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Retraction

Retracted: Application of Convolutional Neural Network Algorithm under Deep Learning in Digital Clothing Design

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] X. Xue and X. Xue, "Application of Convolutional Neural Network Algorithm under Deep Learning in Digital Clothing Design," *Security and Communication Networks*, vol. 2022, Article ID 4880555, 12 pages, 2022.

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Research Article

Application of Convolutional Neural Network Algorithm under Deep Learning in Digital Clothing Design

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In order to overcome the influence of background, lighting, deformation, and other factors, using a constitutional neural network structure combined with metric learning, specifically, it includes two model structures, Siamese, and Triplet. The use of bicubic NURBS surfaces is proposed, the idea of constructing mannequins and garment pieces, the experimental results show that NURBS surface control is flexible and simple, and the calculation is stable, and it is the best surface for constructing virtual samples and avatars. Based on studying the three-dimensional structure design of clothing, based on the 10 key curves of the human body, the curve and surface interpolation algorithm is applied, by calling OpenGL related functions, the establishment of the benchmark human body model is well realized, and it lays a foundation for the deformation of the human body model based on parameters in the future.

1. Introduction

As competition in the global market intensifies, businesses are under increasing pressure. It has become an important issue for the survival and development of enterprises that it is necessary in the shortest possible time, with the lowest possible cost, to produce the highest possible quality product. The virtual product development technology is produced in such an era background [1]. It uses computers to complete product development, Based on life cycle modeling of products combined with computer graphics, artificial intelligence, concurrent engineering, network technology, multimedia technology and virtual reality, and other technologies that are integrated, in virtual conditions, conceive, design, manufacture, test, and evaluate products. One of its salient features is the use of digital models stored inside the computer—virtual products are used instead of physical models for simulation and analysis, thereby improving the decision-making level of products in multiple objectives such as time, quality, cost, service, and environment, and it forms a good rapid response mechanism with the market to improve the profitability of the product, to achieve the purpose of global optimization and one-time development success. The emergence of virtual product development technology, had a huge impact on the manufacturing industry. A more successful example is the application in the manufacture of Boeing 777 and European Airbus, its development cycle, from the original required 8 years and 4 years, respectively, down to 5 and 2.5 years today. Therefore, virtual product development technology is more and more widely valued by enterprises, and it has become a research hotspot in the current manufacturing industry. China's garment industry is a traditional industry with a low degree of modernization; most clothing design is still based on handmade design, compared with advanced garment companies in other countries, and there is a large gap in design capability and brand effect. With the reform and opening and the development of computer technology, clothing enterprises have also introduced advanced technology and high-tech products one after another, especially the application of garment CAD system in the garment industry, the design and production of garment enterprises have brought great economic and social benefits [2]. However, fashion designers have always hoped that the display of three-dimensional effects can be realized on the computer, as shown in Figure 1. At present, whether manual design or computer design, none of them have solved the key technology of 2D template to 3D effect display. Apparel design, including style design, sample design, and the dressing effect can only be observed after the actual sample clothes are actually sewn, and there is a certain blindness and lag. If the expected effect is not achieved, it can only be modified and sewed many times, which is time-consuming, laborious, and expensive. Therefore, if "virtual sample clothing generation" can be realized, that is, "conversion and display of 2D template to 3D effect," it can not only solve the above problems well but also enable enterprises to adapt to the development trend of the modern clothing market, that is, multiproducts, small batches, fashion, and personalization, providing technical support for rapid response. At present, the two-dimensional garment CAD technology is relatively mature. Based on 2D, CAD technology has been applied to clothing design and production, which greatly shorten the development cycle of clothing products to a certain extent, and the contradiction between the long prediction cycle of clothing popularity and the short consumption cycle has been alleviated. But for the effect of the design, especially whether the model design (structural design) fits well, in the existing clothing CAD system, and whether it is a clothing style design system or a structural design system, none of them have addressed or solved this problem [3]. The display of the clothing effect of the clothing design belongs to the category of 3D clothing CAD technology. The 3D digitization technology of clothing is a hotspot of concern and research in the academic and business circles at home and abroad in recent years. In the 2002 National 863 Plan, in the field of advanced manufacturing and automation technology, a special topic of digital design and manufacturing has been opened, and it is required to focus on the development and industrialization of 3D digital design system, to carry out innovative research on several key technologies in digital design system and manufacturing. In addition to virtual clothing style design and virtual clothing structure design, virtual clothing design also includes virtual garment craft design. Optimal arrangement of garment production lines is an important content of virtual garment craft design. The important task of the clothing production line arrangement is to coordinate the human, material, financial, and energy aspects of the clothing sewing line. At present, all kinds of garment enterprises do not have a unified design model for the arrangement of production lines, usually only relying on the experience and feeling of the process planner, making manual estimates and piecing together, lack of knowledge, regularity, and randomness is relatively large, not only is the workload huge and time-consuming, and because there is no prior forecast, it increases the production cycle and production cost of the product, it restricts the improvement of economic benefits, which is incompatible with the constantly developing modern garment manufacturing industry. If the clothing production line can be optimized and arranged, it not only frees process planners from heavy and repetitive manual labor but also shortens the design cycle, guarantees the quality of design, improves the standardization of process design of garment enterprises, improves the production efficiency, technical level, management level, and economic benefits of the garment industry [4].

2. Literature Review

Digital clothing technology is the product of a combination of digital technology and traditional clothing design and production, and the use of digital technology, the design, production, marketing, delivery, and other links of clothing enterprises have been transformed and improved [5]. Puzyrev et al. found that 3D anthropometry is the basis of human and clothing modeling, 3D anthropometric techniques fall into two categories: One is the laser-based scanning technology (laser-based), and the other is the moire-based projection technology (moire-based) [6]. Based on the technical principle of laser, the three-dimensional image is obtained by using the laser scanning triangulation method. Ripple-based technology uses a white light source to project sinusoidal fringes onto the surface of an object, through the target object, and the phase transition of the projected light occurs to describe the surface contour of the object. The representative product of the former is the American Cyber-ware system, and the latter is the PMP system of the American TC2 company. How to extract the feature size required for clothing design from 3D scanning data is an area to be improved [7], Anton et al. developed a software to extract dimensions from digitized images, and it has been applied in the US military [8]. Shan et al. used feature-based technology to extract the feature size required for clothing from 3D human model data. A 3D human body modeling and clothing has always been a hot and difficult point in the field of computer graphics and CAD clothing [9]. For a long time, research in this field mainly formed the following modeling methods: use points, lines, and curves to build a 3D wireframe model, and use voxels to build a 3D solid model; use points, edges, and surfaces to build a 3D surface model, using the mesh facet method; and the 3D surface model is built on the basis of 3D physical modeling. Albelwi et al. found that there are additional neural networks for the exploration of freeform surface reconstruction. These methods have their own advantages in terms of operation speed, model controllability, and model smoothness, for example: The wireframe model has a fast calculation speed, but the model has a poor sense of reality, prone to ambiguity. The solid model is better in modeling efficiency and realism; however, the fitting of the human body surface shape is not ideal, and the topological relationship between voxels is complex: The mesh facet method is simple and effective, and with the increase of the number of facets, the simulation effect of the surface is better [10]. Ni et al. found that due to the large number of data points, the operation speed will be slowed down, and it is difficult to locate and control a single data point. The surface method uses parametric surface equations to build models. The data control points are few, the operation speed is fast, and the surface can be continuous in any order, and the information

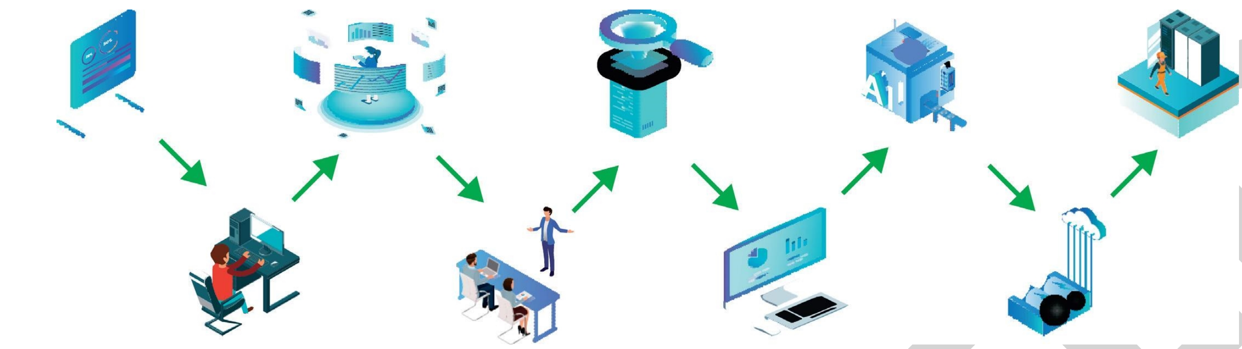

Figure 1: Flowchart of digital clothing design.

of the points on the surface is easy to obtain. In physically based 3D modeling methods, the physical information of the human body and the external environmental factors (such as gravity) where the human body is located are introduced into traditional geometric modeling methods; therefore, a more realistic modeling effect can be obtained; however, compared with traditional geometric modeling methods, it is much more complicated in operation. Neural network surface reconstruction has the advantages of high fitting accuracy to the measurement data, fewer surface patches, and editing and modification of local surfaces, but the problem is how to choose network parameters reasonably, solving the contradiction between network training speed and approximation accuracy, and solving problems such as continuous splicing which deserves further study. Therefore, in computer 3D clothing design including 2D and 3D mutual conversion, there is a need to do a study of fabric texture mapping, analysis of optical and mechanical properties, and 3D interactive design [11]. Bangari et al. found that many institutions at home and abroad are currently engaged in the research and development of 3D CAD apparel. From the perspective of 3D garment CAD system and application, PAD system has a certain conversion function from 2D to 3D, but its generated 3D clothing lacks realism: Lectra's high-end CDI-U4Ia already contains three-dimensional technology, and partially realizes the function of transforming 3D designs into 2D pieces, allowing designers to cut designs; however, its technology is not yet perfect, first of all, it has extremely high requirements on hardware configuration, and requires a workstation configuration, and ordinary PCs cannot be used at all. Second, its simulation effect needs to be further improved [12]. In addition, Fashion Studio System of Dynamic Graphics of Canada can produce more realistic three-dimensional clothing than the Maya Clothing module of Alias/Front Company in the United States; it also has powerful modeling functions of flexible bodies such as clothing and fabrics, but these systems are geared toward clothing animation, not clothing production of 3D clothing systems, and there is a certain distance from practical application. In the 3D clothing generation technology, an important link is the generation and stitching of garment pieces. In this process, 2D clothing cutouts are sewn onto a 3D mannequin, and form the initial shape of the three-dimensional clothing. Luo et al. adopted the elastic deformation model in which the clothing surface is discretized into a particle system and by solving the differential equation of the space motion of the particle system, we get the evolution of the system from a time series. Its research focuses on the dynamic simulation of fabrics, introduces external constraints, and controls the stitching of 2D garment pieces to 3D garments [13]. Using the energy approach, Patel et al. map the two-dimensional clothing piece to the three-dimensional mannequin, forming a joined rigid surface, and the mechanics of the fabric are characterized as energy equations. The method is constrained by the human model, and the large deformation prediction is carried out with the minimum energy at each point in space, gets the shape of the 3D garment in equilibrium, and it is suitable for expressing the static effect of 3D clothing [14]. Jagtap et al. studied virtual humanoid clothing, both of which adopted the classical proton-spring model. The description of the mechanical properties of the fabric is simple and clear; however, the fabric is required to be meshed on four sides according to the warp and weft directions, which bring certain difficulties to the sewing of complex garments [15]. Lin et al. proposed a two-dimensional and three-dimensional mapping algorithm based on the spring mass deformation model and considered the problem of interference checking [16].

3. Methods

Clothing virtual design facilitates the fashion designers to put the ideas in their minds, and it can be realized accurately and quickly in the computer through virtual technology, and the three-dimensional effect can be seen without the need to make samples. Therefore, it can not only shorten the production cycle and saves production costs but also enables products to enter the market as soon as possible, better highlights the fashion features of clothing, considers the protection of design patents, reduces business risk. Clothing design consists of three parts: clothing style design, clothing structure design, and clothing technology design; therefore, the virtual clothing design should include these three contents. With the proliferation of digital images under the rapid development of Internet information technology, image retrieval method based on text description and traditional method of extracting resources based on content have gradually been unable to meet people's needs; therefore, many scholars have turned their attention to deep learning, which has unique advantages in the field of images; using the deep learning convolutional neural network method, the image is introduced into the neural to conduct research related to image classification and retrieval [17].

Deep learning is one of the most popular branches of machine learning, covering many fields such as neural networks, graph modeling, pattern recognition, optimization theory, and signal processing. With a focus on business and education, the model of deep learning is a neural network device based on the study of the structure of the axonal communication network formed by the millions of neurons in the human brain and transforms the data in a similar way—simulation. Brain data is collected by simulating this structure, and the first layer is propagated to the next layer. Each layer works differently. Deep learning models differ from shallow models such as support vector systems and Markov hidden models, as well as deep neural network models for automatic learning. Undertaking Developer Neural Networks solves the problems that can change the neural networks mapping. Neural network refers to the potential of neural network to change. On the given sample set {x, y} according to the neuron principle of deep learning, the mapping transformation structure of a single neuron to the input and output is shown in Figure 2:

A single neuron model is also called a logistic regression model:

(1) Input and output:

In the neuron model of Figure 2, the input is x and the output is the following:

$$f(x) = f\left(\sum_{i=1}^{5} w_i x_i + b\right). \tag{1}$$

(2) Activation function

In Figure 2, (f)(x) is the activation function, which generally chooses the Sigmoid function, the hyperbolic tangent Tanh function, and the expressions of Sigmoid functions such as ReLU function, Softmax function, and Tanh function that are shown in formulas (2) and (3), and the image is shown in Figure 3:

$$f_1(z) = \frac{1}{1+e^{-z}}, \tag{2}$$

$$f_2(z) = \tanh(z) = \frac{e^{z}-e^{-z}}{e^{z}-e^{-z}}. \tag{3}$$

As can be seen from the image, the relationship between the Tanh function and the Sigmoid function is shown in the following formula:

$$\tanh(x) = 2\ \sin\mathrm{moid}(2x) - 1. \tag{4}$$

The derivative of the sigmoid function directly uses its own output value, which is convenient for derivation; however, because it outputs the result to [0, 1], and both ends tend to be saturated, resulting in the saturation of the

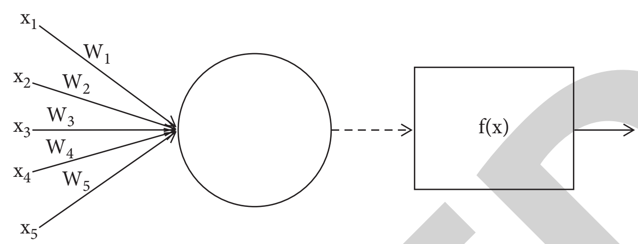

Figure 2: Structure of a single neuron model.

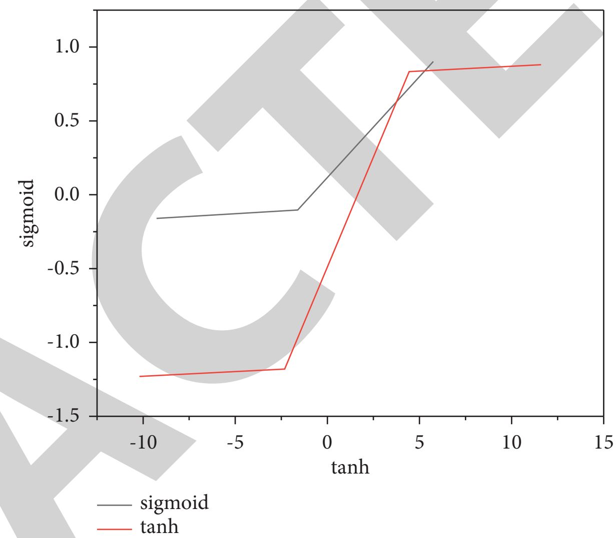

Figure 3: Image of Sigmoid function and Tanh function.

gradient, which is prone to the problem of gradient disappearance. Tanh function has faster convergence speed, and the output is centered at the origin, but there is still the problem of gradient disappearance, and the ReLU function effectively solves the problem of gradient disappearance. Currently, ReLU is generally selected as the activation function. Extend the single neuron model, backpropagation with chain derivation and gradient descent, and it constitutes a general artificial neural network. CNN convolution neural networks are special, deep feedforward artificial neural networks with translations, scaling, and tilt invariance, and a neural network formed by nonperfect connections between multiple networks. The overall structure of the convolutional neural network is shown in Figure 4:

In the overall structure of the convolutional neural network, it is mainly composed of a input layer, an output layer, and a hidden layer; the hidden layer only uses the convolution kernel, as the base convolution operation in the form of filters and accepts the full connection later. Convolution layer is used to reduce the loss of data feature, so it is called convolutional neural network. Convolution type neural networks have excellent results in image fields because of convolution of the design structure, weight sharing, and pooling operation to pile convolution and pooling layers, and convolutional neural networks have characteristics of image features and translation invariance. Image transfer between layers to extract functions can save enough image attributes. The core of the convolution type neural network is extracting the characteristics of the

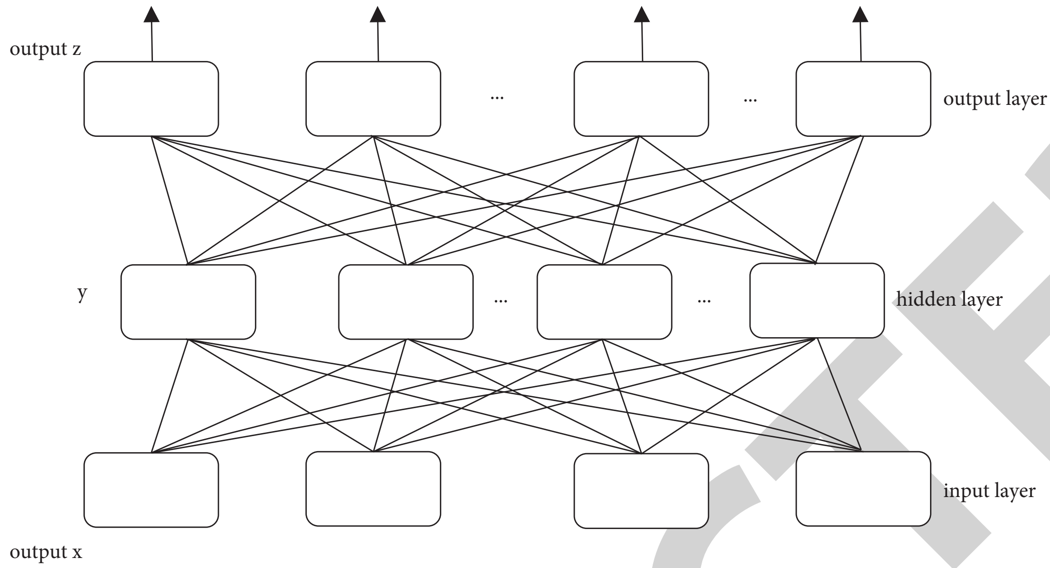

Figure 4: Overall architecture of convolutional neural network.

convolution level and pooling level, and the convolution level interacts with the input data to extract the characteristic through the convolution kernel, and the pooling level weakens location information and high-frequency important information is removed. Generates more abstract features and extracts layers and combines layers from full description layer, weight sharing, and pooling features to reduce the number of parameters. Convolution neural network with excellent feature extraction performance is required to increase the learning speed. Convolution neural networks are generally composed of data input layers and convolutional layers. ReLU has excitation layer, pooling layer, fully connected layer, and output layer [18]. Convolutional neural networks are mainly composed of some convolutional layers with a certain number of channels stacked, and the convolution operation of incoming data is checked by convolution to perform feature extraction and feature mapping and weighted summation of the incoming activation layers with multiple feature maps, to get the feature map for nonlinear feature extraction. The formula of the convolution operation is shown in equation (5):

$$s(i, j) = (X * W)(i, j) = \sum_m \sum_n X(m, n) W(i - m, j - n). \quad (5)$$

Convolutional neural networks generally use SAME convolution operations and VALD convolution operations for image data of input size N ∗ N; the convolution kernel is F ∗ F, if the step size is S, and the output size of the SAME convolution operation, and the VALD convolution operation is shown in formulas (6) and (7):

$$\text{Height} = \text{Weitht} = \frac{N}{S}, \quad (6)$$

$$\text{Height} = \text{Weight} = \frac{N - F + 1}{S}. \quad (7)$$

The VALD convolution operation of the convolutional layer is shown in Figure 5:

The excitation function of CNN generally adopts rectification linear unit (Relu), and Relu is easy to compute, have fast convergence velocities, easy to find gradients related to Sigmoid function and Tanh, and the problem of gradient disappearance is effectively relaxed and may form deeper networks [19]. The relay is used to correct the linear unit as an excitation function to perform B4 nonlinear mapping on the convolution layer output results. As shown in formula (8)

$$f(x) = \max(0, x). \quad (8)$$

Figure 6 shows the image of the Relu activation function:

In general, for convolutional layers with small receptive fields and strides, the feature maps obtained after convolution are larger. This time places a pooling layer in successive convolutional layers, and on the premise of ensuring that the depth features remain unchanged, sampling is performed. This method is used to reduce the dimensionality of map features. The characteristics data generated by the convolution level are sampled for dimensional reduction and compression of regional characteristics. Figure 7 shows the pooling operation of the pool layer.

Typically, after the last grouping layer, a plurality of fully connected layers is connected as hidden layers [20].

The key to learning lies in setting up the training process, and the weights between the layers of the neural network; the mapping relationship is updated by updating the weights. It is used in the forward propagation process to calculate the partial derivative of the loss function for each weight in the gradient derivative, and the gradient is updated according to the gradient descent equation to optimize the net to optimize the back propagation. In forward propagation, if the weight of each layer of the net is w for the sample passed to the neural net, the mapping function is f, and after passing through each layer, the output result is the matrix multiplication of the sum weight, reaching the output layer. The output equation is shown in formula (9):

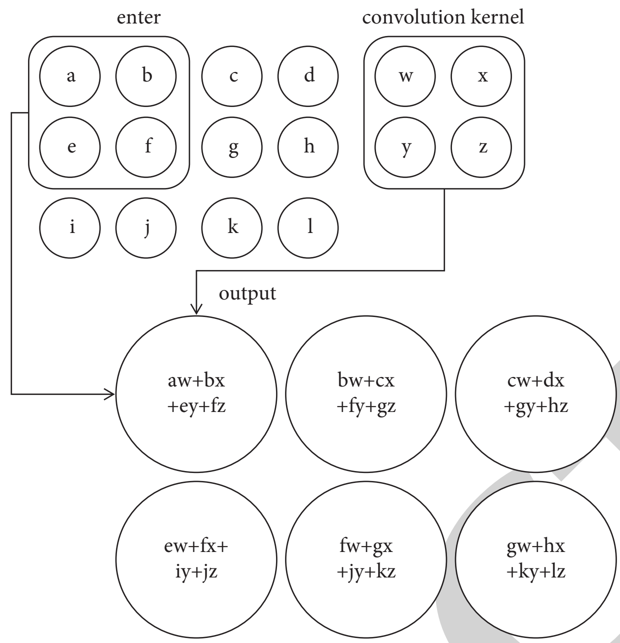

Figure 5: VALD convolution operation.

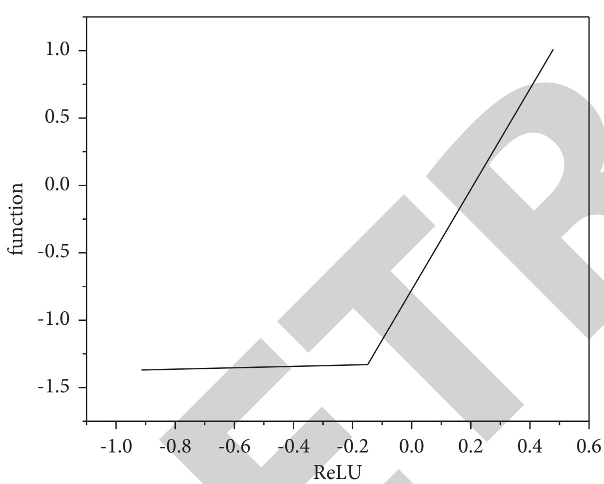

Figure 6: Relu activation function image.

$$o_p = F_n\left(\cdots\left(F_2\left(F_1\left(X_p W^{(1)}\right)W^{(2)}\right)\cdots\right)W^{(n)}\right). \tag{9}$$

Backpropagation refers to the rate of output from the neural network, which is propagated by the error of the actual output rate, adjusting the weight coefficient obtained in the forward propagation process, and reducing operating costs. Sample backpropagation error formula is as follows:

$$E^n = \frac{1}{2}\sum_{k-1}^{c}\left(t_k^n - y_k^n\right)^2 = \frac{1}{2}\left\|t^n - y^n\right\|_2^2, \tag{10}$$

where C is the total number of categories in the sample set. t_k^n K-th classification cup in the sample data, y_k^n. The k-th output data corresponding to the k-th sample value.

The update process of the weights by the backpropagation algorithm is as follows:

For a given sample set $D = \{(x, t)\}$, initialize network structure $d \times n_H \times c$.

Repeat the loop multiple times until the expected average misunion is achieved for the sample set. Calculating the error :

$$J = J_x(\omega) = \frac{1}{2}\sum_{K-1}^{C}\left(t_k - z_k\right)^2. \tag{11}$$

GoogleNet is the 2014 ILSVRC classification challenge and is the CNN model that won the championship with a Top5 error rate of 6.67%. It has a faster convergence speed than VGGNet, effectively shortening the training time, and there are 22 layers of network, including 21 convolutional layers and 1 fully connected layer. Local densification of sparse matrix operations in the form of multiscale convolution, after the features are processed in parallel, and feature concatenation is performed [21]. The 1×1 convolution kernel is used for dimensionality reduction, which effectively improves the computational efficiency. The model component of the Inception Module and the different scales of perceptual fields are obtained through different convolution kernels, then, data splicing improves the feature expression ability of the network, approximate to a CNN with a dense structure. The Inception Module structure is shown in Figure 8:

For the performance evaluation criteria of image classification and retrieval, the standard for evaluating the quality of classification performance generally considers the classification accuracy, the evaluation of retrieval performance mainly includes retrieval accuracy, sorting effect, and retrieval speed. The accuracy rate reflects the performance of the feature extraction algorithm and the similarity matching algorithm, and the sorting effect and retrieval speed reflect the image feature indexing effect and the complexity of the similarity matching algorithm.

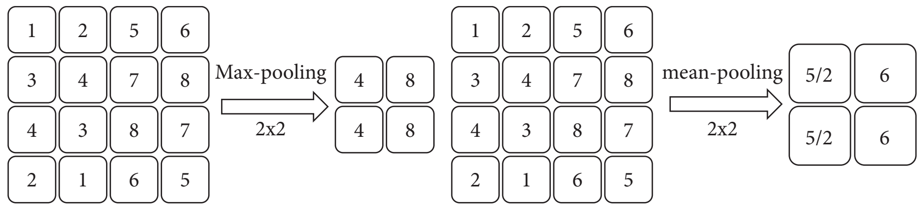

Figure 7: Max pooling (left) and mean pooling (right) process.

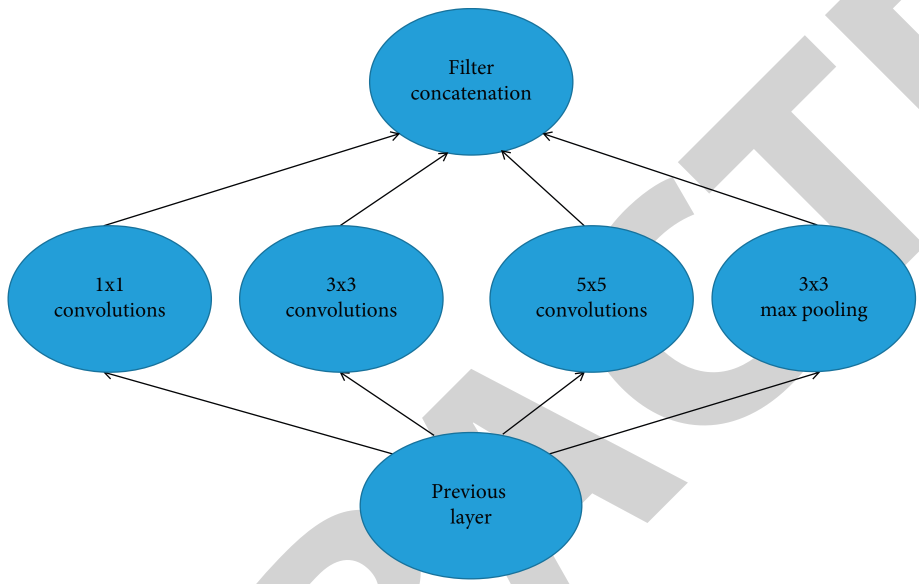

Figure 8: Inception Module structure.

For classification and retrieval accuracy, generally, precision, recall, and precision are used to evaluate. Precision is a measure of retrieval accuracy, which is defined as follows: during a retrieval process, the system that returns the search results. The total number of images is returned as the percentage of the correct images. Recall is used to represent the ratio of the number of correct images to the number of correct images in the image library to get the information defined as a search result. The precision points to the percentage of the total number of returned correctly. General consideration parameters are shown in Table 1:

The formulas for precision, recall and precision are as follows:

$$\begin{aligned}\text{Precision} &= \frac{\text{Number of correct images in retrieved images}}{\text{The number of correct results in the system}} = \frac{\text{TP}}{\text{TP}+\text{FP}},\\ \text{Recall} &= \frac{\text{The number of correct results retrieved}}{\text{The number of all correct results in the library}} = \frac{\text{TP}}{\text{TP}+\text{FN}},\\ \text{Accuracy} &= \frac{\text{Number of correct images in retrieved images}}{\text{Number of all retrieved results}} = \frac{\text{TP}+\text{TN}}{\text{TP}+\text{TN}+\text{FP}+\text{FN}}.\end{aligned} \tag{12}$$

Usually, the ranking evaluation method and the matching percentage are used as a measure of the sorting performance of retrieval results.

The recall rate and precision rate do not consider the position of the returned relevant image in the retrieved image, and it is impossible to judge the quality of the search result sequence. The average sequence number of the retrieved related images can be used to solve this problem, for TP, FP, FN, TN in Table 1, o is the sequence number of the retrieved related pictures in the retrieved pictures, let K represent the average ranking number of the relevant images returned by the system when retrieving:

$$K_1 = \frac{1}{\text{TP}} \sum_{r=1}^{\text{TP}} O_r. \tag{13}$$

Table 1: Performance evaluation criteria.

	Relevant	NonRelevant
Retrieved	TP	FP
Not retrieved	FN	TN

For the best algorithm implementation, the more relevant the image in the retrieval result is, the higher the sequence number is, that is, the ideal average sequence number is the following:

$$K_2 = \frac{TP}{2}. \quad (14)$$

The retrieval performance of a single relevant image was evaluated using the matching percentage, and for ideal retrieval algorithm results, the target image should be ranked first; however, it is difficult to achieve this retrieval effect in the actual situation to evaluate the performance of the system retrieval for a single image, which is defined as follows:

$$M = \frac{N - S}{N - 1} \times 100\%, \quad (15)$$

where N is the number of results returned by the system during retrieval, S is the order of the target image in the returned retrieval results, and usually, the average value of multiple experiments is used to indicate the quality of retrieval effect.

The model needs to perform feature extraction, similarity measurement, and sorting of clothing images during retrieval, using different feature extraction algorithms and similarity matching algorithms, searches that return the same number of search results will result in different search times; therefore, the retrieval speed is defined as the ratio of the number of retrieved results to the retrieval time. For the data in Table 1, in the retrieval process of a batch, if the retrieval time is T, the retrieval speed is defined as follows:

$$\text{retrieval speed} = \frac{\text{Number of results to retrieve output}}{\text{Search time}}, \quad (16)$$
$$= \frac{TP + FP}{T}.$$

4. Results and Discussion

The results of the process analysis can be represented by a process flow diagram. In the industrialized production of garments, the basic data of the assembly line production arrangement are the process flow chart. The process flow chart is based on the before-and-after relationship of garment processing, and the processing sequence and time are expressed graphically [22]. The process flow chart should include the name of the processing process, the processing time (pure processing time or standard processing time), and the type and model of the equipment used (as shown in Figure 9). Usually, various fixed graphic symbols are used to distinguish the operation nature of each process (Figure 10).

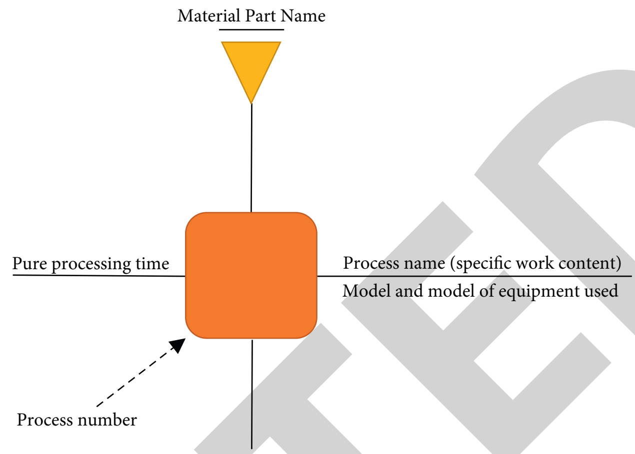

Figure 9: Process flow chart expression.

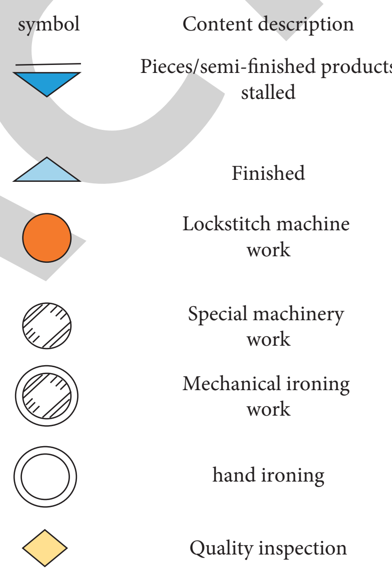

Figure 10: Graphical symbols of each process.

According to actual needs, enterprises can also formulate certain symbols by themselves.

The general flow of the neural network algorithm is shown in Figure 11:

Step 1. Randomly generate the initial population, the number of individuals is certain, and everyone is represented as the gene code of the chromosome.

Step 2. If it matches, you will meet the optimal criteria, calculate individual fitness, and the judge will output the best individual and its representative optimal solution and exit the calculation, otherwise to the third step.

Step 3. Choosing individuals updated according to fitness, high fitness individuals can have selected high probability and eliminate low fitness individuals.

Step 4. Create new individuals according to certain crossover probability and crossover methods.

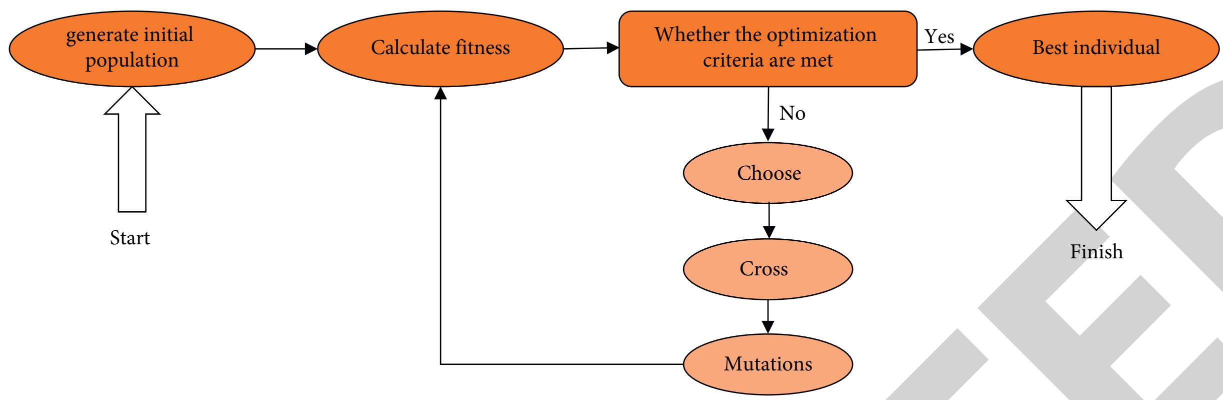

Figure 11: Flowchart of the convolutional neural network algorithm.

Step 5. Generating new individuals according to certain mutation probabilities and mutation methods.

Step 6. Generate a new generation of population by crossover and mutation, and return to Step 2.

In the process of recombination, the randomly generated chromosomes are rearranged, making it conform to the sequence of processing procedures, and in order to facilitate the calculation of the fitness function, generate an array of job numbers and machines. Among them, the array job number records the branch number of each process and its relative position in the branch, the array jiqi records the processing equipment number and tool number of each process. The main flowchart of the reorganization operation is shown in Figure 12:

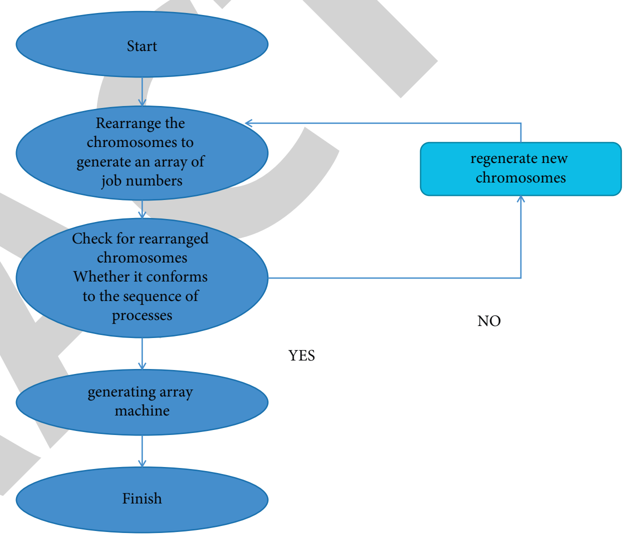

Figure 12: Main flow chart of reorganization operation.

When running the quadratic selection convolutional neural network algorithm program, some parameters need to be selected in advance; they include population size, crossover rate, normal mutation rate, inbreeding mutation rate, evolutionary generation, etc. These parameters have an important impact on the performance of the quadratic selection convolutional neural network algorithm. For specific problems, whether the measurement parameters are set appropriately or not, it should be judged based on the convergence of multiple runs and the quality of the solution [23]. If it is difficult to adjust the parameters to effectively improve the performance of the convolutional neural network algorithm, and it is often necessary to improve the convolutional neural network algorithm again. Taking the process flow diagram of Figure 13 as an example below, the optimized process arrangement scheme is given, and the parameters set are shown in Table 2:

Figure 14 shows individual fitness (maximum and average) evolution curves over generations.

From Figure 13, it can be seen intuitively that from the optimized process arrangement plan, the processing time of the whole process as 405 s is obtained, and the waiting time of the equipment during the processing is 0s. In Figure 14, the abscissa represents the number of iterations, the ordinate represents the fitness value, and the upper curve represents the best fitness in each generation of the population, and the curve below represents the average fitness of the population across generations. It can be seen that the algorithm produces a local convergence phenomenon before the 10th generation, but after several generations of evolution, it jumped out of this local convergence zone, and the superior performance of the quadratic selection convolutional neural network algorithm was confirmed [24].

The algorithm adopts the quadratic selection strategy and the expanding population sorting method, and the fitness curve of the past generations of the quadratic selection convolutional neural network algorithm is shown in Figure 15, and the parameter settings of the algorithm are shown in Table 3. In this algorithm, when the population size is 200, the number of selected crossover individuals is only 100, and the number of mutant individuals is only 50, the remaining 50 individuals are directly added to the matching set. Therefore, when the crossover rate is 1, the number of crossover parent individuals is only 100, and the corresponding crossover rate of the standard convolutional neural network algorithm is $100/200 = 0.5$. When the mutation rate is 0.5, the number of mutated parental individuals is only about $50 \times 0.5 = 25$, and the corresponding standard convolutional neural network algorithm has a mutation rate of $25/200 = 0.125$.

As can be seen from Figure 15, after running for 100 generations, the fitness of the best individual is 18, and the

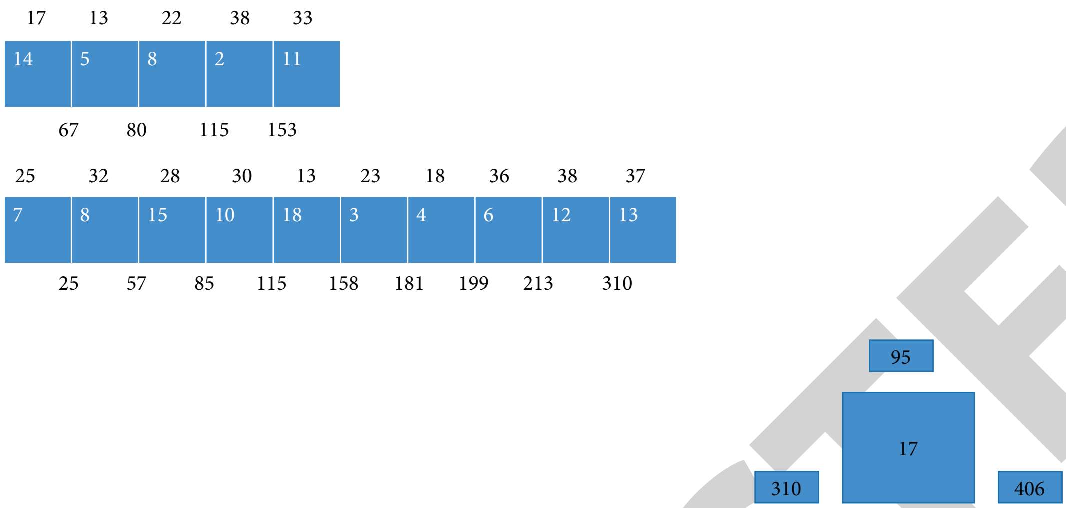

FIGURE 13: Shows the optimization scheme of the process choreography represented by the Gantt chart.

TABLE 2: Parameters of the quadratic selection convolutional neural network algorithm.

Population size (popsize)	100
Evolutionary algebra (generation)	50
Crossover rate (pc)	1
Normal variation rate (Pm)	0.5
Consanguineous variation rate (pmr)	1

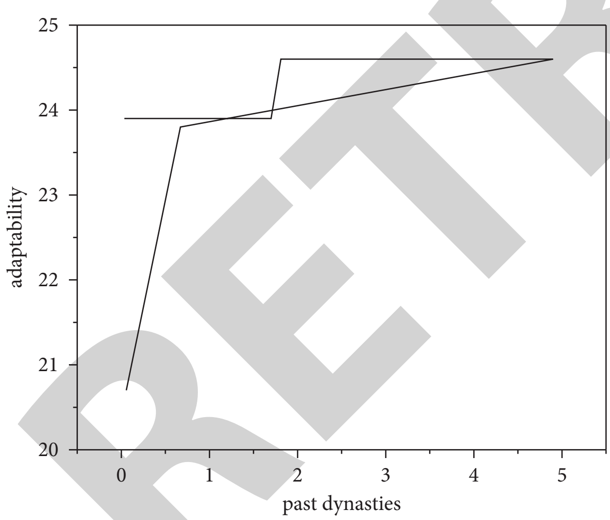

FIGURE 14: Fitness curve of past generations.

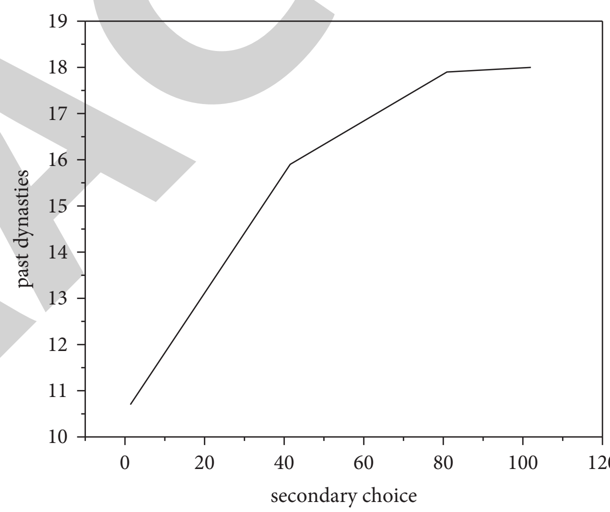

FIGURE 15: The fitness curve of successive generations of the quadratic selection convolutional neural network algorithm.

TABLE 3: Quadratic selection convolutional neural network algorithm parameters.

Population size (popsize)	200
Evolutionary algebra	100
Crossover rate	1
Normal variation rate (Pm)	0.5
Consanguineous variation rate (pmr)	1

average fitness is also 18, compared with the previous algorithm, the fitness and average fitness of the best individual obtained by this algorithm are the highest. The convergence of the algorithm is good, and after running the algorithm several times, the result converges to the global optimal solution. In addition, when local convergence occurs, although the individuals in the population are very close; however, since the algorithm adopts the mutation operation on close relatives, the new individuals produced by crossover have obvious changes, which are quite beneficial to the evolution of the population. And even if there is a local convergence phenomenon, the algorithm can also perform mutation operations, and the diversity of the population is maintained, so that the algorithm can jump out of the local convergence zone. From the above comparison, the quadratic selection convolutional neural network algorithm has better stability and convergence, and obtained satisfactory optimization performance [25].

5. Conclusion

Introducing relevant theories of deep learning, it focuses on the relevant principles and commonly used model components of convolution neural networks used by authors, including convolutional layers, pooling layers and activation functions, and the gradient calculation method of each component in the convolutional neural network. Expounds the concept, method, and content of virtual design and manufacturing, on this basis, and the main contents and models of virtual clothing design are analyzed and studied, a key issue in 3D garment CAD is researched emphatically, that is, the conversion of a 2D model to a 3D effect display. Based on the theory of computer graphics and clothing structure design, a method of converting 2D to 3D display based on the idea of decision is proposed, and an implementation plan is given. According to the characteristics of human body and clothing, the methods and characteristics of various curved surfaces are analyzed and compared, and the idea of using the bicubic NURBS surface to construct the human body model and the clothing piece is proposed. The experimental results show that the NURBS surface control is flexible and simple, the calculation is stable, and it is the best surface for constructing virtual samples and avatars. Based on studying the three-dimensional structure design of clothing, based on the 10 key curves of the human body, the curve and surface interpolation algorithm is applied, and OpenGL related functions are called, the establishment of the benchmark human body model is well realized, and the foundation for the deformation of the parameter-based human body model in the future is laid. Human body model building method, compared with the human body model construction method in the relevant literature, has the characteristics of good surface fitting effect, fast calculation speed, and strong model realism. Combined with clothing structure design technology, with the help of cutting knowledge, a method from 2D template to 3D dress effect display is proposed: Constructing "virtual capsids" to generate middleware, and through the correspondence between the positioning lines on the two-dimensional template and the corresponding positions of the shell, the mapping of the clothing piece to the avatar and the stitching of the virtual clothing piece are realized.

Data Availability

The labeled dataset used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no competing interests.

Authors' Contributions

Xiangyi Xue contributed to the writing of the manuscript and data analysis. Xiangying Xue supervised the work and designed the study. All the authors have read and agreed the final version to be published. Xiangying Xue provided great help in the revision of the final draft and agreed to be included in the author list of the article. All unanimously agreed to the above arrangement. All the authors have read and agreed the final version to be published.

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