Application Research of 3D Printing Technology on Dress Form

Hye-Won Lim[1], Thomas Cassidy[2] and Tracy Diane Cassidy[3]

***Abstract*— Dress form is an essential tool in the clothing-making process for pattern block development, draping and quality inspection. However, it is noted that a single dress form is not applicable for a large variety body shapes. There are adjustable dress forms and custom-made dress forms to attempt to make up for the insufficiency of conventional dress forms. However, such types of dress forms are rather costly and their effectiveness is debatable. With this is mind, a customised adjustable kit for the dress form was developed, with the aim to cover different sizes and shapes more precisely. The kit adopts 3D printing technology which enables generating and changing the shape of components efficiently.**

***Index Terms*— 3D printing, adjustable dress form, body shape, dress form, padding**

I. Introduction

In general, most of all fashion industries are using a dress form in different departments for clothing manufacturing and the dress form manufacturers have been trying to produce advanced and functional dress forms to fulfill customers' satisfaction. However, the differences of body shape and size are distinctive and the special needs for specific body type cannot be produced [1]. Nowadays, 3D printing technology which helps to realise any creative idea become reality with affordable prices and prompt time is becoming popular [2].

The purpose of this study was to conduct an experiment to develop a prototype for customising adjustable padding kit using a 3D printer and following a DRM (Design Research Methodology).

The objectives of this study were: (1) To identify the requirements of an adjustable function at the dress forms. (2) To test a design process for the adjustable padding kit. (3) To find out the possibilities to adopt and improve factors.

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II. Background

A dress form which is also called a dummy, a dress stand, a body form, a model form or a figure is a basic requirement in the clothing manufacturing process. A dress form is defined as "a replica a human form made of cloth, padded and mounted on a metal base that is used for draping and fitting garments"[3].

The dress form manufacturers have been considering how to develop enhanced and functional dress forms to satisfy mass production processes but also they have to match special needs for specific body types and clothes for better fit [1]. One type is the adjustable dress forms which are modules of shape and padding type. The modular type developed by Singer Direct® has twelve dials to adjust the sizes to their requirements by tightening or loosening (Figure 1) [4]. The padding type, 'Uniquely You' is a pre-shaped dress form to be adjusted which is made of high density soft polyurethane known as foam rubber as it can be squeezed and reshaped easily (Figure 2) [5].

Figure 1: Adjustable dress forms manufactured by Singer Direct®

Figure 2: 'Uniquely You'

Adjustable dress forms provide different sizes to fit for diverse body shapes and help the customers who do not have the measurements sizes the same as the manufactured dress forms. However, to measure and figure out the exact size and shapes is not easy.

Fabulous Fit® in the U.S.A. produce a fitting solution kit by inserting moulded pads under dress form covers to duplicate the targeted size and shape (Figure 3) [6]. Manual padding up of the dress form is still popularly used to correct the size for a gap between the bodies but this process is time consuming and laborious (Figure 4) [7, 8].

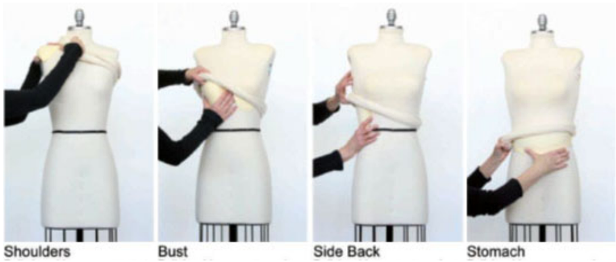

Figure 3: Customising padding kits


Figure 4: Padding with manual method

Since the later 1990s, some dress form companies started to use 3D body scanners for particular needs. For example, ‘Shapely Shadow’ and ‘Alvanon’ manufacture customised dress forms for certain brands or a fitting model’s measurement sizes using a 3D body scanner. 3D body scanning helps to capture a specific body image to develop a dress form which is perfectly and accurately matched for the needs of garment designers, clothing manufacturers, and retailers [9].
The emerging technologies, 3D scanning and 3D printing can help to create any design and shape quickly and efficiently [2]. These technologies also help to save time and money because of spending less on raw materials and only printing the necessary parts.

III. Materials

The dress form used in this study is a half-scaled (1/2) body or so-called mini body. The material of the dress form is urethane foam sufficiently soft for pinning hempen fabric covering onto it. The dress form in this study is represented the half scale of size 55 which is one of the Korean women’s clothing size [10]. The 3D printer used was a 3Dison Multi, manufactured by Rokit in South Korea [11]. The printing method and type of 3Dison Multi are FFF (Fused Filament Fabrication) and an extruder type, respectively. In this study, the PLA filament was chosen as an experimental material due to its cost and accessibility.

IV. Methods and Design Process

According to DRM a better understanding of the current situation is necessary to determine the influencing criteria and requirements to complete the practical outcomes of the project. [12].
The current understanding of requirements and insufficient adaptability of current dress forms were revealed from the literature. Improved and supportive design which could compensate these defects was determined by adopting body shape classification and utilizing the flexibility and accuracy of a 3D printer.

First, each section for adjusting body parts were selected to create specific body shapes according to the body shape classification (see Figure 5). Rasband classified the body types of female body into 6 different shapes; ‘Triangle shape’, ‘Inverted triangle shape’, ‘Rectangle shape’, ‘Hourglass shape’, ‘Diamond shape’, and ‘Rounded shape’ [13]. Each shape is targeted to describe a specific wider or bigger body component of the dress form. In this study, the components for creating the four body types from Rasband’s classification and additional wider waist, protruding bust and hip were developed (see Table 1). The added amounts for each part were from 1 cm to 2cm depending on the body parts.

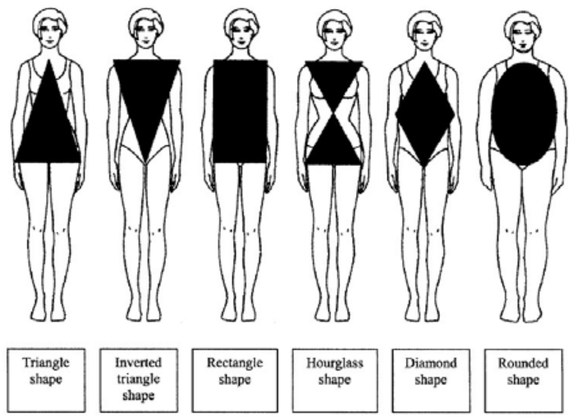

Figure 5 Classification of Body shapes by Rasband [13]

Next, the experimental dress form was 3D scanned then the shape of each component was developed into 3D CAD images. The original scanned images were copied as the new layer of skin and the parts of intended shapes were extracted with added amount. The offset 3D images outline were trimmed smoother and thinner to fit the experimental dress form without any gap. The 3D CAD files were then inputted to a 3D printer and the prototype produced.

Body Parts	Size	Added Amounts	Intended shape
Shoulder Length	18.5	1cm	Inverted triangle shape
Bust Circumference	43cm	2cm	Protruding bust
Waist Circumference	32cm	2cm	Wider Waist
Side hip Circumference	45.5cm	2cm	Triangle shape*
Hip Circumference	45.5cm	2cm	Protruding hip
Shoulder + Hip	18.5cm/ 45.5cm	1cm/2cm	Hourglass shape*
Waist + Side Hip	32cm/ 45.5cm	2cm/2cm	Rectangle shape*

Table 1: Original sizes, added amounts, and intended shape of the dress form

Lastly, some extra supporters were removed and surfaces were trimmed smoothly using an emery cloth. The 3D printed padding kit was attached to the dress form using double-sided adhesive tapes. As with manual padding methods, the adjustable kits were attached at the right side.

The development process of the customised adjustable kit was planned in five stages; ‘idea design’- ‘3D scanning of the dress form’ - ‘3D modeling of the kits’- ‘3D printing of the developments’ - ‘post processing’ (see Figure 6). The customised adjustable kit was designed to create a wide or large size or shape than the fixed sized dress forms. Because to make a dress form smaller is physically impossible and an image processing of smaller size is not allowed on the program.

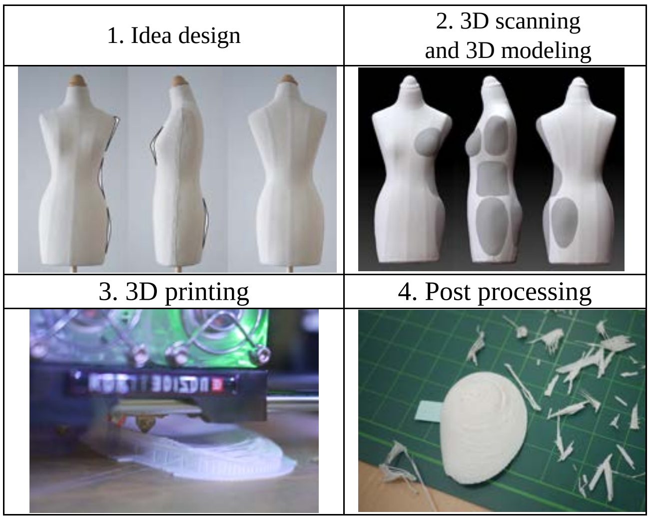

Figure 6: Customised adjustable kit development process.

V. RESULTS

The developed parts of the customised adjustable kit are shown on the Figure 7.

In total, the outcomes of 3D printing were convincing in consideration of the initial experiment. The intended shapes of each component were printed without differences of the idea design shown on the screen and the size of added amounts were applied affordably.

Although not everything need be disclosed, a paper must contain new, useable, and fully described information. For example, a specimen's chemical composition need not be reported if the main purpose of a paper is to introduce a new measurement technique. Authors should expect to be challenged by reviewers if the results are not supported by adequate data and critical details.

However, there was a subtle gap between the components and the dress form around the edges even though the nozzle size of the experimental 3D printer was only 0.4cm. In case of the material of the kit, the suitability of the component coverings was not totally satisfactory even though this weakness was expected at the idea design stage. The hardness was adequate enough to match the material of the dress form but pinning which is the most required function of the dress form was not possible. However, a manufactured dress form cover with a soft foam layer could be covered and the thickness of the cover could be calculated at the 3D modelling stage. In addition, the rubber or flexible material which can be put into the inside easily and different added amount components can be developed in further developments.

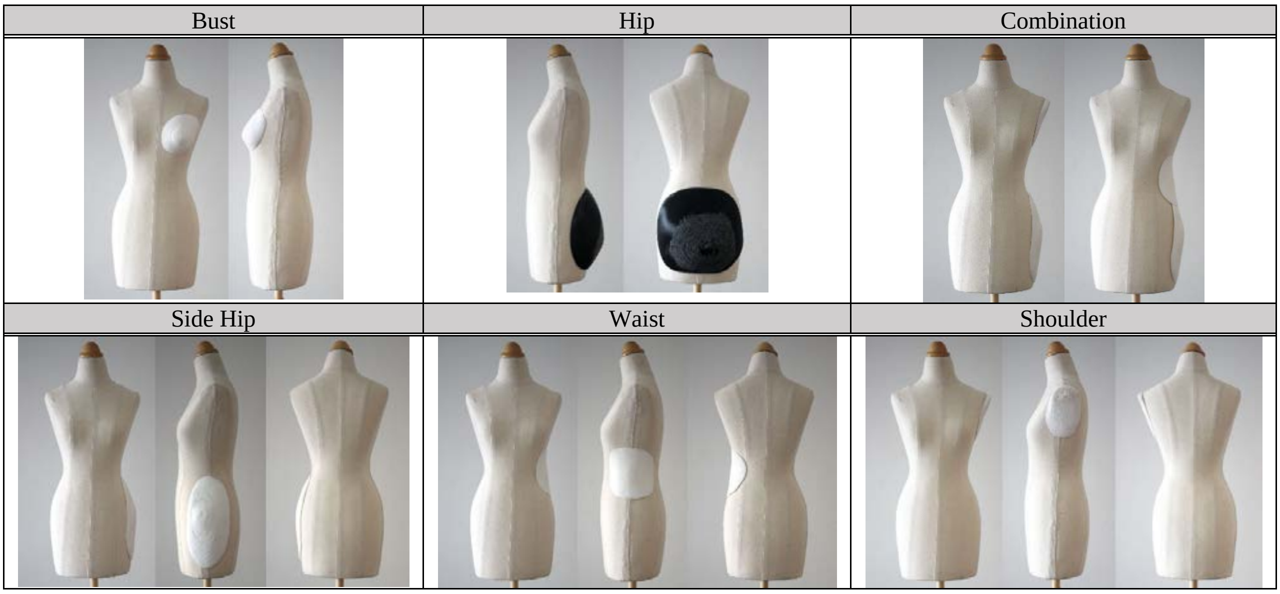

Figure 7: Adjustable padding kit development

VI. CONCLUSIONS

In this study, an experiment of developing an adjustable padding kit was conducted for the precise duplications which targeted specific body shapes using 3D scanning, 3D modelling and 3D printing technology. It was founded that the applicability and effectiveness of developments of an adjustable padding kit has a possibility to be adopted due to its size accuracy and convenience. There is no difficulty to produce any adjustable body parts. Thickness can also be changed easily when 3D scanned images were available. This study can be extended to apply to other materials and other body parts and those can be evaluated.

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Tracy Diane Cassidy is a trained knitwear designer experienced in knitwear and bespoke bridal-wear design, manufacture and retail. She obtained her PhD through the investigation of Colour forecasting and is the first author of the book Colour Forecasting (Blackwell). Tracy is a Reader in Fashion & Textiles, at the University of Huddersfield, and continues to conduct research in fashion and textile design, trends and marketing. While trends and colour have remained particular areas of research interest in both design and marketing applications, more recently research interests include home furnishings and interiors encompassing fashion and textiles in a much broader context. Tracy recently trained as a master upholsterer using both modern and traditional materials and techniques. Upholstery and furniture decoration are the mainstay of her practice. She is an established author with international presence, a reviewer for many reputable journals, and editorial board member. Further chapters Tracy has published in the area of colour forecasting include Sustainable Colour Forecasting in Gardetti & Torres' 'Sustainable Fashion & Textiles' (2013) and Colour Forecasting: Seasonal Colours' in DeLong & Martinson's 'Colour & Design' (2012). Tracy's research into subcultures includes an exploration of Lolita Fashion (Fashion, Style and Popular Culture, 2015: 2: 2); The rise of vintage fashion and the vintage consumer (Journal of Fashion Practice, 2012: 4: 2) and Youth identity ownership from a fashion marketing perspective (Journal of Fashion Marketing & Management, 2011: 15: 2).