Title: An Intelligent Anti-Cheating Surveillance and Detection System for Examination Halls Using IoT and Embedded Systems

Abstract:
This paper presents the design and implementation of an embedded anti-cheating surveillance and detection system tailored for large-scale examination halls. Using ESP32 and Arduino microcontrollers, the system integrates multiple sensors such as IR modules, load sensors, RFID readers, and microphones to detect anomalies including sheet swapping, whispering, and unauthorized hand movements. The setup includes a centralized display for invigilators to receive real-time alerts and reports. With no dependency on the internet, this cost-effective, scalable solution is optimized for single-classroom zones accommodating up to 300 students. The paper outlines the technical design, operational workflow, advantages over existing methods, and real-world applicability.

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1. Introduction

Unfair practices during examinations remain a major challenge in educational institutions. Traditional invigilation methods are limited by human attention span and can be bypassed in crowded exam settings. This system proposes a smart, sensor-integrated framework to detect suspicious activity and report it to the teacher in real-time, minimizing the opportunity for cheating and increasing exam integrity.

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2. Problem Statement

Large examination halls with limited invigilation staff provide opportunities for students to engage in malpractices such as whispering answers, exchanging answer sheets, and passing unauthorized items. Existing methods lack real-time detection or rely heavily on manual observation. A low-cost, sensor-based detection system can fill this gap.

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3. System Architecture and Components

3.1 Hardware Components:

- **ESP32/Arduino Microcontroller:** Central controller for signal processing.
- **Load/Weight Sensors:** Detect student presence on benches.

- **RFID Reader Modules:** Validate and monitor answer sheet tags.
- **IR Sensors:** Detect hand movements under desks.
- **Microphones:** Identify whispering or low-volume speech.
- **Teacher's Display Unit:** Central OLED or LCD screen showing alerts and system data.

3.2 Network and Power Setup:

- All components are locally powered.
- Central unit communicates with all sensors via GPIO/I2C/SPI/UART.

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4. Key Functional Features

- **Sheet Tampering Detection:** RFID mismatch raises an alert.
- **Whisper Detection:** Microphone thresholds identify sound spikes.
- **Under-Desk Movement Monitoring:** IR sensor triggers flag on object/hand movement.
- **Presence Tracking:** Load sensor confirms student seating.
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Real-Time Invigilator Alert System: Central display reflects anomalies live.

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5. Use Cases

- **Colleges and Universities:** Automated invigilation in mass exams.
- **Government Exams:** Improved transparency in recruitment and competitive tests.
- **Remote Surveillance:** Teachers can monitor from a separate control unit.

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6. Results and Challenges

The system was tested in a classroom environment with simulated inputs. Alerts were timely and accurate under most conditions. Potential challenges include sensor calibration, false positives due to noise, and RFID read failures. Solutions involve using filter algorithms and redundancy.

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7. Cost Estimation (For 200 students)

Component	Cost per Unit (INR)	Quantity	Total (INR)
Load Sensor	60	200	12,000
IR Sensor	20	200	4,000
RFID Tag + Reader	80	200	16,000
Microphone Module	30	200	6,000
ESP32 Controllers	300	2	600
LCD Display for Teacher	700	1	700
Wires, Boards, Casings	-	-	3,000
Estimated Total			**42,300**

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8. Conclusion
This anti-cheating system provides a scalable, real-time solution to monitor and detect common malpractices in examination settings. By combining multiple sensors with microcontroller logic, it significantly reduces human error and increases transparency. Future enhancements can include wireless mesh networking, data logging, and integration with exam management software.

References

1. Espressif IoT Development Framework

2. HC-SR04, HX711, MFRC522 Module Datasheets

3. Arduino + ESP32 Real-Time Communication Systems

4. Research on Whisper Detection Algorithms

5. Patents on Automated Exam Invigilation Tools