

# Autonomous Recharging for Swarms of Flying Robots



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## Purpose

Quadcopters are multicopter helicopters often used in swarm robotics research, which is inspired by the collective behaviors observed in biological systems such as insect colonies and flocks of birds. Some of the greatest problems for swarm robotics are energy-related, as the whole system may shut down if energy sources are depleted.

Motors, flight systems, on-board computers and external equipment are all powered by the main battery and consequently flight times and range of operation are limited. This project addresses the energy problem so the batteries can be recharged out in the field and thereby aims to make quadcopter swarms more self-sustainable.

## Approach

Due to the problem of having a very small area to place solar panels, this is the first known attempt to modify an existing quadcopter to recharge the battery using solar power.

- Mounted a main solar panel on top of the quadcopter using carbon fiber and thin film solar panels with a total output of 0.75 W.
- Additional panels will be placed on the side of the top cover and on the boom-arms in strategic angles to capture as much sunlight as possible.
- Implemented sun tracking for the main solar panel by using two light sensors and a micro servo motor.
- Designed the charge circuit to use Maximum Power Point Tracking algorithms which are used to get the maximum power output for any given environmental conditions.



Main solar panel.



The main panel uses light sensors to track the sun's movement in the sky in the vertical plane during charging to maximize energy harvesting.

## Expected Performance

- The quadcopters will be able to make two full flights each day or several shorter ones.
- The solar panels will help counteract the effect of added weight on flight time and revive quadcopters with depleted batteries.

## Practical Applications

With autonomous quadcopters the operations below will be able to be performed without designated personnel at the site to follow and replace batteries. This is particularly important in locations and environments where it is not possible to have human presence from a safety and economical point of view.

### Mining Industry

- Prospectivity mapping
- Collecting magnetic field data

### Space Industry

- Planetary exploration

### Bird's Eye View

- Surveillance
- Locating missing people
- 3D mapping
- Hazardous environments



## Acknowledgements

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