

The Center for Cyber Defenders

Expanding computer security knowledge

Drone Detection

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Problem Statement:

The rapidly increasing prevalence of drones worldwide poses a unique security and privacy threat to U.S. government and commercial interests. Detection of these Unmanned Aerial Vehicles (UAVs) is a critical step in ensuring public safety. The OpenCV library is the most widely used library in industry for computer vision. While it has historically been utilized for facial detection, a heavily researched topic, OpenCV has seen very little application in the field of optical drone detection. Our goal is to use the OpenCV library to enable our target devices to reliably detect flying drones and quadcopters.

Objective:

- Create software to optically detect drones using the target devices
- Detect general motion
- Detect edges of moving objects
- Identify moving object

Approach:

- Use background subtraction/temporal differencing to detect changes in successive frames captured by the camera within a specific pixel threshold
- Convert the camera image to grayscale to detect contours within variable threshold and draw rectangles on moving objects within the camera frame
- Collect large image database of hundreds of drones/quadcopters. Combine "positive" images with "negative" images (images without drones) to generate a Haar Cascade Classifier file containing the visual attributes of the drones/quadcopters targeted
- Analyze camera frames, especially highlighted regions where motion was detected, to determine if a drone/quadcopter is in the camera's field of view

Results:

- Successfully detected and displayed motion by drawing contours and rectangles around moving objects
- Compiled image database consisting of thousands of images
- Trained Haar Cascade Classifier using database of drone images
- Device will now use trained Haar Cascade Classifier to draw colored box around any detected drone or quadcopter within the camera's field of view
- Device interface can be utilized not just to detect drones, but also for general motion detection in full color or binary representation
- Achieved varying degrees of success in drone detection
- Created process of achieving general object detection



Impact and Benefits:

- Overall object detection framework can be used to achieve Haar Cascade Classifier training and file creation more quickly
- Can be used to detect both general motion and specific objects (drones and quadcopters)
- Existing database can be modified to detect any object
- Useful for military purposes as well as general privacy

