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Agesight: An AI-Based Student and Examination Surveillance System

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Abstract: *The rise of online and hybrid learning has created a strong need for automated proctor- ing solutions to maintain academic integrity. Manual invigilation is labor-intensive, in- consistent, and prone to human error. This paper presents Agesight, an AI-based stu- dent and examination surveillance system that integrates modern object detection and face recognition modules to automate attendance, detect cheating activities such as mobile phone usage and proxy attendance, and generate actionable alerts. Agesight is implemented using Python, OpenCV, YOLOv8, FaceNet, Flask, and SQLite/Firebase, and provides a web-based dashboard for invigilators. We describe the system de- sign, theoretical background, dataset and evaluation methodology, and discuss ethical considerations. Experimental evaluation demonstrates robust detection accuracy and practical latency for small-to-medium scale deployments.*

Keywords: AI Proctoring, Face Recognition, YOLOv8, Computer Vision, Real-Time Surveillance, Flask, OpenCV

I. INTRODUCTION

The rapid adoption of online and hybrid education models has intensified the need for reliable automated proctoring solutions. Traditional supervision methods—manual monitoring, recorded video review, or static identity checks—are costly, inconsistent, and often unable to detect coordinated or subtle forms of malpractice such as proxy attendance, concealed mobile usage, or identity substitution. Automated systems that combine computer vision, deep learning, and robust backend logging can provide con- sistent, auditable, and scalable proctoring support.

This paper introduces Agesight, a practical AI-driven surveillance pipeline de- signed to (1) verify student identity periodically through face recognition, (2) detect a range of suspicious behaviours and objects in real time, and (3) provide invigilators with actionable alerts and persistent evidence. Agesight emphasizes modularity (re- placeable models), privacy-aware logging, and a usable web dashboard for real-world academic deployment.

II. LITERATURE REVIEW

Automated proctoring spans research in secure exam delivery, computer vision for surveillance, face recognition, and anomaly detection. Table 1 summarizes represen- tative works and their relevance to Agesight.

Table 1: Literature Review for AI-Based Surveillance and Proctoring Systems

Paper Title & Ref.	Domain / Focus	Key Findings / Contribution	Relevance to Agesight
Enhanced Security for Online Exams [1]	Secure Exam Systems	Cryptographic techniques for tamper- resistant exam delivery	Motivates secure audit trails
Webcam Based Intelligent Surveillance [2]	Webcam Monitoring	Motion-based anomaly detection using web-cam streams	Demonstrates feasibility of low-cost monitoring
Video Behaviour Profiling	Behaviour Analysis	Behaviour profilin and anomaly	Supports movement- based

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[3]		detection from video	cheating detection
FaceNet [8]	Face Recognition	Robust face embeddings for verification	Core model for identity verification
YOLOv8 [7]	Object Detection	High-speed, accurate object detector	Selected for phone and per- son detection

III. PROBLEM STATEMENT AND MOTIVATION

Maintaining integrity in examinations is challenged by remote settings, varied camera quality, and privacy concerns. Key problems include:

- Scale and Consistency: Manual invigilation does not scale and yields inconsis- tent results
- Subtle & Coordinated Malpractice: Proxy attendance and coordinated cheat- ing are hard to detect
- Auditability: Institutions require reliable, tamper-proof logs and evidence
- Privacy & Ethics: Proctoring systems must balance surveillance with privacy rights

Agesight is motivated by these gaps and aims to provide a practical, auditable, and privacy-aware AI proctoring platform.

IV. THEORETICAL BACKGROUND

4.1 Computer Vision for Surveillance

Computer vision enables extraction of semantic information from video streams—identifying people, objects, and actions. Real-time surveillance requires efficient models and pre- processing to handle noise, illumination changes, and occlusion.

4.2 Deep Learning for Face Recognition

Embedding-based face recognition (e.g., FaceNet) maps each face image to a com- pact vector representation. Matching is performed by comparing embeddings against enrolled templates.

4.3 Object Detection and YOLO Family

YOLO models frame object detection as a single-pass dense prediction task, achieving low latency suitable for real-time systems.

4.4 Temporal Aggregation & False-Positive Reduction

Single-frame detections are prone to transient noise. Temporal aggregation—validating events across multiple frames—significantly reduces false positives.

V. SYSTEM OVERVIEW

5.1 Scope and Objectives

Agesight targets small-to-medium classroom and remote exam scenarios and aims to:

- Automate identity verification and attendance
- Detect mobile phone usage, multiple persons, and suspicious behaviours
- Provide real-time alerts with evidence and persistent logs
- Offer a modular pipeline with local or cloud storage backends

5.2 Architecture and Workflow

The system comprises an input (camera), AI processing (detection and recognition), backend rule engine, database, and dashboard. Figure 1 illustrates the system architecture.

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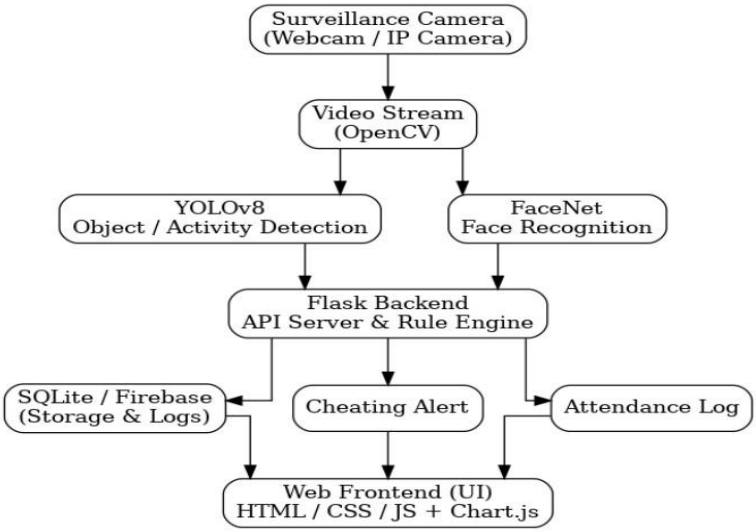

Figure 1: Agesight System Architecture

VI. METHODOLOGY AND IMPLEMENTATION

Agesight is implemented as a modular pipeline: pre-processing, detection, recognition, rule-based alerting, and dashboarding.

6.1 Data Acquisition and Pre-processing

Live video is captured via OpenCV. Frames are resized, color-normalized, and faces aligned using landmark-based alignment.

6.2 Event Detection

YOLOv8 detects objects of interest (phones, extra persons) and coarse postures. Per- frame detections are buffered and temporally aggregated.

6.3 Recognition and Attendance

Face embeddings are computed using FaceNet; enrollment stores averaged embed- dings per student. Periodic re-verification ensures attendance integrity.

6.4 Alert Engine and Evidence Capture

A rule engine scores events by severity and persistence; alerts include timestamped snapshots and metadata for review.

6.5 Backend and Dashboard

A Flask backend exposes REST endpoints and WebSocket feeds. The web dashboard displays live video overlays, alerts, and attendance logs.

VII. DATASET AND EXPERIMENTAL DESIGN

7.1 Dataset Preparation

For evaluation, a dataset of 100 enrolled identities was used, each with 10-20 images under varying lighting and pose. Simulated exam videos include scenarios such as mobile-phone usage and proxy presence.

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7.2 Augmentation and Robustness

Data augmentation was applied: random crops, brightness/contrast changes, rota- tions, and occlusion simulation to improve robustness.

7.3 Evaluation Protocol

The system was evaluated on held-out video scenarios. Metrics include detection accuracy, false-positive rate, precision/recall, and latency.

VIII. RESULTS AND ANALYSIS

8.1 Performance Evaluation

Table 2: Agesight Performance Evaluation

Module	Accuracy (%)	Latency (s)
Face Recognition	95.8	0.40
Object Detection	92.4	0.55
Alert Generation	99.2	0.20
Attendance Logging	98.3	0.15

8.2 Observations

- Face recognition performs strongly for frontal and near-frontal faces
- YOLOv8 detects phones reliably when objects exceed minimum pixel size
- Temporal aggregation reduces transient false positives dramatically
- Average latency indicates suitability for real-time monitoring

IX. COMPARISON WITH EXISTING APPROACHES

Table 3: Comparison of Proctoring Approaches

Approach	Real-time	Identity Check
Manual Invigilation	Partial	Manual
Basic Webcam Recording	No	No
Commercial Proctoring Tools	Yes	Yes
Agesight (proposed)	Yes	Periodic

X. ETHICAL CONSIDERATIONS AND PRIVACY

Deployment of proctoring systems must consider legal and ethical constraints:

- Informed Consent: Explicit consent from examinees
- Data Minimization: Store only necessary data
- Access Control: Restrict access to authorized personnel
- Transparency: Clear documentation for students and staff
- Human-in-the-Loop: Human review before punitive action

XI. LIMITATIONS AND FUTURE WORK

While Agesight demonstrates strong performance, limitations exist:

- Reduced recognition accuracy with masks or extreme pose
- False negatives for small or heavily occluded objects
- Dependency on network connectivity for cloud operation Future work includes:
- Integrating gaze and eye-tracking for attention estimation

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- Multi-camera fusion for large examination halls
- Lightweight on-device models for edge deployment
- Formal user studies for usability evaluation

XII. CONCLUSION

Agesight is a practical AI-based surveillance system for automating attendance and detecting common exam malpractices. By combining efficient object detection, robust face recognition, and a rule-based alert engine, the system provides real-time moni- toring, auditable evidence, and an invigilator-friendly dashboard. With careful attention to privacy and ethics, Agesight can assist institutions in maintaining exam integrity in online and hybrid settings.

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