

Smart Attendance System Using Face Recognition for Tertiary Institutions in Nigeria

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Abstract - Student participation in a class is an important factor in a student's success in a course. It is one of the prerequisites for taking the exam at Nigerian universities and colleges. The traditional method of keeping track of student attendance in Nigerian institutions involves having each student sign their name on an attendance list that is sent around the class before lectures begin. This approach consumes time and increases the risk of fraud, especially in a crowded class. In some situations, the lecturer or teacher reads out the names of each student who signed on the attendance list to prevent proxy attendance. In this paper, a smart attendance system using face recognition is proposed to eliminate the problems of the manual method of attendance in Nigerian institutions. The proposed system maps the various courses to the available lecturers and teachers based on area of specialty, experience, and their current workload and keeps track of students' participation in the courses. The proposed smart attendance system was implemented and tested using a random set of students who enrolled in different courses. Based on the experimental results, the proposed system achieves face recognition accuracy of 100% and course-to-teacher mapping accuracy of 100%. With the level of performance shown by the system, it can be a useful tool for course-to-teacher mapping and student participation measurement.

Introduction

The ability of a student to succeed in a course is greatly influenced by their attendance. One of the prerequisites for taking the exam at a certain university is that a student must be present for class [1]. The traditional method of keeping track of student attendance involves having each student sign their name on an attendance list that is sent around the class before lectures begin. However, this method wastes time and raises the risk of fraud, especially in large classes where one student could sign for multiple students who aren't actually in the class. Sometimes the professor reads aloud the names of each student who has signed their name on the attendance list in order to prevent fraud. This approach will consume lecture time and reduce the lesson's efficacy [2].

Automated attendance systems are a contemporary method of keeping track of attendance. Numerous automated attendance systems that use biometric recognition, such as palm vein recognition [3], face recognition [4-7], and fingerprint recognition [8-10], to identify and track present students, have been developed. The other proposed attendance systems obtained student ID for the attendance process using barcodes, [3] QR codes, [11], RFID [12], and near field communication (NFC) mobile devices [13]. The aforementioned approaches are associated with processing time constraints, cost, misuse, and other related issues.

One of the major challenges with the fingerprint attendance system is the failure to capture the students' attendance when there is physical damage to the finger. The finger print data can be stolen and misused by inappropriate people, which leads to serious crimes. Also, the deployment cost for a fingerprint attendance system can be very expensive. The barcode and QR code attendance systems require a special device called a scanner, which emits and collects light to decode the code. The need for the special device can incur more cost when the barcode and QR code attendance systems are deployed. Also, a simple scratch in the barcode or QR code can result in scanning problems.

The facial recognition attendance system can address the challenges faced by fingerprint, barcode, and QR code attendance systems. It is faster, more convenient, and supports multifactor authentication, which enhances its security. In this paper, we propose a smart attendance system using face recognition for tertiary institutions in Nigeria. The system measures students' participation in a class by verifying their face information. The system is capable of segregating the students participation based on courses registered by the students. Aside from measuring the participation of students in a class, the proposed system automatically allocates the courses offered by a department to the available teachers under the department and marks the student's attendance for each course during the class hours. The proposed model allocates the courses to teachers based on their area of specialty, years of experience, and current workload.

The major objectives of this paper are summarized as follows:

- To develop a smart attendance system that measures the participation of students in a class.
- To develop a tool that maps courses to teachers and track the students attendance under each teacher and course
- To develop a system that eliminate the challenges in the manual attendance system

The remainder of this paper is organised as follows: The research done by researchers to measure the participation of students in a class is examined in Section 2. In Section 3 of this work, a smart attendance system using face recognition is presented in detail. We describe the experiment's specifics and the outcomes produced by the proposed system in Section 4. Finally, in Section 5, we wrap up this work and discuss our plans for further work.

Literature Review

The authors of [14] have proposed an RFID-based system in which students carry ID cards with RFID tags that they must swipe across the card reader to have their attendance tracked. The system is connected to the computer using RS232, which is also used to save the database with the recorded attendance. The issue of fraudulent access could arise as a result of this arrangement. Unauthorised individuals may access the organisation using an authorised ID card.

Authors in [15] develop a portable fingerprint gadget that allows pupils to place their finger on the sensor during class without the instructor's help. This approach ensures that the attendance will be recorded infallibly. The issue with this strategy is that students' attention may be diverted if devices are passed around during class.

In [16], the authors suggested an iris recognition system based on the Daugmans algorithm. The iris recognition management system used by this system captures, extracts, stores, and matches images of iris recognition.

However, it can be challenging to install transmission lines if the topography is poor.

Materials and Methods

In this section, the various phases of the developed smart attendance system using face recognition are described. The system consists of two main modules: course teacher mapping module and student attendance marking module as depicted in figure 1. The course teacher mapping module assign the available courses to the teachers based on their area of specialization, years or experience and the current workload allocated to the teacher. The student attendance module registers the students for the courses, capture their records and mark their attendance during the class hours.

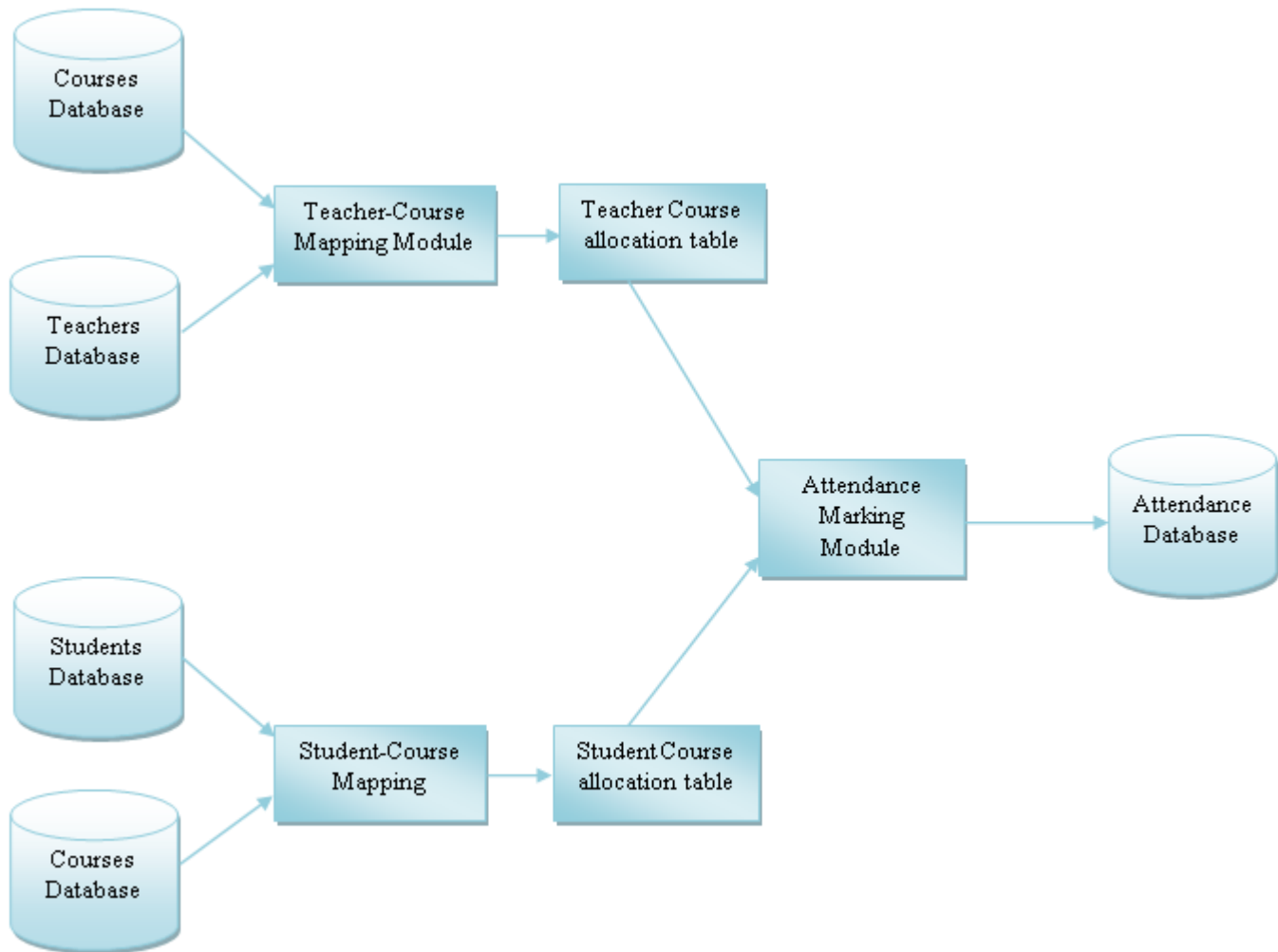


Figure 1 Architecture of the Students Attendance System

Course Teacher Mapping Phase

In this module, the various courses are allocated to the available teachers based on their area of specialty, number of workload allocated to the teacher, and their years of experience. The module fetches the various courses from the courses database and the details of the available teachers from the teacher's database. The teachers details contains the teacher's date of first appointment, department, name, area of specialty, and teacher ID. The course details include the course code, course title, number of hours per week and the course area. To allocate a course to a teacher, the maximum number of hours per hour is set. Based on the available weekly hours, years of experience and area of specialty, the mapping of the courses is performed. The algorithm for the mapping is presented below:

Algorithm 1: Course-Teacher Mapping Algorithm

Input: course table, teachers table, maximum weekly hours

Output: course-teacher mapping table

Teachers-workload[]

Teacher-id=NULL

For each course in course table **do**

Experience=0

For i=1 to len(teachers):

If teacher.area-of-speciality == course area **then**

If teachers-workload[i]!=max-weekly-hour **then**

If teacher.years-of-experience > Experience **then**

Teacher-id = teacher.teacher-id

Experience = teacher.years-of-experience

End if

End if

End if

End for

Teachers-workload[i] = Teachers-workload[i] + course.number-of-hours

Allocate course to teacher.teacher-id

Update teacher-course mapping table

End for

After the mapping of courses to teachers, the mapping is updated in the teacher-course mapping table for the respective course attendance marking.

Student Course Mapping Phase

In this module, the registered students are allowed to login and select courses based on their level of study. The student details and courses selected by the student are stored in the student-course mapping table for marking of student's attendance by their respective teachers. The student details contains the students name, registration number, current year of study, face id captured using faceio facial authentication framework and their respective students id. The courses details contain the details of the courses registered by the students such as course code, course title, credit unit and type. After the selection of courses by the students, the mapping module populate the student-course mapping table with the student and course details, which is used for the attendance marking.

Attendance Marking Phase

In this phase, the student attendance is captured and updated in the attendance database. First, the course teacher logged in to the teachers dashboard and select the course to be conducted at the class hours from the list of courses allotted to the teacher. The teacher begins the attendance capture and the faces of the students are captured for attendance marking. After login by the teacher, the courses under the teacher are fetched automatically from the teacher-course mapping table to enable the teacher select the course for the specific period of time. When a student is captured by the system, the percentage attendance of the student for that specific course is updated in the student attendance database.

The flowchart of the attendance marking is shown in figure 2 below:

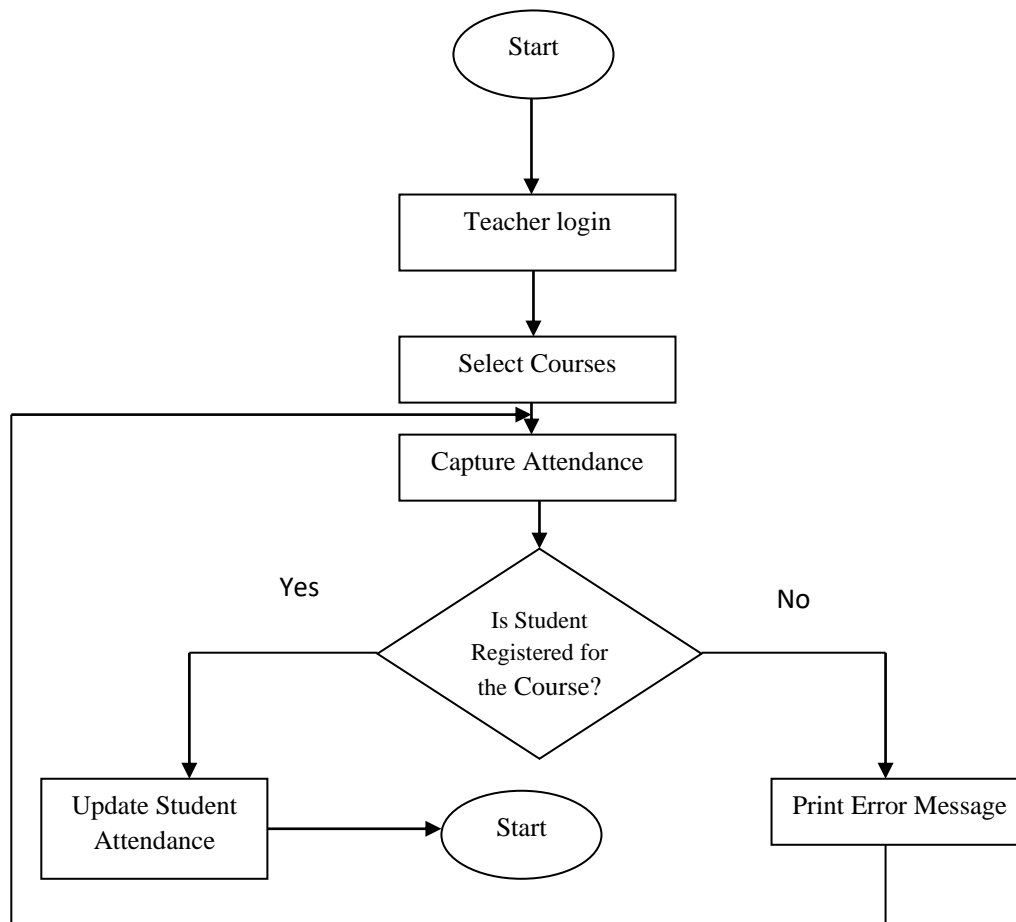


Figure 2 Flowchart of the Attendance Marking

Data Capture Phase

In this phase, the students and teachers data are captured and stored in the databases for course teacher mapping and student’s attendance marking. The student’s faces are captured and stored in the database, which will be used to compare the faces of the students in the class and the faces stored in the database for verification. When a student face is captured and verified with the face in the database, the student attendance will be updated for those specific courses. The teacher’s faces are captured as well to verify the teacher before updating the attendance upon completion of the class.

Experiment and Results

The smart attendance system in this work was developed using HTML, PHP, CSS, and Java script. The user interfaces were designed using HTML and CSS and the query handling modules were developed using PHP and Java script. The face authentication module was developed using facio cross browser facial recognition framework, which was developed based o java script.

To test the model and evaluates it performance, we collect the information of 50 students including their facial images. The students were registered for some number of courses, which were used for the attendance marking. Also, we registered five (5) teachers by providing their date of first appointment, area of specialization, teacher id, and name and then register ten (10) courses for allocation to the teachers. The mapping of course to teachers were done by the proposed course-teacher mapping algorithm and the mapping results were compared with the mapping results of first come first serve (FCFS) and Random mapping algorithm. To further evaluate the performance of the mapping algorithm, we increased the number of courses on interval of 10 and record the mapping accuracy of the algorithm.

Table 1 Mapping accuracy for ten (10) courses

Algorithm	Accuracy (%)	Error (%)
FCFS	52	48
Random	65	35
Proposed CT-Mapping	100	100

Table 1 shows the performance accuracy of First Come First Serve (FCFS), Random algorithm and proposed Course-Teacher Mapping (CT-Mapping) algorithm. Based on the table, it can be observed that the proposed CT-Mapping algorithm achieved the best mapping accuracy.

Table 2 Mapping accuracy for twenty (20) courses

Algorithm	Accuracy (%)	Error (%)
FCFS	63	37
Random	79	21
Proposed CT-Mapping	100	100

Table 2 shows the performance accuracy of First Come First Serve (FCFS), Random algorithm and proposed Course-Teacher Mapping (CT-Mapping) algorithm on 20 different courses and 5 teachers. Based on the table, it can be observed that the proposed CT-Mapping algorithm outperform the FCFS and Random mapping algorithm.

To evaluate the performance of the attendance marking module, we select random number of students irrespective of their registered courses and departments. The randomly selected students were captured and their attendance updated by the system. Table 3 below shows the number of students selected and performance accuracy of the model.

Table 3: Attendance Marking Accuracy of the Model

Number of Students Sampled	Number of Attendance Updated	Number of Students Rejected	Percentage Error (%)	Accuracy (%)
10	2	8	0	100
20	11	9	0	100
30	19	11	0	100
40	18	22	0	100
50	20	30	0	100

In table 3, the number of students sampled indicates the randomly selected students for the experiment, the number of attendance updated indicates the number of students who were registered for the course under consideration, the number of rejected students indicates the students used for the test but not registered for the course under consideration, percentage error indicates the percentage of students who has not registered for the course but were updated in the attendance database and the accuracy indicates the attendance marking accuracy.

Based on the results, it is evident that the model can be reliable when it comes to allocation of courses to teachers and racking student's attendance.

CONCLUSION

The participation of student in a class is crucial; it determines the success of a student in a course. One of the requirements for a student to appear in an examination is the percentage attendance he/she acquires at the end of the course. To measure the students' participation in a course, this paper proposed a smart attendance system for tertiary institutions in Nigeria. The proposed system automatically allocates the courses offered by a department to the available teachers under the department and marks the student's attendance for each course during the class hours. The proposed model allocates the courses to teachers based on their area of specialty, years of experience and their current workload. Based on the experiment conducted, the proposed model achieves allocation accuracy of 100% with variable number of courses. Also, the proposed attendance marking system achieves face recognition accuracy of 100% by using the facio cross browser face recognition framework. With this development, the Nigerian tertiary institutions can employ this application as a tool for mapping of courses to teachers and measure of students participation in a course.

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