CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

S0906

Project Title

An Apparatus for Enabling Long Flights with Drones Using Robotic Battery Replacement

Abstract

Objectives/Goals

The objective of the project is to design an automated battery replacement system for quadcopters. For package delivery, quadcopters are the future. The effectiveness of quadcopters is limited by their battery life. Currently, quadcopter batteries last about 10-12 minutes or 6-8 miles. The purpose of this project is to create an efficient yet effective method of replacing quadcopter batteries, so that they can continue flying. To do this, we set two constraints. The design constraints of the project are i) dimensions less than 5 ft. by 5 ft. by 5 ft.,ii) replace the batteries successfully, and iii) replacement in under 2 minutes. The system enables the quadcopter to land, replace its batteries, and take off with a fully charged battery. The applications are package delivery, medical delivery, aid for natural disasters, and many more.

Methods/Materials

The key elements of the project are a robotic arm, spring loaded battery contacts, and battery carriers. The robotic arm was programmed to replace batteries in three compartments, a temporary holding station, a charging station, and a quadcopter station. The robotic arm was able to pick and place batteries with a suction system. To connect and disconnect the batteries easily, spring loaded contacts were used. The batteries are placed on their carriers with the spring loaded contact at the bottom of the carrier. The carrier fits inside the compartments making contact with the receptacle at the bottom of the compartment. This allows for a simple connection by the robotic arm.

Results

The design constraints were met successfully; the batteries are replaced in an average of 47.6 seconds; also the dimensions are substantially under the constraint with measurements of 36 inches by 15 inches by 4 inches.

Conclusions/Discussion

These successfully met constraints mean that this replacement system has potential to be a mainstream solution to the problem. Although, there are a few further steps to make it a viable solution. The next steps to make the system more practical are to weather-proof the system for outdoor operation and use renewable energy sources for the charger and the robotic arm. This project could be used to create an effective package delivery system or a delivery system for medical supplies for people in need. In conclusion, with this battery-replacement system, quadcopter-based delivery could become a reality.

Summary Statement

Drones are currently limited in their effectiveness due to the short battery life, this solution using a robotic arm allows for automated replacement of batteries in drones, thus enabling longer flights.

Help Received

Mr. Peter Chester helped learn CAD software, to design prototype. Mr. Roy Osterberg helped learn programming.