Implementation of Classroom Attendance through Facial Recognition

ELECTRICAL ENGINEERING & COMPUTER SCIENCE
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Abstract

In this project, we are developing an innovative system which performs facial detection and recognition to determine classroom attendance. Different computer vision techniques, such as eigenfaces and convolutional neural networks are being explored and implemented in order to obtain optimal results. The goal of this project is to achieve an accuracy of approximately 90%.

Background

In recent years, in order to improve the quality of education and ensure that students are obtaining an optimal educational experience, some instructors have made attendance mandatory. Currently, this has been enforced through the use of some sort of sign-in sheet or clickers that record student responses. Unfortunately, in many instances, this has led to a rise in academic dis-integrity and the policies have not resulted in the intended effect. This project aims to implement an innovative approach to record classroom attendance through the use of computer vision techniques.

Approach

In order to determine classroom attendance, face detection and face recognition are performed. Face detection is used to determine the location of the faces in the classroom image and extract sub images for each face. Then, in face recognition, the face images detected will be compared with the faces images from the students in the class and attendance will be recorded accordingly. This process is illustrated in Figure 1.

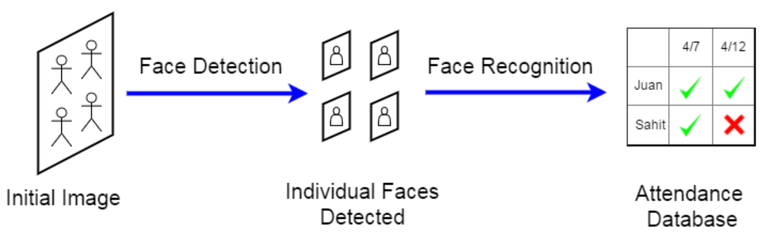

Figure 1: High-Level System Architecture

Challenges

The known challenges of face detection and classification include:

1. Pose variation, which is present when the subject's face is angled away from the direction of the camera;
2. Feature occlusion, where the subject's face is partially covered by another object;
3. Ambient conditions such as poor lighting or low image resolution.

Face Detection

To detect the faces present in the image, the classroom photo was first converted into the YCbCr color space and then filtered to display regions where color resembling human skin color is present. After determining the skin-colored regions, a blob detection filter was applied to determine possible areas where a student's face may be present. The potential zones are then operated on again with a finer skin color filter and then checked to see whether the region contains a face-shape, at which point, the potential zone is determined to be containing a student's face.

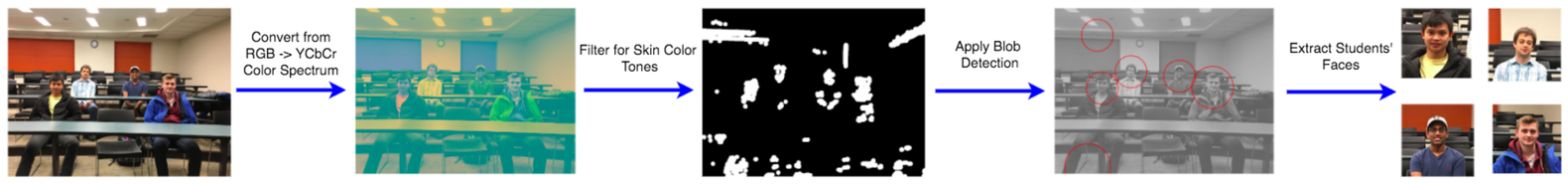

Figure 3: Face Detection Method

Face Recognition

Eigenfaces

Images are projected onto a feature space that spans the variations among a set of known face images. principal components of the set of faces and represent significant features

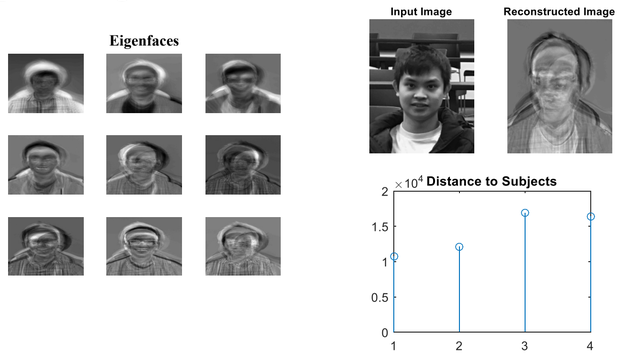

Figure 4: Eigenfaces Method

Neural Network

A simple neural network was implemented for face recognition. The architecture of this layer is shown in Figure 5. Training of this NN was done by using 200 images picturing 40 different subjects from the ORL database. Testing the performance of the NN using the entire dataset, which consists of 400 images, an accuracy of 90% was achieved.

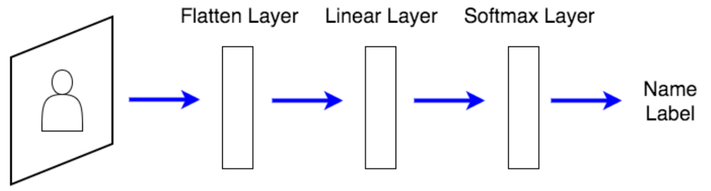

Figure 5: Neural Network Framework

Next Steps

- Convolutional neural networks (CNN) will be implemented for both face detection and recognition for robustness purposes.
  - For face detection, it is hoped to overcome challenges such as feature occlusion and irregular lighting conditions
  - For face recognition, it is hoped to overcome pose variation challenges

Conclusions

So far we have implemented very naïve methods for both face detection and recognition that achieve about 80% at best for a very limited dataset. As our current results are greatly affected by face lighting, orientation, and size variation, it is hoped to improve on the results obtained by using CNNs trained using expanded face databases such as the ORL, AFW, and Yale. Ultimately, it is hoped to obtain an accuracy of approximately 90% and provide a comparison between the methods implemented.

References

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