

Consider the embedded system described below:

Your goal is to design an embedded system (embedded system board with electronics and sensors) that interfaces with a quad rotor's flight control board that will prevent the vehicle from colliding with objects.

- Req. 1. The embedded system (board) you design will consist of a microcontroller, sensors, and any other circuitry needed.
- Req. 2. The board will be bolted to the bottom of the quadrotor vehicle.
- Req. 3. The embedded system will use inexpensive, low-mass ultrasound sensors that are digitally triggered (microcontroller sends a pulse to activate, gets a pulse back when an object is detected).
- Req. 4. The embedded system will use an inexpensive MSP430 microcontroller.
- Req. 5. The embedded system will determine if a collision is imminent (1 meter) and instruct the quad rotor flight control board to move in a safe direction.
- Req. 6. The embedded system should sense an imminent collision in all directions except up.
- Req. 7. The embedded system will communicate with the quad rotor flight control board via UART.
- Req. 8. The embedded system will have access to 5v, 3.3v, and ground from the quad rotor flight control board.
- Req. 9. The embedded system will send a single data byte to the quad rotor flight control board to indicate the direction to move (including "no change needed").
- Req. 10. The quad rotor flight control board will respond to the embedded system with an ACK or NAK response.
- Req. 11. The embedded system should send the move commands 10 times a second.
- Req. 12. The speed of sound is 340 m/s.

Test Questions

- 1) Which MSP430 chip would you choose to work on the embedded system board and why? (use the MSP430 reference pages from the appendix) (10 points)
- 2) Draw a hardware block diagram of your embedded system. Include connection labels. Do not include the quad rotor flight control board (that is already designed!). (30 points)
- 3) Write the software interface description for communications between the embedded system board and the quad rotor flight control board. (20 points).
- 4) Write the algorithms needed for the embedded system board to operate. (40 points)