PEAT

Face Recognition Based Attendance System for Students

Ng Swee Peng[1], NajibAl-Fadhali[1]*, Huda Majid[1], MSM Gismalla[2], Jameel A. A. Mukred[2],

[1]Department of Electrical Engineering Technology, Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia, 84600 Pagoh, Johor, MALAYSIA

[2]School of Electrical Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, 81310 Skudai, MALAYSIA

*Corresponding Author Designation

Abstract: The traditional method of scoring student attendance is often fraught with difficulties. Lecturers need to check the attendance by calling out student name and tick the attendance on paper or pass the paper to student to sign the attendance. or The other method is by using attendance system, register date and student scan the QR code These methods may cause some human error, proxy attendance and waste time. Therefore, this project proposed a new attendance system with face recognition to overcome the problem. The proposed system is developed using n OpenCV (Open-Source Computer Vision Library), Python, Viola Jones algorithm and LBPH (Local Binary Patterns Histograms), as feature extraction. The Viola Jones algorithm is selected due to the ability to have fast rate face detection. The developed system able to identify students' face segment from a video frame and record their attendance. Recognition effect will be greatly reduced depend on the environment, expression and position but project can expect that will benefit the college to prevent proxy attendance and save time.

Keywords: Attendance, Face Recognition, Python, OpenCV

1. Introduction

Traditional student attendance scoring methods are frequently fraught with difficulties. In addition, attendance is the biggest problem that instructors may face in the classroom. It requires time, effort, and difficult management. This not only interferes with the teaching process, but it also distracts pupils during lectures. Therefore, our project will focus on student attendance with build a system that will help instructors to take attendance of students in a professional way. Face Recognition Student Attendance System highlights its simplicity by removing traditional student attendance scoring

procedures. Furthermore, a face recognition-based automated student attendance system can eliminate the problem of cheating about attendance [1].

1.1 Attendance System

A good attendance system is more than just the basic function of monitoring student for punctuality. There are various types of attendance recognition systems on the market right now such as RFID (Radio-frequency identification) based Attendance System, Fingerprint Attendance System, Face Recognition based Attendance System and QR code (Quick Response Code) based Attendance System [2].

RFID based attendance systems are routinely used to track tags in any implanted device that communicates between the tag and the reader using modulation and encoding techniques. It drastically reduces the potential of fake attendance records. To record their attendance, students must hold their RFID cards up to an ID card reader [3].

Fingerprint based attendance systems work by capturing the pattern of ridges and valleys on the finger. This data is then examined by the device's pattern analysis/matching software, which compares it to a database of registered fingerprints. A successful match means that the identity has been validated. [4]. This method necessitates the use of a portable fingerprint device to capture and identify student fingerprints to track attendance.

Face recognition technology works based on three fundamental steps: creating a database, obtaining target face photos for current recognition, and comparing and filtering the target face photos against the database's existing face photos. [5] To check a student's attendance for a class, the computer uses a real-time video feed to capture the student's face to forecast whether the student matches anybody in the database, and if so, further identifies the student's identity.

QR codes are machine-readable symbols that carry bits of data, and the data from QR codes may be automatically gathered and saved in a database, this attendance system consists of three modules: a mobile module, a web module, and a backend service module. The QR code generated by the backend service module is displayed by the web module. [6] Students can validate their attendance by scanning the QR code with the mobile module. The request is subsequently routed to the back-end service module for approval. Once the attendance has been verified, the back-end service module will update the attendance records database.

In conclusion, RFID card systems are used because they are simple, but there is a risk of card loss or users assisting their friends to check in if they have their friend's card. They can scan QR code for their acquaintance. The fingerprint system is good, but it is inefficient because the verification process takes time, because students must stand in line and be checked one by one [5]. As a result, face recognition system is suggesting that a be integrated into the student attendance system due to other reason as show at Table 1.

Table 1: Fingerprint Vs Face

Fingerprint Recognition	Face Recognition
Students cannot identify from a distance	Students can identify from a distance.
Requires Fingerprint Machine	Can be completely software based with a camera
Waste time if many students	Save more time

2.   Previous Studies

In the paper "Attendance System based on Face Recognition" written by Venkata Kalyan Polamarasetty, Muralidhar Reddy Reddem, Dheeraj Ravi, Mahith Sai Madala(2018), they suggest capturing pictures from a camera and present a MATLAB system to do it. They employed HD cameras to acquire the results to achieve a greater level of precision. The B-box method is used as the descent class for face discrimination. The faces are cut down to a tiny picture with a desired size of 112x92 pixels and due to the 11KB size limit and store in database to do the face recognition based on information on feature.[7]

In the paper "Face Recognition Based Attendance System" written by Nandhini R. and Chokkalingam, S. P. (2019), CNN (Convolutional Neural Network) computation is executed to recognize faces. CNN utilizes a framework like a multilayer perceptron with the aim of processing preconditions faster. After the work of differentiating and preparing the faces, they are compared with the faces in the student database to refresh the student's engagement. The post-preparation component includes a way to refresh the names of the stand-ins into exceeded expectations tables. [8]

In the paper "Student Attendance System in Classroom Using Face Recognition Technique composed by Samuel Lukas, Aditya Rama Mitra, Ririn Ikana Desanti, Dion Krisnadi(2016), authors make sure that the number of highlights in a student's photo of any given face is consistent, for example 16 DCT coefficients. This process is completed by performing grayscale standardization, histogram balancing, discrete wavelet transforms (DWT), and discrete cosine transform (DCT). Further examination of the disappointments in recognizing the rest of the mug shots shows that the substitute student could probably be recognized as another [9].

3.   Methodology

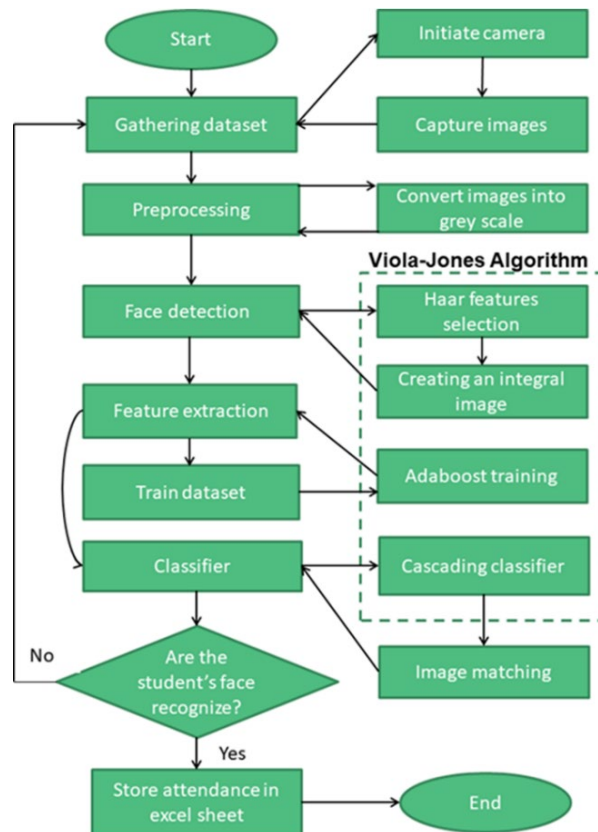The flowchart for the proposed system is show as Figure 1:

Figure 1: Flowchart of System

This work is characterized using camera, supplemented by dataset, image processing, face detection, face recognition, and other technical means to design a fully functional computer application to complete the entry verification of identity. When the face recognition is completed, the attendance information will be automatically counted, and the attendance results will be written in excel sheet for the convenience of lecturers.

To capture face images, it can do with batch importing existing face images and real-time face image capture. Camera is used to collect 60 images of each student to build a face database. After that, in the process of face recognition, the images recognized each time are saved and filter out the face images that do not meet the quality requirements of face recognition and pre-processing convert corresponding image into grayscale, filtering and do the image size normalization. The purpose of face image pre-processing is to make further processing of the face image based on the system's detection of the face image to facilitate the feature extraction of the face image.

Human face is mainly composed of eyes, forehead, nose, ears, mouth and other parts, these parts and the structural relationship between them can be described by features because each human face image can have a matching feature so features extraction can help in face recognition. Next, image with a face image may also include other material, so face detection is needed. To put it another way, in a face image, system will exactly find the location and size of the face, pick the important image information, and automatically delete extraneous superfluous image information to guarantee that the face images is acquired accurately.

Overall system is divided into two parts. The first part is to collect student face image samples through terminals, and the second part is to manage attendance records through the backend. For specific applications, student faces are registered, sample face information is collected and saved in the database, feature base algorithms are used to train the face dataset of registered students in the database, followed by using the trained model to recognize the face information of individuals in the attendance management process, confirming the identity, and generating attendance results from the recognition results to be stored in the database.

The process of taking attendance records is the lecturer in the computer client, enter the attendance interface, click start attendance for face recognition, when student's face is detected, the attendance is record, it will be written to the database; if the attendance fails it can be applied to the lecturer and added manually. Attendance management module is mainly for students to grade their attendance and count the attendance of students in class. It includes, attendance setting, attendance record statistics and attendance status adjustment as the following:

i) Student information collection

This function means, collecting student's personal face images according to the relevant requirements, registering them, and collecting 60 image samples as a personal information database, the system will first pre-process these images for face alignment, light normalization, etc. After that, the feature base algorithm is used for training, and the obtained model is used to extract features.

ii) Attendance management

This function is mainly to audit attendance records and generate statistical reports from attendance records for attendance regulations and can generate a report through the attendance result to check the class's student's attendance.

iii) Face recognition technology process

Face recognition technology works based on three fundamental steps: creating a database, obtaining target face photos for current recognition, and comparing and filtering the target face photos against the database's existing face photos. The technological procedure based on the principle of face recognition

technology is divided into four parts: picture acquisition, pre-processing, face detection, face feature extraction, and face recognition.

iv) Attendance result declaration

After face feature information is detected and recognized to obtain attendance records, the system records the attendance results. Among them, leave of absence needs to be added manually by lecturers after verifying the situation. If a student comes to the classroom but the attendance is abnormal, it needs to be adjusted manually by the lecturer to ensure the fairness of the attendance result. These results will store as excel file.

3.1 Algorithm

Viola-Jones Algorithm is used for face detection in this system because faster detection speed. Haar feature selection, integral image creation, Adaboost training, and cascading classifiers are parts of the process in Viola-Jones Algorithm. The sum of image pixels inside a rectangular region is one of the features that the detection framework looks for. As a result, they resemble the Haar basis functions used in image-based object recognition in the past. [10] Viola's and Jones' characteristics, on the other hand, are generally more complicated since they both rely on more than one rectangular region. The feature template contains both white and black rectangles and defines the feature value of this template as the white rectangle pixel sum minus the black rectangle pixel sum 3 major categories of characteristics used in the framework are depicted in Figure 2.
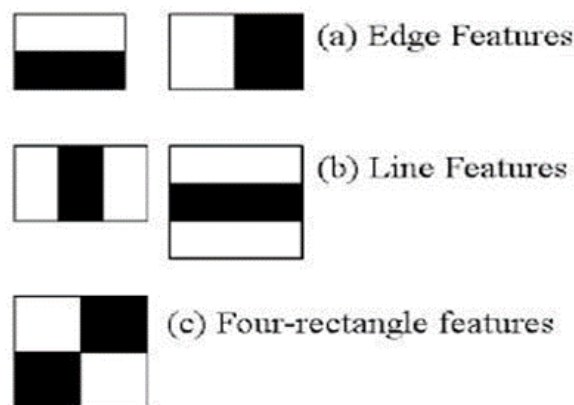

Figure 2: Haar Feature [10]

The total number of pixels in the transparent rectangle minus the total number of pixels in the shaded rectangle equals the value of each feature. When contrasted to other options like steerable filters, rectangular features are simple. They are sensitive to both vertical and horizontal characteristics, but their responses are substantially coarser. Haar feature value reflects the grayscale variation of the image. [10] For example, some features of the face can be described simply by the rectangle feature, such as: the eyes should be darker than the cheeks, the sides of the nose should be darker than the bridge of the nose, the mouth should be darker than the surrounding color, etc. However, rectangular features are only more sensitive to some simple graphic structures such as edges and line segments, so they can only describe structures with specific orientations (horizontal, vertical, diagonal). Since sometimes faces may not be oriented and may be skewed and train rectangular features rotated by a certain angle to recognize faces. [10]

For integral of image in Figure 3, the sum of the pixels to the left of and above a given point determines the value of the integral picture at that point. The total of the pixels in rectangle A is the value of the integral image at point 1. Position 2 has the value of the sum of A and B (A+B), position 3 has the value of the sum of A and C (A+C), and position 4 has the value of the sum of all regions

(A+B+C+D). To remove rectangles A, B, and C, the sum in area D may be calculated by simply adding and subtracting on the diagonal at locations 4 + 1 - (2 + 3). [10]
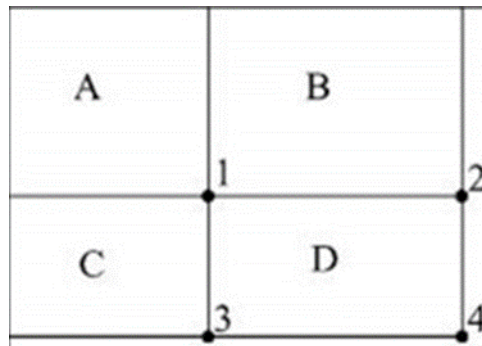

Figure 3: Integral of Image [10]

For Adaboost, also known as "Adaptive Boosting," is a well-known boosting strategy that combines numerous "weak classifiers" into a single "strong classifier." According on the findings of the previous classifier and how much weight should be given to each classifier to make it a meaningful classifier, a training set is chosen for each subsequent classifier. [11]

For feature extraction, LBPH (Local Binary Patterns Histograms) are use as way to do feature extraction this project. The basic idea of face recognition method based on LBPH is as follows: firstly, take each pixel as the center, judge the relationship with the surrounding pixel gray value size, followed by the construction of a statistical histogram of LBP features in each sub-region and binary encode it, to obtain the LBP encoded image of the whole image as show in Figure 4. [12]
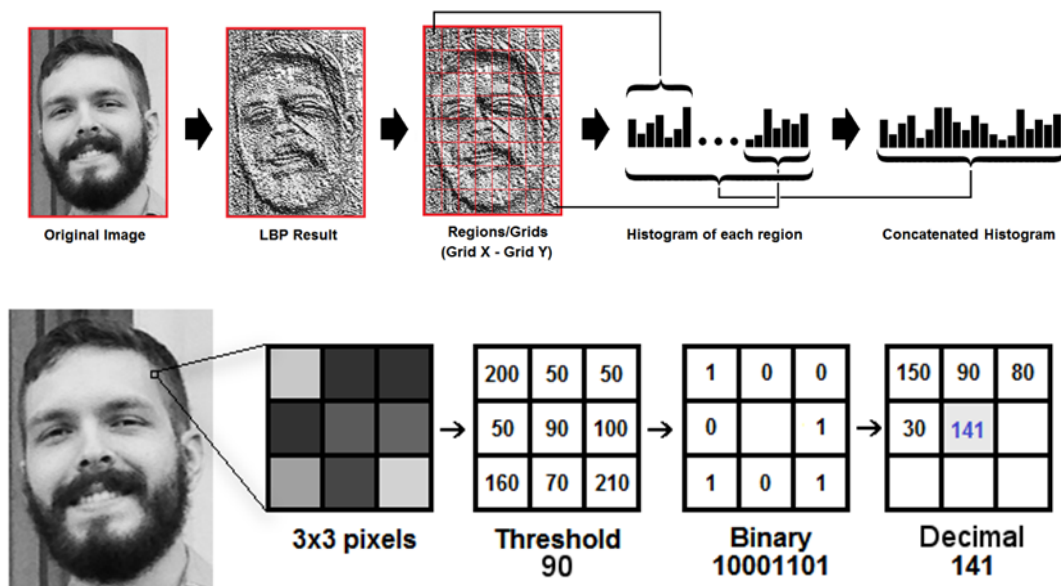

Figure 4: Local Binary Patterns Histograms [12]

3.2 Software

Python, OpenCV (Open Source Computer Vision Library), Microsoft Excel and Microsoft OneDrive are used to create attendance system.

Python's design philosophy stresses code readability, as shown by its frequent use of whitespace. Its language features and object-oriented approach are designed to assist programmers in writing clear, logical code for both small and major projects. Procedural, object-oriented, and functional programming

are also among the programming paradigms supported. Python provides a wide range of options for creating GUIs (Graphical User Interfaces). Tkinter is the most extensively used of all the GUI techniques. It is a standard Python interface to Python's built-in Tk GUI toolkit. Python with tkinter is the quickest and most straightforward way to create GUI programs. Python also fast growing in past few years because it is easier to learn and use than other programming languages. Figure 5 show the GUI create using Tkinter module with Python.
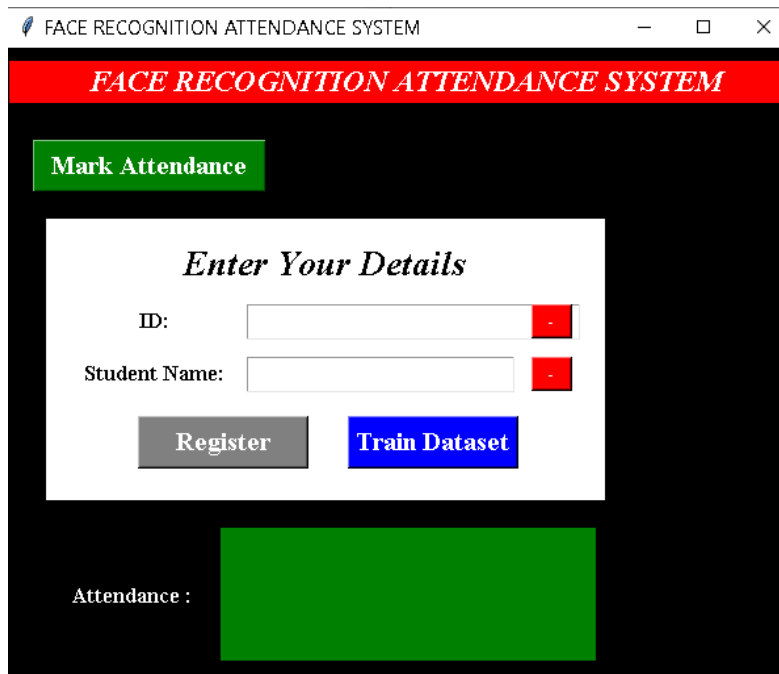

Figure 5: GUI create using Tkinter module with Python

OpenCV is a free and open-source computer vision and machine learning software library that aims to provide a standard infrastructure for computer vision applications and make machine vision more accessible in commercial goods. OpenCV may be used to create real-time image processing, computer vision, and pattern recognition algorithms. It is compact and efficient, with largely C functions and a few C++ classes, and it includes interfaces to languages like Python, Ruby, and MATLAB, as well as a variety of general-purpose image processing and computer vision methods.

Microsoft Excel is a spreadsheet software developed by Microsoft for Windows. Calculations, graphing tools, pivot tables, and Visual Basic for Applications, a macro programming language are all included in one software. Microsoft Excel is a widely used spreadsheet tool, with spreadsheet software being used in a variety of industries. In this project, the report will be saved as excel file.

Microsoft OneDrive is a network drive and cloud service from Microsoft. Users can upload their files to a web server and browse those files through a web browser. Users can also edit and view Microsoft Office files directly. It also introduces synchronization uploading software that allows direct access and synchronization of files from the computer. In this project, system is store in cloud using OneDrive and when a new exam record is generated, the record is also stored in the cloud.

4. Results and Discussion

4.1 Results

From registration to taking attendance and create attendance report, the system works fine, and can take turns to take attendances or take attendances in the same frame. Figure 6 show the process take attendances in the same frame.
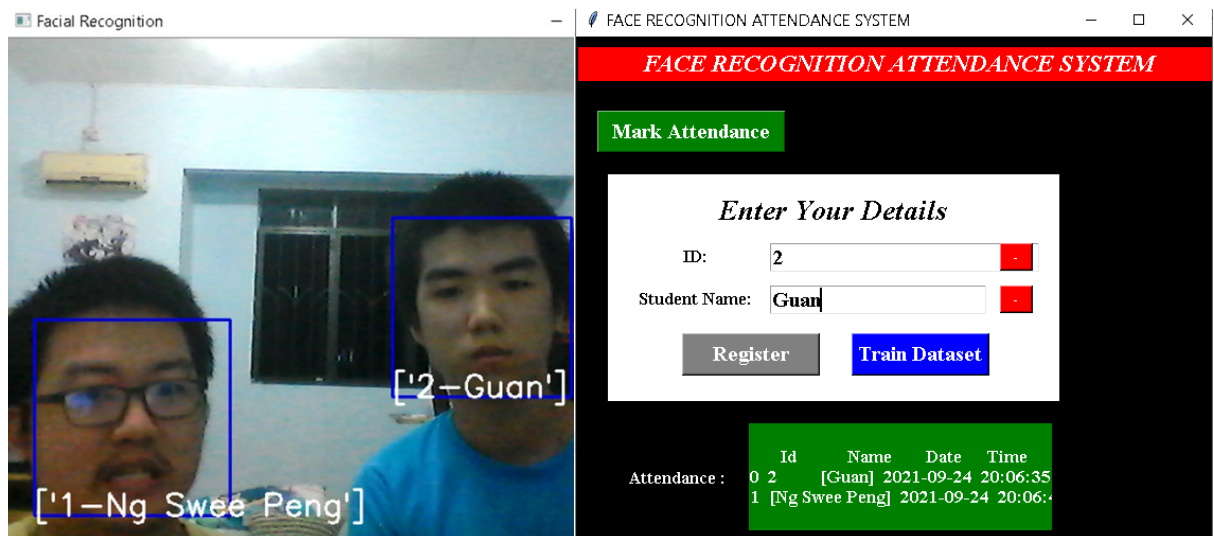
Figure 6: Take attendances in the same frame

If there is light from the window in the background or other factors will cause the system not to detect the face. From here can see that this system is very vulnerable to the effects of light. To avoid the problem of light, set the place of taking attendance to a place where there is no window. Furthermore, method of blocking up the light in the background is also feasible. Figure 7 show the result of light from the window in background and use a shade to block the light on background
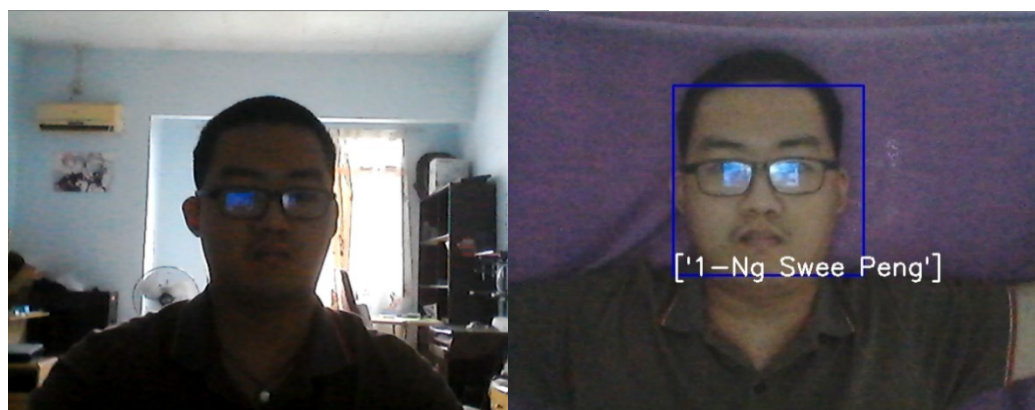

Figure 7: Light from the window in background vs use a shade to block the light on background

And sometimes when change places to take attendance, system will show unknown in person although the dataset of that person is in system. This is trouble because need to adjust position, condition and face expression to make face recognize and take attendance. Figure 8 show the result of before and after adjust position, condition and face expression.
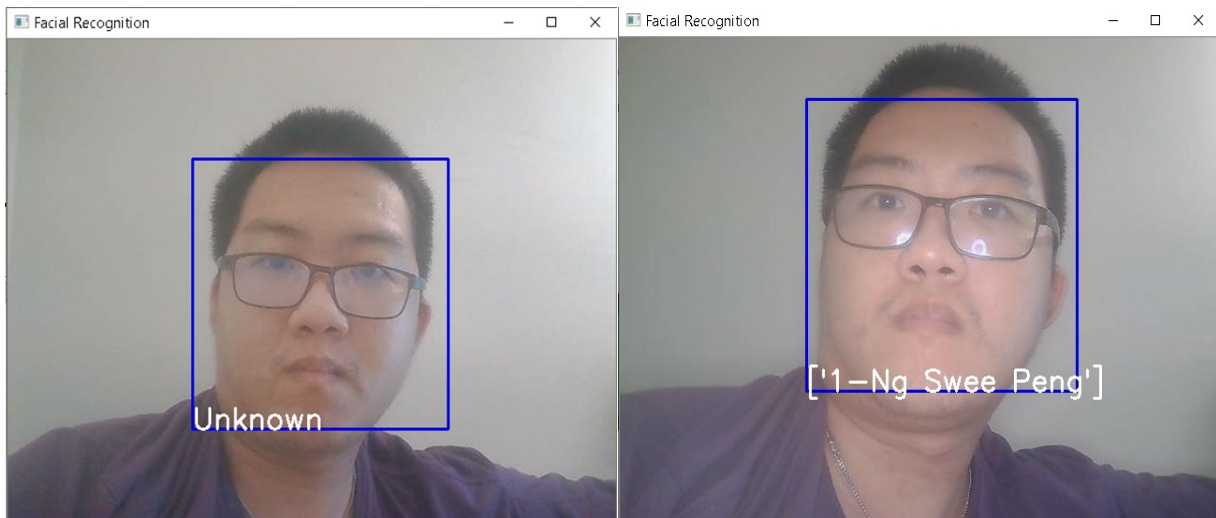
Figure 8: Before and after adjust position, condition and face expression

4.2 Discussions

Viola-Jones Algorithm and LBPH detect faces and calculated to compare with the corresponding feature information of known faces in the face database. The best matching face is finally obtained by comparing the feature information with the known face in the face database. It takes up less space and fast but its reduce recognition rate for changes caused by light and suffers from poor robustness, and once the expression and pose change slightly, the recognition effect will be greatly reduced. These two algorithms more susceptible to weakness of face detection such as light, expression and position.

Since recognition rate reduce caused by light and suffers from poor robustness, and once the expression and pose change slightly, more modern face recognition method such as deep learning based approach,3D models to increase accuracy but slower rate. Each recognition method cannot achieve perfect recognition rate and faster recognition speed. They have their own advantages and disadvantages, therefore, many researchers now prefer to use a variety of recognition methods combined application, take the advantages of various recognition methods, integrated use, to achieve a faster and higher recognition rate.

5. Conclusion

Proxy attendance in university class has always been a problem faced by major colleges. Students tend to commit a lot of fraud while using the current method such as signing for a friend who did not actually attend the class. The existing system also causes a lot of human error on the part of lecturers, such as mark wrong people or lost attendance sheet. In response to these phenomena, face recognition student attendance system by computer vision, image processing and artificial intelligence that can detect and recognize faces was proposed and expected that can proxy attendance and save time. Each project has its own objectives. Similarly with this face recognition-based attendance system, main objective of this project is to solve problem stated above. Although many weaknesses have been identified but the objectives for this project have been achieved to take attendance for student and save time. The proposed system is implemented in OpenCV and Python. Furthermore, Viola Jones algorithm was chosen as face detection method because of the faster face detection and feature extraction using LBPH. The innovation of this work is the use of face recognition, which is efficient, fast and easy to use. However, the use of this system also has some weaknesses, the system is sensitive to the environment, expression and position that will affect the accuracy of detection.

Acknowledgement

References

[1]   S. C. Hoo, & H. Ibrahim, Biometric-based attendance tracking system for education sectors: A literature survey on hardware requirements. Journal of Sensors 2019

[2]   P. Tan, H. Wu, P. Li, & H. Xu, Teaching management system with applications of RFID and IoT technology. Education Sciences, 8(1), 26 (2018)

[3]   Q. Miao, F. Xiao, H. Huang, L. Sun & R. Wang, Smart attendance system based on frequency distribution algorithm with passive RFID tags. Tsinghua Science and Technology, 25(2), 217-226 (2019)

[4]   A. Rahmatulloh, R. Gunawan, & I. Darmawan, Web Services to Overcome Interoperability in Fingerprint-based Attendance System. In Proceedings of the 2018 International Conference on Industrial Enterprise and System Engineering (IcoIESE 2018) (Vol. 2, pp. 277-282) (2019)

[5]   W. Kuang, & Baul, A. A Real-time Attendance System Using Deep-learning Face Recognition. In 2020 ASEE Virtual Annual Conference Experience (2020)

[6]   W. L. Yong, Smart Attendance System Using QR Code. (Doctoral dissertation, UTAR) (2019)

[7]   Polamarasetty, V. K., Reddem, M. R., Ravi, D., & Madala, M. S. (2018). Attendance system based on face recognition. Work, 5(04).

[8]   R. Nandhini, N. Duraimurugan & S. P. Chokkalingam, Face recognition based attendance system. International Journal of Engineering and Advanced Technology (IJEAT), 8(3S) (2019)

[9]   S. Lukas, A. R. Mitra, R. I. Desanti & D. Krisnadi, Student attendance system in classroom using face recognition technique. In 2016 International Conference on Information and Communication Technology Convergence (ICTC) (pp. 1032-1035). IEEE (2016)

[10]   H. Chin, Face recognition based automated student attendance system (Doctoral dissertation, UTAR) (2018)

[11]   P. Li, H. Wang, Y. Li & M. Liu, Analysis of face detection based on skin color characteristic and AdaBoost algorithm. In Journal of Physics: Conference Series (Vol. 1601, No. 5, p. 052019). IOP Publishing (2020)

[12]   K. S. D. Prado, Face Recognition: Understanding LBPH Algorithm - Towards Data Science. Medium.   https://towardsdatascience.com/face-recognition-how-lbph-works-90ec258c3d6b (2018)