Interactive Projection Mappings in a Japanese Traditional House

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(a) On shoji(1) (b) On shoji(2) (c) On tatami

Figure 1: Interactive projection mappings in a Japanese traditional house.

CCS CONCEPTS

• **Computing methodologies** → **Computer graphics**; • **Applied computing** → **Media arts**; • **Human-centered computing** → *Human computer interaction (HCI)*;

KEYWORDS

CG, Media Art, Interaction, Projection Mapping

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1 INTRODUCTION

We introduce interactive projection mappings in a traditional Japanese house. In Japanese traditional houses, sliding doors / windows called shoji are often used. The shoji is a panel stuck with paper on the frame of the tree, and it can be used as a projector screen. We created two types of interactive projection mappings on shoji (Figure 1(a)(b)). Other characteristics of Japanese traditional houses is tatami : straw mats flooring. We also created an interactive projection mapping on tatami flooring (Figure 1(c)).

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We used these interactive projection mappings at a Japanese traditional tea ceremony. Participants of the tea ceremony enjoyed our interactive contents very favorably that tradition culture and latest digital technology were fused together.

2 SHOJI PROJECTION MAPPING

2.1 On three walls with shoji and a picture

One type of shoji projection mappings is on three walls with shoji and a picture in a tea room (Figure 2(a)). A picture is hanging on the wall (A), and the wall (B) is composed of soil wall with a shoji window embedded. The wall (C) is composed of two shoji doors.

A grasshopper and a lizard in the picture are spotlighted, and animations of grasses shaking are projected on the wall (B) and (C) at the beginning (Figure 2(b)). Then the grasshopper and the lizard slip out of the picture and start to move. They roam not only on the wall (A) but on the wall (B) and (C) (Figure 2(c)(d)).

The grasshopper and the lizard decide their routes of roaming in real time, and move interactively. When the grasshopper, the lizard and the grasses are projected on the picture or on the soil wall, the images are realistic. On the other hand, when they are projected on the shoji, they look like shadow pictures.

Two projectors are embedded under the floor for wall (A) and (B), and a projector is put behind the wall (C). A scene composed of a grasshopper, a lizard and grasses is generated as real time 3DCG. Three areas are cut from it, and each area is projected on three walls with three projectors.

Switching of images between walls and shoji uses the properties of the depth buffer in 3DCG (Figure 3). Each model of the CG objects has a two-layer structure of a realistic model and a shadow model. In addition, transparent plates are placed in front of the 3DCG scene at the points corresponding to shoji. The system

(a) A tea room (b) Spotlights and animations

(c) A rooming lozard on the wall (d) A rooming lozard on the shoji

Figure 2: Projection mappings on three walls with shoji.

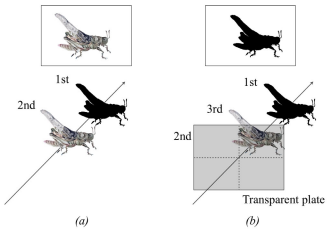

Figure 3: A method for automatic switching of images of a grasshopper, a lizard, and grasses between walls and shoji.

draws in order of shadow models, transparent plates, and realistic models. As a result, realistic models are drawn in portions corresponding to the soil wall. On the other hand, in portions corresponding to shoji with transparent plates, realistic models are not drawn due to the influence of the depth buffer updated by transparent plates, and only the shadow models are rendered.

2.2 Using a live image of the moon

Another projection mapping on shoji uses a live image of the moon that rises with the lapse of time. When people stand in front of the shoji, their shadows appear on the shoji, and many stars are generated from the shadow. It is possible to interact with the stars through the shadows, such as shooting stars with shadows of their hands. The moon is not hidden behind shadows even when they are cast on the shoji. People can enjoy the interaction with the stars while watching the live image of the moon (Figure 4).

Two projectors project images on the shoji. One projector placed in front of the shoji projects a background image and stars, and becomes a light source of shadows. Another projector placed behind the shoji projects images of the moon and glasses. Therefore, the image of the moon and glasses are not hidden by the shadows.

The method of shadow-based interaction is realized based on shadow simulation [Iwasaki et al. 2016]. A Kinect acquires the 3D shape of people in front of the projector who make shadows on the shoji, and the system calculates the areas of the shadows based on shadow simulation.

3 TATAMI PROJECTION MAPPING

In this projection mapping, an image of a ground with leaves is projected on the entire tatami floor in a tea room. As people walk

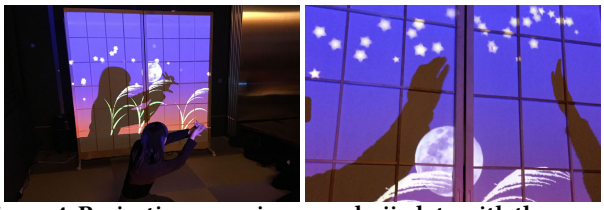

Figure 4: Projection mapping on a shoji plate with the moon.

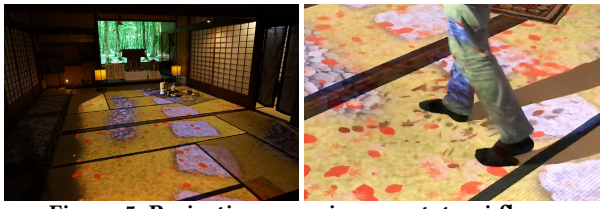

Figure 5: Projection mapping on a tatami floor.

Figure 6: The tea ceremony with our projection mappings.

on the floor, the leaves of the nearby leap away. As the result, people in the tea room would feel like being in the garden (Figure 5).

A projector is embedded in the wall and projects images on the floor, and a Kinect is put at the end of the room. The Kinect is used to detect people in the room based on a depth image and calculate their positions. When the system detects people in the room, it applies force to the leaves that exist near the foot of each person in the room. As the result, the leaves leap away as the people walk around in the room.

4 EXIBITION

The interactive projection mappings which we created were exhibited at a traditional Japanese tea ceremony as shown in Figure 6. Our projection mappings were suited to traditional Japanese style, and tea mentors who participated in the tea ceremony had very favorable impressions on our projection mapping.

5 CONCLUSION

In this paper, we introduced interactive projection mappings at a Japanese traditional house and exhibited them at a Japanese traditional tea ceremony. Participants of the tea ceremony enjoyed our interactive contents very favorably that tradition culture and latest digital technology were fused together.

The participation of young people to the tea ceremony is decreasing recently. As our projection mappings have been accepted from veterans of the tea ceremony, there is a possibility to activate the tea ceremony.

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