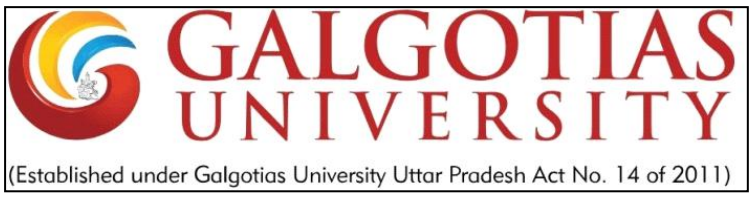
A Project Report

on

Face Recognition based Attendance Management System

Submitted in partial fulfillment of the
requirement for the award of the degree of

Bachelor of Technology in Computer Science and Engineering



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INDIA
December 2021

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING
GALGOTIAS UNIVERSITY, GREATER NOIDA

CANDIDATE'S DECLARATION

We hereby certify that the work which is being presented in the project, entitled **"FACE RECOGNITION BASED ATTENDANCE MANAGEMENT SYSTEM"** in partial fulfillment of the requirements for the award of the **BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE AND ENGINEERIN** submitted in the School of Computing Science and Engineering of Galgotias University, Greater Noida, is an original work carried out during **JULY-2021 to DECEMBER-2021**, under the supervision of **Ms. Swati Sharma, Assistant Professor**, **Department of Computer Science and Engineering** Department of Computer Science and Engineering, Galgotias University, Greater Noida.

The matter presented in the project has not been submitted by us for the award of any other degree of this or any other places.

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This to certify that the above statement made by the candidates is correct to the best of my knowledge.

Supervisor

Name: Swati Sharma

Designation: Assistant Professor

CERTIFICATE

The Final Project Viva-Voce examination of Piyush Kumar Jha(18SCSE1010753) Sakshi Pandey(18SCSE1010654) has been held on 20/12/2021 and his/her work is recommended for the award of **BACHELOR OF TECHNOLOGY IN COMPUTER SCIENCE AND ENGINEERING**.

Signature of Examiner **Signature of Supervisor**

Signature of Project Coordinator **Signature of Dean**

Date:

Place: Greater Noida

ACKNOWLEDGEMENTS

I would like to thank everyone who contributed to the successful completion of this project. First, I would like to express my utmost gratitude to my research supervisor, Swati Sharma who in spite of being extraordinarily busy with her duties, took time to give invaluable advice and guidance throughout the development of the research.

In addition, I would also like to express my deepest appreciation to my loving parents and family members for their constant support and encouragement. Last but not least, I am grateful for the unselfish cooperation and assistance that my friends have given me to complete this task.

ABSTRACT

In this digital age, the face recognition system plays an important role in almost all sectors. Face recognition is one of the widely used biometric. Can be used for security, authenticity, identification, and has many, many benefits. Despite of having low accuracy compared to known iris as well finger recognition, widely used because of it communication and offline process. In addition, face the recognition system can also be used to mark attendees at schools, colleges, offices, etc. This program aims to create a category a program to visit those who use the concept of face recognition as the current one-to-one process is time consuming hard to keep. And there may be opportunities for representation they are not present. Therefore, the need for this program is increasing. This program consists of sections with data structure, face detection, face recognition, revival of attendees.Collecting time cards and entering numbers manually on paper timesheets/online spreadsheets seem to be easy at first. But they can quickly become a mess when more team members join, or you simply don't have time for some admin work that week.

We're all human and we can easily make mistakes when collecting data manually.Employees don't always punch in the correct date and time.

You may face situations in which employees come to you asking why they receive less than the hours they've worked, or you may lose thousands of dollars without even knowing it.Collecting time cards, verifying them, and processing them for payroll is surely time-consuming, especially when you manage a larger team.Every time there are errors or issues regarding their attendance, staff will flood in to ask you to make adjustments. Admin work will soon suck at least 5 more hours of your week, which means you've lost over 260 hours every year.Employee work hours need to be recorded and stored for compliance purpose. If you're still using paper timesheets, paperwork will soon drown you in boredom and irritation.Paper timesheets aren't cheap, take up more space, and are hard to retrieve when needed. Time and attendance tracking software are solutions that help businesses monitor employees' attendance and working hours, as well as paying staff accurately. Automated attendance software eliminates the risk of human error, hence providing more accurate data for payroll. Employers don't have to be afraid of compliance issues, and

employees don’t have to be afraid of being paid incorrectly. Attendance apps aren’t just beneficial for employees’ performance, but for managers as well. You can spend less time checking attendance and more on things that require your attention. If you are dealing with manual employee attendance tracking, you know it’s a tedious and time-consuming practice that often involves a great deal of human error.

Hence, we have proposed an automated student attendance system based on face recognition. A face recognition system is very useful in life applications, especially in security control systems. The airport protection system uses face recognition to identify suspects and the FBI (Federal Bureau of Investigation) uses face recognition for criminal investigations. In our proposed approach, firstly, video framing is performed by activating the camera through a user-friendly interface. The face ROI is detected and segmented from the video frame by using the Viola-Jones algorithm. In the pre-processing stage, scaling of the size of images is performed if necessary in order to prevent the loss of information. The median filtering is applied to remove noise followed by conversion of color images to grayscale images. After that, contrast-limited adaptive histogram equalization (CLAHE) is implemented on images to enhance the contrast of images. In the face recognition stage, enhanced local binary pattern (LBP) and principal component analysis (PCA) are applied correspondingly in order to extract the features from facial images. In our proposed approach, the enhanced local binary pattern outperforms the original LBP by reducing the illumination effect and increasing the recognition rate. Next, the features extracted from the test images are compared with the features extracted from the training images. The average accuracy of recognition is 100 % for good quality images, 94.12 % for low-quality images, and 95.76 % for the Yale face database when two images per person are trained.

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CHAPTER-1

INTRODUCTION

The main objective of this project is to develop a face recognition-based automated student attendance system. In order to achieve better performance, the test images and training images of this proposed approach are limited to frontal and upright facial images that consist of a single face only. The test images and training images have to be captured using the same device to ensure no quality difference. In addition, the students have to register in the database to be recognized. The enrolment can be done on the spot through a user-friendly interface.

1.1 Background

The human face is a unique representation of individual identity. Thus, face recognition is defined as a biometric method in which identification of an individual is performed by comparing real-time capture images with stored images in the database of that person. Nowadays, a face recognition system is prevalent due to its simplicity and awesome performance. For instance, airport protection systems and the FBI use face recognition for criminal investigations by tracking suspects, missing children, and drug activities. Apart from that, Facebook which is a popular social networking website implements face recognition to allow users to tag their friends in the photo for entertainment purposes. Furthermore, Intel Company allows users to use face recognition to get access to their online accounts. Apple allows users to unlock their mobile phone, iPhone X, using face recognition.

This project is being carried out due to the concerns that have been highlighted about the methods which lectures use to take attendance during lectures. The use of clickers, ID cards swiping, and manually writing down names on a sheet of paper as a method to track student attendants has prompted this project to be carried out. This is not in any way to criticize the various methods used for student attendance but to build a system that will detect the number of faces present in a classroom as well as recognize them. The traditional way of marking attendees is a tedious task in many schools and colleges. It is also an additional burden on the power that should mark the presence by

hand gesture student names may take up to five minutes time. This is time-consuming. There are certain possibilities for representative representation. These days, facial recognition is gaining more popularity as well as being widely used. In this paper, we have proposed a plan to get readers' faces from live streaming video classes and attendance will be marked when the received face is found in the database. After that, he first got a face to use features of eyes, nose, mouth, hair, and different postures of the face of the image.

In this paper, critical reviews are presented on the various problems of the visual systems, and various solutions to these problems are analyzed by presenting the existing methods that have been suggested in the literature. This paper contains a literature review, proposed model, implementation, result, and conclusion of this project.

1.2 Problem Statement

Traditional student attendance marking techniques are often facing a lot of trouble. The face recognition student attendance system emphasizes its simplicity by eliminating classical student attendance marking techniques such as calling student names or checking respective identification cards. There are not only disturb the teaching process but also cause a distraction for students during exam sessions. Apart from calling names, an attendance sheet is passed around the classroom during the lecture sessions. The lecture class especially the class with a large number of students might find it difficult to have the attendance sheet being passed around the class. Thus, a face recognition student attendance system is proposed in order to replace the manual signing of the presence of students which is burdensome and causes students to get distracted in order to sign for their attendance. Furthermore, the face recognition-based automated student attendance system is able to overcome the problem of fraudulent approaches, and lecturers do not have to count the number of students several times to ensure the presence of the students.

1.3 Aims and Objectives

The objective of this project is to develop a face recognition-based automated student attendance system. Expected achievements in order to fulfill the objectives are: To detect the face segment from the video frame. To extract the useful features from the face detected. To classify the features in order to recognize the face detected. To record the attendance of the identified student.

1.4 Thesis Organization

Chapter 2 includes a brief review of the approaches and studies that have been done previously by other researchers whereas Chapter 3 describes proposed methods and approaches used to obtain the desired output. The results of the proposed approach would be presented and discussed in Chapter 4. The conclusion, as well as some recommendations, would be included in Chapter 5.

CHAPTER-2
Literature Survey/Project Design

The face recognition system uses biometrics to map facial features from a photo or video. It compares data with a familiar face database to find matches. That's because face recognition has all kinds of commercial apps. It can be used for everything from visual to marketing.Attendances of every student are being maintained by every school, college and university. Empirical evidences have shown that there is a significant correlation between students' attendances and their academic performances. There was also a claim stated that the students who have poor attendance records will generally link to poor retention. Therefore, faculty has to maintain proper record for the attendance. The manual attendance record system is not efficient and requires more time to arrange record and to calculate the average attendance of each student. Hence there is a requirement of a system that will solve the problem of student record arrangement and student average attendance calculation. One alternative to make student attendance system automatic is provided by facial recognition. There was a lot of difficulty in holding hands like Keep all the paperwork, mark the current / non-pen daily so it takes a lot of effort and it takes a lot of time. But this is all limitations removed by default automated system. The main purpose of the paper was to find photos or videos of the student's face, their position and their presence. There were others plans for the purpose of the visit but were few limitations-

- Biometric based system: Scan unique component of a finger-like body and mark those present. However and time consuming.

- Bluetooth function: This application cannot be paired again requires 8 connections at a time.

- RFID system: In such a system each person should use it RFID card attendees by swiping. But it is difficulty when RFID card is lost.

The basic idea was the same behind this existing solution to improve the travel system through facial recognition process. This will reduce proxy visits and increase accuracy.

In the proposed program facial recognition was performed using Arduino and nerves. The general idea for this paper is divided in several steps.

- At first the learner completes the registration form and all the details, which are stored in the college database. Student photo / image is also stored in the database. This action is required only once.

- Then the camera will be set up at the classroom door I heard with a microcontroller. Here the PIR sensor is used measuring radiation from an object. It has also been found the movement of objects.

- When the learner enters the classroom the first sensor of the PIR measured object radiation and movement. If the rays belong to the human category and then the camera activate and take pictures.

- After clicking on the student's pictures you compare that image with database if the image is matched there then updates the database yet. Otherwise it is marked as out of the database.

- This system also works for intelligence in the same way. Technically there was another database that had created it.

In this chapter, a brief overview of studies made on face detection and recognition will be introduced alongside some popular face detection and recognition algorithms. This will give a general idea of the history of systems and approaches that have been used so far.

Face Detection or face detector will detect any given face in the given image or input video. Face localization will detect where the faces are located in the given image/video, by use of bounding boxes. Face Alignment is when the system will find a face and align landmarks such as nose, eyes, chin, mouth for feature extraction. Feature extraction extracts key features such as the eyes, nose, mouth to undergo tracking. Feature matching and classification. matches a face based on a trained data set of pictures from a database of about 200 pictures. Face recognition

gives a positive or negative output of a recognized face based on feature matching and classification from a referenced facial image.

2.1 Student Attendance System

Face detection is the process of locating a face in a digital image by any special computer software built for this purpose. In the early years, face detection algorithms focused mainly on the frontal part of the human face suggest that newer algorithms take into consideration different perspectives for face detection. Researchers have used such systems but the most challenge that has been faced is to make a system detect faces irrespective of different illumination conditions. The fingerprint system is indeed effective but not efficient because it takes time for the verification process so the user has to line up and perform the verification one by one. However, for face recognition, the human face is always exposed and contains less information compared to the iris. Iris recognition system which contains more detail might invade the privacy of the user. Voice recognition is available, but it is less accurate compared to other methods. Hence, the face recognition system is suggested to be implemented in the student attendance system.

Advantages & Disadvantages of Different Biometric Systems-

System type	Advantages	Disadvantages
RFID card system	Simple	Fraudulent usage
Fingerprint system	Accurate	Time-consuming
Voice recognition system	-	Less accurate compared to others
Iris recognition system	Accurate	Privacy Invasion

2.2 Face Detection

Difference between face detection and face recognition is often misunderstood. Face detection is to determine only the face segment or face region from the image, whereas face recognition is to identify the owner of the facial image. A few factors cause face detection and face recognition to encounter difficulties. These factors consist of background, illumination, pose, expression, occlusion, rotation, scaling, and translation.

Factors Causing Face Detection Difficulties-

Background	Variation of background and environment around people in the image affect the efficiency of face recognition.
Illumination	Illumination is the variation caused by various lighting environments which degrade the facial feature detection.
Pose	Pose variation means the different angle of the acquired facial image which causes distortion to the recognition process, especially for the Eigenface and Fisher face recognition method.
Expression	Different facial expressions are used to express feelings and emotions. The expression variation causes spatial relation change and the facial-feature shape change.
Occlusion	Occlusion means part of the human face is unobserved. This will diminish the performance of face recognition algorithms due to deficiency information.
Rotation, scaling, and translation	Transformation of images might cause distortion of the original information about the images.

There are a few face detection methods that previous researchers have worked on. However, most of them used frontal upright facial images which consist of only one face. The face region is fully exposed without obstacles and free from the spectacles.

Advantages & Disadvantages of Face Detection Methods

Face detection method	Advantages	Disadvantages
Viola jones algorithm	1. High detection speed 2. High accuracy.	1. Long training time. 2. Limited head pose. 3. Not able to detect dark faces.
Local Binary pattern	1. Simple computation. 2. High tolerance against the monotonic illumination changes.	1. Only used for binary and grey images. 2. Overall performance is inaccurate compared to Viola-Jones algorithm.
AdaBoost algorithm (part of Viola jones algorithm)	Need not to have any prior knowledge about face structure.	The result highly depends on the training data and is affected by weak classifiers
SMQT Features and SNOW Classifier Method	1. Capable to deal with lighting problem in object detection. 2. Efficient in computation.	The region containing very similar grey value regions will be misidentified as the face.
Neural-Network	High accuracy only if large size of the image were trained.	1. Detection process is slow and computation is complex. 2. Overall performance is weaker than Viola-Jones algorithm.

2.3 Pre-Processing

Pre processing enhances the performance of the system. It plays an essential role to improve the accuracy of face recognition. Scaling is one of the important pre processing steps to manipulate the size of the image. The scaling down of an image increases the processing speed by reducing the system computations since the number of pixels is reduced. The size and pixels of the image carry spatial information. Spatial information is a measure of the smallest discernible detail in an image. Hence, spatial information has to be manipulated carefully to avoid distortion of images to prevent the checkerboard effect. The size should be the same for all the images for normalization and standardization purposes. PCA (Principal Component Analysis) to extract features from facial images, same length and width of the image are preferred, thus images were scaled to 120 × 120 pixels.

Besides scaling of images, a color image is usually converted to a grayscale image for pre-processing. Grayscale images are believed to be less sensitive to illumination conditions and take less computational time. A grayscale image is an 8-bit image which pixels range from 0 to 255 whereas the color image is a 24-bit image in which pixels can have 16 77 7216 values. Hence, the color image requires more storage space and more computational power compared to grayscale images. If a color image is not necessary for computation, then it is considered as noise. In addition, pre-processing is important to enhance the contrast of images. Histogram equalization is one of the methods of pre-processing in order to improve the contrast of the image. It provides uniform distribution of intensities over the intensity level axis, which is able to reduce uneven illumination effect at the same time.

2.4 Feature Extraction

The feature is a set of data that represents the information in an image. Extraction of facial features is most essential for face recognition. However, the selection of features could be an arduous task. Feature extraction algorithm has to be consistent and stable over a variety of changes in order to give high accuracy results. There are a few feature extraction methods for face recognition. PCA is famous for its robust and high-speed computation. Basically, PCA retains data variation and removes unnecessary existing correlations among the original features. PCA is basically a dimension reduction algorithm. It compresses each facial image which is represented by the matrix into a single column vector. Furthermore, PCA removes the average value from the image to centralize the image data. The Principle Component of the distribution of facial images is known as Eigenfaces. Every single facial image from the training set contributes to Eigenfaces. As a result, Eigenface encodes the best variation among known facial images. Training images and test images are then projected onto Eigenface space to obtain projected training images and projected test images respectively. Euclidean distance is computed by comparing the distance between projected training images and projected test images to perform the recognition. PCA feature extraction process includes all trained facial images. Hence, the extracted feature contains a correlation between facial images in the training set and the result of the recognition of PCA highly depends on the training set image.

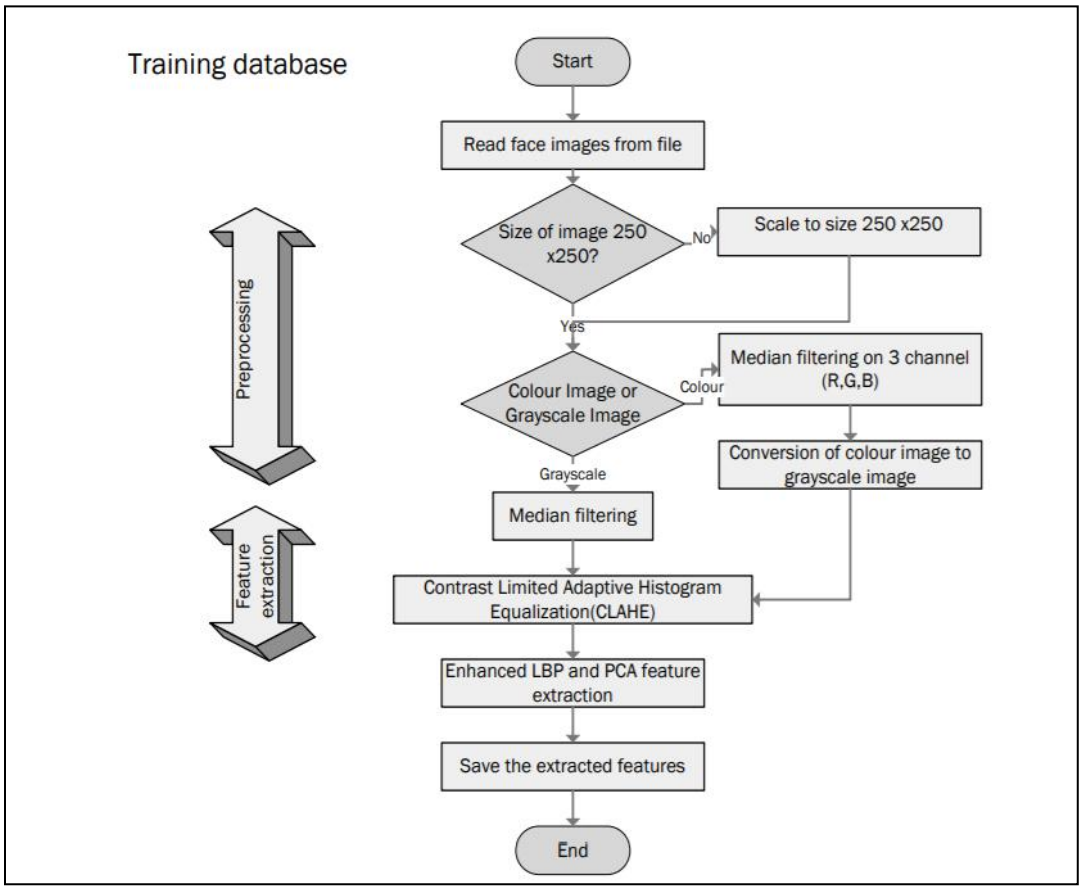
Types of Feature Extraction

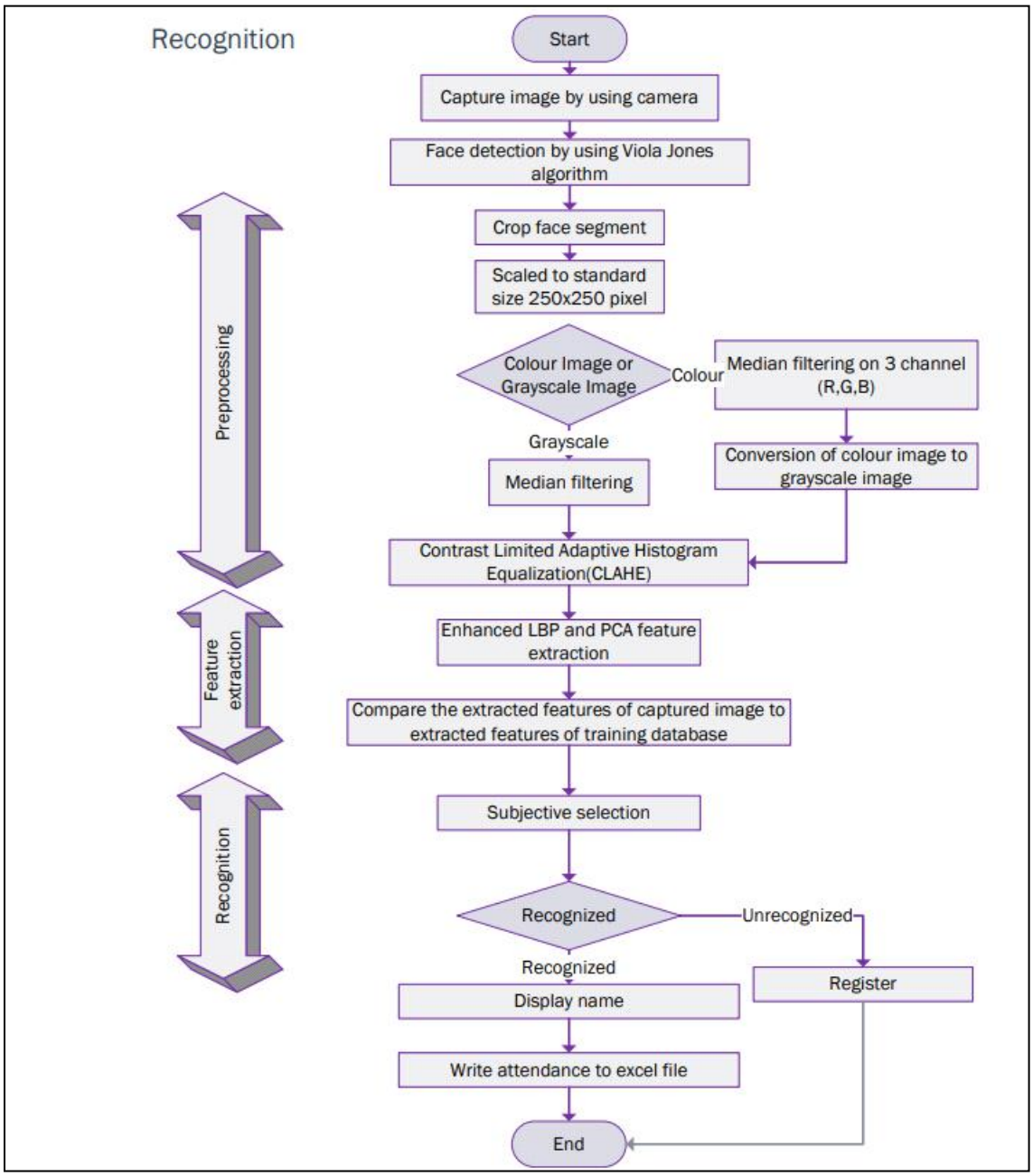
Face recognition systems can be categorized into a few Holistic-based methods, Feature-based methods, and Hybrid methods. Holistic-based methods are also known as appearance-based methods, which mean entire information about a face patch is involved and used to perform some transformation to obtain a complex representation for recognition. Examples of Holistic-based methods are PCA(Principal Component Analysis) and LDA(Linear dependent Analysis).On the other hand, feature-based methods directly extract detail from specific points especially facial features such as eyes, noses, and lips whereas other information which is considered redundant will be discarded. An example of the feature-based method is LBP (Local Binary Pattern). These methods mentioned are usually combined to exist as Hybrid method, for example, Holistic-based method combined with Feature-based in order to increase efficiency. Distance classifier finds the distance between the test image and train image based on the extracted features. The smaller the distance between the input feature points and the trained feature points, the higher the similarity of the test image and training image. In other words, the facial images with the smallest/minimum distance will be classified as the same person. A face is classified as belonging to a class only if its distance is below the chosen threshold, otherwise, the face is classified as unknown.

CHAPTER 3
METHODOLOGY

3.1 Methodology Flow

The approach performs a face recognition-based student attendance system. The methodology flow begins with the capture of images by using the simple and handy interface, followed by pre-processing of the captured facial images, then feature extraction from the facial images, subjective selection, and lastly classification of the facial images to be recognized. Both LBP and PCA feature extraction methods are studied in detail and computed in this proposed approach in order to make comparisons. LBP is enhanced in this approach to reduce the illumination effect. An algorithm to combine enhanced LBP and PCA is also designed for subjective selection in order to increase accuracy. The details of each stage will be discussed in the following sections. The flow chart for the proposed system is categorized into two parts, first training of images followed by testing images.





The overall objective of the Face detection part of this project will be to find out if any faces exist in the input image and if present will return the location in bounding boxes and extent of each face, counting the number of faces detected. It is a challenge to this project due to the variations in location, scale, pose orientation, facial expression, illumination or lighting condition, and various appearance features such as facial hair, makeup, etc. It will be difficult to achieve an excellent result. However, the performance of the system will be evaluated, taking into consideration the learning time, execution time, and the number of samples required for training, and

the ratio between the detection rate and false detection. They have used different sizes of image datasets. Some have used a combination of different algorithms and applied other methods like color filtering etc. and different training sets to obtain their results. However, we can conclude the Viola-Jones algorithm which is on its own classifies images based on local features only and can still detect at very high accuracy and rapidly than pixel-based systems.

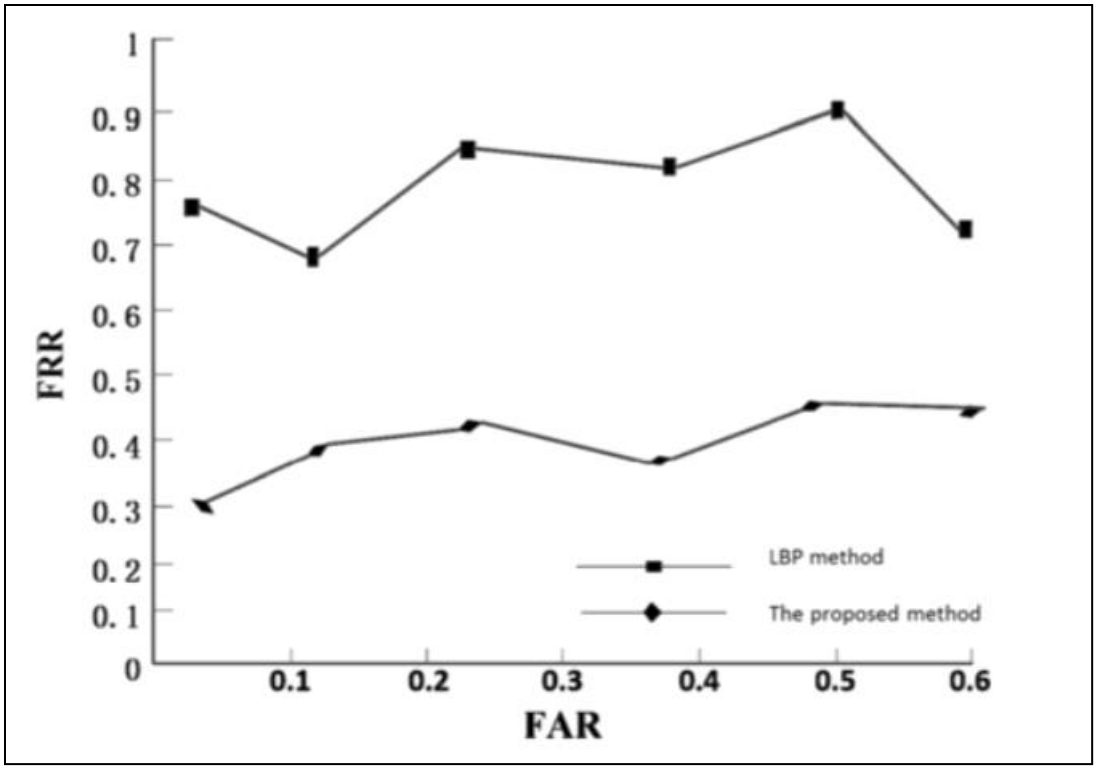
3.2 Input Images

Although our own database should be used to design a real-time face recognition student attendance system, the databases that are provided by the previous researchers are also used to design the system more effectively, efficiently, and for evaluation purposes. Yale face database is used as both a training set and testing set to evaluate the performance. Yale face database contains one hundred and sixty-five grayscale images of fifteen individuals. There are eleven images per individual; each image of the individual is indifferent condition. The conditions included center-light, with glasses, happy, left-light, without glasses, normal, right-light, sad, sleepy, surprised, and wink. These different variations provided by the database are able to ensure the system to be operated consistently in a variety of situations and conditions.

For our own database, the images of students are captured by using laptop built in camera and mobile phone camera. Each student provided four images, two for the training set and two for the testing set. The images captured by using a laptop built-in camera are categorized as low quality images, whereas mobile phone camera-captured images are categorized as high quality images. The high quality images consists of seventeen students while low quality images consists of twenty-six students. Scaling of images is one of the frequent tasks in image processing. The size of the images has to be carefully manipulated to prevent loss of spatial information. In order to perform face recognition, the size of the image has to be equalized. This has become crucial, especially in the feature extraction process, the test images and training images have to be in the same size and dimension to ensure the precise outcome. Thus, in this proposed approach test images and train images are standardize at size 250 × 250 pixels.

Camera captures color images, however the proposed contrast improvement method CLAHE can only be performed on grayscale images. After improving the contrast, the illumination effect of the images able to be reduced. LBP extracts the grayscale features from the contrast improved images as 8-bit texture description Therefore, color images have to be converted to grayscale images before proceeding to the later steps. By converting color images to grayscale images, the complexity of the computation can be reduced resulting in higher speed of computation. Feature Extraction Different facial images mean there are changes in textural or geometric information. In order to perform face recognition, these features have to be extracted from the facial images and classified appropriately. In this project, enhanced LBP and PCA are used for face recognition. The idea comes from nature of human visual perception which performs face recognition depending on the local statistic and global statistic features. Enhanced LBP extracts the local grayscale features by performing feature extraction on a small region throughout the entire image. On the other hand, PCA extracts the global grayscale features which means feature extraction is performed on the whole image.

3D Face Recognition Methods; performs recognition of faces with any pose by means of linear equations capable of making out face description. It works independently of facial pose and light variations. Unlike other methods, it has its limitation which is the computational complexity of the face fitting process. Shiwen et al. (2015) in their research on 3D face recognition on the FRGC v2.0 3D Face database evaluated the recognition performance of Single Region by extracting eLBP operator a new local feature proposed in their study known as the Extended Local Binary Pattern (eLBP). They obtained an approximate recognition rate of 97.80%. In another study by Li et al. (2017), on 3D face recognition in a cloud environment (cloud computing platform). They used the CASIA 3D face V1 database in order to test their proposed method. The results they obtained showed an approximate result of 89% for their proposed method on a neural expression of the 3D image and an 83% recognition rate for LBP based on a neutral expression. They further computed the False Acceptance Rate and False Reject Rate to obtain the Receiver Operating Characteristics curve to measure the performance of these two methods, i.e. the LBP and their proposed method.



However, the review of the different approaches seen in this section has been evaluated by the experts stated on different databases. There are bound to be disparities in the experimental setup which leaves one to conclude that, there is no worst or best-performing approach. But this can lead us into making a choice to target our application which will be discussed in the implementation phase. Therefore, the main purpose for face recognition related to this paper is to match a given face image of a student captured in a lecture, to a database of known faces, in order to identify the student in the query image. Unlike any other system for face detection and face recognition, the investigation will not be limited to challenges but will test some of the methods in the review to achieve the aim of the project.

Requirements and Analysis:

This stage will discuss the various tools that are used to achieve the project goals and objectives.

Functional Requirements: Functional requirements are features that the system will need in order to deliver or operate. The functional requirements have been gathered from the user story developed from the minutes collected during meetings with the client and are outlined here.

- Capture face images via webcam or external USB camera.
- A professional HD Camera
- Faces on an image must be detected.
- The faces must be detected in bounding boxes.
- Compute the total attendance based on detected faces.
- Crop the total number of faces detected.
- Resize the cropped faces to match faces the size required for recognition.
- Store the cropped faces in a folder.
- Load faces on the database.
- Train faces for recognition.
- Perform recognition for faces stored on a database.
- Compute recognition rate of the system.
- Perform recognition one after the other for each face cropped by Face Detector.
- Display the input image alongside the output image side by side on the same plot.
- Display the name of the output image above the image in the plot area.

Non-Functional Requirements: Non-functional requirements are a set of requirements with specific criteria to judge the operation of the system. These requirements have been collected based on the following after meetings with the client. They cover ease of use to the client, security, support availability, operational speed, and implementation considerations. More specifically:

- The user will find it very convenient to take photos.
- The user will inform the students when taking a photo with clear instructions on how to position their faces.
- The system is very secure.
- The system will have a response time of 10 seconds.
- The system can be easily installed.
- The system is 100% efficient.
- The system must be fast and reliable.

Due to the unique login of the university, it is easy to trace who is using this system. However, if this system is to go commercial, this will be a requirement to be implemented. Must-Have: With regards to this project, the “Must Have” are the

requirements that have been identified by the client that must be implemented for the final solution. Without these requirements, the final solution will not achieve its aim and objectives.

- The application must detect images by use of bounding boxes.
- Crop the total number of faces detected.
- The application must resize faces to match the size of faces stored on the database.
- Compute the total attendance based on the number of faces detected.
- Train Images for recognition.
- Display the input image alongside the output image side by side on the same plot.
- Display the name of the output image above the image in the plot area.

Should Have: These are priority features that the system “Should Have” as identified by the client during the meeting.

- Display the name of the input search image and the output image in the command window. Determine the percentage Recognition of an image to that found on the database.
- Compute recognition rate of the system.

Due to the unique login of the university, it is easy to trace who is using this system. However, if this system is to go commercial, this will be a requirement to be implemented.

CHAPTER 4
RESULT AND DISCUSSION

4.1 Result

This chapter represents design concepts that have led to the current implementation of the prototype of this project. The design of this system is going to be carried out using the requirements analyzed in the previous chapter in order to produce a description of the system's internal structure that will serve as the basis to implement the system. This will result in the systems architecture, showing how the system will be decomposed and organized into components alongside the interface of those components. The model design of this system will form a blueprint for the implementation that will be put together to achieve the project objectives and best performance for the final product. This system design consists of activities that fit between software requirements analysis and software construction. The algorithms that compute the functionalities of this system have been discussed further in this chapter.

Face recognition student attendance system with userfriendly interface is designed by using GUI(Graphic User Interface). A few buttons are designed in the interface, each provides a specific function, for example, the start button is to initialize the camera and to perform face recognition automatically according to the face detected, register button allows enrolment or registrations of students, and the update button is to train the latest images that have been registered in the database. Lastly, the browse button and recognize button is to browse facial images from a selected database and recognized the selected image to test the functionality of the system respectively. In this part, enhanced LBP with radius two is chosen and used as a proposed algorithm. The analysis of choosing the radius size will be further explained in the discussion.

4.2 Discussion

This proposed approach provides a method to perform face recognition for the student attendance system, which is based on the texture-based features of facial images. Face recognition is the identification of an individual by comparing his/her real-time captured image with stored images in the database of that person. Thus, a training set has to be chosen based on the latest appearance of an individual other than taking important factors for instance illumination into consideration. The proposed approach is being trained and tested on different datasets. Yale face database which consists of one hundred and sixty-five images of fifteen individuals with multiple conditions is implemented. However, this database consists of only grayscale images. Hence, our own database with color images is further categorized into high-quality sets and low-quality sets, as images are different in their quality: some images are blurred while some are clearer. The statistics of each data set have been discussed in the earlier chapter. Viola-Jones object detection framework is applied in this approach to detect and localize the face given a facial image or provided a video frame. From the detected face, an algorithm that can extract the important features to perform face recognition is designed. Some pre-processing steps are performed on the input facial image before the features are extracted. Median filtering is used because it is able to preserve the edges of the image while removing the image noises. The facial image will be scaled to a suitable size for standardizing purposes and converted to the grayscale image if it is not a grayscale image because CLAHE and LBP operator works on a grayscale image. One of the factors that are usually a stumbling stone for face recognition performance is uneven lighting conditions. Hence, many alternatives have been conducted in this proposed approach in order to reduce the non-uniform lighting condition. Before feature extraction takes place, pre-processing is performed on the cropped face image (ROI) to reduce the illumination problem. 47 In the previous chapters, Contrast Limited Adaptive Histogram Equalization (CLAHE) is proposed in pre-processing in order to improve the image contrast and reduce the illumination effect. Most of the previous researchers have implemented histogram equalization in their approach. In order to study the difference between the CLAHE and histogram equalization, the comparison is made and tabulated. For the comparison, our own database and Yale face database are used. From the result tabulated, CLAHE appears to perform better compared to histogram equalization.

From the image of our own database, the left-hand side of the original image appears to be darker compared to the right-hand side. However, histogram equalization does not improve the contrast effect, which causes the image to remain darker on the left-hand side. Unlike histogram equalization, CLAHE appears to improve the contrast more evenly throughout the entire facial image. This could help to reduce uneven illumination. In the Yale face database, CLAHE prevents some region appears to be washed out as well as reduce the enhancement of noise. Besides, CLAHE shows a clear edge and contour compared to histogram equalization. In addition, by referring to the histograms, the pixel is widely spanned over the intensity scale axis 0 to 255 for CLAHE whereas for histogram equalization the pixel span from 0 to only about 200 over the intensity scale axis. Hence, it can be said that the contrast of the image is more evenly improved throughout the image by CLAHE compared to histogram equalization based on the result obtained. After pre-processing, a useful feature is extracted by using enhanced LBP (Local Binary Pattern). Unlike the original LBP operator, an enhanced LBP operator consisting of different radius sizes is proposed as mentioned in previous chapters. This different radius size enhanced LBP operator is less affected by uneven lighting compared to the original LBP operator. The extracted feature for different radius is shown and tabulated.

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In this approach, a face recognition-based automated student attendance system is thoroughly described. The proposed approach provides a method to identify the individuals by comparing their input images obtained from recording video frames with respect to train images. This proposed approach is able to detect and localize faces from an input facial image, which is obtained from the recording video frame. Besides, it provides a method in pre-processing stage to enhance the image contrast and reduce the illumination effect. Extraction of features from the facial image is performed by applying both LBP and PCA. The algorithm designed to combine LBP and PCA is able to stabilize the system by giving consistent results. The accuracy of this proposed approach is 100 % for high-quality images, 92.31 % for low-quality images, and 95.76 % of the Yale face database when two images per person are trained. As a conclusion for analysis, the extraction of facial features could be challenging especially in different lighting. In the pre-processing stage, Contrast Limited Adaptive Histogram Equalization is able to reduce the illumination effect. CLAHE performs better compared to histogram equalization in terms of contrast improvement. Enhanced LBP with larger radius size specifically, radius size two, perform better compared to original LBP operator, with less affected by illumination and more consistent compared to other radius sizes. 59 5.2 Recommendation In this proposed approach, there are a few limitations. First, the input image has to be frontal and an upright single facial image. Second, the accuracy might drop under extreme illumination problems. Third, false recognition might occur if the captured image is blurred. Besides, LBP is a textural-based descriptor that extracts local features. Hence, test images and train images have to be of the same quality which is captured by using the same device in order to have high accuracy. Lastly, if an individual wears makeup in the image for face recognition, the important features will be covered. In fact, a better camera with a better lighting source is able to reduce the illumination problem and also able to avoid the capture of blurred images. In this proposed approach, a laptop’s built-in camera is a default device. However, the lighting source of the laptop

camera is very dim, which causes the system to be unstable. For future work, a better camera and a better lighting source can be used in order to obtain better results. This can reduce the dependency on the brightness of the environment, especially the places to capture test and train images. Furthermore, a face recognition system that has more faces other than a single facial image can be designed. This can increase the efficiency of the system. The test image and train image in this approach are highly related to each other and highly dependent on the image captured device. The capture device has to be the same for this approach to perform better. Thus, other algorithms can be used instead of LBP, for example, AI (artificial intelligence) algorithm can be implemented to perform face recognition. CNN (Convolution Neural Network) which is a hot topic recently, is a machine deep learning algorithm that is able to perform recognition with less dependency on a particular train image given a large database. However, CNN requires an extremely large database to increase its accuracy or having a relatively small class size to have high performance. In the pre-processing stage, an algorithm, for instance, affine transform can be applied to align the facial image based on coordinates in the middle of the eyes. This might help, especially in the PCA algorithm, which maps test images to train images to perform face recognition.

Also, future work and strategies on how to improve the system are further in this section.

Future Scope:

More detailed research is needed on a project as such. The methods used could be combined with others to achieve great results. Different methods have been implemented in the past according to the literature review. The use of HMM with other feature extraction methods can be implemented and tested. This will need more time as it is only a trial that will be made taking into consideration the method that already exists in order to have a completely new idea. A login functionality would be implemented on the system for security purposes. The system will be deployed as a standalone which could be used by other schools. Data confidentiality is very important. At the start of each school year, the images of new students are taken and stored by the university. Each student will have the right to be informed about the use of their faces for a face recognition attendance system. This must be in line with the government laws on ethical issues and data protection laws and rights. The students will have to consent to their images used for the purpose of attendance. The system that has been delivered and should only be used for experimental purposes as it is not completely reliable.

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