Project Introduction

Our project goal was to design and build a Quadcopter that achieves stable and controlled flight.

Quadcopters, which are classified as rotorcraft, are lifted and propelled by four rotors.

Quadcopters have higher maneuverability and versatility than fixed winged UAV’s.

Has both military and civilian applications

Theory of Operation

Rotors produce thrust and torque

Rotor pairs counter rotate for zero net torque

Flight control of yaw, pitch, roll, and altitude

Flight motion results from controlling differential spin rates of the rotors (eg. Lowering speed of one of the rotors while increasing the rotor speed of the opposite arm results in the slower arm dipping. This dip will cause the Quadcopter to move in that direction)

Gyroscope and feedback control is required to maintain flight stability by sensing tilt and automatically adjusting motor speeds accordingly to maintain zero tilt

Components

10x47 propellers
850kv Brushless Motor
20 Amp Brushless programmable Electronic Speed Control
MaxSonar Higher Performance Ultrasonic Range Finder
Camera Control Circuit

6 Channel 2.4 GHz Radio Receiver
Linksprite Jpeg Color Camera
2.4 GHz 500mW audio/video transmitter
Power Distribution Board
6 Channel 2.4 GHz Radio Transmitter

Xbee- PRO 900 extended range module (Telemetry system)
Lipo 3 cell battery
EasyCAP usb2.0 audio video creator capture

Inertial Measurement Unit (IMU)

• 3 Axis Accelerometer
• 3 Axis Gyroscope
• Barometer
• Magnetometer

Arduino ArduPilot Mega Board
Computer Science: Gerad Bottorff
Advising Professor: Dr. Bill Eads
Electrical Engineering: Matt Parker

Tethered Test Flight

Untethered Test Flight
Graphical User Interface

Informational Toolbar
At the top of the GUI we designed a toolbar that will constantly refresh and be visible throughout the duration of the flight. It includes status indicators for various sensors on the copter such as the altitude, a GPS indicator to tell us when our GPS acquires satellite lock and status bars indicating the signal strength of the Xbee and battery level.

Automatic Flight Maneuvers
In the design of the GUI, we included buttons that will use custom built algorithms to preform flight maneuvers such as hover, take off and land.

Google Map Integration
Using a 3rd party open source project called GMap .NET, we were able to integrate Google Maps into our GUI. With this we can overlay an icon showing the current position and direction of the Quadcopter.

On Board Video Camera
In conjunction with a wireless video transfer device we employ code from two open source projects to be able to see the onboard video and capture it to an AVI video file.

Manual Control
Controlling the Quadcopter via our GUI is possible by leveraging two different open source projects. One allows us to capture keystrokes which we then pass through a custom filter to selectively use the W, A, S, D, Up, Down, Left, and Right keys to control the copter. The second is a protocol; MAVLink, that allows us to emulate an 8 channel RC controller to send this data to the copter and be interpreted by the Arduino.

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Goals and Achievements

Starting Objectives
• Tethered stable flight
• Wireless communication
• Ground base station for data collection
• Radio controlled

Successes
• Untethered stable flight
• Wireless communication and video
• Custom command and control GUI
• Radio and computer control
• Autonomous altitude hold

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Revised schedule after summer