WEAPONS DETECTION FROM BODY-CAM

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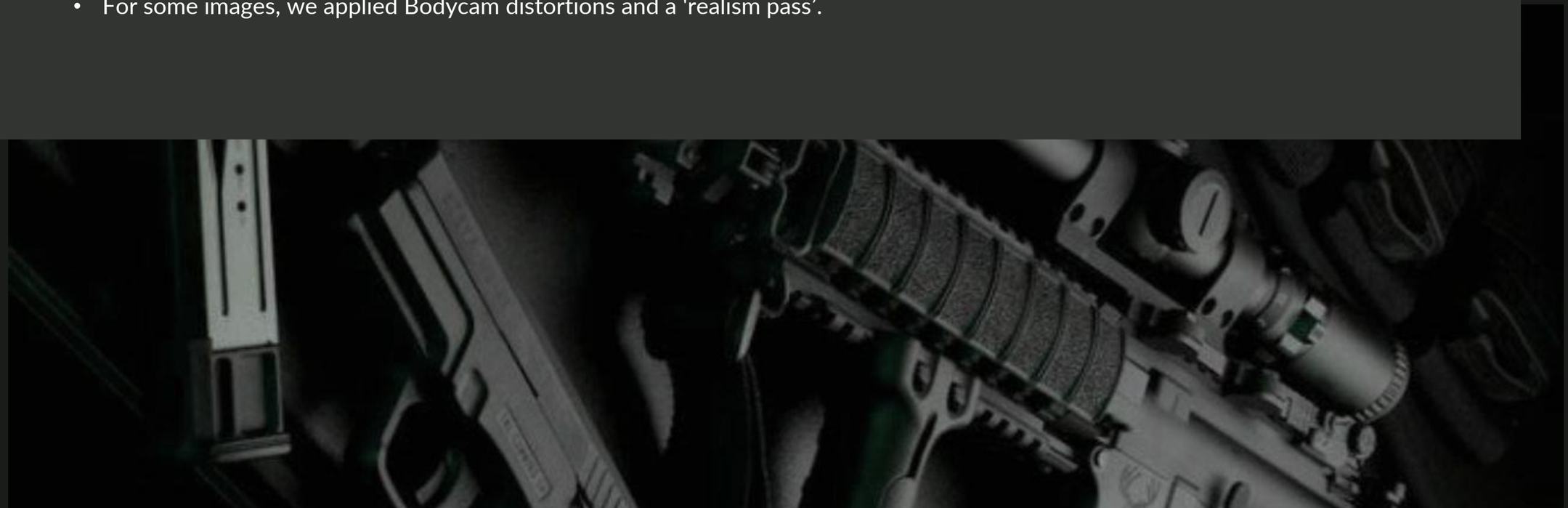
Generative AI and Computer Vision, semester A

PROJECT REVIEW

- Detect weapons from body-worn cameras for military and public safety applications.
- Real-time alerts, enhanced situational awareness and efficient post event analysis.
- For some images, we applied Bodycam distortions and a 'realism pass’.



PREVIOUS WORK

Article name	About	Relevance	Link
“Using a High-Precision YOLO Surveillance System for Gun Detection to Prevent Mass Shootings”	YOLO based deep learning for real time firearm detection to enhance threat identification and security response.	Provides dataset examples that are closely related to the data used in our project.	https://www.mdpi.com/2673-2688/6/9/198
“Systematic review on weapon detection in surveillance footage through deep learning”	"A review of deep learning methods for real-time weapons detection in security environments.	From this review, we identified which deep learning approaches are most suitable for our project and which are less effective.	https://www.sciencedirect.com/science/article/abs/pii/S1574013723000795
“Effective Strategies for Enhancing Real-Time Weapons Detection in Industry”	Enhancing real-time weapons detection with AI for improved accuracy and small object recognition.	Inspired by this paper for real-time image capture while maintaining quality and features.	https://www.mdpi.com/2076-3417/14/18/8198

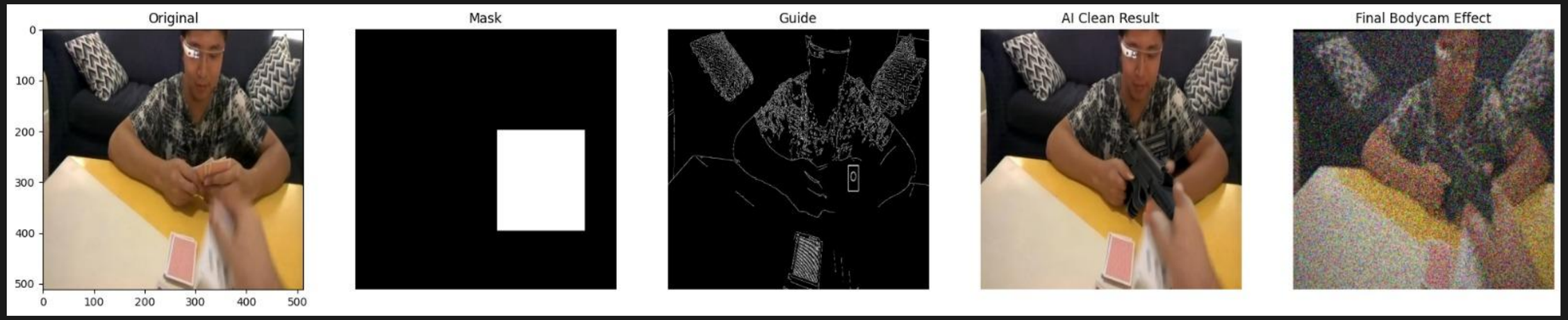
DATASET

- **Augment existing dataset**: introduce distortions to existing surveillance images with already labeled weapons.

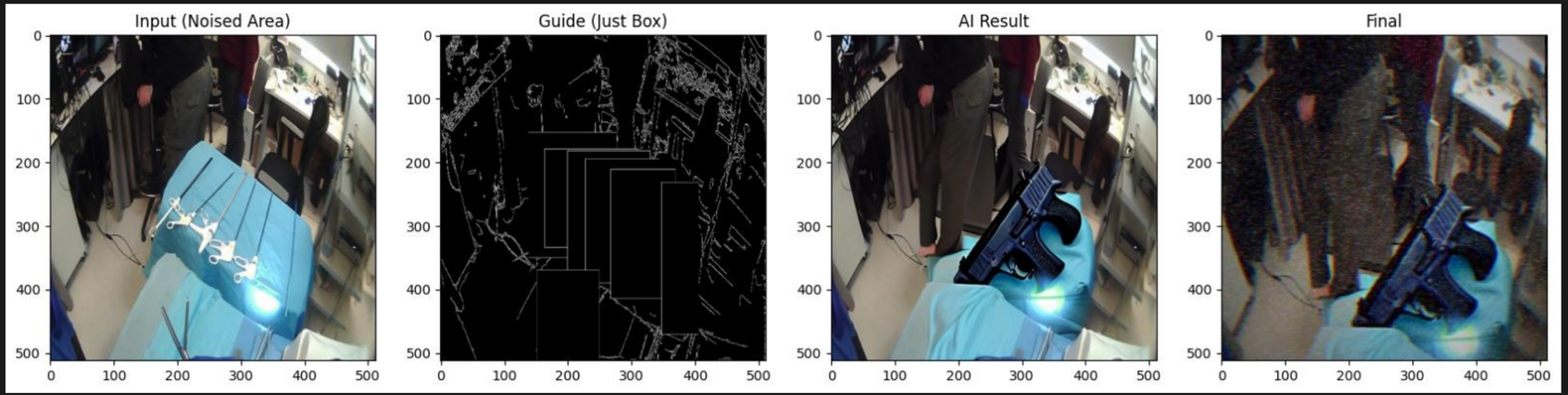
  Used: Used Fisheye effect, image distortion augmentation, with Albumentations + OpenCV.

- **Inpainting:** use existing FPV footage and in-paint weapons into target locations.

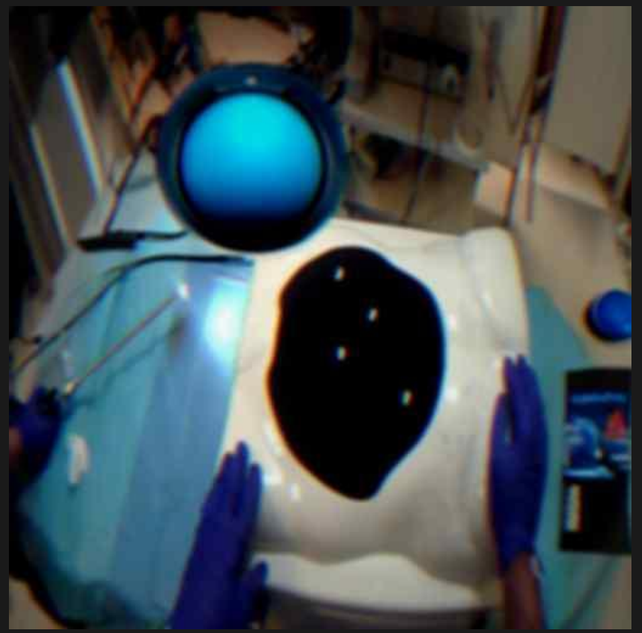
  Used: used labeled hand/surgical base photos with inpainting and guidance masks, and applied fisheye distortions and sensor noise to emulate real-world bodycam footage.



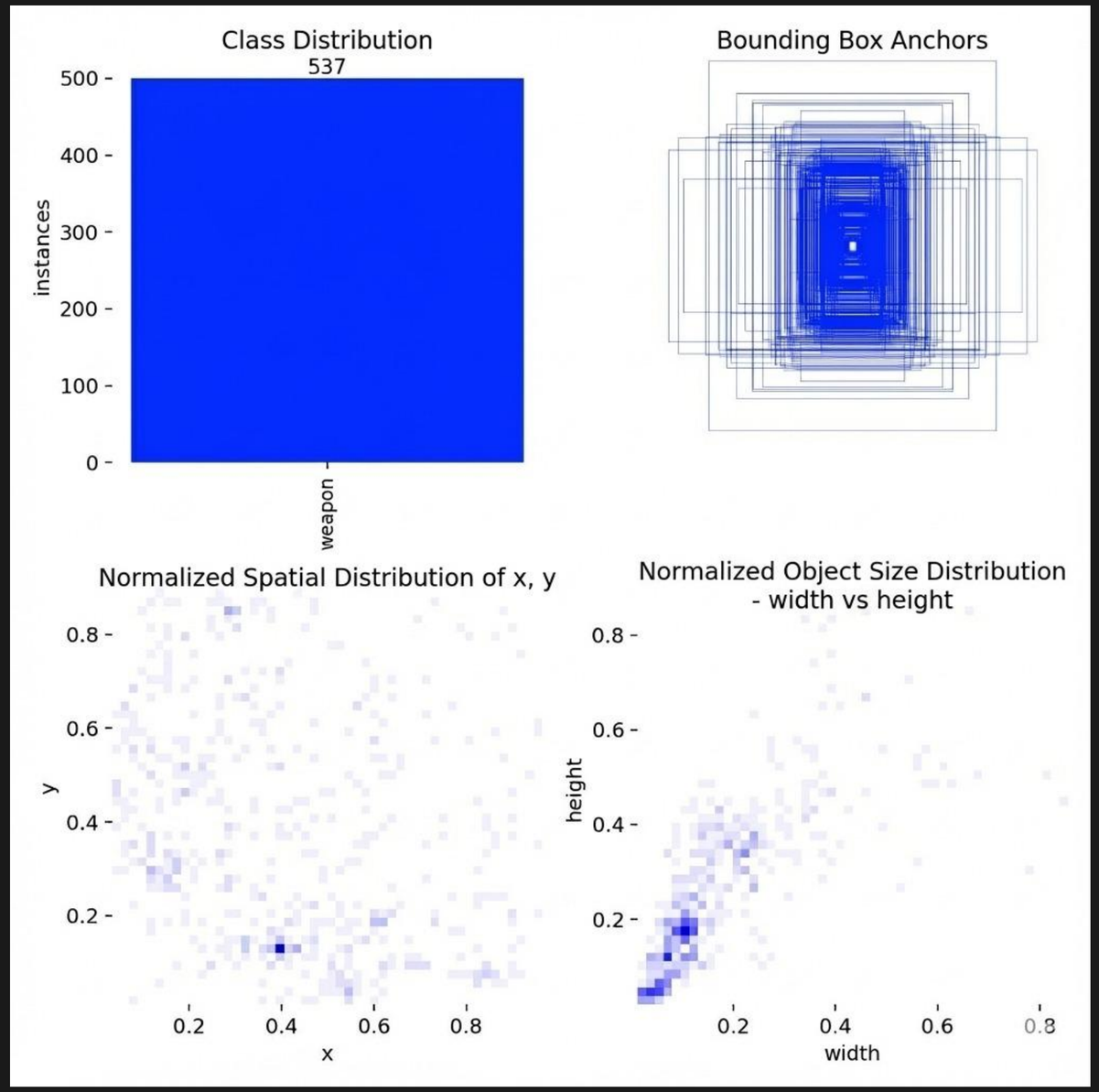
DATASET



- **Unsuccessful Inpainting photos:**

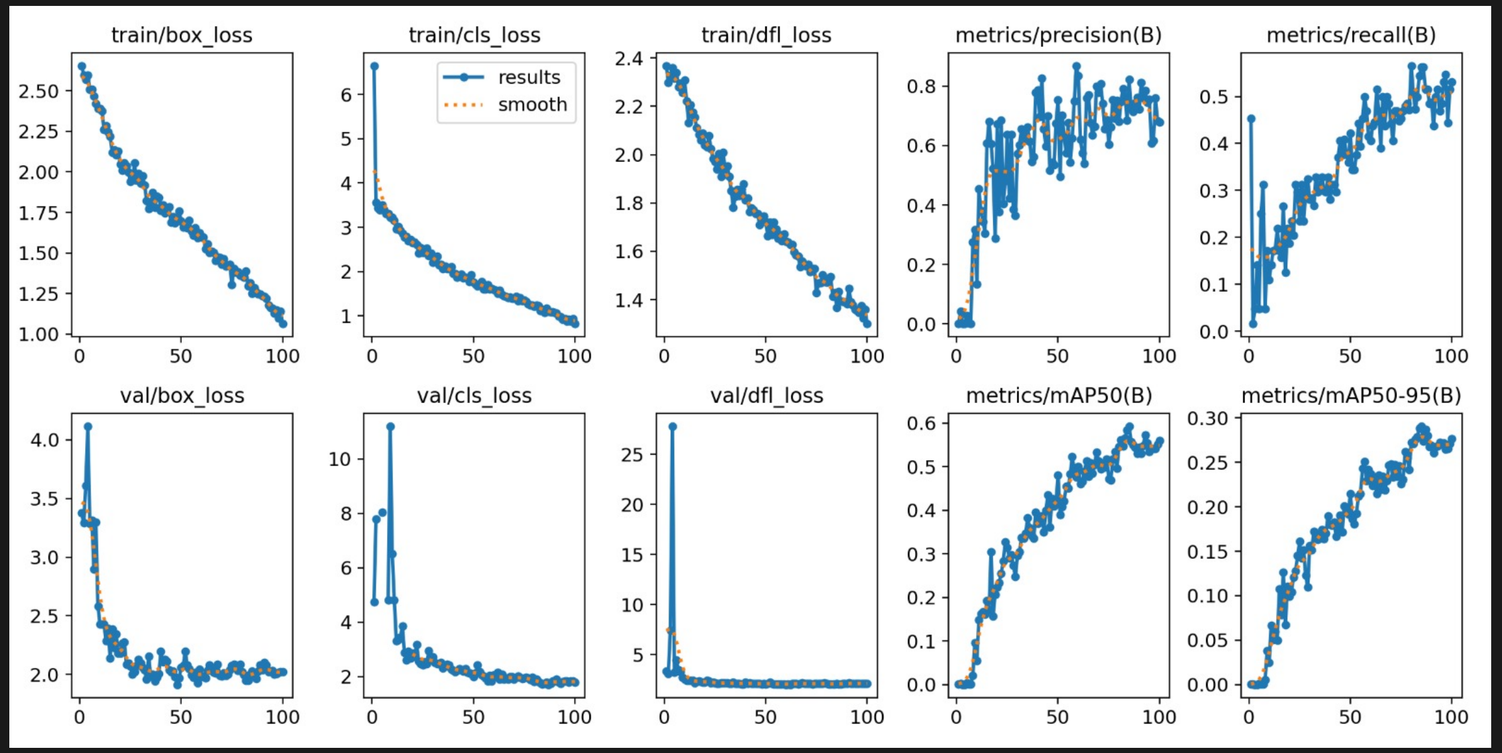


DATASET EDA


Class Distribution
537
500
400
300
200
100
0
instances
weapon
Bounding Box Anchors
Normalized Spatial Distribution of x, y
0.8
0.6
0.4
0.2
y
0.2
0.4
0.6
0.8
x
Normalized Object Size Distribution
- width vs height
0.8
0.6
0.4
0.2
height
0.2
0.4
0.6
0.8
width

BASELINE SOLUTION AND RESULTS

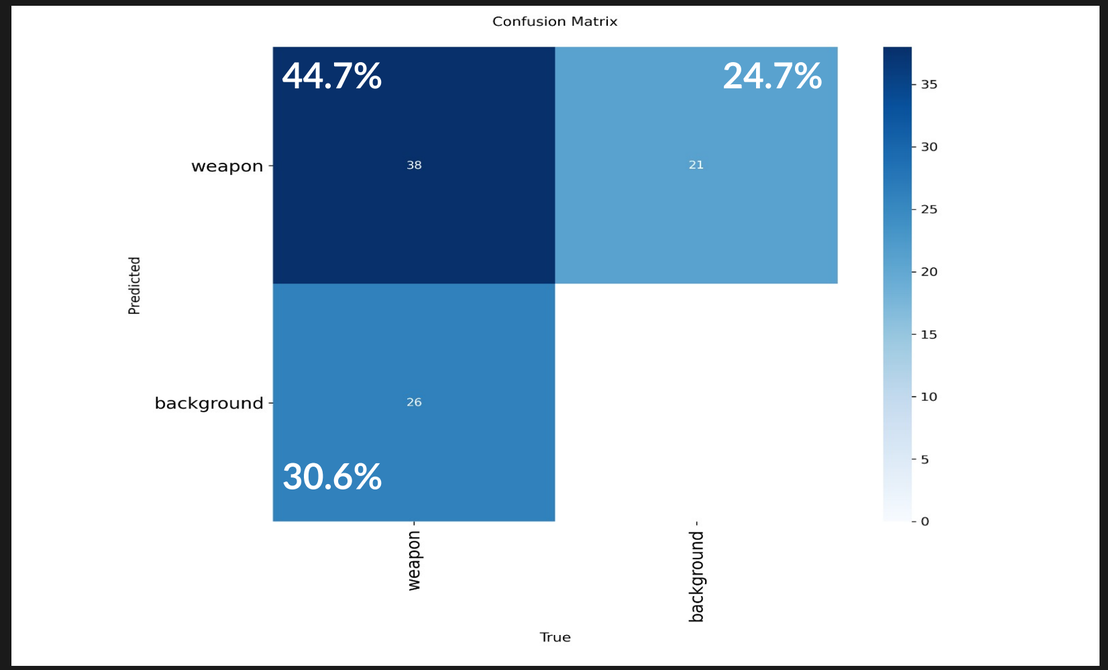
01 **Train metrics**



BASELINE SOLUTION AND RESULTS

02

Confusion Matrix



03

Baseline Model Evaluation

Metric	Value
mAP50	(53.2%) 0.532
Precision	(69.2%) 0.692
Recall	(50.8%) 0.508
Inference Speed	5.4ms per image (T4 GPU)

PLAN

Core Model: YOLOv8s (Small)

Hybrid Training Strategy: Combining real-world labeled hand-surgical frames with AI-Generated Synthetic Weapon Data (Diffusion-based inpainting).

Evaluation Metrics: Optimization will focus on balancing Precision (minimizing false alarms) and mAP@.5:.95 (localization accuracy under distortion).

Task/Milestone	Description & Technical Scope	Expected Outcome	Due Date
Phase 2: Synthetic Expansion	Integrating 500+ AI-generated weapon images with specialized prompt guidance.	Diverse dataset with varying lighting & occlusions	Week 10
Phase 3: Hybrid Training	Fine-tuning the YOLOv8 model on the merged (Real + Synthetic) dataset.	Improvement in mAP50 (>60%) and Recall.	Week 11
Phase 4: Optimization	Hyperparameter tuning (learning rate, mosaic augmentation) and model pruning.	A robust, deployment-ready weights file.	Week 12
Phase 5: Final Validation	Testing on unseen "wild" bodycam footage and error analysis.	Final performance report and video demos.	Week 13
Final Preparation	Preparing the final presentation and technical documentation.	Comprehensive Project Submission.	Week 14