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# A Hybrid approach for the Detection and Recognition of Faces with PCA & Enhanced K-Mean Clustering in facial image Database

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**Abstract—**Biometrics is one of the fastest growing areas because of need of high security. The basic recognition that is employed in biometrics is unique characteristics of human so that they can be differentiated easily. Uniqueness in traits of humans have lead to hike in popularity of these biometric systems in all parts of the world. The features that are used in biometric systems are fingerprints, eye retina, voice or either facial features. Face recognition is one of reliable biometric system that captures and recognizes facial features of an individual. Face recognition is said to be reliable biometric system because of differences in human facial features. Many techniques like PCA, Linear Discriminant Analysis and Support Vector Machine etc have been used conventionally for face recognition. The need is to improve the speed and the accuracy of the technique employed for recognizing face. In this paper, a hybrid approach has been proposed for the face recognition. Along with PCA, K-mean clustering is used for generating efficient and accurate results. From the results obtained it is concluded that the accuracy of this proposed system is more than the traditional face recognition system. A comparison is performed that show that the error of this system is less. Also the processing time less.

**Keywords—** Face recognition, PCA, K-mean clustering, Biometeric system

## INTRODUCTION

Biometrics is mechanized strategies for perceiving a man in view of a physiological or behavioral trademark. The past of biometrics incorporates the distinguishing proof of individuals by particular body elements, marks or some unique features that distinguish them from other individuals like height, skin color or texture, retina, voice etc [1]. The present components are face acknowledgment, fingerprints, penmanship, hand geometry, iris, vein, voice and retinal output. Biometric procedure is presently turning into the establishment of a wide exhibit of exceedingly secure ID and individual confirmation. The need to increase the level of security rupture and exchange trick builds, the requirement for well secure recognizable proof and individual confirmation innovations is getting to be obvious. Late world occasions had lead to an expansion enthusiasm for security that will incite biometrics into larger part utilize. Territories of future use contain Internet exchanges, accessing systems, telephone exchanges and tourist industry. There have diverse sorts of biometrics: Some are old or others are most recent innovation. Biometric systems use fingerprint, facial features, eye retina, voice, signatures, hand geometry as the matching features for distinguishing individuals and the advancements in the field are still taking place [1].

Face recognition is one of the applications of biometrics that differentiates an individual from others [2]. By analyzing and comparing two images and then extracting and matching the features of both the images, face recognition can be done and this application of biometrics is used widely and primarily for security reasons [3].

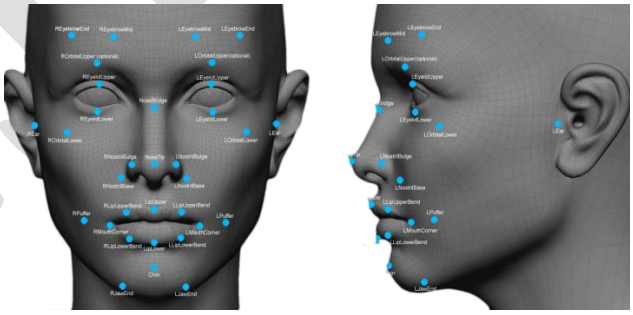

Fig 1 Face recognition process.

Face identification and acknowledgment are assuming an essential part in our present society, because of their utilization for an extensive variety of uses, for example, observation, banking and mixed media gear as cameras and computer game consoles [4] which are only some of the examples from its wide applications. Face recognition is a particular instance of article class discovery, which principle undertaking is to discover the position and size of items in a picture having a place with a given class. Face recognition

calculations were firstly engaged in the location of frontal human appearances, yet these days they endeavor to be more broad attempting to tackle face multi-view identification: in-plane revolution and out-of-plane turn. Be that as it may, face recognition is still an exceptionally troublesome test because of the high variability in size, shape, shading and composition of human appearances. By and large, confront discovery calculations execute face location as a parallel example order assignment. That implies, that given an information picture, it is separated in pieces and every square is changed into an element. Highlights from class face and non face are utilized to prepare a specific classifier. At that point given another info picture, the classifier will have the capacity to choose if the specimen is a face or not .Face recognition can also be used to detect faces in image or videos and it can be used for recognizing criminals too [5]. Many techniques are used for face recognition like PCA i.e. Principal Component Analysis, LDA, SVM i.e. Support Vector Machine, LBP i.e. Linear Binary Patterns, ICA, Gabor wavelet etc. [2]. The prime need of the face recognition technique is reliability and accuracy and that is what have been improved in each new developed technique.

## TECHNIQUES FOR FACE RECOGNITION

Various techniques have been used till date for extracting the features from an image for face recognition. Some of the techniques have been described below:

i. **Principal Component Analysis**: PCA is the earliest method that was used for face recognition. Recognition is done by reducing the original data space by using feature space. The drawback of the PCA technique for face recognition is high computation and low discriminating power which was then overcome using LDA technique [6].

ii. **Linear Discriminant Analysis:** LDA finds most of its applications in appearance based methods. It is considered to be an efficient and qualitative algorithm for selection of features in the applications it is being employed. But whenever LDA is applied, it is applied together with PCA. The dimensions are reduced using PCA and the problem of low power is overcome by LDA as it maximizes power. The demerit of LDA is that it is inefficient in extracting features [7].

iii. **Support Vector Machine**: This algorithm finds its uses in classification problems such as face recognition [8]. This algorithm cannot be applied for extracting features when entries are missing from any sample. This method is considered better than neural networks because it performs better than those networks and generates much efficient and better results than conventional ANN systems [8].

iv. **Independent Component Analysis**: ICA is a strategy for finding hidden variables or segments from multivariate (multidimensional) measurable information. There is have to actualize face acknowledgment framework utilizing ICA for facial pictures having face introductions and diverse light conditions, which will give better results as contrasted and existing frameworks. The advantage of using ICA method for face recognition is that it not only considers non Gaussian components but also takes into account statistically independent components [8].

v. **Gabor Wavelet**: Gabor wavelet when used along with ICA method extracts enhanced features for face recognition. The features that are extracted using Gabor wavelet approach are considered to be the best features that could be extracted for face recognition [9].

vi. **Artificial Neural Networks**: Artificial Neural networks have been used in face recognition because of their simplicity. This method of face recognition is capable of matching patterns after obtaining training. These neural networks are intelligent systems that generate output on the basis of training provided to these at the beginning [10]. These are useful in classification problems.

vii. **Local Binary Patter**n: LBP technique was developed with the prime purpose of texture description [4]. It's invariant to monotonic dark scale changes which are fundamental for surface depiction and investigation for the reason of computational effortlessness handling of picture continuously is conceivable. With LBP it's conceivable to clarify the composition and model of an electronic computerized picture. This is finished by isolating a photo into a few little areas from which the components are extricated. These components contain paired examples that portray the natural surroundings of pixels in the locales. The elements that are framed from the areas are connected into a solitary element histogram, which depicts to shapes a representation of the picture. Pictures will then be thought about by measuring the similitude (separation) between their histograms. Concurring various studies face acknowledgment using the LBP technique gives positive results, both with respect to speed and segregation execution. Because of the way the surface and model of pictures is portrayed, the strategy is clearly entirely hearty against face pictures with various outward appearances, changed helping conditions, maturing of persons and picture pivot. Facial representation in view of Local Binary Pattern (LBP) highlights for individual autonomous outward appearance acknowledgment. LBP elements were proposed initially for composition investigation, and as of late have now been acquainted with speak to faces

in facial pictures examination. The most pivotal properties of LBP elements are their resistance against light changes and its simple computation [11].

viii. **Compound Local Binary Pattern**: An augmentation of the first LBP administrator that allots a 2P-bit code to the middle pixel taking into account the dark estimations of a nearby neighborhood containing P neighbors. Not at all like the LBP that utilizes one piece for every neighbor to express just the indication of the contrast between the middle and the relating neighbor dark values, the CBLP strategy utilizes two bits for every neighbor keeping in mind the end goal to speak to the sign and additionally the size data of the distinction between the inside and the neighbor dim qualities. Here, the principal bit speaks about the difference between the value of middle bit and the value of its neighbor pixel. The CLBP administrator sets this bit to 1 if the greatness of the contrast between the middle and the comparing neighbor is more noteworthy than the edge Message Otherwise, it is set to 0. Message is considered as reference value and the bit is set to 1 if the difference between the middle and its neighbor comes out to be higher than the reference value and 0 if vice versa [12].

## PROBLEM FORMULATION

Face is our primary focus of attention in social intercourses. It plays an important role in providing human identity. Face recognition is a section of pattern recognition in which human visual perception is saved in computer. This approach is much popular in many of the fields the main and the important one is recognition or can say as the security or authentication purpose. Many researchers are working on this field from many of the years, many algorithms and techniques are developed to update the traditional systems the common these days are PCA, LDA, and Gabor etc. But these approaches individually are not that much efficient in some of the cases, so the mixing of the algorithms are done as an example if PCA approach is used it will provide better results for small datasets. So to overcome these disadvantages the continuous research is processed to get better results. There is one issue too if the algorithms are getting advanced the fake parties are also able to make the algorithm crack able. So there is need to develop an algorithm which will work as advanced and modified approach to make classification that much complex that will not be easy to crack up to an extent, so a study gives an proposed work for thesis in field of classification or security.

## PROPOSED WORK

In which the main approach will be to extract the features with the PCA and k-mean clustering techniques and the systems as this is much better approach to work with as per literature and more successful for large dataset. After combining feature extraction of both techniques. Finally the classification will be done and the performance will be evaluated.

## METHODOLOGY

In this a new method for face recognition is proposed .this method is proven to be better than the traditional methods. The methodology if the proposed work is defined below.

1) Initially selection of the images is done for creating the data base. So that further this set is used for the classification.
2) After creating the data base, next step is to extract the features is done; these features are used for matching purpose.
3) In this step the features that are extracted are collaborated by using the hybrid approach. As these features are used for the detection purpose.
4) Now a data set for the classification of the features is created, after the features are collaborated by using an hybrid approach.
5) In this step the testing images are browsed, the features are extracted from the selected images these features are then matched with the features of image that are extracted earlier and the difference is calculated.
6) Finally the calculation of the various parameters that are obtained is done the results calculated will depict the accuracy of the system. The proposed system is more accurate than the traditional systems.

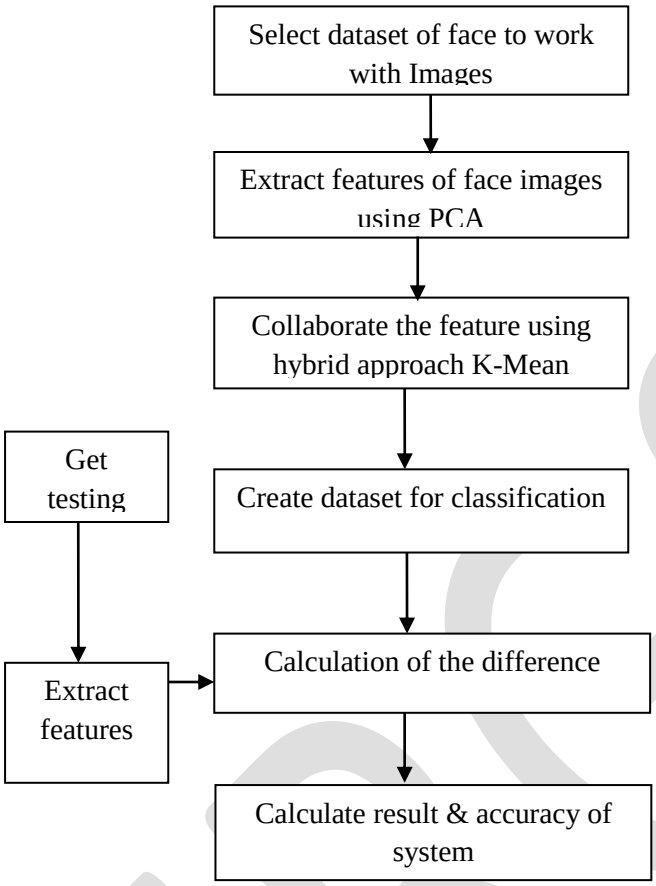


Fig 2. Flow diagram of the proposed approach

## RESULTS AND ANALYSIS

The technique proposed in paper for face recognition is K-mean clustering is combined with PCA and named as hybrid system, for obtaining better results. The accuracy of the proposed technique is better than the conventional algorithm used for face recognition. The results for accuracy of the proposed technique are shown below:

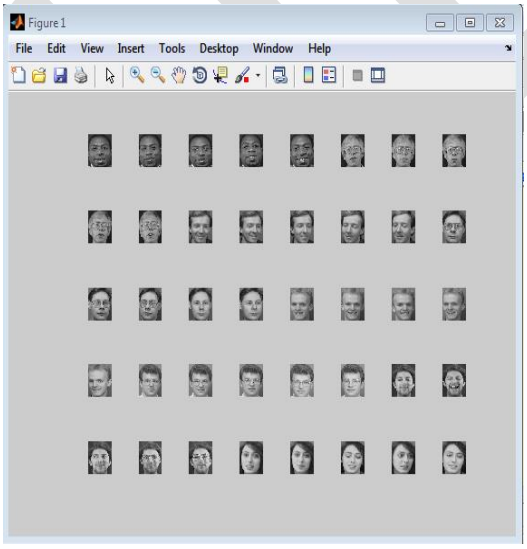


Fig 3 Training images

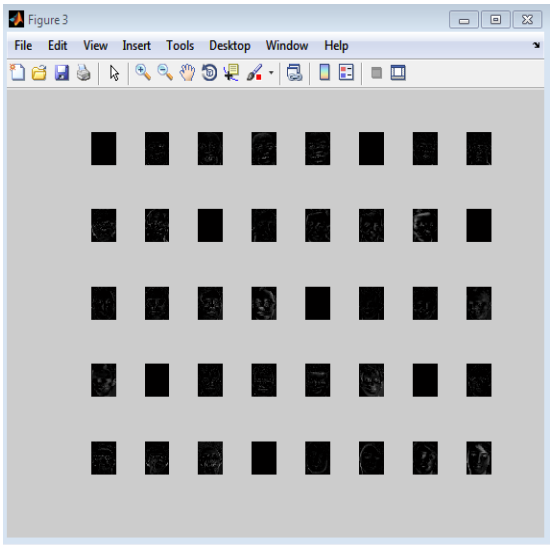


Fig 4 Applying PCA on the training images

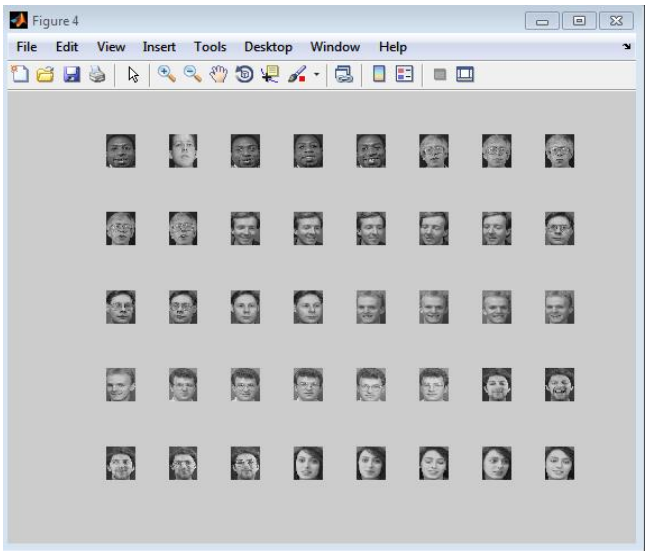


Fig 5 Testing images

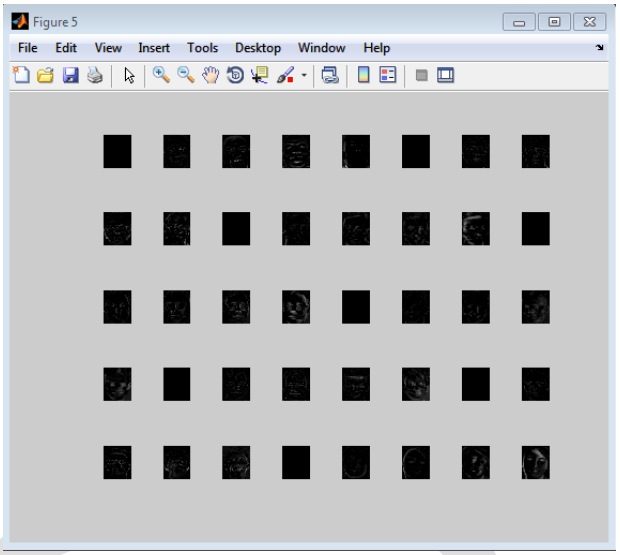


Fig 6 Applying PCA on testing images

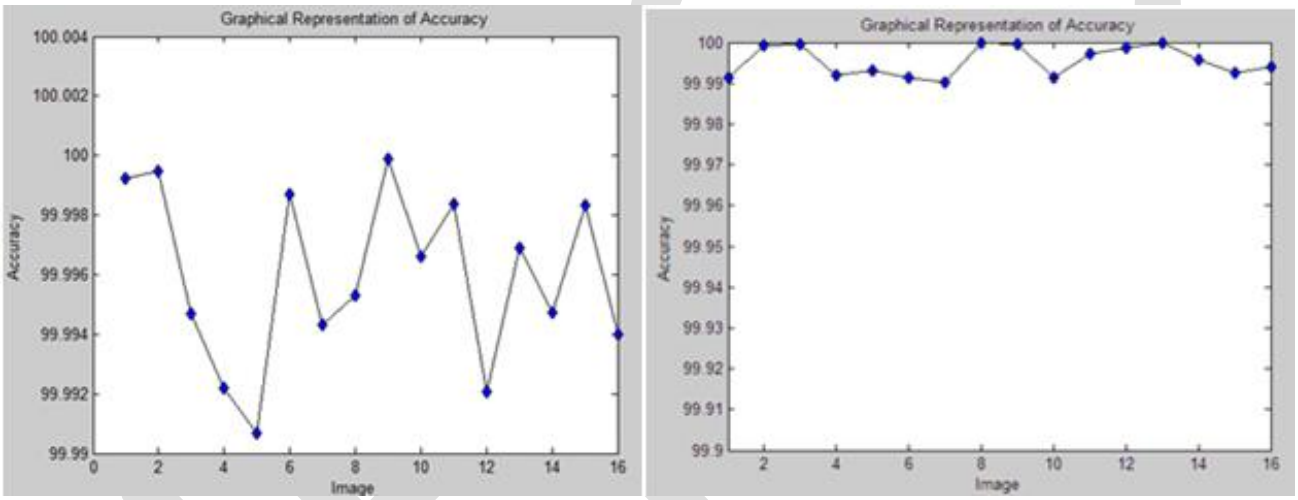


Fig 7 The accuracy of the proposed technique i.e. PCA with K-Mean Clustering

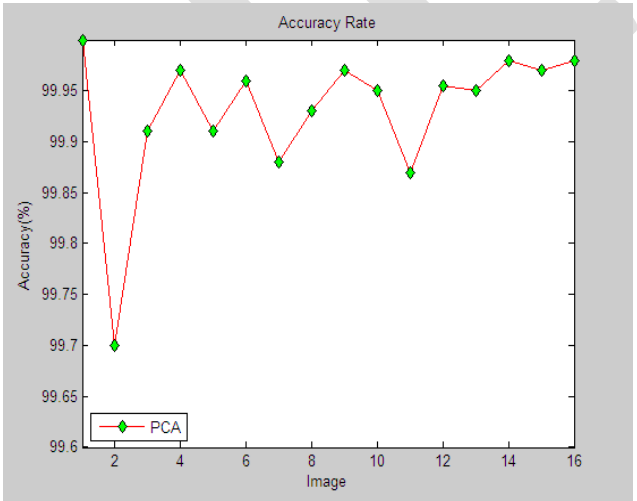


Fig 8. The accuracy representation of the PCA algorithm alone.

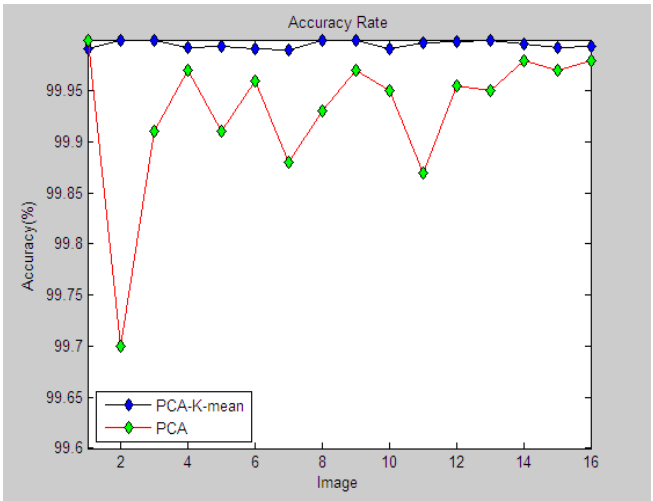


Fig 9 The comparison of accuracy rate of the proposed and individual PCA technique

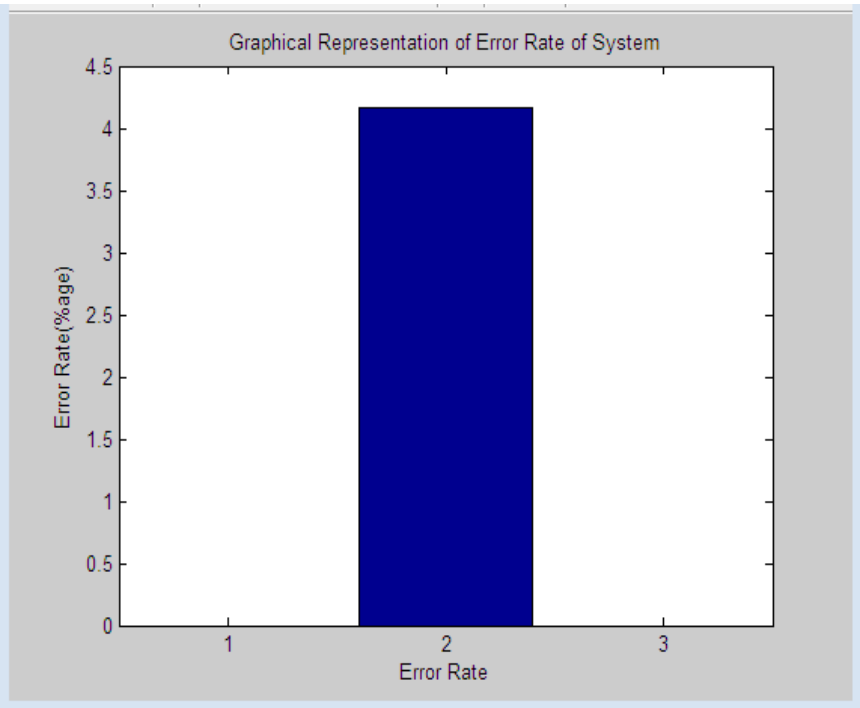


Fig 10 Error-rate of proposed technique

| Total No. of Images | Variation in images | Accuracy | Error-rate |
|---|---|---|---|
| **16** | 1 | 99.99% | 1.4% |
| **16** | 3 | 99.96% | 4.2% |
| **16** | 5 | 89% | 6.9% |
| **20** | 3 | 99.97% | 3.3% |
| **20** | 5 | 88.9% | 5.5% |
| **30** | 3 | 99.98% | 2.3% |
| **30** | 7 | 89% | 5% |
| **40** | 3 | 99.9% | 1.7% |
| **40** | 1 | 99.99% | 0.5% |

Fig 11 Accuracy, Error-rate Table

## CONCLUSION AND FUTURE SCOPE

Face recognition system is one of the widely used biometric systems that is used for the identification In this paper the hybrid system is designed for the face recognition .In this PCA and k-mean clustering approach is used for the designing the system . From the results obtained it is concluded that the processing time and accuracy of the system is more as compared to the traditional approaches.

The accuracy rate of the hybrid system is high as compared to the traditional systems. So this system is considered to be better and efficient.

In future the enhancement can be done by using the trending techniques for the feature extraction so that the accuracy of the system can be increased as the detection is done precisely.

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