

Submission Summary

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Paper Title

Foreign Object Debris Detection and Classification Using Deep Learning Method for Airways

Abstract

Foreign Object Debris (FOD) poses a critical safety and operational challenge in the aviation industry, contributing to an estimated loss of over \$4 billion annually due to incidents such as engine failure, tire punctures, and airframe damage. Current detection practices rely primarily on manual inspection and conventional surveillance, which are inefficient, time-consuming, and prone to human error, particularly under low-light and adverse weather conditions. To address these limitations, this study presents a Deep Learning–based FOD Detection and Classification System designed to automate and enhance runway safety monitoring. The proposed system employs three state-of-the-art object detection architectures YOLOv8, Single Shot MultiBox Detector (SSD), and Faster R-CNN with a ResNet-50-FPN backbone to accurately detect and classify debris from live video feeds captured in the airport’s Air Operations Area. The system classifies detected objects into Living (e.g., animals, birds) and Non-Living (e.g., tools, metallic parts, stones) categories, with further classification of non-living objects as Hazardous or Non-Hazardous. Using a dataset composed of varied FOD scenarios, each model was trained and evaluated based on detection accuracy, mean average precision (mAP), and inference speed. Experimental results indicate that Faster R-CNN achieved the highest detection accuracy, while YOLOv8 demonstrated superior realtime performance. The integration of these models ensures both precision and speed in detecting potential runway hazards. This deep learning–driven approach significantly reduces inspection time, minimizes human dependency, and improves overall airfield safety, representing a major advancement toward fully automated FOD management in modern airports.

Keywords – Foreign Object Debris (FOD), Deep Learning, Object Detection, YOLOv8, SSD, Faster R-CNN, ResNet-50-FPN, Aviation Safety, Computer Vision, Real-Time Detection, AI-based Monitoring

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Authors

Author**Individual Conflicts /****Attested?****Vaishnavi S** (Rajalakshmi Engineering College)

(0) No

<vaishnavis0121@gmail.com>

Santhosh V (Rajalakshmi Engineering College)

(0) No

<221801047@rajalakshmi.edu.in>

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