest solution, but this study was able to solve the problem of the brightness of a projector at a low price using two projectors currently held (Panasonic PT-D7700). We can say this method is suitable for small-scale Projection Mapping research without expensive equipment.

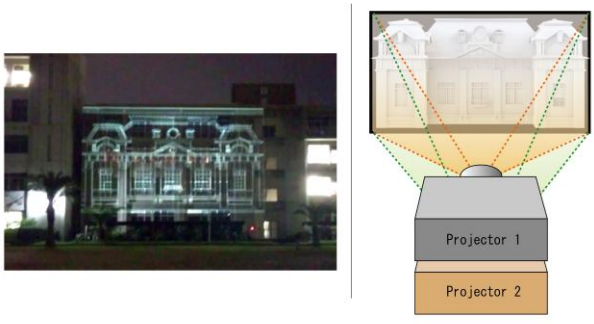


Fig.13 1st Experiment Image

4-2 Experiment 2

In the 2nd experiment, we conducted the experiment at the projection target (Mojiko station); we set the projectors and the projection object with accurate distance and positioning and conducted a matching experiment. We checked how well the projection object and the projection video match on the images of wire frame model and worked on making 2 projectors focus. At the time, some parts didn't partially match but by using Adobe After Effects program we were able to correct them on the spot. We were able to focus 2 projectors by using the data we calculated beforehand and adjusting the lens control function. On the other hand, in the middle of the second experiment, we saw that the projection video stopped and the stereoscopic effect of the video was poor. It was difficult to control the video with the overloading program and project the normal video contents when we played the video stored in Full HD, but in this study we handled it with the system configuration (Figure 12). We set up 2 workstations played the video at the same time, switched the screen with a portable switcher "Any cast station" to handle the situation. And as for colors of the stereoscopic effect of the video, comparing the colors of the video projected by a projector and those of the video on a computer, in some cases those by a projector looked faded. It is important to consider the coloration when creating a video. In this study, we modified the intensity and contrast and fixed remaining issues.

In the meantime, during the second experiment, a phenomenon of stopping images or a problem of reduced 3D effect was found. It turned out that it was caused by a phenomenon of the overload of program in playing images produced in Full HD resolution. A normal image control and projection of image contents were difficult, but this study responded to the phenomenon of stopping images with system configuration of Figure 12 as a solution. Images were played simultaneously with 2 Work Stations, and when the images stopped, the display shifted to portable switcher Sony Any Cast Station to respond to the problem of stopping images. In addition, with the effects of surroundings and changes in weather, when the 3D effect of the images projected from the projector was compared to that of those on the computer monitor, there was a phenomenon in which the 3D effect of those projected from the projector looked lower. The present study responded to the problem of low 3D effect by correcting the images by increasing the contrast of brightness in Adobe After Effect editing program. By the nature of Projection Mapping, which is sensitive to the brightness of surroundings and changes in weather, in producing images, the 3D effect and the brightness of the projector should be sufficiently considered, and in the future, this should be studied more in depth.

Fig.14 The state of Projection Experiment

4-3 Performance

On December 24th 2011, we performed Projection Mapping methods at Kyushu Mojiko station as the projection object in Mojiko, Kitakyushu-city. The video was about 10 minutes long. In this performance we started projecting at 18:30 and we played it 7 times for 1.5 hours. Because of the media report the day before, we were able to have a large audience. We published the entire video of this performance on the internet.

With this work, we won a special award in "Kitakyushu Digital creator contest 2012" presented by Human Media Creation Center / KYUSHU and a prize in "2012 ASIA DIGITAL ART AWARD" we were able to obtain a certain level of achievement.

Fig.15 The state of Mojiko Station Projection Mapping

5 Conclusion

This study produced contents that are differentiated from existing commercial or advertising works, which were for cultural heritages using Projection Mapping technology and approached Projection Mapping technology in the aspect of providing people with interesting experiences. As a result, the expression combining images with real objects was made for cultural heritages as the objects of projection, and the methods of expressing contents based on the cultural heritages could be obtained. By presenting works, it is considered that social evaluation was obtained as even people who did not know the histories and stories about the cultural heritages could enjoy and watch them and they could look back on the history of Mojiko with many others. Moreover, it is considered that by making experiments of Projection Mapping, it is necessary to express the materials of cultural heritages with image contents and to study the problems that occur during the process of production more in the future.

In the near future, in order to perfect the techniques based on this research we think it is important to clarify how to develop the contents of Projection Mapping and techniques by testing them and experimenting under various conditions. We especially need to identify specific issues such as light source issues by using Projection Mapping and the reproducibility of the contents and solve them in future research.

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