Video Attendance

CS 101

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Project Report Stage 1

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Problem Statement

Attendance for students and employees at institutions around the world has been revolutionized by biometric systems. But there are problems that persist. Living in the era of smart computing machines, we still spend a portion of our time in this formal procedure which is significant on a cumulative basis.

Our challenge is to design an application which can recognize multiple faces in single frames captured from a webcam over the network, match them with known faces in a centralized database and mark attendance. In principle, this can be fully automated and is potentially the future of security and identifier systems.

Why we chose this topic?

- We figured this is a challenging topic.
- It has numerous practical applications.
- There are wide horizons for us to explore and attain new skills.
- We envision the code to be flexible enough to extend applications to other areas of image/video processing.
- It has something to do with our daily lives.
- It provides us an insight into our own brain; how we identify faces

Methodology

Four algorithms were possible candidates:

1. Linear Discriminant Analysis using Principal Component Analysis(PCA) or Independent Component Analysis(ICA)
2. Hidden Markov Model(HMM) coupled with suitable algorithms for clustering of images
3. Pseudo 2D HMM using Discrete Cosine Transform(Very effective)
4. Associative chaining using minimal spanning tree(MST) algorithm

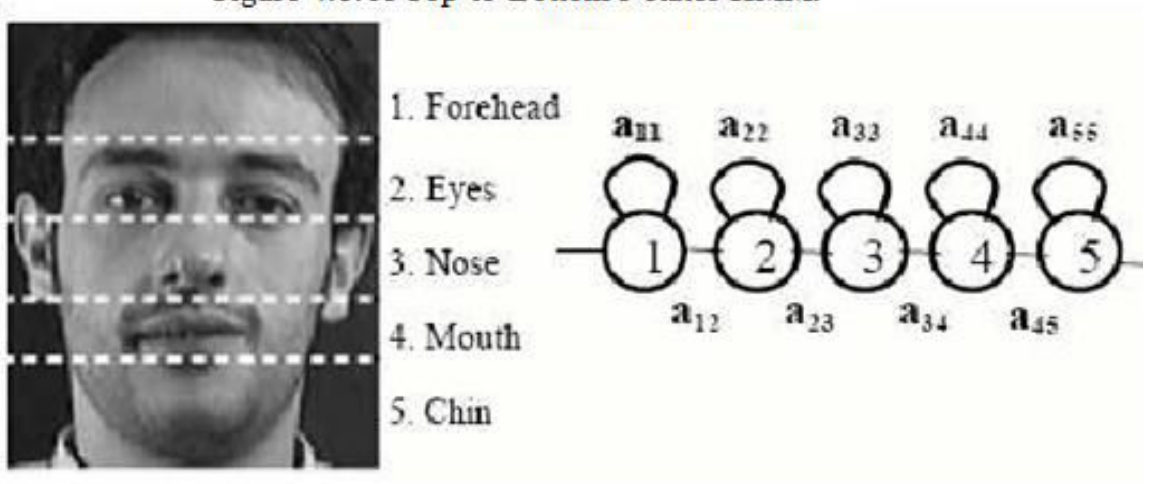
The first three are supervised but the last one is unsupervised, and each one can be trained. The HMM models all perform based on the confidence generated by comparing some transformation of the images and the expected values of a particular test subject generating the observable set of images. There is a problem with unsupervised learning that it will analyse images and automatically train itself to recognise new images, however even then human intervention is needed to identify the image sets with a subject of a particular serial number before it can update the database of attendance. The third method is known to give a 100% result with the ORL database. The second method has over 97% success with ORL database. The first approach is popular and not difficult to implement but with lower success rate than the other three.

With the above arguments in mind, Pseudo 2D HMM using DCT is the algorithm that shall be used within our application.

Brief Description of Algorithm

The basic condition for the task of face retrieval is a database of labelled face images. The database may be recorded from TB broadcast or video surveillance, and semi-automatically labelled. A HMM is trained for each image in the database. The ranking of the images for the query image would be based on the “likelihood” given by the Viterbi algorithm. A more feasible method might be the Forward-Backward algorithm which we shall try to explore.

Figure 4.1. A Top-to-Bottom 5 states HMM.



Salient Features

- Attendance can be marked down if someone leaves before scheduled departure
- Human effort is remarkably reduced. Part from the minimal amount of supervision required to train the machine to recognize faces, there is no human intervention required for the execution of the application
- The application is capable to recognize multiple faces in the same frame, thus enabling it to mark attendance for multiple persons at once.
- Face recognition is confirmed by tracking the person's face across frames and attendance is triggered by detection of "blinking" of eyes
- The program updates its central database regularly to account for inaccuracy due to evolution of facial features.

Issues and Precautions

- Abrupt changes in facial features, although unlikely is known to cause inaccuracy In prediction
- Facial effects such as sunglasses and cape hinder the function of the application as bad as the last point. Subjects can be directed to avoid such effects.
- The recognition is illumination dependent. There is listed feature-request to make our algorithm illumination independent and it is expected to be included in the beta-release. Explicit illumination design can be provided.
- Subject can come up with a bizarre facial expression to confuse the machine but it is unclear why would anyone want to do so. Data collection should account for all imaginative facial expression that a person expresses in a normal mental state.

Project Timeline