RESEARCH ARTICLE

Study and Analysis of Different Pose Invariant for Face Recognition Under Lighting Condition

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ABSTRACT

Human face detection and recognition is the most influential area of image processing and analysis. It is one of the most manifold techniques used to distinguish an individual. There are two major challenges, Pose and Illumination among the various factors that impact the face recognition technique. The key objective of this paper is to develop a system which provides more precise face recognition system and recognizes the identity of a person with accuracy. The proposed system basically consists of two phases, image illumination and classification. Image illumination enhances the quality of image for the post phase of face recognition. Pose variations diminish the performance of human face recognition. Feature Extraction is the technique used to improve Performance and Dimensionality using Face Component Analysis and Discriminant Analysis. We propose a novel approach for face recognition under pose invariant and ambient illumination condition. Moreover, there will be no limitation on the invariant pose conditions. In the classification phase, images that were not considered in a training set, can be considered for testing. In order to train during the face recognition phase, various classifiers such as Naive Bayes Classifier and SVM (Support Vector Machine) algorithms are used to classify the images and analyze the face Recognition Rate.

Keywords: Bayesian Discriminating Feature, Generalized Discriminate Analysis, Support Vector Machines

1. INTRODUCTION

Face recognition has been one of the most interesting and important research fields in the past two decades. Many papers have been published to overcome difference factors (such as illumination, expression, scale, pose etc.) and achieve better recognition rate; but, there is no efficient technique against uncontrolled practical cases which may involve kinds of factors simultaneously. The problem of pose is a big challenge applying this technology under the real word condition. In this report, the face detection and face recognition by using different classifiers has been discussed. Face recognition has diverse applications; in the identification solution which can meet the crime needs in security area [1]. R. Raja et. al. [2-6] Feature Extraction is a very useful method for extracting the features of the image. It includes dimensionality and reduction. Facial images must be processed for normal Inaction in order to evaluate its severability. It can be done using Gabor filter; it differentiates expression and dimensions. Principle Component Analysis and Linear Discriminate Analysis can be used for reorganization purpose by multi-classifiers. The Classifier includes the discriminant function and evaluates the featured data. In this particular case, the featured data can be obtained from the input Eigen vector of image. The featured Eigen vector determines the excess of decrement projection. The vectors can be clustered by using k-mean clustering algorithm. It provides a success rate of 91%. Principle Component Analysis can be used for multiple feature extraction and fusion. It uses high dimensional related features with facial expression. Finally, it calculates Euclidean distance in order to obtain similarity between facial expressions among same templates. The steps of accomplishing objectives are:

- Image Illumination to enhance the quality of the image.
- Principle Component Analysis for robust image processing.
- Linear Discriminant Analysis to enhance the object feature approach.

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2456-8783© 2017 Sreyas Publications by Sreyas Institute of Engineering and Technology. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
- Variant pose registration to identify the similar characteristics of the same image.
- Feature Extraction for image classification.
- Face recognition using different classifiers which are used in the image processing.

2. LITERATURE SURVEY

Feature extraction, an important step in image preprocessing, includes different features. As per the view of Jiang X and Riopka T [7-9], the geometrical feature extraction is proposed on the basis of size, shape, height, width, length etc.; they are extracted and these methods are used. Wiskott L. [10] also added his work for geometrical feature extraction. Wang X. [1] proposed Principal component analysis on the basis of Eigen vectors which is a common technique used for geometric feature extraction like Oriented principal component analysis, Principal Component Analysis and Probabilistic Principal Component Analysis are considered.

Wang X. et al [1], proposed work for texture-based extraction of single training images where Gabor features are extracted and 85% accuracy is achieved; and, he also made his contribution for describing various face recognition techniques based on texture. According to Tan X. [11], NS focused and described the Object Oriented Feature Extraction is for Aerial Images.

The recognition of significant features is very important consideration while developing the present method. The survey which is carried out also deals with various approaches of detection of geometrical, object oriented, homographic and texture based methods and is helpful in finding the best method for image mosaicing Kisku D. [12].

3. RESULTS AND DISCUSSIONS

The Steps for Face Recognition is as shown in Figure1. The Flowchart of Naive Bayes Classifier is as shown in Figure2. Human face recognition system is disrupted whenever the direction of the light, effect of the light, pose of the face change. There are many problems on human face recognition system which have been observed as follows:

- Face recognition by the human perception is the dedicated process i.e. artificial face recognition system should also be face specific.
- To recognize different faces is easier than typical ones.

- To represent and recognize the faces, features used are global and local features.

![Figure 1. Steps for Face Recognition (Testing and Training)](image)

In this Figure, firstly the preprocessing of the image has been done; then, features are extracted from the image. After this construct, the Model which serves as generic model to render the set of basis information of each subject for different poses. Take any unknown image from the testing database and classify by using different classifiers.

**Developed Algorithm**

**Algorithm1: Image Illumination**

Step 1: Read all the source and target images.

Step 2: Divide the target image into equal blocks; this is called as framing of images.

Step 3: For each block with respect to the source image, calculate the global intensity differences.

**Algorithm2: Variant Pose Registration**

For each block with respect to source image, the steps are as follows:

Step 1: Compute the common points of the block of particular target images and source images; the common points are evaluated.

Step 2: For both common points are correlation establishment.

Step 3: Best matching points are obtained and are set range for classifiers.

**Algorithm 3: Training Phase of Data**

For each source image:

Step 1: Compute the shape and feature parameter of the particular image.

Step 2: Estimate illumination coefficient and texture information using Gabor filter.

Step 3: Features are extracted using Linear Discriminate Analysis and Principal Component Analysis.

Step 4: Extracted features are saved for testing the phase of face recognition.

**Algorithm 4: Testing Phase of Data.**

For source image:

Step 1: Compute against the classifier training set.
Step 2: Estimate similarity coefficient and class information using the classifier.
Step 3: All the source image features are verified against the particular class.
Step 4: Image is recognized based on the class and features.

In the present work experimental setup and result analysis of novel face recognition system using different classifiers. Various algorithm and calculation have been done in order to achieve maximum accuracy in the face recognition. Begin with illumination and lightening effects, followed by feature extraction and classification of images. We demonstrate in variant illumination of similar images as well as different pose of particular image can be tedious to recognize with accuracy. So, ambient illumination is mandatory to achieve higher success ratio. Different classifiers are used to get assuredly for better recognition rate.

Novel Bayesian Discriminating Features (BDF) Method is used for multiple frontal face detection. In BDF method, images are trained only from one database. It works on the test images from different sources and shows fast normalization performance. The essence of this paper comes from integrating different features of the input image. Statical approach to classify the image based on frontal face attributes is considered in BDF. Initial features which are having discriminating values can be stored in the form of vectors. This vector can be further used to detect similar object, then statical modeling is used for calculating the probability of density function and the variance coefficient. While the classes are modeled based on multivariate distribution of Eigen values to calculate this broad set of values, the subset calculation will be helpful. Bayes classifier detects frontal face using conditional PDF principle discriminant factor.

Complete process is described in the following 3 segments which are as follows:
A. Face illumination and pose invariant.
B. Image classification using Naive Bayes Classifier.
C. Image classification using SVM (Support vector Machine) classifier.

A. Face illumination and pose invariant:
In this part, we present some images from our dataset (Figure 3). We are applying lights from different direction on various poses of face which can be shown in Figure 3. In this part we get the illuminated faces with good quality and better visibility. These images are ready to get trained.

Figure 3. Post illumination effects of source images

B. Image classification using Naive Bayes Classifier
Figure 4 shows the illumination phase over. We generated illuminated images with different pose. The results show better visibility and lighting.

Figure 2. Flowchart of Naive Bayes Classifier

Figure 4. Training data with illuminated images
Figure 5 shows the test image against the trained data set, where face is recognized and it shows human perception class description as well as machine perception class of image according to similarity index.

Figure 6 presents the class which is the same but has invariant features due to different pose.

Figure 7 presents the details of image testing which has different pose; but, the result shows human perception class and machine perception class is the same. This concludes that our system is trained against the various test data.

**Image classification using SVM (Support vector Machine) classifier**

When we run the program, a window opens, which contains some options (Generate database, Create SVM, Test on Photos and Exit) as shown in Figure 4.3.5.1. On clicking the Generate Database, it stores all the trained data in the database i.e. it loads all the facial and non facial images in the database; then creation of SVM takes place. It shows how SVM classifier is used to detect the face and non face part image. Images have been tested against the training data.

We presented a technique and evaluated the performance with respect to robustness against illumination and different poses. The component-based system is used for detection and extraction.

A set of 69 facial components are arranged in a single feature vector that has been classified by linear SVMs. In this system the whole face is detected, extracted from the image and is used as input to the classifiers. The system consisted of a single SVM for each person in the database and is trained with a set of view-specific SVM classifiers. The performance of classifier depends on the characteristics of the data to be classified. There is not a single classifier that works best on all the given problems. To compare the performance of the classifier, various empirical tests have to be performed.

In this part, the images have to be taken from the database and classified into training and testing set. For example, the database contains 69 images of persons and for training and other purposes and some images are used for testing. Thus, by using the trained images the values are entered into the reference matrix and then used as a reference to compare the values generated from the testing images. Input the image function from the database and is applied to the Gabor function to get the Gabor output. These images are convolved with the
Gabor output to get the Gabor magnitude and phase. The database is split into training and testing sets.

![Image of the person used for extracting Gabor features and Gabor output](image1)

**Figure 8.** Image of the person used for extracting Gabor features and Gabor output

![Gabor Magnitude output](image2)

**Figure 9: Gabor Magnitude output**

**Getting local and global Gabor features:**

When the magnitude and the phase are modeled, subdivision of the image takes place into a series of smaller images and the local Gabor magnitude and phase representations are obtained. After combining, we get the Gabor magnitude phase texture representation. Figure 8 shows Image of the person used for extracting Gabor features and Gabor output. Figure 9 shows Gabor Magnitude output.

The SVM classifier is commonly used for face detection and classification of the image. It is based on the extracted feature and it detects and recognizes the image object such as face. The SVM maps the features to Multi order multi dimension matrices and after that derive an optimal solution hyper plane for that space. This refers as it is very efficient and contains mandatory information or data of images to classify the images with optimality. The higher and multi-dimensionality of this particular model provides, the greater the discrimination power; and, in order to achieve proper feature extraction, hit and trail process for selection of kernel function can play crucial role.

![Face detection using SVM](image3)

**Figure 10.** Face detection using SVM in a dataset

Figure 10 shows the face detection using the svm. Green part shows the face area

![Face area of Input image](image4)

**Figure 11.** Face area of Input image

Figure 11 shows the highlighted area is human face.

![Final face detection using SVM](image5)

**Figure 12.** Final face detection using SVM

Figure 12 shows how SVM classifier is used to detect the face and non face part of image. Images have been tested against the training data.
CONCLUSION

We proposed pose invariant for face recognition and lightening conditions using Naive Bayes Classifier and Support Vector Machine Classifier. In the first phase we performed illumination and lightening of images, we also carried out experiment with different poses of similar images in order to extract feature. In the second phase we trained our datasets using classifiers based on features we extracted earlier. After that we performed test on several images against the trained data sets. Bayes classifier provides the classes according to the trained data and when the target image is tested against source image, it shows human perception and machine perception of outcome which is same for our test cases, ensures the correct classification and face recognition. In Support Vector Machine try to classify between non faces and faces which are two classes. It successfully detects the face in very less execution time. So, we can conclude that our approach is well suited for large scale face recognition systems.

Future scope:
Implementation & integration of WSN + GIS based systems.

REFERENCES


