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IPRO 312: Unmanned Aerial Systems

Kay, Vlad, Akshay,
Chris, Andrew, Sebastian, Anurag, Ani, Ivo, Roger

Dr. Vural

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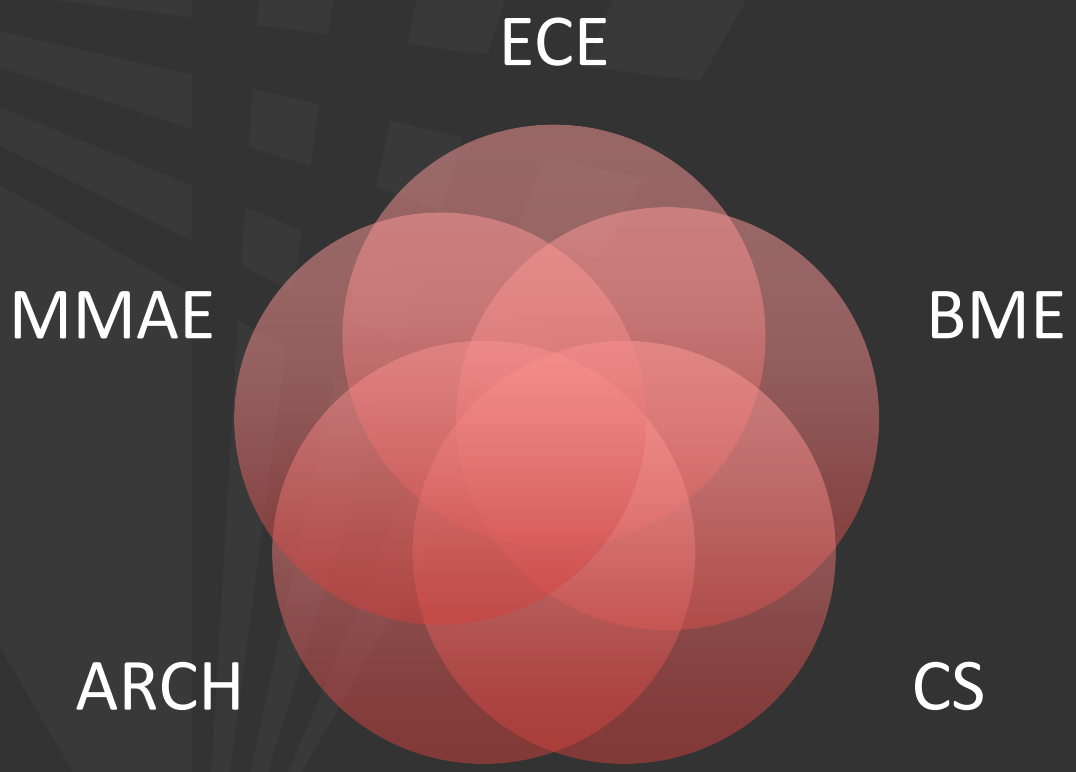
Diverse IPRO Group



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Outline

- Background
- Approach
- Team Research
- Integration
- The Future

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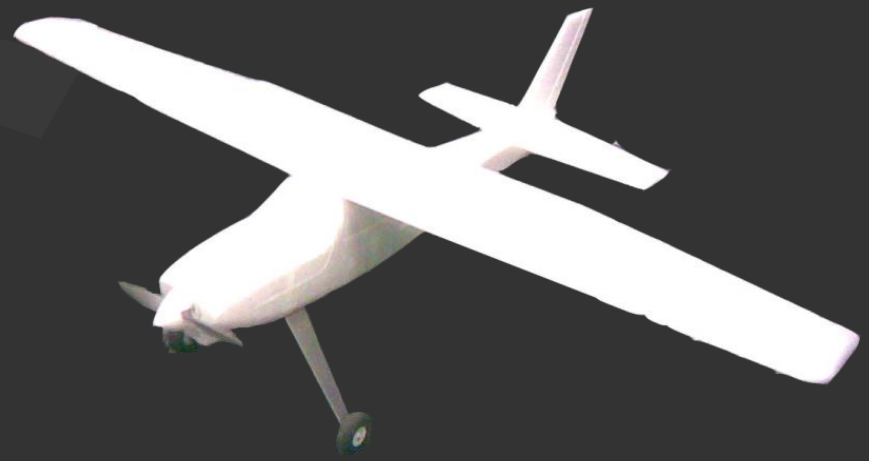
What is a UAS?

- Unmanned Aerial System
- Remotely piloted vehicle
- Air planes, helicopters, drones etc.



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Why a UAS?

- Autonomous Flights Research
- Remote Sensing
- Transport
- Search & Rescue
- Repetitive/Hazardous Tasks
- Armed Attacks

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Our Goal

- Develop an unmanned aircraft capable of
  - Autonomous flights
  - Real Time Object Recognition

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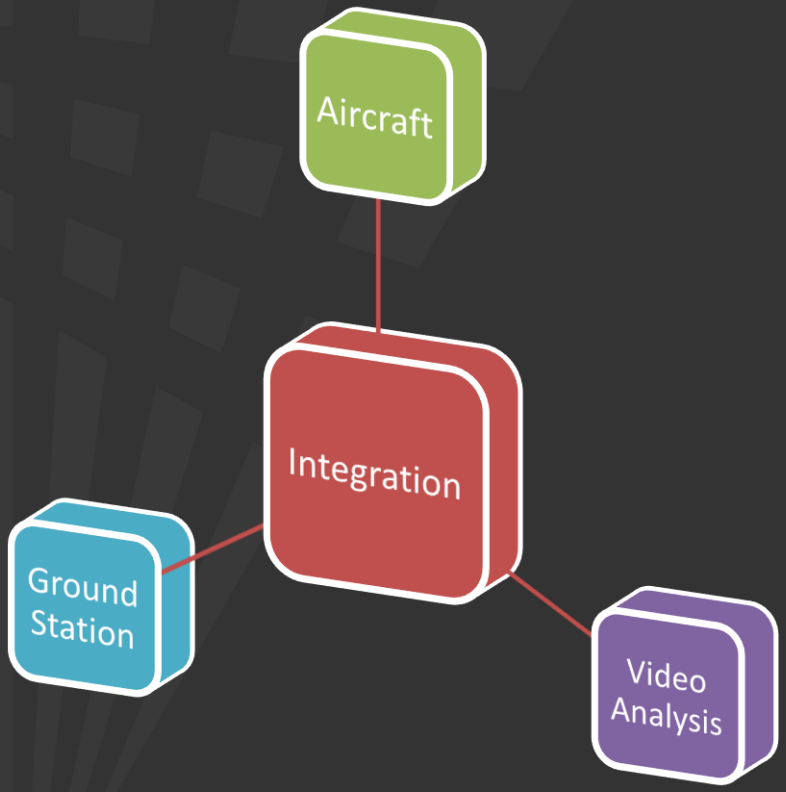
Approach - Dividing teams



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Team Structure

I Vision Team

- Kay Traylor
- Aniruddha Katre
- Ivo Semerdjiev *

II Ground Station Team

- Christopher Ragsdale
- Akshay Goliya
- Andrew Ellickson

III Autopilot Team

- Anurag Kotha*
- Chieh Luo
- Vladimir Semenov
- Sebastian Bilski

*** Legal Team – Investigating legal implications and guidelines**

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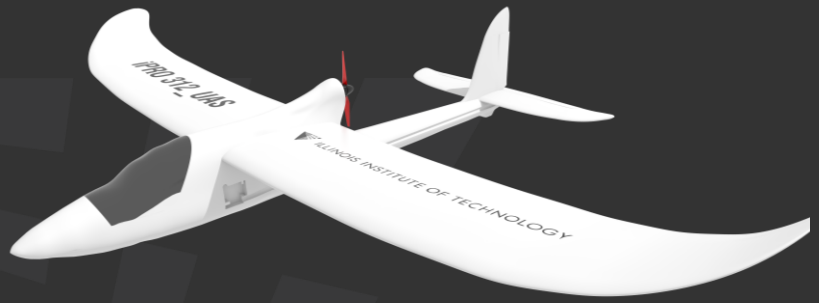
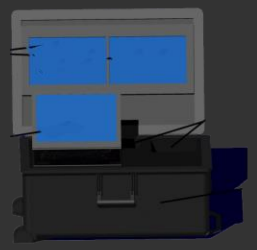
Big Picture





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Auto Pilot - Goals

- Learn autopilot open-source code
- Tune to aircraft dynamics
- Assemble electronics & control hardware
- Sensor integration and verification

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Auto Pilot – Hardware

- Assembled Hardware
  - ATmega1280 microprocessor
  - Flash Memory
  - 3-axix gyroscope
  - Accelerometer
  - Magnetometer
  - Pressure sensor (differential & absolute)
  - Temperature sensor
  - Long range ultrasonic range finder
  - GPS receiver
  - Xbee long range radio modem(900 MHz)
- 72 MHz radio for manual control
- Testing to assure functionality

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Auto Pilot- Software

- Stabilization using 3 axis gyroscope
- Autonomous landing with controlled rate of descent (Ultrasound range finder)
- Autonomous Take off using air temp, pressure sensors and GPS receivers
- Autonomous waypoint navigation & return to home using 3 axis gyroscope, accelerometer, air speed, altitude sensors, and GPS
- In-Flight route modification
- Continuous transmission telemetry info to Ground Station

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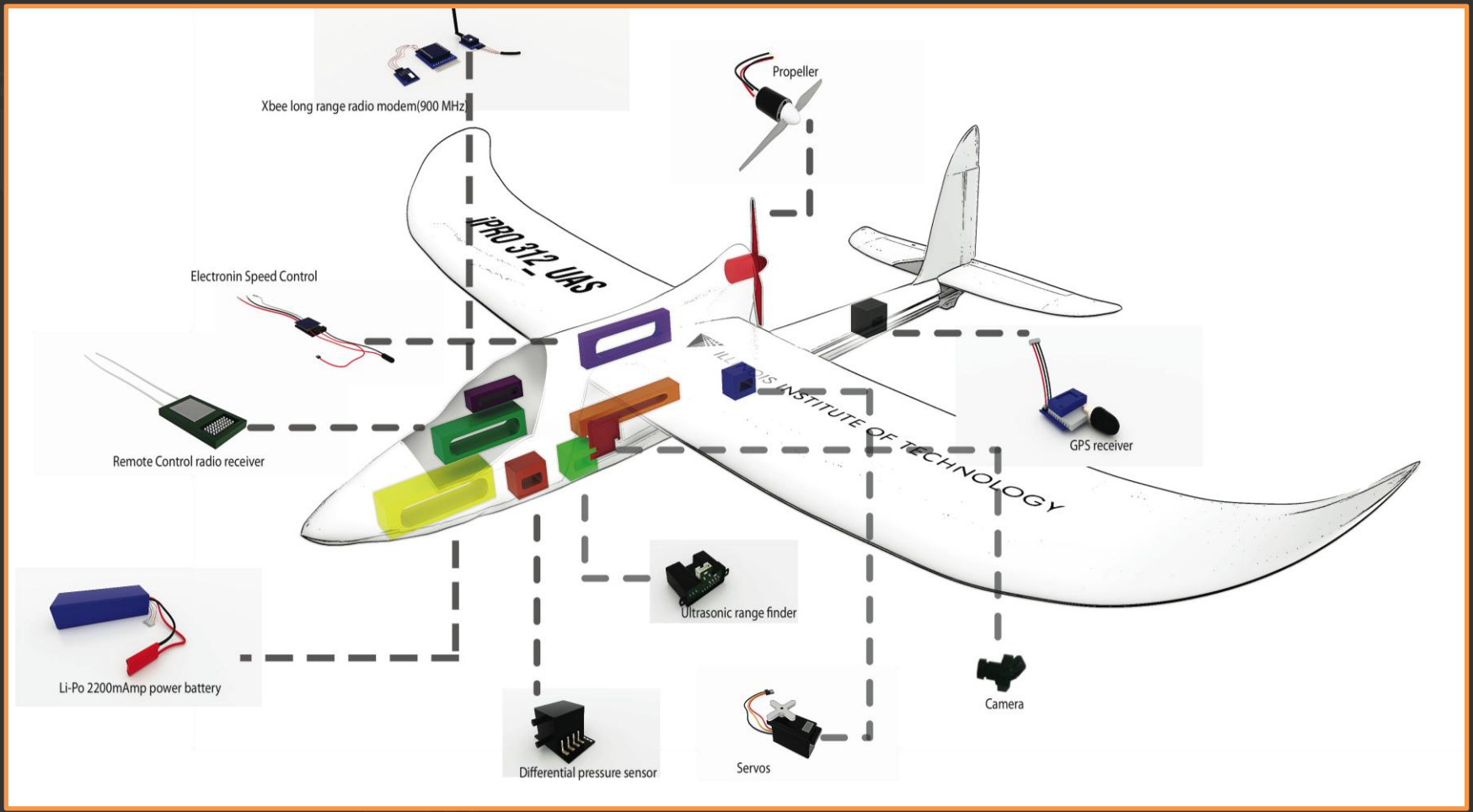

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Image Processing - Goals

- Install software into Linux Environment
- Create positive (target) and negative (background) sample images
- Use haarcascade to develop classifier and train face detect code to detect defined targets
- Integrate with rest of system

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Software

- OpenCV
  - Open source library of programming functions aimed at real time computer vision originally developed by Intel
- MATLAB
  - Create sample images

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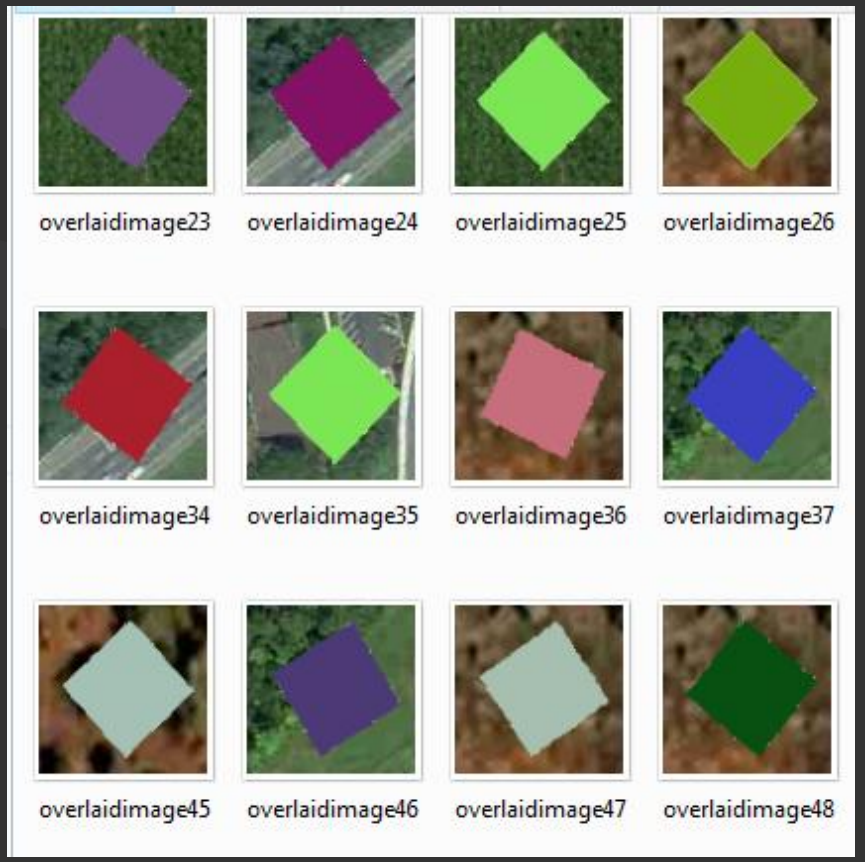
Creating Sample Images

- Developed an automatic method to produce several thousand positive and negative samples
  - Tried using OpenCV
  - Developed a program in MATLAB to rotate shapes and overlay those onto backgrounds



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Haarcascade

- Use created sample images to train a classifier to detect specified target
  - Issues
  - Segmentation fault
  - Parameter values
  - Pixel size
- To be done
  - Used trained classifiers in Object Detect

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Ground Station Functions

- Connects airframe to image processing
- Connects airframe to control software
  - Update GPS waypoints
- Sends and receives information to and from airframe
  - Airspeed, Altitude, orientation
- Acts as human interface to airframe
  - GUI enables human intervention and control

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Ground Station - Goals

- Facilitate total system integration
- Maximize range of receivers & transmitters
- Maintain constant signal with UAS during flight
- Develop a graphical user interface for all UAS relevant information
- Keep costs down while maintaining versatility

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Ground Station Components

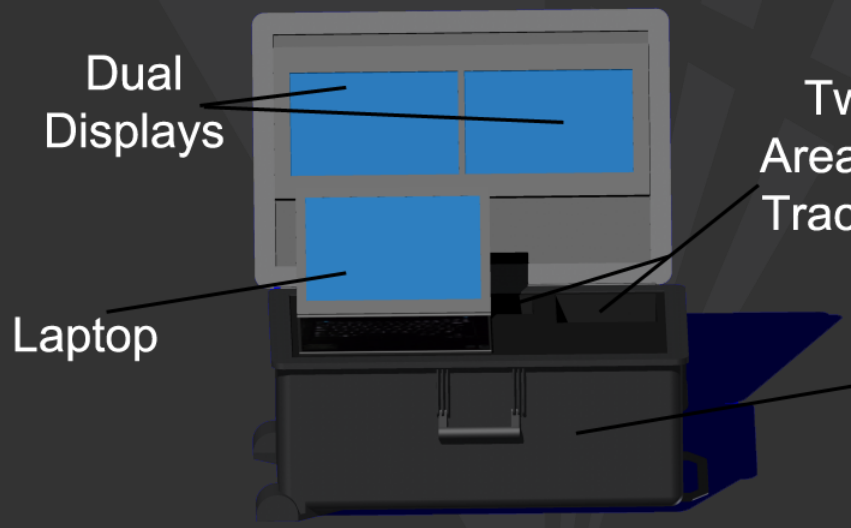
Data Processing and Control Station

Dual Displays

Laptop

Two Storage Areas for Antena Tracking System

Portable Waterproof Case



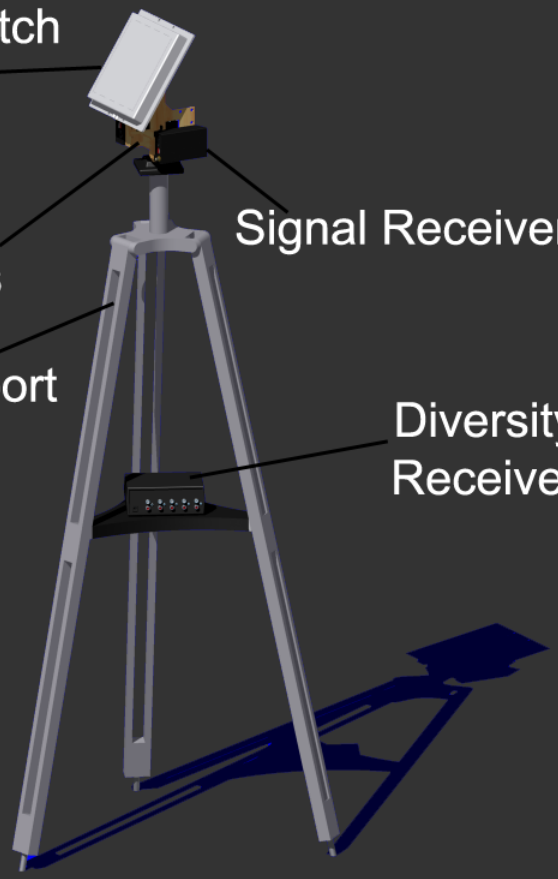
Dual Polarity Patch Antenna

Antenna Tracker Mount with Servos

Signal Receivers

Tripod Support Structure

Diversity Receiver



Antenna Tracking System

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Ground Station Progress

- Completed assembly and programming of antenna tracking system
- Purchased majority of the components
  - Need to purchase the case and batteries
- Completed graphical user interface (GUI) development
- Currently testing hardware and software

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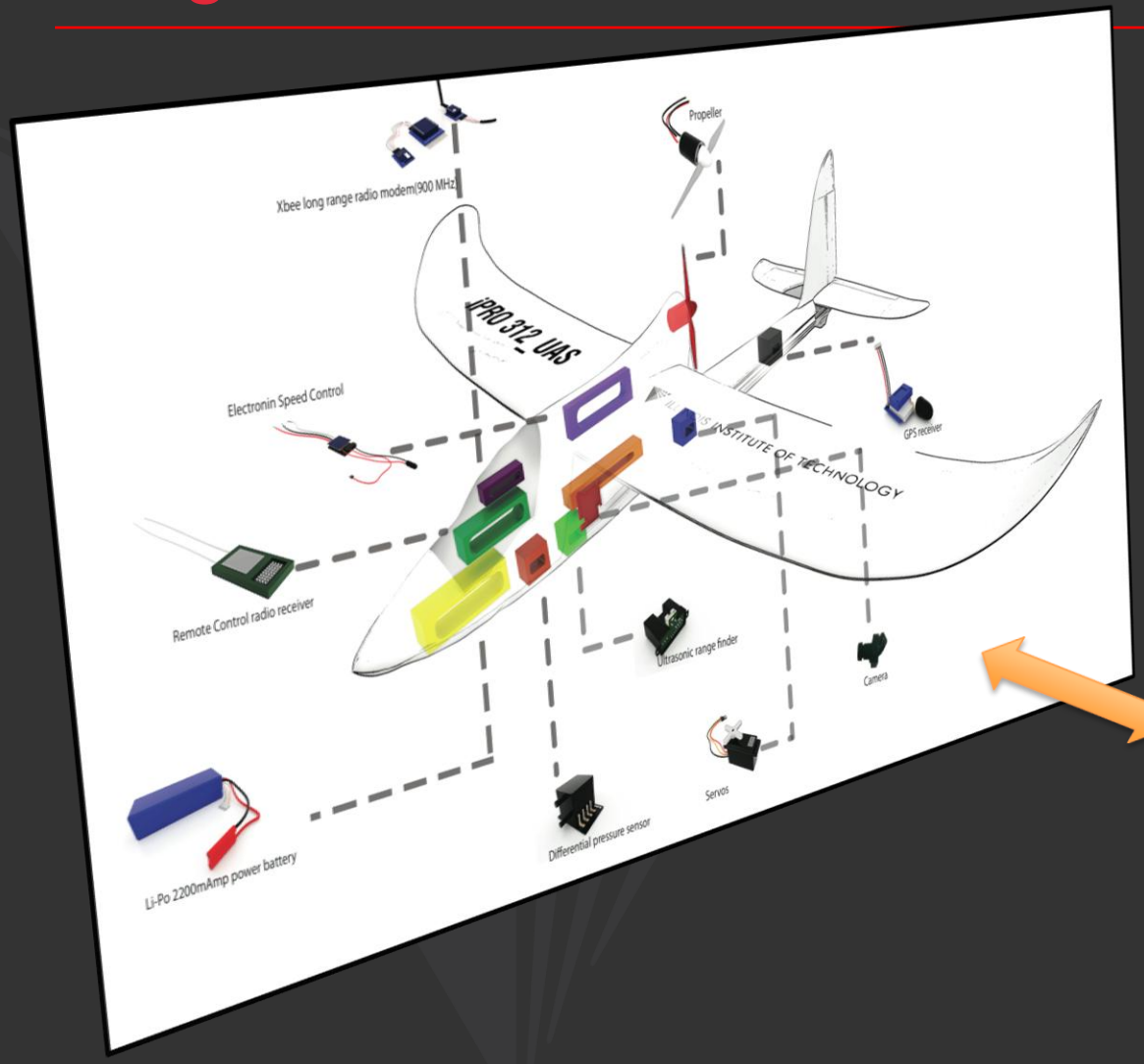
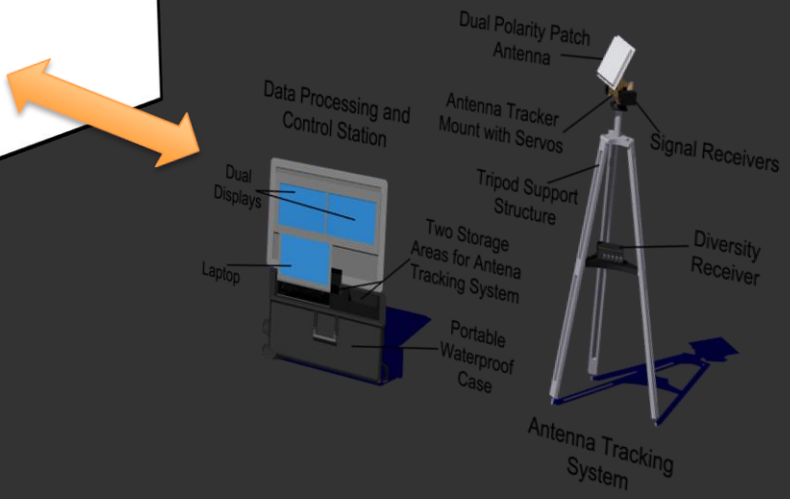
Integration





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Future Work

- Take part in AUVASI Competition
- Integration of autopilot and image processing into ground station
- Developing a pre-flight checklist and diagnostic manual
- Testing & Analysis
- Approaching sponsors

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Questions?