Journal of Fiber Bioengineering & Informatics 4:2 (2011) 177–186
http://www.jfbi.org | doi:10.3993/jfbi06201108

A Case Study on Developing Virtual Dress Form Based on Body Shape Classification

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Abstract

In this paper, a new approach has been developed to create virtual dress based on different body types. A 3D scan data of 232 Chinese females were analyzed. Firstly, samples were classified into four categories which were Torso Volume Index (TVI), slender, average, full and heavy. Secondly, 3D body frame, including 10 feature cross-sections extracted from the scan data, was defined and preprocessed. After that, the average data of 3D body frame in each body type group was calculated and a comparative analysis of the feature measurements among the four average body frames was performed. Finally, a shape deformation algorithm was presented to modify the template model according to four average body frames. And surface fitting is implemented by using NURBS technology. In conclusion, the research has created four mannequins representing the average body shape of each group subjects. The results can contribute to the future study on customizing digital mannequins for 3D virtual apparel design system, according to the body shape of target population.

Keywords: 3D Scan Data; Virtual Dress Form; Body Shape Classification; Shape Deformation

1 Introduction

Dress form plays an important role in solving the fitting problem during the process of garment design, manufacturing and selling. In many countries, apparel mannequins have been developed according to their national body feature and sizing system. Undoubtedly, it has exerted a profound effect on the development of apparel industry. However, several problems of the traditional methods have yet to be addressed in order to develop mannequin.

(1) The standard sizing system on which the dress form development is based has been outdated. The current sizing standards in China were based on an anthropometric survey in 1974-1975 [1]. The shapes and proportions of today's Chinese population differ greatly from the shapes of the generations before because of factors such as diets, physical exercise and activities, increased immigration, disproportionate growth rates in minority groups, and sedentary lifestyles [2]. Moreover, many scholars and pattern experts hold that this method of sizing does not conform to the diversity of human shapes that currently exist in many countries [3].

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(2) The traditional body surveys that the sizing standards are based on usually used manual anthropometric tools like Martin-type anthropometry. In this way, only one-dimensional measurements can be obtained, the consequence of which is that, the precision of 3D shape of the mannequin often depends on crafts persons' experience, which is especially true in china.

(3) With the market subdividing, manufacturers often need to design garment products for target customer population with special body types, such as fat customers, the old customers and so on. But in the traditional method, it is difficult to create a personalized model with flexibility.

Fortunately, with the development of the 3D body scanning technology, it is promising to solve the problems mentioned above. In the process of developing the virtual standard mannequin for apparel, three main aspects should be considered. Namely, the aspects are the body survey, body shape analysis and body modeling. A brief review of the related works on these fields is as follows.

In terms of body survey, many national or international surveys using 3D scanner have been carried out. In 1997, the Civilian American and European Anthropometry Resource (CEASAR) project, a comprehensive research study, was conducted to gather data relating to the various shapes and sizes of the 18- to 65-year-old population in the United States and Europe (Netherlands and Italy) using a Cyberware WB-4 whole body scanner. The national sizing survey of the United Kingdom (SizeUK) began in 2000 and was completed in 2001 with 11, 000 subjects from all over the United Kingdom scanned using the $[TC]^2$ body scanner that extracted 130 body measurements. The aim of the survey was to develop sizing standards that represent the population of UK. SizeUSA, funded by the U.S. Department of Commerce and industry partners, was conducted between July 2002 and July 2003. Data was collected by the $[TC]^2$ body scanner from 12, 000 subjects from all over the United States, including six age groups ranging from 18-66+, four ethnic groups and four weight categories [4, 5].

Prior to 3D scanning technology, the scope for body shape analysis was much more limited. The problem drew much attention from researchers. Karla Simmons et al. [3] developed software on female figure identification. Nine female body figure categories were defined in the software based on six measurements taken from the body scan data. A research, using 3D scans for fit analysis, has been done by Susan P. Ashdown et al. [6]. The objective of the research is to improve existing apparel sizing system based on the target market 3D scan data. Body Aspect Ltd has much experience in providing body scanning services in three sectors (medical, apparel, healthy). It enjoys international recognition for developing innovative 3D body shape analysis system [7]. The software enables a range of information to be obtained, including body measurements, body shape measurements, cross-section shape and 3D averaging body.

There is considerable amount of literature on body modeling based on 3D scanning technology. An improved algorithm has been presented to reconstruct the surface of the human body from 3D scanner data using local B-spline patches [8, 9]. Young Sook Cho et al. described the scheme to develop an interactive body model that can be altered to match individual body perimeters and postures, including depths, for the purpose of computerized pattern making [10]. A set of techniques based on examples for generating realistic human whole-body models were discussed by Hyewon Seo and Nadia Magnenat-Thalmann [11]. These techniques include the preprocessing of each scan data, the constructing of the modeling synthesizer deriving the correlation between the parameters and body geometry from examples, and the construction of the modifier synthesizer for more subtle manipulations of example models using high-level parameters such as fat percentage. Wang CCL [12] proposed a feature-based human model approach, which gives a point-to-point correspondence among a set of human models with a same common topological structure for the