A Parameterized Mannequin for Apparel Design

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Abstract: The function of mannequin is important for designing and making clothes, and the garment size is crucial foundation for making out the standardized mannequins. With the extensive application of the non-contact three-dimensional human body scanning technology, the digitization of the anthropometric measurement has been realized which provides full support towards computer aided design of mannequins in garment industry. In order to match with the present national standard, intermediate forms of mannequin have been developed for fitting garments made to measure instead of human body. This paper reports related preliminary research of parameterized mannequin, based on the survey of female university students in the mid-west area in China. Using statistical calculations as the foundation, 7 categories of somatotypes were used to obtain intermediate sizes and stepping values. This mannequin provides variational control for middle layer measurements with the help of scanner software. Having measured girths of middle layer across breast, waist and hip separately, change relations after the statistical analysis provide the basis for determining changes in middle layers. Through the programming under the platform of VC++.net and OpenGL, parameterized mannequin can be created, enabling us to construct an intermediate model. Parameterized mannequin can fit standard series or customized, if necessary, to incorporate changes not only by stepping values based on statistical analysis, but also by arbitrary adjusting within an allowable range.

Keywords: body scanning, parameterized mannequin, surface shape, garment CAD

1. Introduction

It is an important role that a mannequin plays in design and production of apparel. It reflects the characteristics of the human body as well as beautifies it. The mannequin is not the same as the human body shape. Compared with human body, the breast part of mannequin is slightly smoother, the wide-spaced nipples are a little larger and shoulder angle is bigger [1]. The use of mannequin includes design production type and apparel exhibiting type. The dimension specification of the latter corresponds with garment size standards.

As Chinese Garment Size standards have been promulgated for a long time, the so called domestic mannequins used by enterprises and scientific research institutions are inconsistent with Chinese somatotypes. Although some were made in China, the data of manufacturing was from abroad.

The somatic data measured by conventional method can not reflect the 3D characteristics of the human body. Size distribution artificially divides bodies into different classifications while human dimensions take on continuous variation, inevitably leading to absence of adequate information affecting the fitting of clothing. Traditional method cannot provide mannequins for 3D garment design, whereas the parameterized mannequins based on body measurement are able to overcome these shortcomings.

With the gradual maturity of the 3D body scanning technology, the productions of mannequins are likely to become more scientific [2]. Indeed in today's design world, parameterized mannequins can make a target of a particular group to generate specific shapes and intermediates.

Associated with application of digital MTM (Made To Measure) system and fitting system on the internet [3], the customer can try a virtual dress on through selecting a digital mannequin which

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accords with their physical characteristics [4]. If inappropriate, one can modify it on digital mannequin then export digital patterns to auto cutter after transformation from 3D to 2D. Virtual mannequin lays the foundation for garment CAD, which may improve the efficiency of personalized apparel design and production. In this paper, we report the development of parameterized mannequin using the data derived from 3D body scanning.

2. Three Dimensional Non-Contact Measuring Method

The data for parameterized mannequin in this research was collected by the Vitus/Smart body scanner of the Lectra Company provided by Shaanxi Research Center of Clothing Engineering & Technology. It is a non-contact laser 3D body scanning system which is composed of software and hardware.

The process is that a model is measured by several laser range finders and cameras receive laser beam reflected from surface of the body. According to light location, time interval and optical axis angle, whole surface data of a human body can be calculated by computer [5]. The ScanWorX, software supplied with the scanning system (similar as a digital ruler), may compile and measure every aspect automatically.

A survey was carried out in Shaanxi Research Center of Clothing Engineering & Technology and measuring time ranged from April to August, when temperature was controlled in 27°C ± 3°C and humidity was of 60% ± 10%, in line with the existing environmental temperature and humidity. To ensure accuracy of measurements, the measuring crews, mainly postgraduates of Clothing and Art Design College in the Xi'an Polytechnic University, were trained for the measuring system and process in advance. The models used for the study were female students in college whose ages were between 19 to 25 years old, and they grew in the mid-west area of China.

The body measurement of previous research chose 78 measuring items under 10 broad headings [6], in which item name, nomenclature, and measuring method were complied with ISO3635-1981 -"Size Designation of Clothes- Definitions and Body Measurement Procedure" [7]. The research of parameterized mannequin was mainly based on statistics and measurement of preliminary work studied on female students in college in the mid-west area of China, and it divided body types into 7 categories to get intermediate sizes and stepping values [8].

As mannequin modeling is only restricted in truncal department, not including four limbs and head, this research focused on mid neck girth, breast girth, waist girth and hip girth as the structural basis. These main control parameters were chosen as the intermediate body of the somatotype on the basis of clustering sizes after statistical analysis [9]

2.1 Intermediate Sizes and Middle Layers

Adjusting a parameterized mannequin will affect fitness of garments, if attention is only paid to measurements of one's breast, waist and hips and intermediate sizes ignored. Some virtual mannequins only adjust to girth of breast, waist and hip, not taking into consideration the circumference adjustment of middle layers. Modulated parameters to construct a mannequin, would require to look at the circumferences of middle layers which varied along with the Three Circumferences.

As circumferential variation is on the basis of the same height, the thoracolumbar middle layers are the parts divided into trisection between breast girth and waist girth along towards height direction, and the layers are named breastwaist-1 and breastwaist-2 separately. The waist and hip part follows the same division as above, which are called waisthip-1 and waisthip-2 respectively.

For this investigation we had chosen a 3rd kind of intermediate body shape among a total of 7 types obtained by cluster analysis in preliminary work [6]. Each digital body scanned by 3D body scanner comprises about 50,000 cloud points. As the circumferences of middle layers can't be obtained automatically, sizes can be arrived at via interactive measuring tools supplemented by the scanning system.

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