CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

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Project Number

33832

Project Title

Rapid Aerial Outdoor and 3D Indoor Mapping by Autonomous Quadrotor UAVs with CV Feature Targeting for Disaster Recovery

Abstract

Objectives/Goals

Our engineering goal is the design and construction of an affordable autonomous quadrotor based aerial photography system for rapid acquisition of accurate and up-to-date maps to aid disaster response or commercial interests coupled with indoor 3D scanning to allow responders to locate victims in a damaged building.

Methods/Materials

After developing 3 main hardware prototypes, our final drone uses a self contained image and telemetry collection unit, while initially we used the Arduino microprocessor. Our system 1) captures low resolution imagery with a high altitude drone to 2) automatically identify damaged areas where 3) low altitude drones capture very high resolution imagery. Data is 4) presented on existing aerial mapping tools used by first responders.

Within dangerous buildings, quadrotors with 3D cameras capture full 3D maps of building interiors where bodies are detected and sent to doctors for remote diagnosis. This technology saves the lives of first responders as they do not need to search inside a collapsing building.

Results

Our system captures outdoor aerial imagery, First Person View panoramas and 3D indoor point clouds. Each intelligent quadrotor drone is under $400 per unit. It has a maximum angular resolution of under 5 cm, while the GeoEye1 satellite has an angular resolution of 41 cm; our drones are almost an order of magnitude better.

Conclusions/Discussion

We effectively produce up to date, high resolution maps and models that assist with fast damage assessment in disaster response, search and rescue, and indoor survivor search. Our system has an order of magnitude better angular resolution than current satellite imaging, and each drone is under $400, compared to current UAVs ranging from tens to hundreds of thousands of dollars.

Summary Statement

We created an autonomous quadrotor system to: 1) quickly map outdoor disaster zones to prioritize rescue efforts and 2) create 3D maps of building interiors for remote diagnosis of trapped victims.

Help Received

Bruce Kawanami and our parents guided us, gave us advice, helped with motivation and ensured our safety, and our parents helped with board assembly.

Preliminary