CHAPTER- 4
SYSTEM DESIGN AND ARCHITECTURE

4.1 Functional overview of the proposed system

4.1.1 Implementation

The proposed system introduces an automated attendance system which integrates a web cam and face recognition algorithms. Any laptop with a web camera can capture a live video for detection and recognition. The live video undergoes face detection and face recognition, the detected faces are extracted from the image. The extracted faces are then compared with the the database and the database is updated with the attendance and a sheet is generated and displayed to the user.

Step I Generating Dataset

In this stage and perform detection and recognition. Further this data will be used to compare the detected images in all the uploaded files and update the attendance.

Training of the person Y is performed by taking the training image from various angle and various expressions.

One can train any number of images of a particular person as required. Basically in this stage the capturing of the live video will be done using webcam and further.

Step II Face Detection

Face detection is done with live webcam. The faces are detected by using the training data stored in the database. The face of a person is detected and the message shown is "OUT OF PERIOD" as the person is present before the specified time of lecture.

Step III Face Recognition

Face Recognition is performed by using the algorithms, which compare the generated data with the data trained in the database.

The professor can define lecture timings directly in the GUI according to his/her need. Once the lecture timing has started then the process is started and

if the student is present in the specified lecture timing and lecture threshold the face of the person is recognized from the trained images from the database and shown in the GUI with his/her name. If a candidate is not trained it displayed as showing "UNKNOWN".

Step IV Attendance Updation

As soon as the name of the student is identified the attendance is updated with current date and time. Attendance Record of the students with date and time is marked if the face is matched with the trained data. Eventually, the attendance sheet is generated.

4.1.2 Improving face detection

Face detection can be improved by tuning the detectors parameters to yield satisfactory results. The parameters to be adjusted are explained as follows.

Scale Increase Rate

The scale increase rate specifies how quickly the face detector function should increase the scale for face detection with each pass it makes over an image. Setting the scale increase rate high makes the detector run faster by running fewer passes. If it is set too high it may jump quickly between the scales and miss the faces. The default increase rate in Open CV is 1.1. This implies that the scale increases by a factor of 10 % each pass.

The parameters assume a value of 1.1, 1.2, 1.3 or 1.4.

Minimum Neighbour's Threshold

The minimum neighbour's threshold sets the cut-off level for discarding or keeping rectangle groups as either faces or not. This is based on the number of raw detections in the group and its values ranges from zero to four.

When the face detector is called behind the scenes, each positive face region generates many hits from the Haar detector. The face region itself generates large cluster of rectangles that to a large extend overlap. The isolated

detections are usually false detections and are discarded. The face detection function does all this before returning the list of the detected faces. Over view of this system shown in Figure 4.1.

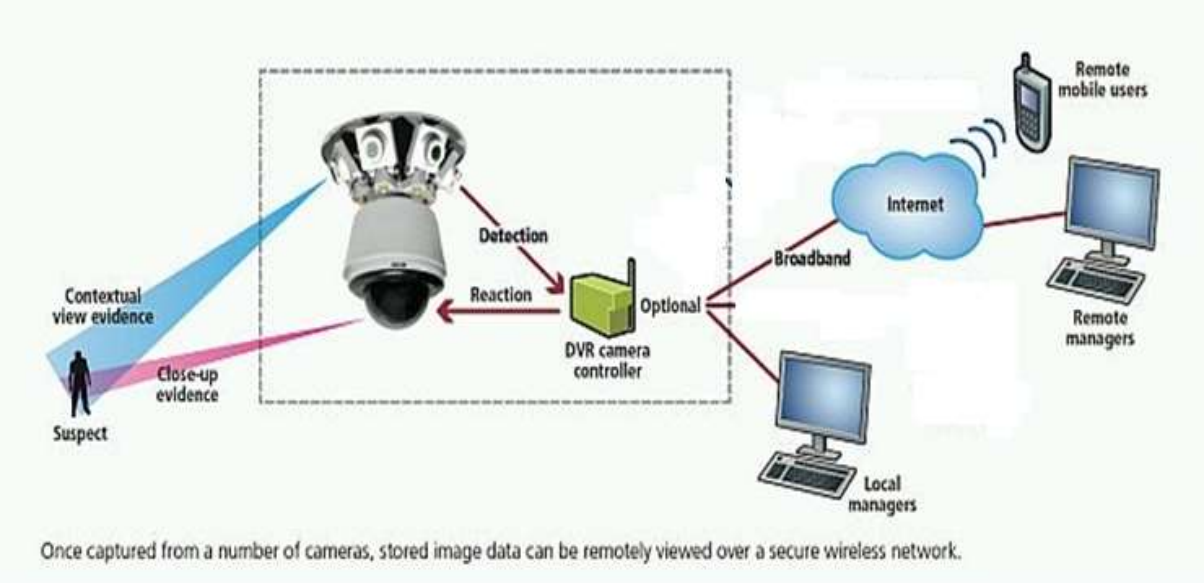

Figure 4.1 Overview of the proposed system

Digital video recorder camera will detect student information from the class room. Then it will send the information to Remote Management system, information of student will be processed and report will be generated using system software. Finally Hall ticket for particular student will be generated using above information, the system software will sent information to the corresponding student as E-mail.

4.2 System architecture

In this proposed system, the system is instantiated by the mobile .After triggering then the system starts processing the image for which we want to mark the attendance. Image capturing phase is the one in which the image will be captured. This is basic phase from which system start initializing. The captured image from a camera which is predominantly checked for certain constraints like lightning, spacing, density, facial expressions.

In this project, individuals and different frontal postures are taken so that the accuracy can be attained to the maximum extent. In the training database phase every individual has been classified based on labels. To capture image, from an every object frontal faces defected. This detects only faces and removes every other parts since it is exploring the features of only faces.

These detected faces are stored in the test database for further enquiry. Features are extracted in this extraction phase. The detected bounding boxes are further queried to look for features extraction and the extracted features are stored in matrix. Features we look here are shape, edge, colour, wavelet, are concentrated. Figure 4.2 shows the System Architecture.

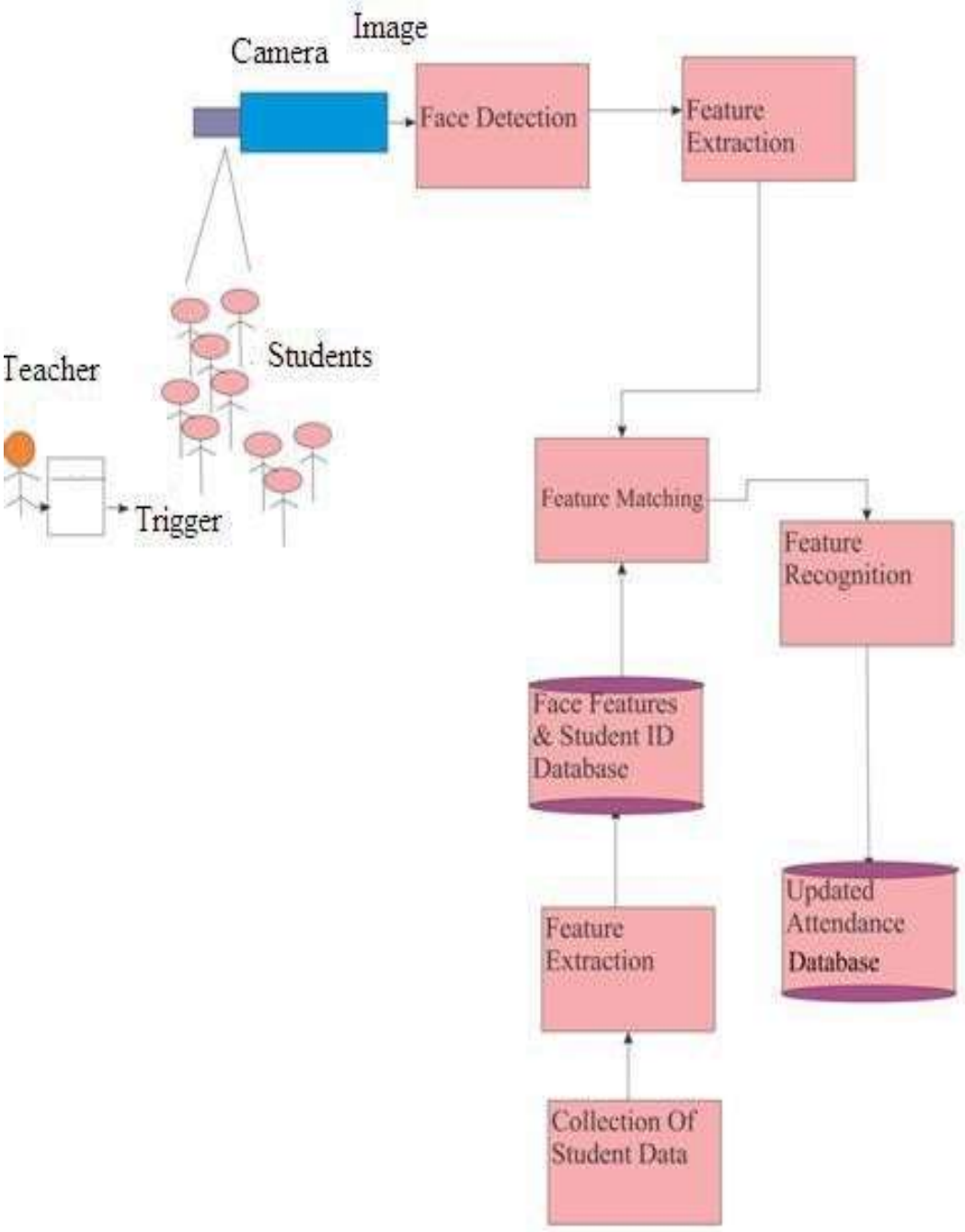

Figure 4.2 System Architecture

4.2.1 Face detection

Face detection is a computer technology being used in a variety of applications that identifies human faces in digital images. Face detection also refers to the psychological process by which humans locate and attend to faces in a visual scene. Face detection can be regarded as a specific case of object-class detection. In object-class detection, the task is to find the locations and sizes of all objects in an image that belong to a given class. Examples include upper torsos, pedestrians, and cars. Face-detection algorithms focus on the detection of frontal human faces. It is analogous to image detection in which the image of a person is matched bit by bit. Image matches with the image stores in database. Any facial feature changes in the database will invalidate the matching process.

A reliable face-detection approach based on the genetic algorithm and the eigen face technique: Firstly, the possible human eye regions are detected by testing all the valley regions in the gray-level image. Then the genetic algorithm is used to generate all the possible face regions which include the eyebrows, the iris, the nostril and the mouth corners. Each possible face candidates is normalized to reduce lightning effect caused due to uneven illumination and the shirring effect due to head movement. The fitness value of each candidate is measured based on its projection on the eigen faces. After a number of iterations, all the face candidates with a high fitness value are selected for further verification. At this stage, the face symmetry is measured and the existence of the different facial features is verified for each face candidate.

4.2.2 Face recognition

A facial recognition system is a computer application capable of identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database. It is typically used in security systems and can be compared to other biometrics such as fingerprint or eye iris recognition

systems. Some facial recognition algorithms identify facial features by extracting landmarks, or features, from an image of the subject face. For example, an algorithm may analyze the relative position, size, and/or shape of the eyes, nose, cheekbones, and jaw. These features are then used to search for other images with matching features. Other algorithms normalize a gallery of face images and then compress the face data, only saving the data in the image that is useful for face recognition.

A probe image is then compared with the face data. One of the earliest successful systems is based on template matching techniques applied to a set of salient facial features, providing a sort of compressed face representation. Recognition algorithms can be divided into two main approaches, geometric, which look at distinguishing features, or photometric, which is a statistical approach that distills an image into values and compares the values with templates to eliminate variances. Popular recognition algorithms include Principal Component Analysis using eigen faces, Linear Discriminate Analysis, Elastic Bunch Graph Matching using the Fisher face algorithm, the Hidden Markov model, the Multi-linear Subspace Learning using tensor representation, and the neuronal motivated dynamic link matching.

4.2.3 Attendance database

Recognizing a face means to identify that particular face from a list of faces on a database. The dataset includes candidate faces under a very wide range of the monochromatic and lightning conditions along at different poses and angle. The college at the time of admission takes picture from every student, and those images are stored in the database. The dataset is then trained to identify the student even if there are gradual changes in the appearance of a student.

The camera in the proposed system is set up such that it captures only frontal images so the problem of pose is not an issue. During the detection phase the image is converted into gray scale. The same technique is applied to

faces in student image database. Background subtraction on images is also done so that other objects do not interfere during the process.

Another issue is that faces are subject of change during time (facial hair, different hairstyles etc.). Whenever a face is successfully identified and a copy of that face is stored in the database which is a training set. Together with the image it store the time and date when this image was taken. This way it identifies gradual appearance changes of the students on each scan for a student, the recognition operation performs comparison of images stored in the database, sorted in descending order by date. This approach was used since the latest image of a student on database is most likely to be more similar to the current captured image.

Of course, a sudden drastic change on a student's look cannot be identified for that particular instance. To solve this issue, included a module, which lists all unidentified faces and the teacher is able to manually connect a captured face with a student from the list. This corresponding image is stored as an updated picture of a particular student. The recognition process is performed only once. In a face subsequent scan, the student is identified automatically by the system.

Training Dataset

Separating data into training and testing sets is an important part of evaluating data mining models. Typically, larger portion the data is used for training, and less portion of the data is used for testing.

A validation dataset is a sample of data held back from training object model that is used to give an estimate of model skill while tuning model's hyper parameters.

By using similar data for training and testing, system can minimize the effects of data discrepancies and better understanding the characteristics of the model.

4.3 Data flow diagrams

A Data flow diagram (DFD) is a graphical representation of the “flow” of data through an information system. It differs from the flowchart as it shows the data flow instead of the control flow of the program. Data flow diagram are directed graphs in which the nodes specify processing activities and the processing activities and the arcs specify data items transmitted between processing nodes.

4.3.1 Level-0 DFD of automated attendance system

Automated attendance system contains three components which are given below.

DFD Level 0

- Webcam
- Main System
- Database

Using webcam, image will be captured and it will be passed to the remote system. Remote system will update the attendance to database. Figure 4.3.1 data flow diagram of automated attendance system.

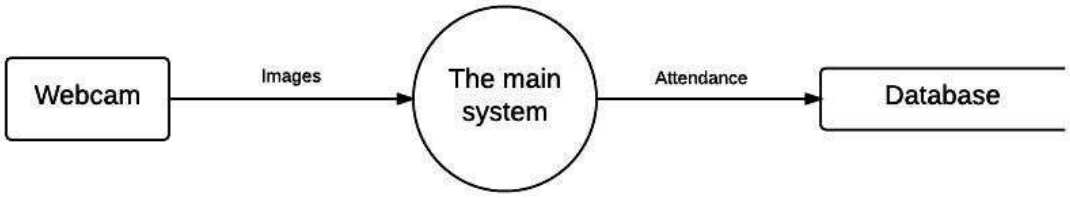

Figure 4.3.1: DFD Level 0 of automated attendance system

Main system process the images and attendance of processed image will be stored into the database.

4.3.2 Level-1 DFD of automated attendance system

Main Automated system will consist following factors.

Figure 4.3.2: shows DFD Level 1 data flow diagram of automated attendance system

DFD Level 1

- Image Processing
- Face Detection
- Face Recognition

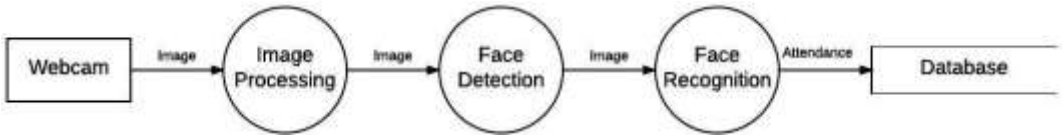

Figure 4.3.2: DFD Level 1 of automated attendance system

Webcam detect the images to send to the remote system, remote system will process those images and detect the frontal face of captured images, the recognition phase uses machine learning algorithms to recognize face corresponding information will be updated to the database.

4.3.3 Level-2 DFD of automated attendance system

Automated attendance system uses the GUI (Graphical user interface) to improve the effective utilization of system.

Webcam will be installed and used with use of webcam deriver, without the webcam driver will not able to work with webcam. Face detection will be done with use of haar cascade that is yml/xml file, it is used to detect the frontal face of the student.

Frontal faces will be detected and recognized with use of machine learning algorithms; there are different type of machine learning algorithms are used to recognize the faces in the images.

Figure 4.3.3 shows the DFD Level 2 data flow diagram of automated attendance system.

Machine learning algorithms are

- PCA (Principal Component Analysis)
- LDA (Linear Discriminate Analysis)
- LBPH (Local Binary Pattern Histogram)

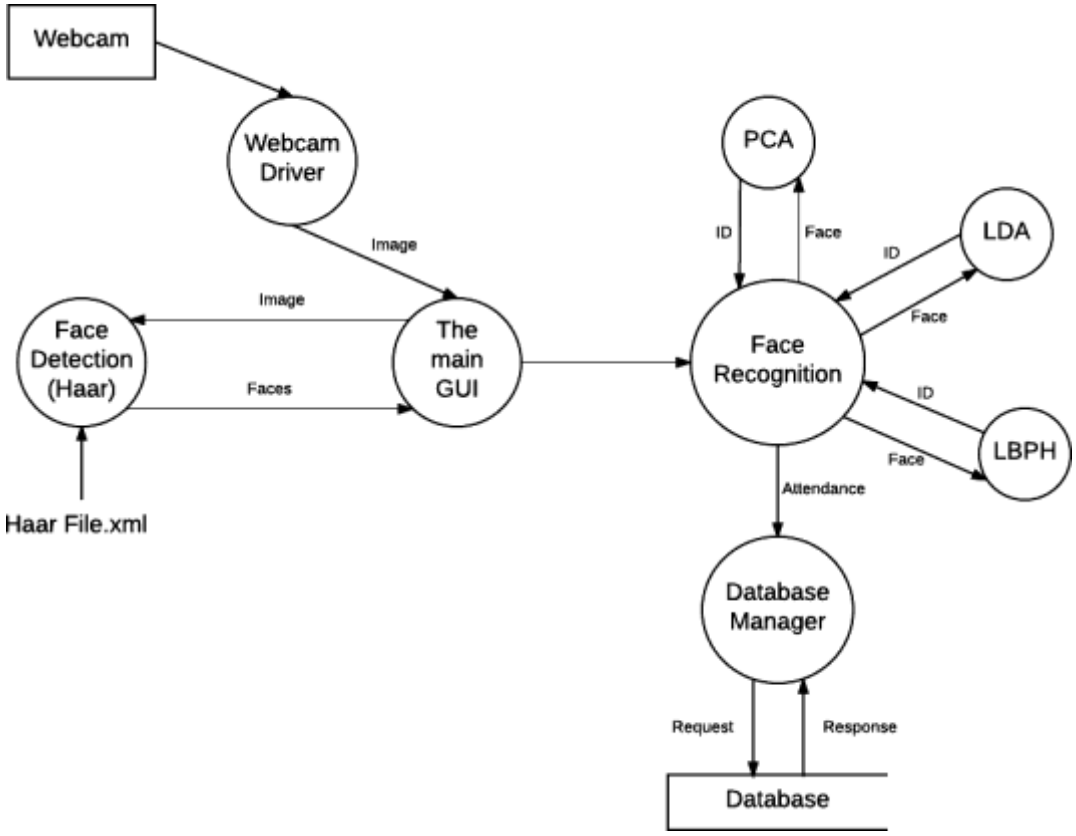

Figure 4.3.3: DFD Level 2 of automated attendance system

` Database store the information of student, admin and also professor details.

Recognized images are marked as present into the database. Information is used to generate the report of student in order to calculate attendance percentage and also to generate the hall-ticket for the corresponding student.

If a candidate fulfills the minimum attendance criteria (80%), will set hall ticket and be allowed to examination.

4.4 UML Diagram

4.4.1 Use case diagram

Use Case Diagram are behavioral diagrams used to describe a set of actions (use-cases) that some system or systems (subject) should or can perform in collaboration with one or more external users of the system (actor). It has a remote system and local manager, actor as a professor, administrator, and student. Action like update student information, professor information, admin information, generate report, hall ticket generation, face detection, face recognition, training the images are identified. Figure 4.3 shows the Use case diagram of automated attendance system

The use case of face recognition explain the authorities of exist user and new user , that new user the only function can do it to sign up to create new account and add it to the list as a photo.

Exit user can do many functions that allow him to log in to the system ,take photo by computes camera or enter a facial picture, then the system will make comparison between the stored photo and the photo that entered by exist user it in the system.

The use case of automated attendance system admin can access the database which contains the student details and attendance details. Professors can trigger the application and they can update their details.

Student will get the hall ticket from their registered mail that is generated by the application.

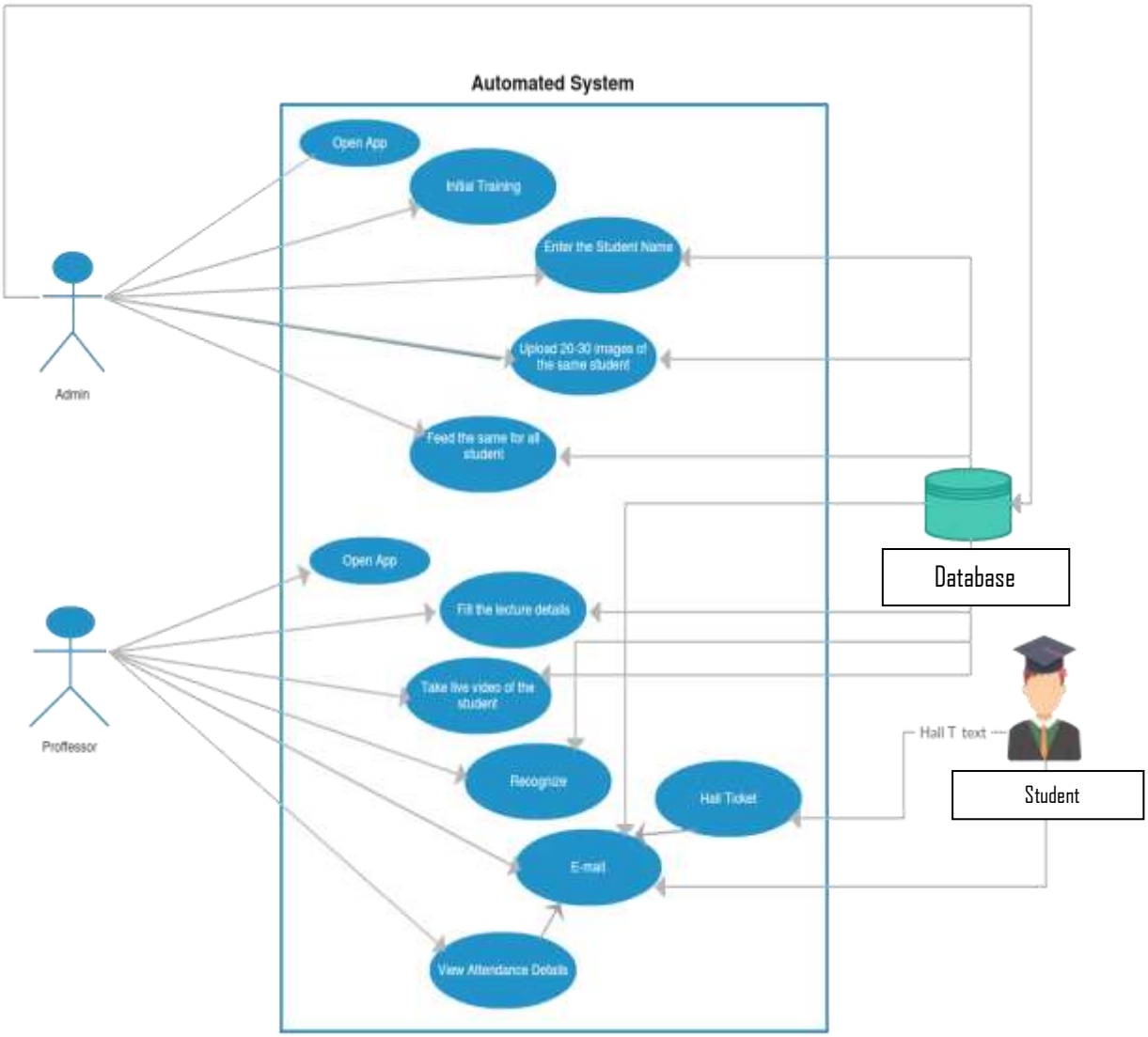

Figure 4.4.1 Use case diagram of automated attendance system

Admin can access the whole information form the database, professor can open application and update their information also their corresponding class student details, and students will get the information of attendance details and hall-ticket for the corresponding semester.

4.4.2 Activity diagram

The Activity diagram is graphical representation of workflow of stepwise activities and action with support for choice, iteration and concurrency. In the Unified Modeling language, activity diagram are intended to model both computational and organizational processes.

If new user wants to use system, first should submit your name, and system register him by storing name and image in database in this way the user has an account for using system again.

This activity diagram taking images for each user either existing or new user is added. After that make sure those images matching with users faces, if matching store in database.

Activity diagram contains different activity that are enrollment of student details also admin, professor details, another process of activity to detect student frontal faces and recognize student information to update attendance details, detected faces that are processed using the machine learning algorithms and training dataset are created to recognize the faces. Training data set are used to compare detected faces with registered user images. If registered images detected then it will update the information as present otherwise marked as absent into the attendance database. Information of attendance details will sent to the professors and hall-ticket for students generated message will be as E-mail. Figure 4.4.2 shows the activity diagram of automated attendance system. Figure 4.4.3 shows the flowchart of automated attendance system.

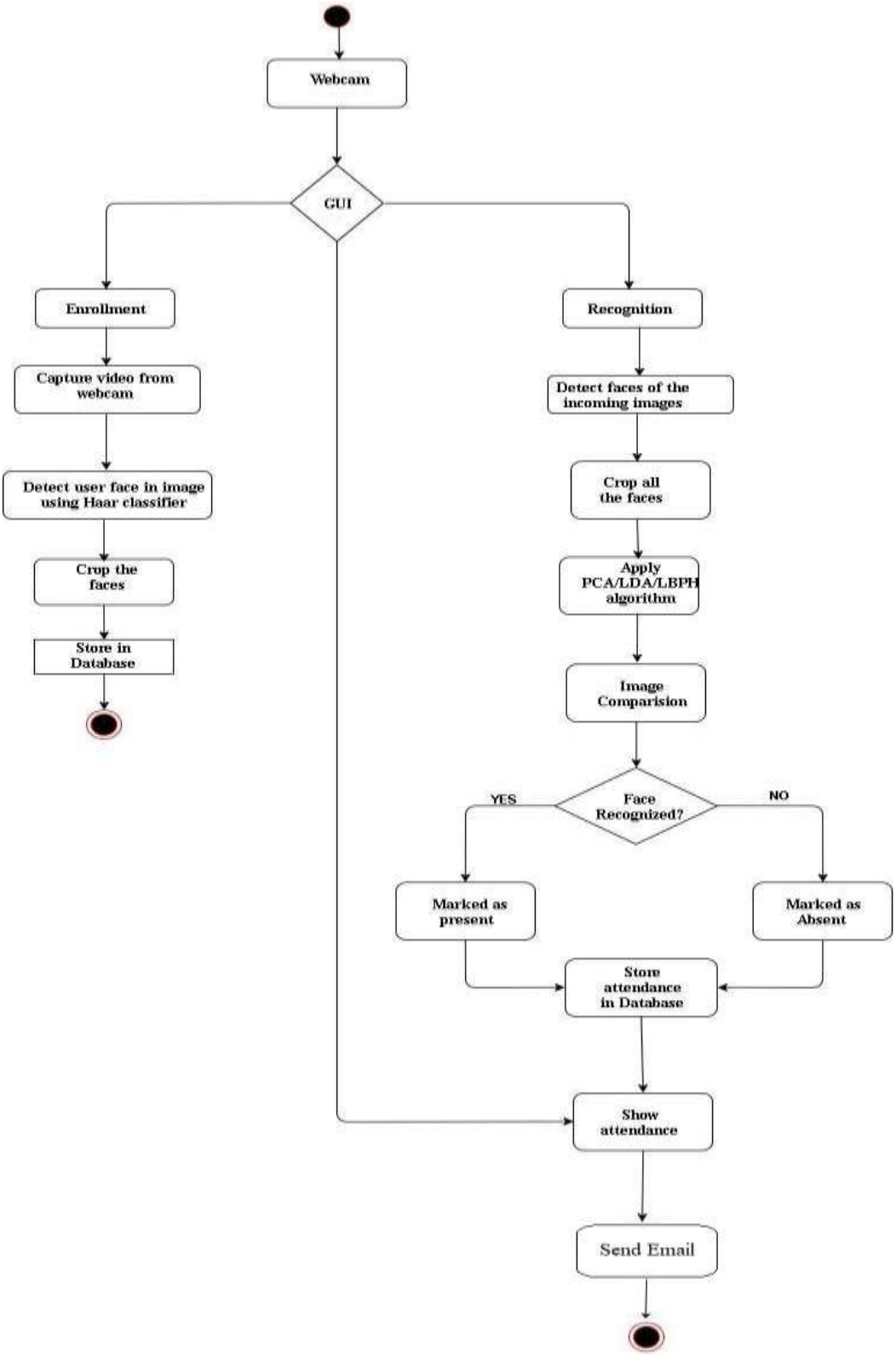

Figure 4.4.2 Activity Diagram of Automated attendance system

4.4.3 Flow chart

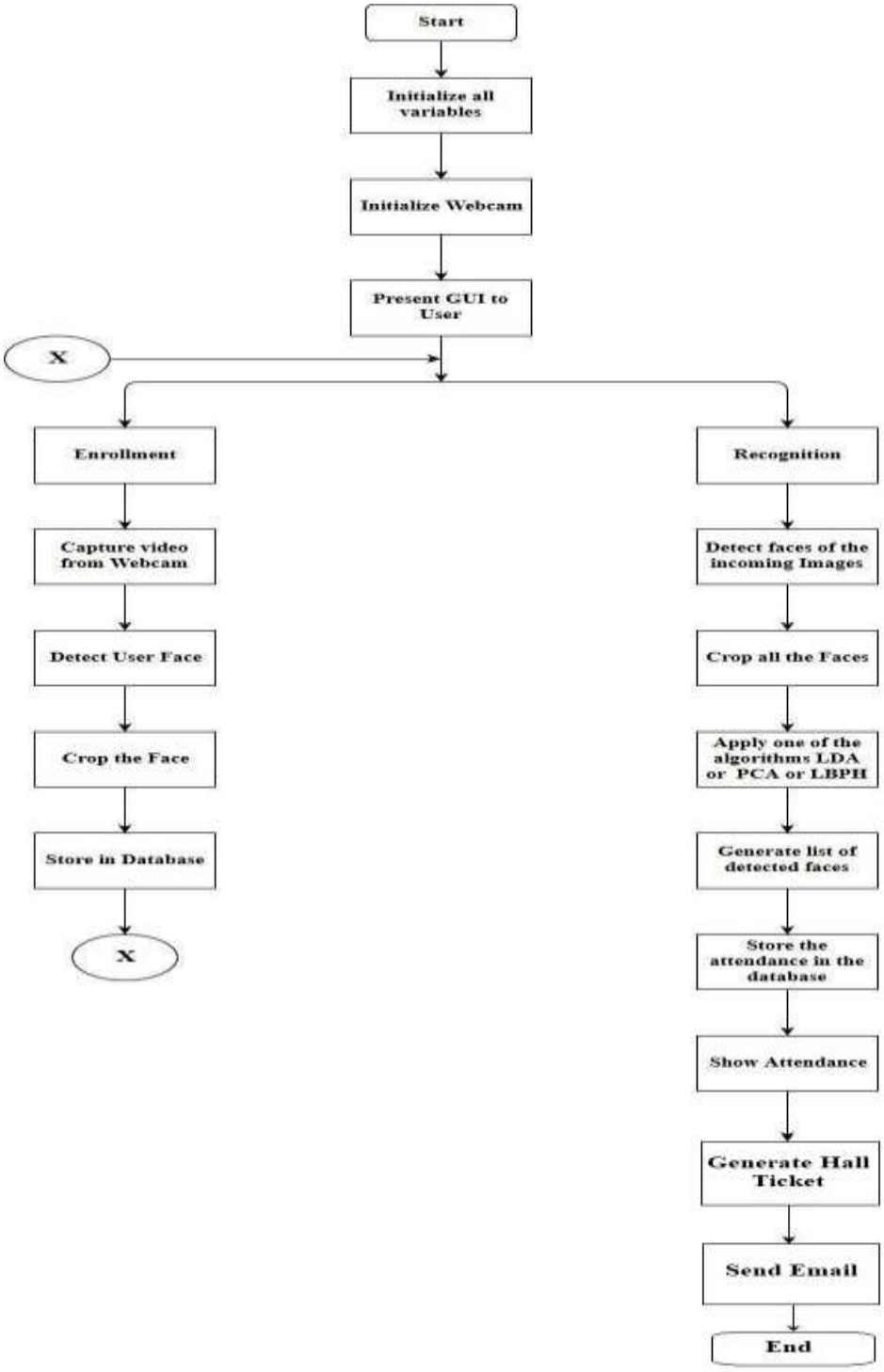

Figure 4.4.3 Flow Chart of Automated attendance system

4.4.4 Sequence diagram

Sequence diagram describes interaction among classes in terms of an exchange of messages over time. Sequence diagrams models the collaboration of objects based on a time sequence. Figure 4.4.4 shows the sequence diagram of automated attendance system

The new user will make new registration as a sign up by interface, the registration requirements will send to the desktop that will send it to the facial system and store it in the data base. Now new account will add to the list in the data base.

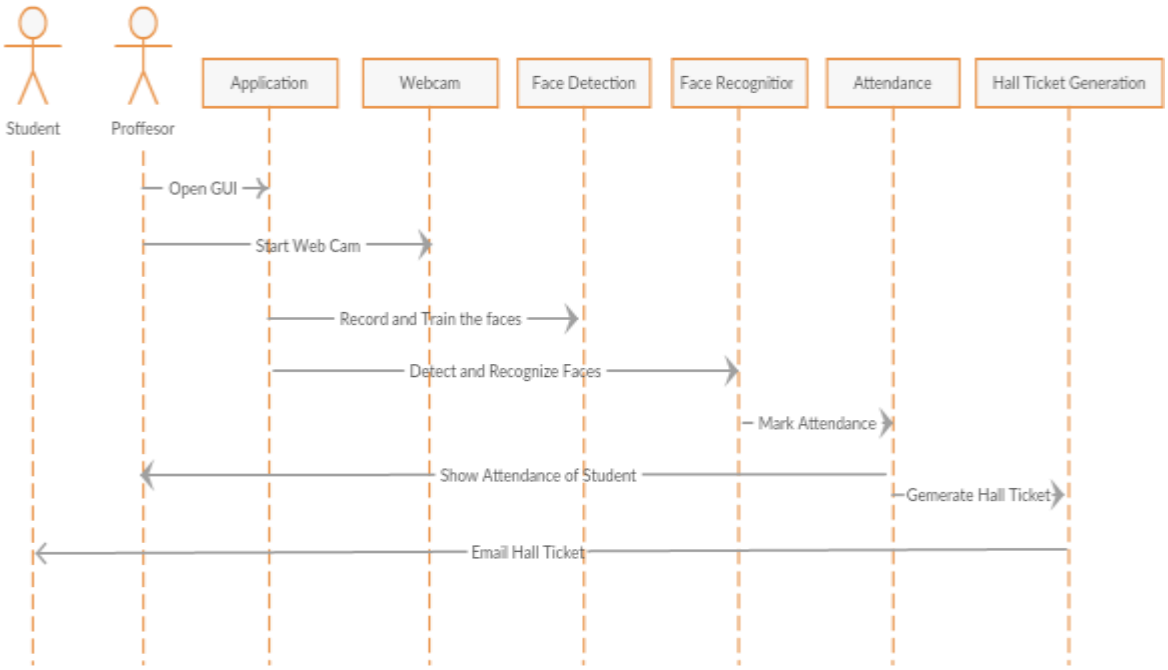

Figure 4.4.4 Sequence diagram of automated attendance system

Professor will start the application, and then webcam will start to capture the image of student in the class room. Webcam will send image to the main system, images are detected and recognized and marked into the attendance, attendance details are send to the professor to know the information of student. Finally hall ticket will be generated that will be send to student through E-mail.

The exist user will make sign in because already has an account, he will take a photo by interface which has a computer's camera that enable the user to take a picture " if the camera not work the user can enter any facial picture in

some constraints" then the photo will be sent to the facial recognition system and it is task to matching the photo inside facial recognition system object.

This enable the system to make comparison between the entered photo and the stored one in the data base, if the matching were more than 70% the system will allow the user see the file by desktop , if the matching were less than 70% the system will not allow the user to see the file ,of the system will allow this user see the files but the files will show as encryption.

4.4.5 Component diagram

In Unified Modeling Language, a component diagram depicts how components are wired together to form larger components or software systems. They are used to illustrate the structure of arbitrarily complex systems. which is shown in Figure 4.4.5

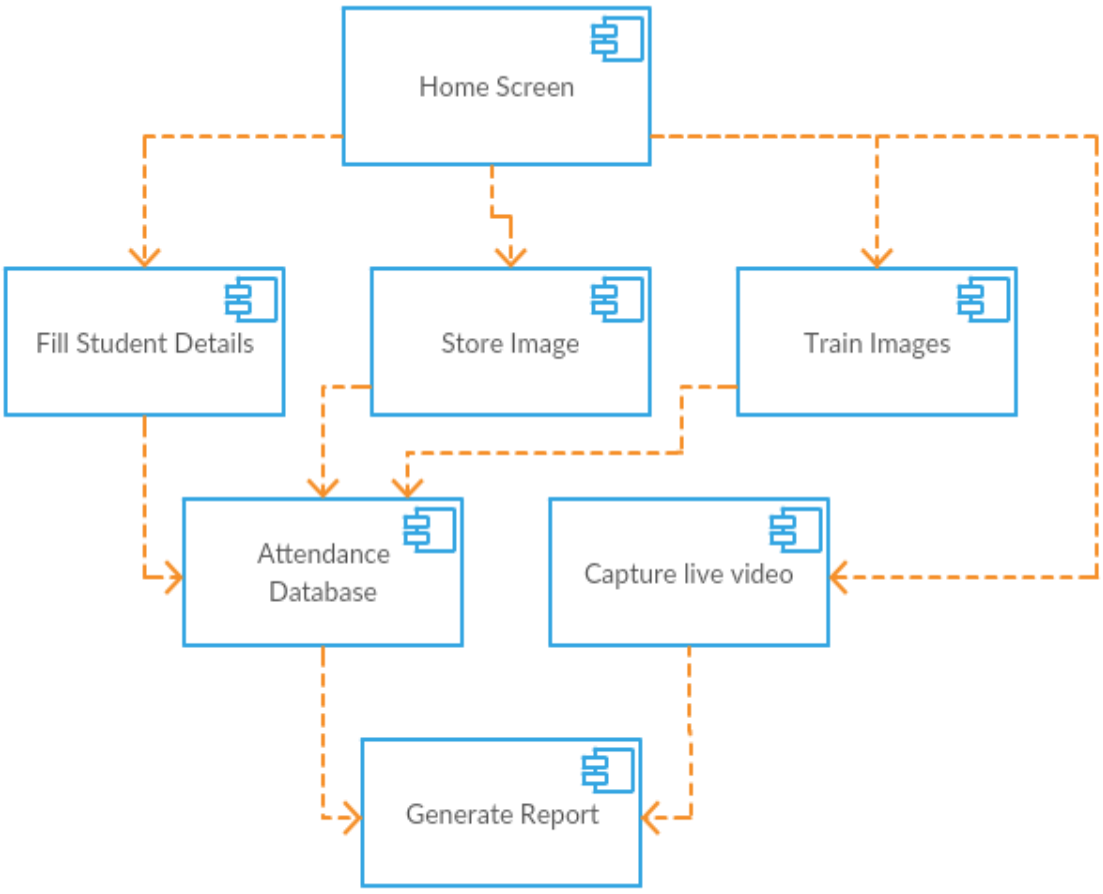

Figure 4.4.5 Component diagram of automated attendance system

The exist user will make sign in because already has an account, he will take a photo by interface which has a computer's camera that enable the user to take a picture " if the camera not work the user can enter any facial picture in some constraints" then the photo will be sent to the facial recognition system and it is task to matching the photo inside facial recognition system object this enable the system to make comparison between the entered photo and the stored one in the data base.

Home screen contains the basic information of Automated attendance system, if we want to update student details then Home screen will linked to File student details, if in case of requirement to train the images then Home screen will linked to the training images.

Attendance details will be stored with use of the database and student information database, training set will required student images to recognize the images

Report generation will be done with generation report component.