CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

S1412

Project Title

Hawkeye: Unmanned Search and Rescue Missions through Intelligent Drones Guided by Computer Vision & Dynamic Pathfinding

Abstract

Objectives/Goals

Build and program an autonomous drone that can carry out search and rescue missions in realistically dangerous terrain, without human control. More specifically, the drone should be able to: 1) Fly a flight pattern around an area of land, 2) Search for and identify people, 3) Bring these people back to pre-designated safe locations, and 4) Detect and navigate around obstacles throughout the process.

Methods/Materials

Software Components: OpenCV Computer Vision Library (python), modified facial recognition classifier algorithm with 500 additional positives and 400 additional negatives for drone capability. Paper written by Sven Koenig and Maxim Likhachev (http://robotics.cs.tamu.edu/dshell/cs625/aaai02b.pdf) detailing D*Lite Pathfinding Algorithm. Computer with Python 2.6 Suite and stock math libraries.
Hardware Components: 3DR Y6 Drone Body. SF and SFP Propellers. Raspberry Pi 2 B+ Running Debian OS. 5500 mAH LiPo battery. Various wires. Soldering materials. Wi-Fi Module for Ad-Hoc Network.

Results

Drone modified by us to hold a Raspberry Pi and Camera successfully searched for and identified 2 out of 2 people in windy environment using computer vision algorithms/classifier we trained. Drone proceeded to lead said people back to safe locations while detecting/avoiding obstacles using the D*Lite pathfinding algorithm.
Hardware: Successful interfacing between Raspberry Pi Camera, Raspberry Pi, Pixhawk Drone CPU, and Drone.
Software: 1) Successful person recognition (modified OpenCV) 2) Successful spoofing of MavLink commands to control drone 3) Successful obstacle detection using OpenCV 4) Successful obstacle avoidance using D* Lite Pathfinding Algorithm (same algorithm was used on Mars Rovers Spirit and Opportunity)

Conclusions/Discussion

In the status quo, search and rescue missions remain immensely dependent on a large human volunteer base - which can be problematic in rural or dangerous locations. Our project allows for a $40 modification to an existing industrial drone that can automate it to carry out search and rescue missions independently - something which we believe will be immensely useful to government organizations. Secondly, we have developed a modular way for a Raspberry Pi and Camera to interface with a common drone CPU (the Pixhawk) and create an Ad-Hoc network for computer connection - something that any developer can use to automate drones.

Summary Statement

We created a $40 method of automating industrial drones to carry out unmanned search and rescue missions in realistically rough and windy terrain.

Help Received

None, save for open source libraries (OpenCV, math libraries) and this paper: Pathfinding with D* Lite (http://robotics.cs.tamu.edu/dshell/cs625/aaai02b.pdf)