Grenze International Journal of Engineering and Technology, Jan Issue

WebSocket based Smart Attendance System

Pranav Salunkhe[1], Sakshee Agrawal[2], Raj Salunkhe[3], Sakshee Jagdale[4], Sahil Shirodkar[5] and Prof. Vijaykumar Bhanuse[6]
[1-6]Vishwakarma Institute of Technology, Pune, India
Email: pranav.salunkhe21@vit.edu, sakshee.agrawal21@vit.edu, raj.salunkhe21@vit.edu, ashok.sakshi21@vit.edu, sahil.shirodkar21@vit.edu, vijaykumar.bhanuse@vit.edu

***Abstract*—Attendance systems are a critical tool to track attendance in various organizations. The integration of Internet of Things (IoT) technology has brought new advancements to attendance systems, with the inclusion of biometric sensors. Biometric sensors, such as fingerprint or facial recognition, ensure the accuracy of attendance records by verifying the identity of the individual. This paper focuses on the implementation of a smart attendance system that leverages the latest IoT technology. The system utilizes a compact and powerful microcontroller board, the ESP32, with in-built Bluetooth and Wi-Fi module for real-time communication through webSocket. The ESP32 also has a low power functionality, operating on a voltage of 3.3V, making it an ideal choice for IoT applications. By combining biometric sensors with webSocket, an instant communication protocol, attendance systems can deliver real-time updates on employee attendance. This allows for increased efficiency, accountability, and security, making IoT-enabled attendance systems an ideal solution for modern businesses.**

***Index Terms*— WebSocket, Real-time communication, Web application, Internet of Things (IoT), Biometric authentication, Fingerprint recognition.**

I. INTRODUCTION

In recent years, there has been a growing interest in using Internet of Things (IoT) technology to automate and streamline various processes. One area that has seen significant improvements is the attendance system. Traditional attendance systems are often prone to errors, time-consuming, and not very secure. An IoT-based smart attendance system can provide a solution that is accurate, reliable, and easy to use.

The proposed IoT-based smart attendance system utilises several technologies, including fingerprint recognition WebSocket communication protocol. Fingerprint recognition is a biometric technology that is used to identify individuals based on their unique physiological characteristics, such as fingerprints

WebSocket communication protocol is used to transmit attendance data between the webSocket client and webSocket server in real-time over a Local Area Network. This is essential for an attendance system as it ensures that the attendance data is always up to-date. WebSocket is a communication protocol that enables real-time, bi-directional communication between devices over a single, robust connection. It is highly scalable, lightweight, and requires fewer resources compared to traditional HTTP requests. WebSocket provides a secure communication channel, making it ideal for transmitting sensitive attendance data.

The proposed system is designed to offer an accurate and reliable attendance tracking and monitoring solution that is easy to use, secure, and cost-effective. The system consists of two main components: a client-side application and a server. The client-side application includes a webSocket channel, while the server-side includes ESP32 development board and R305 fingerprint scanner module.

Grenze ID: 01.GIJET.10.1.510_1

The proposed IoT-based smart attendance system using fingerprint and WebSocket technologies has the potential to revolutionise attendance tracking and monitoring. By leveraging advanced biometric and wireless technologies, the system offers a range of benefits over traditional attendance systems, including accuracy, reliability, security, cost-effectiveness, scalability, and real-time data transmission. The system can help educational institutions and organisations to automate their attendance management, reduce administrative workload, and improve communication and collaboration between stakeholders. The implementation of such a system can ultimately lead to better outcomes for students, staff, and administrators.

II. Literature Review

[1] proposes smart attendance system utilizing IoT and ML. The system employs sensors to collect attendance data and ML algorithms to manage attendance on a cloud-based server. It is highly accurate, efficient and can be integrated with existing systems. The system [2] describes the development of a smart attendance system utilizing RFID and IoT technologies. RFID tags are used to track students' attendance, eliminating the need for manual attendance-taking making the system accurate and fast.

[3] introduces an IoT-driven attendance management system that employs fingerprint recognition to ensure high levels of precision and security, and can process extensive attendance data. The authors elaborate on the system's structure and fingerprint recognition algorithms. The proposed system [4] utilizes sensors and wireless communication to collect attendance data, which is then transmitted to a cloud-based server. The system is efficient, reliable, and offers a cost-effective solution for attendance management. It [5] presents an IoT-based smart attendance system that uses a mobile application to track students' attendance, utilizing BLE technology to communicate with beacons installed in class-rooms. The system is highly efficient and accurate, providing real-time attendance data.

In [6], the authors propose an Internet of Things (IoT)-based smart attendance system that utilizes Bluetooth Low Energy (BLE) beacons to track students' at-tendance. The system consists of a mobile application and a web-based dash-board for attendance management. The proposed system is designed to be easy to use and provides real-time attendance data. An IoT-based smart attendance system utilizing face recognition is proposed in [7]. The system employs a camera and a neural network to identify students, eliminating the need for manual at-tendance-taking making the system accurate, reliable and fast. The system [8] utilizes IOT to employ the sensors to collect attendance data and machine learning (ML) algorithms to manage attendance on a cloud-based server. The system is real-time and efficient, and can be integrated with existing systems. In [9] an Internet of Things (IoT)-based smart attendance system that uses Rasp-berry Pi as the main controller is introduces. The system includes sensors to collect attendance data and a Wi-Fi module to transmit the data to a cloud-based server. The proposed system is cost-effective, easy to use, and provides real-time attendance data.

The system[10] employs a fingerprint scanner to identify students and sends attendance data to a cloud-based server. The system is highly accurate and eliminates the need for manual attendance-taking. The paper [11]proposes attendance management system that uses fingerprints for identification and verification. Each employee or student is registered in the system with their unique finger-print, which is stored in the database. The attendance record is then logged in the database when the employee or student arrives and scans their fingerprint. The system that automates attendance management using RFID, Wi-Fi, and a cloud-based database is presented in [12]. The system is efficient, cost-effective, and easy to use, making it a promising solution for attendance monitoring and management in different contexts.

The paper [13] evaluates the use of WebSocket in IoT applications and high-lights its advantages over other protocols. The authors also discuss the associated challenges and conduct experiments to evaluate its performance. The results show that WebSocket perform well in terms of speed and reliability, making it suitable for IoT applications. [14] surveys the use of WebSocket in IoT applications, discussing advantages like low latency and reduced network overhead. It presents case studies of WebSocket in smart homes, industrial automation, and transportation systems, concluding that WebSocket are promising for real-time IoT and suggesting areas for further research. WebSocket technology is utilised in [15] for real-time monitoring of wireless coverage data. It consists of a wireless monitoring module that collects and transmits the data, and a WebSocket server that receives and displays it on a dashboard. The dashboard provides information on signal strength, signal quality, and network latency, and is designed for easy monitoring of wireless network performance.

III. Design and Methodology

The proposed system aims to provide a more accurate, efficient, and automated method of tracking attendance in schools, colleges, and offices. The system aims to eliminate the manual process of attendance marking which is prone to errors and time-consuming. The system requires hardware such as fingerprint scanners, ESP32 microcontroller with built-in Wi-Fi and Bluetooth connectivity and power supply. The software requirements include WebSocket communication protocol, Arduino IDE for ESP32 programming, database management system, web development tools for building the user interface, and security protocols for handling sensitive attendance data. The functional requirements of the system include authentication using fingerprint automatic marking of attendance when students/employees enter the premises, and real-time updating and storage of attendance data in a centralized database. The non-functional requirements include scalability to handle a large number of students/employees and attendance data, and a user-friendly interface.

The proposed system has various use cases. Administrator of the system creates user and device accounts, sets up notification settings, generates attendance reports. Teachers view the attendance records and marks attendance manually for students with technical issues. Students can view there attendance record. WebSocket Server manages communication between devices and the system, receives attendance data from sensors, and sends attendance data to the system.

The components included in the proposed system are students/employees whose attendance is being tracked, their associated attendance data which includes date, time, and status (present/absent), the fingerprint scanner used to scan and authenticate their biometric data, the ESP32 microcontroller used to manage communication between the sensors and the software, the WebSocket server used to enable real-time communication between the microcontroller and the web interface, and the database used to store attendance data. The relationships between these components include the unique identification of each student/employee and their corresponding biometric data stored in the system, the attendance entity being associated with each student/employee, the connection of the fingerprint scanner to the ESP32 microcontroller, the communication between the webSocket server and webSocket client to update attendance data in real-time, and the storage of attendance data in the database for further analysis and reporting.

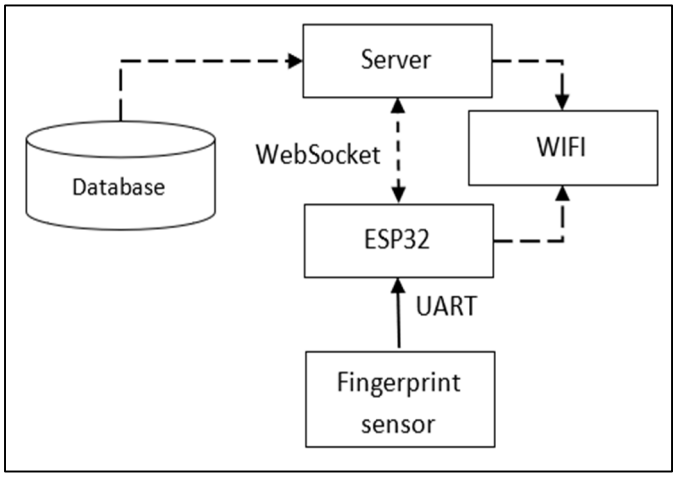

Figure 1 System Architecture

It requires a User Model, and Attendance Model for efficient data storage, retrieval, and processing. The User Model includes user information such as name, ID number (PRN), fingerprint data, while the Attendance Model includes date, time, user ID, and fingerprint data for each attendance record. These models are critical for user authentication and accurate attendance tracking, and should support integration, communication, and flexibility for future updates. In addition to these models, a Course Model is also required, which includes course-related attributes such as course name, course code, and instructor name. The Course Model allows attendance records to be associated with specific courses or classes, enabling the system to generate attendance reports for individual courses or instructors.

This system uses several types of services such as attendance tracking services, communication services. Attendance Tracking service collects attendance data from fingerprint scanners. Communication Service facilitates the transmission of attendance data from the devices to the system.

The functionality of the system starts with the user verifying his/her identity through the Fingerprint sensor. The data of the user collected through these sensors is serially sent to the ESP32 microcontroller board. string is used to send packets of data. The Wi-Fi-enabled ESP32 microcontroller which is also acting as a webSocket server thereby sends the sensor data to the virtual webSocket client deployed on the attendance monitoring website through a particular webSocket channel. The data received by the data is then parsed in the website backend and stored in the database thereby making it accessible to the website frontend.

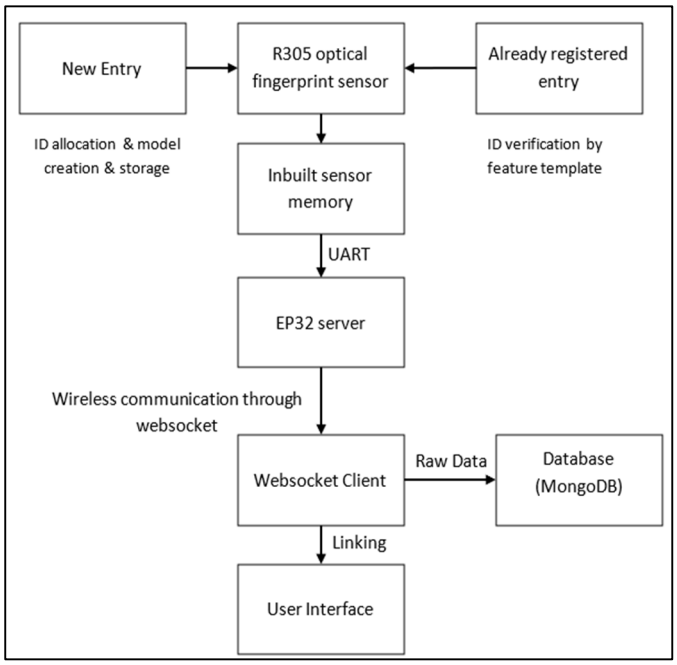

Figure 2 Data flow Diagram of Propoosed System

IV. Results and Discussion

The Websocket based smart attendance system is a reliable, efficient system for marking attendance. As per the system design, the Wi-Fi enabled esp32 microcontroller connects to a Local Area Network and a particular IP address is assigned to it. The virtual client hosted on the attendance monitoring website then connects to the esp32 with reference to the IP assigned to the server. Whenever, a registered user puts his/her finger on the fingerprint scanner, the fingerprint ID corresponding to the fingerprint is sent to the WebSocket client in the string format. The ID is then compared to the already appended user data in the data base, and after verification, attendance of the user is marked by the system . The attendance system allows both students and teachers to access attendance records. Students can view their own attendance records, while teachers have access to attendance records of all students in their class. This feature provides transparency and allows students to keep track of their attendance throughout the semester.

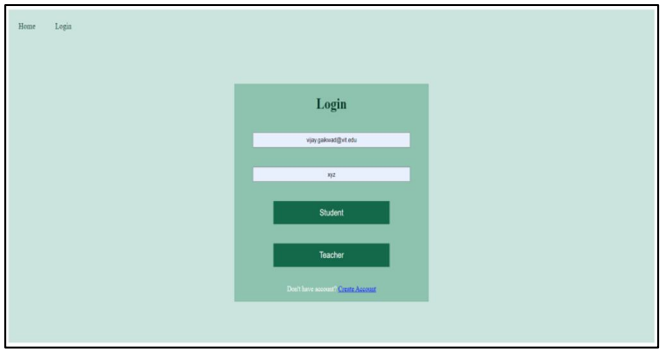

Figure 3 Login page

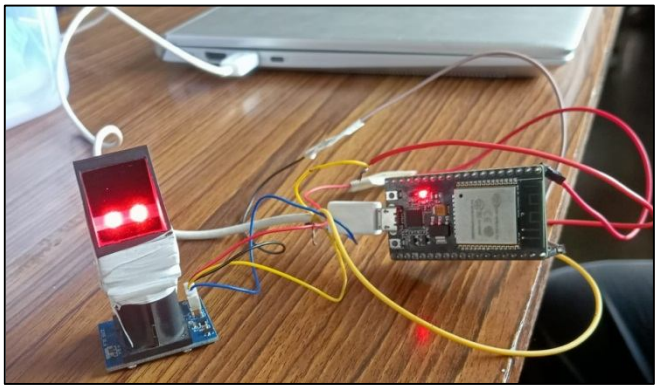

Figure 4 System Prototype

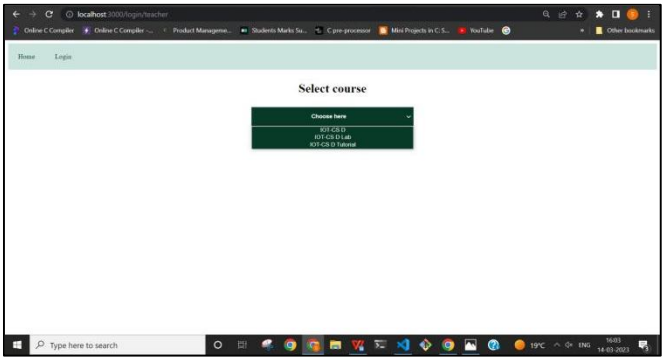

Figure 5 All Records

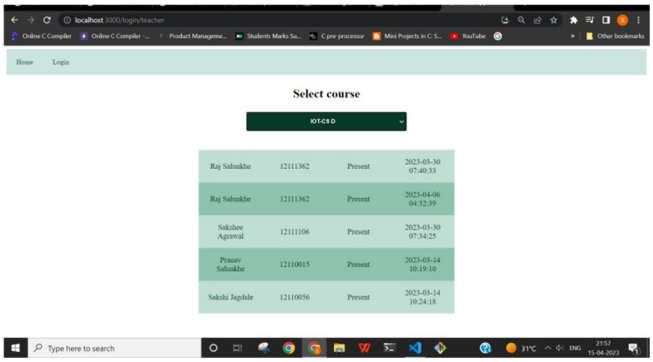

Figure 6 Attendence Record

V. CONCLUSION

In conclusion, the WebSocket-based smart attendance system using fingerprint technology is a reliable and efficient solution for attendance management in various settings such as schools, universities, and businesses. The system employs WebSocket technology for real-time communication between the client and server, allowing for instantaneous data transmission and response.

Fingerprint technology provides a secure and accurate means of identifying students or employees, eliminating the possibility of fraud or inaccuracies associated with traditional methods such as paper-based attendance sheets. The system's ability to generate real-time reports and monitor attendance trends allows for effective decision-making and planning.

Furthermore, the system can be easily integrated with other technologies such as facial recognition and RFID, providing versatility and scalability for different environments. The system's future scope includes the potential for further development and improvement, such as the use of machine learning algorithms, the development of a mobile application or cloud-based solution, and the incorporation of analytics and reporting capabilities. These potential developments could enhance the accuracy and functionality of the system, making it an even more valuable tool for organizations looking to streamline their attendance management processes.

In summary, the WebSocket-based smart attendance system using fingerprint technology offers convenience, accuracy, and security in modern-day attendance management. It provides a reliable and efficient solution for attendance management and has the potential for further development and improvement, making it a promising tool for various organizations.

REFERENCES

[1] Abdullah, S. A., Al Hamid, M. A., & Al-Fuqaha, A. "Smart Attendance System Using IoT and Machine Learning." IEEE 5th World Forum on Internet of Things (WF-IoT), pp. 655-659. IEEE, 2019.

[2] [Ahmed, S., Ahmed, S., & Ahmed, S. "Smart Attendance System using RFID and IoT." IEEE 5th International Conference on Engineering Technologies and Applied Sciences (ICETAS), pp. 1-5. IEEE, 2018.

[3] Shah, A. A., & Naseem, I. "IoT-Based Smart Attendance System using Fingerprint Recognition."International Conference on Computer, Communication, and Signal Processing (ICCCSP), pp. 66-70. IEEE, 2020.

[4] Kattan, A. M., & Kays, A. S. "Design of Smart Attendance System Using IoT." International Journal of Advanced Science and Technology 29, no. 9 (2020): 3213-3220.

[5] Gupta, R. "IoT-based Smart Attendance System." International Journal of Engineering and Advanced Technology 8, no. 2 (2018): 299-304.

[6] Nasution, A. H., & Rahim, R. A. "An IoT-based Smart Attendance System Using Bluetooth Low Energy (BLE) Beacons." International Journal of Interactive Mobile Technologies 14, no. 4 (2020): 155-168.

[7] Sahu, S., & Bhaduria, H. S. "IoT-Based Smart Attendance System using Face Recognition." International Journal of Innovative Technology and Exploring Engineering 9, no. 2 (2019): 426-429.

[8] Mishra, A., & Kumar, A. "Smart Attendance System using IoT and Ma-chine Learning." International Journal of Electrical and Computer Engineering 10, no. 2 (2020): 1425-1430.

[9] Patil, S. S., & Bagade, S. M. "IoT-Based Smart Attendance System using Raspberry Pi." International Journal of Computer Applications 179, no. 43 (2019): 5-7.

[10] Sarode, S., & Borkar, S. P. "Smart Attendance System using IoT and Biometric Authentication." International Journal of Computer Applications 179, no. 38 (2020): 15-19.

[11] Ezema, Longinus S., C. K. A. Joe-Uzuegbu, J. N. Eneh, and I. Amanze. "Fingerprint based attendance management system." International journal of scientific and Engineering research 6, no. 7 (2015): 1623-1628.

[12] Aparna, K., G. Krishna Murhty, J.N.T.U.A.C.E. Kalikiri, and Pulivendula JNTUACEP. "Smart Attendance System using IoT." International Journal of Pure and Applied Mathematics 119, no. 12 (2018): 1623-1630.

[13] Wang, X., Liu, Z., Xing, J., & Chen, X. “Using WebSockets in IoT: An Experimental Evaluation”. IEEE Access, 9, 36676-36687(2021).

[14] Liu, Xiaodong, et al. "WebSockets in Internet of Things: Survey, Challenges , and Solutions." IEEE Access 8 (2020): 51845-51858

[15] Liu, Quan, Gang Yang, Ruien Zhao, and Yingchun Xia. "Design and implementation of real-time monitoring system for wireless coverage data based on webSocket." In 2018 IEEE 3rd International Conference on Cloud Computing and Internet of Things (CCIOT), pp. 63-67. IEEE, 2018.