

# Development of a Multicopter Aerial Vehicle capable of Autonomous Navigation

**Project members:**

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# Motivation and Problem Description

- ▮ Development of a platform that is:
  - ▮ Small enough to fly indoors.
  - ▮ Powerful enough to carry higher payload.
  - ▮ Off-the-shelf parts:
    - ▮ Keep cost low.
    - ▮ Easily replaceable/repairable/replicable.
- ▮ A platform that can support different sensor modalities.
  - ▮ Monocular Vision.
  - ▮ Stereo Vision.
  - ▮ Sound Localization.

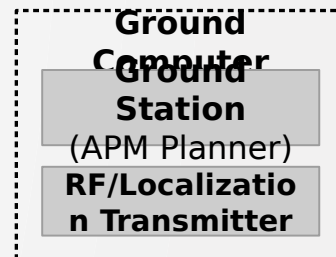


# Proposed Approach

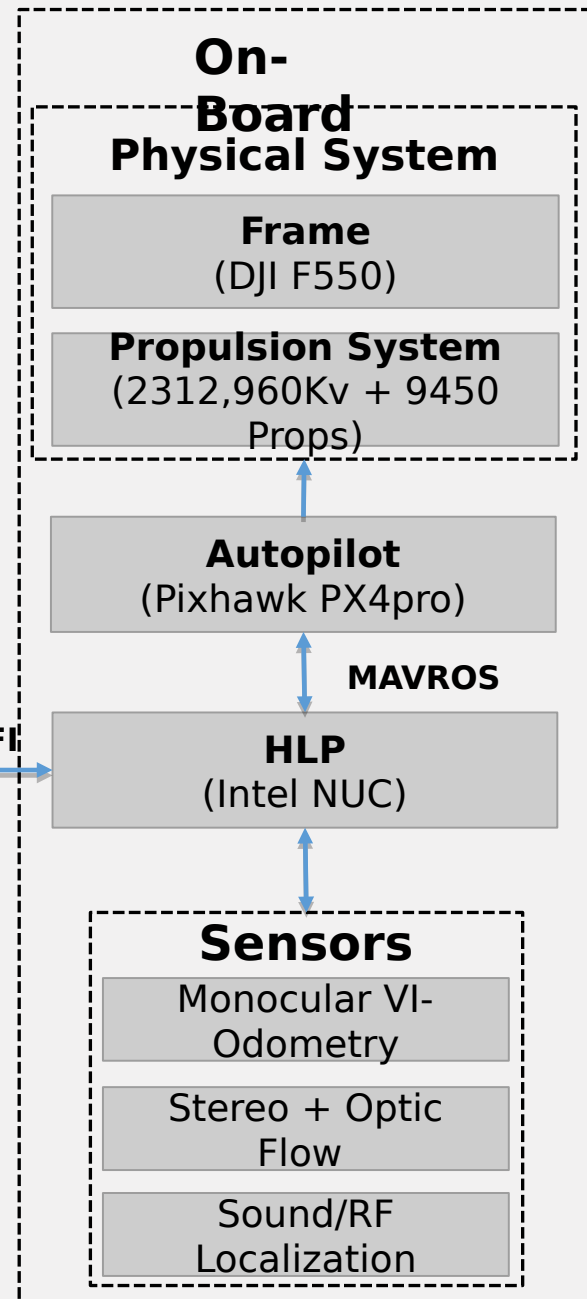
- System Design:
  - Reiterative approach.
  - Initial system weight guess (~1700).
  - Design for Thrust to Weight ratio of 2.5-3.
- Modular Design:
  - Each Sensor on with it's on mounting mechanism.

The screenshot shows the APM Planner software interface. The 'General' tab is active, displaying various configuration options for the drone. Below the configuration fields, there are six circular gauges showing real-time or estimated values: Load (19.9), Hover Flight Time (20), electric Power (213), est. Temperature (54), Thrust-Weight (3.6), and specific Thrust (8.41). At the bottom, there is a 'Remarks' section with a table of performance metrics.

Battery		Motor @ Optimum Efficiency		Motor @ Maximum		Motor @ Hover		Total Drive		Multicopter	
Load:	19.90 C	Current:	7.90 A	Current:	16.58 A	Current:	2.13 A	Drive Weight:	1085 g	All-up Weight:	1563 g
Voltage:	13.01 V	Voltage:	13.87 V	Voltage:	12.84 V	Voltage:	14.55 V		38.3 oz		55.1 oz
Rated Voltage:	14.80 V	Revolutions*:	12348 rpm	Revolutions*:	10307 rpm	Revolutions*:	4865 rpm	Thrust-Weight:	3.6 : 1	add. Payload:	3259 g
Energy:	74 Wh	electric Power:	109.6 W	electric Power:	213.0 W	Throttle (log):	26 %	Current @ Hover:	12.78 A		115 oz
Total Capacity:	5000 mAh	mech. Power:	94.4 W	mech. Power:	172.6 W	Throttle (linear):	40 %	P(in) @ Hover:	189.1 W	max Tilt:	71 °
Used Capacity:	4250 mAh	Efficiency:	86.2 %	Efficiency:	81.1 %	electric Power:	31.0 W	P(out) @ Hover:	153.5 W	max. Speed:	63 km/h
min. Flight Time:	2.6 min			est. Temperature:	54 °C	mech. Power:	25.6 W	Efficiency @ Hover:	81.2 %		39.1 mph
Mixed Flight Time:	11.5 min				129 °F	Efficiency:	82.6 %	Current @ max:	99.50 A	est. rate of climb:	12.8 m/s
Hover Flight Time:	20.0 min					est. Temperature:	29 °C	P(in) @ max:	1472.5 W		2520 f/min
Weight:	476 g						84 °F	P(out) @ max:	1035.8 W	with Rotor fail:	✓
	16.8 oz					specific Thrust:	8.41 g/W	Efficiency @ max:	70.3 %		
							0.3 oz/W				



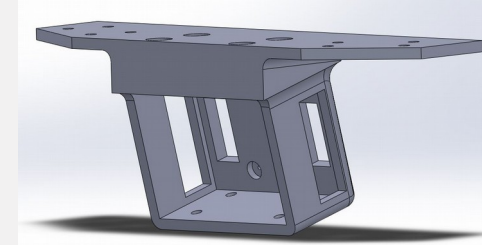
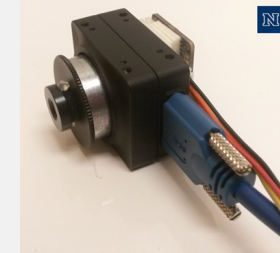
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# System Description

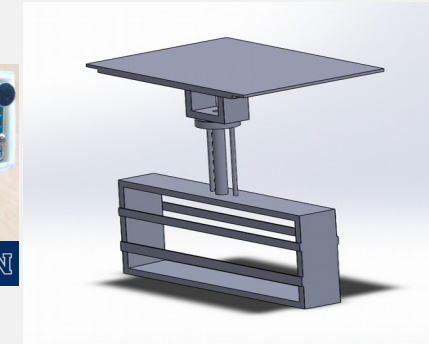
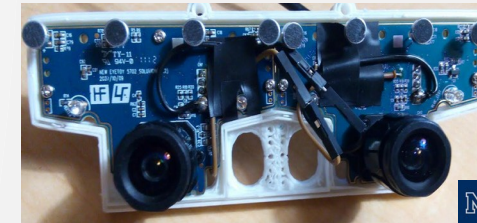
## Monocular System:

- ▮ Purpose: VI-Odometry.
- ▮ Hardware: Pointgrey Chameleon 3 + UM7 IMU.
- ▮ Software: ROVIO<sup>1</sup>.



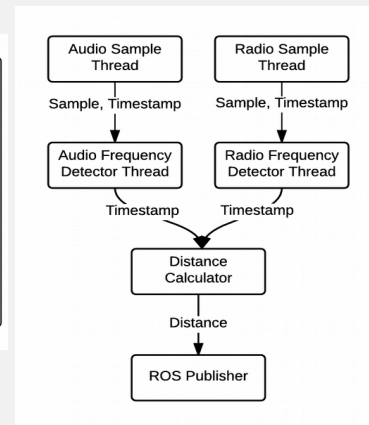
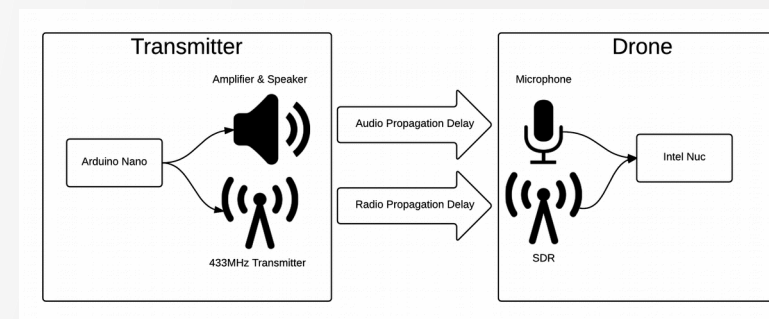
## Stereo System:

- ▮ Purpose: Optic Flow / VI - SLAM.
- ▮ Hardware: PSeye Camera + UM7 IMU + Gimbal System.
- ▮ Software: Custom ROS package.



## Sound/RF Localization:

- ▮ Purpose: Distance Estimation using sound and RF delay propagation.
- ▮ Hardware: Arduino + Transmitter/Receiver.
- ▮ Software: Python Script + ROS Package.

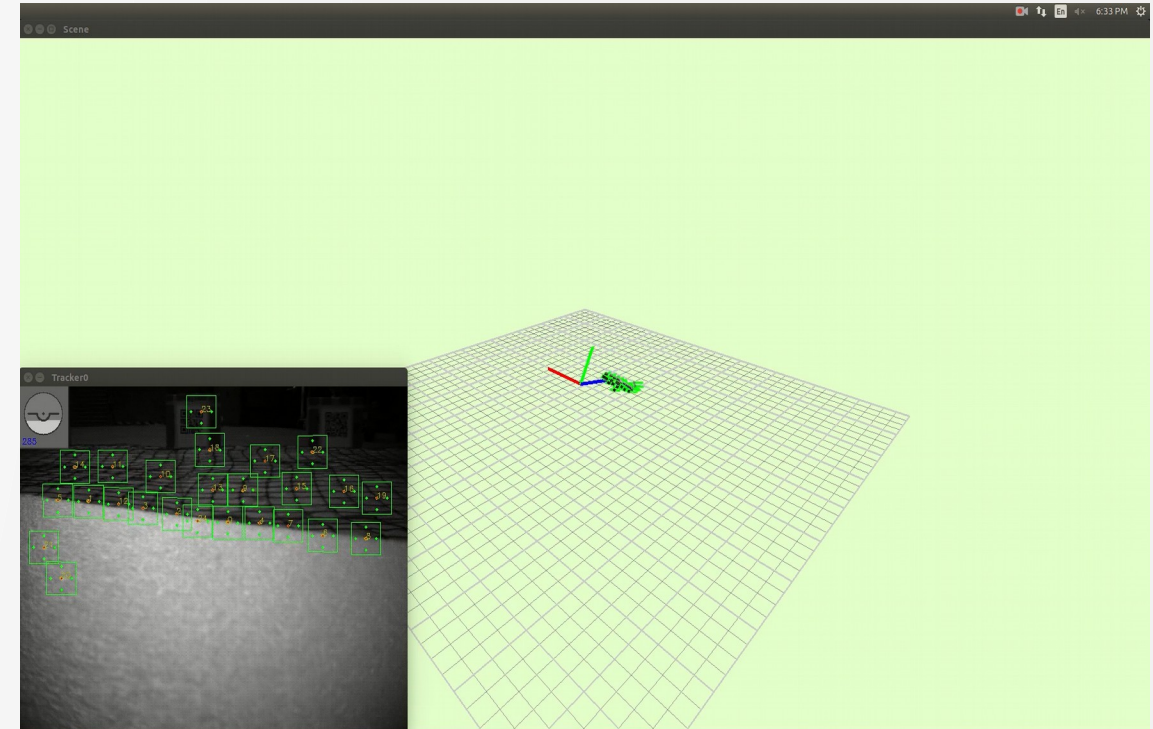


<sup>1</sup>Bloesch, Michael, Omari, Sammy, Hutter, Marco and Siegwart, Roland Yves. Robust Visual Inertial Odometry Using a Direct EKF-Based Approach. ETH-Zürich (IROS 2015).



# Results

- Working Robot capable of carrying heavier payloads.
- Computational and Sensory Capability of doing autonomous indoor navigation.





# Thank you

Questions, Comments, Suggestions, Criticism, Witticism.....