Pose Invariant Face Recognition and Tracking for Human Identification

Chen Cui, Binu M Nair, Yakov Diskin

Advisor: Dr. Vijayan Asari

Research objective: To improve face recognition accuracy for variations in face pose, lighting direction, and facial expression by developing an efficient real-time face recognition algorithm based on a Modular Principal Component Analysis approach.

Introduction

Identification of humans using faces is a challenging task as the facial features of an individual are prone to changes due to illumination, facial expression, head orientation and head pose.

The system can be divided into three major parts:

- Multi-view face detection using 'Haar' Cascades
- Face recognition using weighted modular PCA
- Multiple Face Kalman Tracker.

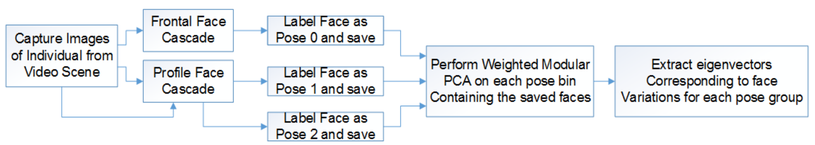

Figure 1- Training Phase

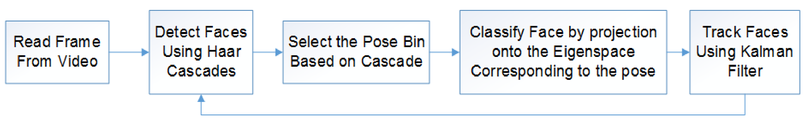

Figure 2- Testing Phase

Principal Component Analysis Training

- Functions by extracting distinguishing features based on the mean image of the data set
- Creates unique weight sets for each person in the database
- Reduces the dimensions of the images allowing faster comparison computations
- While effective in some cases, it is not adept to variances in pose and lighting

Figure 3- The PCA process creates unique weight sets for each person in the database using all of the saved normalized face images·

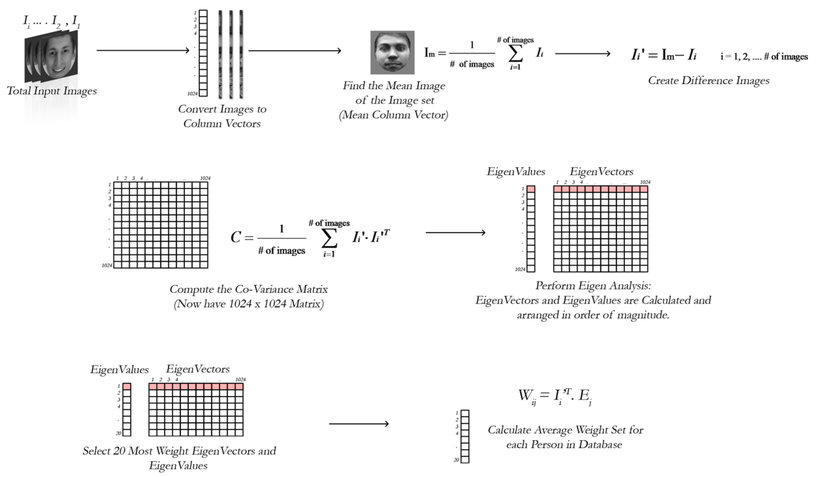

Figure 4- The PCA process

Modular PCA Training

The Principal Component Analysis process is enhanced by:

- Separating the images into N × N modules
- Applying PCA to each module
- Applying Weights to each module based on module variance

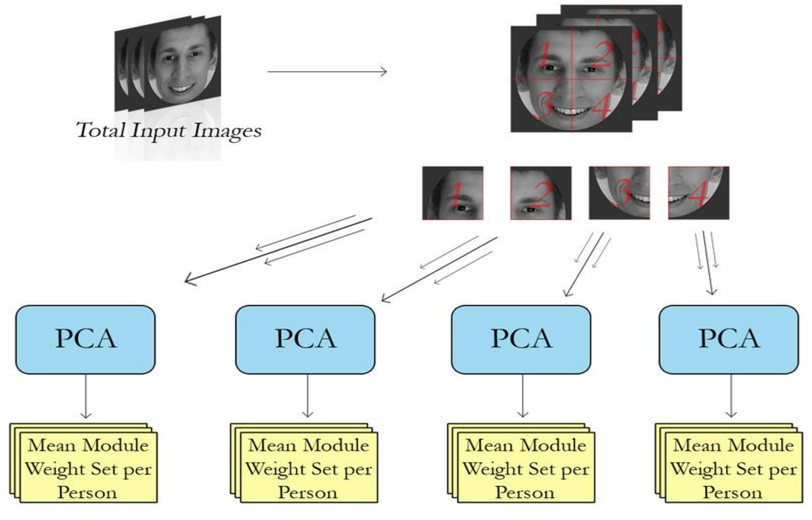

Figure 5-The MPCA process includes separating the input images into independent modules and performing PCA on each module.

Tracking Using the Kalman Filter

The Kalman filter is used as a tracking system and tracks the location of a detected face based on the position of the face and the identity of the individual. The states of the Kalman tracker are set to the coordinates of the bounding box of the detected face and the features used in the matching purposes for tracking is the recognition result determined by the system.

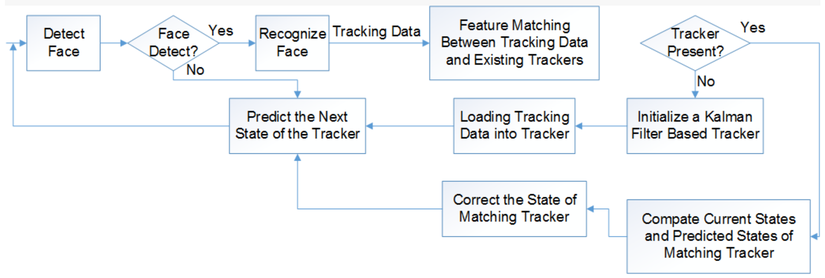

Figure 6– Tracking System

Results and Conclusions

Working at real-time and have good accuracy in recognizing and tracking faces

Figure 7– The first line : Face Detection; The second line : Multi-pose Detection and Recognition; The third line : Face Tracking