Smart Attendance System Using Face Recognition

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ABSTRACT

Face recognition is a challenging problem for computer vision scientists for the last few decades. Hence it was the center of the attention for computer vision researchers. With the rapid technology advancement, face recognition system can be implemented in mobile device such as smart phones. This report will illustrate the process of face recognition in android devices starting from detecting a face until identifying the person when it sees them again. The recognition algorithm is being investigated in depth is the Haar Cascade algorithm. Furthermore the report will cover the literature review of the face recognition problems. The algorithm used in this system is Haar Cascade. The system is not only detecting the faces but also the distance of the facial characters under varying conditions. The proposed system provides the success rate at face recognition is around 93% to 95% and face identification is 99% and gives better result than the existing methods. Therefore, proposed system is more effective, always good in quality of recovering data compared to other existing attendance system. Thus the prospective of enhancing a private device, the management system is well-established on a private cloud sector by internal resources which can be recurrence easily and it makes system more comfortable.

Keywords: Student attendance, Face Recognition, Image Processing, biometric.

I. INTRODUCTION

Student attendance is an important factor for students to succeed in a course. In a certain university, student attendance in a course is also used as one of requirements for student to take the examination. A conventional approach to record student attendance is performed by asking every student to sign on an attendance list that passes through all students during the beginning of lectures. When such application is on mobile devices, the use for it can be extended dramatically. Face recognition subject emerged in the early 1970s; after the establishment of new technologies in the field of image processing and machine learning. Face recognition system is a programthat is used to identify faces automatically and verify the identity of a person from a digital image. In general, the face recognition problem is composed of two stages. First, detecting a face, i.e. finding a face in an image frame regardless of who the person is. Second, identifying whom the person is in the frame. By comparing the features of the detected face to the image faces database the system can identify the person in the image. To be able to label the person in the image, the machine should have been trained beforehand. The training steps involve detecting a face then use some image process techniques to insure the clarity of the face for the application. This paper proposed an attendance system using face recognition by employing

Android smart phone to capture student face. The image was then sent to server for attendance process. A modern approach to record attendance is by using automated attendance system. Several automated attendance system have been proposed byemploying biometric recognition face recognition to recognize students who are present and record their attendance.

Motivation

The main motivation was to explore the image processing capability on android devices. Moreover, I want to create an easy and secure way to access an android device using only the basic hardware of android mobile device i.e. the mobile device's camera Therefore, my objective was to create an android application that canlearn faces then identify them whenever the application sees those faces again. To formulate the problem: given an image with a face in it, how can we detect the face then determine the identity of the person in the image from known people to the system using android device.

Aim

The goal of this research is to build a system that can detect and recognize faces of people using image-processing techniques. Practically, this idea can be implemented in institutions for attendance. The benefits of this system are:

- Use available android phones and servers in corporation.
- Ease the attendance hassle.
- Implement the face detection and recognition algorithms to run over the mobile phones to minimize time and efforts.

Objectives

Our primary goal is to help the lecturers, improve and organize the process of track and manage student attendance and absenteeism. Additionally, we seek to:

- Provides a valuable attendance service for both teachers and students.
- Reduce manual process errors by provide automated and a reliable attendance system uses face recognition technology.
- Increase privacy and security which student cannot presenting himself or his friend while they are not.
- Produce monthly reports for lecturers.
- Flexibility, Lectures capability of editing attendance records.

II. LITERATURE REVIEW

Background History

We as humans use faces to recognize and identify our friends and family.Computers can now also identify people automatically using stored information suchas figure, iris or face to identify a particular person. Earlier many face recognitionalgorithms were used to achieve fully automated face identification process. The firstface recognition system was created in the 1960s. It was not fully automated and itrequired manual inputs of the location of the eyes, ears, nose and mouth on the imagesthen it calculates a distance to some common point the nit compares it to the storeddata. In 1971, Goldstein, Harmon and Lesk used some specific features of the human face such as hair color, nose size and lips thickness trying to automate the

recognitionprocess. The main problem back in the 1960s and 1970s was that manual inputs wererequired. The late 1980s Sirovich and Kirby used Principal component analysis (PCA)a standard liner algebra technique to reduce Face Recognition On Android6thecomplexity of the face recognition problem. In early1990sTurk and Pentland foundthat by Eigen faces techniques, the residual error could be used to detect faces inimages (Turk & Pentland, Face Recognition Using Eigenfaces, 1991).

This was animportant discovery of the history of the face recognition. It enables real-time and automated face recognition [1]. Since then automated face recognition has beenevolving and became a major interest for researcher in image possessing andcomputer scientists. Face recognition and sometime is called face identifying issimply putting a label to known faces just like human as mentioned above, we learnthe faces of our family and celebrities just by looking at their faces. Since the 1970's there was many techniques and algorithms were developed for a machine to learn torecognize known faces. Most of the recent techniques involve at least four steps:

Student Registration

- Face Detection
- Face Preprocessing
- Collecting and Learning the Faces
- Face Recognition

The images are captured using camera module and the extracted facial character will be compared with the existing image. If the face of the student is matched with the facial character stored in the database then the attendance timing for respective student gets started. The earliest pioneers of facial recognition were Woody Bledsoe, Helen Chan Wolf and Charles Bisson. In 1964 and 1965, Bledsoe, alongwith Wolf and Bisson began work using computers to recognize the human face. Due to the funding of the project originating from an unnamed intelligence agency, much of their work was never published. However it was later revealed that their initial work involved the manual marking of various "landmarks" on the face such as eye centers, mouth etc. These were then mathematically rotated by a computer to compensate for pose variation. The distances between landmarks were also automatically computed and compared between images to determine identity. These earliest steps into Facial Recognition by Bledsoe, Wolf and Bisson were severely hampered by the technology of the era, but it remains an important first step in proving that Facial Recognition was a viable biometric. Launched in 2006, the primary goal of the Face Recognition Grand Challenge (FRGC) was to promote and advance face recognition technology designed to support existing face recognition efforts in the U.S. Government [2]. The FRGC evaluated the latest face recognition algorithms available. High resolution face images, 3D face scans, and iris images were used in the tests. The results indicated that the new algorithms were 10 times more accurate than the face recognition algorithms of 2002 and 100 times more accurate than those of 1995, showing the advancements of facial recognition technology over the past decade. Back in 2010, Facebook began implementing facial recognition functionality that helped identify people whose faces may feature in the photos that Facebook users update daily. The feature was instantly controversial with the Smart attendance using face recognition news media, sparking a slew of privacy- related articles. However, Facebook users by and large did not seem to mind. Having no apparent negative impact on the website's usage or popularity, more than 350 million photos are uploaded and tagged using face recognition each day.

Related Work

There have been various techniques used to develop Attendance management system (AMS). Some of these techniques used Radio Frequency Identification (RFID), fingerprint, iris, palm, print, voice etc. For instance, a wireless attendance management system that used Iris identification was proposed by [3]. The system consisted of three modules: Iris verification and identification module, Iris management module and Wireless communication module. The implementation of the system was carried out with Daugman. Local Binary Pattern Histogram algorithm was used to design an application for both facial detection and identification of students by [9]. The algorithm identifies face by matching some parameters in which the algorithm was trained. An Embedded Computer-based Lecture Attendance Management System based on a single chip computer was used to capture the lecture attendance of different students. The identity of each student was validated through a card reader interface with a computer system. An efficient management system based biometric design was proposed by [4]. The system takes attendance electronically with the aid of a fingerprint device. The attendance stored in a database was marked after the identification of students. Sirovich and Kirby proposed a facial recognition approach that used Eigen face technique. The Eigen face recognition utilized information from the raw pixel image for training and classifying image identity. He suggested that the system can be used as the basis for the development of android applications such as android mobile security application and as an archive for the recognition of human identity. [4] proposed a RFID employee attendance system that was incorporated into a database system. The RFID attendance system was developed using components such as tags which was used as a replacement of IDcards and a reader device that could read the information related to an employee attendance. The system has the ability to store the information of all employee. Their experiment was conducted on a sample of 60 students, enrolled in a particular course. Based on experiment, the total time taken to record the attendance of a class of 60 students by manual entry took about 10 minutes while120 seconds was taken to take the attendance of 60 students using barcode and RFID technology [4].

Attendance Management System could be made smarter by using facial recognition technique based on Viola–Jones and Eigen faces algorithms developed on Android-based device. Implemented Feature-based approach also known as local face recognition system, used in pointing the key features of the face like eyes, ears, nose, mouth, edges, etc., Numerous algorithms and techniques have been developed for face recognition but the concept to be implemented here is Deep Learning. Proposed system tackles the predicament of recognition of faces in biometric systems subject to different real time scenarios such as illumination, rotation and scaling [1].

III. OVERVIEW OF FACE RECOGNITION USING OPEN CV

System Design

The proposed automated attendance management system uses a face recognition algorithm. The distance between the face parts is first calculated and then to be stored in the system. The facial characters stored are to be compared with thereal time image of the students. When the student enters the classroom the system starts identifying the faces of the students. The time for the period also gets started and the system now detects the faces and extracts the facial characters of the students. The extracted facial character will be compared with the database image. If the face ofthe student is matched with the facial character stored in the database then the attendance timing for respective student gets started.
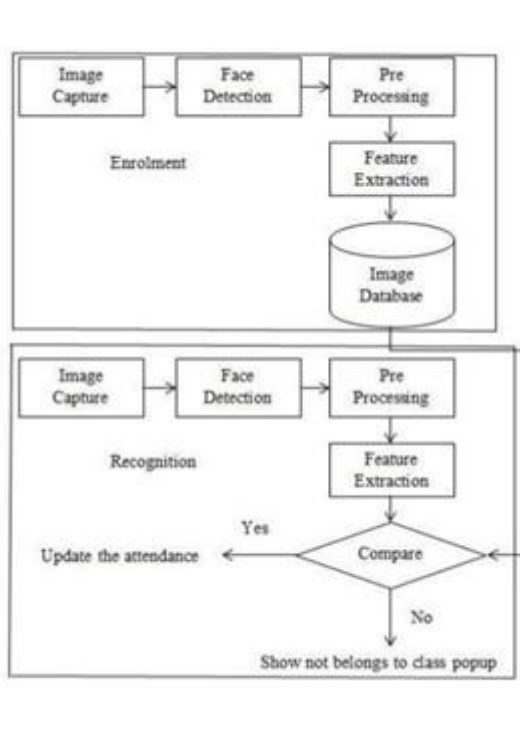
Fig. 3.1 : System Architecture

System Analysis Client

We have used Xml to create login page and Java to build login page, Add student, etc. In android we used xml for designing our layouts because xml is a lightweight language so it does not make our layout heavy.

Java is used for programming parts and it is a technology of choices for building app using managed code that can execute on mobile devices. Java files are the files where all the process occurs and allows users to interact with the system. Xml and Java are both portable standards. The result of using the combination of these two technologies is portable, reusable data and portable behavior.

The proposed system describes a simple and easy software implementation of face detection using OpenCV which helps in detecting and recognizing faces from a captured image input which is open source and can be used. Both real time face detection and face detection from specific images, i.e. Object Detection, is carried out and the proposed system stored the faces detected. The Functionality of this system is mainly categorized in following steps. To enroll and detect faces using camera module of an android device. The code imports certain modules that enable functions such as face recognition.

Open CV Library

OpenCV (Open Source Computer Vision) is a library that was designed by Intel to process images, because it was meant for image processing it is loaded with many of algorithms and functions to help computer scientists solve vision related problems. OpenCV offers applications that will help to train cascade classifier. In addition, OpenCV provide three face recognition algorithms built-in. Early 2010 OpenCV starts supporting android (OpenCV Dev Team, 2013).Since then the OpenCV4Android being developed to accelerate the development of OpenCV for Android. "OpenCV4Android (OpenCV DevTeam, 2013). Since then the OpenCV4Android being developed to accelerate the development of OpenCV for Android. "OpenCV4Android is the official name of the Android port of the OpenCV library" (OpenCV Dev Team, 2013). Most OpenCV

functionality are ported to Java API, which means the API is not yet mature leading to some lack of functions that areavailable in the full version[7].
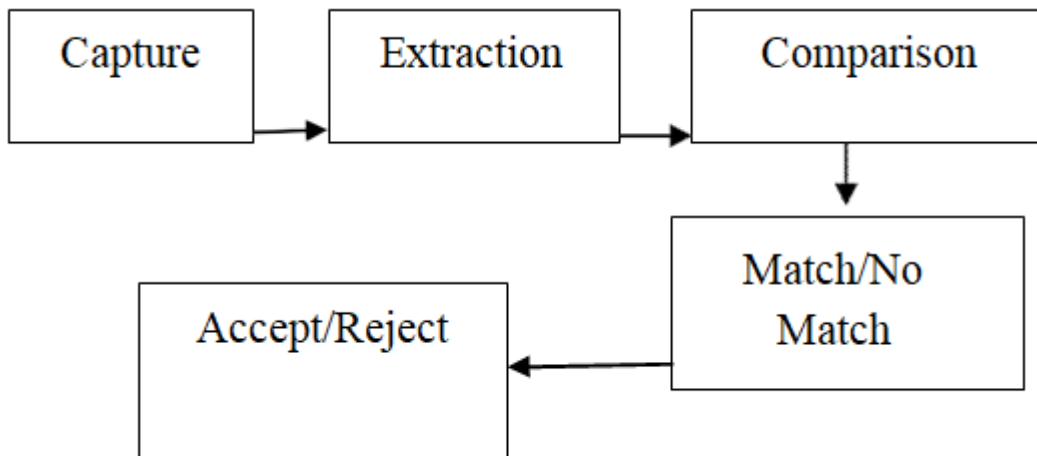

Fig. 3.2 : Stages for Authentication technique

Driver API's

APIs are intended for use by an application or computer. Into our Project user initiates to add the data of student then the application will use an API to ask the web server to store the student's data in its database. The API is the middleman between our application and the web server. And every time you use software to communicate with other software or online web servers, you're using APIs to request the information you need.

Server

What is a database server?

It is similar to data warehouse where the website store or maintain their data and information. A Database Server is a computer in a LAN that is dedicated to database storage and retrieval. The database server holds the Database Management System (DBMS) and the databases. Upon requests from the client machines, it searches the database for selected records and passes them back over the network.

A database server can be defined as a server dedicated to providing database services. Such a server runs the database software. A database server can typically be seen in a client-server environment where it provides information sought by the client systems.

Problem Definition

Face recognition is an important part for the purpose of taking Attendance. Hence there is a need for an efficient and cost effective System. The goal of this research is to build a system that can detect and recognize faces of people using image-processing techniques.

Practically, this idea can be implemented in large placesto provide security.

Feasibility Study

Here user have to analyse one important thing that this work is not only to support large volume of data but to preserve integrity, calculate the performance of time factor, graphically representation of query processing and execution i.e. the time required to get the answer of the query is also been considered to provide answer to give

the proper result. Thus the system is fully technically feasible. This provides all the facilities required that in the both front end and back end are native to it so there isno problem of compatibility. The system contains the existing resources which are efficient for developing and no extra hardware is required. Thus the system is economically feasible.

IV. SYSTEM IMPLEMENTATION AND TESTING

Software Design
It includes Android Studio, OpenCV, API/PHP Web Services, MySQL, Android Device with a camera module.
Android Studio
Android Studio is the official integrated development environment (IDE) for android application development. The Android studio contains one or more modules with resource files and source code files. These includes different types of modules :
- Android app modules
- OpenCV Library modules

By default, Android Studio display our project files in the android project view, as shown in below image. This view is formed by modules to provide quick access to our project's key source files.

These builds files are visible to the top-level under Gradle Scripts. And the app modules contains the following folders:
- Manifests :- It contains the AndroidManifest.xml files.
- Java :- It contains the source code of java files, including JUnit test code.
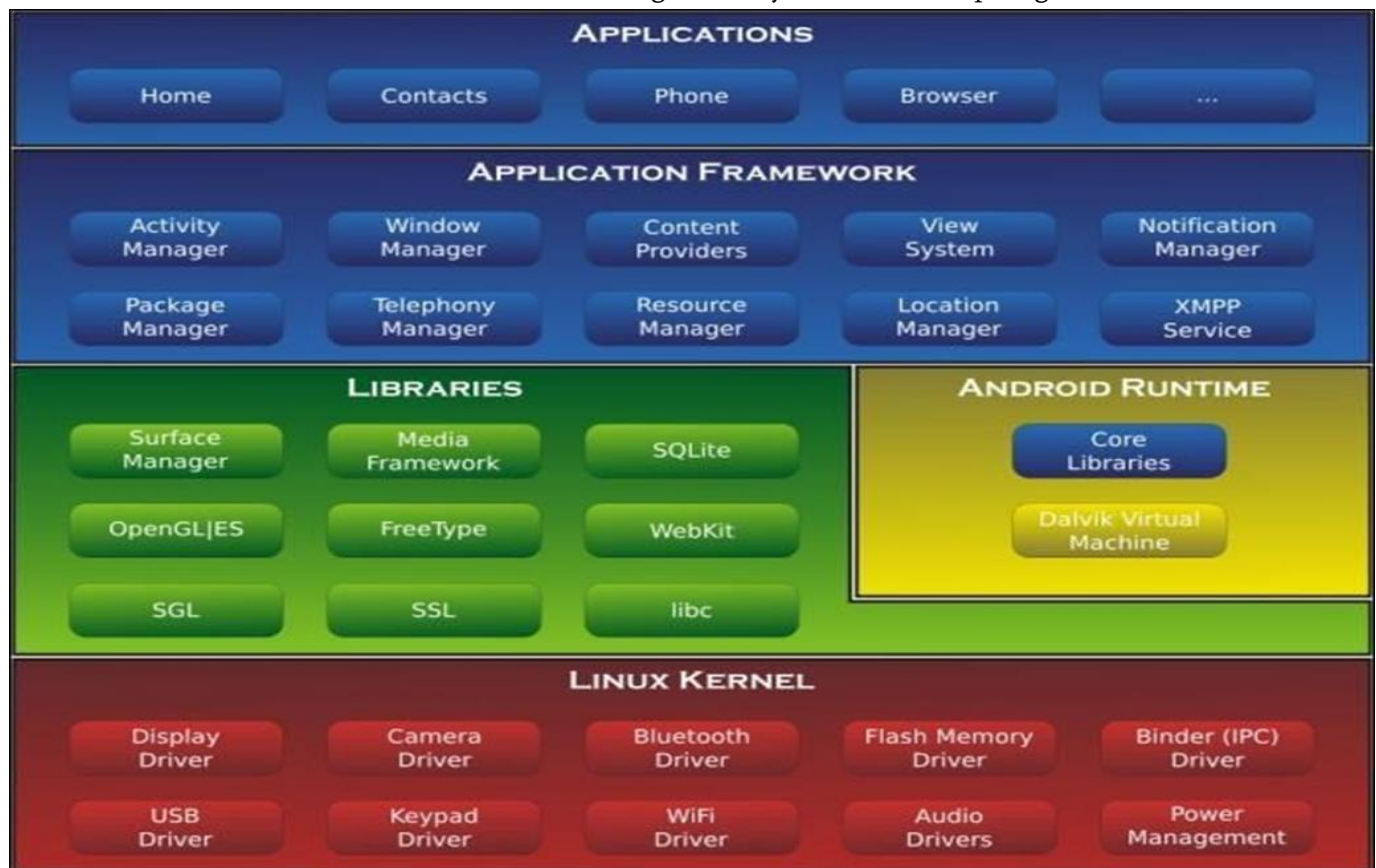- Src :- It contains all non-code resources, UI string, XML layouts, and bitmapimages.

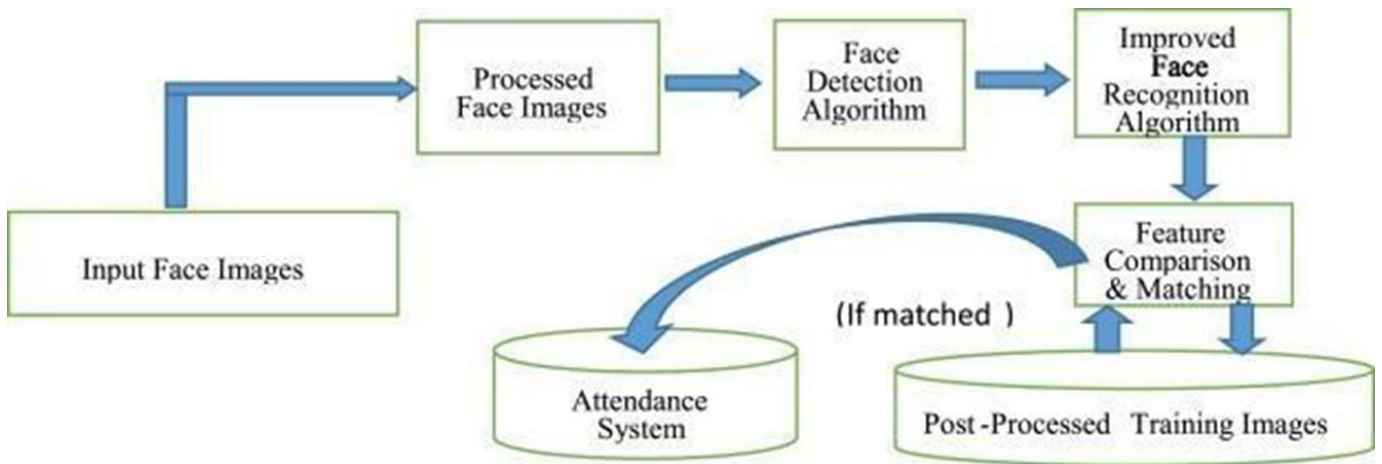Fig. 4.1 : Android's Architecture Diagram

Fig. 4.2: Face Detection and recognition system overview
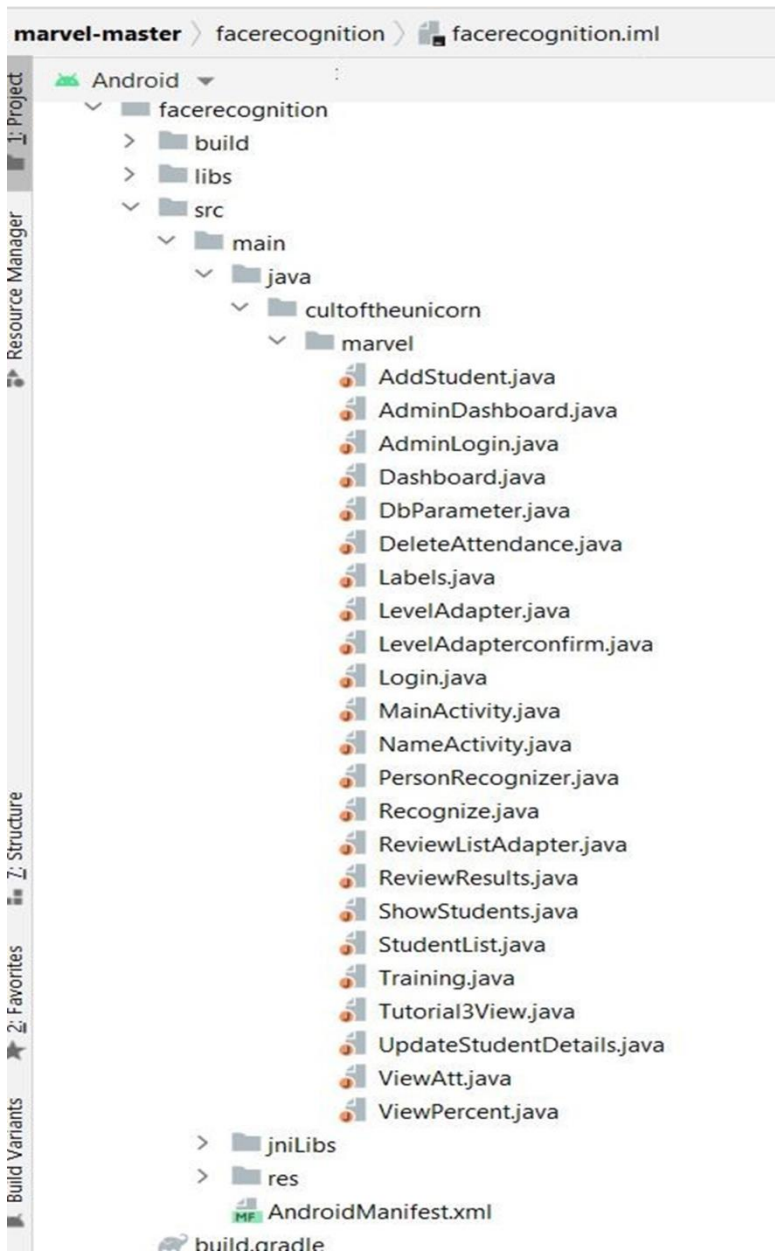
Source Files in Android Studio

Fig. 4.3 : Android's File Structure

OpenCV

Given an image, which can come from a file or from live video, the face detector examines each image location and classifies it as "Face" or "Not Face." Classification assumes a fixed scale for the face, say 50x50 pixels. Since faces in an image might be smaller or larger than this, the classifier runs over the image several times, to search for faces across a range of scales. This may seem an enormous amount of processing, but thanks to algorithmic tricks, explained in the sidebar, classification is very fast, even when it's applied at several scales. The classifier uses data stored in an XML file to decide how to classify each image location. The OpenCV download includes four flavors of XML data for frontal face detection and one for profile faces. It also includes three non- face XML files - one for full body (pedestrian) detection, one for upper body, and one for lower body.

Haar-Cascade

Face detection is performed by using Haar-Cascade Classifier with OpenCV. Haar Cascade algorithm need to be trained to detect human faces before it can be usedfor face detection. This is called feature extraction. The haar-cascade training data used in an xml file.
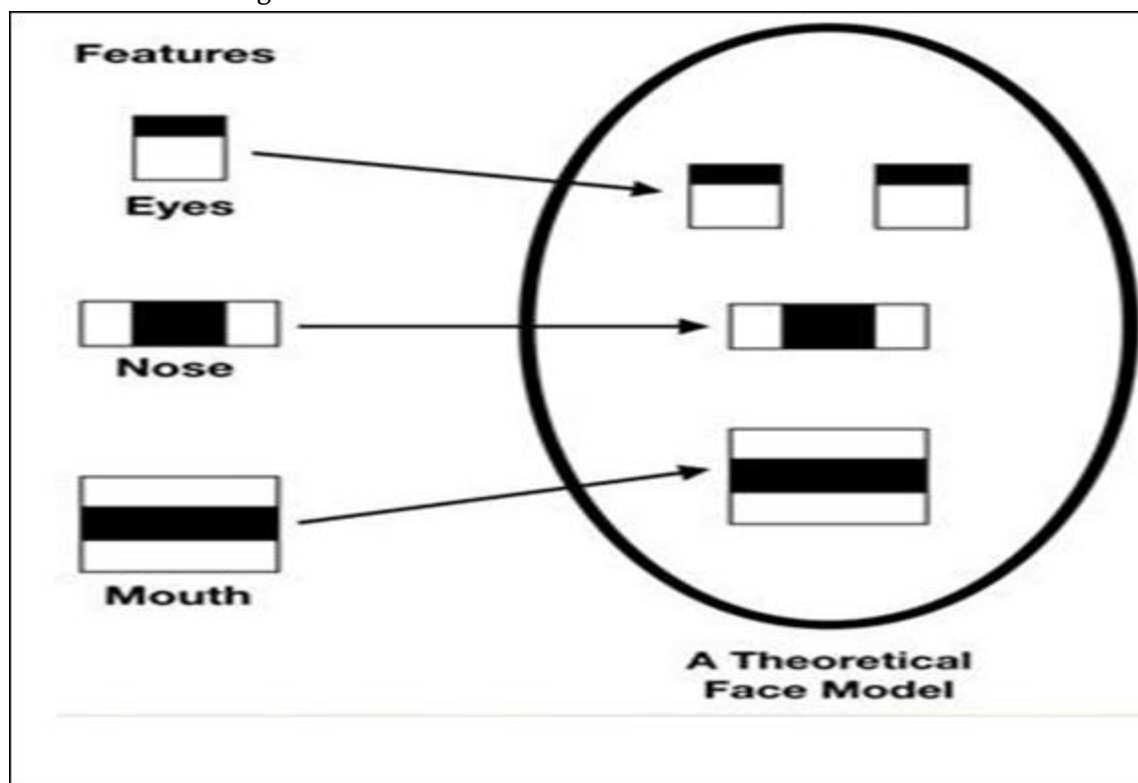

Fig. 4.4 :Haar Feature Extraction

A Haar wavelet is a mathematical function that produces square-shaped waveswith a beginning and end and used to create box shaped patterns.

Face detection on a human face is perform by matching a combination of different Haar-like- features. For example, forehead, eyebrows and eyes contrast as well as the nose with eyes as shown in above figure.

Here we are using detect Multi Scale module from OpenCV. This is required to create a rectangle around the faces in an image.

It has got three parameters to consider- scale Factor, min Neighbors, min Size.Scale Factor is used to indicate how much an image must be reduced in each image scale.

Min Neighbors specifies how many neighbors each candidate rectangle must have. Higher values usually detect less faces but detects high quality in image. Min Size specifies the minimum object size. By default it is [8]. The parameters used in this system is scale Factor and min Neighbors with the values 1.3 and 5 respectively [5] .

API

An application programming interface is a set of rules that define how computers, applications, or machines can talk to each other. You can think of it this way: the typical user interface is intended for use by a human being, while APIs are intended for use by an application or computer.

Most web APIs sit between the application and the web server. The user initiates an API call that tells the application to do something, then the applicationwill use an API to ask the web server to do something. The API is the middleman between the application and the web server, and the API call is the request. And everytime you use software to communicate with other software or online web servers, you're using APIs to request the information you need.

It's important to note that while web APIs are the most common, APIs aren't limited to the web. There are APIs for virtually every machine or system that expects to interact with other machines or systems.
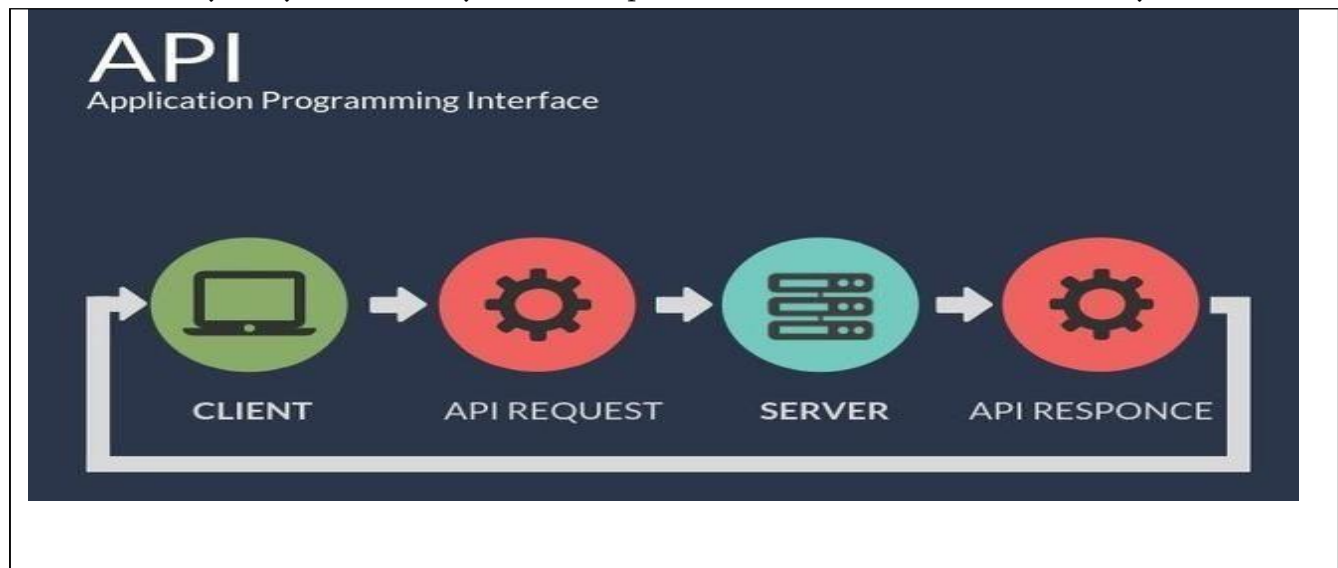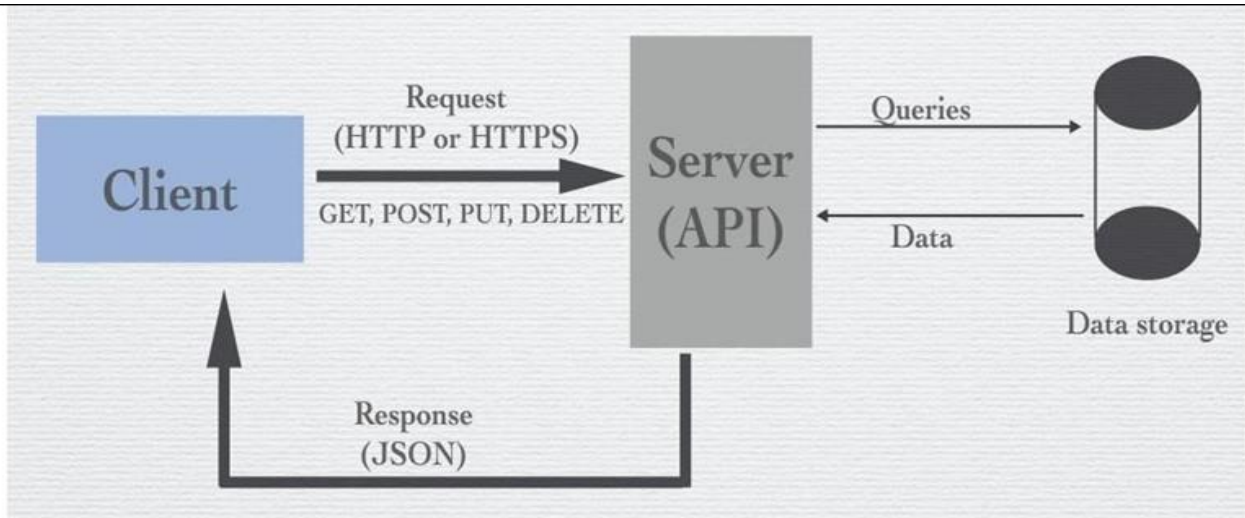

Fig. 4.5 : Implementation of API's in Smart Attendance

Fig. 4.6 :API Workflow

PHP

Is a server side scripting language that designed for web development, as well as used for general purpose language. The PHP code can be combined with several web frameworks and templating engines or simply it can be mixed with HTML code. The PHP code is generally processed by a PHP interpreter, which is commonly executed as native module of web server or a Common Gateway Interface (CGI) executable. After interpretation and execution of the PHP code, the results will be sent by web server to its client. Zend Engine has powered the standard PHP interpreter, which is free software liberated under the PHP license. There are many versions of the PHP, and the version, I have used for my application is the PHP. PhpMyAdmin It is an open source tool and also, it is free written in PHP, XHTML, CSS, and JavaScript planned to manage the administration of MySQL by using of a web. It is able to perform various missions like creating, modifying databases, tables, fields, executing SQL statements or managing and supervise users.

Database MySQL

Database is the collection of face images and extracted images. And also database is a collection of information that is organized so that it can easily be accessed, managed and updated.

A database provides for storing and controlling information of student such as name of student and registration number of each students.

The first step in the Attendance System is the creation of a database of faces that will be used. Different individuals are considered and a camera is used for the detection of faces and the recording of the frontal face. The number of frames to be taken for consideration can be modified for accuracy levels. These images are then stored in database along with the Registration ID. The core of the MySQL database is the MySQL Server. This server is available as a separate program and responsible for handling all the database instructions, statements, or commands. The working of MySQL database with MySQL Server are as follows:

MySQL creates a database that allows you to build many tables to store andmanipulate data and defining the relationship between each table.

Clients make requests through the GUI screen or command prompt by usingspecific SQL expressions on MySQL.

Finally, the server application will respond with the requested expressions andproduce the desired result on the client-side.
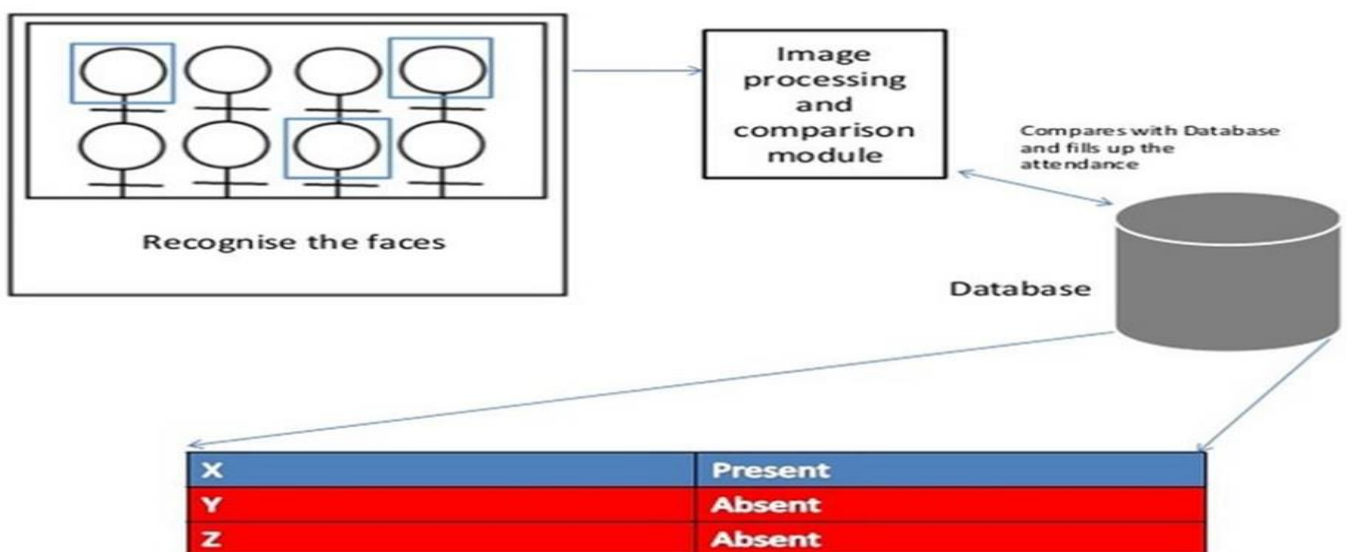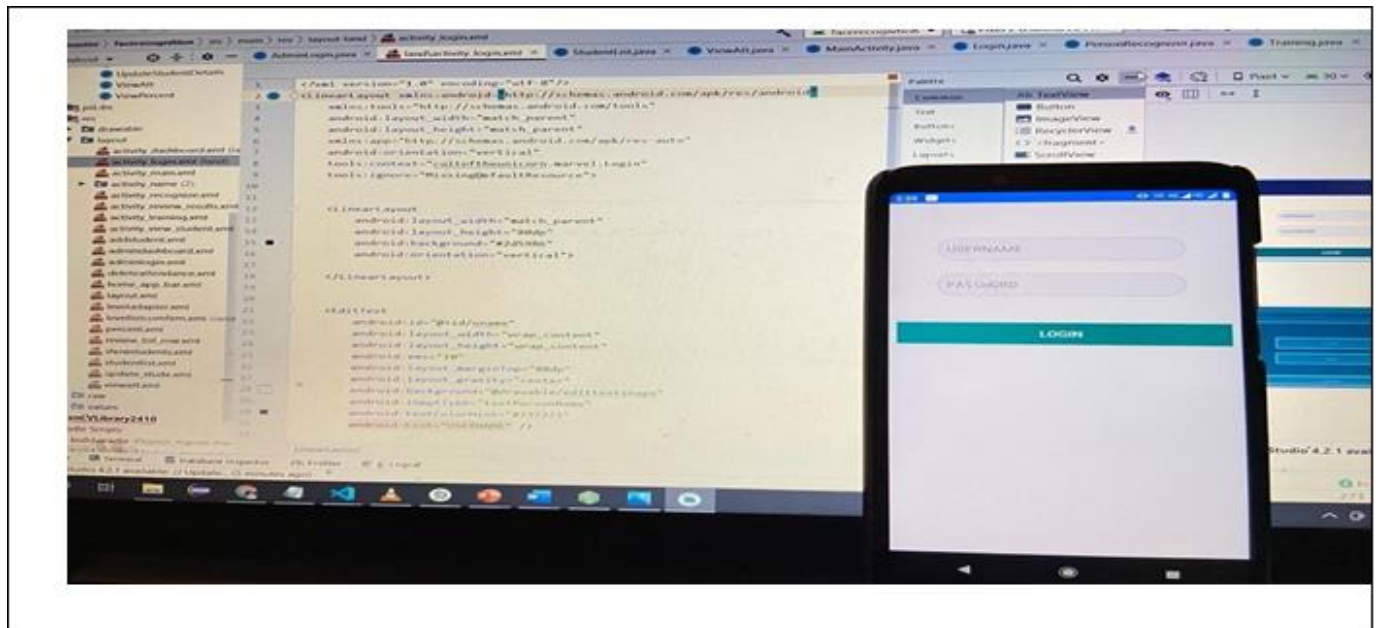
## Basic Structure

Fig. 4.6 : Basic Structure

Table 4.1 : Database Table

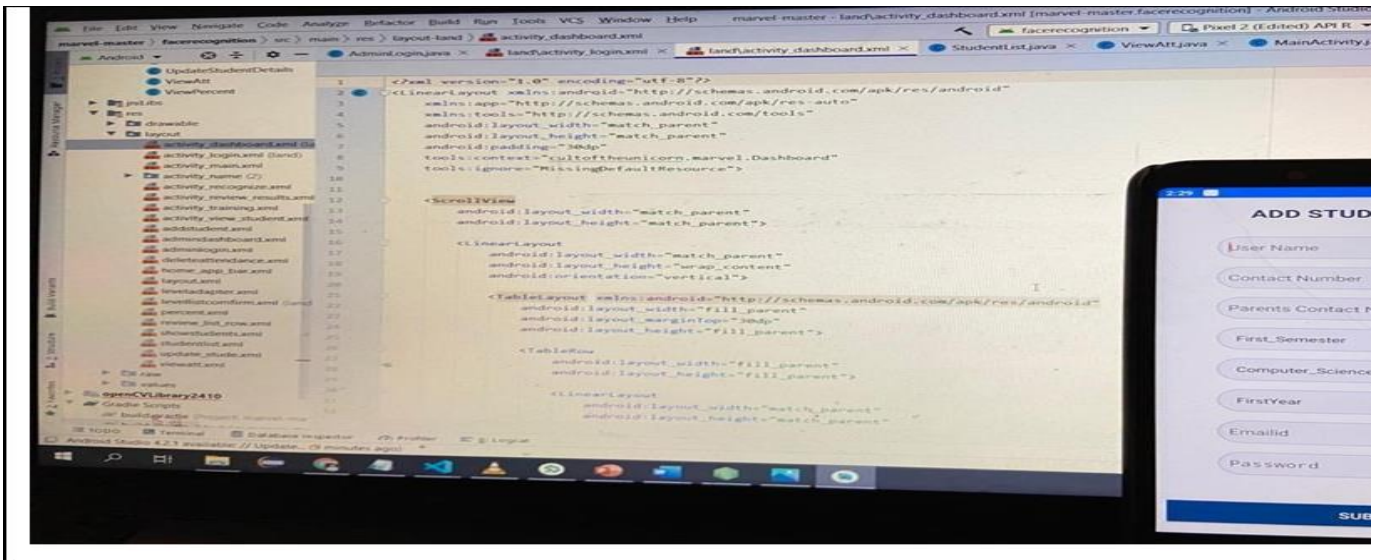| Uid	Uname	Branch	Year	Sem	Contact	Email-id	Attendance
123	anagha	CSE	Final	8th	9604341335	ak@gmail.com	P
124	payal	CSE	Final	7th	7972715744	ppj@gmail.com	P
125	raj	IT	First	2nd	9130162638	raj@gmail.com	A
126	sumit	CSE	Second	4th	8390586560	sumit@gmail.co m	A

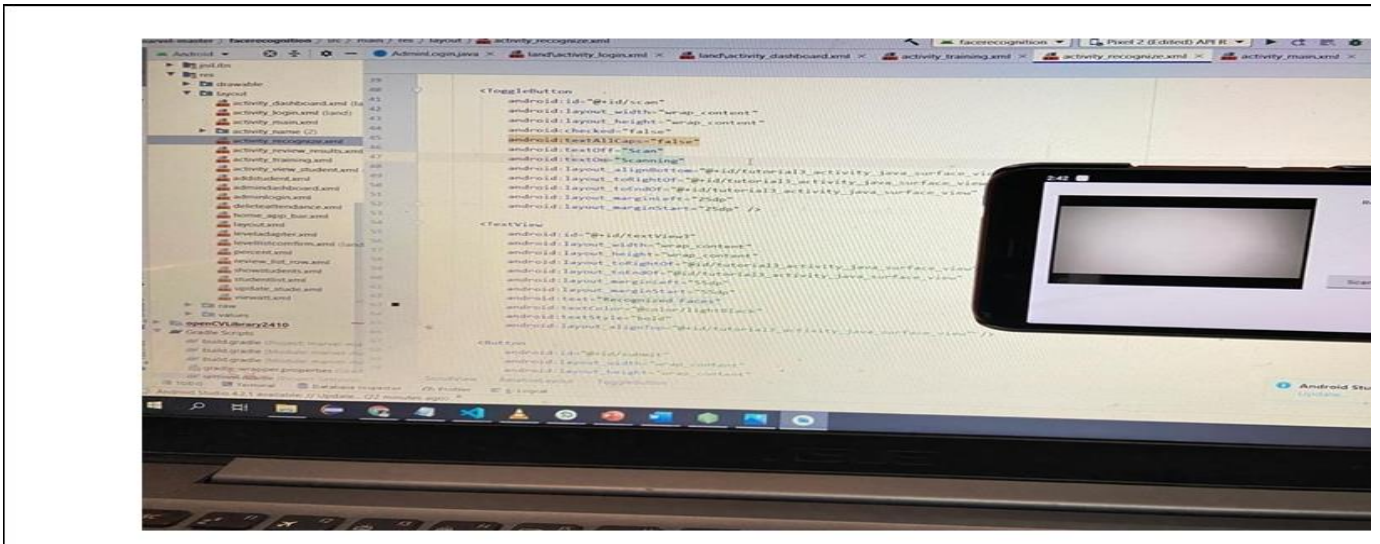## System Execution Details with snapshots
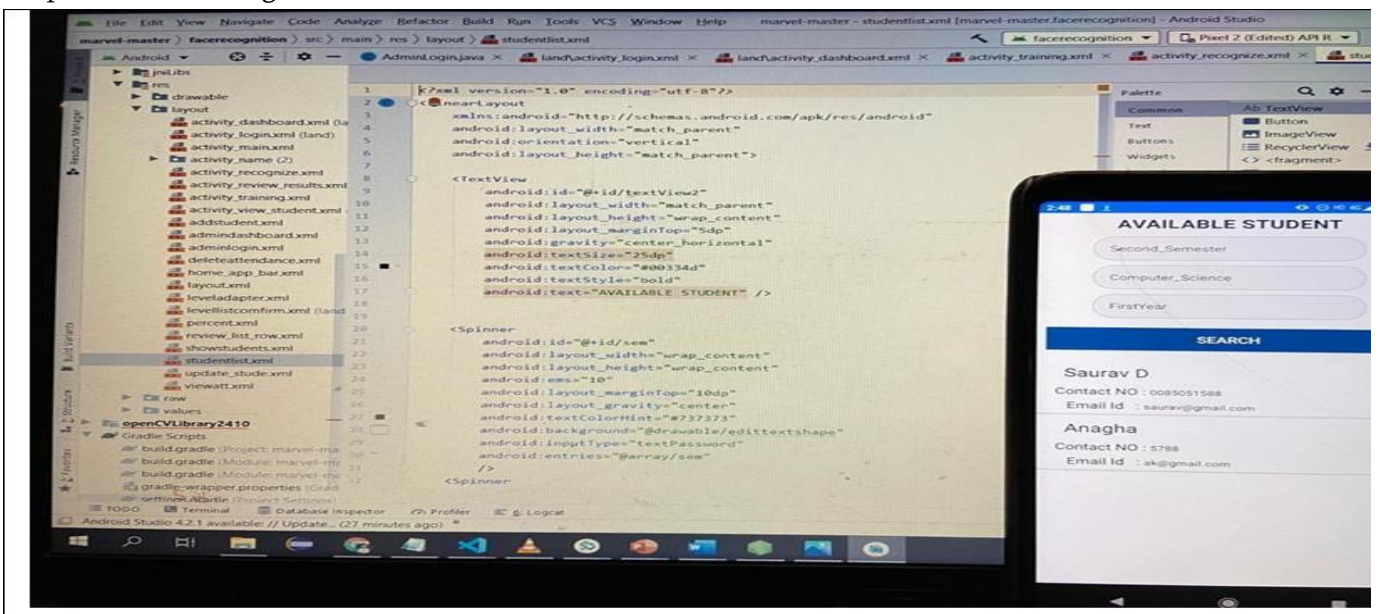

Snapshots 4.1 : Admin Login
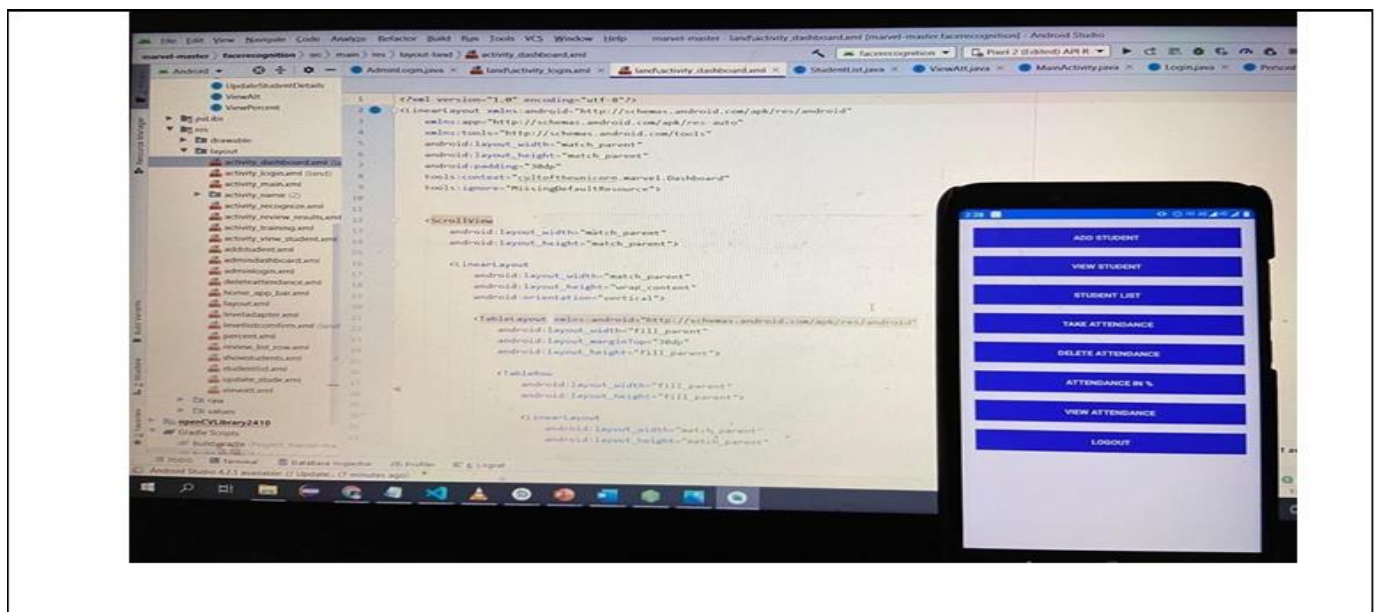
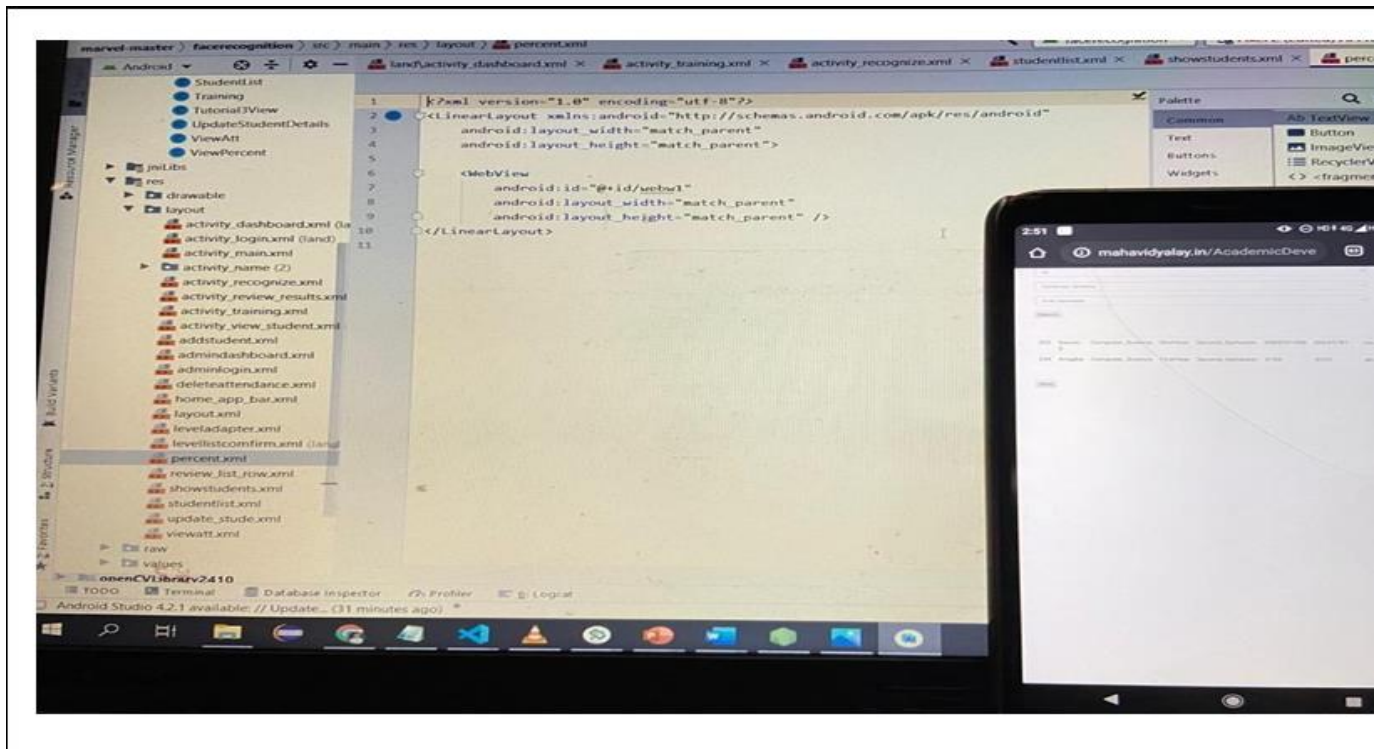Snapshots 4.2 : Admin Dashboard

Snapshots 4.3 : Adding the Student with Information

Snapshots 4.4 : Taking the Students Attendance

Snapshots 4.5 : Students List

Snapshots 4.6 : Viewing Attendance

V. ADVANTAGES AND LIMITATIONS

Advantages

- **Easy to Manage :** Since the artificial intelligence based attendance system is fully automated, managing the records and keeping a track of day to day activities will become much easier than the manual system.
- **Cost Effective :** As the whole process will be done by a computer, it means the total attendance registration and calculation will be automated and done by the system itself, therefore, saving us the money which would have been otherwise spent o the labor cost to do that.
- **Time Saving :** As you can work remotely and still see who all are coming and going. This calls for the point that, this whole system is much faster and time saving method to record attendance.

Limitations

- The quality of the reference images plays an important role in the identification process. If the resolution of the said images is not high enough, it can cause camera to be tricked into believing that the person being scanned is not the sameas in the photo.
- Depending on the quality of the input data, a system would need an appropriate amount of storage. This could be troublesome if the data collected is of high quality and requires large amount of storage space especially for events with a large expected attendance.
- Inconsistency in data entry and generate data errors.
- System is fully dependent on skilled individuals.
- Entry of false information.
- Lack of security.
- Duplication of data entry.

VI. CONCLUSION

This system aims to build an effective class attendance system using face recognition techniques. The proposed system will be able to mark the attendance via face Id. It will detect faces via webcam and then recognize the faces.

After recognition it will mark the attendance of the recognized student and update the attendance record.

VII. FUTURE SCOPE

The system we have developed as successfully able to accomplish the task of marking the attendance in the classroom automatically and output obtained in an excelsheet.

Another important aspect where we can work is towards creating the databaseof the attendance and its automatic updating. Hence maintaining attendance automatically with the help of face recognition will be very helpful and less prone to errors as compared to manual process.

This will also reduce manipulation of attendance record done by students andit will save time as well.

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