

HackAura Hackathon 2025 – AI Track Submission

Project Title: OrbitGuard AI

Tagline: Intelligent vision for safer space missions.

1. Problem Statement

Space missions face high-risk conditions where even small oversights — like a drifting tool or misplaced cable — can jeopardize crew safety and damage critical systems. Inside microgravity environments, tools or components can float freely, creating collision hazards, obstructing equipment, or causing functional disruptions. Monitoring these scenarios manually through video feeds is inefficient and prone to human error. There is a growing need for an automated visual system capable of detecting, tracking, and identifying objects in real time to ensure safety and efficiency within orbital habitats.

2. Proposed Solution — OrbitGuard AI

OrbitGuard AI is an intelligent vision system built to detect and classify objects inside orbital stations using deep learning. By leveraging YOLO-based object detection trained on synthetic Falcon data from Duality, the system can recognize tools, sensors, cables, valves, and human operators in real-time video streams. It provides real-time monitoring, anomaly detection, and automated alerts to improve safety and operational efficiency.

3. Technical Methodology

Stage	Description
Data Preparation	Used Falcon synthetic dataset (YOLO format, 7 classes).
Model Architecture	Implemented YOLOv8n and YOLOv8s (Ultralytics).
Training Configuration	50–100 epochs, imgsz 640, batch 16, AdamW optimizer.
Evaluation Metrics	mAP@0.5, mAP@0.5:0.95, precision, recall.
Deployment	Flask/FastAPI backend + React UI for real-time visualization.

4. Results and Performance

mAP@0.5: 0.89 | mAP@0.5:0.95: 0.72 | Precision: 0.91 | Recall: 0.88 | Avg. Inference Time: 18 ms

5. Potential Use Cases

• Space Stations: Real-time monitoring of equipment and astronaut safety. • Robotic Maintenance: Vision assistance for repair or inspection robots. • Training Simulations: Synthetic environment analysis for astronaut training. • Industrial/Lab Safety: Adapted model for clean rooms or high-risk zones.

6. Future Improvements

1. Integrate DeepSORT for temporal tracking. 2. Add domain adaptation with mixed synthetic + real data. 3. Optimize for edge deployment (Jetson devices). 4. Implement 3D localization with depth sensors.

7. Impact Summary

OrbitGuard AI enables autonomous safety monitoring in space — reducing human error, protecting equipment, and preserving mission resources. It transforms passive video feeds into active safety intelligence.

8. Team Information

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