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Research Paper

Face Recognition Using Hausdroff Distance as a Matching Algorithm

Engineering

KEYWORDS : Principal Component Analysis, Hausdroff distance algorithm, the eigen vectors and eigen values etc.

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ABSTRACT

Face recognition is one of the most talked and important research areas. A lot of work has been done on facial recognition. But most of the works suffered from the common problem. It is the execution time and matching delay .Features which has been extracted for matching need to be matched with faster algorithm to diminish the problem of execution time. In our proposed method, we have implemented principal component Analysis (PCA) for feature extraction and Hausdroff distance algorithm for matching rather than Euclidian distance algorithm

I. INDRODUCTION

Face recognition is a vital part of object recognition research which the scientific community has shown a growing attention in the past few decades. Since then, the rapid development of technology and the commercialization of technological achievements, face detection became more popular. One of the challenges in face recognition systems is to recognize faces around different poses and laminations. The face recognition phases include image preprocessing, feature extraction, and clustering. Face recognition is a vital part of object recognition research which the scientific community has shown a growing attention in the past few decades. Since then, the rapid development of technology and the commercialization of technological achievements, face detection became more popular.

One of the challenges in face recognition systems is to recognize faces around different poses and illuminations. The face recognition phases include image preprocessing, feature extraction, and clustering. This research focus on developing a face recognition system based on Principal Component Analysis (PCA) and Self-Organizing Maps (SOM) unsupervised learning algorithm. Face recognition gained much attention in recent years, due to it is wide real situation, such as for securing the building, authorizing identification, crime investigation and many others. The automation of recognizing human's face is crucial and much needed to avoid human's error. The automation system will also save time, cost and effective. Therefore this research investigates the method of Principal Component Analysis (PCA) and Self-Organizing Maps (SOM) in recognizing human faces. Face recognition system is determined by how to extract feature vector exactly and to classify them into a group accurately. Therefore, is necessary to closely focus at the feature extractor and classifier.

Face recognition can be described as identification of people from their face images. In this study, an automatic face recognition system has been designed by using frontal images photographed in our lab. The automatic face recognition procedure consists of an alignment process which includes face detection, eye detection, mapping of the center coordinates of the eyes to a standard face template. This is followed by classification of aligned faces. In literature, face alignment process is usually done with manually and high recognition rates can be achieved due to very well aligned faces. However, in real-time face recognition applications, it's not possible to align face images manually. Therefore, successful classification rates reported in the literature are mostly misleading. In this study, we aligned faces in a fully automatic manner and we obtained more reliable and realistic face recognition rates. Face images are represented with gray level, LBP, LTP, and two dimensional Gabor filter features and performances are tested with Eigen faces, Fisher faces, and DCV methods.

Basically the face recognition contains three processes there are image preprocessing process, feature extraction process, and clustering .

A. Image Preprocessing

Image processing is a form of an image or image processing by means of numerical processing of the image, in this case that is processed each pixel or point of the image.

1) Convert RGB images to grayscale:

For many applications of image processing, color information doesn't help us identify important edges or other features. But there's an exceptions if we need to identify object of known hue, for example: we need to recognize an orange fruit in front of the green leaves, then the color information could be useful. If we don't need color, then we can consider it noise. The result of this stage is no color in the image but only degrees of gray.

Figure 1. RGB image to Grayscale image

2) Cropping: is a process to clean the outside of the image to correct or re-frame an image or digital image, cropping is needed to separate the face just so the background image will not affect the process of recognition.

Figure 2. Grayscale image and cropping image

3) Binarization: is a process of transforming a gray scale image to a binary image. It is contain only two classes of pixels, white as background and black as for ground. Classification is carried out with a separation intensity value called threshold. Threshold plays a major role in binarization and choosing of an appropriate threshold value is an important one. Because in most cases color documents can be converted to grayscale without losing much

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information as far as distinction between page foreground and background is concerned.

$$b(x,y) = \begin{cases} 0 & if\ I(x,y) \le T(x,y) \\ 1 & otherwise \end{cases} \quad (1)$$

The b(x, y) is the binary image processing results binarization of b(x, y) and T declared value threshold. Convert the image into binary process is almost the same as changing the image to grayscale, the average color difference will be grouped into two, if the intensity of the color starting from 0 up to 255 then take the middle score is 128, if below 128 then the color will tend to be above 128 black and white colors will tend.

B. Principal Component Analysis

Principal Component Analysis is a mathematics tools to extract out the characteristic features called eigen faces from original image data.

The algorithm for face recognition system using eigen faces.

1) Preparing the face image data: In this stage, first the face image database must be prepared and feature vectors are calculated.

$$\Psi = \frac{1}{M}\sum_{n-1}^{M} T_n \quad (2)$$

2) Find the difference between the input matrix with the average matrix. Previous average of the input matrix must be calculated (‘¥), then subtracted the input matrix (Ti)’ This reduction results then stored in the variable <t>a.

$$\phi_i = T_i - \Psi \quad (3)$$

3) Calculate the covariance matrix of the variable (<t>a. At this stage, the covariance matrix or the total scatter matrix of the face image will be calculated and will be used in the acquisition of eigenvectors.

$$C = \frac{1}{M}\sum_{n-1}^{M} \phi_n - \phi_n^T \quad (4)$$

4) Calculate the eigenvectors and Eigen values of the covariance matrix. The eigen vectors that obtained from the covariance matrix will be sorted according to the largest eigen values.

5) Select the principal component, From M eigenvectors (eigen faces), only M should be chosen, which have the highest eigen values. The higher the eigen value, the more characteristic features of a face does the particular eigen vector describe.

C. Clustering - Self Organizing Maps

Kohonen Self-Organizing Maps , is an unsupervised learning neural network. Self Organizing Maps is used to classify patterns of image feature extraction by Principal Component Analysis method, Self Organizing Maps algorithm steps are:

1) Initialization input data from the feature extraction, learning rate determines the alpha and the mean square error.

2) Initial weight initialization, determining the initial weights were randomly as initial parameters in the initialization process of computing and neighbor distance=O, the assumption that only the weight of the winner will be update. raised early on as much weight as the unit is a unit of information the cluster assumption for the input data after obtaining the optimum weights and each variable as each unit contains of the same dimension as the result of feature extraction matrix.

3) Input data, the data attributes that influence changes in weight training during the training process of computing the Data.

4) Closest distance calculation using Euclidean distance method, which is between the input data (vector) with weights and nodes that have the minimum distance between the data input node weights declared as the winner.

II. LITERATURE REVIEW

B.Rajakimari et, al.(2015) In this paper Recognition of Emotion can be identified using Eye Tracking methods which may benon-intrusive. SVD and HMM are used for eye tracking to recognize emotions, which classifies six different emotions with less correlation co efficiency and 77% accuracy is achieved. This work also focus on emotion recognition with HMM using the distance calculation method, measuring sclera and iris distance. A fully automatic eye tracking system is developed for emotion detection with eye tracking. Face Detection, Feature extraction, Distance Calculation and Emotion classification are developed to recognize emotions.

A.Srinivasan et, al.(2011) In this paper, a novel framework for face recognition is developed by using adaptive binning and adaboost technique. Adaptive binning is an efficient classifier technique to classify the object and the results are represented in Histogram Gabor Phase Pattern improve the efficiency of the pattern by further reducing the computational complexity. This new framework is experimentally verified with FERET and found that the recognition rate of the system is improved. A new framework for face recognition is developed by combining two classification algorithms: Adaptive binning and a boost. This system is tested with a larger database and the results show better identification of face with better efficiency. The feature space and execution time of this framework is reduced drastically compared with the other face recognition systems.

Zhimin Caoet,al. We present a novel approach to address the representation issue and the matching issue in face recognition verification. Firstly, our approach encodes the micro structures of the face by a new learning-based encoding technique. Unlike many previous manually designed encoding methods (e.g., LBP or SIFT), we use unsupervised learning techniques to learn an encoder from the training examples, which can automatically achieve very good tradeoff between discriminative power and invariance. Then we apply PCA to get a compact face descriptor. We find that a simple normalization mechanism after PCA can further improve the discriminative ability of the descriptor. The resulting face representation, learning-based (LE) descriptor, is compact, highly discriminative, and easy-to-extract. To handle the large pose variation in real-life scenarios, we propose a pose-adaptive matching method that uses pose-specific classifiers to deal with different pose combinations (e.g., frontal v.s. frontal, frontal v.s. left) of the matching face pair.

Taketo Horiuchiet, al (2010) Biometrics is now recognized as an essential technology for establishing secure access control. It uses physiological characteristics of humans for identifying individual, and face is one of the attributes usable for biometrics. Individual identification technology using human faces, usually called face recognition technology . The face recognition technology is now used in various services. According to the evaluation results of NIST in 2010, first place was 92.3% against the database of 1.6 million images of criminals, if conducted by the best algorithm.

Dian Retno Anggraini et, al.(2014) This research focus on de-

veloping a face recognition system based on Principal Component Analysis (PCA) and Self-Organizing Maps (SOM) unsupervised learning algorithm. The preprocessing steps contain grey scaling, cropping and binarization. The selected dataset for this research is Essex database that are collect at University of Essex which consist of 7900 face images taken from 395 individuals (male and female). Face recognition is a vital part of object recognition research which the scientific community has shown a growing attention in the past few decades. Since then, the rapid development of technology and the commercialization of technological achievements, face detection became more popular. Pattern recognition is incorporated in different environments. One of them is face recognition. The face images of different people were collected and a database was created.

HasanSerhanYavuz, HakanÇevikalpet,al.(2014) This paper presents we aligned faces in a fully automatic manner and we obtained more reliable and realistic face recognition rates. Face images are represented with gray level, LBP, LTP, and two dimensional Gabor filter features and performances are tested with Eigen faces, Fisher faces, and DCV methods. Experimental results showed that the automatic recognition rates can reach close to 90% correct recognition rates.

III.TECHNOQUE USED (RESEARCH METHODOLOGY)

In our proposed method, we are going to use number of images as training samples. After using a feature extraction algorithm, we will be extracting the features that we need to recognize. The focus of our proposed algorithm is to reduce the distance measuring algorithm's complexity as well as to increase the performance at the same time. The performance decreases if the co-relations, noise to signal ratio goes difficult to set up.

Using Hausdroff distance algorithm, images with lesser pixel dimension will also get more accuracy percentage.

1. Import the training images
2. Apply Principle component analysis on each image to extract the features

2.1. Taking the whole dataset
0.1. Compute the mean vector
0.2. Compute the scatter matrix
0.3. Compute the co-variant matrix
0.4. Compute the eigen vectors and eigen values

3. Compute the distance using the hausdroff distance
   3.1 use the following equation to calculate

$$h(A,B) = \max_{a \in A} \{ \min_{b \in B} \{ d(a,b) \} \}$$

Here a and b are two points of sets A and B respectively, and d (a, b) is any metric between these.

IV. SOFTWARE DETAIL

Matlab is a programming environment as well as a high level, interpreted, dynamically typed language. It is well suited for numerical computation, particularly computation involving matrix operations and linear algebra.

V.CONCLUSION

We are proposing a novel method to implement face recognition using Principle Component Analysis (PCA).Though there are quality amount of work is done on PCA, the main drawback which was occurred was the distance calculation problem. In our research ,we are going to solve it using Hausddroff distance algorithm due to its advantages mentioned above.

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