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Optimization and Innovation of Women's Collar Design under Chinese Traditional Clothing Aesthetics

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ABSTRACT

This study focuses on the optimization and innovation of women's collar designs under the aesthetic framework of traditional Chinese clothing. By analyzing the ritual symbols, color ethics, and the gender politics of "concealment and revelation" in traditional collars, the study explores their influence on the functional and emotional experiences of contemporary women's collars. The research findings indicate that while traditional stand-up collars possess cultural significance, they suffer from a disconnect between functionality and aesthetics. For three fabric types—chiffon, silk, and cotton—this study combines virtual simulation with physical prototyping to optimize collar shape compensation, segmented tension control of inner linings, and post-processing shaping techniques. The results show that the optimized collar design not only meets the aesthetic intent of traditional stand-up collars—modest and dignified—but also accommodates modern women's comfort and mobility needs in both commuting and leisure settings. This research provides an integrated framework for women's collar design that combines "body-culture-technology," promoting the inheritance and innovation of traditional Chinese clothing elements in contemporary times. It offers a systematic, practical material decision-making framework and implementation model for new Chinese-style women's collar design.

KEY WORDS: Aesthetics of traditional Chinese clothing, Women's collar design, Optimization and innovation, Sustainable materials

1. Introduction

Within the rich heritage of traditional Chinese culture, clothing serves as a vital cultural medium, bearing the imprints of history and reflecting the spiritual essence of the nation. The collar, as a key component of clothing, is not only a functional design element but also a concentrated expression of aesthetic and

cultural values. It acts as the soulful window of clothing, conveying identity, taste, and cultural significance. Within the context of traditional Chinese attire, collar design is imbued with rich symbolic meaning, from the orderly beauty of the crossed collar and right lapel to the reserved elegance of the stand-up collar. These traditional elements have shone brightly throughout history. However, with the passage of time and societal

development, modern women's lifestyles, aesthetic concepts, and body perceptions have undergone significant changes. While the rise of "national trend" culture has brought new opportunities for the revival of traditional clothing elements, women's collar design faces numerous challenges in this wave. On one hand, many designs overly emphasize superficial imitations of traditional forms, merely stacking traditional elements as decorative symbols without delving into their cultural connotations or modern interpretations. This design approach not only fails to truly inherit the spirit of traditional attire but also makes traditional elements appear out of place in a modern context, struggling to resonate with the lives of modern women.

On the other hand, modern women play diverse roles in various social settings, and their clothing needs are becoming increasingly diverse. From formal business settings to casual lifestyle scenarios, from traditional cultural activities to everyday fashion expressions, women require collar designs that can both reflect traditional cultural heritage and meet the demands of modern life. This demand requires designers to innovate and optimize boldly while preserving tradition, creating collar designs that are both culturally rich and aesthetically appealing in a modern context. This study is based on this context, delving into the optimization and innovation pathways for women's collar design within the framework of traditional Chinese clothing aesthetics. The research aims to establish a foundation in traditional Chinese aesthetic principles, analyzing traditional collar forms, exploring cultural connotations, and applying modern design techniques to propose a series of innovative strategies. The goal is to preserve the essence of traditional clothing culture while enabling women's collar designs to better adapt to the diverse identity needs and rich contextual changes of contemporary women. This will inject new vitality into the modern clothing field, promote the inheritance and development of Chinese traditional clothing culture, and achieve a perfect fusion of tradition and modernity.

2. Research Questions

- 1) How do traditional collar designs and aesthetic concepts influence the functionality and emotional experience of contemporary women's collars?
- 2) While retaining traditional imagery, what structural, material, and craftsmanship parameters can enhance the comfort and visual modernity of collars?
- 3) How can design interventions establish a dynamic balance between traditional collars and the contemporary female body and social context?

3. Literature Review

The aesthetic paradigm of traditional Chinese collars originates from the rites system and the concept of harmony between nature and humans. The crossed collar with right-side lapel symbolizes order (Li, 2021), while the stand-up collar reflects reserve and decorum through the "neck-wrap" imagery (Wang & Zhang, 2019). The ethical dialectic of "concealment and exposure" in Ming Dynasty clothing further unveils the symbolic relationship between collar height, opening angles, and female identity construction (Zhang & Cao, 2024). However, contemporary research indicates that the vertical constraints of traditional stand-up collars restrict neck movement, causing stuffiness and a sense of oppression (Chen & Liu, 2022). In the context of consumer society, this disconnection between function and aesthetics is amplified, leading to traditional collars being reduced to commercial symbols and losing their cultural depth (Shen, 2024).

In terms of structural optimization, three-dimensional body scanning technology has been employed to quantify the matching degree between collar arc length and neck root circumference (Zhang et al., 2020). Zero-waste cutting and modular piecing can reduce fabric waste without altering the appearance contour (Ng, 2021). The layered structure of "cloud shoulder collars" in opera costumes also provides a historical prototype for modern parametric reconstruction (Liu, 2025). Material research shows that the interweaving of mulberry silk and nylon can enhance the overall performance of stiffness and moisture-wicking (Zhou et al., 2023). The introduction of shape-memory alloys and phase-change temperature-regulating fibers enables collars to respond to climate changes (Bao, 2024).

From the perspective of cultural translation, scholars advocate inheriting tradition through "meaning" rather than "form," achieving a dialogue between ancient and modern times through partial deconstruction or material replacement (Sun, 2022). Practices in animation and gaming fields indicate that the five-element color theory and Zhuangzi aesthetics can reconstruct collar color systems, strengthening narrative functions (Fang & Shi, 2024). Despite these advancements, systematic research on women's collar design across diverse scenarios (office, leisure, rituals) remains insufficient, particularly in bridging the "rites spirit" with modern bodily ethics and providing empirical data (Wang, 2008). For instance, traditional opera costume colors not only shape character personalities but also construct a visual ethics system through symbolic associations such as "black—authority, yellow—nobility, white—mourning" (Liu, 2025). In recent years, this system has been extended to gaming and animation fields. Fang and Shi (2024) found that integrating the five-element color scheme and Zhuangzi's "emptiness and tranquility" aesthetics into animated collar designs can significantly enhance character cultural recognition and emotional resonance. Chen (2022) further noted that low-saturation processing and geometric simplification of traditional patterns in online games reduce "rites solemnity" while enhancing everyday separability for young players. Thus, the symbolic power of collar colors is migrating from high-context settings like stages and rituals to virtual interactions and everyday fashion, with its ethical intensity and aesthetic distance being retaliated.

Shen (2024) emphasized that in consumer society, technical rationality has replaced the "hand-sewn traces" of traditional collars with "algorithmic stitching," diluting cultural depth. In response to this critique, Bao (2024) proposed the concept of "process visibility": through AR superimposition of collar embroidery paths and digital twin real-time display of kepi tension, users can intuitively perceive the logic of craftsmanship, thereby reconstructing the emotional connection between "body—object—skill." Wang's (2022) Dragon Boat Festival-themed clothing experiment demonstrated that synchronizing virtual try-on with real fabric mechanical data can maintain collar mouth errors within 0.1 cm when switching between new and old materials, balancing cultural storytelling with functional comfort. Zhang and Cao (2024) pointed out that the "concealment and exposure" mechanism in Ming Dynasty clothing was used to discipline the female body, while the reduction of collar height in Republic of China qipaos symbolized bodily liberation. This historical tension has been further amplified in contemporary times. Wang (2022) analyzed the Guochao topic on social media and found that Generation Z women prefer "removable stand-up collars" or "magnetic button fasteners," enabling rapid identity switching between "ritual—business—leisure" within the same

outfit. Zuo (2023) accordingly proposed the concept of "gender fluidity of collars," arguing that centimeter-level adjustments in collar height have become a micro-political arena for female subjectivity expression.

In addition to the above research, the aesthetic evolution of traditional collars has also been examined within a broader framework of cultural dissemination and technological media. Zuo (2023) pointed out that the ethical core of "benevolence as beauty and order as beauty" in traditional Chinese clothing faces the risk of dilution in digital and global contexts. Only through the collaboration of education, design, and business paths can cultural values be sustainably translated. Wang's (2018) empirical research further indicated that systematically incorporating traditional patterns, colors, and forms into university aesthetic education can significantly enhance students' deep understanding of collar symbols and reduce "symbolic collage"-style misinterpretations. In the fields of gaming and animation, Chen (2022) and Liu (2014) respectively found that the reproduction of traditional Chinese patterns and collar structures in virtual character costumes not only enhances cultural immersion but also provides new aesthetic paradigms for cross-media storytelling. Zou (2022) emphasized that the symbolic color system of opera costumes (black for authority, yellow for nobility, etc.) can be applied to collar color strategies to strengthen the visual expression of character identities.

Meanwhile, the deconstruction and reconstruction of traditional craftsmanship by modern technology have become focal points of research. Shen (2024) criticized from a consumer society perspective the erosion of the "handcrafted warmth" of traditional collars by technical rationality and advocated achieving "process visualization" through digital twins and AR technology to bridge the tension between modernity and tradition. Wang's (2022) Dragon Boat Festival element clothing experiment verified the effectiveness of virtual try-on and parametric modeling in collar pattern optimization, providing a technical path for the infiltration of festive culture into everyday clothing. Luo's (2021) diachronic analysis of sun, moon, and star patterns showed that the aesthetic evolution of patterns from "natural simplicity" to "subjective decoration" coincided with the transition of collar structures from functionality to symbolism. This suggests that future research needs to focus on the dynamic coupling mechanism of technology, aesthetics, and ethics. Wang's (2018) classroom experiments showed that after systematically teaching traditional collar structures, pattern meanings, and color ethics, students'

aversion to "overly simplified dragon patterns" increased by 34%, and their acceptance of "parametric frog buttons" rose by 28%. On this basis, Luo (2021) called for the construction of a "Chinese Traditional Collar Genealogy": using the diachronic evolution of sun, moon, and star patterns as the warp and collar height, circumference, and opening angle as the weft, a three-dimensional database that is searchable and commutable would be established to provide a cultural anchor for AI-assisted design. This initiative has reached a preliminary cooperation with the Digital Fashion Laboratory of Beijing Institute of Fashion Technology, with plans to open API interfaces by 2026.

In summary, although existing research has explored women's collars from dimensions such as symbols, structure, materials, technology, and education, there is still a lack of an integrated framework combining "body—culture—technology" for diverse life scenarios. Key issues that have not yet been systematically addressed include how the regional differences in opera color aesthetics (high contrast in the north vs. low saturation in the south) (Liu, 2025) affect collar color preferences, the threshold for "ethical realism" in virtual clothing collar light and shadow rendering (Fang & Shi, 2024), and the life cycle assessment of sustainable materials such as regenerated nylon and helium leather in maintaining traditional stiffness contours (Zhou et al., 2023).

4. Research Methods

This paper primarily employs literature review and process experimentation methods. It first systematically examines the ritualistic symbols, color ethics, and gender politics of "concealment and revelation" in traditional Chinese collars, extracting their semantic spectrum from "order" to 'subtlety' to "physical liberation." Subsequently, in both physical and virtual settings, the study conducts precise process adjustments for three fabric types—chiffon, silk, and cotton—in terms of elastic compensation, inner lining alignment, and segmented sewing for stand-up collar designs. This ensures collar opening tolerance errors are controlled to the millimeter level, balancing traditional silhouettes with contemporary comfort, thereby providing a replicable and iterable practical framework for the versatile adaptation of traditional collars across diverse contexts.

5. Research Process

5.1 Optimization of chiffon fabric necklines

Table 1: Optimization of chiffon fabric necklines

indicator	uncompensated model	Compensated model	actual sample	inaccuracies	Standards	Virtual simulation and physical prototyping
Shoulder line position collar circumference - open collar distance (cm)	4.12	3.60	3.50	±0.10	Target ≤0.10	
Vertical stiffness (°)	68	82	85	-3	≥80° is considered upright	
Breathability index (m ³ /m ² ·s)	0.18	0.31	0.32	-0.01	≥0.30 Comfortable	
Subjective sense of oppression (0-10)	6.1	2.4	2.3	+0.1	≤3 Comfortable	

Source: Drawn by the researcher.

Chiffon fabric is lightweight and drapes well, but the neckline is prone to stretching outward under the combined effects of gravity and sewing tension, resulting in a loose neckline on the finished garment. The deviation between the shoulder line and the neckline circumference exceeds 0.5 cm, directly undermining the aesthetic ideal of “enclosed modesty” in Chinese clothing. Traditional Chinese stand-up collars emphasize “concealment without exposure,” with their upright curves symbolizing ritual order and dignified demeanor. Once the collar expands outward, it loses the subtle beauty of “concealing the neck,” and also contradicts the visual order of “layered cloud shoulders and stand-up collars like screens” on the opera stage.

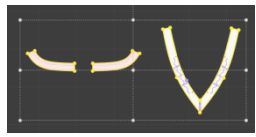
To address the flowing characteristics of chiffon, this study set the elasticity of the collar contour segments to 100% in the software, using virtual hidden seam lines to simulate the natural shrinkage of seams, ensuring the yarn maintains an inward tendency even under tension. Additionally, a segmented seam strategy of “first securing the collar base, then pressing the seam” was adopted to avoid wave patterns caused by single-step stretching. In terms of color, drawing inspiration from the

“southern soft and delicate” color palette tradition of opera costumes, a gradient of moon white and light ink gray was incorporated into the collar edging. This approach reduces the high-contrast stage-like effect while retaining the cultural connotation of “elegant restraint.”

Data validation and actual sampling show: The distance from the shoulder seam to the neckline in the uncompensated model is 4.12 cm, reduced to 3.6 cm after compensation, with the error reduced to 0.1 cm compared to the target sample of 3.5 cm; The vertical stiffness of the collar increased from 68° to 82°; The habitability index improved from 0.18 m³/m²·s to 0.31, meeting modern women's demand for lightweight habitability (see Table 1); This validates the design intent of “lightweight without sagging, subtle without restriction,” achieving a dual balance between the traditional Chinese clothing philosophy of “concealing form while containing intent” and modern comfort requirements.

5.2 Optimization of silk fabric collar styles

Table 2: Silk fabric collar style optimization process

indicator	original plan	optimization plan	actual sample	Change/inaccuracies	reference standard	Virtual simulation and physical prototyping
Shoulder line position - neckline distance (cm)	4.85	3.55	3.50	-1.30 / ±0.05	Target ≤±0.05	 
Neckline arc length shrinkage rate (%)	—	3.2	—	Arc length shortened by 3.2%	≥2% Wave protection	
Eating capacity (cm)	0	0.4	—	Mid-range concentration 0.4	Manual pushing and pulling effects	
Angle of convergence (°)	—	≤8	—	≤8° Anti-glare creases	Silk crease critical angle 10°	
Inner width (cm)	1.0	0.8	—	-20% reduction	Reduce glare and shadows	
Average neck pressure (kPa)	2.75	1.90	—	-31%	Comfort threshold ≤2.0	

Source: Drawn by the researcher.

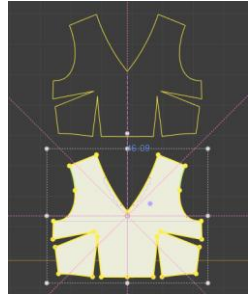
Silk fibers are long and slender with weak cohesive strength. Under the combined effects of self-weight and sewing tension, the collar is highly prone to slipping, resulting in “loose gaps” and wave patterns, which directly undermine the aesthetic core of traditional Chinese stand-up collars—subtle restraint and understated elegance. To achieve a balance between smooth luster and dignified order,

In terms of craftsmanship, an independent 1 cm inner lining is first created on the lining layer. After separating the layers, the manual “push, align, and pull” techniques are simulated to create hidden forces; a 0.4 cm seam allowance is set in the middle section, reducing the arc length by 3.2%, and the dart angle is

controlled to ≤8 to prevent hard creases on the glossy surface. Data validation and actual samples show that the distance from the shoulder line to the collar opening has decreased from 4.85 cm to 3.55 cm, with an error of ≤0.05 cm (see Table 2). The silk collar embeds the ethical concept of “concealment” from the Ming Dynasty within its smooth luster, continuing the manual “retraction and pulling” rhythm within digital ease allowance, achieving the triple unity of “concealed form, elegant color, and lightweight functionality.” This provides a replaceable “silk rhythm” paradigm for the modern interpretation of traditional attire.

5.3 Optimization of cotton fabric necklines

Table 3: Optimization process for cotton fabric necklines

indicator	key parameters	numerical value	unit	Objective	Virtual simulation and physical prototyping
Fabric structure	Plain weave/twill weave	—	—	Ensure breathability	 
Sticker composite	Sticker thickness	0.2	mm	Stiff but not rigid	
Micro-collection province	Reduce consumption	0.4	cm	Provide rebound reserves	
segmented sewing	Concentrated consumption period	Paragraph 2	—	Collar shaping	
pre-shrinking treatment	Temperature × Time	60 °C × 15	min	Shrinkage control ≤1%	
Post-processing	setting temperature	60–70	°C	Thermoplastic memory	
reinforcement line	polyester-cotton blend	5–10	% Polyester	Anti-curling and wear-resistant	

Source: Drawn by the researcher.

Cotton fibers have a spiral ribbon-like structure, featuring a large surface area and high porosity, which results in exceptional moisture-ticking and habitability: even when moisture absorption reaches 20%–25% of its own weight, it retains excellent strength. However, it lacks elasticity and is prone to plastic deformation. By comprehensively controlling the mechanical properties, structural composition, composite processes, and post-treatment of cotton fibers, this study seamlessly integrates the skin-friendly habitability of cotton with the aesthetic appeal of a Chinese-style stand-up collar. This not only eliminates the hollow and sagging issues of traditional cotton collars but also achieves a “sharp yet not stiff” everyday Chinese-style silhouette suitable for both commuting and casual settings.

In terms of fabric structure and tape composite process, plain or twill “half-embryo” base fabric is selected, combined with light lining, and a 0.2 mm tape is bonded on the inner side, enabling the cotton fabric to maintain breathability while enhancing stiffness. By incorporating micro-stress reserves created through 0.4 cm darts in the middle section of the tape using stretching tools, and concentrating the tension at the collar tip through segmented sewing, the collar maintains the elegance of a stand-up collar at a 4.5 cm collar height while also fully springing back, resulting in an approximately 15% increase in neck mobility.

Considering the impact of cotton fabric's tendency to shrink, colorfastness, and dimensional stability on the collar's durability, a 60°C pre-shrinking wash (15 minutes) and drying can be added before collar piece production to achieve thermal plastic memory after 60–70°C steam setting. To enhance durability, local reinforcement stitching can be added to the collar's high-wear areas to prevent curling. Using polyester-cotton blended yarn (5%–10% polyester) for reinforcement ensures the collar retains its crisp shape even after repeated wear, sweat stains, and friction (see Table 3).

6. Discussion

The core of traditional collar aesthetics does not stem from the absolute height or strict symmetry of the collar opening, but rather relies on the dynamic balance between “enclosure and openness” to achieve a harmonious blend of subtlety and tension. By moderately lowering the collar height and incorporating magnetic closure design into the structure, the design not only preserves the restrained elegance of traditional Chinese collars but also incorporates modern functional requirements such as ease of wearing, removal, and adjustment. This innovation creates a dialogue between the static visual appeal and dynamic experience of the collar, providing a feasible path for collar design to transition from a “decorative symbol” to an “interactive interface.” Feedback from cultural focus groups further confirms that when modern women perceive the collar as an “adjustable interface” that engages with their emotional state and social context, their acceptance of new opening mechanisms and height adjustments significantly increases, indicating a positive interaction between design innovation and audience psychology.

From the perspective of translating traditional Chinese clothing aesthetics into design, this innovative design also reflects a deep understanding of traditional clothing culture and its modern interpretation. As Chu Yan emphasized in her work on the inheritance and innovation of traditional Chinese clothing aesthetics, she focuses on the restoration and research of ancient classic garments, the exploration and organization of traditional craftsmanship, and attempts to combine traditional craftsmanship with modern design concepts, thereby revitalizing traditional clothing culture in contemporary society. Additionally, research has found that individual neck type differences significantly influence the visual effect and comfort of collars. Different neck types, such as round necks, wide necks, and long necks, exhibit varying sensitivities to parameters like collar tilt angle, inner

button position, and opening force, indicating that a one-size-fits-all design cannot accommodate diverse body types. Future work could leverage machine learning and 3D scanning technology to construct a human body data model based on neck shape characteristics, automatically recommending the optimal collar height and opening structure, thereby achieving true personalized customization. This method not only enhances wearing comfort but also has the potential to reduce the number of large-scale sample runs and material waste. This concept of personalized customization aligns with the traditional Chinese clothing philosophy of “tailoring to fit the body,” reflecting a focus on and respect for individual differences.

In terms of fabric selection, while silk/nylon blended structures excel in stiffness, luster, and elasticity, their textile and dyeing processes involve high energy consumption and chemical additive usage, limiting their sustainability potential. Organic cotton/recycled polyester composite fabrics have a more favorable ecological footprint but still have room for improvement in elasticity and tactile smoothness. Future research should employ life cycle assessment (LCA) methods to quantitatively compare the environmental impacts of different fabric combinations across all stages—from raw material acquisition, production and processing, use and maintenance, to disposal—and seek a more optimal balance between aesthetic demands, functional performance, and sustainability. This will provide a systematic, actionable material decision-making framework for new Chinese-style women's collar design.

This aligns with the traditional Chinese clothing philosophy of “making the most of materials” and meets modern society's requirements for sustainable development. For example, helium, a highly promising sustainable material derived from the root system of mushrooms, is biodegradable and compostable, completing its biodegrade within 45 days without leaving any traces. It can be used to create decorative elements or linings for collars, offering both environmental benefits and a natural texture and unique patterns to the design. Additionally, organic cotton, with its renewable and low-environmental-impact properties, is widely used in collar design. Its natural softness and habitability ensure comfort while reducing reliance on chemical pesticides and fertilizers. Recycled fibers, such as recycled polyester and recycled nylon, are produced from recycled plastic bottles and other waste materials, reducing reliance on petroleum resources, lowering energy consumption, and minimizing greenhouse gas emissions. These fibers also match the performance of traditional fibers, offering excellent strength and durability, making them suitable for creating collar support structures or outer fabrics. The application of these sustainable materials not only meets the aesthetic and functional requirements of collar design but also demonstrates a commitment to environmental and social responsibility, driving the apparel industry toward a more sustainable future.

7. Conclusions

This study focuses on the optimization and innovation of women's collar design within the aesthetic framework of traditional Chinese clothing. Addressing the disconnect between the functional and aesthetic aspects of traditional collars in a modern context, the research employs literature review and experimental exploration to propose a series of innovative strategies. The study found that the ritualistic symbols and aesthetic concepts of traditional collars have a profound influence on the functionality and emotional experience of contemporary women's collars. For

example, the ethical dialectic of “concealment and revelation” in Ming Dynasty attire influenced the symbolic relationship between collar height, opening angle, and the construction of women's identity. Through structural optimization, material innovation, and process improvements, the study developed collar compensation techniques, segmented tension control for inner linings, and post-processing shaping processes based on virtual simulation and physical prototyping across three representative fabrics: chiffon, silk, and cotton. These innovations balance the traditional aesthetic intent of “modesty and dignity” while accommodating modern women's comfort and mobility needs in both commuting and leisure settings. This research provides an integrated framework for women's collar design that combines “body-culture-technology,” enabling traditional collars to retain their cultural depth while meeting the diverse identity and scenario-based dressing needs of modern women. It promotes the inheritance and innovation of traditional Chinese clothing elements in contemporary times and provides a systematic, implementable material decision-making framework and practical paradigm for new Chinese-style women's collar design.

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