Development of Automated and Biometric Students Attendance System for Nigeria University Institutions Using Blended Applications of VB.Net and Remote MYSQL

Adeleke Israel A.[1]; Abdulrauff, Muinat F.[2]; Olalekan Akolade A.[3] & Adegoke Taiwo B.[4]

[1&2]Department of Data Science, Informatics and Computer Science, Emmanuel Alayande University of Education, Oyo
[3]Department of Computer Science, University of Ibadan, Ibadan
[4]Department of Software Engineering, University of Greater Manchester, Greater Manchester, United Kingdom

Abstract	Original Research Article

Students' absenteeism in class lectures without being disciplined and sanctioned appropriately in line with university examination edicts has underestimated and relegated the dignity of students' lectures attendance to the background level. Meanwhile, manual attendance systems that are widely adopted presently in most schools are susceptible to errors, fraud, and ineffectiveness, which ultimately affect the outcomes of students' performance and invariably downgrading educational system of our nation. Considering all these deficiencies, this paper thus introduced the development of an Automated and Biometric Students' Attendance System (ABSAS) that is made through Visual Basic (VB) using the .NET Framework 4.6 and web database (MySQL). It made use of the fingerprint scanner (DigitalPersonaU.are.U) to make sure that the attendance record is accurate and tamper-free, and only the students who attend the lectures personally can be registered as present. Designed using Visual Studio 2019 IDE, ABSAS is a graphically user-friendly application with a broad set of modules to manage faculties, departments, courses, students, and various types of attendance. The implementation of the system architecture was well defined and executed by utilizing the Entity Relationship (ER) modeling and Unified Machine Language (UML) diagrams. ABSAS requires a certain fingerprint hardware level, and has improved tremendously on accuracy and security of data and administrative efficiency in students' attendance management.

Keywords: students' absenteeism, examination edicts, manual attendance, automated, biometric.

1.0   Introduction

The possibility of retaining and recalling what one heard and seen during any class lectures is higher than reading in isolation. This then aids students' good academic performance whenever they have course to write any examination.

Therefore, all formal institutions of learning put a greater premium on class attendance and it is so vital that any student who does not make the benchmark assigned to class attendance may not be allowed to sit for examination (Okokpujie, *et al*; 2017). Thus, good teaching strategies and content can be very useful, but without constant

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attendance, such teaching cannot produce the intended outcome in the life such listeners. To buttress this assertion, Fadare (2021) postulated that, if attendance did not affect the ability of a student to comprehend relatively complex subject matter like Mathematics, a decent number of students would habitually find a way to miss lectures just as they do in courses that they can teach themselves with relative ease. This is an indication that the interaction in the classroom, particularly in the subject areas that need to be taught stepwise and require a detailed explanation is unique.

It is unfortunate to note that several institutions still use very old-fashioned and manual ways of conducting attendance, and as such, attendance taking is highly vulnerable to errors, fraud, and inefficient. Such deficiencies are causing an increasing rate of absenteeism and poor grades among the learners, together with the overall deterioration of student discipline.

Olasupo, *et al*. (2022) described the most Nigerian tertiary institutions' method of taking students' attendance as follows: "The traditional attendance system has been used for recording the presence of students during classes. The class representative passes the paper across to all students present in the class, then the student writes down their name and matric number with their signature. At the end of the class, the class representative submits the attendance paper to the lecturer, and the lecturer then keeps the paper for record purposes. The traditional processes of attendance marking are inclined to many human errors and time consuming for both the students and lecturer during classes. There are several problems associated with the traditional attendance system such as; loss of attendance sheet, impersonation, time wastage, not secure and lack of accuracy."

To solve this problem, this paper suggests a Fingerprint-based student attendance system. This is an automated, secure, and tamper-proof system to record the students' attendance. It is more effective in controlling attendance because only physically present students will be marked present, and hence students learn to be punctual, therefore increasing the participation in classes and providing timely academic assistance to struggling students.

Fingerprinting has proved to be one of the best ways of biometric identification and has experienced massive adoption because of its non-alterable and unforgettable nature. Each person has a unique fingerprint which cannot be distorted at any point in time. Additionally, fingerprinting has also been proved to be fast, accurate, and cheap when it comes to the identification of individuals (Adámek, Matýsek, & Neumann, 2015)

2.   Statement of the Problem

Attendance taking is a standard practice in every educational system but there are quite numerous methods used to take class attendance (Okokpujie, *et al*; 2017). This attendance taking coupled with numerous methods came on board because majority of our students nowadays are interested in boycotting lectures which has greatly contributed to their poor performance in their sessional examinations. Thus, many are been advised to withdraw. They intentionally abscond the lectures because manual methods of taking students attendance permeate impersonation, misplacement of attendance sheets and other inadequacies such that most of these students have ways of including their names into the attendance sheets. Although the edict says before any student would be qualified and admitted to sit for examination, he must have 75% attendance, still this laid down standard is been frustrated and unachievable. Thus, we should magnanimously address this non-challant and unethical behaviour of our students by ensuring that larger number of them participate in class lectures in other to improve their academic performance. Therefore, there is an urgent need to transform from manual methods to automated system by using fingerprint-based system of student lectures attendance. This will give us accurate attendance record, tamper-free and ultimately only the students who attended the lectures physically would be captured, registered and eventually allowed to sit for the scheduled examination.

3.   Significance of the Study

Students' lectures attendance is a prominent activity in schooling system that must not be taking with levity. This is because it is easier for someone to recall and retain what has been heard

and possibly seen in one time or the other. Meanwhile, it is observed that this generation of students are not concerned about their study but rather looking for every fraudulent means to have their ways to acquire certificates. Thus, there is need to monitor their attendance during lectures to mandatorily force larger percentage if not all of them to attend classes during lectures. This study is significant in that it will safeguard them from embarking on lectures attendance impersonation.

4. Related Work

Ujan and Ismaili (2011) developed a Biometric Attendance System (BAS) that was implemented in C#.NET using a Veridicom fingerprint sensor on Windows. It employed fingerprint image enhancement via Gabor filters and the Crossing Number method for minutiae extraction, enabling secure attendance tracking. The system compared extracted features with a fingerprint database for identification. The work limitations included difficulties with noisy/low-quality images, inability to enroll some users, and security risks like fake fingerprints. Findings showed improved ridge clarity, accurate minutiae detection, and reduced false positives through post-processing. Findings confirmed fingerprint-based attendance is feasible, though enhancement and validation are crucial for reliable matching.

Murugavel and Sabarinathan (2020) proposed an Android-based Biometric Attendance System (BAS) using fingerprint authentication to replace manual attendance in educational institutions. Students register once by enrolling their fingerprint, stored securely as a byte array in a cloud database. During each class, they mark attendance by scanning their fingerprint via an external USB scanner connected with OTG to smartphones, eliminating faculty involvement and preventing proxy attendance. The system uses minutiae extraction and matching algorithms for accurate validation, achieving 100% matching accuracy during testing. Results show improved efficiency, reduced paper usage, and secure, real-time updates. Future enhancements include multi-fingerprint registration and backup methods.

Sreelakshmi and Sindhu (2021) developed the Student Attendance Monitoring System that uses NodeMCU ESP8266, R305 fingerprint sensor, and an OLED display to record attendance. Fingerprint templates are stored in the sensor and synced via Wi-Fi to a PHP-based web server with a database, allowing real-time monitoring and export of records. The system improves security and prevents proxy attendance. Limitations include fingerprint storage limits (127 users), error rates due to weather/physical conditions, and high cost of biometric devices. Results showed accurate registration, automated absentee alerts, and reduced time theft. Findings proved that it's efficient, user-friendly, and cost-effective compared to traditional attendance systems.

Olasupo *et al*. (2022) designed and implemented a Fingerprint-Based Attendance Management System (FAMS) for Olabisi Onabanjo University to address flaws in traditional paper-based systems (e.g., impersonation, time waste). Using the Software Development Life Cycle (SDLC), the system employed a Digital Persona fingerprint scanner for biometric capture, C# for logic, and SQL Server for database management. The graphical user interface (GUI) was developed in Visual Studio IDE. Results showed that FAMS were accurate, secure, and efficient, eliminating impersonation and saving time. Limitations included dependency on hardware (scanners) and network infrastructure. Future work suggested a web-based expansion. The system successfully modernized attendance tracking, proving faster and more reliable than manual methods.

Elebede, *et al*. (2024) designed and implemented a fingerprint-based attendance system for tracking students' time and attendance aids in easing these difficulties. The authors achieved this through the combination of components including a fingerprint RS305 module, an atmega328P microcontroller, a red, green and blue (RGB) light-emitting diode (LED), a liquid crystal display (LCD) along with a Personal Computer. the software used in this work was produced using visual basic.net and Arduino programming. Hence, the system was able to register and capture students' attendance record for a particular course; and at the end of each semester, a detailed report showing how many classes were held for the semester and then produced a report that provided the percentage of

attendance or absence for a specific student during a semester.

5.   Methodology

System Design

Automated and Biometric Student Attendance System design was done using Unified Modeling Language (UML) such as Use Cases, Context Diagram, and Entity Relationship Diagram.

USE CASES

The Use Case Diagram illustrates the interactions between Actors (Admin, Lecturer, and Student) and Use Cases (actions performed by the system).
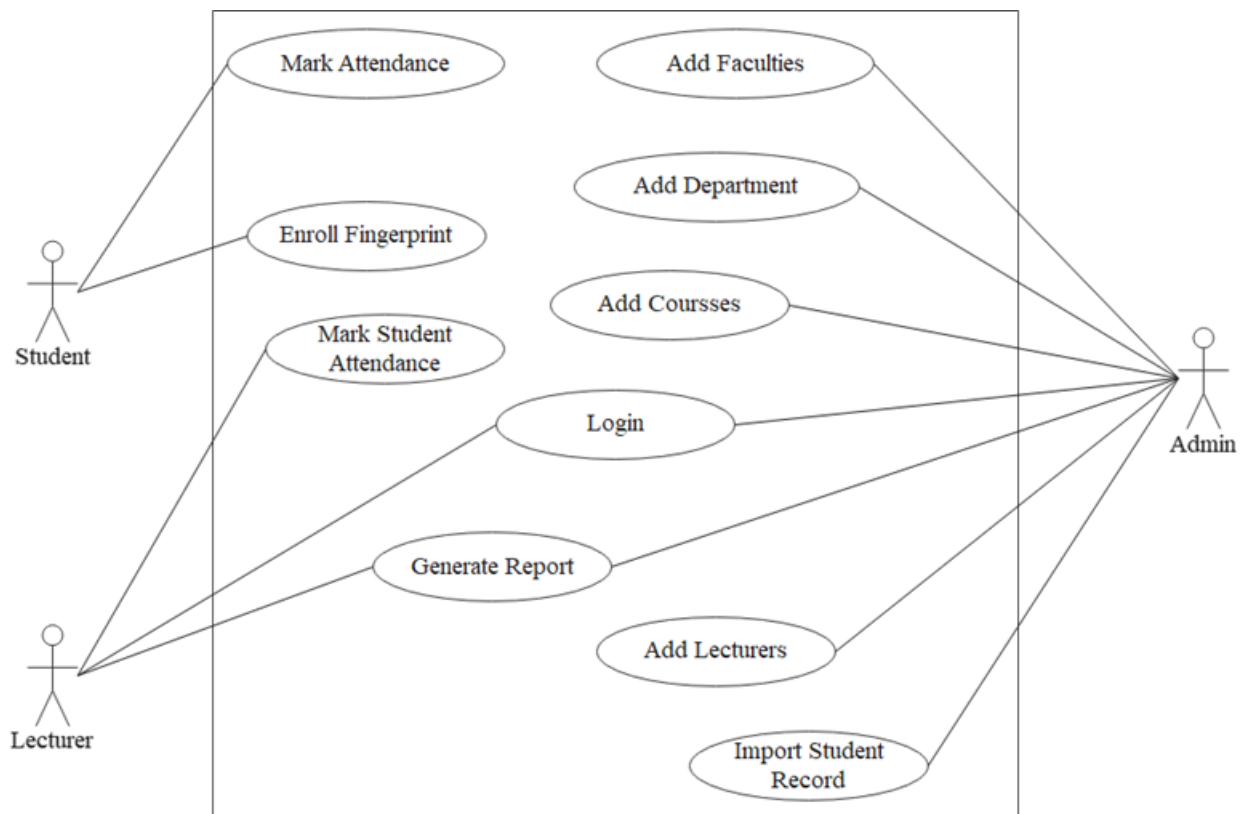

Fig 1: Use Case Diagram

Actors: They are third-party entities that operate through the system to accomplish certain tasks.

1.   **Student**: Symbolizes the students who use the system.

2.   **Lecturer**: It denotes the lecturers who use the system.

3.   **Admin**: The administrator; he controls the system.

Use Cases: The Use Cases will reflect the various functions or operations the system has to offer to the actors. Use Cases of this diagram are:

CONTEXT DIAGRAM

Context Diagram illustrates the ABSAS and its interactions with different entities (Admin, Student, Lecturer, and Database).
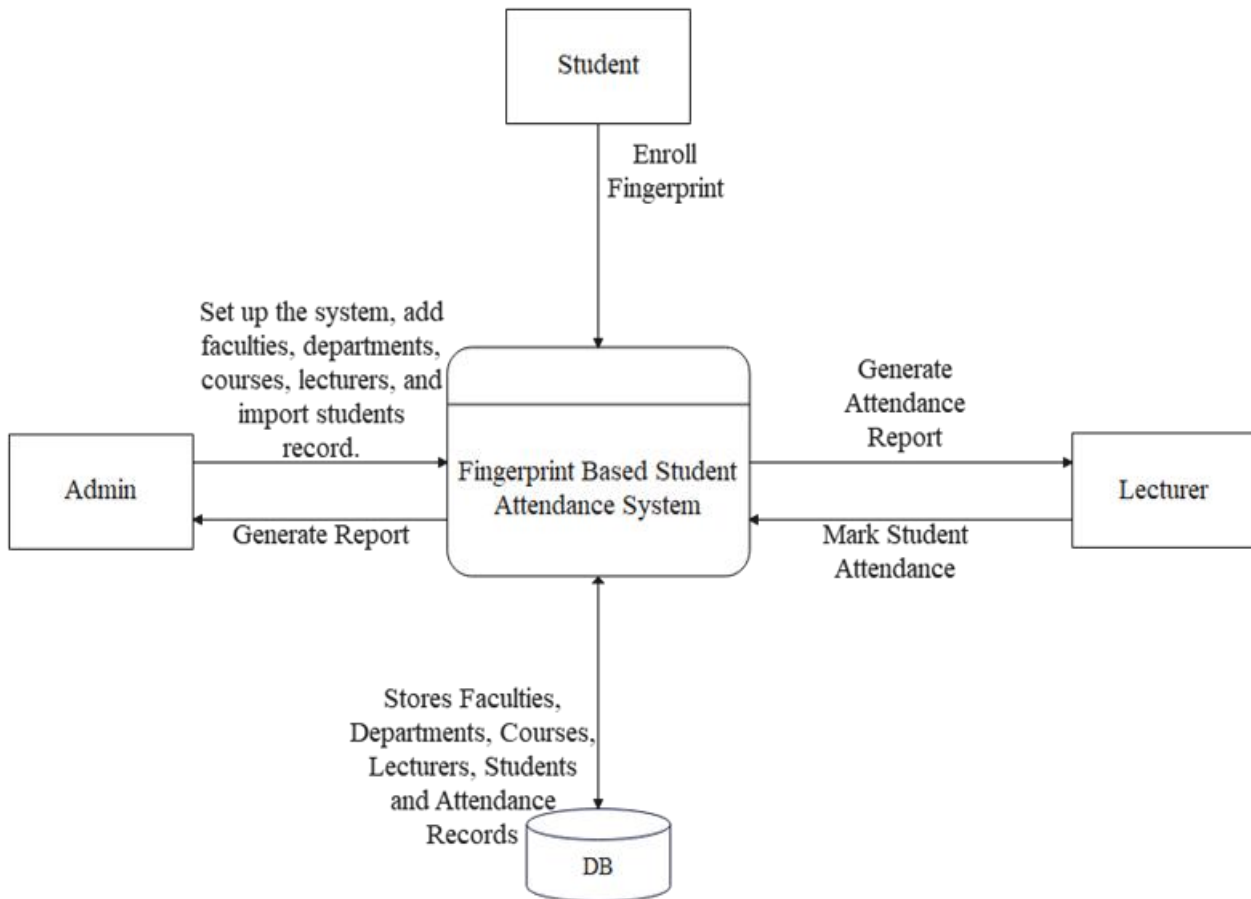
Fig 2: Context Diagram

ENTITY RELATIONSHIP DIAGRAM

An Entity Relationship Diagram (ERD) illustrates the relationships and data structure for the system, related to student attendance management.
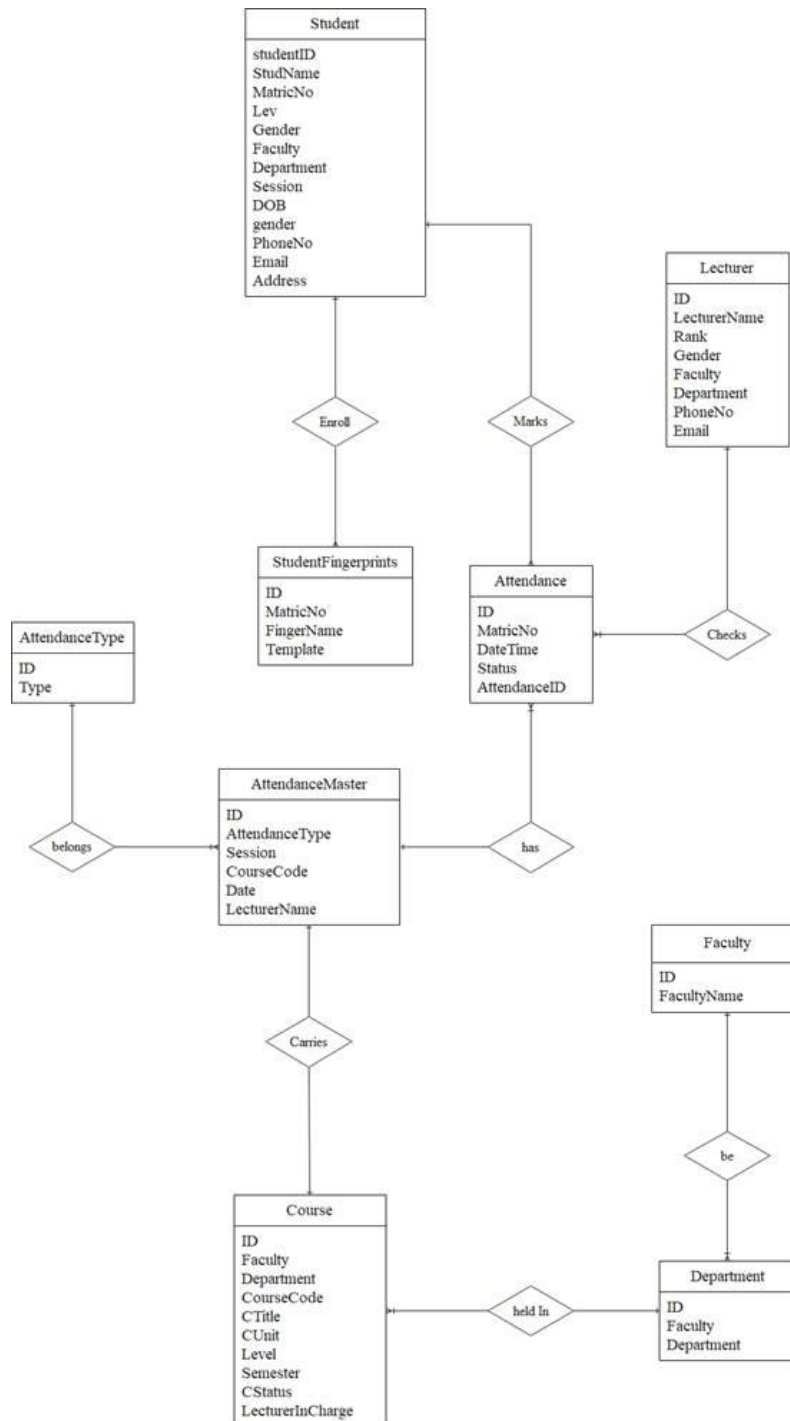
Fig 3: Entity Relationship Diagram

The entities of the system are Student, Lecturer, AttendanceType, StudentFingerprints, Attendance, AttendanceMaster, Course, Faculty and Department.

Implementation

Automated and Biometric Students' Attendance System (ABSAS) was developed using Visual Basic (VB) with the .NET Framework 4.6, the Microsoft interface on which Windows-based applications are developed. The development was performed with the use of the Visual Studio with an integrated development environment (IDE), which contains tools applicable in writing, debugging, and handling the code. The design and generation of detailed and dynamic reports that can support decision-making based on data was done with the use of Crystal Reports to retrieve data directly within the system which can be printed or downloaded as PDF (Portable Digital File). In the case of fingerprint authentication, the system has adopted DigitalPersona, a biometric system that further features security with the help of fingerprint detectors. The database system used in this work to create database tables and data was MySQL, a Relational Database Management System (RDBMS). A relational database management system is a database management system in which data is stored in the form of tables, and the relationship among the data is also stored in the form of tables. Each table has multiple columns and rows. The Relational system has been the most used of all databases and has various features that make it simple yet elegant (Harrington, 2016).

A remote database was used to enhance central access and make the administration efficient. The central database accesses all courses and lecturers and any registered lecturer will be able to access the attendance and student records in any system that has the software (ABSAS) installed, including the system of a colleague without being restricted to a single device. Under this strategy, seamless integration as well as flexibility is possible throughout the institution. It also helps administrators to get an attendance report any time without any consultation with the lecturer in charge, providing opportunities in making decisions concerning the academics and administration.

The ABSAS is capable of running on any Windows operating system platform and has the following menu and features:

1. **Utilities:** to add new users, change password, and transfer students from one level to another.

2. **School:** to register various school names (i.e. Faculty) and academic sessions (e.g 2025/2026)

3. **Department:** to register departments (course of study) in relation to faculty previously registered.

4. **Lecturer:** to register lecturer personal details (in related with Faculty and department)

5. **Course:** to register for new courses which its attendance record is intended to be kept.

6. **Students:** to register the students (i.e. entering of the students' personal records, in relation to the departmental courses already registered).

7. **Attendance:** to register attendance type (such as Lecture, Practical, Examination etc.) and attendance entry.

8. **Imports:** to import multiple students at a time

9. **Records:** to view registered students and attendance records.

10. **Reports:** to generate the attendance sheet as per the user query for printing.

Other features include:

- Export of students and attendance records to Excel

- Attendance sheet reports can also be converted to PDF format or Excel

- Inclusion of tools like Note Pad, Calculator, WordPad etc.

- Unlimited or Multiple user access.

The system is designed and implemented such that the following are carried out during its use:

Fingerprint Enrollment

Fingerprint enrolment is also a very crucial parameter in the system; it was meant to facilitate easy and secure attendance management. When

a student is being registered under the Students Registration process the lecturer or the system administrator need to enroll the fingerprint of each of the students by using the DigitalPersona fingerprint scanner. This will entail taking numerous scans of the finger of the student to come up with a thumbprint that is dependable to use as a template and store in the MySQL database with hard link to the profile of the respective student. Subsequently, fingerprint information is utilized in determining the identity biometrically in the attendance process, where the student only scans his or her fingerprint and can authenticate that information. This will result in the fact that the attendance will be marked only by the registered student, thus there will be no instances of impersonation, and the integrity of the attendance lists will be increased.

Authentication

The system was pre-installed with administrator access using "Admin" as username and password. However, this can be changed to suit the users' preferred login details. This means that only the authorized user can login to the system.

Students Registration

Since the system will be used by both the lecturers and the administrator, the lecturer/admin is expected to register the students in the department on the system or import students records and ensure the students come in person to enroll their fingers.

Course Registration

Courses that the lecturer is in charge from the first year through final year are to be registered on the system.

Taking Attendance

Students are expected to appear in person to take attendance by placing their enrolled finger on the fingerprint scanner (DigitalPersona). Attendance can also be taken by the lecturer in charge of the course at his/her convenient time or place.

Computation of Attendance

The lecturer performs the computation of students' attendance to generate the attendance record which can later be printed by saving the attendance record at the end of each semester before the examination commences.

Printing of Attendance sheet

After computation of various attendance of the students (i.e. attendance sheet.)

6. RESULTS AND DISCUSSIONS

The user (i.e. lecturer/admin) login to the system to perform the various operations and the login screen is as shown in Fig. 4.
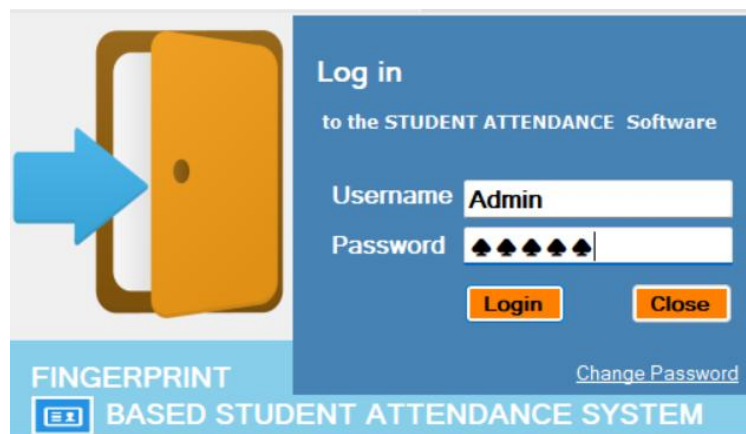
Fig. 4: Login Screen

Once the user is able to log in, the main menu window appears which comprises the following options (i.e. School, Department, Lecturer, Course, Students, Attendance, Imports, Records, Utilities, Tools, Reports, About and Logout, see Fig. 5.).
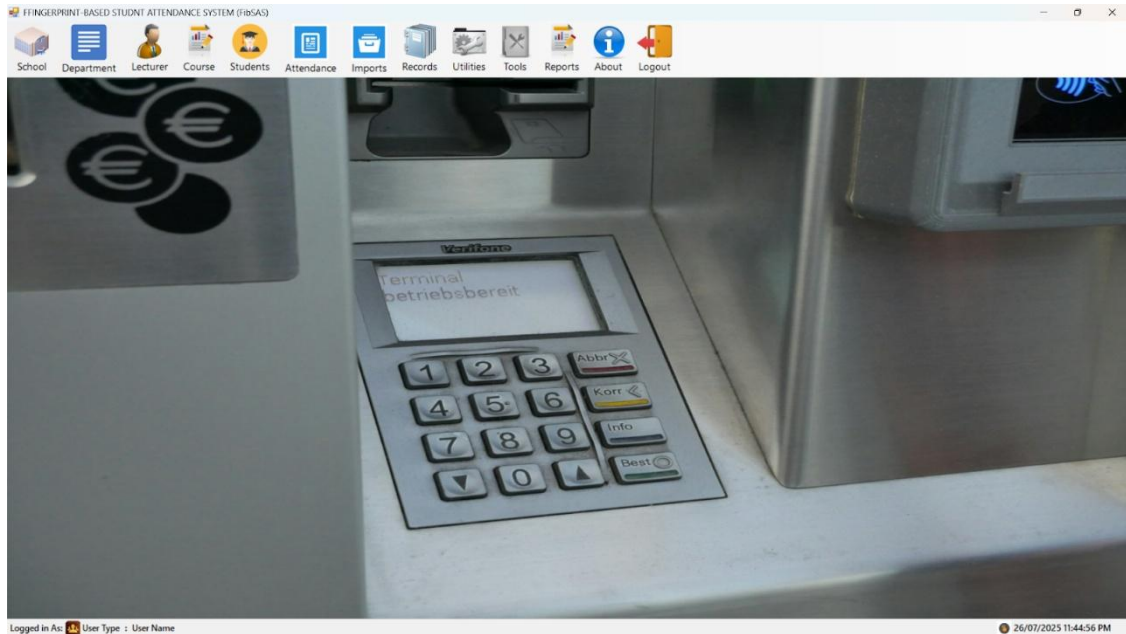
Fig. 5: Main menu window of the system

Admin can perform the following operations (i.e. Add new user, faculty, Academic Session, department, lecturer, course, students and attendance, Import of students' record, input of attendance records, export of records, and Printing of attendance sheet).

After the student information might have been captured or imported, Students can enroll their fingerprints as shown in fig.6 which will later be used for taking attendance and the enrolled finger(s) indicated green.
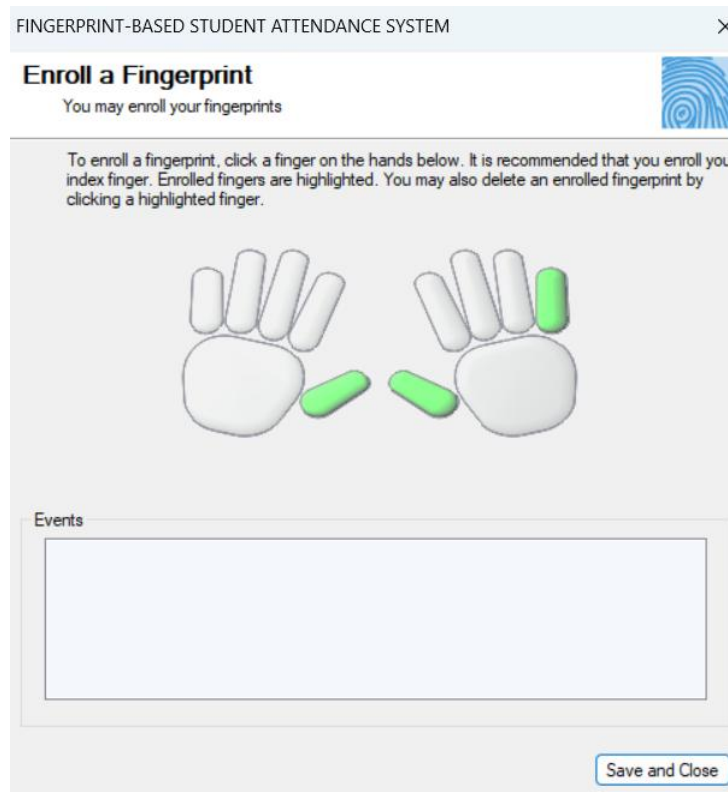
Fig. 6: Students fingerprint enrollment

The pertinent parameters of attendance, including the session, course and the type of attendance are chosen during the class session by the lecturer. When these are chosen, the list of registered students is automatically filled in the system. The students are thereafter to mark their attendance by placing their fingers on the fingerprint scanner. When the authentication succeeds, the icon of fingerprint on the interface changes to green color and the name of the student being authenticated too changes to green color to show presence. Moreover, the system saves the time of arrival of the student and gives an appropriate display, to perfectly and effectively keep a tab on attendance as shown on fig. 7.

Fig. 7: Students attendance panel

In case the fingerprint scan of a student does not match, the system will raise an error message accordingly. In the same way, in case a student has marked their presence during the session the system alerts the user that he cannot mark it twice.

When the fingerprint hardware is not working or unavailable, the lecturer may use the lecturer menu page to mark all students in the enrolled class present in the lecture room as shown in Fig.

8. This makes the system flexible and not affected by different conditions hence resulting in sustainability.

The system also allows the administrator and/or lecturer to generate an attendance report that gives the list of students who attended the class, number of sessions attended by the student and percentage of the total classes attended by each student as shown in fig 9.

Fig. 8: Students manual attendance panel

Fig. 9: Students attendance records panel

Fig. 10: Attendance sheet (where attendance percentage is greater than 70)

Fig. 11: Attendance sheet (all students)

7. Conclusion

Based on the study, the following conclusions were drawn. Automated and Biometric Students' Attendance System that can ease the processing of students' attendance in Nigerian tertiary institutions was carefully developed, tested, and found to meet the stated objectives and work as expected. The system is resilient, handles a large student population, and offers a comprehensive solution to attendance sheet computation as well as archived students' records for future

integrated systems. It easily retrieves any required information for prompt decision making. The ABSAS was developed using Microsoft Visual Studio in the Visual Studio 2019 IDE environment. The database used in this work to create the database tables and data was a remote database (MySQL). The new system uses a graphical user interface (GUI) rather than a command-line approach, making the system easy to use, reasonably secure, and enforcing data integrity resulting from the use of a relational database management system.

8. Recommendations

The following recommendations are hereby made for the purpose of effective usage of this developed system;

1. Management of the educational institutions in Nigeria should endeavour to use developed system in processing students' attendance to enable prompt generation and error-free attendance sheets that will reflect the correct attendance of the students.
2. Organization of in-service training for staff to enable them to be well-grounded in ICT compliance for the effective application of the new system.
3. The lecturer(s) should make an effort to validate the data entered to ensure the correctness of the data.
4. Adequate facilities needed for the implementation of the system by the management should be put in place.
5. Maintenance routine should be put in place for the smooth running of the system.

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