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A Review on Illumination Invariant Face Recognition

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Abstract*—Face recognition is a biometric method, which is used to identify the image of face. It is a computer application to automatic identifies face from input image. Face recognition is used such as Image Database Management, Access Control, Security Monitoring and Human Computer Interface. Many of the research have been done in this field. Some of the challenging problems like variation in illumination face, face with different poses and face expression. Which minimize the performance of the face recognition system. In this referred the different approaches that used to overcome face image. In general, there are different techniques are used for Pre-processing, feature Extraction and Classification.*

Keywords- *pre-processing,Feature Extraction,Classification, Face recognition*

I. INTRODUCTION

A facial recognition system is a computer application capable of identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database.It is typically used in security systems and can be compared to other biometrics such as fingerprint or eye iris recognition systems.

The face is our key of attention in social interactions; it plays an important role in conveying identity and emotion. Human beings have ability to recognize lots of faces learned throughout the life span and even they can recognize the faces even after years of parting. This ability of human is quite robust; human can identify a face even if that face has presence of structural components such as beard or mustaches or glasses and also if that face is in different lighting conditions and face with varied facial expressions. Developing face recognition's computational model is fairly hard as it is very difficult to implement a skill that human possess for recognizing the face. Face Recognition became more important and competent with other biometric applications due to rapid advances in technologies such as digital cameras, portable digital computing devices, internet and wireless communication.

There is a strong requirement for the system that should be user-friendly system than can secure out material goods, resources or assets and guard our privacy. In recent scenarios there are different security schemes like a password for a computer, password for internet access, one need PIN to withdraw cash from the ATM and so many. There are also exceptionally reliable methods of biometrics exist, such as fingerprint analysis, iris or retinal scans, or speech recognition. These biometric methods depend on the support of test subject or participants to work, like Finger print analysis requires to place participant's hand on the system, in iris scan participant need stand in front of the camera and these methods cannot perform mass identification. It is advantageous than other methods such as it does not rely on cooperation of the participant to work. It also can do mass- identification; it can identify

the person from the crowd of the people without people having knowledge of it. Face recognition is an important research problem spanning numerous fields and disciplines. This because face recognition, in additional to having numerous practical applications such as bankcard identification, access control, Mug shots searching, security monitoring, and surveillance system, is a fundamental human behavior that is essential for effective communications and interactions among people.

Face recognition is very challenging task. There are some problems which can degrade the performance of face recognition system. Most important problems are changes or variation in illumination, variability in facial expressions, the presence of accessories (glasses, beards, etc.), and face may be partially or wholly occluded by some objects and the rotation of a face may change many facial characteristics. Up to now, so many methods have been proposed to deal with the illumination invariant face recognition technique. Some known algorithms are: principal component analysis (PCA), linear discriminate analysis (LDA), independent component analysis (ICA), Local Binary Pattern (LBP),and for classification template matching, Neural Network, support vector machine, k-means, k-medoids and so on.

II. LITERATURE SURVEY

Illumination Invariant Face Recognition System [1]

In this paper, Proposed approach, PCA with Back propagation Neural Network (BPNN) gives better result and it is very speedy than PCA with Euclidean Distance. Recognition rate of face recognition system with neural network is higher when numbers of training images are higher. Here, modified DCT is proposed in which appropriate number of low frequency coefficients are truncated and high frequency coefficients are scaled, which gives clear detail of the face and it outperforms the DCT. When, modified DCT applied with Euclidean distance and neural network. Modified DCT with neural network outperforms the Modified DCT with Euclidean distance.

Illumination Invariant Face Recognition Using Discrete Cosine Transform And Principal Component Analysis[2].

In this paper, a methodology on illumination invariant face recognition using Discrete Cosine Transform (DCT) and Principal Component Analysis (PCA) is discussed through the process of normalization, compensation and recognition of face images. Since variation of lighting condition in input face image is the major problem in face recognition, plenty of techniques were developed for effective recognition under these circumstances. The technique DCT with PCA in Yale Database B proves good recognition rate. With these results, I conclude that the combination of DCT with any other recognition approaches could be experimented in order to improve the illumination invariant recognition accuracy. However, it is identified that the efficiency of the face recognition system could be increased by the fusion of the existing approaches in a system so that, the combinational results will outperforms the existing methods in face recognition. Therefore, in future work, the fusion of two illuminationinvariant face recognition approaches could be experimented for recognition efficiency in order to determine the most effective approach in face recognition across variations in illumination.

Face Recognition Using Principal Component Analysis and Self Organizing Maps [3]

In this research Principal Component Analysis is applied to find the characteristic of face images and Self Organizing Maps for clustering. There are most common problems in face images, due to a real capture system, like lighting variations, head pose and different faces dimensions. In Face Recognition there are three phases to build a face recognition system, namely: image pre-processing used to resolve some of the issues contained in the image such as light, Feature Extraction is used to get the characteristic of a human faces and 93 clustering is used to group a set of objects in the same class. Based on the result from previous researcher Essex Database give a better result using PCA, therefore this research is using Essex Database.

A Survey of Face Recognition Techniques [4]

In this paper, Research has been conducted vigorously in this area for the past four decades or so, and though huge progress has been made, encouraging results have been obtained and current face recognition systems have reached a certain degree of maturity when operating under constrained conditions; however, they are far from achieving the ideal of being able to perform adequately in all the various situations that are commonly encountered by applications utilizing these techniques in practical life. The ultimate goal of researchers in this area is to enable computers to emulate the human vision system and, as has been aptly pointed out by Torres [225], “Strong and coordinated effort between the computer vision, signal processing, and psychophysics and neurosciences communities is needed” to attain this objective.

A Review on Face Recognition Using Different Techniques [5]

In this paper, Face recognition presents a challenging problem in the field of image analysis and computer vision, and as such has received a great deal of attention over the last few years because of its many applications in various domains. This article surveys forensic face-recognition approaches and the different techniques of face recognition. Face recognition is finding identity of any detected face using different recognition methods. The propose approach involves Heterogeneous face recognition. Heterogeneous faces are the images captured from different types of devices in different light intensity. The method use has a relational feature representation for face images.

A MATLAB based Face Recognition System using Image Processing and Neural Networks [6]

This paper has presented a novel face recognition technique that uses features derived from DCT coefficients, along with a SOM-based classifier. The system was evaluated in MATLAB using an image database of 25 face images, containing five subjects and each subject having 5 images with different facial expressions. After training for approximately 850 epochs the system achieved a recognition rate of 81.36% for 10 consecutive trials. A reduced feature space, described for experiment 2 above, dramatically reduces the computational requirements of the method as compared with standard DCT- feature extraction methods. This makes our system well suited for low-cost, real-time

hardware implementation. Commercial implementations of this technique do not currently exist. However, it is conceivable that a practical SOM-based face recognition system may be possible in the future.

Illumination Invariant Face Recognition [7]

In the proposed research work a technique based on the combination of Retinex and LOG(DCT) method is introduced for illumination suppression, images normalized with proposed method when used with LBP feature extraction method then it gives good recognition results as compared to other retinex methods but results are slightly down as compared to Small scale and large scale technique proposed. In the proposed research work the proposed method is applied on Extended Yale B database with simple LBP feature extraction technique. The future work include the use of proposed method on more face databases and with other advanced LBP techniques for further improvement of results.

Analysis and Implementation Of Modified K-Medoids Algorithm To Increase Scalability And Efficiency For Large Dataset [8]

Clustering plays a vital role in research area in the field of data mining. Clustering is a process of partitioning a set of data in a meaningful sub classes called clusters. It helps users to understand the natural grouping of cluster from the data set. It is unsupervised classification that means it has no predefined classes. Applications of cluster analysis are Economic Science, Document classification, Pattern Recognition, Image Processing, text mining. Hence, in this study some algorithms are presented which can be used according to one's requirement. K-means is the most popular algorithm used for the purpose of data segmentation. K-means is not very effective in many cases. Also it is not even applicable for data segmentation in some specific kinds of matrices like Absolute Pearson. Whereas K-Medoids is considered flexible than k-means and also carry compatibility to work with almost every type of data matrix. The medoids computed using k-Medoids algorithm is roughly comparable to the median. After checking the literature on median, we have found a number of advantages of median over arithmetic mean. In this paper, we have used a modified version of k-medoids algorithm for the large data sets. Proposed k-medoids algorithm has been modified to perform faster than k-means because speed is the major cause behind the k-medoids unpopularity as compared to k- means. Our experimental results have shown that improved k-medoids performed better than k-means and k-medoids in terms of cluster quality and elapsed time.

III. GENERAL OVERVIEW

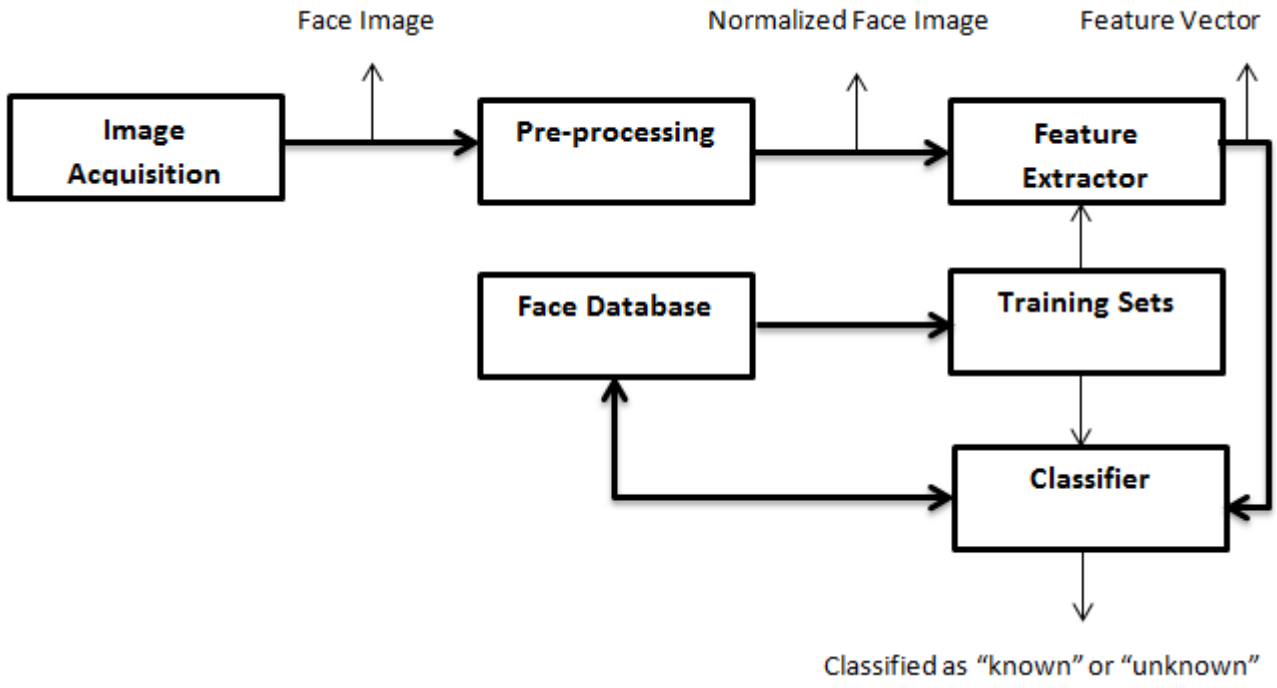

Figure.1- A general overview

As every system is designed for specific application, so the design of system depends on the function and environment conditions. Face Recognition systems can generally be divided in three common steps: (1) Pre-processing (2) Feature Extraction and (4) Classification.

IV. PRE-PROCESSING

In pre-processing requirement is enhancement and restoration. it involve processes which improve the quality of image by eliminating noises, reversing the damages, de blurring to recover the original sharpness of an image, highlighting edges of the images.

A) Histogram Equalization

The Histogram Equalization enhances the contrast of images by transforming the values in an intensity image so that the histogram of the output image approximately matches a specified histogram. A processed (output) image is obtained by mapping each pixel with level r in the input image into a corresponding pixel with level s in the output image.

B) Rank Normalization

The rank normalization function applies rank normalization to the pixel intensity values of an image. This means that all pixels in an image are ordered from the most negative to the most positive. After the ordering the first pixel is assigned a rank of one, the second the rank of two,..., and the last is assigned a rank of N, where N is the number of pixels in the image.

C) Pre-processing using DCT

DCT coverts image from spatial domain to frequency domain. It is performed on the whole face image to get all frequency components/coefficients of the face image. The output image of logarithm transform is given to discrete cosine transform.

- Low frequency coefficient removal.

The effect of illumination is more at low frequency coefficients. So normalization of illumination is carried out by discarding low frequency coefficient by setting zero value to low frequency coefficients.. The first DCT coefficient (i.e., the DC component) determines the overall illumination of a face image.

- High frequency coefficient scaling

While removing low frequency coefficients, we scale some high frequency coefficients of DCT to make details of the face image clearer. Under poor illuminations, the high-frequency features become more vital in recognition. These high frequency coefficients are multiplied with some scalar value that is how it gives enhanced details of the image. Scaling of high frequency coefficients are also done by following zigzag pattern.

D) Median Filtering

It comes under the category of nonlinear filters. It changesthe gray value of the pixels to the median of the gray value ofsurrounding pixels. We use a 3x3 mask and calculate thecorresponding gray value of each pixel using the 8neighboring pixels. This helps in noise removal. Medianfiltering gives advantages such as no reduction in contrastsince output values are its neighborhood values, boundariesremain unchanged. Median filters are very useful in thepresence of impulse noises also called salt and pepper noisebecause of its appearance as white and black dotssuperimposed on an image.

E) Morphological Operations

They are generally used to remover noise from the imperfect segmentation. Morphological operations are especially suited for binary images. So they are performed on output image of thresholding. Here Dilation and erosion are performed. Dilation and erosion are used to remove holes in the detected foreground. In the process of dilation the size and shape determination of structuring element is very important.

V. FEATURE EXTRACTION

A)Gabor Filter

The Gabor filter is used for extracting the image features. It generates an optimal resolution in the spatial and frequency domain. To operate the Gabor filter, two orientation and frequency parameters are required. The selection of the parameters in the Gabor filter is a critical issue. Therefore in the mentioned technique for reducing the extracted feature vector, 15 Gabor filters (5 orientation parameters and 3 spatial frequency parameters) are applied.

B) Local Binary Pattern

LBP is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number. Due to its discriminative power and computational simplicity,

LBP texture operator has become a popular approach in various applications. It can be seen as a unifying approach to the traditionally divergent statistical and structural models of texture analysis. Perhaps the most important property of the LBP operator in real-world applications is its robustness to monotonic gray-scale changes caused, for example, by illumination variations. Another important property is its computational simplicity, which makes it possible to analyze images in challenging real-time settings.The drawbacks in this system are it is highly sensitive to glasses and it is time consuming process.

*C***)** *Feature Extraction using PCA*

This approach attempts to extract facial features which are invariant to illumination variations. Here, Principle Component Analysis (PCA) is employed to extract important facial features. PCA method converts the high dimensional image space to low dimensional space; it computes the maximum variations in data. These extracted projections of face images are given to Artificial Neural Networks for training and testing purposes.

VI. CLASSIFICATION

Classification is used to identify and converting mage text into editable and readable text. To perform character recognition we should first perform character segmentation with high accuracy. Otherwise character recognition will have errors.

A) Face Recognition using Euclidean Classifier

The feature subset representing each image is the face gallery that is used for similarity measurement in the recognition stage. The test image is also reduced in dimension in order to have the same set of features as the images in the gallery(training images). The P-dimensional Euclidean distance between them is calculated.

B)Face Recognition using Neural Network

After the feature extraction using PCA, this generated feature vector is used for recognition process. Artificial neural network is a mathematical or computational model which is based on biological neural networks.Back propagation is supervised learning network and a multi- layer feed forward network based on gradient descent learning rule. Here an input signal propagates in forward direction through the network and from left to right and layer by layer basis. This BPNN is computationally efficient method. It takes much time to train the network but once it completes training, testing does not take any more time. It becomes speedy. Being a gradient descent method it minimizes the total squared error of the output computed by the network. The aim is to train the network to achieve a balance between the ability to respond correctly to the input patterns that are used for training and the ability to provide good response to the input that are similar.

C) Support Vector Machine (SVM)

SVMs have become more and more important in the field of pattern recognition. SVM is forcefully competing with many methods for classification. An SVM is a supervised learning technique. SVM takes Statistical Learning Theory (SLT) as its theoretical foundation, and the structural risk minimization as its optimal object to realize the best generalization. They are based on some simple ideas and provide a clear intuition of what learning from examples is all about. More importantly, they possess the feature of high performance in practical applications. The SVMs use hyper planes to separate the different classes. Many hyper planes are fitted to separate the classes, but there is only one optimal separating hyper plane. The optimal one is expected to generalize well in comparison to the others. A new data sample is classified by the SVM according to the decision boundary defined by the hyper plane. Among many classification methods, SVM has demonstrated superior performance.

D)Face Recognition using K-Means

K-mean algorithm is one of the centroid based technique. It takes input parameter k and partition a set of n object from k clusters. The similarity between clusters is measured in regards to the mean value of the object. The random selection of k object is first step of algorithm which represents cluster mean or center. By comparing most similarity other objects are assigning to the cluster.

E) Face Recognition using K-Medoids

The k-means method is based on the centroid techniques to represent the cluster and it is sensitive to outliers. This means, a data object with an extremely large value may disrupt the distribution of data. To overcome the problem we used K-medoids method which is based on representative object techniques. Medoids is replaced with centroid to represent the cluster. Medoids is the most centrally located data object in a cluster. Here, k data objects are selected randomly as medoids to represent k cluster and remaining all data objects are placed in a cluster having medoids nearest (or most similar) to that data object. After processing all data objects, new medoids is determined which can represent cluster in a better way and the entire process is repeated. Again all data objects are

bound to the clusters based on the new medoids. In each iteration, medoids change their location step by step. This process is continued until no any medoids move. As a result, k clusters are found representing a set of n data objects.

VII. CONCLUSION

Face Recognition has different phases and accuracy of each phase dependent on previous phase. Different lightning conditions as well as the environment conditions under which the systems are designed to operate are the main challenges. From this survey it can be concluded that different pre-processing techniques like Histogram Equalization, Rank Normalization, Median Filter, Morphological Operations, and Discrete Cosine Transform used to improve the quality of input face image,Feature Extraction like Gabor filter, Local Binary Pattern and Principal Component Analysis are mostlyused to extract the features of the face. The classification can be improved by Euclidean classifier, Neural Network, SVM, K-means, and K-Medoids.

REFERENCES

[1] Chande Anita, Shah Khushbu"ILLUMINATION INVARIANT FACE RECOGNITION SYSTEM" International Journal For Technological Research In Engineering Volume 1, Issue 10, June-2014 ISSN (Online): 2347 – 4718

[2] Shermina.J"ILLUMINATION INVARIANT FACE RECOGNITION USING DISCRETE COSINE TRANSFORM AND PRINCIPAL COMPONENT ANALYSIS" PROCEEDINGS OF ICETECT 2011 978-1-4244-7926-9/11/$26.00 ©2011 IEEE.

[3] Dian RetnoAnggraini"Face Recognition Using Principal Component Analysis and Self Organizing Maps" 2014 Third ICT International Student Project Conference (ICT-ISPC2014) 978-1-4799-5573-2/14/$31.00 ©2014 IEEE

[4] RabiaJafri* and Hamid R. Arabnia* "A Survey of Face Recognition Techniques" Journal of Information Processing Systems, Vol.5, No.2, June 2009 41 DOI : 10.3745/JIPS.2009.5.2.041

[5] Er. KavneetKaur and Vijay Kumar Banga "A Review on Face Recognition Using Different Techniques" Kalamkar et al., International Journal of Advanced Research in Computer Science and Software Engineering 5(1), January - 2015, pp. 99-102
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[6] JawadNagi, Syed Khaleel Ahmed FarrukhNagi "A MATLAB based Face Recognition System using Image Processing and Neural Networks "4th International Colloquium on Signal Processing and its Applications, March 7-9, 2008, Kuala Lumpur, Malaysia. © Faculty of Electrical Engineering, UiTM Shah Alam, Malaysia. ISBN: 978-983-42747-9-5

[7] HardeepKaur, AmandeepKaur "Illumination Invariant Face Recognition " International Journal of Computer Applications (0975 – 8887) Volume 64– No.21, February 2013.

[8] Gopi Gandhi1, RohitSrivastava " ANALYSIS AND IMPLEMENTATION OF MODIFIED K-MEDOIDS ALGORITHM TO INCREASE SCALABILITY AND EFFICIENCY FOR LARGE DATASET" IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308 Volume: 03 Issue: 06 | Jun-2014, Available @ http://www.ijret.org

[9] C.Nagaraju, B.Srinu, E. SrinivasaRao"An efficient Facial Features extraction Technique for Face Recognition system Using Local Binary Patterns " International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-2, Issue-6, May 2013

[10] Weilong Chen, MengJooEr, Member, IEEE, and Shiqian Wu, Member, IEEE "Illumination Compensation and Normalization for Robust Face Recognition Using Discrete Cosine Transform in Logarithm Domain" IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS—PART B: CYBERNETICS, VOL. 36, NO. 2, APRIL 2006.

[11] Matlab: DigitalImageProcessingusingMATLAB, second edition by RafaelC. Gonzales.