Good morning Dr Althea Liang and Prof Deepu Rajan! I am Wen Jun. Today, I will be giving a presentation on my final year project which is on a face-recognition based attendance system.

Face-recognition systems are used to identify or verify an individual’s identity using a digital image or a video frame from a video source. Face recognition is important in many computer vision applications such as human-computer interactions and security systems.

Attendance plays an important role in our education system. It is crucial to monitor the students’ attendance in the classroom to make sure that they come for lessons. Traditional methods of attendance taking involve teachers passing the attendance sheet around for students to sign their attendance or calling out the names of the students individually to take their attendance. This might create a lot of loopholes in the system as students might sign the attendance of another student who is not present in the classroom. Teachers might also make mistakes and consume a lot of time to take the students attendance.

Hence, a face-recognition based attendance system is being developed for this project. The objective of the face recognition-based attendance system is to take the attendance of students in a classroom using face recognition. The face recognition attendance system will be placed at the entrance of the classroom. Students will need to look into the camera for their attendance to be taken. Students can choose to register their attendance either individually or as a group of up to five students. The students’ faces are detected using the Viola Jones object detection framework. The detected faces are being extracted and are used to compare with training images with matching features. After a student’s face is being detected, a rectangle is drawn around the detected student’s face. The name (label) of the recognized face will be placed outside the rectangle of the detected face. If the student’s attendance is submitted successfully, an “Attendance Submitted Successfully” message will be read out by the voice conversion system. After the students’ faces are recognized, their attendance will be taken and recorded into the database. Teachers can view, modify or update the attendance records of the students. If the students’ attendance are not able to be captured by the face recognition system, teachers are able to insert the students’ attendance records manually. Teachers can also export the attendance records into an excel sheet. When students who do not belong to the class tries to take their attendance, their faces will be recognized as “UNKNOWN”. This also means that the face recognition system is unable to recognize their faces after their faces are compared with all the other training images in the training set.

In order for the students faces to be recognized correctly, there must be training face images of students in the training set first. Administrators can obtain the training images of students to be placed into the training set through the following ways:

1. Obtain training face images of students from the students Facebook accounts.
2. By asking students to look into the camera with different positions, orientations, lighting conditions and angle of their faces to get their training face images extracted and placed into the training set. This is because face recognition algorithms which uses Principal Component Analysis do more than one comparison and matches between a face detected and the training images in the training set.
3. Obtain training face images of students from face images being captured by the CCTV camera and placed into the training set.

As shown in the figure below, the training face images are cropped, converted to grayscale (to remove the unnecessary information which coloured images may introduce) and stored in a folder with names assigned to every training image. The first label(name) will correspond to the first training image, the second label(name) will correspond to the second training image and so on. Labels (Names) will be assigned to each training face image in the training set. The training image names (or labels) are separated by “%” in the TrainedLabels.txt file where the first two digits indicate the number of training images in the training set. When a student looks into the camera to get his attendance taken, the face extracted will be compared with all the other training face images in the training set. The labels of the training face images with the closest match will be returned.

Eigenfaces is the technique used in my face-recognition based attendance system. It is made up of a linear combination of weighted eigenvectors where eigenvectors are made up of the covariance matrix of a training image set. It is created from the statistical analysis of many images of faces. For example, a person’s face can be made up of 20% from eigenface 1, 25% from eigenface 2 and 25% from eigenface 3. These Eigenfaces are created by dark and light areas arranged in a certain pattern.

The libraries used in my face-recognition based attendance system project are Open CV and Emgu CV.

Sometimes, the training images extracted from the students Facebook accounts and CCTV cameras are of low-resolution especially training images from the students Facebook accounts which might have been taken by a low-resolution camera such as the cameras from our mobile phones.

The camera being used to capture the students’ attendance might have also been of low-resolution. Super-resolution techniques can help to improve the resolution of the frames captured by the camera by generating a high-resolution image from a sequence of low-resolution images. This helps to improve the face recognition accuracy of the system.

For example, as can be seen in the diagram below, the input images on the left represent the low-resolution input images and the images on the right represent the super-resolved high-resolution images.

Experiments were conducted on the face images to determine how the various factors such as the eigen distance threshold value, epsilon value and the number of training images affect the accuracy rate and the speed of face recognition. It is important to determine the accuracy rate of the face recognition system to reduce the number of students’ attendance being taken incorrectly. The face recognition speed of the system is also important as well as it is important for students to take their attendance quickly so that they do not need to take a long time to queue up to get their attendance taken.

The experiments use 20 identities where 7 training images were used per identity and 4 testing images were used per identity. Out of these 20 identities used in my experiments, 15 identities were taken from the Yale face database. The remaining 5 identities were from my test subjects, which includes my family members and friends. These identities of the same person have different expressions, angles and positions of the face. This can help to improve the face recognition accuracy as the face recognition algorithms which uses Eigenfaces do multiple comparisons and matches between a face detected and the trained images.

After the experiment is conducted on all the 80 testing images, the face recognition accuracy (in %), the average time taken to process an image (in seconds) and the percentage of faces being detected as “UNKNOWN” are displayed as shown below.

The following diagram shows the experimental results of the relationship between the Eigen Distance Threshold value and face recognition accuracy. As can be seen from the graph, when the Eigen distance threshold value increases, the face recognition accuracy (in %) also increases.

The following diagram shows the experimental results of the relationship between the epsilon values and the face recognition accuracy. As can be seen from the graph, when the epsilon value decreases, the face recognition accuracy (in %) increases.

The following diagram shows the experimental results of the relationship between the number of training images for each person and the face recognition accuracy. As can be seen from the graph, when the number of training images increases from 2 to 6, the face recognition accuracy (in %) increases, with the optimal number of training images being 6.

The following diagram shows the experimental results of the relationship between the eigen distance threshold values and the speed of face recognition. As can be seen from the graph, the eigen distance threshold values has no effect on the speed of face recognition.

The following diagram shows the experimental results of the relationship between the epsilon values and the average time taken to process each image. As can be seen from the graph, the lower the epsilon value, the more time needed to process each image.

The following diagram shows the experimental results of the relationship between the number of training images per person and the average time taken to process each image (in seconds). As can be seen from the graph, when the number of training images per person increases, the average time taken to process each image increases.

In conclusion, the optimal settings which should be used for the face-recognition based attendance system are as follows:

Eigen distance threshold value = 6000

Epsilon value = 0.01

Number of training images = 6

In conclusion, the face-recognition based attendance system is useful for students to take their attendance. It helps to save time as teachers can make use of the time to conduct lessons and up to five students can take their attendance at a time. It helps to prevent errors and students are not able to sign the attendance of another student.

The following are the recommendations which I can use to improve on my project:

1. The project can be further enhanced to cater to the needs of new students who join the class.
2. The speed of the face recognition can be increased when there are a large number of training images. An example may be to split the training set into smaller groups.
3. The project can also be further enhanced to enable teachers to monitor the student’s attention in class.
4. A mobile application can also be developed to be used as a face recognition based attendance system. This mobile application is a much more convenient way for students to take their attendance as students do not need to queue up to get their attendance taken.

This is the end of my presentation. Thank you.