IPRO 312: Unmanned Aerial Systems

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What is a UAS?

Unmanned
Aerial
System

Unmanned
Aerial
Vehicle

UAS encompasses the entire operational platform, not just the aircraft (UAV)

UAS components:

Vehicle (UAV)

Payload

Ground Station

Benefits

- Lightweight
- Inexpensive
- Low emissions
- Stealthy
- Fast
- Low maintenance
- No launcher device necessary

Potential Markets

- Military
- Law Enforcement
- Agriculture
- Construction
- Maps
- Customs and Border Protection
- Wildlife and conservation
- Communications

The major graded items/events are:

- Final Journal Paper
- Oral Presentation
- Flight Readiness Review
- Flight Mission
  - Take off
  - Waypoint Navigation
  - En Route Search
  - Targets
  - Area Search
  - Landing

Ethical and Legal Considerations

In order to fly, operators must complete **ONE** of the following:

- **Obtain an FAA issued Airworthiness Certificate for UAS and a Program Letter of Restriction**
- **Obtain an FAA issued Certificate of Authorization or Waiver (COA)**
- **Fly in Special Use Airspace**
- **Fly as a Model Aircraft**

Team Structure

Team Members: Lidens Cheng, Nishanth Samala, Matt Simpson

Leader: Lidens Cheng

Team Members: Kay Traylor, Yaofu Zhou, Jiang Lan, Bernie Mendez

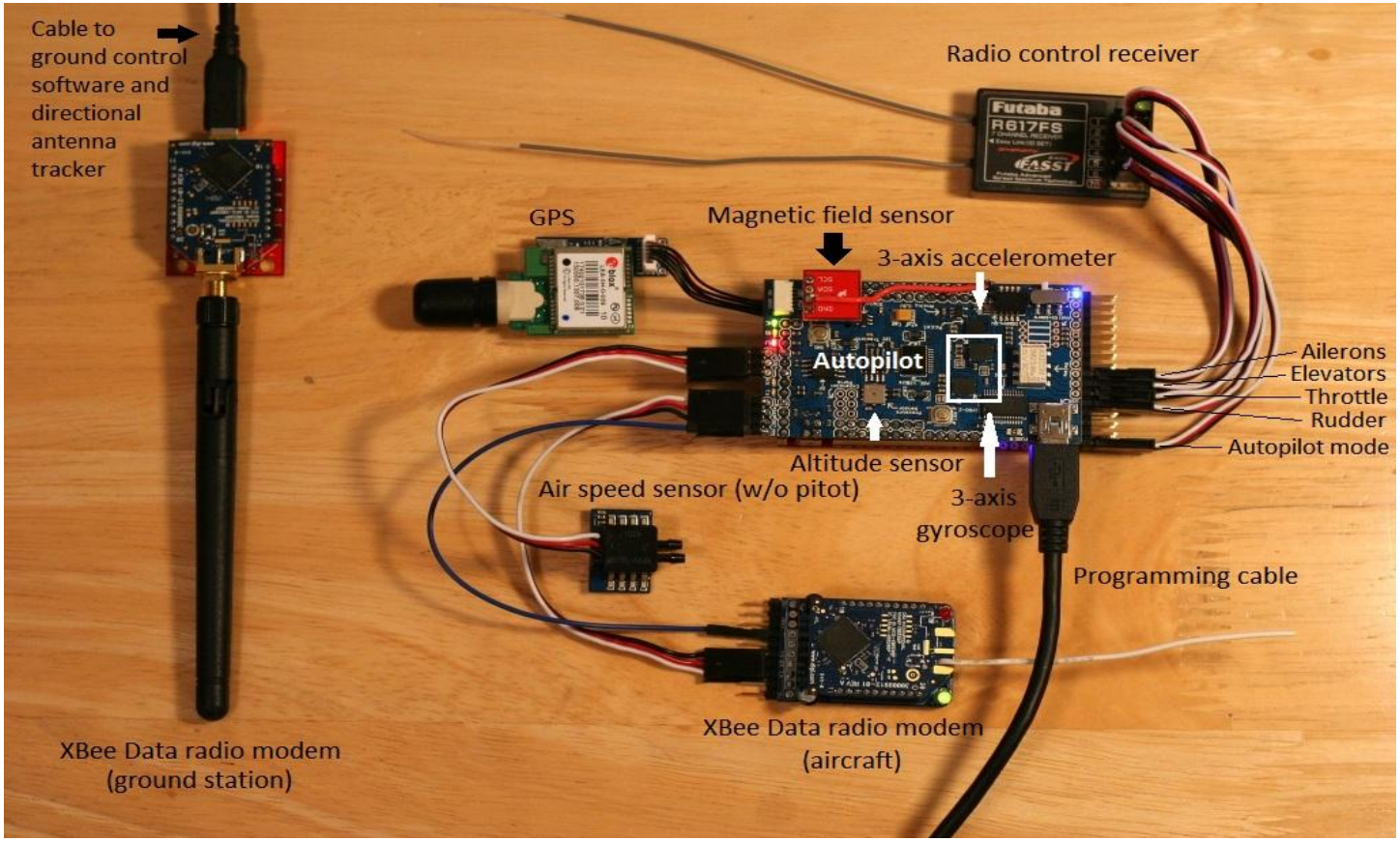
Leader: Kay Traylor

Team Members: Artemio Perez, Tushar Nair, Brian Schubert
Leader: Artemio Perez


AUTO
PILOT

Problem

The ArduPilot Mega autopilot software from last semester must be modified in order to achieve autonomous flight



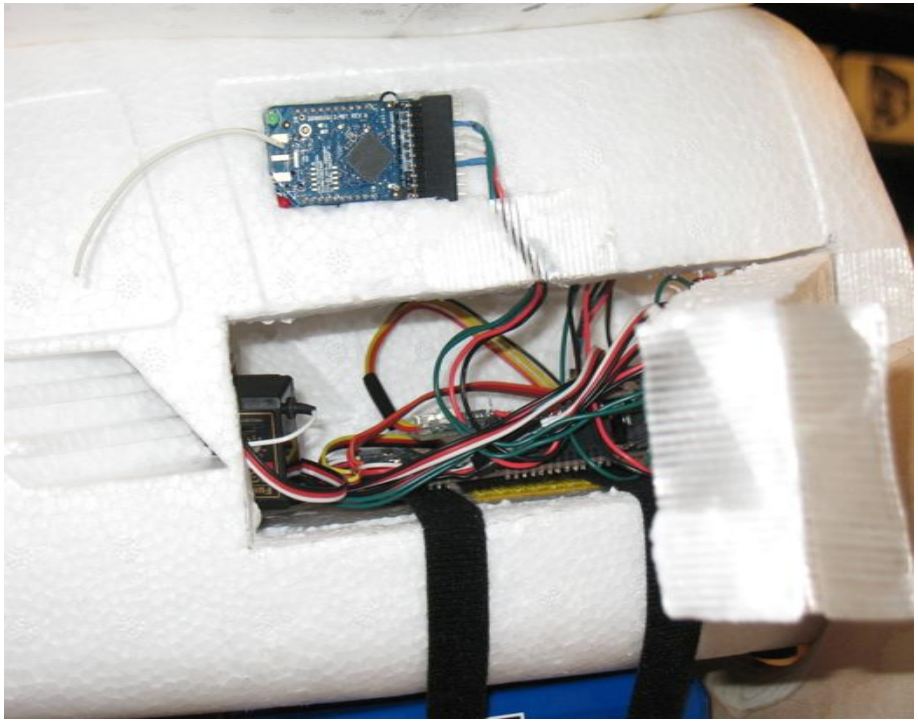
Goals

Modify software for:

- Autonomous takeoff and landing
- Navigation through waypoints
- A fail-safe feature (Return to Launch mode) if loses radio or video transmission
- Perform a series of test flights

Tasks Completed

- All modes recognized by radio:
  - Manual (hardware)
  - Manual (software)
  - Autopilot
  - Fly-by-wire A
  - Fly-by-wire B
  - Return to Launch
- Changed to a bigger airframe
- Manual modes tested in flight
- Connection to Ground Control Station

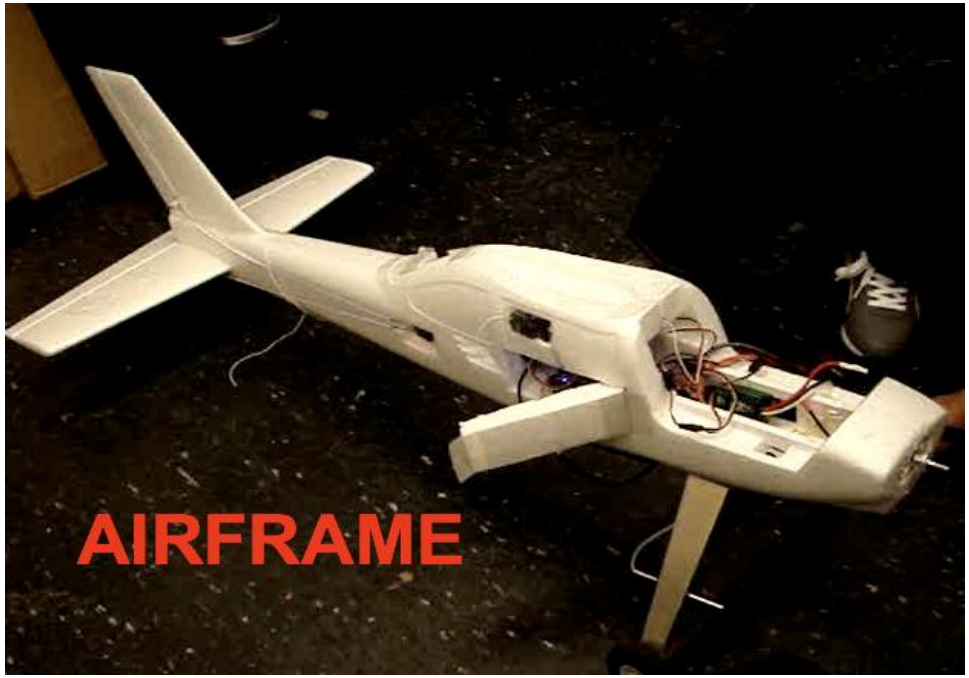


Challenges

- Fail-safe feature not included in the old version of code
- Autopilot mode not tuned for new airframe/new code
- Autopilot hardware short circuit
- Uncooperative weather conditions

Future Tasks

- Need to perform more test flights to test the other 4 modes
- Autopilot mode tests:
  - Autonomous takeoff
  - Navigation to waypoints
  - Autonomous landing
  - Fail-safe feature




VISUAL

Problem

- Develop a system that can:
  - Acquire and send images from UAV to ground station
  - Autonomously detect and identify targets
    - Shape
    - Overlaying alphanumeric character
    - Color of shape and alphanumeric character

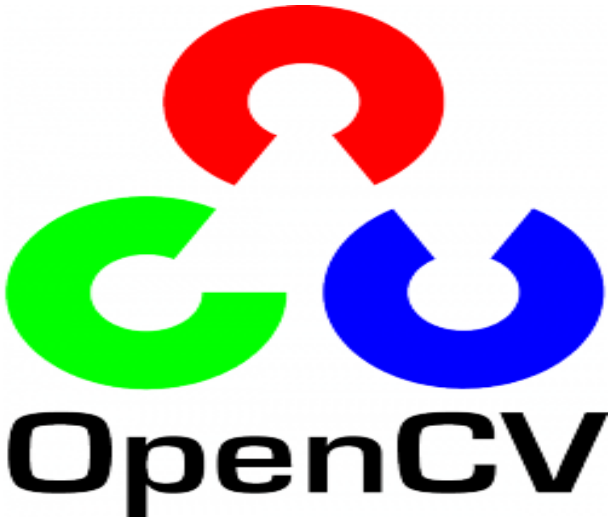
Goals

- Complete image detection and identification code
- Acquire and install camera
- Acquire and install image transmission system

Software

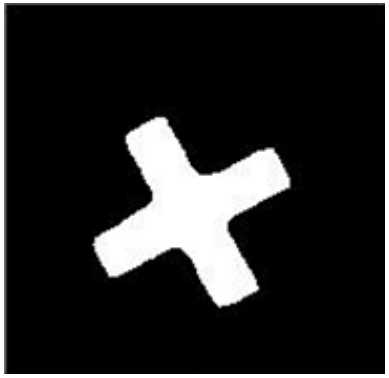
- OpenCV: Open-source Vision Library

- Two Parts
  1. Target Detection
  2. Target Identification

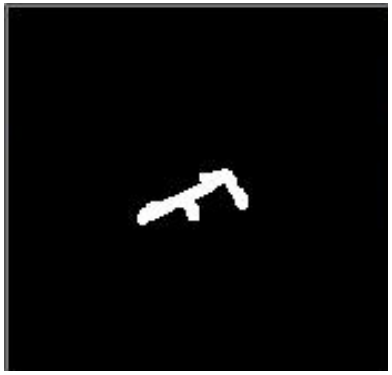


Target Detection

Shape Identification



Alphanumeric Identification



Camera

- Last Semester: SN777
  - 20 grams
  - 480x640 Resolution

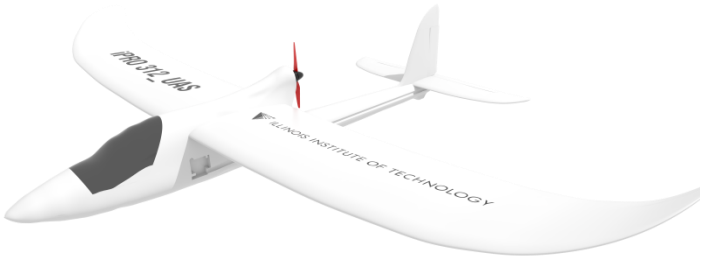
- Current: GoPro Surf Hero
  - 94 grams
  - HD Quality
  - Eye-Fi Transmission

Image Transmission

Eye-Fi SD Card

Beagleboard

Wi-Fi Transmitter



Wireless Router

Ground Station:
Post Processing

Challenges

- Image Quality
- Integration with other systems
- Time Constraints

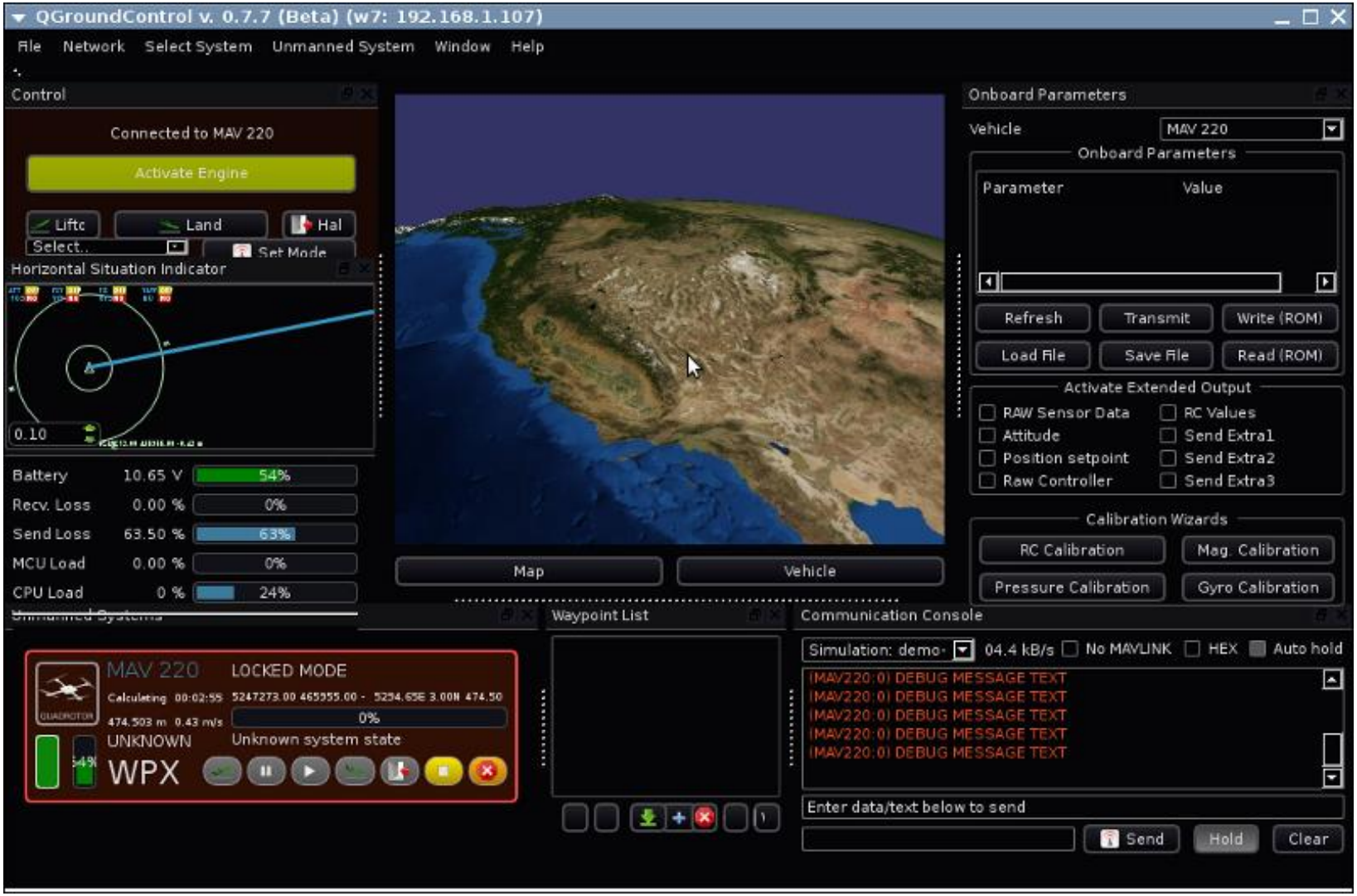
  Ordering parts, installing
- Test System


GROUND STATION

Background

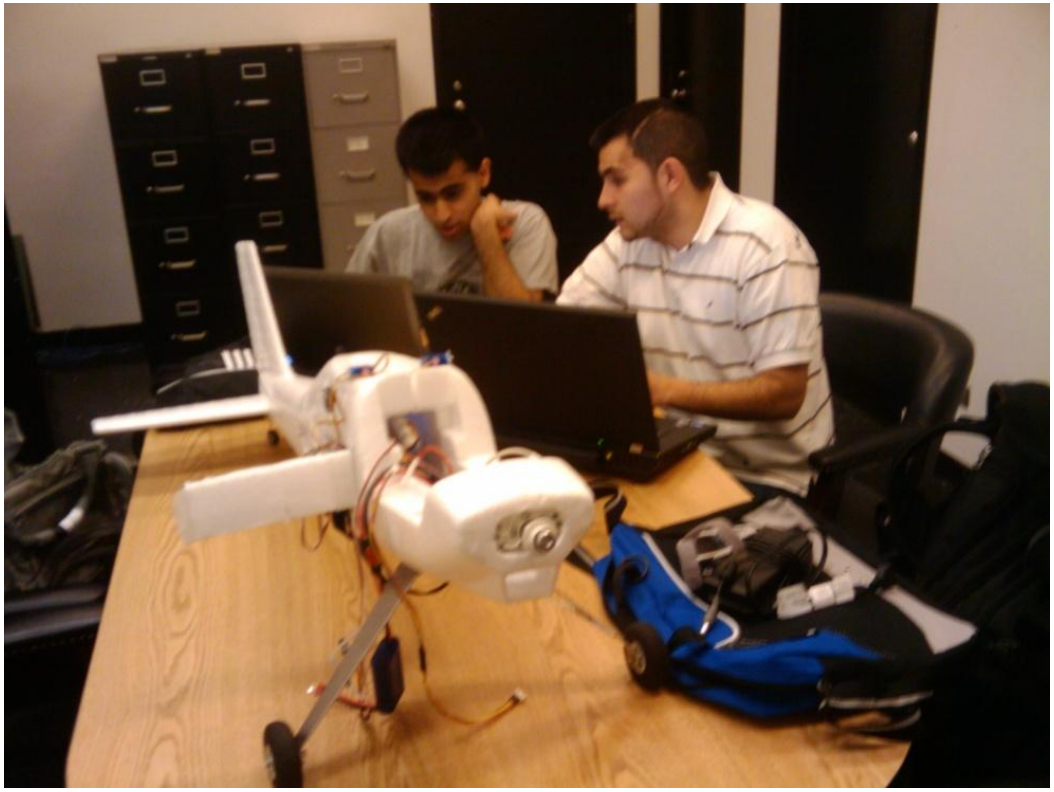
- Point of integration of all subsystems
- Data extraction port
- Mission objectives injection port

Software


QGroundControl v. 0.7.7 (Beta) (w7: 192.168.1.107)
File
Network
Select System
Unmanned System
Window
Help
Control
Connected to MAV 220
Activate Engine
Liftc
Land
Hal
Select..
Set Mode
Horizontal Situation Indicator
0.10
Battery 10.65 V 54%
Recv. Loss 0.00 % 0%
Send Loss 63.50 % 63%
MCU Load 0.00 % 0%
CPU Load 0 % 24%
Map
Vehicle
Onboard Parameters
Vehicle
MAV 220
Onboard Parameters
Parameter
Value
Refresh
Transmit
Write (ROM)
Load File
Save File
Read (ROM)
Activate Extended Output
RAW Sensor Data
Attitude
Position setpoint
Raw Controller
RC Values
Send Extra1
Send Extra2
Send Extra3
Calibration Wizards
RC Calibration
Mag. Calibration
Pressure Calibration
Gyro Calibration
Unmanned Systems
MAV 220
LOCKED MODE
Calculating 00:02:55 5247273.00 465555.00 - 5234.65E 3.00N 474.50
474.503 m 0.43 m/s
0%
UNKNOWN
Unknown system state
WPX
Waypoint List
Communication Console
Simulation: demo-
04.4 kB/s
No MAVLINK
HEX
Auto hold
|MAV220:0| DEBUG MESSAGE TEXT
|MAV220:0| DEBUG MESSAGE TEXT
|MAV220:0| DEBUG MESSAGE TEXT
|MAV220:0| DEBUG MESSAGE TEXT
|MAV220:0| DEBUG MESSAGE TEXT
Enter data/text below to send
Send
Hold
Clear

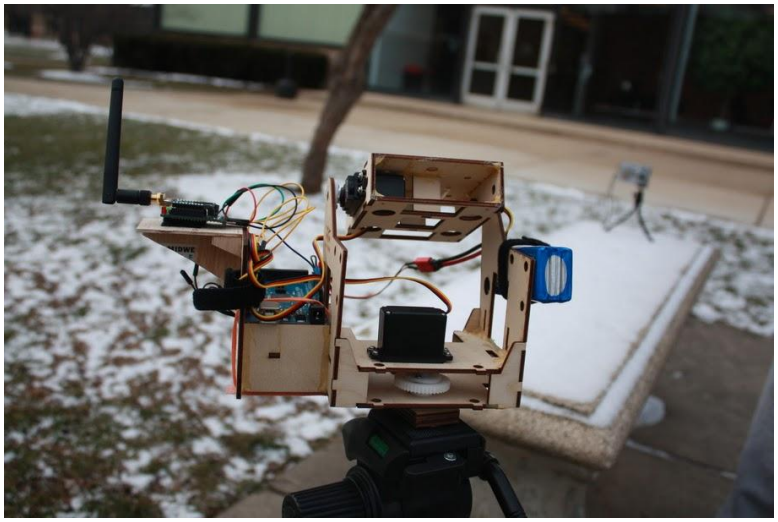
Challenges

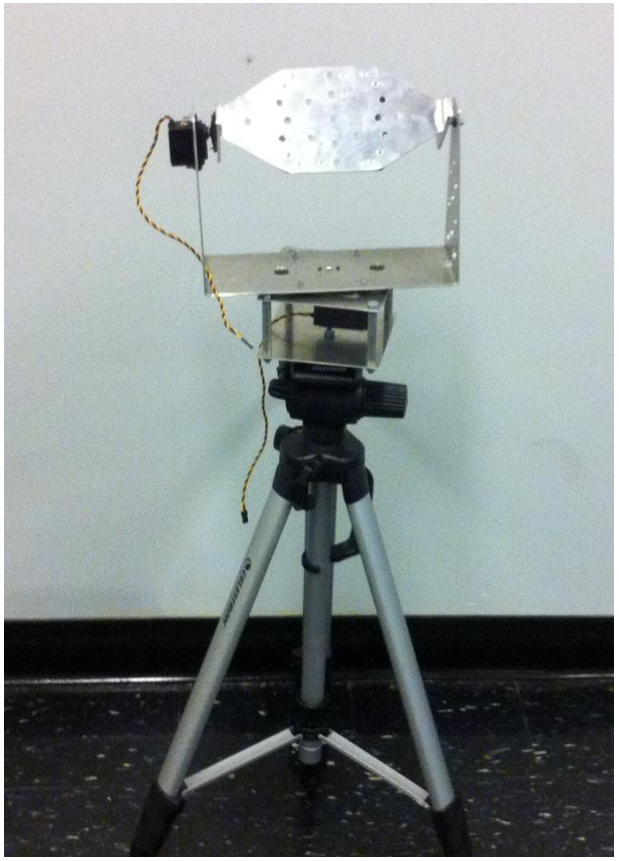
- Data transmission



Future Tasks

Aircraft tracking





Characteristics

Durabiliity. Survivabiliity. Portabiliity. Reliabiliity

What's Next?

- Integration of Systems
- Test Flights
- Data AUVSI UAV Competition

Questions?

Thank you