Electrical Design

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Here are some of my designs.

Solar Energy Airship Fire Detector

Background

There are more than 5000 Forest fires every year in China, destroying over 70,000 ha valuable forest resources. Forest victimization rate of China is higher than other developed countries. However, China only use remote sensing fire at large forestry, but fails to meet the request that detect fire at initial period by the resolution 250M remote sensor, so they still use man power to detect fire.

Goal

The airship carrying fire detecting equipments is able to stay in air over a long period of time, flying 50-100 meters above the ground, and also able to be set to auto-fly with a specific area. And the airship will report to the ground station when a fire source is detected, sending other details of the fire, like its location and temperature.

Core

Fire Detecting: Select and use Hamamatsu UV TRON R2868 flame/fire detector, which is called flame finder, because it will act as soon as a spark generated. Hamamatsu R22868 is using ultraviolet rays and via metal’s photoelectric effect and gas multiplication effect to detect spark. It is able to detect 185 to 260 narrow spectrum sensitive sources and is totally not sensitive to visible light, so it can work without any visible light filter. It has a small volume but wide sensible angle, and is able to detect a flame generated by a cigarette 5m away.

Control: The main processor is a ARM7 microcontroller: AT91SAM7S series. Assistor processors Atmel’s Atmega128 AVR microcontrollers which are able to reach 16MIPS at the frequency of 16MHz.

Power Supply: The airship uses electrical motor which powered by solar energy. Solar energy is converted directly to electrical energy by solar cells (or a "photovoltaic" cell). During the day, a part of power will be stored into a rechargeable battery, which will supply the power to airship during the night.

GPS and other sensor: Using U-Box GPS module. Other sensor include altitude, humidity, temperature, ultrasonic distance detecting.

Auto-fly algorithm: This algorithm is for the main processor, which controls the airship, and make it roams within a limited area. All the date and background is provided from the GPS and sensors. The algorithm will also prevent the ship being blew away by wind.

Problems Power Supply: Originally, We planed to use solar energy as the power source, but, later, we found that the weight of solar energy battery for providing about 50W power was too heavy. And another problem was that, after calculating, we wonder whether the motor need more power to prevent the force of wind.

Solutions:
Although, 2 years ago(2003-2004), flexible solar battery was inaccessible on customer-end market, now it is available, and the weight is extremely light.