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Face Recognition Attendance System

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Abstract: ***The management of the attendance can be a great burden on the teachers if it is done by hand. To resolve this problem, smart and auto attendance management system is being utilized. The execution of the algorithm had to run on the mobile phone, so there was need for a lightweight image recognition algorithm.***
By utilizing this framework, the problem of proxies and students being marked present even though they are not physically present can easily be solved. When a user takes a picture of a human, our application searches related information in a database using image recognition.
Since a user of the application can take a picture under different circumstances, the used image recognition algorithm had to be in variant to changes in illumination and view point. By computing the distances between the vectors of an unknown image and known database images, a best match can be selected.
Android is flexible and provides many tools for developing applications. We explored, evaluated and used many of Android's possibilities.
Keywords: Attendance system, automated attendance, Image Processing, Face detection, Feature matching, Face recognition.

I. INTRODUCTION

Human face plays an important role in our day to day life mostly for identification of a person. Face recognition is a part of biometric identification that extracts the facial features of a face, and then stores it as a unique face print to uniquely recognize a person.

Attendance systems of old practices are not quite efficient now a days for keeping track on student's attendance. Student enrolment in schools and colleges increasing every year and taking each student attendance plays a very vital role. So, it is necessary to discuss the effective system which records the attendance of a student automatically. [6, 7]. Maintaining the attendance is very important in all the schools/colleges for checking the performance of students.

Every school/college has its own method in this regard. Some are taking attendance of students manually using attendance registers or marking attendance sheets or file based approach and some have adopted the methods of automatic attendance using some biometric techniques.

But in these methods, students have to wait for a long time in making a queue at the time they enter inside the classroom. [6, 7]. Many biometric systems are available in the market but the key authentications are same in all of the techniques. Every biometric system consists of enrolment process in which the unique features of a person is stored in the database and after that, there are some processes of identification and verification of the person. These two processes compare the biometric feature of a person with previously stored template captured at the time of enrolment of a student. Biometric templates can be of many types like Fingerprints, Eye Iris, voice etc.

Our system uses the face recognition approach for the automatic attendance of the students in the classroom environment without student intervention. The purpose of developing the new attendance management system is to computerize the traditional methods of taking the attendance.

Therefore, in order to drag the attention of students and make them interactive in observing technologies, we try to move on to the latest upcoming trends on developing attendance systems. This is the reason for college/school attendance management system to come up with an approach that ensures a strong contribution of students in classrooms. [6]. There are many different face recognition algorithms introduced to increase the efficiency of the system [9]. The system provides an increased accuracy due to the use of a large number of features like Shape, colour, wavelet, Auto Correlation etc. of the face. However, the face recognition still remains a challenging problem for us because of its fundamental difficulties regarding various factor like illumination changes, face rotation, facial expression etc. [10].

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II. LITERATURE SURVEY

One of the most successful applications of image analysis and understanding, face recognition has recently received a significant attention, especially during the past few years. In addition to this, the problem of machine recognition of human faces continues to attract researchers from disciplines such as image processing, pattern recognition, neural networks, computer vision, computer graphics and psychology [1].

The strong need for user-friendly systems that can secure our assets and protect our privacy without losing our identity in a sea of numbers is obvious.

We as humans use faces to recognize and identify our friends and family. Computers can now also identify people automatically using stored information such as figure, iris or face to identify a particular person. Earlier many face recognition algorithms were used to achieve fully automated face identification process [2].

The first face recognition system was created in the 1960s. It was not fully automated and it required inputs of the location of the eyes, ears, nose and mouth on the images then it calculates a distance to some common point then it compares it to the stored data. The still image problem has several inherent advantages and disadvantages.

For applications such as driver's license, due to the controlled nature of the image acquisition process, the segmentation problem is rather easy [4].

However, if only a static picture of an airport scene is available, automatic location and segmentation of a face could pose serious challenges to any segmentation algorithm.

On the other hand, if a video sequence is available, segmentation of a moving person can be more easily accomplished using motion as a cue. But the small size and low image quality of faces captured from video can significantly increase the difficulty in recognition.

Face recognition and sometime is called face identifying is simply putting a label to known faces just like human as mentioned above, we learn the faces of our family and celebrities just by looking at their faces. Since the 1970s there was many techniques and algorithms were developed for a machine to learn to recognize known faces [5]. Most of the recent techniques involve at least three steps:

1) Face detection
2) Face preprocessing
3) Face recognition

III. METHODOLOGY

In our proposed system, the system is instantiated by the mobile .After it triggers then the system starts processing the image of the students for which we want to mark the attendance.

Image Capturing phase is one in which we capture the image of the students. This is the very basic phase from which we start initializing our system. We capture an image from our camera which predominantly checks for certain constraints like lightning, spacing, density, facial expressions etc. The captured image is resolute according to our requirements. Once it is resolute, we make sure it is either in .png or .jpeg format.

We take frontal posture of an individual so that the accuracy can be attained to the maximum extent. This is the training database in which we classify every individual based on labels. For the captured image, from an every object we detect only frontal faces. This detects only face and removes every other parts since we are exploring the features of faces only. These detected faces are stored somewhere in the database for further enquiry. Features are extracted in the extraction phase.

IV. APPROACH

The entire process of our proposed approach is summarized in Fig. 1. It can be considered in three phases:

1) Detection
2) Recognition
3) Push to Database.

The block diagram in figure 4.1 describes the proposed design for multiple face recognition system. The system requires a device capable of capturing and transmitting images over HTTP. The working is explained in brief below:

The figure 4.1 subsections and describes the detailed design of each phase.

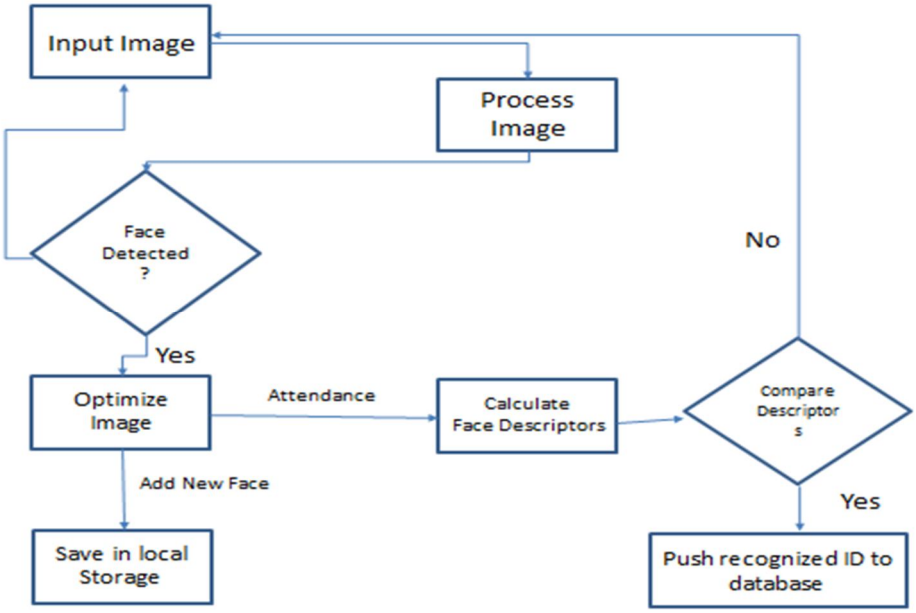

Figure 4.1. Dataflow of modules.

a) *Input Image:* This is first stage in which face data of the user is created, in which an image of user is fed to system through front or back camera.

b) *Process Image:* Recognize and locate facial features. Get the coordinates of the eyes, ears, cheeks, nose, and mouth of every face detected.

c) *Optimize image*

Steps involve in pre-processing optimization are:

- *Resizing:* Face is resized to a fixed pixel resolution after the face is detected.
- *Cropping:* Background is removed from the image.

d) *Save in Local Storage:* For future use as for comparing feature data of saved image with new input face detected image.

e) *Push Recognized ID to Database:* If Boolean function responsible for recognition of face returns true, the recognized ID associated with face of user is pushed to database for marking attendance.

The above dataflow can be simplified to three core modules of the project. These three core modules are visualized in below figure.

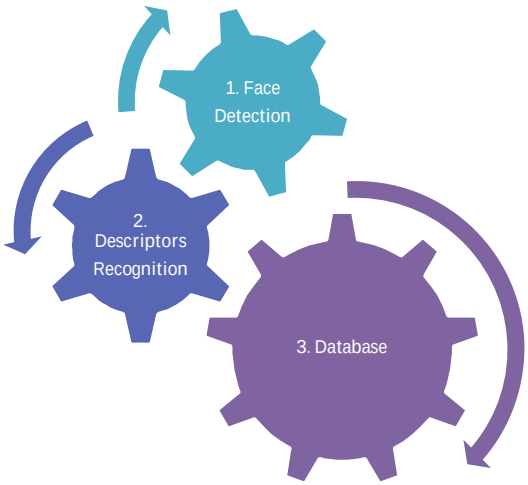

Figure.4.2 System Skeleton

A. Face Detection and Cropping

The captured image from an android app is sent as a list to the local storage. The image is nothing but a matrix of numbers which correspond to the pixel values. The software doesn't know where in this collection of numbers the faces are present, which are the input for our algorithm. Thus, face detection performs this task. We use the method 'face locations (image)' from face recognition library where the image is the captured image. This function detects the face based on the Histogram of Oriented Gradients or just HOG for short. The sequence of steps in this algorithm is as follows.

1) Read the image captured in the previous step
2) The faces are detected from the above image as explained
3) Crop the area of the image where the faces are marked and save into a folder named unknown as individual image files in JPEG format.

The algorithm detects all the faces clearly visible in the captured image of the classroom. Each student should be in an upright position and facing the camera to avoid exclusion of their presence by the system.

B. Face Recognition

Facial Recognition using Face descriptors upon successful identification of face of interest and processing it to extract coordinates of specific features of interest, one now has to make calculations of displacement of these points from one another to develop face graph for the face in question. To perform the task of face recognition the detect face first has to complete the process of feature extraction. Using landmarks approach one is limited to a maximum of twelve mention fiducial point:

1) Left Eye
2) Right Eye
3) Nose Base
4) Left Cheek
5) Right Cheek
6) Left Mouth
7) Bottom Mouth
8) Right Mouth
9) Left Ear
10) Left Ear Tip
11) Right Ear
12) Right Tip

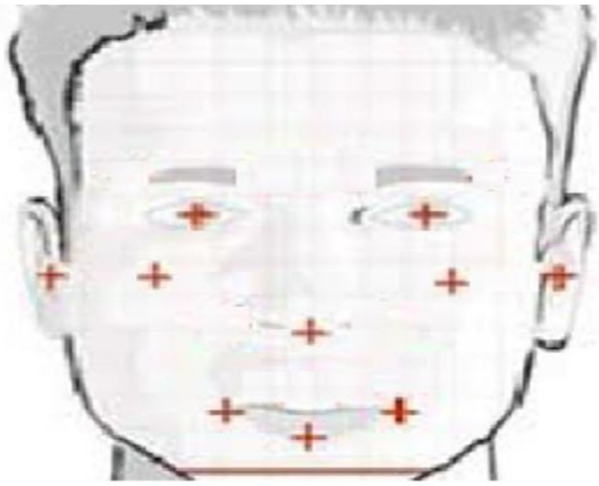

Figure. 4.3 Fiducial points

As shown in figure 4.3, these fiducial Points would return a particular point on the image which contain both an "X" as well "Y" value. These values could be used to identify where each feature is on the image.

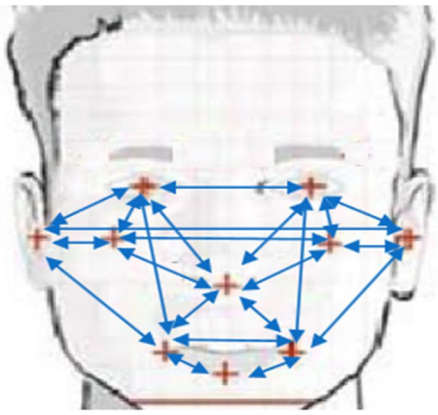

Figure 4.4 Descriptor calculation by using distance between fiducial points on face

The values do not reveal the full picture and subsequent use for face recognition. The values have to be compared with each other to tell the displacement of each to one another as shown in figure 4.4.

The following happens after faces are cropped and stored.

a) Each image in unknown folder is taken and its face encodings are generated using face encodings (unknown image) method from face recognition library where unknown image is an image in unknown folder.

b) The encoding is directly compared against all the encodings of known images stored in JSON file.

c) When an image is not recognized then the names are appended to the unidentified image list.

d) Identified list is returned as a dictionary to the main server-side google firebase.

C. Store Recognized Entries

Whenever the algorithm finds a match, the name of the images identified are first stored in a dictionary with two keys where one represents identified and other represents unidentified. Based on the list we then update the corresponding field of the person in the firebase database with a respective unique id on that particular date using firebase library. Firebase provides a very efficient way of storing the data.

D. View the Attendance in dashboard

The attendance is posted for a given date and session in Firebase real-time database. Identified people images and date and session details are stored by generating temporary ids for each. The firebase database's application protocol interface fetches these details and displays it in a clean UI. See the visual output of firebase database API in the result section.

E. Image Acquisition

Face recognition technology can be obtain from almost any camera or video system that creates the image of ample quality and determination. We are using our mobile phones (Motorola g 5G & Asus Zenfone Max) powered by android for the image acquisition.

F. Programming Environment

1) *Java:* Java is an exceptionally famous programming language created by Sun Microsystems (now owned by Oracle). C and C++ programming language are developed a long before java, Java consolidates a significant number of the intense features of those dominant languages whereas addressing some of their flaws. XML tags are not predefined in XML, therefore we have to define our own Tags .In Android XML, is used for making our layouts because it is a lightweight language which does not make our layout heavy. Android Studio offers the quickest tools for the construction of application on every type of Android gadget. Android Studio is the integrated development environment (IDE) for Google's Android operating system constructed on Jet Brains' Intellij IDEA software and deliberately design for Android development.

2) *Hardware Environment:* The development capable device used for the execution of module has the specification as 4 Gigabytes RAM and Snapdragon 750G processor. In order to install android application and execution, device needs to at least have 100 Megabytes of free memory.

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V. RESULT AND DISCUSSION

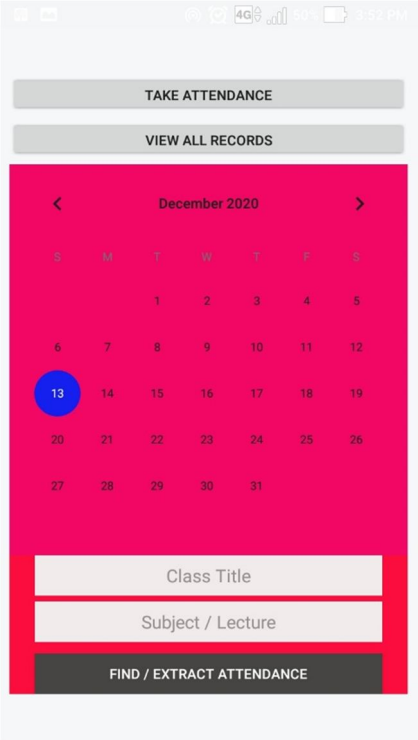


Figure 5.1 Home screen

The above snapshot shows the home screen of the system. This home screen provides interaction operation to the navigation panel among user and the system. While the cloud database services are yet to be implemented, the UI components implemented for exploring attendance records are inactive until cloud API integration to the system i.e. the third core module of this project.

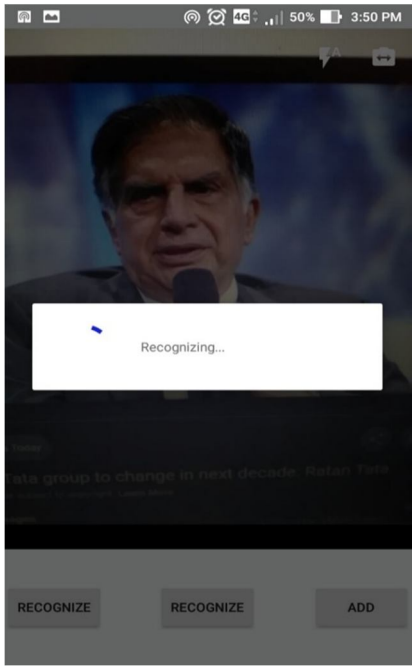


Figure 5.2 Recognition phase

This snap shows the UI components rendering on screen while backend of the system is calculating Face descriptors and use that descriptor data for further operations.

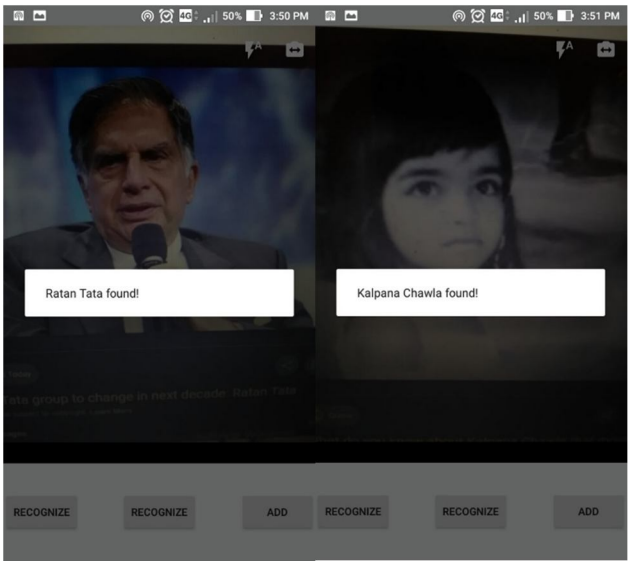


Figure 5.3 Single Face Recognition Result

The above snaps shows the result found as the face descriptors are matched to the trained image data stored in the system storage in past stage.

The application is not only capable of detecting single faces as shown in the previous image but could also detect multiple faces as shown in the figures below.

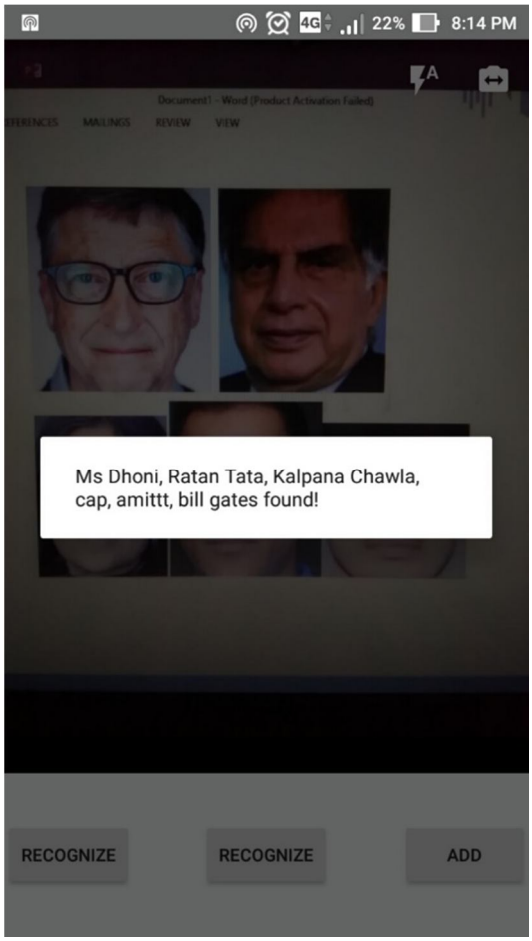


Figure 5.4 multiple faces recognition Result

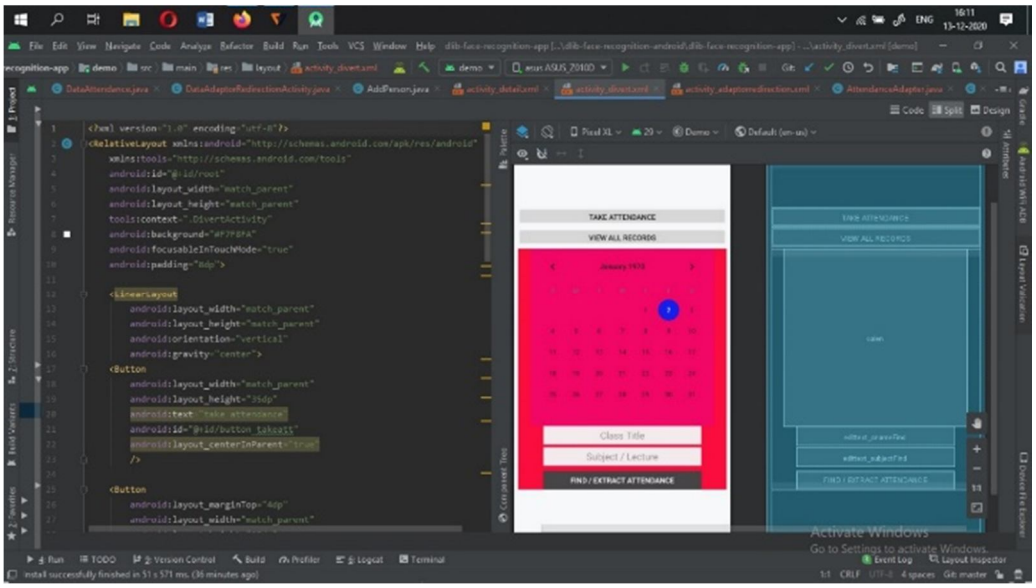


Figure 5.5 UI development

In above figure 5.5 UI development phase is represented. XML is a mark-up language just like HTML which is used to define data. XML is understandable both by human and machine and it is scalable and easy to develop. XML tags are not predefined in XML, therefore we have to define our own Tags .In Android XML, is used for making our layouts because it is a lightweight language which does not make our layout heavy.

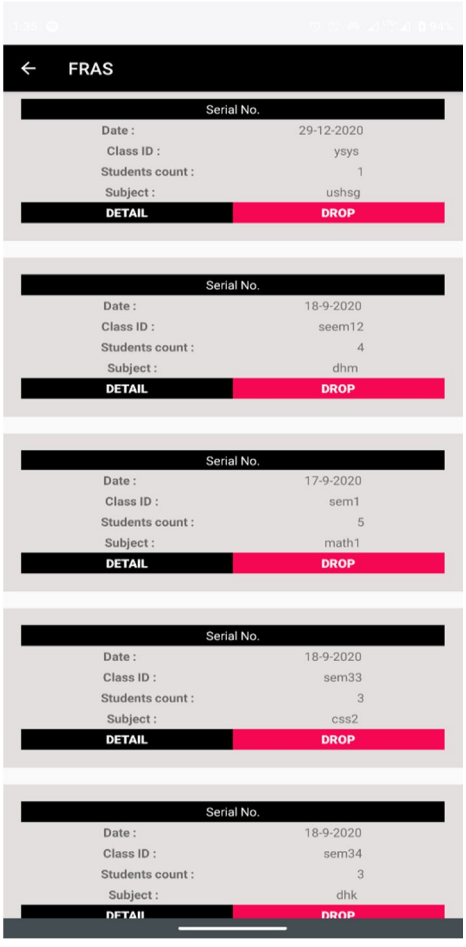
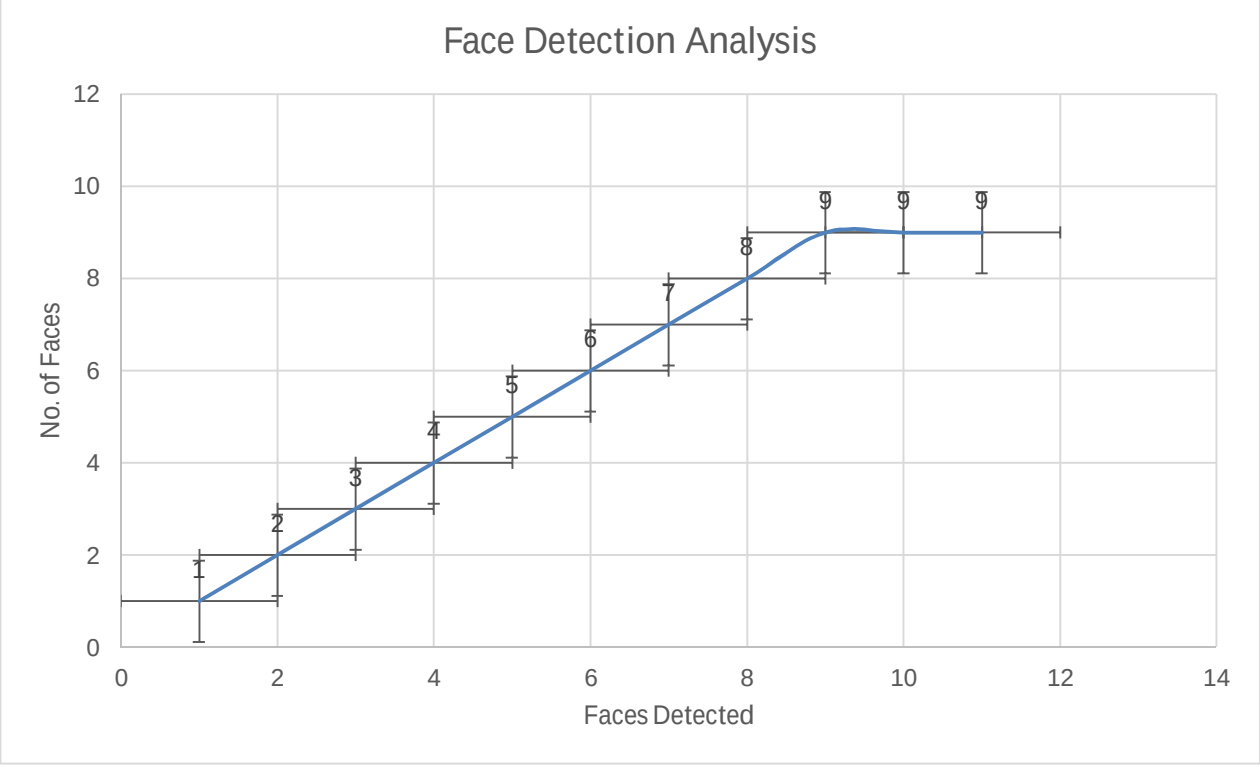


Figure 5.6 Attendance dashboard

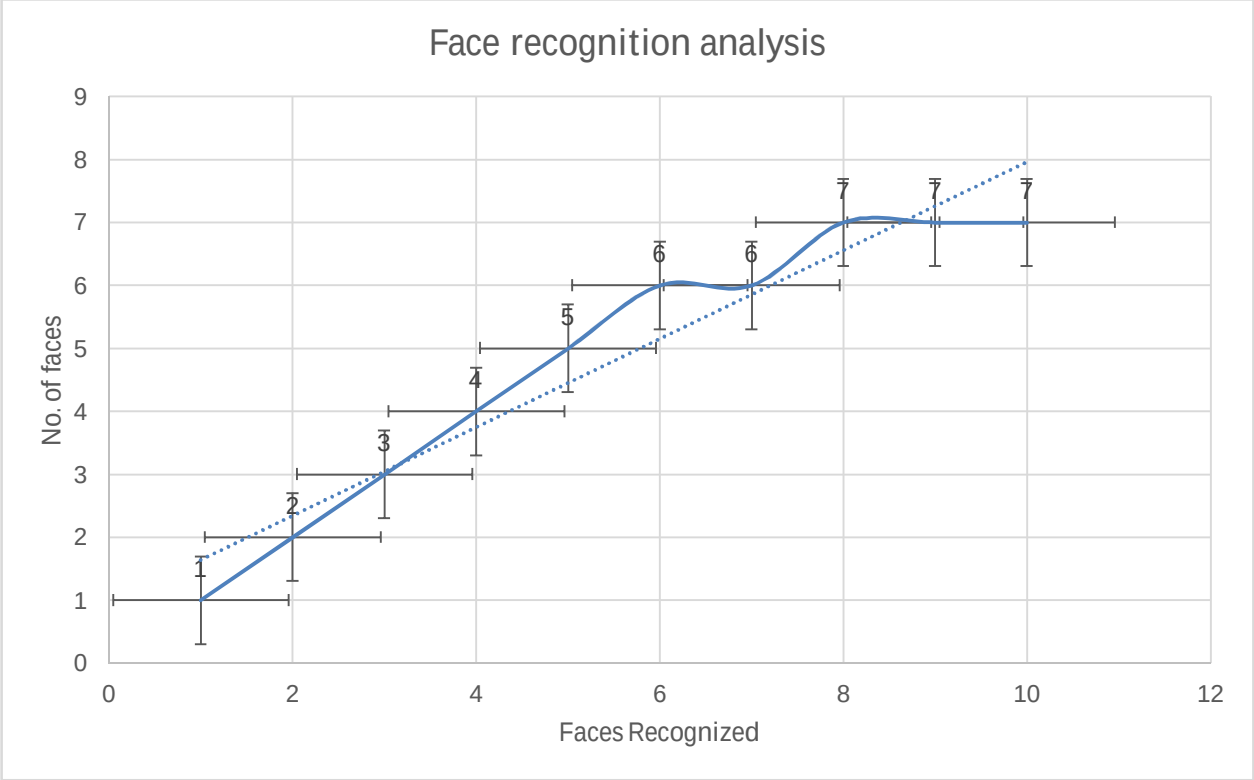
Table 4.1 shows the number of face detected and recognized ant their detection and recognition rate.

No. of students	Detection Rate	Recognition rate
1	100%	100%
2	100%	100%
3	100%	100%
4	100%	100%
5	100%	100%
6	100%	100%
7	100%	100%
8	100%	87%
9	88%	77%
10	80%	70%
11	72%	63.63%

Table 5.1: Recognition testing observations



Graph 5.1: Face detection graph



Graph 5.2: Face recognition graph

A. Graph Representation

From the graph we can observe that detection of faces in an image decreases with increase in number of faces in same image.
This is an expected output as the faces become more distorted. From the graph we can calculate the accuracy which is 93.81% in detecting and 94.18% in face recognition and with total accuracy as 88.36%.

VI. SUMMARY AND CONCLUSIONS

The present paper proposes a flexible and real-time face recognition-based mobile attendance management system. Thus, the aim of the paper to demonstrate multiple face detection and recognition is successfully achieved by using Dlib's ResNet Network.
The application software is able to distinguish and compare the face descriptors data in order to perform face recognition. The first method of face detection perform when image is capture with optimum condition i.e. good lighting, distance of camera to face small, face properly aligned, full face exist clear in image.
The application presently uses Face detector. Face API class present for android platform to enable the application to perform better in varying environment, the class should be incorporated with a face training capability. This would help the application to perform better with increasing number of faces and varying background. The application also extract features from the images detected for further processing to be performed to get the identity of the person in the image.
The cloud based Real-time database will be integrated to the modules to achieve the feature of pushing records to the cloud and ease the access.
This application needs to go through testing and quality analysis to detect minor bugs and debugging.
We have identified various issues in our face recognition systems:-

A. Illumination Problem

The illumination problem is that where the same face appears different due to a change in lighting. The changes induced by illumination are often larger than the differences between individuals, causing systems based on comparing images to misclassify input images.

B. Distance Problem

Our face recognition system fails if the distance between the camera and the face exceeds more than 3 meters.

C. Camera Problem

Resolution of a camera plays a very important role in recognizing the image. Better the camera, more accurately it will recognize the face. For example, we have tested our face recognition system with two phones and we have found that the phone with high resolution camera does the better than the other.

D. Number of People

Our face recognition system is limited to only 7-8 people at a time. If this number exceeds, our system fails to recognize.

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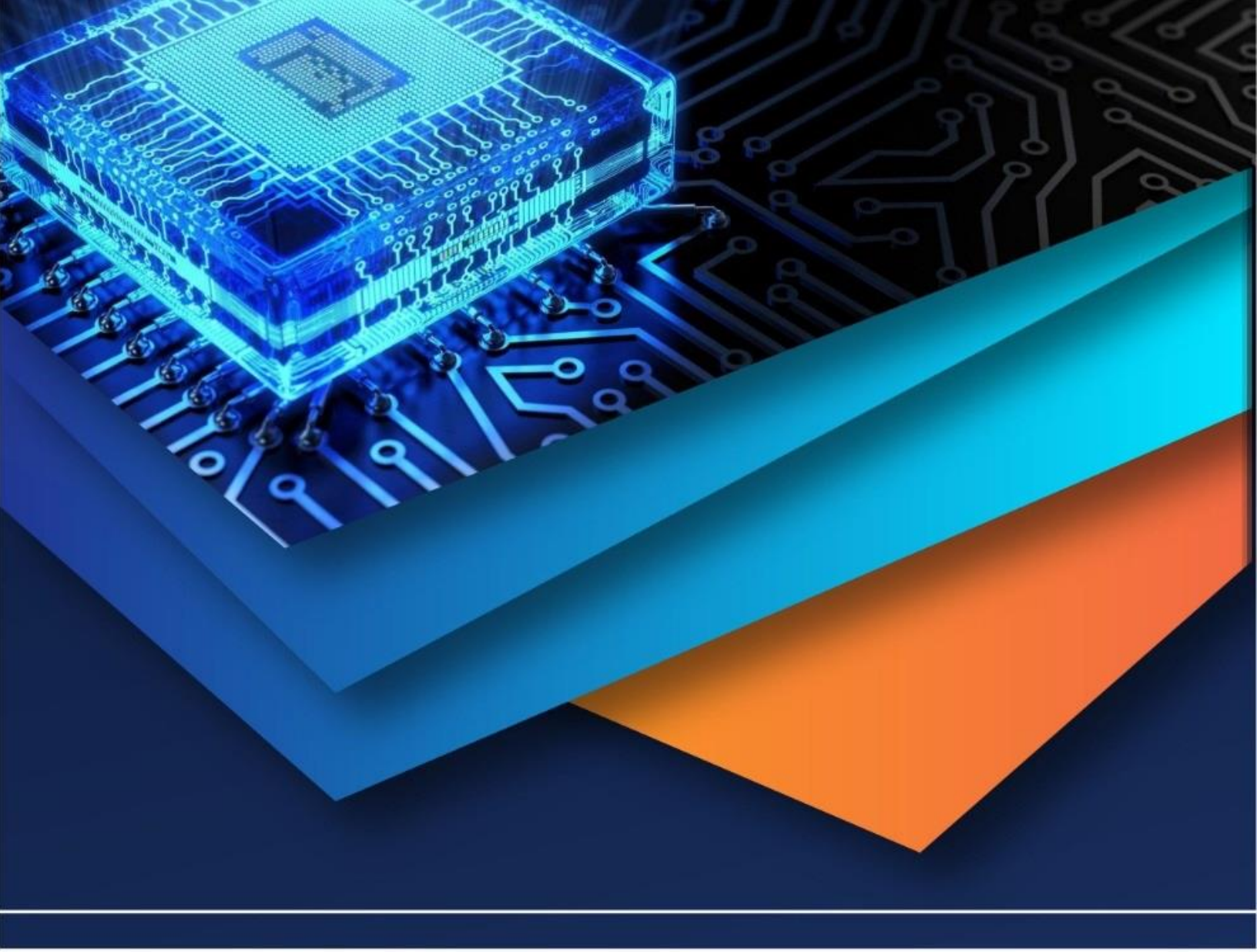

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