BSSE FINAL PROJECT
Software Design Specification

INVIGILEYE

Project Advisor

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Software Design Specification

SDP Phase II

INVIGILEYE

Advisor: Ms. Saher Zia

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Zieshan Ali	**Prototype & Document**
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Table of Contents

Revision History

Name	Date	Reason For Changes	Version

Previous Phases Feedback

Idea Defense Feedback (Screenshot)

Abstract

InvigilEye is an AI-powered invigilation system for physical examinations. It enhances exam integrity and fairness through facial recognition for automated attendance and unauthorized face detection, posing estimation to flag suspicious behavior and instant alert to invigilators. The system will also be able to save snapshots (visual evidence) for post exam reports, while admins will be able to configure exam parameters (e.g., venues, students' data etc.) and be able to download reports. InvigilEye reduces 70-80% of manual workload by applying ML models and integrating cameras with desktop interface, ensures unbiased monitoring and provides insights-modernizing exam security from student authentication to detailed reporting.

1. Introduction

1.1 Product

InvigilEye is basically an AI-powered invigilation system mainly designed for physical examinations. It majorly enhances exam integrity and fairness through advanced facial recognition, which automates attendance and also detects unauthorized faces in real time. The system also uses pose estimation to flag overall suspicious behavior and sends quite instant alerts to invigilators, ensuring very timely action during exams.

With the ability to simply save snapshots as visual evidence, InvigilEye also supports post-exam analysis and reporting. Admins can easily configure essential exam parameters, such as venues and student data, and download detailed reports whenever they are needed.

InvigilEye reduces about 70–80% of manual workload just by integrating machine learning models with a camera-enabled desktop interface. This ensures unbiased, consistent monitoring and provides highly valuable insights—modernizing exam security from overall student authentication to complete reporting. It's a really smart solution for institutions seeking a highly reliable and tech-driven approach to physical exam supervision.

1.2 Background

1. Online Proctoring Platforms

- [1]**Proctorio** mainly offers an AI-powered, browser-based monitoring system designed for conducting remote exams. It generally supports features like identity verification and screen tracking.
- [2]**ProctorU** combines live and automated proctoring with core functionalities such as ID checks and session recording for all sorts of online assessments.

Limitations: Both platforms are simply limited to online exams only. They offer absolutely no support for physical exam halls, lack pose estimation to analyze behavior, and cannot even generate real-time alerts within in-person environments.

2. Traditional and CCTV-Based Invigilation

- **Manual Supervision:** Heavily depends on invigilators that are physically monitoring the exam hall, which is highly prone to human fatigue, limited coverage, and unintentional oversight.
- **CCTV Monitoring:** While some institutions use some sort of fixed cameras during exams, these setups mainly lack AI integration. As a result, they cannot automatically detect cheating behaviors or generate instant reports or alerts.

How InvigilEye Differs:

InvigilEye is developed specifically for physical examination scenarios. It simply combines facial recognition for attendance, pose estimation to detect cheating behaviors, and real-time alerts for invigilators. Additionally, it generates detailed automated reports with timestamped visual evidence. Unlike earlier solutions, it offers a pretty complete package for in-person exam monitoring, using AI to enhance overall accuracy, reduce workload, and improve academic integrity.

1.3 Objective(s)/Aim(s)/Target(s)

The aim of this project is to build a system that:

1. cut down manual invigilation work by 70–80%.
2. automatically detects and highlights suspicious activities like passing notes or unusual movements during exams.
3. automatically verifies attendance and identifying unauthorized students during exams.
4. sends instant real-time alerts to invigilators during any sort of suspicious actions.
5. helps the examination department by providing post-exam reports highlighting attendees and exam details.
6. provides an interactive desktop-based dashboard for both admins and invigilators where invigilators can easily monitor live alerts, call UMC, ask for material (e.g., extra sheets), and review exam reports.

1.4 Scope

The following features which are in-scope and out-scope of InvigilEye are:

1.4.1 In-Scope Features:

- **Automate Attendance:** It automatically verifies the student's attendance during exam using facial recognition system.
- **Cheating Detection:** It determines suspicious activity through pose estimation they may include cheating.
- **Alert System:** It alerts the invigilators about suspicious activities and about unknown students.
- **Snapshot Capturing:** It automatically captures the snapshots of suspicious actions for review and evidence.
- **Admin Dashboard:** It provides features for admins to login, set venues, manage exam sessions, and students' records.
- **Invigilator Dashboard:** It also provides features of invigilators to login, ask for UMC and demand material.
- **Exam Report:** It automatically generates downloadable exam and attendance report.

1.4.2 Out-Scope Features:

- Support for web/mobile platform.
- Integration with LMS.
- Grading System.

1.5 Document Conventions

The abbreviations used in this document are given below:

AI	Artificial Intelligence
GPU	Graphics Processing Unit
ML	Machine Learning
SDS	Software Design Specification
RTSP	Real Time Streaming Protocol
OpenCV	Python library of face scanning
YOLOv8	You Only Look Once Version 8 (Python library for pose estimation)
UMC	Unfair Means Case
PDF	Portable Document Format

CSV	Comma Separated Values
ERD	Entity Relationship Diagram

Table 1: Document Conventions

2. Overall Description

2.1 Product Features

InvigilEye is specifically an AI-based system mainly designed to enhance the overall physical exam monitoring. It automatically marks student attendance using facial recognition and also detects cheating through real-time pose estimation. The system sends highly instant alerts to invigilators upon detecting any sort of suspicious behavior and captures snapshots as visual evidence.

After each exam, it simply generates downloadable PDF reports containing attendance data and incident records. Admins can also manage exam setups, student data, and system configurations through a dedicated dashboard, while invigilators mainly use their dashboard to monitor alerts, request materials, and access reports.

2.2 Functional Description

InvigilEye is an AI-powered system for physical exam invigilation. It ensures exam integrity through automated processes.

2.2.1.1 Core Functions

1. **Facial Recognition**
    - Automates attendance by verifying students.
    - Detects and alerts invigilators about unauthorized faces.
2. **Pose Estimation**
    - Flags suspicious behaviors like unusual movements.
    - Sends instant alerts to invigilators.
3. **Evidence & Reporting**

- Saves snapshots of flagged incidents as visual proof.
- Generates post-exam reports with timestamps.

4. **Admin Controls**
   - Configures exam settings (venues, student data).
   - Provides downloadable reports for record-keeping.
5. **Desktop Interface**
   - Integrates with cameras for live monitoring.
   - Displays alerts and allows invigilator actions.

2.3 User Classes and Characteristics

The system is designed for the following user types:

1. Invigilators

- **Use:** Invigilators will be able to handle alerts about unverified or cheating students. They are also able to download exam reports, demand material and call for UMC.
- **Expertise:** Moderate technical knowledge.

2. Admin

- **Use:** Admin will be able to manage examinations. They upload students' data, set up exam details (such as venue and timing) and review post-exam reports and snapshots. Admins can also respond to material demand and UMC, raised by invigilators.
- **Expertise:** Moderate technical skills.

3. Students (Passive Users)

- **Use:** No direct interaction with the system - their faces and behavior are analyzed for verification and detection
- **Expertise:** Not required.

The most critical users to satisfy are invigilators and admins, as they rely on the system for smooth and effective monitoring during exams.

2.4 Design and Implementation Constraints

Here are the risk factors which are holding us back (and how we will oversee it):

- Bad Lighting:

Challenge: Bad Lighting might affect the accuracy of the system – might face difficulty in scanning student's faces.

Solution: Use WDR cameras + Train models on low light data as well.

- Budget Issues:

  Challenges: Schools cannot afford expensive cameras and GPUs.

  Solution: Support affordable (mid-range) cameras and consumer GPUs.

- Privacy Concerns:

  Challenges: Students' trust regarding their privacy.

  Solution: No raw images are saved, and snapshots can be deleted easily with a one-click option.

2.5 Assumptions and Dependencies

2.5.1 Key Assumptions

It is highly assumed that all invigilators who will be using this system will be trained before using our InvigilEye system by simply reading the overall user manual and watching a few tutorial videos. The exam environment is mainly expected to have a highly stable power supply and a properly working Wi-Fi connection. Cameras should be correctly installed at the recommended heights and positions to simply ensure that our system works 100% correctly.

2.5.2 Dependencies

The system mainly depends on IP cameras that also support RTSP, and such computers with NVIDIA GPUs to run all the AI models smoothly. It will use all these software tools like Python, OpenCV, and YOLOv8 for its main functions. The system also majorly requires overall access to the school's database for all important student information and a reliable internet connection to work properly.

Technical Architecture

2.6 Application and Data Architecture

2.6.1 Class Diagram

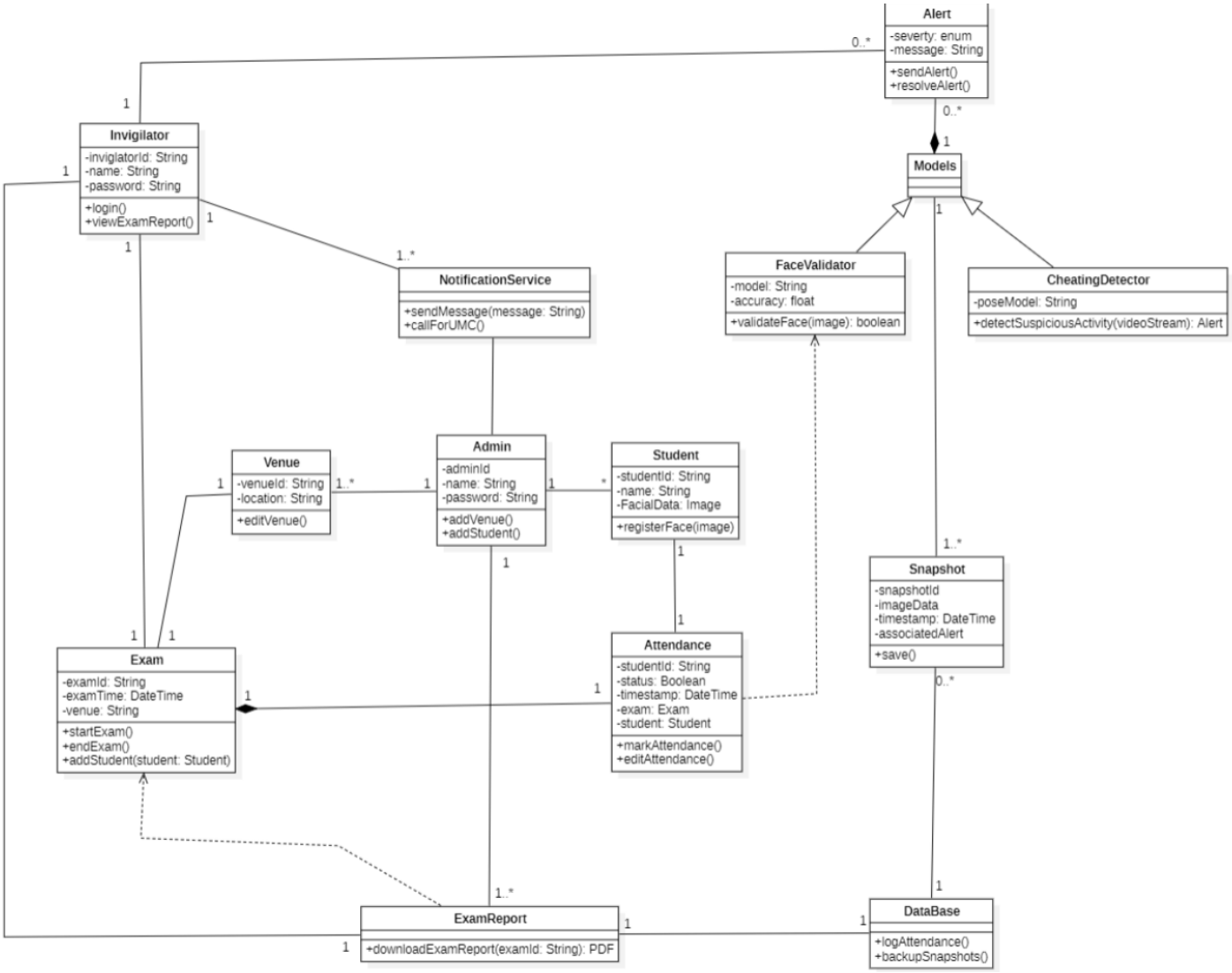


Fig.1: Class Diagram

2.6.2 Entity Relationship Diagram

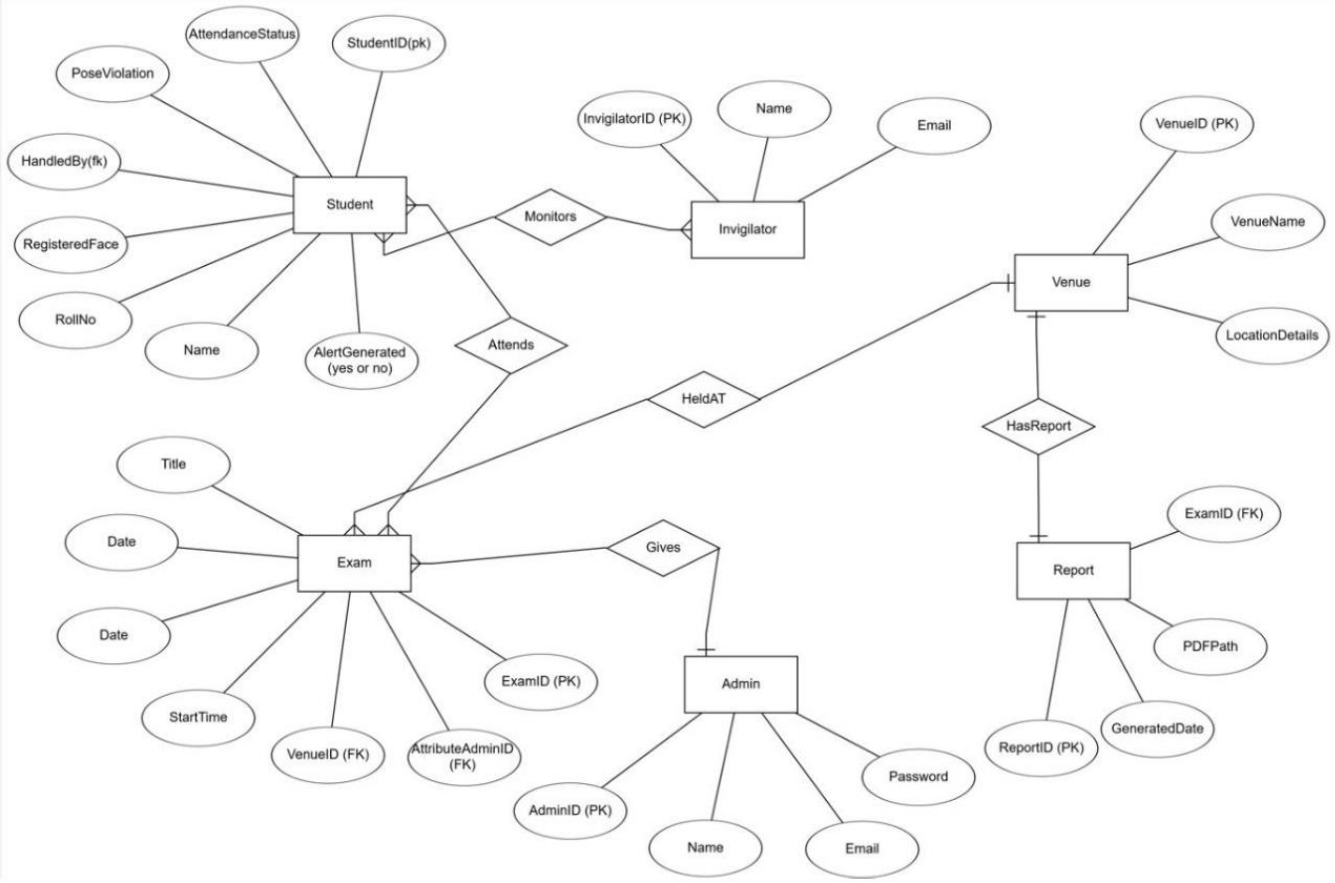


Fig.2: ERD

2.7 Component Interactions and Collaborations

2.7.1 Data Flow Diagram

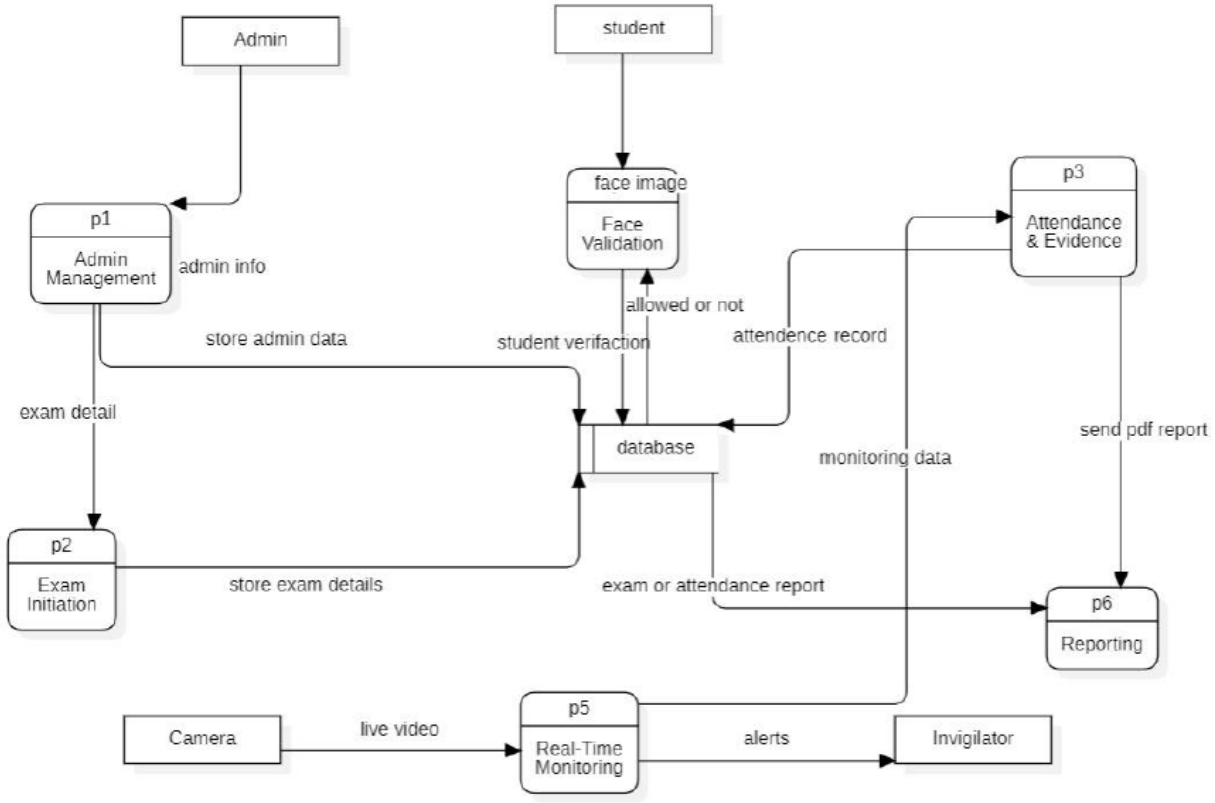
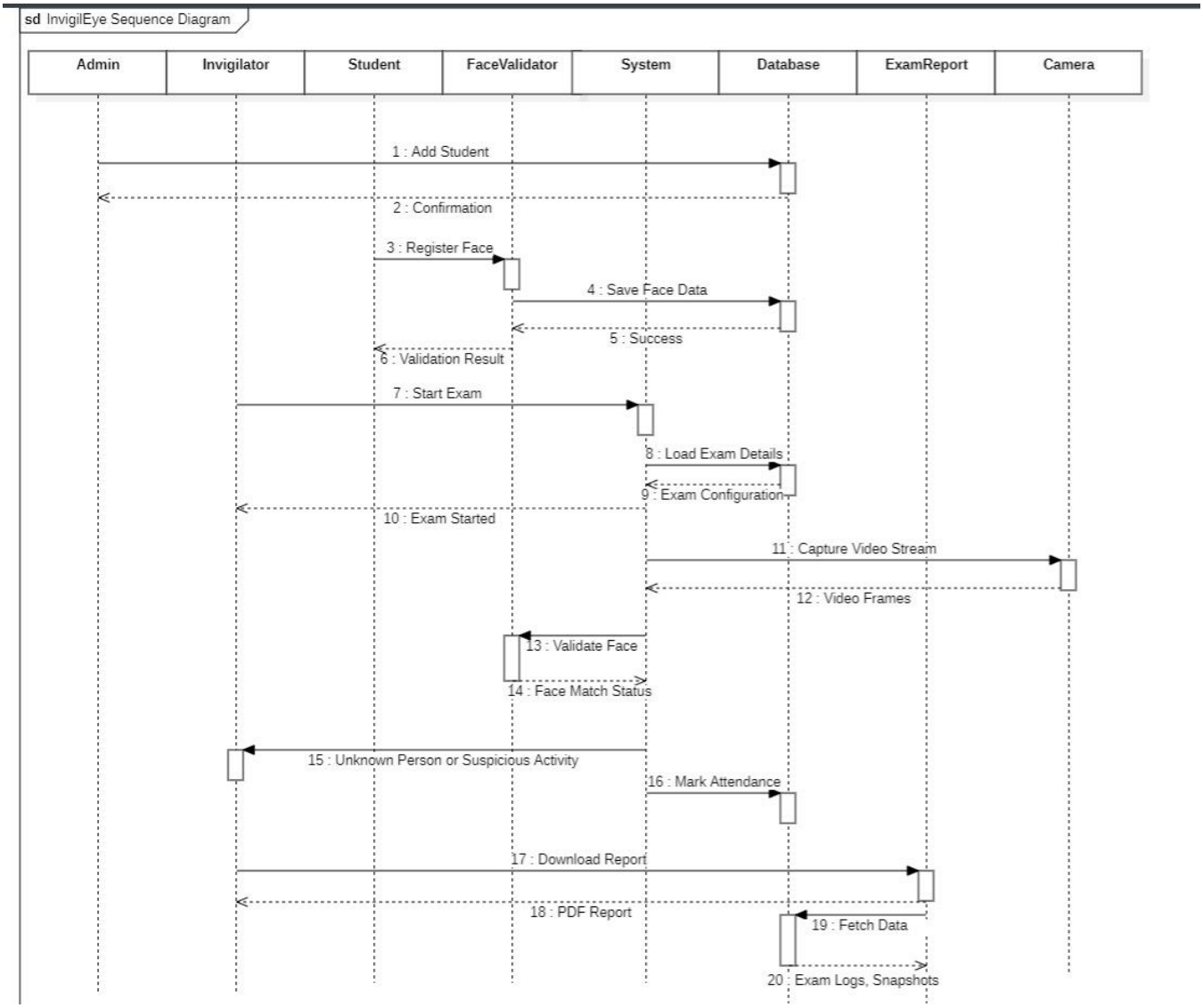


Fig.3: Data Flow Diagram

2.7.2 Sequence Diagram



2.8 Design Reuse and Design Patterns

2.8.1 Design Reuse in InvigilEye

The system utilizes the following design reuse:

1. Facial recognition technology is reused for both:
    - Automated student attendance
    - Unauthorized face detection

2. Pose estimation technology is reused for:
    - Detecting suspicious behaviors
    - Triggering real-time alerts
3. The alert system is reused for:
    - Unauthorized face notifications
    - Suspicious behavior notifications
4. The reporting module is reused for:
    - Live monitoring data
    - Post-exam reports

2.8.2 Design Patterns in InvigilEye

The system inherently uses these patterns based on described functionality:

1. Observer Pattern:
    - For real-time alert notifications to invigilators
    - When unauthorized faces or suspicious poses are detected
2. Singleton Pattern:
    - For the admin configuration interface
    - Ensures single control point for exam parameters
3. Facade Pattern:
    - Simplifies the complex interaction between:
        i. Camera systems
        ii. AI processing modules
        iii. User interface

2.9 Technology Architecture

2.9.1 Platform & System Hosting

- **Desktop Application** – Primary interface for invigilators/admins (Windows/macOS/Linux support implied).
- **Local Server/On-Premises Hosting** – Processes facial recognition, pose estimation, and alert generation.

2.9.2 Hardware Components

- **Cameras** – Integrated for real-time video feed in exam halls.
- **Workstation/PC** – Hosts the AI models and desktop application.

2.9.3 Connectivity Requirements

- **Local Network** – Connects cameras to the processing workstation.

2.9.4 Modes of Operation

- **Real-Time Monitoring** – Continuous analysis of exam hall footage.
- **Alert Mode** – Instant notifications to invigilators upon detection.
- **Report Generation** – Post-exam evidence compilation.

3. Screenshots/Prototype

3.1 Workflow

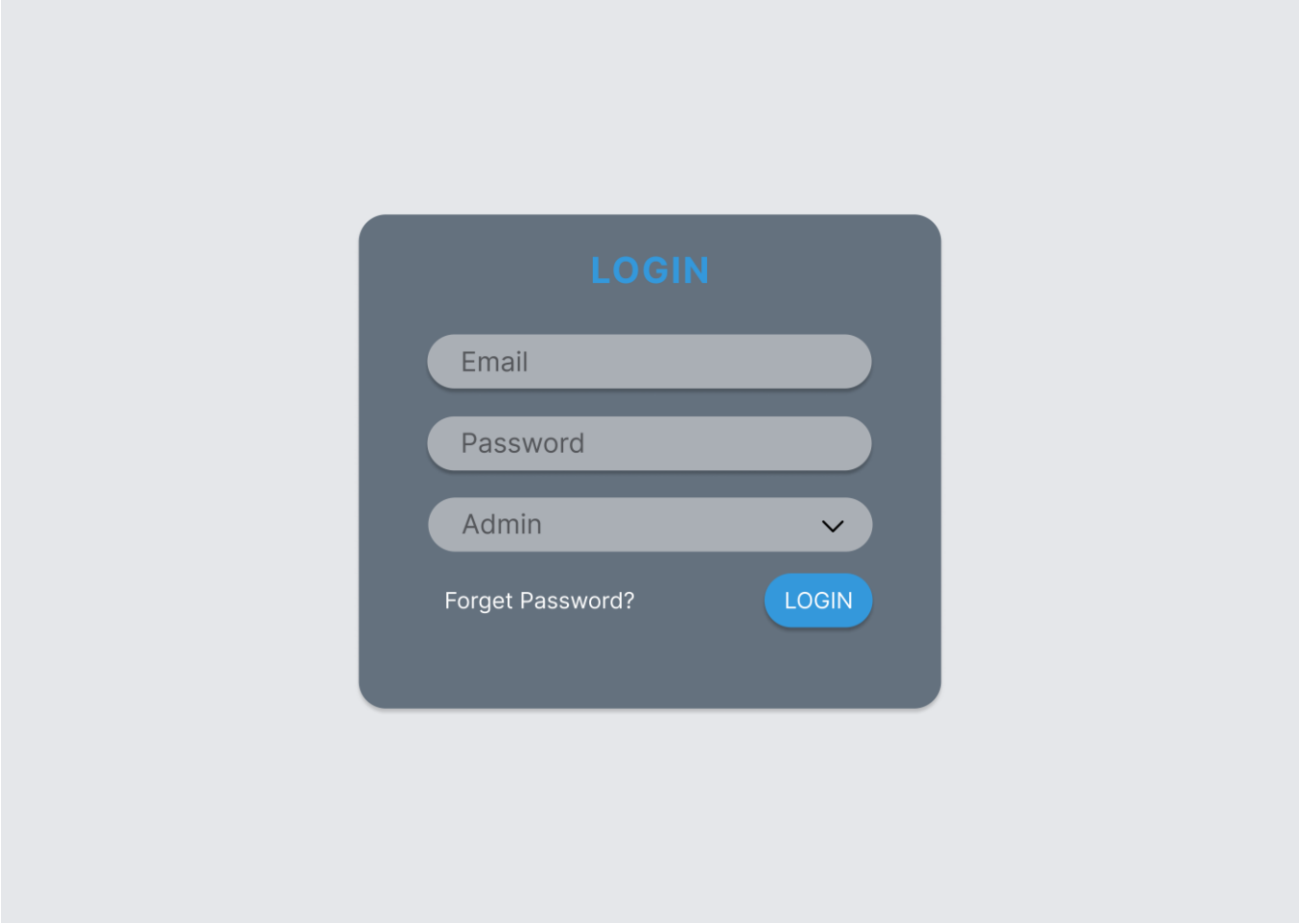
1. **Exam Setup (Admin)**
   - Admin logs in, sets up a new exam and enters details (venue, time, date, invigilator etc.).
   - Data is stored in the database with preload facial images of students.
2. **Exam Initiation (Invigilator)**
   - The invigilator logs in, sees the exam time and date, and starts the exam by clicking on ‘start’ button.
   - The system activates the camera and starts video streaming.
3. **Face Recognition**
   - Students sit at their seats; the system starts capturing their faces for attendance.
   - The system starts matching captured faces with stored facial images.
   - The system flags unauthorized on unmatched faces.
4. **Monitoring**

- The system starts monitoring students and pops up red alerts on screen on suspicious students.
- For evidence, the system stores the snapshot of suspected students.

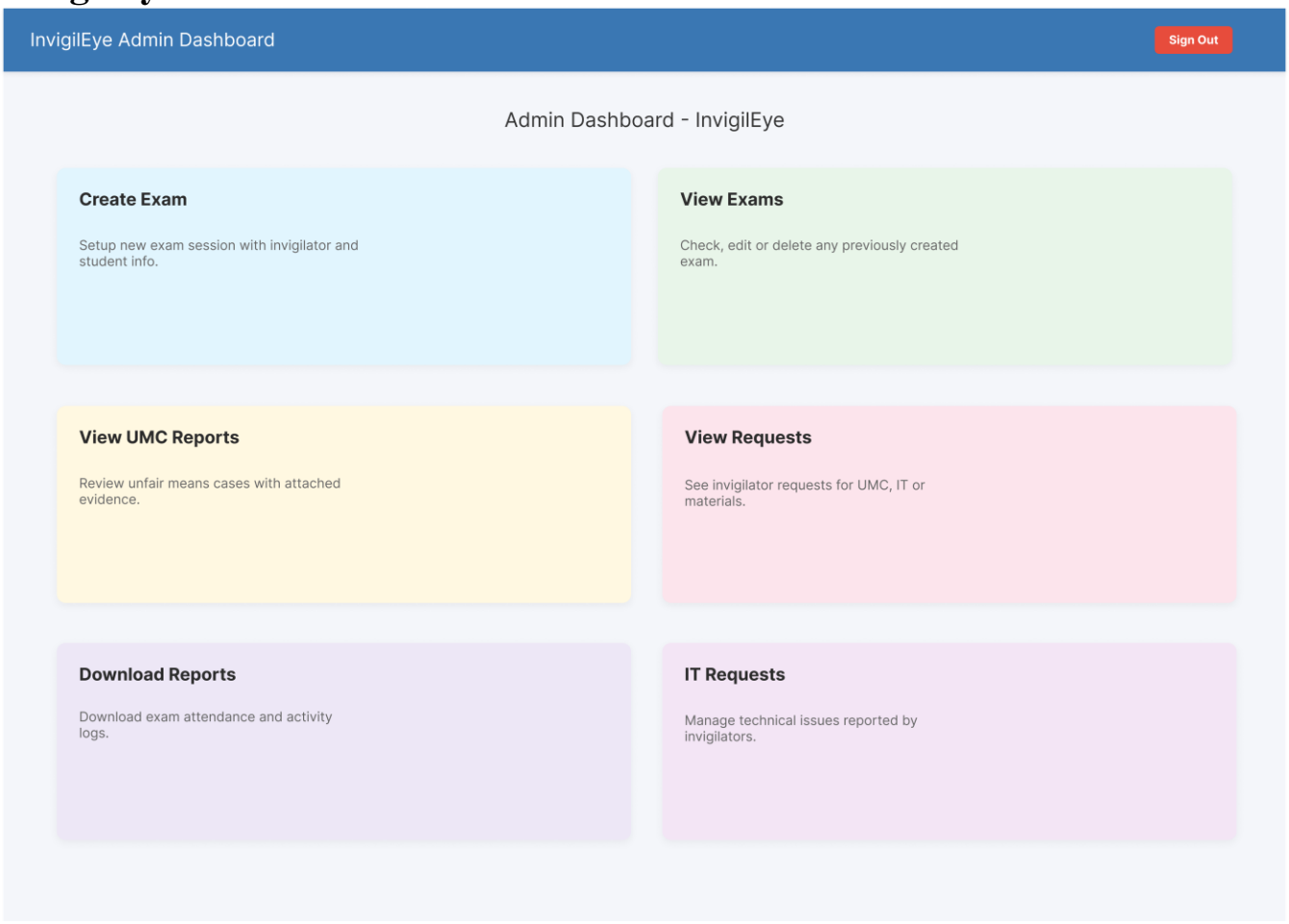
5. **Communication**
   - Invigilators can call the UMC or ask for help/material through one way messaging with admin.
6. **Post Exam Reporting**
   - Admin and invigilator can see attendance record and snapshots by clicking on 'Details' button of respected exam.

3.2 Screens

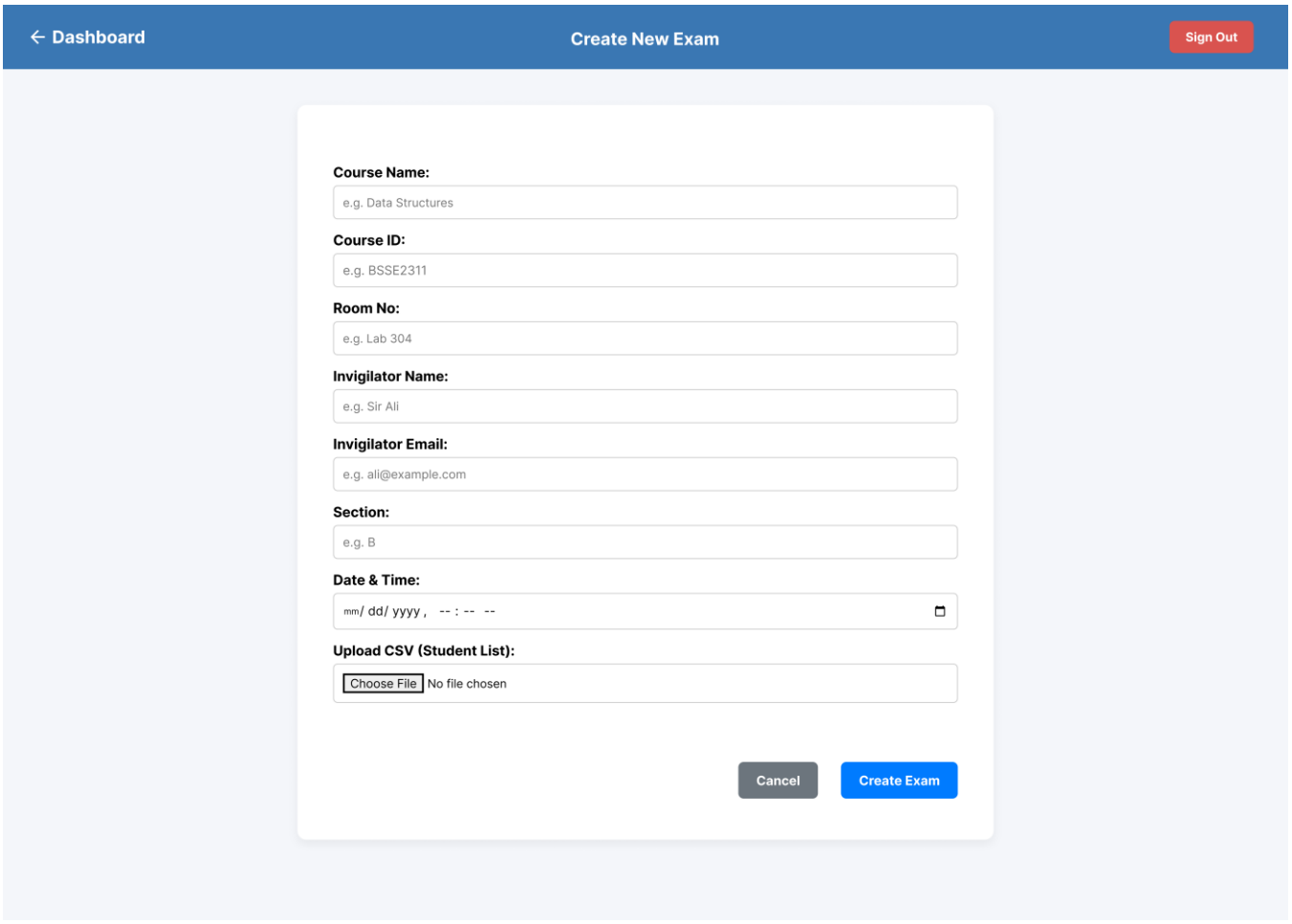
Login Page for Admin:


LOGIN
Email
Password
Admin
Forget Password?
LOGIN

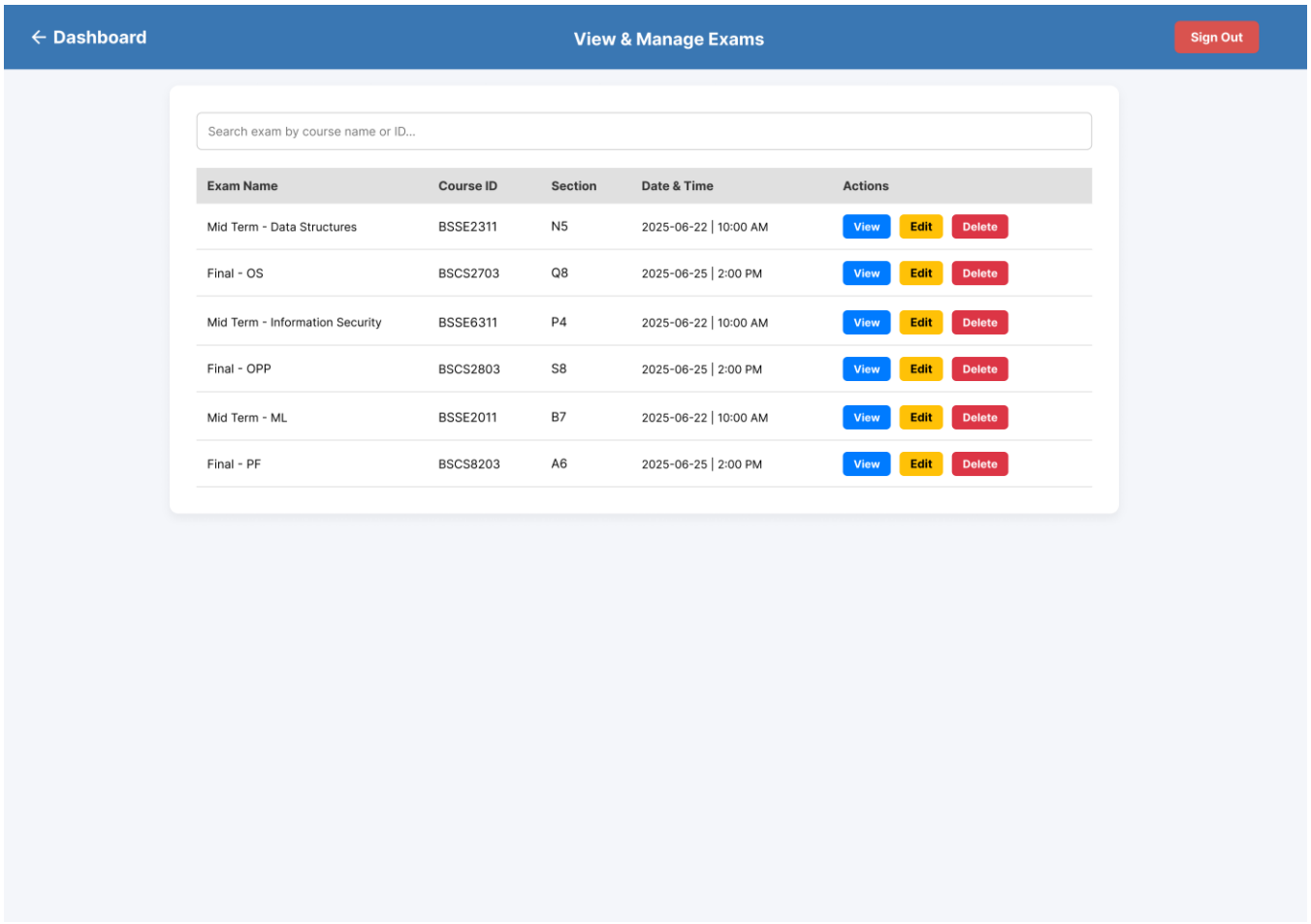
InvigilEye Admin Dashboard:



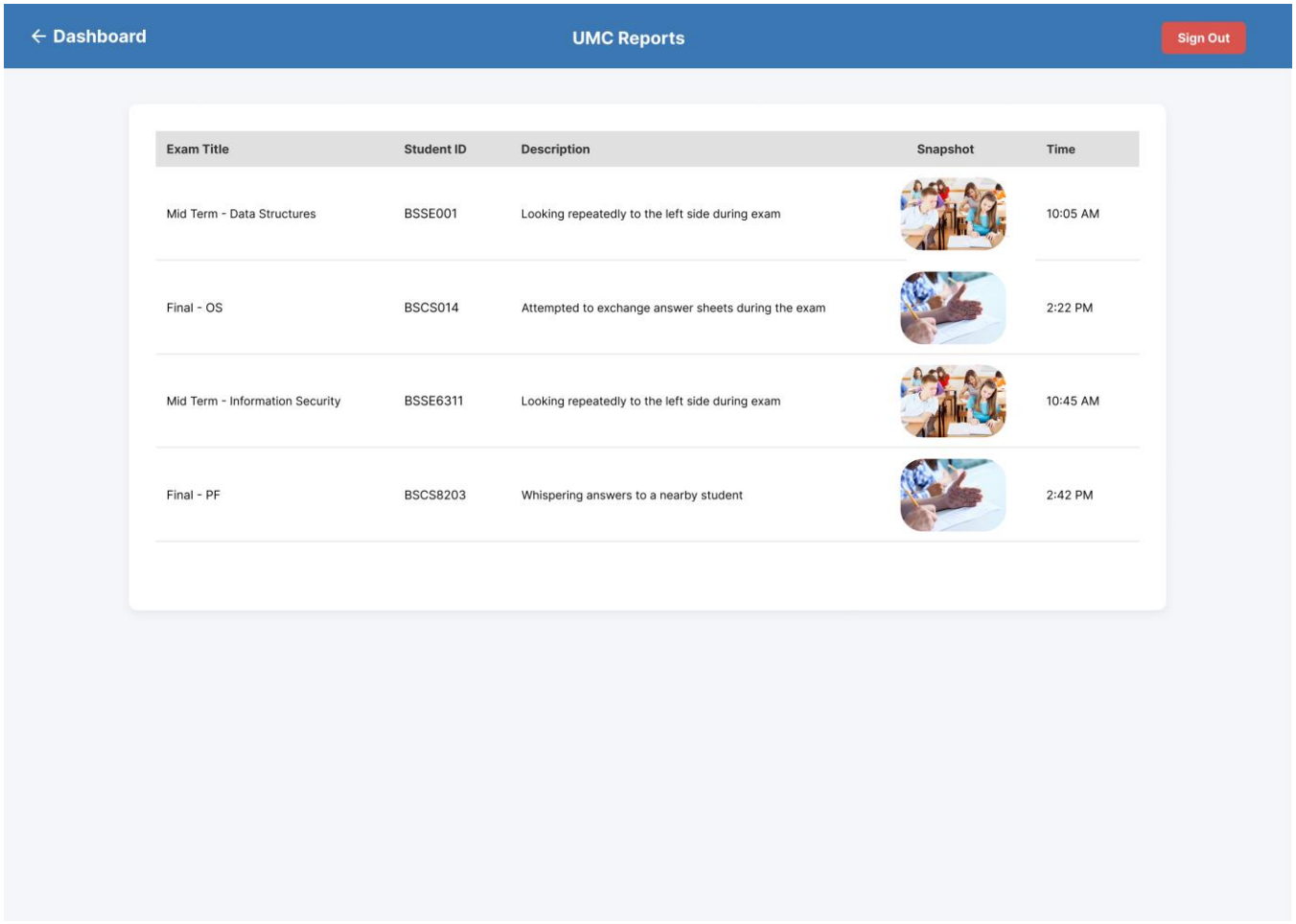
Create New Exam:



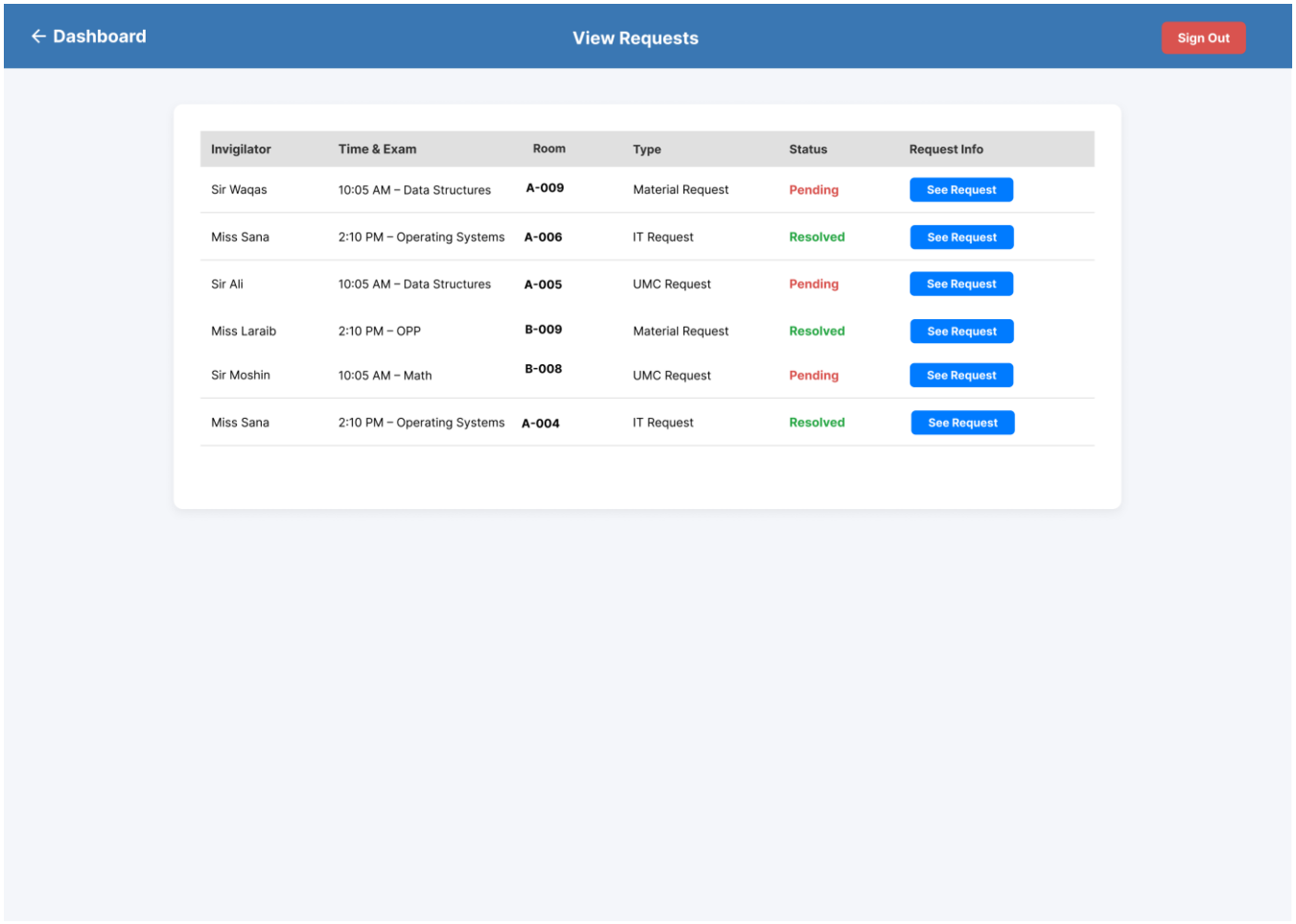
View & Manage Exams


← Dashboard
View & Manage Exams
Sign Out
Search exam by course name or ID...
Exam Name
Course ID
Section
Date & Time
Actions
Mid Term - Data Structures
BSSE2311
N5
2025-06-22 | 10:00 AM
Final - OS
BSCS2703
Q8
2025-06-25 | 2:00 PM
Mid Term - Information Security
BSSE6311
P4
2025-06-22 | 10:00 AM
Final - OPP
BSCS2803
S8
2025-06-25 | 2:00 PM
Mid Term - ML
BSSE2011
B7
2025-06-22 | 10:00 AM
Final - PF
BSCS8203
A6
2025-06-25 | 2:00 PM
View
Edit
Delete

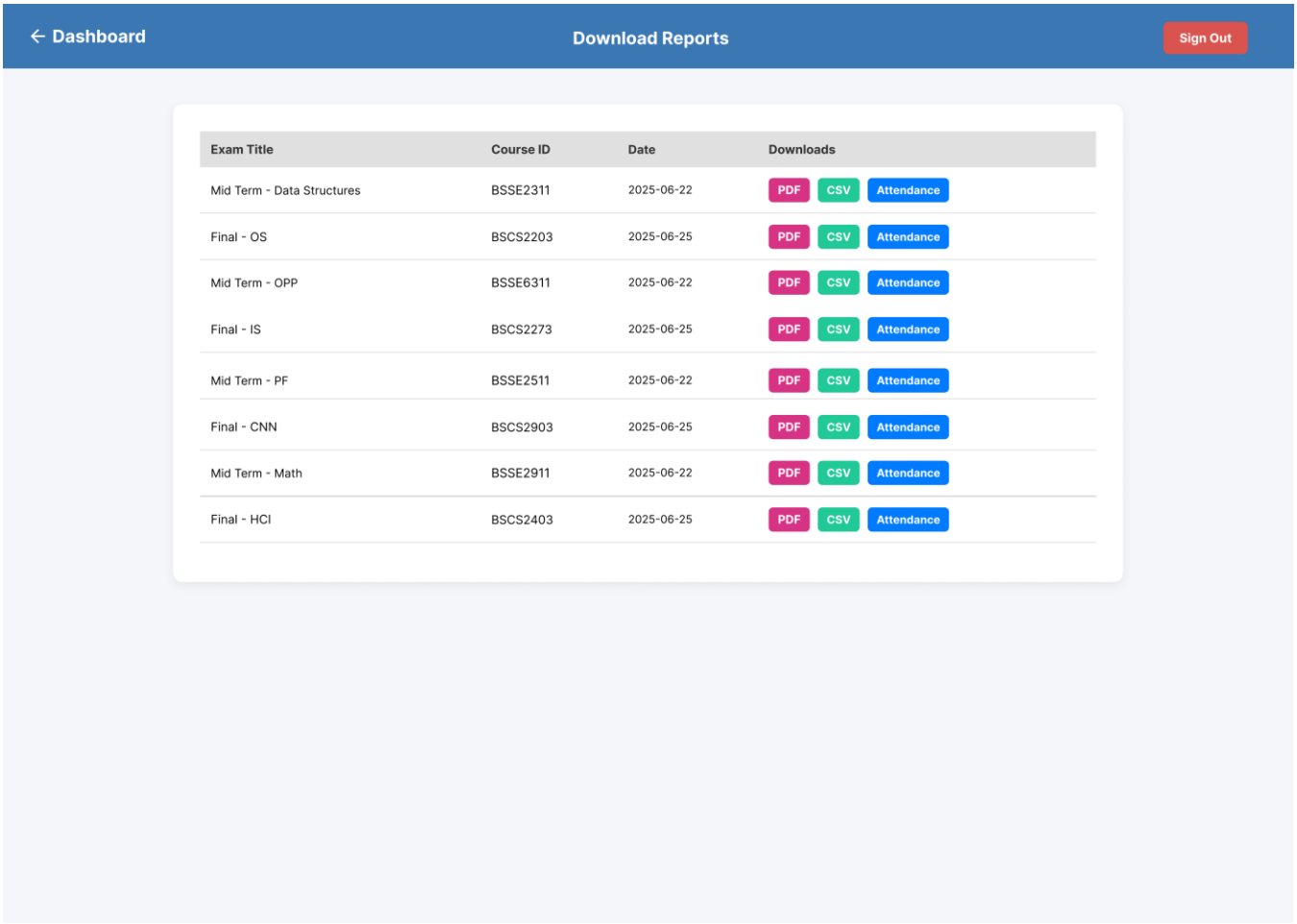
UMC Reports:


← Dashboard
UMC Reports
Sign Out
Exam Title
Student ID
Description
Snapshot
Time
Mid Term - Data Structures
BSSE001
Looking repeatedly to the left side during exam
10:05 AM
Final - OS
BSCS014
Attempted to exchange answer sheets during the exam
2:22 PM
Mid Term - Information Security
BSSE6311
Looking repeatedly to the left side during exam
10:45 AM
Final - PF
BSCS8203
Whispering answers to a nearby student
2:42 PM

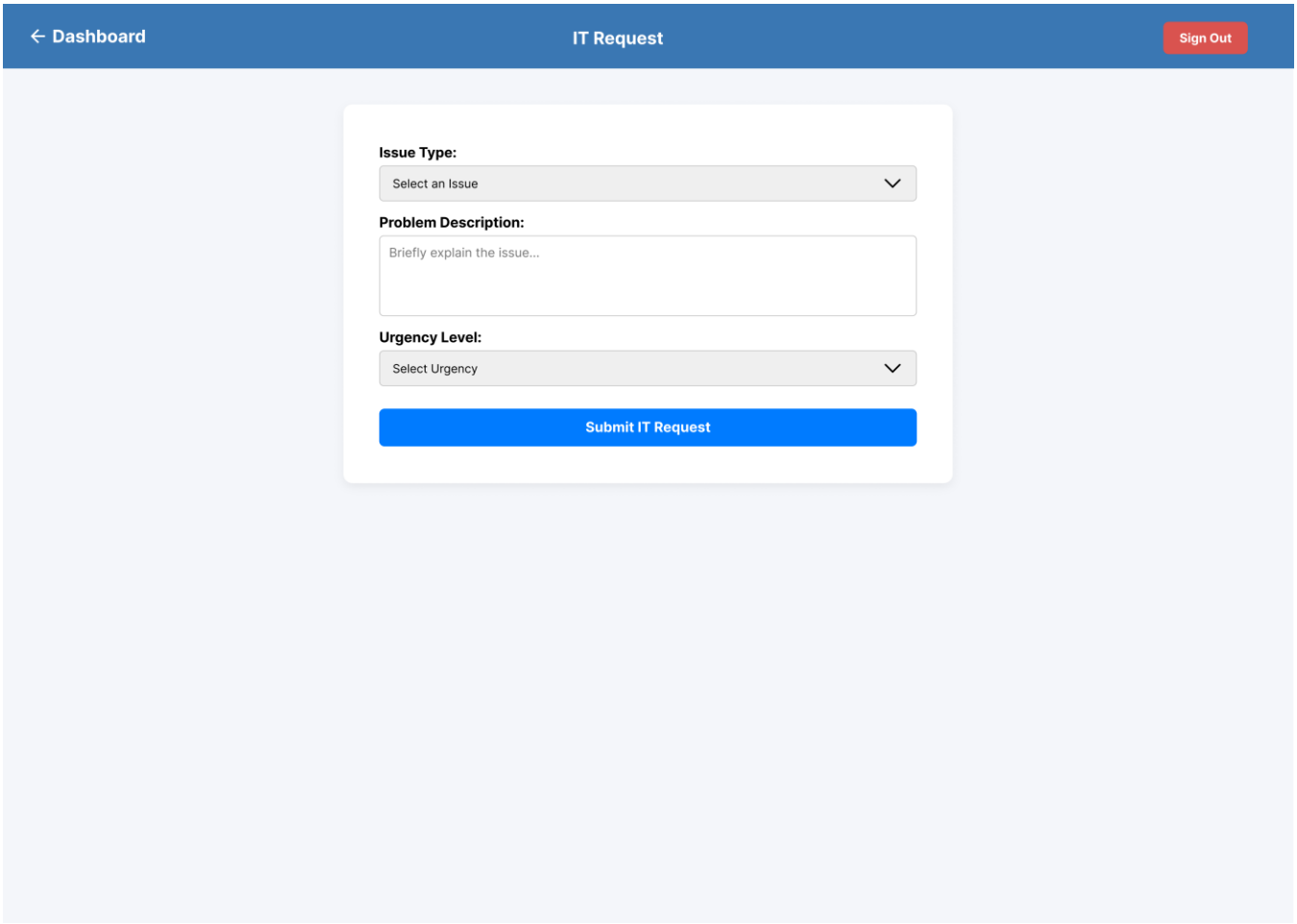
View Requests:



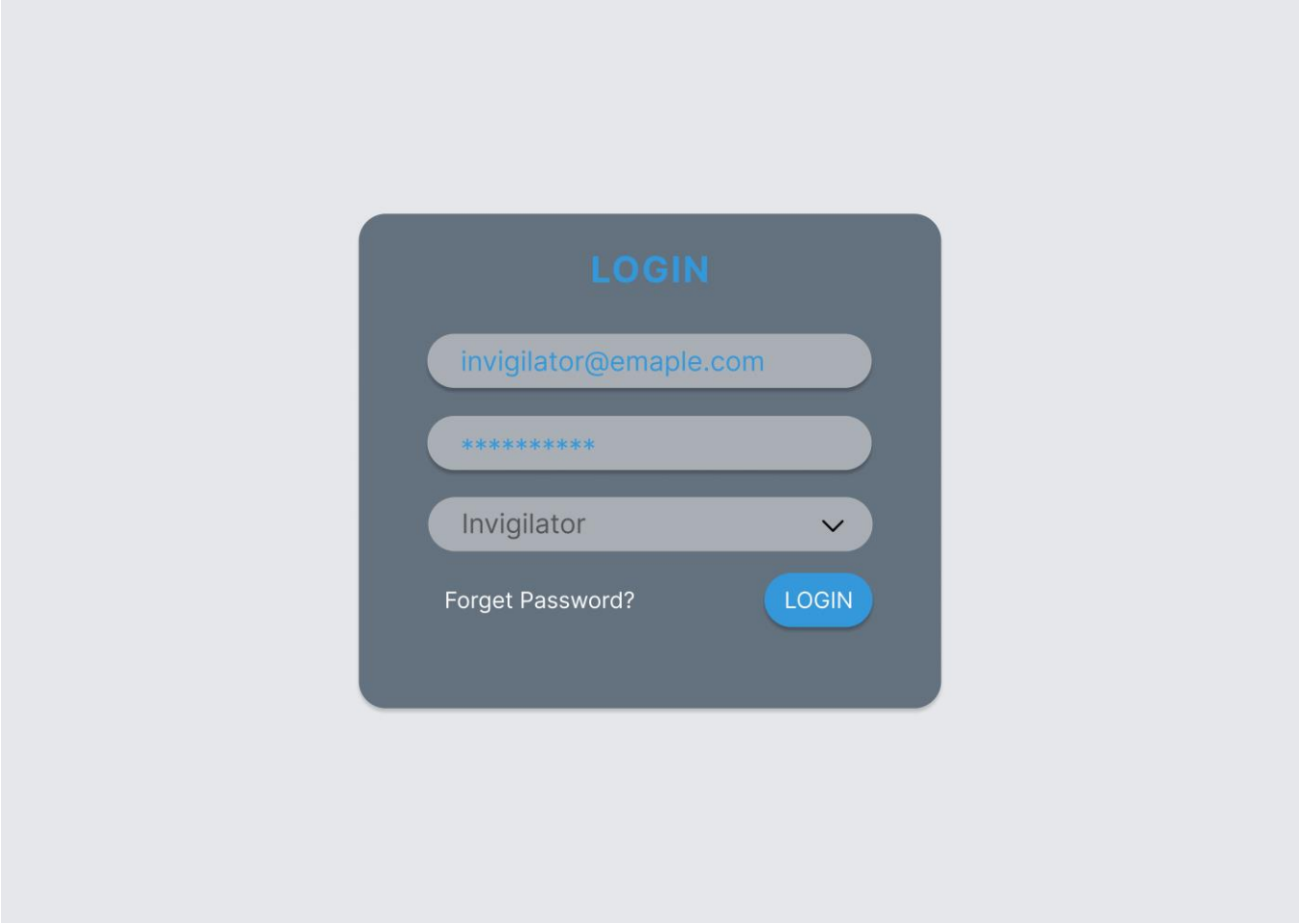
Download Reports:



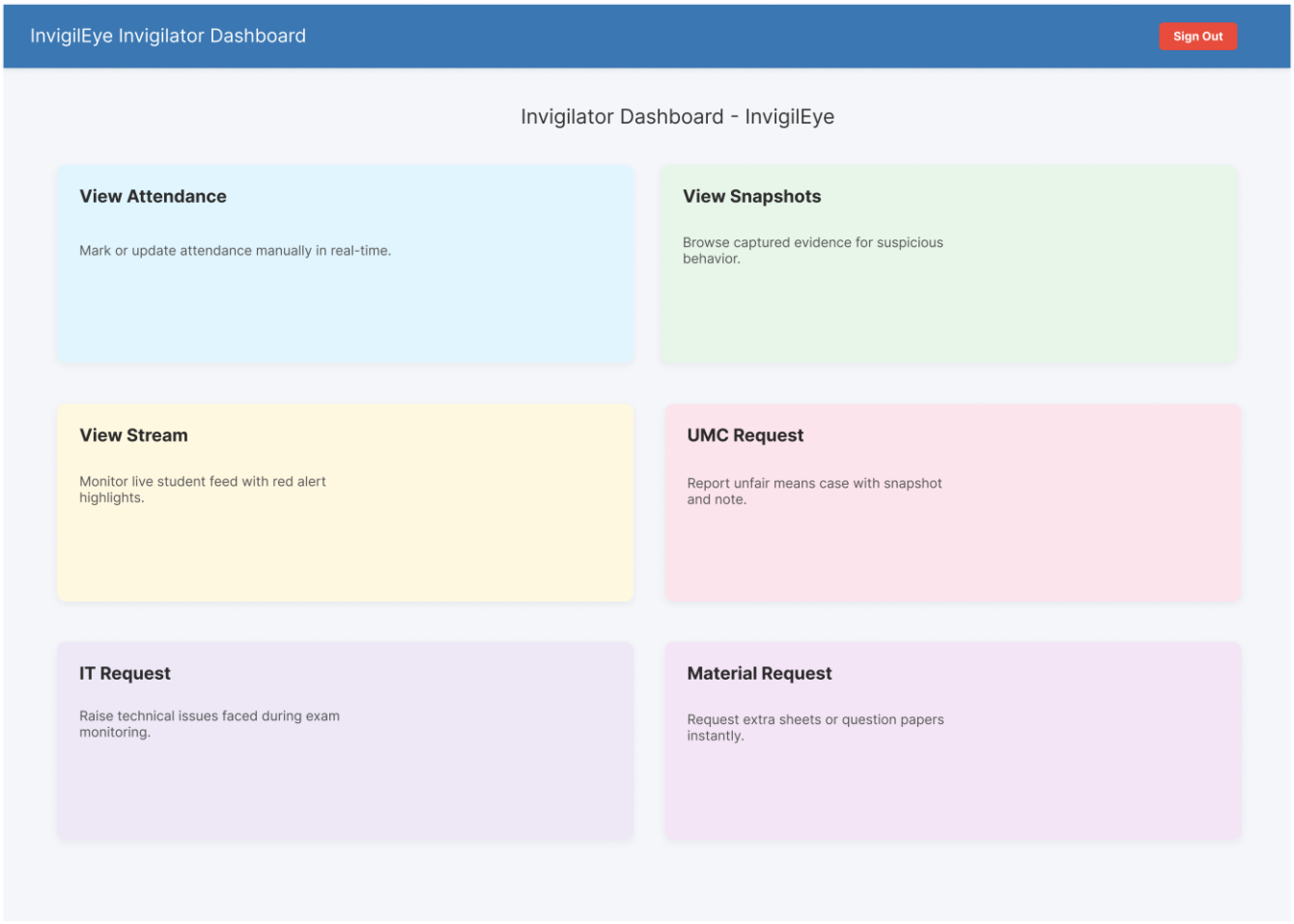
IT Request:


← Dashboard
IT Request
Sign Out
Issue Type:
Select an Issue
Problem Description:
Briefly explain the issue...
Urgency Level:
Select Urgency
Submit IT Request

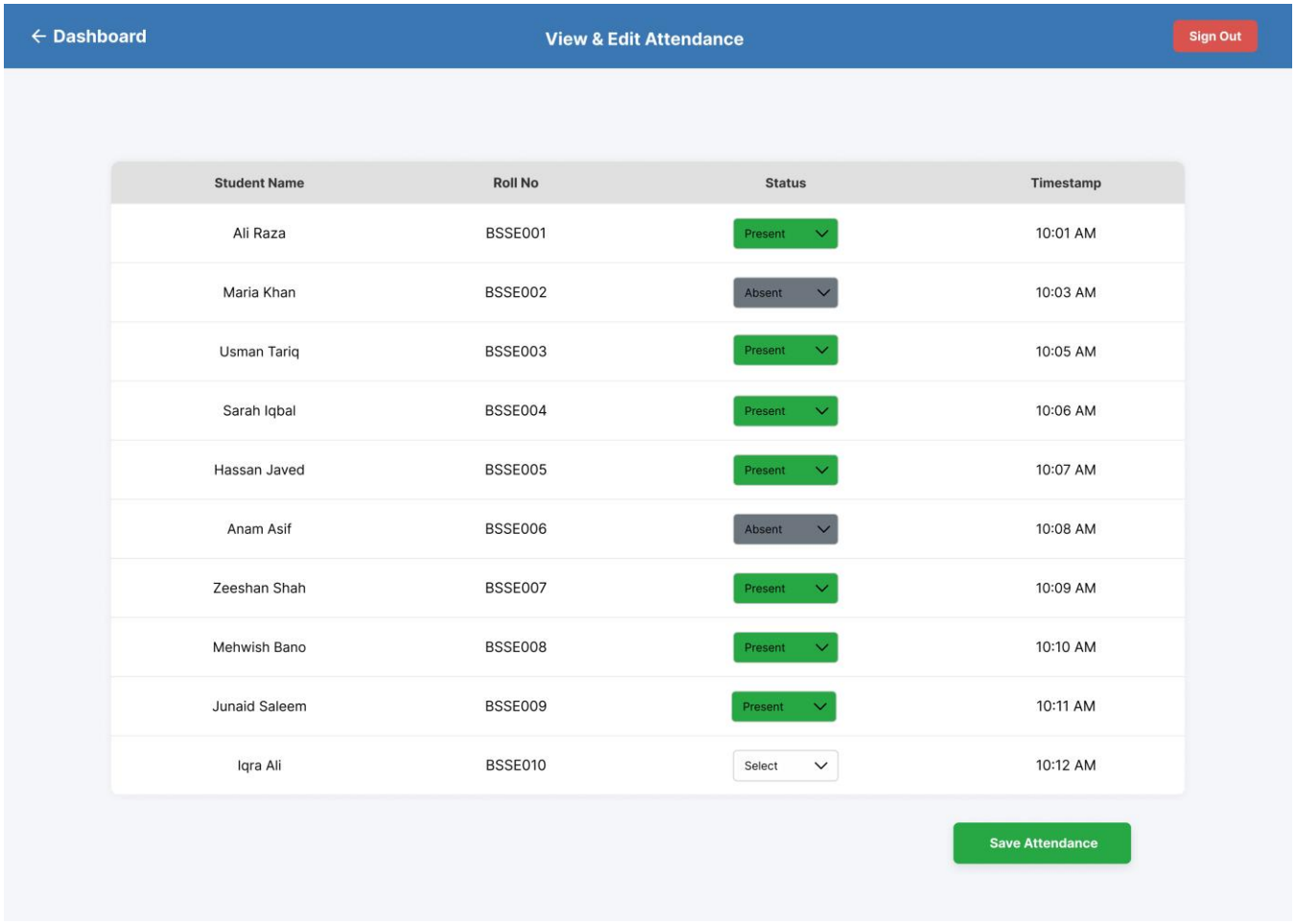
Invigilator Side Login Page:



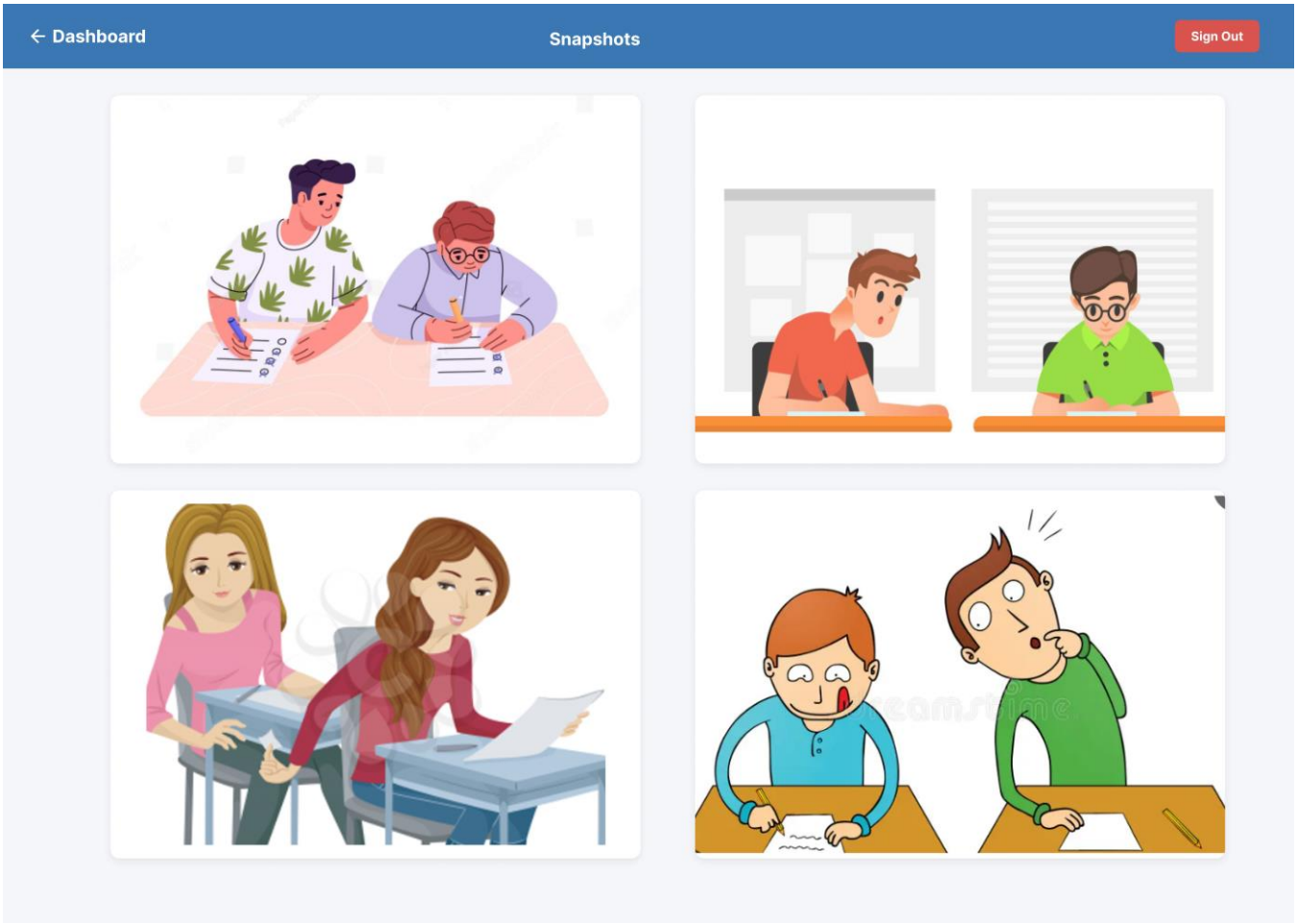
InvigilEye Invigilator Dashboard:



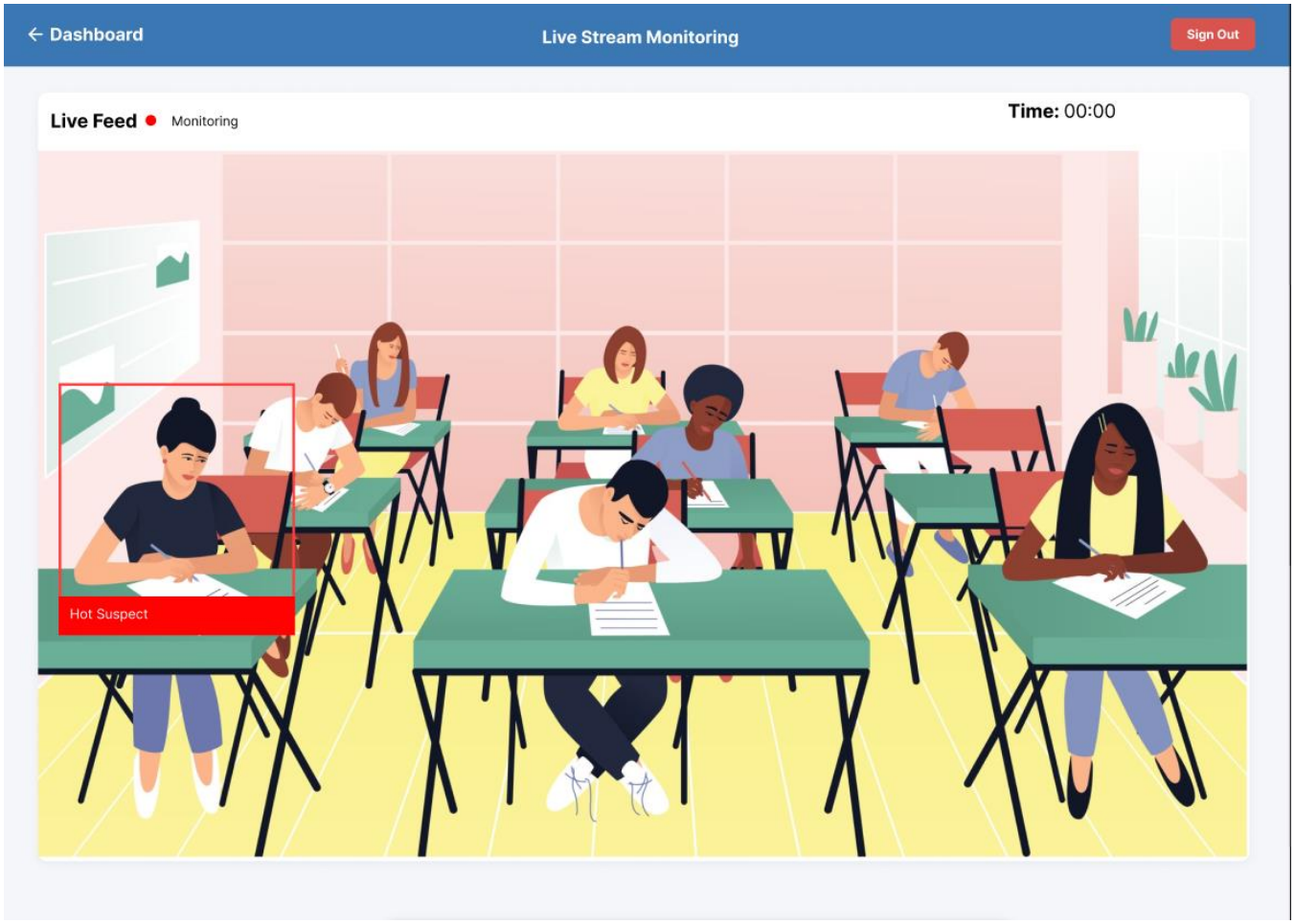
View & Edit Attendance:



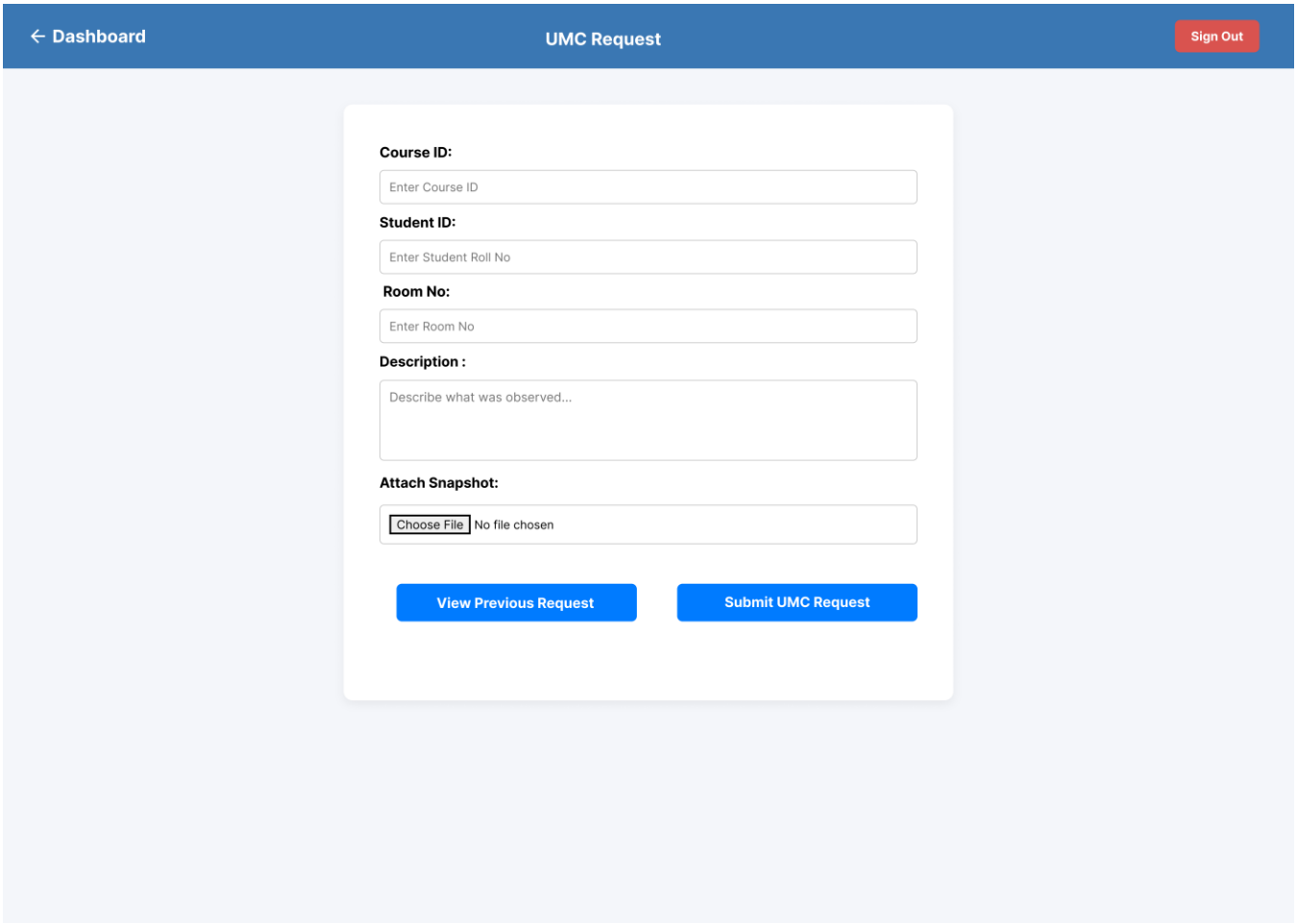
Snapshots:



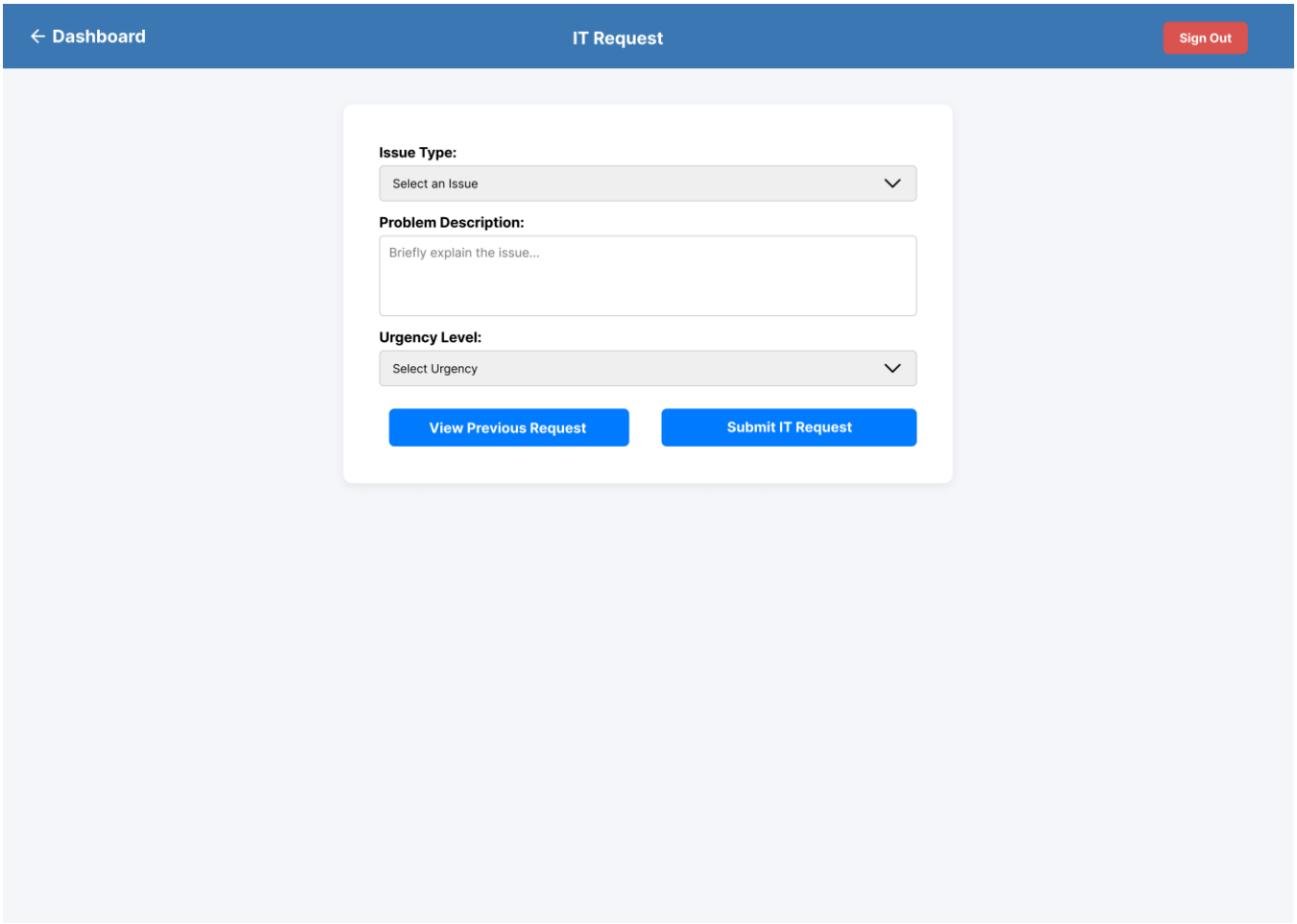
Live Stream Monitoring:



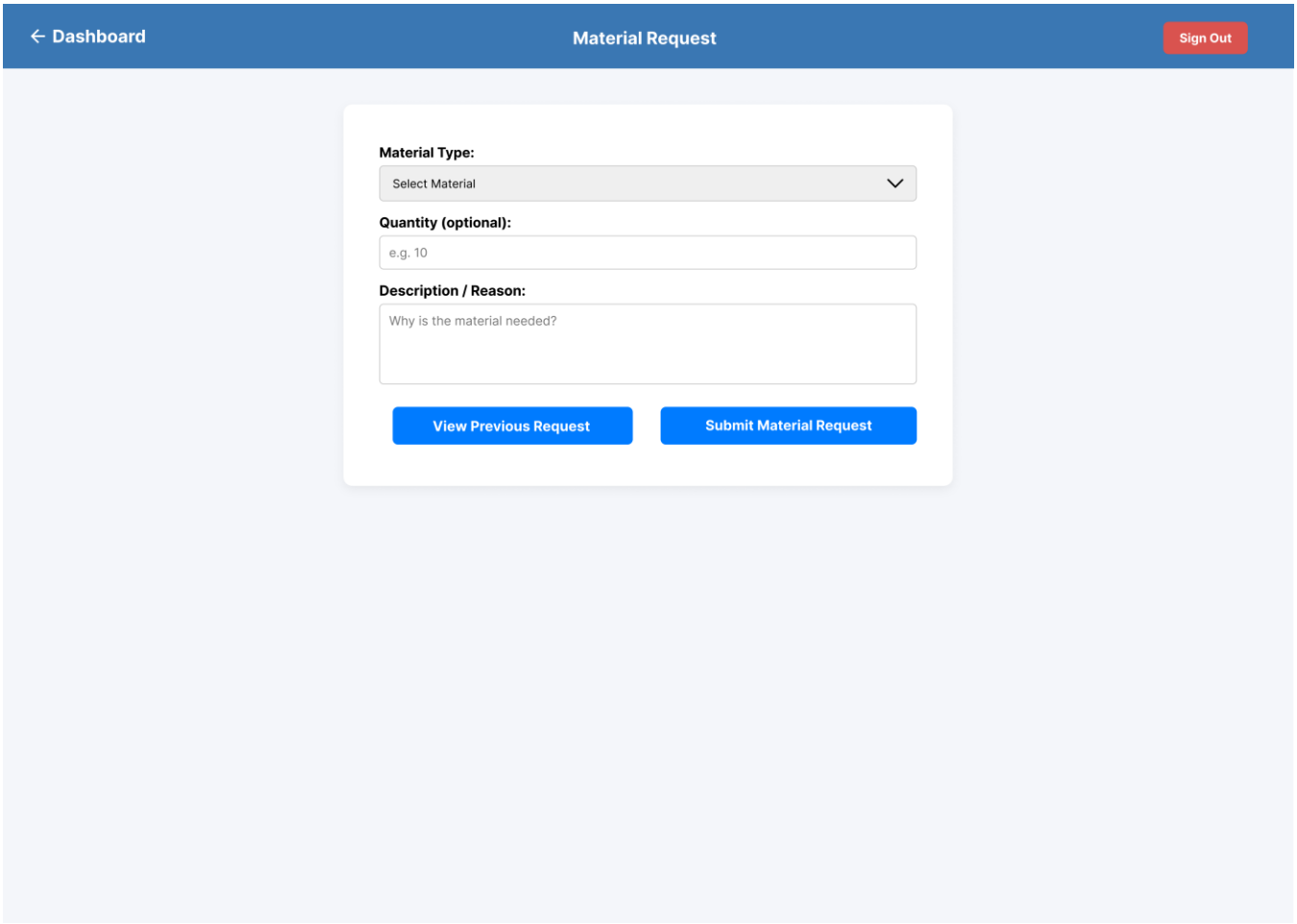
UMC Request:


← Dashboard
UMC Request
Sign Out
Course ID:
Enter Course ID
Student ID:
Enter Student Roll No
Room No:
Enter Room No
Description :
Describe what was observed...
Attach Snapshot:
Choose File
No file chosen
View Previous Request
Submit UMC Request

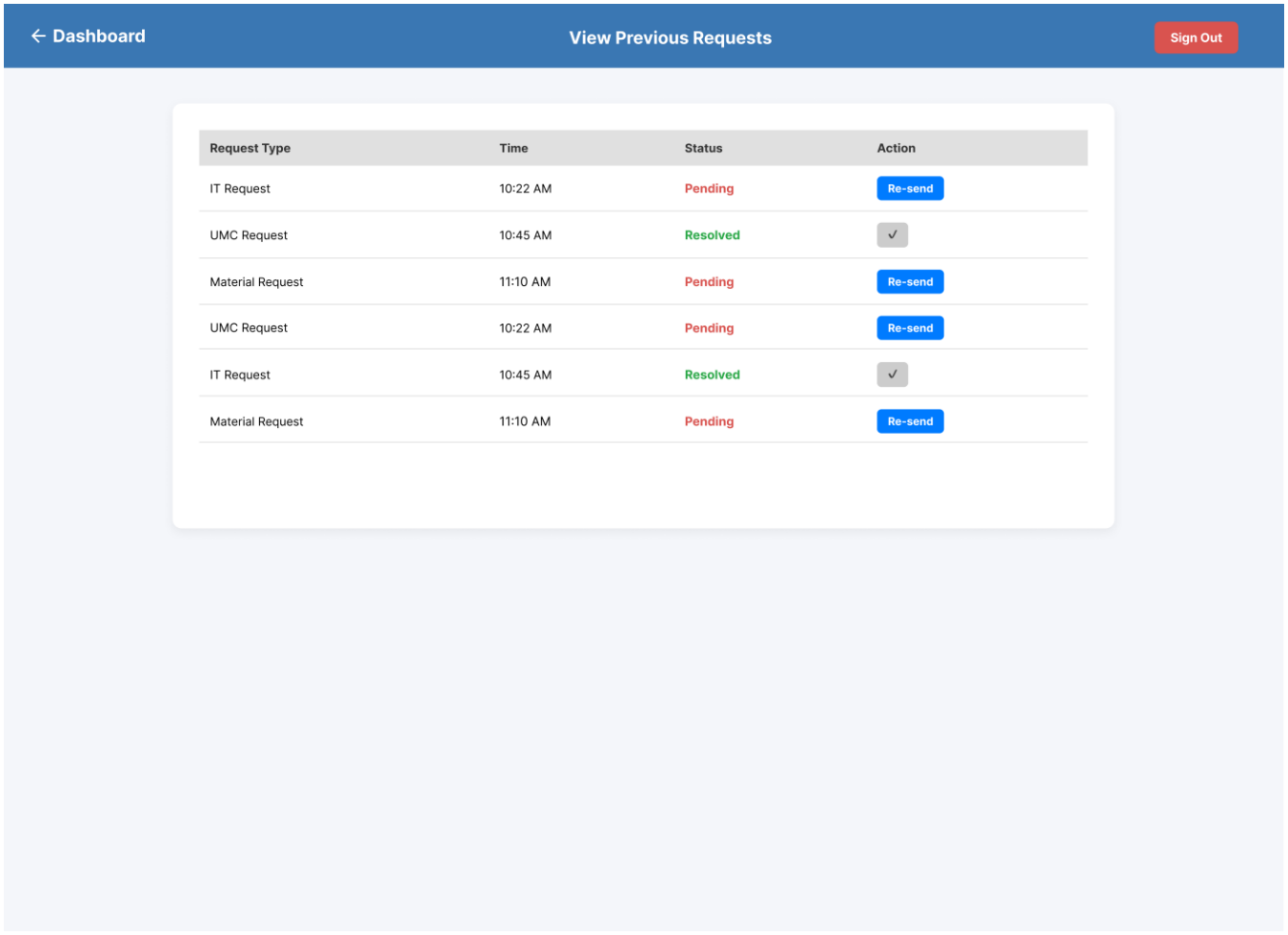
IT Request:


← Dashboard
IT Request
Sign Out
Issue Type:
Select an Issue
Problem Description:
Briefly explain the issue...
Urgency Level:
Select Urgency
View Previous Request
Submit IT Request

Material Request:



View Previous Requests:



4. Other Design Details

4.1 Core System Focus

- **Exam Hall Monitoring Only** – Designed specifically for physical exam supervision (no online/remote capabilities).
- **Desktop-Based** – No mobile or web access.

4.2 Hardware Dependency

- **Requires Cameras** – Must be connected to the processing PC.
- **No Specialized Hardware** – Uses standard desktop setup.

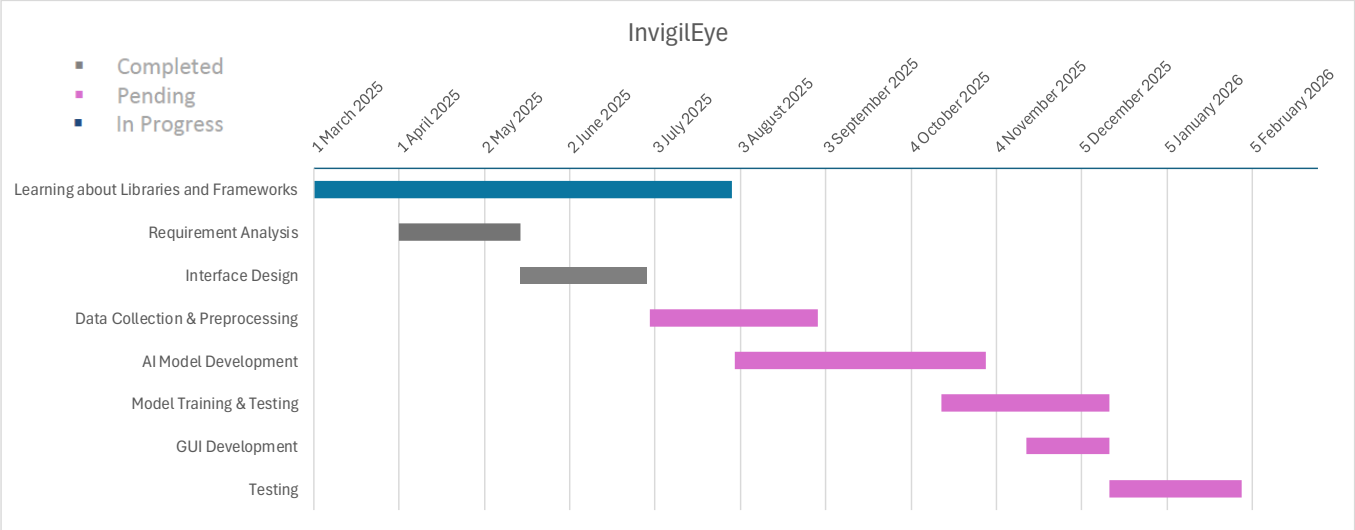
4.3 Reporting

- **Automated Reports** – Generated post-exam.

4.4 Limitations

- **No Offline Mode Mentioned** – Require active camera feed.
- **Need Active Internet Connection**

5. Revised Project Plan



6. References

[1] Proctorio. "Online Proctoring | Proctorio." [Online]. Available: https://proctorio.com. Accessed: June 17, 2025.

[2] ProctorU. "Remote Proctoring & Live Online Exam Proctoring." [Online]. Available: https://proctoru.com. Accessed: June 17, 2025.

7. Appendix A: Glossary

This glossary defines the key terms used throughout the Software **Design** Specification (S**D**S) for the InvigilEye.

Term	**Definition**
Admin	An admin is a primary system user with administrative privileges responsibilities.
GPU	A specialized processor designed to accelerate graphics rendering and is suitable for AI & ML tasks.
Invigilator	A person who is responsible for managing the system during exam session and has every right to take suitable action against suspicious activities.
Facial Recognition	AI technology that identifies and verifies identities through face and posture of body.
UMC	A formal action again illegal activities during exam session.
Snapshot	An image captured at a specific point of incident.
RTSP	Network protocol to stream video data from camera in real time.
Hot suspect	A label for students for highly suspicious.

Appendix B: IV & V Report

(Independent verification & validation)
IV & V Resource

Name Signature

S#	Defect Description	Origin Stage	Status	Fix Time	
				Hours	Minutes
1					
2					
3					
…					

Table 1: List of non-trivial defects

This document has been adapted from the following:

1. Previous project templates at UCP
2. High-level Technical Design, Centers for Medicare & Medicaid Services. (www.cms.gov)