

A Survey on Face Recognition algorithm

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ABSTRACT

Biometric identification is one of the most widely used technique for the identification of human being. Face recognition system is a type of biometric identification. Face recognition system is used to identify a person from the digital image of his/her face. The objective of this paper is to present a survey of face recognition methods and algorithms based on these method. In this paper, we presented an overview of the methods used for face recognition. This paper provides review on most used technique in this domain, the review on algorithms includes PCA, KPCA, LDA, SVM, SIFT etc.

Keywords: PCA, KPCA, SVM, LDA, SIFT

INTRODUCTION

Biometrics is a methodological phrase for measurements and calculations of human being. Biometric identification is a method to uniquely identify a person. These exclusive identifiers include face recognition, earlobe geometry, fingerprints, retina, iris patterns, hand geometry, voice waves, signatures and DNA. Biometric systems intrinsically works on two modes. Identification mode and verification modes. It depends on the application where biometric systems are used. In the identification modes, the system identify a person by matching the biometrics in the database. Vishakha Mehta¹ Research Scholar Dept. of Computer Science Geetanjali Institute of Technical Studies, Udaipur Mrs. Sarika Khandelwal² Associate Professor Dept. of Computer Science Geetanjali Institute of Technical Studies, Udaipur Where as in the verification mode the system verify a person. Biometric identification are further categorized in to two categories. Physical biometrics and Behavioral Biometrics. Physical biometrics characteristics are stable human characteristics. For example face recognition, DNA, palm print, fingerprint, iris recognition, hand geometry, retina. Behavioral characteristics are based on the behavioral characteristics like signature, voice etc. The process of biometric identification is again sub divided into two types, one is uni-modal biometric system in which it uses single biometric identifier to identify a person. Second one is multimodal system which combines two or more biometric identifiers to identify a person. [1] Face recognition is widely used application of image processing. Face recognition is a technique of uniquely identify a person and one of the method of biometric identification. This system helps in many ways for e.g. in security, checking criminal records, detection of such type of persons in public places, CCTV footage for finding criminals etc. Video surveillance is a domain where face recognition is used more than any other domain, because the

information that can be extracted by video is more accurate and usable information than any other type of information.

Face Recognition System

A complete process of Face recognition system consists of three steps that are, face detection then feature extraction and then face recognition [2]. First of all face detection is done on the input image. In this process, face is being detected that whether there is any face present or not in the input image. It detect the location of the face in the image and if the face is detected it returns the location. Face detection itself has some applications like face tracking, pose estimation etc. Then after face detection the next step is feature extraction. In this step, facial features are extracted from the input image. These features could be some face regions, different variations and angles of the face. This process also has some applications like tracking facial features from a face or recognizing emotions from face by extracting features from face. [3] For the detection of face in the input image, there are some provocation that has to be overcome [4]. Such type of challenges are there when the image is taken in uncontrolled environment. Pose variations, occlusion, facial expression and the condition of the image are some of the major problem occur in face detection method. Pose variations appear because of the movement of person in camera's angle. The problem of occlusion happens when faces are partially covered by any other object and so the detection cannot be done properly. Facial expression may vary the facial gestures and leads to the problem of face detection, and the condition of image is also an important aspect as it may changes because of the environmental conditions, light and background of the room. [5] Feature Extraction is a process of extracting useful information from the input image. This extracted information is again important for the later process. This step must be efficient and the output must be optimized. This process includes dimension reduction and feature selection. [6]

Related Work

Kim et al. [7] explains about the feature extraction mechanism that is based on PCA. Here it follows the polynomial kernel method for facial pattern generation. By improving the effectiveness of the proposed approach with the help of the ORL database recognition.

Gan et.al [8] discussed the merits and demerits of PCA for better improvement in the research methodology. Here analyzed the two different type of classes' performance based on the normalization of face images. Timotius et.al [9] proposed a new approach with the combination of KPCA and SVM technology. With the help of KPCA, image extraction can be possible. But the SVM is used to differentiate the images based on input source. Ebied Rala M, et.al

[10] presents the advances of linear and nonlinear mechanism for image extraction. Here used the ORL database and it contains more images especially different pose with different emotions. Compared to others, Gaussian will give better promotion. Sharma et.al [11] suggests the efficient algorithm to compute fast PCA [15] without using any matrix formulation and diagonal and inverse matrix. Fan et.al [12] presents the algorithm, which is used to establish the local data structure for the high dense populated areas. It provides It provides an accuracy was very high compared to previous approaches. Lawrence et.al [13] proposed the hybrid neural network and it consists of local image sampling approach and then convolution neural network. Local image sampling method gives reduction in image dimensions as well as convolutional neural network helps to provide the invariance matrix in partial images. Xia Sun et.al [14] suggest the non-negative factorization for the SVM classifier method.

Face Recognition Methods

Depending upon the input images, poses, angles, features and appearance, face recognition methods are divided into categories like Knowledge-based methods, Template matching methods, Appearance-based methods.

Knowledge-based methods

Knowledge-based methods collect knowledge from our face and then render into set of rules. Knowledge-based methods are rule-based methods. In this method, rules are created by the knowledge collected from the face. For example, in a face there are two eyes that are symmetric and the color intensity difference between eyes and nearby area like cheeks forehead. But depending on these set of rules create some problems because these sets are not appropriate set of rules. [16]

Template Matching Method

In this method, face is defined as a function and algorithms based on this method compare input images with already stored templates of face. A template can be designed on the basis of features of faces like eyes, face contour, face and mouth. But template matching methods are limited to only frontal face images or images that purely visible, partial or any type of occlusion is not accepted. This approach is comparatively simple and easy to execute but the results are not good enough in the case of occlusion or any pose variation. [16]

Appearance-based methods

Appearance-based methods are type of template matching method in which the templates or patterns are learnt from training set of images from the database. These methods are dependent on the techniques of machine learning or statistical analysis to find appropriate matching templates from the images. [17] 5. Face Recognition Algorithms The research on face recognition has become an active topic in recent years. Researchers has proposed many solutions to reduce the challenges and increase the efficiency and accuracy of recognition rate. In this section various approaches towards solving the face recognition problem is discussed. 5.1 PCA Principal Component Analysis is one of the most used method for face recognition. The main approach of using this algorithm is it reduce the dimension of the image by compressing image and then provide the best usable low dimension structure of face. The process of dimension reduction eliminate the useless information and decomposes into components and these components are known as eigenface. Then

all the facial images are represented as weighted sum of Eigen faces and are stored in one dimensional array. Then this probe image is matched with the database. [18]

KPCA

KPCA is an extended algorithm of PCA. As PCA works only on linear method, KPCA allows PCA method to non-linear dimension reduction. The KPCA method represent non-linear mapping in higher dimension. A non-linear kernel function is used for face recognition problem to reduce the dimension. [7]

LDA

Linear Discriminant Analysis comes under appearance based technique. LDA is also used for dimensionality reduction. LDA technique provide small set of features which are having the appropriate information. It is also known as Fisher's Discriminant Analysis. LDA maximizes the between – class scattering matrix measure while minimizes the within – class scatter matrix measure, which make it more reliable for classification [19]. In this technique a class is represented by a block, and these blocks are having large variations within the classes. Then those vectors are searched that discriminate in between the classes. LDA makes linear combination of these independent features that gives the highest mean difference in the classes. [18] There is a disadvantage of LDA, the class matrix is always single but the number of pixels in the images are always larger, the detection of error rates increases if pose variation is there or any difference in lighting condition in the environment where the picture has been taken. [20]

Neural Networks

Artificial neural networks become common and popular tool in face recognition. It has been used in many other applications for example in pattern recognition, character recognition and other type of object recognition process. The main aim of using neural network for the process of face recognition is that the feasibility of the system being trained for recognition of the patterns. This methods has been used in number of layers, number of nodes to get the best performance. The accuracy of this method is better than the other methods [21]. The combination of neural network with other algorithm gives results better than other successful algorithm. Multi-Layer Perceptron (MLP) with a feed forward learning was opted as it out performed better for pattern matching. It was applied to many other pattern recognition problems [22]. Neural Network was combined with Gabor filter and this algorithm was applied for face recognition by implementing MLP with backpropagation method. [13]

SVM

SVM is a method for learning based on binary classifier. It separate two data sets which are having maximum distance between them, it is a classification method. The main concept of SVM is to extend the resolution around the margin by mapping in such a way that the division in between the classes increased. There is a disadvantage of this algorithm, in the case of occlusion this method is not applied directly to the problem because the values are not known to the algorithm. This algorithm is applied for solving two class pattern recognition problems. [24]

SIFT

Scale Invariant Feature Transform is based on invariant features. These features are invariant to image rotation, occlusion, and

image scaling. In this process, first key points are detected and identify in the scale space and then after detecting the key points are located. The process of SIFT are divided into 4 steps. First finding the scale-space extreme the localization of key points then orientation assignment and lastly key point descriptor. The SIFT descriptor accept 128 dimensional vector used to identify the near around pixel. SIFT extract the key points for the images, then an image is given to SIFT that extracts the key points in that image and then compares to the dataset. [25]

Conclusion

In this paper, we presented an extensive study about the concept of biometric and face recognition system, the various applications of face recognition system. The step by step process of face recognition and steps required which are face detection and feature extraction. A brief description of methods is given in this paper in which the whole process of face recognition is divided into and then the review of face recognition algorithm is given.

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