

Study on Recognizing the Human Face under Invariant Pose, Illumination and Expression using LBP, LoG and SVM

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Abstract: Face recognition system uses human face for the identification of the person. Face recognition is a very difficult task there is no separate method that provides an accurate and efficient solution in all the situations like the face image with different pose, illumination and expressions. Local Binary Pattern (LBP) and Laplacian of Gaussian (LoG) operators. Support Vector Machine classifier is used to recognize the human face. The LoG algorithm is used to preprocess the image to detect the edges of the face image to get the image information. The LBP operator divides the face image into several blocks to generate the features information on pixel level by creating LBP labels for all the blocks of image is obtained by concatenating all the individual local histograms. Support Vector Machine classifier (SVM) is used to classify the image. The algorithm performances are verified under the constraints like illumination, expression and pose variation.

Keywords: Face Recognition, Local Binary Pattern, Laplacian of Gaussian, histogram, illumination, pose angle, expression variations, SVM.

1. Introduction

The Technology used for recognizing the face under security systems works on the biometric principles. There are many human characteristics which can be used for biometric identification such that palm, finger print, face, and iris etc. one of these biometrics methods face recognition is advantageous because of it can be detected from much more distance without need of scanning devices this provides easy observation to identify individuals in group of persons. Most of the military application security systems, attendance systems, authentication, criminal identity etc. are performed using this technology. The computer uses this recognition technology to identify or to compare the person with same person or with some other person. The human faces are very important factor to identify who the person is and how the people will make out his/her face. The images of faces are taken from the distance without having contact with a person, capturing the face images.

Verification and Identification steps are used for comparison. The first method is verification which compares the face image with his/her image which is already stored in database. It is one to one matching because it tries to match individual against same person's image stored in database. The second method is identification which identifies the unknown person. It is called one to n matching because it matches individual person's face image with every person's face images. If the face images are affected by lightning condition, different posing angle or different expression then it is difficult to identify the human face. Many algorithms are used to extract features of face and to match the face images such as Principal Component Analysis (PCA) and Independent Component Analysis (ICA) [1], Elastic Bunch Graph Matching (EBGM) [2], K-nearest neighbor algorithm classifier and Linear Discriminant Analysis (LDA) [3].

This paper is organized as follows: Section II reviews the related works done on data security in cloud. Section III describes the proposed system and assumptions. Section IV provides the conclusion of the paper.

2. Related Work

Face Recognition becomes one of the most biometrics authentication techniques from the past few years. Face recognition is an interesting and successful application of Pattern recognition and Image analysis. It compares a query face image against all image templates in a face database. Face recognition is very important due to its wide range of commercial and law enforcement applications, which include forensic identification, access control, border surveillance and human interactions and availability of low cost recording devices.

Principal Component Analysis and Independent Component Analysis [1], Elastic Bunch Graph Matching [2], K-nearest neighbor algorithm classifier and Linear Discriminant Analysis [3], Local Derivative pattern and Local Binary Pattern [4]. These algorithms are still having some problems to recognize the face under the constraints like variations in pose, expression and illumination. This variation in the image degrades the performance of recognition rate.

Local Binary Pattern (LBP) and Laplacian of Gaussian (LoG) is used to reduce the illumination effects by increasing the contrast of the image which does not effect to the original image and differential excitation pixel used for preprocessing which is to make the algorithm invariant to the illumination changes [4].

The Local Directional Pattern descriptor (LDP) uses the edge values of surrounding pixel of the center pixel and

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Two Dimensional Principal Analysis (2D-PCA) is used for feature extraction which uses Euclidean distance to measure the similarity between training database images and test image features. The nearest neighbor classifier is used to classify the images [5].

To reduce the influence of illumination from an input image an adaptive homomorphic filtering is used in adaptive homomorphic eight local directional patterns (AH-ELDP) [6] method. This method produces eight directional edge images and to create an illumination-insensitive representation for face recognition it uses all the directional information.

The light variations impact more on recognition of the image because the changes in the lightning condition may increase or decrease the intensities of the face regions due to the shadow cast given by some light source [7].

To normalize the illumination condition many algorithms are proposed. Belhumeur et.al. [8], used three principal components to reduce the illumination changes in the images by normalizing the face image.

The face expressions [9] are most natural used to identify the expressions of the person. One of the limitations of the non-frontal view method is that the images will be in different poses. The training dataset should contain the data having possible views of face images to identify the angle of view before using algorithms directly. Though all these methods are used for particular applications but due to some drawbacks of these methods the local feature extraction method is used.

Survey of face recognition under varying facial expressions is done in order to analyze different techniques, motion-based, model-based and muscles-based approaches have been used in order to handle the facial expression and recognition [10].

SVM-LBP method [11] is used to recognize the face under complex background and different face positions. Median filter is used to remove the noise from the image. Local Binary Pattern is used to extract the features of face and Support Vector Machine classifier is used to classify the face images.

3. Proposed System

The flow of the process is shown in Figure 1. The query image consists of different problems like illumination, expression and poses which is preprocessed to enhance the facial features more. The Laplacian of Gaussian (LoG) method is used for preprocessing. Then the LBP operator is applied to the face image to extract the facial feature. The Support vector machines used to classify the training and test dataset images. JAFFE image database is used as training dataset.

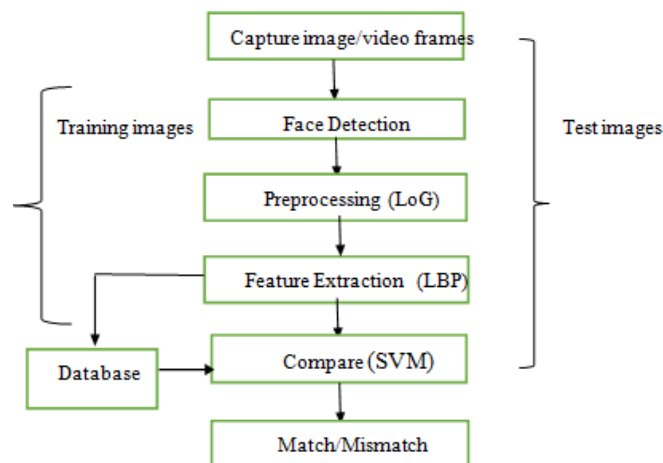


Figure 1: Flow Chart

A. Laplacian of Gaussian (LoG)

The LoG operator is used to detect the edges of the face image to get the image information. The LoG of an image highlights the regions where the intensity is changed and it removes the noise from the image. The LoG operator will take gray level image as input and it will produce gray level image as an output. Then the LBP operator is applied to the face image.

B. Local Binary Pattern (LBP)

The Local Binary Pattern (LBP) algorithm is used to extract the face image features. The LBP code is calculated for every pixel in the image block and features like eyes, nose and mouth distances are calculated. LBP code is noted. Then the image is split into several blocks as shown in Figure 2.

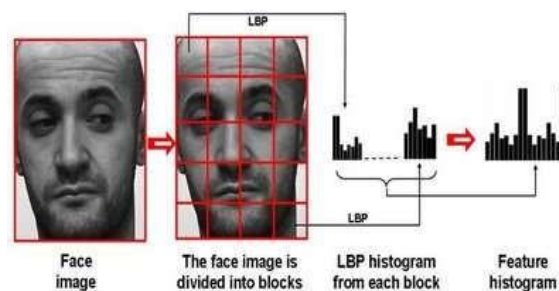


Figure 2: Face descriptions with local binary patterns

Histogram of each block is calculated and then it is combined together to single vector to get global histogram values [12] as shown In Figure 3. The LBP is used to summarize the local structure in an image by comparing every pixel with its surrounding neighborhood. Center pixel value is taken and threshold it with its neighborhood pixel. If the intensity of the center pixel value is more than or equal to neighbor pixel value then denote it with 1 otherwise 0. With 8 surrounding pixels 2^8 possible values combinations will get.

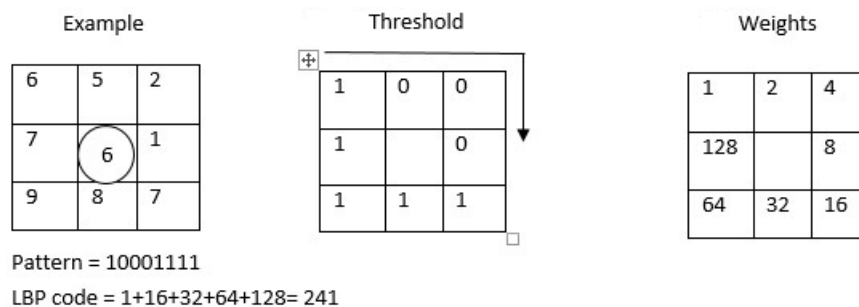


Figure 3: Basic LBP operation

C. Support vector machines (SVM)

SVM is applied to the face image to classify the image. It can be used for various applications such as text recognition, character recognition and handwriting recognition. SVM classifier [13] finds the separation between the two images. The classifier matches the training dataset images with the query images and gives the final output that whether the image is matching or not matching.

4. Conclusion

In the proposed face recognition system Laplacian of Gaussian and Local Binary Pattern methods are used for feature extraction. During the classification phase Support Vector Machine classifier is tested for wide facial variations. Combination of these three methods will provide results than any other conventional methods. The facial expressions such as happy, sad, disgusting, cry, surprise are taken to identify the person. LBP is totally invariant to illumination effect, so it easy to recognize the face of same person with invariant illumination and invariant expression image. LBP gives the better recognition rate in the case of the various illuminated face image.

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