

Survey Face Detection and Recognition

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Abstract: In this paper we present a comprehensive and critical survey of face detection algorithms. Face detection is a necessary first-step in face recognition systems, with the purpose of localizing and extracting the face region from the background. It also has several applications in areas such as content-based image retrieval, video coding, video conferencing, crowd surveillance, and intelligent human-computer interfaces. However, it was not until recently that the face detection problem received considerable attention among researchers. The human face is a dynamic object and has a high degree of variability in its appearance, which makes face detection a difficult problem in computer vision. A wide variety of techniques have been proposed, ranging from simple edge-based algorithms to composite high-level approaches utilizing advanced pattern recognition methods. The algorithms presented in this paper are classified as either feature-based or image-based and are discussed in terms of their technical approach and performance. Due to the lack of standardized tests, we do not provide a comprehensive comparative evaluation, but in cases where results are reported on common datasets, comparisons are presented. We also give a presentation of some proposed applications and possible application areas.

Keywords: Classification, Face detection, Face recognition, Feature extraction, Preprocessing, Neural networks, Supports Vectors Machines (SVM).

I. INTRODUCTION

Face recognition is an important area of research in computer vision. It is easy for humans to detect and recognize face in images, but not for machines. There are several techniques in machine learning to detect and recognize a face. Human face consists of multidimensional structure and required a quality computing technique for recognition. To identify a faces in images, there are several things to look as a pattern, such as height, color of the faces, width of other parts of the face like lips, nose, eyes, etc. Clearly, there is a pattern, different faces have different dimensions, and similar faces have similar dimensions. face recognition technology is widely used in life, such as station security, time and attendance punching, and secure payment [1-3], but different face recognition devices use different algorithms. During the installation of an automated system for face recognition, the context of its field of application sets its operating mode: authentication (one to one) or identification (one to many). In the first mode, the system must verify the identity of a person by declaring him as a legitimate user or impostor. Whilst for the second, the system must affect an identity to a person from those registered or declare him as unknown. In both modes, the system must have a reference database (Gallery) that contains all the feature vectors (signatures) of faces of persons assumed known by the system. These signatures are learned during a phase called enrollment. The latter is achieved off-line by executing the key steps described hereafter and illustrated by figure 1. Furthermore, to identify or authenticate a person from his face image (query face image) in the recognition phase, the same steps have to be treated, but this time around on-line.

In this paper, we are proposing the preprocessing step for noise removal, and contrast enhancement, and illumination equalization. SVM classifier is then used to classify features extracted from the input image. In maximum classifier input dimension is fixed but the number of key points extracted from different images are not same. That means dimension of input is not same. The result of SVM is obtained by classifying all key points in the image. So according to the analysis of SVM result computer will identify the person.

II. RELATED WORKC

C Rahmad, R A Asmara, D R H Putra, I Dharma, H Darmono and I Muhiqqin [1] has compared The Haar Cascade and HOG base face detection and found more accuracy in HOG base face detection. Improving in the Face recognition performance is always the challenge ever since the first algorithm was developed. In 1991. Alex Pentland and Matthew Turk [2] applied Principal Component Analysis (PCA). Which is known as the eigenface method and it is an approach for all face recognition algorithm progressing nowadays, Navneet Dalal et al. [3] made a modification by introducing Histogram of Oriented Gradient (HOG) features instead of Eigen faces which are in the PCA algorithms,

Dadi HS and Pillutla GM [4] and Albiol A, Monzo D, Martin A, Sastre J, Albiol [6] found more accuracy in HOG features based face recognition rather than holistic methods, such as PCA[2] or LDA. Anila S, Devarajan N. [7] proposed a method of preprocessing by combining some preprocessing algorithms like histogram equalization, gabber filter. Bora DJ, Gupta AK. [8] In 2016 proposed a new technique AERSCIEA for satellite color images. Which is a binary search based CLAHE and got far better result than CLAHE. Benitez-Garcia G, Olivares-Mercado J, Aguilar-Torres G, Sanchez-Perez G, Perez-Meana H .[10] applied CLAHE on PCA basd face recognition. Guo G and Li SZ, Chan K. [11] represented the face recognition technique using linear support vector machines with the help of binary tree classification strategy. The experimental results show that the SVMs are a better learning algorithm compare to the nearest center approach for face recognition

III. METHODOLOGY FOR FACE RECOGNITION

The following figure represents the steps involved in the proposed approach in a sequence manner:

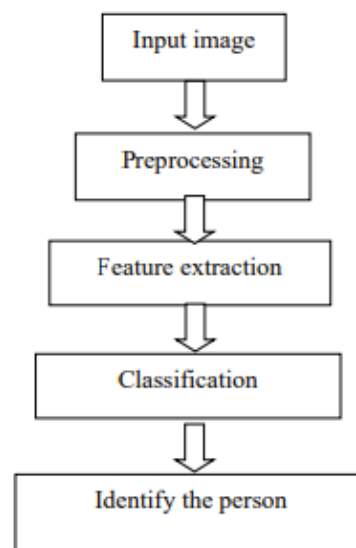


Fig.1. Block diagram of the propose method

A. Preprocessing

Preprocessing is playing an important role in image processing field. Histogram equalization is image processing technique for adjusting the image's intensity. This enhances the contrast in an image. It could be explained by using a histogram. An equalized histogram is that where the image uses all gray levels in equal quantity. So, that intensity is finely distributed on the histogram. CLAHE is an advanced form of AHE. Pisano et al. [4] (1998) have implemented an algorithm to detect speculations in dense mammograms which are known as CLAHE. AHE had a drawback of over amplifying noise. CLAHE limits the amplification by clipping the histogram at a predetermined value. Adaptive histogram equalization causes noise to be amplified in near-constant regions. CLAHE limits the contrast amplification to reduce amplified noise. It does so by distributing that part of the histogram that exceeds the clip limit equally across all histograms. CLAHE is a variant of AHE designed to reduce the contrast in uniform areas of the image to reduce over enhancement, thereby minimizing the noise ratio. In this method, the image is divided into non overlapping regions called the contextual region. For each region a

histogram is computed, and the maximum height of each contextual region histogram is computed. The height measure is the clip limit to enhance the contrast. The clip limit is the threshold value and the histograms are redistributed without exceeding the limit. This procedure increases the contrast, but results in intensity in homogeneity. Contrast: It is the difference in luminance and color that makes an object determinable.

$$Contrast = \frac{I_{max} - I_{min}}{I_{max} + I_{min}}$$

Where I_{max} is the highest and I_{min} is the lowest luminance. In a digital image, ‘luminance’ is a value that goes from 0 (black) to a maximum value depending on color depth. In case of typical 8-bit images i.e. gray scale, the value is $2^8 - 1 = 255$, since this is the number of combinations, one can be achieve with 8 bits sequences, assuming 0-1 values for each. To perform CLAHE we need to take the input image I , number of bins n , minimum intensity min , maximum intensity max , window size ht_w , wd_w and clip limit $clip$ as input parameters and return an output image with new intensities after CLAHE. The following plot shows the input and output intensities of our input image.

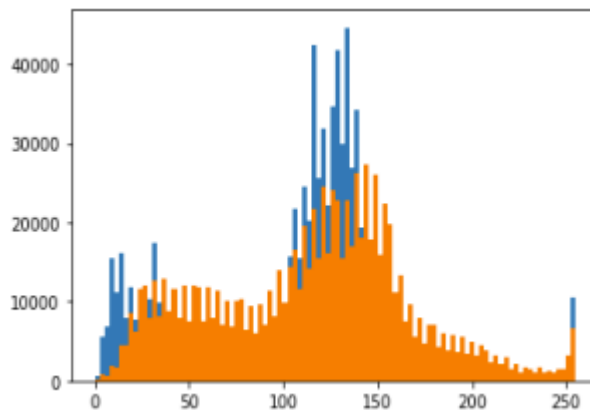


Fig.2. Blue plot indicating input image intensities and Orange are indicating CLAHE intensities.

Based linguistics which used in image. It is generally used in computer vision for the purpose of detecting the objects. Gradient computation: Calculation of gradient values is the first step in computation. The first method is to apply 1-dimensional derivative masks both vertical and horizontal directions. Orientation binning: 2nd step is Orientation binning in extracting the HOG features. Based on the number of values contained in the gradient computation, each pixel within the cell casts a weighted vote for a histogram channel which is based on the orientation. The cells can be either outspread or rectangular shape and channels are spread over 0 to 3600 or 0 to 1800 and it depends on whether the gradient is marked or not. Descriptor blocks: The power of the gradient must be normalized locally in order to account the changes in contrast and illumination. This requires bunching of cells into larger and spatially attached blocks. The Histogram of Oriented Gradients descriptor is obtained by sequence the components of the cell histograms which are normalized from all the block regions. These blocks overlap typically, means that every cell contributes to the final descriptors at least more than once. Block normalization: Dalal and Triggs [3] explored four different methods for block normalization. Let us assume ‘ v ’ be the non-normalized vector. And ‘ v ’ is containing all histograms in a given block, k v be its k -norm for $k=1,2$ and e be some small constant. Then the normalization factor can be anyone of the following:

$$L2\text{-norm: } f = \frac{v}{\sqrt{\|v\|_2^2 + e^2}}$$

L2-hys: L2-norm followed by clipping and renormalizing, as in

$$L1\text{-norm: } f = \frac{v}{\|v\|_1 + e}$$

$$L1\text{-sqrt: } f = \frac{v}{\sqrt{\|v\|_1 + e}}$$

All four methods showed very significant improvement over the non-normalize data.

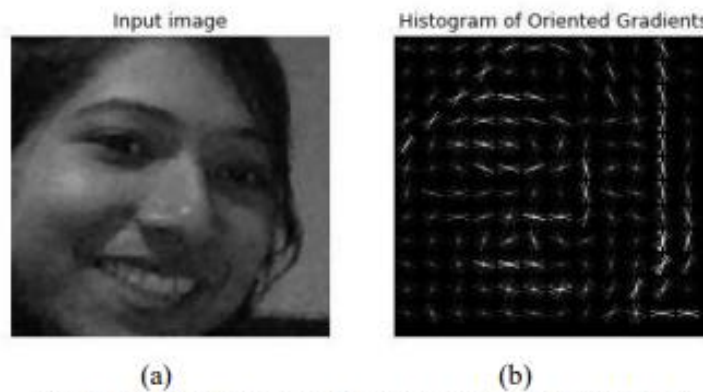


Fig.3. (a) Sample image from training dataset. (b) HOG features of the image

B. EXTRACTION OF THE FEATURE VECTOR

This is a crucial step in a face recognition system. This step also called indexing or modeling, allows the extraction of the face image detected the pertinent information that characterizes it: feature vector or signature. This vector must be different from one person to another and invariant for different facial appearances of the same person. In the literature, there is a multitude of algorithms for feature extraction [12] [13] [14] [15] [16] [17]

C. CLASSIFICATION

This step permits the classification of the feature vector of the person to recognize. His treatment requires the introduction of a comparison algorithm or classification which provides at its output a score of similarity or distance between this characteristic vector and the reference feature vectors of the database (gallery). This score is compared subsequently to a decision threshold fixed in advance for provide a final decision on identity.

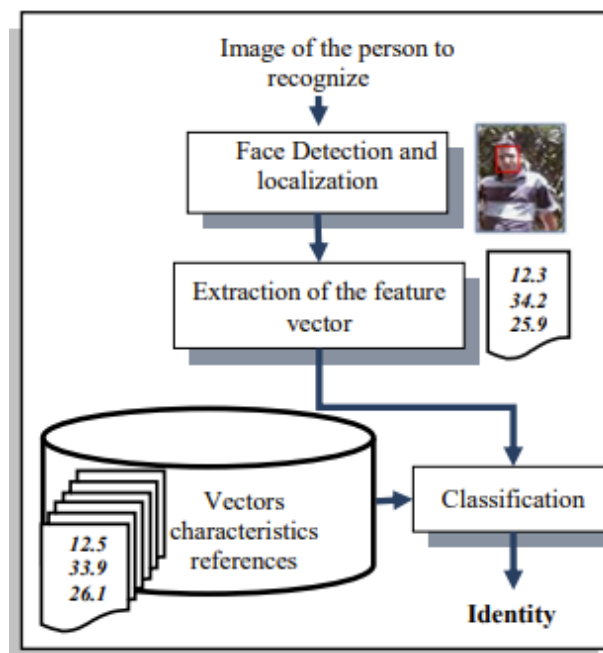


Fig. 4. Basic architecture of an artificial system of face recognition

In this article, it focused in the synthesis of the most widely used methods in the classification process of a face recognition system, namely: Metric distances, neural networks and Supports Vectors Machines (SVM).

IV. SUPPORT VECTORS MACHINES (SVM)

Support vector machine is a supervised learning algorithm. It is a two-class classifier, while it has been extended to be multiclass. It is also used for regression. Support vectors: Support Vectors are the data points. SVM currently attracting much attention in the community of machine learning, which proves their gain in popularity and use in many applications such as pattern recognition (handwritten scriptures, faces, ...), text categorization (classification of emails, web pages classification, ...), medical diagnosis (risk assessment of cancer, cardiac arrhythmia detection, ...), The main objective of SVM is to find a decision boundary that separates the data points of two different classes. This boundary is called a separator, must be a hyper plane. In general, there may be multiple hyper planes possible separators between the two classes. However, it made a particular choice among all possible separators, it seeks Optimal Separating hyper plane (figure 5). To determine the latter, closest uses only data points (the points of the boundary between the two classes of data) from the total set of learning, these points are called support vectors (support vectors). The distance between these points is called margin. It is this distance that we must maximize (maximum margin). For details on obtaining certain mathematical formulas necessary for the implementation of the SVM or an understanding of SVM.

SVM is a classification method that has proven effective in solving some problems related to the field of face recognition, such as:

- The detection of faces in an image, specifically for the face and non-face classification of objects located in an image [18][19]
- The classification of feature vectors (signatures) faces [16] [20][21]

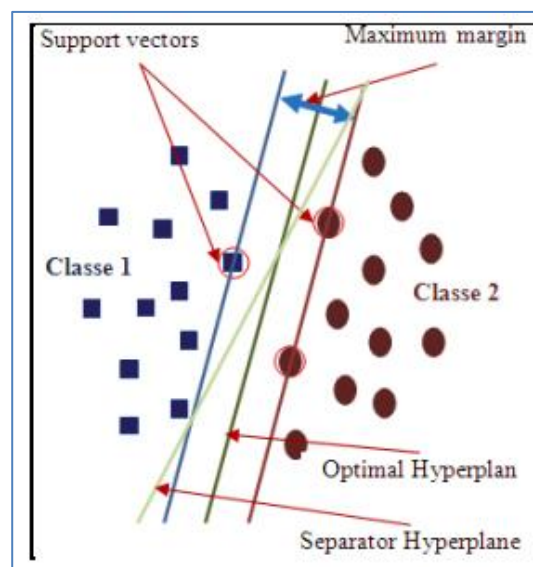


Fig. 5. Basic SVM illustration

V. EXPERIMENTAL RESULT

The proposed methodology is tested with different images. Some of the results are shown in below:



Fig.6. Face detection

In the above figure, we can see that it has detected 22 persons and one false-positive result is showing. It could not detect 3 persons. Because their faces are not fully appearing in the image. So, we can see that the accuracy level is much higher in this algorithm. In the above figure.6, we have observed that 6(a) Svm based algorithm couldn't detect and recognize the face. But in 6(b) which is our proposed method it is detecting and recognizing the face

VI. CONCLUSION

Face recognition technology has become one of the most popular research directions in computer vision and has made great achievements. With the development of computer technology, more and more classification methods will appear. In this paper, features and SVM classifier based face recognition algorithm is introduced. The SVM classifier based face recognition algorithm. Results show that the proposed algorithm is having an improved face recognition performance. It is a time-consuming algorithm but give more accuracy and productiveness rather than other machine learning algorithms.

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