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Classroom Automation and Attendance Tracking System

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ABSTRACT: This Research Project — CLASSROOM AUTOMATION AND ATTENDANCE TRACKING SYSTEM & SMART CLASS ROOM Light Controller is a reliable circuit that takes over the task of controlling the room lights as well us counting number of persons / visitors in the room very accurately. When somebody enters into the room then the counter is incremented by one and the light in the room will be switched ON and when any one leaves the room then the counter is decremented by one. The light will be only switched OFF until all the persons in the room go out. The total number of persons inside the room is also displayed on the seven segment displays and send through GSM modem to head the display also indicates the current time. The microcontroller does the above job. It receives the signals from the sensors, and this signal is operated under the control of software which is stored in ROM. Microcontroller AT89S52 continuously monitor the Infrared Receivers. When any object pass through the IR Receiver's then the IR Rays falling on the receivers are obstructed. This obstruction is sensed by the Microcontroller. Classroom Automation and Attendance Tracking System is focused on developing a new hardware system for human face detection that is based on the Raspberry Pi, a versatile computer that is commonly used in electronic devices. The system utilizes the Raspberry Pi Camera to capture images and display them in a monitoring system. The integration of the Internet of Things (IoT) technology has made this process even more streamlined and efficient

KEYWORDS: classroom Automation, Attendance Tracking System, Smart Classroom, Smart Light Controller, Human Detection System, Raspberry Pi, Face Detection, IoT Technology, GSM Modem, Infrared Sensors, AT89S52 Microcontroller, RFID Attendance System, Embedded System, Automatic Room Light Control, Visitor Counter, Seven Segment Display, Smart Monitoring System, Digital Attendance Management, Wireless Communication, Classroom Energy Management, Intelligent Classroom System, Real-Time Monitoring, Sensor-Based Automation, Face Recognition Attendance, Electronic Attendance System, Smart Education Technology, Automation using IoT, Raspberry Pi Camera, IR Receiver, Smart Security System, Automated Classroom Environment.

I. INTRODUCTION

Organizations of all sizes use attendance systems to record when student or employees start and stop work and the department where the work is performed. Some organizations also keep detailed records of attendance issues such as who calls in sick and who comes in late. An attendance system provides many benefits to organizations. Traditional approach for attendance is professor calls student name & record attendance. It takes some time to record attendance. Suppose duration of class of one subject is about 50minutes & to record attendance takes 5 to 10 minutes. For each lecture this is wastage of time. To avoid these losses, we are about to use automatic process which is based on raspberry pi. In this novel approach, we are using face detection & face recognition system. This face detection differentiates faces from non-faces and is therefore essential for accurate attendance. The other strategy involves face recognition for marking the student's attendance. The Raspberry pi module is used for face detection & recognition. The camera will be connected to the Raspberry pi module. The database is collected. The database includes name of the person, their images. One of the unique features of our brain is that it can think only in images not inwards. Once you may forget to keep your Car's key but you will never forget to bring a face with [1][2].

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II. SYSTEM MODEL

The research system is a CLASSROOM AUTOMATION AND ATTENDANCE TRACKING SYSTEM & SMART CLASS ROOM Light Controller, Figure 2. shows the proposed smart track monitoring system based on the ESP32 microcontroller. The system is designed to continuously monitor railway track conditions and environmental parameters for improving railway safety and automation. The complete system consists of a power supply unit, sensing devices, ESP32 controller, OLED display module, and relay driver circuit.

2.1. Power Supply Unit

The system operates from a 220V AC mains supply. The AC supply is converted into 12V DC using a 12V power supply unit. A voltage regulator further converts the voltage into regulated 5V DC required for the ESP32 controller and sensor modules. This regulated supply ensures stable and reliable operation of the complete monitoring system.

2.2. ESP32 Microcontroller

The ESP32 acts as the central processing unit of the system. It receives input data from different sensors such as ultrasonic sensors, temperature sensor, and LDR sensor. The controller processes the sensor data and performs monitoring and decision-making operations. Due to its inbuilt Wi-Fi and Bluetooth capabilities, ESP32 is highly suitable for smart and IoT-based railway applications.

2.3. Ultrasonic Sensors

The ultrasonic sensors are used for human presence detection and attendance monitoring inside the classroom. These sensors detect the movement and presence of students entering or leaving the classroom. The collected data can be used to estimate occupancy and support automated attendance tracking.

2.4. Temperature Sensor

The temperature sensor monitors the classroom environmental conditions. The measured temperature values help maintain a comfortable classroom atmosphere and can also be used to automatically control cooling devices such as fans or air conditioners.

2.5. LDR Sensor

The Light Dependent Resistor (LDR) detects the intensity of light inside the classroom. Based on ambient lighting conditions, the ESP32 automatically controls classroom lighting systems through the relay driver to reduce energy consumption.

2.6. OLED Display

The OLED display is used to show real-time system information such as attendance count, room temperature, light status, and automation conditions. The display provides continuous monitoring and user-friendly interaction.

2.7. Relay Driver Circuit

The relay driver section controls electrical appliances such as classroom lights, fans, projectors, or other automation devices. The relay outputs RL1 and RL2 are activated according to sensor inputs and programmed control logic implemented in the ESP32 controller.

Working Principle Initially, the system receives power from the regulated power supply section. The ESP32 continuously monitors the ultrasonic sensors, temperature sensor, and LDR sensor. The ultrasonic sensors detect student presence for attendance tracking, while the LDR and temperature sensor monitor classroom conditions. Based on sensor readings, the ESP32 automatically controls classroom appliances through the relay driver circuit. Simultaneously, the OLED display shows real-time information regarding attendance and classroom status

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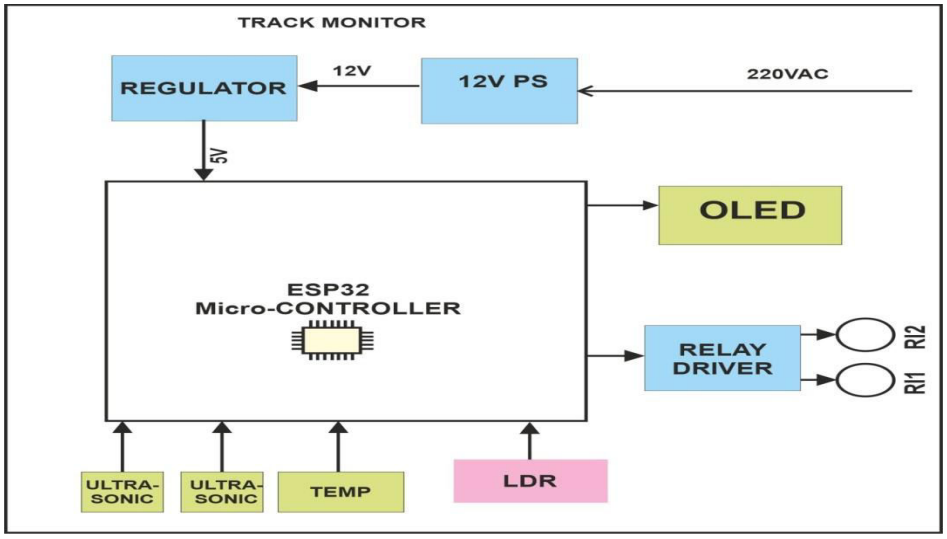

Figure 2.1 Block Diagram CLASSROOM AUTOMATION AND ATTENDANCE TRACKING SYSTEM & SMART CLASS ROOM Light Controller

III. SYSTEM ARCHITECTURE & MODEL

The proposed Classroom Automation and Attendance Tracking System is designed using a MICROCONTROLLER as the central processing unit. The MICROCONTROLLER is the most important component of the system because it stores the student database, executes the entire project program, and controls all sensing and automation operations. The system is developed to automate classroom attendance and monitoring processes efficiently.

The system uses IR sensors for tracking the movement of students inside the classroom. The IR sensors continuously monitor the field of view and detect the presence of students by sensing object movement and emitted radiation from moving objects. This enables automatic identification of student entry and exit in the classroom environment.

Figure.: 3.1 Final Model for CLASSROOM AUTOMATION AND ATTENDANCE TRACKING SYSTEM & SMART CLASS ROOM Light Controll

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In addition, piezo sensor modules are used for attendance tracking purposes. The piezo sensors help in detecting student presence and classroom activity. By integrating these sensing modules with the MICROCONTROLLER, the teacher can automatically receive attendance information without manually calling student names in the classroom.
The attendance collected by the system is automatically sent to the registered email ID through the MICROCONTROLLER communication module. This feature reduces the time required for attendance management and improves classroom efficiency.

For intelligent monitoring, OpenCV and Python libraries are installed and configured on the MICROCONTROLLER platform. A camera or sensor module is connected to the MICROCONTROLLER board to perform student counting and monitoring operations. The implemented computer vision algorithm uses OpenCV-based object recognition techniques to identify and count students present in the classroom.

The recognized student information is compared with the stored database inside the MICROCONTROLLER system to determine which students are present. Once the verification process is completed, the attendance records are automatically generated and stored digitally. The system then sends the attendance details to the registered mail ID configured in the MICROCONTROLLER.Thus, the proposed system provides an automated, reliable, and time-saving solution for classroom attendance management and smart classroom automation. The integration of sensors, computer vision, and IoT communication technologies makes the system efficient, accurate, and suitable for modern educational institutions

IV. RESULTS

The developed Classroom Automation and Attendance Tracking System was successfully implemented and tested using IR sensors, occupancy detection modules, GSM communication, Raspberry Pi monitoring, and IoT-based web interface technology. The system effectively monitored classroom occupancy, controlled electrical appliances automatically, and provided real-time attendance and monitoring information.

The experimental results in Figure 4.1. show that the occupancy detector accurately detected the number of persons entering and leaving the classroom. The system continuously updated the person count and displayed the values on the monitoring dashboard. The web-based interface successfully displayed parameters such as the total number of persons, distance measurements from sensors, temperature values, LDR readings, threshold values, and relay status conditions.

During testing, the system automatically switched ON the classroom lights when persons were detected inside the room and switched OFF the lights when the classroom became empty. This demonstrates the energy-saving capability of the smart classroom automation system. The relay modules operated correctly according to occupancy conditions and threshold settings.

The Raspberry Pi-based monitoring system successfully hosted the occupancy detector dashboard using the local IP address. Real-time data transmission and monitoring were achieved through IoT integration. The GSM module and display interface were also capable of sending and showing classroom status information effectively.

The Students Count detection and monitoring process using the Raspberry Pi Senors worked efficiently for classroom attendance applications. The data can be further integrated with cloud storage and database systems for future smart classroom enhancements.

4.1. Observed Results

- Accurate person counting using IR sensors.
- Automatic light control based on occupancy.
- Real-time monitoring through mobile/web interface.
- Successful relay switching operations.
- Temperature and LDR monitoring performed correctly.
- IoT dashboard displayed live classroom parameters.
- Reduced manual attendance effort.
- Improved classroom energy efficiency.

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4.2. Analysis

The implemented system provides a reliable and intelligent solution for smart classroom automation. The integration of sensors, embedded controllers, Raspberry Pi, and IoT technology improved monitoring accuracy and automation efficiency. The project successfully reduced unnecessary power consumption and minimized human intervention in attendance tracking and classroom management.

The results indicate that the system is suitable for deployment in schools, colleges, universities, and smart educational institutions where automated attendance and energy-efficient classroom operation are required..

V. CONCLUSION

The Classroom Automation and Attendance Tracking System successfully demonstrates an intelligent and energy-efficient smart classroom solution using embedded systems and IoT technology. The developed system effectively automates attendance monitoring, occupancy detection, and classroom appliance control with high accuracy and reliability.

The integration of IR sensors, Raspberry Pi, GSM communication, Senosrs technology, and microcontroller-based automation helped in reducing manual effort and improving classroom management efficiency. The system automatically monitored the number of persons inside the classroom and controlled lighting systems according to occupancy conditions, thereby minimizing unnecessary power consumption.

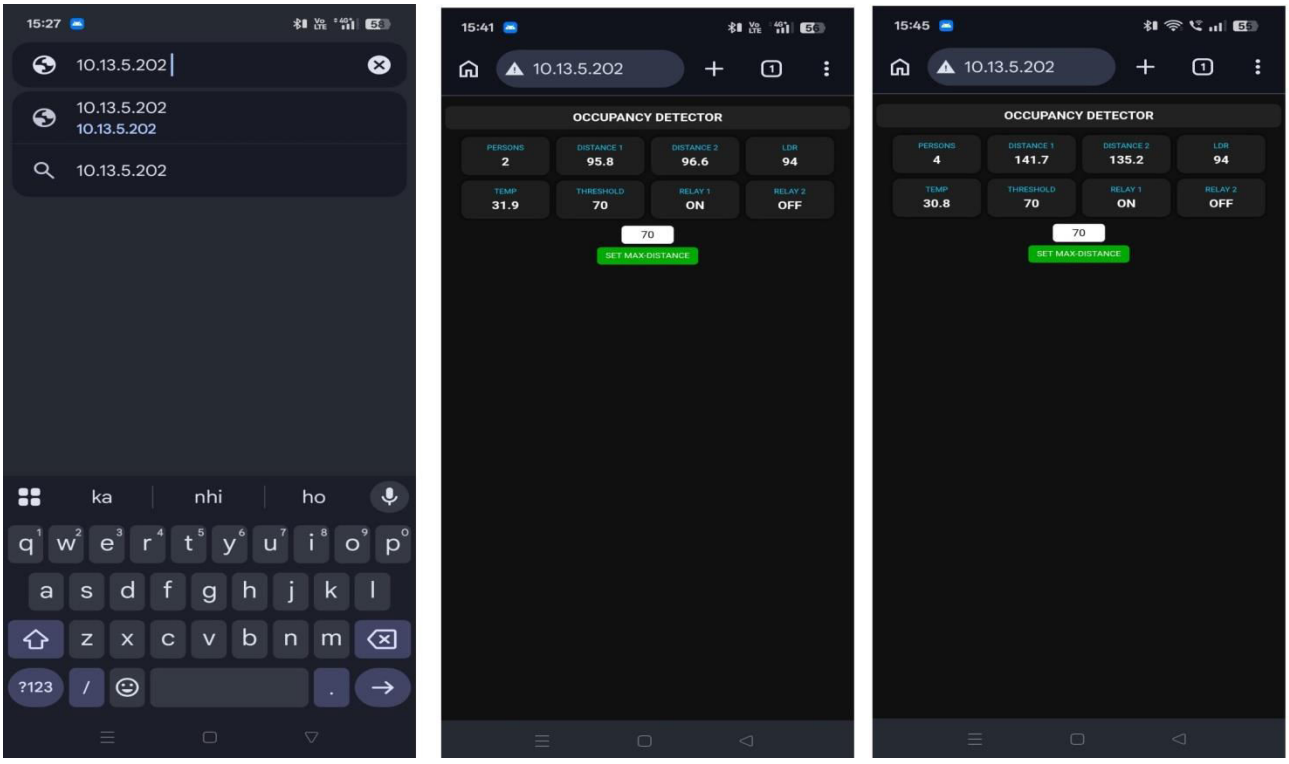

Figure.4.1. Real Time implementation of Classroom Automation And Attendance Tracking System

The IoT-based monitoring dashboard provided real-time classroom status updates including person count, temperature, relay status, sensor values, and environmental conditions. The attendance tracking process became more secure and accurate through automated detection and monitoring methods.

The project proved to be cost-effective, user-friendly, and suitable for implementation in schools, colleges, universities, and smart educational institutions. Furthermore, the system can be enhanced in future with cloud integration, artificial intelligence, mobile applications, and advanced biometric authentication methods for developing fully automated smart classrooms.

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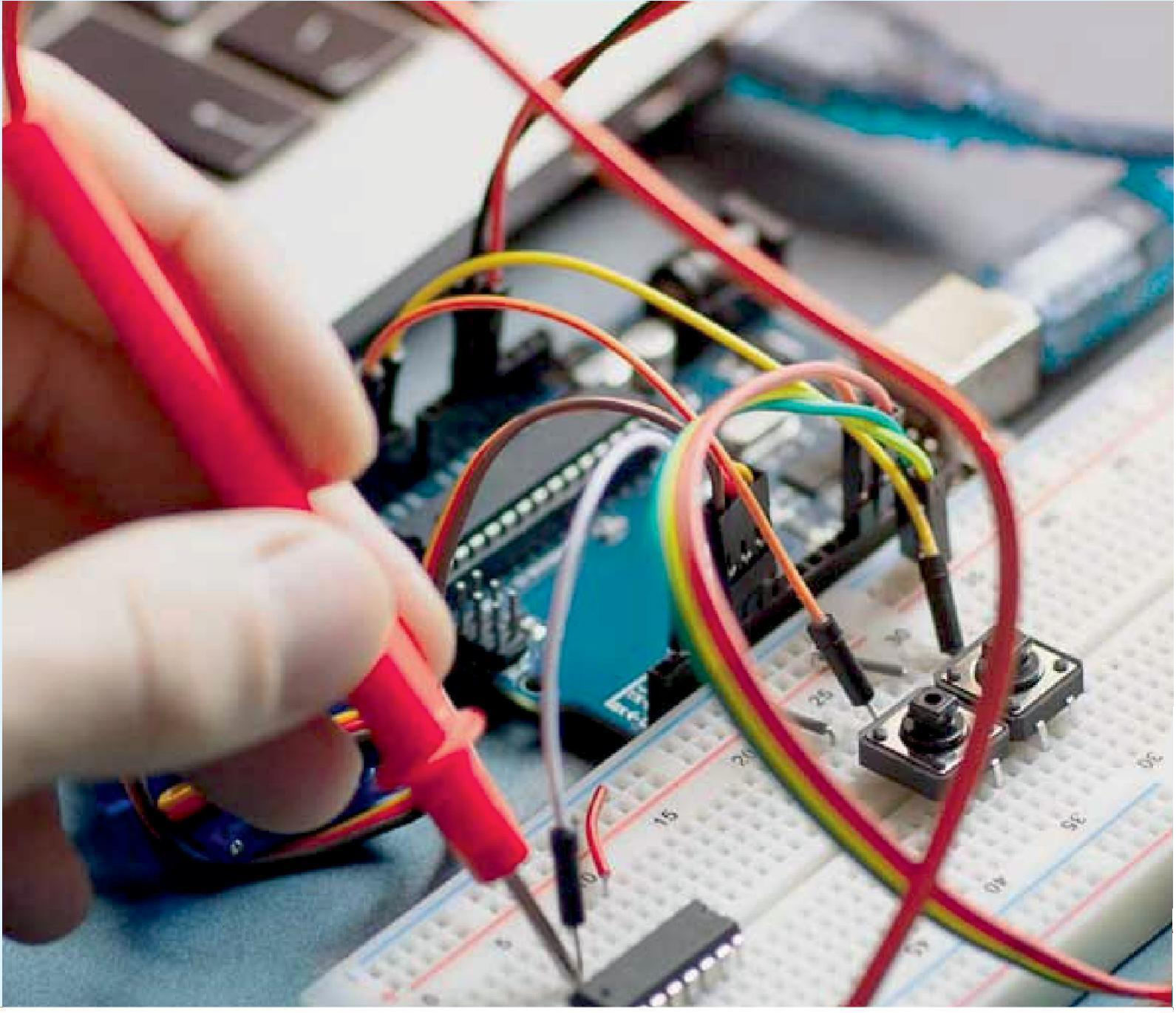

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