AUVSI-SUAS Autonomous Unmanned Vehicle Hardware System Honors Capstone

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AUVSI-SUAS Mission Objectives

- Simulated package delivery
- Autonomously navigate series of waypoints in 6 mile long path
  - Avoid GPS-based stationary obstacles and other aircraft
- Search for and classify targets using aerial photography and computer vision
- Drop payload of Unmanned Ground Vehicle (UGV) which must autonomously drive to delivery location
- Maximum of 30 minutes flight time

Autopilot

- Interface for sensors and servos
- Companion computer support (MAVLink)
- Configurable modes and tuning
- Separate power distribution board

[1]

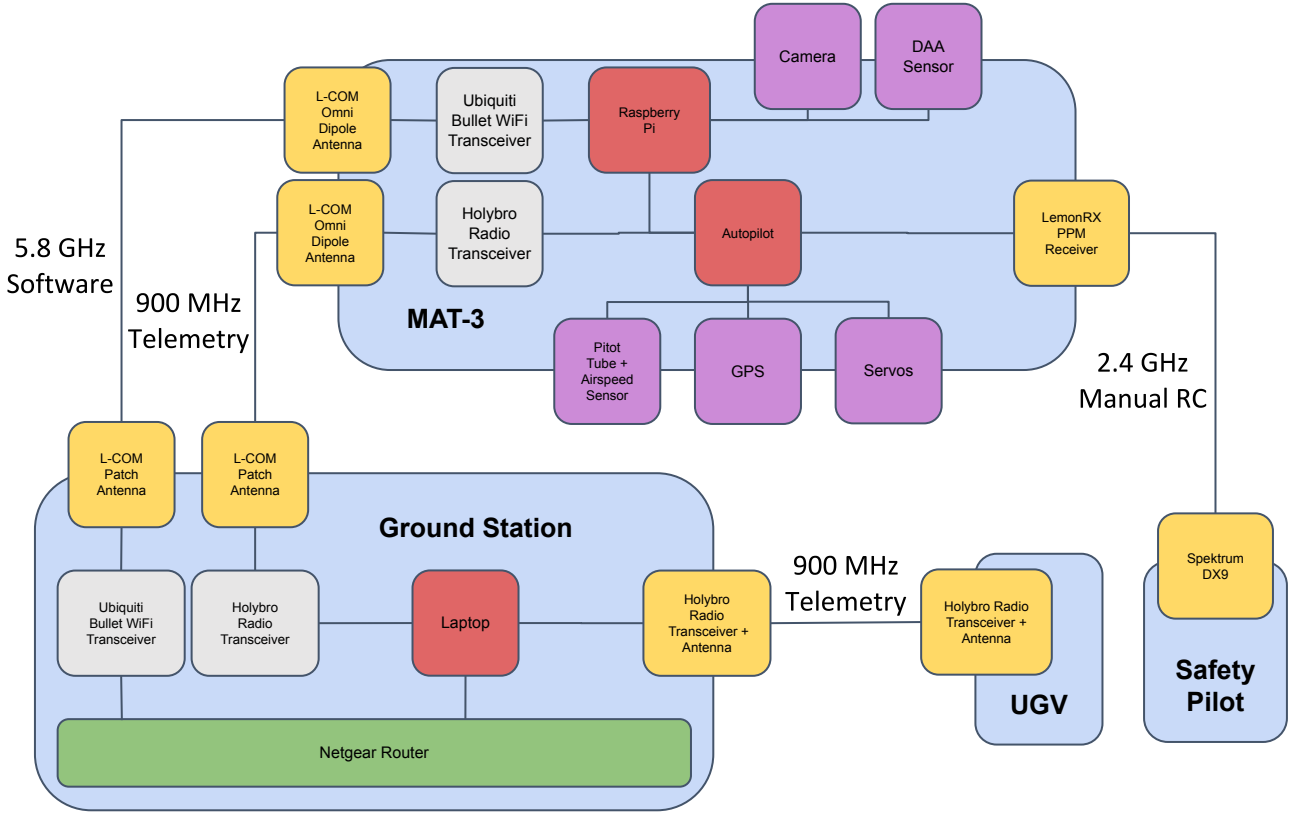
[1] (https://docs.px4.io/v1.9.0/en/flight_controller/pixhawk4.html, 2019)

Companion Flight Computer

- Using Raspberry Pi for peripheral tasks
- Payload drop
- Solution for dynamic detection and avoidance

[2] (https://www.raspberrypi.org/products/raspberry-pi-3-model-b-plus.html, 2019)

Communications Design



Flight Communication Hardware

- 900 MHz - Telemetry
- 5.8 GHz - Imaging and Interop
- 2.4 GHz - RC Control

[7]

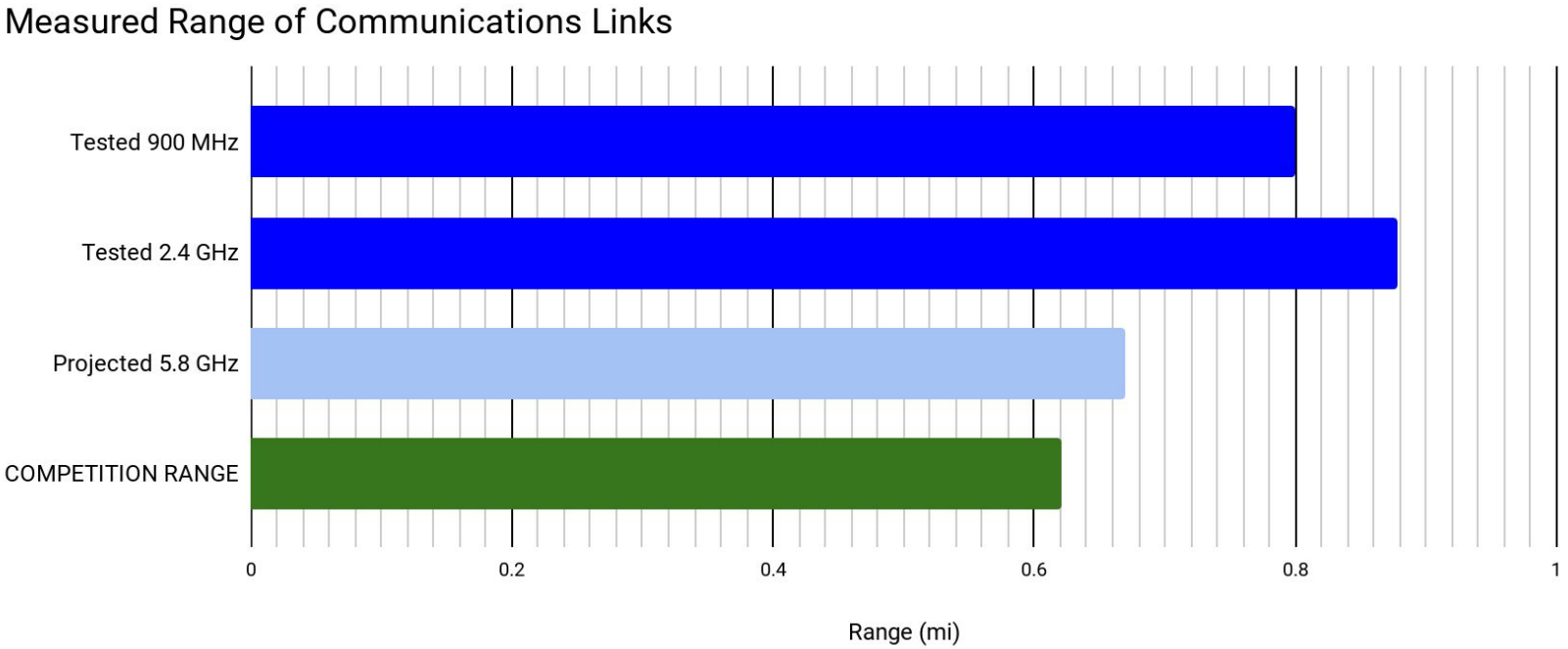

[4]


[5]

[4] (https://www.spektrumrc.com/Products/Default.aspx?ProdID=SPMAR9030T, 2020)
[5] (http://www.l-com.com/wireless-antenna-58-ghz-6-dbi-professional-omnidirectional-antenna.html, 2019)
[6] (http://www.l-com.com/wireless-antenna-800-900-mhz-3-dbi-omnidirectional-antenna.html, 2019)
[7] (https://www.ui.com/airmax/bulletm.html, 2019)
[8] (http://www.holybro.com/product/transceiver-telemetry-radio-v3.html, 2019)

RC Antenna Placement

Hardware: Communications Range Testing

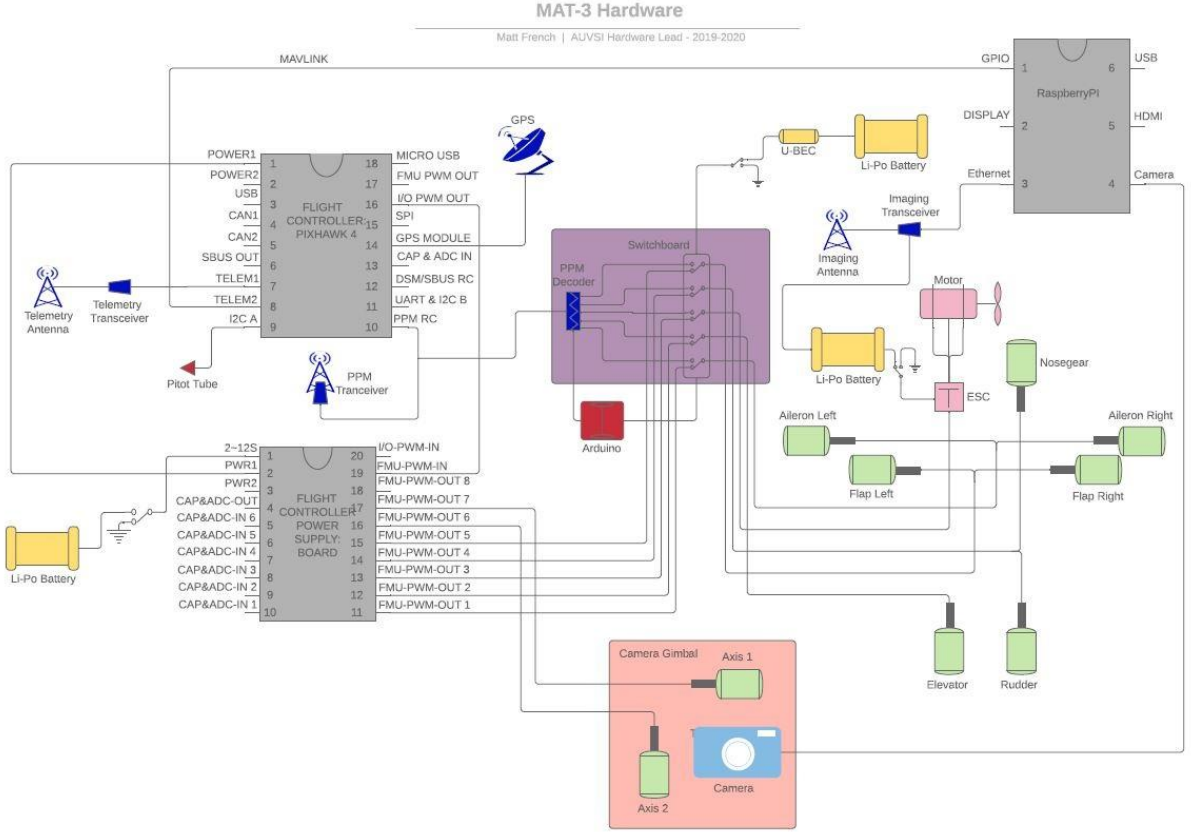


Computer Vision: Camera

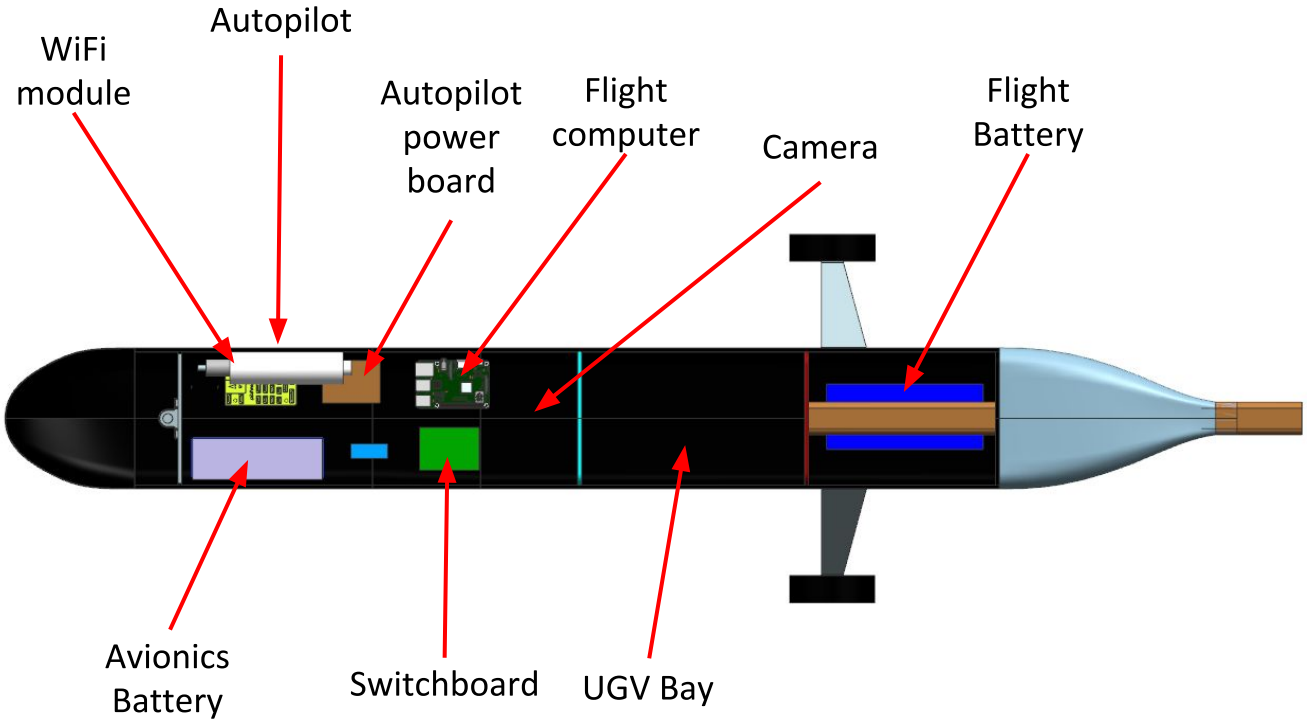
- Sony IMX219 Color CMOS
- 8 MP (3280x2464)
- 25.0mm CS lens
  - 16.7 degree FOV
- PiCamera Library

https://www.robotshop.com/en/arducam-8mp-sony-imx219-camera-module-cs-lens-2718-raspberry-pi.html

Wiring Harness

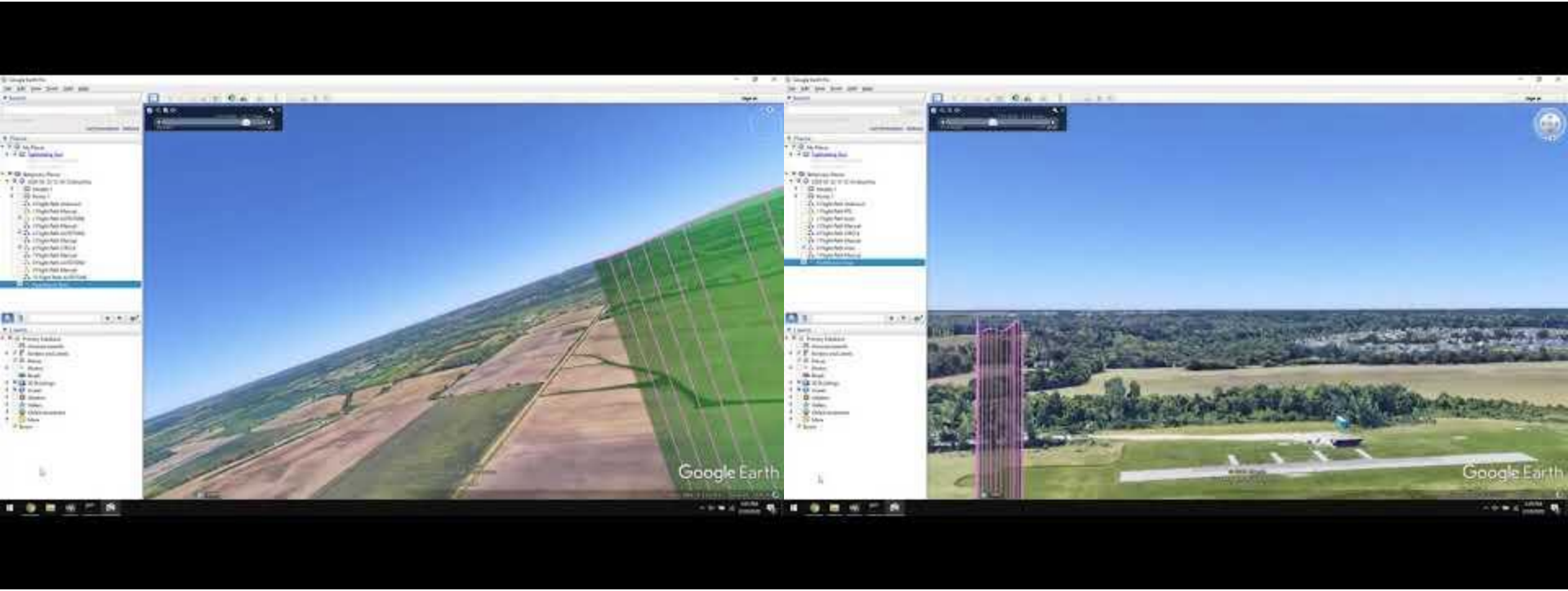


Airframe: Fuselage Layout



https://youtu.be/y3U0MlLJsVc

https://youtu.be/6rynrRpIypQ



Hardware: Link Budgets

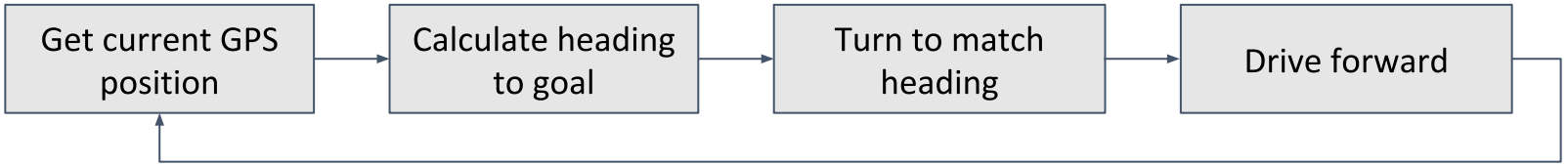
Frequency	P_t (dBm)	G_t(dBi)	G_r(dBi)	L_{fs} (dBm)	P_r (dBm)	Sensitivity (dBm)	Margin (dBm)
900 MHz	20.0	3.0	5.0	-91.7	-63.7	-117.0	53.3
5.8 GHz	20.0	6.0	8.0	-107.7	-73.7	-80.0	6.3
2.4 GHz	10.0	2.0	2.0	-100.0	-86.0	-98.0	12.0

$$\text{Margin} = P_r - \text{Sensitivity}$$

$$P_r = P_t + G_t + G_r - L_{fs}$$

Air Delivery: Unmanned Ground Vehicle

- Hardware
  - Arduino Nano microcontroller
  - Navigates using GPS and compass heading
  - 900 MHz telemetry using different channel than aircraft telemetry
- Software
  - Language: AVR C
  - Motion control loop



Scoring Breakdown

Task	Task Weight	Subtask	Subtask Weight	Percentage
Mission Demonstration	60.00%	Timeline	10.00%	6%
		Autonomous Flight	10.00%	6%
		Obstacle Avoidance	20.00%	12%
		ODLC	30.00%	18%
		Air Drop	20.00%	12%
		Operational Excellence	10.00%	6%
Technical Design Paper	20.00%	Payload Design	40.00%	8%
		Autonomous Flight Design	40.00%	8%
		Safey, Risks, and Mitigations	20.00%	4%
Flight Readiness Review	20.00%	System Overview	20.00%	4%
		Developmental Testing	50.00%	10%
		Mission Testing	30.00%	6%