ABSTRACT
Biometrics is used to establish personal authenticity and to detect impostors. The present circumstances around us demand increased level of security and so its importance is growing in the present scenario of global security concern. Development of biometric system for personal identification fulfills the requirements for access control of secured areas and other applications like identity validation for social welfare, crime detection, ATM access, computer security etc. These requirements are felt to be the need of the day. There are several biometric techniques. These may be based on characteristics like fingerprint, iris etc. or on traits like voice dynamics, gait etc. Face Recognition is also an important part of today’s emerging biometrics. In this paper we are trying to do a comparative study of various techniques and propose a new system which gives a better performance. The new technique, called the Combo approach is designed by using the already existing PCA and DCT techniques for facial recognition.

1. INTRODUCTION
In present scenario of global security concern, biometrics is used to establish the identity of a person. Biometric signatures cannot be stolen, forgotten, lost or communicated to another. But this is possible in the case of authentication employing cards, keys or passwords. There are many robust biometric techniques which are based on physiological characteristics like fingerprint, iris and behavioral traits like voice dynamics etc.

Humans have always had the innate ability to recognize and distinguish between faces, yet computers only recently have shown the same ability. In the mid 1960s, scientists began working on using the computer to recognize human faces. Since then, facial recognition software has come a long way. This resulted in the development of successful algorithms in the field of face recognition. Face identification from a single image is a challenging task because of variable factors like alterations in scale, location, pose, facial expression, lighting condition and overall appearance of the face. In the past, facial recognition software has relied on a 2D image to compare or identify another 2D image from the database. To be effective and accurate, the image captured needed to be of a face that was looking almost directly at the camera, with little variance of light or facial expression from the image in the database. This created quite a problem. In most instances the images were not taken in a controlled environment. Even the smallest changes in light or orientation could reduce the effectiveness of the system, so they couldn't be matched to any face in the database, leading to a high rate of failure.

1.1 FACE RECOGNITION
Face recognition is the ability to recognize people by their facial characteristics. Using the technique of face recognition users can be granted secure access to their computer, mobile devices, simply by looking into their web camera. Why go for face recognition? In many applications like surveillance and monitoring, say of a public place, the traditional biometric techniques will fail as for obvious reasons we can not ask everyone to come and put his/her thumb on a slide or something similar. So we need a system which is similar to the human eye in some sense to identify a person. To cater to this need and using the observations of human psychophysics, face recognition as a field emerged. In short, we can say that facial recognition is

- More suitable at public places
- Doesn't require physical interaction
- It allows passive Identification in one to many environment
- It doesn't require expert to interpret the comparison

1.2. THE FACE
Your face is an important part of who you are and how people identify you. If you look in the mirror, you can see that your face has certain distinguishable landmarks. These are the peaks and valleys that make up the different facial features. These are called nodal points. There are about 80 nodal points on a human face. Here are a few of the nodal points that are measured by the software:

- Distance between eyes
- Width of nose
- Depth of eye sockets
- Cheekbones
1.3 THE GALLERY (OR ENROLLED) IMAGE DATA
The gallery is the set of biometric templates against which any verification or identification task is done. In order to create the gallery, images of each individual’s face needs to be enrolled by the FRS. Enrollment into the system means that images have to go through the first three steps of the recognition process outlined above (i.e., face detection, normalization and feature extraction). This will then create a biometric template—stored in the gallery—against which probe images will be compared.

1.4 THE PROBE IMAGE DATA
The similarity of collection conditions of the probe image to the gallery and developmental images can make a significant difference in the performance of all FRS. Image captured must be of “good quality” i.e. under expected conditions. Otherwise, the face and necessary landmarks, such as the eyes, cannot be located. Without the accurate location of landmarks, normalization will be unsuccessful, which will affect the performance of FRS. The expected conditions are:-

- In one in which the subject is looking directly at the camera
- Has appropriate brightness and contrast
- Shows eyes open and clearly visible
- Shows subject facing square onto camera
- Has a plain light-colored background
- Has uniform lighting showing no shadows.

2. FACIAL RECOGNITION SYSTEM
Facial Recognition System is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source. The computer can distinguish the same person with different appearances; for example, with or without glasses, change of hair style and seasonal skin color changes.

2.1 STEPS INVOLVED IN FACE RECOGNITION
A series of steps to verify the identity of an individual are:

Detection
Acquiring an image can be accomplished by digitally scanning an existing photograph (2D) or by using a video image to acquire a live picture of a subject (3D).

Alignment
Once it detects a face, the system determines the head's position, size and pose. The subject has the potential to be recognized up to 90 degrees, while with 2D, the head must be turned at least 35 degrees toward the camera.

Measurement
The system then measures the curves of the face on a sub-millimeter (or microwave) scale and creates a template.

Representation
The system translates the template into a unique code. This coding gives each template a set of numbers to represent the features on a subject's face.

2.2 USES OF FACERECOGNITION SYSTEMS
1. These systems have been used by the government and defense agencies for security.
2. To eliminate voter fraud.
3. Such systems are being now used in banks.
4. These are also being used for ATM security.
5. Passport and visa verification can also be done using face recognition technology.
6. Driving license verification can also be done.

3. PCA-BASED APPROACH
PCA, commonly referred to as the use of eigenfaces, is the technique pioneered by Kirby and Sirivich in 1988. Face detection is carried out from the captured images and then eigenface are computed. A set of weightages is obtained for projecting a facial image on the face space. Recognition is based on the distance of set of weightages of the projected query face from the distances of set of weightages of the projected reference faces.

Face detection is carried out from a given image. Discrete cosine transform of face image is computed. The recognition is based on the distance of the DCT code of the query face from the reference DCT codes in the database. DCT-based face recognition software was unable to extract the correct face to be the best match in few cases. Thus, DCT implementation alone was unsuitable for access control application.

![Sample face and DCT plot](image)

Fig 5.1 Sample face The corresponding DCT plot from database[1]
The advantage of DCT is that it is not much affected by background, lighting conditions, camera distance, and the size and orientation of the head in most cases. But it does not perform well if time elapsed between the images to be compared is more.

5. THE PROPOSED APPROACH - COMBO APPROACH
Combo approach is based on PCA followed by DCT. The steps involved are:
1. The facial image is grabbed and its location is detected and normalized.
2. A facial template, comprising of eyes, nose, mouth, is selected. This template is stored in the reference database.
3. PCA analysis is then carried out. A set of weightages for all the registered users are calculated and stored.
4. DCT codes are also extracted from the facial image and stored in the database.
5. Query image is grabbed and then it is normalized w.r.t size and illumination.
6. The PCA and DCT signatures are extracted. Using these signatures, matching is carried out against the reference database.

4. DCT-BASED APPROACH
By combining the two techniques, our recognition system has an advantage over other systems.

- It is relatively insensitive to changes in expression, including blinking, frowning, or smiling.
- Has the ability to compensate for moustache or beard growth and the appearance of eyeglasses.
- The system is also uniform with respect to race and gender.

However, it is not a perfect system as it has some disadvantages. There are some factors that could get in the way of recognition, including:

- Wearing sunglasses or glares.
- Long hair obscuring the central part of the face.
- Lack of resolution (image was taken too far away).

**CONCLUSION**

Various approaches for facial recognition were analyzed by calculating the ratio of cases where best match is correct match to the total attempts. It was observed that combining two facial recognition techniques improved the recognition rate. When we combine PCA and DCT methods in combo approach, the recognition rate improves.

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