An Android-based Face Recognition System for Class Attendance and Malpractice Control

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***Abstract*—Over time, examination malpractice in form of students indulging in impersonation has been a serious setback to academic growth in several Educational institutions. Conventional methods of keeping student's attendance records has proved inefficient as there are so many cases of data loss and mismanagement. Several systems developed to solve this problem are either immobile or costly to implement. In order to solve this problem of cost and rigidity as well as remove the problem of examination impersonation, a mobile system running on the Android Operating System was developed using the Viola-Jones object detection framework and Eigen faces to carry out Facial Recognition of students and take record of attendance in classes in a user-friendly and secure manner. The facial recognition ability of the system was tested with 95% accuracy while that of Facial Detection ability gave an accuracy of 78%. The optimum security performance achieved by the system was based on its strong backend and its distinct modular structure.**

Keywords-Impersonation; Examination Malpractice; Student's Attendance Record; Android Operating System; Facial Recognition; Viola-Jones; Eigen Faces.

I. INTRODUCTION

Taking and monitoring student's attendance in classes have been a long-standing issue amongst lecturers and the school management as a whole because of the numerous deficiencies associated with the conventional paper and pen approach of taking attendance [1]. It is a very stressful method of keeping record with important data and information getting lost easily, thus making the process inefficient for monitoring student's attendance in classes [2,3]. Furthermore, most schools tie the students' class attendance with their examination, using it as a criteria for admitting students into halls of examination by determining whether the student is a member of the class meet up with the number of required classes that qualifies him/her to sit for the examination. This helps in fiercely combating examination malpractice in form of impersonation since a non-student member of the class cannot be admitted to the venue to write such examination.

The conventional approach has over time proven inefficient as students can easily write attendance for their absent friends, and the fact that records can be misplaced or destroyed easily [4,5]. There is also the problem of impersonation amongst students, false identities being used in getting into the examination hall to partake in examinations [6]. This has terribly affected the credibility of examinations and the suitability of graduates being employed into job positions after school.

This study develop a system that eliminates the issues encountered with the use of conventional method of keeping record of student's attendance in classes using facial recognition system to identify and distinguish the genuine and fake students, hence making examination conduct less stressful, saving valuable time and resources. In addition, the menace called examination impersonation can be eliminated from the institutions to provide an atmosphere with free and fair examination. This in turn makes the award of degrees from institutions much more credible.

II. RELATED WORKS

There have been various techniques used to develop Attendance management system (AMS). Some of these techniques used Radio Frequency Identification (RFID) [7,8], fingerprint [9,10], iris [11,12], palm print [13,14], voice [15,16] etc. For instance, a wireless attendance management system that used Iris identification was proposed by [17]. The system consisted of three modules: Iris verification and identification module, Iris management module and Wireless communication module. The implementation of the system was carried out with Daugman. Local Binary Pattern Histogram algorithm was used to design an application for both facial detection and identification of students by [18]. The algorithm identifies face by matching some parameters in which the algorithm was trained. An Embedded Computer-based Lecture Attendance Management System based on a single chip computer was used to capture the lecture attendance of different students. The identity of each student was validated through a card reader interface with a computer system [19]. An efficient management system based biometric design was proposed by [20] . The system takes attendance electronically with the aid of a fingerprint devise. The attendance stored in a database was marked after the identification of students. [21] proposed a facial recognition approach that used Eigen face technique. The Eigen face recognition [22] utilized information from the raw pixel image for training and classifying image identity. He suggested that the system can be used as the basis for the development of android applications such as android mobile security application and as an archive for the recognition of human identity. [23] proposed a RFID employee attendance system that was incorporated into a database system. The RFID attendance system was developed using components such as tags which was used as a replacement of ID cards and a reader device that could read the information related to an employee attendance. The system has the ability to store the information of all employee. [24] also used Radio Frequency Identification (RFID) technology for the attendance management system developed. Their experiment was conducted on a sample of 60 students, enrolled in a particular course. Based on experiment, the total time taken to record the attendance of a class of 60 students by manual entry took about 10 minutes while 120 seconds was taken to take the attendance of 60 students using barcode and RFID technology.

Attendance Management System could be made smarter by using facial recognition technique based on Viola–Jones and Eigen faces algorithms developed on Android-based device.

III. PROPOSED APPROACH

The design of Android-based face recognition system for class attendance and examination malpractice control involved the use of two different modules working together to meet the stated objective. These modules are the 'Registration Module' and 'Attendance/Verification Module'. These modules actively interact with each other to query the database, which serves as a reservoir of information and the central backend for AFRS as data storing and retrieval activities are carried out in the database. Fig. 1 shows the architecture of the system.

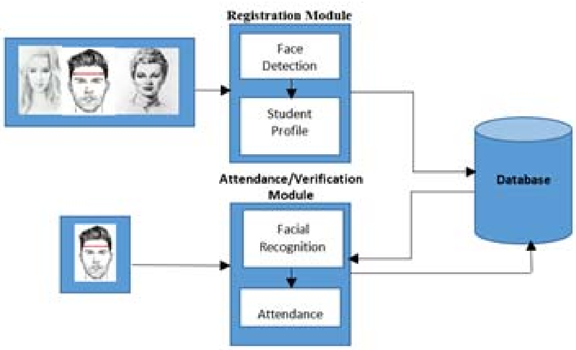

Fig. 1. System architecture

A. *Viola-Jones Algorithm for Detection*

The proposed technique employed Viola-Jones algorithm which is used to identify faces in digital images [25, 26]. The algorithm has four main parts which enhances its detection of images in real time, they include; Haar feature selection, integral image formation, AdaBoost training, and cascade classifiers [27] as shown in Fig. 2. Haar feature selection was used to determine if a face presented in an image was existing or not. The essence of integral image formation phase was to change the original image into integral image which helps to speedily estimate the sum of values in a rectangle subset of a pixel grid. Also, the Viola-Jones used AdaBoost to choose a specific group of features to enable the training of the classifiers to be used in image detection process. Finally, the cascaded classifier speed up the removal of incorrect image rapidly by removing images that are not classified as faces at the initial phase. When an image is classified as a true face, it is sent to the next phase of the cascade which is more complex than the earlier one. A face is successfully identified if it scaled through all the necessary phases.

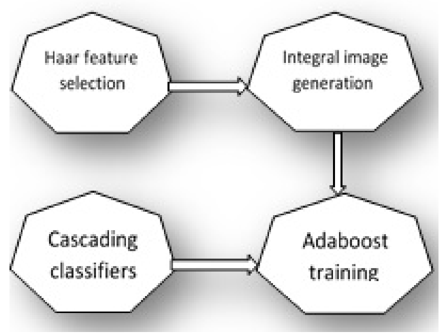

Fig. 2. Phases of Viola-Jones algorithm

B. *Eigenface for Face Recognition*

Eigenface algorithm is regularly employed in identifying different features in presented facial images [28, 29, 22]. The algorithm used Principal Component Analysis as the fundamental idea for face identification [30]. It operates by forming an eigenface from the specified face image. Then the Euclidian distances between the eigenface and the earlier stored eigenfaces are computed. The eigenface with the minimum Euclidian distance represents the one that best identified a person. That is, a new face A is projected into a face space by $B = \hat{C}^T (A - D)$, where $\hat{C}$ denotes the set of major eigenvectors. Also, the weight vector B represents the new face in face space. In order to decide which face class A fits into, the Euclidean distance is minimized as shown in equation 1.

$$\epsilon k = \|B - Bk\| \qquad 1$$

B_k denotes the weight vector that represents the kth face class. The face A is assumed as belonging to class k if the minimum ϵk is smaller than some predefined threshold $\theta\epsilon$, otherwise, it is categorized as not known.

Therefore, to effectively mark a student's attendance, the input image must be run through this component which in turn compares the facial features (length of nose, depth of eye sockets, shape of cheekbones, etc.) to the dataset of stored images in the database which were collected in the facial detection phase. If the corresponding image fails to match any of the stored images, the facial recognition step fails and the student's attendance will not be taken by the Attendance module. The attendance component of the Attendance/Verification Module is responsible for marking student's attendance. When the facial detection and recognition phases are successful, the Attendance component is invoked to mark the student as either present in the class or not. Similarly, when any of the facial detection or recognition phase fail, the attendance is not marked. The following condition are satisfied before the system can marks a student's attendance as present:

1. Student must appear in person at the lecture location to take attendance.
2. Student must have completed the registration stage successfully.
3. Student's image must pass the attendance test during facial recognition and also matches the image presented during registration.

Students will be confirmed absent by the system until the all conditions stated above are fulfilled. That is, by default, students are marked absent until they pass the Facial Recognition phase whose requirement is to complete the Registration Module correctly.

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IV. SYSTEM IMPLEMENTATION

The proposed system was built to be a very robust, modular, scalable and secured. This was achieved using Android Studio, JAVA (Android), SQLite Database and XML. Android Studio makes it possible to create applications that work on the Android OS. JAVA was employed because of its powerful libraries (Shane et al, 2010). XML in Android development was used to create the user interface of the application. It was used to style the application layout as well as the various elements of the layout and to pass data around the various elements of the Android system. SQLite is a relational database management system that was embedded into the system to make it versatile and easily accessible. The following are the output of the implementation of the system**.**

The Home Screen is the first screen that is loaded and is by default, the Main Activity of the system. It contains the user interaction modules needed to navigate to other activities (screens) within the system and can be considered generally as the entrance to using the application. This is shown in Fig. 3 and 4.

Fig. 3. Home Screen Navigation Drawer

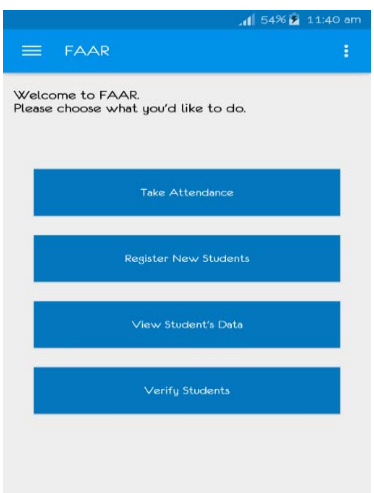

Fig. 4. Home Screen

Fig. 5 shows the attendance screen. The system marks the student's attendance and perform the general face recognition activity.

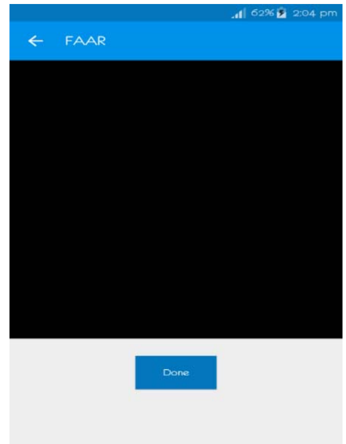

Fig. 5. The Attendance Screen

Fig. 6 and Fig. 7 constitute the entire Registration process.

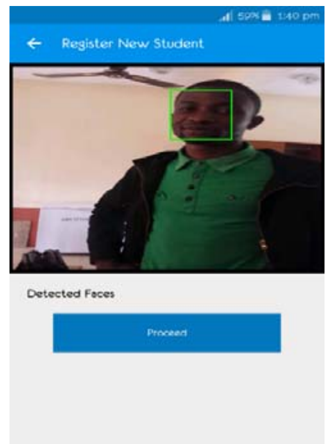

Fig. 6 Face Detection Phase

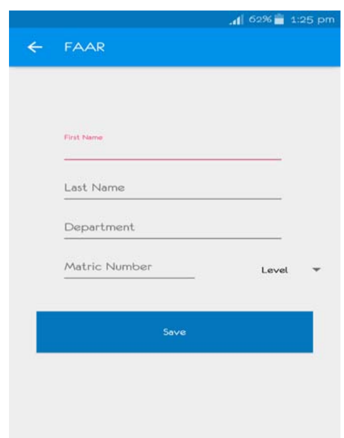

Fig.7 List of Registered Students

Fig. 8 is the module for viewing student's data. The registered students are displayed on this screen and a user can easily view detailed information regarding how frequent a student attends classes.

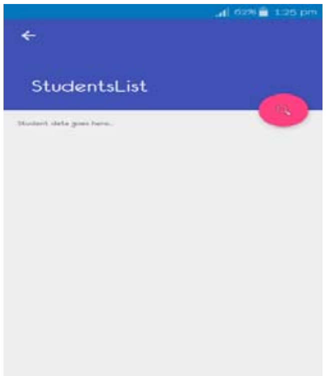

Fig. 8 List of Registered Students

It is also possible for users to view every student that registered in a class. The system can remove a student from a class based on misconduct and also verify if a certain student is a member of a class and if they meet the minimum required number of attendance to sit for tests or examinations.

V. SYSTEM EVALUATION

The system was tested using facial data which included live feed images of 50 students and 20 static general human faces and we tested the % Success rate, %Failure rate and % of false positives of the Facial detection and Facial recognition processes. Although for testing static human images only the Facial detection process was tested because it is impractical to detect the faces that are without dynamic features such as pose, texture, and lightning as these are static images that do not change. Sources of these static images include; books, billboards and posters.

The result of testing the system with the aforementioned parameters are detailed in Table 1 and Table 2, for student's live facial data:

TABLE 1
RESULTS OF TESTING 50 LIVE FACIAL DATA

	%Success Rate	%Failure Rate	%False Positives
Face Detection	94.3%	0.3%	5.3%
Face Recognition	67%	25%	8%

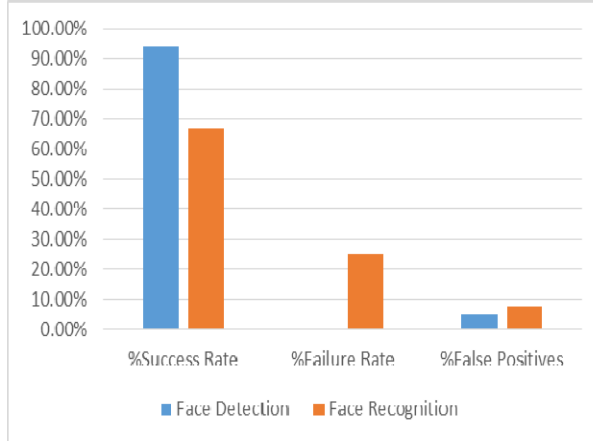

Fig. 9 Visualization graph for 50 live facial data

For static general facial data:

TABLE 2
RESULTS OF TESTING 20 STATIC FACIAL DATA

	%Success Rate	%Failure Rate	%False Positives
Face Detection	91%	6.7%	2.3%

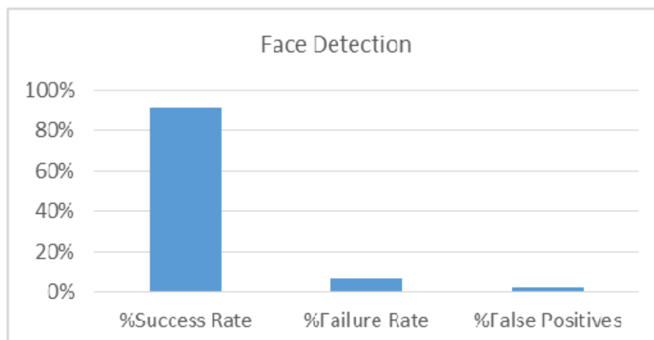

Fig. 10 Visualization graph for 20 static facial data

From the data presented above, it is clear from the visualization charts in figures 9 that the system handled Facial detection activities very well with 5.3% false positives rate detected while testing live data was as a result of inadequacies in the Viola-Jones algorithm being used for the detection process. Also, as seen in figure 10, we recorded a 6.7% failure rate while detecting the faces from static sources because most of the faces in these sources were not full frontal facing images, most of them contained images that have only the side view of faces and the system was unable to detect faces that were not front facing in images.

Facial Recognition activities on the other hand witnessed a major drop in performance as opposed to Facial Detection. This is as a result of unavailability of large sets of images for a face which would be used to train the engine for Facial Recognition. To obtain optimal

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results and performance boost required that set(s) of training images are provided for Facial Recognition. The larger the set of training images for an image, the better the accuracy of the Recognition exercise.

VI. Conclusion

The implemented system proved to be a great step in the right direction, as it provides a means of adequately and properly managing student's attendance as well as controlling examination malpractices. The system provides a secure avenue to store data and generally makes it easier for students and lecturers to work together seamlessly removing the challenges faced by the conventional method of paper-pen attendance taking. With the possession of a robust backend as well as a modular framework, it is easier for the system to attain its security goals and also provides optimum performance.

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