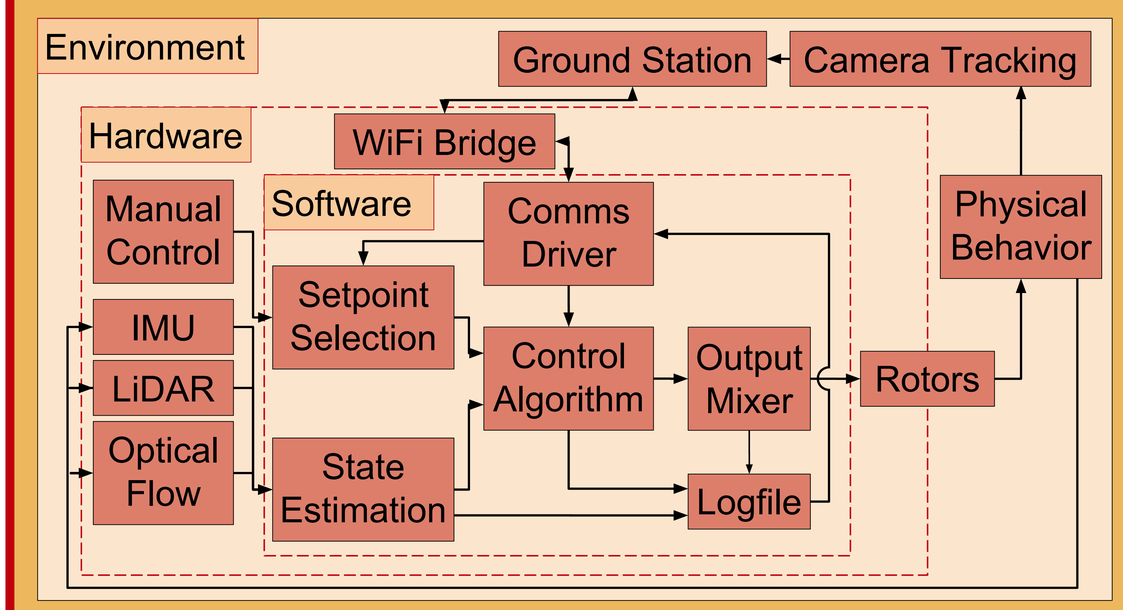
Iowa State University
Electrical and Computer Engineering

MicroCART
May 19-20

Summary

MicroCART is a modular quadcopter platform useful for graduate research and Departmental Demos alike. Researchers can also use the project as a stable platform for use in embedded systems and controls theory testing.

System Diagram



Requirements

- Functional
  - Swappable control algorithm
  - Stable example controllers
  - Verified mathematical model of the quad
  - Real time logging of sensor data
- Non-Functional
  - Quad maintains a control loop that operates fully in under 5ms.
  - Groundstation can process camera environment and quad sensor data within 10ms while also controlling the quad.

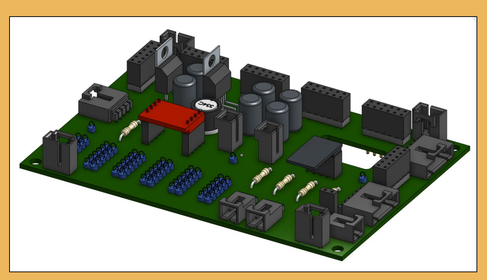
Testing and Evaluation

- Utilizing Simulink, a virtual version of the quad system can be created in order to test the functionality of new features.
- A Continuous Integration scheme ensures new features do not result in non-functional physical builds of the quad platform.
- Unit-functional hardware platforms allow for detailed FPGA module debugging and verification

Areas of Development

Our goal this year was to improve the viability of MicroCART as a research platform by improving performance in the following areas:

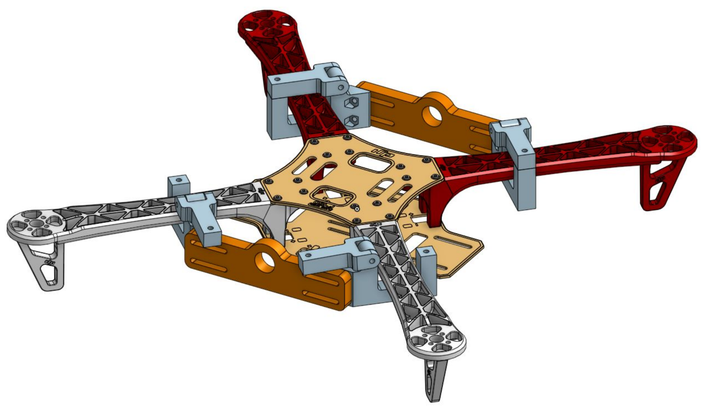
- Software Modularity
  - Swapping control algorithms can now be accomplished by replacing a single C code file
- Research Viability
  - Real-time flight data can be transmitted to the groundstation during flight and displayed graphically to the user utilizing a GUI created in QtCreator and a MATLAB graphical display.
- Hardware Interface
  - PCB shield allows for improved wire routing, power management, and debugging
  - New Vivado toolchain enables for faster additions and modifications by users



- Testing Environment
  - New 3D-printed quad clamps make system testing and research tasks safer and more reliable

Project Vision

- Increase stability of platform with the goal of developing non-research applications.
- Incorporating machine vision to improve autonomous capabilities of the platform.



Standards & Best Practices

- In order to belay the relatively low risk for physical harm caused by software failures on the quad, the utmost attention was paid to safety in the testing environment. This includes:
  - Use of protective eyeware whenever the quad was in operation
  - A tether to physically anchor the quad to the ground and prevent uncontrolled flight

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