# Facial Credential Validation and Real-time Motion Detection through Principle Component Analysis (PCA)

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**Abstract -***Face recognition is a novel technique to analyze the human facial genitalia as an input digital image and is a fundamental part of any face processing system. Numerous algorithms used for human facial recognition and location detection of an individual. The objective of this paper is to provide a methodology for facial recognition and location tracking in real time environment with use of open source OpenCV platform through which the system will recognize facial credentials and will locate them using Principle Component Analysis(PCA) algorithm.*

*Keywords- Face Recognition, Location Detection, OpenCV, Principle Component Analysis (PCA).*

## 1. INTRODUCTION

Face recognition is a technology based on determining the dimensions and sizes of human faces. It focuses on detecting the facial features and tends to give less priority to the surrounding for better recognition. Human face recognition and location detection is currently an active research area in the computer technology sector specializing on how to recognize faces within images or videos and detecting the location of the individual. Location detection of faces is a prerequisite for face recognition. Facial detection and localization are common applications used in face recognition, image database management and video surveillance. Prior step of face recognition involves face detection of the individual which is also a big challenge.
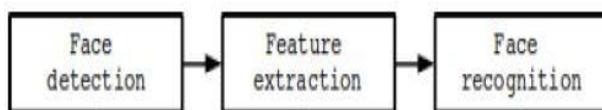


Fig1: Face recognition system

The challenge in face recognition is that of a chance of high uncertainty due to certain external light conditions, and the color features of the human faces. Therefore to avoid the problem, grayscale image, which are less affected by the external environment changes will be used.

OpenCV (Open Source Computer Vision Library),is a library of programming functions which mainly has a goal of real time computer vision. The application of OpenCV contains the 2-dimensional and 3-dimensional feature extractions, facial recognition system, human computer interaction, mobile robotics, etc.

The face recognition system's input is an image or video stream. The output is the recognition of a person's image or video in which he/she appeared. Face recognition requires three steps as shown in fig.1.

Hence, the face detection and extraction phases must run simultaneously to recognize the human face.

## 2. EXISTING SYSTEM

The current existing systems have an approach for 3D face recognition which involves size variation that makes use of a purely curvature-based representation. They can handle size change between faces, but run into problems with change in facial expressions when comparing between captured image and the stored reference image. This is one of the major drawbacks of existing systems. Face recognition is done in 2 dimensional (2D) and 3 dimensional (3D) algorithms. The main problem in experimental validation and comparison of 3D face recognition is lack of appropriate datasets.

Certain desirable properties of such dataset include:

1. A large number and demographic variety of people represented.

2. Images of a given person taken at repeated intervals of time.

3. Images of a given person that represent substantial variation in facial expression.

4. High spatial resolution, for example, depth resolution of 0.1 mm or better.

5. Low frequency of sensor-specific artifacts in the data.

## 3. LITERATURE SURVEY

Authors in [1] mainly address the building of face recognition system by using Principal Component Analysis (PCA). PCA is a statistical approach used for reducing the number of variables in face recognition. In PCA, every image in the training set is represented as a linear

combination of weighted eigenvectors called Eigen faces. Recognition is performed by projecting a test image onto the subspace spanned by the Eigen faces and then classification is done by measuring minimum Euclidean distance.

System proposed in [2] provides a panoramic and critical survey of various face detection algorithms. The algorithms presented the said article are categorized as either feature-based or image-based and are discussed in terms of their technical approach and performance. Due to the lack of standard testing process, a comprehensive and comparative evaluation is not provided, but in cases where results are reported on common datasets, comparisons are presented.

System proposed in [3] presents a comparative study of three most recently methods for face recognition. One of the approach is eigenface, fisherfaces and other one is the elastic bunch graph matching

System proposed in [4] tries to implement an AFR system based on Eigen face method where noise filtering is also added. It also provides comparative study between systems and tries to explain some pre-processing difficulties (illumination, pose variation, image quality etc.) and its explanation for face recognition system.

System proposed in [5] performs location detection with the help of mobile stations. The mobile station measures signal strength of each of a set of signals associated with the mobile station, then determines whether a number of signals in the set is less than a predetermined threshold. Based on the determination, the mobile station calculates a difference in power between a first and second signal associated with the mobile station. Thereafter, power on a channel corresponding to the mobile station is increased for a predetermined number of frames based on the calculation. The location of the mobile station is determined during the power increase.

The proposed system in [6] is based on performing real-time position detection and motion tracking of mobile communications devices moving about in a defined space comprised of a plurality of locales is provided. A plurality of access points is disposed about the space to provide an interface between mobile devices and a network having functionality and data available or accessible there from. Knowledge of adjacency of locales may be used to better determine the location of the mobile device as it transitions between locales and feedback may be provided to monitor the status and configuration of the access points.

The system in [7] proposes a technique to give a high percentage of face detection based on correlation and post-processing. The first module concentrates on the approach used in solving this problem, namely: correlation, false/repeated hits removal techniques, color segmentation and multi-resolution approach. The second module includes the actual implementation, where results will be obtained after performing the algorithm on training images.

## 4. FACE RECOGNITION

Human face images captured are represented as high-dimensional pixel arrays, but often belong to a lower dimension. In statistical approach, each image is represented in terms of the features. So, it's viewed as a point or a vector in a d-dimensional space. The dimensionality number of coordinates needed to specify a data point of this data is too high. Therefore, the goal is to choose and apply the right statistical tool for extraction and analyze. Therefore, it would be able to make it a defined line, curve, plane or hyper plane that classifies faces belonging. Many of these statistical tools are not used alone. They are modified or extended by researchers in order to get better outputs and results. Some of them are embedded into higher systems, or they are a part of a recognition algorithm. Our system will be using PCA algorithm to perform face recognition.
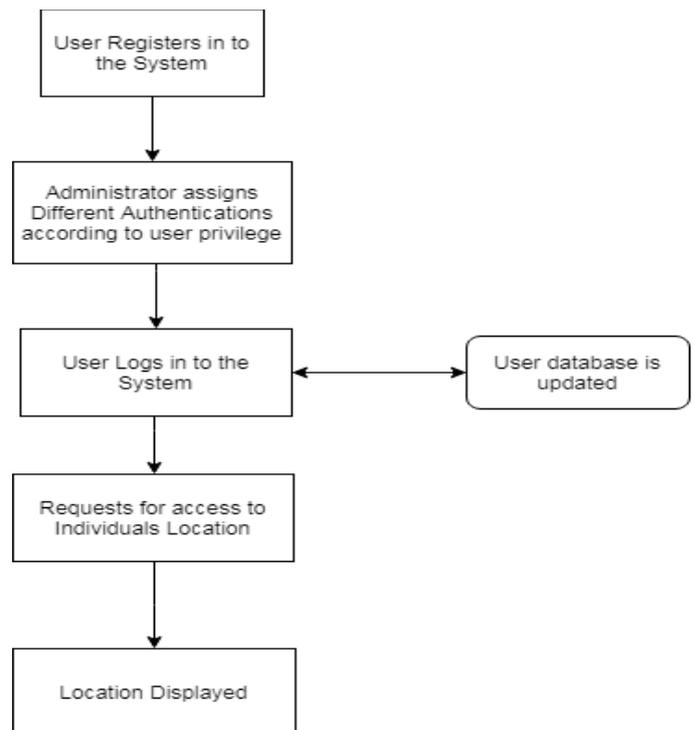


Fig 2: Block Diagram for the proposed system

The PCA method is an improvement of the Eigenface method for the dimensionality reduction. It maximizes the ratio of between-class scatter to that of within-class scatter, and works for the purpose of Variance. The PCA is especially useful when facial images have large variations in facial structures and expression. It is able to take advantage of information, minimizingleast square reconstruction error.

## 5. METHODOLOGY

Step 1: Login and Registration

This step is also known as the authorization phase. In this step, the user must log in to the system or register himself if he is a new user by using their email. Their credentials are stored in the database and after that they are grant the access to view location of the particular individual.

Step 2: Image Processing (Comparison) and use of PCA algorithm

In this step, the portable system with Android Operating System including OpenCV library, USB and serial port performs the image processing. Using a USB camera interface, continuous images are captured by segmenting the live video into frames and these images are processed with help of OpenCV and compared with existing database. If the current images are matching with any of the existing images, the system generates command to the Step 3.

Step3: Location Detection

In step 3, we will perform the location identification using GPS and forward the necessary individual using GPRS to administrator for updating the new location in the database. Thus, the current location of the individual is displayed to the user as shown in fig.2
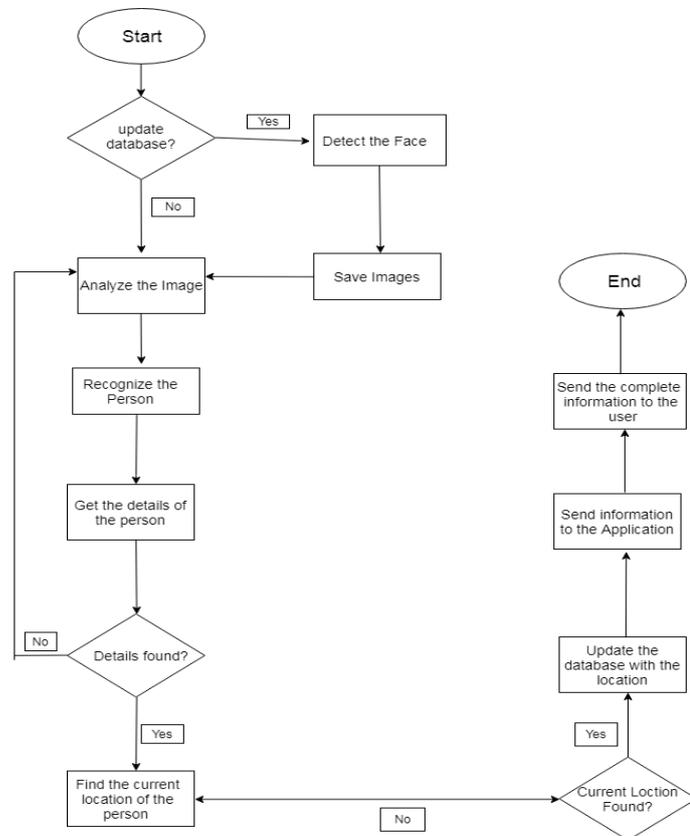


Fig 3: Implementation flowchart of the proposed System

Algorithmic Description:

The PCA algorithm we are going to implement:

- PCA steps: transform an $N \times d$ matrix $X$ into an $N \times m$ matrix $Y$:

- Centralized the data (subtract the mean).

- Calculate the $d \times d$ covariance matrix: $C = 1\ N{-}1\ X^T X$ (different notation from tutorial!!!) o $C_{i,j} = 1\ N{-}1\ X_{q,i} . X_{q,j} N q{=}1$ o $C_{i,i}$ (diagonal) is the variance of variable i. o $C_{i,j}$ (off-diagonal) is the covariance between variables i and j.

- Calculate the eigenvectors of the covariance matrix (orthonormal).

- Select m eigenvectors that correspond to the largest m eigenvalues to be the new basis.

## 6. CONCLUSION

Different methods and algorithms of face detection

have been reviewed in this paper. We should choose the face recognition methods based on the applications demands and need to make the system more efficient. The search to find and make a universal efficient method for the application is still going on. The proposed system will help and create an impact at both local and global levels if according modifications are made to the system. Further the system can be modified by using the concept of Artificial Intelligence, Machine Learning etc., will be able to enhance the system. At a local level, the system can be used for schools, colleges in order to locate the teacher's/student's whereabouts. At a global level, the system can be used to find and track the location of a missing person, which will also be helpful for the police. It can also be used in banks, transport sector, hotels, corporate offices and it can make security and its purposes more defined and systematic.

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