Airport Threat Mitigation System

Russell Snyder, Brandon Breuil, and Benjamin O'Brien

Embry-Riddle Aeronautical University

EXTENDED ABSTRACT

Introduction

The FAA has reported over 79,000 wildlife strikes since 2000 resulting in hundreds of millions of dollars in damage, and injuring and killing numerous individuals[1]. Over 90% of these strikes occur at low elevation during landings, take-offs, and associated procedures. Several systems exist today to reduce the potential for wildlife strikes at airports, but are either very costly or require extra personnel to operate. The need exists for a low-cost, low-impact system to deter wildlife threats from airports operable at small to mid-sized airfields with limited budgets.

Design and Technologies

The Airport Threat Mitigation System (ATMS) is a semi-autonomous system composed of three major components: the vision subsystem, the unmanned ground vehicle (UGV) subsystem, and a ground control station (GCS). The vision subsystem uses monocular vision to detect, classify, and localize threats within the airport environment. The architecture of the vision subsystem supports multiple cameras so that the area covered can be appropriately scaled based upon the size of the airport. Each camera is also equipped with a pan/tilt unit which provides an increased field of view. The image processing software detects potential threats using a background subtraction algorithm that uses a Bayesian decision framework to segment foreground objects (potential threats) from background objects[2]. Once a threat has been detected, it is then classified into one of the following categories: bird, human, vehicle, or unknown using a feature-based categorization algorithm. The threat's position is then calculated by projecting the threat's 2D image coordinate into the 3D coordinate space. The GCS is notified of all threat information, and computes priorities for each threat based upon their classification, location, and proximity to runways, taxiways, and ground vehicles. UGVs are deployed by the GCS to navigate to the threats and activate available deterrence mechanisms, which include lights and predator sounds. The UGVs use A* path planning to avoid runways and taxiways.

Results

The system requires human interaction in safety-critical situations. In order to cross runways and taxiways, a UGV requests permission from an operator. The operator can manually pan-tilt the camera to track a threat. The UGV can also be driven remotely, and its deterrence systems can be manually activated.

Initial system tests have shown the designs viability in detecting, identifying, and deterring potential threats to aircraft on a simulated airport facility. With development costs under $1,500, this highly portable and expandable system is an affordable solution for airports of all sizes to effectively reduce the risk of wildlife collisions for all types of aircraft.

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[1] FAA Wildlife Strike Database - http://wildlife-mitigation.tc.faa.gov/wildlife/database.aspx

[2] *Foreground Object Detection from Videos Containing Complex Background*, Liyuan Li, Weimin Huang, Irene Y.H. Gu, and Qi Tian, ACM MM2003