ARM IT

Junior Colloquia

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Mentor: Dr. Anil Deane

Overview

- Background Information
- Methodology
- Progress
- Goals
- Challenges
- Advice for future teams
- Closing Remarks

3DR, “solo-smart-drone-12” https://3dr.com/wp-content/uploads/2015/12/solo-smart-drone-12.png
3DR, “solo-drone-controller” https://3dr.com/wp-content/uploads/2015/11/solo-drone-controller.png

Purpose

L. Matthews, “21 Photos of Hurricane Matthew’s Destruction,” *Popular Mechanics*, 07-Oct-2016. [Online]. [Accessed: 26-Oct-2016].

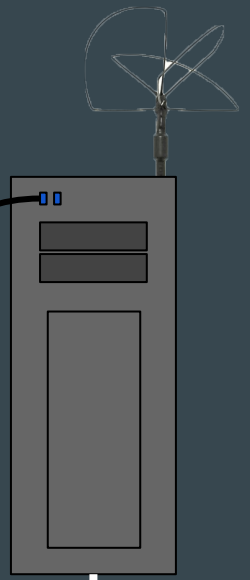
- Disaster areas are treacherous environments
- Unmanned Aerial Vehicles (UAVs) can aid search and rescue operations

Structural Overview

- Head Tracking
- Stereoscopic Vision
- VR+AR Overlays

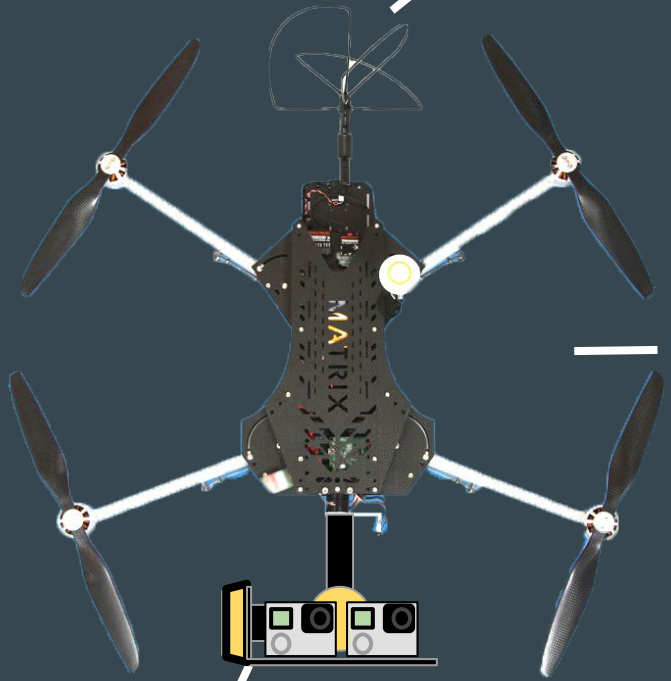
VR + AR
Interface

Antenna



Ground
Computer

Antenna



UAV

Camera
Payload

oculus vr, "Oculus-Rift-2"
http://www.wired.com/wp-content/uploads/2015/06/Oculus-Rift-2-1024x576.jpg
Sierra Hobby, "cloverleafultra1.3", http://www.sierrarc.com/images/cloverleafultra1.3.jpg
GoPro, "sits_pod15", http://shop.gopro.com/accessories/3d-hero-system/AHD3D-001.html.
Wow Hobbies, "matrix_topview", http://www.wowhobbies.com/images/matrix_topview.jpg

Research Questions

How can stereoscopic vision improve UAV operations?

How does a VR + AR video feed affect operator visualization of a scene?

How can a VR + AR interface improve on existing search and rescue methods?

VR: Virtual Reality

AR: Augmented Reality

Goals

- Develop HUD overlay displaying tactical info
- Design and construct stereoscopic gimbal
- Integrate hardware and software into finished product
- Test final configuration using flight simulation

UAV

Controls

Autopilot

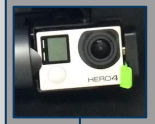
Gimbal

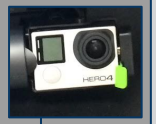
Telemetry

Gimbal Controller

Drive Motors

Cameras





Connex tx

Connex tx

Rx

Rx

GCS (Ground Control Station)

User/Pilot

Rc tx

Telemetry

Computer

HDMI Capture Card

Oculus Software

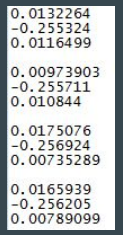
Head Tracking Data

Oculus HMD

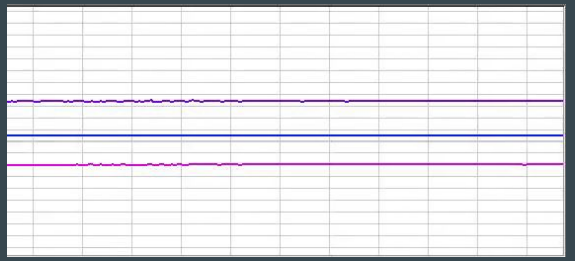
Mission Planner GCS Software

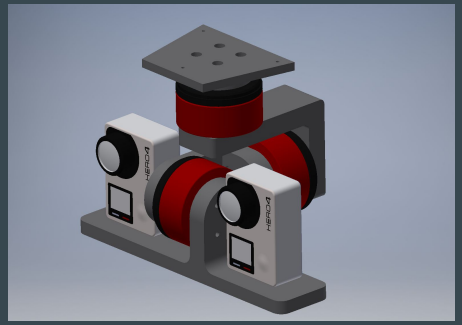
GetFPV. (n.d.). [Connex HD Video Downlink]. Retrieved October 26, 2016, from http://www.getfpv.com/connex-hd-video-downlink.html

Control Flow



T(x, y, z)



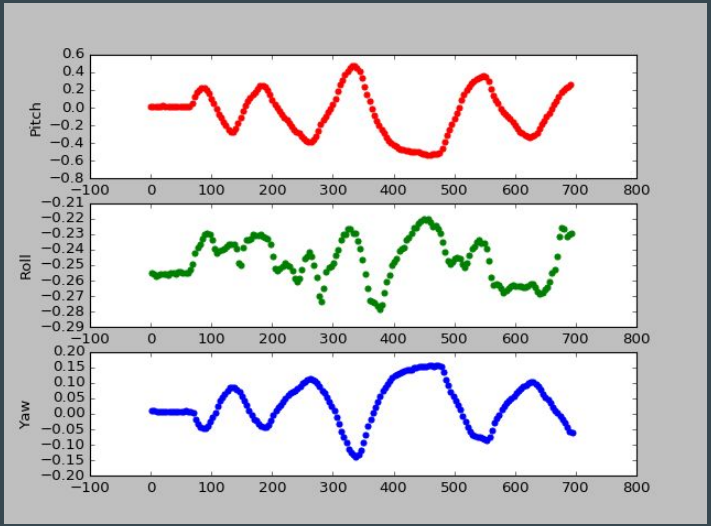


Oculus

- Stereo feed into Oculus
- Headtracking data
- Headtracking telemetry

Comparing Headtracking Data

Oculus Position



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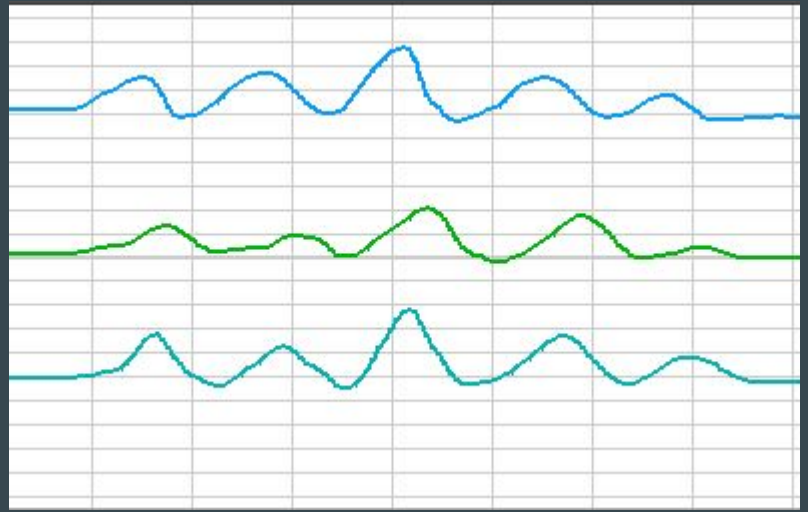
Gimbal Position



UAV

Controls

Autopilot

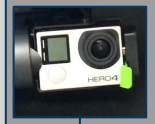
Gimbal

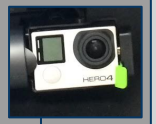
Telemetry

Gimbal Controller

Drive Motors

Cameras





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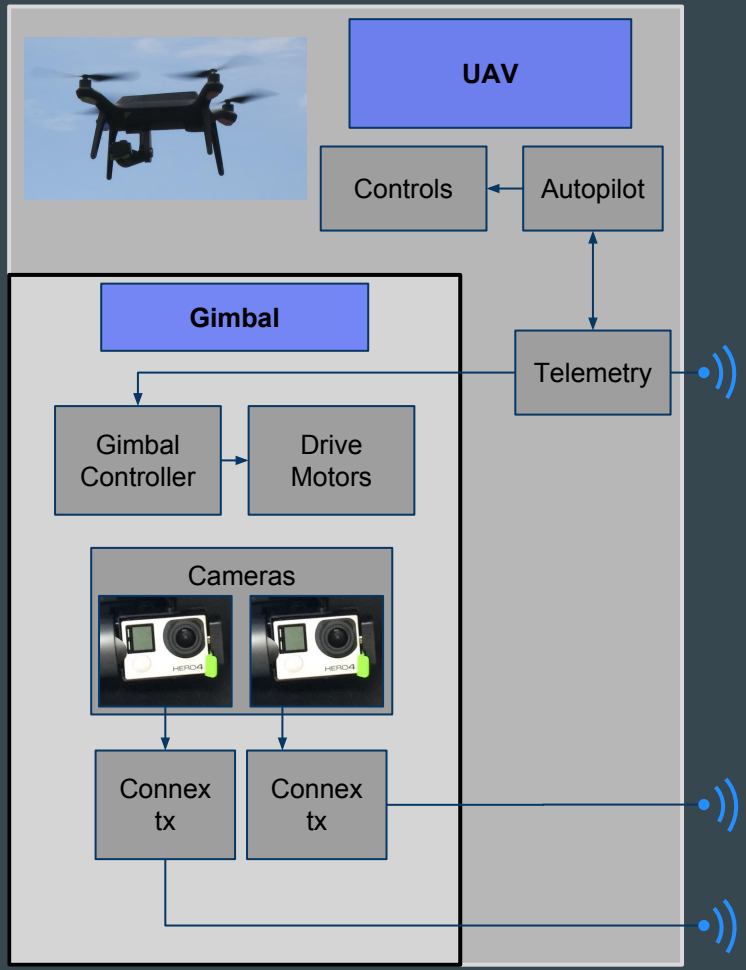


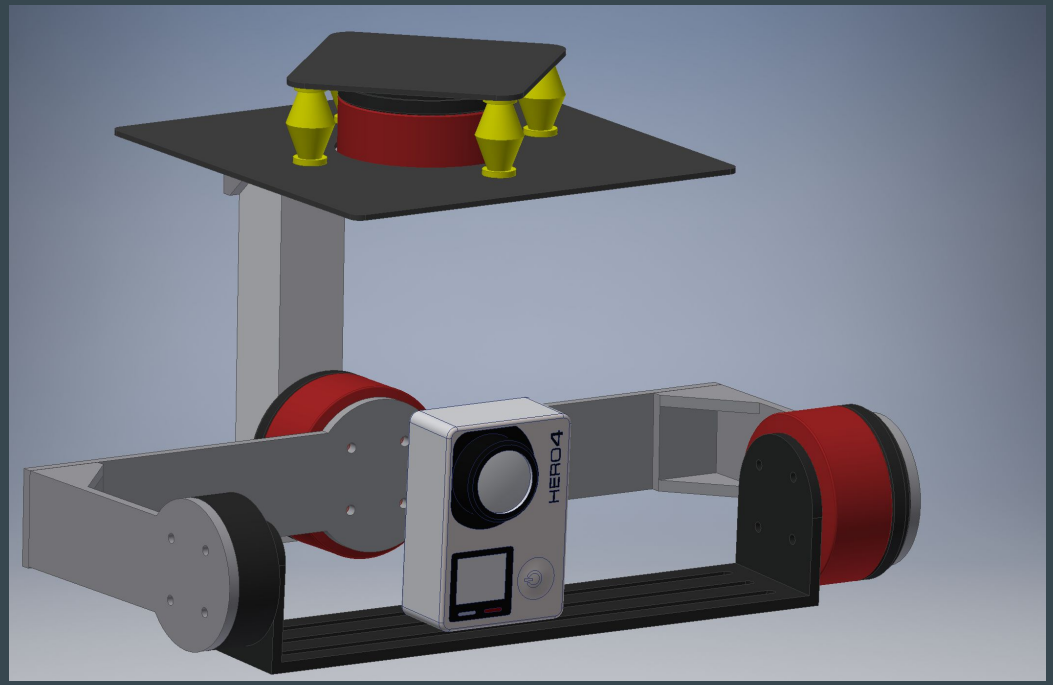
UAV

- Currently using 3DR X-8 UAV
- Interface with UAV autopilot
- Head tracking data transmitted over existing telemetry radio module
- Connex digital video transmitters
- Custom gimbal carried underneath

Payload Development

Version 1

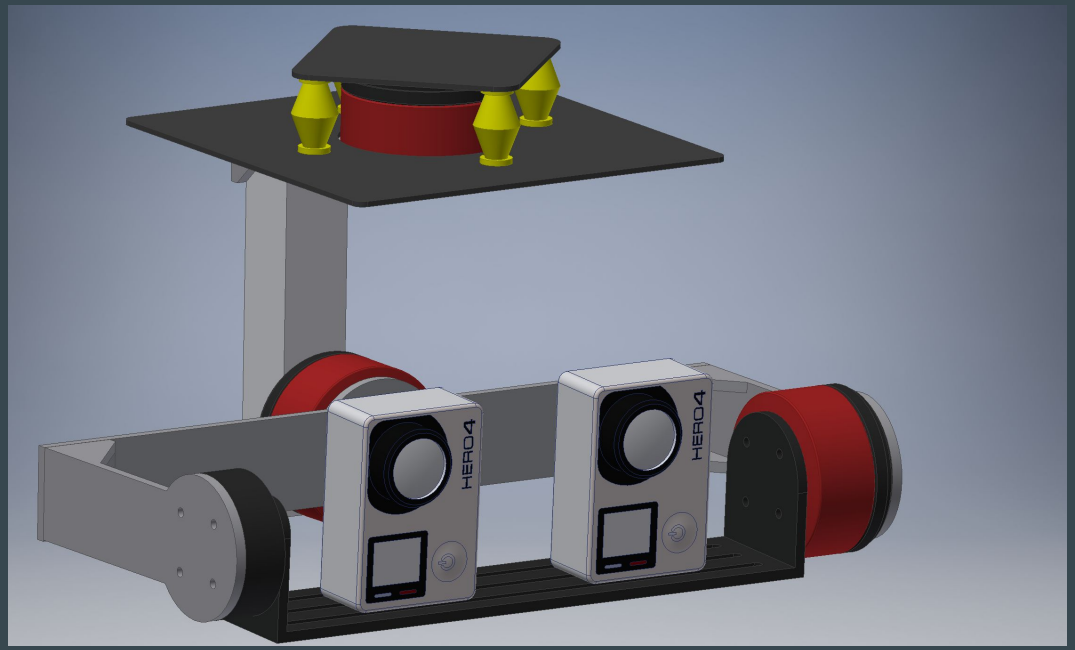
- Generic gimbal
- 3 rotational DOF
- Brushless motor driven



Payload Development

Version 2

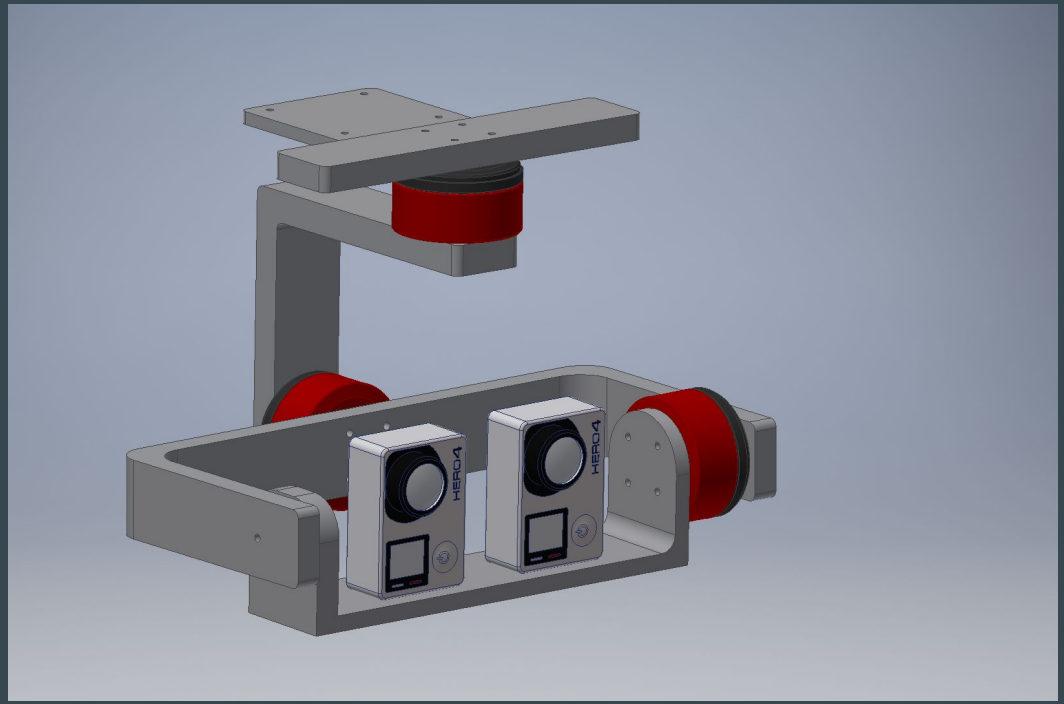
- Add second camera



Payload Development

Version 3

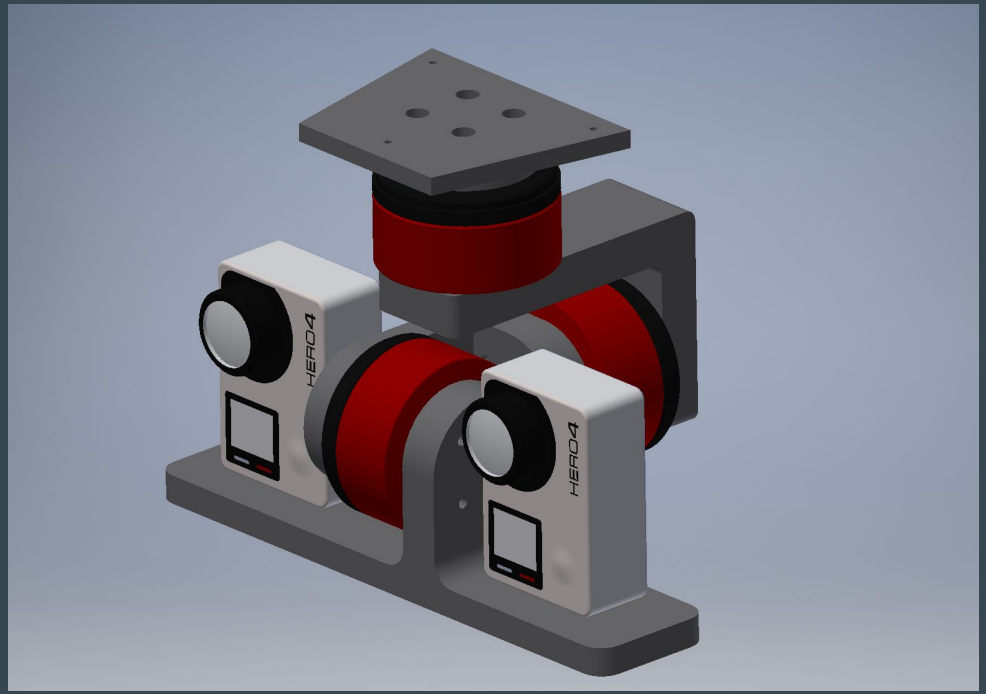
- Redesign to make simpler to print
- Simplify part count



Payload Development

Version 4

- Downsize while retaining functionality
- Simplify part count further



Testing

- How can stereoscopic vision improve UAV operations?
- Vision test: find hidden objects in an environment
  - Record time to locate target
- UAV handling test: flight simulator
  - Accurate handling
  - Track time, collisions

Team Challenges

- FAA rule changes
- Product release time - Oculus shipping delays
- Steep learning curve
- Feasibility/Budget
    - Infrared camera
    - Transmission
    - Live Video Compression

Advice for future teams

- We have a larger team than usual - more diversity/challenge
- Don’t worry about gaps of experience/knowledge, always chances to learn
- Everyone brings their own talents
- Set and keep internal deadlines
- Establish ground rules
- Be realistic

Future Plans

GetFPV. (n.d.). [Connex HD Video Downlink]. Retrieved October 26, 2016, from http://www.getfpv.com/connex-hd-video-downlink.html

M. Van Droogenbroeck and O. Barnich. ViBe: A Disruptive Method for Background Subtraction. In T. Bouwmans, F. Porikli, B. Hoferlin, and A. Vacavant, editors, Background Modeling and Foreground Detection for Video Surveillance, chapter 7. Chapman and Hall/CRC, June 2014.

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Hackman, "Drone Delivers Medicine to Rural Virginia Clinic," Retrieved November 14, 2016 from http://www.wsj.com/articles/drone-delivers-medicine-to-rural-virginia-clinic-1437155114

Summary

- Design system to aid in search and rescue operations
- Current Accomplishments:
  - Collected and analyzed head tracking data
  - Prototyped gimbal
  - Conducted testing on individual components
  - Began creation of flight simulator
- Advance and integrate individual subcomponents

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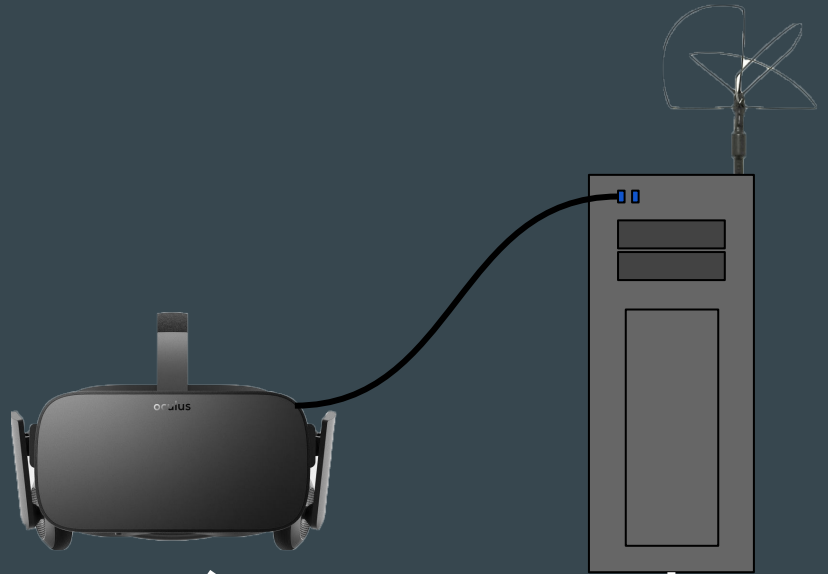
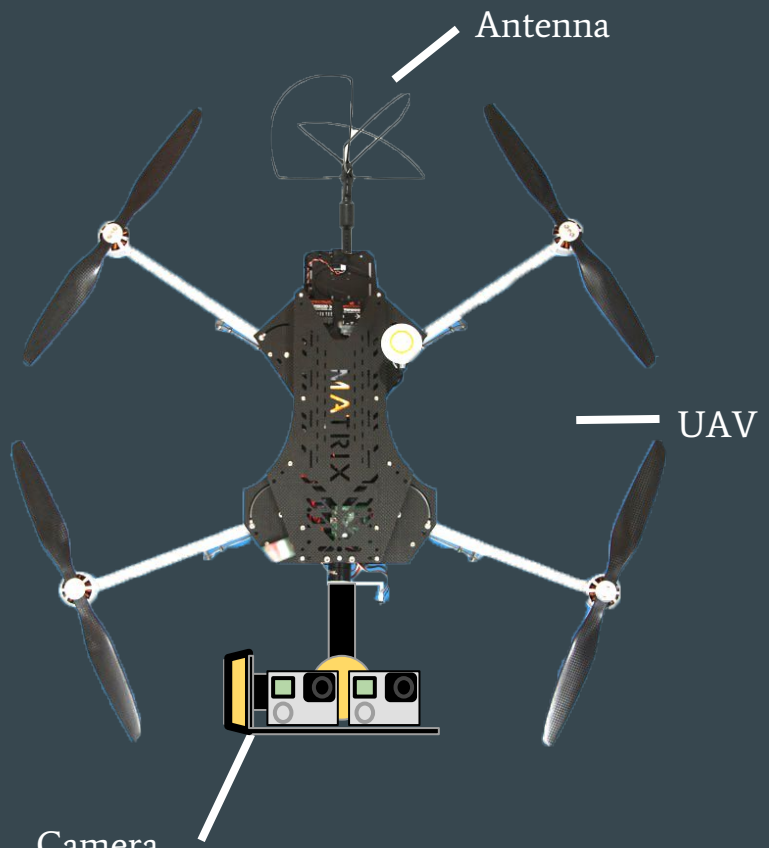
Acknowledgements

Thanks to the Institute of Physical Sciences and Technology, our mentor Dr. Anil Deane, and Dr. Huan Xu for providing the use of:

- 3DR SOLO UAV
- Oculus Rift
- Gimbal and GoPro Camera
- Zed Stereoscopic camera
- Lab Space with access to:
  - 5K Display
  - 3D Display
  - Dual Compute GPU unit
  - Custom Built Workstation PC

Questions?





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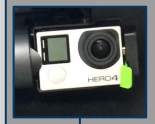

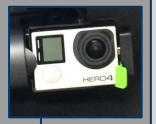

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