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Bluetooth-Based Smart Attendance System Using ESP32

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Abstract: ***The Bluetooth-Based Smart Attendance System is designed to automate and simplify the attendance tracking process in educational institutions. Traditional attendance systems such as manual registers or roll calls consume time and are prone to errors and proxy attendance. This project introduces a smart solution that uses Bluetooth Low Energy (BLE), where students broadcasts their roll numbers through BLE signals. ESP32 microcontrollers installed in classrooms continuously scan for these signals and detect nearby student devices. The detected attendance data is uploaded to a Firebase Realtime Database for instant synchronization. Teachers can view and manage attendance through a web portal built using PHP and MySQL. The system ensures real-time attendance monitoring, prevents proxy attendance, reduces manual work for teachers, and generates attendance reports automatically. This solution is cost-effective, scalable, and suitable for modern educational institutions that aim to implement digital attendance management.***

Keywords: Smart Attendance System, Bluetooth Low Energy (BLE), ESP32, Android Application, Firebase Realtime Database, Web Portal, Automated Attendance.

I. INTRODUCTION

Attendance management plays an important role in educational institutions as it helps monitor student participation and academic discipline. Traditional attendance systems such as manual registers or roll calling take significant classroom time and often lead to errors or proxy attendance. To overcome these problems, the Bluetooth-Based Smart Attendance System is developed. This system uses Bluetooth Low Energy (BLE) technology to detect the presence of students automatically when they enter the classroom.

Students use an Android mobile application that broadcasts their roll numbers through BLE signals. ESP32 devices installed in classrooms scan these signals and send the detected data to a cloud database. Teachers can view and manage attendance through a web portal in real time.

By integrating IoT technology, cloud services, and mobile applications, this system provides an efficient and automated solution for attendance management while reducing manual work and improving accuracy.

II. MODULE IDENTIFICATION

The Bluetooth-Based Smart Attendance System consists of several modules that work together to manage attendance efficiently. The Student Mobile Application Module allows students to register their academic details and broadcast their roll numbers using Bluetooth Low Energy signals. The ESP32 Scanner Module is installed in classrooms and continuously scans for BLE signals from student devices. When a valid signal is detected, the system records the student's roll number. The Cloud Database Module uses Firebase Realtime Database to store attendance data instantly and synchronize it across devices. The Teacher Web Portal Module allows teachers to view attendance records, mark absentees, and confirm attendance for each session. The Database Management Module uses MySQL to store permanent attendance records and generate reports. The Reporting and Analytics Module generates attendance reports such as daily, monthly, and subject-wise reports for teachers and administrators. Together, these modules provide a complete automated attendance management solution.

III. SCOPE

The Bluetooth-Based Smart Attendance System is designed to automate the entire attendance process in educational institutions. Teachers can monitor attendance in real time through the web portal while students only need to keep the mobile application active. The system eliminates manual attendance marking and prevents proxy attendance by verifying the physical presence of students using BLE signals. The system can be deployed in schools, colleges, training institutes, and corporate environments. It reduces administrative workload and improves accuracy in attendance tracking. With the integration of cloud services and mobile technology, the system also provides secure data storage, automated reporting, and easy access to attendance records.

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IV. EXISTING SYSTEM

Table I Existing System

Sr. No.	Title of Paper	Year	Author	Gap Identified	Key Points
1	RFID Based Attendance System	2019	R. Patel, A. Singh	Requires physical cards which can be lost or shared	Uses RFID cards to record attendance but requires additional hardware and card management
Sr. No.	Title of Paper	Year	Author	Gap Identified	Key Points
2	Biometric Attendance System	2020	S. Kumar	Expensive infrastructure and hygiene concerns	Uses fingerprint or facial recognition but causes queuing delays
3	QR Code Attendance System	2021	P. Sharma	Vulnerable to proxy attendance through screenshots	Uses QR codes for attendance but can be manipulated
4	Mobile App Attendance System	2022	J. Lee	Can be manipulated through location spoofing	Allows students to mark attendance through mobile apps but lacks secure verification

V. ARCHITECTURE DIAGRAM

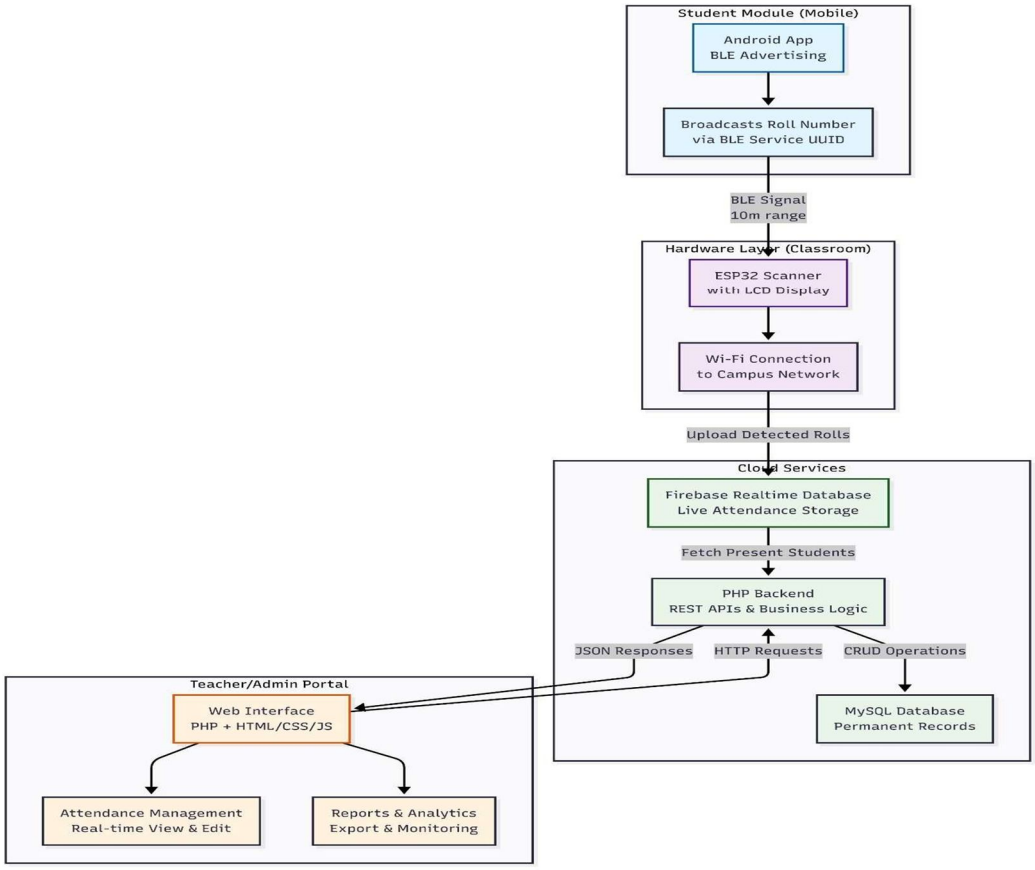


Fig. 1. Architecture Diagram

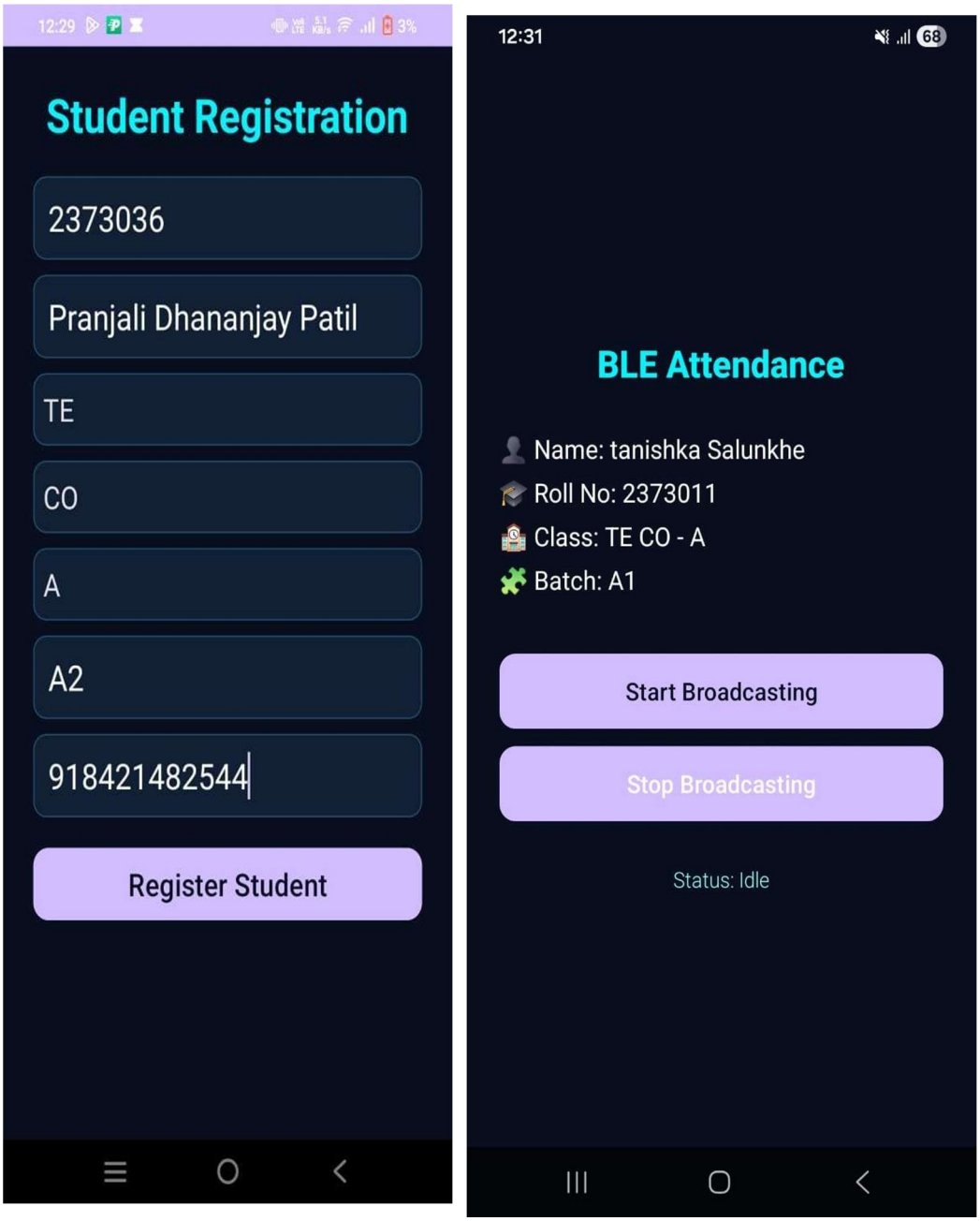
PROPOSED SYSTEM

The proposed system introduces an automated attendance management solution using Bluetooth Low Energy technology.

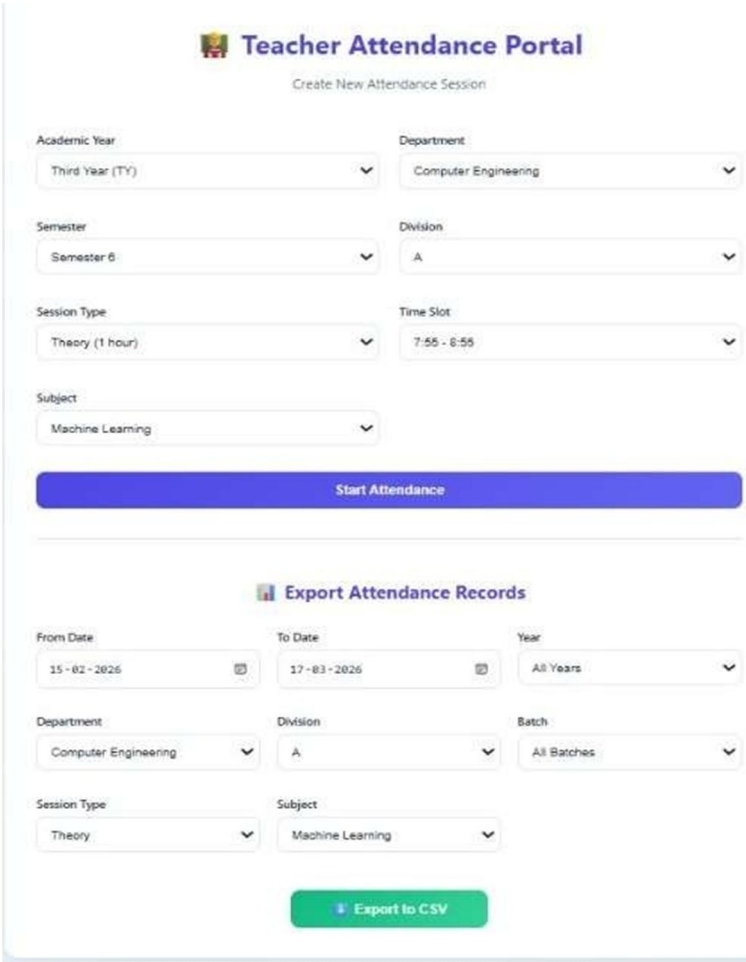
1) Students broadcast their roll numbers using an Android application.
2) ESP32 scanners detect BLE signals within the classroom.
3) Attendance data is uploaded to Firebase in real time.
4) Teachers can view and manage attendance through a web portal.
5) MySQL database stores attendance records permanently for reporting.

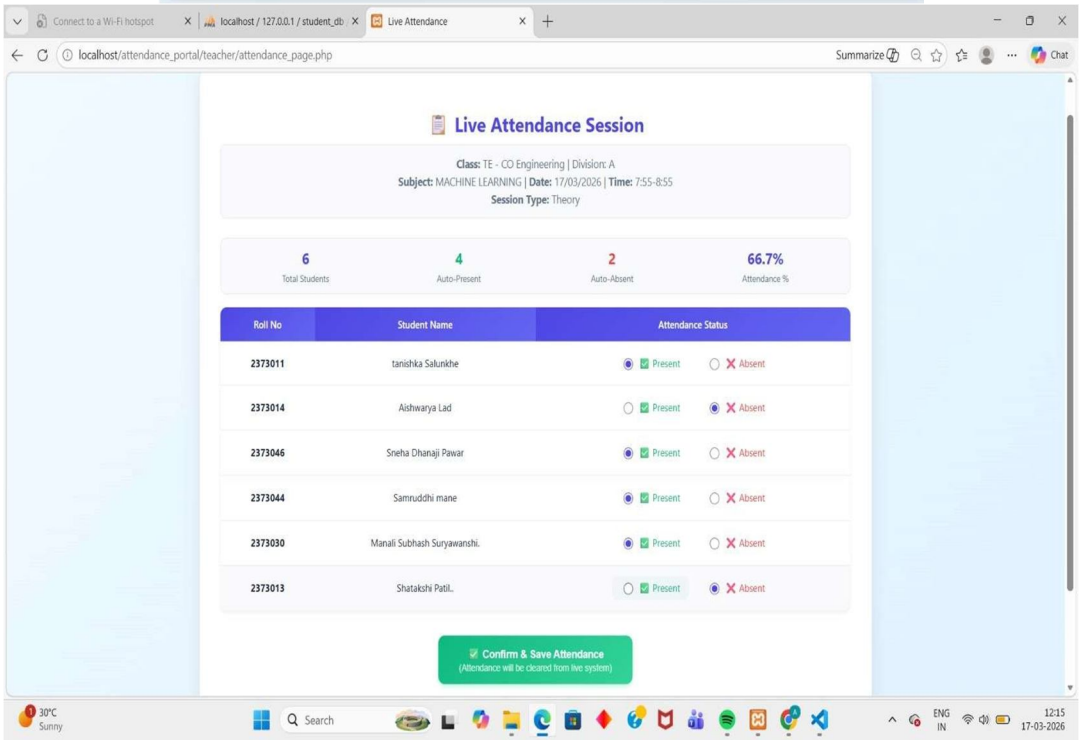
This system ensures accurate attendance tracking, prevents proxy attendance, and reduces the time required for manual attendance processes.

VI. RESULT

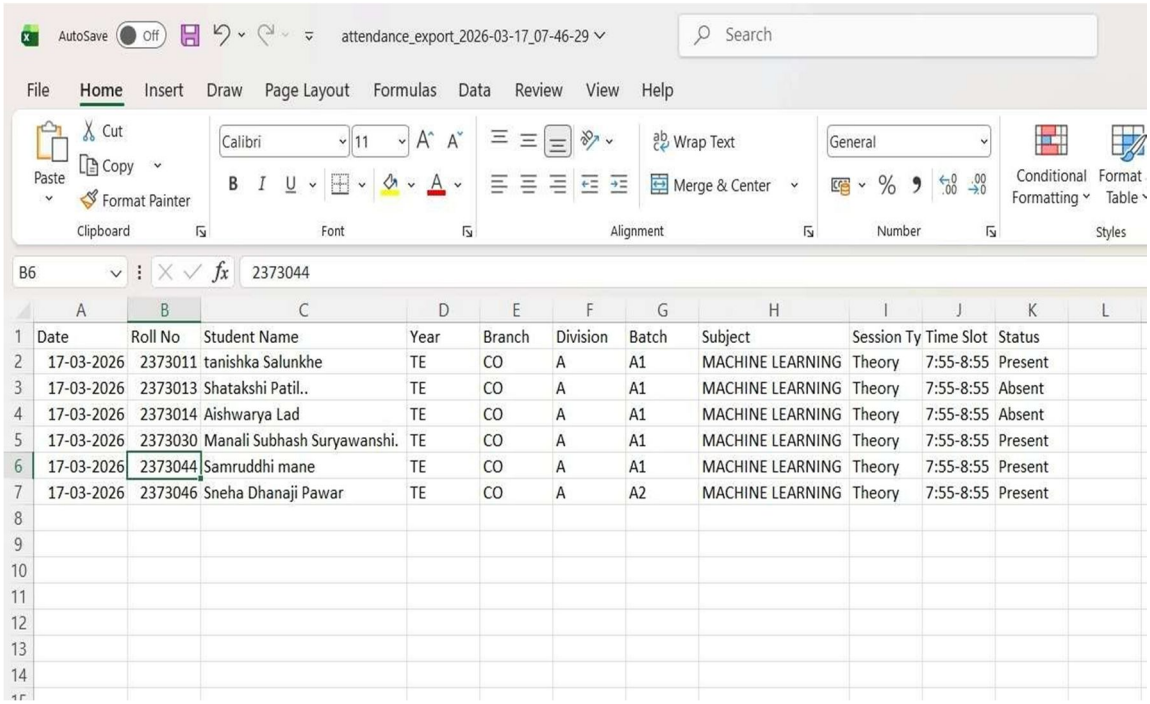


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Teacher Attendance Portal
Create New Attendance Session
Academic Year
Third Year (TY)
Department
Computer Engineering
Semester
Semester 6
Division
A
Session Type
Theory (1 hour)
Time Slot
7:55 - 8:55
Subject
Machine Learning
Start Attendance
Export Attendance Records
From Date
15-02-2026
To Date
17-03-2026
Year
All Years
Department
Computer Engineering
Division
A
Batch
All Batches
Session Type
Theory
Subject
Machine Learning
Export to CSV

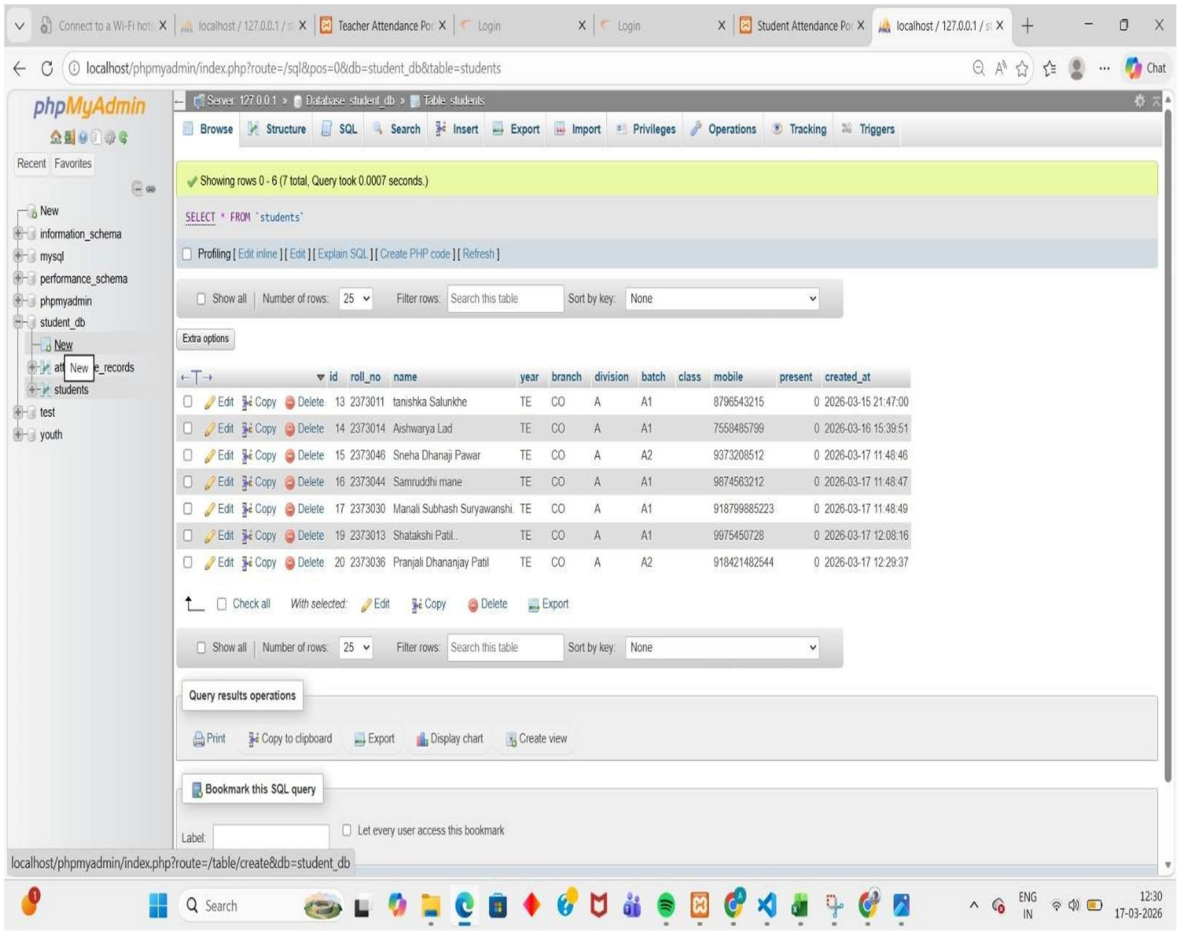

localhost/attendance_portal/teacher/attendance_page.php
Live Attendance Session
Class: TE - CO Engineering | Division: A
Subject: MACHINE LEARNING | Date: 17/03/2026 | Time: 7:55-8:55
Session Type: Theory
6
Total Students
4
Auto-Present
2
Auto-Absent
66.7%
Attendance %
Roll No
Student Name
Attendance Status
2373011
tanishka Salunkhe
2373014
Aishwarya Lad
2373046
Sneha Dhanaji Pawar
2373044
Samruddhi mane
2373030
Manali Subhash Suryawanshi.
2373013
Shatakshi Patil..
Present
Absent
Confirm & Save Attendance
(Attendance will be cleared from live system)

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attendance_export_2026-03-17_07-46-29

Date	Roll No	Student Name	Year	Branch	Division	Batch	Subject	Session Ty	Time Slot	Status
17-03-2026	2373011	tanishka Salunkhe	TE	CO	A	A1	MACHINE LEARNING	Theory	7:55-8:55	Present
17-03-2026	2373013	Shatakshi Patil..	TE	CO	A	A1	MACHINE LEARNING	Theory	7:55-8:55	Absent
17-03-2026	2373014	Aishwarya Lad	TE	CO	A	A1	MACHINE LEARNING	Theory	7:55-8:55	Absent
17-03-2026	2373030	Manali Subhash Suryawanshi.	TE	CO	A	A1	MACHINE LEARNING	Theory	7:55-8:55	Present
17-03-2026	2373044	Samruddhi mane	TE	CO	A	A1	MACHINE LEARNING	Theory	7:55-8:55	Present
17-03-2026	2373046	Sneha Dhanaji Pawar	TE	CO	A	A2	MACHINE LEARNING	Theory	7:55-8:55	Present



localhost/phpmyadmin/index.php?route=/sql&pos=0&db=student_db&table=students

id	roll_no	name	year	branch	division	batch	class	mobile	present	created_at
13	2373011	tanishka Salunkhe	TE	CO	A	A1		8796543215	0	2026-03-15 21:47:00
14	2373014	Aishwarya Lad	TE	CO	A	A1		7558485799	0	2026-03-16 15:39:51
15	2373046	Sneha Dhanaji Pawar	TE	CO	A	A2		9373208512	0	2026-03-17 11:48:46
16	2373044	Samruddhi mane	TE	CO	A	A1		9874563212	0	2026-03-17 11:48:47
17	2373030	Manali Subhash Suryawanshi.	TE	CO	A	A1		918799885223	0	2026-03-17 11:48:49
19	2373013	Shatakshi Patil..	TE	CO	A	A1		9975450728	0	2026-03-17 12:08:16
20	2373036	Pranjali Dhananjay Patil	TE	CO	A	A2		918421482544	0	2026-03-17 12:29:37



Fig. 2. Result Output

VII. CONCLUSION

The Bluetooth-Based Smart Attendance System successfully automates the attendance process using modern technologies such as BLE, ESP32, Firebase, and web applications. The system reduces the time spent on attendance management and improves the accuracy of attendance records. By detecting student presence automatically through BLE signals, the system eliminates proxy attendance and minimizes manual errors. Teachers can easily view attendance data and generate reports through the web portal. Overall, this system provides an efficient, scalable, and cost-effective solution for educational institutions looking to implement digital attendance management systems.

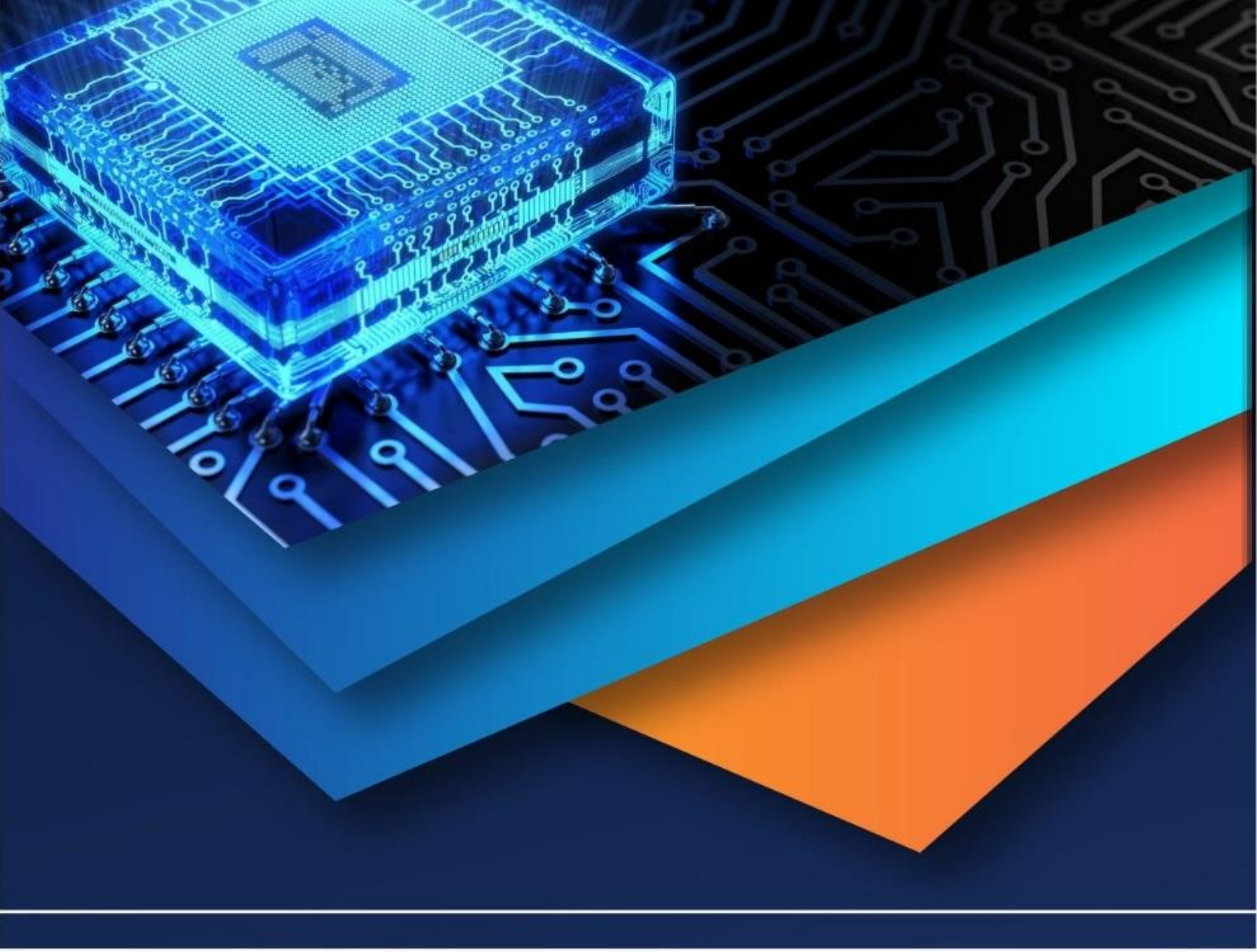
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