MicroCart (Microprocessor Controlled Aerial Robotics Team)
sdmay19-20
Week 10 Report
October 22 — October 28
Client/Advisor: Dr. Phillip Jones

Team Members
James Talbert — *Hardware*
Sarah Koch — *Controls*
Anthony Bertucci — *Ground Station*
Tina Li — *Quad Software*
Nina Moriguchi — *Quad Simulation*

Summary of Progress this Report

- **James**
    - Continued to test the new quad platform on the FPGA.
        - The updated control board (Zybo Z7020) has been installed on our backup quadcopter frame to connect it to all the sensors.
        - Initial tests showed all individual sensors and outputs functional.
        - Ran a test without motors powered, using a oscilloscope to check motor output. All sensors and outputs appear functional, but the specific pin assignments (locations of motors) and the mounting of the IMU were different.
            - Remapping has been done in software
            - The accelerometer and gyroscope *correctly* change the motor outputs when the quad is rotated or tilted. This was tested at a very basic level for low frequencies.
        - Completed version 1 of the PWM Recorder User Manual
- **Sarah**
    - Created a tutorial for running the simulink-based quad flight simulator
        - Worked on using this simulator to create a demo showing what happens when a PID controller is poorly designed or used on a quad that has different flight parameters
    - Practiced using the Ultiboard software for PCB design and created a "rough draft" version of the MicroCART PCB
    - Worked on recreating the computational graph implementation of the PID controller based off of the MATLAB model as a way to practice and double check my work before attempting to create a computational graph implementation for the LQR controller
- **Tony**
    - Began writing software to run GUI.m from the backend following the completion of a flight.
        - Currently writing tests that will check if MATLAB scripts will be able to dynamically populate graphs based on incoming data.
        - Located documentation and code in GitLab detailing specific use of GUI.m and

DataAnalysis.m to complete graphical analysis of flight log .txt files.

- **Tina**
  - Worked on base station side -
    - Investigated the GUI code for the quad, to identify how to format the packets. Identified where code changes need to be made; packet handling
  - Noticed errors in fixing sensor RT - lots of extra unused variables in the struct. Started work rewriting the code
  - Created communication protocol for configuration packet
  - Created communication protocol for sensor RT packets
  - Started creating documentation
  - Added code that sends actuator data
  - Started taking apart the quad to understand what is hooked up to what
- **Nina**
  - Absent

Pending Issues

- **James**
  - The wiring of the two quads is inconsistent. It is undesirable to disassemble the working quad to replace the control board, so the second quad needs lots of debugging work to identify what changes need to be made. At present, each individual item appears to work correctly, but the controls don't work correctly on the second quad (reason unknown). It seems to me that it is trying to fly, but it just isn't tuned right (for the second quad).
  - Due to failed flight tests, a rotor has been broken and needs to be replaced.
- **Sarah**
  - Encountered and resolved issues with installing Eagle. Familiarization with the software has been delayed, but will be completed during the next reporting period.
  - The PID controller for the first quad does not appear to be a good enough approximation to fly the second quad. This means we will need to parametrize the second quad and create a PID controller specifically for the second quad.
- **Tony**
  - Utilization of existing MATLAB scripts will require .txt file of flight data to be populated by Quad following flight. The relevant code to this is largely located on the quad side of things so continued communication with Tina regarding updating quad software will be required.
  - MATLAB scripts are currently written to convert a log file into graphical representations only after the log file is finished being populated. It might not be feasible to update graph data in real time, but instead to update graph data once at the end of the flight (this solution will still eliminate the need for a buffer period after flights)
- **Tina**
  - Work on PCB
  - Modify sensor real time graphing scripts
  - Verify that code works
  - Check the transmission latency

- **Nina**
  - Absent

Plans for Upcoming Reporting Period
- **James**
  - Remove an extra timer module from the HW design, switching all usage to the internal PS timer.
  - Work with Sarah to recharacterize the second quad to tune the controller.
- **Sarah**
  - Assist James in parameterizing the second quad
  - Begin working with Professor Umesh on his self-tuning and black-box controllers
    - Provide flight data and a project overview
  - Create a simple PCB layout for practice using Eagle
  - Continue working on creating controls documentation
- **Tony**
  - Write test to determine if feasible to update graphical flight data in "real time" and, if not, modify GUI to handle updating graphical data once from text file at the end of a flight (but still not after a buffer period following the flight)
- **Tina**
  - Start working on PCB design, deadline is coming up
  - Determine dimensions of board carefully and make sure footprints are placed in the exact place
  - Look into how sensors are connected to the board
- **Nina**
  - Absent

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
James Talbert	- Ran system tests of the new quad platform - Created PWM Recorder User Manual	10	58
Sarah Koch	- Created a tutorial for the simulink-based quad controls simulator - Created a practice PCB board using Ultiboard - Began process of recreating the computational graph implementation of the PID as a practice exercise	6	43

Anthony Bertucci	● Began writing test to determine feasibility of "real-time" updates vs. single update at completion of flight.	4	39
Tina Li	● Investigated the base-station code and made plans for editing the ground station code to receive real time packets ● Created a backup GUI that graphs data in real time ● Investigated quad wiring and created documentation	5	37
Nina Moriguchi		0	17

Gitlab Activity Summary

```
---------------------------------------------------------
Action: opened, Sun Oct 28 2018
Author: skoch
Title: Update Controls README.md,  Type: MergeRequest
---------------------------------------------------------
Action: pushed new, Sun Oct 28 2018
Author: skoch
---------------------------------------------------------
Action: pushed to, Fri Oct 26 2018
Author: James Talbert
Title: The quad seems close to working (maybe).
---------------------------------------------------------
Action: commented on, Thu Oct 25 2018
Author: James Talbert
Title: Transition current hardware platform to Vivado,  Type: Note
Comment: Additionally, I'm not sure how to connect the quad to the ground station
to get the control graph. @bertucci, can you meet up Tuesday morning?
---------------------------------------------------------
Action: commented on, Thu Oct 25 2018
Author: James Talbert
Title: Transition current hardware platform to Vivado,  Type: Note
```

Comment: It didn't.

Action: commented on, Thu Oct 25 2018
Author: James Talbert
Title: Transition current hardware platform to Vivado, Type: Note
Comment: The hardware interfaces seem to work correctly. The current issue is that the controls are not functioning on this quad. I am going to attempt to revert the quad_app software to the golden build and see if that helps.

Action: commented on, Tue Oct 23 2018
Author: James Talbert
Title: Add Linux to second core, Type: Note
Comment: Relevant Document:
https://www.xilinx.com/support/documentation/application_notes/xapp1078-amp-linux-bare-metal.pdf
(shows how to do linux on CPU0, that launches a baremetal app on CPU1). I think we would prefer the other way aroun, but it should be OK.

Action: opened, Tue Oct 23 2018
Author: James Talbert
Title: Remove usage of axi_timer on the qaud, Type: Issue

Action: opened, Tue Oct 23 2018
Author: James Talbert
Title: Add Linux to second core, Type: Issue

Action: pushed new, Tue Oct 23 2018
Author: tinali

Action: pushed to, Tue Oct 23 2018
Author: tinali
Title: datasheets for sensors

Action: pushed to, Tue Oct 23 2018
Author: tinali
Title: sensor data stuff