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BP neural network-based sports expression recognition model's performing sports competition performance rating applied research

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ABSTRACT

Neural network algorithms has been paid very high attentions in each field, due to its relative strong self fault-tolerant ability and self-training learning ability as well as other good advantages, it has great applied prospects in competition rating of sports competition performing events or events with performing properties. The paper just based on the superiority, it constructs BP neural network model, the algorithms use face moving instant expression to make intelligent recognition, and comprehensive adopt foreign facial expression database to teat on it. The result shows the model is reasonable, so using BP neural network algorithms to carry out face recognition and expression analysis has obvious superiorities, neural network model provides extremely wide development space for sports performance mode recognition model researching.

KEYWORDS

Face recognition;
BP neural network model;
Sports expression;
Recognition model.

INTRODUCTION

Present pattern recognition has already mapped into each corner of life, pattern recognition is particularly important for future recognition system establishment, especially for sports competition performing kind of events, human body pattern recognition is becoming more and more important, and nowadays most applied is facial movement expression recognition.

Regarding facial expression recognition aspect researches, lots of people have made efforts, and got achievements, which provides beneficial conditions for scholars from all circles of society making research and provides impetus for scientific face recognition development. Such as: Zuo Kun-Long in face recognition research, he proposed that face recognition had several ways, from which the active appearance model was utilizing human face uneven features to extract feature points, and using handwork to mark, but the way consumed long time and was tedious, so he proposed face recognition semiautomatic auxiliary marking so that improved features points extracting manual efficiency.

The paper on the basis of previous research result, it analyzes face movement recognition required methods, and applies BP neural network to carry out pattern recognition on people sports expression, combines with database to do experiment and state the method implementation and application, the research result has important effects on establishing neural network human body movement expression recognition pattern's re-

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searches.

BP NEURAL NETWORKS FORMING

BP neural network theoretical model establishment

Hierarchical neural network is one important mode of neural network, is one kind of two main connection ways, the most important is that it is a kind of feed forward and multiple layer's one kind of important network model or method, its hidden layer only has one form, and its basic structural form unit is nerve cell, as following Figure 1 show.

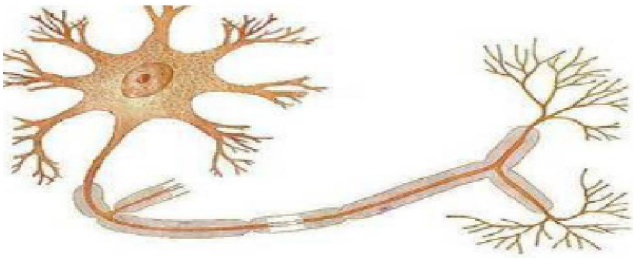

Figure 1 : Neurone

BP neural network generally is using output layer, hidden layer and input layer such three layers to build BP neural network model's structural frame, as following Figure 2 show:

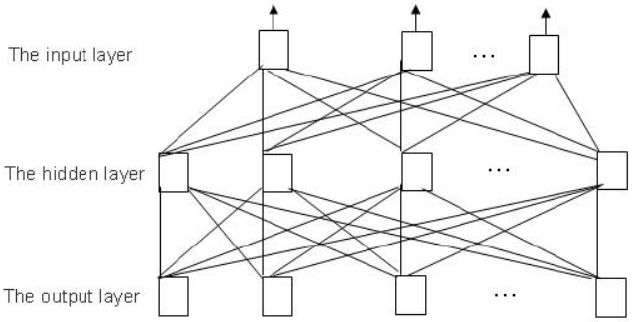

Figure 2 : Neural network theory process

Meanwhile, though there are no any connections among them, their nerve cells are mutual correlated. The algorithm learning process is composed of two directions that are respectively forward direction process and reverse two propagation processes, from which, forward propagation is: $net_{jk}^{l} = \sum_{j} \omega_{jk}^{l} o_{jk}^{l-1}$

In above formula, $l-1$ represents number of layers, is expressed by o_{jk}^{l-1}, and when output j pieces of units nodes, the input is the k sample, then $o_{jk}^{l} = f(net_{jk}^{l})$

Reverse propagation:

① If input unit node is j, then $o_{jk}^{l} = \bar{y}_{jk}$

Among them, use j as actual output unit which is expressed by $\bar{y}_{jk}$. $\delta_{jk}^{t} = -(y_k - \bar{y}_k) f^{/}(net_{jk}^{t})$

② If input unit node is not j, then $\delta_{jk}^{t} = \sum_{m} \delta_{mk}^{l+1} \omega_{mj}^{l+1} f^{/}(net_{jk}^{t})$

$\frac{\partial E_k}{\partial \omega_{ij}} = \delta_{jk}^{l} o_{jk}^{l-1}$, revise weight: $\omega_{ij} = \omega_{IJ} - \mu \frac{\partial E}{\partial \omega_{ij}}, \mu \succ 0$. Here $\frac{\partial E}{\partial \omega_{ij}} = \sum_{K=1}^{N} \frac{\partial E}{\partial \omega_{ij}}$.

Among them, the process from input layer to hidden layer and then transfer to output layer is information forward direction propagation, but once end cannot get corresponding output result, it will automatically turn to reverse propagation, and the model weight values defining and adjustment are adopting reverse propagation learning algorithm. The algorithm can thoroughly reflect their inner features, therefore it overcomes grey model and multiple regression seriously shortcomings.

One nerve cell k is expressed by following formula:

$$u_k = \sum_{t=1}^{m} w_{ik} x_t$$

$$y_k = f(u_k + b_k)$$

In above formula, nerve cell unit threshold value is b_k, in linear combination, input signal output is u_k, output signal is y_k, protruded weight is w_{ik}, input signal is x_k, and meanwhile activated function is $F()$, corresponding function formula is as following:

Due to BP neural network nerve cell does not change; corresponding model is as Figure 3:

For BP nerve cell, its input end is: $net = x_1 w_1 + x_2 w_2 + \cdots + x_n w_n$

In above formula, connection weight value: $w_1, w_2, \cdots, w_n$

Input value: $x_1, x_2, \cdots, x_n$

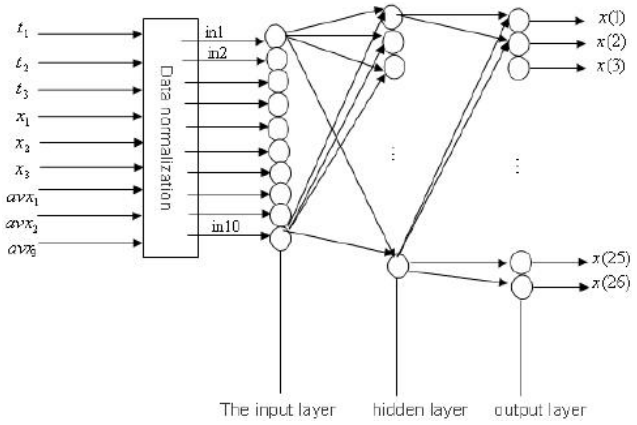

Figure 3 : Neural network operation process

These nerve cells all activated functions use S type function, the function not only is continuous but also can derive.

Neural network learning process

Neural network is mainly up to two aspects: model parameters, features, from which parameters include learning rate, hidden layer, stopping criterion, as above Figure 3show, learning process starts implementing form initialized network, and then inputs the input layer into a training corresponding mode, after network transitive signal recognition, it defines output value size and automatically sets a matching minimum value, when error is out of the value, system will automatically circulate the function till error reduces to given range.

Original data standardization process

Define that between 0 and 1 is BP neural network node value, if input information hasn't arrived at hidden layer, then the node is 0, therefore to avoid the fault status, we adopt standardization handling with these original data, adopt: $h = \sqrt{m+n} + a$

Hidden point initial number values can be defined by formula (2), that is:

$$S_{\max} = \text{int}\sqrt{0.43nm + 0.12n^2 + 0.54m + 0.77n + 0.35 + 0.51}$$

Among them, in above two formulas, a is a constant, and is a number between 1and 10, n, m are the number of output and input nodes. We work out an initial value by relative formula, and then solve it gradually.

Define error

Assume when outputs network, error value is:

$$E_K = \frac{1}{2}\sum_J (y_{jk} - o_{jk})^2$$

We assume that $E = \sum E_K$ is the sum of the model whole process generated output errors, and in above formula, actual output value is o_{jlk}, ideal output value is y_{jk}.

REGARDING FACE RECOGNITION AND MOVEMENT EXPRESSION'S BP ALGORITHM APPLICATION

Neural network structural learning among classes

In modern times, a very typical perception is three layers, and it is simultaneously composed of network 1 and network 2, network 1, 2 input values are A, B two parameters values, network corresponding distance criteria D is used to calculate d_{AB}, and D_{AB} expectation is calculate4d by experiment finally obtained results, we let different expressions according to following formula :

$$D_{AB} = (\lambda\sum_{i=1}^{m}(x_i^A - x_i^B)^2)/(\sum_{J\in S, j\neq A}\sum_{i=1}^{m}((x_i^A - x_i^B)^2))$$

If it is among same kind, then set expectation value distance to be 0, on above λ rate factor represents current compares to expression kinds, its range is $0 \le \lambda \le 1$, in addition, A, B $\in$ S (**happy, surprise, sad, angry, fear, disgust, neutral**),

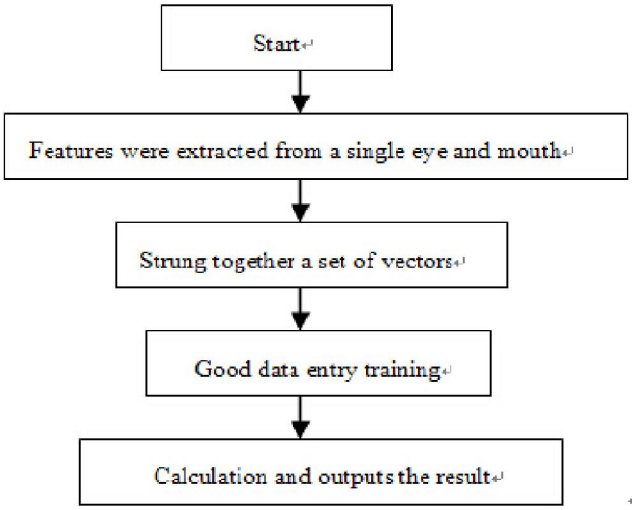

Figure 4 : Classification process

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Expression recognition classification

After carrying out neural network training among classes, adopt single BP neural network to proceed with expression classified recognition, and then test facial partial expression's image features, use classification to recognize, its flow chart is as Figure 4 show:

Intercept expression image database source

According to Nihon university, Yale university about face recognition researches' database, intercept facial seven expressions that mainly are :Disgust, surprise, fear, sad, happy, neutral, intercepts 500 face images, these data totally divides into two groups to test, each occupies half that are respectively test data, network training data, every image intercepts eyes and mouth image information, and then normalizes the information, after standardization, by sampling processing, it trains neural network recognition, extract 80 in every input layer, so totally input 160, use three layers' neural network as a BP network classified recognition system, number of output layers is 4, number of hidden layers is designed as 10, we assume momentum factor is 0.5, learning factor is 0.2, and λ is set as 0.7, and then two expressions' expectation D_{AB} result is as TABLE 1 show.

After expression image features extracting, obtained expression classification test result, its average recognition rate is92%, each kind of expression recognition rate is as TABLE 2 show:

In this experiment, by database, intercepted partial people's expression is as Figure 5 show:

TABLE 1 : Expression pairs distance expectation value

Expression (A, B)	Fear-surprise	Angry-disgust	Surprise-disgust	Happy-disgust	Fear-disgust	Sad-angry	Happy-surprise	Sad-surprise
D_A	0.7	0.6	0.4	0.4	0.3	0.5	0.6	0.6
Expression (A, B)	**Happy-sad**	**Sad-disgust**	**Fear-disgust**	**Surprise-angry**	**Happy- angry**	**Fear- angry**	**Happy-surprise**	
D_A	0.7	0.5	0.4	0.5	0.3	0.5	0.6	

TABLE 2 : Expression type recognition rate

Expression type	neutral	disgust	fear	angry	sad	Surprise	Happy
Recognition rate	87.9	93.6%	89.9%	92.5%	87.8%	94.6%	93.2%

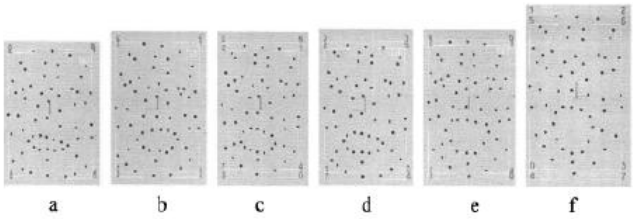

Figure 5 : Part of the face

In the database, no matter men or women, old or young, different people's expressions, each orientations' one all are included, by different comparing, it can establish a relative stable face movement expression recognition database.

CONCLUSIONS

The paper not only introduces performance mode recognition BP neural network algorithm, and it also applies specific examples to verify, the result shows the model structural rationality. By establishing BP neural network model to recognize face movement expression, though it still have tiny deviation with real person, it is already very advanced by comparing with other algorithm, so the model makes indelible contributions for future mode recognition researching. Regarding face recognition and expression analysis that affected by lots of factors, use BP neural network method to recognize that shows it has obvious superiorities.

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