Hindawi
Advances in Multimedia
Volume 2022, Article ID 7387218, 13 pages
https://doi.org/10.1155/2022/7387218

Research Article

The Application of Practical Clothing Design Method in the Teaching of Clothing Specialty

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Received 26 May 2022; Revised 24 June 2022; Accepted 8 July 2022; Published 4 August 2022

Academic Editor: Qiangyi Li

To improve the teaching practice effect of clothing major, this study applies the practical clothing design method to the teaching of clothing major to analyze the digital clothing design and establishes a convex quadratic conic programming model for a class of force optimization problems. Then, this study transforms the optimality condition of the problem into a new projection equation system, constructs a suitable constant coefficient matrix according to the characteristics of the equation system, and obtains an equivalent linear equation system. In addition, this study proposes a full Newton step projection algorithm to directly solve the convex quadratic conic programming. Through the results of the experimental research, it can be seen that the practical clothing design method has a good application in the teaching of clothing majors, and it can be applied in the practice of clothing teaching.

1. Introduction

To optimize the teaching of computer experiments in clothing design, teachers and students must first attach great importance to computer experiments. In the teaching process, teachers should urge students to fully understand the importance of computer graphics, let students understand the role of computer experiments in the entire professional learning, and understand the specific functions of software involved in computer experiments. The computer experiment of clothing design should cultivate three kinds of abilities of students: one is the ability to master various operation commands, the other is the ability to draw graphics, and the third is the ability to initially master the ability to analyze and process advanced graphics [1]. Among these three abilities, the operation ability is based on the basic status, and the graphic drawing ability is further developed. The graphics post-processing capability is an organic combination of the first two capabilities. These three capabilities are in a progressive relationship, and each capability must be solidly cultivated to lay a solid foundation for subsequent capabilities [2]. When setting topics, teachers should pay attention to comprehensive exercises, that is, to design a design topic that integrates various operation steps for students, so that students can understand necessary program commands by checking and filling omissions [3]. In the computer experiment, teachers should use a large number of cases to make students understand that with the help of the powerful logical operation function of the computer, the patterns and fabrics of clothing paintings and clothing design renderings can be changed in a diversified manner. At the same time, the computer can fill in flower patterns or colors in the closed area after the online drawing is completed in a few seconds, reducing the design burden of students and improving their design efficiency. Through such teaching, students can give due attention to computer experiments [4].

The process of theoretical or practical teaching should be interpenetrated [5]. In the study of "point," "line," "surface," and "body" of design element theory, students can be required to use the avatar to operate. Through the morphological analysis of the avatar, the concept of "body" is clearer. No longer stop at the two-dimensional level to develop design. Finally, not only through the human body model to complete the design works [6]. It also deepened the understanding of the physical differences between men and women and also grasped the design effects obtained by changing, decorating, exaggerating, and deforming key parts such as shoulders, chest, waist, hips, and bottom swing [7].

“Practicality” is the core part of practical clothing design method. The specific performance is that in the process of clothing design, theory should be combined with practice, and any creative thinking must be tested in practice. Traditional clothing design focuses on art and light skills. Design generally only stays on paper, and art and technology are separated, so that creative ideas cannot be effectively and accurately transformed into objects [8]. The biggest difference between the practical clothing design method and the traditional clothing design method is that the design is not limited to drawing, but fully integrates design, plate making, technology, and computer-aided design and works together in the molding process of the sample [9]. The systematic practical clothing design method is a system that integrates the four functional modules of design, board making, craftsmanship, and computer-aided design and its related knowledge with design as the source, emphasizing the integration of design and technology, and the equal emphasis on design and technology. Time-effective design is not limited to the conception stage. Design runs through the entire process of transforming design intentions into real objects. In this process, the design should use all simple, fast, and effective means to make the design intention highly match the finished product [10]. With the current progress and development of science and technology and the rapid development of information technology, computer-aided design plays an increasingly important role in clothing design such as virtual clothing design and simulation, 3D technology, clothing CAD, and other technologies, which can realize the expression and effect of clothing style drawings, digital clothing tailoring, 3D fitting technology, 2D to 3D sample clothing in clothing CAD, and dynamic virtual simulation of clothing dressing effects. The use of computer-aided design to provide convenience for clothing design can greatly shorten the product development cycle of enterprises, thereby improving the production efficiency of enterprises [11].

Clothing design includes three elements: style, color, and material. Clothing style is the interior and exterior styling of clothing. The style is related to the shape characteristics, activity function, and shape of the human body structure and is also restricted by the needs of the wearing object. The style design mainly includes three aspects: the outer contour structure design, the inner structure design, and the component design [12]. The outer contour is the silhouette of the outer shape of the clothing, which plays a decisive role in the change in clothing style. The most obvious feature of the evolution of clothing fashion is the change in the outer contour. The internal structure of the garment is the design of the internal structure shape and the edge shape of the parts other than the outline, such as the design of the dividing line, darts, and pleats, on the garment piece. The overall shape of clothing is composed of various parts, and the design of each part has a certain decorativeness. It is organically combined with the main body shape to form a coordinated and unified visual effect [13]. Clothing color is one of the main elements of clothing design. Different color matching will have different visual effects, which will lead to different associations and aesthetics. Color also has emotional characteristics, and different color schemes can express different moods such as gray calm, red warm, and orange warm. The design of clothing should be based on the occasion of wearing, customs, seasons, color matching rules, and other reasonable color and color matching. Clothing fabrics are the material basis in clothing design. Any clothing is processed through the selection, cutting, and production of fabrics to achieve the purpose of wearing and displaying [14]. The structure and characteristics of clothing styles, the color application and matching of clothing, and the wearing effect of clothing are all reflected by clothing fabrics. Now, there are many kinds of clothing materials and various structures. In the design of clothing modeling, it is necessary to adapt measures to materials and rationally use the characteristics of clothing materials and the appearance of fabrics to improve clothing quality and aesthetics [15]. Plate making clothing refers to the process of designing clothing structure through the analysis of clothing styles, combined with the characteristics of the wearing human body, using plane or three-dimensional modeling methods, and finally expressing the three-dimensional state in the form of plane. In the structural design of clothing, the position of the clothing structure line should be reasonably set, the amount of relaxation of each part of the clothing should be grasped, and the performance of the fabric should be correctly used to make clothing samples. The technical processing method of the clothing structure determines the appearance of the clothing, and the specifications of the clothing, the proportional relationship of each part, and the specific processing method used are closely related to the presentation effect of the clothing [16].

The knowledge structure of fashion design talents in vocational education should match the knowledge structure corresponding to the needs of enterprise fashion design talents, so as to adapt to the sustainable development needs of the society. Through literature research, it is known that there are many problems in the teaching of clothing major in current vocational education: the knowledge structure of clothing design talents at all levels is not clear; the methods and means of clothing design are backward; and the lack of practical ability and innovative spirit [17], the imperfection of the clothing design evaluation mechanism, and so on are still to be solved. This requires each school to accurately position itself according to their own school conditions. The teaching content of the clothing major should be closely integrated with the needs of the clothing industry and the market, organically integrate various disciplines, break the stereotype of clothing design, change the method of clothing design, and use advanced design methods and means, emphasizing the importance of practice and cultivating professional operation ability [18]. Literature [19] proposed that teaching should be closely integrated with industry and market needs and that curriculum reform should start from the school’s curriculum setting; graduates’ own employment; and the human needs of enterprises (markets). Literature [20] pointed out that “to improve the structural design of art design courses, we should base on general education, highlight the main courses of majors, close the connection of courses at all stages and levels, and take into account the organic integration of courses in various disciplines, so as to realize the integration of art design education sustainable development."

This study applies the practical clothing design method to the teaching of clothing majors to improve the practical effect of modern clothing design teaching.

2. Intelligent Projection Algorithm

2.1. Convex Quadratic Conic Programming. Convex quadratic conic programming is to minimize a convex quadratic function under the constraints of the intersection of non-self-dual cones and linear equations. This study discusses the following convex quadratic conic programming problem:

$$(CQP)\min\left\{\frac{1}{2}x^T Qx + c^T x\colon Ax = b, x \in C_\theta\right\}. \tag{1}$$

Its dual problem is as follows:

$$(CQD)\max\left\{b^T y - \frac{1}{2}x^T Qx\colon A^T y - Qx + s = c, s \in C_\theta^*\right\}. \tag{2}$$

Among them, $\theta \in (0, \pi/2)$ is the rotation angle of the cone, Q is a symmetric positive definite matrix, $A \in R^{m\times n}, c \in R^n, b \in R^m$ are a known parameter, and $x \in C_\theta, s \in C_\theta^*$ are an unknown variable. C_θ is the Cartesian product of several cones, namely,

$$C_\theta = C_\theta^1 \times C_\theta^2 \times \cdots \times C_\theta^N. \tag{3}$$

Among them, C_θ^* is the dual cone of C_θ. Likewise, if $N = 1$ is assumed, all the analyses in this section can be generalized to all cases without loss of generality. When Q is a zero matrix, the convex quadratic cone program is a linear cone program. Moreover, the convex quadratic circular cone programming is also a generalization of the convex quadratic second-order cone programming. These two transformation methods provide a good theoretical basis for our subsequent research.

If it is assumed that both the convex quadratic circular cone programming primal problem (CQP) and the dual problem (CQD) satisfy the strict feasible conditions, then according to the dual theory of circular cone programming, the problem can be equivalent to solving the following optimality conditions:

$$\begin{cases} Ax = b, x \in C_\theta, \\ A^T y - Qx + s = c, s \in C_\theta^*, \\ x^T s = 0. \end{cases} \tag{4}$$

Convex quadratic conic programming has a very wide range of applications, and some non-convex optimization, combinatorial optimization, and some NP-hard problems can be transformed into convex quadratic conic programming problems. Moreover, it can solve many practical engineering problems, especially it plays a crucial role in force optimization problems, such as robot grasping force optimization, real-time grip force control, and contact force optimization problems of multiple contact points. Based on the dynamic equations and friction constraints of the object, these problems can be transformed into convex quadratic conic programming models to solve. Next, a mathematical model of a class of force optimization problems is given.

2.2. Mathematical Model of Force Optimization Problem. In this section, a single-contact friction model of a force optimization problem is taken as an example, and it is assumed that there are M contact points on the object, and the position of the contact point is denoted as $p^i \in R^3, i = 1, 2, \ldots, M$. Among them, $f^i = (f_x^i, f_y^i, f_z^i) \in R^3$ represents the force exerted on the contact point p^i, f_z^i is the normal force, and $(f_x^i, f_y^i)^T$ is the tangential force. The point contact force must satisfy the following friction cone constraints:

$$\left\|\left(f_x^i, f_y^i\right)^T\right\| \le \mu_i f_z^i. \tag{5}$$

Among them, μ_i is the coefficient of friction at the contact point p^i.

Next, the force and moment balance conditions are given, and D^i is a 3×3 orthogonal matrix that can transform the contact force at point p^i from the local coordinate system to the global coordinate system. Therefore, the force balance condition is as follows:

$$D^1 f^1 + \cdots + D^M f^M + f^{ext} = 0. \tag{6}$$

Among them, $f^{ext} \in R^3$ is the sum of the external forces acting on the object. The moment of the force applied to the object through the contact point p^i is $p^i \otimes D^i f^i$. Then, the moment balance condition is expressed as follows:

$$S^1 D^1 f^1 + \cdots + S^M D^M f^M + l^{ext} = 0. \tag{7}$$

Among them, S^i is an antisymmetric matrix that satisfies $S^i x = p^i \otimes x, l^{ext} \in R^3$ is the external resultant moment acting on the object and has the following:

$$S^i = \begin{bmatrix} 0 & -p_z^i & p_y^i \\ p_z^i & 0 & -p_x^i \\ -p_y^i & p_x^i & 0 \end{bmatrix}. \tag{8}$$

$f = (f^1, f^2, \ldots, f^M)^T \in R^{3M}$, $A = [A_1, A_2, \ldots, A_M]^T \in R^{6\times 3M}$, where $A_i \in R^{6\times 3}$, and $A_i = [D^i, S^i D^i]^T, i = 1, 2, \ldots, M$. The external force screw is recorded as $\omega^{ext} = [f^{ext}, l^{ext}]^T \in R^6$, so the force and moment balance conditions are as follows:

$$Af = -\omega^{ext}. \tag{9}$$

Therefore, the single-contact friction model for the force optimization problem can be expressed as follows:

$$\min \frac{1}{2} f^T f,$$

$$s\begin{cases} Af = -\omega^{ext}, \\ \left\| \left(f_x^i, f_y^i\right)^T \right\| \le \mu_i f_z^i, i = 1, 2, \ldots, N. \end{cases} \quad (10)$$

In fact, the friction cone constraint can be expressed as a cone:

$$C_{\theta i} := = \left\{ f_i = \left[f_x^i, f_y^i, f_z^i\right]^T : \left\| \left(f_x^i, f_y^i\right)^T \right\| \le \tan \theta_i f_z^i \right\}. \quad (11)$$

The rotation angle here is $\theta_i = \tan^{-1}\mu_i$, and when $\theta_i = \pi/4$, the cone is a second-order cone:

$$K_i := = \left\{ f_i = \left[f_x^i, f_y^i, f_z^i\right]^T : \left\| \left(f_x^i, f_y^i\right)^T \right\| \le f_z^i \right\}. \quad (12)$$

Therefore, model (10) can be expressed as a force optimization problem on a cone:

$$\min \frac{1}{2} f^T f,$$

$$s\begin{cases} Af = -\omega^{ext}, \\ f \in C_\theta. \end{cases} \quad (13)$$

Among them, C_θ is the Cartesian product of M cones, namely, $C_\theta = C_{\theta 1} \times C_{\theta 2} \times \cdots \times C_{\theta M}$.

Obviously, this is a special case of a convex quadratic conic programming problem, and $x_i = [f_z^i, f_x^i, f_y^i]^T$, $b = -\omega^{ext}$, which can transform problem (13) into a convex quadratic conic programming problem:

$$\min\left\{ \frac{1}{2} x^T Q x + c^T x \colon Ax = b, x \in C_\theta \right\}. \quad (14)$$

Among them, $Q = I^{3M}$ is an identity matrix, $c \in R^{3M}$ is a zero vector, $b \in R^6$, and its dual problem is as follows:

$$\max\left\{ b^T y - \frac{1}{2} x^T Q x \colon A^T y - Qx + s = c, s \in C_\theta^* \right\}. \quad (15)$$

Among them, $y \in R^6, C_\theta^*$ is the dual cone of C_θ and $C_\theta^* = C_{\theta 1}^* \times C_{\theta 2}^* \times \cdots \times C_{\theta M}^*$.

Therefore, the point contact friction model in many force optimization problems can be converted into a convex quadratic conic programming, and then, a simple and efficient algorithm can be designed to solve it. Next, for the convex quadratic conic programming problem, this study presents a full Newton step projection algorithm with simple calculation process and higher efficiency.

2.3. Algorithm Design. We assume that both problems CQP and CQD satisfy the interior point condition. According to the algebraic relationship between the cone and the second-order cone (17), using the reversible linear map H and its inverse map H^{-1}, the convex quadratic conic programming problem can be transformed into the following convex quadratic second-order cone programming problem:

$$\begin{aligned} &\min\left\{ \frac{1}{2} \tilde{x}^T \tilde{Q} \tilde{x} + \tilde{c}^T \tilde{x} \colon \tilde{A}\tilde{x} = b, \tilde{x} \in K^n \right\}, \\ &\max\left\{ b^T y - \frac{1}{2} \tilde{x}^T \tilde{Q} \tilde{x} \colon \tilde{A}^T y = \tilde{Q}\tilde{x} + \tilde{s} = \tilde{c}, \tilde{s} \in K^n \right\}. \end{aligned} \quad (16)$$

Among them, $\tilde{x} = Hx, \tilde{s} = H^{-1}s, \tilde{A} = AH^{-1}$, $\tilde{Q} = H^{-1}QH^{-1}$, and $\tilde{c} = H^{-1}c$. Similarly, according to the dual theory of second-order cone programming, the optimal conditions for convex quadratic second-order cone programming can be obtained as follows:

$$\begin{cases} \tilde{A}\tilde{x} = b, \tilde{x} \in K^n, \\ \tilde{A}^T y - \tilde{Q}\tilde{x} + \tilde{s} = \tilde{c}, \tilde{s} \in K^n, \\ \tilde{x}^T \tilde{s} = 0. \end{cases} \quad (17)$$

For any vector $\tilde{x} = (\tilde{x}_0, \tilde{x}_{1:n}) \in R \times R^{n-1}$, according to its spectral decomposition formula (13) associated with the second-order cone K^n, the projection equation on the second-order cone can be obtained as follows:

$$P_K(\tilde{x}) = \frac{1}{2}\left(\tilde{x}_0 - \left\|\tilde{x}_{1:n}\right\|\right) \begin{bmatrix} 1 \\ -\varpi \end{bmatrix} + \frac{1}{2}\left(\tilde{x}_0 + \left\|\tilde{x}_{1:n}\right\|\right) \begin{bmatrix} 1 \\ \varpi \end{bmatrix}. \quad (18)$$

Among them, $\varpi \in R^{n-1}$. If $\tilde{x}_{1:n} \ne 0$, then $\varpi = \tilde{x}_{1:n}/\|\tilde{x}_{1:n}\|^{\circ}$. If $\tilde{x}_{1:n} = 0$, then ϖ is any vector satisfying $\|\varpi\| = 1$.

Using the algebraic relationship between the cone and the second-order cone (18), we can know $x^T s = 0 \Leftrightarrow \tilde{x}^T \tilde{s} = 0$. According to Theorem 1, the complementary condition of convex quadratic conic programming can be equivalent to a projection equation, namely,

$$x^T s = 0 \Leftrightarrow H^{-1}s = P_K\left(H^{-1}s - Hx\right). \quad (19)$$

According to the optimality condition (4), a new projection equation system is constructed. If $u = (x, y, s) \in C_\theta \times R^m \times C_\theta^*$ and the function is $\Phi(u) = \Phi(x, y, s)$, the projection equations equivalent to the convex quadratic conic programming problem can be obtained as follows:

$$\Phi(u) = \Phi(x, y, s) = \begin{pmatrix} Ax - b \\ c - A^T y - s + Qx \\ H^{-1}s - P_K\left(H^{-1}s - Hx\right) \end{pmatrix} = 0. \quad (20)$$

On the basis of the second-order cone programming algorithm in the literature, different constant coefficient matrices are constructed according to the characteristics of the projection equation system (20), and the problem is transformed into a new linear equation system to solve. For the convenience of discussion, we set $\tilde{Q} = H^{-1}QH^{-1}$ and first assume the following:

$$z = \begin{pmatrix} Hx \\ y \end{pmatrix},$$
$$B = \begin{pmatrix} \tilde{Q} + I_n & -(AH^{-1})^T \\ AH^{-1} & I_m \end{pmatrix},$$
$$q = \begin{pmatrix} H^{-1}(c - s) \\ -b \end{pmatrix}, \quad (21)$$
$$\varphi(u) = \begin{pmatrix} H^{-1}(Qx + c - A^T y - s) \\ Ax - b \end{pmatrix}.$$

For an arbitrary given initial point $(x, y) \in C_\theta \times R^m$, if s is updated to $s = HP_K(H^{-1}(Qx + c - A^T y) - Hx)$ according to the new projection rule, according to formula (20), we only need to satisfy $Ax - b = 0$ and $c - A^T y - s + Qx = 0$, which is equivalent to solving a linear equation system $\varphi(u) = 0$ of a constant coefficient matrix, so that the solution set $u = (x, y, s)$ of the projection equation system $\Phi(u) = 0$ can be obtained. Obviously, u is also the solution of the optimality condition (4), which leads to the optimal solutions of the convex quadratic conic programming problems CQP and CQD.

The full Newton step projection algorithm for solving convex quadratic conic programming is as follows:

(i) Step 0. The algorithm takes the parameter $\theta \in (0, \pi/2), \gamma \in (0, 2)$, gives the error tolerance $\varepsilon > 0$, and randomly generates the initial point $(x^0, y^0, s^0) \in C_\theta \times R^m \times C_\theta^*$, where s^0 is updated to $s^0 = HP_K(H^{-1}(Qx^0 + c - A^T y^0) - Hx^0))$ according to the new projection rule, and $k = 0$.

(ii) Step 1. If $\|\varphi(u^k)\|^2 \le \varepsilon$, the algorithm stops iterating; otherwise, go to step 2.

(iii) Step 2. The algorithm solves the following system of linear equations.

$$B(\Delta z^k) = -\gamma\varphi(u^k). \quad (22)$$

to get Δz^k: $= (\Delta x^k, \Delta y^k)^T \in R^n \times R^m$.

(iv) Step 3. The algorithm uses full Newton steps to update the iteration points

$$\begin{aligned} x^{k+1} &= H^{-1} P_K(Hx^k + \Delta x^k), \\ y^{k+1} &= y^k + \Delta y^k, \\ s^{k+1} &= HP_K(H^{-1}(Qx^{k+1} + c - A^T y^{k+1}) - Hx^{k+1}). \end{aligned} \quad (23)$$

The algorithm sets $k = k + 1$ and returns to step 1.

Theorem 1. *For any affine constraint coefficient matrix $A \in R^{m\times n}$ in convex quadratic conic programming problem, the invertible matrix is $H \in R^{n\times n}$, and the algorithm is well-posed.*

Proof. In step 2 of the algorithm, the coefficient matrix of the linear equation system is B, and we have the following:

$$B = \begin{pmatrix} I_n + \tilde{Q} & -(AH^{-1})^T \\ AH^{-1} & I_m \end{pmatrix}. \quad (24)$$

Therefore, the matrix B is always invertible, the linear equation system in the algorithm step 2 has a unique solution, and the algorithm is feasible. □

2.4. Convergence Analysis. We assume that Ω^* is the nonempty bounded solution set of the optimality condition of convex quadratic conic programming problem. Combined with the analysis methods of algorithm convergence in the literature, the following two theorems are given to prove the global convergence of the proposed algorithm.

Theorem 2. *If $\{u^k\}$ is the iterative point sequence generated by the full Newton step projection algorithm, and the parameter is $\gamma \in (0, 2)$, then for any $u^* = (x^*, y^*, s^*) \in \Omega^*$, the following conclusions are satisfied:*

$$\|B(z^{k+1} - z^*)\|^2 \le \|B(z^k - z^*)\|^2 - \gamma(2 - \gamma)\|\varphi(u^k)\|^2. \quad (25)$$

Proof. $Bz^{k+1} = Bz^k - \gamma\varphi(u^k)$ is known from step 2 of the algorithm, and Bz^* is subtracted from both sides to get

$$B(z^{k+1} - z^*) = B(z^k - z^*) - \gamma\varphi(u^k), \quad (26)$$

We perform the following operations on both sides of (26) at the same time:

$$\begin{aligned} \|B(z^{k+1} - z^*)\|^2 = &\|B(z^k - z^*)\|^2 + \gamma^2\|\varphi(u^k)\|^2 \\ &- 2\gamma\langle B(z^k - z^*), \varphi(u^k)\rangle, \end{aligned} \quad (27)$$

Since $u^* \in \Omega^*$ satisfies the optimality condition (4) of the convex quadratic cone programming, according to the relational expressions (17) and (18) of the cone and the second-order cone, there are $(Hx^*, H^{-1}s^*) \in K^n \times K^n$ and $\langle Hx^*, H^{-1}s^*\rangle = 0$. Then, from the dual theory of second-order cone programming, we can get the following:

$$\langle (Hx^*; y^*), (H^{-1}(s^k - s^*); 0_m)\rangle \ge 0. \quad (28)$$

We take $v = H^{-1}(Qx + c - A^T y^k) - Hx^k, \omega = H^{-1}s^*$. From the known condition $P_K(v) = H^{-1}s^k$ and the projection property (16), we get the following:

$$\langle (v - H^{-1}s^k; \alpha_m), (H^{-1}(s^k - s^*); 0_m)\rangle \ge 0. \quad (29)$$

We combine formula (29) into formula (28) and set

$$\begin{aligned} \hat{x} &= H(x^k - x^*) - H^{-1}(c - A^T y^k - s^k + Qx), \\ \hat{y} &= \alpha_m - y^*. \end{aligned} \quad (30)$$

After finishing, $\langle (\hat{x}; \hat{y}), (H^{-1}s^* - H^{-1}s^k; 0_m)\rangle \ge 0$ is obtained.

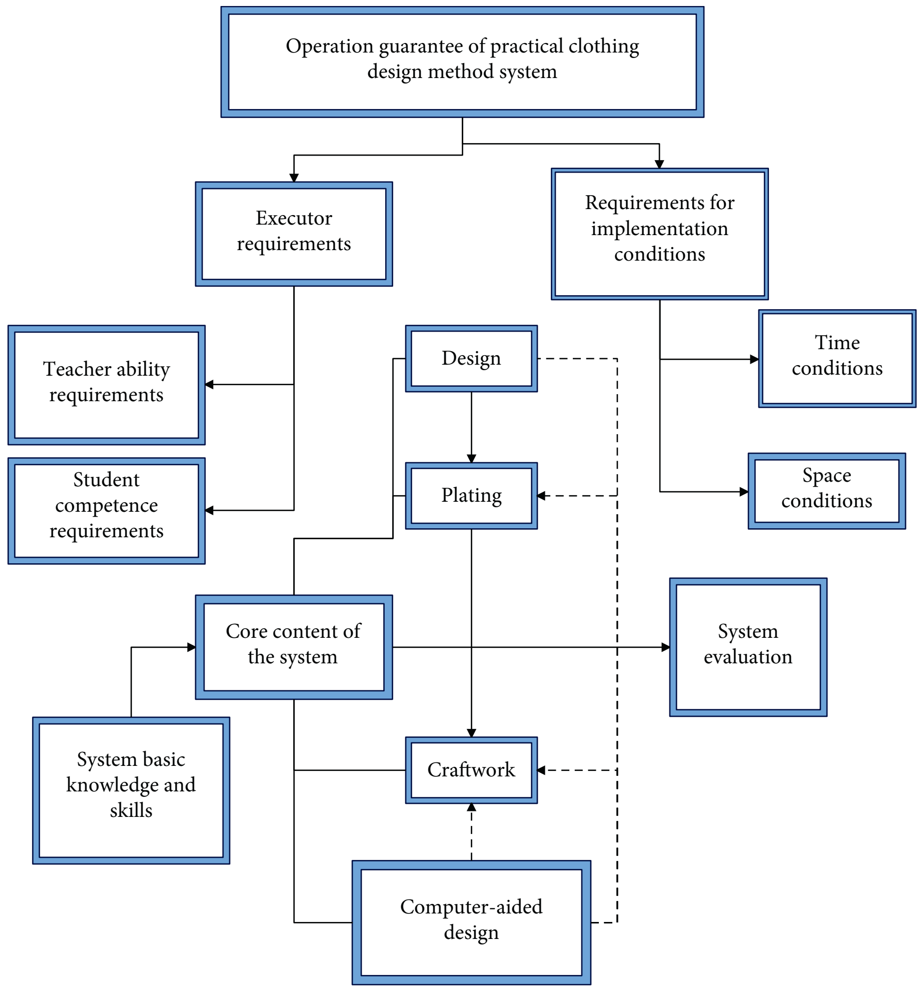

Figure 1: Implementation process of the practical clothing design system.

We set $\alpha_m = y^k - Ax^k + b$. Due to $u^* \in \Omega^*$, after transformation, we get the following:

$$\langle z^k - z^* - \varphi(u^k), (I - B)(z^k - z^*) + \varphi(u^k)\rangle \geq 0. \quad (31)$$

Among them, the matrix is as follows:

$$I - B = \begin{bmatrix} -\tilde{Q} & (AH^{-1})^T \\ -AH^{-1} & 0_{m\times n} \end{bmatrix}. \quad (32)$$

Considering that $\tilde{Q}$ is a symmetric positive definite matrix, $\langle z^k - z^*, (I - B)(z^k - z^*)\rangle \leq 0$ can be deduced. Therefore, there is

$$\langle \varphi(u^k), B(z^k - z^*)\rangle \geq \|\varphi(u^k)\|^2. \quad (33)$$

After substituting it into formula (27), we get the conclusion:

$$\|B(z^{k+1} - z^*)\|^2 \leq \|B(z^k - z^*)\|^2 - \gamma(2-\gamma)\|\varphi(u^k)\|^2. \quad (34)$$

□

Theorem 3. *If $\{u^k\}$ is any point sequence generated by the full Newton step projection algorithm to solve the convex quadratic conic programming problem, then $\{u^k\}$ converges to $u^* \in \Omega^*$.*

Proof. If $\hat{u} = (\hat{x}, \hat{y}, \hat{s}) \in \Omega^*, \hat{z} = (H\hat{x}, \hat{y})^T$, then

$$\|B(z^k - \hat{z})\|^2 = \|z^k - \hat{z} + (B - I)(z^k - \hat{z})\|^2 \quad (35)$$

Then, combined with Theorem 2, we can see that

$$\|z^k - \hat{z}\|^2 \leq \|B(z^k - \hat{z})\|^2 \leq \|B(z^0 - \hat{z})\|^2. \quad (36)$$

This shows that the sequence $\{z^k\}$ is bounded; that is, the sequence $\{x^k\}, \{y^k\}$ is bounded. Then, according to the continuity of the projection operator, it can be known that the sequence $\{s^k\}$ is bounded, so the sequence $\{u^k\}$ is bounded, and there is a clustering point.

On the other hand, $s = HP_K(H^{-1}(Qx + c - A^T y) - Hx)$ is known from the update rule of s^k in the algorithm.

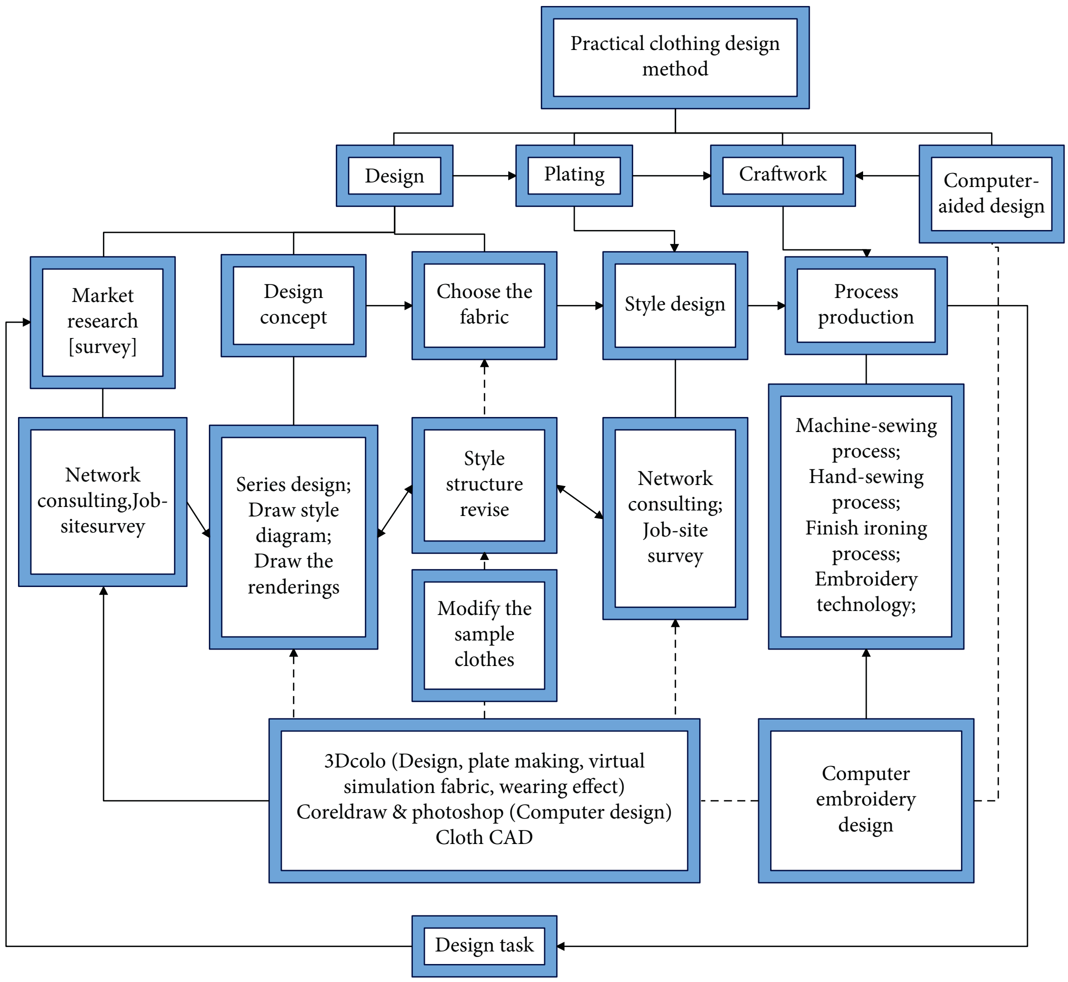

Figure 2: Implementation roadmap of practical clothing design method.

Combining the projection property (17), we get the following:

$$\begin{aligned} &\left\| H^{-1}s^k - P_K\left(H^{-1}s^k - Hx^k\right)\right\|^2 \\ &\leq \left\| H^{-1}\left(Qx + c - A^T y^k - s^k\right)\right\|^2. \end{aligned} \tag{37}$$

Then, from the definition of $\Phi(u)$ in formula (20), we can get the following:

$$\left\|\Phi\left(u^k\right)\right\|^2 \leq \left\|\varphi\left(u^k\right)\right\|^2 + \left\|Qx + c - A^T y^k - s^k\right\|^2. \tag{38}$$

We assume that $u^* = (x^*, y^*, s^*)$ is any aggregation point of sequence $\{u^k\}$, and there exists a subsequence $\{u^{ki}\}$ that converges to u^*. According to Theorem 2, $\lim_{k\longrightarrow+\infty}\|\varphi(u^k)\|^2 = 0$ is easy to obtain, and then, we get the following:

$$\lim_{k\longrightarrow+\infty} \left\|\Phi\left(u^k\right)\right\|^2 = 0. \tag{39}$$

It can be concluded that

$$\lim_{k\longrightarrow+\infty} \Phi\left(x^{ki}, y^{ki}, s^{ki}\right) = \Phi\left(x^*, y^*, s^*\right) = 0. \tag{40}$$

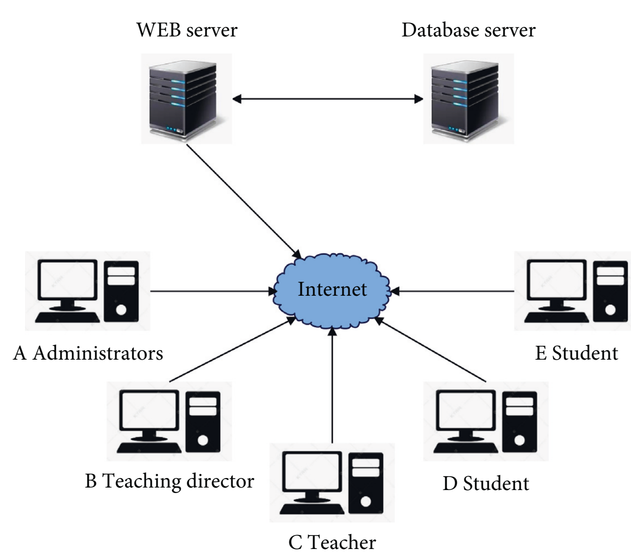

Figure 3: System software structure diagram.

Therefore, u^* is the solution of the system of projection equations $\Phi(u) = 0$, and thus, (x^*, y^*, s^*) is the optimal solution of the convex quadratic conic programming problems CQP and CQD. □

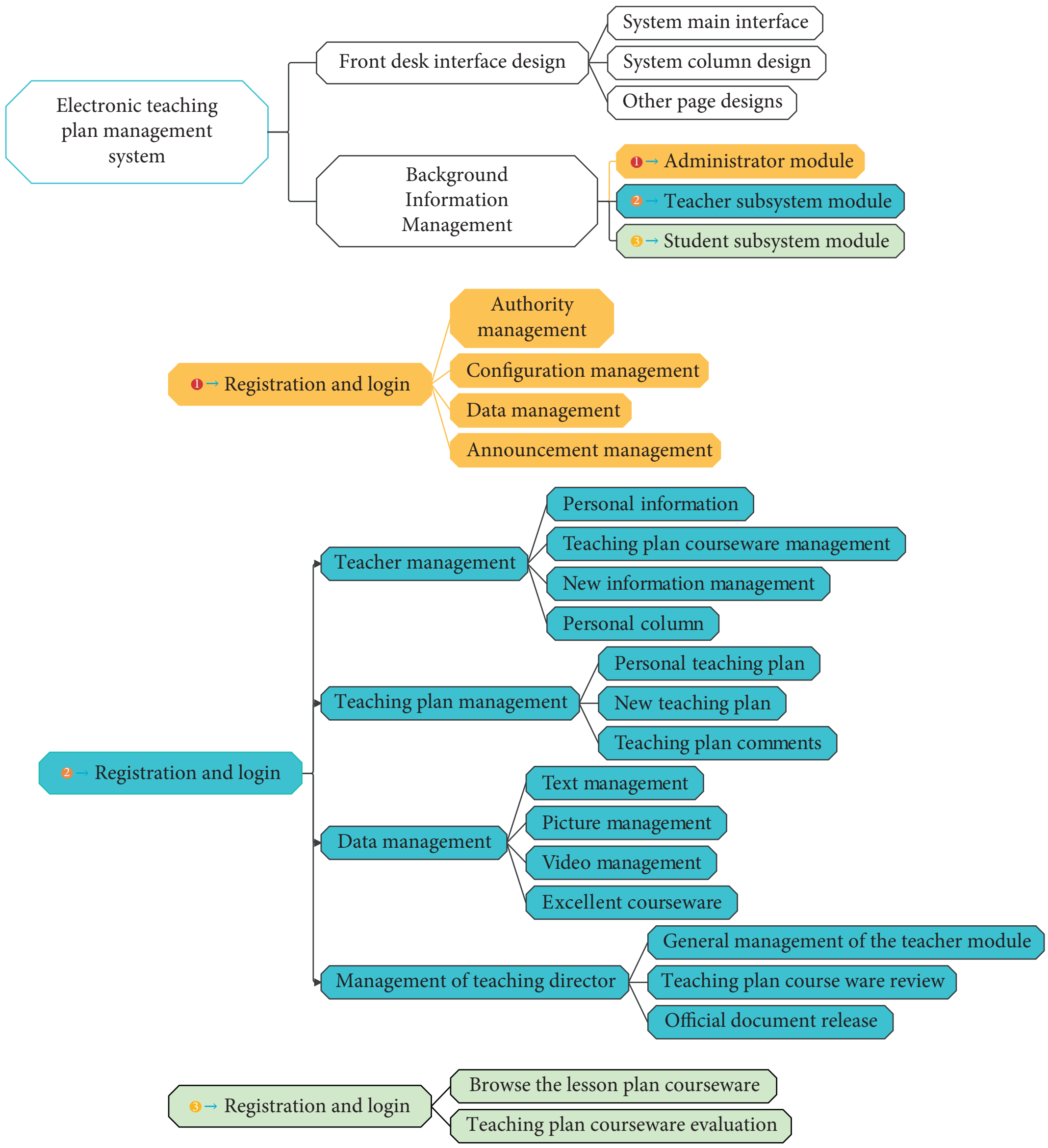

Figure 4: System function module structure diagram.

3. The Application of Practical Clothing Design Method in the Teaching of Clothing Specialty

Practical clothing design requires basic knowledge and skills. The implementation of practical clothing design takes the project design task as the carrier, integrates the four major modules of design, board making, craftsmanship, and computer-aided design, and completes the whole process of transforming the design intent into the finished product in one unit time. Finally, the implementation process and results of the design tasks are evaluated. In this process, the ability level of system implementers (teachers, students), implementation environment, implementation equipment, and "three-stage" talent training system escort the operation of the entire system, as shown in Figure 1.

The practical application of the clothing design method is demonstrated in the three teaching stages of the application of the intermediate section, the advanced section, and the technician section. The implementation path of teaching is shown in Figure 2. In the specific implementation, the practical clothing design content of each stage is based on the project task. Among them, the intermediate workers use a single design task, the senior workers use a series of design tasks, and the reserve technicians use a style design task. According to the differences in the knowledge and ability structure of students in each stage, the focus and difficulty of tasks in each stage will also be different. Generally speaking, the design of the project task content at each stage is from shallow to deep and from simple to complex. Through the practical operation of the "three-stage" clothing design project tasks, students' knowledge and ability structure are progressively advanced.

The B/S structure is used in the software of this system, and the database of the electronic lesson plan management stores a large amount of data information required by the system and finally can jointly maintain and share this data

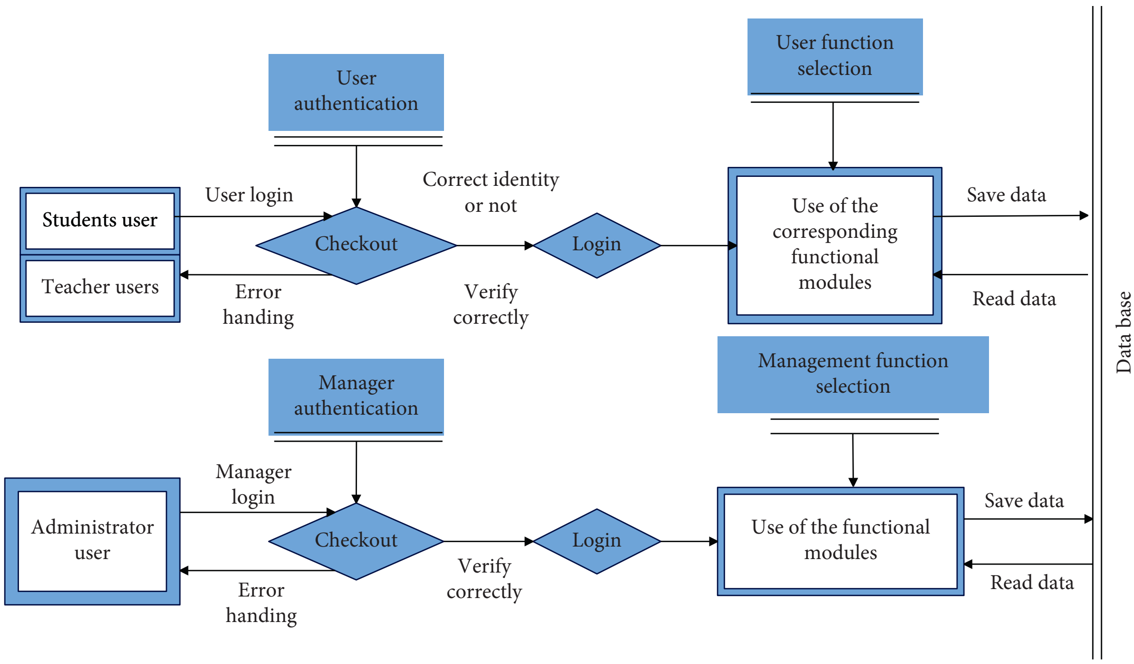

FIGURE 5: Design diagram of program flow.

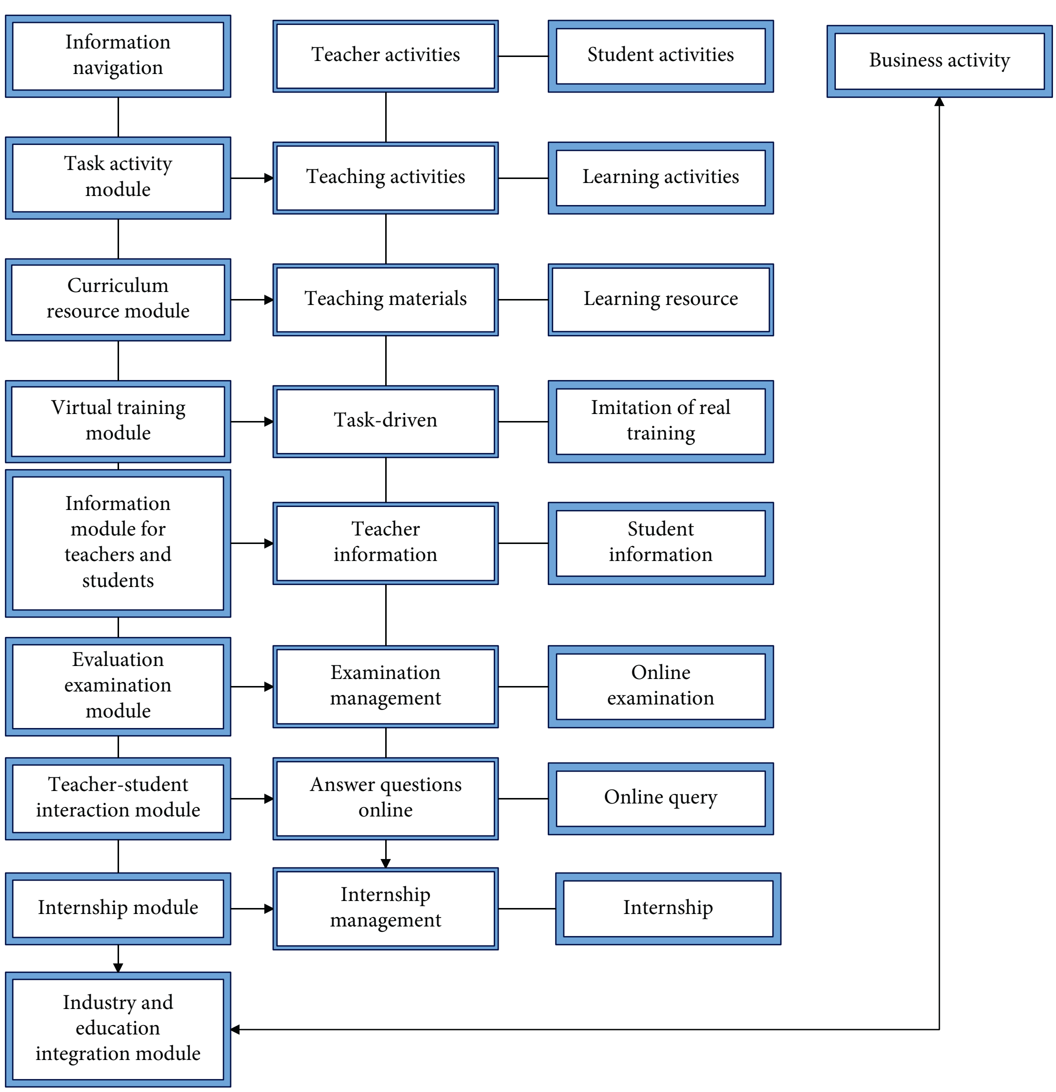

FIGURE 6: Design diagram of cloud platform course system.

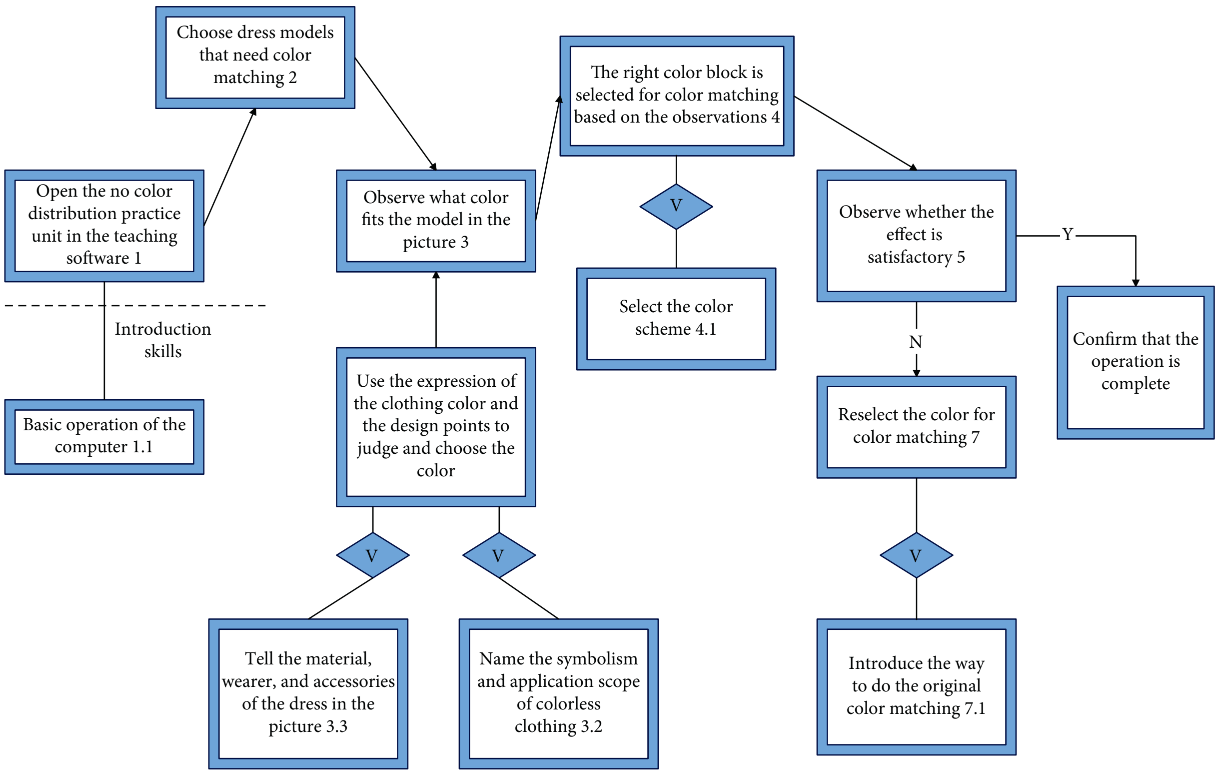

Figure 7: Analysis of the teaching purpose of learners' wisdom skills.

information. Because the electronic lesson plan management system software is placed on the back-end Web server, the Web browser can be networked to realize the use of the system software functions. At the same time, the user's authority determines that the user can use the corresponding functions of the software in the system under the action of the B/S structure. The advantage of software using B/S structure is that it is more convenient to upgrade and maintain the system. Its system software structure is shown in Figure 3.

The electronic lesson plan management system of the College of Fashion includes two parts: front-end interface design and back-end information management. Its functional module structure is shown in Figure 4. The system function module is composed of three function modules: the administrator module (system management), the student subsystem module, and the teacher subsystem module.

Teacher and student users can be set up to authenticate their identities when they register and log in. If the identity is illegal, they return to the login interface, and the registration must fill in the real and correct personal information to log in successfully (such as school, class, and student number). For system administrator user login, identity information and authority need to be verified (such as school, department, position, and faculty ID). Those who log in illegally will issue a warning and return to the login interface. Only when they are correct they can enter the background information management interface. Its program flow design is shown in Figure 5.

At present, with the rapid development of the Internet and information technology, technological innovation and the rapid response capability of production have become the key factors for the survival and development of garment enterprises. Clothing product design and development, production process management, product sales, and promotion are gradually developing into an integrated production and sales model with information flow as the core product. There is no doubt that the textile and garment industry has completely entered the information age. The development trend of networkization and informatization of clothing enterprises requires that the curriculum system of secondary vocational clothing majors must speed up the pace of reform, vigorously promote the construction of the informatization curriculum system, and step up the construction of a cloud platform for the training of clothing talents that integrates teaching, learning, and doing. Through scientific analysis of the characteristics of the clothing subject curriculum, it is divided into eight functional modules, and the structure is shown in Figure 6.

Dependent skills are those skills required to accomplish each step of the instructional purpose. Introductory skills refer to the skills that learners should have mastered before entering teaching. The purpose of subordinate skills analysis is to determine the subordinate skill set for each step. If the required skills are not taught in teaching, and neither will many students, teaching will not work well. On the other hand, if too many skills are included in the teaching, the teaching will be overtime, and too many unnecessary skills will interfere with the learning of the required skills.

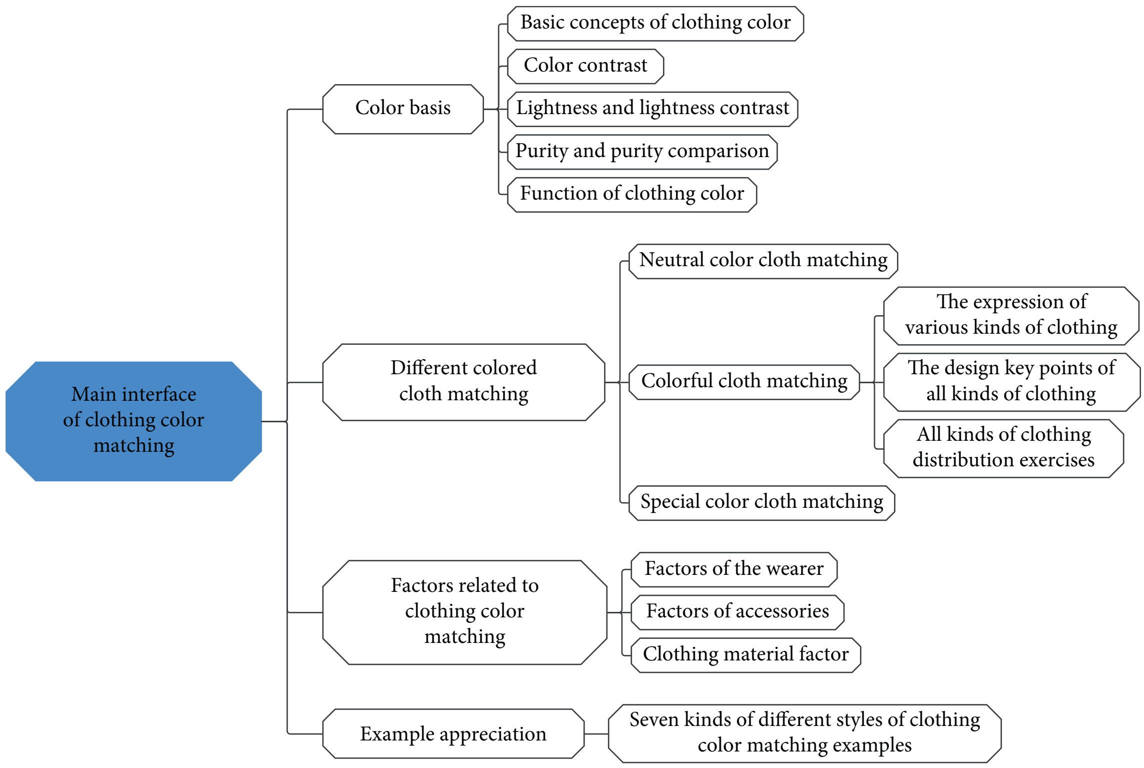

Figure 8: Main structure of the teaching software of the clothing color matching course.

Table 1: Validation of the effect of practical clothing design methods.

Number	Design effect	Number	Design effect	Number	Design effect
1	86.57	13	88.52	25	87.66
2	81.80	14	84.00	26	81.03
3	84.51	15	84.01	27	86.59
4	86.19	16	86.62	28	86.61
5	81.77	17	88.05	29	83.97
6	87.44	18	84.98	30	88.06
7	88.06	19	88.06	31	86.73
8	81.22	20	84.30	32	83.75
9	84.58	21	83.75	33	87.15
10	87.56	22	85.86	34	85.36
11	83.83	23	81.86	35	84.78
12	84.95	24	86.16	36	88.06

Table 2: Effect of practical clothing design methods in the teaching of clothing majors.

Number	Teaching practice	Number	Teaching practice	Number	Teaching practice
1	84.54	13	85.69	25	83.79
2	78.29	14	84.50	26	83.03
3	82.24	15	80.47	27	85.48
4	78.82	16	80.66	28	80.19
5	83.51	17	79.98	29	85.45
6	80.46	18	82.64	30	79.31
7	80.85	19	85.00	31	77.95
8	80.26	20	78.70	32	79.05
9	77.50	21	78.00	33	84.81
10	81.57	22	85.84	34	85.67
11	83.09	23	77.02	35	82.00
12	82.15	24	77.67	36	78.31

Therefore, it is necessary for us to conduct an analysis of subordinate skills for teaching purposes. Next, we take the important module content of the clothing color matching course teaching software as an example to analyze the subordinate skills and entry skills, as shown in Figure 7.

The design of clothing color teaching software is divided into four modules: color basis, color matching of clothing of different colors, relevant factors of clothing color matching, and appreciation of examples. The main structure is shown in Figure 8.

The practical clothing design system proposed in this study is simulated and studied to explore the reliability of the method, and the results are shown in Table 1.

The above data verify the reliability of the practical clothing design method, and on this basis, the effect of this system in the teaching of clothing majors is verified, and the results shown in Table 2 are obtained.

From the results shown in Table 2, it can be seen that the practical clothing design method has a good application in the teaching of clothing majors, and it can be applied in the practice of clothing teaching.

4. Conclusion

The practical teaching of clothing major in colleges and universities is different from other technical clothing education. In the continuous cycle of theory-practice-theory, students' ability to combine theory with practice in practice should be cultivated subtly. Moreover, clothing theory has a positive guiding effect on clothing design and practice. Clothing theory can virtually improve the design thinking ability of clothing designers, so that designers can use this ability to process and choose the form of clothing at a theoretical height and achieve twice the result with half the effort. This study applies the practical fashion design method to the teaching of fashion major to improve the practical effect of modern fashion design teaching. Through the results of the experimental research, it can be seen that the practical clothing design method has a good application in the teaching of clothing majors, and it can be applied in the practice of clothing teaching.

Data Availability

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

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This study was sponsored by Tongmyong University.

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