Safecopter: Developing a Collision Avoidance and Mapping System Based on an Array of Time-of-Flight 3D Cameras

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Multicopters have a wide range of applications from search and rescue to package delivery and medical support. Although growing in popularity, they are not used yet on an industrial scale for safety reasons. The goal of Safecopter is to develop a modular collision detection, avoidance, and mapping system that would make flying a multicopter in autonomous or tele-operated mode completely safe and responsive to the changing environment. The dynamic mapping system can be shared and used by multiple robots working on a mission. An array of time-of-flight 3D cameras provides point cloud data with a full 360° view and a six meter radius. An accurate simulated world environment was created in the Gazebo physics simulator to evaluate the performance of the simultaneous collision avoidance and mapping algorithm. Safecopter was modeled in 3D along with a complex environment that included several trees and a damaged fire station to simulate a search and rescue mission. The octomap probabilistic approach demonstrated the most optimal results. In comparison to other common mapping techniques such as topographical and multi-level mapping, its probabilistic approach best accommodated for a realistic dynamic environment. It also stored the data in compact binary trees, proving efficiency in both storage and computing speed. Based on the research performed, the simultaneous collision avoidance and mapping approach can be reliably integrated in the real-world environment. It expands the versatility of Safecopter for use in search and rescue operations, including with multi-robot teams.

Awards Won:
American Institute of Aeronautics &amp Astronautics: Second Award of $1500.00
NASA: First Award of $2500