Enhanced Object Detection, Tracking, and Re-Identification for High-Altitude Aerial Surveillance applications

In collaboration with NESCOM

SAFEAI

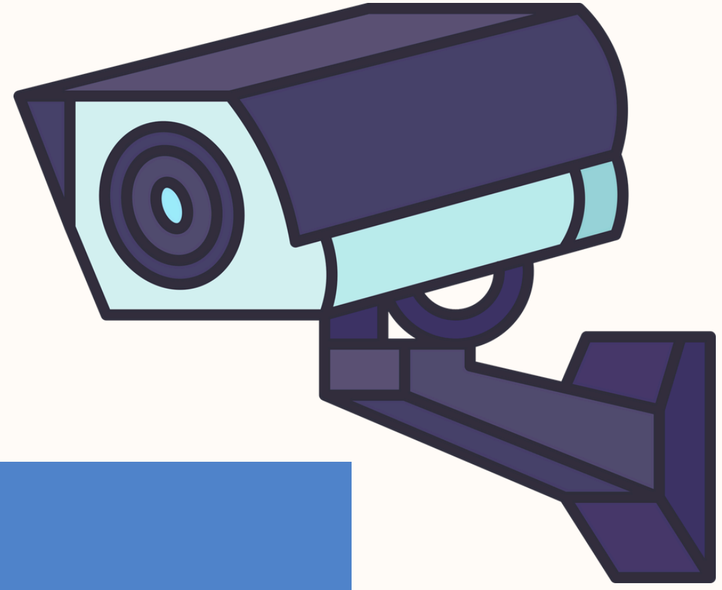
Presented by: Hiba Imran, Ahmed Hammad, Shizra Burney

21i-2685 21i-1543 21i-2660

Supervised by Dr. Imran Ashraf

Co-supervisor: Dr. Salman Khalid (NESCOM)

MOTIVATION



- Passion for AI & Surveillance
- Innovative Solutions
- Real-World Impact

PROBLEM STATEMENT

Core Problem: The difficulty of accurately detecting, identifying, and re-identifying small objects in aerial imagery due to variations in appearance and environmental conditions.

LITERATURE REVIEW

Study	Objectives	Methodology	Results	Limitations	Strenghts
Suo et al. (2023)	Present HIT-UAV dataset for UAV-based object detection	Dataset creation from UAV videos, bounding box annotation	Improved detection, YOLOv4 mAP 84.75%	Limited to infrared images	First high-altitude infrared dataset
Ural & Turker (2023)	Assess UAVs for land monitoring	UAV image capture, image processing	Detailed land use analysis, flexible	Limited flight time, weather-sensitive	Practical urban monitoring assessment
Zhang et al. (2023)	Develop object detection algorithm for UAVs	Deep learning algorithm development	Outperformed existing models	High computational needs	Strong performance, algorithm innovation
Khashabi et al. (2022)	Apply ML to UAV-captured images	Real-time object detection and classification	High accuracy, effective real-time	Training data bias, sensor limits	ML integration, real-time processing

CHALLENGES

Small Object Detection

The difficulty of detecting small-sized objects and ensuring accuracy in your detection system

Re-Identification Complexity

Challenges in consistently re-identifying objects across varying scenarios.

Processing on live streamed data

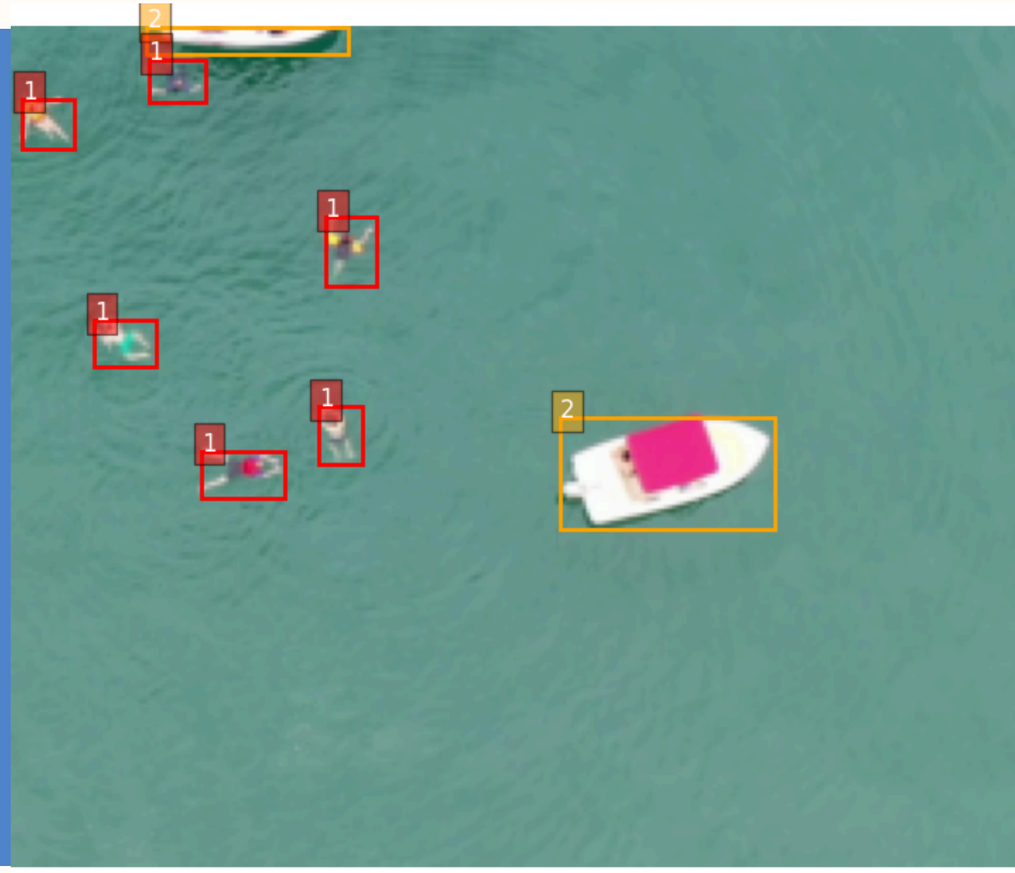
Poses the difficulty of choosing the most accurate models while maintaining FPS

RESEARCH GAP

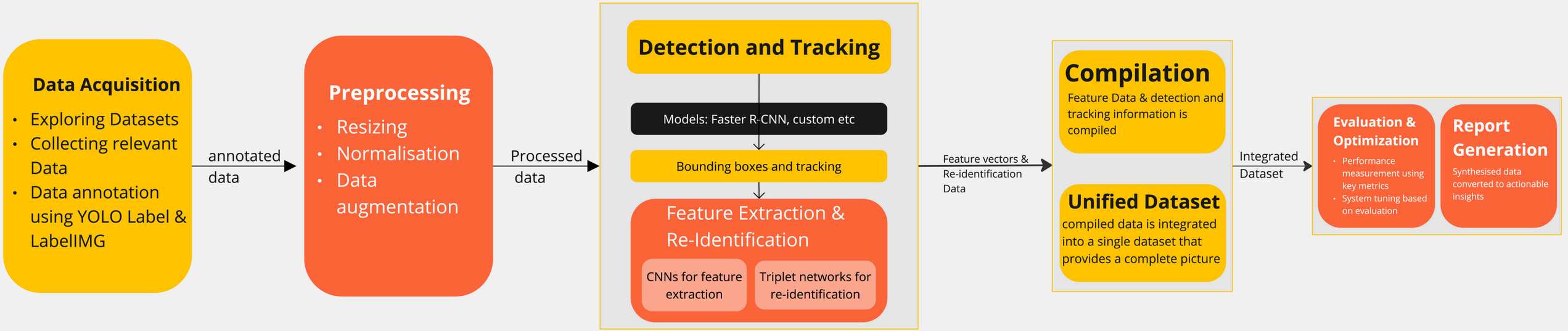
- Lack of focus on High-Altitude Aerial Imagery
- The need for Integrated Systems that combine Detection Tracking, & Re-Identification

PROPOSED SOLUTION

- AI and Computer Vision Techniques
- Deep Learning Models
- Feature Extraction
- Tracking Algorithms



OVERVIEW & METHODOLOGY



OVERVIEW & METHODOLOGY

Data Acquisition

- Exploring Datasets
- Collecting relevant Data
- Data annotation using YOLO Label & LabelIMG

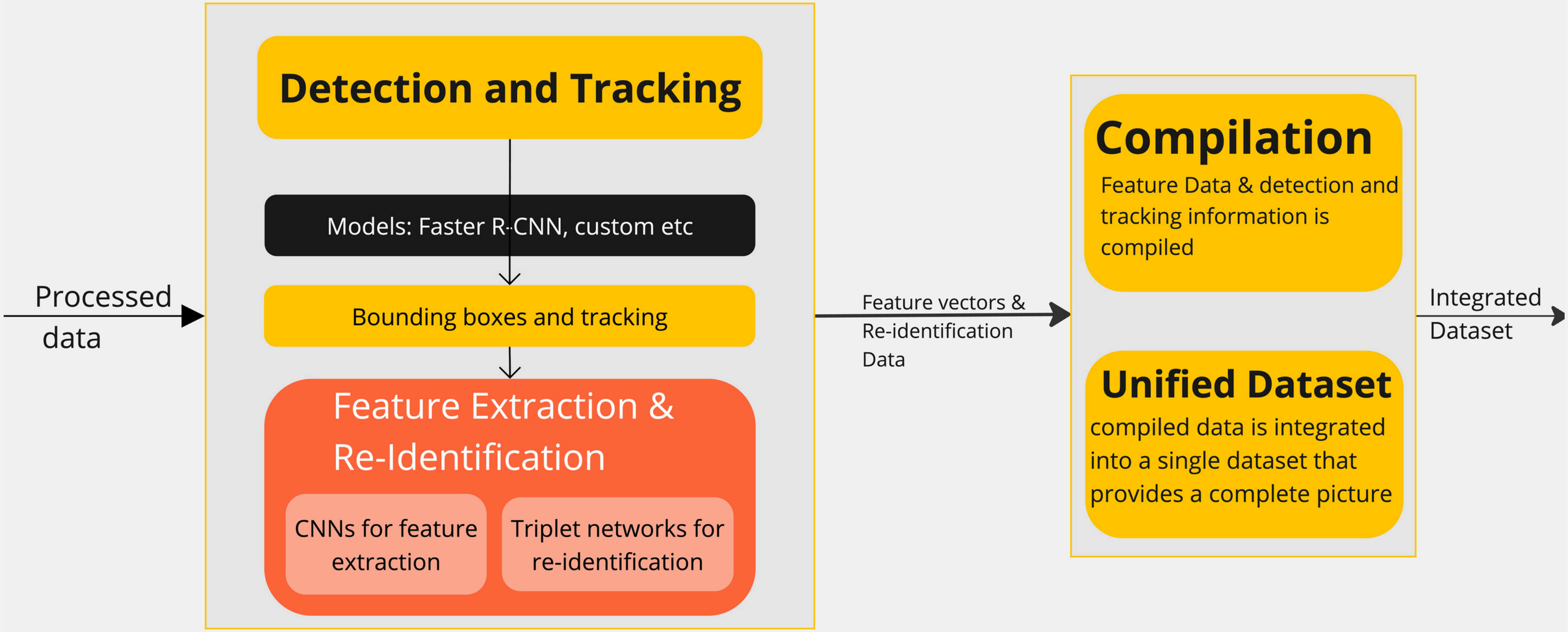
annotated data

Preprocessing

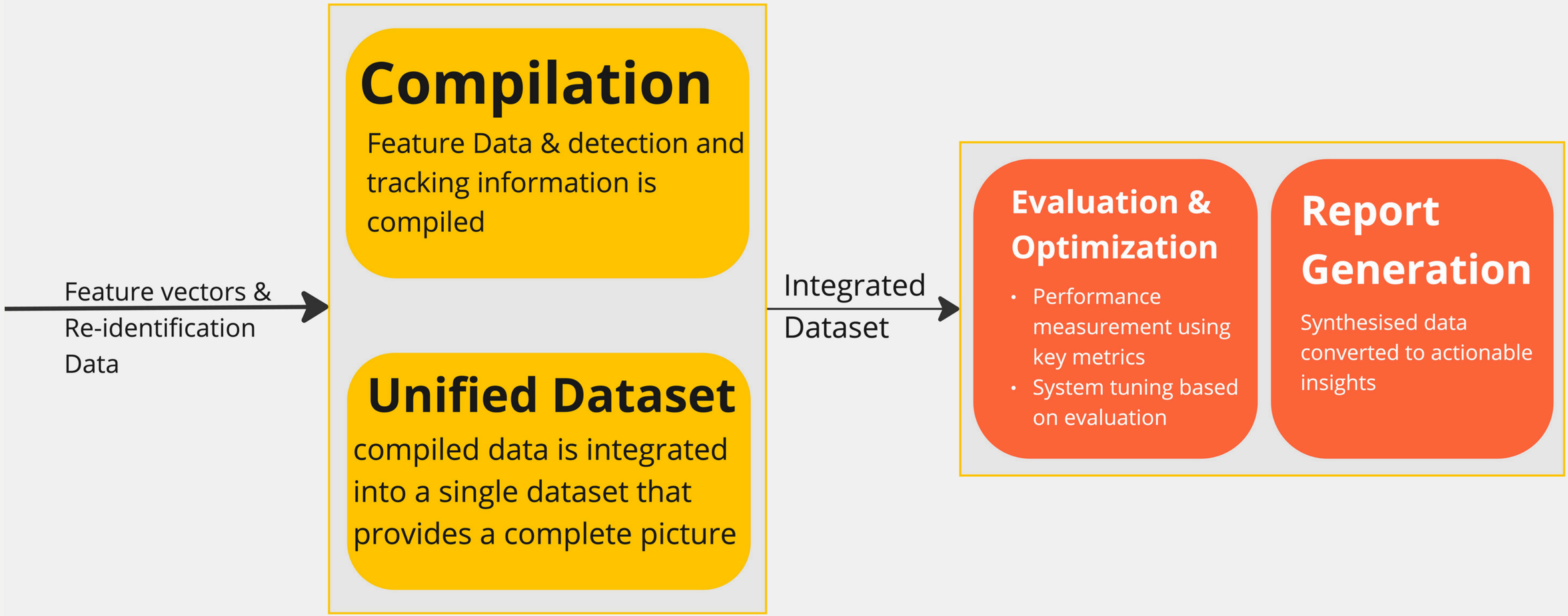
- Resizing
- Normalisation
- Data augmentation

Processed data

OVERVIEW & METHODOLOGY



OVERVIEW & METHODOLOGY

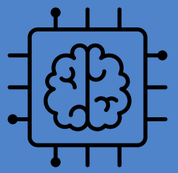


INDUSTRIAL REQUIREMENTS

- Identification of IR Images
- Re-Identification of IR Images
- Run-Time/Live Stream Data
- Serial Link Communication

TOOLS & TECHNOLOGY

- Python, PyTorch.
- Front end development using MEAN/MERN.
- ML algorithms, neural networks, and deep learning architectures.
- Advance detection models.
- Computer Vision Libraries: OpenCV, DLIB.
- Github for version control & Documentation



DATASETS

- **Camel Dataset**

  Classes: Person, Vehicle. 30 sequences

- **HIT-UAV Dataset**

  Classes: Person, Bicycle, Car, Other Vehicle.

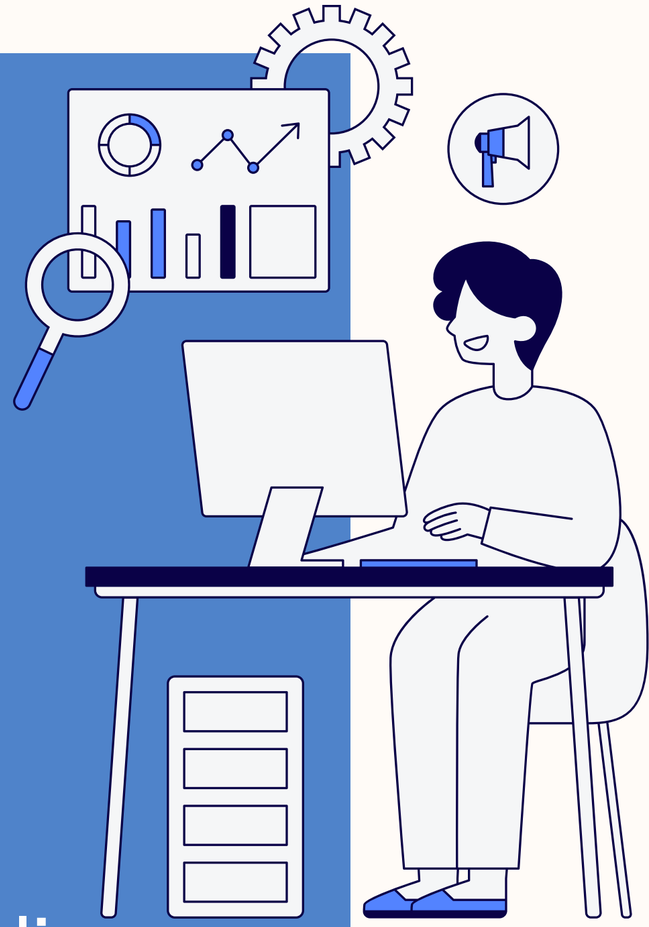
  2,898 images

- **SeaDroneSee Dataset**

  Classes: Swimmer, Boat, Jetski, Life-saving appliances.

  Train: 8,930 images, Val: 1,547 images,

  Test: 3,750 images



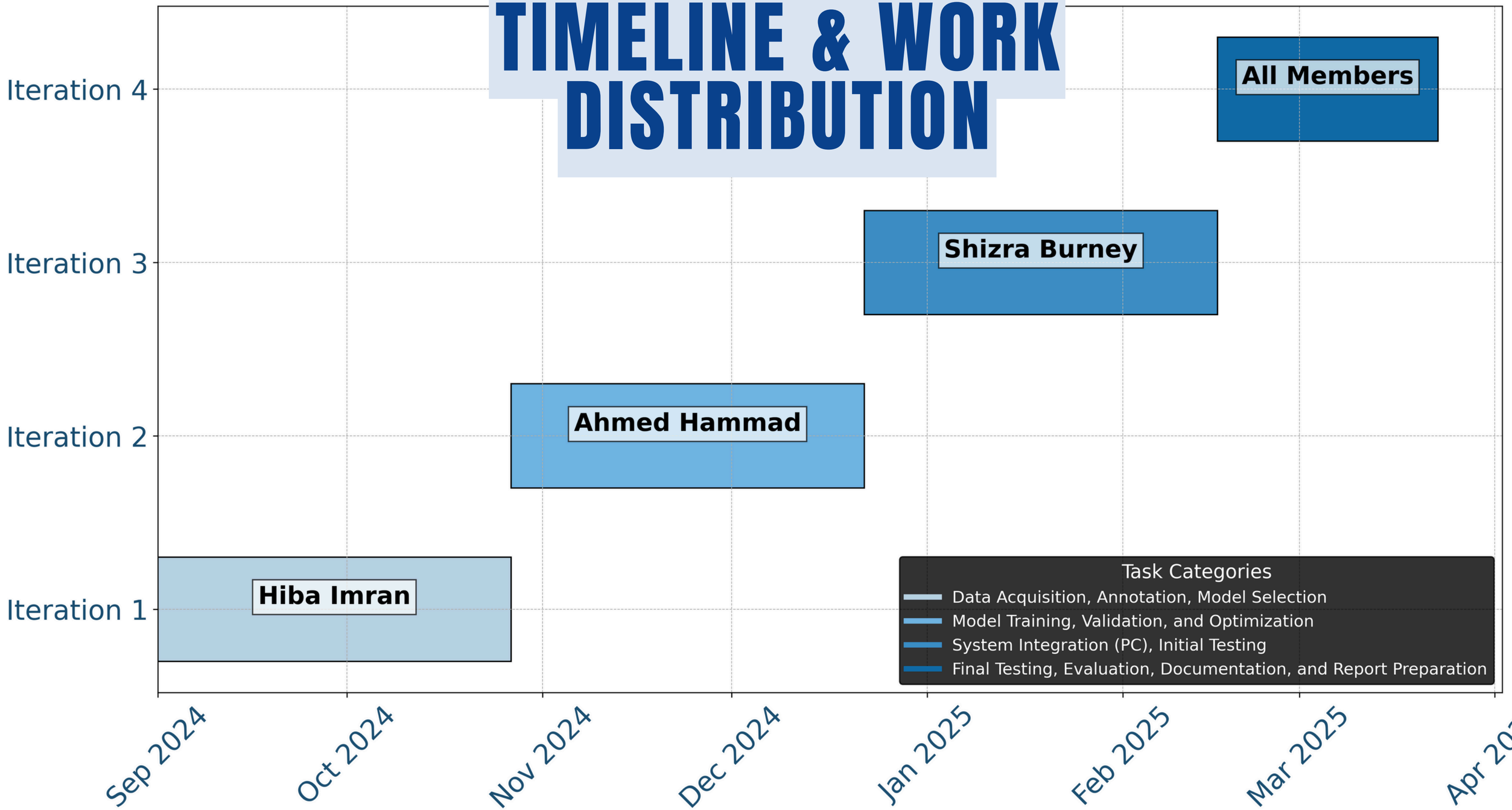
PERFORMANCE MEASURES

- Detection Accuracy: % of correct Identifications using Precision and Recall
- Re-ID Accuracy: Success Rate in consistent Object Tracking across frames.
- Processing Speed: Benchmark FPS during live feed processing using performance profiling tools.

PROJECT SCOPE

- **Objective:** Elevate drone surveillance with cutting-edge AI.
- **Deliverables:** Working AI model & performance reports across varied datasets
- **Target Users:** Security agencies requiring enhanced high-altitude day-night surveillance.

TIMELINE & WORK DISTRIBUTION



REFERENCES

- Ma, J., Liu, D., Qin, S., Jia, G., Zhang, J., & Xu, Z. (2023). An asymmetric feature enhancement network for multiple object tracking of unmanned aerial vehicle. Remote Sensing, 16(1), 70. https://doi.org/10.3390/rs16010070
- Collaborative training of Object Detection and Re-Identification in Multi-Object Tracking using YOLOV8. (2024, April 26). IEEE Conference Publication | IEEE Xplore. https://ieeexplore.ieee.org/abstract/document/10560451
- Suo, J., Wang, T., Zhang, X., Chen, H., Zhou, W., & Shi, W. (2023). HIT-UAV: A high-altitude infrared thermal dataset for Unmanned Aerial Vehicle-based object detection. Scientific Data, 10(1). https://doi.org/10.1038/s41597-023-02066-6

QUESTIONS & DISCUSSION

Presented by: Hiba Imran, Ahmed Hammad, Shizra Burney
21i-2685 21i-1543 21i-2660

In collaboration with NESCOM