Real-time Attendance System

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Abstract—***With the advent of the era of big data in the world and the commercial value of face recognition technology, the prospects for face recognition technology are very bright and have great market demand. This article aims to design a face recognition attendance system based on real-time video processing. This article mainly sets four directions to consider the problems: the accuracy rate of the face recognition system in the actual check-in, the stability of the face recognition attendance system with real-time video processing, the truancy rate of the face recognition attendance system with real-time video processing and the interface settings of the face recognition attendance system using real-time video processing. By analyzing the situation of these problems, the concept of attendance system based on face recognition technology is proposed, and the research on face recognition attendance system based on real-time video processing is carried out. Experimental data shows that the accuracy rate of the video face recognition system is up to 82%. Compared with the traditional check-in method, the face recognition attendance system can be reduced by about 60%. The rate of skipping classes has greatly reduced the phenomenon of students leaving early and skipping classes. The face recognition time and attendance system with real-time video processing through the above experimental certification can quickly complete the tasks of students in the time and attendance check-in system, get rid of the complex naming phenomenon, greatly improve the efficiency of class, and play an important role in guiding the development of the time and attendance system.***

I. INTRODUCTION

The modern time attendance and workforce management software that you see today is the result of a long transformational journey. In today's evolving workforce structure, time attendance systems have moved from good-to-have to must-have solutions for every organization. Today, the word 'hour' is a critical aspect of the daily operations of businesses.

It was only during the industrial revolution that factories and industries realized the true need of time measurement and workforce monitoring. The logistic movements, the working hours of employees, and the finished goods had to be coordinated. Later, time had to be standardized, and workers were given time-bound shifts. Mechanical clocks and card punching were used, and the first attendance system was established. By the late 20th century, the advent of electronic systems overtook mechanical systems. In the '90s, smartcard-based attendance came into existence, which was considered to be advanced for its time. The current fingerprint attendance system has an error rate of about 5 %. As workforce systems evolved, these systems became insufficient and left a lot to be desired. In this era of Internet explosion, computer technology has involved many areas of people's lives and work. As an important identity label for people to distinguish different individuals, face recognition technology has gradually entered people's lives. Face recognition is the combination of artificial intelligence and computer. Because of its huge challenging innovation and broad application prospects, it has become the most challenging topic in this field. The face recognition system has higher accuracy than the earlier system. In recent years, the face recognition application system has developed rapidly as a computer security technology in the world, especially today, when terrorist activities are rampant, this technology has received more and more attention. Face recognition technology belongs to biometric recognition technology, which mainly includes four parts: face image collection, face image preprocessing, face image feature extraction, matching and combining hard recognition, combined with hardware cameras, network lines and computing device. Face image feature representation is a key part in face recognition, and good feature representation can improve the robustness of image matching.

To sum up, our proposed solution is flexible, easy to implement and adaptive and it selectively extracts the amount of facial features and data that can characterize the face image and it effectively reduces the amount of calculations thereby improving the calculation speed and accuracy thus getting faster results

Rest of the paper is organized as follows: Section-II presents the brief analysis of the related work where prominent methodology is discussed. Section-III explains the proposed method in detail. Experimental results are given in Section-IV. Finally, conclusion of the work is given in Section-V.

II. RELATED WORK

A brief analysis of the existing literature related to face detection and recognition algorithms is presented in this section. Several methods [1-3] are available in the literature to address the problem of detection of face recognition and further research work is going on to improve the detection and recognition efficiency.

During the past thirty years, a number of face recognition techniques have been proposed, all of these methods focus on image-based face recognition that use a still image as input data.

In this regard, Linear Discriminant Analysis (LDA) which is also called fisherface is an appearance-based technique used for the dimensionality reduction and recorded a great performance in face recognition. This method works on the same principle as the eigenface method (PCA).it performs dimensionality reduction while preserving as much of the class discriminatory information as possible. LDA makes use of projections of training images into a subspace defined by the fisher faces known as fisherspace. Recognition is performed by projecting a new face onto the fisher space, The KNN algorithm is then applied for identification. This algorithm is to find a set of linear transformations that minimize the intra-class dispersion between each category and maximize the inter-class dispersion.

The major drawback of applying LDA is that it may encounter the so-called small sample size problem [14]. This problem arises whenever the number of samples is smaller than the dimensionality of the samples. Under these circumstances, the sample scatter matrix may become singular, and the execution of LDA may encounter computational difficulty.

Since the structures of facial features like the eyes, nose, ears, and mouth vary, many human faces are portrayed using various traits of the distinctive shapes of these organs. The description and identification of the side profile of a human face was the first application of geometric features. The profile line of the person's side is used to determine a number of feature points, and these feature points are used to produce a set of feature values for recognition, such as angle and distance.

It has the advantage of using simple geometric information, which reduces the time cost of classification and storage space and allows for continued use even with a low rate of image recognition. It is also insensitive to changes in lighting. Its drawbacks include the difficulty in isolating stable features from images, sensitivity to changes in posture and expression, and low levels of stability.

Neural network is a very powerful and robust classification technique which can be used for predicting not only for the known data, but also for the unknown data. It works well for both linear and non-linear separable dataset. NN has been used in many areas such as interpreting visual scenes, speech recognition, face recognition, fingerprint recognition, iris recognition, etc. An ANN is composed of a network of artificial neurons also known as "nodes". These nodes are connected to each other, and the strength of them connections to one another is assigned a value based on their strength: inhibition (maximum being -1.0) or excitation (maximum being +1.0). If the value of the connection is high, then it indicates that there is a strong connection. Within each node's design, a transfer function is built in. There are three types of neutrons in an ANN, input nodes, hidden nodes, and output nodes. Although neural networks have some advantages in face recognition, they also have considerable defects. The structure of neural networks is huge and complex, and their training requires a huge sample library. The training time often takes days or even months. The speed is not fast enough. Therefore, neural networks are not commonly used in the actual application of face recognition.

SVM is a classification algorithm developed by V. Vapnik and his team. Based on the underlying optimization and statistical learning theories, SVMs provide a new approach to the problem of pattern recognition. In this paper, both linear and nonlinear SVM training models are used in face recognition. Faces in different orientations are taken as training samples. Primary results show that nonlinear training machine is better than linear machine; the former one always has a much larger margin, which means that it has a much stronger ability in classification and recognition.

Support vector machines need high-dimensional space projection, which calls for the assistance of kernel functions; however, selecting kernel functions is in fact very difficult. Finally, although support vector machines may classify on their own, doing so often necessitates feature extraction for faces due to the poor results of direct face classification.

III. PROPOSED METHOD

The face detection technology is used to locate and segment a partial face image from the image; the feature extraction technology extracts the amount of data that can characterize the face image and forms the features to be stored in the feature database. Face recognition process: face positioning and image processing in the image; feature extraction and selection; detecting and recognizing the image and returning the recognition result. First create a facial image file of the face. That is, use the camera to collect facial image files of the person’s face or take their photos to form a facial image file, and store these facial image files to generate faceprint codes. Get the current human face. That is, use the current facial image captured by the camera, or take a photo input, and generate a facial texture code from the current facial image file. Compare with the current facial texture encoding and file inventory. That is, to retrieve and compare the current facial texture code with the facial texture code in the file inventory. The above-mentioned ‘‘face coding’’ method works according to the essential characteristics of the human face and the beginning. This facial coding can resist changes in light, skin tone, facial hair, hairstyle, glasses, expression and posture, and has strong reliability, so that it can accurately identify a person from millions of people. The face recognition process can be completed automatically, continuously, and in real time using ordinary image processing equipment. When designing a system to select a face recognition algorithm, we have to consider the following factors: recognition rate, algorithm robustness, and matching time.

To sum up, the system selects Gabor features plus Fisher based discriminant analysis method based on orthogonal basis to become a linear discrimination method. Face image feature representation is a key part in face recognition, and good feature representation can improve the robustness of image matching. Gabor wavelet feature description method is a comprehensive method that combines gray and local descriptions. It has the advantages of gray-based and feature-based methods.

Gabor kernel definition of wavelet transform:

$$\Psi_j(\vec{x}) = \frac{\vec{k}_j^2}{\sigma^2}\exp\left(-\frac{\vec{k}_j^2\vec{x}^2}{2\sigma^2}\right)\left[\exp(i\vec{k}_j\vec{x}) - \exp\left(-\frac{\sigma^2}{2}\right)\right]$$

$\overline{x}$ = (x, y) is a spatial domain variable, and $\overline{k}$ j is a frequency vector that determines the scale and direction of the Gabor kernel. We selected an image I($\overline{x}$), and the Gabor transform at the $\overline{x}_0$ point at a specific position in the picture can be realized by convolution with Gabor kernel at this point. The face image is I(z), and the z = (x, y) picture scale direction is μ, ν, there is a formula:

$$G_{\mu,\nu}(z) = I(z) * \psi_{\mu,\nu}(z) \qquad (9)$$

With $z = (x, y)$, the calculation formula can be obtained:

$$G(x, y) = \frac{\mu^2+\nu^2}{\sigma^2}\exp\left(-\frac{(\mu^2+\nu^2)(x^2+y^2)}{2\sigma^2}\right) \times \left[\exp(i(\mu x+\nu y)) - \exp\left(-\frac{\sigma^2}{2}\right)\right] \qquad (10)$$

Among them, $k = \left(\frac{\mu}{\nu}\right)$, $\mu = \frac{k_{\max}}{f^N}\cos\left(\frac{\pi M}{8}\right)$, $\upsilon = \frac{k_{\max}}{f^N}\sin\left(\frac{\pi M}{8}\right)$, $k_{\max} = \frac{\pi}{2}, f = \sqrt{2}, \sigma = 2\pi$

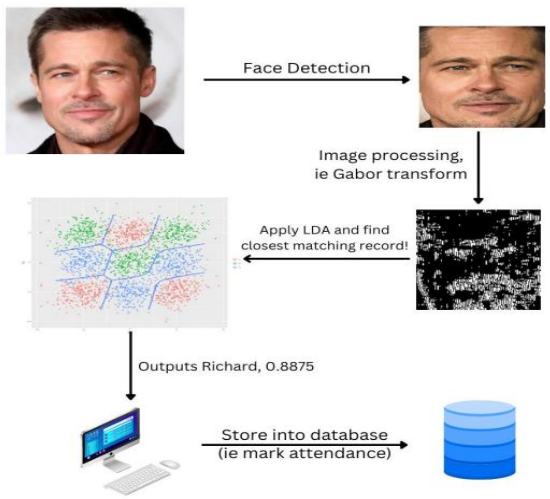
Fisher discriminant analysis is an improved algorithm based on PCA. It adopts the method of dimensionality reduction to effectively reduce the amount of calculation, thereby improving the calculation speed [20]. This method can ensure that the projected samples have the smallest intra-class distance and the largest inter-class distance in the new space, that is, the best separability in the space. Introduce Fisher discriminant criteria table:

$$I_{fisher}(\varphi) = \frac{\varphi^T S_b \varphi}{\varphi^T S_w \varphi}$$

where ϕ is any n-dimensional column vector. Fisher's linear discrimination method selects the vector ϕ that maximizes Ifisher(ϕ) as the projection direction, so that the projected samples have the largest inter-class dispersion and the smallest intra-class dispersion. Among them, Sb is the inter-class separation matrix, and Sw is the intra-class separation matrix. Let F 0 k , k = 1, 2, . . . , L be the average of the training samples of class ϕk after PCA and LDA transformation. Use the nearest domain classifier for face recognition classification:

$$\delta(Y, F0k) = \min \delta(Y, F0k), Y \in \phi k$$

as a class of pictures, and the recognition is successful; otherwise, they are not classified as similar pictures and Y is a non-training sample image.



IV. EXPERMENTAL RESULT

1) EXPERIMENTAL SETUP

The experiment uses a real-time video processing face recognition attendance system. Pick the same number of students for the experiment, gather, count, and analyze the data. Then, look at the application space, the potential for development of a face recognition system for use during actual check-in, and potential issues that might arise.

2) EXPERIMENTAL PROCEDURE

(i) Accuracy rate of face recognition system in actual check-in: The face recognition attendance system using real-time video processing is used to count the number of students from a class or lecture hall, and to compare and analyze the accuracy rate of the face recognition attendance system using real-time video processing.

(ii) The face image is convolved with a bunch of Gabor wavelets and the subsequent pictures are additionally handled for acknowledgment reason. The Gabor wavelets are typically called Gabor channels or Gabor Filters in the extent of utilizations. The major reason for using Gabor wavelet is because it reduces the amount of standard deviation with respect to its time and frequency values.

(iii) Fisher Face is a mathematical modelling of images. After the tensor is gets PC analyzed, the next step is to create a fisher face based on the obtained data. Fisher Face has much advantage over Eigen Face because, Fisher face is less susceptible to error & also because of the effort to maximize the separation between various classes in the dataset over the time of training.

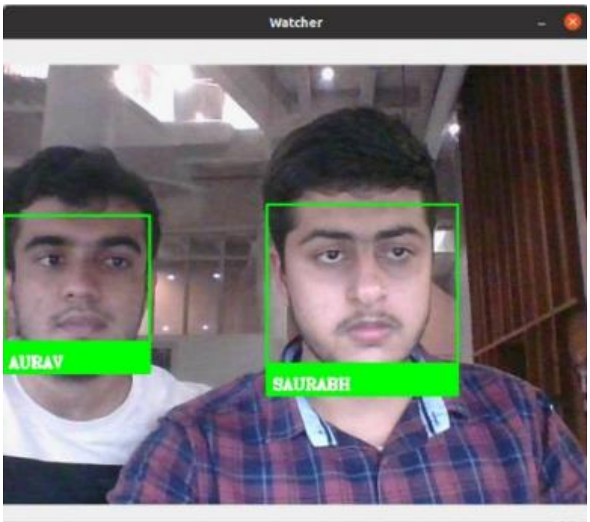
(iv) Principal Component Analysis is a dimensionality reduction process with which the larger size sets have been reduced to lower size sets with retaining the maximum amount of data it can hold. So the process of the dimensionality reduction results in making the system less time consuming. It is also proved that for machine learning based calculations, it is always better to use smaller sets, which is dimensionally reduced sets.

3) RESULT AND PERFORMANCE ANALYSIS

As taking the whole output response as reference, the proposed system produce much more accurate output than any other existing face recognition system. Fisher Linear Discriminant Analysis combined with Principal Component Analysis makes the system less susceptible to error and more user friendly. Compared with the existing systems, proposed system possess much more stability while performing the operations, that is the system is stable and there is only less chance of having error. Amount of junk value generation is reduced to a certain level, so the output will not be affected with junk. Occluded Face Recognition can be performed by using the proposed system with 80% more accuracy than any other system. Computational Time has been reduced drastically so that all the operations are done rapidly.

Test Set Count	Accuracy		
	SLRC	Helmert Contrast	Fisher LDA
10 ~ 20	0.79	0.79	0.87
20 ~ 30	0.78	0.73	0.85
30 ~ 40	0.76	0.73	0.85
40 ~ 50	0.73	0.73	0.84
50 ~ 60	0.73	0.73	0.81

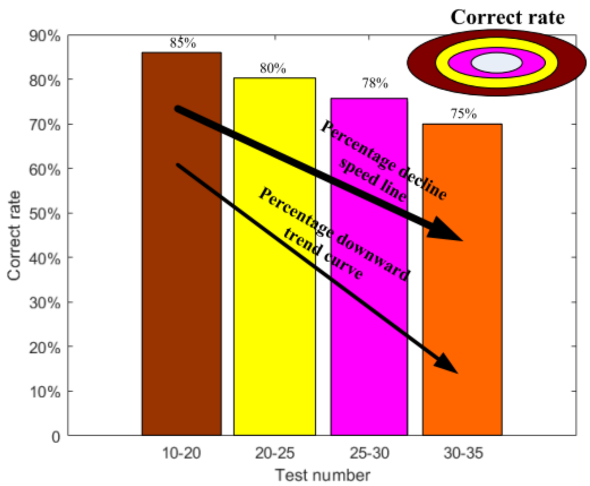
Performance analysis chart



Output

Test number	Correct rate
10～20	85%
20～25	80%
25～30	78%
30～35	75%

Test Number and Accuracy Rate Table



Test Number and Accuracy Rate Chart

V. CONCLUSION

Face recognition can be used as a security method. But here it act as an identification factor. The proposed system provides an output that is much more accurate than any other system. Unlike all the systems, the proposed system has less mathematical processing background, so it is much easier to implement and easier to amend. Accurate face recognition is done so that no unwanted or misleading prediction will happen, and the system will always remain error free. The attendance system realizes the expected attendance results through face recognition technology with the help of a computer, which fully reflects the feasibility design of the overall algorithm.

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