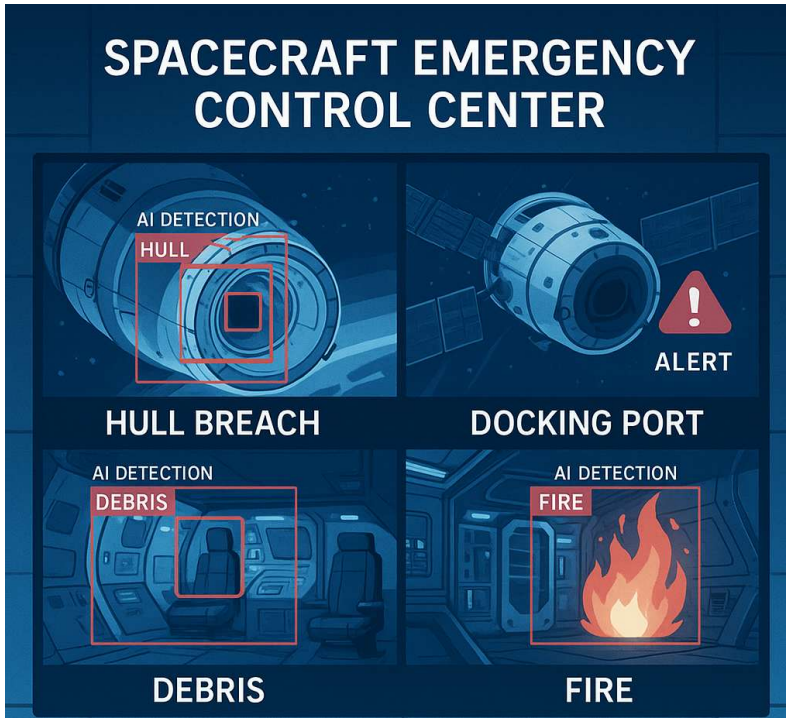
Problem Statement and Team Details

Problem Statement: During spacecraft emergencies (fires, depressurization, equipment failures), astronauts face critical time constraints to locate essential safety equipment.



Team Name: Smashverick

Team Leader Name: Ansh Chauchan

Institute Name: Delhi Technical Campus

Theme Name: AI & Space Technology / Safety Systems

Team Leader Email ID: chauhananshh289@gmail.com

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Problem

Astronauts face life-threatening emergencies (fire, depressurization, equipment failure) in spacecraft.

- Visibility may be severely limited due to microgravity and smoke doesn't rise and obscures equipment.

- Time pressure: Delays in locating fire extinguishers, oxygen tanks, or toolboxes can be fatal.

- No automated real-time solution for finding critical safety tools during emergencies inside a spacecraft.

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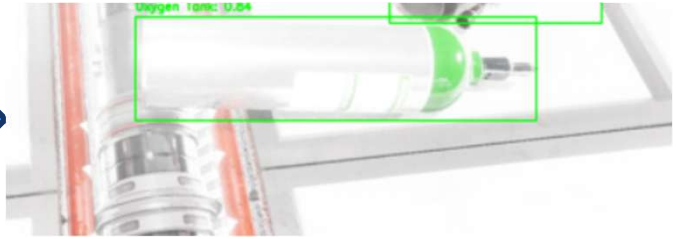
Solution

Developed an AI-powered system for real-time detection of toolbox, fire extinguisher, and oxygen tank.

- Instantly highlights the nearest safety equipment using a tablet or AR device's camera feed during emergencies.
- System uses deep-learning object detection (YOLOv8) to ensure high accuracy and low false positives.

EMERGENCY



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Tech Stack

- Framework: Ultralytics YOLOv8 (state-of-the-art object detection)
- Jupyter Notebook (Both **Kaggle Notebooks** and **Google Colab** are built on the **Jupyter Notebook ecosystem**)
- Libraries: PyTorch, OpenCV, Streamlit, TensorFlow Lite (for edge deployment), Matplotlib
- Hardware: NVIDIA Tesla T4 GPU for training, compatible with tablets/cameras for inference
- Deployment formats: PyTorch (.pt), ONNX, TensorFlow Lite (.tflite) for mobile/edge devices

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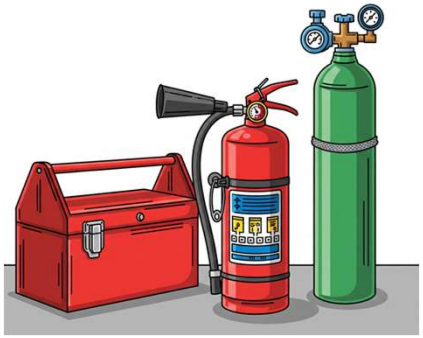
Methodology & Implementation

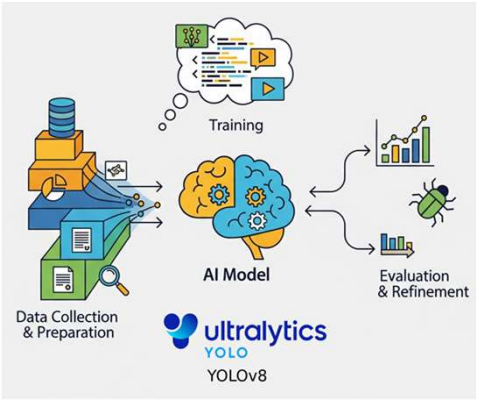
Data Foundation



400+ spacecraft images

Train/Val/Test: 70/20/10

AI Model Development



YOLOv8s - PyTorch 2.6.0 + CUDA 11.8

Optimization

Label reviews, tuning, hyperparameter optimization

Application

Streamlit interface + OpenCV

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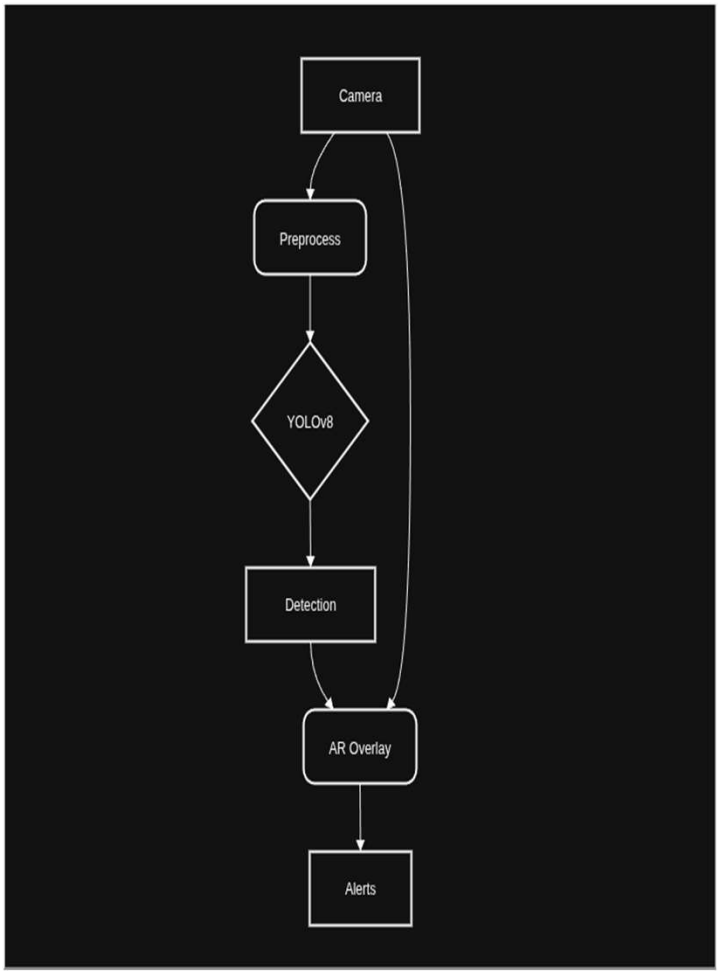
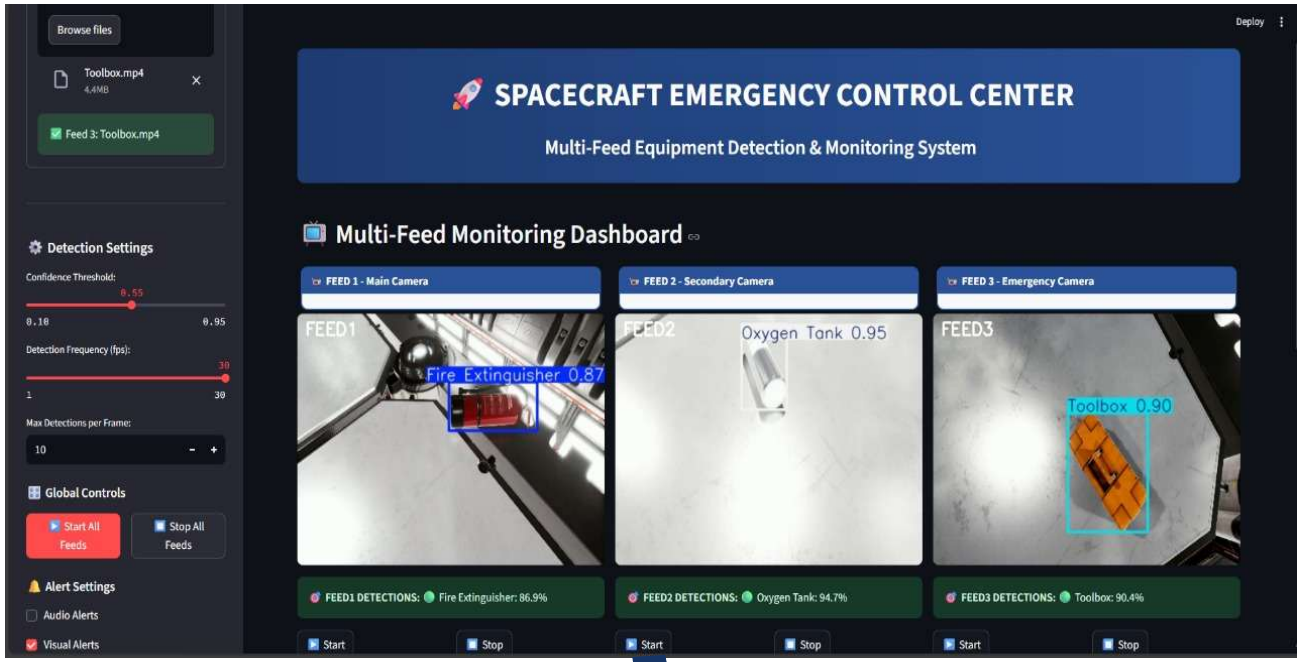
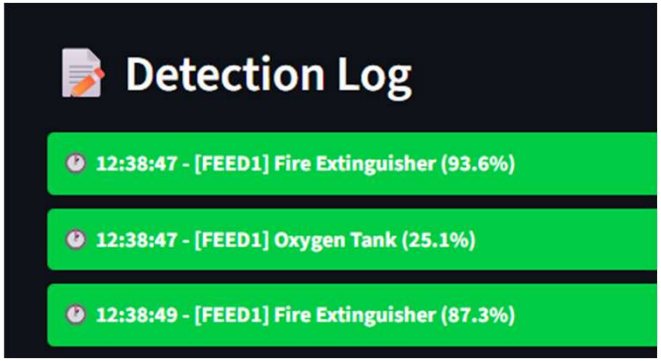
Flowchart & Supporting Images



Demo


Browse files
Toolbox.mp4
4.4MB
Feed 3: Toolbox.mp4
Deploy
SPACECRAFT EMERGENCY CONTROL CENTER
Multi-Feed Equipment Detection & Monitoring System
Multi-Feed Monitoring Dashboard
Detection Settings
Confidence Threshold:
0.55
0.10
0.95
Detection Frequency (fps):
30
1
30
Max Detections per Frame:
10
Global Controls
Start All Feeds
Stop All Feeds
Alert Settings
Audio Alerts
Visual Alerts
FEED 1 - Main Camera
FEED 2 - Secondary Camera
FEED 3 - Emergency Camera
FEED1
Fire Extinguisher 0.87
FEED2
Oxygen Tank 0.95
FEED3
Toolbox 0.90
FEED1 DETECTIONS: Fire Extinguisher: 86.9%
FEED2 DETECTIONS: Oxygen Tank: 94.7%
FEED3 DETECTIONS: Toolbox: 90.4%
Start
Stop
Start
Stop
Start
Stop


Detection Log
12:38:47 - [FEED1] Fire Extinguisher (93.6%)
12:38:47 - [FEED1] Oxygen Tank (25.1%)
12:38:49 - [FEED1] Fire Extinguisher (87.3%)

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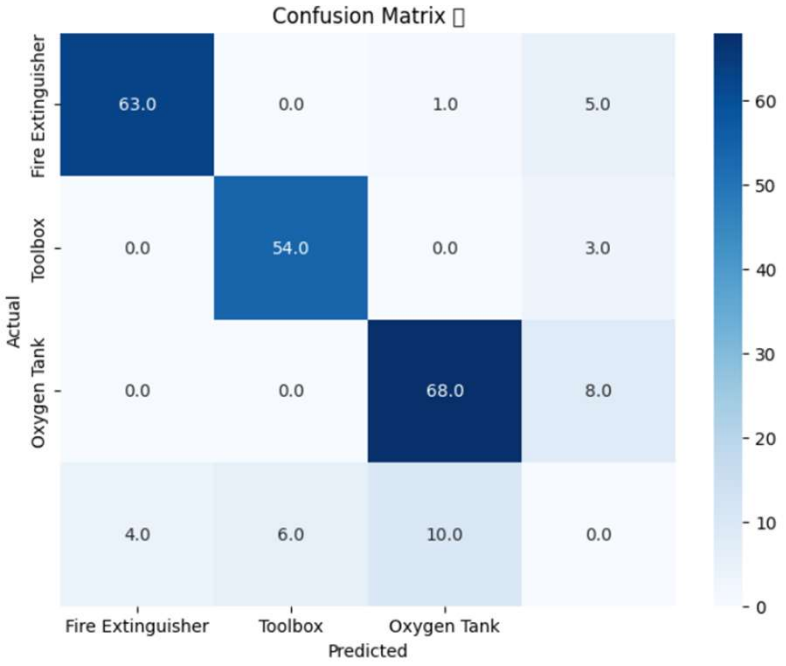
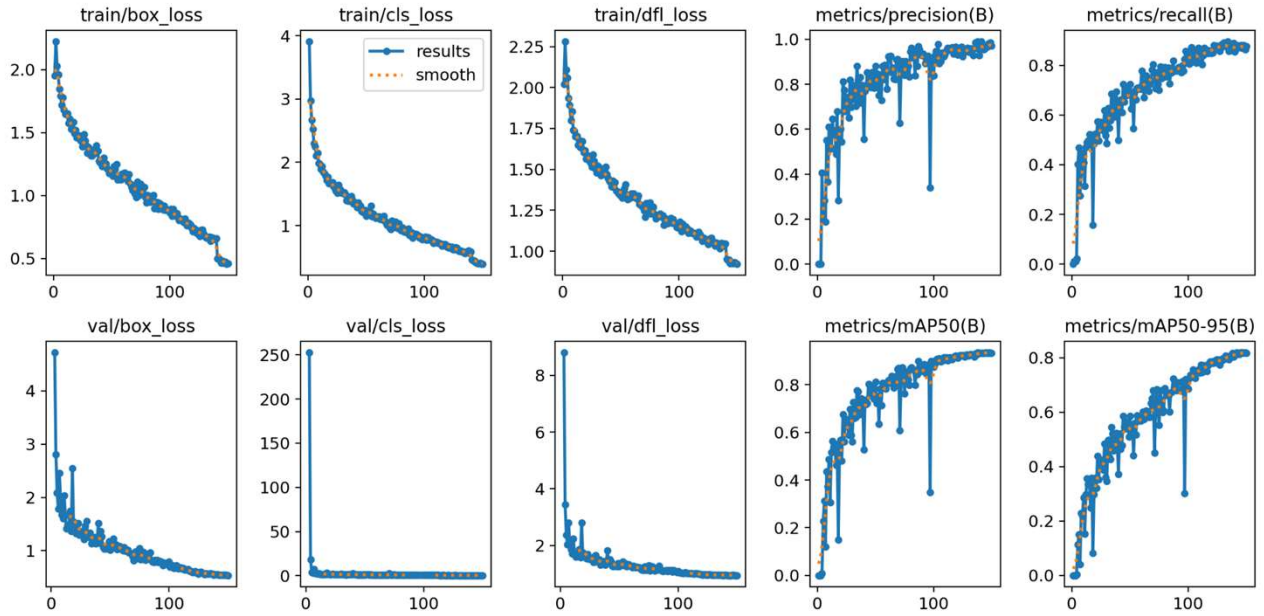
Benchmark Results





Feasibility and Market Use

🔧 Technical Feasibility

- **Offline AI Processing**: YOLO-based detection with no internet dependency
- **Real-Time Response**: <100ms detection latency for emergency response
- **Multi-Format Support**: MP4, AVI, MOV, MKV, WebM; 240p–4K resolution
- **Customizable Models**: Tailored for spacecraft-specific equipment

🌎 Market Opportunity

- **Target Customers**: NASA, ESA, SpaceX, Virgin Galactic, ISRO
- **Market Size**: $3.2B TAM (2024); AI Video Analytics to hit $32.4B by 2030
- **Competitive Edge**: First-to-market, emergency alerts, cost-effective

💵 Economics & ROI

- **Development Cost**: ~$50K (already built!)
- **Deployment**: $10K–25K per site;
- **Revenue Model**: $50K–200K/year licenses; $1M+ damage prevention

🎯 Key Metrics & Next Steps

- **Success Metrics**: >95% accuracy, 99.9% uptime, $45M revenue by Year 5
- **Next Steps**: ISRO pilot, $2M funding, certifications, global expansion

Conclusion

Metric	Our Result	Industry Std	Status
mAP@0.5	93.4%	50-60%	✅ Exceptional
Precision	98.04%	70-80%	✅ Outstanding
Recall	88.06%	60-70%	✅ Excellent
Speed	11.9ms	<20ms	✅ Real-time

Impact: - Solves real emergency issue - 93.4% accuracy - Deployable in space missions

Why It Wins: - Innovation - Tech excellence - Market ready

Next Steps: - Azure & HoloLens integration - Microsoft Teams + Power Platform dashboard