An IoT ENABLED EXAMINATION HALL MONITORINNG AND ATTENDANCE RECORDING SYSTEM

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Abstract - Maintaining integrity and discipline during examinations is a significant challenge for educational institutions. Traditional exam hall monitoring methods rely mainly on manual invigilation, which can result in limited supervision, human error, and increased possibilities of malpractice. To address these issues, IoT-based Exam Hall Monitoring System is proposed. The proposed system utilizes the ESP32CAM module for real-time video surveillance and image capture within the examination hall. This enables continuous monitoring of student activities and helps to detect suspicious behaviours such as unauthorized movement and abnormal interactions. An RFID scanner is implemented for secure student authentication and automatic attendance marking, thereby preventing impersonation and proxy attendance. A sound sensor is integrated to detect unusual noise levels, including whispering and unauthorized communication. When the sound intensity exceeds a predefined threshold, the system triggers alerts and captures images as evidence. All collected data, including attendance records and alert notifications, are transmitted via Wi-Fi to a cloud platform for real-time remote monitoring. The proposed system provides a cost-effective, scalable, and efficient solution that enhances examination security, improves transparency, and reduces dependence on manual supervision. The proposed system mainly supports SDG 4 - Quality Education by ensuring fair and transparent examinations. It is also in align with SDG 9 - Industry, Innovation and Infrastructure through the use of smart technologies.

Keywords – monitoring, esp32cam, attendance recording, sensors.

I. INTRODUCTION

In today's educational system, it is very important to ensure fairness and transparency during examinations. Examinations are the one which plays a crucial role in analysing a student's knowledge, skills, performance and their academic progress. However, maintaining discipline and integrity in exam hall is one of the major challenges for educational institutions. Traditional methods of monitoring, which rely heavily on invigilators, it leads to human error, lack of constant attention, and difficulty in monitoring large numbers of students effectively. These challenges can lead to unfair practices like cheating, impersonation, and unauthorized communication.

Due to the development of technology, the need to shift from traditional monitoring systems to smarter and more reliable solution is growing. So, the Internet of Things (IoT) technology offers a powerful approach to enhance examination hall security and efficiency. IoT enables devices to communicate and share data in real time, making it possible to monitor environments continuously and respond instantly to unusual activities which produced by sounds.

The proposed system is designed as an IoT-based exam hall monitoring solution that aims to overcome the demerits of traditional methods. By combining modern technologies like ESP32-CAM, RFID authentication, and sound detection, it ensures a more secure and automated examination process. The ESP32-CAM module gives a real-time video surveillance. it continuously monitors student's behaviour and helps to identify suspicious activities. The RFID system simplifies attendance recording by securely verifying student's identity and eliminates the chances of proxy attendance.

In addition to that, the inclusion of a sound sensor adds another layer of monitoring by detecting abnormal noise levels, such as whispering, murmuring or communication between students. When suspicious activities are detected, the system can immediately generate alerts and captures image as evidence. All collected data is transmitted to a cloud platform, enables remote monitoring and authorities can easily access.

Overall, this system gives a smart, cost-effective, and scalable technology that improves examination hall. It reduces dependence on manual supervision and increases transparency, accountability, and trust in the examination process. By adopting to these technologies, educational institutions can create a more disciplined and fair examination environment, aligning with the goals of quality education and technological advancement.

II. RELATED WORKS

Several studies have explored IoT, AI, and sensor-based approaches for examination hall monitoring and attendance recording, each contributing insights that inform the design of the proposed system.

Adhatrao et al. [1] proposed an AI-based surveillance system using deep learning. It detects abnormal student's behaviour during exam hall in real time. It works well in terms of detection accuracy, but it depends significant computing power and has no way of confirming who the students actually are, when they enter. it takes a lighter approach-pairing the esp32cam with RFID.so the system can both watch and verify, without need of costly hardware to run AI models onsite.

Morerwa et al. [2] focused on keeping unauthorized people out of exam hall using RFID card at the gate. it does attendance recording in effective way but once students enter the exam hall it will not monitor them.so, Our system helps to overcome this by providing both monitoring and attendance recording. Because the camera and sound sensor will continuously monitor student's behaviour.

Al-Airaji et al. [3] uses video surveillance for monitoring exam halls, and it helps in detecting suspicious student interactions. however, did not have automated alert system or cloud-based remote access. But our system automates this process -the moment sound sensor detects unusual sounds and the camera captures the image immediately and produce real time alert and it will appear in cloud.

Shrestha et al. [4] went a step further by combining an IoT-based exam hall authentication system using fingerprint recognition combined with temperature sensing. the idea is solid, but fingerprint readers add cost and its complexity is high, limiting scalability. But our system adopts RFID as a practical, cost-effective alternative while retaining the IoT-based cloud transmission architecture.

Padhiyar and Prajapati [5] reviewed AI techniques to detect suspicious movement in exam hall. The review makes one point clearly: there is a real need for low cost, integrated hardware solutions, not just algorithms. The proposed system directly addresses this by combining ESP32-CAM, RFID, and a sound sensor on a single embedded platform and connects everything to the cloud without dependence on high-cost AI infrastructure.

Looking across these studies, existing works have explored addresses a piece of the puzzle in isolation-entry control here, video monitoring, AI detection somewhere else. What has been missing is a single, affordable system that handles all three at once. That is the exact gap our proposed system is designed to fill.

III. PROPOSED SYSTEM ARCHITECHTURE

The design of our system came out of a simple question: what does an exam hall actually need to be genuinely secure? The answer points to three things- knowing who is in the room, being able to see what is happening and catching unusual sounds before a problem arrives. This system architecture shown in fig.1, ties all three together through a shared wi-fi link to the cloud.

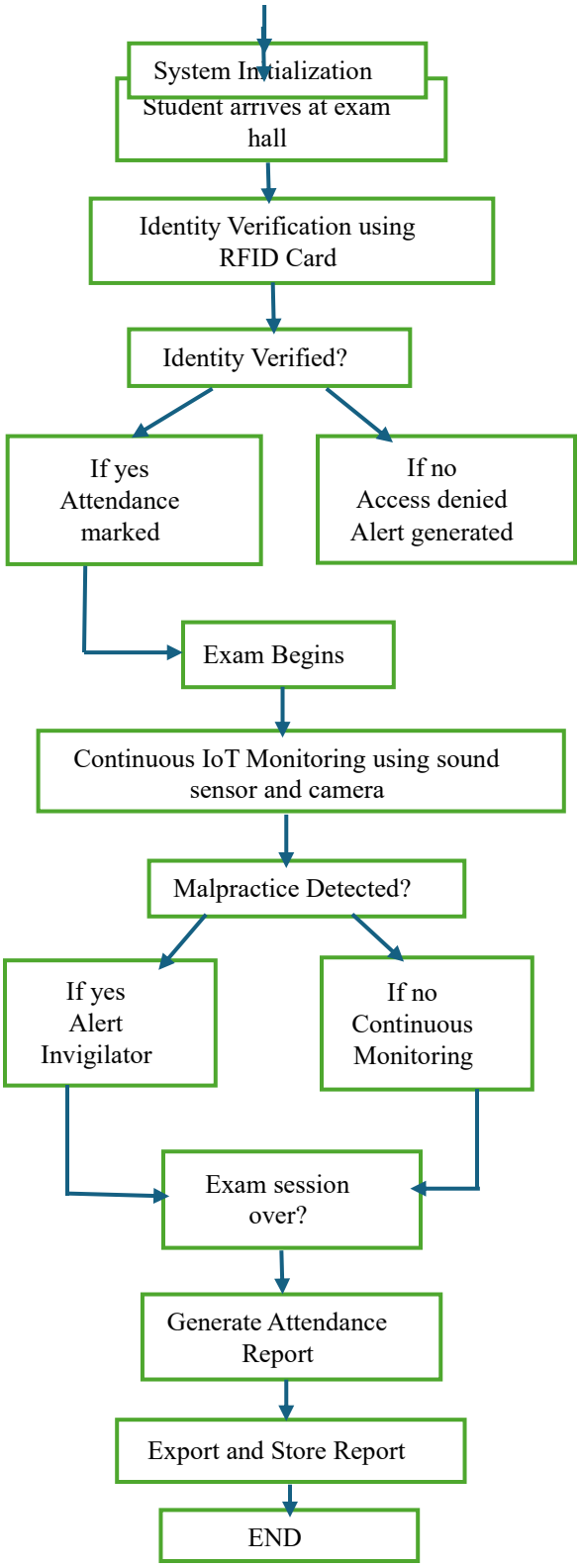


Figure 1. flowchart

In practice, the workflow goes like this: a student walks up to the entry point, scans their RFID card, and their attendance is immediately written to the google sheets, then they take their seat. From that point on, the ESP32CAM keeps a live feed running so any administrator can observe the hall remotely. Meanwhile, the sound sensor is quietly listening in the background. if

noise exceed the predefined threshold – say, someone whispering – the camera captures a photo, attach a timestamp and the alert shows up in the cloud dashboard within some seconds.

A. ESP32 - CAMERA MODULE

ESP32 CAMERA is a small but capable board that packs as a dual – core processor, build-in wi-fi and Bluetooth, and an OV2640CAMERA into a compact form factor. It can capture images up-to UXGA resolution (1600x1200) and has a microSD card. Slot for optional local storage .it runs on 3.3v and is programmed through the Arduino IDE, which makes it easy to work with. In this system, the ESP32CAMERA wears two hats. day to day, it streams a live feed of the hall. So, remote supervisor can check in at any time. when a sound alert fires, it switches to capturing a still image as evidence. that image gets send to the Google Apps Script end point has an http POST request and store in cloud for future review [1].

B. ARDUINO UNO

Arduino UNO is used as central microcontroller unit which is based on the ATmega328P processor. The main reason for choosing this hardware is that it consumes very minimal amount of power and it can be programmed easily with the help of Arduino IDE which is a free and open-source programming environment. The other features of this component include, it has 14 input/output pins, 2KB SRAM, 32KB FLASH, 1KB EEPROM memory for storage and its processor generates oscillations at the rate of 16Mhz [2].

C.RFID SCANNER(MFRC522)

The MFRC522 reads cards at 13.56MHZ. and talks to the ESP32 over SPI. Every student is given an RFID Card that carries their enrolment number. when they tap in, the reader pulls the card's UID, the ESP32 checks it against the registered data base, and if it matches, an attendance record with a time stamp gets posted to Google Sheets.

Because physical position of the right card is required to get a valid scan, proxy attendance becomes very difficult to pull off. If an unrecognised UID appears, the system immediately logs it as an unauthorised entry attempt [3].

The detection module uses a small condenser microphone paired with an KY038 comparator. It outputs a digital HIGH whenever ambient noise crosses the threshold that is set on the sound sensor alongside an analogy voltage that reflects the actual sound level. The digital line connects to a GPIO interrupt pin on the ESP32-CAM, so the response is near-instant.Getting the threshold right is important. The system was calibrated against the typical background of an exam hall-pages turning, chairs shifting- so that only loud, more deliberate sounds like whispering will trigger alert. When a detection occurs, the system captures a photo and send alert to the cloud [4].

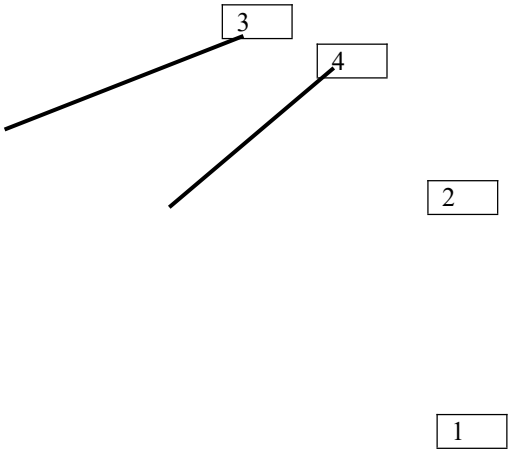
E. CLOUD INTEGRATION (GOOGLE SHEETS)

All system data- attendance entries, sound alerts, captured images ends-up in a Google Sheets Spread Sheets. The script is deployed as a public HTTPS endpoint, so the ESP32-CAM can reach it over the Standard Wi-Fi connections without any server [5].

S.NO	COMPONENT	SPECIFICATION
1.	Camera	ESP32-CAM
2.	Arduino UNO	Microcontroller
3.	RFID Scanner	MFRC522
4.	Sound Sensor	KY038
5.	Cloud backend	Google Apps Script + Sheets

Table.1 Specification of each component

IV. PERFORMANCE ANALYSIS



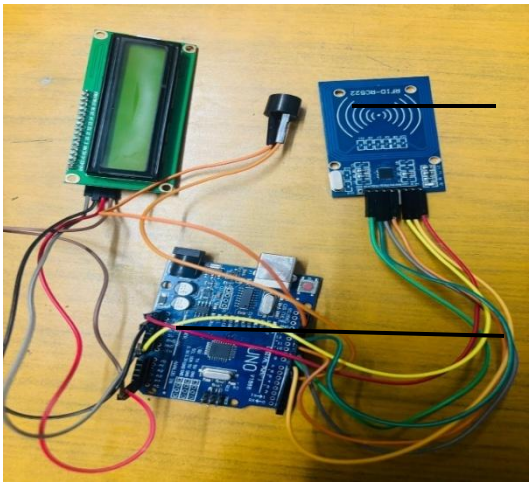
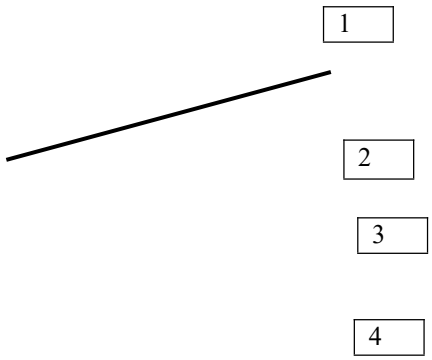


Figure.2
Attendance Recording System

Component No	Name of the Component
1	ARDUINO UNO
2	RFID READER
3	LCD DISPLAY (16X2)
4	BUZZER

Table.2: Specification of Attendance Recording System Components



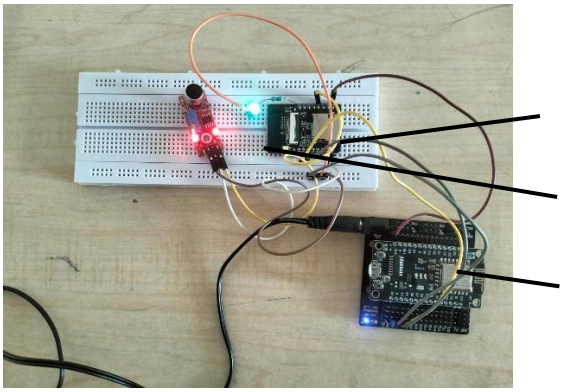
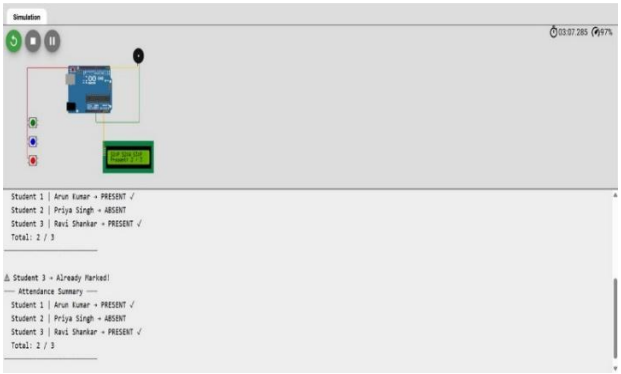


Figure.3
Exam Hall Monitoring System

Component No	Name of the Component
1	Sound Sensor
2	ESP32 Camera
3	LED
4	ESP8266

Table 3: Specification of Exam Hall Monitoring System Components



V. CONCLUSION

The proposed smart exam hall monitoring system improves examination security, transparency, and discipline by providing automated monitoring and alert mechanisms. It helps to reduce malpractice, human errors, and dependency on manual supervision while ensuring a fair examination environment.

In future, the system can be enhanced using Machine Learning and Deep Learning techniques to detect chit papers, suspicious activities, and cheating behaviour more accurately. The system can be used in schools, colleges, universities, competitive exam centers and other educational institutions for secure and efficient examination management.

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