SMART VISION FACE ATTENDNACE SYSTEM

Project Report Submitted in Partial Fulfilment of the Requirements for the Degree of

Bachelor of Technology

in

CSE

Submitted by

Yashika Bawra (210102554)

Ayush Tariyal (210102134)

Simran Chauhan (210102124)

Under the Supervision of

Mr. Ankit Agarwal

Assistant professor

Computer Science and Engineering

May, 2025

DECLARATION

We declare that this written submission represents my ideas in my own words and where other's ides or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea in my submission. We understand that any violation of the above will be cause for disciplinary action by the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed. The plagiarism check report is attached at the end of this document.

- Yashika Bawra __1000016742

- Ayush Tariyal __1000016589

- Simran Chauhan __1000016322

ACKNOWLEDGEMENT

First of all, we would like to express our thanks to our guide Mr. Ankit Agarwal Assistant Professor, Computer Science and Engineering Department, DIT University, Dehradun for being an excellent mentor for us during our whole course of thesis. His encouragement and valuable advice during the entire period have made it possible for us to complete our project.

We would also like to give our regards to Dr. Priyanka Dahiya, Assistant professor, Computer Science and Engineering Department, DIT University and the entire faculties and staff of the Department and our friends who devoted their valuable time in completion of this project.

Lastly, we would like to thank our parents for their years of unyielding love and encouragement. They have wanted the best for us and we admire their sacrifice and determination.

Yashika Bawra (210102554)

Ayush Tariyal (210102134)

Simran Chauhan (210102124)

ABSTRACT

The face of a human is crucial for conveying identity. Face is the representation of one's identity. Hence, we have proposed an automated student attendance system based on face recognition. Face recognition system is very useful in life applications especially in security control system. The airport protection system uses face recognition to identify suspects and FBI (Federal Bureau of Investigation) uses face recognition for criminal investigations. Con-temporary traditional way of recording attendance involves human intervention and requires cooperation of the students which is hectic and contribute towards waste of class time.

An automated real-time classroom attendance system detects students from still image or video frame coming from digital camera, and marks his/her attendance by recognizing them. The system utilizes Viola-Jones object detection framework which is capable of processing images extremely rapidly with high detection rates. In the pre-processing stage, scaling of the size of images is performed if necessary in order to prevent loss of information. The median filtering is applied to remove the noise followed by conversion of colour images to grayscale images.

After that, contrast-limited adaptive histogram equalization (CLAHE) is implemented on images to enhance the contrast of images. In the next stage, enhanced local binary pattern (LBP) and principal component analysis (PCA) is applied correspondingly in order to extract the features from facial images. In our proposed approach, the enhanced local binary pattern out perform the original LBP by reducing the illumination effect and increasing the recognition rate. The facial images are then classified and recognized based on the best result obtained from the combination of algorithm, enhanced LBP and PCA. Finally, the attendance of the recognized student will be marked and saved in the excel file. The student who is not registered will also be able to register on the spot and notification will be given if students sign in more than once.

TABLE OF CONTENTS

LIST OF FIGURES/TABLES

CHAPTER: 1

INTRODUCTION

The main ideal of this design is to develop a face recognition-grounded automated student attendance system. To achieve better performance, the test images and training images of this proposed approach are limited to frontal and upright facial images confirming of a single face only. The test images and training images have to be captured using the same device to insure no quality difference. In addition, the scholars have to register in the database to be recognized. Registration can be done on the spot through the user-friendly interface.

1.1 Background

Face recognition is crucial in daily life to identify family, friends, or someone we are familiar with. We might not perceive that several steps have been taken to recognize human faces. Human intelligence allows us to receive information and interpret the information in the recognition process. We receive information through the image projected into our eyes, specifically the retina in the form of light. Robinson-Riegler, G., & Robinson-Riegler, B. (2008) mentioned that after visual processing is done by the human visual system, we classify the shape, size, contour, and texture of the object to analyze the information. The analyzed information will be compared to other representations of objects or faces that exist in our memory to recognize. It is a hard challenge to build an automated system to have the same capability as a human to recognize faces. However, we need large memory to recognize different faces, for example, in Universities, there are a lot of students of different races and genders, and it is impossible to remember every face of the individual without making mistakes. To overcome human limitations, computers with almost limitless memory, high processing speed, and power are used in face recognition systems.

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 (Margaret Rouse, 2012). Furthermore, Intel Company allows users to use face recognition to get access to their online accounts (Reichert, C., 2017). Apple allows users to unlock their mobile phone, iPhone X by using face recognition (deAgonia, M., 2017). The work on face recognition began in 1960. Woody Bledsoe, Helen Chan Wolf, and Charles Bisson introduced a system that required the administrator to locate eyes, ears, nose, and mouth from images. The distance and ratios between the located features and the common reference points are then calculated and compared. The studies were further enhanced by Goldstein, Harmon, and Lesk in 1970 by using other features such as hair color and lip thickness to automate the recognition. In 1988, Kirby and Sirovich first suggested principle component analysis (PCA) to solve the face recognition problem. Many studies on face recognition were been conducted continuously until today (Ashley DuVal, 2012).

1.2 Problem Statement

The main problem with the traditional attendance system is that it is subject to manipulation and there remains a chance of human error during data entry. Though it is easier to implement and saves technology expenses, the organization cannot benefit from the innovation of data analysis which has huge implications. In addition to this, the contemporary attendance method in the classroom requires human intervention and cooperation from students which contributes to the wastage of precious class time.

The paper proposed by Zhao, W et al. (2003) has listed the difficulties of facial identification. One of the difficulties of facial identification is the identification between known and unknown images. In addition, a paper proposed by Pooja G.R et al. (2010) found that the training process for the face recognition student attendance system is slow and time-consuming. In addition, the paper proposed by Priyanka Wagh et al. (2015) mentioned that different lighting and head poses are often the problems that could degrade the performance of a face recognition-based student attendance system.

Hence, there is a need to develop a real-time operating student attendance system which means the identification process must be done within defined time constraints to prevent omission. The extracted features from facial images that represent the identity of the students have to be consistent with a change in background, illumination, pose, and expression. High accuracy and fast computation time will be the evaluation points of the performance.

1.3 Aims and Objectives

This project aims to accomplish a face recognition-based automated student attendance system. Expected achievements to fulfill the objectives are:

- To record the attendance of the identified student.
- To extract the useful features from the face detected.
- Develop an intuitive user interface for the navigation of functionalities within the system.
- Accurately match detected students' faces to those on the database.

1.4 Report Organization

This document presents the workflow for the realization of the classroom attendance system and it is organized into 5 chapters. This introductory chapter explains the background, problem statement, aims, and objectives of the project.

Chapter 2 includes a brief review of the approaches and studies that have been done previously by other researchers.

Chapter 3 includes proposed methods and approaches used to obtain the desired output.

Chapter 4 includes the result of the proposed approach.

Chapter 5 includes the conclusion as well as some recommendations.

CHAPTER: 2

LITERATURE REVIEW

Facial recognition is a biometric technology that maps and stores an individual's facial features as a faceprint to verify identity. Commonly used in security systems, smartphone unlocking, law enforcement, and surveillance, it relies on deep learning algorithms to match faces with stored data. While it offers a contactless method for identity verification, its accuracy is generally lower compared to other biometric methods like fingerprint, palm, or iris recognition. [1]

- ***Margaret Rouse. (2012). What is facial recognition? – Definition from WhatIs.com. [online] Available at: http://whatis.techtarget.com/definition/facial-recognition [Accessed 25 Mar. 2018].***

Human beings perform face recognition automatically every day and practically with no effort. Although it sounds like a very simple task for us, it has proven to be a complex task for a computer, as it has many variables that can impair the accuracy of the methods, for example: illumination variation, low resolution, occlusion, amongst others. In this paper, we also get to know the difference between face detection and face recognition. The objective of this post is to explain the LBPH as simple as possible, showing the method step-by-step. Local Binary Pattern (LBP) is a simple yet very efficient texture operator that labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number. It was first described in 1994 (LBP) and has since been found to be a powerful feature for texture classification.

1. Parameters
2. training the algorithm
3. applying the LBP operation
4. extracting the histogram
5. performing the face recognition [2]

- ***Face Recognition: Understanding LBPH Algorithm, Towards Data Science-90ec258c3d6b, Kelvin Salton do Prado, Nov 11, 2017.[Online]. Available:https://towardsdatascience.com/face-recognition-how-lbph-works 90ec258c3d6b***

In this paper, we study that One of the hallmark features of Apple’s cutting-edge iPhone X smartphone – Face ID – replaces Touch ID for unlocking the device and for mobile payment authentication. Here's what it does and why it's more secure than Touch ID.

When reports began picking up steam this year that Apple would release an iPhone without Touch ID – the Home button-based authentication method that’s been around since 2013 – longtime Apple users were wary. Touch ID, which was updated with an even faster sensor in 2015, has become second nature to iPhone (and iPad) owners when it comes to unlocking their phones and tablets and when making Apple Pay payments. Touch ID is a classic piece of Apple tech: It just works. It’s simple to set up and easy to use – just place a finger on the sensor to unlock your device. Since its arrival, Touch ID has played no role in any major security breaches and has helped advance the move to mobile payments.

The iPhone X’s “notch” – the dark strip at the top of the display – houses a variety of sensors, including the new True Depth camera system. This includes an infrared camera, a flood illuminator, a regular camera, and a dot projector. The flood illuminator shines infrared light at your face, which allows the system to detect whoever is in front of the iPhone, even in low-light situations or if the person is wearing glasses (or a hat). Then the dot projector shines more than 30,000 pin-points of light onto your face, building a depth map that can be read by the infrared camera. [3]

- ***deAgonia, M. (2017). Apple's Face ID [The iPhone X's facial recognition tech explained]. [online] Computerworld. Available at: https//www.computerworld.com/article/3235140/apple-ios/apples-face-id-the- iphone-xs-facial-recognition-tech-explained.html [Accessed 25 Mar. 2018].***

Kihwan Kim's 2011 Computer Vision Final Project explores a hybrid approach to face detection by integrating the Viola-Jones algorithm. The Viola-Jones algorithm is renowned for its real-time face detection capabilities, utilizing Haar-like features, integral images, and a cascade of classifiers to efficiently identify facial regions. Kim enhances this method by incorporating morphological techniques, such as dilation and erosion, which refine the detection process by eliminating noise and improving the accuracy of facial feature localization. This combination aims to address challenges like varying lighting conditions, diverse facial expressions, and occlusions, thereby improving detection performance in complex environments. The project underscores the effectiveness of combining traditional detection algorithms with image processing techniques to achieve more robust and reliable face detection outcomes. [4]

- ***Kihwan Kim. (2011). Computer Vision Final Project: Viola-Jones https://www.cc.gatech.edu/~kihwan23/imageCV/Final2005/FinalProject_KH.htm [Accessed 22 Apr. 2018].***

Face recognition from real data, capture images, sensor images, and database images is a challenging problem due to the wide variation of face appearances, illumination effect, and the complexity of the image background. Face recognition is one of the most effective and relevant applications of image processing and biometric systems. In this paper, we are discussing the face recognition methods, and algorithms proposed by many researchers using artificial neural networks (ANN) which have been used in the field of image processing and pattern recognition. How ANN will used for the face recognition system and how it is effective than other methods will also be discussed in this paper. There are many ANN proposed methods that give an overview of face recognition using ANN. Therefore, this research includes a general review of face detection studies and systems based on different ANN approaches and algorithms. The strengths and limitations of these literature studies and systems were included, and also the performance analysis of different ANN approaches and algorithms is analyzed in this research study. [5]

- ***Kasar, M., Bhattacharyya, D. and Kim, T. (2016). Face Recognition Using Neural Network: A Review. International Journal of Security and Its Applications, 10(3), pp.81-100.***

Image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. Image processing is classified into two types. They are analog and digital image processing. Student attendance record plays an important role in every school, college, and university. Student attendance can be classified into two types. They are, The manual attendance system makes it very difficult for faculty to verify and maintain every student record in a large class environment and requires more time for calculating the average and recording the attendance of each student. The automated attendance system will extract the face image when a student enters the classroom and mark the attendance automatically. This project is based on the Face Recognition technique. A face recognition system is a computer application for identifying or verifying a person automatically from a digital image or a video frame from a video source. Facial Recognition algorithms identify facial features by extracting landmarks, or features, from an image of the subject’s face. For example, an algorithm may analyze the relative position, size, and/or shape of the eyes, nose, cheekbones, and jaw. These features are then used to search for other images with matching features. Recognition algorithms are Principal Component Analysis (PCA) using eigenfaces, Linear Discriminate Analysis, Elastic Bunch Graph Matching using the Fisher face algorithm, Hidden Markov model, Multi-linear Subspace Learning using tensor representation, and neuronal motivated dynamic link matching. [6]

- ***D. Nithya (2015). Automated Class Attendance System based on Face Recognition using PCA Algorithm. International Journal of Engineering Research and, V4 (12).***

CHAPTER : 3

METHODOLOGY

3.1 Methodology Flow

The classroom attendance system consists of a graphical user interface to interact with different functionalities that are provided by the system. The use case diagram for the system is shown below :

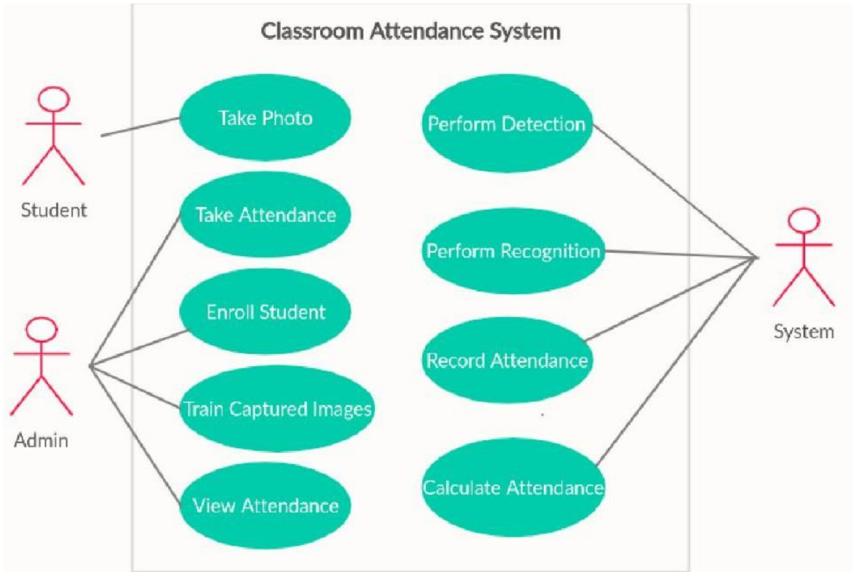


FIGURE 3.1 The use case diagram

The proposed face recognition-based student attendance system begins with capturing facial images, followed by pre-processing, feature extraction, subjective selection, and classification. Both LBP and PCA methods are studied and compared, with an enhanced LBP approach used to reduce illumination effects. An algorithm combining enhanced LBP and PCA is designed to improve accuracy. The system workflow is divided into two parts: training images and testing (recognizing unknown input images).

3.2 Input Images for Recognition

"Input images" in the context of face recognition system refers to the photographs or digital images that are provided to the system for processing. These images are used as the initial data that the system analyses in order to perform tasks such as face detection, feature extraction, and recognition.

In a face recognition-based attendance system, input images are typically:

1. Captured images
2. Training input
3. Testing input

These input images are processed to extract key features (like the shape and position of facial landmarks) that the system uses to recognize and verify individuals. In summary, input images are the starting point that feeds into the face recognition system, whether they are used for training or real-time recognition tasks.

The images captured using the laptop's built-in camera were categorized as low-quality images due to the limitations of the camera's resolution and image clarity. Laptop cameras typically offer lower quality compared to modern mobile phone cameras, resulting in images with less detail, which can affect the accuracy of face recognition. These images were still used in the dataset to assess how well the system performs under less ideal conditions, simulating real-world scenarios where image quality may vary.

3.3 Limitations of the Images

The input image for the proposed approach has to be frontal, upright, and only a single face. Although the system is designed to be able to recognize students with glasses and without glasses, students should provide both facial images with and without glasses to be trained to increase the accuracy to be recognized without glasses. The training image and testing image should be captured by using the same device to avoid a quality difference. The students have to register to be recognized. Enrollment can be done on the spot through the user-friendly interface. These conditions have to be satisfied to ensure that the proposed approach can perform well.

3.4 Face Detection

Face detection and face recognition are often confused but are distinct processes. Face detection refers to identifying the face region in an image, while face recognition involves identifying the individual based on their facial features. Both processes can face difficulties due to several factors, including background, lighting conditions, head pose, facial expressions, occlusion (when part of the face is blocked), and transformations like rotation, scaling, and translation. These factors can affect the efficiency and accuracy of both face detection and recognition. The definition of each factor is tabulated in table 3.4.1

Table 3.4.1 Factors Causing Face Detection Difficulties (S.Aanjanadevi et al., 2017)

BACKGROUND	Variations in the background and environment around the person can affect the face recognition process.
ILLUMINATION	Changes in lighting conditions can degrade facial feature detection.
POSE	Different angles from which the face is captured can distort recognition, especially for methods like Eigenface and Fisherface.
EXPRESSION	Changes in facial expression affect the spatial relationship and shape of facial features.
OCCLUSION	Partially blocked faces (e.g., by glasses) can reduce recognition accuracy due to missing facial data.
ROTATION, SCALING, AND TRANSLATION	Transformations like image rotation, resizing, and shifting can distort facial information, making recognition harder

There are a few face detection methods that the 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.

Akshara Jadhav et al. (2017) and P. Arun Mozhi Devan et al. (2017) suggested the Viola-Jones algorithm for face detection for the student attendance system. They concluded that out of methods such as face geometry-based methods, Feature Invariant methods, and Machine learning methods, the Viola-Jones algorithm is not only fast and robust, but also gives a high detection rate and performs better in different lighting conditions. In addition, in the paper by Mrunmayee Shirodkar et al. (2015), they mentioned that the Viola-Jones algorithm can eliminate the issues of illumination as well as scaling and rotation. In addition, Naveed Khan Baloch (2012) proposed that the Viola-Jones algorithm is the most efficient among all algorithms for instance the AdaBoost algorithm, the FloatBoost algorithm, Neural Networks, the S-AdaBoost algorithm, Support Vector Machines (SVM), and the Bayes classifier.

Varsha Gupta and Dipesh Sharma (2014) studied Local Binary Pattern (LBP), the Adaboost algorithm, local successive mean quantization transform (SMQT) Features, a sparse network of winnows (SNOW) Classifier Method, and Neural Network-based face detection methods in addition to Viola-Jones algorithm. They concluded that the Viola-Jones algorithm has the highest speed and highest accuracy among all the methods. Other instance methods Local Binary Pattern and SMQT Features have simple computation and can deal with illumination problems, their overall performance is weaker than Viola-Jones algorithm for face detection. The advantages and disadvantages of the methods are studied and tabulated in Table 3.4.2

Table 3.4.2 Advantages & Disadvantages of Face Detection Methods (Varsha Gupta and Dipesh Sharma, 2014)

FACE DETECTION METHOD	**ADVANTAGES**	**DISADVANTAGES**
Viola-Jones Algorithm	1. High detection speed 2. High accuracy	1. Long training time 2. Limited head pose support
Local Binary Pattern	1. Simple computation 2. High tolerance to illumination changes	1. Only for binary/grey images 2. Less accurate than viola-jones
AdaBoost Algorithm	1. No need for prior face structure knowledge	1. Performance heavily depends on training data, affected by weak classifiers

SMQT Features and SNOW Classifier	1. Good for handling lightning issues 2. Efficient computation	1. Faces with similar grey value regions can be misidentified as faces
Neural Networks	1. High accuracy with large training sets	1. Slow detection process and complex computation. 2. Less effective than viola-jones

3.5 Viola-Jones Algorithm

Viola-Jones algorithm which was introduced by P. Viola, M. J. Jones (2001) is the most popular algorithm to localize the face segment from static images or video frames. The concept of the Viola-Jones algorithm consists of four parts. The first part is known as the Haar feature, the second part is where the integral image is created, followed by the implementation of Adaboost in the third part, and lastly cascading process.

Viola-Jones algorithm analyses a given image using Haar features consisting of multiple rectangles (Mekha Joseph et al., 2016). Figure 3.5 shows several types of Haar features. The features perform as window function mapping onto the image. A single value result, which representing each feature can be computed by subtracting the sum of the white rectangle(s) from the sum of the black rectangle(s) (Mekha Joseph et al., 2016).

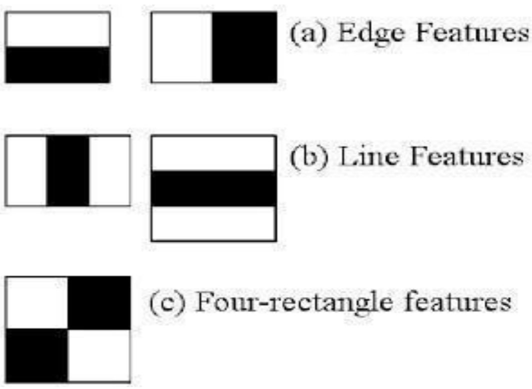


Figure 3.5

KEY FEATURES :

1. High Speed :
   It detects faces very quickly, making it suitable for real-time applications like security cameras and student attendance systems.

2. High Accuracy :
   It provides reliable detection, especially for frontal, upright faces.

3. Works in Different Lighting :
   The method can handle variations in lighting better than many earlier approaches.

3.6 Pre-Processing :

Subhi Singh et al. (2015) suggested cropping of detected face and colour image was converted to grayscale for pre-processing. They also proposed affine transform to be applied to align the facial image based on coordinates in middle of the eyes and scaling of image to be performed.

Pre-processing is a crucial step in enhancing the performance and accuracy of face recognition systems. One important pre-processing method is scaling, which adjusts the size of images. Scaling down images helps increase processing speed by reducing the number of pixels and, therefore, the computational load. Since the size and pixel details of an image carry essential spatial information—defined by Gonzalez and W oods (2008) as the measure of the smallest discernible detail—care must be taken to scale images without causing distortion, such as the checkerboard effect. To maintain consistency and improve recognition accuracy, all images must have the same size for normalization and standardization. Following this principle, Subhi Singh et al. (2015) recommended resizing images to 120 × 120 pixels when using Principal Component Analysis (PCA) for feature extraction.

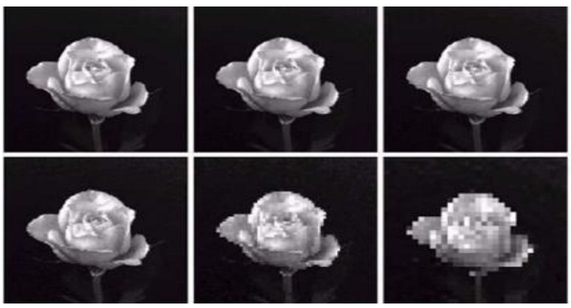


Figure 3.6.1 Images Show Checkerboard Effect Significantly Increasing from Left to Right (Gonzalez, R. C., & Woods, 2008)

Besides scaling 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 in which the pixel ranges from 0 to 255 whereas a color image is a 24-bit image in which the pixel 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 in computation, then it is considered as noise. In addition, pre-processing is important to enhance the contrast of images.

Figure 3.6.2 Facial image converted to grayscale

There are a few methods to improve the contrast of images other than Histogram Equalization. Unlike Histogram equalization, which operates on the data of the entire image, CLAHE operates on data of small regions throughout the image. Hence, the Contrast Limited Adaptive Histogram Equalization is believed to outperform the conventional Histogram Equalization.

Summary of Contrast Improvement

Histogram Equalization (HE) is a contrast enhancement method that works by transforming the intensity values of an image to produce a uniformly distributed histogram. It has the advantage of being less sensitive to noise; however, it relies on the global statistics of an image, which can cause problems. Specifically, HE may lead to over-enhancement in certain regions while other areas, like the peripheral regions, may still require more enhancement. To address some of these issues.

Contrast Limited Adaptive Histogram Equalization (CLAHE) was developed. Unlike traditional HE, CLAHE operates on small regions (tiles) of the image, enhancing the contrast within each tile separately and then combining them using bilinear interpolation. This approach prevents over-enhancement and minimizes noise amplification. However, CLAHE can be more sensitive to noise compared to standard histogram equalization.

3.6.1 Scaling of image :

Scaling is an essential image processing step to standardize image size and the size of image has to be carefully manipulated to prevent loss of spatial information. For accurate face recognition and feature extraction, both test and training images have to be in the same size and are resized to **250 × 250 pixels** to maintain consistency.

3.6.2 Median filtering :

Median filtering is a robust noise reduction technique that preserves important image details. It is widely used in various applications due to its capability to remove unwanted noises as well as retaining useful detail in images. For color images (RGB), median filtering is applied separately to each channel. For grayscale images, it is applied directly, helping to clean images without losing key features.

Figure 3.6.2.1 Median filtering done on three channels

3.6.3 Conversion to Grayscale Image :

Since CLAHE and LBP require grayscale images, color images captured by the camera are converted to grayscale. After improving the contrast, the illumination effect of the images able to be reduced. This conversion simplifies computation, reduces processing time, and improves feature extraction quality.

Figure 3.6.3 Conversion of the image to grayscale image

3.6.4 Contrast Limited Adaptive Histogram Equalization (CLAHE) :

The contrast improvement is usually performed on the grayscale image. CLAHE enhances image contrast by operating on small regions rather than the entire image, preventing over-enhancement and preserving image features. Image contrast is improved by stretching the range of its pixel intensity values to span over the desired range of values, between 0 and 255 in grayscale. It is preferred over traditional histogram equalization, which can distort important facial features due to global adjustments.

Figure 3.6.4 Contrast improvement

3.7 Feature Extraction

The feature is a set of data that represents the information in an image. Extraction of facial feature is most essential for face recognition. However, 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 result.

There are few feature extraction methods for face recognition. PCA is famous for its robust and high-speed computation. PCA retains data variation and removes unnecessary existing correlations among the original features. PCA is 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 principal 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, Eigen's face encodes the best variation among known facial images. Training images and test images are then projected onto Eigen face 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 recognition of PCA highly depends on the training set image.

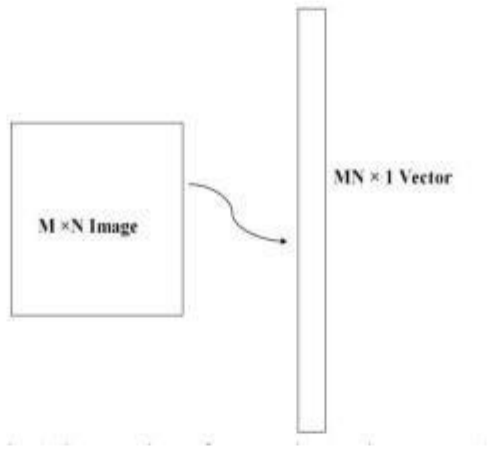


Figure 3.7.1 PCA dimension reduction

The original LBP (Local Binary Patterns) operator was introduced in the paper of Timo Ojala et al. (2002). In the paper by Md. Abdur Rahim et al. (2013), proposed LBP to extract both texture details and contour to represent facial images. LBP divides each facial image into smaller regions and a histogram of each region is extracted. The histograms of every region are concatenated into a single feature vector. This feature vector is the representation of the facial image and Chi-square statistic is used to measure similarities between facial images. The smallest window size of each region is 3 by 3. It is computed by thresholding each pixel in a window where the middle pixel is the threshold value. The neighborhood larger than the threshold value is assigned to 1 whereas the neighborhood lower than the threshold value is assigned to 0. Then the resulting binary pixels will form a byte value representing the center pixel.

LBP has a few advantages which make it popular to be implemented. It has a high tolerance against monotonic illumination changes and it can deal with a variety of facial expressions, image rotation, and aging of persons. These overwhelming characteristics cause LBP to be prevalent in real-time applications.

Neural networks were initially used for face detection and later extended to face recognition. According to Manisha M. Kasar et al. (2016), **Artificial Neural Networks (ANN)** consist of interconnected nodes, functioning like the human brain to perform recognition and classification tasks. These nodes are organized into three layers: input, hidden, and output. Input nodes carry weighted values based on their importance, hidden nodes apply mathematical and thresholding functions to process information, and output nodes provide the final result. Hidden layers can be multiple and help in complex prediction tasks.

Convolutional Neural Networks (CNN) are another type of neural network used for face recognition. Like ANN, CNN has input, hidden, and output layers, but the hidden layers are more complex, including convolutional, pooling, normalization, and fully connected layers. CNNs require training on thousands or even millions of images to achieve high accuracy, as seen in systems like Facebook's DeepFace. However, CNN training can be very time-consuming.

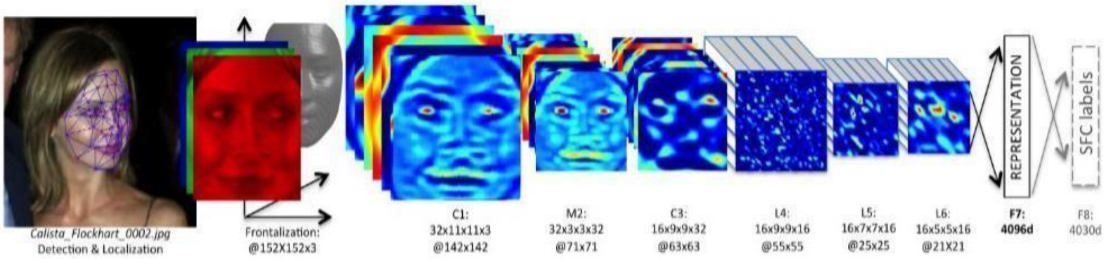


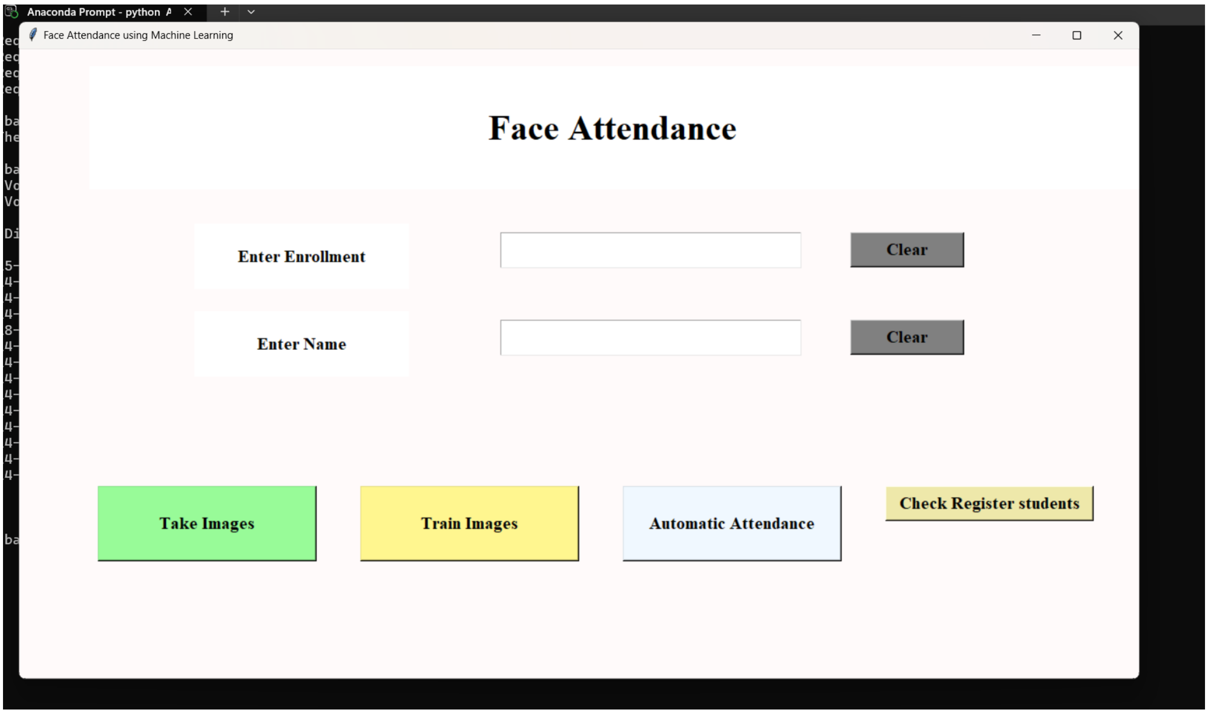
Figure 3.7.2 Deep Face Architecture by Facebook

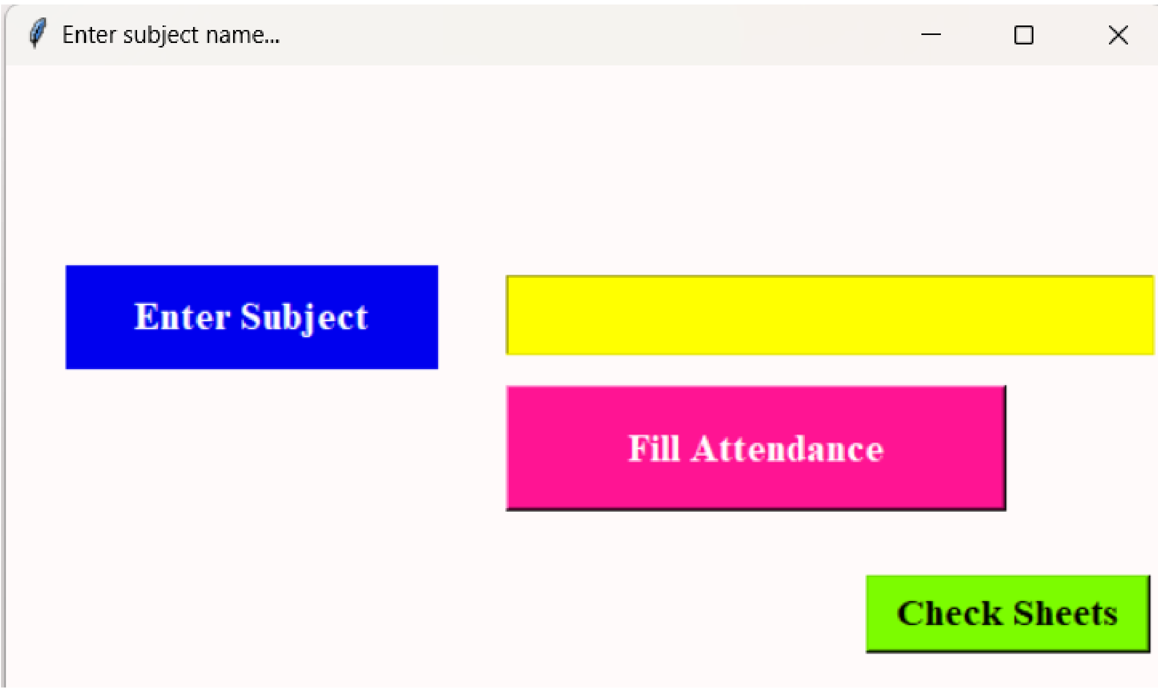
CHAPTER: 4

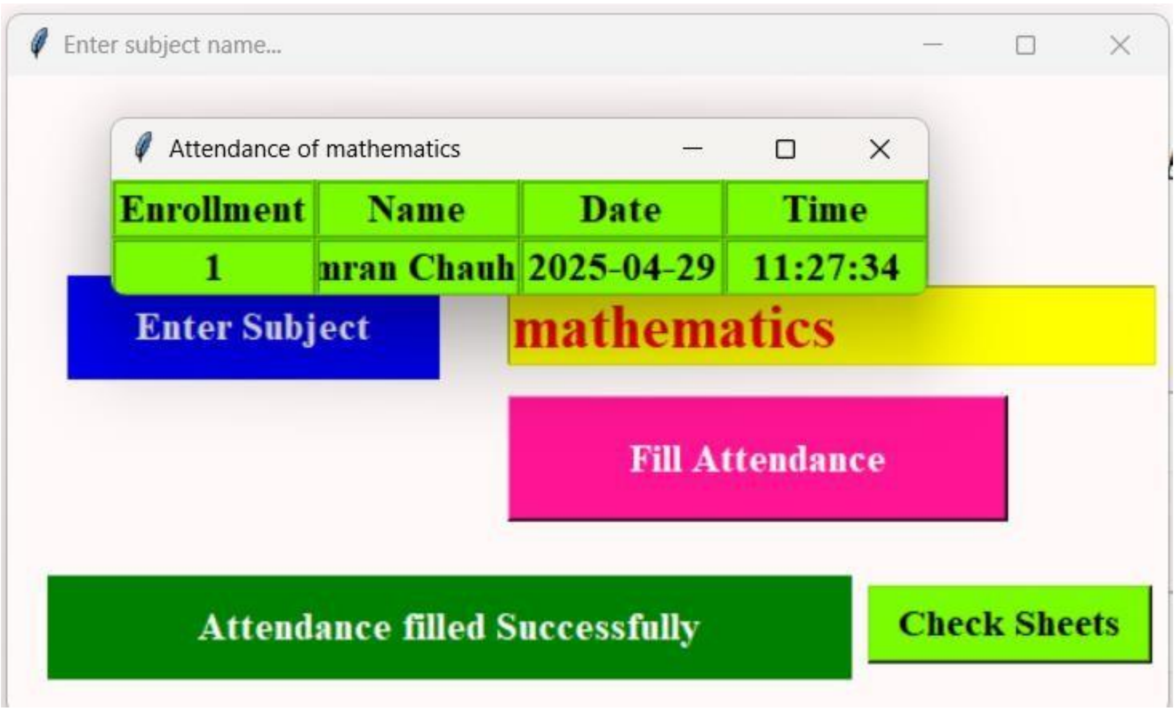
RESULT AND DISCUSSION

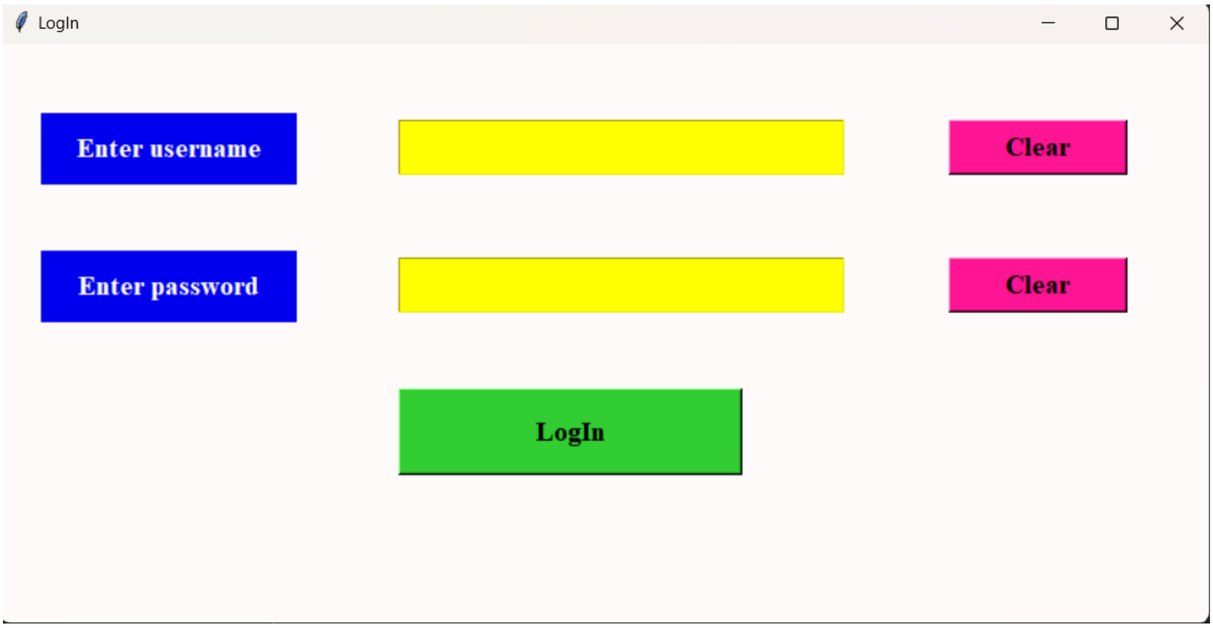
4.1 Result

In this proposed approach, face recognition student attendance system with user- friendly interface is designed by using MATLAB GUI(Graphic User Interface). A few buttons are designed in the interface, each providing a specific function, for example, the start button is to initialize the camera and to perform face recognition automatically according to the face detected, the 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 to browse facial images from a selected database and recognize the selected image to test the functionality of the system respectively.




Enter subject name...
Enter Subject
Fill Attendance
Check Sheets


Enter subject name...
Attendance of mathematics
Enrollment
Name
Date
Time
1
nran Chauh
2025-04-29
11:27:34
Enter Subject
mathematics
Fill Attendance
Attendance filled Successfully
Check Sheets




Student Details

Enrollment	Name	Date	Time
10	:xtrinsicTec	2025-03-24	15:56:13
1	nran Chauh	2025-03-24	15:56:31
1	nran Chauh	2025-03-24	16:05:23
1	nran Chauh	2025-03-24	16:05:35
2	ingshuk sing	2025-03-24	16:18:01

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, the training set has to be chosen based on the latest appearance of an individual rather than taking important factors for instance illumination into consideration.

Our database with color images which is further categorized into high quality set and a low quality set, as images are different in their quality: some images are blurred and some clearer. 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 can 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 operators work on a grayscale image.

One of the factors that are usually a stumbling stone for face recognition performance is uneven lighting condition. 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.

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. However, histogram equalization does not improve the contrast effectively, which causes the image remains darker at 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.

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. This different radius size enhanced LBP operator is less affected by uneven lighting compared to the original LBP operator.

When the radius size increases, only facial images with conditions of right light, left light, and center light are affected whereas for the other conditions, the recognition rate remains constant. This shows that by increasing the radius, the uneven lighting effect can be reduced without distorting the detail of the image. However, the LBP operator with different radii does not give significant results because there is no critical illumination problem exists in the images of our database. Hence, the pixels of good quality images of our database are modified to generate the illumination effects to determine the impact of different size LBP operators. By increasing the radius size, the detail information is simplified and the contour or shape of the face is emphasized. This illustrates that some of the useless or redundant information is removed and more emphasis is on the critical details for recognition.

As it is proven any increasing radius LBP performs better compared to the original by reducing the illumination effect, the consistency of the system is also emphasized other than the accuracy of the system.

From the result of the proposed LBP, a database with good-quality color images, achieves the highest accuracy (100 %) when either one image or two images per individual is trained whereas a database with poor-quality color images has an average accuracy of (86.54 %) when only one image per individual is trained and average accuracy of (88.46 %) when two images per individual are trained. It can be said that the approach works best with good-quality images, poor quality images could degrade.

The performance of the algorithm. Poor quality images were captured by using Laptop camera. The poor quality images might include the relatively darker images, blur images or having too much unwanted noise. In blurred images, the face is blurred out. Unwanted noise can be reduced by applying median filtering, but for those blurred images there are no suitable ways to get rid of it.

4.3 Weakness of the Algorithm

The proposed algorithm can only work with a single face. Multiple faces appear in the same image causes each of them to be small. Small face region gives inaccurate features, this will decreases the performance of the system. Hence, whenever more than a face is detected, the system will not perform the recognition.

The LBP algorithm is highly sensitive to image quality and highly affected by the blurred image. LBP is the texture based descriptor which extracts the local grayscale features by performing feature extraction on a small region throughout the entire image. Hence, test image and train image have to be the same quality and captured by the same device in order to have high accuracy.

The laptop built in webcam is the default device in this proposed approach to capture image. The webcam and lighting source of the laptop have low performance which cause the captured images appear to be darker and blurred. This cause the system only function the best if the test image and train image are both captured at the same place under approximately same illumination.

Besides, false recognition occurs when the facial image is blurred. The blurred image caused by the after image created by movement will degrade the performance. The face feature extracted from the blurred image would be totally different compared to train image resulting in false recognition.

In addition, if an individual wears makeup in the image for face recognition, the important features will be covered. Similarly, the face region should not be covered by hair, beard, or any accessories to ensure better performance. For instance, if a girl provides a facial image with her face covered by hair, it causes false recognition to occur if the girl ties her hair. This is because anything covering the face region will be assumed a face feature. This causes a relatively large difference between the test image and the train image.

Different levels of brightness or lighting could be a challenging problem for face recognition. Hence, the limitation of the proposed algorithm is studied and analysis is conducted by modifying the pixels of high-quality images to manipulate the brightness of the facial images. The recognition rate of facial images under different levels of brightness is computed and tabulated.

4.4 Problem faced and solution taken

One of the problems in real-time face recognition is the difficulty of obtaining sufficient and suitable images for training and testing purposes. It is hard to obtain in real-time databases with a variety of variables, Hence, our database consists of colour images which are categorized into high-quality images, and low-quality images are also used.

Besides, it is very difficult to obtain an open source or the free face recognition software in order to make comparisons. Viola-Jones algorithm can cause false face detection. This can be solved by increasing the detection threshold (Mathworks.com, 2018). The threshold indicates the number of detections needed to declare a final detection around an object. By using MATLAB's built-in function, Merge Threshold, the detection threshold can be adjusted to reduce the false face detection.

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 image obtained from recording video frames concerning train images. This proposed approach 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 the 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 can stabilize the system by giving consistent results. The accuracy of this proposed approach is 100 % for high-quality images, and 92.31 % for low-quality images.

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 (CLAHE) can reduce the illumination effect. CLAHE performs better compared to histogram equalization in terms of contrast improvement. Enhanced LBP with a larger radius size specifically, radius size two, performs better compared to the original LBP operator, with less affected by illumination and more consistent compared to other radius sizes.

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, the test image and train image have to be of the same quality which is captured by using the same device to have high accuracy. Lastly, if an individual wears makeup in the image for face recognition, the important features will be covered.

A better camera with a better lighting source can reduce the illumination problem and also able to avoid the capture of blurred images. In this proposed approach, a laptop built-in camera is the 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 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 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, A. I (artificial intelligence) algorithm which can be implemented to perform face recognition. CNN (Convolution Neural Network) which has been a hot topic recently, is a machine deep learning algorithm that can 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 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.

REFERENCES

1. Margaret Rouse. (2012). What is facial recognition? – Definition from WhatIs.com. [online] Available at: http://whatis.techtarget.com/definition/facial-recognition [Accessed 25 Mar. 2018].

2. Face Recognition: Understanding LBPH Algorithm,Towards Data Science-90ec258c3d6b,Kelvin Salton do Prado, Nov 11, 2017.[Online]. Available :https://towardsdatascience.com/face-recognition-how-lbph-works-90ec258c3d6b

3. deAgonia, M. (2017). Apple's Face ID [The iPhone X's facial recognition tech explained]. [online] Computerworld. Available at: https://www.computerworld.com/article/3235140/apple-ios/apples-face-id-the-iphone-xs-facial-recognition-tech-explained.html [Accessed 25 Mar. 2018].

4. Kihwan Kim. (2011). Computer Vision Final Project:Viola-Jones https://www.cc.gatech.edu/~kihwan23/imageCV/Final2005/FinalProject_KH.htm [Accessed 22 Apr. 2018].

5. Kasar, M., Bhattacharyya, D. and Kim, T. (2016). Face Recognition Using Neural Network: A Review. International Journal of Security and Its Applications, 10(3), pp.81-100.

6. D. Nithya (2015). Automated Class Attendance System based on Face Recognition using PCA Algorithm. International Journal of Engineering Research and, V4 (12).

7. Robert Silk. (2017). *Biometrics: Facial recognition tech coming to an airport near you: Travel Weekly*. http://www.travelweekly.com/Travel-News/Airline-News/Biometrics-Facial-recognition-tech-coming-airport-near-you [Accessed 25 Mar. 2018].

8. Jesse Davis West. (2017). *History of Face Recognition - Facial recognition software*. [online] Available at: https://www.facefirst.com/blog/brief-history-of-face- recognition-software/ [Accessed 25 Mar. 2018].

9. Rahul V. Patil and S. B.Bangar. (2017). Video Surveillance Based Attendance system. *IJARCCE*, 6(3), pp.708-713.

10. Shireesha Chintalapati, M.V. Raghunadh. (2014), “Automated Attendance Management System Based On Face Recognition Algorithms”, *IEEE International Conference on Computational Intelligence and Computing Research*.

Report

ORIGINALITY REPORT

19%	13%	14%	7%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	eprints.utar.edu.my Internet Source	3%
2	azpdf.org Internet Source	2%
3	www.slideshare.net Internet Source	2%
4	Submitted to Federal University of Technology Student Paper	2%
5	ece.anits.edu.in Internet Source	1%
6	www.computerworld.com Internet Source	1%
7	www.ijert.org Internet Source	1%
8	www.coursehero.com Internet Source	1%
9	www.jetir.org Internet Source	<1%
10	Submitted to Visvesvaraya Technological University, Belagavi Student Paper	<1%
11	ymerdigital.com Internet Source	<1%