Research on the collar-placket shape of modern vests and the inheritance of digital fashion matching

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ABSTRACT – REZUMAT

Research on the collar-placket shape of modern vests and the inheritance of digital fashion matching

The vest is a traditional clothing item in China that has been continuously used to the present day. It is highly practical, diverse in form, lightweight, flexible, and suitable for a wide range of occasions. Based on 81 physical objects and 76 historical image materials of modern vests collected by the Jiangnan University Folk Costume Museum as research samples, the study compares the evolution of vests, collar-placket shapes, and the evolution of wearing and matching through a triple-evidence methodology: physical surveying, historical imagery, and archival documentation. The study reveals that during the late Qing Dynasty and early Republic of China periods, popular stand-up collar styles of modern vests included single-breasted placket, pipa placket, front-opening placket, pair placket, and herringbone placket. The traditional continuation of the round-collar placket includes the single-breasted placket, pipa placket, front-opening placket, wavy single-breasted placket, pair placket, eight-character front placket, shoulder-opening placket, and no front placket. Additionally, special collar forms that reflect a blend of Chinese and Western styles include a square-collar front-opening placket, a boat-shaped collar with a shoulder-opening placket, a heart-shaped open collar with a slanting front, and a pullover collar. The research clarifies that vest wearing and matching evolved from the late Qing Dynasty combinations, such as vests worn with Manchu-style clothing, traditional long gowns and skirts, and traditional Chinese jackets and trousers, to the Republic of China era, where vests were commonly paired with cheongsams and inverted big sleeve suits. The AHP fuzzy comprehensive evaluation method has proven effective in assessing the digital display of modern vest-wearing forms, offering new insights into the preservation and inheritance of modern vest culture.

Keywords: *modern vest, vest evolution, collar-placket shape, digital wearing matching, fuzzy comprehensive evaluation method*

Studiu privind forma gulerului și a fentei de închidere a vestelor moderne și transmiterea tradiției potrivirii digitale în domeniul modei

Vesta este o piesă vestimentară tradițională din China, care a fost folosită în mod continuu până în prezent. Este extrem de practică, are forme variate, este ușoară, flexibilă și potrivită pentru o gamă largă de ocazii. Bazat pe 81 de obiecte fizice și 76 de materiale imagistice istorice reprezentând veste moderne, colectate de Muzeul Costumelor Populare al Universității Jiangnan ca eșantioane de cercetare, studiul compară evoluția vestelor, a formelor gulerului și a modului de purtare și asortare prin intermediul unei metodologii bazate pe trei tipuri de dovezi: studii fizice, imagini istorice și documentație de arhivă. Studiul relevă faptul că, în perioada de la sfârșitul dinastiei Qing și începutul Republicii Chineze, stilurile populare de guler ridicat ale vestelor moderne includeau gulerul cu fentă simplă, fenta „pipa”, fenta cu deschidere frontală, fenta dublă și fenta în zig-zag. Printre variantele tradiționale ale gulerului rotund care s-au păstrat se numără gulerul cu fenta simplă, fenta „pipa”, fenta cu deschidere frontală, fenta ondulată simplă, fenta dublă, fenta frontală în formă de opt, fenta cu deschidere la umăr și fenta fără deschidere frontală. În plus, formele speciale de guler care reflectă o îmbinare a stilurilor chinezesc și occidental includ gulerul pătrat cu fentă cu deschidere frontală, gulerul în formă de barcă cu fentă cu deschidere la umăr, gulerul deschis în formă de inimă cu partea frontală înclinată și gulerul tip pulover. Cercetarea arată că modul de purtare și asortare a vestelor a evoluat de la combinațiile din perioada târzie a dinastiei Qing, precum vestele purtate cu ținute în stil manciurian, rochiile lungi și fustele tradiționale, precum și jacheta și pantalonii tradiționali chinezești, până în epoca Republicii Chineze, când vestele erau asortate în mod obișnuit cu cheongsam-urile și costumele cu mâneci largi răsucite. Metoda de evaluare cuprinzătoare fuzzy AHP s-a dovedit eficientă în evaluarea reprezentării digitale a formelor moderne de purtare a vestelor, oferind perspective noi asupra conservării și moștenirii culturii moderne a vestelor.

Cuvinte-cheie: *vestă modernă, evoluția vestei, forma gulerului și a fentei, asortarea digitală a ținutelor, metodă cuprinzătoare de evaluare de tip fuzzy*

INTRODUCTION

Vest, also known as “Kanjian” or “close-fitting”, evolved from military uniforms and serves as a general term for multi-button sleeveless shirts. During the Qing Dynasty, the vest was referred to as “Junjikan”, and among the Manchu people, it was called “Batu Lu Kanjian”. According to the “Qing Bei Lei Cao·Clothing”, it was recorded: “In the capital, the Batu Lu jacket was highly popular. When officials from various ministries met court officials, they often

wore this garment" [1]. The Batulu Kanjian was originally worn by important officials of the imperial court, and later became a semi-ceremonial dress. The modern vest is a type of clothing with high popularity and frequency of wear for both men and women. Its collar and front placket, as key components of the vest, play an important role in accentuating the beauty of the face and neck, and the shape of the collar and front placket also reflects the aesthetic tendency and artistic style of clothing in that era [2].

At present, academic discussion on vests mostly focuses on the design and shape [3, 4], decorative art [5] and manufacturing techniques [6]. However, there remains a lack of specialised studies on the collars and front plackets structures and wearing form of modern vests. In terms of digital display of clothing, examples include the spring outing painting of Lady Guo [7], Beauties Wearing Flowers [8] and the plain unlined silk gauze gown of the Mawangdui Han Dynasty Tomb [9]. The purpose of this paper is to measure and analyse the modern vest heirloom objects, explore their collar and front structure, and systematically sort out their dressing collocation. By integrating digital simulation technology with the visual display of modern vest wear, this study seeks to provide a new perspective for the design innovation and promotion of traditional Chinese vest styles.

METHOD

General scheme

This paper primarily examines the collar-placket shape of modern vests and the inheritance of digital fashion matching from three perspectives, as shown in figure 1. First, it traces the origin and development of the vest form and sorts out its development trajectory and evolution rules. Next, it delves into the collar-placket shape of modern vests; stand-up collars were prevalent during the late Qing Dynasty and early Republic of China periods, reflecting the characteristics of the era. The round collar shape continued the tradition, showcasing the inheritance of culture. Additionally, there were unique collar-placket shapes that blended Chinese and Western styles, reflecting cultural integration. In terms of digital fashion pairing and simulation effect evaluation for modern vests, the study examines the evolution of wearing matching, covering various combinations with garments such as Manchu-style clothing, traditional long gowns and skirts, traditional Chinese jackets and trousers, cheongsams and inverted big-sleeve suits, showcasing a wide variety of styles.

Furthermore, the simulation effect evaluation of digital matching is carried out, utilising three-dimensional simulation technology to present the matching effect of modern vests. The multi-level fuzzy comprehensive evaluation theory is introduced to construct a digital matching simulation effect evaluation system for modern vests. Through fuzzy comprehensive evaluation, the simulation effect of different matching forms is quantitatively analysed, providing a scientific basis for the research on the fashion matching of modern vests.

The origin and development of the form of the vest

Throughout multiple dynasties, the vest design primarily featured sleeveless, collarless, or short-sleeved, collarless upper garments [4]. Changes

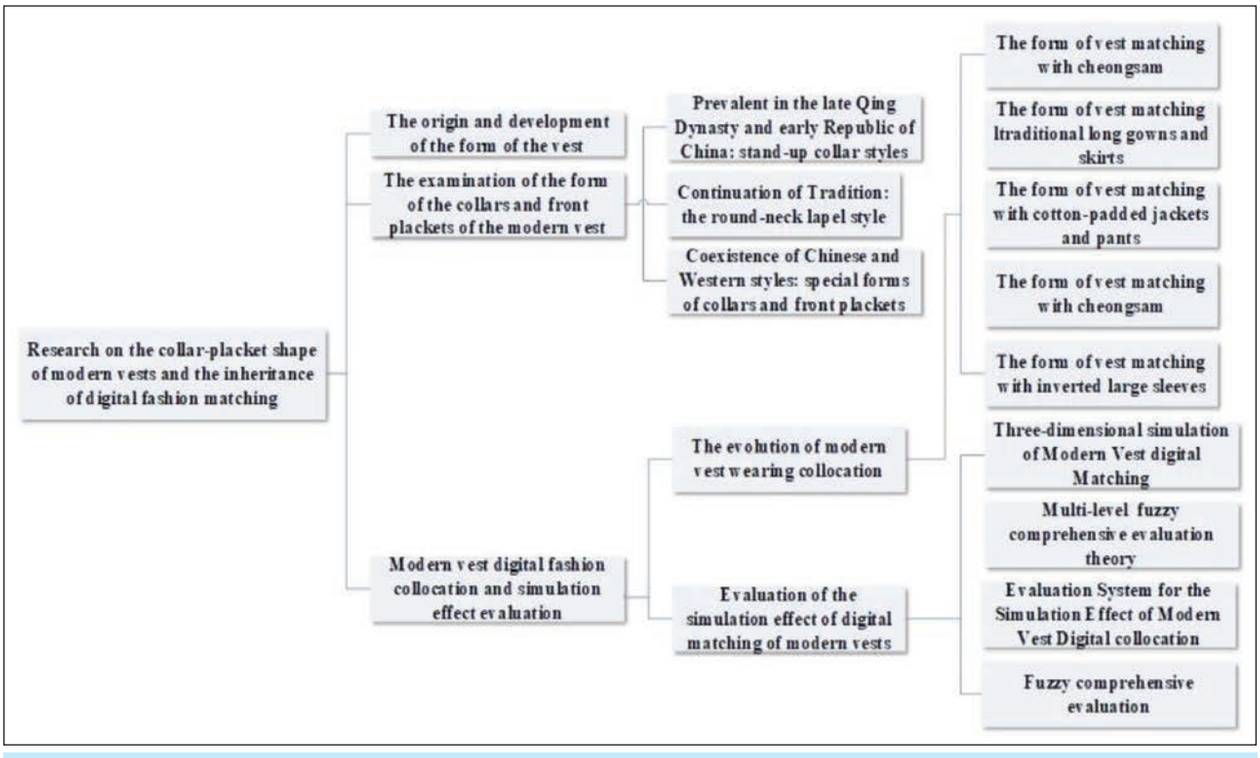


Fig. 1. Research on the collar-placket shape of modern vests and the technical route of digital fashion matching inheritance

occurred in the shape of the collar, the length of the sleeves, and the closure method of the vest. As shown in table 1, the earliest shape of the vest can be traced back to the military armour of the Qin Dynasty, establishing the basic shape of the sleeveless vest [10]. Based on sleeve length, the armour of the Qin Dynasty, the Qin-Han Dynasty's Liangdang, the Ming Dynasty's bijia, and the Qing Dynasty's vests all featured the modern sleeveless vest shape; From the shape of the collar, from the pre-Qin period to the Ming Dynasty, the mainstream collar styles included collarless, straight collar, vertical collar, crossed collar, and square collar, etc. By the Qing Dynasty, round collars and stand-up collars gradually became dominant; From the perspective of front placket shape, in the Song–Yuan Dynasty, Han–Mongol integrated dahu garments primarily adopted large plackets. During the Ming dynasty, the armour predominantly featured the pair plackets. The most distinctive feature of Qing-dynasty vests lies in the diversification of placket forms under Manchu–Han cultural integration. Judging from the overall shape of the collar-placket, the earliest collar-placket shapes of traditional vests were mostly cross-collar right placket, straight collar and pair plackets, round collar and slanted plackets, etc. By the Qing Dynasty, they primarily featured stand-up collars or round collars paired with various front placket shapes. This resulted in a uniquely distinctive Chinese-style vest shape that remains in use today and aligns with modern vest terminology. This shape also closely resembles the contemporary vest silhouette. During this evolutionary process, ancient vests underwent an important transformation from practical function to decorative expression.

A study of the collar-placket shape of the modern vest

"Shi Ming·Shi Yi Fu": "The collar is the neck, used to surround the neck. It is also called the 'overall collar,' as it forms the first part of the garment" [11]. "The collar is the most eye-catching part of clothing, surrounding the neck. It is an important factor in showing the overall shape of the garment" [12]. "Shi Ming·Shi Yi Fu": "Placket" means "closed off". "It is crossed in front, so as to prevent the wind and cold" [13]. The placket is the opening and closure of the garment [14]. It is designed to facilitate putting on and taking off the garment, and is an opening form. Its shape determines how the vest is worn. The front opening line is located at the front of the chest and abdomen, playing a crucial role in defining the overall style of the clothing [15].

Table 1

THE EVOLUTION OF VEST SHAPES IN THE PAST DYNASTIES

Name / Dynasty	The armour of the Qin Dynasty	Qin-Han Dynasty's Liangdang	The Northern and Southern Dynasties' Liangdang armour	Tang Dynasty's half-sleeve
Character outfit illustration				
Shape Illustration				
Name / Dynasty	The Song-Yuan Dynasty's dahu	Ming Dynasty's armour	The Ming Dynasty's bijia	The Qing Dynasty's vests
Character outfit illustration				
Shape illustration				

Through the analysis and organisation of 81 physical specimens and 76 image materials of modern vests from the Jiangnan University Folk Costume Museum and other institutions, modern vests exhibited diverse collar-placket shapes, comprising five shapes of stand-up collar and placket, eight predominant round collar placket shapes, and four unique collar-placket forms. From the regional distribution of modern vests, stand-up collar one-line plackets predominantly originated from Jiangnan; stand-up collar large plackets were common in Jiangnan and Shanxi; stand-up collar pair plackets were more prevalent in southern Fujian and northern Shanxi; round-collar plackets had widespread origins; while unique collar-placket forms were primarily from Shanxi and Shandong. Moreover, the collars and necklines of modern vests frequently employed decorative techniques such as edging. The wide variety of edging decorations and diverse craftsmanship contributed to a more structured silhouette.

Popular in the late Qing and early republican periods: the stand-up collar and placket shape

The origins of the stand-up collar can be traced back to the "vertical collar" of the mid-Ming Dynasty, which flourished during the late Qing Dynasty and early Republic of China, also known as the Chinese-style collar. The edges of the stand-up collar on modern vests typically feature trim, with a stiff lining sandwiched between the collar pieces to maintain a straight and upright appearance when worn. As shown in table 2, according to chronological development, five major combinations of vest collar–placket forms can be identified: first, the stand-up collar one-line placket from the early to mid-Qing dynasty, representing military practicality and aristocratic symbolism. The buttons are all fastened on the chest in a straight line, also known as the "multi-button vest". Initially, it was worn as ceremonial attire by royalty, princesses, and Manchu nobility, but later became popular among both men and women among the general populace. The second type is the stand-up collar pipa placket, which became common in the mid- to late Qing period as Manchu–Han integration extended traditional forms into civilian use. It is described in The Yangzhou Painting Boat Record: …Each wore a blue lotus cotton shirt with a reverse-curved collar structure. The lower right side of the collar was cut off to form a notch, which is known as a "pipa lapel" [16]. This was a type of slanting front placket with a missing panel, also known as a stand-up collar incomplete placket. Third, the stand-up collar large placket persisted from Han tradition into the Manchu-Han fusion era of the mid-to-late Qing. If the placket overlaps to the right, it is called a right front placket, and if it overlaps to the left, it is called a left front placket. In modern times, Han Chinese vests often feature a right front placket as a stylistic characteristic. Fourth, the stand-up collar pair placket emerged as unisex wear in the late Qing and early Republican era, constituting the largest proportion in terms of quantity. The garment panels align on both sides of the front placket when worn, with the left and right plackets parallel, suitable for layering beneath or over long robes, mandarin jackets, Cheongsams, or overcoats. The fifth type is the stand-up collar herringbone placket, characterised by decorative innovation from the late Qing to the Republican era. The herringbone placket has two structural forms: the first involves cutting the central sides of the front panel collar to create the opening, followed by stitching one placket edge; The other skips cutting, instead using lace or decoration to mimic a pair placket, giving the appearance of a double front. In both forms, the right side placket still serves the functional purpose of opening and closing [17]. The "herringbone placket" features a single button at the collar opening, with the lower sides of the collar slightly cut downward on both sides, causing the upper part of the placket to form a "human" shape, hence the name [18] was widely seen in modern women's vests and cheongsams.

Table 2

THE ANALYSIS RESULTS OF MODERN VEST STAND-UP COLLAR OPENING FORM

Type of collar-placket	Physical examples	Shape drawing	Number of items/ratio
Stand-up collar one-line placket			20 12.7%
Stand-up collar pipa placket			21 13.4%
Stand-up collar large placket			21 13.4%
Stand-up collar pair placket			28 17.8%
Stand-up collar herringbone placket			2 1.3%

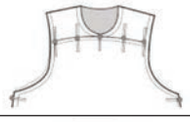
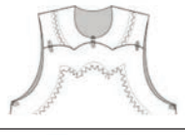
Continuation of tradition: round collar placket shape

The round collar, also referred to as the "panling", "tuanling", or "quling" in ancient texts, was prevalent during the Tang Dynasty and

inherited the tradition of collarless Hanfu. The round collar of the modern vest is usually reinforced with stiff interlining; most necklines are fitted with frog fastenings. In modern vests, the flat round collar is most common. When worn, it reveals the collars of the underlying aogua or cheongsam, creating a layered effect at the neckline. As shown in table 3, chronologically, eight major front-placket shapes can be identified. First, the round-collar large placket continues Han traditions in the early to mid-Qing period, as described in "Qing Bei Lei Chao · Clothing": "By custom the right hand is considered dominant, thus the right placket is called the large placket" [17]. In round-collar vests, the collar opening lies between the shoulder and neckline centre, with the placket arranged on the right side. Second, the round-collar pipa placket derived from Manchu riding and working garments in the mid to late Qing period, whose shape is quite similar to the large placket style. The placket surface resembles half a pipa (Chinese lute) cradled across the chest, hence the name "pipa placket". Third, the round-collar straight-line placket transitioned from military insignia to civilian wear in the late Qing and early Republican era. Due to the seven vertical buttons arranged horizontally along the front placket and three horizontal buttons arranged vertically along the side seams at the waist, totalling thirteen buttons, giving rise to the nickname "Thirteen Taibao"; fourth, a round-collar pair placket, which became the most prevalent during the late Qing and early Republican periods. The garment has two plackets opening symmetrically at the chest, making dressing and undressing convenient. Unrestricted by social rank, ethnicity, age or gender, it was widely worn by commoners and nobility alike among the Manchu, Mongol and Han peoples. Fifth, the decorative round-collar figure-eight placket of the mid-Republican era resembles the double-placket and straight-line placket shapes. The difference from the herringbone placket lies in the fact that the collar opening does not intersect with the double plackets at a single point, but instead the front placket is horizontally opened across the chest, resulting in an "eight-shaped" appearance; sixth, the round-collar wave-shaped placket combines decoration and functionality in the mid to late Republican period, with three frog buttons placed along a wavy line, one in the centre of the round collar, one on each side. The triple-fold curved line corresponds to three buttons, six fewer than the straight-line placket; Seventh, the round collar without placket of the late Republican period combines minimalism with functionality. Since there is no front placket, the collar curve is generally cut lower to facilitate putting on and taking off, and the front panel can display a complete auspicious pattern. This round collar without a placket is commonly seen in children's vests; the eighth, round-collar, shoulder-opening placket, blends functional and modernist exploration, also known as the shoulder-opening vest. It is primarily worn as innerwear for practical warmth. When worn in winter, they are lined with silk cotton. Due to its excellent warmth and universality across gender, age, and social class, it was widely popular in modern daily life.

Table 3

THE ANALYSIS RESULTS OF MODERN VEST ROUND COLLAR AND OPENING FORM

Type of collar-placket	Physical examples	Shape drawing	Number of items/ratio
Round-collar large placket			7 4.6%
Round-collar pipa placket			6 3.8%
Round-collar straight-line placket			6 3.8%
Round collar pair placket			32 20.4%
Round-collar figure-eight placket			1 0.6%
Round-collar wave-shaped placket			1 0.6%
Round collar without placket			1 0.6%
Round-collar shoulder-opening placket			2 1.3%

East-West coexistence: unique collar-placket form

With the influx of Western influences in modern times, the collar-placket shapes of women's vests became increasingly diverse, giving rise to forms that blended Chinese and Western elements. Westernised features appeared in collar-placket shapes, such as

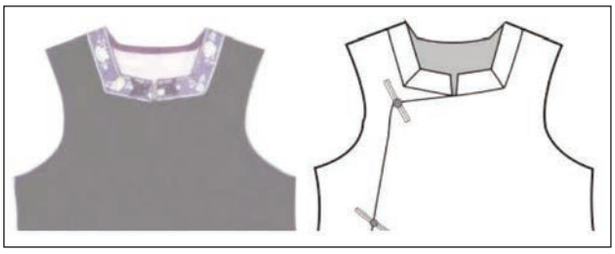


Fig. 2. Square-collar diagonal-placket vest collections and style



Fig. 3. Collections and style of boat-shaped collar and shoulder-opening placket vest

square collars, heart-shaped collars on shoulder-opening plackets, and oblique plackets. This reflected a coexistence of Eastern and Western elements, blending old and new. The square-collar diagonal-placket vest (figure 2) has square-shaped corners on both sides of the collar, with an opening at the centre front. It is a collarless form with a relatively deep and low neckline. Inside the square collar, one usually wears a standing-collar cheongsam or a cross-collar shirt. The boat-shaped collar emphasises the elegant combination of the neckline curve with the body's contours, giving the effect of lengthening the neck and refining the facial shape. The shoulder-opening placket extends from the edge of the boat-shaped neckline, following the collar and shoulder line, fastened at the shoulder with a horizontal button. This single-side opening at the shoulder seam allows for easy donning and removal (figure 3).

The heart-shaped collar slanted-placket vests adopt Western design principles with heart-shaped necklines. Figure 4 shows a black dark satin heart-shaped collar slanted-placket vest. The front placket features a slanted placket, while the neckline forms a heart shape. The lower hem with slits on both sides gradually tapers upward, giving the heart-shaped collar a delicate and refined appearance. Typically worn over a stand-collar cheongsam, it is suitable for young women. The through-head collar-placket originated from the typical attire of the Neolithic period, namely the pullover garment, representing the earliest form of collars. Mr Shen Congwen described the pullover garment in Research on Ancient Chinese Costume as: "an opening left at the upper centre for the head to pass through". This "central opening" served as the prototype for early collars, while the need to "allow the head to emerge" was the reason collars emerged. As shown in figure 5, it was a wrap-style vest, created by folding a rectangular piece of cloth and cutting an aperture to facilitate insertion of the head and neck. The garment panel is rectangular in cut, connected only at the right shoulder, with the left shoulder fastened by a button. These garments were generally small in size, primarily worn by infants and young children.

Modern vests digital fashion pairings and simulation effect evaluation

Though vests have existed since ancient times, they reached their peak popularity during the Qing Dynasty, worn by both men and women. Initially serving as an undergarment, their styles were relatively close-fitting. By the late Qing, styles became more varied, with refined edging and embellishments, and vests were often worn as outer garments. Entering the early Republican era, their shapes inherited Qing features, but decoration gradually Westernised, becoming shorter and more fitted, while still worn as outerwear. In the modern period, women's vest matching showcased far greater diversity. Presenting vest styling through digital virtualisation can more effectively showcase the varied expressions of women's attire matching across different social strata.

The evolution of modern vest wearing and matching

Early vests were decorated with black wide borders, limited to edging details like the collar and front placket, rarely employing embroidery or complex patterns. They were worn over long gowns or jackets, mostly shaped with stand collars and no sleeves. As society transformed, the occasions for wearing vests expanded further. Women often paired vests with inverted big-sleeve suits and long skirts, forming a typical new style of dress. At the same time, the integration of vests with Western-style garments began to emerge, with some women trying to combine vests



Fig. 4. Black dark satin heart-shaped collar slanted-placket vest collections and style



Fig. 5. Collections and style of the through-head collar-placket vest

with qipao or Western coats, reflecting a trend of Sino-Western aesthetic fusion.

Forms of vest matching with banner garments

In the early Qing dynasty, banner garments (qizhuang) were characterised by four-sided slits and narrow horse-hoof sleeves; at this time, vests served as functional outerwear. During the Qianlong reign, this prompted two major transformations in vest shape: firstly, the length extended to the knees, developing into the 'long vest'; secondly, it incorporated satin embroidery and multiple edging trims. In the late Qing period, under Manchu–Han cultural integration, fitted vests paired with banner garments exhibited diversified collar–placket shapes. As shown in type 6a, an old photograph of Su Guaerjia Youlan, the birth mother of Emperor Puyi, is a fitted banner dress with a stand-up collar, large placket, and floor-length hem. The low-standing collar and straight-fronted vest clearly retained Manchu sartorial traditions. Its silhouette was narrow and short, appearing more fitted compared to the wide robes and broad sleeves of Han attire. Manchu women cherished elaborate clothing styles, and vests were no exception. Their clothing matching emphasised a "multi-layered style", with vests worn over banner robes. The multi-layered contrasting trimmings occupied most of the vest's surface, embodying typical Qing craftsmanship and aesthetic features.

Forms of vest matching with gown and skirt

In the late Qing period, Han Chinese women continued the Ming-dynasty tradition of wearing an upper jacket and a lower skirt. Vests of this period retained the traditional loose-fitting style. The vest was worn over a wide women's gua, with a loose body and large cuffs, paired with a horse-face skirt. This ensemble exhibited a 'de-Manchuised' aesthetic, as illustrated in figure 6, a representation of women's vest collocation form in Qing figure paintings. The gua featured a wide cut and broad sleeves. When worn by women, the cuffs revealed the rolled sleeves of the undergarment. A capacious vest was layered atop; it could be matched with a horse-face skirt. After the Jiaqing and Daoguang reigns, the decorative edging on the collars and plackets of Han women's gua, as well as the edging on the collars and vests, tended to narrow. During this period, narrow decorative trims were in vogue. The overall outfit presented a relaxed and free-flowing silhouette. The fabric hung naturally, forming fluid and graceful folds that fully showcased the dignified and elegant static charm of Han Chinese attire.

The form of vest with cotton padded coat and pants

The combination of vests with Coat-and-Pants ensembles marked a transition from a three-layer to a two-layer clothing structure. The rise of pants was also linked to labour demands; before the Tongzhi era, working women predominantly wore coat-pants directly. By the Guangxu era, pants became widespread; By the Xuantong period, skirt wearers dwindled, with upper coats and pants becoming the dominant attire. Older women, maidservants, or northern women typically wore pants without skirts. A sleeveless vest was then layered over the long jacket, demonstrating the practical utility of pairing vests with cotton padded Coat and Pants. As shown in figure 6, in a late Qing photograph, a Han woman wears a brow-band on her head, a round-collar, large-placket cotton Coat with a wide cut, paired with trousers. The cotton Coat itself contains a cotton interlayer. Wearing the vest over the cotton Coat helped trap the static air within the cotton padding, thereby enhancing thermal insulation and cold resistance. The combination of the loose-fitting robe with its narrow sleeves and the tapered trousers reflected Han Chinese style while facilitating labour.

Vest pairings with inverted big sleeve suit

In the early 1920s, women in Shanghai were among the first to break away from traditional dress frameworks (figure 6). As autumn cooled, they frequently wore a vest extending below the calf over their robes and coats, replacing the function of a skirt. These vests typically featured a large placket, resembling a sleeveless cheongsam. As an outer garment substituting for skirts, it eliminated the need for additional skirts when worn over outer garments [19]. As shown in figure 6, the pairing of long vests with inverted-big-sleeve blouses in a 1920s calendar poster broke away from the traditional top-and-skirt feminine attire [20]. The pale orange plum blossom print on the long vest echoes the orange geometric print at the cuffs of the off-white inverted-sleeve blouse. The black lace trim on the stand-up collar large placket of the long vest harmonised with the black lace edging along the inverted-big-sleeve flared cuffs. The overall combination embodied an aesthetic of formal symmetry and resonance.

In fact, it was precisely this pairing of inverted-sleeve blouses and long vests that evolved into the later knee-length inverted-big-sleeve cheongsam style. The layering of long vest and inverted-big-sleeve blouse did not last long. Though warm in winter, it was stuffy in summer. Women cut away the blouse body, leaving only the sleeves attached to the vest shoulders, forming an integrated vest-cheongsam [21]. This design reduced layering while retaining the modesty of traditional robes and incorporating the convenience of Western-style dresses. It formed a unique "fusion of East and West" style. Another popular combination featured a short vest paired with an inverted-big-sleeve ensemble, creating the iconic look of the "New Woman". As seen on the cover of Liangyou Pictorial (figure 6). Over the straight-cut, rounded-hem jacket with inverted-big-sleeve, a fitted, stand-collared, large-placket vest was worn, exposing the flared sleeves. This demonstrates that women of the period were not confined to the simple pairing of tops with skirts, but instead flexibly layered vests of various styles.

Vest paired with Cheongsam

Following the widespread adoption of the Cheongsam, traditional constraints were entirely shed. As the cheongsam adopted a tightened waistline, a pairing



Fig. 6. Modern vest digital overall wear collocation display

of short vests with long cheongsams emerged [22]. Over time, their shape became increasingly Westernised, with colours and styles coordinated with the cheongsam [23]. As shown in figure 7 calendar poster, a black vest with dark floral patterns is paired with a blue cheongsam with black stripes, with sharp colour contrasts and clear layering. A white square-collared, large-placket vest worn with a standing-collar, large-placket cheongsam enhances the slenderness and grace of the woman's neck. A mid-sleeve, below-knee Chinese cheongsam combined with a fitted vest with a curved hem, paired with white leather high-heeled shoes, made the female figure appear more slender and carried a unique charm. The evolution of vest shape centred on the liberation of the female form, shifting from concealment to accentuating curves, mirroring society's redefinition of women's roles.

Evaluation of digital matching simulation effects of modern vests

Given the prominent role of modern women's vests in sartorial artistry, this paper employs CLO3D digital simulation technology to achieve an in-depth digital recreation of vest wearing forms. To ensure the credibility of simulated garments, the AHP fuzzy comprehensive evaluation method is utilised to validate the accuracy of simulation outcomes. The AHP method decomposes complex problems into multiple hierarchical levels, establishing the relative importance of factors through pairwise comparisons. This renders it suitable for evaluating multi-factor, multi-level digital vest matching. The fuzzy comprehensive evaluation



Fig. 7. The virtual display technology process of modern vest and cheongsam

method addresses ambiguity and uncertainty in the evaluation process, enabling a more accurate representation of the overall characteristics of digital vest matching. This approach aims to streamline the physical restoration process of modern vests and provide an intuitive representation of wearing effects. Simultaneously, the digital vest data facilitates storage, replication, and dissemination, enabling broader audiences to engage with traditional garments [24].

Three-dimensional simulation of modern vest digital matching

Through analysis and summary of vest styling in modern calendars and vintage photographs, six common vest styling forms are digitally presented. As illustrated in figure 7, using Republican-era calendar posters as reference: AI software first rendered patterns for a square-collar large-placket vest and a stand-collar large-placket cheongsam; ET software generated a pattern-drafting diagram; Photoshop rendered the subtle patterns and blue stripes. A virtual mannequin of 160 cm height was constructed based on modern female body measurements, with garment data meticulously reconstructed from historical artefacts and archival records. The garment pattern piece was then imported as a DXF file into a 2D view for fine-tuning, precisely positioned on the 3D mannequin, and virtually sewn according to garment construction. Further adjustments were made during virtual fitting to ensure high fidelity of pattern reproduction. Fabric properties were then analysed from extant artefacts to set restoration parameters, incorporating materials, colours, and patterns for enhanced realism. The final presentation showcased the virtual simulation pairing of waistcoat and cheongsam. The remaining six vest combinations underwent identical digital styling procedures for fashion presentation. This shows that through advanced 3D technology, traditional culture can be revitalised in the digital space, promoting the digital protection and display of cultural heritage [25].

Multi-level fuzzy comprehensive evaluation theory

To ensure the credibility of virtual simulation outcomes, four evaluation indicators are established: garment shape, detailed structure, fabric material, and garment craftsmanship [26]. In order to obtain a reasonable evaluation, the Analytic Hierarchy Process (AHP) is used to construct a judgment matrix and perform a consistency test to calculate the weights of the four indicators. The specific steps are as follows. Determination of the fuzzy evaluation matrix: Evaluate the indicators in u_i based on the n evaluation criteria in the evaluation set. Pairwise comparisons of elements in the matrix yield an n-order comparative judgment matrix $R_{i\times j}$ [27].

$$R_{i\times j} = \begin{pmatrix} r_{11} & r_{12} & r_{1\ldots} & r_{1j} \\ r_{21} & r_{22} & r_{2\ldots} & r_{2j} \\ r_{\ldots} & r_{\ldots} & r_{\ldots} & r_{\ldots} \\ r_{i1} & r_{i2} & r_{i\ldots} & r_{ij} \end{pmatrix} \quad (1)$$

Evaluation system of digital matching simulation effects of modern vest

The virtual reconstruction of modern vest ensembles employs a comprehensive approach, simulating key information such as overall structure, stylistic details, fabric characteristics, craftsmanship features, and wearing combinations based on physical artefacts, calendar cards, and historical photographs. To scientifically evaluate reconstruction outcomes, a three-tiered assessment framework, comprising target layer, criterion layer, and indicator layer, has been established, adhering to standard assessment paradigms. As shown in table 4, the target layer focuses on the digital matching and virtual reconstruction of modern vests. The criteria layer provides a comprehensive assessment framework across four dimensions: Garment shape u_1, Detailed structure u_2, Garment fabric u_3, and Garment craftsmanship u_4. The indicator layer refines the assessment content, including 14 indicators such as External silhouette u_{11}, Proportional allocation u_{12}, etc. To enhance the operational feasibility of the assessment system, concise 'evaluation criteria' have been added for each indicator at this level. For example, the evaluation criterion for external silhouette u_{11} is the degree of similarity between the overall ensemble silhouette of the reconstructed vest and that observed in the original reference materials, including the smoothness of the overall contour and proportional harmony.

Table 4

EVALUATION SYSTEM FOR DIGITAL-SIMULATED EFFECT OF MODERN VEST MATCHING

Target layer	Criterion layer	Indicator layer
Modern vest digital matching virtual restoration effect (U)	Garment shape u_1	External silhouette u_{11} Proportional allocation u_{12} Layered styling u_{13}
	Detailed structure u_2	Bodice structure u_{21} Sleeve structure u_{22} Collar structure u_{23} Hem structure u_{24} Front placket structure u_{25}
	Garment fabric u_3	Fabric colour u_{31} Fabric pattern u_{32} Fabric properties u_{33}
	Garment craftsmanship u_4	Patchwork technique u_{41} Fastening method u_{42} Embroidery/printing u_{43}

After constructing the evaluation system, it is necessary to determine the weight coefficients of each indicator. Different indicators exert varying influences on the assessment of modern waistcoat digital matching effects. This paper employs the Analytic Hierarchy Process (AHP) to calculate the weights of each indicator. Five experts specialising in modern costume evaluation were invited to apply a 1–9 point quantitative scoring system. Experts pairwise compared the importance of indicators across levels. Table 5 shows the linguistic scale of the 1–9 scoring standard.

Table 5

SCALE OF THE JUDGMENT MATRIX

Importance intensity	Definition	Content
1	Equal importance	Both indicators are equally important
3	Slightly important	The former is slightly more important than the latter
5	Clearly important	The former is clearly more important than the latter
7	Very important	The former is much more important than the latter
9	Extremely important	The former is much more important than the latter
2, 4, 6, 8	-	Between the adjacent indicators above
Reciprocal	-	If the importance ratio of indicator i to indicator j is a_{ij}, then the importance ratio of indicator j to indicator i is $a_{ij} = 1/a_{ij}$

Based on the scoring results from five experts, the judgment matrices G can be obtained: G_1 is the pairwise comparison judgment matrix for factors (u_1,u_2,u_3,u_4) under the objective layer; G_{21} is the pairwise comparison judgment matrix for the subordinate factors (u_{11},u_{12},u_{13}) of u_1; G_{22} is the pairwise comparison judgment matrix for the subordinate factors $(u_{21},u_{22},u_{23},u_{24},u_{25})$ of u_2, G_{23} is the pairwise comparison judgment matrix for the subordinate factors (u_{31},u_{32},u_{33}) of u_3, and G_{24} is the pairwise comparison judgment matrix for the subordinate factors (u_{41},u_{42},u_{43}) of u_4. For example, the matrix obtained from the scoring results of the first expert:

$$G_1 = \begin{pmatrix} 1 & 2 & 3 & 2 \\ \frac{1}{2} & 1 & 1 & 3 \\ \frac{1}{3} & 1 & 1 & 1 \\ \frac{1}{2} & \frac{1}{3} & 1 & 1 \end{pmatrix} \quad G_{21} = \begin{pmatrix} 1 & \frac{1}{3} & \frac{1}{2} \\ 3 & 1 & 2 \\ 2 & \frac{1}{2} & 1 \end{pmatrix}$$

$$G_{22} = \begin{pmatrix} 1 & 4 & 5 & 5 & 4 \\ \frac{1}{4} & 1 & \frac{1}{2} & 1 & \frac{1}{5} \\ \frac{1}{5} & 2 & 1 & 4 & \frac{1}{2} \\ \frac{1}{5} & 1 & \frac{1}{4} & 1 & \frac{1}{5} \\ \frac{1}{4} & 5 & 2 & 5 & 1 \end{pmatrix} \quad (2)$$

$$G_{23} = \begin{pmatrix} 1 & \frac{1}{3} & 2 \\ 3 & 1 & 3 \\ \frac{1}{2} & \frac{1}{3} & 1 \end{pmatrix} \quad G_{24} = \begin{pmatrix} 1 & 5 & \frac{1}{2} \\ \frac{1}{5} & 1 & \frac{1}{5} \\ \frac{1}{2} & 5 & 1 \end{pmatrix}$$

The eigenvector method is used to calculate weights. Taking matrix G_1 as an example, its largest eigenvalue is $\lambda_{max} = 4.1752$, yielding the corresponding weight vector $w = (0.4198, 0.2600, 0.1725, 0.1477)$.
Calculations proceed as follows:

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (3)$$

where CI denotes the consistency index, and n represents the order of the matrix. The calculation yields $CI = 0.0584$. Given $RI = 0.90$, the consistency ratio is obtained as $CR = CI/RI = 0.0649 < 0.1$, thus passing the consistency test [28]. As a result, the weight coefficients of the first-level indicators were calculated as W = (0.4198, 0.2600, 0.1725, 0.1477). Using the same method, the weight coefficients for the second-level indicators are obtained. By synthesising the expert evaluation results, the weight coefficients for each indicator are derived, as shown in table 6.
From the table data, we obtain W = (0.3820, 0.1961, 0.2536, 0.1683), w1 = (0.3108, 0.3361, 0.3531), w2 = (0.4341, 0.0982, 0.1613, 0.0856, 0.2208), w3 = (0.2861, 0.5331, 0.1808), w4 = (0.3908, 0.1374, 0.4718). Therefore, the four evaluation indicators are ranked by importance as follows: Garment Shape > Garment Fabric > Detailed Structure > Garment Craftsmanship; Layered styling > Proportional allocation > External Silhouette; Bodice structure > Front Placket Structure > Collar Structure > Sleeve Structure > Hem Structure; Fabric Pattern > Fabric Colour > Fabric Performance; Embroidery & Printing > Patchwork Technique > Fastening Method.

Fuzzy comprehensive evaluation

After determining the weight coefficients for primary and secondary indicators using the Analytic Hierarchy Process (AHP), a questionnaire survey method was employed to evaluate each element within the secondary indicators. This ensured a high degree of objectivity in the digital matching simulation restoration of modern vests. The questionnaire employed a 1–5 evaluation scale, V = (V1, V2, V3, V4, V5) = (Excellent, Good, Average, Poor, Very Poor). The survey primarily targeted university students with knowledge of ancient attire and virtual clothing. A total of 243 questionnaires were distributed, with 233 valid responses collected, yielding a valid response rate of 95.9%. The compiled statistical results of the evaluations are presented in table 7.
Based on the statistical results, the single-factor fuzzy comprehensive evaluation matrix for secondary indicators is obtained:

$$R_1 = \begin{pmatrix} 0.39 & 0.46 & 0.12 & 0.01 & 0.02 \\ 0.36 & 0.55 & 0.07 & 0.02 & 0 \\ 0.41 & 0.53 & 0.05 & 0 & 0.01 \end{pmatrix}$$

$$R_2 = \begin{pmatrix} 0.38 & 0.44 & 0.11 & 0.04 & 0.03 \\ 0.35 & 0.56 & 0.07 & 0.02 & 0 \\ 0.43 & 0.47 & 0.08 & 0 & 0.02 \\ 0.41 & 0.50 & 0.06 & 0.03 & 0 \\ 0.33 & 0.54 & 0.12 & 0.01 & 0 \end{pmatrix}$$

$$R_3 = \begin{pmatrix} 0.36 & 0.57 & 0.04 & 0.01 & 0.02 \\ 0.33 & 0.53 & 0.10 & 0.03 & 0.01 \\ 0.43 & 0.47 & 0.08 & 0.02 & 0 \end{pmatrix} \quad (4)$$

$$R_4 = \begin{pmatrix} 0.42 & 0.51 & 0.05 & 0.02 & 0 \\ 0.40 & 0.43 & 0.13 & 0.01 & 0.03 \\ 0.39 & 0.44 & 0.14 & 0.03 & 0 \end{pmatrix}$$

Each row R_i represents the evaluation of the simulation effect of modern vest digital matching, examining the membership degrees of fuzzy subsets at different levels from various factors. According to multi-level fuzzy comprehensive evaluation theory, the matrices R_i were combined with the corresponding fuzzy weight vectors to yield the fuzzy evaluation results B [29].

Table 6

WEIGHT COEFFICIENTS OF EVALUATION INDICATORS FOR THE DIGITAL SIMULATION OF MODERN VEST MATCHING

Primary indicator	Weight	Second-level indicator	Weight	Comprehensive weight
Garment shape u_1	0.3820	External silhouette u_{11}	0.3108	0.1187
		Proportional allocation u_{12}	0.3361	0.1283
		Layered styling u_{13}	0.3531	0.1348
Detailed structure u_2	0.1961	Bodice structure u_{21}	0.4341	0.0851
		Sleeve structure u_{22}	0.0982	0.0192
		Collar structure u_{23}	0.1613	0.0316
		Hem structure u_{24}	0.0856	0.0167
		Front placket structure u_{25}	0.2208	0.0432
Garment fabric u_3	0.2536	Fabric colour u_{31}	0.2861	0.0725
		Fabric pattern u_{32}	0.5331	0.1351
		Fabric performance u_{33}	0.1808	0.0458
Garment craftsmanship u_4	0.1683	Patchwork u_{40}, Technique u_{41}	0.3908	0.0657
		Fastening method u_{42}	0.1374	0.0231
		Embroidery/printing u_{43}	0.4718	0.0794

Table 7

STATISTICAL RESULTS OF EVALUATION FOR MODERN VEST DIGITAL MATCHING SIMULATION EFFECTS						
Criterion Layer	**Target Layer**	**Excellent**	**Good**	**Average**	**Poor**	**Very Poor**
Garment shape u_1	External silhouette u_{11}	0.39	0.46	0.12	0.01	0.02
	Proportional allocation u_{12}	0.36	0.55	0.07	0.02	0
	Layered styling u_{13}	0.41	0.53	0.05	0	0.01
Detailed structure u_2	Bodice structure u_{21}	0.38	0.44	0.11	0.04	0.03
	Sleeve structure u_{22}	0.35	0.56	0.07	0.02	0
	Collar structure u_{23}	0.43	0.47	0.08	0	0.02
	Hem structure u_{24}	0.41	0.50	0.06	0.03	0
	Front placket structure u_{25}	0.33	0.54	0.12	0.01	0
Garment fabric u_3	Fabric colour u_{31}	0.36	0.57	0.04	0.01	0.02
	Fabric pattern u_{32}	0.33	0.53	0.10	0.03	0.01
	Fabric properties u_{33}	0.43	0.47	0.08	0.02	0
Garment craftsmanship u_4	Fabric patchwork u_{41}	0.42	0.51	0.05	0.02	0
	Fastening method u_{42}	0.40	0.43	0.13	0.01	0.03
	Embroidery/printing u_{43}	0.39	0.44	0.14	0.03	0

Based on the formula $B_i = w_i \cdot R_i$, the fuzzy comprehensive evaluation results for secondary indicators can be calculated:

$$B_1 = w_1 \cdot R_1 = (0.3108 \;\; 0.3361 \;\; 0.3531) \cdot \cdot \begin{pmatrix} 0.39 & 0.46 & 0.12 & 0.01 & 0.02 \\ 0.36 & 0.55 & 0.07 & 0.02 & 0 \\ 0.41 & 0.53 & 0.05 & 0 & 0.01 \end{pmatrix} =$$

$$= (0.3870 \;\; 0.5150 \;\; 0.0785 \;\; 0.0098 \;\; 0.0097) \quad (5)$$

Similarly:

$$B_2 = w_2 \cdot R_2 =$$

$$= (0.3766 \;\; 0.4838 \;\; 0.0992 \;\; 0.0241 \;\; 0.0162),$$

$$B_3 = w_3 \cdot R_3 =$$

$$= (0.3576 \;\; 0.5306 \;\; 0.0792 \;\; 0.0225 \;\; 0.0110), \quad (6)$$

$$B_4 = w_4 \cdot R_4 =$$

$$= (0.4031 \;\; 0.4660 \;\; 0.1035 \;\; 0.0233 \;\; 0.0041)$$

In summary, the simulation results of modern vest digital matching across all dimensions demonstrate satisfactory performance, with the following specific percentages: Attribute of garment shape 51.50%; Detailed structural accuracy 48.38%; Garment fabric 53.06%; Garment craftsmanship 46.60%. Based on the weight vector $W = (0.3820, 0.1961, 0.2536, 0.1683)$ for the primary indicators, the evaluation results for the simulation effect of modern vest digital matching are calculated as follows:

$$Z = W \cdot B = W \cdot \begin{pmatrix} B_1 \\ B_2 \\ B_3 \\ B_4 \end{pmatrix} = (0.3820, 0.1961, 0.2536, 0.1683) \cdot$$

$$\cdot \begin{pmatrix} 0.3870 & 0.5150 & 0.0785 & 0.0098 & 0.0097 \\ 0.3766 & 0.4838 & 0.0992 & 0.0241 & 0.0162 \\ 0.3576 & 0.5306 & 0.0792 & 0.0225 & 0.0110 \\ 0.4031 & 0.4660 & 0.1035 & 0.0233 & 0.0041 \end{pmatrix} =$$

$$= (0.3802 \;\; 0.5046 \;\; 0.0869 \;\; 0.0181 \;\; 0.0104) \quad (7)$$

The fuzzy comprehensive evaluation yields Z with membership degrees of 38.02%, 50.46%, 8.69%, 1.81%, and 1.04%. Applying the maximum membership principle, the simulation effect of the modern vest digital matching is rated as “Good”.

CONCLUSION

The traditional Chinese vest shape has evolved over nearly two millennia. Owing to its simple shape, ease of wearing, practicality, and distinctive decoration, it holds a unique place among historical garments. Due to its high practical value, the form of the Chinese vest has persisted to this day. In modern times, the sleeveless vest’s primary variations lie in the collar-placket. Traditional vest collar-plackets featured straight collars, square collar front-opening plackets, or crossed collars with a slanting front, while modern collar-placket combinations became more varied without fixed patterns. Nevertheless, stand collars and round collars persisted due to their broad adaptability. Among them, the stand-up collar pair placket was the most prevalent, followed by the stand-up collar large placket, the pipa-style placket, and the one-line placket, all serving as foundational styles of the modern vest. The distinctive stand-up collar herringbone placket was predominantly worn by women, with only two surviving examples. Round-neck vests offer the widest range of front-opening combinations, with eight distinct styles possible. While any opening placket style can be paired, the pair placket remains the most common. Followed by the round-collar large placket, the one-line placket, and the pipa placket. Among these, the round-collar wave-shaped placket, the eight-character front opening placket, the placket without a front opening, and the shoulder-opening placket offered greater convenience. Vests featuring distinctive collar-placket shapes, such as square collar slanted plackets and full-head-through collar-plackets, exhibit Sino-Western fusion characteristics.

Only nine such vests exist, accounting for approximately 5.7% of the total. This demonstrates that modern vests exhibited diverse collar-placket shapes, with numerous innovative and distinctive collar-placket styles emerging alongside common basic models. Modern women's vest styling exhibited greater diversity than men's. Pairings included long vests with inverted big sleeve blouses; skirt-and-vest combinations like vests over inverted big sleeve blouses with tube skirts, or vests over female-style gua with horse-face skirts; and vest-and-trouser ensembles such as vests over female-style cotton coats with drawstring trousers. And combinations of vests with cheongsams, or vests paired with cheongsams and inverted big sleeve blouses; these configurations formed a crucial transitional phase leading to the later development of vest-cheongsams and inverted big sleeve cheongsams styles. Modern vests are suitable for both winter and summer wear, featuring diverse collar-placket shapes and dressing style options, and they were presented using digital virtual simulation. Finally, an integrated evaluation model for vest digital matching restoration was established using the Analytic Hierarchy Process (AHP) and fuzzy comprehensive evaluation. Results indicate that the AHP-fuzzy approach combines qualitative and quantitative analysis with strong scientific rigour, yielding highly credible evaluation outcomes. This significantly enhances the visualisation of vest wear-matching and offers innovative application insights for contemporary new Chinese-style clothing design. Digitalisation will drive multi-dimensional innovation within the traditional vest industry. Through holographic projection, users may virtually examine vest structures and dynamically try them on, simulating historical settings to enrich cultural experiences. AI algorithms generate design proposals based on user data, with rapid customisation achieved via 3D printing or intelligent cutting, advancing the "one pattern per person" model. The digital transformation of traditional vests will deeply integrate into daily life, bridging history, the future, culture and technology.

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