CPE 496/498 Capstone Design Course

Camouflage Reveal Neural Network App (CaReNN)

Nathan Ogden, Lilly Redmond, Olivia Tucker, Christian Boldin, Barrett Peterson
Mentor: Dr. David Coe, Associate Professor, Electrical and Computer Engineering, UAH

The Need: Military personnel require improved detection of camouflaged threats in complex environments. Advancements in camouflage make threats hard to detect.

The Solution: CaReNN is a smartphone-based system that identifies camouflaged objects in real-time, using YOLOv8 and operating offline for security purposes and portability.

Status: The CaReNN model is trained to a Mean Average Precision (mAP) of 70% and deployed on the Google Pixel 9 Pro. Object detection is now operational, running in real time using a TensorFlow Lite model for on-device camouflage detection.

Requirements

Marketing	Engineering
M1: Detect camouflaged objects in real-time.	**E1:** The system must achieve a camouflage detection Mean Average Precision (mAP) of at least 70% at a 50% Intersection over Union (IoU) threshold, tested on 500+ objects in diverse environments.
M2: Work effectively in different environment conditions.	**E2:** Train in 5,000+ images (≥ 640 x 640 resolution).
M3: Mobile app functionality	**E3:** Include live video with ≤1s delay at ≥15 FPS.
	E4: Include a confidence slider for detection sensitivity.
	E5: Highlight detected objects with bounding boxes.

Acknowledgements and References

The CaReNN Group thanks Dr. David Coe for his mentorship and guidance throughout this project. We also appreciate University of Alabama in Huntsville (UAH) for providing funding in our research.

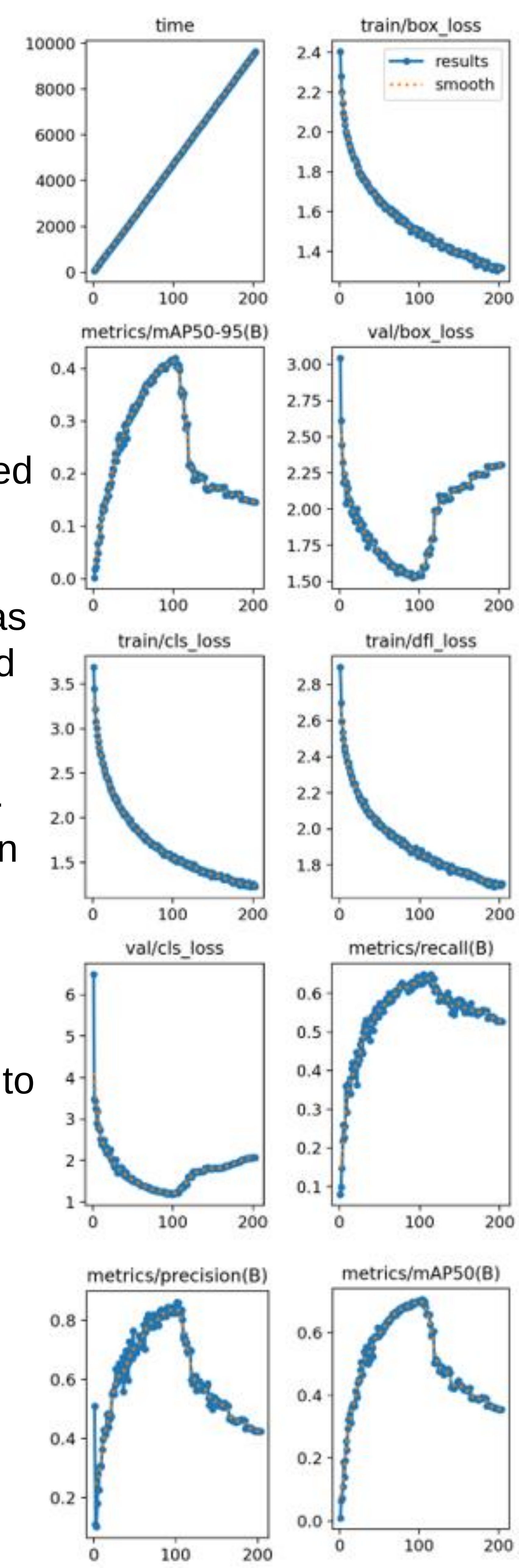
Current Results:

Model Performance: Achieved 70% mAP @ 50% IoU, trained on 5,000+ images across diverse environments.

App Functionality: Has live camera feed and a login page for extra security.

App Deployment: Application installed on Google Pixel 9 Pro

Conclusion: The CaReNN project has successfully developed and integrated an Android Studio application and a trained YOLOv8-based camouflage detection model into a functional real-time detection system. The application now performs on-device inference, enabling live camouflage detection through a smartphone camera feed. Datasets used in training include military-specific personnel in addition to common types of camouflage in an effort to improve the model's performance and relevance in field scenarios. This project serves as a successful proof of concept for deploying camouflage detection models on edge devices, demonstrating the practicality and effectiveness of real-time, on-device object recognition.



Timing Diagram