Journal of Fiber Bioengineering and Informatics 17:2 (2024) 77–87

Cite as: S. P. Liu et al.
doi:10.3993/jfbim01561

Children's Body Type Discrimination Model and Prototype Paper Pattern Automatic Generation Model Analysis

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Abstract

With the growing demand for personalized clothing, the children's apparel market is receiving significant attention. Traditional pattern-making methods often fail to accommodate the diverse body shapes and preferences of preschoolers, negatively impacting consumer satisfaction. Although existing studies have examined various pattern-making techniques, they frequently overlook the unique needs of children, resulting in limited customization options and reduced efficiency. Therefore, a comprehensive approach is necessary to effectively integrate body size data with personalized pattern-making rules. This study investigates a parameterized model for generating personalized children's clothing paper patterns. It aims to streamline the production process while catering to personalised preferences. Through the analysis of preschooler body size data, 24 body type features are identified, leading to the development of a discrimination model based on principal component analysis and support vector machine. This model, integrated with clothing pattern-making rules, enhances the structure of paper patterns. Furthermore, a parameterised paper pattern for children's clothing is created, utilizing children's body data to generate tailored paper patterns efficiently. Additionally, a linkage model combining 3D and 2D aspects is employed to evaluate clothing fit and overall effects through virtual try-on simulations. Findings suggest reduced production complexity, time, and improved efficiency and quality in personalized pattern making.

Keywords: Body Type Discrimination Model; Children's Clothing Prototype; Pattern Generation; Grasshopper Parameterization; Virtual Fitting

1 Introduction

Computer-aided design and parametric software are shaping personalized children's clothing design. Traditional empirical pattern-making struggles to meet individual demands, hindering industry progress. Extensive research on parametric pattern-making has been conducted [1]. Utilising three-dimensional modelling software, specific integrated clothing patterns are created [2].

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Jun. 2024

This integration enhances pattern fit and efficiency. Additionally, secondary development capabilities drive other drafting or digital image processing software, overcoming traditional CAD pattern-making limitations. Combined with reverse pattern generation methods, this approach produces integrated patterns [3]. Research explores the relationship between detailed measurements and automated clothing pattern generation [4]. Computer language and drafting software secondary development methods [5], along with LISP design language [6] and BP neural network models [7], enable automatic parametric pattern generation.

In summary, parametric pattern making is primarily used in the adult clothing field, with limited application in children's clothing due to cost and threshold considerations. This study addresses pattern modification and generation inefficiencies by establishing a children's body type discrimination model. Integrating this model with Rhinoceros three-dimensional modelling software, we generate parametric children's paper pattern models, offering new perspectives for intelligent clothing manufacturing research.

2 Theory and Method

2.1 Human Body Measurement Experiment

This experiment collected data on the body size of 244 preschoolers aged 3 to 5 using manual measurements and three-dimensional scanning technology. The main tools used were the Martin measuring tape and the Anthroscan 3D human body scanner. Manual measurements included height, chest circumference, waist circumference, hip circumference, shoulder width, back width, back length, arm length, front chest width, and neck circumference, totalling 10 body parameters. Three-dimensional scanning technology mainly focused on measuring the angles of children's upper body, chest, and shoulders, obtaining a total of 24 features, including length characteristics, dimensional parameters, and derived variables, as shown in Table 1.

Table 1: Children's Measurement items

Feature Parameter	Measurements
Length	Height, back length, crotch length, waist and knee length, lower body length, waist height, arm length
Width	Shoulder width, back width, front chest width
Girth	Chest circumference, waist circumference, hip circumference, thigh circumference, calf circumference, neck circumference, upper arm circumference, ankle circumference
Derived Variable	Chest-to-back ratio, chest-to-waist ratio, waist-to-hip ratio, waist-to-body ratio, waist to knee height ratio, leg to circumference ratio