



AUTOMATIC STUDENT-BASED FACIAL RECOGNITION ATTENDANCE SYSTEM USING OPENCV

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ABSTRACT

For decades, attendance is taken in educational institutions to ensure that students are present in class, however it is mainly done manually. Manually taking attendance is a tiresome task, which is inconvenient for both the student and the lecturer while filling up the attendance sheet. As a result, the idea of building an automatic attendance system based on a unique biometric approach such as facial recognition to improve the accuracy of the attendance file was born. The goal of this research is to create an automatic student attendance system that can update an attendance file during a lecture in the shortest time feasible utilizing the students' facial attributes. The system was implemented in python environment using Opencv library and over 150 faces of 400level students of the department of Computer Science, University of Ilorin, Ilorin, were captured, registered, processed and lastly a report of the attendance was generated in a csv file. The result of this system shows that it was able to detect and recognize 150 student faces in under 15 minutes automatically and successfully recognized 94% of the students. With the successful implementation of the system, it is our believe that it will greatly reduce the time spent in taking attendance and can also be utilized at any educational institution.

Keywords: Attendance, facial recognition, opencv, python, computer vision, haar-features.

INTRODUCTION

Attendance maintenance is an important task adopted mostly by educational institutions such as schools, colleges, and universities to monitor student's performances and activities. Administrators of educational institutions in our country are concerned about the regularity of student attendance which means student's overall academic performance is affected by the student's present in his institute and a key factor of improving the quality of education is having students attend classes regularly. As result of frequent absences from class, students are at greater risk of failing and dropping out early. Attendance check is an effective method to increase a student's class attendance. Besides, Empirical evidence has shown that there is a significant correlation between students' attendances and their academic performances and a more satisfying educational experience this reflected in student feedback (Mansoor, Sadineni, & Kauser, 2021; Muir, 2015; Unnati & Swaminarayan, 2014; Fuzail, Muhammad, Nouman, Mushtaq, Raza, Tayyab, Talib, 2014). However, the manual way of taking attendance is time-consuming and when the number of students is large, the attendance sheet can be misplaced, and the correctness of the attendance is not validated. In such cases, a present student A can record the attendance for an absent student B.

A better way of solving these problems is to computerize the attendance system which is a process

to automatically estimate the presence or the absence of the student in the classroom, this can be done by using an authentication mechanism like a biometric system. A biometric system is a unique means of identifying the body that can be used to differentiate one person among others and it is a fundamental technology of biometrics, which has been applied to a variety of areas like computer vision, security systems (pattern recognition), human-machine interaction and image processing (Nandhini, Duraimurugan & Chokkalingam, 2019; Devan, Venkateshan, Vignesh, & Karthikraj, 2017).

Despite the numerous biometrics techniques that exist, this paper focus on facial recognition as one of the biometric means to automate student attendance. This is because the human face is one of the natural traits that can uniquely identify an individual. Therefore, it is used to trace identity as the possibilities for a face to deviate or being duplicated is low (Jing, 2018). The biometric (facial) system consists of an enrollment process in which the specific features of a person's face are registered in a database and then the recognition and authentication processes. The detected face (acquired from the webcam) in a picture is matched with the previously stored faces captured in this process at the time of attendance (Chakraborty, Muzammel, Khatun, & Islam, 2020)

Facial recognition technology can be performed using a different library and algorithm like Principal Components Analysis (PCA), Eigenfaces algorithm,



Successive Mean Quantization Transform (SMQT) techniques, Viola-Jones algorithm, etc. but this study opted for a real-time library called OpenCV, is one of the Python library frameworks and has multiple computer vision algorithms for face detection, face recognition and for tracking the head position. This library has in-built face detector and face recognizer (Mordvintsev & Abid, 2017).

The proposed system will be implemented using OpenCV, it comprises the use of Haar-Classifiers for Face detection and Local Binary Pattern Histogram (LBPH) as a face recognizer by providing a Graphical User Interface (GUI) built using Tkinter. This graphical user interface offers a way for students to engage with the system; it includes widgets for recording student faces and their associated information (ID and name). Once the recognition is completed, the attendance will be instantly updated in an excel sheet, along with the student's name, date, and time. The proposed system will be test run using faces of 400 level students of the department of Computer science, University of Ilorin, Ilorin, Nigeria.

Specifically, the contributions of this paper are as follows:

- i. Design of an automatic attendance system using real-time library
- ii. Implementation of the system using locally generated data
- iii. Automatic generation of the attendance report in a csv format

LITERATURE REVIEW

Ozdemir and Ugur (2021) used face recognition to construct a system for measuring the student engagement rate in synchronous courses offered by Learning Management Systems (LMS). Tests were carried out utilizing unique image processing filters in their suggested model, and in cases when the number of samples was increased, more than 80% accuracy was achieved. The proposed design model was created using the Visual Studio.Net platform and programmed in C#. The database administration system is SQL Server, and the image processing phases are handled by the EmguCV library.

Kewalramani (2018) published work on automatic attendance systems by face recognition using machine learning. The author used a combination of RGB color fade and HSV (hue, saturation, value) algorithm which are implemented in a MATLAB environment. In this work, the attendance doesn't have a specific area of application. Their system can be used for any attendance system. Moreover, it was not implemented with any known data.

Kumbhar and Angal (2018) proposed a smart attendance using face recognition. In this system, the authors used Support Vector Machine (SVM) and K-Nearest Neighbor (KNN) machine learning algorithm for face features extractions by making use of the scikit-learn library and create an approach of converting the face into a vector and features sorted using Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) algorithms. In addition, the system was implemented in real-time environment using Raspberry Pi 3 hardware platform and it achieved 98% cross-validation and 83% testing accuracy using SVM classifier while 92% cross-validation and 80% testing accuracy using KNN classifier.

Jing (2018) developed a system for recording staff and student attendance using face recognition. The author used OpenCV as the technique for face recognition and provide a Graphical User Interface (GUI) to allow student and lecturer to enter their details which are stored in a MySQL database through a website for attendance. The website is implemented using PHP5 to display the hosted webpage and used phpMyAdmin to aid MySQL configuration.

This system required some packages such as a pi camera module to interact with the Raspberry pi's camera and a pymysql module to ease the interaction between Python and MySQL because the system is implemented in a Python environment such as Pycharm.

Devan, Venkateshan, Vignesh, and Karthikraj (2017) developed a smart system for recording the attendance of students using face recognition. This system is implemented in a MATLAB environment, by using the Viola-Jones face detection algorithm which makes use of Integral Image and AdaBoost learning algorithm as a classifier combined with multiple Haar classifiers to achieve a better detection. The authors used the PCA algorithm for feature extraction while the Support Vector Machine (SVM) is used for the classification. In this system, the author has taken a brilliant approach of updating the students' attendance in an Excel sheet after recognizing the faces of the students' roll numbers which is equipped with the facility of sending notification messages to the absentees. Based on the experimentation carried out by the researchers, it is concluded that the success rate at face recognition is around 93% to 95% and regarding face identification is 99% and the system error rate was around 5-7%.

Patole and Vispute (2017) built a system recording attendance for the students. The authors provided a means for tracking student attendance using different algorithms for each face recognition process, for feature extraction the proposed system integrates techniques. Such as Principal Component Analysis

(PCA), voila-jones for face detection, and Euclidian distance classifier for the recognition. The system used the Eigenface algorithm methodology to make a comparison between the detected faces stored in the database and the existing ones. All these algorithms are implemented in MATLAB software. They provided a GUI interface for face capturing through with the facial recognition processes will execute and the attendance is automatically updated in an Excel environment.

In the work of Kumbhar, Attaullah, Dhere, and Hipparagi(2017), they did an attendance system using face recognition. Their system was able to create a real-time Face detection and tracking, the head poses position from high-definition video using Haar Classifier through Raspberry Pi BCM2835 CPU processor which is a combination of Broadcom system on a chip (SoC) with Graphics Processing Unit (GPU) based Architecture. SimpleCV and OpenCV libraries were used for face detection and tracking the head poses position. The experimental result computed by using computer vision SimpleCV and OpenCV framework libraries along with the above-mentioned hardware results were obtained through 30 fps under 1080p resolutions for higher accuracy and speediness for face detection and tracking the head poses position. This system doesn't have a specific area of application and was implemented with some Raspberry Pi devices.

Choudhary, Tripathi, Bajaj, Rathi, and Nandini (2016) created a smart attendance system for students using face recognition. The authors implemented the system using the Viola-Jones algorithm for face detection and Principal Component Analysis (PCA) algorithm for face recognition. In this system, the attendance is recorded by using an installed camera in the classroom that takes the picture of the whole class followed by detecting individual faces in the image, recognizing the students, and then updating their attendance automatically.

Mehta (2016) published a work titled "An Efficient Attendance Management System based on Face Recognition using Matlab and Raspberry Pi 2". In this proposed system, the author used two techniques Local Binary Pattern (LBP) and Histogram of Oriented Gradients (HOG) algorithms for face recognition and Viola-Jones Algorithm for face detection but used Support vector machine (SVM) classifier to compare stored features with extracted features which are implemented in a MATLAB R2014a as the environment. This work made use of some hardware devices, it includes a raspberry pi 2 model B module with a raspberry pi camera module for capturing the students' images which will be stored in a database and make use of the above-mentioned algorithms for face detection and recognition. This system has an accuracy of 92% with means in a total

of 20 students this system can perfectly detect and recognize efficiently 19 student faces.

METHODOLOGY

The Proposed System

The stages involved in achieving the proposed system are as follows:

1. Collection of the data that will be used to store and extract each student details (Name and ID)
2. Capturing of student's faces by the library to extract each student's unique facial features.
3. Linking each student faces to their respective details.
4. Face recognition and attendance update, the details of the student whose face was recognized by the system will be stored in the attendance followed by the time and date.
5. Evaluation of the proposed system.

The proposed system framework is shown in figure 1.

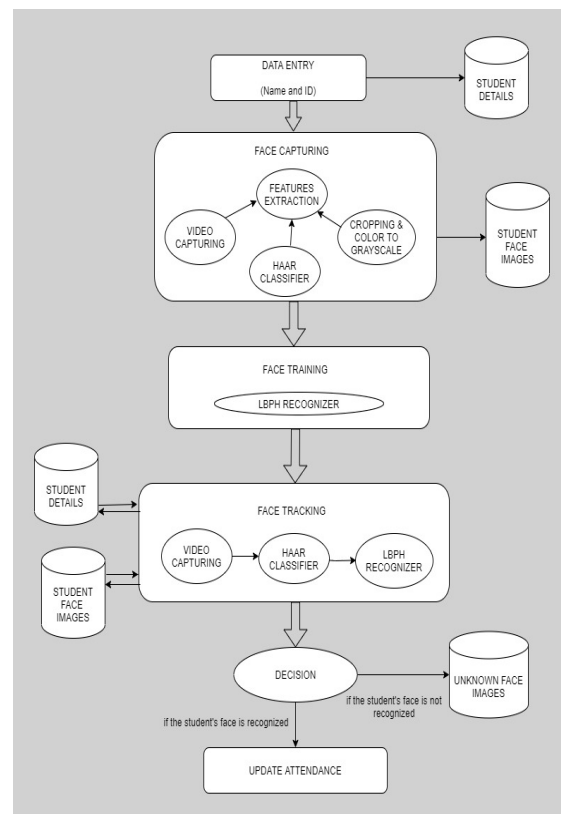


Figure 1: Proposed System Framework

Each of the phases in the framework are explained in the subsequent sections

Data Entry

This is the initial phase in the proposed system, and it entails students entering their personal information (ID and name) into the system using the designed Graphical User Interface (GUI). The 400L Computer Science students at Unilorin is the case study for this system, and 150 students' data were collected for this system. To ensure that each student is identified, the first two and final three digits of their matric number were used to create a five-digit ID. At the time of registration, students are required to supply their name and student ID which are stored in a csv file. Figure 2 shows the interface through which students will be registered with the system.

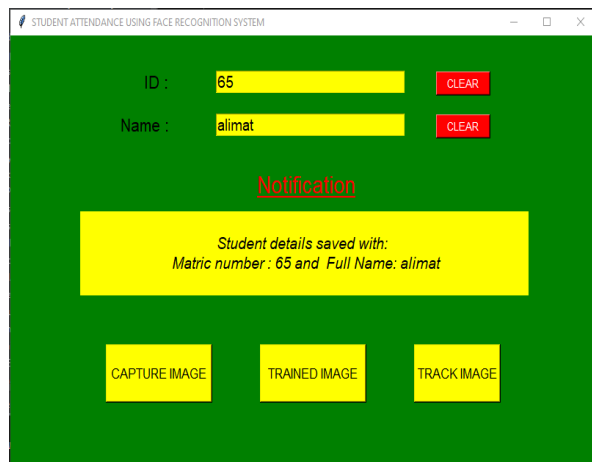


Figure 2: Data entry GUI.

Face Capturing

During this initial phase, the system camera opens to take a picture of students' face through a live video stream, and the camera takes up to 50 faces of each student, which was stored in a specific folder. This phase was possible with the help of the haarcascade classifier file, Haarcascade_frontalface_default.xml which is a detection algorithm build to identify frontal faces in an image or a video stream. After the student has provided their corresponding ID and name, he will be taken to the second step of the procedure. The images below are some of the student face images recorded and kept in the TRAINING IMAGES folder with their corresponding ID and Name. Each image is stored with the student's name, followed by the student's id, and then the image number (varying from 1 to 50), all separated by a dot (.). Below are some samples of students' face captured as depicted in figure 4.



Figure 3: Student with ID 78 and name Shakira face images.

Face Training

The captured faces are scanned through by the Local Binary Pattern Histogram (LBPH) recognizer whose role is to link up each face to their corresponding ID after a successful recognition then a message "Image trained" will pop up to ensure that the image has been perfectly trained and that the student can move on to the next step. Figure 5 shows this stage output.

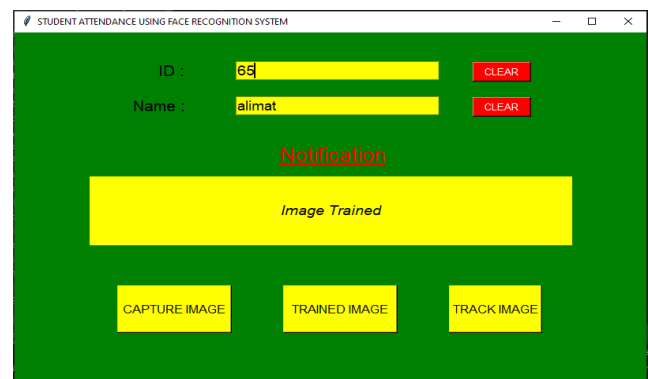


Figure 4: Trained Image's Result.

RESULTS AND DISCUSSIONS

The suggested system's final step comprises reopening the web camera to capture or take the student face represented to it for attendance. Here we use the confidence to measure how accurate is our system. In face detection and comparison systems we rely heavily on this feature. These systems predict whether a face exists in an image or whether it matches a face in another image. We choose a threshold of 60 to evaluate it, when the confidence is less than 60, it

calculates the accuracy between the face presented and the stored photos and fetch out the name of the image for identification. This system effectively recognizes 141 students, at the same time, their information (ID and name) is updated in the attendance file alongside the lecture's date and time. A successful face tracking result and an unsuccessful face tracking result are the two (2) outcomes expected at this stage.

a) Successful Face Tracking

Attendance was recorded in real time during CSC 422 and 428 lectures. When the system recognizes the student's face, his name and ID appear on the system camera, as seen in figure 6. As shown in figure 7, a message "ATTENDANCE UPDATED WITH DETAILS" will be printed on the GUI's notification board, while the student's name, ID, lecture time, and date will be updated in the attendance file automatically generated in csv format.



Figure 5: Successful Face Tracking Result.

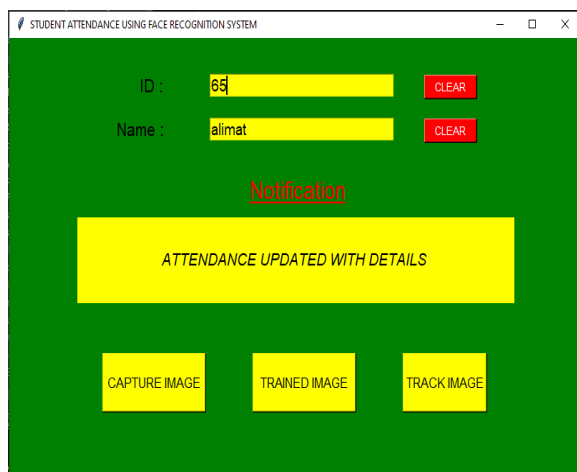


Figure 6: Result of Successful Face Tracking

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	ID	NAME	DATE	TIME											
2															
3		1	[Iyabo]	23-03-202	13:06										
4															
5		78	[Shakira]	23-03-202	14:14										
6															
7		65	[ahmat]	24-03-202	15:21										
8															
9		16041	[Joyce]	24-03-202	15:35										
10															
11		16001	[Eniola]	24-03-202	15:40										
12															
13		16052	[Amin]	24-03-202	16:00										
14															
15		16023	[ahmad]	24-03-202	16:11										
16															
17		16055	[aceem]	24-03-202	16:21										
18															
19															

Figure 7: Successful Face Tracking Attendance Result.

b) Unsuccessful Face Tracking

When a student's face isn't recognized, his ID becomes unknown, as shown in figure 9, and the text "ID UNKNOWN, ATTENDANCE NOT UPDATED" appears in the GUI's notice board, as shown in figure 10. By pressing the TRACK IMAGE button on the GUI again, the student can try to re-track his face.

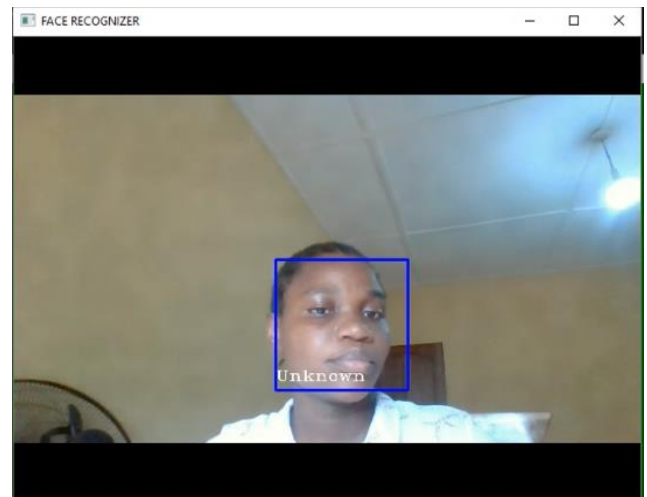


Figure 8: Non-recognized Face Output.

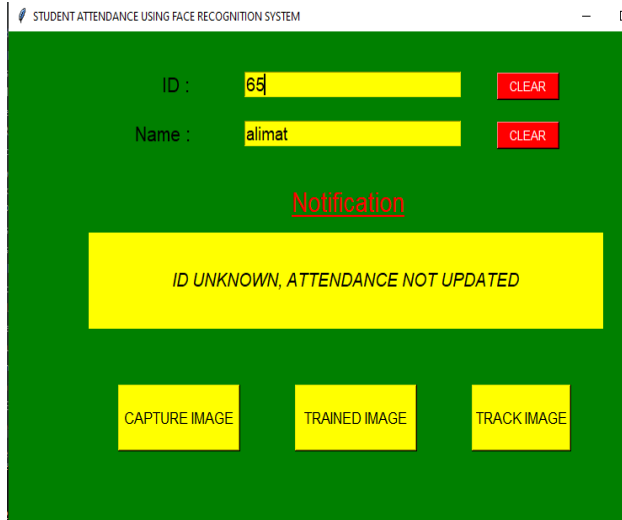


Figure 9: Non-recognized face's text output.

CONCLUSIONS AND FUTURE WORKS

This paper developed a student-based attendance system using openCV library. This will enable lecturers to have a record of each student's attendance file in the shortest time possible, as well as a clean and accurate attendance file, produce each student's attendance statistics, and generate a report on each student's attendance at the end of an academic session. The system was run using locally source data and has proven to recognize and capture attendance of over 100 students within 15 minutes. This has greatly reduced the time and resources used by lecturers in taking attendance. The school management can also benefit greatly from this system through the report being generated. In future, the authors intend to extend this work by using other facial recognition system with the data collected.

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