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Research Article

Outdoor Clothing Design for Traffic Safety Based on Big Data and Artificial Intelligence

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With the development of technologies in various fields, more and more technologies have been applied to safety clothing, which has led to the rapid development of safety clothing. The improvement of living standards is accompanied by the change of consumption concepts. Consumers' requirements for clothing products have become more artistic, healthier, and more ecological, and they look forward to more and better safety clothing to meet their health needs. In this context, this article studies traffic safety outdoor clothing design based on big data (BD) and AI. This article introduces the design method of outdoor safety clothing for traffic based on BD and machine learning in artificial intelligence (AI) and did two experiments. To this end, this paper adopts a Deep Belief Network (DBN), which is trained layer by layer through Restricted Boltzmann Machine (RBM), and successfully solves the problems of lack of a large number of labeled samples and easy to fall into local optimum. The first experiment is to test the accuracy of various machine learning algorithms for clothing size measurement. The results obtained are as follows: the predicted value of the DBN neural network is the closest to the actual value, the average prediction accuracy of DBN for the cuff size is 90%, and the average prediction accuracy for the neck circumference is 91.5%. The second experiment is to investigate the functional needs and performance concerns of children and outdoor workers. The results of the experiment are as follows: for children, 79.9% of people want clothing to have a positioning function, which accounts for the highest proportion. For outdoor workers, the most important clothing function they need is eye-catching style, and 90.1% of those choose this option. In terms of clothing performance concerns, most people choose to care very much, and the second most people choose to care about comfort.

1. Introduction

1.1. Background. With safety as the main purpose, emphasizing a healthy, comfortable, green, and environmentally friendly living environment is what modern people yearn for and look forward to. In the face of the complexity of the traffic environment, the differences in human coping capabilities, and the chaos of special groups, it is necessary to understand the close relationship between clothes and the human body and use the special functions of clothes to reduce traffic accidents. The design of safety clothing requires the use of technologies in multiple disciplines, such as electronic information technology, biological science technology, 3D printing technology, bionic technology, new material technology, and human-computer interaction technology. It is the product of the integration of technological development and clothing. BD is a collection of superlarge amounts of data. The application of BD is the result of the development of modern information technology, and it is also an important tool to promote the development of information technology. Applying BD to the design of outdoor clothing for traffic safety and designing clothing based on AI-related technologies will make the safety performance of clothing more secure.

1.2. Significance. Traffic safety is an important safety issue in people's daily life. Complicated traffic conditions, heavy traffic, and people's low awareness of traffic safety are all important causes of traffic accidents. Traffic accidents are

constantly happening every day, so it is necessary to reduce the occurrence of traffic safety accidents through some means. Therefore, it is very meaningful to combine intelligent technology, BD technology, and clothing technology to design clothing that guarantees traffic safety. Intelligence is regarded as one of the development trends in safety clothing. Application innovation is the core of the development of smart clothing in the network age, innovation with user safety as the core and the soul of the development of safety clothing. BD is currently an important way for people to use information. The analysis of data enables people to better grasp and use information. The design of traffic safety clothing utilizes the information processing capabilities of BD and combines the key technologies of AI. It is believed that the design of safety clothing will get a breakthrough development.

1.3. Related Work. Both BD and AI are new technologies in the Internet era, and their applications have spread to various fields, and many scholars have conducted research on them. Xu et al. examined the privacy issues related to data mining from a broader perspective, studied different methods to ensure sophisticated data, and also put forward some preliminary ideas for future research directions. These methods are designed to decompose the associations between various customers in data mining scenarios, and each customer has their own assessment of sensitive information [1]. Kuang et al. proposed a unified tensor model and ihosvd method. Experimental results show that the proposed unified tensor model and ihosvd method are effective for BD representation and dimensionality reduction, but the research lacks detailed design [2]. Yaoxue and Zhang gave an overview of the topic of big data and conducted a comprehensive investigation on how cloud computing and related technologies respond to the challenges brought by big data. Then, Yaoxue analyzed the shortcomings of cloud computing when BD encountered the Internet of Things and introduced two promising computing paradigms. Finally, he summarized some open challenges and future directions to promote continuous research in this evolving research field. The disadvantage is that the study lacks specific cases [3]. Zhang et al. proposed a cyber-physical system for patient-centric healthcare applications and services called health CPS, which is based on BD analysis technology. The results of this study show that cloud and BD technology can be used to improve the performance of medical systems so that humans can enjoy various intelligent services. The research shows relatively little on the data [4]. Rathore et al. proposed a real-time BD analysis architecture for remote sensing satellite applications. The architecture has the ability to partition, load balance, and process only useful data in parallel. Therefore, the use of Earth observation systems can effectively analyze real-time remote sensing big data. In addition, the proposed architecture is able to store the incoming raw data in order to perform offline analysis on a large number of stored dumps when needed [5]. Rongpeng and Li tried to emphasize one of the most basic characteristics of the revolutionary technology in the 5G era and further introduced the basic concepts of AI. He discussed the relationship between AI and candidate technologies in 5G cellular networks, demonstrating the effectiveness of AI in managing and orchestrating cellular network resources. Rongpeng envisions that 5G cellular networks with AI capabilities will make acclaimed ICT promoters a reality. This research has good ideas but no convincing reasons [6].

1.4. Innovation. The innovation of this article is (1) Combining big data, AI, and traffic safety outdoor clothing design, it introduces the traffic safety outdoor clothing design method based on BD and AI and proposes some algorithms, which is a methodological innovation. (2) It designed experiments to test the clothing size measurement method based on AI and did a questionnaire survey. By investigating the two groups most in need of outdoor traffic safety, this article understands their expectations of clothing functions and their attention to various performances of clothing. This is an experimental innovation.

2. Road Safety Outdoor Clothing Design Method Based on BD and AI

2.1. Clothing Design Based on AI. This chapter mainly uses traditional machine learning methods and improved deep belief networks to intelligently design the size of safety clothing and studies the methods of establishing neural network models.

2.1.1. Construction of Clothing Data Set. The constructed data set is divided into two parts: the data measured by the traditional measurement master and the data produced by the advanced Boke intelligent CAD software. Performing net body size data collection and clothing model size data Icollection [7]. The collected net body size data includes items such as height, upper arm circumference, hip circumference, net sitting circumference, and net waist circumference. The collected clothing model size data includes back length, neck circumference, trouser length, foot opening, front wave, back wave, front small crotch width, and back small crotch width. And ensuring that the collected clothing model size data and the net body size data establish a one-to-one correspondence.

2.1.2. Machine Learning Algorithm Design. AI is developing rapidly. As the core of AI, machine learning is also excellent in the rapid development of AI, and it has attracted more and more people's attention [8]. The following describes the application of machine learning related algorithms in the intelligent design of safety clothing.

(1) BP Algorithm Size Intelligent Design. BP network, in fact, is also a kind of multilayer perceptron and is currently the most widely used neural network. The BP network training process is divided into two steps, one is forward propagation to obtain the output result, and the other is backpropagation to transmit the error back to the input and then adjust the

model parameters. Finally, a neural network model of $6 \times 12 \times 10$ is formed. The result of data normalization is shown in the left image of Figure 1, and the small shoulder width is shown in the right image of Figure 1.

(2) Linear Algorithm Size Intelligent Design. The least square method is also called the least square method. The least square method can achieve the goal of minimizing errors. The sum of squared errors between the obtained data and the actual data can be minimized, and the derivation Formula is as follows [9]:

$$\log L(\theta) = \prod_{i=1}^{m} \frac{1}{\sqrt{2\pi\sigma}} \exp\left(-\frac{\left(y^i - \theta^t x^{i^2} \right)}{2\sigma^2} \right). \tag{1}$$

Expand and simplify

$$\begin{aligned} &\sum_{i=1}^{m} \log \frac{1}{\sqrt{2\pi\sigma}} \exp\left(-\frac{\left(y^i - \theta^t x^i \right)^2}{2\sigma^2} \right) \\ &= m\log \frac{1}{\sqrt{2\pi\sigma}} - \frac{1}{\sigma^2} \cdot \frac{1}{2} \sum_{i=1}^{m} \left(y^i - \theta^t x^i \right)^2. \end{aligned} \tag{2}$$

Simplify the least square method by combining the log-likelihood formula to obtain the following least square method formula. After logarithmic transformation, the larger the likelihood function value, the better.

$$J(\theta) = \frac{\left[\sum_{i=1}^{m} \left(y^i - \theta^t x^i \right)^2 \right]}{2}. \tag{3}$$

When using ordinary least squares regression, the residual sum of squares and similar variance items are used to evaluate the fitting effect of the model. The model evaluation method of the following formula [10]:

$$R^2 = 1 - \frac{\sum_{i=1}^{m} \left(\widehat{y}_i - y_i \right)^2}{\sum_{i=1}^{m} \left(y_i - \overline{y_i} \right)^2}. \tag{4}$$

In the formula, the numerator of the score is the residual sum of squares, and the denominator is a similar variance term.

Establish a linear regression formula by deriving the formula of least squares regression and construct a loss function to solve the parameters a and b when the loss function is minimum, as shown in the following formula:

$$\widehat{y} = ax + b. \tag{5}$$

In the formula, $\widehat{y}$ represents the predicted value.

2.1.3. Improved Deep Belief Network. The Deep Belief Network (DBN) is composed of several restricted Boltzmann machines and a layer of backpropagation network. Its structure is shown in Figure 2 [11].

Its structure is shown in Figure 2. The training process of DBN mainly includes two parts, namely unsupervised layer-by-layer pretraining, using RBM layer-by-layer training as the pretraining stage, each layer of the RBM network is trained independently and unsupervised, and the RBM of the previous layer is output. The value is taken as the RBM input value of the next layer; the other part is to use the supervised improved BP network as the fine-tuning stage, and the error between the output value obtained by the network training and the expected output value is propagated back layer by layer, and the entire Deep belief network to fine-tune the weights.

(1) Restricted Boltzmann Machine. The basic idea of a restricted Boltzmann machine (RBM) is to satisfy self-learning unsupervised learning. It can fit the input parameters to the maximum extent so that the difference between the reconstructed data and the actual input parameters becomes the smallest. It has been widely used in speech recognition, document processing, image recognition, face recognition, etc. However, at present, RBM is mainly used to initialize the parameters of the neural network and extract features during data preprocessing. At present, RBM is mainly used to initialize neural network parameters and extract features in data preprocessing. Each RBM consists of a visible layer and a hidden layer. Its structure is shown in Figure 3. In the figure, h represents the hidden layer, W represents the weight, and V represents the visible layer [12].

Let the reconstructed visible layer neurons calculate the state of the hidden layer neurons again, and then the state of the new hidden layer neurons can be obtained. If the state of the hidden layer or visible layer neuron is determined [13], the activation probability of its unit is as follows:

$$\begin{aligned} p\left(\frac{h_j = 1}{v; \theta} \right) &= f\left(c_j + \sum_{i=1}^{I} w_{ij} v_i \right), \\ p\left(\frac{v_j = 1}{h; \theta} \right) &= f\left(b_j + \sum_{j=1}^{J} w_{ij} h_i \right). \end{aligned} \tag{6}$$

In the formula, the function f represents the sigmoid function.

(2) Backpropagation Network. Backpropagation network (BP) is a supervised classifier trained according to the error backpropagation algorithm, which can achieve the effect of fine-tuning the entire deep belief network model. The backpropagation network (BP) has the following three formulas in the selection of the optimal number of units in the hidden layer of the network structure:

$$\begin{cases} l < \sqrt{a+b} + c, \\ l < n - 1, \\ l = \log_2 n. \end{cases} \tag{7}$$

In the formula, a, b, and l represent the number of nodes in the output layer, input layer, and hidden layer, and c is a constant. Since the Sigmoid activation function is used, it can be seen in the figure that when the output is close to 1, the rate of change of the Sigmoid curve is close

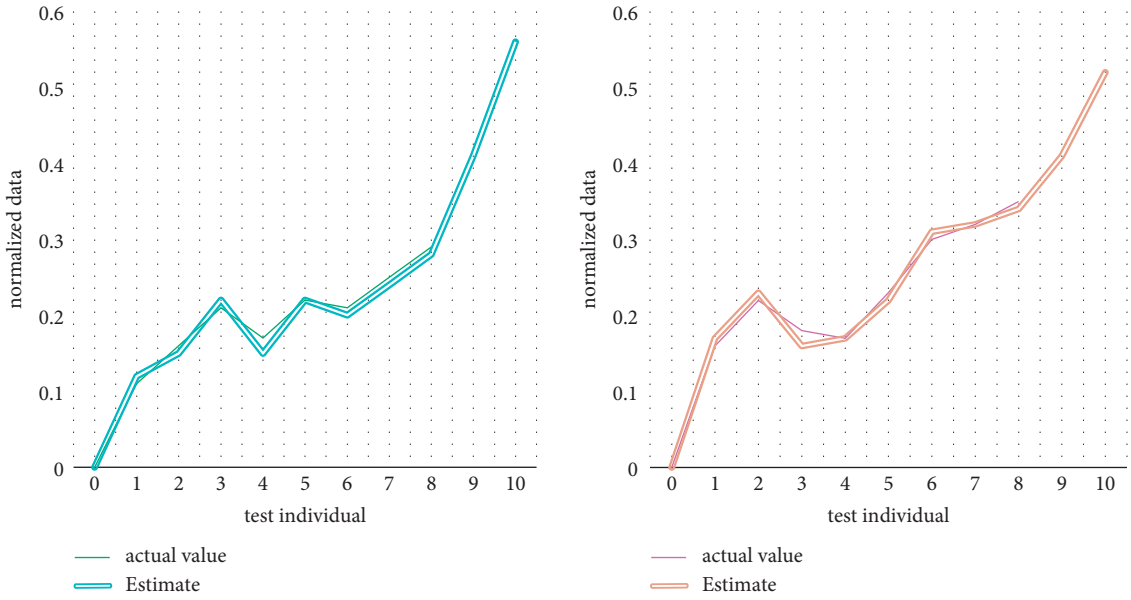

Figure 1: BP algorithm results of neck circumference and small shoulder width.

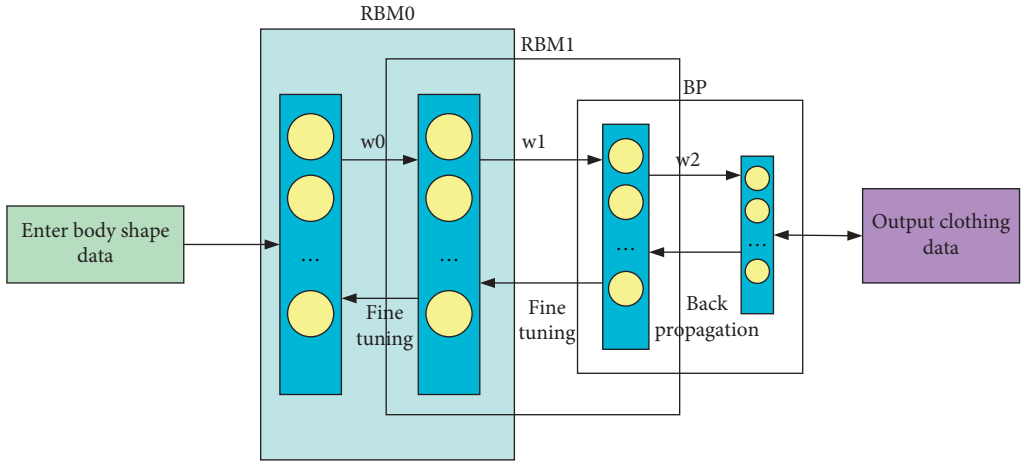

Figure 2: Deep belief network structure.

to 0. At this time, the value of $\sigma'(z)$ is small, which will cause the learning rate of the BP neural network to be relatively slow., in order to change the influence on the learning rate of the BP neural network, This paper uses the cross-entropy cost function [14]:

$$C = -\frac{1}{k}\sum_{X}[y_0 \ln y + (1 - y_0)\ln(1 - y)], \tag{8}$$

where k represents the total training data and y_0 is the expected output value.

(3) The Realization of Deep Belief Network Model. Due to the different units of input data and output data, there will be a certain error in the training of the DBN neural network. In the process of BP neural network, the sigmoid function is regarded as an excitation function. Because the result of the sigmoid function is in (0, 1), the data of the training sample set should be normalized and then resized to a uniform size. The formula is as follows:

$$y = \frac{x_0 - x_{\min}}{x_{\max} - x_{\min}}. \tag{9}$$

In the formula, y represents the standardized data and x_0 represents the original data.

2.1.4. Wearable Clothing Based on Artificial Intelligence. Under the system of "human intelligent clothing environment," wearable clothing has more and more functions. In the design of smart clothing with technical design as the key element, technology determines the overall performance of smart clothing. It will not only directly affect the functionality, comfort, and interaction of smart clothing but also

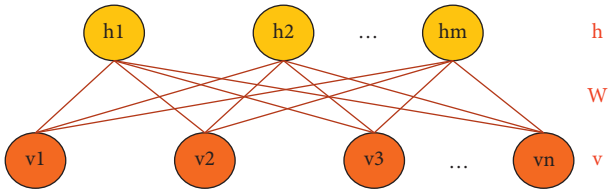

Figure 3: RBM structure diagram.

indirectly affect the appearance fashion of clothing. Therefore, the improvement of technology is undoubtedly a double-edged sword. We should not only ensure the wearability of smart clothing but also "hide" the electronic devices in smart clothing as much as possible.

The positioning function is an important function of wearable clothing. This function is mainly used for children. Children belong to relatively vulnerable groups due to their physical and mental particularity, and the problem of loss is an important problem for children, which mostly concerns parents. Therefore, this function is also the most important function of children's outdoor safety clothing.

Safety protection function is also one of the important functions of intelligent wearable clothing, especially for outdoor workers and cyclists. Multiple reflective strips are installed on the body and trousers of such clothes to improve night safety. In order to prevent accidents, airbag modules are added in important parts of clothing, such as the neck, shoulder, chest, back, and hip, and collision sensors are set at the same time. When the contact point is impacted, the control unit will automatically inflate the airbag quickly so as to protect important parts of the body and improve safety guarantee.

2.2. Clothing Design Based on Big Data

2.2.1. Big Data. BD generally refers to a kind of data collection, which is very large and contains more data than the amount of general data analysis, so it is called "big data." The concept of BD was put forward in the context of human beings entering the era of data. BD means the ability to collect and analyze large amounts of data generated in society [15]. BD is a collection of a large number of various data forms. This collection has high value and high technical requirements for data processing. At the same time, it is accompanied by high data security and information security risks.

2.2.2. Clothing Algorithm Design Based on Big Data. The relevant algorithms of the BD analysis module in this chapter are essentially an application of collective wisdom. It is to collect useful information from traffic safety clothing usage information to help obtain statistically significant conclusions on safety clothing. These conclusions are not available to us with a small amount of data and can reflect the essential elements of safety clothing. This chapter uses a collaborative filtering algorithm to design [16].

First, we use the Sqoop-based BD collection module to investigate people's preferences for safety clothing in a distributed manner and convert these records into a simple triple:

$$\langle \text{UserID}, \text{ItemID}, \text{Preference} \rangle. \tag{10}$$

Then, use metrics such as Euclidean distance, cosine similarity, etc., to calculate the similarity between users. In essence, Euclidean distance represents the true distance between two points in a multidimensional space, and its calculation formula is as follows:

$$d(x, y) = \sqrt{\sum (x_i - y_i)^2}. \tag{11}$$

The similarity expressed by Euclidean distance is as follows:

$$\text{sim}(x, y) = \frac{1}{1 + d(x, y)} = \frac{1}{1 + \sqrt{\sum (x_i - y_i)^2}}. \tag{12}$$

The Pearson correlation coefficient represents the ratio between the covariance and standard deviation between two triples, as follows:

$$\rho(x, y) = \frac{\text{cov}(x, y)}{\sigma_x \sigma_y} = \frac{\sum x_i y_i - \sum x_i y_i / N}{\sqrt{\left(\sum x_i^2 - (\sum x_i)^2 / N\right)\left(\sum y_i^2 - (\sum y)^2 / N\right)}}, \tag{13}$$

$\text{cov}(x, y)$ represents the covariance, and $\sigma_x \sigma_y$ is the standard deviation.

Use x, y to represent triples and N represents the number of triples [17]. The calculation Formula of cosine similarity is as follows:

$$\cos \alpha = \frac{\sum x_i y_i}{\sqrt{\sum x_i^2} \sqrt{\sum y_i^2}}. \tag{14}$$

In summary, different recommendation methods are formed in this system to realize the recommendation process. Then according to the algorithm evaluation mechanism, the optimal method is automatically selected, and the algorithm is submitted to the distributed platform to run, and the final result is obtained, as shown in Figure 4.

2.2.3. Algorithm Evaluation. The accuracy rate represents the ratio of the number of retrieved documents to the total number of retrieved documents [18]. The recall rate represents the ratio of the number of retrieved related documents to the number of all related documents. They are used as evaluation indicators in the field of information retrieval and statistical classification. Defined by confusion matrix: retrieved (True), not retrieved (False), relevant (Positive), and irrelevant (Negative), as shown in Table 1.

2.2.4. Decoding of Collaborative Influence Factors Based on Cloud Computing. According to the three-step process of grounded theoretical concept generation, step-by-step decoding, and construction of the theory, the first step is to extract the smallest decoding unit for safety clothing design influencing factors from document analysis, field research,

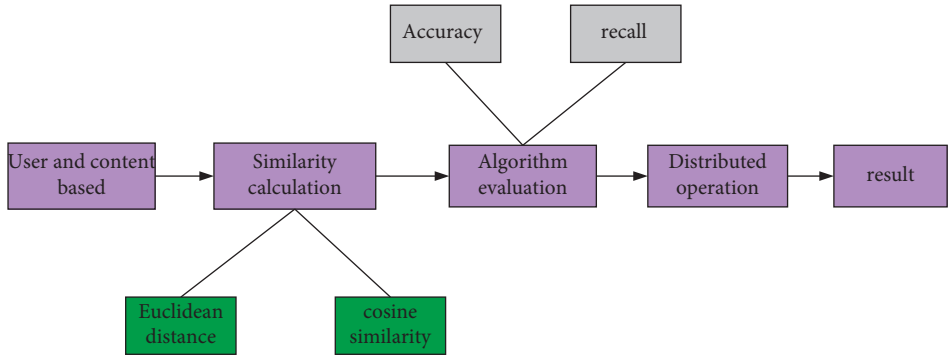

Figure 4: Recommendation process.

and expert interview records [19]. In order to obtain the necessary synergy influencing factors of safety clothing design, the survey results were screened by two methods: average score value and full score frequency.

(1) Average Score Value. First, summarize the scores of each expert for each indicator, and then calculate the average score of each item according to the following formula:

$$V_i = \frac{\sum_{j=1}^{b_j} x_{ij}}{b}, \quad i = 1, 2, \ldots, n;\ j = 1, 2, \ldots, b, \tag{15}$$

V_i represents the average score of index i, b_j represents the number of experts evaluating index j, and x_{ij} refers to the score of the ith expert on index j. The larger the average score, the more important the indicator.

(2) Frequency of Full Marks. The frequency of full score refers to the ratio of the number of experts who give full marks to the i index to the total number of experts who evaluate the i index, namely:

$$f_i = \frac{b_j}{b_i}. \tag{16}$$

Among them, f_i represents the frequency with which index i gets a perfect score, b_j represents the number of experts who scored a perfect score for index j, and b_i represents the total number of experts who evaluated the index i.

2.3. Outdoor Traffic Safety Clothing Design. At present, outdoor traffic safety clothing is mainly used for outdoor workers such as traffic police, sanitation workers, and cyclists. Due to their special work requirements, they need to wear eye-catching clothing to protect their own safety. Nowadays, due to the rapid development of technology, safety clothing is not only specially designed in colors, but also high-tech means such as BD and AI technology can be introduced to design.

2.3.1. Clothing Design Process. With the rapid development of science and technology and the mutual penetration of various fields, many new technologies and methods have emerged. Smart safety clothing will inevitably develop in a multifunctional and comfortable direction. Designers must carefully test the accuracy and power consumption of safety function components when formulating the development process of intelligent safety clothing products. And it organically combines these properties with the basic elements of clothing, thus retaining other factors that may be equally important to consumers under the premise of emphasizing safety functions [20].

(1) Combination of Intelligent Interactive Equipment and Wearer's Clothing. Smart safety clothing includes clothing and accessories that make up a smart system. According to the method of use, it can be divided into four categories: headwear, wristbands, pendants, and body wear. Regardless of the device, the goal of research and development is to improve the portability, wearability, and safety performance of the product according to the user's physical, psychological, and living conditions under the premise of satisfying the preset component functions.

(2) Standardization of the Research and Development Model of Intelligent Safety Clothing. Targeting the characteristics of human-computer interaction, the combination of smart interactive devices and wearer's clothing, and the multi-interaction methods of smart interactive devices and mobile terminals, this research conducts a comprehensive and systematic exploration of the research and development model of smart interactive wearer safety clothing. It puts forward a set of theoretical models with high operability and relatively universal in a certain range and explores the theoretical basis for the industrialization of interactive wearable clothing. Figure 5 is a typical frame diagram of information sharing in multiple interactive modes.

2.3.2. Design Principles of Outdoor Traffic Safety Clothing

(1) Principles of Zoning Design. Elements such as points, lines, and surfaces of clothes design are the basic composition methods. The study of zoning design is dedicated to solving the contradiction between the size of the safety factor and the appearance of the clothing. The zoning design cleverly divides the front and back of the clothes into a layered system of areas and the main fabric of the clothes and seamlessly connects and combines them according to the

Table 1: Accuracy and recall.

		Assigned class		
		Positive	Negative	Total
Actual class	Positive	True positive (TP)	False negative (FP)	TP + FN
	Negative	False positive (TP)	True negative (FP)	FP + TN
	Total	TP + FP	FN + TN	TP + FP + FN + TN

needs of the design appearance. The influencing factors of zoning design include clothing wearing environment, functional indicators, monitoring accuracy, wearing performance, and decorative effects.

(2) Principles of Human-Computer Interaction. Although people live in the real world, they increasingly rely on the information exchange brought about by the virtual world. Based on the development of network technology, it is possible to achieve good communication between clothes and other online worlds. Clothing designers and consumers have clearly guided that clothing and accessories are the most primitive but the most natural wearable clothing, always inseparable. Compared with many wearables as additional accessories, wearing clothes seems to have no extra burden at all. Smart safety clothes are based on the interaction of three parts, namely the interaction of body, climate, and clothes. In the interactive system, the body, climate, and clothes form an interdependent relationship. The body and the environment exist objectively, so people can only change their clothes to adapt to the body and the environment.

2.3.3. Current Situation of Outdoor Traffic Safety Clothing. Due to the special professional needs of outdoor workers such as traffic police, sanitation workers, and cycling athletes, most of the current outdoor traffic safety clothes are designed for these practitioners. Traffic police on-duty clothing is related to traffic safety. Reasonable and efficient traffic police clothing design will provide a favorable guarantee for China's road traffic safety. Within the scope stipulated by law, the modeling setting of traffic police clothing, the proportion of color area, and the design of details, styles, and structural processes need to be more scientific and reasonable. Giving the functionality of traffic police clothing styles has become an urgent problem to be solved. Figure 6 shows the clothing of Chinese traffic police. It can be seen that the clothing has bright color, comfortable style, and reasonable design, which is in line with the professional characteristics of traffic police.

With the rise of cycling, the development of cycling clothing in the industry is also advancing by leaps and bounds. It is one of the most potential types of intelligent clothing and fabrics. In order to reduce the resistance of the wind, the riding clothes mostly adopt the close-fitting style. During cycling, the upper body of the human body keeps leaning forward, and the arms lean forward, so the length of the front piece is shorter than that of the back piece, and the sleeves are designed to cut forward. In the process of cycling, the wearer also has functional needs for color. The color can be used as a warning for people to express each other's rationality when riding so that they can use color to express each other's rationality and avoid each other's movement. At the same time, on the premise of meeting the aesthetic effect of clothing, the fabric of clothing should also have the properties of adapting to the expansion of body movement, efficient perspiration, moisture permeability, warmth preservation, wind resistance, sun resistance, water washing resistance, and so on. Figure 7 shows a classic cycling suit.

3. Outdoor Clothing Design for Traffic Safety Based on BD and AI

3.1. Clothing Design Experiment Based on AI

3.1.1. The Overall Design of the Experiment. This chapter conducts experiments based on the Linear algorithm, BP algorithm, and DBN algorithm introduced in 3.1. This chapter uses these three algorithms to predict the cuff size and neck size of the human body and then compares them with the actual values to explore the prediction accuracy of these algorithms.

3.1.2. Algorithm Flow Design. A linear algorithm is a traditional machine learning algorithm, the process of which has been described in the previous article, so I will not repeat it here.

(1) BP Algorithm Process. The BP network training process is divided into two steps. The first is to calculate the output of each unit of the hidden layer and the output layer and calculate the square error $E(i)$ between the output result and the actual value. If all $E(i)$ meet the requirements, the training ends. If the requirements are not met, recalculate until the parameter $E(i)$ meets all the requirements. Its work flowchart is shown in Figure 8.

(2) DBN Algorithm Flow. The training of the DBN network mainly includes unsupervised layer-by-layer pretraining of RBM and supervised fine-tuning of BP and DBN network structure. The training steps of the deep belief neural network are shown in Figure 9.

In unsupervised pretraining, the human body shape data is assigned to the output layer as input data, and the CD algorithm is used to train the input layer. After the training, the RBM0 parameter reaches the highest value. With the help of the trained RBM0, the value of the hidden layer is obtained, the data of the input layer is regarded as the data of the input layer, and RBM1 is formed with the second hidden layer. The training method is used to train the RBM1, and

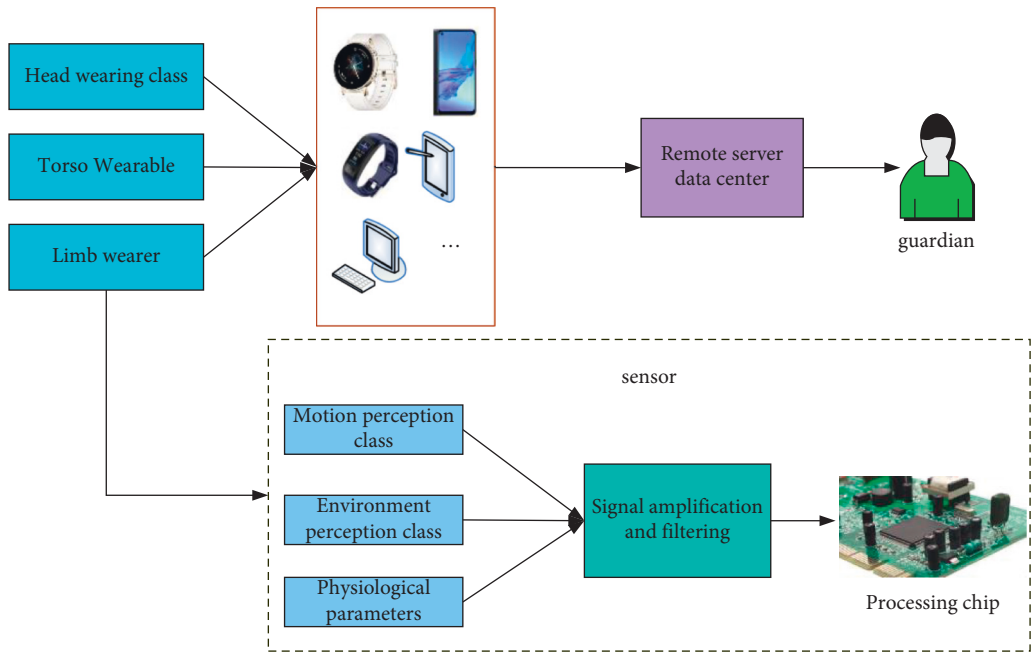

Figure 5: Multi-interaction information sharing framework diagram.

Figure 6: Chinese traffic police clothing.

finally, the optimal parameters of the RBM1 network are obtained.

3.1.3. Experimental results and analysis. The Linear algorithm, BP algorithm, and DBN algorithm are used to predict the cuff size according to the steps described, and the actual values of the cuff size and the size predicted by the three algorithms are counted, and the results are shown in Figure 10.

It can be seen from the figure that among the three algorithms, the cuff value measured by the linear algorithm is the farthest from the actual value. The predicted value of the DBM algorithm is the closest to the true value. It can be seen that the DBM algorithm has the highest accuracy for the predicted value of the size. In order to better verify this conclusion, we have done another neck circumference measurement experiment, and the results are shown in Figure 11.

In the measurement of neck circumference, the predicted values of the three algorithms are relatively close, and there is no significant difference. However, the measured value of the DNB algorithm is still the closest to the true value, so it can be seen from the two experiments

Figure 7: Cycling clothes.

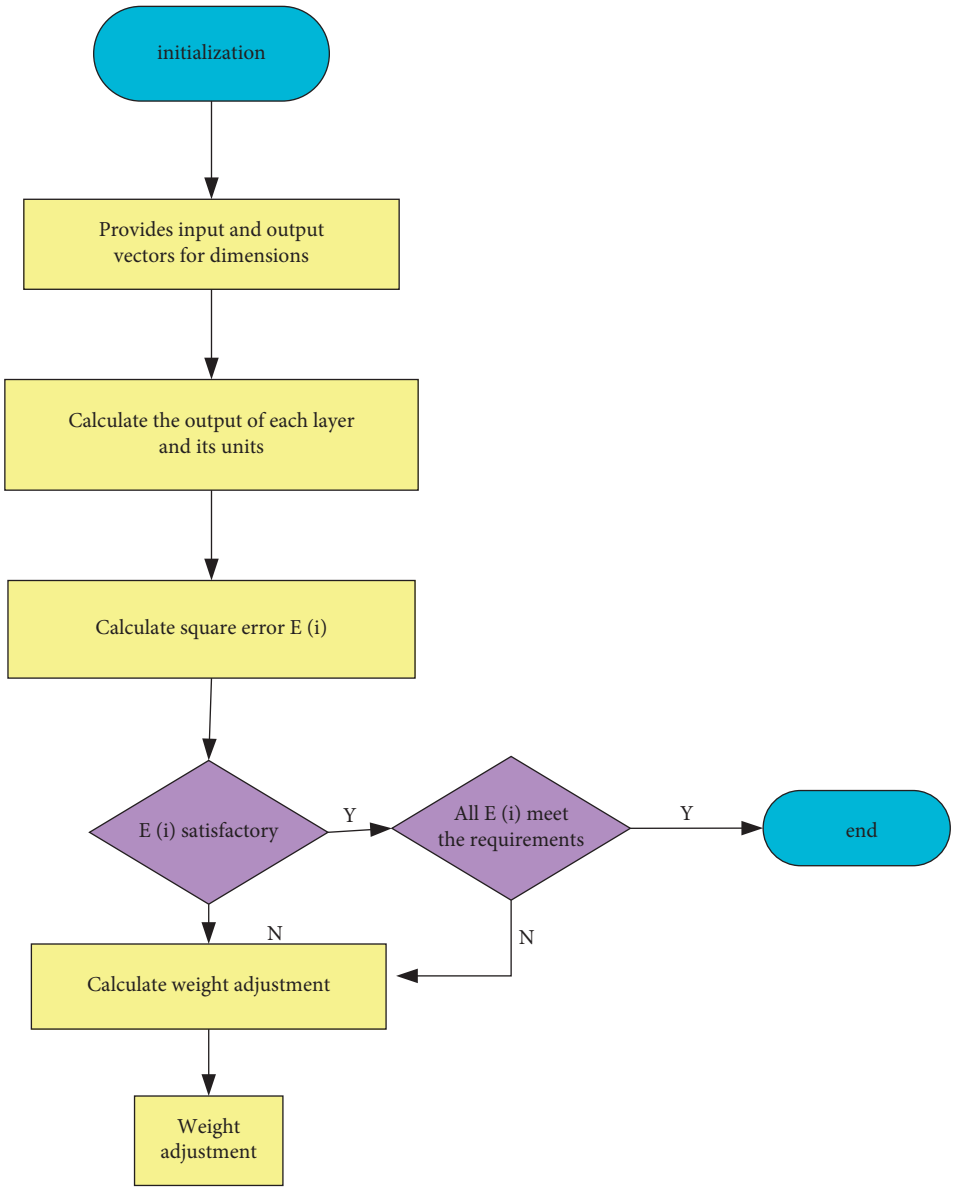

Figure 8: BP algorithm flowchart.

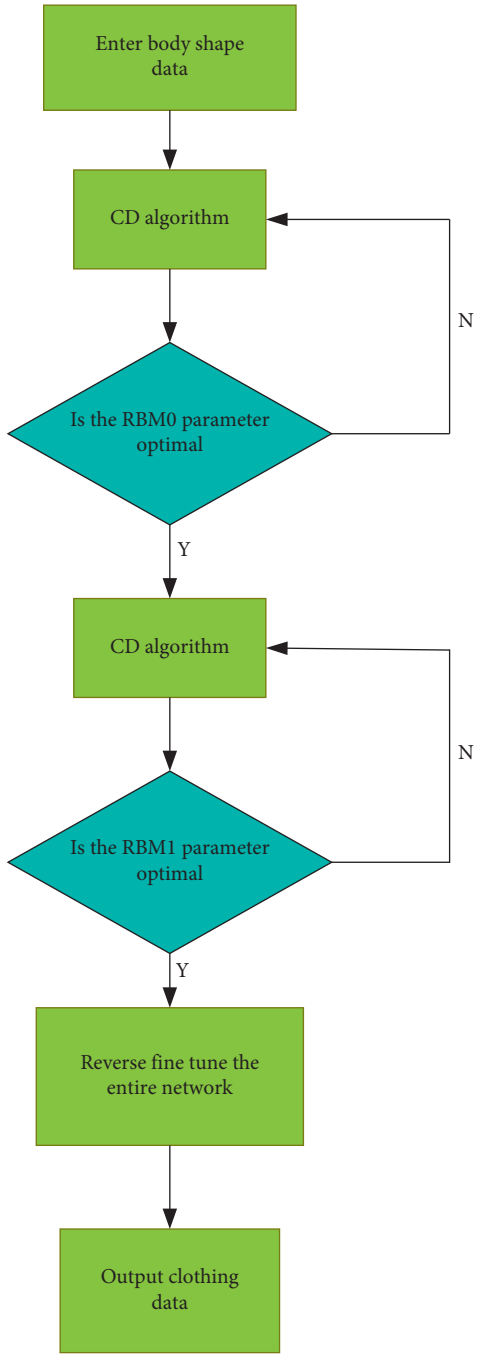

Figure 9: DBN network training flowchart.

that the prediction of DBN is the closest to the true value compared to the predicted value of the other two algorithms. And in the measurement of cuff size, DBN's average prediction accuracy rate for different samples is 90%. In the measurement of neck circumference, the average prediction accuracy of DBN for different samples is 91.5%. Although there is a certain error between the predicted value of the DBN neural network and the actual value, this deviation is normal for clothing structure design. At the same time, for 15 different test samples, the effects predicted by the DBN neural network model are also different. For example, the accuracy of the neck circumference is higher than that of the waist circumference. After analysis, it is found that, on the one hand, the data source of the output layer is inconsistent with the data source of the input layer. The data of the input layer is the child's body shape data, and the data of the output layer is the sample size of children's clothing. On the other hand, the training sample set is not large enough. If there is more data for scientific training, the accuracy of this model will be further improved [21, 22].

3.2. Survey on Demand for Outdoor Traffic Safety Clothing. This questionnaire conducted market research and analysis for the two major groups of people who most need outdoor traffic safety clothing. The two major groups are children and outdoor workers. Children have poor self-management skills, weak traffic awareness, and are petite. Outdoor workers often need to work outdoors. The working place is generally on the street, outside the building, and there are many opportunities for contact with vehicles and pedestrians. Therefore, these two types of people are more likely to encounter traffic hazards, so there is a high demand for outdoor traffic safety clothing. The purpose of this experiment is to understand the functional needs and performance concerns of these two groups of people for safety clothing so as to grasp the overall development direction of safety clothing design in the later period. It clarifies the market positioning and future development direction of safety clothing, promotes the process of industrialization of safety clothing, and better meets people's consumer needs [23].

3.2.1. Experimental Method. This test method adopts the questionnaire method, and the contents of the questionnaire are set as follows: Questions are, respectively, asked about the functional expectations of the two types of clothing and the degree of attention to the clothing performance. A total of 300 questionnaires were received in this survey, of which 286 were valid questionnaires, including 144 questionnaires on children's outdoor traffic safety clothing and 142 outdoor workers' safety clothing questionnaires.

3.2.2. Survey Results of Clothing Function Questionnaire. This study first investigated the functions that parents hope that children's safety clothing has, and the results obtained are shown in Table 2.

It can be seen from the table that 79.9% of people hope that clothing has a positioning function, which accounts for the highest proportion. The second is the reminder function, such as a real-time reminder of location information, mood changes, and physical signs changes. It can also be seen that the biggest pain point for parents is that they are afraid of children getting lost when traveling with them. Therefore, when designing children's safety clothing, it is necessary to focus on the design of the positioning function, then the reminder function should be designed well, the clothing style should be eye-catching, and the design of the physical sign monitoring function should be paid attention to.

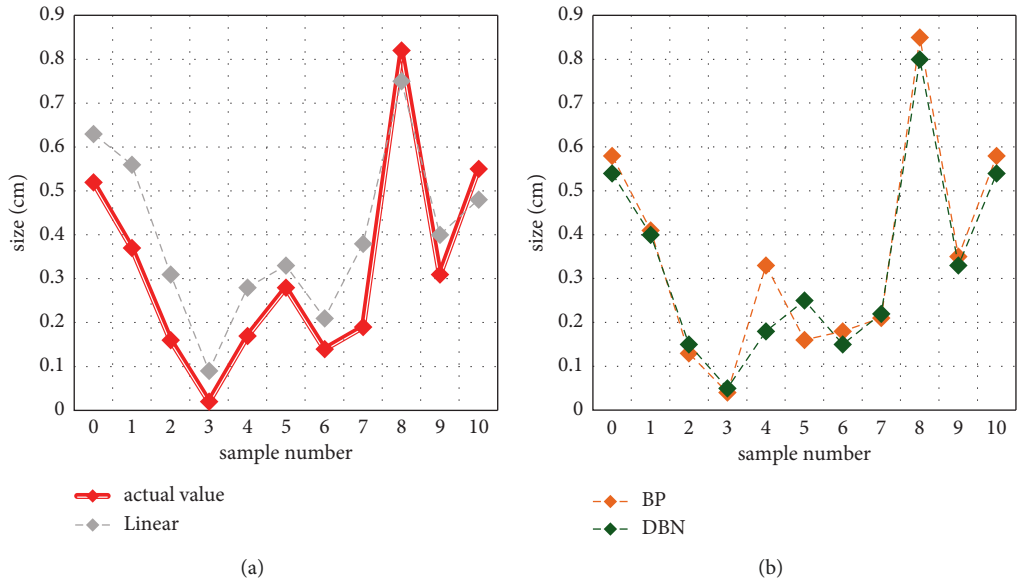

Figure 10: Cuff size of different algorithms: (a) The cuff data is not normalized (b) The cuff data is normalized.

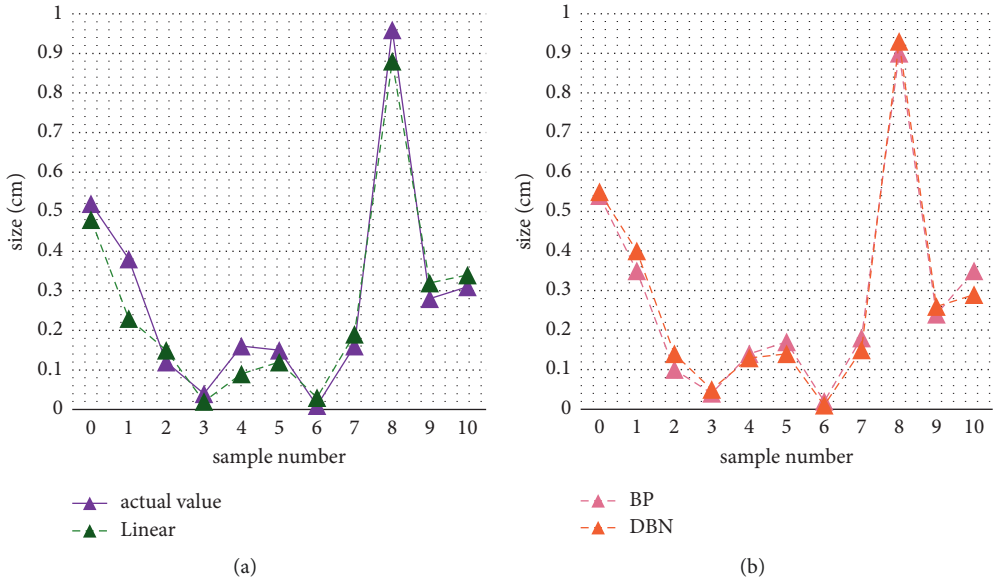

Figure 11: Neck size of different algorithms: (a) Experimental result of cuff. (b) Experimental result of neck circumference.

Table 2: The functions expected of children's clothing.

Function	Number of people	Proportion (%)
Positioning function	115	79.9
Bold style	77	53.5
Sign monitoring	69	48.0
Real-time reminder	103	71.5
Other	21	14.6

Table 3: The functions expected of outdoor worker clothing.

Function	Number of people	Proportion (%)
Bold style	128	90.1
Sign monitoring	73	51.4
Control temperature	105	74.0
Antifouling property	98	69.0
Other	13	9.2

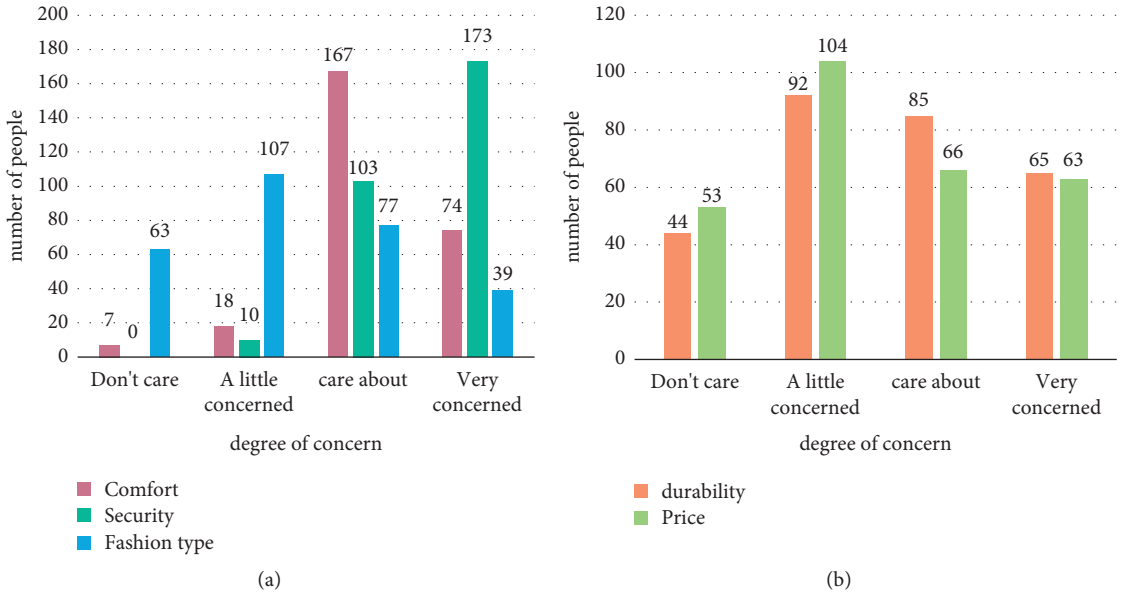

Figure 12: Statistics of the degree of attention to clothing performance.

Next, this study counts the functions that outdoor workers expect safety clothing to have, as shown in Table 3.

It can be seen from the table that for outdoor workers, the most important clothing function is eye-catching style, and 90.1% of those choose this option. The second place is temperature control. Because outdoor workers work outdoors, their temperature is always too cold or too hot. This feature can give them comfort to a great extent. It can be seen that when designing traffic safety clothing for outdoor workers, the style and temperature control function design should be considered as much as possible. In addition, the functions of physical sign monitoring and antifouling should also be considered.

3.2.3. Survey Results of Clothing Performance Questionnaire. In the experiments in this chapter, we investigated the clothing performance expectations of the two groups of people. The performances are comfort, safety, fashion, durability, and price. It counts people's attention to each performance and makes statistics on the results of the questionnaires of the two groups of people, and the results are shown in Figure 12.

It can be seen from the figure that among these five properties, 0 people choose not to care about safety, and most people, 173 people, choose to care about safety very much. Proof that safety should be the basic function of safety clothing. The second most concerning choice is the comfort of the clothing. 74 people chose this option. It proves that in all the performance, safety and comfort are the most concerned by people. Therefore, in the clothing design of outdoor traffic safety, the designer should pay more attention to these two aspects of performance.

4. Discussion

How to ensure one's own safety and eliminate the potential safety hazards caused by the surrounding environment to the human body has become a current hot topic. As an indispensable clothing industry for people's lives, safety clothing has developed rapidly in recent years and has become an important branch of the clothing industry, and it has also been warmly welcomed by people. The design stage of safety clothing is the front end of the clothing production chain, which determines the performance, cost, and impact of the entire product on people, society, and the environment. Smart safety clothing needs to continuously improve the stability and reliability of the system, pay more attention to the interaction between the clothing itself and the environment, and have a more comprehensive understanding of market needs. It is necessary to break down the barriers between clothing design and engineering, strengthen interdisciplinary cooperation, and better reflect the impact of the interaction between smart safety clothing and humans.

5. Conclusion

This article introduces the design method of traffic outdoor safety clothing based on BD and AI machine learning, introduces many related algorithms, and also introduces the principles and processes of traffic outdoor safety clothing design. It did two experiments. The first experiment was to test the accuracy of various machine learning algorithms for clothing size measurement. The results are obtained: In the clothing performance concern, 173 people choose to care about safety the most, and the second most concern is the comfort of the clothing. 74 people choose this option. It can be seen that when designing clothing, children's clothing should pay the most attention to positioning functions, and outdoor worker clothing should pay the most attention to eye-catching styles. In terms of performance, whether it is children's clothing or outdoor workers, safety should be the most basic, followed by the comfort of clothes. After the comparison of the predicted value and the actual value

obtained by DBN, BP, Bagging, and Linear training, respectively, it is concluded that the deep belief neural network (DBN) model established in this paper has higher accuracy than BP, Bagging, and Linear, and can directly improve the efficiency of model design and realize large-scale customized production. It is believed that after training with more data in the later stage, the network will be further improved, and at the same time, it can further design and develop intelligent clothing model sizes directly generated from 3D human body data: Fashion design system.

Data Availability

No data were used to support this study.

Conflicts of Interest

There are no potential conflicts of interest in this study.

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References

[1] L. Xu, C. Jiang, and J. Wang, "Information security in big data: privacy and data mining," *IEEE Access*, vol. 2, no. 2, pp. 1149–1176, 2017.

[2] L. Kuang, F. Hao, and L. T. Yang, "A tensor-based approach for BD representation and dimensionality reduction," *IEEE Transactions on Emerging Topics in Computing*, vol. 2, no. 3, pp. 280–291, 2017.

[3] Z. Yaoxue and J. Zhang, "A survey on emerging computing paradigms for big data," *Chinese Journal of Electronics*, vol. 26, no. 1, pp. 1–12, 2017.

[4] Y. Zhang, M. Qiu, C.-W. Tsai, M. M. Hassan, and A. Alamri, "Health-CPS: healthcare cyber-physical system Assisted by cloud and big data," *IEEE Systems Journal*, vol. 11, no. 1, pp. 88–95, 2017.

[5] M. Rathore, A. Paul, and A. A. hmad, "Real-time BD analytical architecture for remote sensing application," *Ieee Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 8, no. 10, pp. 4610–4621, 2017.

[6] L. Rongpeng and Z. Li, "Intelligent 5G: when cellular networks meet AI," *IEEE Wireless Communications*, vol. 24, no. 5, pp. 175–183, 2017.

[7] H. Lu, Y. Li, and C. Min, "Brain intelligence: go beyond AI," *Mobile Networks and Applications*, vol. 23, no. 7553, pp. 368–375, 2017.

[8] Y. Zheng, "Urban computing: enabling urban intelligence with big data," *Frontiers of Computer Science*, vol. 11, no. 1, pp. 1–3, 2017.

[9] H. Xing, A. Qian, and R. C. Qiu, "A BD architecture design for smart grids based on random matrix theory," *IEEE Transactions on Smart Grid*, vol. 8, no. 2, pp. 674–686, 2017.

[10] Y. Wang, L. Kung, and T. A. Byrd, "Big data analytics: understanding its capabilities and potential benefits for healthcare organizations," *Technological Forecasting and Social Change*, vol. 126, pp. 3–13, 2018, JAN.

[11] C. S. Calude and G. Longo, "The deluge of spurious correlations in big data," *Foundations of Science*, vol. 22, no. 3, pp. 595–612, 2017.

[12] M. Janssen, H. van der Voort, and A. Wahyudi, "Factors influencing big data decision-making quality," *Journal of Business Research*, vol. 70, pp. 338–345, 2017, JAN.

[13] L. Zhou, S. Pan, J. Wang, and A. V. Vasilakos, "Machine learning on big data: opportunities and challenges," *Neurocomputing*, vol. 237, pp. 350–361, 2017, MAY10.

[14] Y. Zhang, S. Ren, Y. Liu, and S. Si, "A big data analytics architecture for cleaner manufacturing and maintenance processes of complex products," *Journal of Cleaner Production*, vol. 142, pp. 626–641, 2017, PT.2.

[15] H. Cai, B. Xu, L. Jiang, and A. V. Vasilakos, "IoT-based big data storage systems in cloud computing: perspectives and challenges," *IEEE Internet of Things Journal*, vol. 4, no. 1, pp. 75–87, 2017.

[16] S. Athey, "Beyond prediction: using big data for policy problems," *Science*, vol. 355, no. 6324, pp. 483–485, 2017.

[17] M. Nasr, A. E. D. Mahmoud, M. Fawzy, and A. Radwan, "Artificial intelligence modeling of cadmium(II) biosorption using rice straw," *Applied Water Science*, vol. 7, no. 2, pp. 823–831, 2017.

[18] J. Lemley, S. Bazrafkan, and P. Corcoran, "Deep Learning for Consumer Devices and Services: pushing the limits for machine learning, artificial intelligence, and computer vision," *IEEE Consumer Electronics Magazine*, vol. 6, no. 2, pp. 48–56, 2017.

[19] R. Chatila, K. Firth-Butterflied, J. C. Havens, and K. Karachalios, "The IEEE global initiative for ethical considerations in artificial intelligence and autonomous systems [standards]," *IEEE Robotics and Automation Magazine*, vol. 24, no. 1, p. 110, 2017.

[20] X. Yang, H. Li, L. Ni, and T. Li, "Application of artificial intelligence in precision marketing," *Journal of Organizational and End User Computing*, vol. 33, no. 4, pp. 209–219, 2021.

[21] N. Man, K. Wang, and L. Liu, "Using computer cognitive atlas to improve students' divergent thinking ability," *Journal of Organizational and End User Computing*, vol. 33, no. 6, pp. 1–16, 2021.

[22] L. Li and J. Zhang, "Research and analysis of an enterprise E-commerce marketing system under the big data environment," *Journal of Organizational and End User Computing*, vol. 33, no. 6, pp. 1–19, 2021.

[23] D. Hassabis, D. Kumaran, C. Summerfield, and M. Botvinick, "Neuroscience-inspired artificial intelligence," *Neuron*, vol. 95, no. 2, pp. 245–258, 2017.