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Wearing Test for New-Bunka Pattern Making of Men's Body Type through Virtual Garment

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Abstract

This study focuses on the needs of both consumers and manufacturers. It aims to find ways for consumers to purchase outfits that would fit their particular body type and preferences at reasonable prices, choose raw materials and style of garments, and virtually try them on. In addition, the study is designed to help apparel manufacturers identify customers' changing needs, reduce inventories, manage information on customers' body type in a digitalized form, and eventually contribute to promoting electronic commerce.

Based on nine basic patterns that fit each subject, 108 virtual garments are created by adjusting the size of the patterns (9 subjects × 4 body parts × 3 patterns = 108 outfits).

In order to determine fitting preferences for each body part and find optimized conditions, cross-tabulation analysis including X^2 and frequency analysis were performed to measure the appearance rate.

A style of virtual garment, which is minus 2cm from chest size was chosen as the most appropriate pattern to the baseline location of front the chest. For the waist parts, the C style as an appropriate virtual garment to front and back view. In the front, lateral and back view, a style was chosen in the response to the sleeve-bodice combinations, the ease amount of armhole area, the armhole depth and the loosening or tightening of armhole line.

Key words : New-Bunka basic pattern, virtual garment, wearing test, 3D body data

Ⅰ. Introduction

Due to its conservative nature compared to women's clothing, there was not a significant change in men's clothing. However, recently, the focus of men's clothing is shifting to casual style, feminine style, and suit.

In Korea, online shopping has been growing at an exponential rate and is expected to grow from 7 trillion won to 19 trillion won by 2010[1]. When it comes to clothing sales on the Internet,

the apparel fit is emerging as an important issue in distribution process. In addition, people are turning their attention to the need for production systems for personalized clothes such as virtual fitting room[2]. Against this backdrop, a variety of software designed for cybernation clothing stores are developed and currently available at home and abroad. They are designed to create a virtual space where the whole process of design, production, ordering, selling, distribution, and customer management are handled online.

Technical approach to this issue includes virtual fitting simulation using computer graphics (CG). Using this technology, customer's fit preferences, design and raw materials are entered into clothing on a computer screen and the image is edited using CG. This allows customer to view the data image of garment even if it does not exist in off-line stores.

Using this technology, online consumers can choose products that are exactly the same as those sold offline. The conventional fitting test was performed by experienced evaluators based on their subjective judgment. By contrast, using virtual fitting simulation, users can carry out fitting test in an objective manner and set an objective standard for evaluating the relationship between human body and clothing.

Unlike in the past when clothes were just meant to be worn, the apparel industry needs to transform into a high value-added industry based on advanced technology. In this regard, apparel manufacturers are implementing the mass customization strategies in order to correlate body type and fit preferences of various consumers without increasing production size[3]. However, access to quality information and data on apparel fit is a prerequisite to the success of custom-fitted clothes[4].

According to the statistics released by the Korea National Statistical Office in May 2003, the volume of online shopping increased to 576.7 billion won. This is a 3 percent increase (16.9 billion won) from the previous month and a 10.4 percent increase (54.1 billion won) from the same month of the previous year. Of the total volume, apparel and fashion products accounted for 10.4 percent, a whopping 47.6 percent increase from the same month of the previous year[5].

Although clothing simulation is adopted to a certain degree, it is still at its infancy. The technology does not go beyond using CG animation. It is not necessarily based on human physique or morphology in rendering change in body size according to measurement variation. Moreover, it does not necessarily represent the link between human body and clothing pattern based on relationship theory.

Although some researches have been conducted on virtual garment[6-9], there was no case of draping experimental clothes over men's subject using simulation program in order to meet the needs of online shoppers. In this respect, this study is designed to present data on ways to improve satisfaction level of basic pattern of men's clothing by exploring how to determine proper ease amount between human body and clothing.

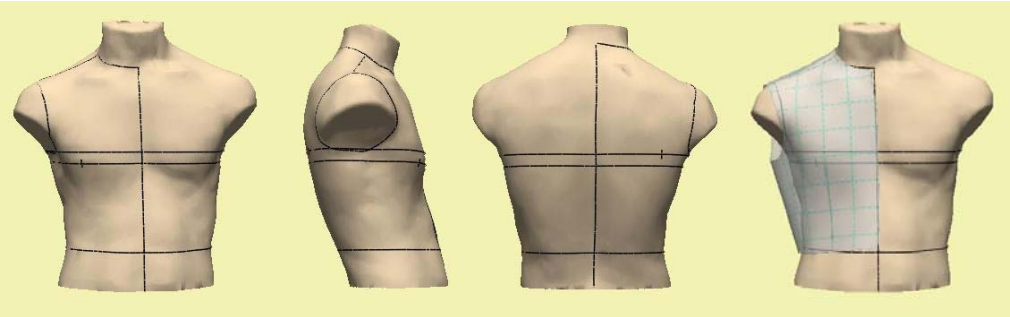
This study focuses on the needs of both consumers and manufacturers. It aims to find ways for consumers to purchase outfits that will fit their particular body type and preferences at reasonable prices, choose raw materials and style of garments, and virtually try them on. In addition, the study is designed to help apparel

manufacturers identify customers' changing needs, reduce inventories, manage information on customers' body type in a digitized form, and eventually contribute to promoting electronic commerce.

Ⅱ. Research Methodology and Procedures

1. Selection of Wearing Test Subjects

This study was conducted between October, 2003 and December 2004. Nine different people in their 20s, target consumers of men's clothing, were selected as subjects for the study based on their chest circumference. To obtain the individual subject information, somatological measurement was conducted on the fifty-three subjects first. After analysis of fundamental information, we select the subject by three subjects who were similar in size 85cm to 89cm, 90cm to 94cm, and 95cm to 99cm according to the chest circumference respectively. It is for even distribution of subjects 〈see Fig. 1〉. In the study, upper trunk was used for the following reasons: Human body changes shape with movement, breathing, and specific conditions. This may result in an increased error rate. By contrast, dress form is an effective tool for objective fitting test since its shape remains constant over time. The physical characteristics of the subjects who participated in this study are described in 〈Table 1〉.



〈Fig. 1〉 Wearing Test Subject and Status of Virtual Garment

〈Table 1〉 Physical Characteristics of Subjects

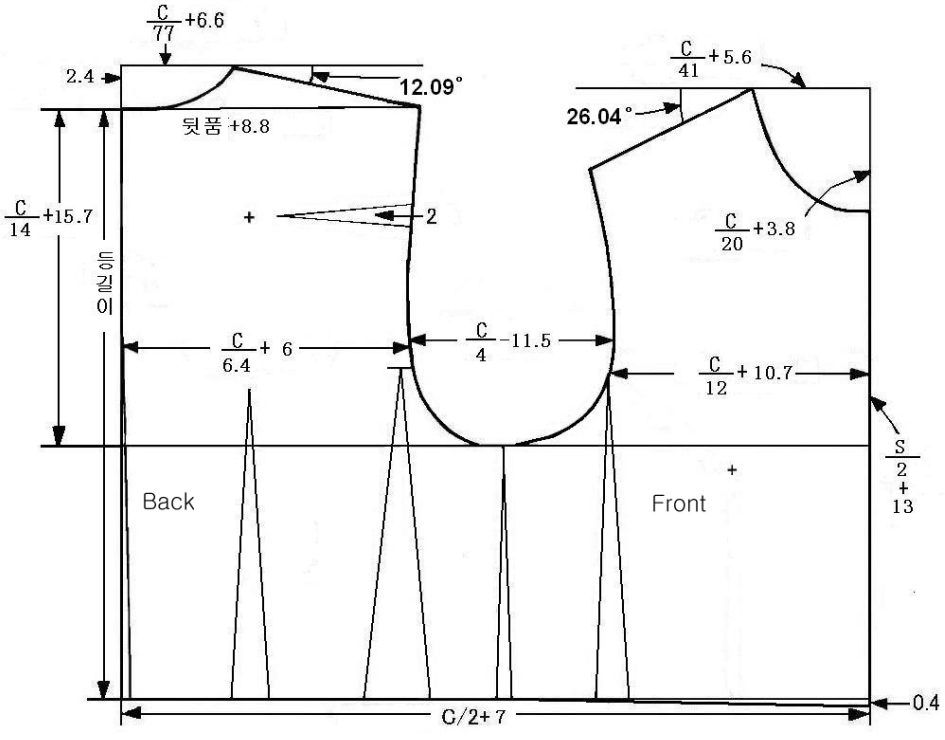
(Unit : Cm, Kg)

Items	Sub. 1	Sub. 2	Sub. 3	Sub. 4	Sub. 5	Sub. 6	Sub. 7	Sub. 8	Sub. 9
Stature	165.5	176.8	167.6	178.0	178.0	169.5	163.0	171.0	182.0
Chest C.	85.2	86.9	88.9	91.4	92.8	90.2	99.1	95.8	97.4
Waist C.	61.0	70.8	74.6	71.3	76.3	74.0	77.6	75.0	81.9
Back L.	39.1	38.0	42.1	40.9	40.5	40.2	43.4	40.8	41.9
Shoulder L. (half)	15.4	12.3	10.8	10.5	13.8	11.3	13.1	10.5	11.6
Weight	59.2	59.2	57.6	61.8	52.9	66.3	65.4	62.0	73.6

Sub. = Subject, C. = circumference, L. = Length

2. Manufacturing of Virtual Garment

Experimental clothes were made based on proportional basic pattern for drafting system, a method used to design basic patterns by selecting size exclusively based on chest measurement[10-11]. The methodology originated from the Bunka methodology. Measurement descriptions include chest circumference and center back length. Drafting system method demonstrated in 〈Fig. 2〉. Virtual garment patterns for each body type are entered using digitizer in a form suitable for the software. Based on 9 basic patterns that fit each subject, 108 virtual garments are created by adjusting the size of the patterns (9 subjects × 4 body parts × 3 patterns = 108 outfits). 100% Cotton cloth expressing experimental clothes is displayed in 5cm^2 green grid line. Pattern size variation was made to chest circumference, waist circumference, and armhole line at intervals of −2cm, 0cm, and +2cm respectively. Variation was also applied to shoulder slope at intervals of −2°, 0, and +2° by adding 1° at front bodice and back bodice.



〈Fig. 2〉 Proportional Basic Pattern for Drafting System

(C = Chest Circumference, S = Back length)

3. Application of Software

The virtual garment software used in this study is the AZ software[12]. The software enables users to enter their measurements using digitizer or drape flat pattern over subject on a screen in 3D real-time and modify it. This virtual garment software is developed for educational purpose, allows users view and design patterns, and is designed to create realistic 3D graphic environments.

In the process of configuring specific point for the AZ software, 3D data of the torso is measured using non-contact 3D body measurement system (NEC, Japan). The data is converted into 3D scan data that can be used in the AZ software, and then the reference point is set using the 3D coordinate value. Baseline is configured using the AZ software designed solely for baseline. In the process of draping experimental clothes over torso, basic patterns that match each torso is converted into a DXF-file format on the coordinate data on the paper using digitizer.

4. Wearing Test

The wearing test was divided into four parts: the influences of ease at bodice for fit satisfaction, and the preferred fit level at specific area.

After draping experimental clothes over torso, adjustments were made, in flat pattern, to bodice ease, the bust width, the width between armpits, shoulder slope and shoulder width. Subjects were classified into three groups based on their chest circumference: A style (circumference and shoulder slope = -2cm), B style (circumference and shoulder slope = +0cm), and C style (circumference and shoulder slope = +2cm).

Using simulation technique, three basic patterns with different shoulder slope and bodice ease are draped over each torso that has already been converted into 3D body data. The patterns are draped in a way that they fit Back Neck Point (BNP) so that center front and center back form a vertical pattern. Experts perform sensory evaluation of each garment simulation. Based on the analysis of sensory evaluation and vacant space distance measurement, conditions for the most visually pleasing basic pattern are identified when flat pattern is generated. In addition, the fitting status of basic pattern which fits particular body type is identified and applied to a variety of items. This allows for objective and quantitative decision-making of consumers about garment fitting.

The evaluators consist of five expert panels who majored in clothing and textiles and have more than 5-year field or teaching experience in clothing construction. They perform sensory evaluation of the modified pattern and perception of the appearance by the experts. Evaluation items are shown in Table 2. These items included on the chest area, waist area, shoulder part and armhole line for fit and appearance of virtual garment[13-15].

In sensory evaluation, each subject is dressed in three virtual garments with different pattern ease and nine images are simultaneously displayed on one screen. Then the selected experts evaluate the images based on evaluation items. They assess the body parts divided into four slices in regular sequence and during the

process, they are not given prior information on pattern.

Evaluation items were selected with consideration for both online and offline shoppers. After viewing the images of the front, the back, and the side of the subject simultaneously, evaluators choose the best fit out of the three styles and mark it on the evaluation sheet.

5. Data Analysis

The data collected from sensory evaluation is exported to the simulation system. Then the relationship between flat pattern and fitting status is identified based on key criteria. This will benefit both retailers and buyers.

In order to determine fitting preferences for each body part and find optimized conditions, cross-tabulation analysis including X^2 and frequency analysis were performed to measure the appearance rate[16]. The statistical analysis was performed using SPSS package program.

〈Table 2〉 Items for wearing test

Body parts	Evaluation items
Chest circumference	Baseline location of front chest, side chest, and back chest
	Ease and apparel fit of front chest and shoulder blade
	Tightening or loosening of front chest, lateral chest, and back chest
Waist circumference	Location of front waist hem line, waist hem line on the side, back waist hem line and front body length
	Ease of waist line
	Appropriateness of side seam
Shoulder parts	Relationship between shoulder line and shoulder slope
	Comfortable posture on the shoulder
	Loosening or tightening of basic pattern on the shoulder
Armhole line	Appropriateness of the armhole seam
	Armhole ease amount
	Loosening or tightening of armhole line

III. Results and Discussion

1. Evaluationof fit and appearance on the chest area

Nine different virtual basic clothing made by each size, and developed according to body area. Exert judges evaluated through computer monitor by made of simulation program for appropriate basic bodice pattern.

Results of the evaluation of the virtual basic garment by five expert judges are presented in 〈Table 3〉. Each garment was judged on the front, lateral and back view of body. A style, which is minus 2cm from chest size was chosen as the most appropriate pattern to the placement of chest line of virtual garment, vacant space distance, ripples or wrinkles on the front view. A style also was chosen as the appropriate pattern on the lateral and back view except the placement of the side chest line.

〈Table 3〉 Frequency distribution for Compare of the Fit and Appearance of the Chest

(Unit : %)

Items		A style	B style	C style
Front	Baseline location of front chest	**20(14.8)**	10(7.4)	15(11.1)
	Ease and apparel fit of front chest	**32(23.7)**	9(6.7)	4(3.0)
	Tightening or loosening of front chest	**24(17.8)**	9(6.7)	12(8.9)
	Total(%)	**76(56.3)**	28(20.7)	31(22.96)
Lateral	Baseline location of side chest	15(11.1)	14(10.4)	**16(11.9)**
	Ease and apparel fit of side chest	**22(16.3)**	19(14.1)	4(3.0)
	Tightening or loosening of side chest	**27(20.0)**	10(7.4)	8(5.9)
	Total(%)	**64(47.4)**	43(31.9)	28(20.7)
Back	Baseline location of back chest	**23(17.0)**	7(5.2)	15(11.1)
	Ease amount at the shoulder blade	**18(13.3)**	17(12.6)	10(7.4)
	Tightening or loosening of back chest	**29(21.5)**	9(6.7)	7(5.2)
	Total(%)	**70(51.9)**	33(24.4)	32(23.7)

A style: (Chest circumference−2cm), B style: (Chest circumference+0cm),
C style: (Chest circumference+2cm)

2. Evaluation of fit and appearance on the waist area

Results of the evaluation of fit and appearance on the waist area are show in 〈Table 4〉. Judges chose the C style as a appropriate virtual garment to front and back waist area.

In the other hand, B style was chosen as an appropriate pattern on the lateral view to the waist hem and side seam placement. For the vacant space distance, C style was chosen by expert judges in the response to the back view. These results depend on the kind of which side view.

〈Table 4〉 Frequency distribution for Compare of the Fit and Appearance of the Waist

(Unit : %)

Items		A style	B style	C style
Front	Location of front waist hem line	13(9.6)	5(3.7)	**27(20.0)**
	Ease of waist line	**21(15.6)**	17(12.6)	7(5.2)
Lateral	Location of waist hem line on the side	15(11.1)	**21(15.6)**	9(6.7)
	Placement of side seam	15(11.1)	**22(16.3)**	8(5.9)
Back	Location of front waist hem line	8(5.9)	16(11.9)	**21(15.6)**
	Ease of waist line	**22(16.3)**	15(11.1)	8(5.9)
	Relation of garment length and Back length	**17(12.6)**	14(10.4)	14(10.4)

A style: (Waist circumference-2cm), B style: (Waist circumference+0cm),
C style: (Waist circumference+2cm)

3. Evaluation of the patterns between shoulder seam and shoulder slope

〈Table 5〉 shows the appropriateness between shoulder seam and shoulder slope according to different shoulder slope angle. As shown in 〈Table 5〉, C style was higher frequency in the response to the shoulder seam placement on the shoulder.

There was no significant difference to the comfortable pattern of the front virtual garment. In the side view, A style, which is basic bodice pattern minus 2 angle was chosen in response to the placement of shoulder seam among the three different size of patterns.

In the back view, A and C style was chosen in the response to the placement of the shoulder seam and winkles and ripples of the back shoulder area.

We realized that New-Bunka pattern making method with Chest was not affect to the shoulder area of the fit and appearance because this pattern just use two sizes, chest and back length of body.

〈Table 5〉 Frequency distribution for Compare of the Fit and Appearance of the Shoulder

(Unit : %)

Items		A style	B style	C style
Front	Relationship between shoulder seam and shoulder slope	15(11.1)	14(10.4)	**16(11.9)**
	Comfortable posture on the shoulder	**16(11.9)**	13(9.6)	**16(11.9)**
Lateral	Relationship between shoulder seam and shoulder slope	**21(15.6)**	13(9.6)	11(8.1)
	Shoulder seam on the center line of shoulder width	**18(13.3)**	12(8.9)	15(11.1)
	Comfortable posture on the shoulder	15(11.1)	14(10.4)	**16(11.9)**
Back	Relationship between shoulder seam and shoulder slope	**16(11.9)**	13(9.6)	**16(11.9)**
	Loosening or tightening of basic pattern on the shoulder	15(11.1)	14(10.4)	**16(11.9)**

4. Evaluation of the armhole among the three different patterns

The armhole is important area related to function of arm movements and comfortable of garment. As shown in Table 6, judges evaluated that A style for suitable of armhole area, sleeve-bodice combinations and wrinkle & ripple of armhole area in the front. To the ease amount of armhole, B style was evaluated as a good virtual garment.

In the lateral and back view, A style was chosen in the response to the sleeve-bodice combinations, the ease amount of armhole area, the armhole depth and the Loosening or tightening of armhole line.

Ⅳ. Conclusion

This study focuses on the needs of both consumers and manufacturers. It aims to find ways for consumers to purchase outfits that would fit their particular body type and preferences at reasonable prices, choose raw materials and style of garments, and virtually try them on. In addition, the study is designed to help apparel manufacturers identify customers' changing needs, reduce inventories, manage information on customers' body type in a digitalized form, and eventually contribute to promoting electronic commerce.

Based on 9 basic patterns that fit each subject,

〈Table 6〉 Frequency distribution for Compare of the Fit and Appearance of the Armhole

(Unit: %)

Items		A style	B style	C style
Front	Appropriateness of the armhole seam	**26(19.3)**	8(5.9)	11(8.1)
	Armhole ease amount	13(9.6)	**24(17.8)**	8(5.9)
	Loosening or tightening of armhole line	**19(14.1)**	16(11.9)	10(7.4)
Lateral	Appropriateness of the armhole seam	**19(14.1)**	12(8.9)	14(10.4)
	Armhole ease amount	**18(13.3)**	16(11.9)	11(8.1)
	Armhole depth	**24(17.0)**	15(11.1)	7(5.2)
	Loosening or tightening of armhole line	**24(17.8)**	8(5.9)	13(9.6)
Back	Appropriateness of the armhole seam	**24(17.8)**	7(5.2)	14(10.4)
	Armhole ease amount	**21(15.6)**	11(8.1)	13(9.6)
	Loosening or tightening of armhole line	**25(18.5)**	5(3.7)	15(11.1)

A style: (Armhole line-2cm), B style: (Armhole line+0cm), C style: (Armhole line+2cm)

108 virtual garments are created by adjusting the size of the patterns. The results of this study are as follows.

A style, which is minus 2cm from chest size was chosen as the most appropriate pattern to the baseline location of front chest of virtual garment. For the waist parts, the C style as a appropriate virtual garment to front and back view.

New-Bunka pattern making method shows independent relation to the shoulder area of the fit and appearance because this pattern just use two sizes, chest and back length of body.

In the front, lateral and back view, A style was chosen in the response to the sleeve-bodice combinations, the ease amount of armhole area, the armhole depth and the Loosening or tightening of armhole line.

This study basically covered not all of the male costumers, further more detail studies might have to follow for the generalization of the virtual garm ent's silhouettes, colors, and materials.

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