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Face Detection and Recognition using Support Vector Machine

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Abstract: ***Technology based on face recognition to identify the person unique identity has been seeking the attention of the people in recent era. Face recognition system has wide range of application, so it is necessary to increase its the robustness. Various techniques have been discovered to overcome various factors like scale, pose, expression and illumination in order achieve better output. But there is no technique which is efficient for various practical cases, also which may serve factors simultaneously. Illumination was the biggest challenge for the techniques when applied in real world. Face recognition system has three stages: First stage is Face detection, second is feature extraction and the last stage is classification. A proper set of feature extraction may improve the performance of the system. Our proposed solution uses Viola Jones for face detection, PCA with Multilevel Grid search method is used for facial data processing and feature extraction. Further SVM is applied on data for classification. Proposed model identifies faces more accurately with the accuracy of 85% compared to current traditional method. Experimental results are measured based on the sensitivity, specificity and precision using the lfw-deep funneled dataset.***

Index Terms: Illumination, Support Vector Machine, Viola Jones and Principal Component Analysis

I. INTRODUCTION

Various techniques are developed to detect and recognize facial feature. Some technique uses background filter to detect the faces from the given input image. Further to determine & extract the features they generate a feature vector using that to classify the faces for the recognition.

In general, human face recognition system has two phase the first is face detection and the second is face recognition. For a machine to recognize face is more difficult than to detect faces because human facial expression may change based on varying lighting condition and cannot be easily recognizable and predictable.There are two linear subspaces, PCA and LDA which are projections of low resolution of facial images [5]. PCA is a procedure based on compression on input of covariance matrix which are Eigen vectors. LDA identifies directions in space by which projection in space is maximized was proposed by fisher. LDA is not always efficient when it comes to recognition accuracy. In some facial recognition technique PCA with LDA was also applied. [6] LDA based recognition system may fail if the datasets are captured in various direction.

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Where facial images are captured from different direction and sight depths and accuracy of LDA based recognition will be reduced heavily. There are many facial recognition systems to overcome this problem on feature extraction one of them is PCA. Since facial feature selection process serves the overall accuracy of the system. Machine learning algorithm, SVM is used as an optimal classifier of the system. In this paper PCA is used of feature extraction and selection and SVM serves the fitness for the classification problem. Main advantage of SVM in the system is it is quick in case of multidimensional space and correctly classifies the vector and recognition process is faster and stable.

II. LITERATURE SURVEY

Siswanto & Adrian Rhesa Septia [1] in their research extracted features from like width of mouth, pupil and detected face using above feature also further they compared it with ROC curve and proved that eigen faces technique gives best result using that they developed attendance system. Limitation of this system is that it is not compatible with large set of images.Zhang & Hongshuai [2] proposed a face detection system using LBP feature extraction but range of this feature is on gray scale image only. Best part of this research was they used CNN which added up more accuracy to the system. But LBP has limitation with the gray scale images, so their accuracy was up to 79% only.One of the most interesting research was done by Manisha & Bhakti [3] in their paper face recognition was done using set theory , set theory was used for mostly surgical faces author also used viola jones algorithm which proves best of the research as in medical imaging this research benefited to recognize those surgical faces by matching with the original one. Limitation of this system is it works only on medical images.Li, X., & Li, D [4] a real time analyst proposed paper using fisher analysis. They used kernel technique using discriminative analysis for the feature extraction. Further they used KPCA for the classification of the faces. There by achieving the accuracy of 82%. Limitation of this system is that it is prone to error. In some real time, it may not give the correct results.

III. PROPOSED SYSTEM

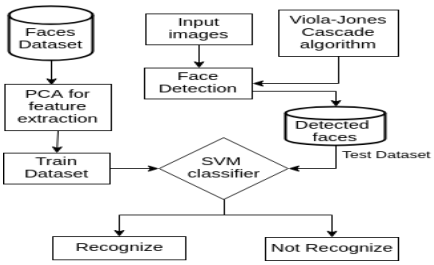

Fig. 1. **Proposed System Architecture**

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A. *Viola Jones for Face detection*

Viola-Jones algorithm should be capable of detecting all visible faces in any possible visible image. Training of objects may be slow, but detection is very fast.
Viola-Jones algorithm scan the sub window of the image and detect face images across the input images. And then fixed size detector runs through these images but first rescale the input image to different sizes. Because of the algorithm takes different size of images for calculation, the approach turns out to be time consuming. And then Viola-Jones rescale the detector despite the input image and again run the identifier ordinarily each time with alternative size through those pictures. At first one may speculate the two ways to deal with be similarly tedious, however Viola-Jones have conceived a scale invariant detector that requires a similar number of calculations no matter what size of the image are there in dataset. Some of the simple rectangular features are detected using Haar wavelet and the detector which is constructed during training phase used integral *image*.

B. *Principal Component Analysis (PCA)*

Principal Component Analysis is the method of extracting relevant features from the datasets. PCA is easy to use because it's non-parametric. PCA is used to identify the similarities and differences in the dataset. The approach transforms those face images into a small set of characteristics feature images, called "Eigen faces" (or principal components) of the initial training images. Then the original data set, and the new image are projected on the Eigen faces. Then by comparing the position of face with its known individual face space position; the face is classified.

C. *Support Vector Machine (SVM)*

SVM is generally a binary classifier or supervised learning classifier algorithm. It comes under the category of machine learning algorithm. It partitions the feature vector into two sub spaces. It is also further modifying to classify into more than two classes for real world problems. It runs basically on training data set. Error caused by the learning algorithm on test data is not used during training. When data outside the train dataset is applied to SVM, it performs well. Training samples which are difficult to classify are called as support vectors. Formulation of SVM is changed by least square value in function. This reduces the computation and complexity for classification of problem. SVM is divided into two stages. First stage is the training stage where SVM learns itself by providing training dataset to learning algorithm. During this phase SVM select suitable boundary for the classes. And other stage is the testing stage. Main advantage of SVM classifier is that it works well in high dimensional feature space and it gives more accurate results.

IV. EXPERIMENTAL RESULTS

To demonstrate the performance of proposed face recognition system, scheme several performance measures like accuracy, specificity and sensitivity are used. Here we are using faces dataset containing 250 x 250 images Input Image and finally recognized face are shown in Fig. 2 and Fig. 3 respectively.

Fig. 2. Input Images

Fig. 3. Recognized Face Image

V. PERFORMANCE MEASURES

Performance measures like precision, recall and F1-score are measured from confusion matrix show in Table 1, and by using Eq 1, 2 and 3 respectively.

A. *Confusion Matrix*

It is used to describe the performance of a classification model on true value of test data

TABLE 1. Confusion Matrix [7]

Predicted by Classifier	Actual Conditions from Ground Truth		Total
Positive	TP	FP	TP+FP
Negative	FN	TN	FN+TN
Total	TP+FN	FP+TN	TP+FP+FN+TN

B. *Precision*

Precision is ratio of how many times actual face was recognized, that is actual positive. Simply precision is "how useful the search results are".

$$\text{Precision} = \frac{TP}{TP+FP} \tag{1}$$

C. *Recall*

Recall is ratio of how many times the person shown in the photos was incorrectly recognized. Simply recall is "how complete the results are".

$$\text{Recall} = \frac{TP}{TP+FN} \tag{2}$$

D. *F1-score*

F1-score is needed When we want a balance between Precision and Recall.

$$F1 = 2 * \frac{\text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}} \tag{3}$$

Table 2 shows the F1 score of the proposed system, which clearly shows the proposed system gives the best results compared to the existing one.

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TABLE 2. Performance Matrix

Images	Proposed System		
	Micro avg.	Macro avg.	Weighted avg.
Precision	0.86	0.86	0.86
Recall	0.90	0.74	0.8
F1-score	**0.87**	**0.86**	**0.85**

TABLE 3. Comparison with existing system

System	Accuracy
Proposed	85 %
Zhang & Hongshuai [2]	73%

VI. CONCLUSION

Viola Jones algorithm is used for face detection which is much faster than other existing approaches and minimizes computation time while achieving high accuracy. Also, PCA used for classification of the images servers the best results with the accuracy of 85%. From Table 3 we can conclude that our system gives the best accuracy compared to the existing systems. Better recognition accuracy and less computational cost achieved in proposed system.

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