Project Proposal

RAG- Powered Exam Integrity & Assessment Platform for Online & Offline Education

1. Executive Summary

Our project is a next-generation **AI-powered online and offline exam monitoring, grading, and instructor's assistant platform** designed to ensure **academic integrity, transparency, and automation** in modern education.

It combines **Computer Vision, Natural Language Processing, AI-driven analytics, and robust full-stack MERN web application** to monitor students, detect cheating, grade exams, and provide instructors with intelligent, actionable reports.

The system provides real-time monitoring, cheating detection, automated grading, and rich analytics through an **interactive, secure, and scalable web platform**. Instructors benefit from an advanced dashboard with live video feeds, instant AI alerts, performance analytics, and AI-assisted decision-making, while students take exams through an intuitive, browser-based interface with built-in identity verification and accessibility features.

Targeted at **universities, training centers, and certification bodies**, AI can be deployed in both **remote exams** and **physical exam halls**, offering a **hybrid proctoring solution** that integrates AI intelligence with a reliable, user-friendly web experience.

2. Problem Statement

Academic dishonesty during examinations (whether online or offline) poses a significant challenge for universities and institutions. Traditional monitoring methods (manual invigilation or basic webcams) cause:

- Manual monitoring overload for instructors, especially in large halls.
- Slow grading for essays and written answers
- Prone to bias and human error.
- Unable to scale to large student cohorts.
- Lacking advanced analytics, transparency, and post-exam insights.

This gap creates an urgent need for an **AI-driven system** that provides **real-time monitoring, automated grading, plagiarism detection, and intelligent reporting**, while supporting both online and offline exam environments.

3. Motivation

- Rapid shift toward digital & hybrid learning makes old proctoring methods obsolete.
- Cheating and impersonation cases are rising globally.
- Current tools rarely unify **monitoring + grading + plagiarism detection + reporting** in one platform.
- Universities need **scalable, fair, and transparent** AI-driven solutions that reduce examiner workload and ensure academic integrity.

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4. Proposed Solution & Final Application

- **Real-time monitoring** (face recognition, gaze tracking, phone detection) via integrated AI services and WebRTC live streaming in the browser.

- **Behavior analytics & suspicion scoring** with instant alerts pushed to the instructor dashboard through WebSockets.

- **AI-powered grading & plagiarism detection** with results displayed in an interactive web interface.

- **Instructor dashboard with AI assistant**, built on React for live data visualization, chat-style AI queries, and historical exam review.

- **Automated reporting with visual evidence**, downloadable via the web platform, including embedded video snapshots and AI explanations.

- **Secure, scalable MERN architecture** providing authentication, role-based access, and encrypted data handling.

- **Responsive, accessible web design** ensuring seamless use across devices for both instructors and students.

5.Features

i. Computer Vision & Proctoring
- Face recognition for ID verification (via AI service) integrated into the student exam page using WebRTC for live camera capture.
- Live face & student tracking displayed on the instructor dashboard in real time.
- Mobile phone detection with instant alert via WebSockets.
- Eye gaze & head pose estimation with visual indicators in the dashboard.
- Impersonation detection combining AI face/voice verification with session authentication logs.
- Suspicion scoring with alerts for:
  - Face not detected
  - Phone detected
  - Looking away too long

ii. Voice Monitoring

- Real-time speech transcription displayed in instructor dashboard chat panel.
- Unauthorized speaking detection triggering alerts via Socket.IO.
- Speaker diarization identifying multiple speakers in session.
- Speech activity logs stored in MongoDB and downloadable from instructor panel.

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iii. Logging & Behavior Analytics

- Timeline-based event logging stored via backend API for retrieval in dashboards.
- Heatmap of attention loss rendered with React chart libraries.
- AI-generated behaviour summaries accessible via dashboard tabs.
- Replay mode in the web app with jump-to-alert controls synced with video storage.
- PDF export with AI explanations generated on-demand from backend endpoints.

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iv. Instructor Dashboard (MERN-Integrated)

- Live student video feeds using WebRTC grid layout.
- Real-time suspicion indicators updated via WebSockets.
- Active/inactive student tracking based on socket connection status.
- AI-generated notes per student displayed in side panels.
- Downloadable reports & history viewer with search and filter controls.
- Manual override of AI decisions with changes logged in backend.

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v. AI Assistant (RAG + LLM)

- Integrated into instructor dashboard as a chat interface.
- Uses Retrieval-Augmented Generation (RAG) to combine real-time monitoring data with relevant course materials, syllabus, and historical logs.
- Allows natural language queries through web UI, sending them to backend for processing by AI services.
- Dynamically retrieves supporting information from:
    - Student behaviour logs in MongoDB
    - Uploaded lecture notes & syllabus (vectorized in FAISS)
    - Instructor-provided rubrics and policies
- Generates personalized feedback backed by retrieved evidence, ensuring transparency.
- Justifies alerts by linking AI decisions to logged events and reference documents.
- Offers context-aware educational assistance during exams without revealing correct answers.

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vi. Auto-Grading System (RAG-powered)
- Integrated into backend exam submission API.
- Uses RAG to retrieve grading rubrics, model answers, and relevant lecture content before evaluation.
- Supports:
  - Semantic grading (meaning-based, not just keyword matching)
  - Partial scoring aligned with retrieved rubric criteria
- Links grades to evidence by embedding retrieved reference excerpts in grading reports.
- Produces PDF grade reports accessible in instructor dashboard.

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vii. Plagiarism & AI Detection (RAG-integrated)
- Embeds all submitted answers into FAISS for internal similarity checks against other students' work.
- Uses RAG to:
  - Retrieve closest-matching past answers for similarity scoring
  - Compare with external sources via APIs
  - Retrieve course content to detect verbatim or paraphrased copying
- Distinguishes between:
  - Human-written but copied text
  - AI-generated content
- Provides originality scores with retrieved reference passages, viewable in the instructor dashboard.

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viii. Reporting
- Auto-generated PDF reports containing:
  - Behaviour summary
  - Suspicion score
  - Grades
  - Plagiarism results
- Instructor overview reports accessible via dashboard.
- Embedded video snapshots of flagged events viewable in browser before download.

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4. Roadmap & Timeline

Phase 1 (First Semester – 5 months)

Deliverables:
  - Online & Offline Exam Monitoring
  - Face recognition, gaze/head pose tracking.
  - Voice monitoring (speech detection, diarization).
  - Instructor Dashboard (basic version with live feeds + alerts).
  - Behavior logging & suspicion scoring.
  - AI Assistant (RAG-powered for justifications & queries).

Phase 2 (Second Semester – 5 months)

Deliverables:
- o Phone detection & impersonation checks.
- o Full Voice Monitoring Suite (speech transcription logs + diarization).
- o Behavior Analytics (AI summaries, heatmaps, replay mode).
- o AI Chatbot (basic support for exam FAQs).
- o Auto-Grading with semantic RAG evaluation.
- o Plagiarism & AI Detection integrated into reports.
- o Automated Reporting with video evidence, AI explanations, and downloadable reports.
- o Enhanced dashboard (historical review, manual overrides, searchable reports).

5. Potential Hardware Requirements

- Cameras & Microphones: For exam halls and online sessions.

- Cloud/Server Infrastructure: For NLP, RAG-based AI, and storage.

6. Final Application

Our project is not just a monitoring tool , it is a **complete AI-powered and web-integrated assessment ecosystem** for both online and offline exams.
By combining advanced AI capabilities with a **secure, scalable, and user-friendly MERN-based web platform**, it ensures integrity, fairness, and efficiency while delivering an exceptional user experience for both students and instructors.
Its hybrid design makes it ideal for academic institutions, training centers, and certification bodies seeking a modern, transparent, and fully automated assessment solution.

7. Team members
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