*IOSR Journal of VLSI and Signal Processing (IOSR-JVSP)*
*Volume 5, Issue 2, Ver. II (Mar. - Apr. 2015), PP 31-35*
*e-ISSN: 2319 – 4200, p-ISSN No. : 2319 – 4197*
*www.iosrjournals.org*

# Face Recognition Using SIFT- PCA Feature Extraction and SVM Classifier

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***Abstract:*** *Face recognition is a biometric software application that can identify a specific individual in a digital image by analyzing and comparing pattern. In the proposed approach, Here main focus on the face recognition system. It will one of the new face recognition system based on an efficient design. This paper present proposed methodology of global thresholding technique, SIFT (Scale Invariant Feature Transform),PCA(Principal Component Analysis) and SVM (Support Vector Machine) classifier. SIFT is used for extract the feature from faces. This SIFT feature will possess strong robustness to the accessory, expression, pose, illumination variations. PCA is a standard technique use for dimensionality reduction in which face data can analyze and observation can be described by several inter-correlated dependent variables. The SVM classifiers are then applied to these extracted features to classify the input images. Global thresholding technique will used for detecting the face. So this proposed system will increases the face identification rate.*
***Keywords:-****Global thresholding technique Biometric, SIFT, PCA, SVM, Face recognition.*

## I. Introduction

In the machine learning area, the auto-authorization becomes a challenging and interesting topic. To realize person specific authorization, the face recognition has attracted many researchers' attention. The face recognition is actually explained as a machine learning process where the high dimensional features of subject are received then the identity of subject must be provided. That process usually is to identify the person by classify the feature of each person. Choosing a good feature determines the efficiency of the classifiers. So how to select a distinguished and robust pattern feature from subject image should be first considered. For detecting the face global thresholding technique is used. The existed well-established face recognition algorithms include namely Eigen faces [1] and Fisher-faces [2]. Recently Scale Invariant Feature Transform (SIFT) [3] proposed by Lowe has been widely and successfully applied to object detection and recognition and it give a better performance than other two methods. Because the important factor which affects the face recognition rate includes of dealing with the faces in different view positions, lightness, accessories and expressions. SIFT feature key points possess the characteristics such as scale invariance, rotation invariance, and affine invariance and has strong robustness for the occlusion problem. So after SIFT was invented, many researchers use it for face recognitions. In this paper, we take advantage of SIFT feature due to its robustness to expression, accessory and pose variations. Also the key points in different persons' images possess distinctive features. A new face recognition system is proposed to identify the person based on the classifier which classifies the SIFT key points. We use SIFT with PCA to reduces the diamanality of data. The classifier used in the proposed system is SVM. In most classifiers, the input dimension is fixed but the number of key points extracted from different images is not the same. That means the dimension of input is different. So we classify each key point instead of integration of all key points in the image. The result of SVM is obtained by classifying each of all key points in the image. We use the identification method to recognize the person in the image according to the analysis of SVM results. The rest of paper is organized as follows. Section 2 gives the literature reviews. Proposed Global thresholding technique, SIFT, PCA and SVM based face recognition approach in Section 4. The conclusion in Section 5.

## II. Literature Review

Patrik Kamencay, Martin Breznan, Dominik Jelsovka, and Martina Zachariasova [4], proposed methodology for face recognition based on preprocessing face images using segmentation algorithm and SIFT (Scale Invariant Feature Transform) descriptor. The proposed method first was tested on ESSEX face database and next on own segmented face database using SIFT-PCA.in this paper experimental result shows that the segmentation in combination with SIFT-PCA has a positive effect for face recognition and accelerates the recognition PCA technique. The proposed approach is compared with eigenfaces and proved its superiority through experiments.

Gautam Narang, Soumya Singh and Arjun Narang[5], this paper proposed an efficient face recognition method based on Scale Invariant Feature Transform (SIFT) for feature extraction and using Levenberg-Marquardt Back propagation (LMBP) neural network for classification. In this proposed method, assign the extracted SIFT features of the face images as input vectors to our neural network instead of using just the raw data as the input. Experiments performed on Yale face database show that the facial images can be recognized by the proposed face identification method efficiently. Also, the traditional face recognition algorithms are compared with the proposed algorithm to show its effectiveness.

Tong Liu, Sung-Hoon Kim, Hyon-Soo Lee, Hyung-Ho Kim[6], This proposed system takes the advantage of SIFT feature which possess strong robustness to the expression, accessory, pose and illumination variations. One MLP (Multi Layer Perceptron) based network is adopted as classifier of SIFT key point feature. The proposed classifier classifies each key point into face ID then an ID index histogram counting method is applied as the identification method to recognize face

images. Also a bootstrapping method is investigated to select training images during training MLP. The performance of face recognition in some challenging databases is improved efficiently. Experiments on ORL and Yale face database show that the best recognition rate reaches 98% and 98.6%.The proposed method give an average recognition rate 98.6% when number of training images is round 8 that give a better performance than the others. L. C. Zhang, J. W. Chen, Y. Lu and P. Wang [7], proposed a face recognition system based on training SIFT feature by using SVM. Although the result is improved a lot, the performance is getting down when dealing with images with larger lighting variations and subject accessory problem. M. Bicego, A. Lagorio, E. Grosso and M. Tistarelli,[8] who first attempted to SIFT approach subdivided images in sub-images using a regular grad with overlapping then performed a matching between two images by computing distance of pairs of subimages. But this method is not efficient for the recognition result. The problem of automatic human face recognition can be stated as follows: given an image of a human face (test set), compare it with pre-stored models of a set of face images labeled with the person's identity (the training set), and report the matching result.In this paper proposed face recognition system which is based on four algorithm like global thresholding technique for detecting the face,SIFT-PCA for extract the feature and SVM classifier used for recognizing the face.

## III. Blok Diagram For Face Recognition System

Any face recognition systems have common steps which explained in the following block diagram[1]:

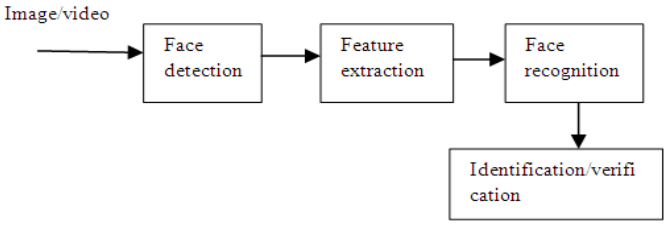



**Figure 1:** Block Diagram Of Face Recognition System

Figure1 shows the block diagram of face recognition system. In this, the first block is face detection which is the process of find the face in the database image or video sequence; we apply the PCA and SIFT on known database that contains faces only for feature extraction then make a face recognition for identification purposes by using SVM classifier.

## IV. Proposed Face Recognition System

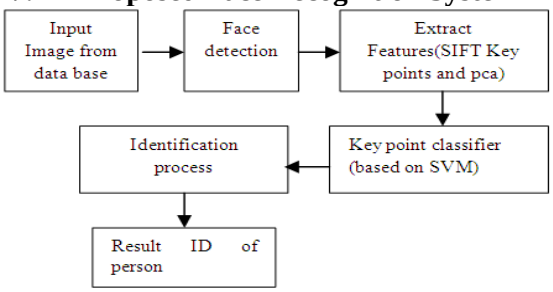



**Figure:-2** Proposed face recognition system.

The proposed face recognition system is based on the Global thresholding technique which is used to detect the face. The output of the global thresholding technique is applied to SIFT-PCA,after that SVM which uses the SIFT key points and PCA as input subject features. The outline of system is illustrated in Fig.2. Once the system gets the test image, firstly the features of image are extracted by SIFT algorithm. Then we use a SVM based classifier to classify each key point feature and finally to recognize the test image by classification results. SVM has been applied in human face recognition by many researchers recent years. It is a good tool for classification through approximating almost any regularity between input and output.

### A. Global Thresholding Technique

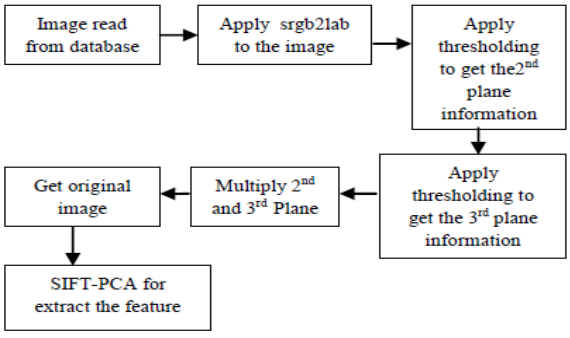



**Figure 3:** Global Thresholding Technique

This technique is used for detecting the face.

When T depends only on f (x, y) (in other words, only on gray-level values) and the value of T Solely relates to the character of pixels, this thresholding technique is called global thresholding technique.

Global thresholding technique is used for detecting the face in which input image can be taken from database this image is apply to srgb2lab.Then apply thresholding to $2^{nd}$ and $3^{rd}$ plane, multiply $2^{nd}$ and $3^{rd}$ plane we will gate the original image.

**B. Principal component analysis**

PCA also known as Karhunen-Loeve method is one of the popular methods for feature selection and dimension reduction. Recognition of human faces using PCA was first done by Turk and Pentland [9] and reconstruction of human faces was done by Kirby and Sirovich [10]. The recognition method, known as eigenface method defines a feature space which reduces the dimensionality of the original data space. This reduced data space is used for recognition. Eigen faces are based on the dimensionality reduction approach of Principal Component Analysis (PCA) [11]. The basic idea is to treat each image as a vector in a high dimensional space. Then PCA is applied to the set of images to produce a new reduced subspace that captures most of the variability between the input images. The Principal Component Vector (eigenvectors of the sample covariance matrix) is called the Eigen face. Every input image can be represented as a linear combination of these eigenfaces by projecting the image onto the new eigenfaces space. Then we can perform the identification process by matching in this reduced space. An input image is transformed into the eigenspace and the nearest face is identified using a nearest neighbor approach. Euclidean distance is used to match the input image against all images in the database. It's a statistical method that objected to reduce the dimensionality space of variables without losing of the data. PCA used in many application and from these applicant it used in face recognition, the scenario of PCA working that we get a database of faces image, build the eigenspace by putting all the image into a one large image, and the mean of every face and subtract it from large image, this step called the normalization stage. Then and the covariance matrix and calculate the eigenvalues and eigenvectors from the matrix, to choose best eigenvalues we should sort them in descending according the eigenvectors. Finally we make projection to eigenspace.

**C. Scale Invariant Feature Transform (SIFT)**

SIFT is a well-known method for object recognition devolved by David LoweS. SIFT discriminate that it invariant to image scaling and rotation, and robustness for illumination and 2D camera view point. It used in many applications mainly for object recognition. Mohammad Ali apply sift method for face recognition [12] and in 2009 Cong and Jiang apply two improvement on sift for face recognition [13]. Sift has four step to identify the feature in the image which is a vector of 128 dimension, first step search about all scale and location using difference of Gaussian function after make blurring by Gaussian filter in image this step called scale space extrema detection and in it decide if the keypoint is interest or not by search for a minimum or maximum value with 26 neighbor related for any pixel (key point). Finally find keypoint descriptor that created from local image gradients and this feature based on orientation histogram.

- **Sift-Pca**

When SIFT-PCA technique is combining it is used For extract the feature and reduces the diamanality of data. PCA is a standard technique for dimensionality reduction, which is well-suited to represent the key point patches and enables us to linearly-project high-dimensional samples into a low-dimensional feature space. In other words, PCA-SIFT use PCA instead of histogram to normalize patch gradient. The feature vector will significantly smaller than the ssstandards SIFT feature vector, and it will be used with a same matching algorithms. PCASIFT, like SIFT, also used Euclidean distance to determine whether the two vectors correspond to the same key point in different images. In PCA-SIFT, a input vector is created by concatenation of the horizontal and vertical gradient maps for the 41x41 patch centered to the key point, which has 2x39x39=3042 elements. According to PCA-SIFT, fewer components requires less storage and will be resulting to a faster matching, and choose the dimensionality of the feature space, n = 20, which results to significant space benefits [14].

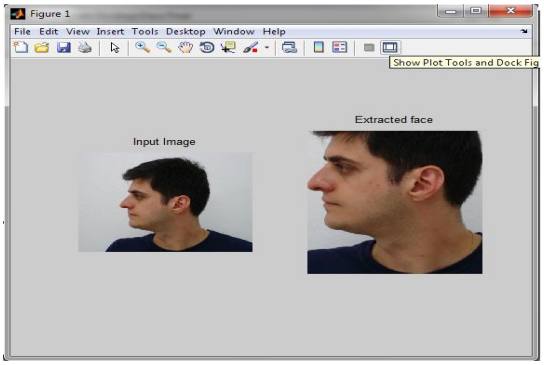
**D. Support Vector Machine**

Support Vector Machines were first introduced to sssssolve the pattern classification and regression problems by Vapnik and his colleagues. SVMs are set of related supervised learning methods used for classification and regression. They belong to a family of generalized linear classification. A special property of SVM is ,SVM simultaneously minimize the empirical classification error and maximize the geometric margin. Support Vector Machines (SVM) are one of the most useful techniques in classification problems. One clear example is face recognition. However, SVM cannot be applied when the feature vectors defining samples have missing entries. A classification algorithm that has successfully been used in this framework is the all-known Support Vector Machines (SVM) , which can be applied to the original appearance space or a subspace of it obtained after applying a feature extraction method. The advantage of SVM classifier over traditional neural network is that SVMs can achieve better generalization performance.

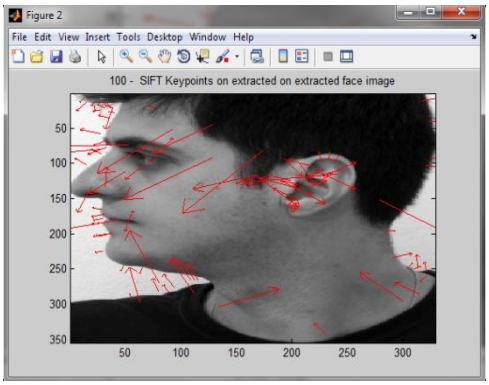
## V. Experimental Result

### 1. Collection Of Database Image

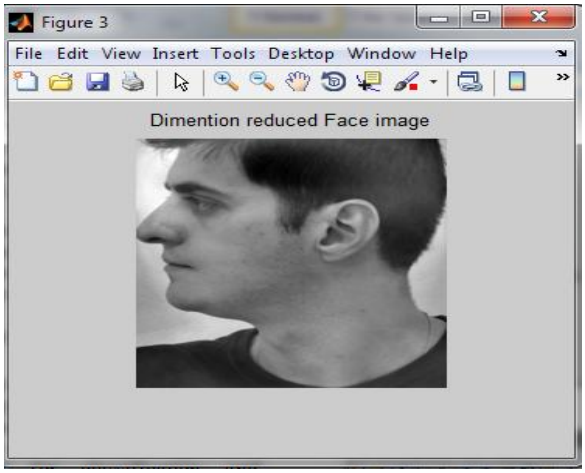
### 2. Global Thresholding Technique



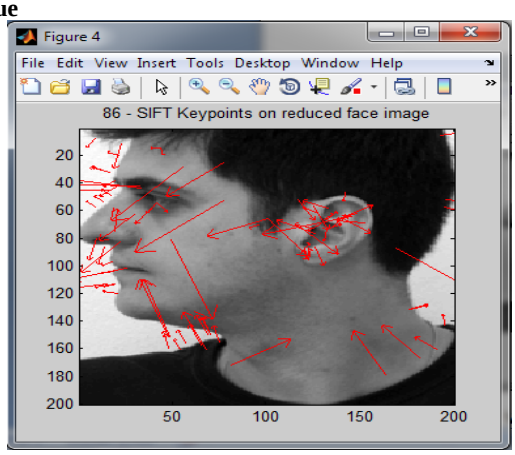

### 3. Scale Invariant Feature Transform



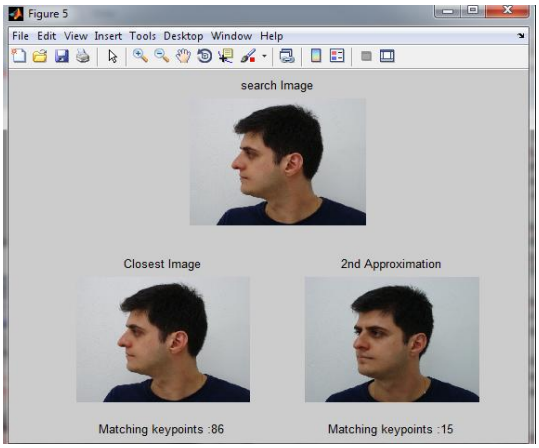

### 4. Principle Component Analysis



**5. PCA-SIFT Combined Technique**




**6. SVM Classifier**




## VI. Conclusion

The face recognition system designed in this paper combine the global thresholding technique with the SIFT key point feature and PCA, and the outperformance of the result is classified using SVM classifier for various face identification. Moreover, an efficient identification method is applied to recognize the face image according to the result of classification of each key point.

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