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A Survey on Automatic Heterogeneous Face Recognition

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Abstract: This paper presents a comprehensive and algorithmic study of face detection that is crucial. Face detection is a necessary first step in the face recognition system, in order to locate and extract the region from the bottom. It also has many applications in intelligent interfaces such as content-based image retrieval, video coding, and video conferencing, monitoring crowd and human and computer. Until recently, however, face detection has received considerable attention from researchers. Face is a dynamic object, and has a high degree of variability in appearance, which makes the face detection is a computer vision problems. Face detection is one of the most studied computer vision problems, not only because of the object's challenge, but also requires many applications in face detection applications as a first step because of. Over the past 15 years, tremendous progress has been made thanks to the availability of data collection conditions, not limitations on the Internet (called sexual), community efforts to develop publicly available benchmarks as well as in powerful computers Visual algorithm development progress

Keywords: Computer Vision, Face recognition, Face detection, Geometric Method, Image Retrieval, Template Based Method.

I. INTRODUCTION

A face recognition system is a computer-based application that is recognized by a digital image or video source or automatically verified by a person. There are many ways to perform the identification or detection. One method is to compare selected face features from the image and face database. This is typically used in a security system and has the flexibility to compare iris with other biometric data, such as eye or system fingerprint recognition.
At the same time a large number of applications, the facial expression is very necessary, only face detection. For example, patients with pain estimates by observing the movement of facial features, man-machine conversation as a conversation or online learning, user or student expression needs to do the most realistic and fruitful dialogue.

The facial features recognized by the facial recognition algorithm extract features from the image of the object of interest. The algorithm normalizes the integrity of the face image of a library, and then compresses the surface data, which preserves only the image data that is useful for face recognition. The acquired image is then compared with the surface data.

Since the understanding of the sealing surface has a more practical value, scholars at home and abroad in the past 20 years have done a lot of research, and put forward some powerful facial recognition models. Feature extraction is the key to facial recognition, which has important influence on subsequent recognition. The face recognition system recognizes faces that are present in the automatic image and video.

It is divided into two ways: 1 (or certification) test 2. To identify the surface (or identification) face verification or verification of a matching one image of the face with the diagnosis of the face template, Was claimed. Recognizing or recognizing one or more of the identity matches that exist in many of the image planes of the face images of all the templates in the comparison database to determine image plane negotiation.
Face Recognition Based on Template Matching Face representation at the angle of the template is covered by multiple masking functions, such as the mouth, eyes and nose. The basis of the detection faces semi-discussion template surface method.
In this study, our approach focused on facial recognition, recognition, and facial expressions. The most difficult part in these areas is to recognize the facial or facial expressions with the minimum required time and with the minimum error rate. We focus on programming and mathematical analysis with recommendations that limit these requirements to minimum and minimum errors.

II. RELATED WORK

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In earlier years, the dimensionality of linear subspaces, such as the restricted mutual subspace method (CIMS) and the discriminate canonical correlation (DCC) are several approaches. In the CIMS approach, the restricted subspace is discussed, where different classes of subspace pairs

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have small canonical correlation analysis. However, this method is very sensitive to the dimensionality of the restricted subspace. The DCC algorithm tries to maximize the typical correlation of the subspace class and the classical subspace of the original low dimensional linear subspace of the class transformation. However, as seen in a large number of subspaces where all the subspaces are concentrated at one point, the CMSM uses the maximum correlation distance and DCC approaches zero for most data. In addition, the maximum correlation distance is not metric and cannot be used with more sophisticated algorithms. Finally, these techniques do not explore linear subspaces, which usually reside in a specific data structure of the manifold, so that they can learn from their unwanted conversions [1].

EGM modified variants, where the morphological decomposition signal (MSD) was used instead of the Gabor analysis, was modelled as the sum of the components in the face image region and presented. The feature vector of each node of a sparse grid is created by reconstructing the value of the gray-level image of the mesh nodes at the facial location by the connection. During the matching process, the variant is called dynamic link MSD imposition. Temporary Shareholders General Assembly on the performance of facial expressions, where the facial landmarks select manual milestones rather than automatically for each facial expression is discriminate analysis automatically identifies the landmark images for each face. Improved accuracy of coincidence with the three extension systems. The first phase coefficients of Gabor differentiate the wave pattern used by the coefficient size. Second, they are used to fit graphics to objects, where nodes are referred to as reference points specific to the reference point. Third, they introduce a new data structure called face bunch chart (FBG), a generalized representation of facial images [2].

One method is based on wavelet curvelet technique and face recognition. This algorithm is based on the similarity of an image embedded in a facial feature extracted using a wavelet curvelet technique. In the implementation of techniques can overcome the mathematical analysis of other mathematical methods. This approach may suffer from the potential of a high-dimensional feature space, so its purpose is to reduce the computational power required for this reduction and the size of the memory dimensions. The nearest sorting medium (NMC) then uses a different face to identify. In this work, three main experiments were conducted. The implementation of these techniques is based on two facial databases (MAFD and ENT) and obtained a higher rate for improved facial recognition techniques, and conducted independent, free, open and periodic evaluations of public adoption improvements in the field. The recognition system is faced with a one-to-many combination of mainly used for trained facial reviewers [3].

There are two basic methods of facial recognition. The first is based on the basic part of the face, the extraction of eigenvectors such as eyes, nose, mouth and chin, and the second method is based on the concept of information theory. A new approach to the development of facial recognition problems is to test each face image distortion in a predefined space for the training of facial images in a predefined deformation pattern. However, in the second approach, the PCA technique was used to extract the most important features of the individual's face. These properties are used as a neural network to classify face inputs. Therefore, this paper adopts the second method to carry out the empirical study on the accuracy of face recognition system based on technology Eigen face and K-NN [4].

Optimized data fusion / pixel-level 3D shapes and textures. Here, in order to make the expression and illumination changes more residing in the subspace of the PCA fusion, the multimodal space is optimized with respect to the pixel values. They also found that performance, using a high-level multifunctional fusion system, further enhances the fusion of recognition functions. The sum of sub-spaces from the convolution of a set of orthogonal basis functions with the image shows that the subspace created by the clear image and the blurred version is equal to the ideal condition for zero-noise. The orientation of the local histogram equalization is used to compensate for edge and orientation (OLHE) of the illumination. The combination of the OLHE feature scheme is used to encode the edge orientation, compactness, edge retention capability and better under extreme lighting conditions. LBP is applied to the Generalized Discriminant Analysis (GDA) of nonlinear discriminant period and local Gabor Ternity Patterns (LTP) for feature extraction. The cosine is used to classify based on the nearest neighbour distance [5].

The hybrid method for feature extraction, which extracts the local and global features of the image, combines these two functions, and then uses the local and global Euclidean distance classifiers separately. If both properties return true it means that the person accepts. In the case of occlusion, the position of the change is different, but not good recognition rate. Histogram A local binary pattern, that is, a local texture descriptor used as a characteristic of the input image. LBP calculates that all local locks are not superimposed on the face. Based on the Euclidean distance used to detect, a good identification of the problem, classification constitutes changes [6].

Technology Zenik Moment (ZM) sieves a new combination to improve facial recognition. In this paper, two methods are used to extract the global and local features of face images. The Zernike moments are used to extract the global information from the images of the face and the SIFT descriptors used to discover different local information of the face images. The algorithm is highly resistant to illumination, posture and expression changes. A new method of finding or measuring the similarity of a self - organizing map (SOM) image. Face recognition is determined by the decision of the probability rule. This article describes the facial recognition of a new and powerful SOM. This new method provides great potential for identifying light / face changes that vary in light, facial pose and results without expression. A new matching

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algorithm uses normalized cross-correlation (NCC). These algorithms can help locate the images of the face of the template and start looking for matching different images of the same person at different times or by using different sensors for NCC. It is done in MAT LAB. Experimental results show that the method developed is a strong similarity measure [7].

III.METHODS

A. Face Recognition Processing

Facial recognition is a visual pattern recognition problem. Also, the face is subjected to illumination, posture, expression, etc. as a three-dimensional object, from which two-dimensional images (which may also be obtained using a three-dimensional image, for example, obtained from a laser) will be recognized. The facial recognition system is typically composed of four modules, as shown in Figure 1: Detection, Alignment, Feature Extraction and Matching, where the position and normalization (Face Detection and alignment) are processing steps before face recognition (facial feature extraction and matching) is performed [8]. Face Detection Split faces from the bottom area. In the case of video, a detected face may need to be tracked using a face tracking component. The goal of face orientation is to achieve a more accurate position and normalized face so that face detection provides a rough estimate of the position and size of each detected face. Based on the positional points, geometrical transformations or deformations are used with respect to the normalization and posture of the facial image, such as the size, of the face. The face is often normalized with more illumination and greyscale relative to the photometric properties. Geometric and photometric normalized surfaces, feature extraction is performed to provide useful and stable information about the difference in face and face relative to changes in geometry and luminosity. A mapping face that extracts a feature vector from a face input relative to a face registered in the database; and when the face identity is issued, the matching is sufficiently confident or unfamiliar with the face designation. The face recognition results are largely dependent on the feature being extracted to represent the distinction between the faces, and the standardized position and bottom face patterns and classification methods can efficiently extract the features. These problems can be analysed from the point of view of subspace or manifold, as follows.

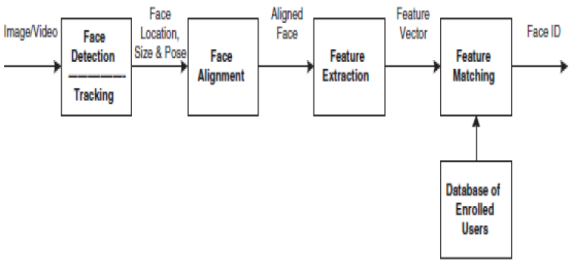

Figure 1: Face Recognition processing flow

B. Non-Negative Matrix Factorization

In part, many machine learning studies have shown that non-negative matrix factorization (NMF) is a useful breakdown for multivariable data, such as face and face recognition. According to the investigation, it is clear that the MFN can be understood as the analysis of the only additive based on both systems, because it decomposes the matrix [9]. The NMF factor of this technique is completely different from that of the principal component analysis (PCA) and the vector quantization (VQ) decomposition matrix. PCA and VQ work in the most-favoured-nation part based on the overall function of matrix decomposition.

C. Face and Facial Parts Detection

CK data sets all images of the found with large faces. First, we use the Viola-Jones algorithm to find faces. In order to detect the eyes, nose and mouth, the application of the cascade object detector in the end of the adjustment area in with the appropriate group of regions can identify the eye of the cascade that the purpose of the detector face has been determined, nose and mouth. In fact, it uses the algorithm Viola-Jones as the underlying system. This object detection algorithm uses a cascade of classifiers to efficiently handle the presence of an image region on a target object. Each stage of the cascade applies an increasingly complex binary classification, allowing the algorithm to quickly reject areas that do not contain targets. If the desired purpose is not found at any stage of the cascade, the detector will immediately reject the zone and end the process

D. Machine Learning Face Recognition.

Facial recognition problems can easily be solved by humans where the limited memory can be the main problem. Facial recognition systems, machine learning problems or limitations are:

1. Facial expression change
2. Illumination variation
3. Ageing
4. Pose change
5. Scaling factor (i.e. size of the image)
6. Frontal vs. profile
7. Presence and absence of spectacles, beard, mustache etc.
8. Occlusion due to scarf, mask or obstacles in front.

Automatic face recognition is a major and complex task involving the detection of complex backgrounds, removing facial features and facial recognition. A complete facial recognition system to solve all the sub-problems, each is an independent research topic [10].

E. Motion Detection Process

Real-time algorithm, motion detection is based on the structure of the fund model. The model consists of all zcomparison between the sequence and the edge found in the current image of the background of the scene. The background refers to the image from the sequence of

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images. There are several advantages to creating a bottom edge image to detect moving objects. The first is that the edge is insensitive to changes in the lighting conditions characterizing the outdoor scene characteristics. Another advantage of this method is that according to the lower level of analysis, this is independent of the shape and number of moving objects. We present the principle of the motion detection algorithm in this section.

F. Template based Methods

Templates are related to the concept of assignment attempts to identify methods that use a global representation face comprehensively. These types of methods are close to the surface as a whole image and try to extract features from the entire area of the face and then classify the images by applying pattern classification. One of the system characteristics for a whole extraction method is based on the following discussion of statistical methods [11].

a. Statistical Approaches

There are some techniques for identifying, parameteizing and analyzing linear subspaces. In addition to the linear subspace, there are some statistical face recognition algorithms based on non-linear subspaces (such as kernel PCA and kernel LDA), processing (such as DCT, DCT and HMM and Fourier transform) and support vector machine techniques (SVM). Facial recognition as a method of PCA, LDA and probability subspace-based method for displaying the 2D face image in the spatial image of the carrier.

b. Neural Network based Approaches

Artificial neural network (ANN) is a very successful tool for pattern recognition. In the Kohonen network association graph, one of the first demonstration reports for the neural network for memory application of face images. Using a small set of face images, accurate memory coverage even when the input image is very noisy, low resolution and size or missing part of the image. Here are some facial recognition techniques that describe NN.

1. An adaptive NN monolayer (per person) for face recognition. 2. Multi-level Perceptions (MLP): Most of the facial recognition systems with neural networks introduce the current literature with a few class results. SELF-ORGANIZING MAP: The self-organizing map describes the quantification of a sample of topological spatial facial images, which is also close to the exit space, with subtle changes in the sample image providing reduced dimensionality and invariant facial features.

c. Hybrid Approaches

The hybrid method uses the technique of face statistical pattern recognition and neural networks. PCA and RBF: data extracted by the intrinsic discriminant feature RBF usage recommendations. They use a hybrid device that learns the algorithm to reduce the size of the search space in the gradient method, which is very complex to optimize the surface of the high dimensional image. First, they attempt to extract the features of facial images using principal component analysis, independent component analysis and linear discriminant analysis. Second, they developed a hybrid learning algorithm to train the RBF network, so the size of the memory space search significantly reduces the gradient method.

G. Geometry Feature based Methods

Based on the use of measurements of facial features, such as the geometrical features of the distance between eyes, the distance between the eyes and nose, etc., but from the technology based on the functional constructs significantly different from each other using facial features [12].

a. Graph Matching based Methods:

In presented dynamic link architecture for noise invariant object recognition which employs elastic bunch graph matching to find the closed stored graph. Objects were produced with sparse graphs whose vertices we relabelled with geometrical distances. Only the magnitudes of the coefficients were used for matching and recognition of face images. When recognizing or identifying a face of a new image, each graph in the model gallery was matched to the image separately and the best match indicated the recognized person which is the output result. They presented good results with a database of 87 subjects and test images composed of different facial expressions and faces turned 15 degree. The matching process was taking roughly 25 seconds to compare an image with 87 stored objects when using a parallel machine with 23 transputer's.

b. Feature based PCA:

A system based on feature-based face recognition system. They use their own methods of sub-image facial (eyes, nose and mouth). They also applied a face recognition system for better rotation of the face images for better results.

H. Correlation Based Methods

A method of calculating a correlation of face detection based on the normalized cross-correlation coefficient. The first step in these methods is to determine the location of prominent features such as eyes, nose or mouth. The importance of face detection for robust detection and recognition has led to the development of various detection algorithms for facial features. A method for detecting facial features raised uses a set of templates for detecting the position of the eye in an image, searching for the maximum absolute value of the correlation coefficient for each of the templates in the test image. A set of templates are used in different scales to cope with changes in scale [13].

I. Elastic Bunch Graph Matching

Elastic beam pattern matching (EBGM) is a method based on well-known features. Also known as Gabor-EBGM. This technology is based on dynamic link structure. A set of fiducial points are selected in the image plane from:

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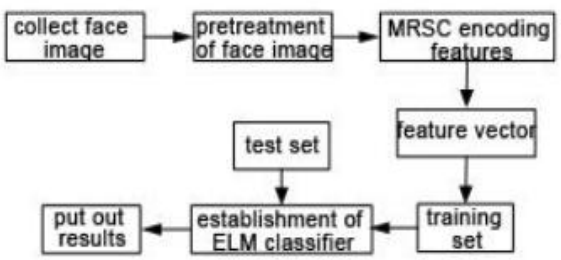
The graphs of the facial images generated in the EBGM are as follows. Each reference point is a complete graphical node connected and responsive to the Gabor filter added to a reference point around a window. A representative group of such graphs in a similar stack, called face group (FBG) combination of structure diagrams. Once the system has a bunch of graphics, you can automatically generate a new pattern of facial images by matching a graph of elastic bunch [14]. A new image of the face of the identified pattern image is compared with all the known face images and the highest similarity measure is selected. EBGM Steps for Face Recognition
The algorithm for EBGM used here. The recognition are as follows:

- Standardization
- Locating landmarks
- Creating face graphics
- Distance measurement
- Identification

J. Feature Extraction in DCT Domain
DCT's own algorithm for fast Fourier transform (FFT), as a great speed advantage is the K-L transform. Based on the theory, the facial feature is extracted before the original facial image is realized DCT. DCT is mainly used to compress data or images. You can convert signals in the spatial frequency domain, and have good performance with decorations. The DCT bases are decomposed in a sub-interval of 8x8 or 16x16 images, and the DCT transforms quantions of the subintervals are separated and then transcoded. The increase in the length of the subinterval, resulting in a dramatic increase in the complexity of the algorithm, is therefore commonly used in conversions in the actual 8x8 subintervals. However, the use of larger sub-intervals can significantly reduce the impact of image blocks.

K. MRCS-ELM Face Recognition Model
a. Process of Face Recognition
Face recognition method MRCS-ELM process shown in Figure 3. First, collect the image of the face so that pre treatment. Then extract effective features facing the Burmese Red Cross and eliminate the useless features of the face. Finally, set face multiple classification using elm, and classify the face recognition and publish the results [15].



Figur3.Workflow of Face Recognition Method

b. Pre-treatment of Face Image
The acquisition is affected by a variety of factors. Therefore, it must be pre-processed. Gabor filter is not sensitive to environmental changes, it must first use the Gabor filter to remove the noise of the pre-processing facial images.

L. Face Recognition Using ANN
a. Skin-color model
The model skin color is used to detect human faces. The skin has 3-color models for model RGB color space, color space model and model HSV color space for YCbCr. In our study, we use the model color space Ycbr.Following steps are performed to detect human image by using YCbCr [16].

1. Input testing image by using matlab function imread().
2. Calculate size of testing image by using size()
3. converting the integer into decimal fraction using double(I)
4. converting RGB space into HSV space
5. converting RGB space into YCrCb space
6. segmenting the yellow skin colour areas
7. if145<=cr(i,j)&cr(i,j)<=165&145<=cb(i,j)&cb(i,j)<=180& 0.01<=hue(i,j)&hue(i,j)<=0.15
8. segment(i,j)=1; %skin areas
9. else
10. segment(i,j)=0;
11. end
12. Covert skin color point to1
13. On the place of one show red pixel values
14. Make the area and draw the box around the face.

b. Feature Extractor and Pre-processing:
The following Steps are performed to extract feature of testing as well as training images of various persons of various angle After feature extraction, processing is done on training images only [17].

1. After face detection, cropped face region of testing image is obtained. Convert cropped image into grey Scale image.
2. Applying feature extractor method of Zernike moments for grey scale image of testing image is to obtain angle, pose, and length.
3. Load the training images.
4. Convert every training images of various persons into grey scale images using function double () in matlab.
5. After conversion images format, grey scale images of training sample is obtained. Apply the feature extractor Method of Zernike moment of training gray scale images of various person is to extracted feature such as angle, pose , length.
6. An extracted feature of training sample is saved into feature vector.
7. Next step is pre-processing of training images by using fuzzy sets. Apply fuzzy set on training images, fuzzy logic

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to shortlist more matching training according to greater than minimum threshold value of matching Feature.
8. Shortlist images of training sample s obtained to ANN

IV. CONCLUSION

Here is a comprehensive study of face detection algorithms that is vital. Face detection is a necessary first step in the face recognition system, in order to locate and extract the region from the bottom. A key step in face recognition systems is the evaluation and benchmarking of numerous algorithms. Several important databases and their associated evaluation methods are reviewed Face detection is currently a very active area of research and technology has gone a long way.

In the past They show great progress in complex environments, such as low-quality gray-scale processing algorithms Images and messy funds. Some of the best algorithms are too computationally expensive to still apply Real-time O processing, but this is likely to be improved with the computer hardware improvements. This article It proposes a technique based on a plurality of features, and on the basis of which the face image can be used for detection. All These methods have their own advantages and disadvantages.

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