

Undergraduate Students E-Attendance System Using Fingerprint and SMS Technologies

An Appraisal to Improve Students and Parents Psychological Stability

Simeon A. Adeyemi

Dept. of Computer Science
Federal Polytechnic, Offa
Offa, Nigeria

Modinat A. Mabayoje, Abdullateef O.

Balogun and Hamed A. Mojeed
Dept. of Computer Science
University of Ilorin
Ilorin, Nigeria
mabayoje.ma@unilorin.edu.ng,

Abstract—Attendance is the measure of presence or absence of a person or an individual in an organized formal group (institutions, organizations, meetings, and so on). The need for a time saving and efficient attendance process, in this era of time management and consciousness, which the present manual method of paper sheet attendance cannot satisfy, is the motivation for this research work. With attendance taking a crucial part of any serious academic requirements, this research work integrates the use of fingerprint biometrics to automate all students' attendance processes (exams, lectures and entrance) by combining minutiae extraction algorithm based on Midpoint Ridge Contour Representation (MRCR), for extraction of minutiae information, with Fingerprint Recognition Minutiae Score Matching (FRMSM) Algorithm which is based on Minutiae Matching Score to match the test fingerprint to the template stored in the database. Also, included is an SMS feature which sends a message to parents upon student's entry and exit into school premises.

The fingerprint image is captured using a reader and the minutiae features are extracted and stored in database against which another features are compared for authentication. The system is implemented using Visual Basic.Net programming language.

Keywords—E-attendance; Bio-metrics; Fingerprint; Minutiae; SMS, Authentication.

I. INTRODUCTION

Organizations of all sizes use time and attendance systems to record when employees start and stop work and when the work is performed. In addition to keeping tracks of when employees work, it also helps to keep tabs on when employees are not working. Education is another crucial area where attendance of students and staff is given serious emphasis, such that it forms part of the requirements and metrics for determining students' performance within the academic activities. Attendance therefore, becomes an inseparable component of any serious academic environment, hence, the need for this research. Electronic Attendance (E-Attendance) is the process of taking the record of presence or absence of an individual within an

organized formal group with the use of computer gadgets. The adoption of E-Attendance as opposed to other methods of taking attendance is preferred on the basis of its advantages premised on computer processing speed, accuracy, throughput, storage capacity, efficiency and flexibility.

Various tools available for implementing this include electronic tags, barcode badges, magnetic stripe cards, biometrics (vein reader, hand geometry, fingerprint, or facial), and touch screens.

Bio-metrics is the measurement and statistical analysis of people's physical and behavioral characteristics with a view to identifying and authenticating such an individual (Mike, 2013). Fingerprint Biometric is used to implement this attendance system, due to its universality and unique identity, combined with the use of SMS as a mode of communicating student's attendance at school to parents/guardians. This will improve students' performance and boosts parents' peace of mind on their wards' whereabouts. Improved performance will eliminate previously failing students' psychological instability. And parents are more fully aware not only of their wards' presence but also absence from school.

As paramount as attendance is to academic performance of students, it is ironic that institutions face, on daily basis, a dwindling number of attendees in lectures. The current adopted manual method of taking attendance on paper has a lot of peculiar problems that makes it inefficient as the appropriate means, such problems include, Wastage of quality lecture time, Room for impersonation, Loss of sheet in transit, Cumbersome and stressful to monitor especially when students' population is large, and so on. More so, due to low attendance, performance deteriorates and as a result, more students suffer psychological instability resulting from these failures. It is convincing therefore that the present method cannot solve the existing associated problems, hence, the need for a transition from manual to electronic. This research is conducted to solve these problems using Electronic Attendance System, by integrating the use of Fingerprint biometrics and SMS technologies.

The main aim of this research is to propose an Electronic Attendance System that combines fingerprint Biometrics to uniquely identify students for attendance and SMS Technologies to solve all students' attendance-related problems, during lectures, exams and entry and exit of students into school and to ensure parents/guardians awareness of their wards' seriousness and presence at school via SMS communication as an attempt to improve students and parents psychological stability arising from the system's performance.

II. METHODOLOGY

Data for this project were obtained from direct interview of students and staff of Federal Polytechnic, Offa, transcription from records, and the Internet. For the implementation of the project, Microsoft Visual Basic.NET 2013 version, MySQL (Version 5.6.12.2) for the database and Fingerprint SDK 2009 by Grianule as well as AT Commands for communicating with SMS-supported devices were adopted.

A total of 200 students and 50 staff of the Federal Polytechnic, Offa, Nigeria, were interviewed. The table below shows the summary of the questions asked during the interview as regards the effect of E-Attendance under the following key points. Each number represents the percentage of the total number of respondents interviewed.

TABLE I. SUMMARY OF THE DIRECT INTERVIEW CONDUCTED FOR STUDENTS AND STAFF OF FEDERAL POLYTECHNIC, OFFA ON THE EFFECT OF E-ATTENDANCE ON PERFORMANCE.

Questions	Students				Lecturers			
	S	A	D	SD	S	A	D	SD
Positive effect on Performance	86 %	9 %	5 %	0 %	90 %	7 %	3 %	0 %
Motivation of student's discipline and punctuality	76 %	15 %	8 %	1 %	82 %	16 %	2 %	0 %
Students at risk of poor academic performance will continue to successfully persist	60 %	25 %	12 %	3 %	75 %	20 %	5 %	0 %
Due to availability, thumbprint will be better and simpler to use for taking attendance.	45 %	35 %	17 %	3 %	53 %	32 %	14 %	1 %
E-Attendance will save quality lecture time	60 %	20 %	18 %	2 %	75 %	20 %	5 %	0 %

E-Attendance record will become more easily accessible					73 %	21 %	6 %	0 %
E-attendance will eliminate issue of record loss					65 %	23 %	12 %	0 %

^b S – Strongly Agree A – Agree D – Disagree SD – Strongly Disagree

A. The Research Design

This project combined minutiae extraction algorithm based on Midpoint Ridge Contour Representation (MRCR) [2], as in Fig. 1, for extraction of minutiae information, with Fingerprint Recognition Minutiae Score Matching (FRMSM) Algorithm which is based on Minutiae Matching Score to match the test fingerprint with the template stored in the database [26], as in Fig. 2. Shown the figures below are the two algorithms.

Step1: Segmentation: To separate foreground from background of fingerprint image. A 64 x 64 region is extracted from fingerprint image.
Step2: Normalization: The grayscale intensities in 64 x 64 regions are normalized to a constant mean and variance to remove the effects of sensor noise and grayscale variations due to finger pressure differences.
Step3: Filtering (Gabor Filter): After the normalization, the contrast of the ridges is enhanced by filtering 64 x 64 normalized windows by appropriately tuned Gabor filter.
Step4: Scanning: Processed fingerprint image is then scanned from top to bottom and left to right and transitions from white (background) to black (foreground) are detected.
Step 5: Calculate Vector: The length vector is calculated in all the eight directions of contour. Each contour element represents a pixel on the contour, contains fields for the x, y coordinates of the pixel.

Fig. 1. Bupesh MRCR algorithm. [2].

The method takes less and do not detect any false minutiae [2].

The FRMSM Algorithm on the other hand is as in Fig. 2.

FRMSM Algorithm By (Ravi, Raja and Venugopal, 2009)
Input: Gray-scale Fingerprint image.
Output: Verified fingerprint image with matching score.
 Step 1: Binarize Fingerprint image
 Step 2: Thin the binarized image
 Step 3: Extract Minutiae points.
 Step 4: Generate Data matrix to get the position, orientation and type of minutiae.
 Step 5: Match test fingerprint with template in database.
 Step 6: Compute Matching Score of the two images.
 Step 7: if matching score is 1, images are matched, else if 0, then they are mismatched.

Fig. 2. FRMSM algorithm [26].

B. System Structural Descriptions

The project is made up of five (5) modules namely:

1) **Registration Module:** This module handles all forms of registrations required from students and Lecturers. All students are required to register their details, including their thumbprint during registration, using an interface and a fingerprint reader device for the data collection.

2) **Entrance Module:** Students coming into or going out of the school premises are required to thumbprint for authentication. Once authenticated, student's detail is displayed, with a passport, and an SMS is sent across to students' parents/guardian's phone, stating the name of such student and the date and time of arrival to or departure from school premise. Student who cannot be authenticated is brought to the notice of security personnel for questioning.

3) **Lecture Attendance Module:** This handles Lecture attendance. A Lecturer supplies his/her staff ID, courses offered by such lecturer are loaded. A course is selected and all registered students for the course are automatically loaded. As each student thumbprints and is authenticated, his/her Matriculation number moves to Attendance List. Lecturer can submit attendance list to the database when he deems it fit during the lecture. Reports of such attendance over a given period or specified interval can be obtained and printed.

4) **Examination Admittance and Attendance Module:** This module handles similar task as Lecture attendance module but information required such as exam date, exam time, duration and venue are required from invigilators before attendance is taken. Each authenticated student will have his/her details displayed, including passport.

4) **SMS Module:** This Module is responsible for encapsulating all SMS features of the system. It involves everything that has to do with sending SMS to student's parent/guardian at entry into and exit from school premises, as well as sending of bulk SMS to all parents or all registered staff by the School Management.

C. Conceptual Model of The System

The system's conceptual model is shown in Fig. 3. Below.

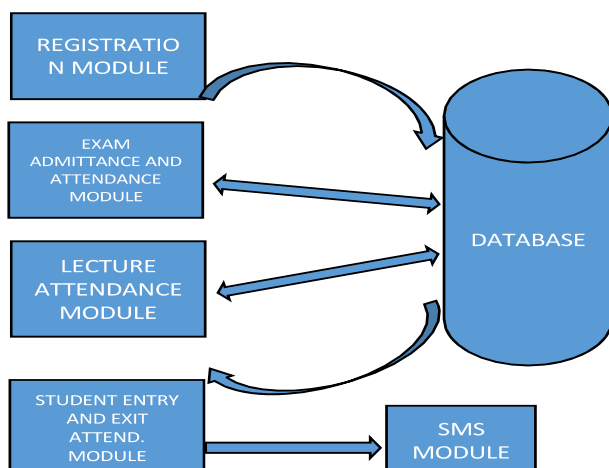


Fig. 3. System conceptual model

D. Use Case Diagram for The System

The use case diagram of the system is as shown below:

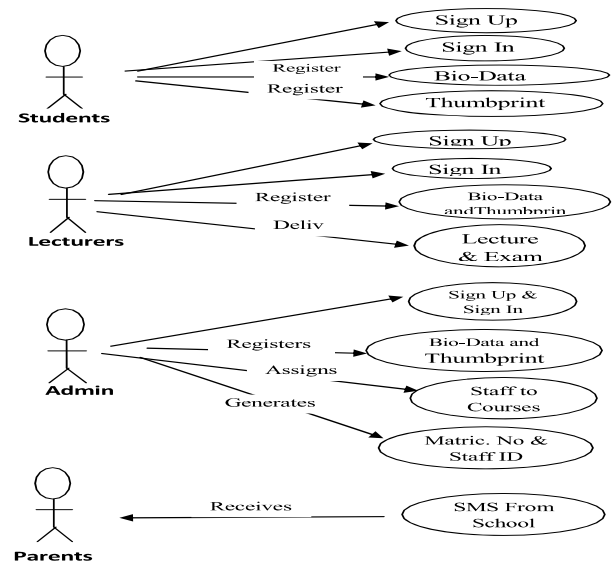


Fig. 4. Use-case diagram of the system.

III. RESULT AND DISCUSSION

After the system was developed, it was run and tested on Windows 7 Operating System environment, installed on Intel(R) Core(TM) i5 – 2540M CPU with 4GB RAM size and operating at a frequency of 2.60GHz. MySQL (Version 5.6.12.2) database was used to store various data obtained from students and staff as well as the minutiae information extracted from the fingerprint data. And it was tested using DigitalPersonaU.Are.U 4000B Fingerprint reader. Some of the output interfaces obtained are as shown in Fig. 5 – Fig. 9 below.



Fig. 5. Main page

Fig. 6. Form showing lecture attendance in progress I

Fig. 7. Form showing lecture attendance in progress II

Fig. 8. Sample bulk SMS sent from school to all staff

The Date	Matric	Surname	Middlename	Firstname
6/6/2016	CS/HND/F15/0001	ADEYE	SIM	DOY
6/12/2016	CS/HND/F15/0001	ADEYE	SIM	DOY
6/12/2016	CS/HND/F15/0002	ADEYEMI	SIMEON	ADEDOYIN

Fig. 9. Lecture attendance report over a specified time interval.

IV. CONCLUSION

Over the years, Attendance in institutions had been done manually. And existing electronic attendance systems only handle a particular attendance requirement and without a feedback to the parents, by and large, for psychological purpose. This research however incorporates a holistic approach to solving all attendance-related issues for undergraduate students and helps to manage effective involvement of parents in collaborative effort to monitoring students' level of participation in school. From the results obtained, it is evident that the proposed system will facilitate academic excellence and improve standard of education as lecture delivery per student will, by implication, increase. It will also reduce health issues associated with fear of failure by students, as students gain more self-confidence with more lecture attendance, as such, they stand a better chance of performing better. Parents also enjoys peace of mind knowing their wards attend school regularly and with knowledge of the wards' whereabouts, hypertensive parents will live better, with such peace. The system will definitely improve Psychological stability of students and their parents alike. It encourages a collaboration of institutions and parents in helping to monitor and instigates students' seriousness academically.

Although, the use of fingerprint Biometrics technology for attendance is not too new, there has not been any of its application integrated with Short Message Service (SMS) technology in Nigerian institutions. Also, at the moment no higher institution has applied this technology ever for students' attendance. Among the few higher institutions using fingerprint biometrics attendance system, it has only been used in taking staff attendance, with focus on ensuring quantifiable service of staff to determine payment. This research however, focuses on students' attendance with a view to solving examination malpractice through

impersonation, lecture attendance associated problems (for increased lecture throughput, by saving the time lecturers spend monitoring students during attendance, also for the authenticity of such attendance) and instigate seriousness of students by ensuring parental/guardian monitoring of student's level of participation or presence and absence in school.

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