Using Optical Flow Modeling Methods and Sensor Fusion to Create a Low-Cost, Competent Autonomous Emergency First Responder

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Lack of efficient emergency response capabilities after a natural disaster causes an average of 100,000 deaths per year worldwide. Autonomous flying robots have tremendous potential to enhance emergency search and rescue operations after a natural disaster. However, currently available flying robots are highly limited in their capabilities because they are not very self-sufficient and are too large, slow, and expensive for practical use in emergencies. The objective of this engineering project is to create a low-cost robotic drone that can autonomously navigate through hazardous environments efficiently and accurately. The Parrot AR Drone 2.0, a robust and relatively low cost platform, was chosen to build the flying robot. Autonomous navigation is proposed through visual image processing and monocular mapping using Lucas-Kanade optical flow modeling and sensory fusion of gas and temperature sensors to plot obstacles in an environment. An embedded computer and a micro-controller enable the drone to quickly process computer vision algorithms and sensory information. The robotic drone was successfully able to map its environment and effectively avoid obstacles around it in real-time. The drone was also able to quickly locate targets even in large spaces. For future work, the drone can be expanded to help first responders track where forest fires are spreading by attaching a pitot tube to the drone to measure wind speed and direction to effectively predict where the fire would spread. This project has the potential to help first responders save thousands of lives annually in an emergency response situation.

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