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Proposal of Interactive Projection Mapping using Human Detection by Machine Learning

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Introduction

- EC (Entertainment Computing)
  - EC has become one of the major industries in Japan.
  - Among them, we focused on projection mapping.

Introduction

- In recent years, exciting projection mapping has received more and more attention.
  - Mapping to buildings.
  - Mapping to clothing, face, notes and other familiar objects.
  - Artist's concert.

Fig. 1. Tokyo Disneyland
Once upon a time.

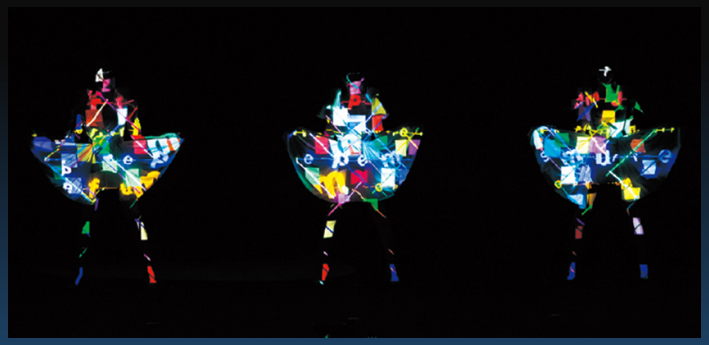

Fig. 2. Perfume
Cannes Lions International Festival of Creativity.

Fig. 3. Closing ceremony for the Rio Olympics.

Introduction

- Conventional projection mapping
  - In the conventional projection mapping, the viewer mainly enjoys watching and enjoying the projected image, so that the viewer's feeling of immersion in the content is considered insufficient.

- In this study, we propose a participatory projection mapping that changes according to the movement of participants by projecting to participants.

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   - Development environment and Library
   - Outline of the system
   - User detection
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3. Result
4. Conclusion

Methods

- Equipment used

- Kinect for Windows v1
  - Kinect for Windows is a peripheral device that enables operation by body movement, gesture and voice without using a controller.

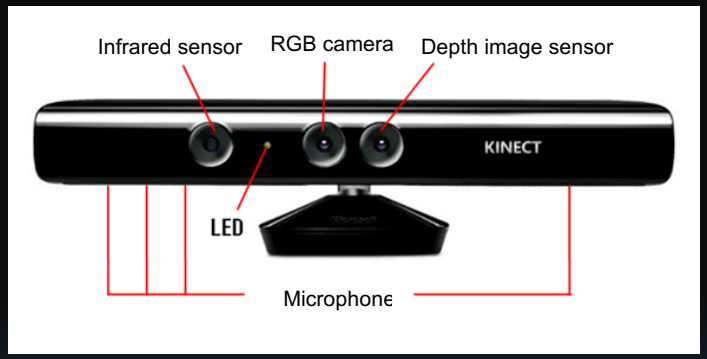

Fig. 4. Kinect for Windows v1.

- Projector

Methods

- Development environment

- Windows10
- Visual Studio 2017
- C++

- Library

- OpenNI2
- NiTE
- OpenCV
- OpenGL

Methods

- Outline of the system

- Screen display on PC

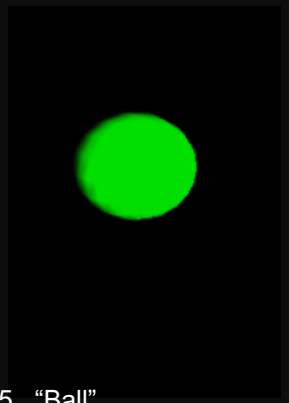

Fig. 5. “Ball”.

Fig. 6. “Color”.

Fig. 7. “Combination” and “Combination_PC”.

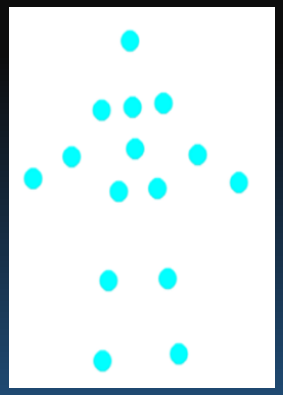

Fig. 8. “Skeleton”.

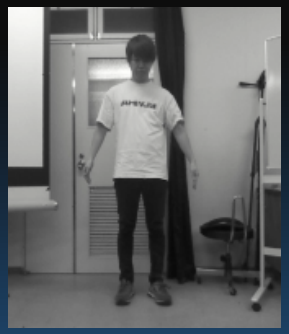

Fig. 9. “Gray”.

Fig. 10. “Cascade”.

Methods

- User detection

- AdaBoost
  - AdaBoost is a technique for creating a classifier with high accuracy by learning by adaptively weighting the recognition rate of the classifier during the learning process.

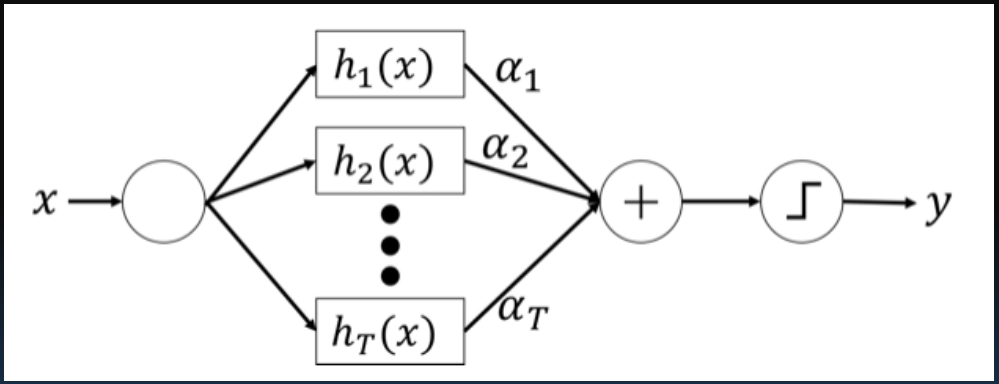

Fig. 11. AdaBoost.

Methods

- **Learning method**

- Learning method
  - Local Binary Pattern (LBP)

- **Training data used for learning**

Positive image	200
Negative image	195
Number of stages	15

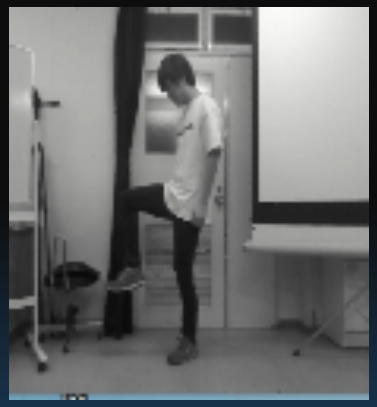

Fig. 12. Positive image.

Fig. 13. Negative image.

Methods

- Extract image features

- LBP (Local Binary Pattern)
  - The classifier learns by extracting the feature amount of the image at the time of creation. In this study, we conducted experiments using LBP.
  - LBP is one of feature quantities that can be used for image recognition and classification.
  - LBP is calculated in a 3x3 pixel area and extracts local features. It is particularly resistant to lighting changes and has the advantage of be able to calculate at high speed.

Methods

- Extract image features

- LBP (Local Binary Pattern)

For example

6	5	2
7	6	1
9	8	7

3x3 brightness value

1	0	0
1		0
1	1	1

Binarization

×

1	2	4
128		8
64	32	16

Weight of each pixel

1	0	0
128		0
64	32	16

brightness value after calculation

$$LBP = 1 + 16 + 32 + 64 + 128 = 241$$

Methods

- Soccer mode and Baseball mode

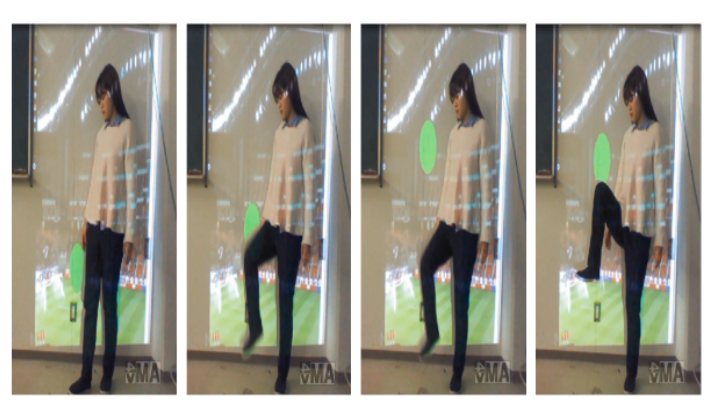

Fig. 14. Soccer mode.

Fig. 15. Baseball mode.

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4. **Conclusion**

Result

- We compared the previous study using the threshold of skeleton coordinates with the method of this study.

Result

- In this study, we performed grayscale on the “Color” screen display obtained from Kinect and detected the user using object detector.

Fig. 16. “Color”.

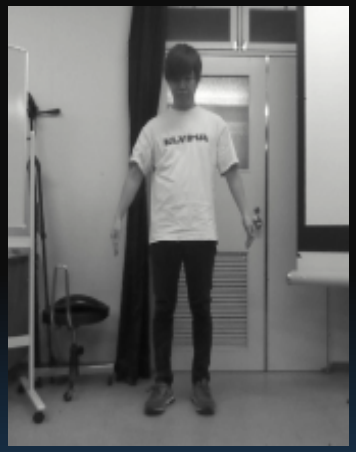

Fig. 17. “Gray”.

Result

- Human body recognition in soccer mode.

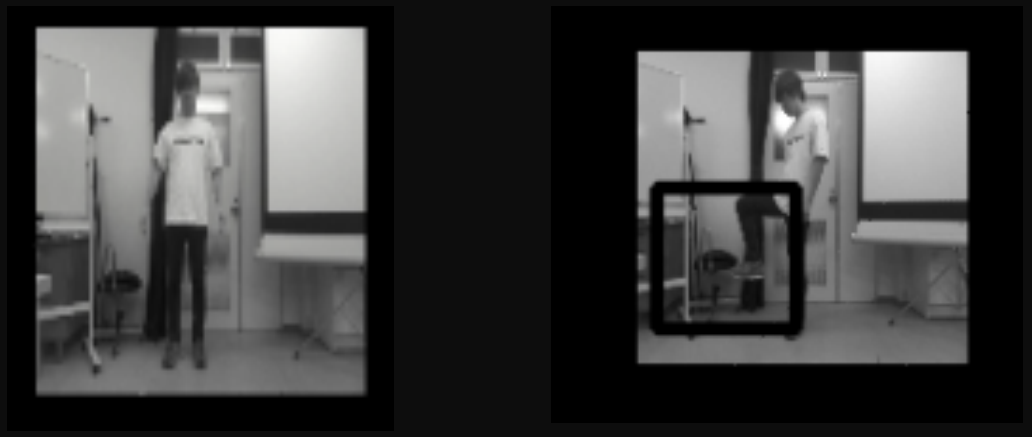

Fig. 18. User detection using human detector in soccer mode.

Result

- In previous study, when the subject disappeared from the Kinect field of view and entered the field of view again, there was a problem that the skeletal information was not retraced and mapping was not successful.

- In this study, we solved the problem by performing human body recognition using OpenCV without using tracking of skeleton coordinates.

Contents

Conclusion

- In this study, we used an object detector created with OpenCV to create an interactive projection mapping whose mapping changes according to human movement.
- The problems of previous studies using thresholds in skeleton coordinates were solved in this study using an arbitrary threshold-free method.

Conclusion

- Performing a projection mapping to match the artist's movements at the artist's concert.

- The difference between the movements of each other is reduced, and more realistic performance can be achieved.
- In the future, we would like to realize interactive projection mapping using more accurate human body classifiers by increasing the number of sample images.

Thank you very much for kind attention.