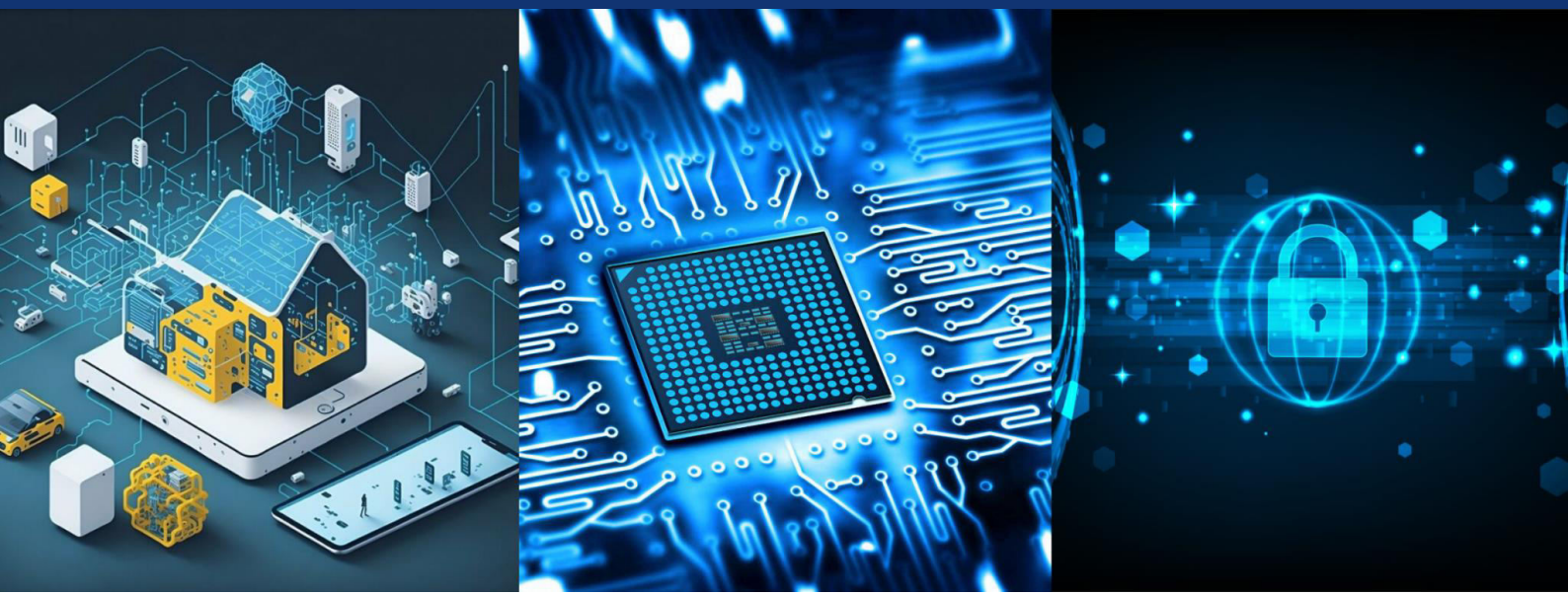
IJIRCCE

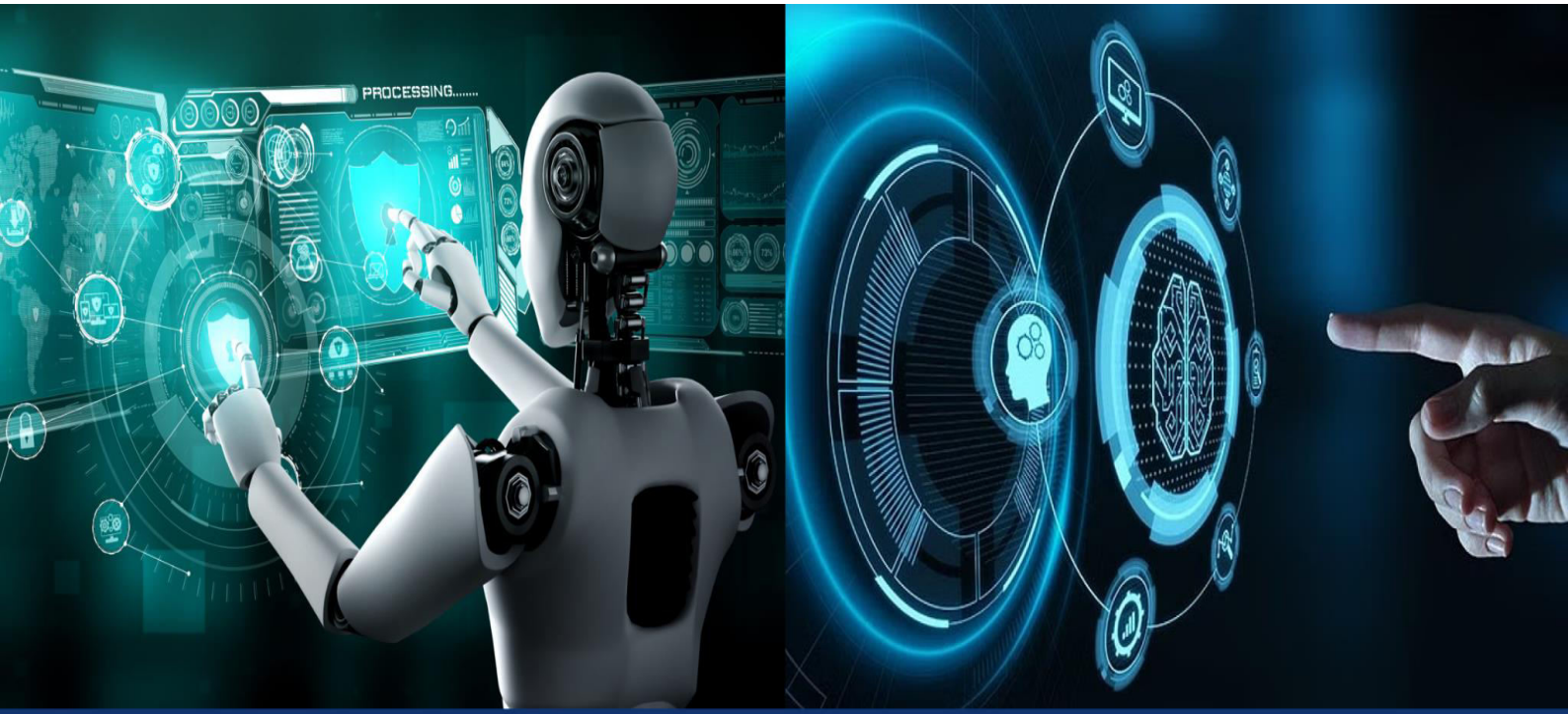
ISSN(O): 2320-9801

ISSN(P): 2320-9798



International Journal of Innovative Research in Computer and Communication Engineering

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.771

Volume 13, Issue 2, February 2025

© 2025 IJIRCCE | Volume 13, Issue 2, February 2025| DOI: 10.15680/IJIRCCE.2025.1302002

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Development and Deployment of a Fingerprint-Based Attendance Tracking System for Students: Case Study at ESPAM-Formation University, Benin Republic

Ayanleye, Emmanuel Iyanuoluwa, Dr. Popoola, Victor Olusegun, Komolafe, Khadijat Omowunmi, Lipeb, Martial

Department of Computer Science, Espam-Formation University, Campus 2, Porto-Novo, Benin Republic

Department of Computer Science, Espam-Formation University, Campus 2, Porto-Novo, Benin Republic

Department of Computer Science, Espam-Formation University, Campus 2, Porto-Novo, Benin Republic

Vice-Chancellor, Espam-Formation University, Campus 2, Porto-Novo, Benin Republic

ABSTRACT: Accurate attendance tracking is a critical aspect of academic administration, yet many institutions still rely on traditional manual methods that are prone to errors, inefficiency, and fraudulent practices such as proxy attendance. This study focuses on the development and deployment of a fingerprint-based attendance tracking system for students at ESPAM Formation University, Benin Republic. The proposed system leverages biometric fingerprint recognition technology to ensure secure, reliable, and automated attendance monitoring. The system is designed to provide real-time authentication, seamless data storage, and easy retrieval of attendance records, improving efficiency for both students and lecturers. The implementation follows a three-tier approach, integrating fingerprint enrollment, cloud-based data storage, and a mobile application for real-time tracking. The system was tested within the university, demonstrating high accuracy, security, and user acceptance compared to conventional attendance methods. Findings suggest that the fingerprint-based system significantly reduces administrative workload, eliminates attendance fraud, and enhances student participation tracking. Future recommendations include expanding the system's capabilities with facial recognition, cloud synchronization, and AI-driven analytics to further optimize attendance management in academic institutions.

I. INTRODUCTION

Many Nigerian and West African universities use the traditional roll call method to monitor attendance in their educational system (Okewu & Okoli, 2023). The roll call attendance tracking system lacks proper verification measures that guarantee the students' presence (Agha et al., 2021). This traditional and manual system has some limitations that may lead to manipulations by students by proxy, becoming a challenge to attaining attendance objectives (Omotuyi et al., 2024). The exercise is inaccurate, unreliable, time-consuming, and open to human errors (Okewu & Okoli, 2023). When a lecturer attends to a large group of students, it becomes a cumbersome and challenging task for the lecturer to call students' names individually to record their attendance (Agha et al., 2021). Also, the emergence of the COVID-19 pandemic urgently demands fast, accurate, and reliable means of logging in students (Omotuyi et al., 2024). This research proposes developing a fingerprint-based attendance tracking system for monitoring students (Okewu & Okoli, 2023). The system is developed to analyze students' attendance in a class by using their unique fingerprint biometrics in a fast, accurate, and reliable manner (Agha et al., 2021). It also enhances real-time communication between the lecturers and students (Omotuyi et al., 2024). The system is employed to log in and out both lecturers and students **to track** students' attendance and assiduity when logged in (Okewu & Okoli, 2023). Chronological data are kept in the database for future retrieval (Agha et al., 2021). With the emergence of COVID-19, this research analyzes the four forms of attendance, and the experiments carried out show that the developed system possesses potential (Omotuyi et al., 2024). Future work and conclusion are presented at the end of the document (Okewu & Okoli, 2023).

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

1.1 Background of the Study

Since the creation of ESPAM Formation University in 2009, the record of student attendance at classes and examinations has been done by pen and paper (Elaskari et al., 2021). The manual system of recording student attendance has many issues, such as a time-consuming process, high cost of stationery, large volume of paper archives, and inappropriate process charges (Ula et al., 2021). Another issue with the pen-and-paper system has been identified as a time-consuming process used for the verification and tracking of students' and lecturers' attendance after the day's lectures (Shrivastava et al., 2025). Additionally, other student fingerprint attendance tracking systems that rely on traditional methods are either partially functional or not naturally portable and require special hardware devices to operate (Elaskari et al., 2021). This discourages their use in some areas where a personal mobile assistant solution exists (Ula et al., 2021). As a solution to these problems, this study aims to develop a fingerprint-based attendance tracking system for students that can be accessed solely on personal mobile devices such as smartphones and run on the Android or iOS operating systems (Shrivastava et al., 2025). It operates in two different applications: the Student Mobile Application for students and the Lecturer Mobile Application for lecturers (Elaskari et al., 2021). The system also includes a Central Server for storing the academic information of its users (Ula et al., 2021). With the system's fingerprint reading capability, the pressing problem of time theft is quickly and definitively addressed (Shrivastava et al., 2025). In addition, the Service Management System records the actual hours worked (Elaskari et al., 2021). The developed fingerprint-based attendance monitoring system uses fingerprint recognition and Secure Hash Algorithm (Ula et al., 2021). The technique is used to recognize unique passcode hashes for every fingerprint pattern recorded in the database on their respective mobile devices at first login (Shrivastava et al., 2025). With the development parameters: acceptance factor, productivity index, and test statistics, the system was assessed (Elaskari et al., 2021).

1.2. Statement of the Problem

Many higher institutions in developing countries struggle with student attendance registration. Most still use traditional methods like paper roll call, which are tedious and time-consuming, especially as student numbers rise. Students often delegate attendance-taking to peers, leading to errors and loss of valuable data that could indicate their engagement in lectures. Manually recording attendance for all students consumes significant time. Afterwards, lecturers must update attendance records, wasting time and increasing data inaccuracies. Consequently, these outdated methods negatively affect schools' efficiency and productivity.

Since schools are required to take student attendance, it becomes necessary to design a user-friendly and efficient tool that will help address all the limitations associated with traditional systems in use.

1.3. Objectives of the Study

This section presents the general and specific objectives of the study.

The study aims to develop an attendance monitoring system for learner authentication in large classrooms, assisting instructors and providing attendance insights. Observations showed that many students neglect regular attendance checks, often inquiring about it just before sessions end. Some manipulate attendance records, having friends check in for them when absent. To address these issues, the research proposes a fingerprint recognition system via an interface to enhance the monitoring process effectively.

In any case, the specific objectives of the work are as follows: Facilitate student authentication in connection with practical work; model relational data, fingerprint management, and database coding; create an interface for our system that includes administrative tools for maintaining the database components; and Analyze the system, perform recognition, and detect errors.

1.4. Significance of the Study

The implementation of an attendance tracking system in academia is crucial for several reasons. Traditional attendance methods are time-consuming and limited by human error. Educators agree that class attendance significantly impacts student success. The primary goal of this initiative is to address the shortcomings of the current method while minimizing the time spent on attendance, allowing lecturers to concentrate on teaching instead of administrative tasks. A computer-based system can enhance academic monitoring by tracking individual student progress, revealing high-performing students who may not need to attend every class. Additionally, it can identify those who struggle academically and require support. Such systems can also assist in grading and recognizing gifted students, enabling tailored assistance to help their development.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

The system will alert students about courses with below-minimum attendance. Those involved in sports or extracurricular activities can understand how their absences impact academic progress. It provides an opportunity to seek help from lecturers or classmates and aids the administration in assessing course effectiveness, identifying less effective lecturers, and determining student preferences for courses. The project will implement a student fingerprint scanner system utilizing embedded hardware and libraries with a web interface. The method's effectiveness will be evaluated by comparing post-deployment results in an academic group.

1.5. Scope and Limitations

This section presents the paper's scope and outlines the proposed system's limitations.

1.5.1. Scope The paper only covers developing and deploying a fingerprint-based attendance tracking system for students. Through the proposed system, administrators can create, modify, and delete classes and courses, add and modify the list of students, and capture and validate attendance. For this paper, the scope was limited to student attendance tracking using fingerprint recognition.

1.5.2. Limitations The proposed system is not free from some limitations, the main ones being: • Attendance cheating by the use of unauthorized multiple-finger templates or by sending companions to record fingerprints as a way of recording the attendance of an absentee student. This limitation is inherent to all fingerprint biometric systems, and the situation is even worse because this system caters to large universities or schools that accommodate up to a thousand students in one classroom. • Effectiveness when used on students seeking enrollment in multiple class schedules and on students with worn fingers. • The method of integrating multiple schedules from legacy systems. • The budget of adopting this system in contrast to deploying large-scale dedicated hardware platforms. • Multiple fingerprint captures to overcome any changes in biometric features and, therefore, increase the accuracy of the attendance authentication.

II. LITERATURE REVIEW

In order to further advance research and significantly enhance scientific performance on a specific subject, it becomes essential to thoroughly delve into the pertinent literature, thereby systematically constructing a comprehensive and well-rounded knowledge base in the relevant areas of study and expertise (Saul et al.). Following this perspective, the present section will discuss the significant importance of the fingerprint attendance system in detail (Ardebili et al., 2023). This exploration will thoroughly cover the main concepts and underlying technologies associated with student attendance systems as they relate to biometric identification methods (Gupta et al., 2023). Furthermore, it will delve into the intricate interaction of biometrics with fingerprints, highlighting how these advanced technologies not only improve accuracy but also streamline the overall process of tracking attendance in educational institutions (Saul et al.). Additionally, the benefits and challenges associated with implementing such systems in educational settings will be carefully considered, providing a rounded view of their impact on modern educational practices and methodologies (Ardebili et al., 2023). Biometrics, as a formal field of scientific inquiry, began to take shape during the late 1980s, primarily as a result of groundbreaking and innovative new studies focusing on technological development and implementation (Gupta et al., 2023).

A comprehensive series of in-depth research efforts and engaging, collaborative discussions were conducted to systematically identify the specific human traits that allow for the unique identification of individuals across diverse populations and environments (Saul et al.). From these thoughtful reflections and extensive analyses, several innovative biometric technologies emerged, significantly contributing to an updated and enhanced understanding of existing biometrics while also exploring potential future developments in connection with various substrates and their practical applications (Ardebili et al., 2023). The ongoing evolution of this field continues to shape how we perceive personal identification, privacy, and security in numerous real-world contexts and scenarios (Gupta et al., 2023). Among the many possibilities offered by a diverse array of biometric technologies, digital fingerprints hold significant prominence due to their numerous advantages, such as non-invasiveness, the permanence of unique patterns, and the ease with which they can be acquired and processed at various scales (Saul et al.). These features make digital fingerprints highly favorable for numerous applications, including but not limited to security, identification, and attendance monitoring in both educational and professional sectors (Ardebili et al., 2023). However, it is essential to also address some disadvantages that need to be carefully discussed and evaluated. Factors such as humidity, the drying out of the skin, aging of individuals, and background noise can all adversely affect the fingerprint matching process, potentially leading to inaccuracies in identification (Gupta et al., 2023). These issues highlight the complex challenges that must be navigated

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

when relying on this technology for accurate and reliable identification of individuals in diverse settings and circumstances (Saul et al.).

2.1. Overview of Attendance Tracking Systems

Automated systems currently play an important role in various critical areas **humans use** (Pranoto & Kusumawardani, 2021). One such area is the academic environment, where the application of technology offers important advantages (Ozdemir & Ugur, 2021). An academic environment needs to manage and monitor the students' attendance (Raj et al., 2024). Manually tracking students' attendance has several disadvantages. They are not accurate or timely (Pranoto & Kusumawardani, 2021). Initially, attendance in universities and colleges used the paper and pen method. This is an old-fashioned and time-consuming way (Ozdemir & Ugur, 2021). To overcome this, universities and colleges are **using** barcodes, RFID techniques, biometric systems, Ethernet or Wi-Fi, smart web services, facial recognition, iris recognition, and fingerprint recognition (Raj et al., 2024). The advantages are a simple interface, records updated at the end of each lecture, and less operational resources required (Pranoto & Kusumawardani, 2021). The conventional methods are prone to security threats. As technologies become easier, hackers will crack the security and enter their details (Ozdemir & Ugur, 2021). Therefore, the biometric system is preferred (Raj et al., 2024).

Among the biometric systems, fingerprint recognition is chosen for students' attendance. Because of the uniqueness of fingerprints, they cannot be used again (Pranoto & Kusumawardani, 2021). There are different ways to implement the fingerprint attendance system. Some universities and colleges use commercial units for attendance, which makes the cost of the hardware high (Ozdemir & Ugur, 2021). If the institution is ready to develop its hardware and software, we can reduce the cost (Raj et al., 2024). Some universities and colleges use commercial fingerprint sensor controllers. Controlling the sensors is a disadvantage (Pranoto & Kusumawardani, 2021). There is a need to have control over the sensors (Ozdemir & Ugur, 2021). To overcome the above disadvantages, we proposed fingerprint sensing unit integration for college students' attendance (Raj et al., 2024). This system will suit universities and colleges (Pranoto & Kusumawardani, 2021).

2.2. Fingerprint-Based Systems in Educational Institutions

The risk of losing worker cards in a smart card-based time attendance management system underlines the importance of a reliable system that does not rely on a specific physical object (Abdul-Al et al., 2024). To counteract this issue and to provide more secure attendance data with precision, various alternative systems based on facial recognition, fingerprint, or the use of a university email address as a key through a smartphone were of great interest (Sumalatha et al., 2024). Various methods have been used to implement an efficient time attendance system using fingerprint-based management, such as using a Raspberry Pi without an internet connection, using the Raspberry Pi connected to the internet, and using a framework (Jayavadivel & Prabaharan, 2021). Biometric fingerprint recognition is a method of automatic non-invasive identification or verification based on the unique traits of the individual (Abdul-Al et al., 2024). In this case, the proposed system is implemented using an algorithm that first captures the user's fingerprints; the fingerprints are then verified using the algorithm (Sumalatha et al., 2024). If these prints are verified, the user is registered automatically, and their data is stored in a database (Jayavadivel & Prabaharan, 2021). On the other hand, if the prints are identified as belonging to a verified user, then the time of arrival, departure, and presence of the user are stored in the database (Abdul-Al et al., 2024).

Finally, the proposed solution can improve the current manual global time attendance system to achieve rigorous and easy management for the user (Sumalatha et al., 2024). The same prototype focuses on improved functionality, financial costs, and user-friendliness (Jayavadivel & Prabaharan, 2021). The current global audio attendance management system requires manual installation and is more complex (Abdul-Al et al., 2024). The added biometric characteristics include identification through the fingerprint and data entry through two interfaces with a larger capacity for information (Sumalatha et al., 2024). The subject does not forget the map and their participation record (Jayavadivel & Prabaharan, 2021).

2.3. Benefits and Challenges of Fingerprint-Based Systems

Fingerprint biometric systems are employed in numerous applications to increase efficiency and provide effective solutions for identity management (Alrawili et al., 2024). The diverse benefits of fingerprint-based systems are convenience, a high degree of reliability, assurance, permanency, unique identification, and accountability (Kumar et al.,

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

2021). Nevertheless, with the ever-increasing adoption and use of fingerprint biometric systems, some commonly cited benefits challenge the uniqueness and universality properties of the human fingerprint, thus affecting the efficiency of biometric devices (Alrawili et al., 2024). Security, privacy, and religious objections have also been identified as hindrances to public acceptance and the usage rate of fingerprint-based systems (Kumar et al., 2021). The use and penetration of fingerprint-based biometric systems have witnessed widespread applications seeking unique, easy-to-remember, easy-to-obtain, and less time-consuming, user-friendly, positive, and perfect personal identification methods (Alrawili et al., 2024). The fastest underlying technologies of computers, digitisers, and communications, along with the easy availability of an individual's digital image, enable fingerprint identification to enter a wide range of fields and opportunities (Kumar et al., 2021). These systems and facial recognition are now supplied to the masses, albeit with many significant issues regarding their design, operations, and usage (Alrawili et al., 2024).

III. METHODOLOGY

I designed and implemented a fingerprint-based attendance tracking system for universities to track students' attendance effectively. This system stores students' information as well as the number of classes that should be attended by each student in an academic session in a database. A registration system was also created to register and add new students. A graphical user interface (GUI) was also built to provide a platform for the administrator to perform functions such as registering and taking attendance during each lecture. This unique student attendance system captures attendance directly on a computer based on the comparison of student fingerprints with the fingerprint from the fingerprint scanner at the same time. This system enables lecturers to record attendance in real-time. The performance of the developed system was analyzed and tested on data from the business education department, and the results show that the system is recommended for small, medium, and large academic institutions.

The method used in developing this system is to retrieve the required information from the university management departments before the appropriate software is realised. The success of the detailed implementation is justified through software engineering concepts. The purpose of software engineering design is to formulate a plan for the solution of the problem at hand. The initial phase of the development process of the attendance system provides a plan through designing the whole system. The decomposition model was authenticated and used to build a prototype model that acted as feedback for the front-end analysis to stakeholders. The importance of this model verifies that it provides much on the supporting experimental system which also includes extensibility. Indeed, the implementation phase was executed by transforming the prototype into a finished system.

3.1. Research Design

This section describes some tools and techniques used to develop and deploy the fingerprint-based attendance tracking web application. The system must have a good user interface to help users perform tasks quickly. A responsive front-end library provides the best front-end look with user-friendly modules. The implementation also uses a server-side language to handle three key activities: data access, event handling, and updates. A strong library enhances the responsiveness of the project, as well as reducing network traffic by paging and searching data on the table.

In the design of the system, the fingerprints of the students are enrolled in order to get the unique key of the students. With this unique key, an attendance card is generated, and two example prints are found to access the access control system and automate attendance records. The system has two databases: the access control and attendance databases for authentication modules and recording access data. The system includes a module based on the attendance tracking template instead of the personalized module. This module is the welcome form representing the web application home screen with a pleasant user interface. Additionally, the application has a remote fingerprint updation module, an acceptance fingerprint module, an access data recording module, and an automated attendance recording module.

3.2. Data Collection Methods

Data collection is the process of gathering and measuring information on variables of interest (El et al., 2022). Data is collected in this project in two major forms: primary and secondary data (Umar & Ko, 2022). The researcher collects Primary data for the specific purpose or project at hand. It is original data that the researcher generates **to address** the research problem at hand. In contrast, secondary data is the type of data that has already been gathered by someone else or for survey purposes other than the problem at hand (Almossa, 2021). By collecting and analyzing both types of data,

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

researchers **can** achieve a broad, comprehensive understanding of the issues (El et al., 2022). The primary data for this project is collected from the staff and ESPAM Formation University students (Umar & Ko, 2022). From them, an in-depth analysis is conducted on the status quo of the current perfunctory biometric attendance tracking system (Almossa, 2021). However, before embarking on collecting this primary data, research is made on this educational technology (El et al., 2022).

Data relevant to this biometric technology were collected and combined to develop a coherent prototype for the ESPAM Formation University case study and beyond (Umar & Ko, 2022). Much has been collected from secondary sources such as papers, monographs, books, and other resources (Almossa, 2021). This study is unique in that it also presents a mobile application that helps users who are at ESPAM or away from it to be linked in real-time to the attendance system while using their mobile devices (El et al., 2022). These students can not only check their attendance report but also verify whether anyone has recorded their ongoing solution (Umar & Ko, 2022). All these features are reliable and authenticated since user identification is corroborated with fingerprint data (Almossa, 2021).

3.3. Data Analysis Techniques

This section discusses the data analysis tools and techniques that will be used to analyze the collected attendance data. It starts with a brief overview, followed by a description of the analysis tools and techniques, and concludes with a summary of the section. The main objective of collecting and analyzing attendance data is to assess the efficacy of the proposed Fingerprint-Based ATSS and the extent to which it has met the goals set for this project. The key goals associated with the ATSS are to monitor the student attendance rate, assess the immediate impact of that data set on students, and ascertain the socio-technical implications of implementing such a system in the university.

In an attempt to identify non-attendance patterns, particularly those indicative of disaffected and disengaged students, the collected data will be examined for initial indicators of the students' experience. Monitoring trends in the collected data will provide feedback about engagement quality, an important component of the student experience. Also, assessing the frequency of disengagement among students will be crucial. Protecting at-risk students and informing long-term strategies will promote the welfare of the students. The analysis of the collected data set will be both quantitative and qualitative. This data analysis will use some of the available or custom tools as well as methods or algorithms in image processing, pattern recognition, etc. The data analysis will cover software development, student data quality, and student attendance record trends.

IV. SYSTEM DESIGN AND DEVELOPMENT

4.1. Purpose and Scope We propose a fingerprint-based attendance tracking system for students that provides an efficient and easy way to perform attendance tasks for routine lessons. Our proposed system uses a fingerprint reader toolkit and ASP.NET, which runs on a Windows environment. We believe the proposed application results in a better way to take attendance since it allows capturing images and characteristics from fingerprints. The main field of application of the proposed system is to provide a better tool to capture information for the attendance task. In this work, we designed, developed, and tested a prototype of the proposed system, and as a demonstration, we used it for a simple example.
4.2. Fingerprint Reader Toolkit Architecture Before developing the attendance tracking web application, it is necessary to study the architecture of the fingerprint reader toolkit. It is a solution available for integrating functionalities and biometric characteristics compatible with fingerprint readers. This document provides a step-by-step description of how to integrate the fingerprint reader. The reader captures images and characteristics from fingerprints provided by the reader.

4.1. System Requirements and Specifications

The proposed system was designed to handle students' attendance in order to help lecturers manage their courses effectively. The system is built using embedded C language. The components used to implement the system are inexpensive. A microcontroller unit (MCU) is a small computer manufactured on a single integrated circuit. Digital and analogue signals are processed by computerized operations. The MCU is made up of a processing unit, a memory unit, and an input/output (I/O) unit to connect the device to other circuits. A PIC16F877 is a well-known microcontroller. It includes many of the features needed to interface with various necessary peripherals. The MCU, 16x2 alphanumeric

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

LCD, FP sensor, and different LEDs are connected in a prototyping printed circuit board (PCB). These components are managed by the professor schema that is implemented in the MCU. The flow chart of this schema is presented.
In order to avoid registered student duplicates, a database was built. This database has 10 different attributes. These attributes store information about each registered student. There are parentheses: ID, Matricule, First name, Last name, Age, Gender, and Finger. Each attribute in a database has specifications. For instance, the student's First name attribute needs six parameters. These parameters are the variable type, the object's size, the object's coordinates, the object's name, location, and auto-hide.

4.2. System Architecture

The backend architecture contains the server, the databases, and the application (Rahkoyo et al., 2024). The server is a virtual private server (VPS) of 4GB with an Intel Xeon processor (Akinola et al., 2021). The choice goes to a virtual private server (VPS) because it is cheaper compared to leasing a full physical server (Pranoto & Kusumawardani, 2021). The databases are two: one for handling teacher data and the other for handling student data (Rahkoyo et al., 2024). The student's records store unique fingerprints, emails, and other useful data (Akinola et al., 2021). The application is a package that integrates the server, databases, fingerprint scanner, and other necessary computing elements (Pranoto & Kusumawardani, 2021). The application is developed using a web framework's functionality (Rahkoyo et al., 2024). The system uses seeders to populate the database with keys such as teachers' records, courses, and slots dynamically (Akinola et al., 2021). To check for attendance, the system will also know the courses that the faculty members and the students are taking (Pranoto & Kusumawardani, 2021). Whenever attendance is required, the system displays the course, program, date, and a timed five-digit random number on the projector at the end of the class (Rahkoyo et al., 2024). Some of the most important components of the backend architecture are those handling attendance (Akinola et al., 2021). To check for students' attendance, the system will show the teacher's email and the courses he or she teaches when the classes start (Pranoto & Kusumawardani, 2021). The faculty member can then enter the course, and an additional random code is shown to the student (Rahkoyo et al., 2024). The faculty member must capture and validate his or her fingerprint to further initiate the validation of the students (Akinola et al., 2021). Then, the student faces the scanner, and the student's fingerprint is compared with the list of fingerprints in the database (Pranoto & Kusumawardani, 2021). If the student has entered the course and has been identified as a member of that course, the system records attendance (Rahkoyo et al., 2024).

4.3. Database Design

The Users Table contains details of people who normally interact with the system by performing operations like the students' attendance record collection (Ula et al., 2021). The Attendance Table consists of columns to be stored in the database of the attendance record, which fingerprints the students (Shrivastava et al., 2025). The Weekly Time Table is a table that stores the school timetable of the users and the different subject schedules of the users in a particular institution (Ula et al., 2021). Important fields include the class subject and the time subject (Shrivastava et al., 2025). In order to implement the system of fingerprint attendance machines, a database is used to store the log details of the students (Ula et al., 2021). This system can accurately and efficiently manage student attendance while eliminating traditional paperwork (Shrivastava et al., 2025). However, the database is being implemented as a relational database for the content design (Ula et al., 2021). This design can effectively handle large amounts of data for student attendance records (Shrivastava et al., 2025). Although the database structure is compatible with employee attendance using fingerprint identification, it can also be ideal for implementing an online student attendance management and monitoring system (Ula et al., 2021).

4.4. User Interface Design

The interface is the main engine for all desktop applications (Ariffin & Aziz, 2023). A well-designed user interface will attract users to use the system (Adigun et al., 2022). This section designs a user interface for the system. It contains four activities that the system can carry out: Add/Edit Students, Attendance Marking, Reports, and Settings (et al.). There is a textbox beside each activity that provides information when the mouse hovers (Ariffin & Aziz, 2023). The textbox helps to give a brief description of the activity linked to the button (Adigun et al., 2022). The design of the tab buttons is similar. The title is green, with a font size of 12 bold, and the font family is sans-serif (et al.). It uses a 50 per cent opacity colour to make them semi-transparent and attractive for the users (Ariffin & Aziz, 2023).

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

There is a report button on the Employee form that shows all staff raters and a button to add or update the details of staff raters to enable easy tracking of staff raters that are due for an update (Adigun et al., 2022). The Add Students frame was designed. The frame used for student registration has fields for name, matric number, faculty, and department to capture students' details as required to easily identify them (et al.). The student's name, matric number, email address, gender, and department are compulsory to fill **out** before submitting the form (Ariffin & Aziz, 2023). The cancel and submit buttons were provided to carry out necessary actions on the page (Adigun et al., 2022). There is a button on the Student form that shows all students saved in the database to enable easy access to the **student's** records (et al.). The Attendance View frame was designed. It comes with a date choice box and buttons to show attendance and report attendance, respectively, to ease the display of attendance and report generation (Ariffin & Aziz, 2023). A report button was also provided to show all attendance marked for easy tracking (Adigun et al., 2022).

V. CASE STUDY AT ESPAM FORMATION UNIVERSITY

ESPAM Formation University of the Republic of Benin adopted the traditional way of taking students' attendance via a sheet of paper that contains a list of students and a signature column in each row beginning with each student's name. Presently, OMR sheets are used. The disadvantage of this method is that some students can sign for their friends or colleagues. Meanwhile, when attendance is taken and the number of students is less than half, some lecturers will feel the need to skip 2 times per week. Those students involve themselves in academic dishonesty by allowing their friends who are not in class to take their fingerprints. Other methods, such as RFID-based and image-based, require different devices that are not embedded on each student's mobile phone, while those that do can be time-consuming and take a long time to install applications.

The motivation behind this work is to introduce a more accurate and secure way of monitoring students' class attendance using a fingerprint-based approach. This work will allow the system to automatically repeat lectures for those students who skipped a class. It will also simplify the calculations of absentee students in a repeated lesson for an instructor to analyze. The design of the system could provide a solution for instruction during increased enrollment in a course. Additionally, it streamlines the process of student attendance and allows class time for other activities. Our proposed solution is an efficient way of recording students' fingerprints, storage, and detection. We also present a technique that resolves inaccuracies by matching the captured fingerprints with those that exist in the database. With the help of these underlying principles, student attendance can be confirmed quickly and accurately. At the same time, unfair attendance, such as a fellow student taking attendance for another student, will be eliminated.

5.1. Background of the University

The École Supérieure Panafricaine de Management Appliqué (ESPAM) university is a multi-campus private higher learning institution of higher education and professional training in Porto-Novo, Republic of Benin. Its Campus 1 facilities are located on the Lagunes motorway, Cotonou – Lomé road around Cotonou. The university provides professional, performing, and innovative practical-based education. It is made up of committed faculties, which innovate and equip learners to explore challenges, equipped with twenty-first-century life and career skills in research environments. It is dedicated to influencing the students, supporters, and other stakeholders. It is constantly and collectively working to meet the principles set out in its mission by continuously improving the learning environment of its stakeholders through its excellent educational programs and dynamic self-evaluation processes. As an innovative partner in the transfer of knowledge and technology to benefit society, it is recognized for its dynamic and successful leaders, employees, and alumni.

5.2. Implementation Process

After the system was fully developed, the 3-tiered approach was employed to allow for a swift implementation. First, through a data addition process, each student's unique fingerprint was enrolled into the platform with the specific student's matriculation identification number and name assigned to his or her unique fingerprint template. Each institution has several students, and this process was accordingly replicated until all current students were enrolled into the database using the batch upload feature. Next, this data, just like all others used in the development of the system, was stored in the cloud, allowing for quick access and use from the server, without necessarily storing information about individual students locally on each device. Finally, the software entity was distributed across the university. Desktops with central processing units (CPUs) having minimum speeds of 2 GHz, memory of at least 4 GB, and around 20 GB of hard disk

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

space were used to register the students' unique fingerprints. The sensor that came with the model alone was used to capture each student's fingerprints live. All students' fingerprint data were captured and saved on a desktop machine using the control panel that was embedded in the server station.

The SDK and the USB driver that came with the fingerprint scanner were installed on individual teachers' smartphones prior to the implementation process. This fingerprint reader was then connected to the software via the USB cable after installing, enabling, and activating the software to broadcast on the local network. The teachers' smartphones compatible with the USB feature were connected to the said fingerprint scanner using a USB cable. Its IP address was provided for each teacher, and the Attendance app was installed, showing the relationship between a teacher and their chosen subject(s). With the app up and running, we clicked on the subject of interest to start taking the class attendance, and it asked for the IP address of the server. Subsequently, the server IP address of the fingerprint reader was detected.

4.1. Material Used The Fingerprint attendance system utilizes the following materials: Software: • Java JDK: IDE with runtime • database server • Workbench • Software entity of the fingerprint Attendance System • Studio to build the mobile application Hardware: • 1 Fingerprint Scanner • 1 Visual Studio with Community version • Mouse for the basic operations. This shows that the system only uses one fingerprint reader. It is through the multi-station synchronization feature of the server that multiple fingerprint attendance management stations can be synchronized to work together. This model simplifies the deployment of our system on students' smart devices.

5.3. Challenges and Solutions

This study presents a case study from a private university in Benin Republic, where the problem of manual attendance tracking is being experienced (Jahangir et al., 2024). A fingerprint-based attendance tracking system was developed for the university in both software and hardware modes (NKATA, 2024). The deployment of this system made it possible for the university to experience cost savings and a reduction in examination malpractice (Thaleeparambil et al., 2024). The feasibility of developing and deploying such a system in African private universities was also justified (Jahangir et al., 2024). The results show that a majority of students preferred the fingerprint technique to other techniques (NKATA, 2024). Many of the students' responses on issues of privacy showed little or no support for the privacy policy (Thaleeparambil et al., 2024). The implications of the responses on ethical and related issues are discussed along with the research limitations and conc**lusions (Jahangir et al., 2024).**

In this section, the challenges and solutions encountered during the development and deployment of the system at the university are presented (NKATA, 2024). The challenges, such as the poor financial state of private universities, software skills, system deployment, lack of time for implementation, and weak infrastructure, had to be addressed to make the deployment of the system at the university possible (Thaleeparambil et al., 2024). To solve some of the challenges, like the poor financial state, the absence of attendance, and assessment monitoring, the system complemented the existing university management system (Jahangir et al., 2024). A guide for system interaction was created for the students and lecturers, while some parts of the lecture notes also allowed for its use (NKATA, 2024).

VI. RESULTS AND DISCUSSION

We have implemented a fingerprint-based system for automatic attendance tracking, and at the same time, we have taken into account issues related to the control and supervision of the attendance of the students. We have developed a web service allowing the teachers to realize the necessary points, manage the planning of all their courses, and consult the reports and statistics around the attendance of the students. Our system is now operational in real time, and the responses of the teachers and the students are useful for research shortly. The quality of biometric measurements carried out is very sensitive to environmental conditions. If we want to use biometric systems in everyday applications, it is necessary to understand under what conditions the system is effective and under what conditions the system is not effective. It is only in this way that we can make biometric systems easily deployable in everyday life.

We have seen the benefits of digital fingerprint detection; the operating time allows the fingerprinting process to be done more consistently, quickly, and effectively. It is not time-consuming and is not subject to fraud or illegal practices. This research innovation on student attendance allows educational non-compliance to be mixed among educational settings.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Furthermore, by automating the student registration system, security is monitored by the teachers to enhance student learning.

6.1. System Performance Evaluation

Students' appraisal is one of the performance evaluation techniques in the educational sector. The definition of the level of knowledge, skills, and competencies possessed by the trainers or the trainees is appreciated through specific evaluation-designed instruments. Attendance registers are usually used to track students' attendance in educational institutions, but filling them manually leads to many problems, including data loss and poor record management. In this work, we designed and developed a fingerprint-based attendance tracking system. The system was implemented at the Department of Computing for the laboratory sessions in the academic year.

This paper aims to present the performance of the Fingerprint-Based Attendance Tracking System. We analyzed the recognition process using three different algorithms through F1-Score, Precision, and Recall approaches. The recognition phase had to find the F1-score value of 80% when using the ULBP algorithm. The overall rate of the system was computed, as well as the percentage of discrimination effectiveness. The outcomes revealed the acceptance of the device by the targeted population based on previous literature, including the subjective evaluation done using a questionnaire. The percentage of discrimination was computed for both students and conferences, and it was 84.21% and 89.83%, respectively, on average.

VII. CONCLUSION AND FUTURE DIRECTIONS

Development and Deployment of the Fingerprint-Based Attendance Tracking System for Students

In this article, we have presented the development and deployment of a Fingerprint-Based Attendance Tracking System for students. The system uses fingerprints as input and applies a fingerprint-matching algorithm to check the validity of the input. The system provides a basis to improve security, consistency, and autonomy in the attendance process. This new attendance system is expected to help lecturers track class attendance and minimize their reporting burden, administrators monitor student attendance more effectively and reduce the rate of the use of proxies and other issues related to the manual attendance marking system. In future work, we will take into account the identification and elimination of potential threats that could undermine students' privacy and the qualities of the different functions. Also, the system's efficiency will be improved, and the support of multiple sensors will be considered. In conclusion, the developed system helps to combine the order, governance, and traceability provided by ATMs and prevents some from failing to mark their presence. The development of the proposed system is a first step toward providing solutions that have not been previously explored within the context of higher education in general.

Conclusion and Future Directions

The purpose of the present study was to address the problem of manual attendance marking and proxy issues. To that end, a fingerprint-based attendance system was developed and deployed. With this solution, we have opened up an avenue to evaluate students' participation in classes, serving university lecturers, students, and administrators alike. The functionalities of the biometrics HSM system were further extended and improved upon to meet the specific requirements related to the aims we wanted to accomplish within the same sensor. For future improvement, several developments are ongoing. The primary task consists of integrating the system into the campus eLearning platform to facilitate interaction with students via smart features of participants. The proposed research is currently underway.

Also, the scheduled system still has the disadvantage of mobile attendance as well as external or third-party threats such as fingerprint theft or identity theft. Therefore, to eliminate the potential of these threats, we intend to install an exterior camera on the robot scheduled to record student attendance during lectures to allow for the synchronization of all activities that were potentially performed. Secondly, we plan to assess the effectiveness of the proposed system and investigate a refined HSM-ATM solution that will smartly control participant acceptance and access based on the distance from and orientation of the image framing of students already enlisted for face identification. It may also use a smartphone within the Bluetooth range for easy and seamless checks. In the meantime, the experiment will now be carried out, and the complete report will be available shortly. Once the study has been completed, the tamper limit verification will provide a robust solution for enhancing the configuration of the biometric system to attendance monitoring.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

7.1. Summary of Findings

This paper presents a fingerprint-based attendance tracking system that was developed and deployed at a university. In the system, teacher and student information were collected and stored in a database. Both teachers and students were identified using their unique fingerprints, and students had their presence automatically recorded in the database each time they used a fingerprint scan. The developed system was then tested on a very large scale, and the results showed a high level of accuracy in a very short processing time. However, occurrences of anomalies were identified and discussed. In conclusion, the developed system was highly successful in addressing the problem that sparked its development in the first place. If all anomalies discussed could be effectively addressed, it could then be very desirable for every higher institution to adopt it. The security and accuracy of the fingerprint-based attendance tracking system should be improved to prevent scenarios where some students could quickly go back in time to mark their attendance. The accuracy and integrity of the fingerprint-based attendance tracking system should be enhanced to ensure that lost attendance is accurately marked. Fingerprint-based attendance tracking must be made more convenient to encourage more students to register and use it.

7.2. Implications for Practice

The results of the research present a high potential impact for various decisions. In terms of practice and profitability, the deployment of the ERP system will meet the needs of the University of Benin in terms of monitoring and surveillance of student attendance in order to supervise lessons and examinations. The strategic value of the present work on the development of the fingerprint-based student attendance tracking system is beneficial for the quality of service. With regard to prospects for career development, this decision will revalue and offer opportunities to teachers in terms of career development and optimization of offered services. It will offer opportunities for national and international training that will further assist in increasing the quality and employability of students. To education in general, the results will increase the quality of the country's education and give rise to a profile of skilled and globally competitive young graduates through the management of an ERP system that offers a program that values its degree. Imperatively, the present work, aside from its significant contribution to the improvement of school attendance, will allow for the biometric authentication of persons available in a session and therefore in the precise choices over the institution's overall attendance time. In addition, the fingerprint-based student attendance tracking system could become an effective tool for staying and working within the framework of students by encouraging its management and teachers deemed to exercise the profession as well as parents wishing to follow the education of children through available monitoring of their attendance.

7.3. Recommendations for Future Research

Since the system was based on fingerprint attendance, detected problems were directly related to fingerprint scanning. A more widespread deployment of the system would connect well to the university's databases, effectively improving attendance on campus. As such, future work should involve leveraging multiple technologies besides fingerprint-based systems to improve accuracy. Modern facial recognition, voice recognition, near field communication, Bluetooth, WiFi, radio frequency identification, and GSM-based tracking can be employed to enhance system accuracy. Moreover, the use of these additional technologies can also reduce reliance on wireless connectivity options. The system is still built to use pretrained fingerprints with the same type of hardware, which includes a small scanner and a thermopile wristband mounting sensor for its deployments. Multiple elevation-deployable sensors can be used to improve current hardware limitations. As one of the system's goals was to link with the university's systems, an official association with a biometric entity located at the Faculty of Customs would help integrate the system with current students and usage requirements. Deployment of student-registered fingerprints would require more primary funding sources, which the university can improve. Finally, the implementation of this system can and should be improved, deployed, and tested on multiple students. The size of the project still limits the abilities of the results. However, as the results showed, the legitimacy of using biometric verification was recommended. Future improvements can only be justified as guidelines show the way to implement.

REFERENCES

1. Okewu, J. & Okoli, A. I. C. (2023). 'Senior Citizen': Ironic Depiction of West Africa's Herder-Farmer Crisis in a Conceptual Ceramics Exposition. African Journal of Inter/Multidisciplinary Studies. journals.co.za
2. Agha, R. O., Oderanti, O. F., & Alao, T. O. (2021). Drumming as a means of Communication and Culture in Nigeria. A Study of Talking Drum. A Study of Talking Drum (May 21, 2021). ssrn.com

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

3. Omotuyi, S., Apeloko, D. O., Bello, M. A., & Chukwudi, C. E. (2024). Visa-on-arrival, ECOWAS-free Mobility and the Securitisation of the Intra-African Migration in Nigeria. India Quarterly, 80(3), 421-438. [HTML]
4. Elaskari, S., Imran, M., Elaskri, A., & Almasoudi, A. (2021). Using barcode to track student attendance and assets in higher education institutions. Procedia Computer Science. sciencedirect.com
5. Ula, M., Pratama, A., Asbar, Y., Fuadi, W., Fajri, R., & Hardi, R. (2021, April). A new model of the student attendance monitoring system using rfid technology. In Journal of Physics: Conference Series (Vol. 1807, No. 1, p. 012026). IOP Publishing. iop.org
6. Shrivastava, A., Suji Prasad, S. J., Yeruva, A. R., Mani, P., Nagpal, P., & Chaturvedi, A. (2025). IoT based RFID attendance monitoring system of students using Arduino ESP8266 & Adafruit. io on defined area. Cybernetics and Systems, 56(1), 21-32. researchgate.net
7. Saul, K. B. S., Saul, J. B., & Soberano, K. T. (). Utilizing Convolutional Neural Networks for Fingerprint-Based Attendance Monitoring. ijmra.in. ijmra.in
8. Ardebili, A., Latifian, A., Aziz, C. F., BinSaeed, R. H., Alizadeh, S. M., & Kostyrin, E. V. (2023). A comprehensive and systematic literature review on the employee attendance management systems based on cloud computing. Journal of Management & Organization, 29(4), 679-696. [HTML]
9. Gupta, P., Gopal, S., Sharma, M., Joshi, S., Kaushal, D., Lakhera, G., ... & Sharma, B. (2023, November). Biometric Employee Identification Using Mobile Devices: ICT integration of Attendance Monitoring System (AMS) and Human Resource Information System (HRIS). In 2023 International Conference on Advances in Computation, Communication and Information Technology (ICAICCIT) (pp. 1169-1174). IEEE. [HTML]
10. Pranoto, H., & Kusumawardani, O. (2021). Real-time triplet loss embedding face recognition for authentication student attendance records system framework. JOIV: International Journal on Informatics Visualization, 5(2), 150-155. joiv.org
11. Ozdemır, D. & Ugur, M. E. (2021). Model proposal on the determination of student attendance in distance education with face recognition technology. Turkish Online Journal of Distance Education. dergipark.org.tr
12. Raj, A., Srivastav, H., Shukla, S., & Gupta, N. (2024, March). Facial Recognition-Based Student Attendance System. In 2024 11th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions)(ICRITO) (pp. 1-5). IEEE. [HTML]
13. Abdul-Al, M., Kyeremeh, G. K., Qahwaji, R., Ali, N. T., & Abd-Alhameed, R. A. (2024). The Evolution of Biometric Authentication: A Deep Dive Into Multi-Modal Facial Recognition: A Review Case Study. IEEE Access. ieee.org
14. Sumalatha, U., Prakasha, K. K., Prabhu, S., & Nayak, V. C. (2024). A Comprehensive Review of Unimodal and Multimodal Fingerprint Biometric Authentication Systems: Fusion, Attacks, and Template Protection. IEEE Access. ieee.org
15. Jayavadivel, R., & Prabaharan, P. (2021). Investigation on automated surveillance monitoring for human identification and recognition using face and iris biometric. Journal of Ambient Intelligence and Humanized Computing, 12(11), 10197-10208. researchgate.net
16. Alrawili, R., AlQahtani, A. A. S., & Khan, M. K. (2024). Comprehensive survey: Biometric user authentication application, evaluation, and discussion. Computers and Electrical Engineering, 119, 109485. [PDF]
17. Kumar, T., Bhushan, S., & Jangra, S. (2021). An improved biometric fusion system of fingerprint and face using whale optimization. International Journal of Advanced Computer Science and Applications, 12(1). researchgate.net
18. El Khatib, M., Alhosani, A., Alhosani, I., Al Matrooshi, O., & Salami, M. (2022). Simulation in Project and Program Management: Utilization, Challenges and Opportunities. American Journal of Industrial and Business Management, 12(4), 731-749. scirp.org
19. Umar, M. & Ko, I. (2022). E-learning: Direct effect of student learning effectiveness and engagement through project-based learning, team cohesion, and flipped learning during the COVID-19 …. Sustainability. mdpi.com
20. Almossa, S. Y. (2021). University students' perspectives toward learning and assessment during COVID-19. Education and Information Technologies. springer.com
21. Rahkoyo, E., Yangdol, S., Kaur, B., Vaithiyanathan, D., & Verma, P. (2024, May). IoT-Based Fingerprint Attendance System: Enhancing Efficiency and Security in Educational and Organizational Settings. In 2024 International Conference on Advances in Modern Age Technologies for Health and Engineering Science (AMATHE) (pp. 1-7). IEEE. [HTML]
22. Akinola, O. A., Olopade, S. O., & Afolabi, A. S. (2021). Development of mobile and desktop applications for a fingerprint-based attendance management system. Indones. J. Electr. Eng. Comput. Sci, 24(1), 570-580. academia.edu

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

23. Otunola, A. O., Alabi, A. O., Abdullateef, A. T., Lawal, M. K., & Olanipekun, N. O. Digital Collaborative Framework for Students' Industrial Work Experience Scheme and Sustainability in Federal Polytechnic Offa, Nigeria. academia.edu
24. Ariffin, M. I. Z., & Aziz, M. F. A. (2023). Student Attendance System using Facial Recognition. Applied Information Technology and Computer Science, 4(1), 1194-1209. uthm.edu.my
25. Adigun, S. O., Ejidokun, T., & Uche-Ihesiulor, E. C. (2022, January). An Excutable Model for Student Registration System using Timed coloured Petrinets. In 2022 30th Southern African Universities Power Engineering Conference (SAUPEC) (pp. 1-5). IEEE. researchgate.net
26. Jahangir, M. T., Abdeen, Z. U., Hussain, A., Shehzad, M., Wajid, A. H., & Arshad, M. (2024). Efficient Mobile-Driven Automated Attendance System Employing Biometric Authentication for University Employees. Journal of Computing & Biomedical Informatics. jcbi.org
27. NKATA, A. (2024). Strengthening Of Students' Class Attendance Using Biometric Authentication System To Enhance Delivery Of Competence-Based Quality Education. The Journal of Informatics. iaa.ac.tz
28. Thaleeparambil, N., Biju, A., & Prathap, B. (2024, March). Integrated Automated Attendance System with RFID, Wi-Fi, and Visual Recognition Technology for Enhanced Classroom Security and Precise Monitoring. In 2024 IEEE International Conference on Contemporary Computing and Communications (InC4) (Vol. 1, pp. 1-6). IEEE. [HTML]

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INNO SPACE SJIF Scientific Journal Impact Factor

doi crossref

निस्केयर NISCAIR

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

9940 572 462 6381 907 438 ijircce@gmail.com

www.ijircce.com

Scan to save the contact details