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Body Constitution Classification by CNN-SVM Based on GWO Optimization

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Abstract. The constitution is formed by the congenital inheritance and acquired. The individual constitution is different, and the physiological response to the outside world is different. Therefore, research on physical classification can better prevent diseases. In order to improve the accuracy of physical classification, while overcoming defects such as slow convergence speed in the neural network, a gray wolf algorithm (GWO) optimized convolutional neural network (CNN) and support vector machine (SVM) human constitution classification method. Most researchers have collected physiological signals as assessment parameters, so we use ECG as a classification, combining tongue image diagrams as a basis basis, and more comprehensive classification of human constitution. First of all, the experimental data is extracted, and secondly, the GWO optimized CNN-SVM is classified and identified by the data sample. The final experimental results are compared with other classifier models. The classification of the classifier designed in the text is accurate.

Keywords. Physical classification; Grey Wolf optimization algorithm; Convolutional neural network; Support vector machine

1. Introduction

Since the 18th National Congress of the Communist Party of China, the Party Central Committee has paid more attention to people's health, which has led many researchers to research on the research on health.

In 2019, Xie Jiacheng's "Application and Practice of Deep Learning in the Classification of Tongue Impact I amiated by Chinese Medicine", which builds a tongue elephant dataset by adding physical classification tags to the tongue data data, thereby establishing a tongue image recognition model, and through the residual nerves in deep learning in deep learning The network structure builds a physical classification model, and then performs physical classification [8]; in 2022, Zhou Yan, Zhou Yan, Yan and other "Research and Thoughts and Thinking of the Classification of Traditional Chinese Medicine" put forward the point of viewing the theoretical constitution of multi - dimensional constitution [9]. The physical fitness is judged from the four aspects of "looking", "smell", "asking", and "cutting" of Chinese medicine. The tongue and pulse are two main aspects. In most cases, the pulse is the same as ECG. Elephant diagrams

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and ECG are used as experimental data, and the basis of physical classification is performed.

Although the current classification technology has developed rapidly, there are still some problems in the classification and identification of human constitution. Such as low classification efficiency, long running time, inaccurate classification and other problems. Therefore, this article uses the CNN and SVM fusion models for physical model recognition and classification, and then the problem of lowering human constitutional classification rates is proposed to optimize the CNN-SVM algorithm, including optimization of SVM nuclear parameters, physical classification Wait for work. Finally, compared with the traditional classifier model, further verify the effectiveness of this method [2-4].

2. Theory Related Theory of Body Physical Classification

2.1. Convolutional neural network

CNN is one of the most famous deep learning models that realize various computer visual tasks (such as image recognition and image classification). In terms of structure, standard CNNs are generally subject to losses, convolutional layers, pooling layers, and full connection layers. constitute. The image data of the loser is convolutioned at the convolutional layer and the convolution nucleus to obtain several feature maps. The characteristic output expression is:

$$x_j^l = f(\sum_{i \in M_j} x_i^{l-1} * k_{ij}^l + b_j^i) \quad (1)$$

Then pass the compression information of the pooling layer to ensure that the information left can best express the characteristics of the image. All the characteristic charts after the pooling are connected to the full connection layer of the person, and the image classification is implemented through the SOFTMAX computing [6].

2.2. Support Vector Machines

SVM is a common supervision and learning optimization algorithm. It uses the boundary (ultra -plane) to describe the data, making it easier for it to view, classify, and distinguish different instances of the data class. Ultra -plane mathematical models can be expressed as:

$$\omega T\bar{x} + b = 0 \quad (2)$$

At any side of the super plane, there are two data classes, so SVM is a dual -value classification algorithm. When facing multiple classification problems, it can be constructed to solve multiple dual -value classification problems. The decision classification function can be expressed as:

$$f(x) = \mathrm{sgn}[\omega T + \bar{x}] \quad (3)$$

When using SVM to process K-dimensional data, if the K-1 dimension super plane is available, the data can be divided, then the data is called linearly divided data. When dealing with complex linear inseparable problems, the nuclear function is usually required. This algorithm has its own model complexity that is not affected by the number of features encountered in the training data, and is very suitable for the learning tasks with a large number of characteristics relative to the number of training instances. At the same time, the algorithm has a strong generalization ability, which is more stable than other machine learning algorithms [1].

2.3. CNN and SVM fusion model

From the above, the main role of CNN is the characteristics of extracting data, and the extracted features are trained in the classifier. SVM has a better classification performance than the SoftMAX classifier in traditional CNN, so SVM is used instead of SoftMAX to achieve classification.

When During the classification, the selection of punishment parameter C and nuclear parameter G has a great impact on the performance of SVM. It is necessary to find an effective intelligent optimization algorithm to apply to the SVM parameter to find the best to improve the accuracy of classification. This article uses a improved gray wolf optimization algorithm to find the optimal punishment parameter C and nuclear parameter G, so that the optimization of the classifier is transformed into parameter optimization problems. [5].

3. The Overall Process of Human Constitution Classification Model

3.1. Pre -processing

3.1.1. ECG signal pre-processing. Human electrocardiophage is a very weak physiological low -frequency electrical signal, which is easily affected by the outside world. It interferes with a lot of noise and strong. First of all, the low -pass filtering method is used to noise the waveform of the original data set, and then the features are processed by the characteristics.

3.1.2. Tongue image diagram. The data pre -processing method is divided into two steps:

Step 1: due to the different sizes of the data concentration, the cutting and transformation of the data make the unified picture.

Step 2: There will be less data classification in the data set calibration, so data expansion of less sample data will be expanded. Common expansion methods include image reversal, random cutting method, adjustment of brightness and adjustment. This article adopts the adjustment of the brightness method.

3.2. Feature extraction

3.2.1. ECG signal feature extraction. After the original ECG signal is completed, feature extraction needs to be performed. In this article, the variance in the time domain, the power of different rhythms in the frequency domain, and the characteristic vector of

differential entropy are extracted. Among them, the calculation formula of the variance is as follows:

$$s^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{N} \tag{4}$$

In order to make the variance estimated from the sample value, the formula 4 is rewritten:

$$s^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{N-1} \tag{5}$$

Since the collected ECG signal is a discrete sequence S (n), the discrete Fourier transformation method DFT is mostly used in the actual operation, and the computer can handle the Fourier transformation with seeking and replacing the integration computing. Applying the ECG signal can get the spectrum:

$$S(k) = DFT[s(n)] = \sum_{n=0}^{N-1} s\,(n) W_N^{nk} = \sum_{n=0}^{N-1} s\,(n) e^{-j(\frac{2\pi}{N})nk} \tag{6}$$

Due to the large calculation of DFT, we use DFT's fast algorithm FFT to replace DFT. After the FFT processing, the frequency band obtained by the FFT processing is decomposed. After the frequency band is decomposed, the power is extracted separately.

The features obtained through feature extraction usually have a high degree of dimension, and the electrostatic characteristics need to be selected to reduce the characteristic dimension. PCA is one of the most commonly used feature -reducing dimensions. Although it can quickly reduce the dimension of the high -vitamin, it only considers the variance between the samples and ignores the relationship with the constitution. The RELIEFF algorithm is efficient and is not limited by the data type,in this way, it can process discrete or continuous data sets. When dealing with multiple types of problems, the RELIEFF algorithm selects the nearest neighbor sample from different types of samples. So the RELIEFF algorithm is more suitable for the dimension of ECG's emotional characteristics. [7].

3.2.2. Tongue image feature extraction. According to the data pre -processing, in terms of the selection of color space, we use RGB and LAB color space for feature extraction, which shows the picture style of the same tongue image in the two color spaces of RGB and LAB, as shown in Figure 1(a), (b) shown:

(a)RGB (b)LAB

Figure 1. RGB color space and LAB color space tongue image picture

Since the collected data cannot guarantee the image of the tongue, you need to extract the tongue image data set and non -tongue image data set from the collected data set. After pre -processing the picture through the above methods, as the Bayesian

classification model and the input of the vector machine, the judgment of the tongue and non -tongue. [8].

3.3. Use GWO to optimize SVM's classification models to build

When the SVM parameters C and G are different, the classification performance of SVM is very different. To get the optimal classification model of high -dimensional space, you need to choose the right SVM parameter. Because the gray wolf algorithm is now simple, the parameters are small, and it is better than PSO, DE and other algorithms in terms of convergence, excellence, etc. Therefore, choose the gray wolf algorithm to find the optimal parameter of SVM. The GWO-SVM classification model process is shown in Figure 2.

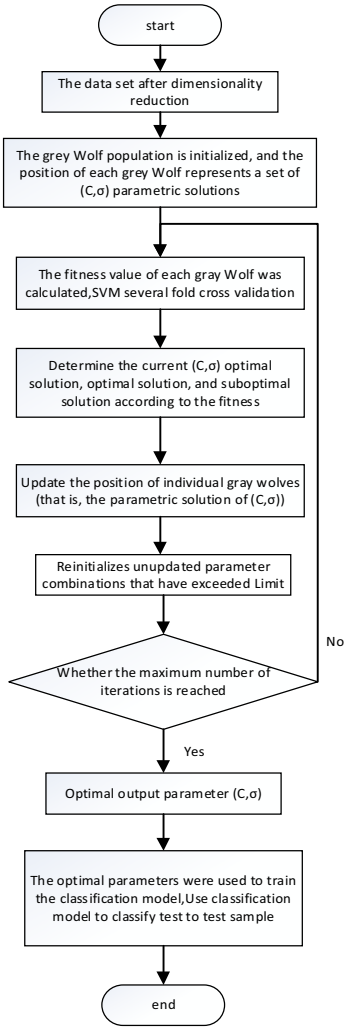

Figure 2. GWO-SVM classification model process.

4. Experiment and analysis

In the experiment, select the MIH-BIT dataset and the collected tongue data image picture (using the mobile phone called iTongue's app to collect college students' tongue. Tags), divide the body's constitution into 9 categories (refer to Table 1), each picture belongs to only one of them.

Table 1. Human constitution type

Physical classification	Classification description	
	Type	***Description***
1	Flat quality	Reddish tongue color; The heartbeat is slow and strong
2	Qi deficiency	Reddish tongue color; Weak heartbeat
3	Yang deficiency	Tongue light fat tender; The heart rate is slow and weak
4	Yin deficiency	Tongue red oligosamine; The heart beat fast and weak
5	phlegm-dampness	Light tongue and thin fu; The heartbeat is fast and smooth
6	Hygrothermal substance	Reddish tongue color, yellow tongue coating; The heartbeat is fast and smooth
7	Blood stasis	Dark tongue or petechiae; Irregular heartbeat
8	Qi stagnation	Light tongue and thin fur; The heart rate is strong and rapid
9	Characteristic substance	Pale reddish tongue color, tongue coating, fat, toothlike; The heart beat fast and weak

After each image is pre -processing, the system describes the corresponding features in Table 1 as image classification features. Each human constitutional level is taken for 100 pictures, of which 50 are used as training samples and 50 are used as test samples. Half of the tongue). Training and testing with algorithms in this article, the classification results obtained are shown in Figures 3 and 4.

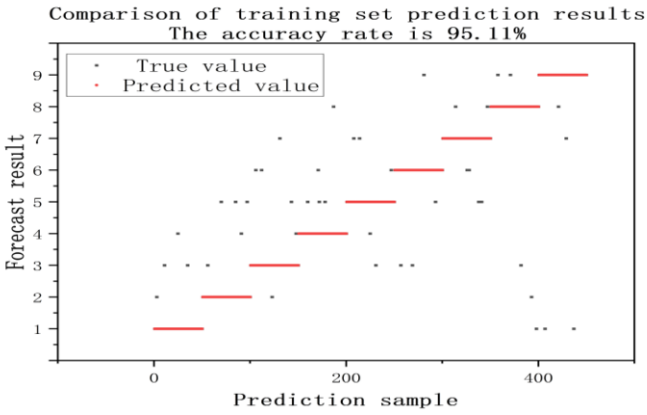

Figure 3. Comparison chart of the training set prediction results.

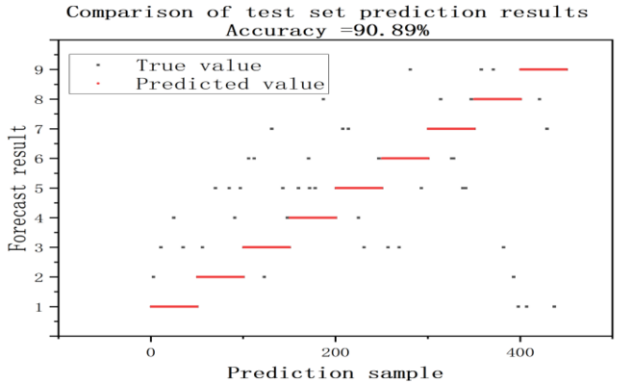

Figure 4. Test set prediction results comparison chart

Experiments show that the GWO optimized CNN-SVM algorithm in this article has high classification accuracy and faster classification speed, and improves the promotion effect of the CNN-SVM classifier, and has achieved excellent classification performance [10].

Use the algorithm with CNN, CNN-SVM, DCNN-SVM,and four methods to compare tests on the OPTDIGITS dataset of the UCI database. The experimental results are shown in Figure 5.

The experimental results show that the text algorithm is better than the CNN and CNN-SVM, DCNN-SVM methods in classification accuracy. Make full use of the automatic extraction characteristics of convolutional neural networks and SVM classifiers can enhance the robustness and generalization of the model. And accuracy, avoiding solution is the global optimal solution of the entire solution. It will not fall into the local optimal solution, but there are still some shortcomings such as: long training time.

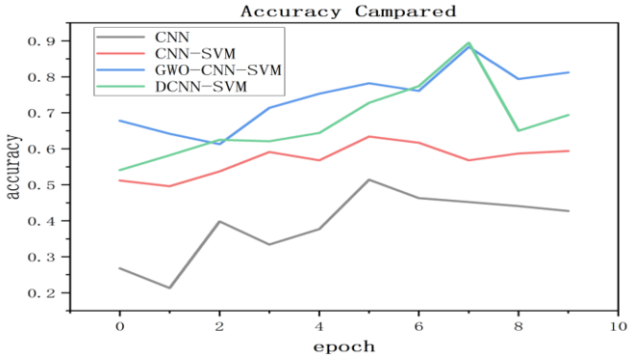

Figure 5. Comparison of the correct rate of 4 methods

5. Conclusions

In order to solve the problem of human physique classification, this paper, aiming at the traditional classification problem, proposes the CNN-SVM classification model

optimized by grey Wolf algorithm, which has improved the convergence speed and accuracy. Through experimental verification, this method has a good effect on human physique classification, and provides guarantee for the subsequent application performance. The selection of kernel parameters in the SVM model is a key step to ensure that the algorithm can improve the physical recognition rate. The grey Wolf optimization algorithm is used to optimize parameters, which reduces the unsatisfactory classification results caused by the subjective factors of parameter setting. It provides a reliable basis for further study.

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