



Classroom Occupancy Monitoring and Behavior Analysis System

Supervisors: Dr. Naoufel Werghi - Dr. Muzammal Nasser - Dr. Maregu Asefa

Examiners: Dr. Panos Liatsis - Dr. Sajid Javed

Team Members:

Alanood Alharmoodi - 100053854

Rodha Alhosani - 100058376

Shaikha Alhammadi - 100058710

Yasmine Benkhelifa - 100059531

Content

- **Introduction**
- **Problem Statement and Objectives**
- **Motivation**
- **SDP I Recap**
- **Requirements**
- **Methodology**
- **Technologies Used**
- **Data Protocol**
- **Model Training Process**
- **Evaluation Metrics**
- **Model Output Systems**
- **Challenges**
- **Next Steps**
- **Conclusion**

Introduction

Problem Statement and Objective

Problem Statement

- Traditional monitoring methods are error-prone and time-consuming.
- Need for real-time, automated solutions in classrooms.

Objective

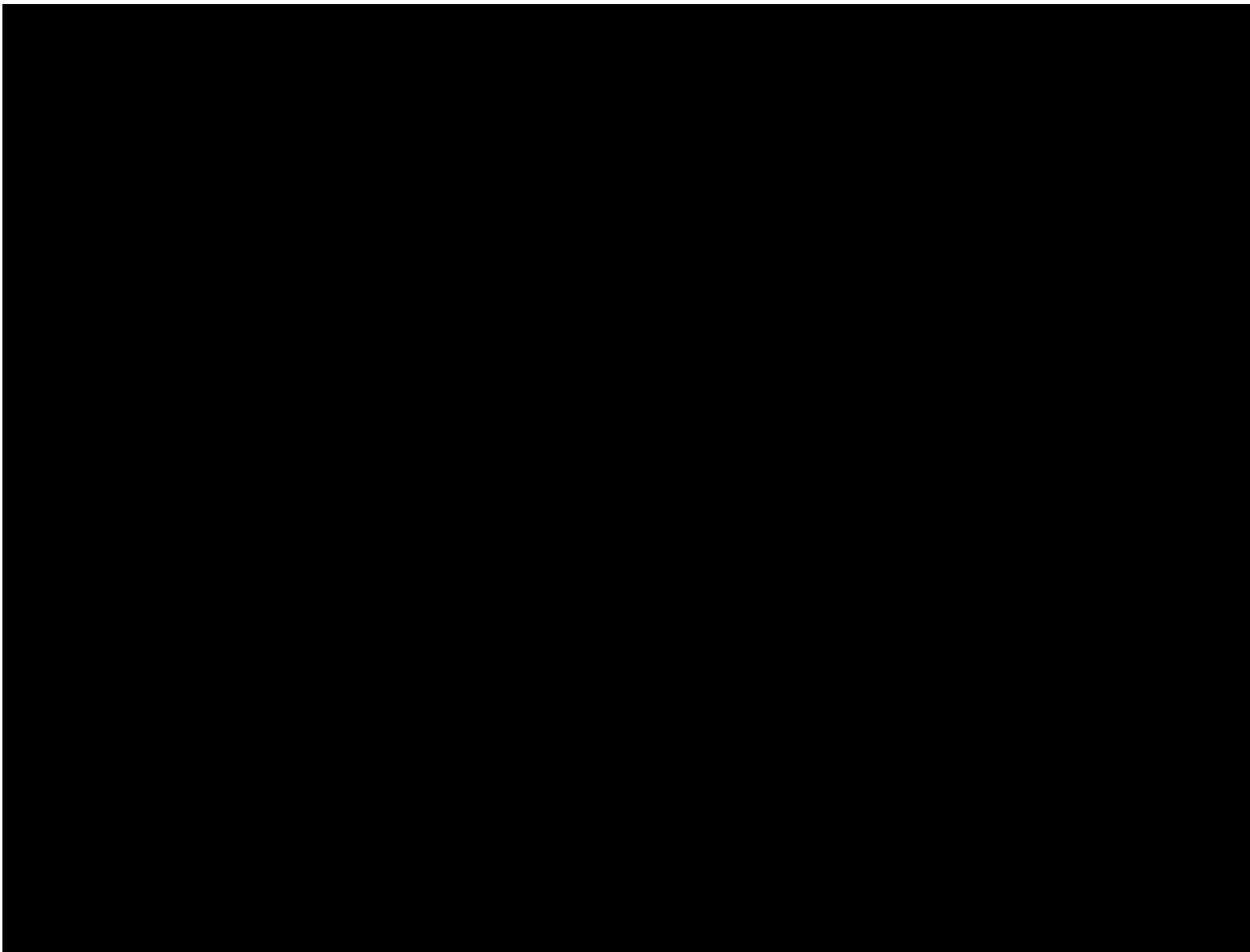
- Develop an AI-driven system to monitor classroom to detect illegal objects, behaviors, and alert when cheating occurs and unauthorized access to restricted area.

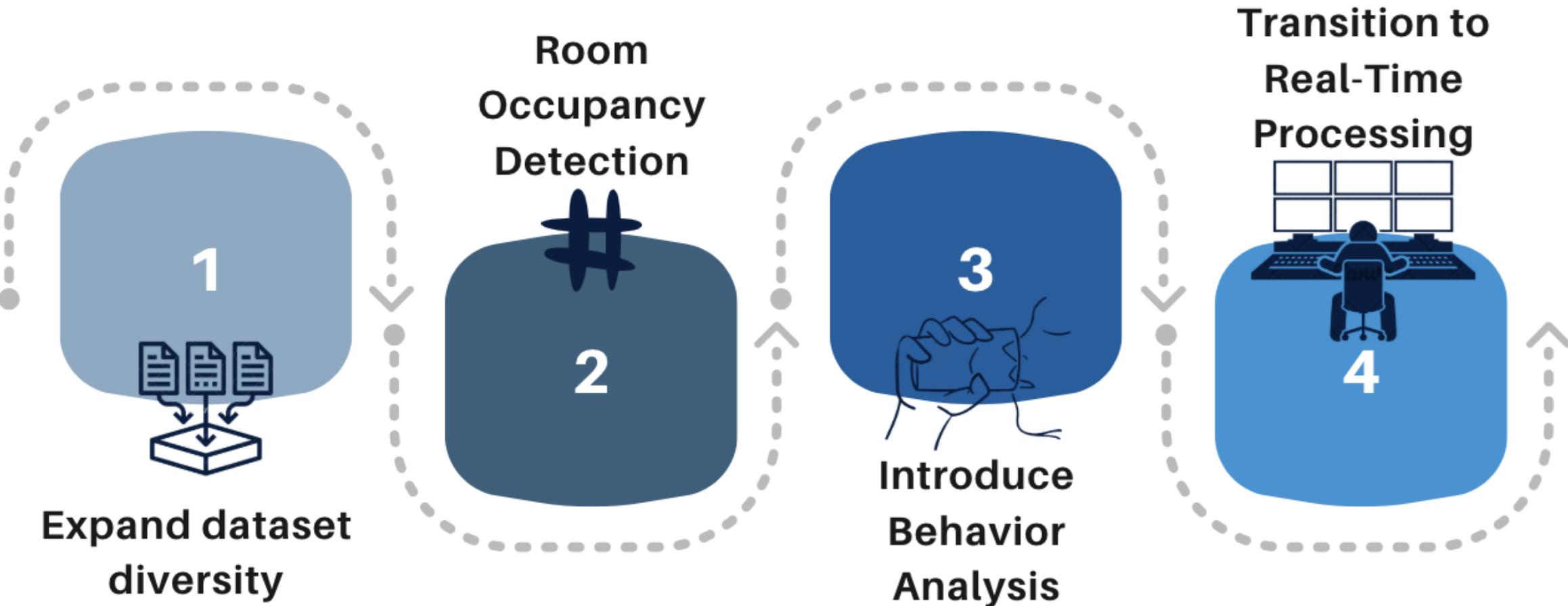
Motivation

- Create a safe, efficient classroom environment.
- Detect illegal objects and behaviors
- Notify unauthorized access in restricted areas.
- Notify when cheating case occurs.
- Reduce reliance on manual labor.

SDP I Recap

Results





Requirements

Functional Requirements

01

ILLEGAL OBJECT DETECTION



02

ILLEGAL AREA DETECTION



03

EVENT LOGGING AND REPORTING



04

OCCUPANCY MONITORING



05

BEHAVIOR ANALYSIS



06

MODE SWITCHING (NORMAL AND EXAM MODES)



07

LIVE AND OFFLINE VIDEO SUPPORT



08

GUI VISUALIZATION



Non-Functional Requirements

01
ACCURACY



02
ROBUSTNESS



03
USABILITY



04
LATENCY



05
EFFICIENCY



Methodology

Technologies Used



Windows 10



Technologies Used



**OpenCV and Webcam
Video Capture**

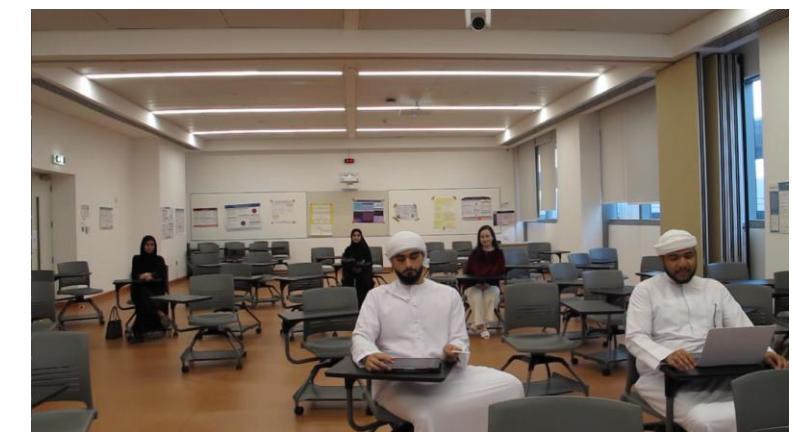
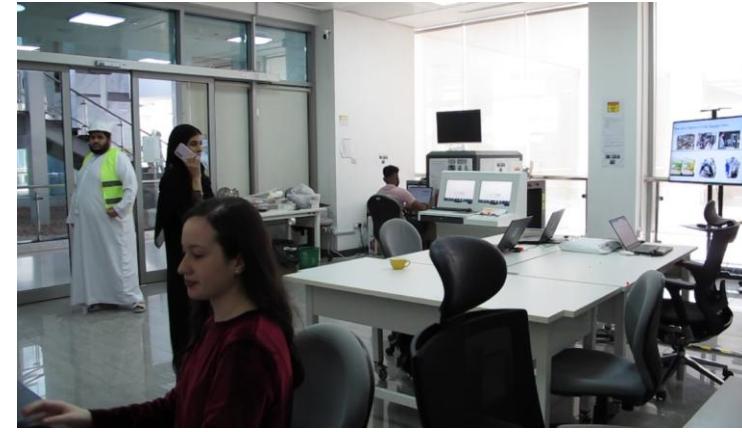
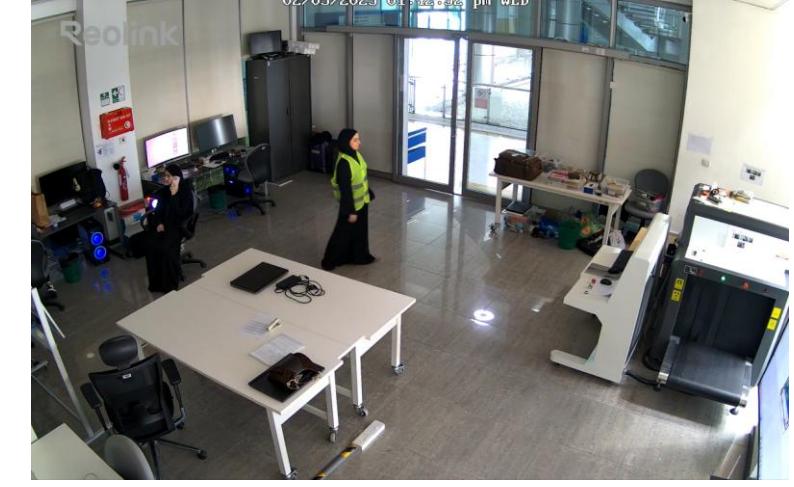
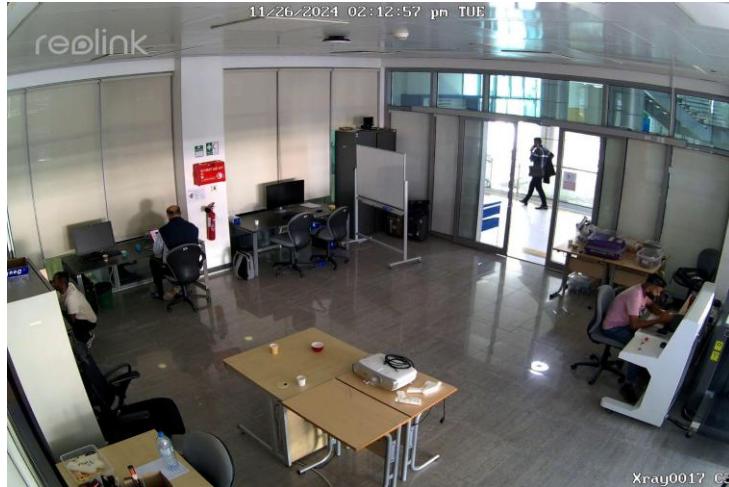
Technologies Used



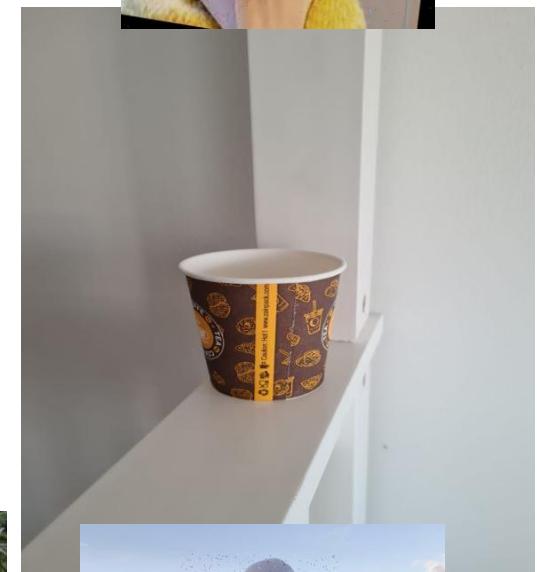
Technologies Used



Data Collection



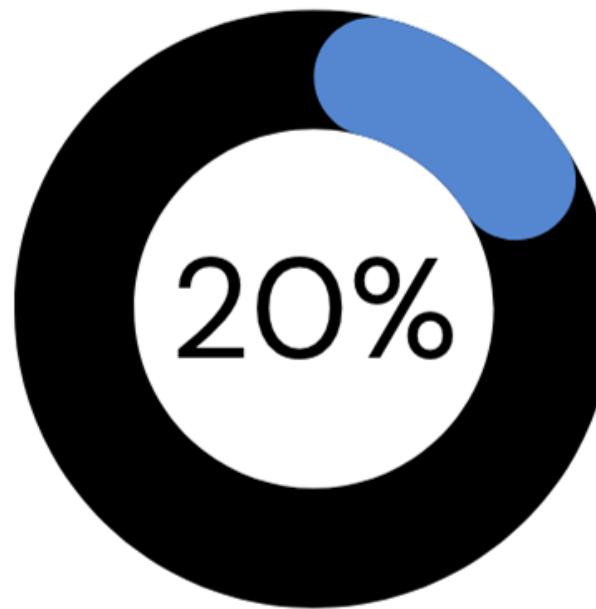
Data Collection



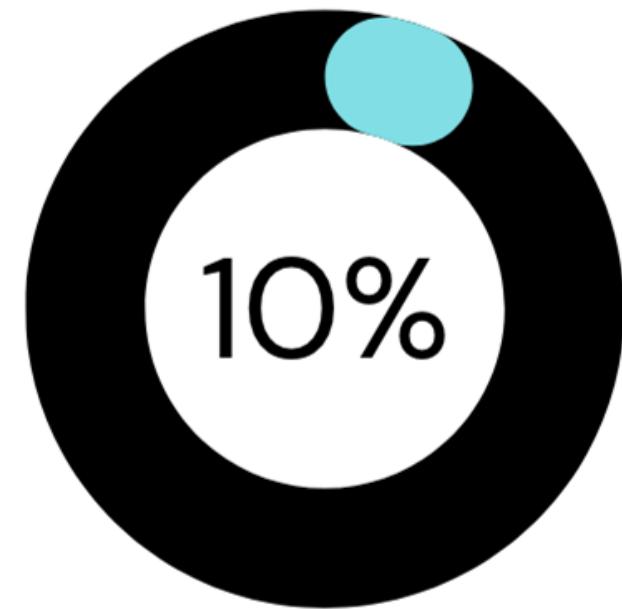
Dataset Split



TRAINING

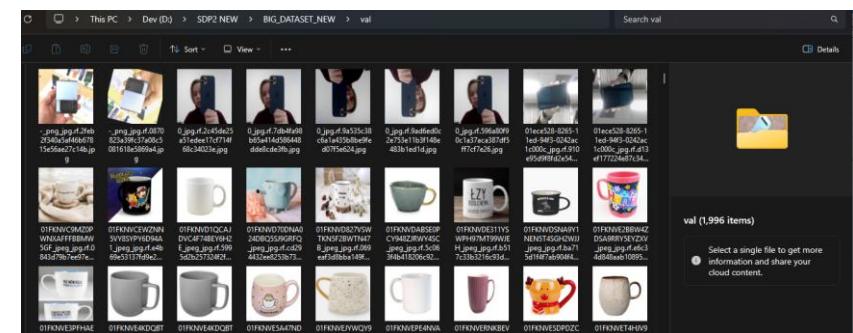
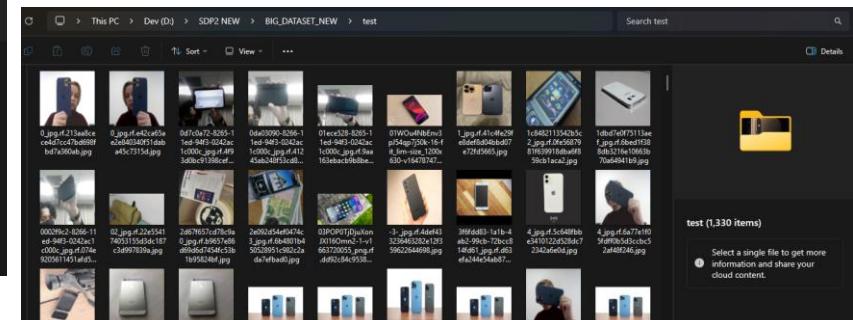
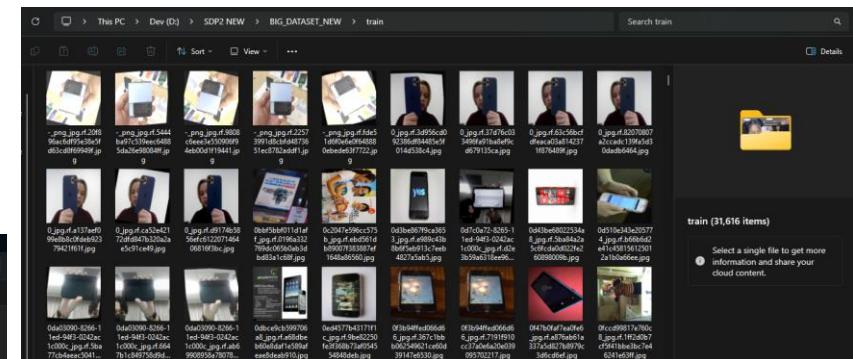
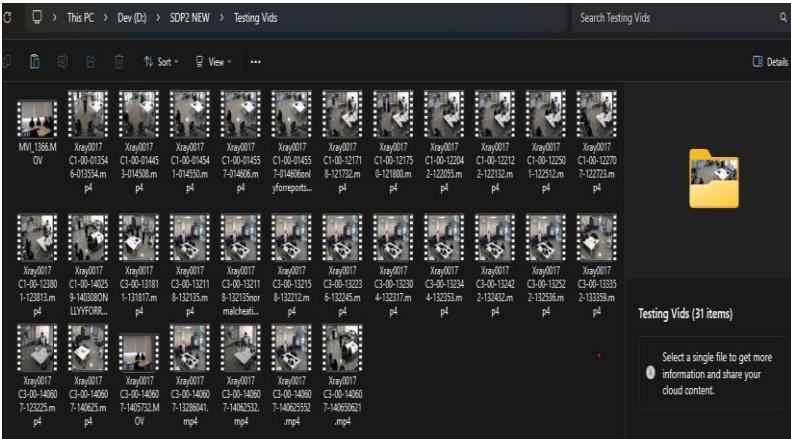
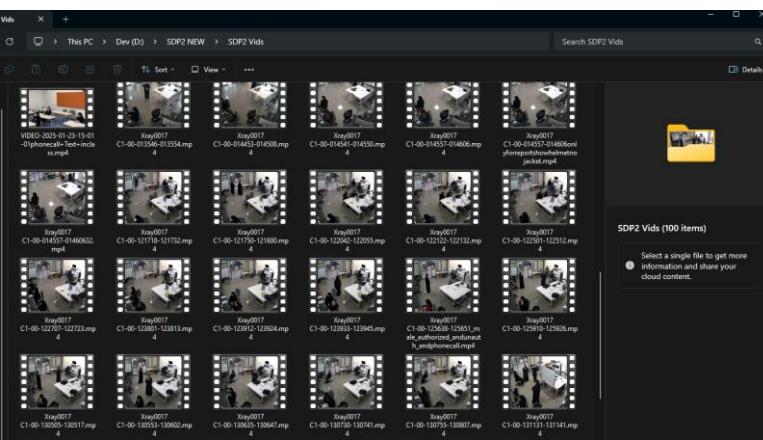
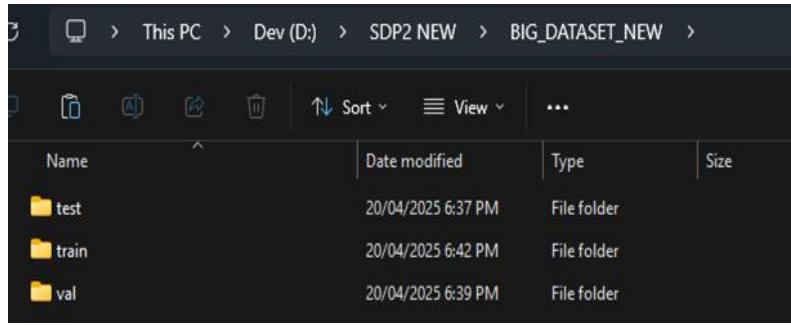


VALIDATION

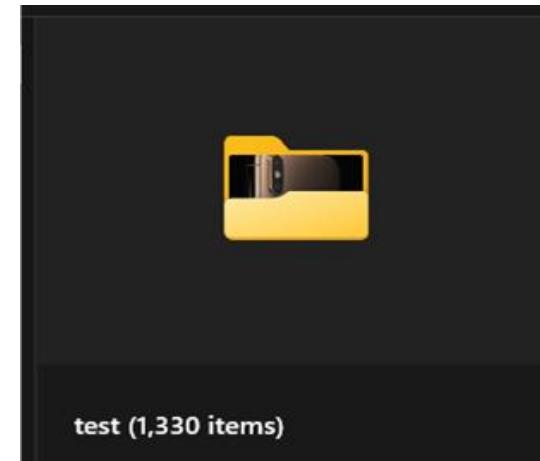
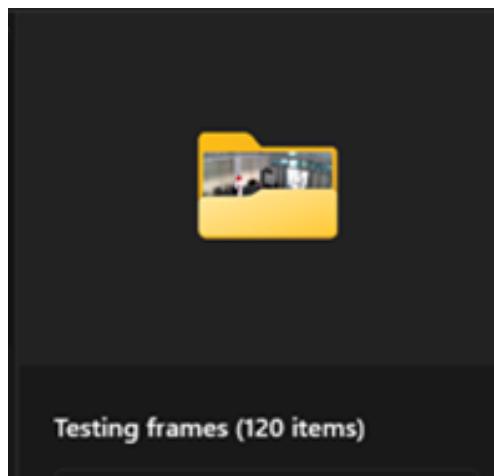
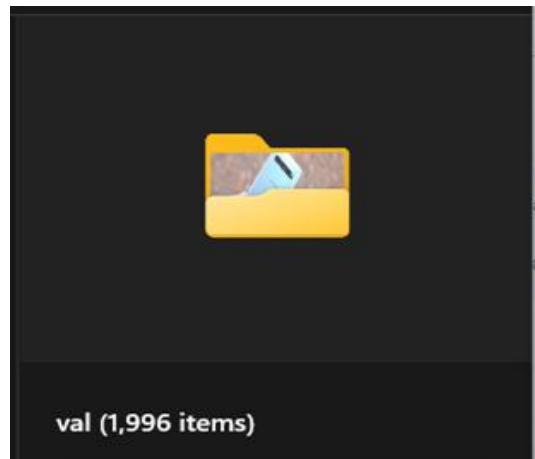
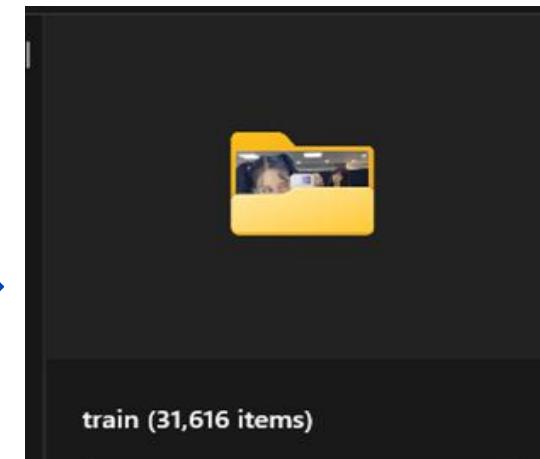
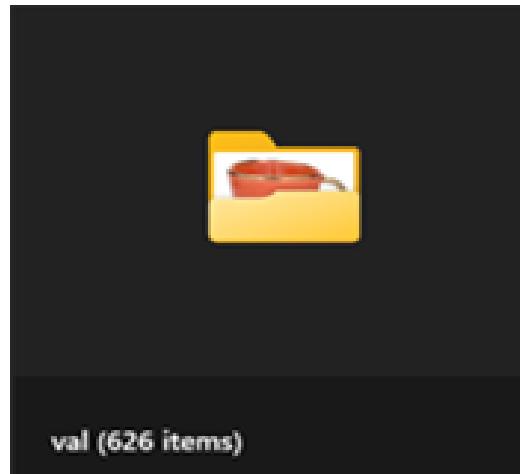
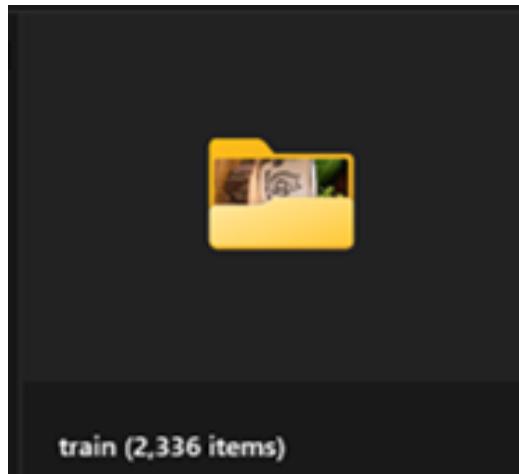


TESTING

Dataset Split



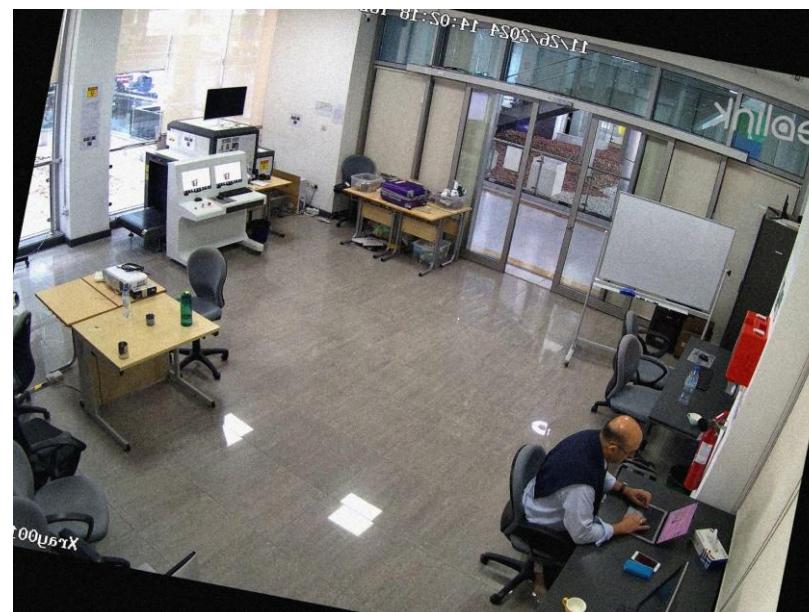
Comparing Dataset Size with SDP I



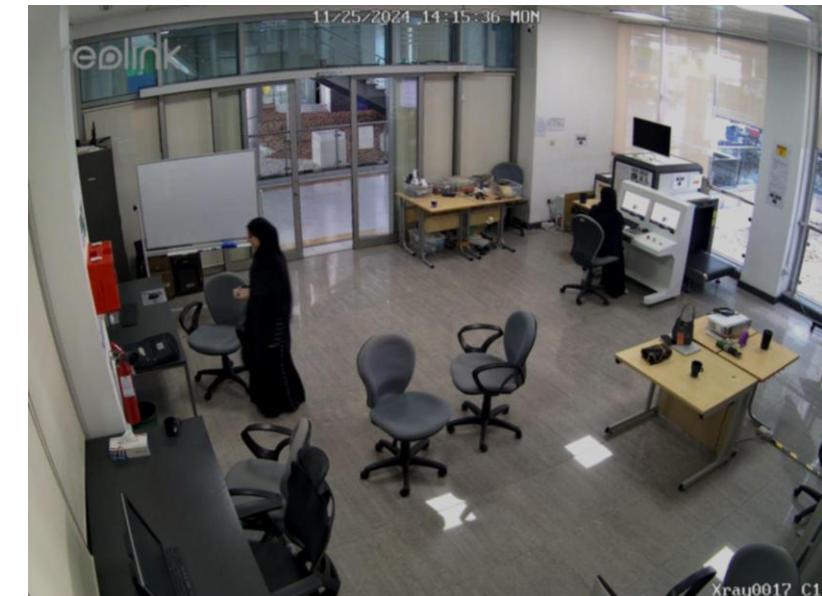
Data Augmentation



Grainy



Rotated & Flipped



Low Brightness & Blurred

Data Augmentation



Rotated



Rotated & Flipped



Blurred & Flipped

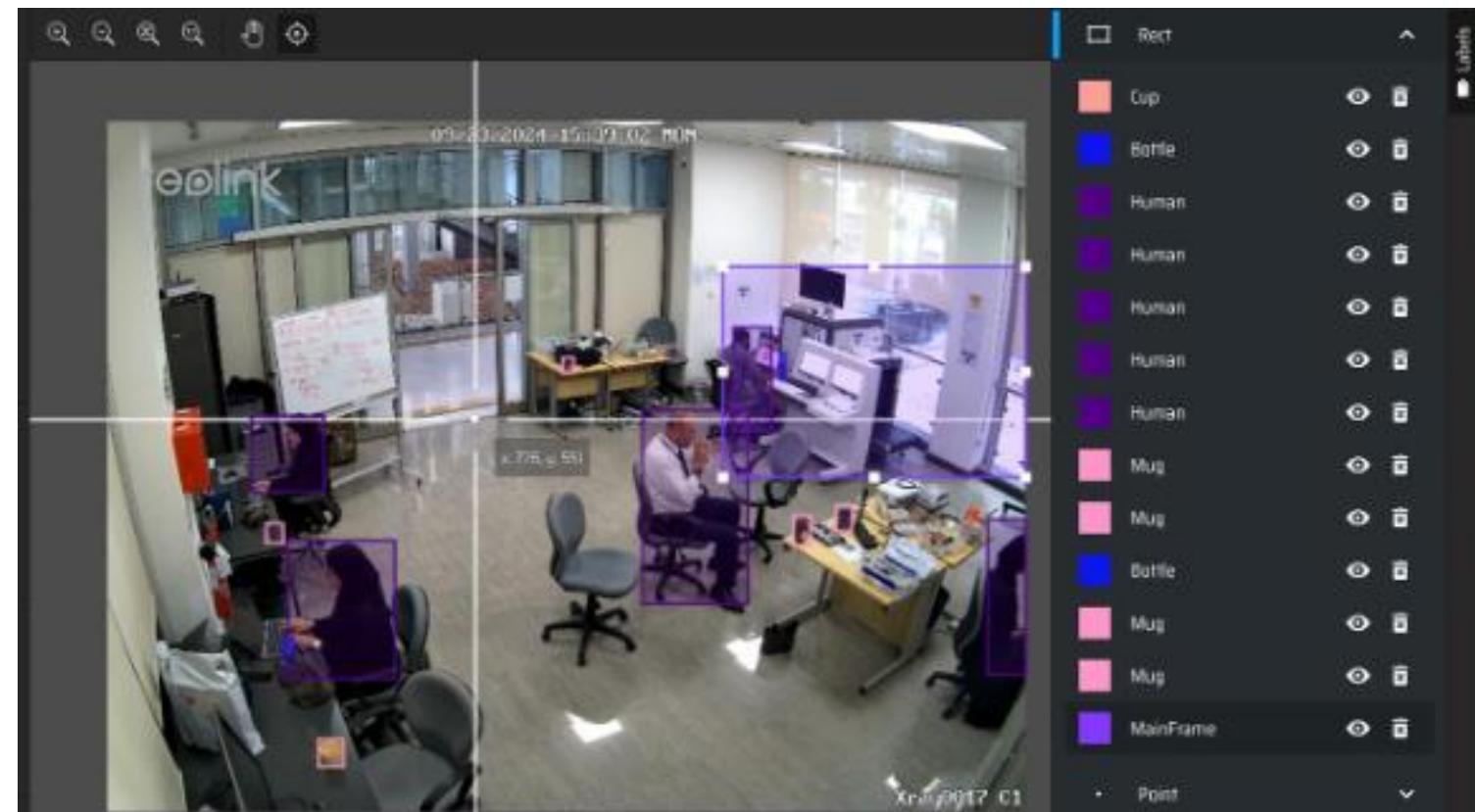
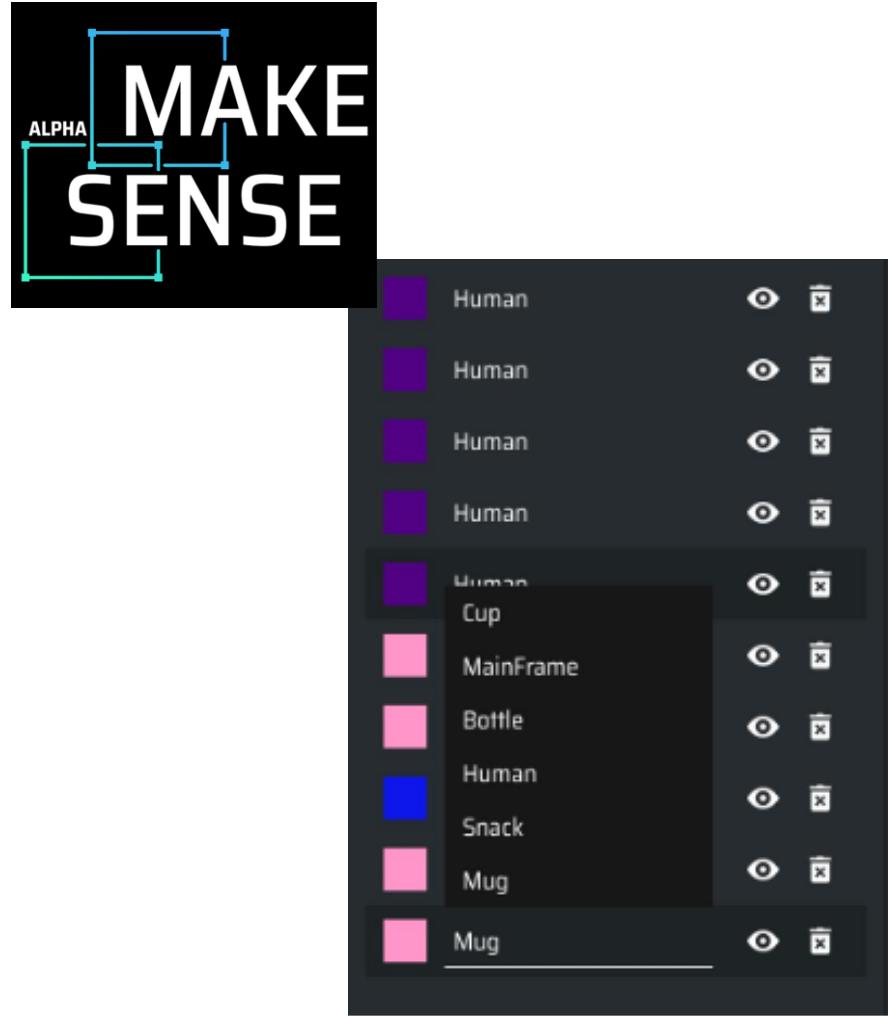
Model Configuration with data.yaml

```
nc: 7
names:
  0: Cup
  1: MainFrame
  2: Bottle
  3: Human
  4: Snack
  5: Mug
  6: Biscuit
```

```
7: SafetyJacket
8: Helmet
9: Eating
10: Drinking
11: Classroom
12: Phone
13: PhoneCall
14: Texting
15: Cheating
```

The classes listed in data.yaml guide the annotation process

Data Annotation Using MakeSense



Model Training Process

Model Selection



SDP I & SDP II: Two Specialized Models

```
# Configuration Constants
MODEL1_PATH = r"D:\SDP2 NEW\trial 2_sdp2_only\runs\detect\train\weights\best.pt" # Behavior analysis model
MODEL2_PATH = r"D:\CS06 SDP I\runs\detect\train15\weights\best.pt"      # Object detection model
```

Training Parameters for Effective Model Learning

60

Epochs

Allows the model to learn from the dataset through multiple iterations

8

Batch Size

Optimizes memory usage and processing speed

512x512

Image Size

Ensures detailed input without overloading the model



Loss Function

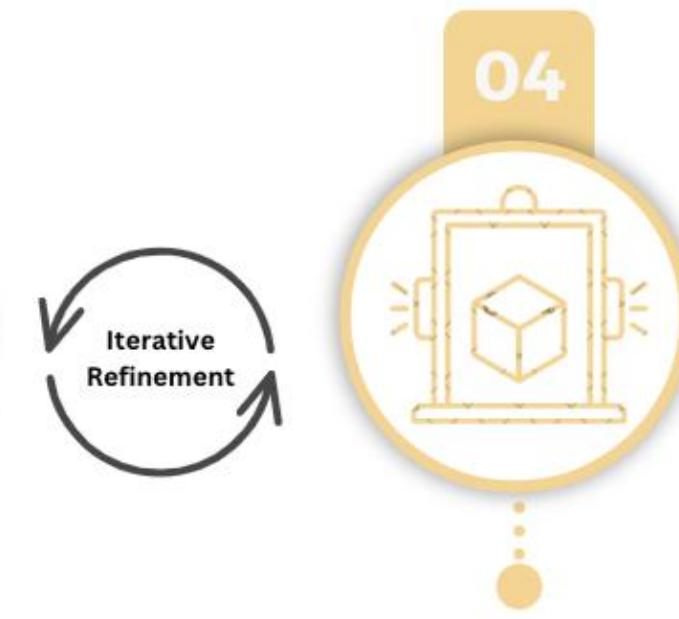
Bounding box loss
Classification loss
Objectness loss



learning rate scheduling

Automatically adjusts to optimize training efficiency and model accuracy

Training Workflow



INPUT DATA

Video Footage from CCTV
Roboflow
Camera & Phone

DATA PROCESSING & LABELING

Frame Extraction
Augmentation
Annotation

YOLOV8S MODEL

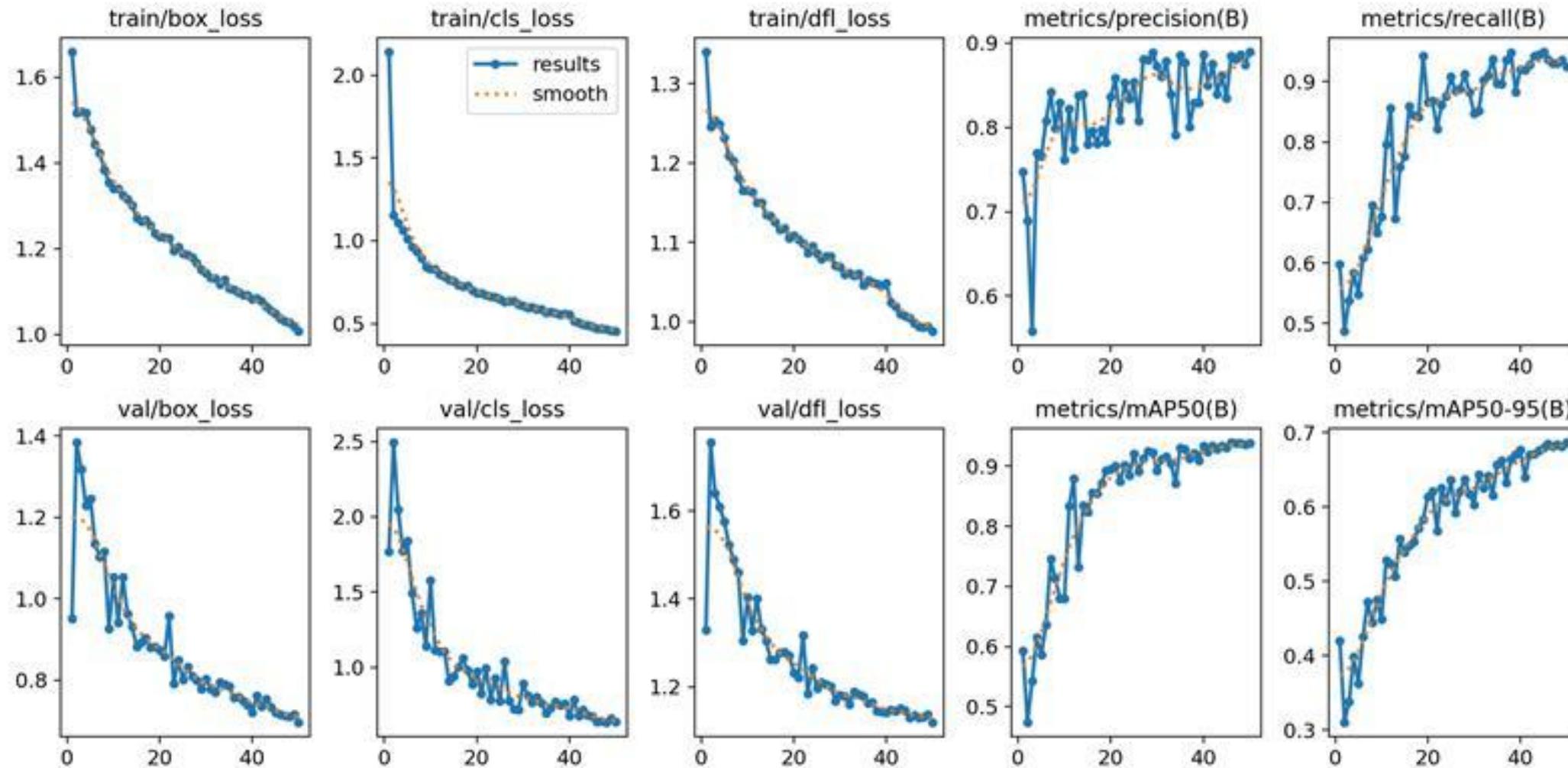
YOLOv8s Training

OUTPUT

Object Detection Results
Unauthorized Access Alerts
Cheating Alerts

Evaluation Metrics Used in Training

YOLO Model Training and Validation Metrics over Epochs



Performance of the Model

Accuracy

74%

mAP

mAP@0.5: 91.00%

mAP@0.5:0.95: 49.96%

System Capabilities

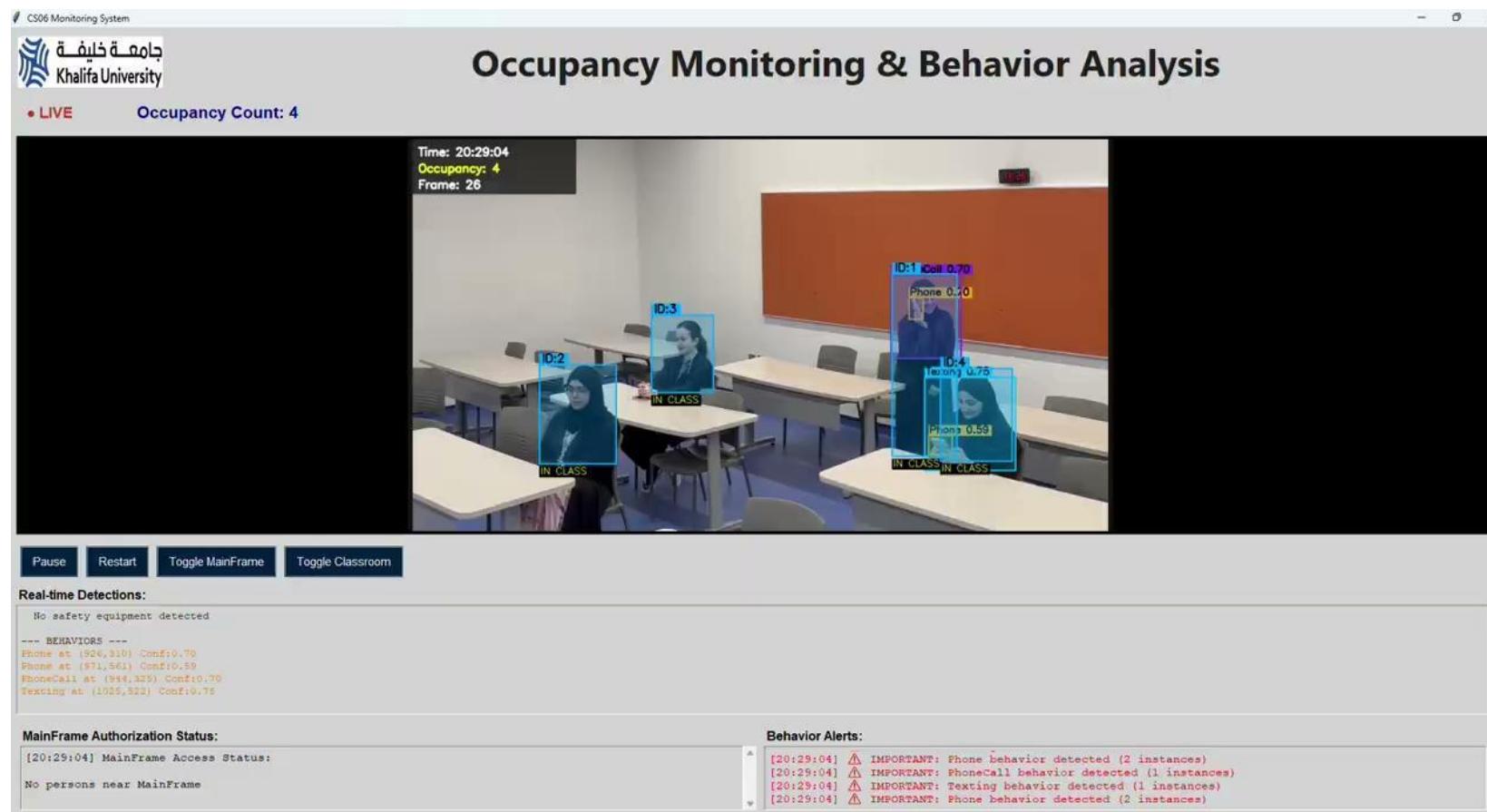


Model Output Systems

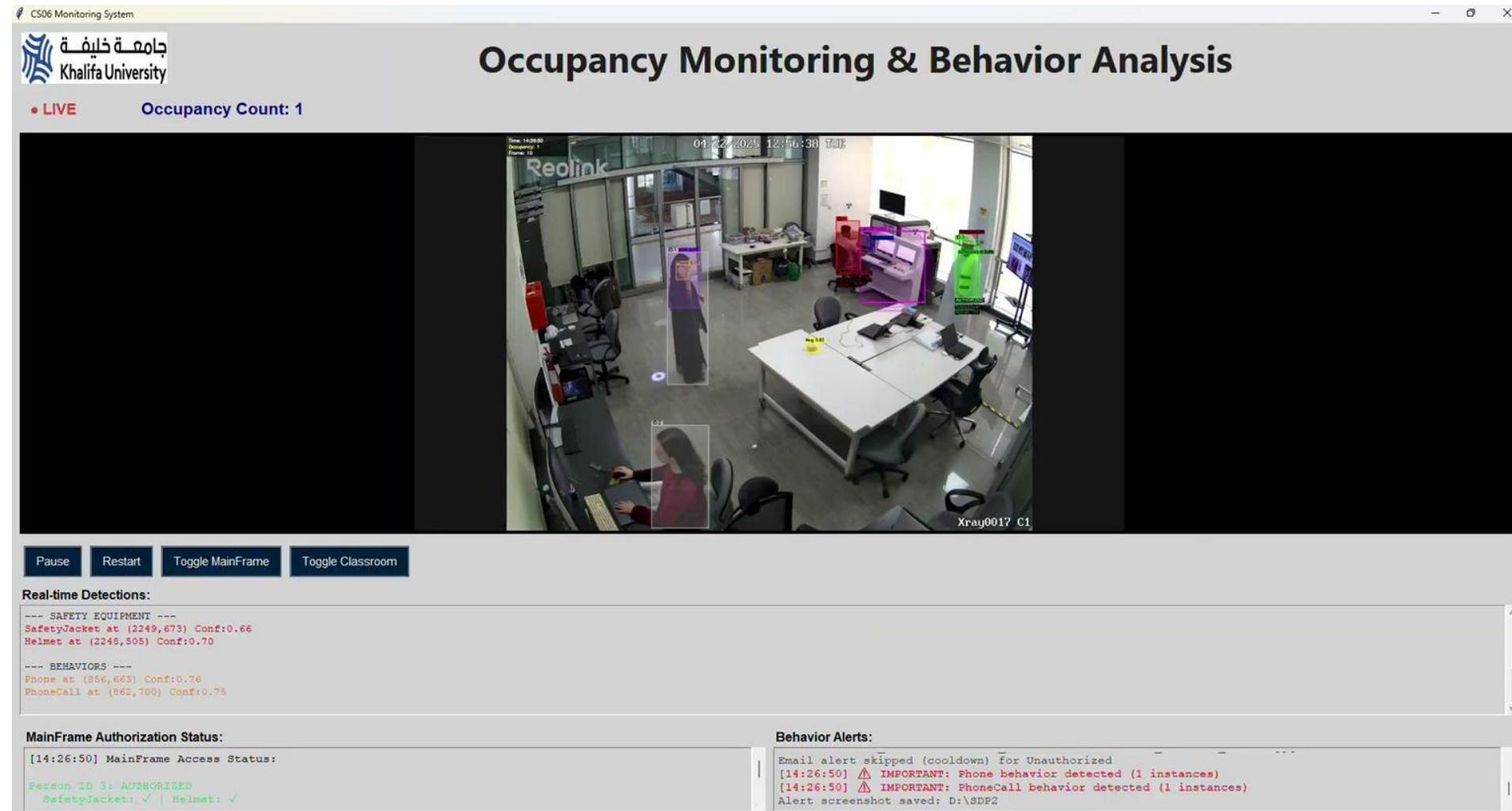
Main Window



Behavior Monitoring System



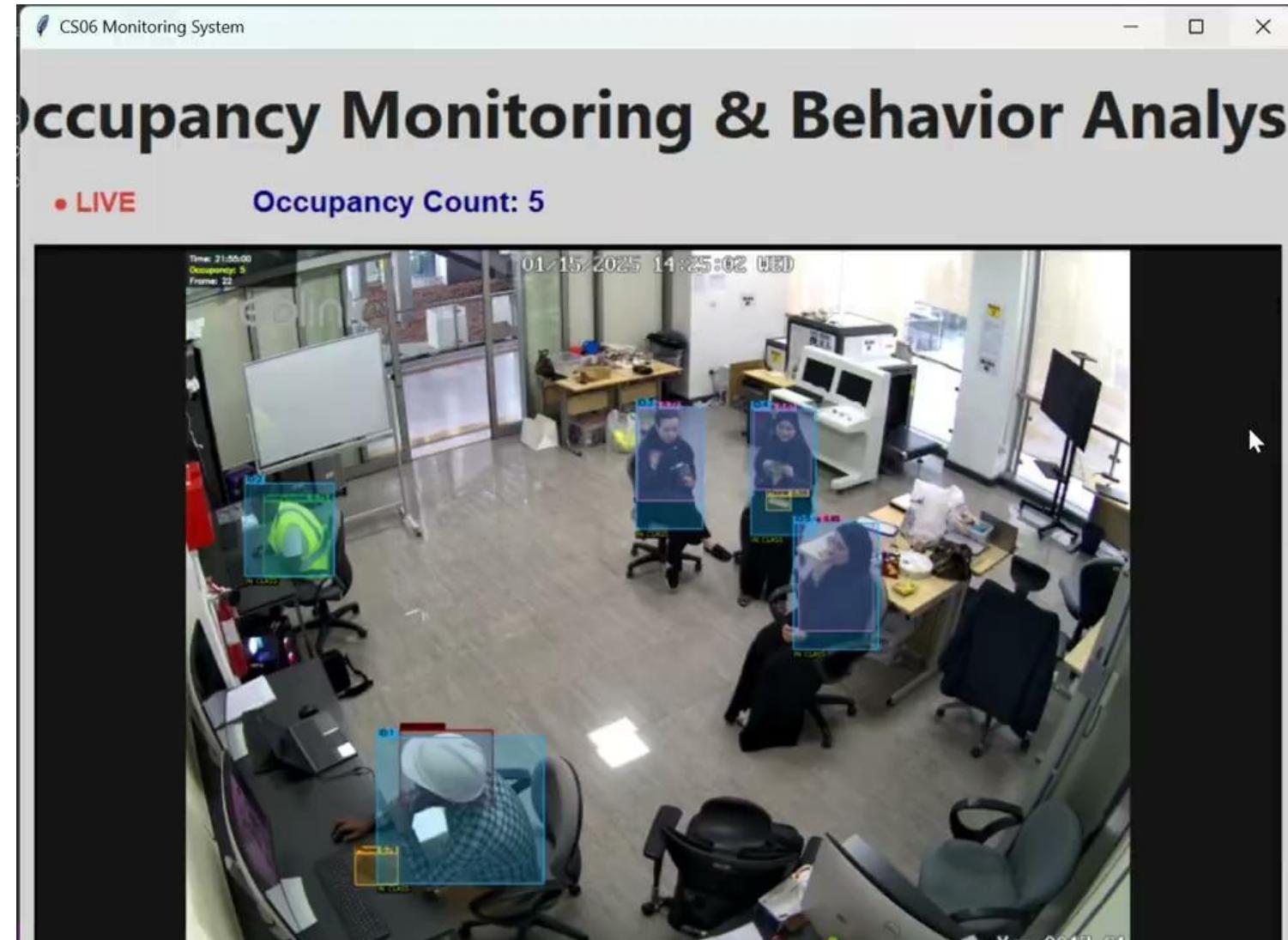
Behavior Monitoring System



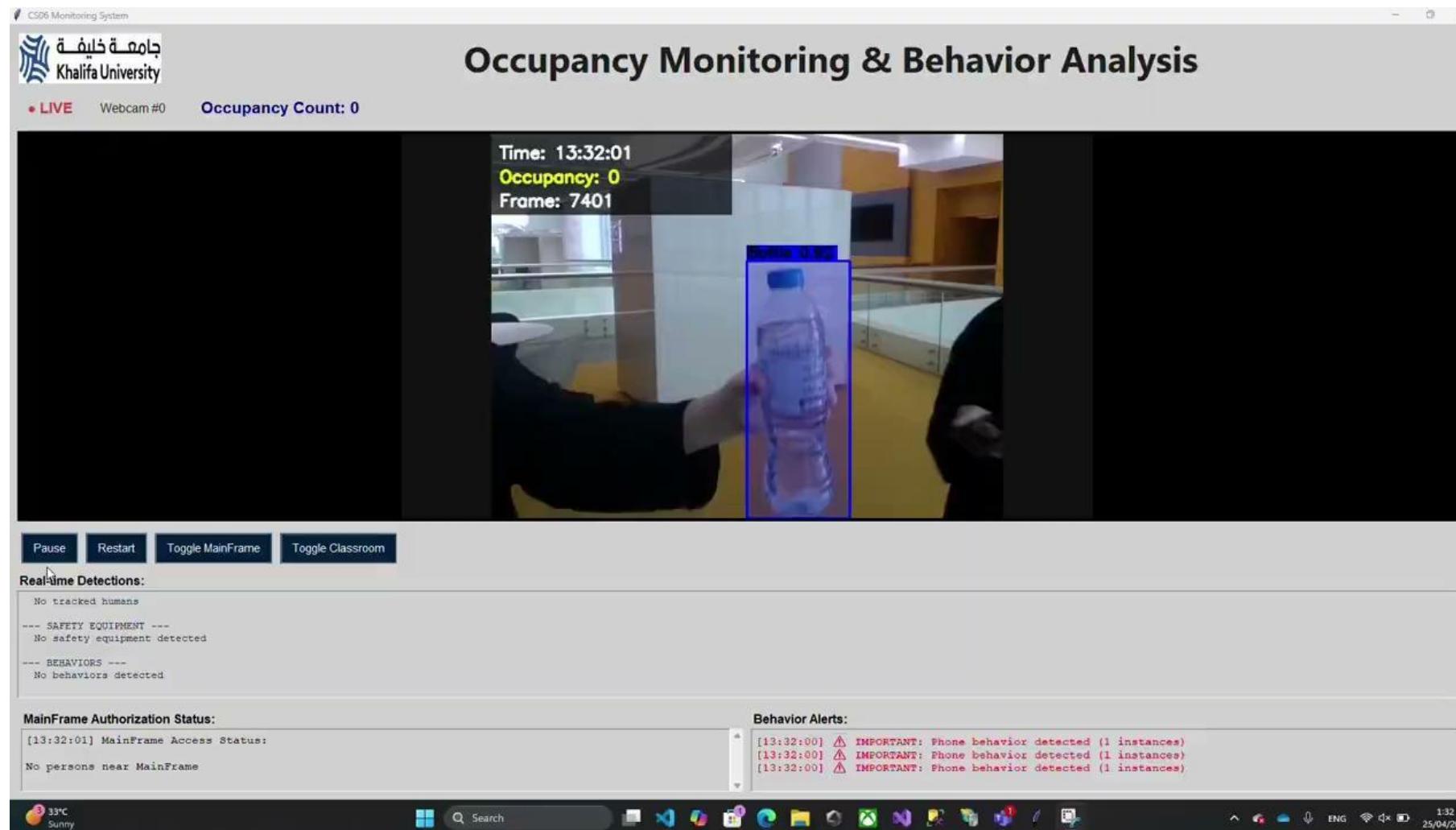
Behavior Monitoring System



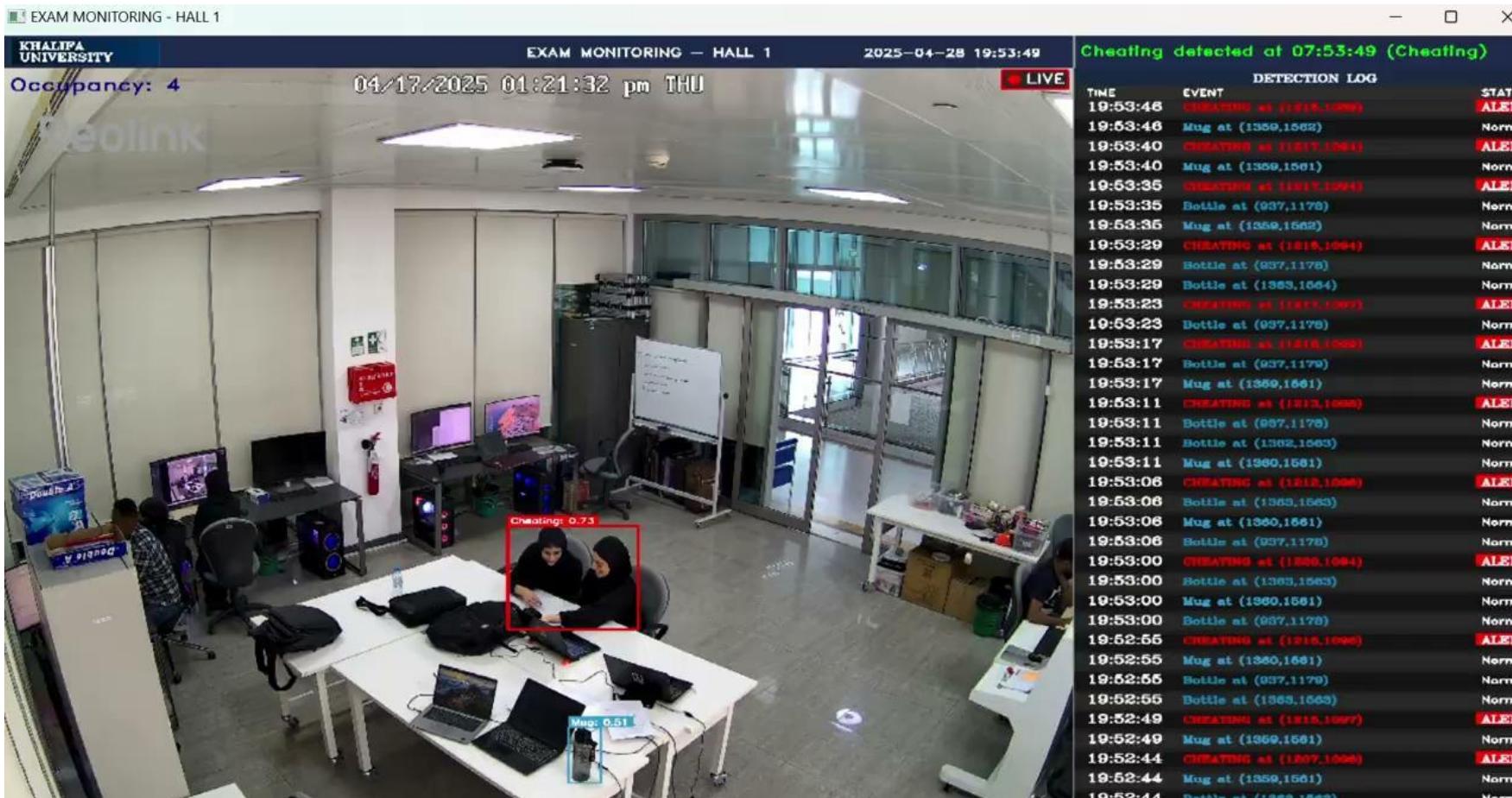
Behavior Monitoring System



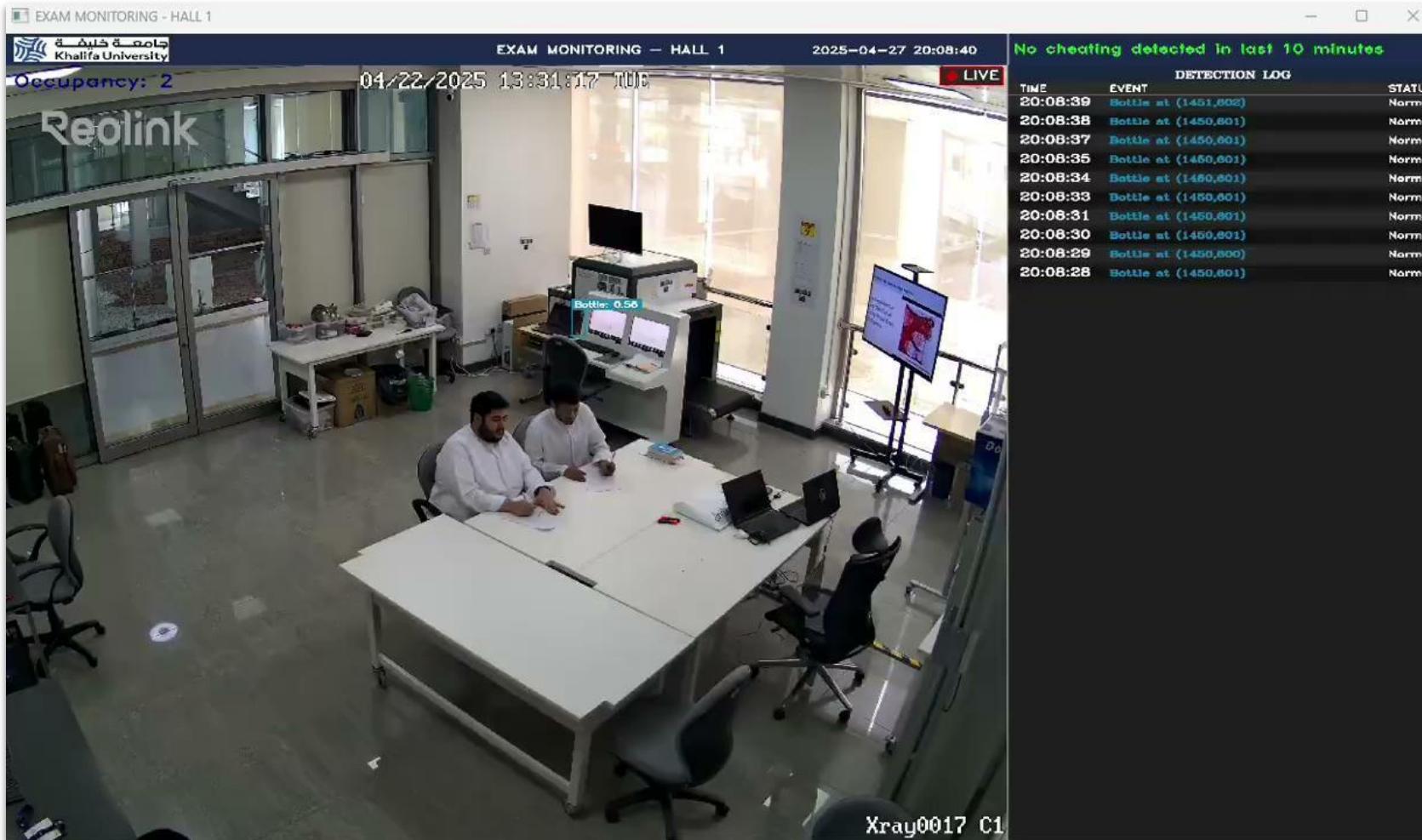
Behavior Monitoring System - LIVE



Cheating Detection System



Cheating Detection System



Cheating Detection System

EXAM MONITORING - HALL 1

KHALIFA UNIVERSITY

Occupancy: 5

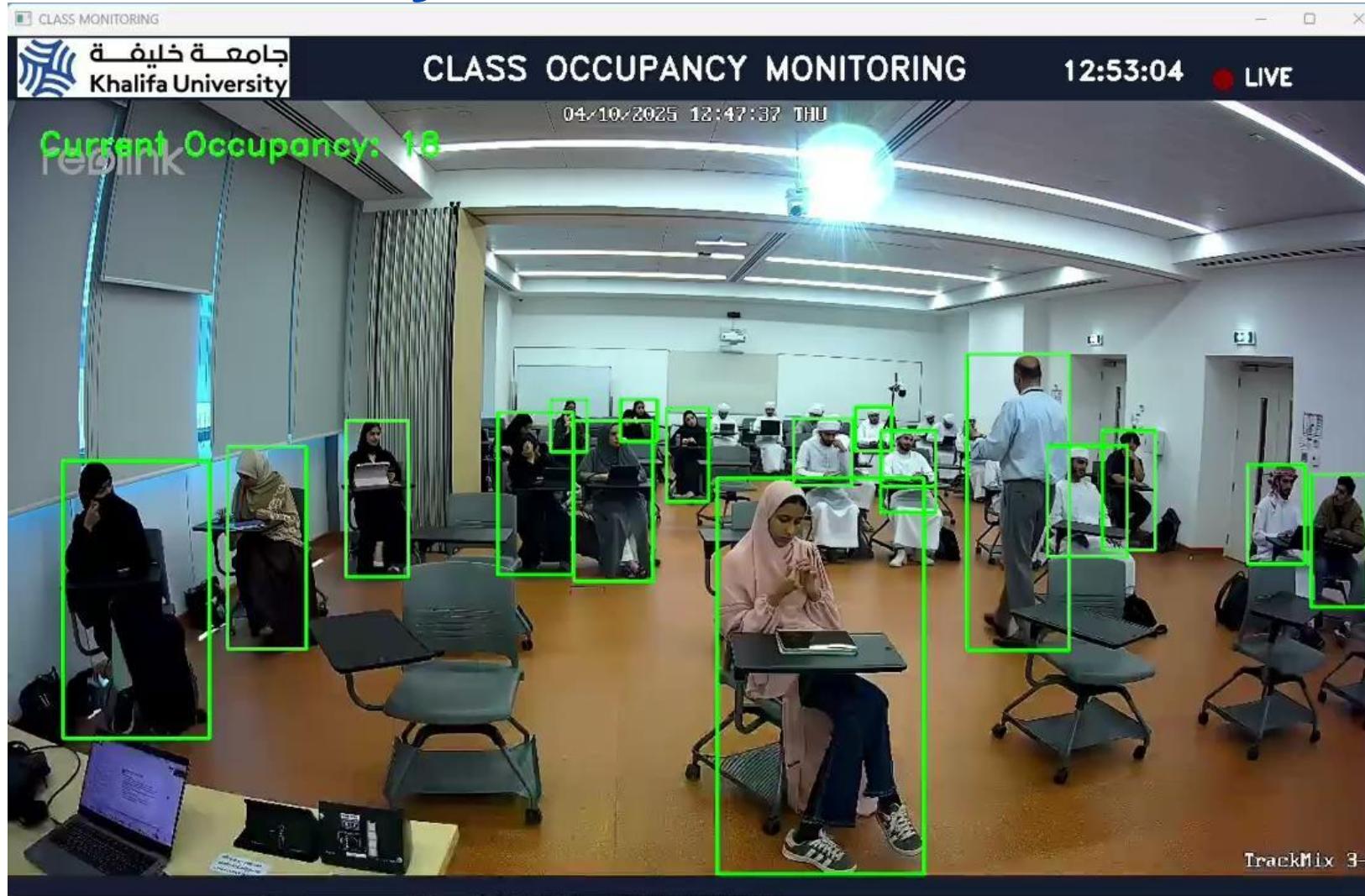
04/17/2025 01:22:41 pm THU

LIVE

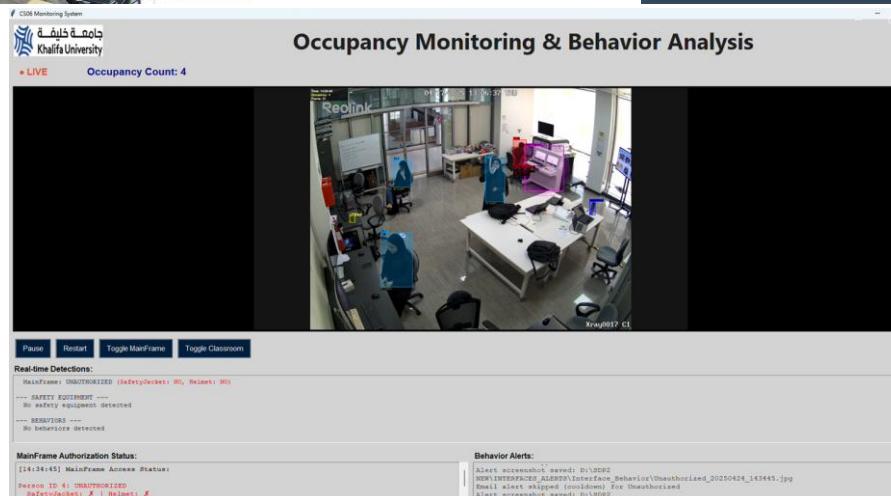
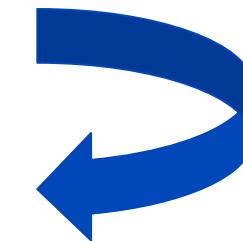
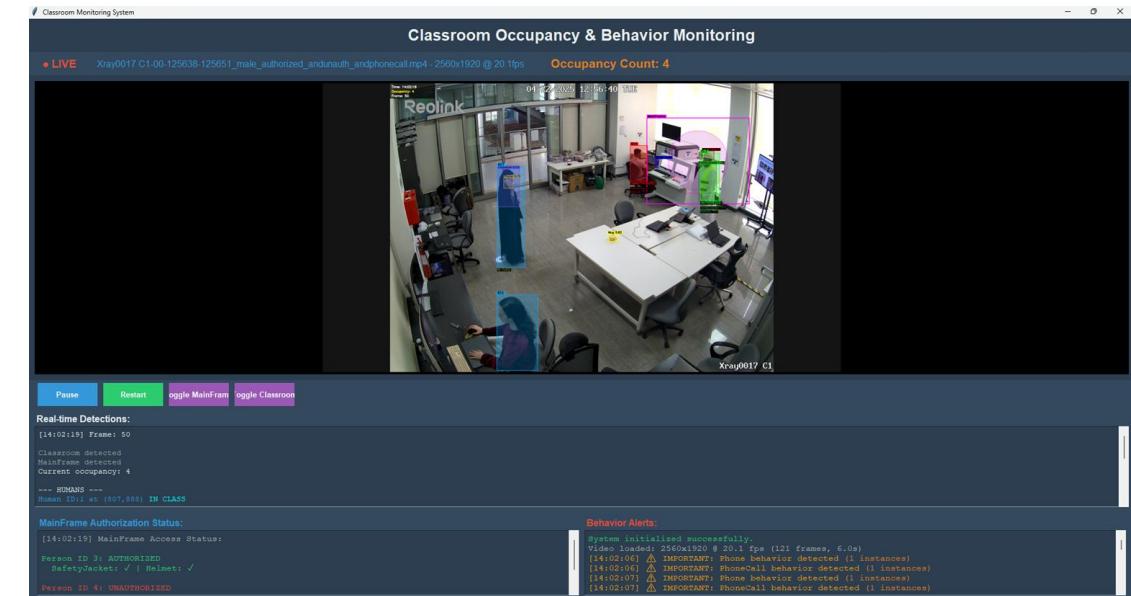
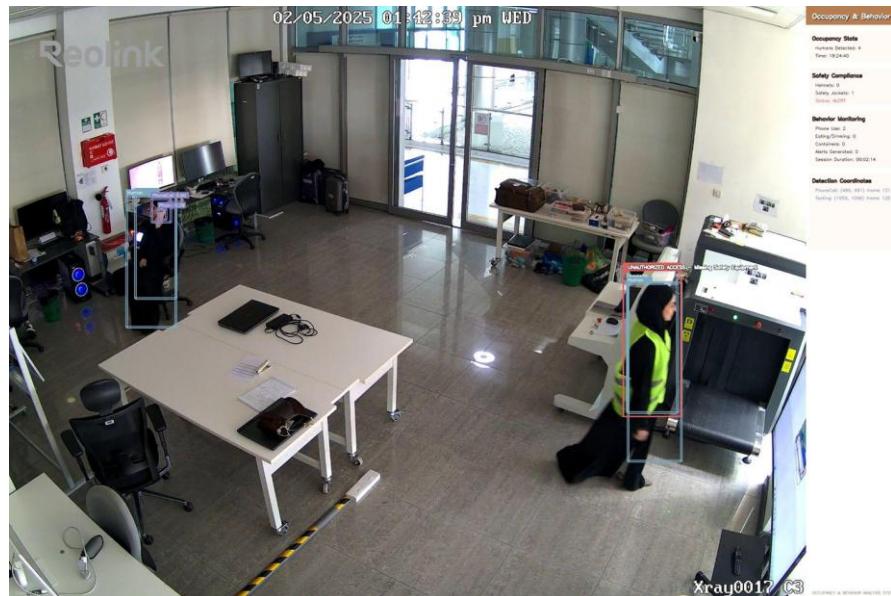
Cheating detected at 09:04:27 (Texting)

TIME	EVENT	STATUS
21:04:27	CHEATING (PhoneCall) at (1610,1187)	ALERT
21:04:27	Phone at (1695,1258)	ALERT
21:04:27	CHEATING (PhoneCall) at (1607,1188)	ALERT
21:04:27	CHEATING (Texting) at (1187,1085)	ALERT
21:04:27	Bottle at (940,1178)	Normal
21:04:27	Mug at (1369,1561)	Normal
21:04:22	CHEATING (PhoneCall) at (1610,1179)	ALERT
21:04:22	Phone at (1607,1246)	ALERT
21:04:22	CHEATING (PhoneCall) at (1610,1179)	ALERT
21:04:22	CHEATING (Texting) at (1187,1084)	ALERT
21:04:22	Bottle at (940,1178)	Normal
21:04:22	Mug at (1369,1562)	Normal
21:04:15	CHEATING (PhoneCall) at (1610,1179)	ALERT
21:04:15	Phone at (1696,1244)	ALERT
21:04:15	CHEATING (PhoneCall) at (1610,1179)	ALERT
21:04:15	CHEATING (Texting) at (1186,1085)	ALERT
21:04:15	Bottle at (940,1178)	Normal
21:04:10	Phone at (1704,1239)	ALERT
21:04:10	CHEATING (PhoneCall) at (1617,1188)	ALERT
21:04:10	CHEATING (PhoneCall) at (1609,1178)	ALERT
21:04:10	CHEATING (Texting) at (1188,1086)	ALERT
21:04:10	Bottle at (940,1178)	Normal
21:04:10	Mug at (1369,1561)	Normal
21:04:04	Phone at (1723,1239)	ALERT
21:04:04	CHEATING (PhoneCall) at (1610,1187)	ALERT
21:04:04	CHEATING (PhoneCall) at (1610,1179)	ALERT
21:04:04	CHEATING (Texting) at (1179,1086)	ALERT
21:04:04	Bottle at (1363,1563)	Normal
21:04:04	Bottle at (940,1177)	Normal
21:04:04	Mug at (1369,1561)	Normal
21:03:58	CHEATING (Texting) at (1177,1086)	ALERT
21:03:58	Bottle at (940,1177)	Normal
21:03:58	Mug at (1369,1562)	Normal
21:03:53	CHEATING (Texting) at (1173,1086)	ALERT
21:03:53	Mug at (1369,1561)	Normal
21:03:53	Bottle at (939,1177)	Normal

Attendance System

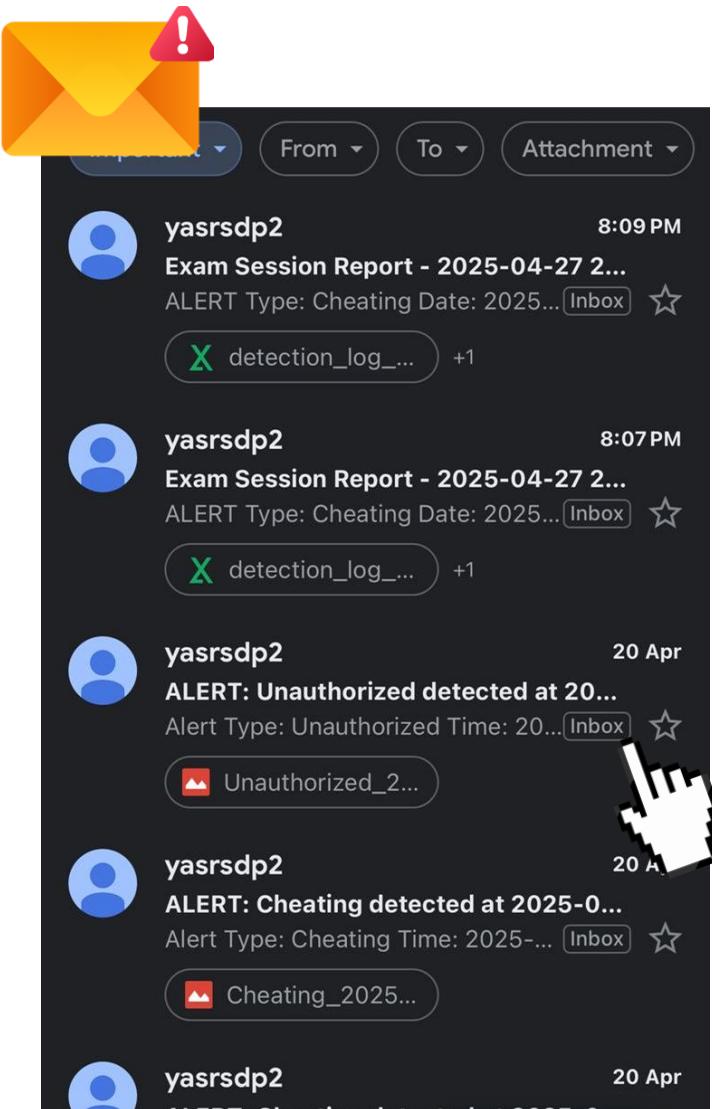


Design Evolution and User Feedback



J12	A	B	C	D	E	F	G	H
1	frame	class_name	confidence	x1	y1	x2	y2	
2	1	MainFrame	0.84	577	81	742	212	
3	1	Bottle	0.74	616	244	629	269	
4	1	Mug	0.71	665	252	682	265	
5	1	Mug	0.68	169	396	198	416	
6	1	Bottle	0.66	722	251	735	270	
7	1	Bottle	0.59	219	168	228	182	
8	1	Mug	0.51	111	203	123	212	
9	1	Human	0.48	178	225	258	314	
10	1	Human	0.44	560	128	590	196	
11	1	Human	0.43	154	191	212	223	
12	1	Bottle	0.4	433	123	440	133	
13	1	Human	0.3	151	190	216	230	
14	1	Mug	0.27	410	144	418	151	
15	2	MainFrame	0.85	577	81	742	212	
16	2	Bottle	0.74	616	244	629	269	
17	2	Mug	0.73	665	252	682	265	
18	2	Mug	0.68	169	396	198	416	
19	2	Bottle	0.66	722	251	735	270	
20	2	Bottle	0.59	219	168	228	182	
21	2	Mug	0.51	111	203	123	212	
22	2	Human	0.48	179	225	258	314	
23	2	Bottle	0.44	433	123	440	133	
24	2	Human	0.44	560	129	590	196	
25	2	Human	0.43	154	191	212	223	
26	2	Human	0.29	151	190	216	230	
27	3	MainFrame	0.85	577	81	742	212	
28	3	Bottle	0.75	616	244	629	269	
29	3	Mug	0.73	665	252	682	265	
30	3	Mug	0.68	169	396	198	416	
31	3	Bottle	0.66	722	251	735	270	
32	3	Bottle	0.59	219	168	228	182	
33	3	Human	0.51	180	225	258	314	
34	3	Mug	0.51	111	203	123	212	
35	3	Human	0.44	155	191	212	222	
36	3	Human	0.44	560	128	590	197	
37	3	Bottle	0.39	433	123	440	133	

Data Logging: CSV file



ALERT: Unauthorized detected at 2025-04-20 00:30:21 [Inbox]

yasrsdp2 20 Apr to me

Alert Type: Unauthorized
Time: 2025-04-20 00:30:21
Alert Type: Unauthorized
Time: 00:30:18
Person ID: 4
Location: (1673, 538)
SafetyJacket: NO
Helmet: NO



Exam Session Report - 2025-04-27 20-08-24 [Inbox]

yasrsdp2 8:09 PM to me

ALERT Type: Cheating
Date: 2025-04-27
Start Time: 20:08:28
End Time: 20:09:28

detection_log_20-08-24.xlsx

CHEATING_DETECTIONS_20-08-24.zip

Data Logging: Email for Detection Alerts

Video Playback Feature



Today

- CHEATING...S_20-49-23 >
- CHEATING...0-49-23.zip
- detection_l...-49-23.xlsx

Today

- cheating_in...onf23.mp4
- cheating_in...onf23.mp4

EXAM MONITORING - HALL 1 2025-04-27 20:49:36 Cheating detected at 08:49:30 (PhoneCall) ▾

Occupancy: 5 03/20/2025 12:21:27 THU LIVE

Reolink

CHEATING (Testing): 0.24

ALERT: CHEATING BEHAVIOR DETECTED (Conf: 0.24)

DETECTION LOG

TIME	EVENT	STATUS
20:49:36	CHEATING (Testing) at (1481,896)	ALERT
20:49:31	Mug at (2084,996)	Normal
20:49:29	CHEATING (PhoneCall) at (1463,896)	ALERT
20:49:28	CHEATING (PhoneCall) at (1464,896)	ALERT

cheating_incident_20250427204936_conf23.mp4

Challenges

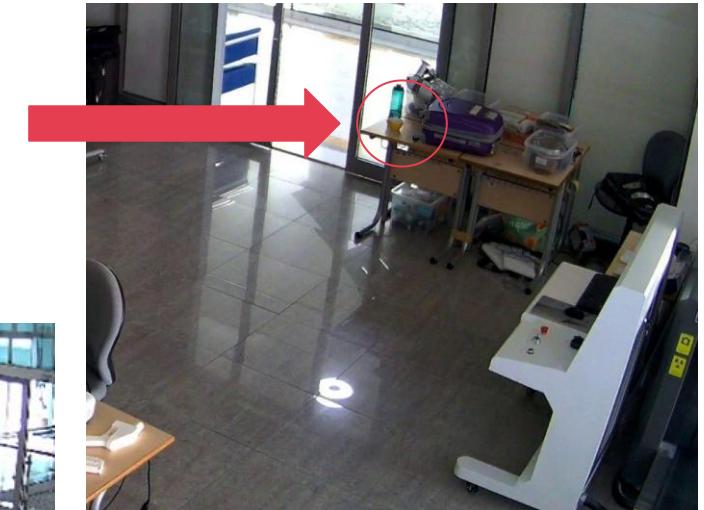
Challenges



Black Mug Behind a Black Bag

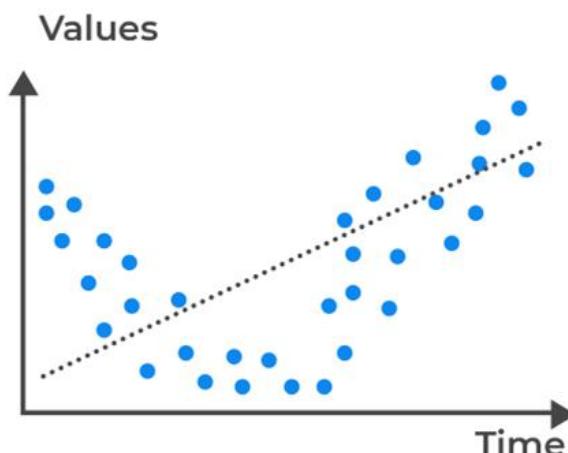


Poor Quality Video Streams

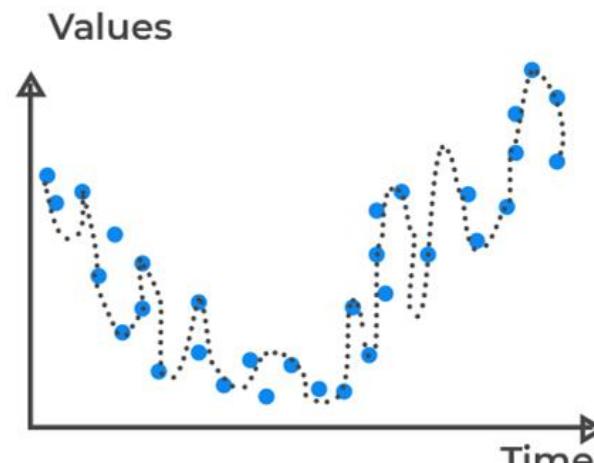


Overlapping Objects

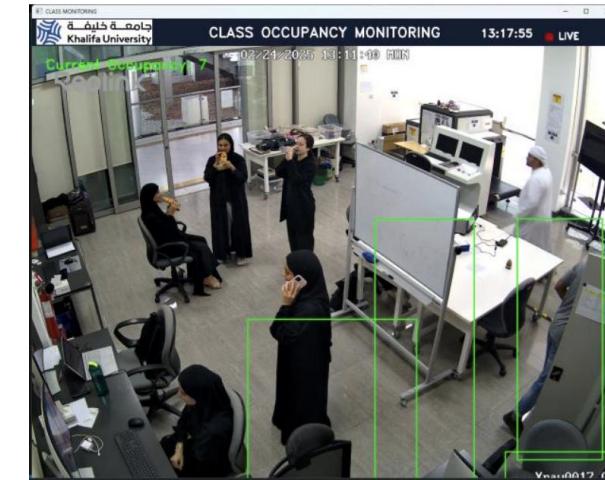
Failure Cases



Underfitted
(High bias error)



Overfitted
(High variance error)



Next Steps



Further Enhance Model Training



Expand Detection Features



Focus on Scalability and Wider Deployment

Conclusion

الحمد لله

Official Computer Science Conc. in AI Graduates



Thank You