BINUS UNIVERSITY GRADUATE PROGRAM Master Program

Master of Computer Science

Human and Animal Detection Using YOLO Algorithms

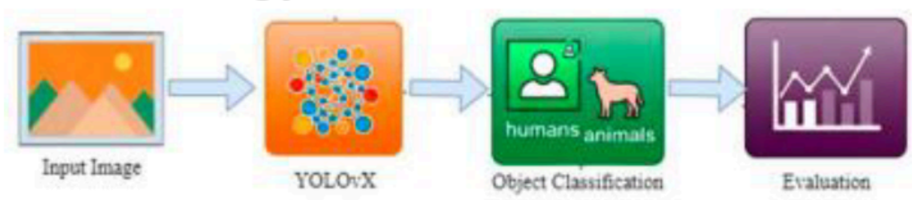
Background

UAV based thermal imaging supports conservation, anti-poaching, and human wildlife conflict mitigation. We benchmarked YOLOv8–v11 on the BIRDSAI dataset (five classes) after fine tuning, evaluating mAP, F1, and speed despite strong validation, test performance fell due to noise and class imbalance; YOLOv11 was most robust, YOLOv10 fastest underscoring accuracy speed trade offs for real world deployment.

Previous Works/State-the-arts

UAV thermal (wildlife) YOLO on BIRDSAI and Aerial Elephant achieves 85% mAP, but small/far objects remain challenging (Xu et al., 2024). YOLOv10 (IR/thermal anti UAV) Precision 98.9%, Recall 92.3%, mAP@0.5 96.5%, mAP@0.5:0.95 67.6%; fast due to NMS free design, but not a wildlife domain study (Q. Zhang et al., 2025)

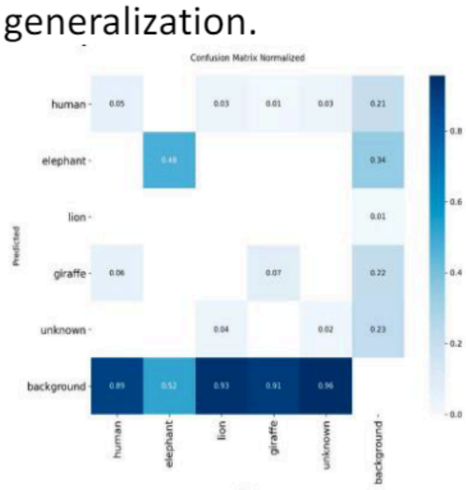
Methodology

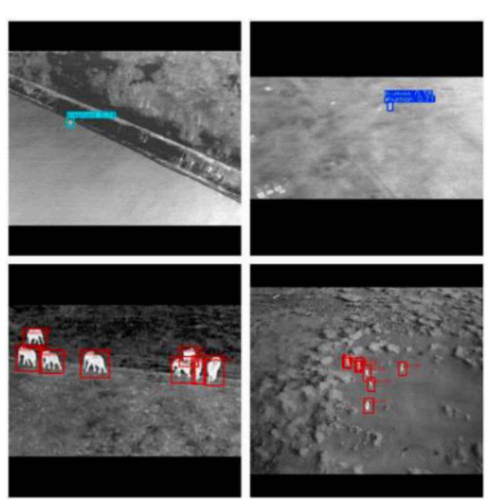


The workflow ingests thermal UAV images, applies preprocessing (noise removal and label correction), then runs each YOLO variant to detect objects in five classes Human, Elephant, Lion, Giraffe, and Unknown (to capture anomalous/OOD cases). Predictions are evaluated on standard metrics IoU, Precision, Recall, F1, AP, and mAP enabling a comparative analysis to identify the best-performing YOLO model for thermal object detection.

Results, Findings & Discussion

Evaluation shows solid validation performance across all models, yet accuracy degrades on noisier, imbalanced test data. Key finding elephants are consistently detected, while human, giraffe, lion, and unknown frequently go missing or are classified as background matching patterns in the confusion matrix and PR curves. This reflects sensitivity to small, low-contrast targets and ambiguous labels. Practically, choose YOLOv10 when latency is critical and YOLOv11 when robustness matters, improving annotation quality and class balance will most impact generalization.





Conclusions

This work benchmarks YOLOv8–YOLOv11 on thermal UAV data for wildlife detection. Despite strong validation, test performance degraded under dataset shift, heavy noise, and pronounced class imbalance, with consistent detections largely limited to elephants. YOLOv11 demonstrated the greatest robustness, whereas YOLOv10 prioritized speed, informing model choice for field deployment.

Selected References

1. Xu et al., (2024). review of deep learning techniques for detecting animals in aerial and satellite images. *International Journal of Applied Earth Observation and Geoinformation*.
2. Q. Zhang et al., (2025). BRA-YOLOv10: UAV small target detection based on YOLOv10. *Drones, 9*(3), 159.

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