Real-Time IOT Driven Multimodal Proctoring for Fraud-Free Offline Assessments

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Abstract*—The Offline Proctoring System using IoT Technology is designed to ensure secure and malpractice-free examinations without relying completely on online proctoring methods. This system uses RFID tags for student authentication and proper seating arrangement, where candidate details and seat information are displayed on an LCD screen, eliminating impersonation. After entry into the examination hall, an IoT-based camera module continuously monitors candidates to detect face spoofing, suspicious movements, head turns, and the usage of mobile phones or unauthorized devices using the YOLO algorithm. Additionally, an I2C MEMS microphone is used to monitor abnormal sound levels such as murmuring or verbal communication by setting a predefined threshold. All the captured data, including RFID information, visual monitoring records, and audio alerts, are securely stored in the cloud for further verification and analysis. By integrating multiple IoT components, the proposed system minimizes human intervention, prevents examination scams, and provides a reliable and efficient offline proctoring solution.*

Keywords*—IoT, RFID, YOLO, Offline Proctoring, MEMS Microphone, Cloud Storage, Examination Security*

I. INTRODUCTION

Examinations play a vital role in evaluating students' academic performance, and maintaining integrity during examinations is a major challenge for educational institutions. Conventional offline examination systems mostly depend on manual invigilation, which is often inefficient and vulnerable to impersonation, human error, and unfair practices [1]. Although human supervision is effective to some extent, it becomes difficult to continuously monitor a large number of candidates in real time.

In recent years, online proctoring systems have been introduced to address examination malpractice using webcams, internet connectivity, and artificial intelligence techniques [2]. These systems enable automated monitoring of candidates through video and audio analysis. However, online proctoring solutions require stable internet connectivity, high bandwidth, and advanced infrastructure, making them unsuitable for many institutions that conduct examinations in offline environments [3].

Several studies have explored the use of RFID technology for student identification and attendance management, proving its effectiveness in preventing impersonation [4]. Similarly, camera-based monitoring systems using computer vision techniques have been proposed to detect suspicious behaviors such as head movements, face spoofing, and the presence of unauthorized devices during examinations [5]. In addition, audio-based monitoring systems using microphones have been studied to detect abnormal sound patterns like murmuring or communication between candidates [6].

To address these limitations, this paper proposes an Offline Proctoring System using IoT Technology that integrates multiple monitoring mechanisms into a unified framework. The proposed system uses RFID tags for secure candidate authentication and seating arrangement verification, a camera module for continuous visual monitoring of candidate behavior and mobile phone detection, and a MEMS microphone for identifying abnormal sound levels during examinations. All monitored data are logged and stored in the cloud for post-examination analysis and verification [7].

II. LITERATURE SURVEY

[1] Earlier examination systems mainly used RFID technology for student identification and attendance, but continuous monitoring of candidate behaviour during exams was not addressed.

[2] Several studies proposed online proctoring systems using webcams and internet-based platforms; however, these systems

depend heavily on stable connectivity and are unsuitable for offline environments.

[3] Vision-based invigilation approaches used camera modules to analyse head movements and facial orientation, but their application was limited to online examinations.

[4] Research on face recognition and anti-spoofing techniques proved effective in preventing impersonation, though integration with offline exam halls was minimal.

[5] Some systems focused on detecting mobile phone usage in restricted areas using surveillance techniques, but they lacked integration with complete exam monitoring frameworks.

[6] Audio monitoring methods using MEMS microphones and sound thresholds were explored to detect abnormal noise such as murmuring, but they were rarely combined with visual surveillance.

[7] IoT-based smart surveillance systems demonstrated efficient sensor data collection and monitoring, mainly for security applications rather than examination proctoring.

[8] Cloud-based IoT platforms enabled secure data storage and analysis, but limited research focused on storing complete exam behaviour logs of candidates.

[9] Automated invigilation systems reduced human intervention, yet most lacked a multi-sensor approach combining RFID, camera, and audio inputs.

[10] From the literature, it is observed that a fully integrated offline IoT-based proctoring system with authentication, visual monitoring, audio detection, and cloud storage is still an open research area.

III. METHODOLOGY

The proposed system follows a systematic pipeline for offline examination proctoring:

- Students authenticate using RFID cards before entering the examination hall.
- The system verifies identity and assigns a seat number, displayed on an LCD screen.
- A camera module continuously monitors candidates during the exam.
- The YOLO algorithm detects suspicious movements and multiple faces.
- A MEMS microphone monitors abnormal sound levels.
- All monitoring data is uploaded to cloud storage.
- Alerts are generated when malpractice is detected.
- Admin reviews logs and recordings for final verification.

IV. SYSTEM ANALYSIS

The proposed system automates student verification and monitoring using a multi-sensor architecture integrating RFID, camera, and microphone modules for multi-level security coverage.

Software: Embedded C, Python, YOLO, Cloud platform.
Hardware: RFID reader, camera module, MEMS microphone, microcontroller.

V. SYSTEM DESIGN

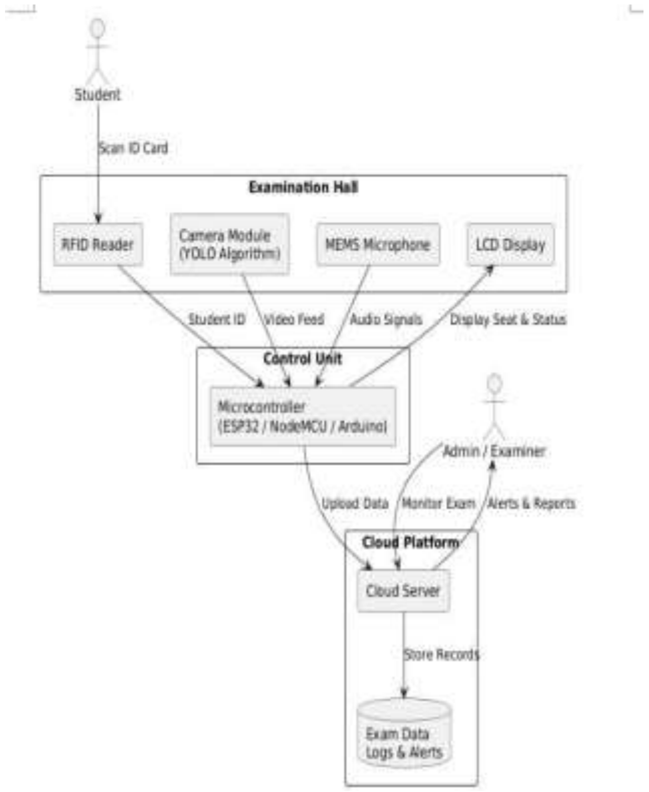
The system design encompasses four major functional modules: RFID-based entry and seating allocation, continuous video monitoring using AI, audio monitoring for unusual sound detection, and cloud storage for exam records and alerts. Technologies employed include IoT, Computer Vision, and Machine Learning.

TABLE I. System Design Components

Module	Technology	Function
Authentication	RFID Reader	Student verification and seat allocation
Visual Monitoring	Camera + YOLO	Detect suspicious movements and unauthorized devices
Audio Monitoring	MEMS Microphone	Detect abnormal sound levels
Data Logging	Cloud Platform	Secure storage of alerts and records

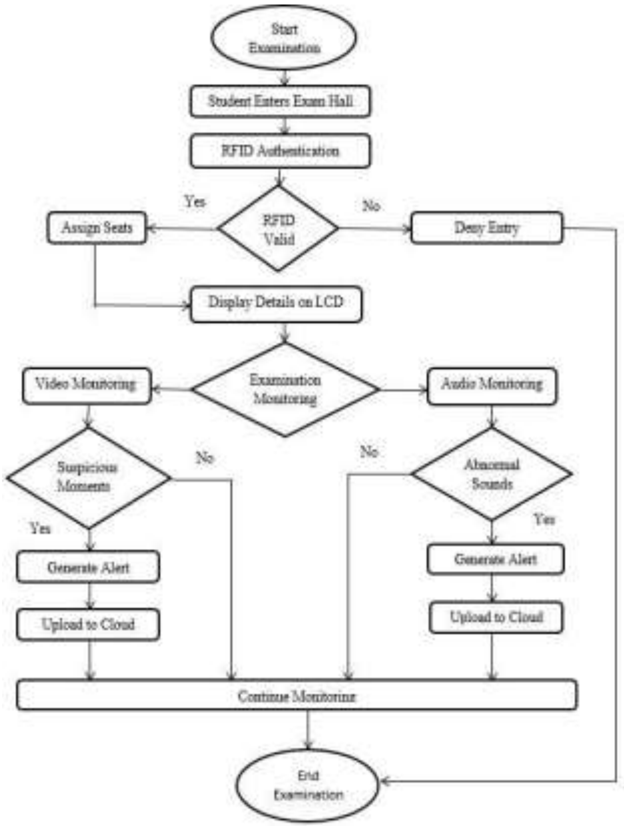
VI. SYSTEM ARCHITECTURE

The system architecture integrates hardware and software components into a cohesive monitoring pipeline. The RFID module handles entry authentication, feeding candidate data to the microcontroller. The camera module streams video to the YOLO-based detection engine, while the MEMS microphone feeds audio data to the sound threshold analyzer. All outputs are aggregated and pushed to the cloud storage platform, where administrators can review alerts, logs, and recordings.



VII. FLOW CHART

The operational flow begins with candidate authentication at the entry point via RFID. Upon successful verification, the candidate is directed to the assigned seat. Throughout the examination, the camera and microphone modules operate concurrently. Any detected anomaly triggers an alert that is logged and transmitted to the cloud for administrator review.

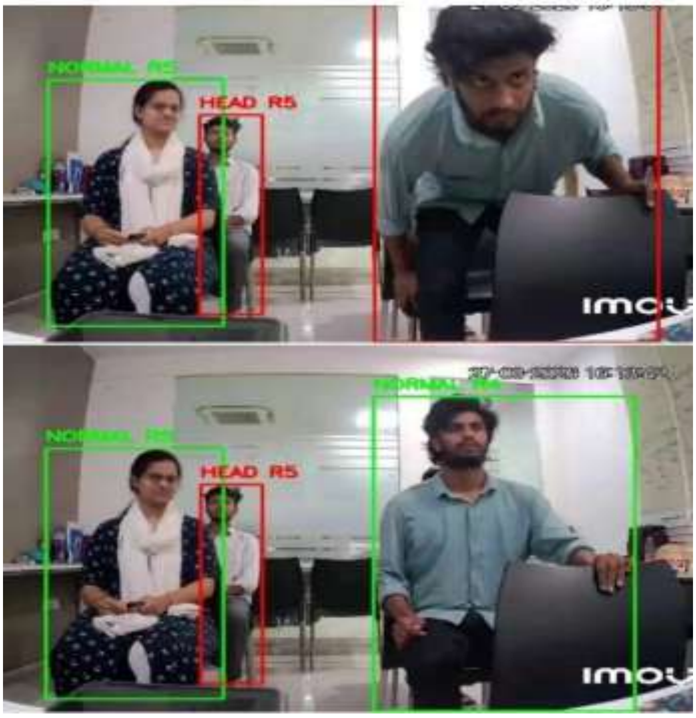


VIII. RESULT

The proposed IoT-based examination proctoring system was successfully implemented and tested under real-time conditions. The system accurately authenticated students using RFID technology, ensuring secure entry into the examination hall. The seating arrangement was effectively displayed on the LCD, reducing confusion and saving time.

The camera module integrated with YOLO-based object detection was able to identify suspicious activities such as unusual movements and interactions between students. Additionally, the MEMS microphone detected abnormal sound levels, helping in identifying possible cheating attempts. Alerts were generated instantly and relevant data was uploaded to the cloud for further review.

Overall, the system significantly reduced the need for manual supervision, minimized human errors, and ensured secure storage of examination data.



IX. CONCLUSION

This project presents an efficient IoT-based examination proctoring system that enhances exam security and transparency. By combining RFID authentication, video monitoring, and audio analysis, the system effectively reduces impersonation and cheating during examinations.

The proposed system provides a reliable solution for offline exam monitoring with minimal human intervention. It ensures accurate tracking, real-time alerts, and secure data management, making it suitable for modern examination environments.

For future improvements, the system can be enhanced by integrating biometric authentication methods such as fingerprint or facial recognition for higher security. Real-time alert notifications can be sent directly to authorities, and advanced AI-based behavior analysis can be implemented to improve detection accuracy further.

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