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Smart Classroom Attendance Counter System

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Abstract-

The Smart Classroom Attendance Counting System is a low-cost embedded system designed to demonstrate motion-based classroom monitoring. The proposed system uses an HC-SR501 Passive Infrared (PIR) sensor, Arduino UNO microcontroller and a 16×2 LCD display. The PIR sensor detects movement by sensing changes in infrared radiation within its detection area. The Arduino UNO processes the sensor output and displays the corresponding motion status or programmed count on the LCD screen. The prototype is assembled using a breadboard and jumper wires, making it simple, economical and suitable for educational applications. The system helps demonstrate automatic motion detection, sensor interfacing and microcontroller-based monitoring. However, a single PIR sensor cannot identify individual students or distinguish between entering and leaving movements. Therefore, the proposed system is a basic classroom monitoring prototype, and further improvements such as dual sensors, RFID technology and data storage can make it more reliable for attendance management.

Index Terms— Smart Classroom, Attendance Monitoring, PIR Sensor, Arduino UNO, 16×2 LCD, Motion Detection, Embedded System.

I. INTRODUCTION

Attendance management is an important activity in schools and colleges. In the traditional method, teachers manually record the attendance of students by calling their names or using an attendance register. This process requires time and may interrupt regular classroom activities, especially when the number of students is large. Therefore, the use of electronic systems for classroom monitoring can help reduce manual effort and improve the efficiency of attendance-related activities.

The proposed Smart Classroom Attendance Counting System is designed using an
Arduino UNO microcontroller, an HCSR501 Passive Infrared (PIR) sensor and a 16×2 LCD display. The PIR sensor detects human movement by sensing changes in infrared radiation within its detection area. The detected signal is sent to the Arduino UNO, which processes the input and updates the information on the LCD display. The circuit is assembled using a

breadboard and connecting wires, making the system simple and economical for practical implementation.

The main aim of this project is to demonstrate automatic motion detection and classroom monitoring using basic electronic components. The system provides a simple indication of detected movement and helps in understanding microcontroller programming and sensor interfacing. However, a single PIR sensor cannot identify individual students or distinguish between entry and exit movements. Further improvements using additional sensors, RFID technology and data storage can be implemented to develop a more reliable classroom attendance management system.

II. PURPOSE OF THE SYSTEM

1.OBJECTIVES OF THE SYSTEM

The main purpose of the Smart Classroom Attendance Counting System is to develop a simple and economical classroom monitoring prototype using an Arduino UNO and a PIR sensor. The system

detects human movement and displays the corresponding information on a 16×2 LCD.

The main objectives of the proposed system are:

1. To detect human movement using an HC-SR501 PIR sensor.
2. To process the sensor output using an Arduino UNO microcontroller.
3. To display the motion status or programmed count on a 16×2 LCD.
4. To develop a low-cost and easy-toassemble breadboard-based prototype.
5. To understand sensor interfacing and embedded system programming.

2. LITERATURE SURVEY

[1] IoT-School Attendance System Using RFID Technology

H. El Mrabet and A. Ait Moussa proposed an IoT-based school attendance system using RFID technology. In this system, RFID cards are used to identify students and record their attendance. This method helps automate attendance recording. However, it requires RFID cards and reader hardware, whereas the proposed project uses a PIR sensor for basic motion detection.

[2] An Improved IoT-Based System for Detecting the Number of People and Their Distribution in a Classroom

S. Matuska, J. Machaj, R. Hudec and P. Kamencay proposed an IoT-based system to detect the number of people and their distribution in a classroom. Their system uses sensors to detect people entering or leaving and to monitor classroom occupancy. It provides more detailed information than a single PIR sensor, but requires multiple sensing units and system integration.

[3] Edge-Based Transfer Learning for Classroom Occupancy Detection in a Smart Campus Context L. Monti and co-authors presented a camera-based classroom occupancy detection system using edgebased transfer learning. Their approach uses image processing and machine-learning techniques to detect classroom occupancy. The proposed project is simpler and does not use cameras or machine learning; it demonstrates basic motion sensing using Arduino UNO.

3. RESEARCH GAP

The reviewed systems use technologies such as RFID, multiple sensors, IoT and camera-based processing. These systems can provide detailed occupancy or identity information but may require additional hardware and complex implementation.

The proposed project focuses on a simple and low-cost arrangement using one PIR sensor, Arduino UNO and a 16×2 LCD. It is useful for demonstrating motion detection and microcontroller interfacing. However, a single PIR sensor cannot identify individual students or reliably distinguish between entry and exit movements.

4. HARDWARE COMPONENTS

The proposed Smart Classroom Attendance Counting System consists of the following hardware components:

[1] Arduino UNO Microcontroller

The Arduino UNO is the main controlling unit of the system. It receives the digital output from the PIR sensor, processes the input according to the programmed logic and controls the LCD display.

[2] PIR Sensor (HC-SR501)

The PIR sensor detects human movement by sensing changes in infrared radiation within its detection area. When movement is detected, it generates a digital output signal that is sent to the Arduino UNO. **[3] 16×2 LCD Display**

The 16×2 LCD is used to display the programmed count or motion status. It receives control and data signals from the Arduino UNO and displays the information in a readable format.

[4] 10 kΩ Potentiometer

The potentiometer is used to adjust the contrast of the LCD display so that the characters can be viewed clearly.

[5] 330 Ω Resistor

The resistor is used in the LCD backlight circuit to limit current as shown in the circuit diagram.

[6] Breadboard

The breadboard is used to connect the electronic components without soldering. It makes the circuit easy to assemble, test and modify.

[7] Jumper Wires

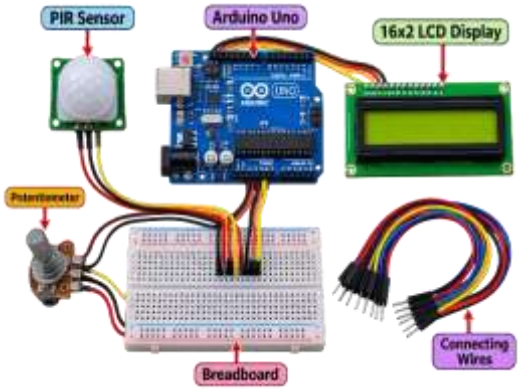
Jumper wires are used to establish electrical connections between the Arduino UNO, PIR sensor, LCD and other components.

Sr. No.	Hardware Component	Main Function
1	Arduino Uno	Acts as the main controller and processes sensor signals.
2	PIR Sensor	Detects human motion and sends signals to Arduino.
3	LCD Display (16×2)	Displays the attendance count and system status.
4	Potentiometer	Adjusts the contrast of the LCD display.
5	Breadboard	Provides a platform for connecting circuit components without soldering.
6	Connecting Wires	Establish electrical connections between components.

Table 1. Hardware component

Sr. No.	Indicator / Software	Main Function
1	LCD Display	Shows the number of detected persons or attendance count.
2	Motion Detection Indication	Indicates when motion is detected by the PIR sensor.
3	Arduino IDE	Used to write, compile and upload the program to Arduino Uno.
4	Embedded C/C++	Used to develop the program for system operation.
5	LiquidCrystal Library	Used to control and interface the 16×2 LCD with Arduin

Table 2. indicators and software



5. SYSTEM ARCHITECTURE

The system consists of three main functional sections: input sensing, data processing and output display.

The PIR sensor acts as the input unit and detects movement in its sensing area. The detected signal is sent to the Arduino UNO, which acts as the processing unit. The Arduino reads the sensor output and executes the programmed instructions. Finally, the 16×2 LCD acts as the output unit and displays the corresponding motion status or programmed count.

System Flow:

PIR Sensor → Arduino UNO → 16×2 LCD Display

The breadboard is used to establish connections between the components, while jumper wires provide the required electrical connections.

6. WORKING PRINCIPLE

The system operates according to the following steps:

[1] Power Supply: The Arduino UNO receives power through USB or a suitable regulated supply and provides the required supply to the connected components.

[2] Motion Detection: The HC-SR501 PIR sensor detects changes in infrared radiation when a person moves within its detection area.

[3] Signal Transfer: The PIR sensor generates a digital output signal and sends it to the Arduino UNO through the connected input pin.

[4] Data Processing: The Arduino reads the sensor output and processes it according to the programmed conditions.

[5] Display Operation: The 16×2 LCD displays the programmed message or count based on the sensor status.

[6] Continuous Monitoring: The Arduino continuously monitors the PIR sensor and updates the LCD whenever the sensor output changes.

7.SOFTWARE IMPLEMENTATION

The system is programmed using the Arduino IDE and Arduino C/C++ programming language. The program controls the PIR sensor and LCD display.

First, the required input and output pins are initialized. The PIR sensor pin is configured as an input, and the LCD is initialized for displaying information. During program execution, the Arduino continuously reads the digital output of the PIR sensor.

When motion is detected, the Arduino executes the programmed condition and updates the LCD display. When no motion is detected, the display shows the corresponding idle status or programmed count.

The software and hardware connections must use the same pin assignments. The final program is uploaded to the Arduino UNO through a USB cable using the Arduino IDE.

8. HARDWARE IMPLEMENTATION AND RESULTS

The hardware prototype is assembled on a breadboard using an Arduino UNO, HCSR501 PIR sensor, 16×2 LCD, potentiometer, resistor and jumper wires.

The PIR sensor is connected to the Arduino UNO to detect movement. The LCD is interfaced with the Arduino to display the required information. The potentiometer is used to adjust the LCD contrast, and the breadboard provides temporary connections between the components.

Expected Operation:

Under normal operation, the LCD displays the programmed initial message or count. When a person moves within the PIR sensor detection area, the sensor output changes and the Arduino responds according to the uploaded program. The LCD then displays the corresponding motion indication or programmed count.

The prototype should be tested by moving in front of the sensor and observing the LCD response. Actual detection range, response time and counting performance should be recorded during practical testing. Numerical accuracy is not claimed without measured test results.

10. LIMITATIONS

The proposed system has the following limitations:

1. A single PIR sensor detects movement but cannot identify individual students.
2. It cannot distinguish between a person entering and leaving the classroom.
3. A stationary person may not continuously activate the PIR sensor.
4. Multiple people moving together may not be counted separately.
5. Sensor performance depends on placement, sensitivity, delay settings and environmental conditions.
6. A motion event alone cannot be considered proof of student attendance.

9. FUTURE SCOPE

The proposed system can be improved by incorporating additional features:

1. Two IR break-beam sensors can be used at the doorway to detect the direction of movement.
2. RFID cards can be added for individual student identification.
3. A Real-Time Clock (RTC) and memory can be used to store attendance with date and time.
4. Wi-Fi or IoT connectivity can be added for remote monitoring.
5. A database can be developed to maintain student attendance records.
6. Repeated testing can be performed with different classroom entry conditions to improve system performance.

III .CONCLUSION

The Smart Classroom Attendance Counting System demonstrates a basic motion-based classroom monitoring application using an HC-SR501 PIR sensor,

Arduino UNO and 16×2 LCD display. The PIR sensor detects movement and sends a digital signal to the Arduino UNO. The microcontroller processes the signal and updates the LCD according to the programmed logic.

The breadboard-based prototype is simple, economical and useful for understanding sensor interfacing and microcontroller programming. However, a single PIR sensor cannot identify individual students or reliably distinguish between entry and exit movements. Therefore, the prototype is a basic classroom motion-monitoring

IV. REFERENCES

demonstration rather than a complete student-wise attendance system. Future improvements such as directional sensors, RFID identification and data storage can make the system more practical and reliable.

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