Unified UAV Proposal

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Overall Plan:
Use the ATMega328 Arduino microcontroller to control a very small UAV.

Need to know: batteries? how do we interface to the actuators/servos?

Components:
Sensors

- Ultrasound distance sensor
  - $35
  - 5V, 35mA: 170mW
  - TTL pulse length --> distance
  - 9 grams
  - http://www.parallax.com/Store/Sensors/ObjectDetection/tabid/176/CategoryID/51/List/0/Level/a/ProductID/92/Default.aspx
- Magnetometer
  - $57.30
  - 3.3V, 1mA: 3.3mW
  - I2C communications
  - requires an additional 100uF electrolytic cap
  - 1 gram
  - http://www.sparkfun.com/commerce/product_info.php?products_id=9371
- Airspeed sensor
  - $35.63
  - 5V, ?mA
  - Analog output between 1.0V and 4.9V
  - ~10 grams
  - http://store.diydrones.com/SearchResults.asp?Cat=12
  - or http://www.amazon.com/Eagle-Tree-AIRSPEED-V3-Microsensor-ETRAIRSPEED-V3/dp/B001I7YID4
- UART Monochrome JPEG camera
  - $54.90
  - 3.3V, 105mA: 347mW
  - straight UART serial connection to the XBee, in parallel with Arduino
  - 17 grams
  - http://www.electronics123.com/s.nl/it.A/id.2864/.f (we can get about 5 images per second)

Communications

- XBee serial radios
  - $120
  - 5V, 50mA: 250mW
  - UART on UAV, TTL-USB to laptop
  - 10 grams
  - 2 x http://www.sparkfun.com/commerce/product_info.php?products_id=8690
  - 2 x http://www.robotshop.com/sfe-xbee-explorer-regulated.html

Microcontroller

- Arduino microcontroller
  - $35

    - 5V, 50mA: 250mW
    - 28 grams
    - http://www.sparkfun.com/commerce/product_info.php?products_id=666

Flight Hardware
- Propeller Motor
    - $0
    - 7V, 1A: 7W
    - ?
- Control Surface Actuators
    - $0
    - ?V power
    - ?
- Structural Foam
    - $0
    - HiLoad-60
- Balsa Wood

Electrical
- Breadboard - $15
- Voltage regulators (2) - $0
- Resistors (various) - $0
- Capacitors (various) - $0
- Wire (various) - $0

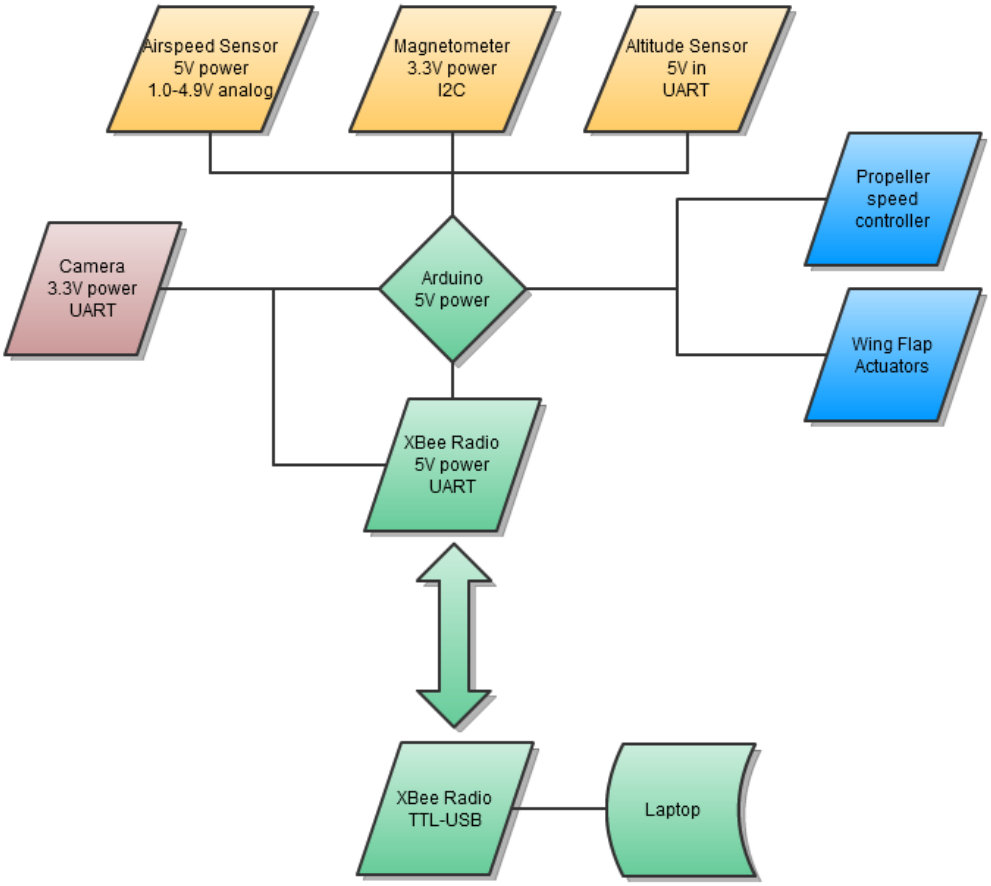
TOTAL COST: $355

Power consumption - 1.1W (avionics), 8W (propulsion, control)
Total mass - 75 grams (avionics), ? grams (aircraft)

Control Plan:
The magnetometer provides the entire aircraft orientation (within a degree or two), the ultrasound distance sensor provides altitude (up to 10 ft), and the airspeed sensor provides airspeed (1-150 m/s).
- The complete orientation vector allows the microcontroller to determine pitch, yaw and roll.
- The combination of airspeed and direction allows the microcontroller to determine the complete velocity vector. Integrating this allows the aircraft to determine its position relative to the starting point.
- The combination of direction and downwards (UAV reference frame) distance to ground ensures that the microcontroller can determine its altitude.

From the current location, altitude, velocity, pitch, yaw and roll of the aircraft, the microcontroller will command the propeller speed controller and control surface actuators.

A series of positional way-points will be used for navigation. These way-points may be pre-loaded or commanded "on the fly" from the laptop. The camera simply streams images over the XBee serial connection at 115200 baud, allowing us to watch the view from the plane from a display on the laptop.


Airspeed Sensor
5V power
1.0-4.9V analog
Magnetometer
3.3V power
I2C
Altitude Sensor
5V in
UART
Propeller
speed
controller
Camera
3.3V power
UART
Arduino
5V power
Wing Flap
Actuators
XBee Radio
5V power
UART
XBee Radio
TTL-USB
Laptop