

Real-Time Systems Project Proposal

Quadrotor Helicopter

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1 Introduction

A quadrotor helicopter is an aircraft propelled and lifted by four rotors. Quadrotor helicopters, or quadrocopters for short, use fixed-pitch blades, unlike standard helicopters.

Vehicle motion is controlled by varying the speed of each rotor to change the thrust and torque provided by each.

At the faculty of information technology we have developed a hardware and mechanical components for a quadrocopter. The purpose of this project is to develop all software required to control this aircraft and to remotely monitor important parameters during flight.

The quadrocopter is controlled via a standard remote control system as used for model airplanes. It can be connected via a wireless ZigBee connection to a mobile computer.



2 Overview

Software System Structure

The software consists of two main parts:

1. A software running on a standard PC, written in Java or Adobe Flex/AIR which permits to monitor sensor values and internal operation of the airplane software. This software connects to the airplane software via a ZigBee wireless communication link.
2. The embedded software running on the aircraft microcontrollers.

Embedded Software Components

The embedded software is comprised of these main components:

1. The quadrocopter control software. This software ensures that the aircraft behaves in a stable and benevolent manner. It takes inputs from the sensors, and controls the brushless motor controllers which determine the rotational speed of the blades.

2. Software for reading and calibrating the sensors. There are three acceleration sensors, one gyroscope, and an air pressure meter sensor.
3. Software for managing calibration data and control parameters. These values are kept inside an EEPROM of the aircraft microcontroller.
4. Software to implement the ZigBee communication link with a remote PC, and which permits access to all configuration parameters of the aircraft from a PC. It shall furthermore be possible to inspect in real-time control relevant values, like sensor values or motor output values.
5. Software to decode the signal coming from the remote control receiver. The signal from this device is PWM encoded.

3 General Requirements

The embedded software shall be separated

- into a part that is hardware dependent and can only run on the embedded controller
- into a part that can run on any hardware

The part that runs just on the hardware shall be minimized.

The part that can run on any hardware shall be thoroughly tested with executable tests on a host computer.

The control part of the application shall be developed using standard control engineering procedures and simulations, e.g. with Matlab/Simulink.

All design steps shall be carefully and fully documented.

The design process shall make sure that the system does not crash during its first flight, i.e. the first flight shall take place in the computer.

4 Mechanical Tasks

As part of the project a device shall be developed that permits to fly the quadcopter in a range of about one meter in either direction without the possibility of a crash, even in case control is lost or the aircraft system malfunctions.

5 Project Evaluation Criteria

Credit will be given based on the following criteria:

1. Documentation and quality of the components developed. Credit will be higher for parts that are more difficult to implement.
2. Completeness of solution.
3. Adherence to a sound development process, including project management, version control, design, and test.
4. A part implemented in high quality and well tested will result in more credit than three mediocre and error-prone parts.
5. Undocumented software with no executable or otherwise documented tests will result in zero credit.