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

Abstract – *This paper investigates the performance of an autonomous drone in static versus dynamic environments (environments are defined as dynamic by constantly changing weather or obstacle configurations). Specifically, the drone will fly a predetermined path around an area of land, search for people, drop down to a found person's level, then bring them back to a predefined "safe location," avoiding obstacles all the while. The underlying technology can be separated into three aspects: flight stack, computer vision for detection of obstacles and people, and dynamic pathfinding. The hardware flight stack proposed leverages 3D Robotics' Y6 drone frame, modified to hold a Raspberry Pi and Raspberry Pi Camera as a companion computer and computer vision sensor. The Raspberry Pi communicates with the Pixhawk drone controller over the MAVLink protocol to enable autonomous control of the drone. Person detection was accomplished by training a custom HAAR classifier using the OpenCV library. A custom classifier was needed to improve accuracy from OpenCV's base classifier and to enable person detection from an increased range of heights and angles. To perform monocular obstacle recognition, a neural network was trained with an NYU dataset of RGB images and corresponding depth-maps. A 3D pathfinding algorithm, functional in a dynamic environment, with angular freedom was necessary for this application, so the D*Lite pathfinding algorithm was chosen and implemented in C++. Then, the durability and performance (computer vision and obstacle avoidance) of the drone was tested under various obstacle and weather conditions. Under static conditions, the drone performed at an average success rate of 90% while under dynamic conditions it performed at a success rate of 60%. This demonstrates the extent of real world applicability of autonomous drones in search and rescue missions.*