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Design of Micro-Expression Recognition System Based on Computer Cloud Computing

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Abstract: This is an era of big data, and the rapid growth of data is no longer an era that can be processed perfectly by a single machine in the past. In order to adapt to the data processing needs of the times, micro-expression recognition, as an old subject of pattern recognition, also needs to make new changes. In this case, this paper designs a micro-expression recognition system based on computer cloud computing. First of all, this paper studies the research status and application value of micro-expression recognition, and then this paper analyzes the MapReduca algorithm, the micro-expression recognition algorithm and the OpenCV computer vision library in detail. Then, this paper uses SVM-Adaboost algorithm and NSMD algorithm to realize the MapReduce micro-expression recognition system. Finally, this article has carried on the experimental test to the recognition effect and recognition time of SVM-Adaboost algorithm and NSMD algorithm, and draws relevant conclusions.

1. Introduction

Micro-expression recognition is one of the key research contents in the field of artificial intelligence. Recognition is an innate ability of human beings, and micro-expression recognition is the most special recognition ability of human beings [1-2]. In the process of intelligently identifying micro-expressions through cloud computing, data storage and calculation are the biggest difficulties, and the design of the classifier on the distributed architecture is also a problem that needs to be solved. With the increasing degree of informatization of society, the role of micro-expression recognition research is also increasing. First of all, micro-expression recognition technology can provide security. Through micro-expression recognition technology, a person's information can be intelligently recognized. Secondly, micro-expression recognition can also provide great help in portrait retrieval and classification. Faced with the complex image database, it can be intelligently sorted, and there is no need to carry out tedious searching work when needed [3]. With

micro-expression recognition as the basic research content, it is a good choice to research related algorithms. Usually, the recognition technology is applied in serial mode. This article uses parallel mode, which can combine more resources.

Chinese scholar Liu Ruhan uses phase-based video action processing technology to amplify the video data in the micro-expression data set. Then use the feature point positioning to obtain the eye coordinates, and replace the original eye video with the enlarged video for image fusion, so as to achieve the elimination of eye interference. Finally, a convolutional neural network model network is designed to realize the recognition of the emotion category of the amplified micro-expression data [4]. Lai Zhenyi pointed out that with the gradual improvement of the spontaneous facial micro-expression recognition and classification method, it is easier to satisfy the real-time application of the application compared with the traditional feature extraction method. In order to perfect the detailed information and fully extract the subtle features of the micro-expression, a combination of the hollow convolution kernel and the automatic face correction algorithm is proposed to complete the model training and testing on the micro-expression public data set [5]. Zhang Yanliang pointed out that the occurrence of micro-expression only involves the local area of the face that has the characteristics of small movement range and short duration. However, while the face produces micro-expression, there are also some unrelated muscle movements. The existing global area method for micro-expression recognition will extract these irrelevant changes in spatio-temporal patterns, thereby reducing the ability of feature vectors to express micro-expressions, thereby affecting the recognition effect [6].

Compared with other physiological characteristics, human micro-expression is the most direct and true carrier of identity information and emotional conditions. It has the characteristics of easy identification, extremely high accuracy, and no contact [7-8]. In the process of conversation, people can well capture the other's characteristic emotions and other information based on a person's micro-expression, and store this information in the brain to form a memory for later use. Because the role of micro-expression recognition is so great, many researchers have conducted in-depth research on micro-expression, and micro-expression recognition technology has become more and more mature, and micro-expression recognition technology has been applied in many fields of society. For example, the police can use micro-expression recognition technology to identify people. The information collected through micro-expression recognition can be compared with the information collected at the crime scene. Criminals can be found quickly, and the efficiency and success rate of solving crimes have been greatly improved [9-10]. Many surveillance equipment such as cameras have been installed in public areas such as shopping malls, communities, and squares. The use of micro-expression recognition technology in these monitoring devices can analyze a person's information very accurately, preventing criminals from committing criminal activities, and ensuring the safety of public areas. In addition, micro-expression recognition technology can also play a role in the game and entertainment industry. For example, in the live broadcast of games such as League of Legends, some anchors will set a cartoon character to synchronize their expressions in real time. Among them, micro-expression recognition technology is used [11-12].

2. Design of Micro-Expression Recognition System Based on Computer Cloud Computing

2.1. MapReduca Algorithm

MapReduce uses the idea of "divide and conquer". It assigns a series of complete large-scale data processing operations to each node under the management of a master node for joint

implementation, and then the master node obtains one by integrating the interrogation results of each node operation final results. When the MapReduce framework performs parallel computing, it is not a simple execution function. It also requires a series of steps to complete a task together. A complete MxpReduce task is controlled by multiple TaskTrackers and JobTradkar node types, and all TaskTrackars are managed and scheduled by JobTradker. JobTraxker is only responsible for dividing Map tasks and Reduce tasks. TaskTraxker is the executor of the task, but the Task Traker of each node needs the support of DatNode. In addition to managing and scheduling tasks, JobTracker also needs to monitor the status of each TaskTncker to ensure the execution progress of the entire task. If an error occurs in a TaxskTracker, JbTradkar will reassign the tasks on the JobTadker to other JobTrackers for execution. But if JobTracker fails, it will cause the execution of the entire task to fail. Therefore, in order to ensure the execution progress of real-time tasks, two or more Jblradkcr can be run. In order to ensure the execution time of tasks, it is necessary to avoid or reduce a large number of network transmissions in the calculation process. MapReduce boxes store the data required by each task in the same computer, reducing the transmission of data in the network and only transmitting calculations. As a result, this is the most effective way to reduce the task's demand for network bandwidth.

2.2. Micro Expression Recognition Algorithm

Micro-expression recognition is a popular technology that combines the two fields of computer and biology. General biological characteristics include fingerprints, palm prints, irises, faces, voices, etc. Compared with other detection technologies, micro-expression recognition has the advantages of being imperceptible and natural. Micro-expression recognition is a topic that often appears in pattern recognition, because micro-expression recognition combines image content extraction, data analysis, and data mining. As we all know, the picture is a dot matrix data for the computer, it is a bunch of integer or floating point data, other than that, it is meaningless. But for humans, an image means a scene, and a scene means there are objects and events in it. How to extract information from images and how to identify the content of this information is an important topic. And micro-expression recognition is in this category. After taking an image for a scene, how to get the person's position from the image. And get the person's information from the person's avatar, which is a complete and intelligent micro-expression recognition process. In view of the increasing popularity of micro-expression location recognition technology, and there are open source applications, such as opencv, the adaboost algorithm is used to achieve this function well.

2.3. OpenCV Computer Vision Library

The micro-expression image is collected and detected through the camera, and OpenCV also provides related operations to handle this situation. The video stream in the camera needs to be read, and the function returns a pointer to store the read image. The user only needs to continuously display and process the read image. OpanCV provides a lot of image processing and image transformation methods and functions. At this stage, the image is optimized as much as possible, and the interference of other factors on the pre-processed image is eliminated and reduced as much as possible, so as to improve image quality and increase recognition efficiency. Since micro-expression library images are generally gray-scale images, this article only considers the processing of gray-scale images. The histogram is used to describe the current color distribution probability of the image target position. When shooting a scene, the exposure time is longer in the darker area, while the exposure time is shorter in the brighter area. Therefore, the image sensor may

not be fully exposed to the image result due to the strong light and dark changes. At this time, the sensor will select an intermediate state for exposure. Histogram equalization is to expand the light and dark areas of the image to a larger range. Generally, it is necessary to process a certain part or some parts of the image in image processing. Set the region of interest on the image, the operation of the function is limited to the region of interest, and other regions will not be changed.

3. MapReduce Implementation of Micro Expression Recognition

3.1. MapReduce Implementation of Feature Extraction

First of all, it is necessary to pre-process the training image set, image grayscale, size standardization and histogram equalization. After the preprocessing is completed, a training set file is formed for all pictures. This file covers all picture information. At this time, the representation of the training set is already in the form of data, not in the form of pictures. After finishing the preprocessing, what needs to be considered is how to perform feature extraction. Both HOG and wavelet transform are suitable for the MxpReduc calculation framework, but in view of the fact that wavelet transform has been used more in micro-expression recognition, and the application of HOG in micro-expression recognition is still relatively small, this article decides to use HOG as the feature extraction method in this article. On the other hand, if you use HOG directly, the final feature vector is still too large and the training speed will be too slow, so it is necessary to compress the information. The feature extraction of HOG is all for a certain picture, so the calculation separation degree of its calculation process is high. In order to compress information, it is necessary to use PCA again, and if RCA is used alone, the final recognition effect is not good. In order to balance recognition effect and recognition speed, even PCA is difficult to achieve parallelization effect on MapRoduce. This article still adopts the method of PCA compression after HOG feature extraction. For PCA dimensionality reduction, only the process of solving eigenvectors and eigenvalues is difficult to optimize using MapReduce in the dimensionality reduction process, but other calculations are highly separable, which is very suitable for the MapRoduce calculation framework. The formulas used in feature extraction are:

$$F = sign\left(\sum_{i=1}^{l} y_i \alpha_i K\left(x_i, x\right) + b\right) \tag{1}$$

3.2. MapReduce Implementation of SVM-Adaboost and NSMD

One of the shortcomings of support vector machines is that they can only use the kernel function in the face of linear inseparability, and there is great uncertainty in finding the kernel function. So far, there is no clear theory to guide how to find the kernel function. The purposeless use of the kernel function to project the original feature vector to high dimensions can easily cause the data to lose its original characteristics. For this reason, this paper proposes a method of using SVM combined with Adaboost to solve the linear inseparability problem without using the kernel function and thus retaining the original characteristics of the feature vector. Although the Adaboast algorithm is not suitable for MapReduce, it is for big data training. For examples with too many training iterations and for micro-expression recognition, when combined with SVM, they are classified into two categories. Therefore, the training data used is small, the training calculation process is simple, the number of training iterations is small, and it still conforms to the characteristics of small calculation granularity, so it does not affect its compliance with the MxpReuw framework. On the other hand, the idea of SVM is to find the best classification plane so

that it has the farthest distance to the boundary sample, but SVM always tries to find a plane to solve the classification problem, which is actually in contradiction with its idea. In order to solve this problem, this paper proposes the NSMD algorithm. The two proposed in this article are Dada-type solving classifiers, which can achieve a 100% recognition rate for sample training, that is, one can always find a classifier that can completely divide the sample. The formulas used in MapReduce implementation are:

$$D(x,y)=\{i\%N \mid \min(A_i - A(x,y)|)\} \tag{2}$$

3.3. NSMD Algorithm

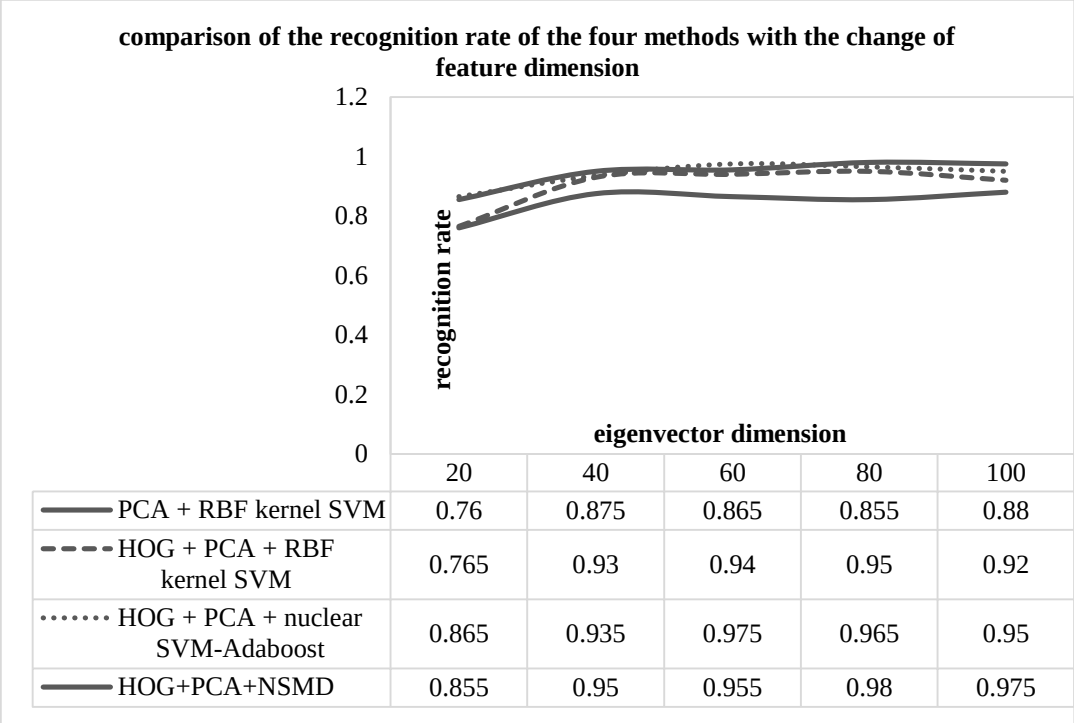
Unlike SVM trying to find an optimal classification plane at one time, the NSMD algorithm recursively finds the current local optimal classification plane multiple times, and then constructs the classifier through the data structure of kd tree. The classification plane can be divided into two categories, but compared with the results obtained by the NSMD algorithm, the classification plane cannot be as far as possible from the boundary samples. SVM tries to find a hyperplane at one time to achieve the farthest distance from the boundary sample, but the way it finds it at one time is very crude. Simply put, on the one hand, SVM wants to make the plane it finds the farthest from the boundary sample, and on the other hand, it tries to find it all at once. In fact, these two aspects are not completely coordinated and contradictory. In order to solve this contradiction and coordinate the relationship between the two, this paper proposes the NSMD algorithm. Under this algorithm, each time the closest two samples of different classes are searched, and then the entire training set is divided into two using the middle plane as the dividing plane, and the above process is repeated for the wrong side of the classification until it is correct. Therefore, under the NSMD algorithm, it is ensured that the classification plane is as far as possible from the boundary samples. If more than two types of classifiers are to be formed, there is no way to do it through the NSMD algorithm alone, and only two types of classifiers can be used to construct a multi-class classifier. One-to-many and one-to-one are two commonly used construction methods, both of which have very good scalability. When adding new data, there is no need to modify the original data, only the addition of two classifiers. Considering that the one-to-many construction method is not effective in fault tolerance and Luban performance, this paper decides to adopt a one-to-one training method.

4. Experiment Analysis

4.1. Analysis of the Recognition Effect of SVM-Adaboost Algorithm and NSMD Algorithm

Table 1. Comparison of the recognition rate of the four methods with the change of feature dimension

Eigenvector dimension	PCA+RBF core SVM recognition rate	HOG+PCA+RBF nuclear SVM recognition rate	HOG+PCA+Coreless SVM-Adaboost Recognition rate	HOG+PCA+NSMD Recognition rate
20	0.76	0.765	0.865	0.855
40	0.875	0.93	0.935	0.95
60	0.865	0.94	0.975	0.955
80	0.855	0.95	0.965	0.98
100	0.88	0.92	0.95	0.975



	20	40	60	80	100
PCA + RBF kernel SVM	0.76	0.875	0.865	0.855	0.88
HOG + PCA + RBF kernel SVM	0.765	0.93	0.94	0.95	0.92
HOG + PCA + nuclear SVM-Adaboost	0.865	0.935	0.975	0.965	0.95
HOG+PCA+NSMD	0.855	0.95	0.955	0.98	0.975

Figure 1. Comparison of the recognition rate of the four methods with the change of feature dimension

According to Table 1 and Figure 1, it can be known that the use of HOG features can effectively improve the classification effect, and the recognition rate of PCA+RBF kernel SVM is significantly lower than the other three methods that use HOG. The recognition effect of SVM-Adaboost and NSMD two classifiers is slightly higher than that of SVM using kernel function, while the effect of NSMD is slightly better than SVM-Adaboost. The recognition rate of NSMD can reach 98%, which also confirms the two two types proposed in this paper. The classification method can well replace the traditional SVM using the kernel function and obtain better and better results.

4.2. Analysis of Recognition Time of SVM-Adaboost Algorithm and NSMD Algorithm

Table 2. Time efficiency comparison

	PCA+RBF core SVM(s)	HOG+PCA+RBF nuclear SVM(s)	HOG+PCA+ coreless SVM-Adaboost(s)	HOG+PCA+NSMD(s)
Training	0.175	0.21	0.23	0.27
Identify	0.008	0.011	0.0135	0.0152

According to Table 2 and Figure 2, in terms of time efficiency, although the SVM-Adaboost and NSDM algorithms take longer than the other two methods, this time consumption is acceptable. HOG+PCA+coreless SVM-Adaboost consumes little more time than HOG+PCA+RBF core SVM. This is because many of the training samples in this article are linearly separable and do not require iterative training. HOG+PCA+NSMD takes the most time, which is actually spent on finding the nearest sample, and the number of iterations often requires two. From the above analysis, it can be concluded that using SVM-Adaboost and NSDM classifiers for micro-expression recognition applications can achieve considerable time efficiency and recognition rate. From the comparison of

PCA+RBF kernel SVM and HOG+PCA+RBF kernel SVM(s), it can also be seen that HOG feature extraction is also desirable in terms of time efficiency, and will not reduce the overall recognition efficiency.

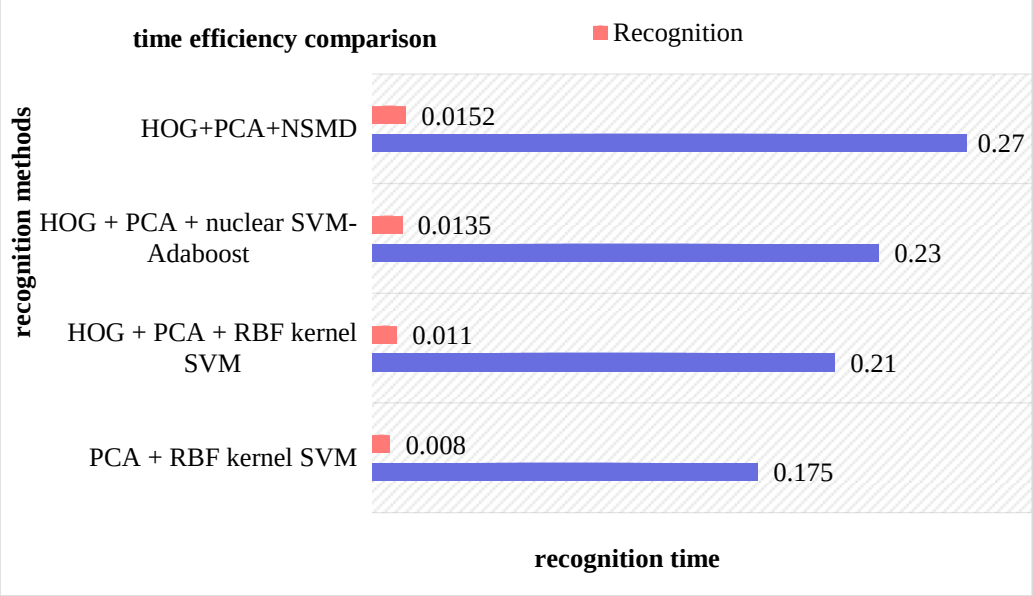


Figure 2. Time efficiency comparison

5. Conclusion

This is an era of big data, and the information mining and classification of big data is an important topic. Micro-expression recognition is such an application of information classification, but in the past, the application of micro-expression recognition was rarely applied to cloud computing platforms. In order to conduct research in this area and solve the situation where micro-expression recognition adapts to big data, this paper implements a micro-expression recognition system based on computer cloud computing. The main work of this paper is as follows: In the feature extraction of face recognition, HOG feature extraction is used, which can be very stable under different illuminations. However, the application of HOG in face recognition is still lacking. This article makes up for this lack to a certain extent. Two classifiers often use the SVM algorithm. The SVM itself can only use the kernel function for linear inseparable cases, and lacks other means, and the choice of kernel function lacks effective theoretical support. In response to this problem, this paper proposes the SVM-Adaboost algorithm combined with the coreless SVM and Adaboost algorithm to solve the linear inseparability problem.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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