




## Cross-Cultural Applications of Big Data and Artificial Intelligence in Fashion Design

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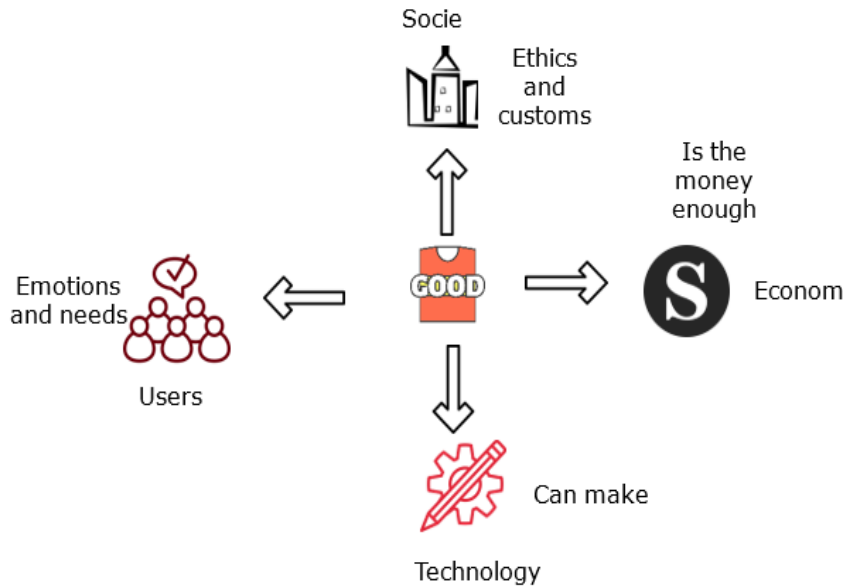
**Abstract.** A major trend in fashion design is to realize the transformation from human design to intelligent design. The article first discusses the problems in the field of fashion design. (1) Lack of innovation in clothing design; lack of independent style (2) single sales channel; lack of adequate market research; (3) lack of innovation awareness of clothing producers; and low awareness among clothing property rights protection. To solve these problems, our innovative clothing production platform based on big data and artificial intelligence has shifted the heavy clothing manufacturing work from humans to machines, which has liberated productivity to a certain extent and allowed clothing design companies to focus more on clothing design innovation development. The clothing design information platform based on big data and artificial intelligence can provide clothing designers with high-value density information, design efficiency, and design accuracy, thereby fundamentally improving clothing design.

**Keywords:** big data, artificial intelligence, clothing design, Cross-Cultural Applications.  
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### 1 INTRODUCTION

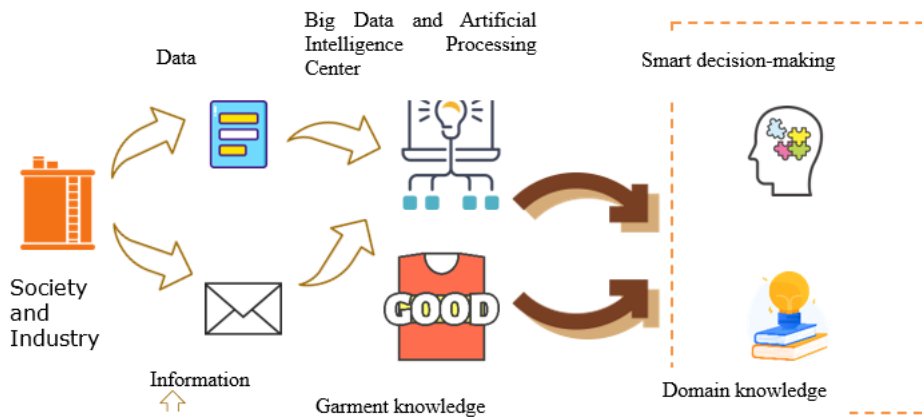
With the changes of the times, clothing is not only for shelter from the cold but also a reflection of social value. The shift in fashion design style reflects the progress of the social economy and the improvement of social, humanistic quality. In the late Paleolithic period, 40,000 to 40,000 years ago, clothing design was further developed. People began to use simple tools to make clothes to decorate themselves, and clothing design grew significantly. The third stage is after the end of the Ice Age in the fourth quarter. The manufacture and production of fibers opened the development process of clothing design in the true sense. In a broad sense, fashion design includes many processes. Fashion designers use computer software according to their domain knowledge to show and present their ideas to users, modify them according to user needs, and finally carry out the whole manufacturing process according to drawings [18-23]. There are two modes of modern clothing design. In engineering clothing design, more emphasis is placed on rational analysis, the overall aesthetics of the design, and designing products that meet the aesthetics of the public. Fashion design is not only an industry in modern society but also a combination of culture and creativity, as well as material and production. Fashion design is limited by various factors, including social development level,

personal purchasing power, emotional and cognitive ability, aesthetic development level, and the needs of socioeconomic conditions [4-10]. The demand elements for clothing design are shown in Figure 1.



**Figure 1:** Requirement elements of clothing design.

Big data is a collection of massive amounts of data. Traditional data analysis and processing cannot be used to capture the knowledge contained in the data. New data processing models must obtain, utilize, and process data and transform low-value density data into high-value data after processing—high-density data. Big data can be used for decision analysis, production process optimization, analysis organization, etc. Data is the core resource of big data and the source of its value. Big Data shows the value of data through data processing. The processing process of big data mainly includes data screening processing, data deep processing, and critical information extraction, which can achieve helpful information from a large amount of low-value density data and meet work requirements. The rapid evolution of machine learning algorithms has brought artificial intelligence to many applications in robotics, image recognition, and decision support. The development of artificial intelligence technology has also brought about the improvement of computer computing and data processing capabilities, allowing computers to have a more vital ability to process big data. Artificial intelligence and big data are closely related. The combination of massive data from big data and deep learning algorithms from artificial intelligence has a more vital ability to analyze and process data. It can process information and capture knowledge more quickly, bringing a series of industries to ecological change. Big data and artificial intelligence are widely used in various fields, and clothing design is no exception. By analyzing different elements of clothing design and user information, big data screens out clothing elements that meet the public's aesthetics, meet the needs of the public, and have aesthetic characteristics, thereby helping the clothing design industry. The application mode for integrating technologies such as big data and artificial intelligence into the field of clothing design is shown in Figure 2 [12-13].



**Figure 2:** The application mode of intelligent technology in clothing design.

## 2 DEVELOPMENT STATUS OF FASHION DESIGN INDUSTRY

### 2.1 Clothing Design Lacks Innovation and Independent Style

A form of innovation in the clothing industry by fashion designers. My country has a long history of clothing production and a mature industrial model, from clothing production to design. The production mode of my country's clothing industry today still uses intensive labor to repeat low-level designs, needing independent styles and help to form brand effects. According to the latest data in June 2022, the per capita consumption of clothing in my country is significantly lower than that of Western developed countries, and consumers tend to buy clothing products with low prices and a lack of design, which shows that there is still much room for improvement in my country's clothing industry. The gap between my country and Western developed countries in the field of clothing design is shown in Table 1 [1-6].

<i>Project</i>	<i>Western developed country</i>	<i>China</i>
<i>Use of color</i>	<i>A+</i>	<i>B</i>
<i>Style innovation</i>	<i>A+</i>	<i>A</i>
<i>Style design</i>	<i>A+</i>	<i>A+</i>
<i>Material selection</i>	<i>B</i>	<i>B</i>
<i>Overall comfort</i>	<i>A</i>	<i>A</i>

**Table 1:** The gap between my country and Western developed countries in clothing design.

### 2.2 Single Sales Channel and Lack of Effective Market Research

Due to the large population of our country, our country is the largest clothing sales country, but according to incomplete statistics, the sales rate of clothing in our country is low. Garment manufacturers unquestioningly expand the market and produce a large number of garments. Still, they cannot sell them, which, to a certain extent, has caused a backlog of clothing inventory in our country. This is partly due to the wide variety of clothing needs. My country has a vast territory, and the North and the South differ regarding geography and culture. Due to the difference in climate between the North and the South, the demand for clothing in the North and the South shows

considerable differences in clothing design styles, materials, and colors. However, clothing design manufacturers do not grasp this difference and cannot design clothing products that meet the needs of consumers in the North and South. Blind production leads to a backlog of clothing products.

On the other hand, it is due to the uneven geographical distribution of my country's garment manufacturing enterprises. According to the data in June 2022, the eastern coastal areas, including Zhejiang, Jiangsu, and the Pearl River Delta, accounted for more than 80% of the country's clothing production, while the inland and western regions accounted for less. Moreover, most of the clothing produced in the eastern coastal areas is mainly medium- and high-end clothing [5-17].

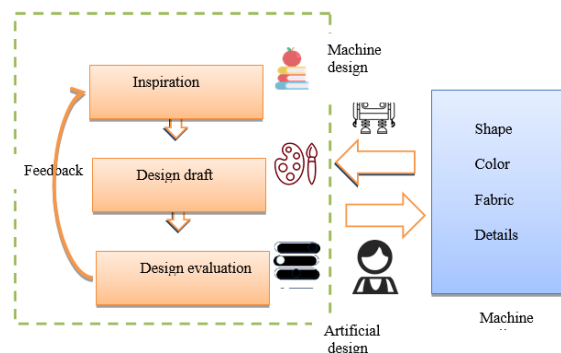
### 2.3 Garment Producers Have Insufficient Innovation Awareness and Low Awareness of Clothing Property Rights Protection

There are a large number of shoddy and counterfeit clothing products in our country. When a brand manufacturer releases a piece of clothing, many manufacturers often imitate or copy this product, and the manufacturer's awareness of innovation could be higher. Clothing manufacturers have followed suit one after another, leading to many fake clothing products on the market in our country. Garment manufacturers are unaware of clothing property rights protection, and our market needs relevant laws to safeguard this right. Maintaining clothing property rights takes much work [15-14].

## 3 CLOTHING DESIGN OPTIMIZATION MODEL BASED ON BIG DATA AND ARTIFICIAL INTELLIGENCE TECHNOLOGY

### 3.1 Model Ideas

The overall development of the fashion design industry is closely related to fashion design. The future development trend of fashion design is to optimize the fashion design process through big data and artificial intelligence technology and to select characteristic elements that satisfy users from many features through big data and artificial intelligence technology. Combining elements such as shapes, colors, and fabrics at all levels of clothing with popular elements and detail elements, under the leading design of fashion designers, clothing products that meet contemporary social trends and customer needs are designed. This model can provide a more scientific and reliable clothing design method for the clothing design industry, reducing the dynamics and errors of manual design. The specific pattern of clothing design is shown in Figure 3 [3-2].



**Figure 3:** Clothing design model based on hierarchical decomposition.

### 3.2 Model Representation

Step 1: Clothing design involves many elements. A piece of clothing includes shape, color, fabric, and details; each component can be divided into multiple levels according to its degree. Specifically, as shown in Table 2, the grading of clothing design elements is expressed as an equation, as shown in Equation (1). Among them,  $W$  represents the whole, and  $w_{nm}$  represents each element of the

clothing design level [19-20].

Project	Grade 1	Level 2	Level 3
Shape	Length, width, shape	X version, Y version, etc.	Specific size
Color	Red, orange, yellow, green	Saturated, lightness	Specific color number
Fabric	Cotton, linen, fiber, etc.	Hard and soft, comfort	Specific fabric composition
Details	Decorations	The shape of the ornament	Specific detail size

**Table 2:** Grading of clothing design elements.

$$W = \begin{bmatrix} w_{11} & w_{12} & \cdots & w_{1m} \\ w_{21} & w_{22} & \cdots & w_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ w_{n1} & w_{n2} & \cdots & w_{nm} \end{bmatrix} \quad (1)$$

Step 2: Optimizing the clothing design model requires using various data, including brand data, popular data, market trends, raw material supply, and other data. Capturing these data involves using big data and Internet of Things technology. The core Equation for capturing data is shown in Equation (2). Among them,  $w_{mnk}$  indicates the source of the data,  $mn$  suggests the level of the data, and  $x$  means a single entity of the data. Due to the large amount of captured data, we need to perform related processing on these data. Specifically, it is shown in Equation (2) [9-16].

$$y_{ij} = \sum_{k=1}^K \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} x_{(i+m)(j+n)k} w_{mnk} \quad (2)$$

Step 3: Since these data sources are different, we must normalize the data to perform unified operations on these data. The specific processing method is shown in Equation (3).

$$x_{i+1} = h(x_i) + F(x_i, \{w_i\}) \quad (3)$$

Step 4: To ensure the effectiveness of data processing, we need to eliminate useless data. The specific method of elimination is shown in Equation (4).

$$G(X) = \sum_{d_i \in D_i^*} (x_{mn} - q_{mn}) - \alpha t_{mn} \quad (4)$$

Step 5: Obtain the data processed by Equation (4). The data we obtain is graded. The first is the first layer classification, and the specific method is shown in Equation (5). Equation (5) is relatively simple and is divided into corresponding grades through simple classification operations [16-21].

$$u(x, d1) = \max_{D_i \leq D_i \sim D_i} \left\{ \sum_{d_i \in D_i} (x_{m,n} - q_{m,n}) - \alpha \max_{d_i \in D_i} \{t_{m,n}\} \right\} \quad (5)$$

Step 6: Threshold detection is required for the processed result of the Equation  $u(x, d1)$ . The specific Equation of the threshold detection is shown in Equation (6). If the result is more significant than  $E$ , keep this item; otherwise, discard this item.

$$E = -\frac{1}{2} \sum_{mn} w_{mn} x_m x_n + \sum_i \theta_m x_m \quad (6)$$

Step 7: Perform secondary screening on the results of Equation (6). The specific Equation for screening is shown in Publication 7. Equation (7) is a secondary screening of the results, dividing the grades into grades. Where  $\min(\frac{1}{2} y_i (w^T x_i + b))$  and  $\max(\frac{1}{2} y_i (w^T x_i + b))$  denote the highest and lowest points of the scale, respectively.

$$u(x, d_2) = \min(\frac{1}{2} y_i (w^T x_i + b)) + \max(\frac{1}{2} y_i (w^T x_i + b)) \quad (7)$$

Step 8: Filter the result of the Equation for the third time, and the specific Equation is shown in Equation (8).

$$u(x, d_3) = r_j + w_{mn} \max_a Q(s_j' \cup a' \cap \theta_i^-) \quad (8)$$

After the above steps, we can obtain the distribution of popular elements, thus providing a basis for the decision-making of clothing enterprises, providing inspiration for fashion designers' design activities, and improving the efficiency of fashion designers' designs.

### 3.3 Model Evaluation

Based on the data obtained in the above chapters, we adopt an evaluation method combining intelligent algorithms and expert evaluation to evaluate the results of implementing the model constructed in this study. The advantage of doing so has the following two points. (1) By training the intelligent algorithm, the intelligent algorithm can simulate the evaluation principle of the human brain, which is in line with human thinking. (2) The evaluation method combining machine evaluation and manual evaluation is used to conduct a comprehensive evaluation which is more comprehensive [8].

As shown in Table 3, the artificial neural network is used for evaluation. The prediction accuracy rate is as high as 95.32 %, which shows that the model constructed in this experiment has very high usability. The influence of outliers is slightly more significant, which shows that it is necessary to strengthen the data preprocessing work to improve the accuracy of input data. Concentration and reliability are also excellent [7].

<i>Project</i>	<i>Value</i>
<i>Prediction accuracy</i>	<i>88.32%</i>
<i>Outlier effect</i>	<i>0.63%</i>
<i>Concentration</i>	<i>95.12%</i>
<i>Degree of reliability</i>	<i>69.8%</i>

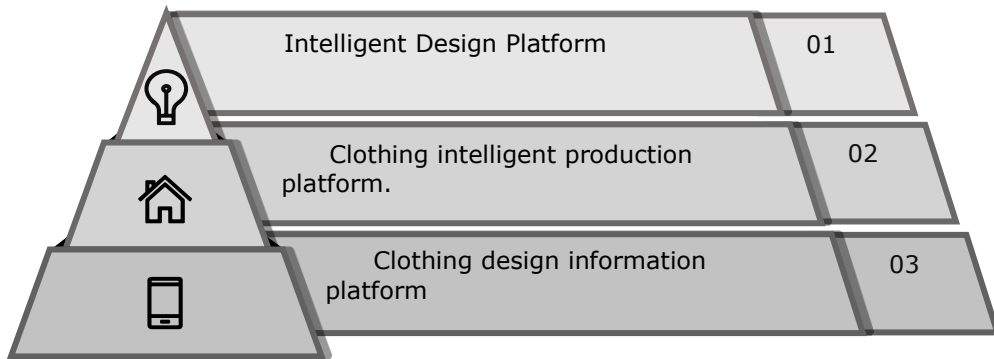
**Table 3:** The results of the evaluation using the comprehensive evaluation method.

### 3.4 Model Significance

This model combines the shape, color, fabric, and other elements of each level of clothing with popular elements and detail elements by constructing a clothing design optimization scheme based on big data and artificial intelligence technology and through intelligent production methods and design methods. Under the leadership of fashion designers, products that meet the fashion design market are constructed.

## 4 OPTIMIZATION SCHEME OF CLOTHING DESIGN

Big data and artificial intelligence technology allow me to optimize clothing design in my country. The intelligent design platform based on big data and artificial intelligence technology can inspire designers to help them create clothing products that satisfy users through human-led interpersonal interaction. The smart clothing production platform based on big data and artificial intelligence has shifted the heavy clothing manufacturing work from humans to machines, which has liberated productivity to a certain extent and allowed clothing design companies to focus more on the innovation and development of clothing design. The clothing design information platform based on big data and artificial intelligence can provide clothing designers with high-value density information, design efficiency, and design accuracy, thereby fundamentally improving clothing design. The specific connection between these three platforms is shown in Figure 4.



**Figure 4:** Clothing design optimization scheme based on big data and artificial intelligence technology.

#### 4.1 Intelligent Design Platform Based on Big Data and Artificial Intelligence Technology

Big data and artificial intelligence have brought many new concepts to fashion design. The efficiency of fashion design can be significantly improved through the comprehensive application of various software, technologies, and styles. The clothing design platform based on big data and artificial intelligence is challenging for the clothing industry. Transform fashion design concepts into achievements through new technologies, but developing this concept requires mature industrial models in enterprises. Enterprises need to have a mature industrial chain from information collection to product release, promptly capture market demand, discover popular market elements, and analyze the information.

#### 4.2 Clothing Intelligent Production Platform Based on Big Data and Artificial Intelligence Technology

The traditional production method is mainly based on manual cutting. Under this production mode, the subjective factors of garment production employees often lead to slow garment production and defective products. Using big data and artificial technology, the intelligent production platform can realize various operations in the production process through artificial intelligence technology. Some companies have combined the Internet of Things with clothing production in foreign countries and built an intelligent production system through RFID technology. This production system can produce many small batches, various clothing elements, and complex clothing, which solves a significant difficulty in applying artificial intelligence and big data technology to clothing production. The birth of this system has changed my country's clothing production from workforce to machine-led, and clothing business managers can focus more on clothing design than clothing production [11].

#### 4.3 Build an Information Platform for Clothing Design Based on Big Data Technology

Big data can store and analyze content data and solve the dilemmas of difficulty in obtaining information, low processing efficiency, effective decision-making, and difficulty in execution in clothing design. Through big data technology, the mass data acquired by the object terminal is stored, analyzed, managed, utilized, and used to make decisions to provide practical information for clothing design, help the clothing design industry better grasp market trends, and clarify the consumption intentions of each consumer to produce products that satisfy customers. At the same time, the clothing design information platform based on big data can also improve the efficiency of designers. The traditional clothing design mode requires designers to collect much information manually. In contrast, the clothing design information platform based on big data can provide designers with processed information. Has a higher value. On the one hand, this saves a lot, which significantly improves the efficiency of the designer's design.

## 5 CONCLUSION

Big data can store and analyze massive amounts of data, and artificial intelligence algorithms can optimize the production process of the clothing design industry. The rapid development of big data and artificial intelligence brings opportunities for the development of clothing design. The article first discusses the problems existing in the field of clothing design. (1) Lack of innovation in clothing design; lack of independent style (2) single sales channel; lack of adequate market research; (3) lack of innovation awareness among clothing producers; and low awareness of clothing property rights protection. To solve these problems, our innovative clothing production platform based on big data and artificial intelligence has shifted the heavy clothing manufacturing work from humans to machines, which has liberated productivity to a certain extent and allowed clothing design companies to focus more on clothing design innovation development. The clothing design information platform based on big data and artificial intelligence can provide clothing designers with high-value density information, design efficiency, and design accuracy, thereby fundamentally improving clothing design. The cross-cultural applications of big data and artificial intelligence in fashion design represent a transformative paradigm for the industry. By seamlessly integrating these technologies, fashion designers, businesses, and consumers can benefit from a more diverse, personalized, and culturally sensitive landscape. This synthesis of data-driven insights and AI-powered tools has the potential to reshape not only the creative process but also the entire fashion ecosystem.

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