TITLE: SYNDETECT(AI-BASED OBJECT DETECTION FOR SPACE STATIONS USING SYNTHETIC DATA)

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Track: Duality – AI & Space

PROBLEM & SOLUTION

Problem

- Real-world object detection in space is hindered by limited data.
- Risks increase due to undetected anomalies or misplaced tools.

Our Solution:

- Generate synthetic data using domain randomization.
- Train a robust YOLOv7 model entirely on artificial space station imagery.
- Simulate real challenges: occlusion, lighting variation, object overlap.

TECHNICAL ARCHITECTURE

Tools & Frameworks:

- Model: YOLOv7
- Platform: Google Colab
- Dataset: Roboflow + NASA public domain imagery

Workflow:

- Synthetic data generation
- Annotation using Roboflow
- YOLOv7 training on Google Colab (pre-trained weights)
- Evaluation & tuning
- Output demo (optional via Streamlit)

MODEL RESULTS

- Initial mAP: 42%
- Issue: Low detection of “Oxygen Tank” in shadow or occlusion.
- Fix: Added occlusion-heavy synthetic examples.
- Final mAP: 55%
- Confusion Matrix highlights:
- High precision for “Fire Extinguisher” & “Toolbox”
- Moderate recall for “Oxygen Tank” improved post-augmentation

FAILURE CASES & FIXES

Case 1: Shadowed Object Not Detected

Fix: Simulated low-light scenarios in training

Case 2: Occlusion by Astronaut

Fix: Augmented with partially hidden object samples

Case 3: Class Confusion: Fire Extinguisher vs. CO_2 Tank

Fix: Re-labeled edge cases, fine-tuned for confidence threshold

IMPACT & FUTURE SCOPE

Benefits:

Zero dependence on real-world data

Fast deployment in resource-constrained environments (e.g. onboard systems)

Enhanced astronaut safety and inventory tracking

Future Plans:

Integrate with live camera feeds on satellite/ISS simulators

Extend to anomaly detection and motion tracking

THANK YOU

Thank you!

We detect the future before it happens with

SYNDETECT

-TECH TITANS