Autonomous Quadcopter with Human Tracking and Gesture Recognition

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Presentation Overview

- Introduction to Quadcopters
- Project Goals
- Initial Design
- New Design

Introduction to Quadcopter

- Quadrotor Helicopter = “Quadcopter”
- Rapidly Expanded Use
  - Commercial
  - Military
  - Private

Project Goals

- Develop Autonomous Platform Capable of
  - Tracking/Following Individual
  - Recognizing/Responding to Gestures
- Personal Assistant
- “Pet Quadcopter”

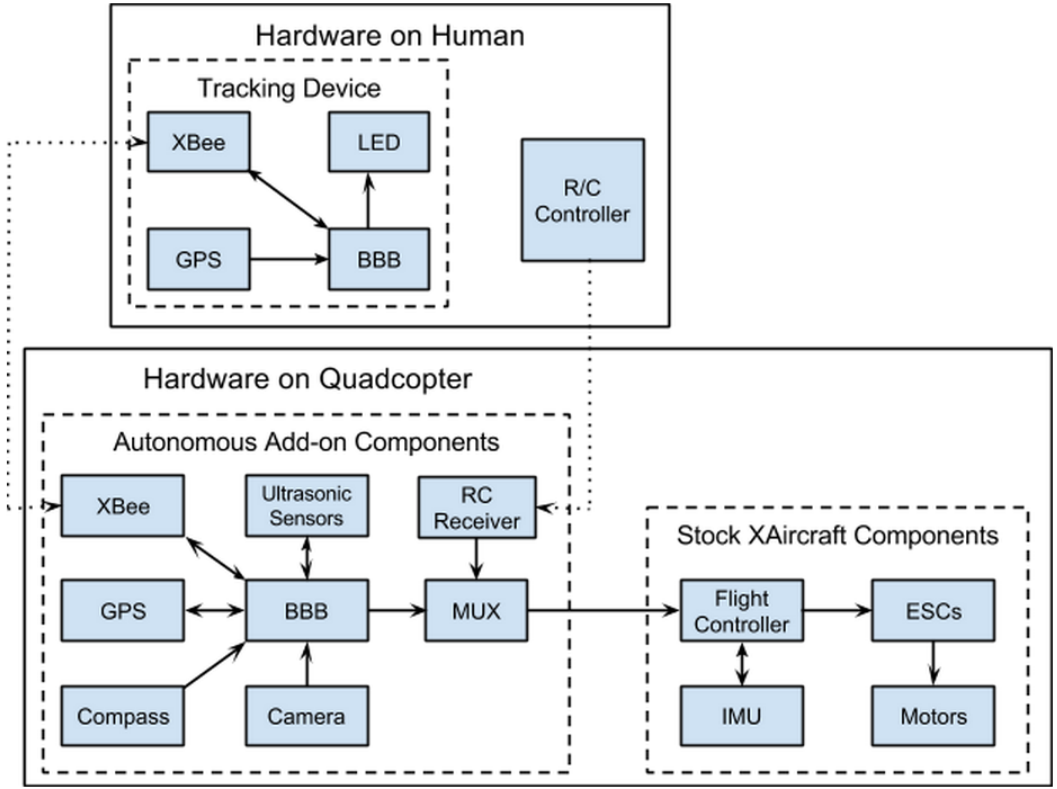
Initial Design

- Platform
- Block Diagram
- Results
- Shortcomings

Initial Design -- Platform

- XAircraft X650CF Platform
- Advantages
  - Large Payload
  - Already Owned

Initial Design -- Block Diagram



Initial Design -- Results

- BBB PWM Signal Output
- Communication Between Human and Quadcopter
  - XBee (IEEE 802.15.4)
  - GPS

Initial Design -- Results cont.

- Obstacle Avoidance System
  - PID Control
- Altitude Hold
- Power Circuitry
- RC Override

Initial Design -- Shortcomings

- Calibration Method
  - PC and Application
  - R/C Trim
- Inability to Hover in Place
- Flight Safety

New Design

- Platform
  - Advantages
  - Disadvantages
- Block Diagram
- Differences

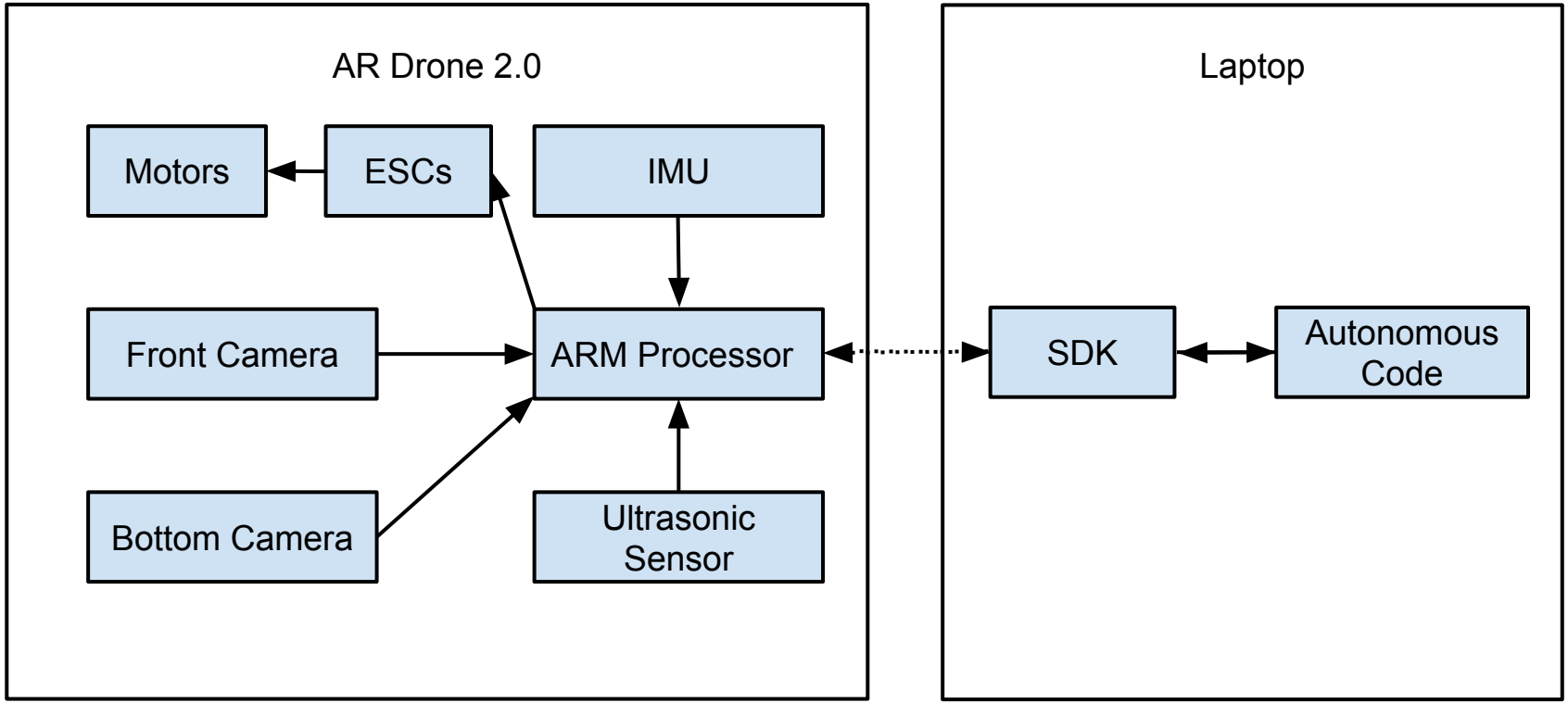
New Design -- Platform

- Parrot AR Drone 2.0
- Advantages
  - Able to Hover in Place
  - Built-in Sensors
    - Two Cameras

New Design -- Platform cont.

- Disadvantages
  - Lower Payload
  - No RC Controller
    - Limits Range

New Design -- Block Diagram



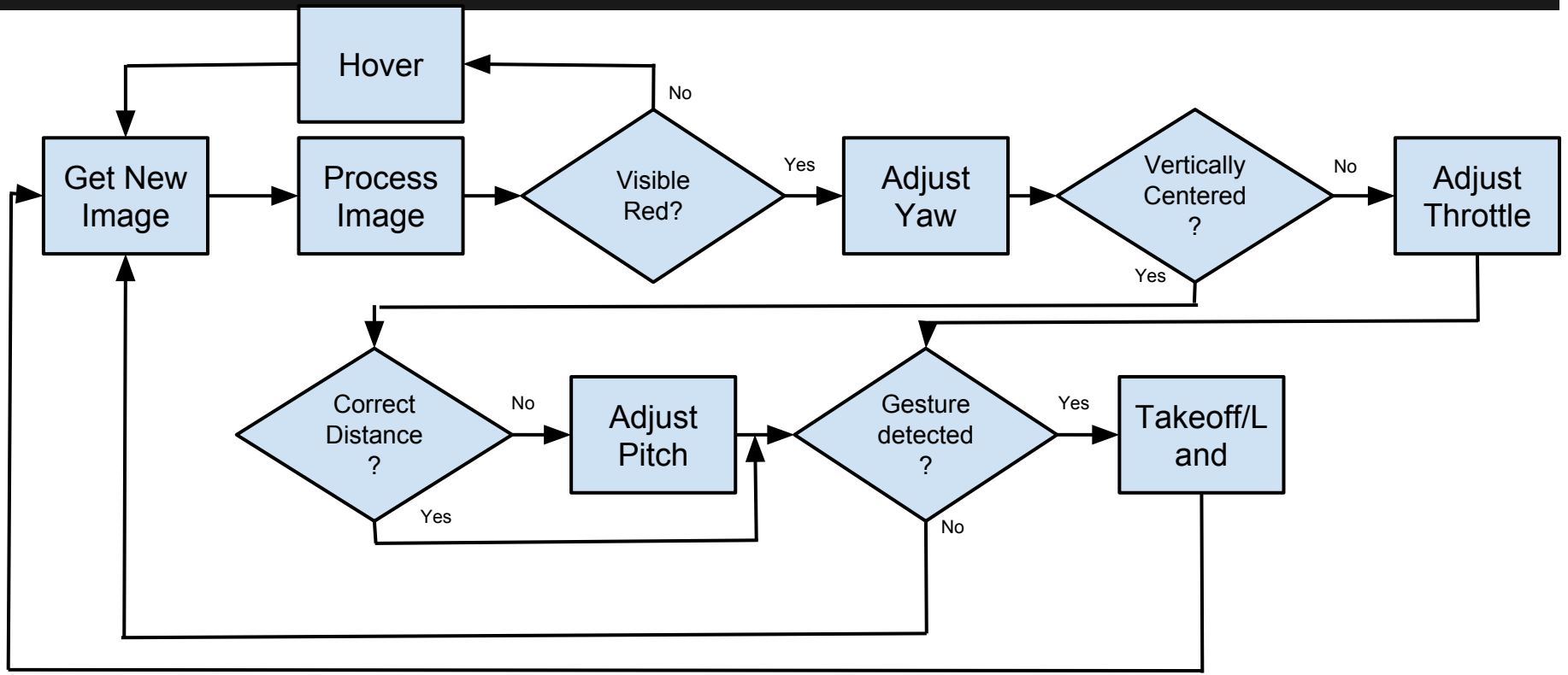
New Design -- Differences

- Onboard Camera
- Payload Decrease
  - GPS
  - Ultrasonic Sensors
- Wireless Communication Method

New Design -- Similarities

- Human Tracking
- Gesture Recognition
- Wireless Communication
- Live Video/Data Feed

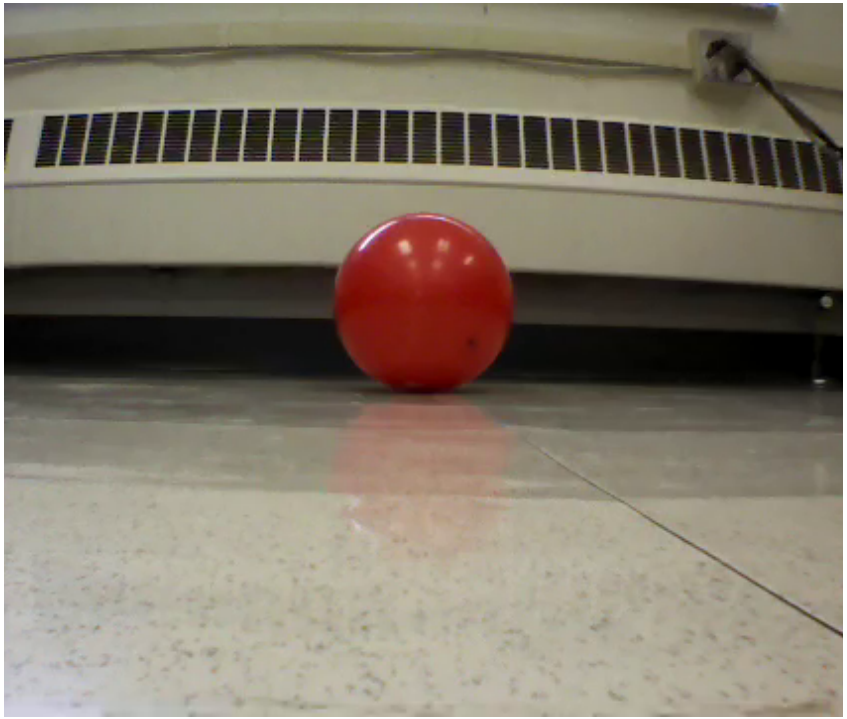
New Design -- Flow Chart

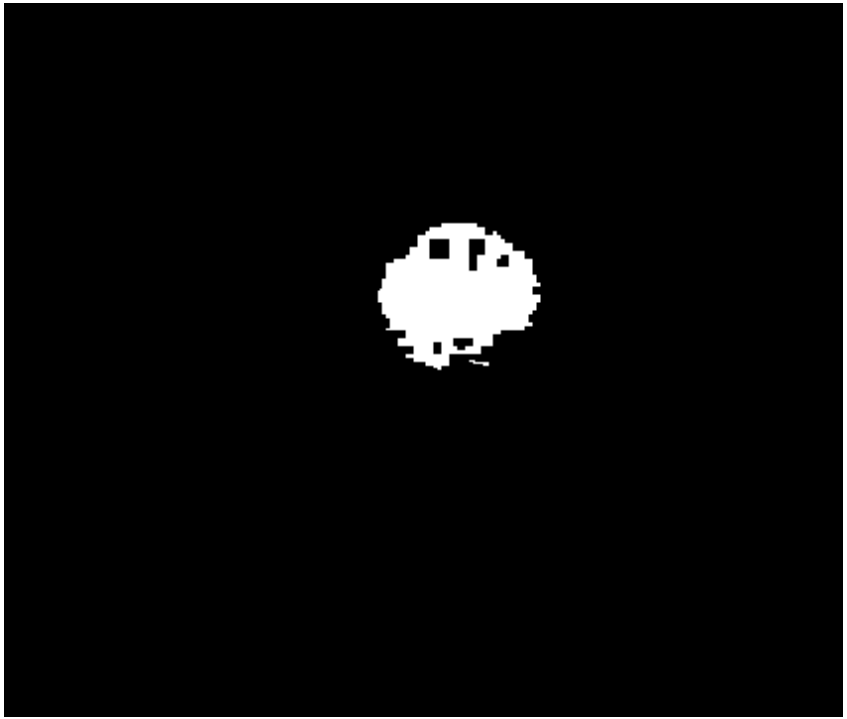


Human Tracking (H.T.)

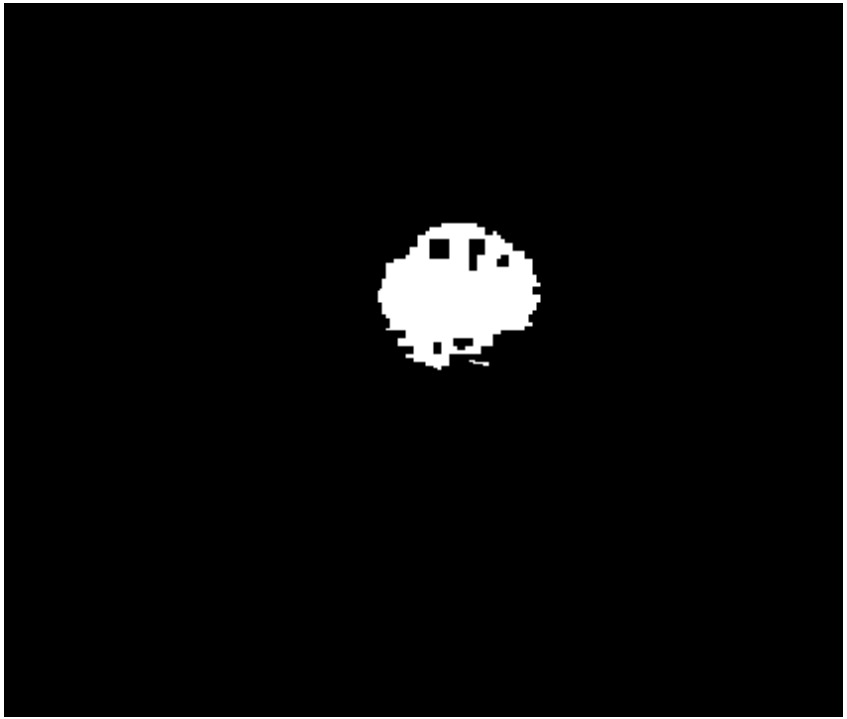
- Human Holds Ball
- Quad Looks for Color of Ball
- Quad Centers the Ball in the Image

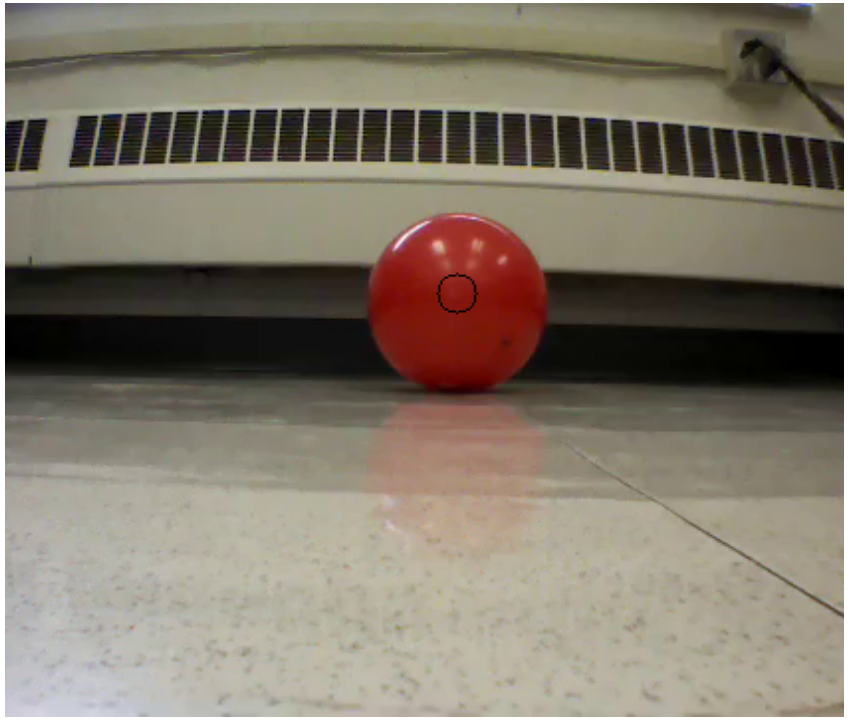
H.T. -- Image Processing





H.T. -- Image Processing

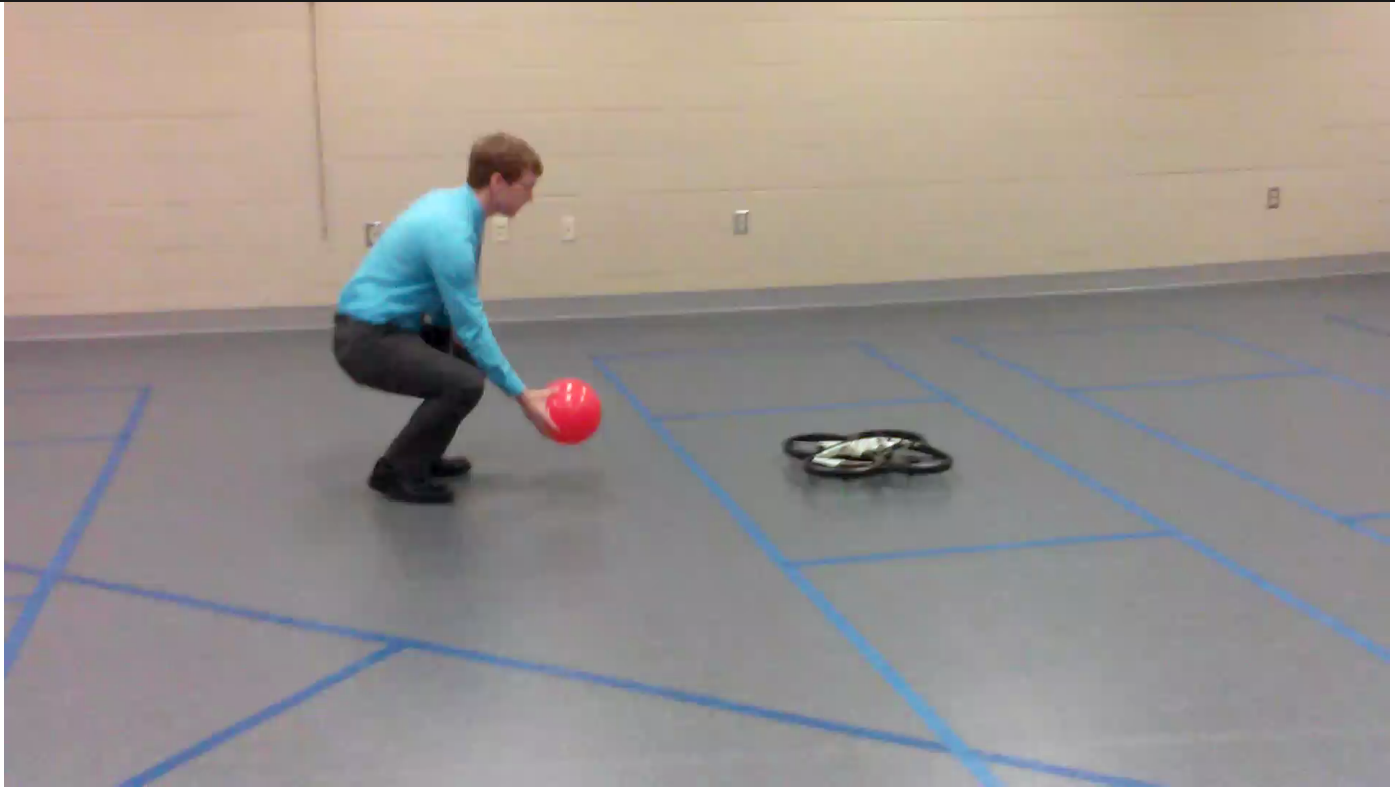




Dynamic Gesture Recognition

- Based on Movement of Ball
- High Velocity Movements
- Two Gestures
  - Vertical Movement
  - Horizontal Movement

Video Demonstration



Summary

- Work Completed on Old Quadcopter
  - XBee, GPS, Ultrasonic Sensors, Power Circuitry, Prop Guard
- Work Completed on New Quadcopter
  - Image-based Human Tracking, Dynamic Gesture Recognition, Live Video/Data Streams

References

[1] "Home-XAircraft." Home-XAircraft. N.p., n.d. Web. 26 Sept. 2013. <http://xaircraft.com/en/portal.php>.

[2] "X650." XAircraft Wiki. N.p., 27 Oct. 2011. Web. 26 Sept. 2013. <http://wiki.xaircraft.com/en-us/X650>.

[3] “AR.Drone AutoPylot.” Autopylot Website. N.p., n.d. Web. 5 May 2014. <http://home.wlu.edu/~levys/software/ardrone_autopylot/#greenball>

[4] “ARDrone_Developer_Guide.” AR Drone SDK. N.p., n.d. Web. 5 May 2014. <http://www.msh-tools.com/ardrone/ARDrone_Developer_Guide.pdf>

Xaircraft Investigation

- Two ESC Failures
- Poor Documentation
- Black Box Controllers
  - FC1212-S (Flight Controller)
  - AHRS-S (IMU)

Alternative Options

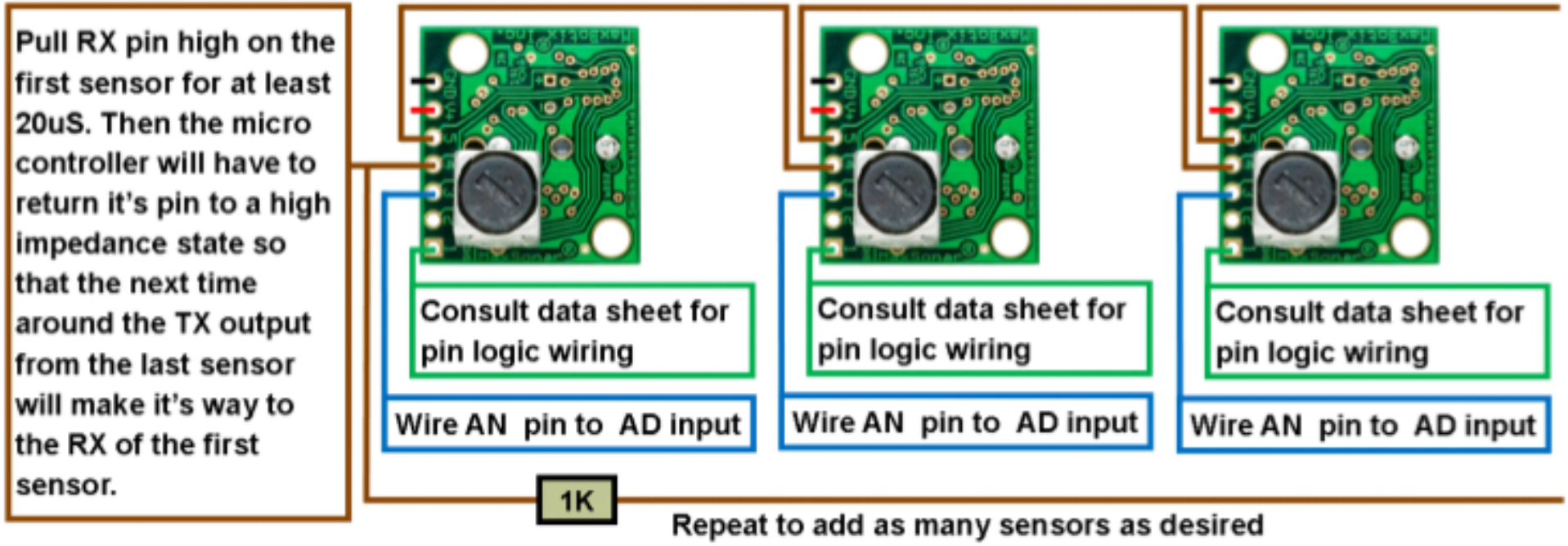
- Option 1 - Repair X650CF
- Option 2 - X650CF Frame, New Parts
- Option 3 - Purchase a New Quadcopter
  - APM:Copter
  - ELEV-8 Parallax

Ultrasonic Sensors

XL-MaxSonar-EZ3 Ultrasonic Sensor

- Size: 2.2cm x 2.0cm x 2.5cm (6.1g)
- Range: 20cm - 750cm (datasheet)
- Reading rate: 10Hz (datasheet)

Low Noise Chaining Diagram

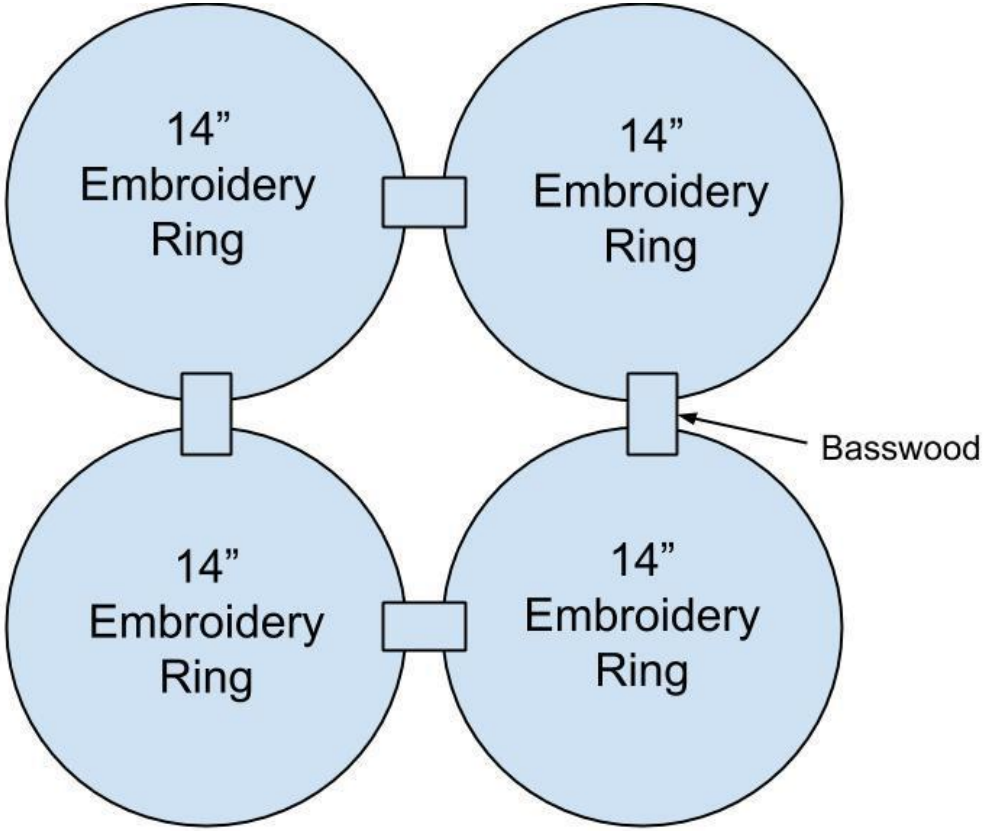


Ultrasonic Sensors Results

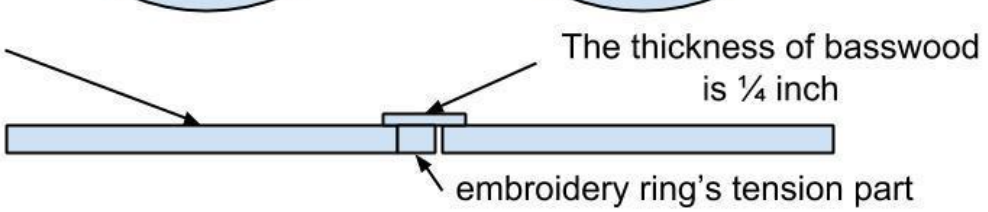
Lab Tests:

- Max Distance = About 500cm
- Chained, about 1.6 Hz
- Travel Limitation = 8m/s (500cm/625ms)

The embroidery rings have a protruding stub that is underneath the basswood and used for additional support. The structure is currently proportional with the basswood being 2 inches in width. and 1 inch of space between each of the rings.



Side view of the guard



Skin Color Detection

Division of Labor

Daniel Garber

- XAircraft Communication/GPS, AR Drone Flight Control and Testing, Website

Jacob Hindle

- Power Circuitry, Autonomous Control, Dynamic Gesture Recognition

Bradley Lan

- Ultrasonic Sensors, Data Collection, Skin Detection