Frugal Flight: Indoor Stabilization of a Computationally Independent Drone without GPS

Devanathan, Nikhil (School: Kennewick High School)

Unmanned aerial vehicles (drones) represent an innovative technology with potential applications in warehouses, factories, buildings, and ships. Current approaches to stabilize drones using the global positioning system (GPS) limit their application in critical tasks, where the GPS signal may be lost or denied. GPS based-stabilization has limitations in moving a drone precisely. The goal of this engineering project was to design, prototype, program, and test an inexpensive drone to demonstrate stabilization and precise motion using efficient and inexpensive computer vision instead of GPS or external computing. The drone utilized two connected onboard computers. The first computer, a Raspberry Pi, ran Python code that polled a connected camera and ran computer vision algorithms. It was connected to the flight controller, the second computer that controlled the drone thrust and stabilization. General purpose hardware was optimized to operate well instead of application-specific hardware. Drone processes were run concurrently on multiple cores. Drones were built on an open carbon fiber frame and powered by a 3-cell, 2200 milliamp hour Lithium Polymer battery that was adequate to power all systems. The drone positioned itself using a novel color detection algorithm, which was optimized for use with minimal computational power. The drone can also deliver or move a small payload. Drone-to-drone communication was tested to show proof of concept that the drones can be part of a swarm. The prototype can be improved with artificial intelligence and more processing power. Using this technology, drones could be utilized indoors to inspect, move components, deliver payload, or conduct co-operative tasks that are unsafe for humans.

Awards Won:

Fourth Award of $500

Air Force Research Laboratory on behalf of the United States Air Force: First Award of $750 in each Intel ISEF Category