Introduction and Application of Projection Mapping Technology

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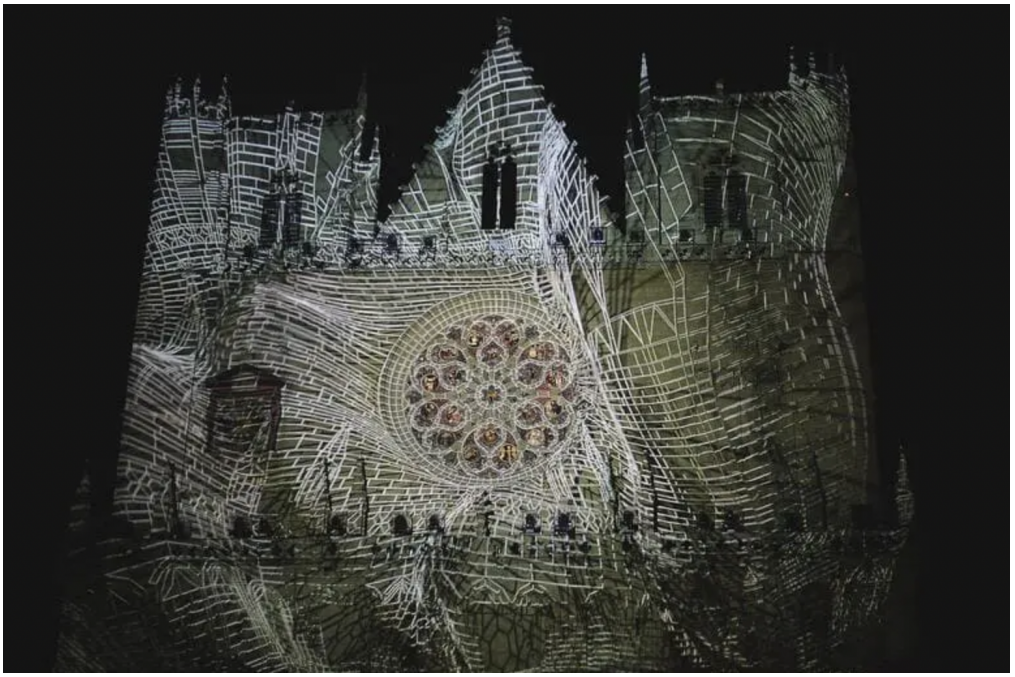


1.1 History and Development of Projection Mapping Technology

The origins of projection mapping technology can be traced back to the 1960s, when artists began to experiment with projecting images onto non-flat surfaces to create more visually striking effects. In the following decades, with the development of computer graphics, digital technology, and projector technology, projection mapping gradually became a mature form of artistic expression.

Early techniques for projection mapping were mostly used for experimental art performances and art installations. As technology kept getting better, though, projection mapping became popular in business, education, and architecture.Nowadays, projection mapping technology has become an important part of the visual arts, stage performances, and urban lighting.

1.2 Key components of projection mapping technology

To realize the projection mapping effect, the following key components are required:

(1) Projector: A projector is the core of projection mapping technology and is used to project images or video content onto a target surface. Modern projectors usually have features such as high resolution, high brightness, and an adjustable focal length to meet the needs of different scenes.

(2) 3D modeling software: 3D modeling software is used to create digital models of target objects and help artists accurately project images or video content onto irregular surfaces. Commonly used 3D modeling software includes Blender, 3ds Max, Maya, etc.

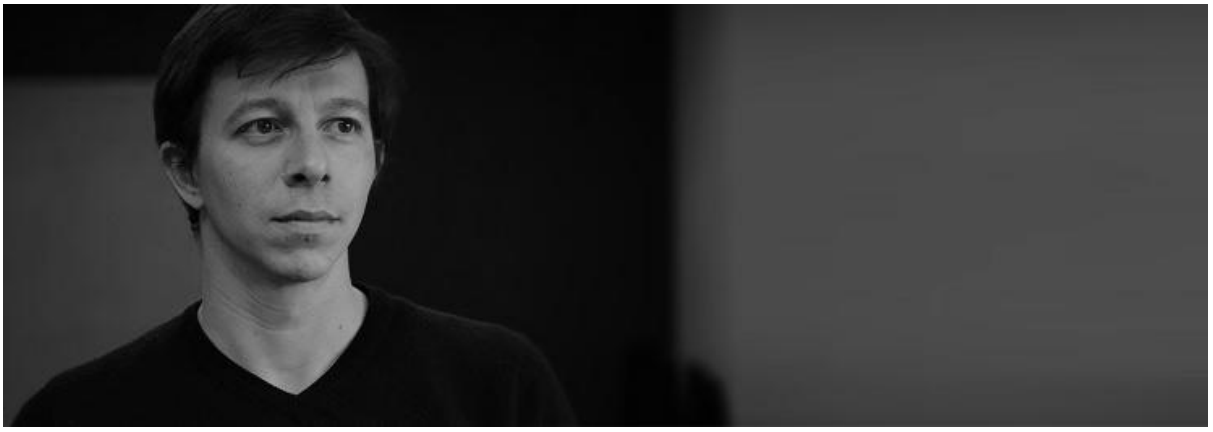
(3) Projection mapping software: This is used to process and calibrate the content that is being projected to make sure that the image fits the surface of the object perfectly.This type of software usually has functions such as alignment, distortion, masking, etc. and can make real-time adjustments to the projected content. Commonly used projection mapping software

includes Resolume Arena, MadMapper, VPT, etc.
(4) Content creation tools: Artists need to use content creation tools to design specialized image or video content to fit the shape and structure of the target object. These tools include Adobe Creative Suite, Cinema 4D, TouchDesigner, etc.

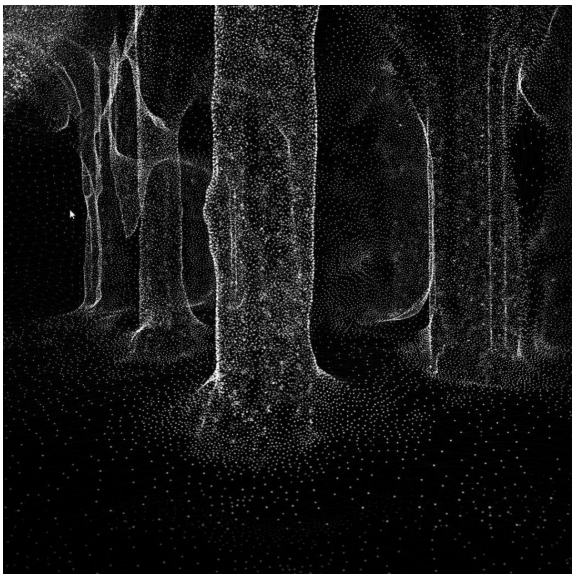
1.3 Challenges and Trends of Projection Mapping Technology
Although projection mapping technology has achieved a lot, it still faces some challenges, such as ambient light interference, the high cost of equipment, and a complex operation process. However, with the continuous development of technology, these challenges are gradually being solved.

(1) Interference from ambient light: In bright places, ambient light can mess up the effect of projection mapping.To solve this problem, researchers and manufacturers are making projectors that are brighter and have more contrast so that projection effects can be seen better in bright places.
(2) Cost of equipment: Some small art groups and independent artists may not be able to afford the equipment needed for projection mapping technology because of how much it costs.But as technology gets better and the market gets more competitive, equipment costs are likely to go down, making projection mapping more popular.
(3) The process of using projection mapping technology is complicated, and artists need a certain level of technical knowledge and experience to use it.In order to simplify the operation process, software developers are developing more intuitive and easy-to-use projection mapping software so that more artists can easily get started.
Integration of augmented reality (AR) and virtual reality (VR), integration of multiple projector systems, and more interaction are also trends in projection mapping technology.These emerging technologies will bring more possibilities for projection mapping and drive its innovation and development in the art field.
In conclusion, projection mapping technology has become an important part of modern visual art, and it has a lot of potential for artistic creation and expression.As technology keeps getting better, we have reason to think that projection mapping will continue to give artists and audiences more surprises and ideas.

Examples of Projection Mapping Technology in the Art Field
In this section, we will explore the application and impact of projection mapping technology in the art field by introducing some famous artists and their works.
2.1 Joanie Lemercier



2.1.1 Background
Joanie Lemercier is a French visual artist known for her outstanding achievements in the fields of projection mapping and digital art. His works are mostly based on geometric shapes with light and space as the theme, and he creates sci-fi visual effects through projection mapping techniques.
2.1.2 Representative work "Nimbes"



One of Joanie Lemercier's representative works is "Nimbes", an immersive music and visual art project that presents unique light and shadow effects on a spherical screen through projection mapping technology. The visuals of Nimbes interact closely with the music, providing the audience with a highly immersive artistic experience.

2.2 Artist and Team UrbanScreen

2.2.1 Background

UrbanScreen is a German art and technology team that focuses on the use of projection mapping technology to create visual art in public spaces. Most of the time, they use buildings as projection surfaces, and the way light and shadow change makes for a stunning visual effect.

2.2.2 Representative Work "555 KUBIK"

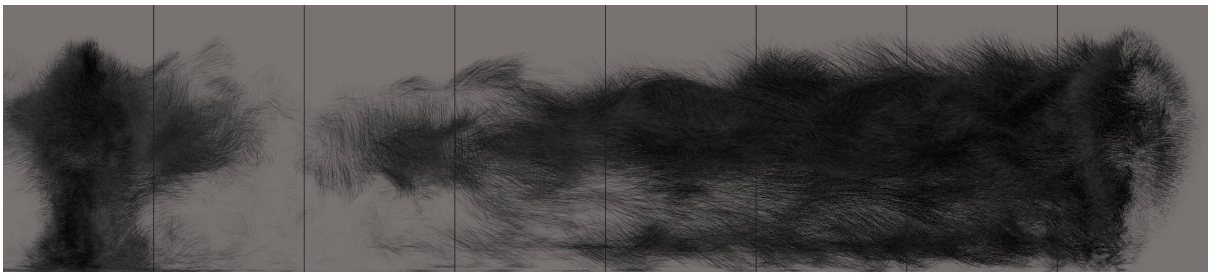
One of UrbanScreen's representative works is "555 KUBIK", a project that transforms the façade of the Museum of Art and Design in Hamburg, Germany, into a dynamic work of visual art. Through precise projection mapping technology, UrbanScreen makes the façade of the building seem to come to life, bringing a visual feast to the audience.

2.3 Artist Team: TeamLab

2.3.1 Background

TeamLab is an interdisciplinary team of artists, consisting of artists, programmers, engineers, animators, mathematicians, and architects. They are dedicated to exploring new frontiers in digital art, blending technology and art. TeamLab's works feature immersive experiences that break the boundaries between art and audience through projection mapping technology and other digital media.

2.3.2 Representative work "Dissipative Figures: 2 Humans"



"Dissipative Figures: 2 Humans" is one of their works, which was first exhibited at the Museum of Emerging Science and Technology in Tokyo in 2019.

The installation shows two life-size human figures projected on a large screen. The human figures consist of thousands of particles that move and interact with each other to create an evolving and dynamically changing image. Both the movement of the human figures and the presence of the viewer in the space have an impact on these particles.

The title "Dissipative Figures" refers to the scientific idea that dissipative structures appear in systems that are not in equilibrium.These structures are patterns that arise spontaneously in the system.

The production approach consists of the following main steps:

Digital modeling: The team used computer software to model two life-size human bodies, including details such as muscles, bones, and skin. The digital bodies were then imported into the animation software for subsequent processing.

Particle System Design: To create the particle effects, the team used a special computer program called the particle system. With this program, the team can control thousands of tiny particles to move and interact according to specific rules. The designers could also assign specific colors and brightness to each particle to create a specific effect.

Designing the projection: To show these digital people and particles on a big screen, the

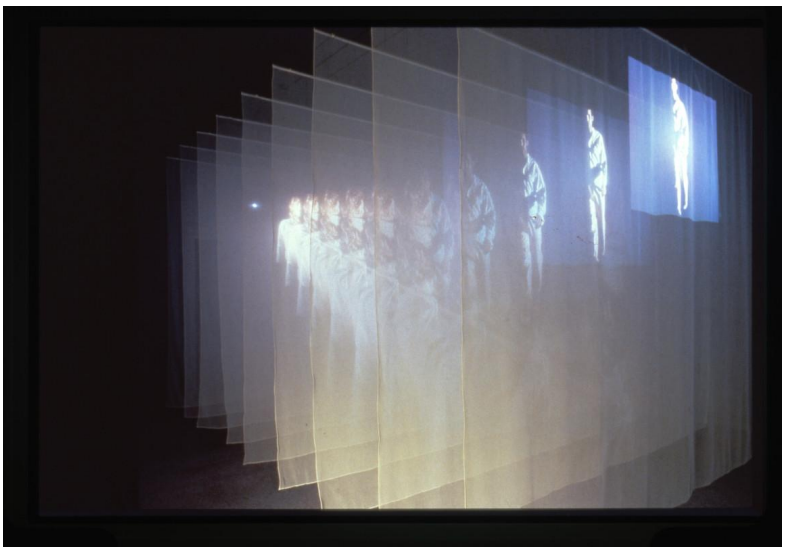
team used a high-definition projector and a computer program to control the image that was shown.They designed a special projection environment in which human figures and particle effects could naturally blend together to create a realistic digital space.
Interactive design: To allow the audience to interact with the digital work, the team designed a number of interactive controls. Viewers can influence the digital human body and particle effects through gestures or movement to make them more active and dynamic.

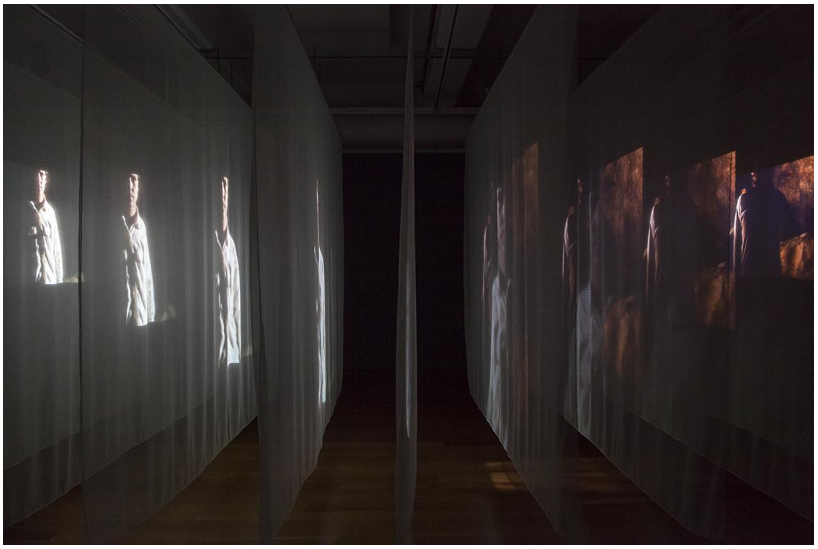
2.4 Bill Viola

2.4.1 Background

Bill Viola, born in 1951 in New York, is a highly acclaimed American video artist. Many people praise him for his ability to combine technology with visual art and for the depth with which he looks at things like life and death, nature, spirituality, and the human experience.Viola has been making art since the 1970s. He has worked in video art, sound, electronic music, and performance art.

2.4.2 Representative work "The Veiling"





The Veiling (1995) is a joint work by video artist Bill Viola and stage designer Robert Wilson. The work was presented at the 1995 Venice Biennale and attracted widespread attention. The installation uses multiple layers of translucent curtains and projection techniques to explore the boundaries between reality and illusion, presence and disappearance.

The piece is made up of nine layers of transparent curtains that are hung vertically. Each layer is kept at a certain distance from the next.The curtains are reflective, allowing the viewer to see the projected images. The work uses two opposite projections, one in front and the other behind, that map each other to create a blurred and mysterious visual effect.

The audience

The audience is invited to walk through the curtain and experience the work firsthand. During the process of walking through, the viewer can see the projected images change and overlap and feel the intertwining of space, time, and light. This experience allows the viewer to think deeply about the boundaries between reality and illusion, the visible and the invisible.

"The Veiling" looks different from Viola's earlier works because it focuses more on space and audience participation.The work shows Viola's unique way of thinking about projection technology and space design. It combines video art and stage installation to create an all-encompassing experience.The manipulation of light and time in the work reflects his concern for life, nature, and human experience.

Summing up:
The above artists and works show how projection mapping technology can be used in many different ways and has a lot of potential in the art world.With projection mapping technology, artists can make visual effects that have never been seen before. These effects engage the audience and push the limits of what is possible in traditional art.As technology keeps getting better and new ideas are added, projection mapping technology will continue to offer artists a wide range of ways to make art.

sources:
https://www.teamlab.art/e/?type=pickup
https://lightform.com/blog/the-history-of-projection-technology
https://www.urbanscreen.com/555-kubik/
https://www.billviola.com/
https://joanielemercier.com/
https://www.linkedin.com/advice/0/what-benefits-challenges-using-projection