



VIPER: Visual & Infrared Position Estimation for Reconnaissance

Samina Farheen | Noah Venegas | Wesley Zalvin | Carter Brown | Eugene Antone
Andrew Hariman | Annie Do | Nicholas Carrano | Andrew Mills | William Tu

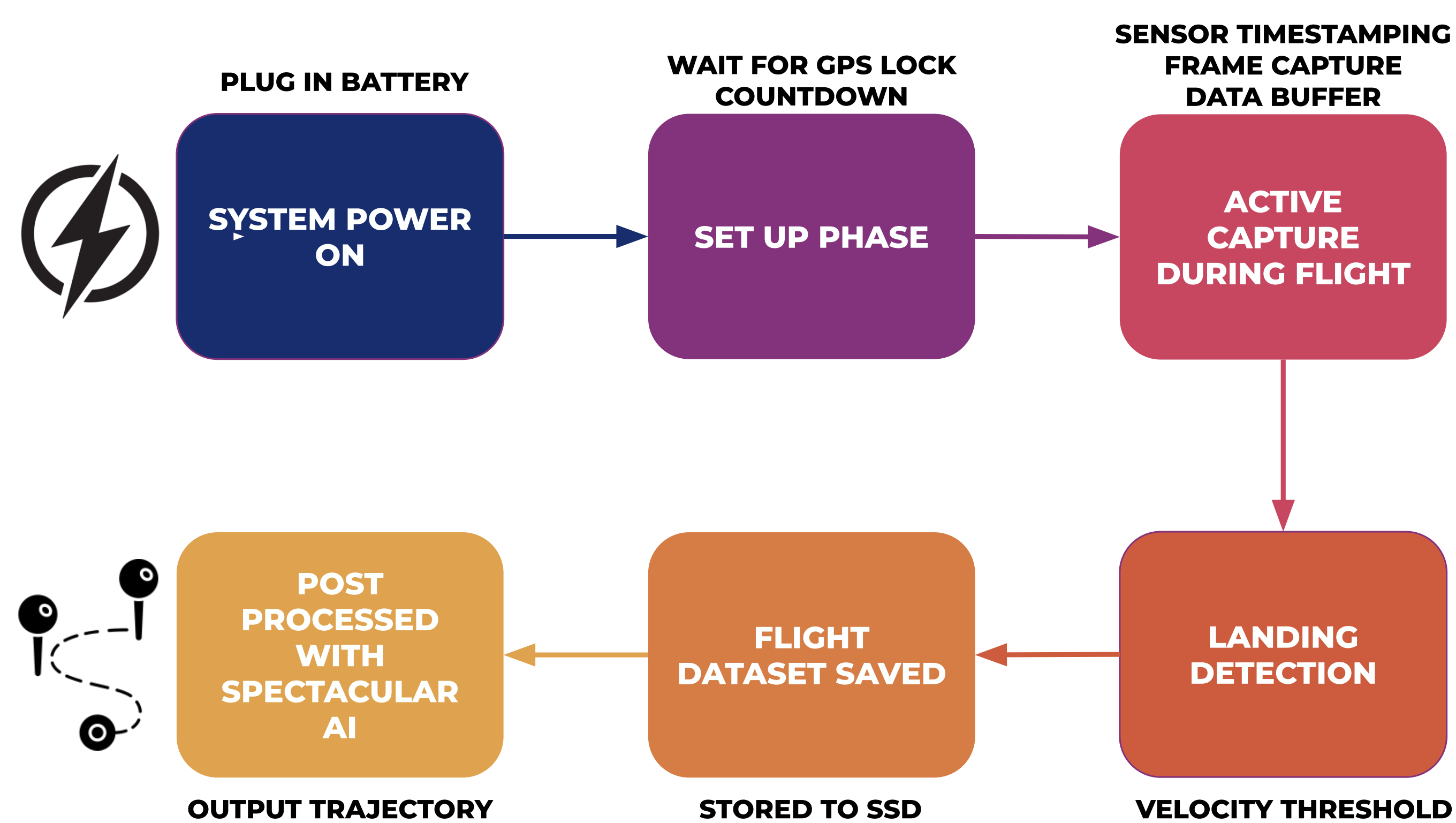
Abstract

Modern search-and-rescue drones face two major limitations: poor nighttime visibility and reliance on GPS for navigation. VIPER (Visual and Infrared Position Estimation for Reconnaissance) addresses both by providing infrared imaging and GPS-denied navigation in a low-cost, 260-gram dual-purpose drone payload. VIPER equips first responders with a tool to help save lives.

AI-Driven Navigation

VIPER merges sensor data with visual and infrared camera frames using AI-powered VIO-SLAM software (Visual-Inertial Odometry Simultaneous Localization and Mapping) to determine the drone's precise position and orientation regardless of the time of day, environmental conditions, or GPS accessibility.

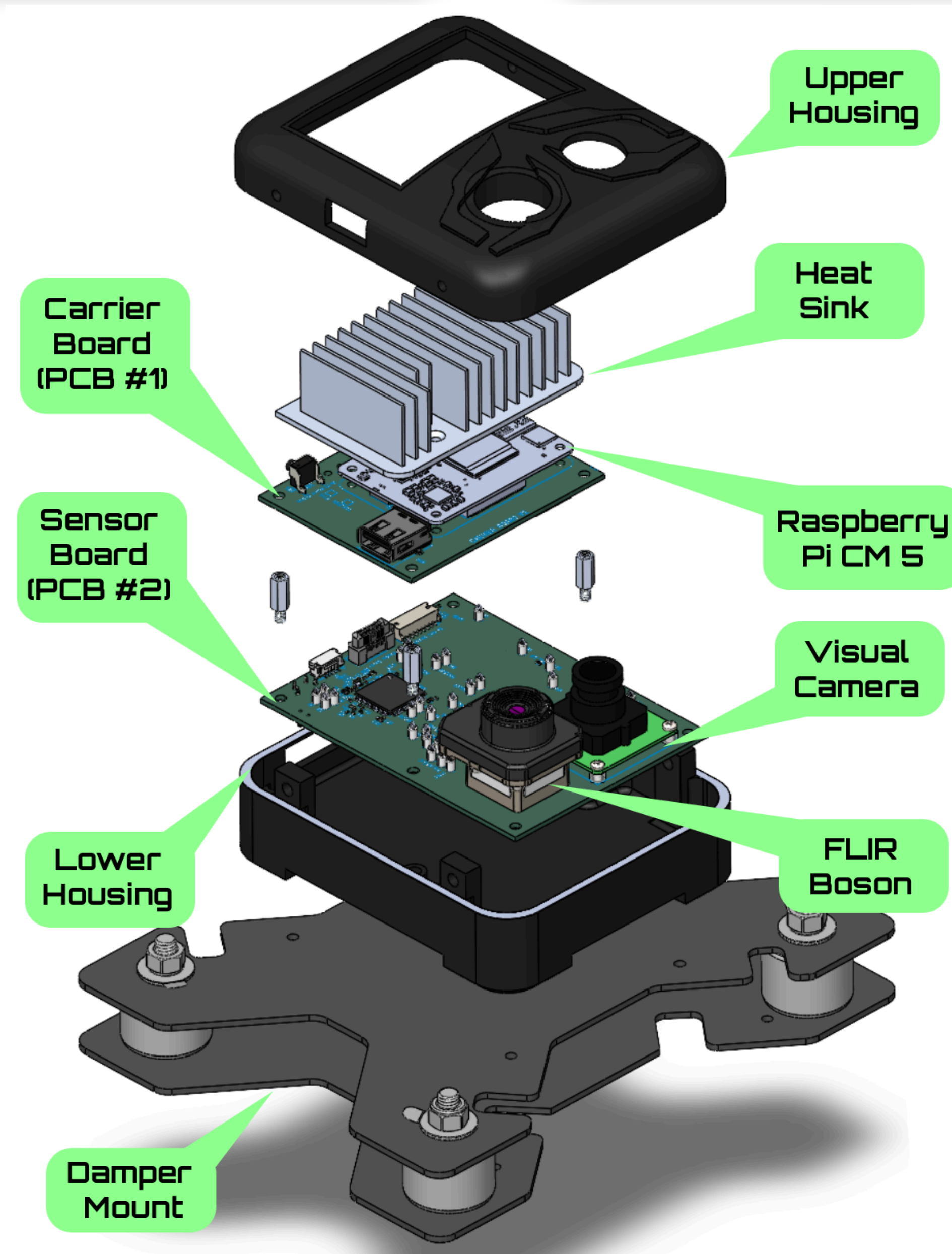
Operational Flowchart



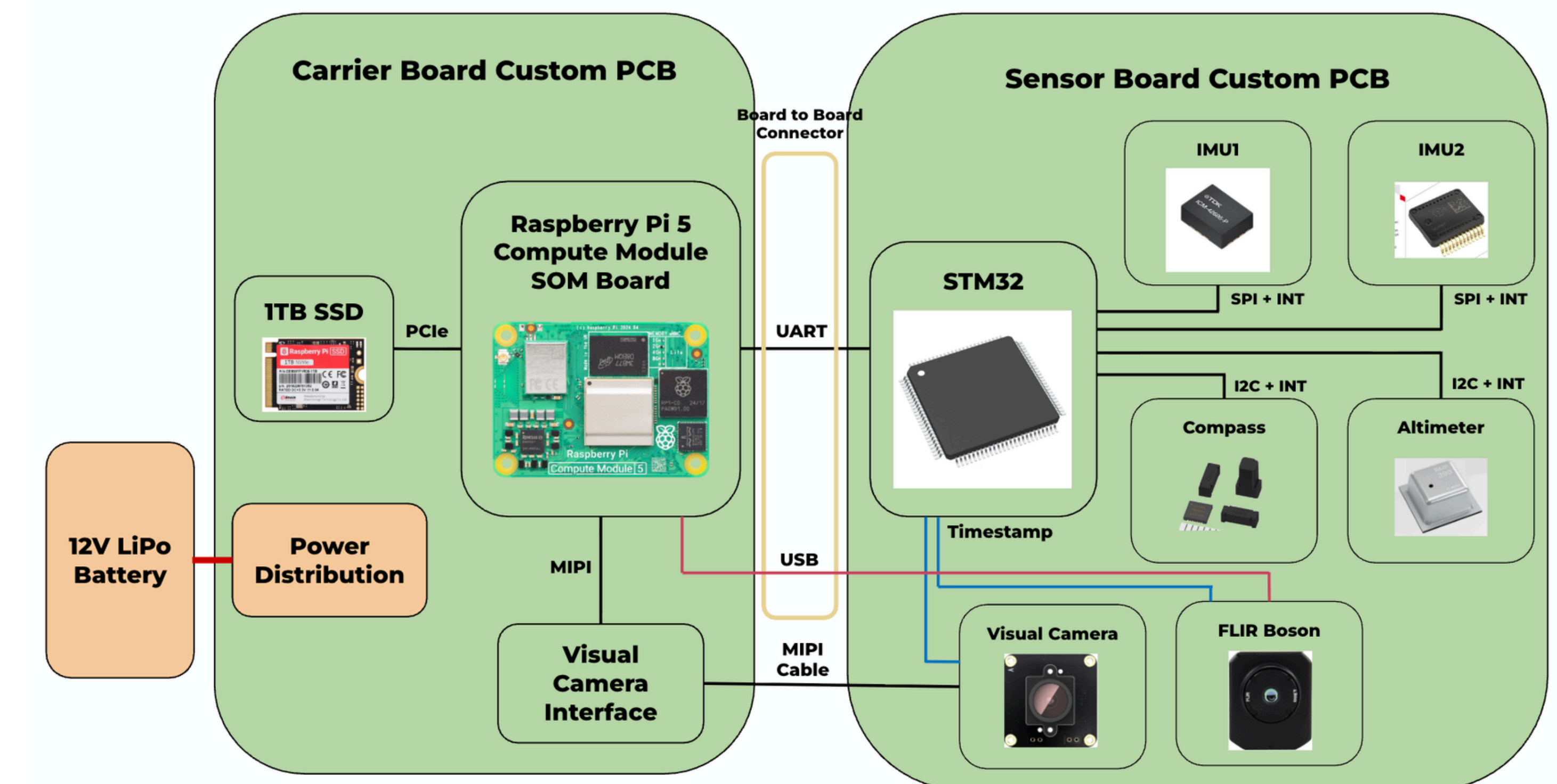
Spectacular AI in post processing produces position estimates using only sensors on board



Final Product

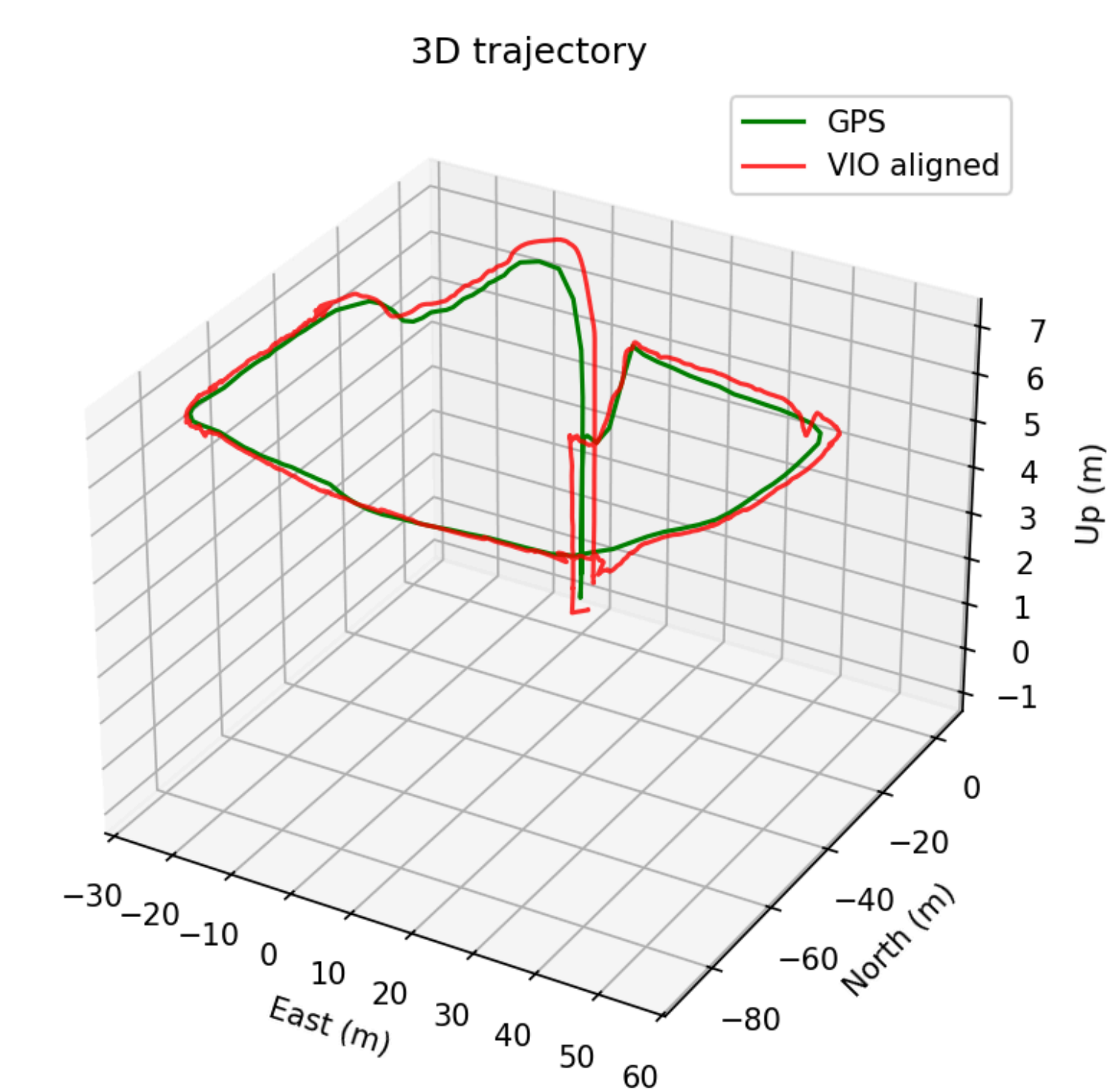


System Block Diagram



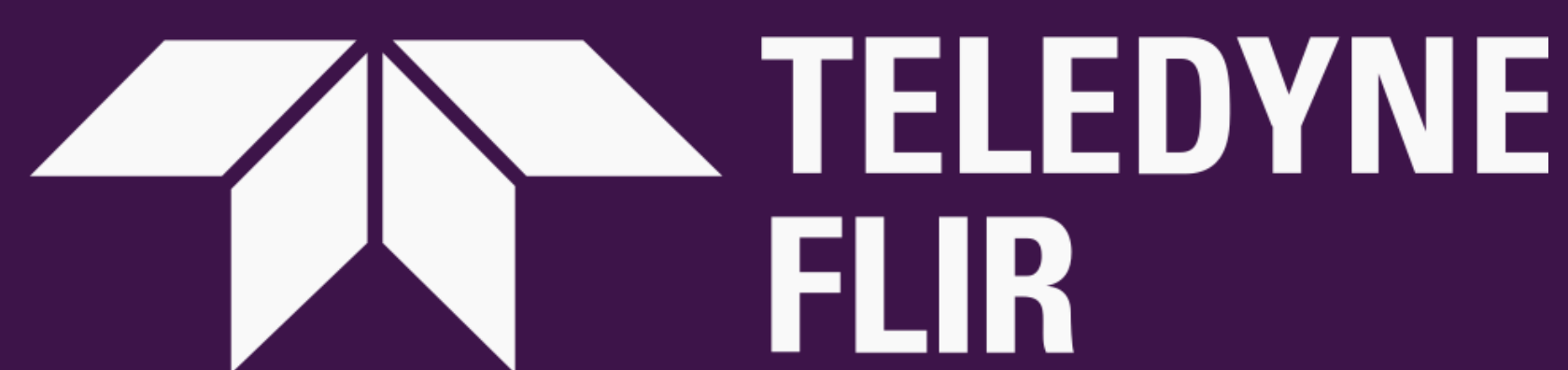
- MCU: STM32H7**
High Speed Model
Real Time Hardware Interrupts
- IMU1: Murata SCH16T-K10-1 - High Stability**
Cyro Bias Instability: 2°/hr
- Infrared Camera: FLIR Boson**
640 x 512, 95° (HFOV), 4.9 mm
- IMU2: TDK InvenSense ICM-45686 - Low Noise, Full Range**
Cyro Noise Density: 3.8 m°/s/sqrt(Hz)
- Visual Camera: Innomaker OV9281**
1280 x 800, 118° (HFOV), 2.8 mm
Global Shutter
- Altimeter: BMP390 - Accurate, Low Noise**
Accuracy: +/- 0.5 hPa = +/- 4m
Noise Floor: ~0.01 hPa
- Compass: PNI RM3100 - Low Noise, Unmatched Precision**
Noise Floor: ~15 nT
Resolution: 13 nT

VIO Performance



Estimated Position vs. GPS

- The robustness of sensor data and timestamping restricts estimate accuracy
- Using the visual camera on a 256m flight, achieved **98% accuracy** for the trajectory of the payload compared to the GPS coordinates



Acknowledgements:

UCSB: Prof. Ilan Ben-Yaacov, Prof. Ted Bennett, Prof. Tyler Susko, Paul Hoff
FLIR: Ryan Stevenson, Ryan Helling, Jeff Haller, Sylvia Madhow

UC SANTA BARBARA
Robert Mehrabian
College of Engineering