Autonomous Quadrocopter

Functional Description & System Block Diagram

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INTRODUCTION

Quadrocopters maintain the ability to move rapidly and agilely through the air much like a plane while maintaining the helicopter's ability to hover and move at low airspeeds. By equipping such a copter with distance sensors and cameras an autonomous aerial vehicle is created which can avoid nearby obstacles regardless of velocity. Information gathered by these sensors will then be used to navigate the quadrocopter through spaces too tight for other styles of autonomous aerial vehicles.

GOALS

- To develop a quadrocopter platform for future senior projects
- Autonomously navigate through narrow passages using onboard and stationary sensors
- Avoid obstacles using video and sensor feedback
- Implement backup fly-by-wire controls for safety and testing

BLOCK DIAGRAM AND FUNCTIONAL DESCRIPTION

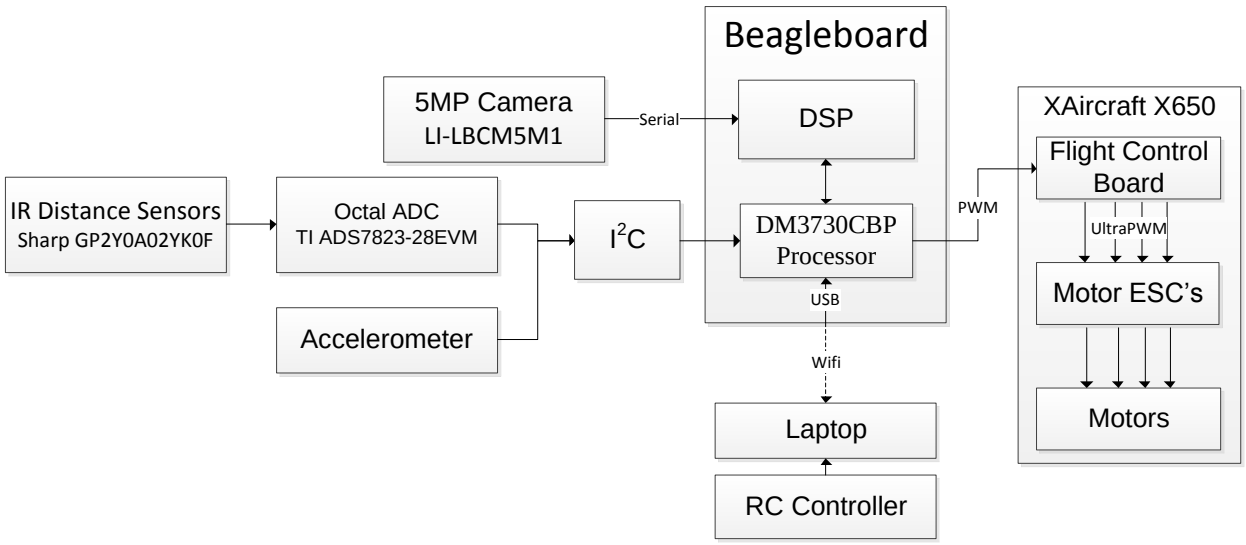

Fig 1.1 System Block Diagram

The quadrocopter consists of the following subsystems:

- XAircraft X650 quadrocopter platform with onboard flight control, ESC's and motors
- Beagleboard for onboard processing and control
- 5MP camera for obstacle avoidance
- Wireless communication to PC for safety
- IR distance sensors and octal ADC with I^2C interface
- Accelerometer with I^2C interface

The system functions as follows:

The Beagleboard will be attached to the quadrocopter and will perform the following functions:

- Video processing
- Sensor processing
- Movement controls
- Wireless Communication

The process flow for processing the sensors will be as follows:

1. The DSP will process camera input as it comes in
2. DSP information is output to the µC
3. Distance information is brought into the µC over I^2C
4. Control parameters determined by µC
5. Control parameters output to the X650 flight controller

SENSORS

The sensors used for this project include:

- IR distance sensors (Sharp GP2Y0A02YK0F)
- 5MP camera (LI-LBCM5M1)
- Accelerometer

IR DISTANCE SENSORS

There will six IR distance sensors onboard, one in each of the +/- x, y, z dimensions. The sensors output an analog voltage based upon how far they are from an obstacle (between 7 and 60 inches). To interface these sensors with the Beagleboard, an octal ADC module (TI ADS7823-28EVM) will be used that will communicate over an I^2C bus that is shared with the accelerometer.

CAMERA

The camera will be positioned on the platform directly attached to the Beagleboard pointing forward. The camera plugs directly into a socket on the Beagleboard and communicates over a serial protocol. The DSP chip will be responsible for processing all camera input.

ACCELEROMETER

An accelerometer will be mounted near the platforms gyroscope to aid in navigation. It will communicate over I^2C and will be processed on the µC.

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