Using Drones to Automate Fall Hazard Monitoring in High-rise Construction

Using Unmanned Aerial Systems for Automated Fall Hazard Monitoring in High-rise Construction Projects

Masoud Gheisari, Behzad Esmaeili, Jana Kosecka, Abbas Rashidi.
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Overview

Unmanned Aerial Systems (UASs)—often referred to as drones—are flying agents operating under remote control. In the construction industry, one emerging technique for using UASs applies robust image processing and computer vision methods to extract useful information from visual data they capture with high-resolution cameras. Researchers have recently focused on developing computer vision techniques to automate various operations, such as 1) detecting job site hazards and safety-related issues and 2) conducting automated and semi-automated safety inspections. This project used UASs to collect true-color images and combined them with novel "computer vision" techniques to create an automated fall hazard detection and monitoring system. The researchers adopted a case study approach, looking at a high-rise building to investigate the development, implementation, and testing of the detection system. Their specific objective was to investigate the practical implementation of UASs for monitoring guardrails near unprotected edges and openings.

Key Findings

- This project developed a three-step machine-learning pipeline to detect guardrails from the UAS-captured images: (A) guardrail detection, (B) floor detection, and (C) space estimation.
- Integrating the second step (floor detection) in the image-processing algorithm significantly enhanced its guardrail detection precision.
- Including a cascade classifier (i.e., a machine-learning object detection algorithm used to identify objects in an image or video based on a binary pattern) with floor detection and guardrail spacing estimation achieved the best performance in terms of precision and recall metrics for guardrail identification.
- The outcomes of the research illustrated that the proposed automated fall hazard recognition system could facilitate recognition of guardrails in high-rise construction projects.

For more information, contact:
Masoud Gheisari: masoud@ufl.edu

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