Project Report

On

Typing Tutor

For the Degree of

BACHELOR OF COMPUTER APPLICATIONS

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DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

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Date :__________________________

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TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION 7

- Background 7
- Problem Statement 9
- Aims and Objectives 9
- Thesis Organization 10

- **CHAPTER 2**
  - **LITERATURE REVIEW** 11
    - Typing Test 11
    - Typing Test Options 11
      - Adding texts 10
    - Pre-Processing 12
    - Feature Extraction 16
      - Types of Feature Extraction 19
    - Feature Classification And Face Recognition 20
    - Evaluation 20

- **CHAPTER 3**
  - **METHODOLOGY** **21**

- Training 22
- Analysis 27
- Feature Extraction 23
  - Working Principle of Original LBP 23
  - Working Principle of Proposed LBP 23

- **CHAPTER 4**
  - **RESULT 24**
    - Result 24

- **CHAPTER 5**
  - **Screnshoots 38**
    - Conclusion 38

- **CHAPTER 6**

- **CONCLUSION 40**
- Conclusion 40

CHAPTER 1

INTRODUCTION

Welcome to Typing tuttor. This powerful typing tutor will help you improve your typing substantially whether you are a novice or a seasoned professional. Typing tuttorhas many courses that will satisfy your changing needs as your skills and speed improve.

The complete touch typing course will teach you the touch typing technique starting with the basics and advancing step-by-step using examples, word drills and games to get you familiar with your keyboard.

Typing tuttorPro also offers a Speed Building course to help you hone your typing skills once you have the basics covered. This is also good for experienced typists looking to keep their skill level up. Courses to practice the numbers, special character keys and the numeric keypad are also included.

Also included is the dynamic Review section and the Typing tuttorPro Satellite, which monitors your typing progress while you are using other programs such as email and word processor. These tools monitor your typing and create customized training to suit your individual needs. Due to the advanced typing analysis of these tools they will help improve your typing long after you have finished with the courses.

This manual will help you get Typing tuttorPro installed and running on your system. All of the features in Typing tuttorPro and the Satellite are also explained. Please read this manual carefully before installing Typing tuttorPro on your computer. This will ensure a trouble free installation and an easy startup. You will also know how to take advantage of all the features Typing tuttorPro has to offer.

- **Background**

Face recognition is crucial in daily life in order to identify family, friends or someone we are familiar with. We might not perceive that several steps have actually taken in order to identify 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, by specifically retina in the form of light. Light is a form of electromagnetic waves which are radiated from a source onto an object and projected to human vision. Robinson-Riegler, G., & Robinson-Riegler, B. (2008) mentioned that after visual processing done by the human visual system, we actually classify shape, size, contour and the texture of the object in order to analyse the information. The analysed information will be compared to other representations of objects or face that exist in our memory to recognize. In fact, 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 the Universities, there are a lot of students with different race and gender, it is impossible to remember every face of the individual without making mistakes. In order 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 image with stored images in the database of that person (Margaret Rouse, 2012).

Nowadays, face recognition system is prevalent due to its simplicity and awesome performance. For instance, airport protection systems and FBI use face recognition for criminal investigations by tracking suspects, missing children and drug activities (Robert Silk, 2017). Apart from that, Facebook which is a popular social networking website implement face recognition to allow the users to tag their friends in the photo for entertainment purposes (Sidney Fussell, 2018). Furthermore, Intel Company allows the users to use face recognition to get access to their online account (Reichert, C., 2017). Apple allows the 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 had introduced a system which 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 are further enhanced by Goldstein, Harmon, and Lesk in 1970 by using other features such as hair colour and lip thickness to automate the recognition. In 1988, Kirby and Sirovich first suggested principle component analysis (PCA) to solve face recognition problem. Many studies on face recognition were then conducted continuously until today (Ashley DuVal, 2012).

- **Problem Statement**

Traditional student attendance marking technique is often facing a lot of trouble. The face recognition student attendance system emphasizes its simplicity by eliminating classical student attendance marking technique such as calling student names or checking respective identification cards. There are not only disturbing the teaching process but also causes distraction for students during exam sessions. Apart from calling names, 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, face recognition student attendance system is proposed in order to replace the manual signing of the presence of students which are burdensome and causes students get distracted in order to sign for their attendance. Furthermore, the face recognition based automated student attendance system able to overcome the problem of fraudulent approach and lecturers does not have to count the number of students several times to ensure the presence of the students.

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, paper proposed by Pooja G.R et al.

(2010) found out that the training process for 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 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 which represent the identity of the students have to be consistent towards a change in background, illumination, pose and expression. High accuracy and fast computation time will be the evaluation points of the performance.

- **Aims and Objectives**

The objective of this project is to develop 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

- **Thesis Organization**

Chapter 2 includes a brief review of the approaches and studies that have been done previously by other researchers whereas Chapter 3 describe 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 REVIEW

- **Typing Test**

TypingMaster Pro includes a typing test that you can use to test your current speed at any time.

- **Typing Test Options**

On the Typing Test screen, under section 1, is an extensive range of test texts which have been included. Select any to take a test. Next, in section 2, select the Duration, a typical typing test is at least 5 minutes long. Lastly click on the' Start Test' button to begin.Once you have completed a test it will appear in the Complete Tests list. This contains all tests and lesson exams you have taken (lesson exams are only used when studying in a school or company environment with teacher led courses). Here select a test and then an option to the right to view results or a certificate. Both these can be printed out (unless printing is disabled by the network administrator).

- **Adding texts**

In addition to the test texts already available, you can add your own text files to be used as test texts. To do this, all you need to do is select 'Add' from the top of the screen and when the file browser pops up select a plain text file to be added.please make sure that the file you select is in plain text (these files usually have the ending .txt) Text files created in a word processor and saved as documents usually contain information on the layout of the text and cannot be used.You can also delete tests from the list. Just select the test you wish to delete and click on the Delete button.Before starting the test you can also specify a duration for the test or specify the duration to be free. When this option is selected the test will continue until the test text is finished or Cancel is selected.The bottom half of the screen contains information on the tests you have previously taken. You can also choose to view and print out a diploma of a selected test. When you select the option 'View/print diploma' a new window will appear with a diploma stating the user's name and test results. This diploma can be printed out by clicking on Print.

- **The Test**

In the typing test, you will copy the text you have selected. The program will count your speed and errors. During the test you can make corrections to the word you are currently typing but after the space bar is pressed, the word is considered final and no corrections can be made.If you jump over a word during the test, TypingMaster will automatically jump to the correct position. Although missing a word is considered to be an error, no error is marked to the text you are writing. This will help keep typing fluent. If you jump over more than one word, the program will mark the typed word as incorrect and display the correct position in the original text by underlining the correct word.After the test, you will receive results on the outcome of the test. The results will be displayed in WPM (Words Per Minute) or KPM (Keystrokes Per Minute) depending on your selections in Settings. The duration of the test will be displayed along with information on Gross speed, Accuracy and Net speed.Gross speed is the speed at which you typed during the test. The accuracy percentage counts the amount of words that were correct. With an accuracy of 100% all words were typed correctly. Net speed shows your final speed after errors and can also be called adjusted speed or adjusted words-per-minute.

- **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. Arun Katara et al (2017), Akshara Jadhav et.al (2017), Shireesha Chintalapati, and M.V. Raghunadh (2013), all of the 3 papers have proposed histogram equalization to be applied to facial image, and scaling of images was performed for 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. Scaling down of an image increases the processing speed by reducing the system computations since the number of pixels are reduced. The size and pixels of the image carry spatial information. Gonzalez, R. C. and Woods (2008) mentioned 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 checkerboard effect. The size should be same for all the images for normalization and standardization purposes.

Subhi Singh et al (2015) proposed PCA (Principal Component Analysis) to extract features from facial images, same length and width of image is preferred, thus images were scaled to 120 × 120 pixels.

Besides scaling of images, colour image is usually converted to grayscale image for pre-processing. Grayscale images are believed to be less sensitive to illumination condition and take less computational time. Grayscale image is 8 bit image which the pixel range from 0 to 255 whereas colour image is 24 bit image which pixel can have 16 77 7216 values. Hence, colour image requires more storage space and more computational power compared to grayscale images. (Kanan and Cottrell, 2012). If colour image is not necessary in computation, then it is considered as noise. In addition, pre-processing is important to enhance the contrast of images. In the paper of Pratiksha M. Patel (2016), he mentioned that 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.

There are a few methods to improve the contrast of images other than Histogram Equalization. Neethu M. Sasi and V. K. Jayasree (2013) studied Histogram Equalization and Contrast Limited Adaptive Histogram Equalization (CLAHE) in order to enhance myocardial perfusion images. Aliaa A. A. Youssif (2006) studied contrast enhancement together with illumination equalization methods to segment retinal vasculature. In addition, in paper by A., I. and E.Z., F. (2016) Image Contrast Enhancement Techniques and performance were studied. Unlike Histogram equalization, which operate 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 the literature review for contrast improvement is tabulated in Table 2.4.

Table 2.4 Summary of Contrast Improvement

Method	**Concept**	**Advantages**	**Disadvantages**
Histogram equalization	Contrast enhancement is performed by transforming the intensity values, resulting in uniformly distributed histogram.	1. Less sensitive to noise.	• It depends on the global statistics of an image. • It cause over enhancement for some part, while peripheral region need more enhancement.
Contrast Limited Adaptive Histogram Equalization (CLAHE)	Unlike, HE which works on entire image, it works on small data regions.	1. It prevent over enhancement as well as noise amplification.	1. More sensitive to noise compared to histogram equalization.

	Each tile's contrast is enhanced to ensure uniformly distributed histogram. Bilinear interpolation is then used to merge the neighbouring tiles.		

- **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 a few feature extraction methods for face recognition. In the paper of Bhuvaneshwari et al. (2017), Abhishek Singh and Saurabh Kumar (2012) and Liton Chandra Paul and Abdulla Al Sumam (2012), they proposed PCA for the face recognition. D. Nithya (2015) also used PCA in face recognition based student attendance system. PCA is famous with its robust and high speed computation. Basically, PCA retains data variation and remove 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 single column vector. Furthermore, PCA removes average value from image to centralize the image data. The Principle Component of distribution of facial images is known as Eigen faces. Every single facial image from training set contributes to Eigen faces. As a result, Eigen face encodes 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 image respectively. Euclidean distance is computed by comparing the distance between projected training images and projected test image to perform the recognition. PCA feature extraction process includes all trained facial images. Hence, the extracted feature contains correlation between facial images in the training set and the result of recognition of PCA highly depends on training set image.

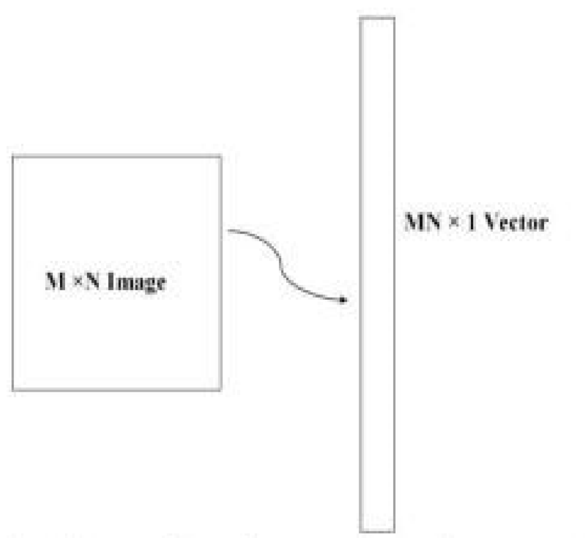


Figure 2.6 PCA Dimension Reduction (Liton Chandra Paul and Abdulla Al Sumam, 2012)

LDA (Linear discriminant analysis) also known as Fisher face is another popular algorithm for face recognition. In the paper by Suman Kumar Bhattacharyya and Kumar Rahul (2013), LDA was proposed for face recognition. LDA extract features by grouping images of the same class and separate images of different classes. LDA is able to perform well even with different facial expressions, illumination and pose due to its class separation characteristic. Same class is defined by facial images of the same individual, but with different facial expressions, varying lighting or pose, whereas facial images of person with different identity are categorized as different classes. Same class images yield within-class scatter matrix meanwhile different class images yield between-class scatter matrix. LDA manage to maximize the ratio of the determinant of the between-class scatter matrix over the determinant of the within class scatter matrix. LDA is believed to have lower error rates compared to PCA only if more samples per class are trained and small size of different class.

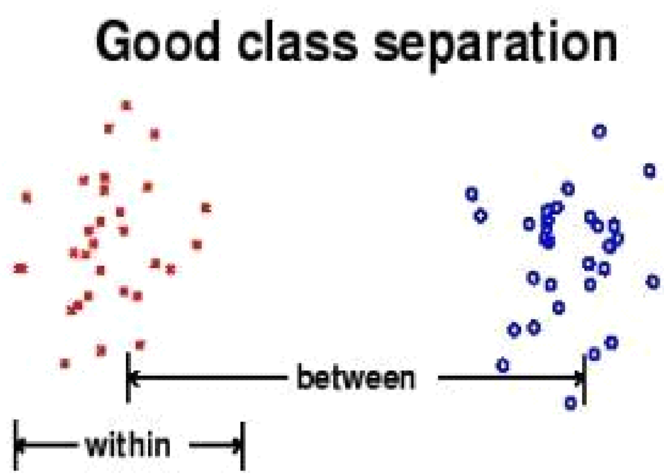


Figure 2.7 Class Separation in LDA (Suman Kumar Bhattacharyya and Kumar Rahul, 2013)

The original LBP (Local Binary Patterns) operator was introduced by the paper of Timo Ojala et al. (2002). In the paper by Md. Abdur Rahim et al. (2013), they proposed LBP to extract both texture details and contour to represent facial images. LBP divides each facial image into smaller regions and 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 middle pixel is the threshold value. The neighborhood larger than threshold value is assigned to 1 whereas the neighborhood lower than threshold value is assigned to 0. Then the resulting binary pixels will form a byte value representing center pixel.

Figure 2.8 LBP Operator (Md. Abdur Rahim et.al, 2013)

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

Neural network is initially used only in face detection. It is then further studied to be implemented in face recognition. In the paper by Manisha M. Kasar et al. (2016), Artificial Neural Network (ANN) was studied for face recognition. ANN consists of the network of artificial neurons known as "nodes". The nodes act as human brain in order to make recognition and classification. These nodes are interconnected and values are assigned to determine the strength of their connections. High value indicates strong connection. Neurons were categorized into three types of nodes or layers which are input nodes, hidden nodes, and output nodes. Input nodes are given weight based on its impact. Hidden nodes consist of some mathematical function and thresholding function to perform prediction or probabilities that determine and block unnecessary inputs and result is yield in output nodes. Hidden nodes can be more than one layer. Multiple inputs generate one output at the output node.

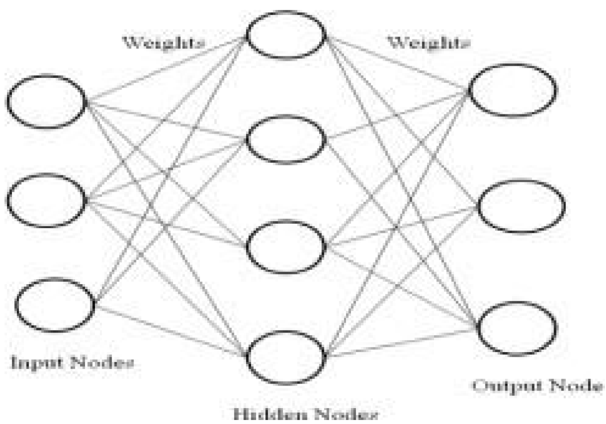


Figure 2.9 Artificial Neural Network (ANN) (Manisha M. Kasar et al., 2016)

Convolutional Neural Network (CNN) is another neural network algorithm for face recognition. Similar to ANN, CNN consists of the input layer, hidden layer and output layer. Hidden layers of a CNN consists of multiple layers which are convolutional layers, pooling layers, fully connected layers and normalization layers. However, a thousand or millions of facial images have to be trained for CNN to work accurately and it takes long time to train, for instance Deepface which is introduced by Facebook.

- **Types of Feature Extraction**

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. Example 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 as redundant will be discarded. Example of feature-based method is LBP (Local Binary Pattern). These methods mentioned are usually combined to exist as Hybrid method, for example Holistic-based method combine with Feature-based in order to increase efficiency.

- **Feature Classification**

Classification involves the process of identification of face. 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. Deepesh Raj (2011) mentioned several types of distance classifiers such as Euclidean Distance, City Block Distance and Mahalanobis distance for face recognition. Md. Abdur Rahim et al. (2013) implemented Chi-Square statistic as distance classifier for LBP operator. The equation of each classification method is defined below.

Chi-Square statistic is suggested to be used as dissimilarity measures for histograms to compute the distance between two images. Abhishek Singh and Saurabh Kumar (2012) proposed Euclidean distance to compute the distance between two images after PCA feature extraction was performed. Threshold can be set for the distance calculated from the classifier. 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.

- **Evaluation**

Different databases are used in order to evaluate the system performance. The database provided by previous researchers with different variable conditions, for example, lighting and expression will be used to justify the system and for study purpose. Furthermore, our own database will be used to analyse the system for real time application. From the literature review of the previous researchers, the common method to justify the performance of the system is by finding the accuracy of recognition.

Table 2.5 Summary of Feature Extraction, The Accuracy Obtained from Handbook of Research on Emerging Perspectives in Intelligent Pattern Recognition (NK Kamila, 2015)

CHAPTER 3

METHODOLOGY

- **Methodology Flow**

The approach performs face recognition based student attendance system. The methodology flow begins with the capture of image by using 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 the 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 (recognize the unknown input image) shown in Figure 3.1 and Figure 3.2 respectively.

- ## Training

This section of the Satellite will help you fine-tune your typing in the problem areas that the Satellite has detected. The training section can be reached from the the Satellite menu in TypingMaster Pro or directly from the Satellite menu.To start training select a duration for the training session from from the drop-down menu labeled section 1. If you select 'No time limits' the lessons will be gone through without any time limitation. Then click on the 'Start Training' button.Once you start training you will be presented with a list of exercises and the difficulty index. You can work through the exercises in any order but it is recommend you take them from top to bottom. The difficulty index of the letters and words you have is displayed at the bottom and will be updated after each exercise.Click the OK button to exit the exercise screen.You can fine-tune your typing with the TypingMaster Satellite continually. Any time you feel the need for some brushing up, just select 'Training...' from the Satellite menu and new material will be created to address your current needs.

- ## Analysis

Under the Analysis tab which you can select from the top of the Satellite page in TypingMaster Pro, information on your difficult keys, capitals and words is shown. The keys and capitals are ordered according to their difficulty. If you have some problematic keys or capitals, it's a good idea to start the customized practice to get you familiar with these keys.The list of difficult words is also ordered according to a word's difficulty. This list of words can also be edited by selecting a word or group of words from the list and selecting 'hide' to hide your selection or 'edit' to edit the last selected word. Words can also be added to this list by selecting 'add' and writing the word or words separated by a comma to the box and selecting OK. When a word is added manually, it will get a difficulty percentage of 100.Conversion to Grayscale ImageContrast Limited Adaptive Histogram Equalization

- **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 images

- **Working Principle of Proposed LBP**

The original LBP operator is composed of 3 × 3 filter size with 9 pixels. Instead of the circular pattern, it looks more rectangular in shape. The 9 pixels adjacent to each other means every detail will be taken as sampling points even the non-essential details. It is more affected by uneven lighting condition because the small filter size emphasizes small scale detail (Lee and Li, 2007), even the shadow created by non-uniform lighting condition. In our proposed approach, a larger radius size, R is implemented in LBP operator. In the paper of Md. Abdur Rahim et.al (2013), the equation of modifying the radius size has been introduced. However, the paper did not mention the effect of changing the radius size. In the proposed approach, analysis is done on different radius sizes in order to enhance the system and reduce the illumination effect. By increasing the radius size, the filter size will be increased. R indicates radius from the centre pixel, θ indicates the angle of the sampling point with respect to the center pixel and P indicates number of sampling points on the edge of the circle taken to compare with the centre pixel. Given the neighbouring's notation (P, R, θ) is implemented, the coordinates of the centre pixel (Xc, Yc) and the coordinates of the P neighbours (Xp, Yp) on the edge of the circle with radius R can be computed with the sines and cosines shown in the equation (Md. Abdur Rahim et.al,2013):

$$Xp = Xc + R\cos(\theta/P)$$
$$Yp = Yc + R\sin(\theta/P) \tag{3.3}$$

Although the radius has been increased, total 8 sampling points are taken which is similar to the original LBP operator. In the approach, CLAHE is performed on the grayscale input facial images to improve the contrast. The contrast improved images remain as grayscale images. The proposed LBP operator extracts the grayscale features from the contrast improved grayscale images which requires only 8 bit computation. After that, the pixels at the sampling points will be encoded as 8 bit binary string in the same way as original LBP operator encoding process. Enhanced LBP with radius size two, perform better compared to original LBP and has more consistent recognition rate compared to other radius size. Hence, enhanced LBP with radius size two will be used as proposed approach. The proposed LBP operator will be further explained in Chapter 4 (result and discussion).

CHAPTER 4

RESULT AND DISCUSSION

- ## 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 provides specific function, for example, 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 update button is to train the latest images that have been registered in the database. Lastly, browse button and recognize button is to browse facial images from 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 proposed algorithm. The analysis of choosing the radius size will be further explained in the discussion

- **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 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 which is further categorized into high quality set and the low quality set, 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 purpose and converted to grayscale image if it is not a grayscale image because CLAHE and LBP operator 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. In order to study the difference between the CLAHE and histogram equalization, comparison is made and tabulated in Table 4.2.

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 right hand side. 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. In Yale face database, CLAHE prevents some region appears to be washed out as well as reduce over 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 span 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, useful feature is extracted by using enhanced LBP (local Binary pattern).Unlike the original LBP operator, enhanced LBP operator consists of different radius size is proposed as mentioned in previous chapters. This different radius size enhanced LBP operator is less affected by uneven lighting compared to original LBP operator. The extracted feature for different radius is shown and tabulated in Table 4.3.The results show when the radius increased, the images are smoothen.

For evaluation purpose, Yale face database with different condition is used for comparison. The normal facial image of each individual in Yale face database is trained and the facial images with varying condition is input as the test image. The recognition rate with the different radius size of LBP operator is computed and tabulated in Table 4.4.

From the Table 4.4,when the radius size increase,only facial images with conditions 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, uneven lighting effect can be reduced without distorting the detail of the image. From Figure 4.6, the line graph shows that the accuracy of different light conditions increase when radius increases. In addition,it shows that among the different lighting conditions,the system work the best in left light condition followed by center light condition and the last is right light condition.

The recognition rate of LBP operator with different radius is then computed by using our own database. However, LBP operator with different radius does not give significant results because there is no critical illumination problem exists in the images of our own database. Hence,the pixels of good quality images of our own database are modified to generate the illumination effects in order to determine the impact of different size LBP operator. Figure 4.7 shows conditions I, II, III and IV which illustrate different illumination effects.

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 original by reducing illumination effect, consistency of the system is also emphasized other than accuracy of the system. From the Table 4.5, although radius three and radius four have higher average accuracy compared to radius two, radius two is more consistent toward different conditions. As the conditions I, II, III and IV is self-simulated conditions, in real time face recognition, the illumination condition is unpredictable. Hence, radius two gives consistent result which is (94.12 %) in condition I, condition III and condition IV is chosen and used as proposed algorithm.

The fact that, the radius might not be the larger the better because larger radius with respect to larger filter size emphasizes complementary information to small scale detail but at the same time it loss discriminative information. The discriminative information is important, for instance to recognize students with glasses free condition.

Figure 4.6 Images of Students With or Without Wearing Glasses

However, it does prove that the enhanced LBP operator with increased radius performs better compared to original LBP in case of illumination effect reduction. Hence, the radius size of the LBP operator has to be wisely selected in order to reduce the illumination effect without sacrificing much of the recognition rate.

From the result, the condition II appears to have lower accuracy compared to others. This is due to the lighting effect of the training image. The training images have its left side relatively darker compared to its right side which is directly opposite of the test image (condition II).

Training Image Test Image
(Condition II)

Figure 4.7 Training Image VS Testing Image

From the result of proposed LBP in Table 4.6, database with good quality colour images, achieves the highest accuracy (100 %) either one image or two images per individual is trained whereas database with poor quality color images have 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.

- **Comparison of LBP and PCA**

In this proposed approach, PCA face recognition is performed in order to identify the differences with respect to LBP by using the same database.From the result obtained in Table 4.7, supposedly PCA should have worked better with high quality images which is similar to enhanced LBP.However,it gives slightly lower accuracy in recognition in high quality images compared to low quality images.This is due to different size of the database are used in the proposed approach.For high quality images there are only seventeen students in the database, whereas low quality images involve twenty-six students, which is almost ten students more than high quality images.It is the PCA's nature to be more affected by the size of the database compared to LBP. Hence,the larger the size of the database which means the more students include in the database,the lower the recognition rate of PCA.

Furthermore,the enhanced LBP is compared with the PCA face recognition,by using the same pre-processing procedure and same image enhancement technique. From the Table 4.6 and Table 4.7, the average accuracy of PCA is lower compared to the LBP in all the databases, our own database with high and low quality images and also Yale face database is used respectively.Hence, it can be said that enhanced LBP works better compared to the PCA face recognition given the same dataset is used for training and testing.

An automated subjective selection algorithm involve both enhanced LBP and PCA is designed for face recognition.The best results from enhanced LBP and PCA correspondingly are compared to obtain a common result.This common result will be classified as recognized individual. By doing so, the system becomes more

reliable,stable and consistent not only in different expression but also in different lighting condition.This is because two algorithms are used for generalization,one act as a reference to another one.Especially in the camera initializing stage,if the camera is started faster than the lighting source, a darker image will be captured. However the dark image is meaningless to be recognized. The combination of enhanced LBP and PCA able to block the meaningless image from being recognized. Overall accuracy with and without combination of LBP and PCA are tabulated in Table 4.8. It shows that with high quality images,make no difference with or without the algorithm. However, for low quality images,it shows significant improvement in the accuracy with the algorithm.

- **Comparison with Previous Researches**

Table 4.1 Summary of Comparison with Previous Researches

Paper/difference	Automated Class Attendance System based on face recognition using PCA Algorithm(D. Nithya, 2015)	Proposed algorithm	Automated Attendance Management System Based On Face Recognition Algorithms(Shireesha Chintalapati, M.V. Raghunadh ,2013)
Noise removal	None	Median filtering	None
Image enhancement	None	Contrast Limited Adaptive	Histogram equalization

		Histogram Equalization	
Featured based	PCA	Enhanced LBP and PCA	PCA/LDA/LBPH

Database	Own database	Own database and Yale face database	NITW-database
Attendance	Write attendance to Excel file	Subjective selection by enhanced LBP and PCA,and write attendace to Excel file	Write attendance to Excel file

From the Table 4.10, proposed algorithm is compared with face recognition student attendance system proposed by previous researchers. The techniques used by the previous researchers to process the images is compared in this proposed approach.

In terms of image enhancement, the paper published in 2013 used histogram equalization to improve the image contrast, while another paper did not apply any technique to improve the image contrast. In this proposed algorithm, CLAHE is used to improve the image contrast. Histogram equalization, which is often used in x-ray applications, gives bone structure a clearer view. However, histogram equalization will tend to cause over enhancement to some of the regions and cause it to be washed out while other regions are not enhanced properly. Hence, CLAHE is implemented instead of histogram equalization to prevent over enhancement and improve the contrast more evenly throughout the image. The difference between CLAHE and histogram equalization is tabulated in result of the previous part.

The research, published in the year 2015 used PCA for feature extraction. While the paper published in the year 2013 used multiple feature extraction algorithms. These feature extraction algorithms are PCA, LDA and LBPH. In this proposed approach, other than enhanced LBP algorithm, PCA is also computed in order to make comparison and to understand their property and performance respectively. In the paper of year 2013, either one of the feature extraction methods PCA, LDA and LBPH is used each time. In this proposed approach, enhanced LBP and PCA are both used as combination to ensure consistent results.

The previous researcher who published the paper in 2015 used their own databases of images in study. The paper published in year 2013 used an image database of 80 individuals (NITW-database) with 20 images of each person, while the paper in year 2015 did not mention the size of image database used. The proposed algorithm uses multiple image databases, which include Yale face database with different lighting and expression for training and testing. In fact, Yale face database allows the study of performance of the proposed algorithm in uneven lighting and variety of expression condition. However, Yale face database consists of only grayscale images without background, thus our own database with colour images is also used in real time application to perform face recognition.

Face recognition is the process of identification of an individual by choosing the closest distance between test image and train image. Hence, quality of images plays an important role in performance of face recognition. Blurred images caused by movement tend to create the after image which can degrade the performance. Furthermore, the test images captured in extremely bright or dark condition can degrade the performance as well because its show a large variation with the train image provided train image is captured in moderate lighting. All these factors have to be taken into consideration when selecting images for testing and training purpose. It is always better to use more images for training, so that the result obtained provides a better generalization and in consequence provide better performance.

In addition, both papers did not apply technique for removal of image noise. In proposed algorithm, Median filtering is used to filter out noises in the image. If the noises on the images are not removed, the algorithm might recognize the noises as part of the crucial features. These will probably affect the overall performance of the algorithm.

Lastly, both papers writes student attendance to Excel file as post-processing. In the proposed approach, a subjective selection algorithm is designed to obtain a common result from enhanced LBP and PCA. This common result from enhanced LBP and PCA is classified as recognized individual and written to Excel file. This algorithm able to reduce false recognition, especially in camera initializing stage, when the camera light is not ready to function. Hence, the proposed algorithm makes the system to be more reliable by giving the consistent result.

- **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 higly 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 make up in the image for face recognition, the important features will be covered. Similarly, face region should not be covered by hair, beard or any accessories to ensure better performance. For instance, 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 as face feature. This causes a relatively large difference between test image and train image.

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

Figure 4.12 shows images with different intensity by adding different constants to pixel. The performance of the proposed algorithm is tabulated in the Table 4.9.

From the Table 4.9, the proposed algorithm function the best when the intensity increase by a constant at the range of 25 and 50.Further increasing or decreasing the intensity level out of this range will cause the recognition rate to drop to (94.12 %) .Hence,it can be said that the system work better in a relatively brighter image then a darker image.

- **Problems Faced and Solutions Taken**

One of the problems in real-time face recognition is the difficulty to obtain sufficient and suitable images for training and testing purpose. It is hard to obtain in real-time databases with a variety of variables, and it is hard to obtain publicly available databases. Yale face database is one of the databases that could be downloaded by the public. Hence, Yale face database is adopted and used in this proposed approach. However, Yale face database consists of only grayscale images without any background. Hence, our own database consists of colour images which is categorized to 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. In this proposed approach, Luxand Face SDK window demo version software is downloaded and implemented in the laptop. By using laptop built in webcam to recognize faces, the proposed algorithm and Luxand Face SDK demo able to be compared.

From the Luxand Face recognition website (Luxand.com, 2018), they explained that the Face SDK is a high performance, multi-platform face recognition, identification and facial feature detection solution. For Luxand Face Recognition software, the self-learning Al enables video-based identification and the enrolment can be done at any time as simple as putting a name tag in a video, the system will identify that subject in all past, present and future videos. As a video-based identification software, it is believed to work better than key-frame based identification. Nevertheless, the detailed information of its working principle is unable to be obtained from their sites.

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 built in function, MergeThreshold, the detection threshold can be adjusted to reduce the false face detection.

CHAPTER 5

SCREENSHOOT's

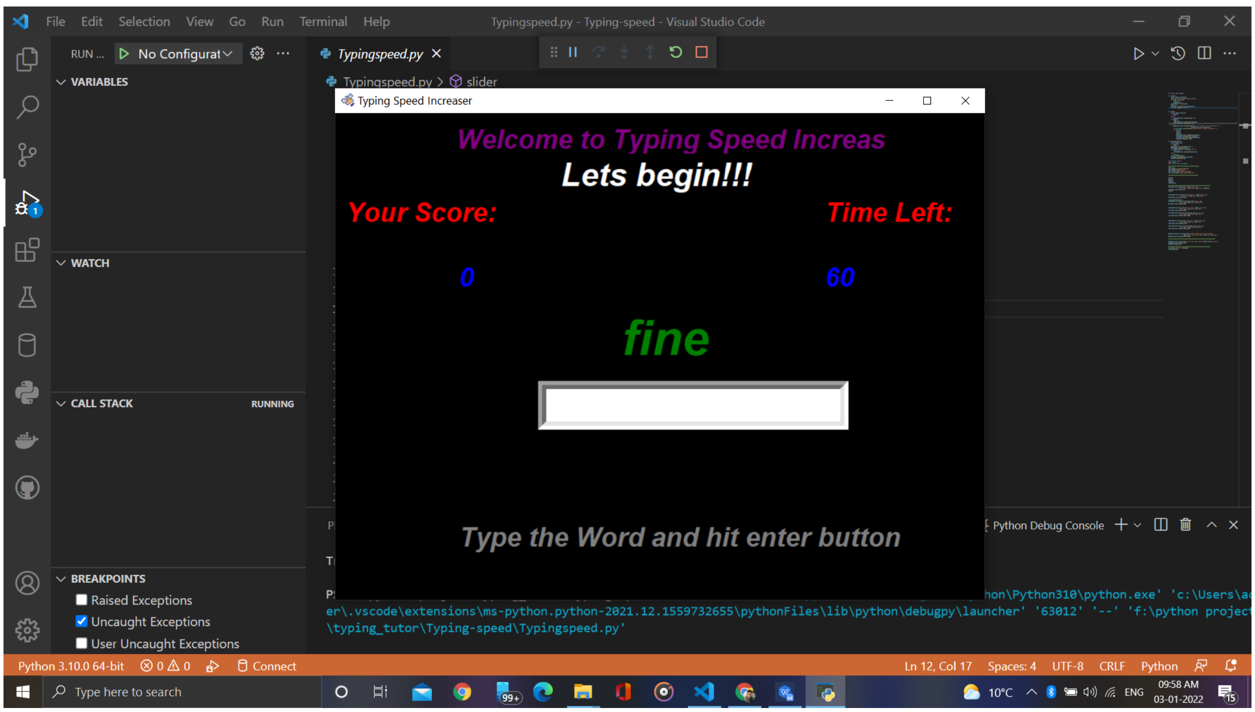
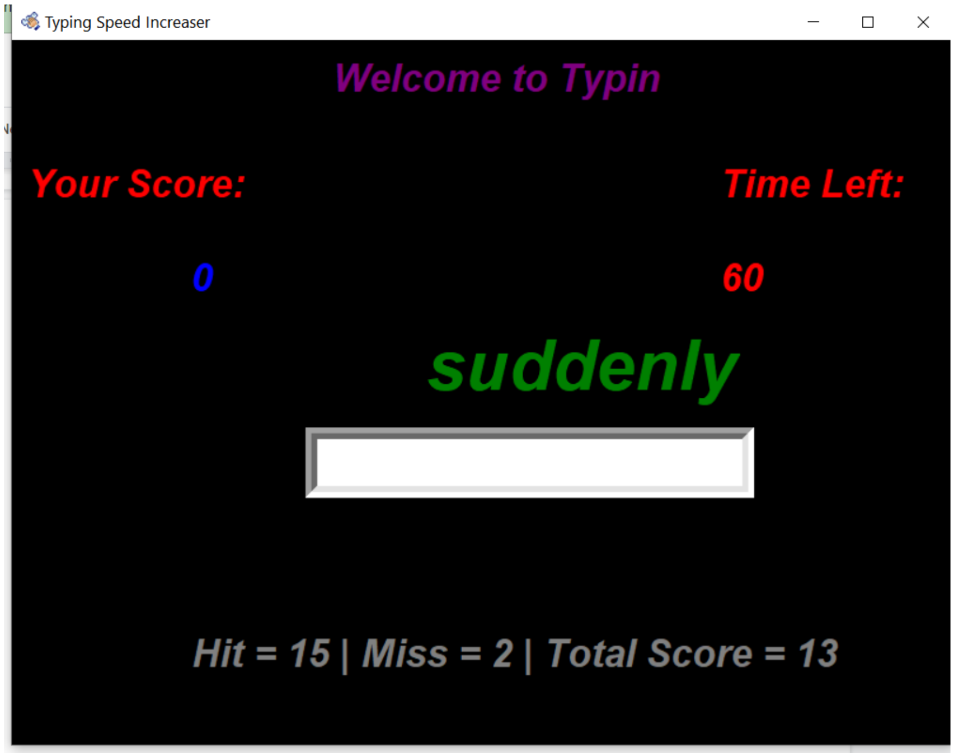


Fig: Main window



Fig; result mention below

CHAPTER 6

CONCLUSION

- **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 frame with respect to train image. This proposed approach able to detect and localize face 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 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 Yale face database when two images per person are trained.

As a conclusion for analysis, the extraction of facial feature could be challenging especially in different lighting. In pre-processing stage, Contrast Limited Adaptive Histogram Equalization (CLAHE) able to reduce the illumination effect. CLAHE perform 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.