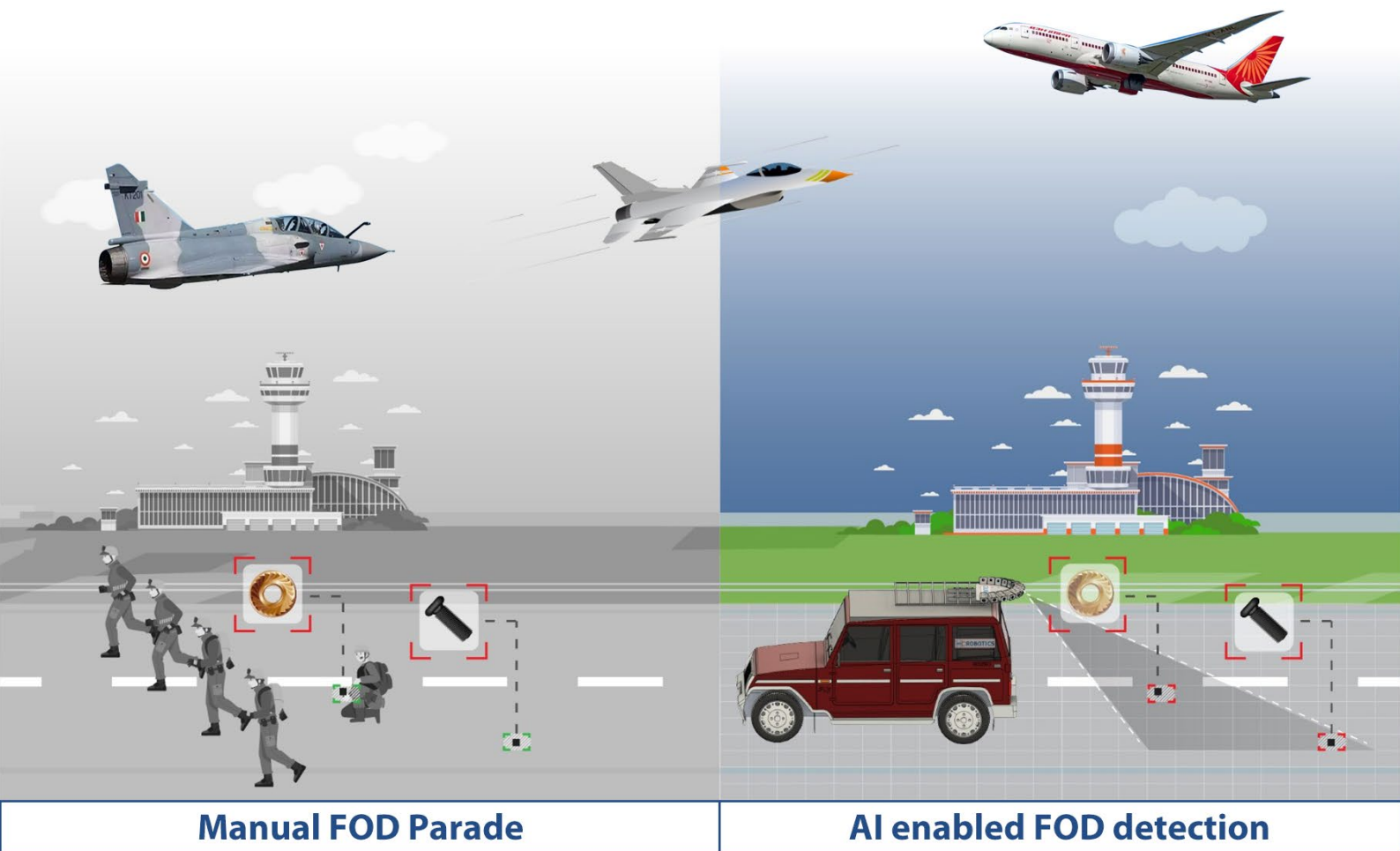


AI-Enabled Foreign Object Debris (FOD) Detection System



HC Robotics:

HC Robotics Private Limited is a cutting-edge technology company focused on creating innovative solutions for the defense, security, surveillance, and aviation safety sectors. Inspired by the **Atma Nirbhar Bharath initiatives**, our research and development efforts emphasize self-reliance and technological advancement. With global support centers in the USA and Europe, we leverage international expertise to enhance our technologies.

Our core expertise lies in utilizing AI-powered image processing and real-time video analytics to deliver AI enabled decision-making capabilities, automation, and operational efficiency.

- MSME company
- Start Up India
- Holding 3 US Patents
- IDEX Winner: Disc-7 Challenge 65: EOIR-POD for Naval Aircraft
- Collaboration with IIT-Hyderabad, NIT-Warangal, IIIT-K
- Working on projects of Indian Army, Indian Navy, Indian Airforce and DRDO labs

We design and manufacture AI-enabled EOIR gyro-stabilized gimbal cameras for long-range surveillance in demanding environments like defense and security. We also manufacture advanced Drone components in Hyderabad, including Edge Flight Controller, Current sensors, GNSS with NavIC, and Power distribution boards, offering versatile, high-performance solutions. Our Made-in-India products help Indian drone manufacturers reduce imports from China and other countries and increase Indigenous Content (IC).

Our Products and Solutions

AI for Airports safety:

- Birds monitoring at Airport
- FOD Detection System
- Wildlife Monitoring near runways
- Aircraft Tracking System
- Runway occupancy analysis

Drone and components:

- Tethered Drones
- Quad and Hex Drones
- Edge Flight Controller
- Indian NavIC + GNSS
- Power Distribution Board

Gimbal Cameras with AI:

- Chakshu EOIR gimbal cameras
- Explosion proof camera
- PTZ cameras

AI products:

- Facial recognition system
- Parking lot monitoring
- Gatepass entry-exit management
- Construction surveillance system
- Perimeter surveillance (RGB/IR)
- Telecom Poles Monitor
- Road Damage Estimation



Chakshu Gyro-Stabilized gimbal camera



HCR Drone M694



Flight Controller

FOD Detection – Problem Statement:

- Foreign Object Debris (FOD) on airport runways poses significant safety risks, potentially causing aircraft damage and operational delays. Air France Flight 4590 crash in the year 2000 is just one of the grim reminders of the magnitude of threat
- Traditional manual inspections are labour-intensive, inconsistent, and often disrupt airport activities, requiring substantial manpower and frequent runway closures
- Factors like fatigue and poor visibility increase the likelihood of missed debris, especially in adverse conditions



Flight 4590 accident



Damage caused by FODs

PROPOSED SOLUTION

To address these challenges, HC Robotics proposes an AI-powered FOD detection system with vehicle-mounted cameras, offering faster, more accurate real-time detection and improved operational efficiency.

HC Robotics' Foreign Object Debris (FOD) detection system combines AI technology with vehicle-mounted cameras to deliver an effective and adaptable solution for maintaining runway safety.

Real-Time Detection

AI-powered cameras continuously monitor the runway, detecting debris in real-time and instantly alerting teams to reduce aircraft risks

Customizable Setup

Configurable to detect varying debris sizes based on runway conditions and customer needs

AI Precision

Trained on diverse datasets to ensure accurate debris detection across varying conditions

FOD Removal

Alerts sent to response teams in real-time with tablets, pinpointing the exact location of debris for quick removal

Operational Efficiency

The system operates seamlessly without disrupting runway activities, minimizing delays and improving overall safety



FOD Detection Vehicle

Customizable UI

Tailored for easy monitoring, alert tracking, and log access, making it user-friendly and adaptable to specific operational requirements

Key Features

- Detection Sensitivity: Capable of detecting FOD as small as 5 mm
- High-Resolution Imaging: Ensure precise and comprehensive runway scans
- Efficient Scanning: Covers the main runway in just 2 to 3 passes
- Rapid Operation: Completes full runway scanning in under 30 minutes
- Real-Time Alerts: Instant audio-visual notifications upon FOD detection
- Precise Retrieval: Facilitates swift removal with FOD-guided vehicles equipped with rugged tablets and precise location data



Sample FODs



FODs detected during PoC

To enhance runway scanning efficiency, multiple AI-powered vehicles can be deployed to cover larger areas simultaneously. This reduces inspection time, accelerates debris removal, and minimizes disruptions, improving overall safety.

Proof of concept – Hakimpet Airforce Station

In 2024 extensive trials of our FOD detection system were conducted at AFS Hakimpet, demonstrating over 95% detection accuracy. These trials were quite successful and significantly boosted operational efficiency and safety, confirming the system's ability to enhance runway monitoring and mitigate FOD risks.

Benefits accrued are tabulated below:

Aspect	Current Manual Methods	Proposed AI-Powered System
Detection Accuracy	Inconsistent, prone to human error	AI-driven detection with over 95% accuracy in trained conditions
Response Time	Manual detection and reporting can take 60 minutes or more	Covered whole runway in 30 minutes
Resource Allocation	High labour cost, requiring 30-45 personnel per inspection	Automated detection, optimized manpower to a minimum of 3
Cost Efficiency	Higher long-term costs due to inefficiencies	Lower costs with streamlined operations
Customization	Limited flexibility and fixed procedures	Customizable to detect debris of different sizes and adapt to specific runway needs