Journal of **N**onlinear **A**nalysis and **O**ptimization
Vol. 11, Issue. 2 : 2020
ISSN : **1906-9685**

ACCOUNTING SYSTEM UTILIZING FACE RECOGNITION

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Abstract: Manually documenting pupils' attendance is time-consuming, boring, and error-prone. We created and tested a web app called RollCall to track student and teacher attendance at the University of Ilorin's Department of Engineering. This system enables teachers to plan lessons, track attendance, and obtain attendance data as needed. Students can upload a photo to their online profile, schedule classes, and examine their attendance history. Face recognition software written in Python, OpenCV, and Sci-kit Learn is used in the attendance system. The web interface was created with JavaScript, HTML5, and the Twitter Bootstrap CSS framework. The study discovered that adopting RollCall to track attendance saved both teachers and students time. The web program is easy to use and improves the efficiency and quality of attendance management as well as the overall educational experience.

Keywords: Face Recognition, Class Attendance, OpenCV, Python

INTRODUCTION

Taking roll is an essential part of every educational setting. This would ensure that students engaged in classroom activities and learned from their teachers. According to the University of Ilorin's information and regulations handbook, students must attend 75% of all class meetings in order to be qualified to take exams in any given semester. The most frequent means of tracking attendance are now signing attendance forms and addressing names. Unfortunately, a large number of pupils are incapable of implementing these tactics swiftly and accurately. Reading everyone's names in a class is a waste of everyone's time. Distributing attendance forms in class can be a distraction, and disruptive students can easily change the forms. Fingerprint attendance tracking systems work well since each person's fingerprint is unique. As a result, children are unable to act as though they are present. Mechanically recording attendance data has been demonstrated to boost productivity and decrease teacher stress (Gheisari et al., 2022; Memane et al., 2022).

Biometric recognition technologies' accuracy and speed are continually improving. A variety of physical and behavioral features can be utilized to uniquely identify a person. It analyzes data, recreates names, and locates individuals using a combination of software and hardware components. Biometric technologies use a person's unique physical traits to authenticate identify (Ghosh, Sharma, & Kesharwani, 2022; Ramrez-Mendoza et al., 2022).

In this experiment, we just recognize the children by their faces. Face recognition technology can detect an individual in a still image or a still frame from a video recording by using patterns based on a person's facial features and shapes. There are several methods for doing so, but they all boil down to matching the subject's facial features in an image to those in a database. Despite its inaccuracy when compared to fingerprint and iris scanning, facial recognition is a prevalent biometric technology. This is due to the fact that it has no harmful side effects. Facial recognition can be used to restrict access to restricted areas, diagnose sickness, and validate IDs at ATMs for security purposes (Smith & Miller, 2022; Ramya et al., 2022).

RELATED WORKS

Class participation has been automated and tracked in a number of works. RFID and fingerprints were investigated by Kumar and colleagues (2021). RFID tags and scanners can be used to track attendance. Secure Digital (SD) cards are used to verify fingerprints. Teachers can check when pupils took attendance using a real-time clock. Jhav et al. (2023) used biometrics to create a fingerprint-based school attendance system. The paper includes recommendations for instructors and students on classroom behavior. Biometrics were used to verify users' identities. The major goal was to build an IoT-based biometric attendance system that would track attendance and collect crucial data for day-to-day operations. The ESP32, OLED, and fingerprint reader may provide the most solid foundation. According to Abdullah (2023), some people reject fingerprint-based attendance tracking systems, even if Vinay et al. (2023) claim they are more trustworthy.

According to Chen and Sun (2022) and Sandhya et al. (2022), spoken language can be used to rapidly receive and transfer data. This is fantastic for tracking attendance. This speech database is used in research on hearing speaker recognition. Large, thorough, and high-quality corpora improve the performance of speaker recognition algorithms. Chen and Sun (2022) discovered a small number of student attendance scene corpora but a large number of general-purpose corpora. To determine the finest phrases to utilize with Chinese students, a corpus of the speaker's actual words was employed. Sandhya et al. (2022) use voice input to track attendance and learn about the situations of students and employees. A fully functional and equipped system has 95% accuracy, which is comparable to humans, according to Mary Meeker's annual Internet Trends Report. Because any problem has to start with the Google Speech Recognition API. Mitra et al. (2017) suggested a technique for tracking class attendance. The student's face characteristics were extracted using discrete wavelet transforms (DWT) and discrete cosine transforms (DCT), and then categorised using the Radial Basis Function (RBF). It also includes a Raspberry Pi 3 Model B, a USB camera, an ESP8266, an RFID reader and tag, and an OLED display. Narendar Singh et al. (2019) created it. The Raspberry Pi was attached to the USB camera that was used to picture the youngsters. Using AWS Rekognition, these photographs are compared to comparable ones in the AWS Cloud. Data is transmitted to an internet service. RFID was used to track the number of study educators. Each employee receives an RFID card. Teachers' attendance can only be tracked by swiping the card over an RFID scanner. Each person's ESP8266 check-in time and date will be displayed on the OLED. A real-time video attendance system was developed by Alhanaee et al. (2021) and Gowda et al. (2020). OpenCV is used to retrieve the movie stills. Dlib users are easily identified by the system. Das et al. (2019) use the facial recognizer library to log and identify persons. Photos taken with Android phone cameras are uploaded to the internet. The service finds human faces in images using an algorithm, encodes them for faster identification, and stores them. With these figures, we can estimate turnout.

MATERIALS AND METHODOLOGIES

Without the web app, facial recognition, and attendance monitoring features, this research experiment would not be possible.

Web Application Section

The user interface of the web app is planned and built in this area so that users (teachers and students) can sign up and begin using it. The package contains a dashboard that shows all of the courses that the instructor has produced, a dashboard for each course that shows a list of students who are enrolled in that course, and a dashboard for each course that shows the number and percentage of students who attended each week's class. Another function enables users to take and share images of themselves while in class. Students can also use a streamlined interface to see what classes are available, sign up for them, examine a list of their registered courses, and upload a photo of themselves with their name on it. We use the Python programming language, the Flask web framework, JavaScript, HTML, CSS, and the SQLite database engine to do this.

Face Recognition Section

This component is in charge of designing and building the image processing, face detection, and face recognition infrastructure for the system. Before being included to the database, the photographs uploaded by students using the online interface will be analyzed to remove any distracting aspects and identify a single face. Figure 1 shows a block diagram illustration of the pupil image gathering procedure.

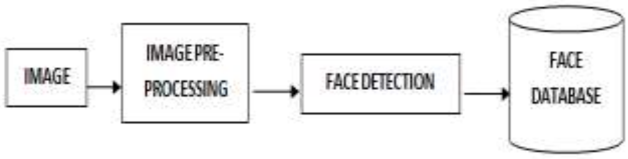

Figure 1. Request form for a child's photograph

Before identifying and mapping face traits, the teacher-submitted photo of the class is cleaned up. After each face's identity has been validated, the data will be saved in a database. Among other things, we employ OpenCV, Scikit-Learn, and Python in this case.

Open CV's Deep Learning Face Detector

The deep learning face identification feature of the OpenCV library is used in this study. The Single Shot Detector (SSD) architecture served as the foundation for this detector, which, unlike prior OpenCV SSDs, uses a ResNet-based network as its core network rather than MobileNet.

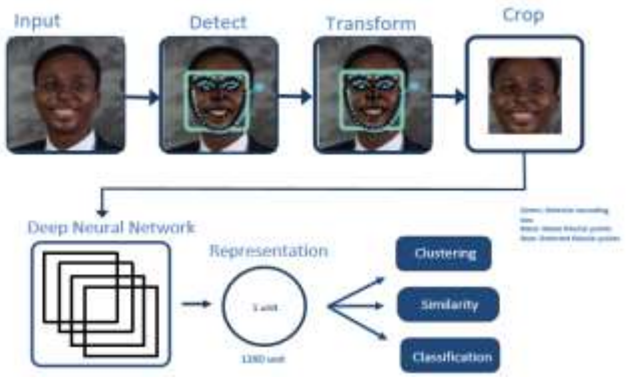

Figure 2. Amos et al. (2016) present an overview of the OpenCV facial detection pipeline

Face Recognition with OpenCV and scikit-learn

While OpenCV was used to help in facial recognition, it was not a success on its own. Figure 2 shows how OpenCV's face detection algorithm works. A convolutional neural network feature extractor is used to build 128-dimensional facial embeddings. Please use the following approach to identify the people depicted:

- The OpenCV face detector, which is discussed in Section 3.2.1, is used to recognize people's faces.
- To create the measurements for each face in the image, OpenFace, a deep learning for face recognition model built in Python and Torch, was utilized. FaceNet was used as a model in this case.
- To measure facial traits, the FaceNet deep learning technique employs a 128-dimensional embedding. Figure 3 depicts the technique.

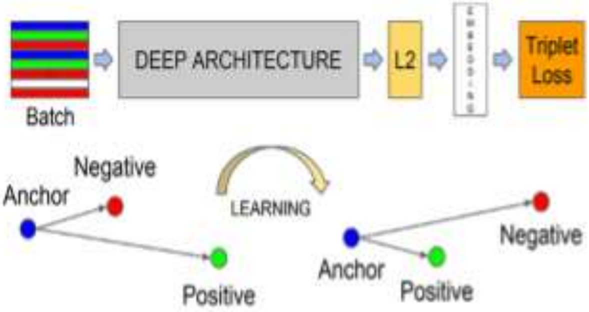

Figure 3. How the deep learning model for facial recognition computes the embedding of the face

An anchor picture, a positive image, and a negative image comprise raw data. These photos are used to build a deep learning model for facial recognition. The letter A on this face identifies it as the anchor's face. The second image is positively identified since it represents the face of person A. The negative photo, on the other hand, might have been taken by anyone with the initials B, C, or even Y! The neural network adjusts the network weights using the triplet loss function to further scatter the negative image embeddings and condense the anchor and positive image embeddings. This is how each individual face is treated. Because of this approach of evaluating features, the network can generate very reliable and discriminative embeddings for face recognition.

Even though the deep learning model hasn't seen the photos it'll be fed, it can nonetheless figure out facial embeddings. Because of their fundamental distinctions, these face embeddings can be utilized to build the OpenCV face detection pipeline with a "standard" machine learning classifier (SVM, SGD classifier, Random Forest, and so on). To classify the data into understandable categories, we used a Support Vector Machine (SVM).

Attendance Marking Section

This section discusses the creation and deployment of the face recognition subsystem, which is in charge of collecting, sorting, storing, and retrieving attendance records. Python, as well as the Flask web framework and the SQLite database engine, are used. The facial recognition and attendance system is depicted in Figure 4 as a block diagram.

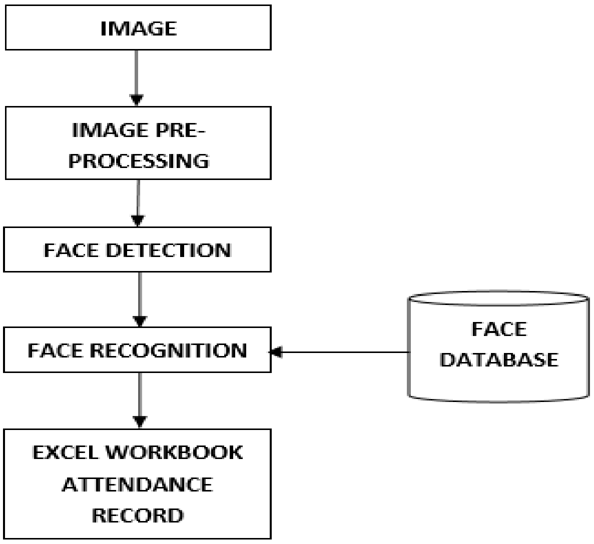

Figure 4. The reasoning that underpins how we track attendance with facial recognition.

Implementation

The work was generated through an iterative (modular) planning and development process. As a result, development, testing, and refining were sped up. To make planning and construction easier, the entire system was divided into more manageable subsystems. After assuring that one component worked properly, the team moved on to the next. This implementation aimed to improve dependability, reproducibility, and management.

Each system component has been dissected, reassembled, and tuned to work in tandem with the others. This means that the overall system will be less vulnerable to individual component failure. Any enhancements to that component are separate from any other enhancements to the system. Figure 5 depicts a user interface movement flow diagram.

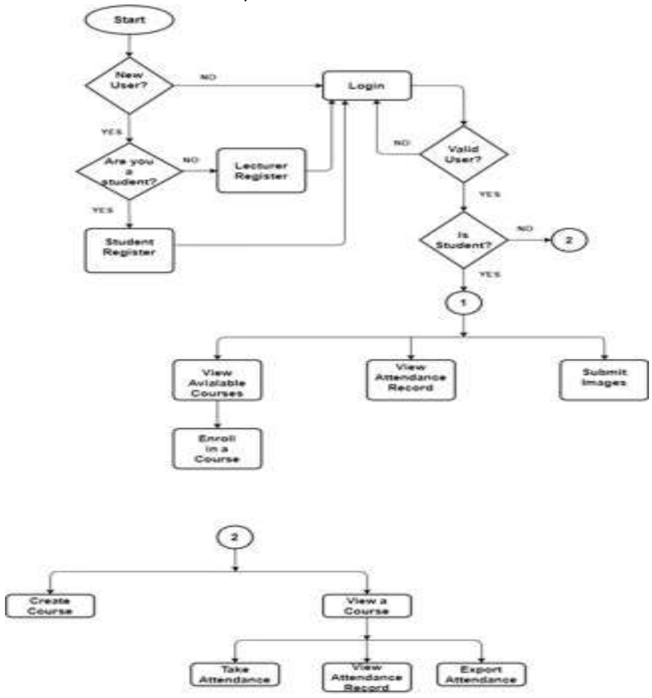

Figure 5. A schematic representation of how to use a particular system.

RESULTS

For the convenience of the user, this RollCall includes the following choices.

Login Page

If you are a registered student or teacher, you can use the portal shown in Figure 6 to access the web application. Once logged in, the user's personalized homepage is displayed.

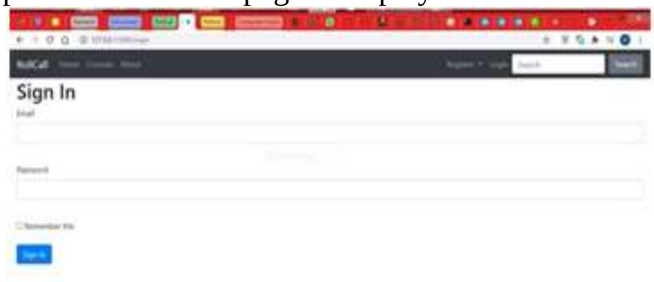

Figure 6. Login page.

Lecturer Registration Page

2. Figure 7 displays the registration screen for teachers who wish to enroll in the online course.

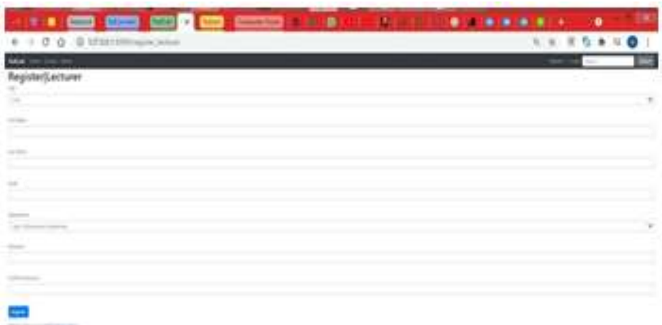

Figure 7. Educator Registration Form

Lecturer Registration Page

Figure 8 displays the student registration interface, which students utilize to register for the online course.

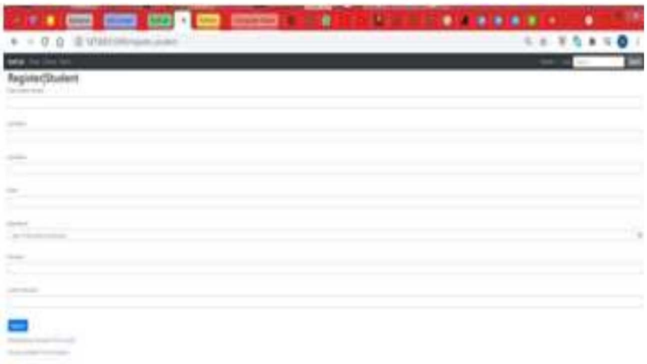

Figure 8. Page of the Registration Form

Student Dashboard

This page shows the courses in which the student is registered, as well as the number of lectures for each course, the number of lectures attended, and the percentage of lectures attended. Click the "Upload Your Image" button to add a photo of yourself to the facial recognition database. Figure 9 is a screen capture of a student's computer.

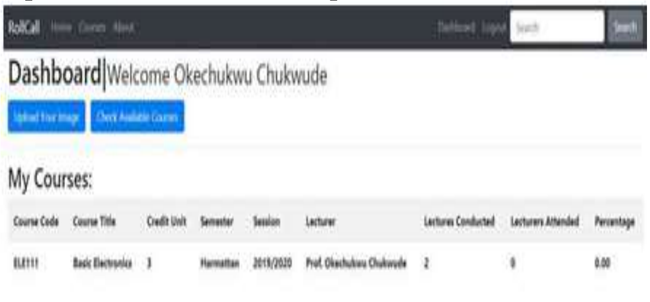

Figure 9. The Educator Dashboard

Upload Image Page

Figure 10 depicts the screen from which students can upload their own photographs to the face recognition library. As soon as the website loads, the camera on the student's smartphone begins recording, and clips are presented in the left canvas. Click the "Snap" button when the student's front is visible on the canvas. When you do this, the image you were viewing on the left canvas will appear where you clicked on the right canvas. If the user is happy with how the image looks on the proper board, he or she can click the "submit" button to send it. Once the image has been processed, the server's reaction will be displayed. One of three possible responses will be displayed depending on the results of the face detector:

If the photo just shows one person, the result will be "Image Upload Successful."

There were no faces in the photograph. If the face analyzer still cannot identify any faces in the image, repeat the following steps: That is where the truth lies.

Individuals whose faces were discovered in the photograph. If a user detects more than one face in an image, they will be asked to "Try Again." The variable "number_of_faces" will be changed to reflect the number of faces spotted in the image.

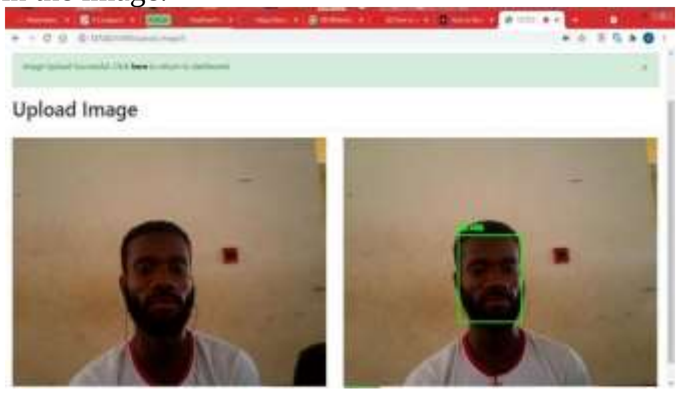

Figure 10. Image Collage Sheet

Available Courses Page

Figure 11 depicts the user interface for the web app, which displays all available classes. When a student clicks on a course, they will be brought to the course's registration page. Lecturer users are limited to reading but not interacting with this page.

Figure 11. Page of Course Catalogue

Lecturer Dashboard

Figure 12 shows an example of a typical university computer display. The page contains a list of the speaker's seminars. A "View" button is located to the right of each list item. The visitor will be directed to a webpage where they can examine attendance records for the specified class. The "Create Course" page allows teachers to create courses that students can enroll in. If you develop a course in this format, it will be added to the "Available Courses Page" where others can access it.

Figure 12. Dashboard for Educators

Create Course Page

Faculty can access a course creation dashboard from this page. Please fill out the form on this page with course-related information. The following information is displayed: course title, number, credits, semester, and session. The lesson creation page is shown in Figure 13.

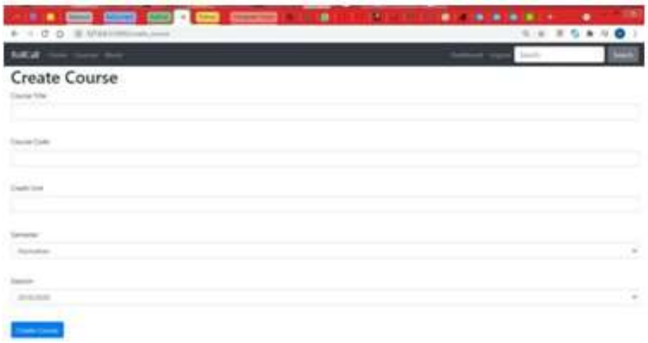

Figure 13. Make a lesson page.

Course Dashboard

Figure 14 depicts the attendance information available on the course monitor tab. The list includes all students enrolled in the class, as well as their matriculation numbers, attendance rates, and class attendance records. Following the list of students is the total number of taught classes. The "Take Attendance" button will direct the instructor to a webpage where they can take class roll. By pressing the "Export Attendance" option, users can export attendance data to an Excel file.

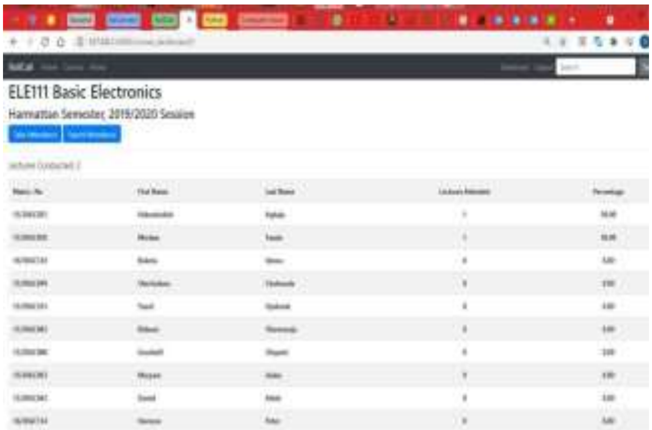

Figure 14. Exhibits for Education

Take Attendance Page

Students can use this page to upload images of themselves for processing and use in an attendance system. Figure 15 shows an example of an attendance sheet.

Figure 15. Attendance Recording Form

Table 1 shows the results of an evaluation of the system's implemented version. We compared the RollCall method, the Name Call method, and the way of passing around attendance sheets.

Table 1 compares the effectiveness of RollCall to different manual procedures.

Attendance Systems	Performance Comparison Metrics			
	Ease of Use	Time Consumed	Efficiency	Accuracy
Name Call	Worst	More time consuming	Less efficient	More accurate
Attendance Sheet Passed Around	Better	Most time consuming	More efficient	Less accurate
RollCall	Best	Lesser time	Most efficient	Most accurate

Positive user feedback has been the norm. The format's usability was lauded by all of the students. One student observed that the method was more efficient than manual attendance taking and reduced class wait times. Another student stated that employing this method made them feel more accountable for attending class. Teachers found the system to be very user-friendly, and their students provided insightful feedback. They valued the time savings, particularly because they no longer had to manually track attendance. One educator stated that they were able to identify and contact students who were having attendance concerns more readily. Some educators, however, were skeptical of the facial recognition system's accuracy when children wore masks or when lighting was poor. Students and faculty members have largely agreed that the web-based facial recognition-based attendance tracking system is a useful and efficient tool for this purpose. However, there is still room for advancement in order to overcome certain lingering precision difficulties.

CONCLUSION

The goal of this project is to simplify the design process for a system that accurately tracks students' attendance in class. Teachers and students could both sign up for the system, add profile photographs, establish courses, enroll students in those courses, take attendance, see attendance statistics, and even export attendance records to an Excel file. All of these attempts have been fruitfully completed. It's a brilliant answer to the problem of managing college student registration. The application is useful since it can correctly record attendance using facial recognition technology.

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