

## *Career Episode 2*

### **Face Recognition System**

#### **A) Introduction**

[CE 2.1] I implemented the project “Face Recognition System” using my Electronics & Communication Engineering knowledge at Karavali Technological University, India.

Project Title: Face Recognition System

Duration: [Date] – [Date]

Location: Karavali Technological University, India

Position: Student

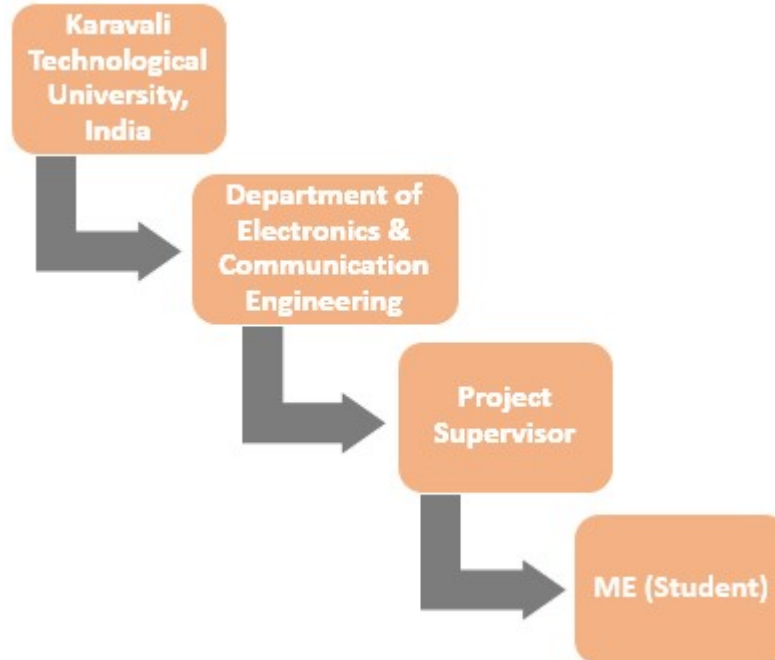
#### **B) Background**

[CE 2.2] In the past two decades, face recognition has been considered as an important research field. Automatic recognition and surveillance system are the major reasons. Human visual system interest on the face recognition and the human-computer interface design are the technical aspects in this matter. This face recognition technology involved researchers and knowledge from disciplines like psychology, neuroscience, pattern recognition, computer vision, machine learning and image processing. Different research papers have been published to accommodate various factors including scale, pose, expression, illumination. It was for achieving better recognition rate and there was no robust method against the uncontrolled cases which involved several factors simultaneously.

[CE 2.3] The project objective was the image-based face recognition. I used the picture from the digital camera and in case if there was any person present inside, where his/her face located at and who he/she was. I implemented the face recognition process which was split into three steps including face detection, feature extraction, and face recognition.

[CE 2.4] I worked on the development of the face recognition system which was for the degree accomplishment in the field of Electronics & Communication Engineering degree at Karavali Technological University, India.

[CE 2.5] Flowchart underneath to show my position in the project.



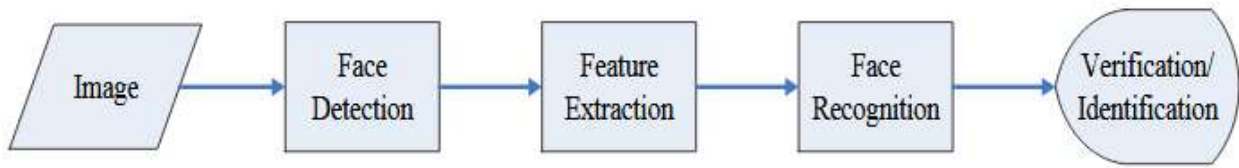
[CE 2.6] My duties in the project were:

- I worked on the face alignment for scaling and patching orientation which was completed with the usage of my Electronics Engineering skills.
- I implemented the face detection which worked as the pre-processing and it was for the retargeting, video and image classification and detection range.
- I extracted the information packing performance along with the analysis on the dimensional reduction, salient extraction and noise cleaning.
- I analyzed the ROC curve relation between the positive rate and the false positive rate.
- I worked on the software designing including embedded software programming for the project implementation.
- I worked on the establishment of the face recognition pattern and monitored performance and safety standards and process for modification and operation of the system using my Electronics Engineering knowledge.
- I worked on the designing and development of algorithms for the face detection system.

### C) Personal Engineering Activity

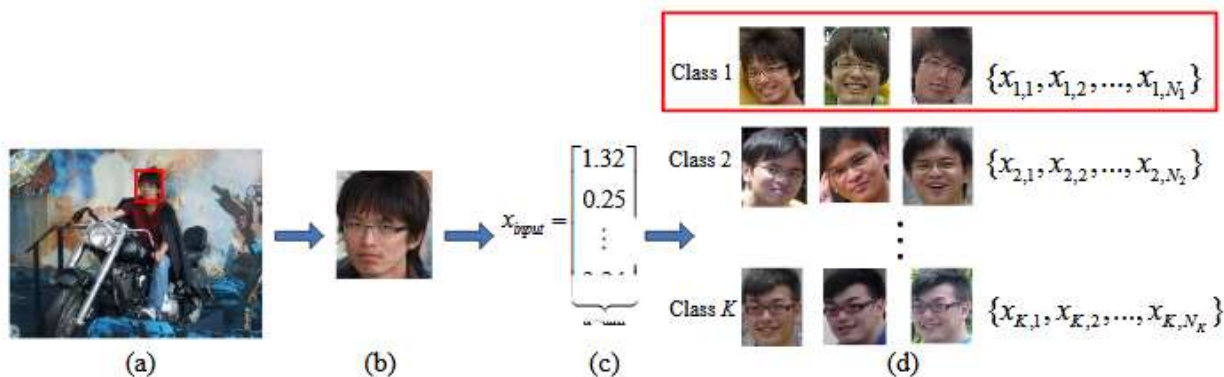
[CE 2.7] I implemented the project of face recognition system in which I determined whether human faces appeared in the given image and also where the faces were located at. I obtained the expected outputs which were patches in the input image containing each face. I adopted the easy and robust design for making improvements in the existing technology. I completed the face

alignment to justify the scales and patches orientations. I used face detection as the pre-processing and it was particularly for the detection range, retargeting, video and image classification.



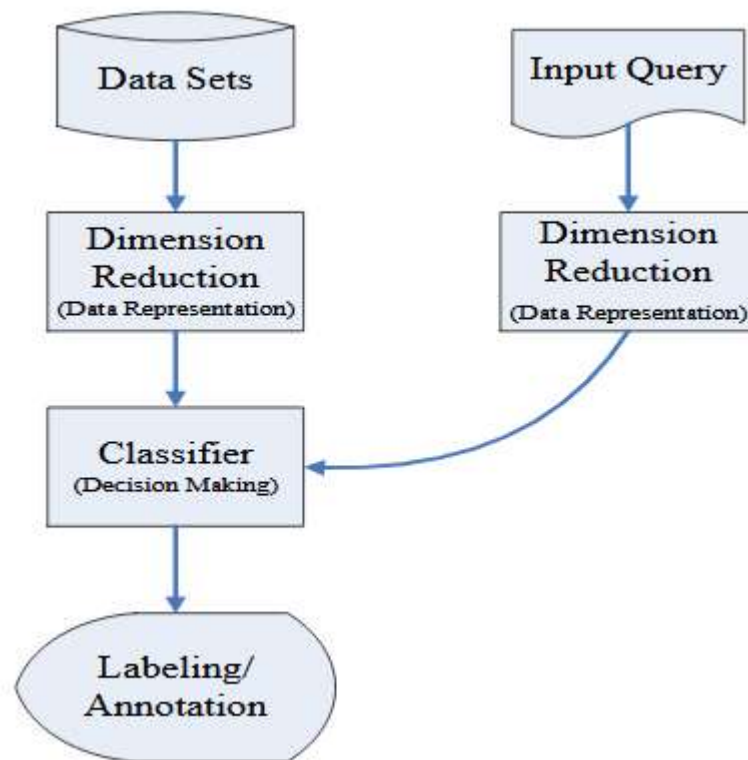
[CE 2.8] I extracted the human-face patches from the images after the face detection step. I directly utilized these patches for face recognition which had some disadvantages but it was the most appropriate technique at that time. There were 1000 pixels in each patch and these were too large for building the robust recognition system. I took the face patches from the different camera alignments with varied face expressions, illumination and it suffered from clutter and occlusion. I completed the extractions for performing the information packing, dimensional reduction, noise cleaning and salient extraction. I applied the face patch which was transformed into the vector with fixed dimension with the set of fiducial points and their corresponding locations.

[CE 2.9] I achieved the automatic recognition with the implementation of the face database as needed. I took several images and their features were extracted and stored in the database. I obtained the input face image and performed face detection and feature extraction. I compared the features to each face class which was stored in the database. I analyzed researches and algorithms to deal with the problem. I worked on the main applications which were identification and verification. I analyzed the face detection provided with the face image and implemented the system completing the identification process. I gave face image and verified the identification in the face verification. I set the system in such a way that it assisted in obtaining right or wrong about the guess. I showed an example in the below figure realizing how the three steps worked on the input image.

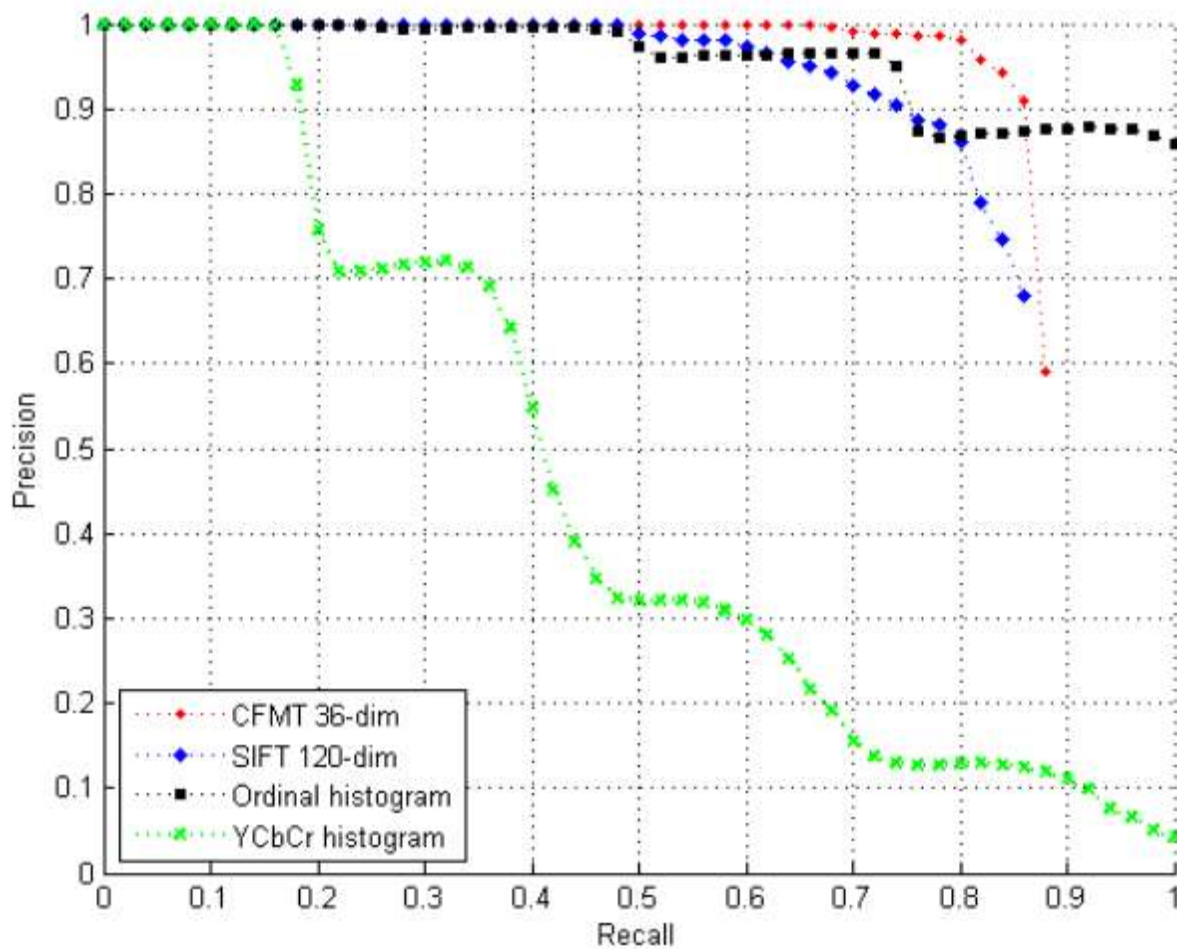


[CE 2.10] I performed the dimension reduced process on the stored raw data. I categorized the dimension reduction method into the data-driven and do-main-knowledge method. I transformed each raw data in the data sets dependent on the features set and the classifier was mainly trained on the features representation. I performed the same dimension reduction process and entered its

features into the classifier. I obtained the classifier output which was based on the optimal class and rejection notes.



[CE 2.11] I evaluated the experimental performance after the implementation of the pattern recognition method. I worked on the main two evaluation points and these were based on the ROC curve and the PR curve. I examined the ROC curve relation among the positive rate and the false positive rate. I worked on the PR curve and it extracted the relation between the detection precision and detection rate. I analyzed the true positive means in the two-class recognition and the false positive worked on the non-face images portion. The detection rate and the recall rate was based on the true positive term. I evaluated the PR curve and there were some frequently used values for analyzing the performance judgments.



[CE 2.12] I completed the face detection system in which the face detection and face recognition were the main parts. It worked on the considerations of the human appearance variations. I also analyzed the design issues and the system execution speed revealed the on-line service possibility and the system ability regarding the data handling in bulk amount. I detected the human faces accurately and determined the identities with the implementation of the complex algorithm. I detected the function with the utilization of the digital camera and focused on the human faces. I implemented the system in which the detection process took less than 0.5 second. I concentrated on the speeding-up the existing pattern recognition system. I worked on the data handling of the large amount and obtained the execution time with the results compared against other experimental techniques. I also worked on the training data size which was another noticeable issue in the algorithm design. I included more data with more information which exploited and resulted in achieving better performance. I used the database which was limited in size and it was because of the difficulty in the human privacy and data acquisition. I designed the algorithm which did not only capture information under the condition of limited data size. I interpolated the missing and unseen data. I examined the eigenface and the fisherface comparison under the limited data size. I obtained the eigenface with better performance than the fisherface.

**[CE 2.13] Problem:** While implementing the detection system, I had one issue regarding the management of raw data and extracting the exact data for matching the pattern recognition. **Solution:** I consulted with the project supervisor regarding this issue and fully used my technical knowledge in the domain of Electronics Engineering. I obtained the solution with the implementation of the dimensional reduction method which assisted me in getting the data-driven approach and solving the issue under consideration.

#### **D) Summary**

**[CE 2.14]** I implemented the face recognition system using the pattern performance recognition techniques. I took important factors into consideration for gaining more insight on the pattern recognition techniques performance. I matched the templates number in each template matching and the adopted distance metric directly affected the recognition result. I considered four important factors in the pattern recognition which included the size of the training data, each feature dimensionality, number of classes and the classifier complexity. I attained higher recognition performance and it made the system more complex. I worked on the development of the algorithms and analyzed various factors. My knowledge in Electronics Engineering improved with this face recognition system project.