

Human Body Shape Imaging and Its Application for Japanese Kimono Design

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Abstract – A yukata is a type of traditional Japanese kimono. An alignment of its texture patterns is an important factor of the yukata design. The wearing condition of the yukata is affected by the wearer's body shape and the way of wearing the yukata. Accordingly, three dimensional display of the yukata is necessary for designing the yukata. In this paper, we developed human body shape imaging system for yukata design. At first, we developed an algorithm to measure the wearer's upper half of the body that is important to display the wearing condition of the yukata. Secondly, we developed an algorithm to map the texture pattern of the kimono cloth on the wearer's body shape. The designer and wearer can make sure the condition of the texture alignment exactly and satisfy the wearer's taste.

I. INTRODUCTION

A yukata is a type of traditional Japanese clothing. An alignment of its texture pattern is an important factor of the yukata design. The wearer has difficulties to know about the impression of the ordered yukata. Therefore, three dimensional display of the yukata is necessary for the designer and the wearer to evaluate the result of the texture alignment. We have developed a CAD system for Japanese kimono and the measurement system for the wearer's body shape [4], [5], [6], [7].

The most important area of the yukata design is the front side. The measurement of the wearer's upper half of the body and the outline of the body is important to display the wearing condition of the yukata. In this paper, we describe about the human body shape imaging system for the yukata design. At first, a imaging system for the wearer's body shape is developed. Secondly, three dimensional display method of the yukata is developed.

II. METHODS

A yukata is one of the kimonos. The yukata consists of several parts; a right body, a left body, a right sleeve, a left sleeve, a right overlap, a left overlap and a collar. There is traditional wearing way of the yukata. At the wearing of the yukata, the wearer adjusts the positions of the yukata parts to the specific positions of the wearer's body. The back

center of the yukata and the wearer's body is adjusted each other. The height of the yukata hem is adjusted to the wearer's ankle. The woman folds the kimono cloth at the waist when she wears the yukata. The folded area is called a tuck. The tuck makes her look tall. In this way, the positions of the texture patterns are changed by the wearer's body shape and the wearing method. Accordingly, measurement of wearer's body shape is necessary for achieving the three dimensional display of the yukata.

A. Imaging system for the wearer's body shape

We developed an imaging system for the wearer's body shape as shown in Fig.1. The imaging system consists of two CCD cameras, a LCD(Liquid Crystal Display) projector and a computer. To measure the wearer's body shape, a color pattern is projected to the wearer's body using the LCD projector. The color pattern is a green circle and taken by two CCD cameras that are placed in parallel to the measurement system. The wearer wears colorless cloth by the measurement and the circle pattern has a color. The subtraction image between the green color components and the blue color components of the circle pattern is obtained. The region of the circle pattern from the subtracted image is detected using thresholding. Then, the

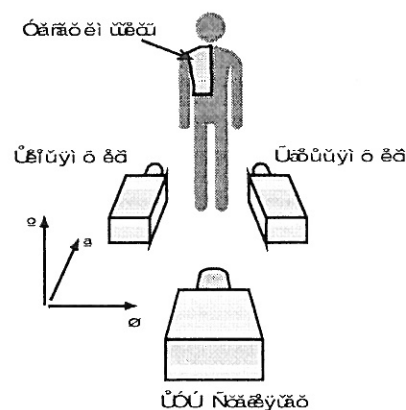
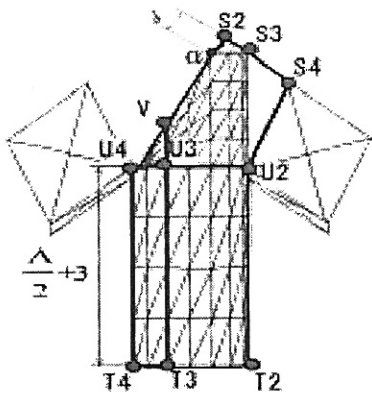


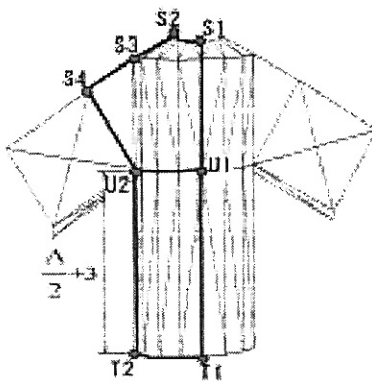
Fig.1 Imaging system for wearer's body shape

Fig.5 shows the texture mapping method of the designed yukata to the wearer's body. The back center, the left ankle, the right ankle, and the ridge of the shoulder become the corresponding points between the wearer's body and the yukata when the texture pattern of the yukata is mapped on the wearer's body.

Fig.6 shows the kimono cloth of the left body part. The sizes of yukata parts are calculated using data of the wearer A, B and C by the traditional yukata making method. The shape of the left body is represented by a rectangle. The left body is folded by the line S1 S2 S3 S4 at the center. The left part is corresponding to the backside of the left body and the right side is corresponding to the front side of the left body. The gray area is the tuck. The size of the tuck decided so that the left body is suited on the wearer's body shape.



a) Front view



b) Rear view

Fig.5 Texture arrangement of the yukata to the wearer's body

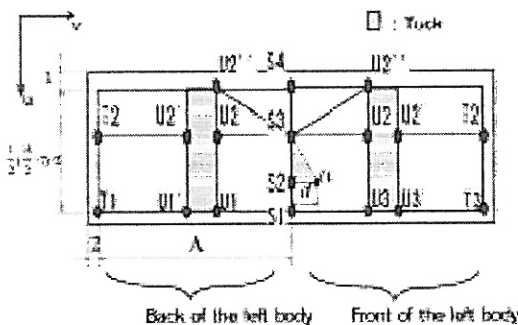


Fig.6 Kimono cloth of the left body part

Corresponding points between the wearer's body shape and the kimono cloth such as S1, S2, T1 and U1 as shown in Fig.5 and Fig.6 are set by the wearing method of the yukata. Points S1, S2, S3 and S4 in Fig. 5 can be set at the fold line of the left body in Fig.6. The point S4 of a curve S1, S2, S3 and S4 in Fig.5 is determined so that the length of a straight line S1, S2, S3 and S4 in Fig.6 is equal to the width of the left body. The position of the tuck is slightly longer than a half of the wearer's height. Therefore, the position of the points U1, U2, U3 and U4 are calculated by the wearer's height.

The wearer's body shape is represented by triangles as shown in Fig.5 a). The point α in Fig.6 is set so that the distance between the point S2 and the point α is equal to the Three dimensional distance d that is derived in Fig.5 a). The texture pattern in the triangle S2, α , S3 in Fig.6 is mapped to the triangle S2, α , S3 in Fig.5 a). In the same way, the other parts of the texture pattern in the left body part are divided into triangles corresponding to the wearer's body shape and mapped to the wearer's body.

The texture patterns of the right body, the right sleeve, the left sleeve and the left overlap are mapped on the wearer's body in similar way.

III. RESULTS

A female student who is 163 cm in height, 68 cm in the shoulder plus sleeve length and 88 cm in the hip designed herself her own yukata. She sits on the chair in front of the measurement system.

Fig.7 shows the measurement data of the body shape. The measurement area is from the throat to the waist. We use measurement data of the breast.

Fig.8 shows a result of the body shape imaging. The outline of the upper part of the body and the breast shape are replaced by the measurement data.

By using our CAD system [4][5][6], she can easily and automatically perform the texture alignment of the yukata according to the traditional Japanese texture alignment rules, such as

- i) Stencil pattern should not be close to each other.
- ii) Stencil pattern should not be positioned horizontally.
- iii) Stencil pattern should be positioned in whole of the yukata.

Fig.9 shows the yukata without the texture alignment.

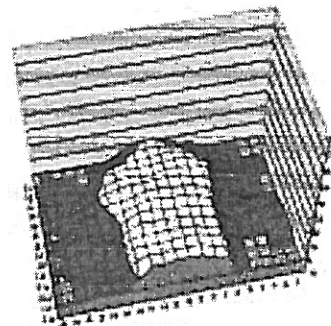


Fig.7 wearer's body shape

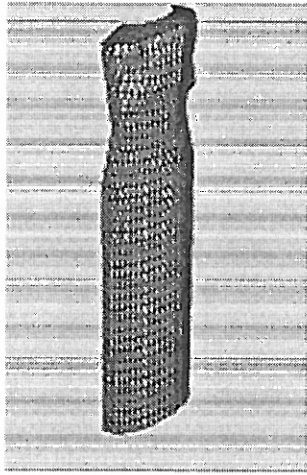


Fig.8 Wire frame display of the wearer's body shape

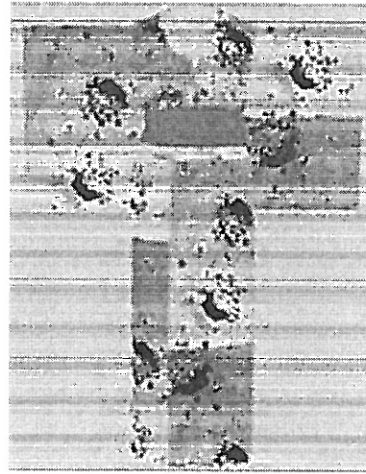


Fig.11 Three dimensional display of the yukata without texture alignment

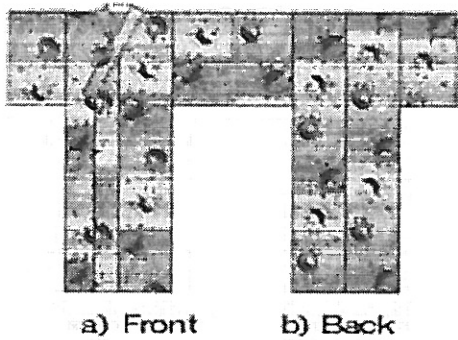


Fig.9 Two dimensional display of the yukata without texture alignment

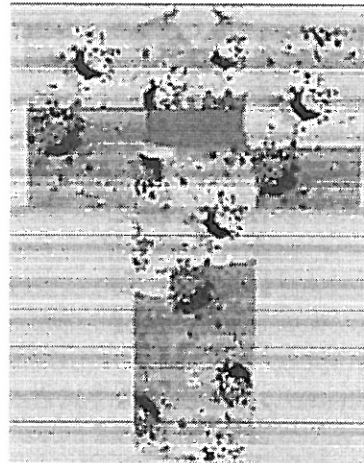


Fig.12 Cutting Pattern of the designed yukata with texture alignment

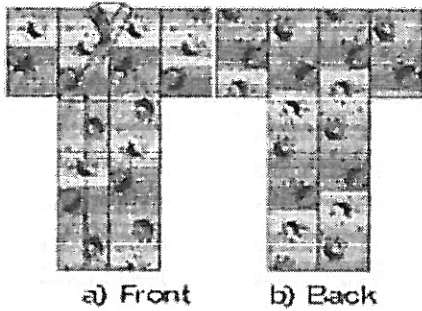


Fig.10 Two dimensional display of the designed yukata with texture alignment

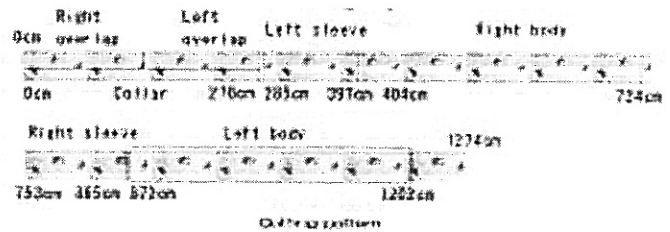


Fig.13 Cutting Pattern of the designed yukata with texture alignment

Fig.10 shows the results of the texture alignment. We have a best feel for the texture alignment based on traditional rules.

The texture pattern of the left body, the right body, and the left overlap is mapped on the body. Fig.11 shows the wearing condition of the yukata without the texture alignment. And Fig 12 shows the wearing condition of the designed yukata according to the traditional rules.

She can make sure the texture alignment of the yukata. The cutting pattern is automatically obtained by the CAD

system as shown in Fig.13. Thus, the yukata was made as shown in Fig.14.

By using this system, designer and wearer can easily tailor the yukata regardless of their skill.

IV. CONCLUSIONS

In this study, we developed a human body shape imaging system for the yukata. At first, the human body shape at the

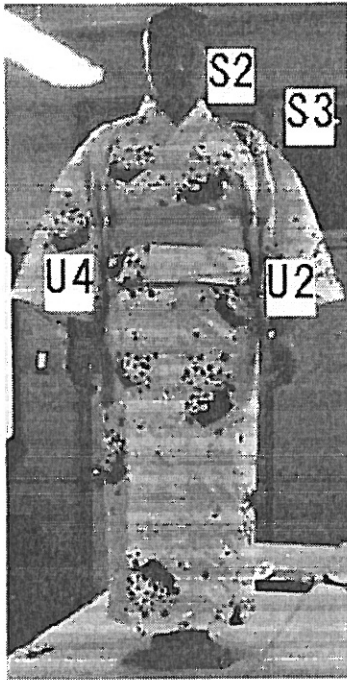


Fig.14 The yukata

yukata wearing is approximated by the elliptical column. Secondly, the outline and the breast shape data of the wearer, which is the most important data for the yukata design, is measured using proposed method. In this way, we can obtain the wearer's body data that represents the wearing condition of the yukata. The texture pattern of the yukata is mapped on the wearer's body based on the yukata design.

By the proposed system, the wearer and designer can make sure the impression of the yukata. The design support system could assist retried and confirmed texture alignments if necessary. In this way, the designer can make the yukata, which satisfied the wearer's taste.

V. REFERENCES

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