EE CprE 491 – May 1716
MicroCART Senior Design Team
Week 2 Report

September 12– 18
Faculty Advisors: Phillip Jones, Nicola Elia

Team Members:

Brendan Bartels — *Key Concept Holder*
Kris Burney — *Key Concept Holder*
Joe Bush — *Key Concept Holder*
Jake Drahos — *Key Concept Holder*
Eric Middleton — *Key Concept Holder*
Tara Mina — *Key Concept Holder*
Andy Snawerdt — *Key Concept Holder*
David Wehr — *Key Concept Holder*

Summary for Progress this Week

This week, we started to learn more about how to use different equipment available to us in the Controls lab, and continued becoming more familiar with the theory behind our project and its current state. We also continued developing some tools for easy communication between group members of the state of our project.

Past Week Accomplishments

- Learn how to use measurement equipment - Brendan Bartels, Andy Snawerdt, and Tara Mina
  - Ian taught us how to use the equipment for taking measurements on the quadcopter
  - With different inputs and measurements, we can experimentally find the moment of inertia of the quadcopter about different axes of rotation
  - Can give different inputs, including:
    - Step input
    - Ramp input
  - Can take measurements about the rotational dynamics, including:
    - Angle
    - Angular velocity
  - Inputs are entered as voltages - must convert to angular velocity (described in manual)
  - Measurements are taken as “ticks” - must convert to radians (described in manual)
- Wifi communication - David Wehr
  - Successfully measured the latency from serial communication
  - Determined usable range of WiFi module
  - Documented setup and results from experiments
- Reading chapter 2 of Matt’s thesis - Brendan Bartels, Andy Snawerdt, and Tara Mina
  - Will help us gain insight on how to model the mechanical physics of the quadcopter, which is a first step in understanding how to create an optimal control system
  - Have read about the frames of reference and their vector representations, including:

        - Body frame of reference
        - Earth frame of reference
    - Learned about coordinate transformations between references
- Base station - Kris Burney, Jake Drahos, and Eric Middleton
    - Discussed modular design and advantages of C++/Boost
    - First focus: VRPN module
- Trello board created and updated with core objectives - David Wehr and Joe Bush
    - Provides us with a project tracking tool to monitor tasks
- Lab schedule poll sent out - Andy Snawerdt
    - Will help us determine times most of us have available to reserve the lab every week
    - To coordinate camera system usage times with RADA, the other senior design team in the Controls lab this semester
- Set up a group email for the course - Tara Mina
    - Email address: may1716@iastate.edu
    - Includes all team members on MicroCART this year

Pending Issues

- Team member roles still need to be determined
- Still need to test TCP latency
- Still working on documentation for testing the latency and range for Wifi and serial communication

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
Brendan Bartels	Documentation, ECP Training, Matt's Thesis	8	8
Kris Burney	ECP training, Documentation, modular design	4	16
Joe Bush	Read documentation, Set up trello tasks	6	11
Jake Drahos	Modular design, VRPN module, C++	6	11
Eric Middleton	Base station, documentation, modular design	8	23
Tara Mina	Matt's thesis, ECP training	8	16
Andy Snawerdt	Lab Scheduling, ECP Training, Matt's Thesis	7	8
David Wehr	WiFi testing	7	19

Comments and Extended Discussion

We have not experienced any major issues so far, but we are scoping out the starting tasks and general objectives for this semester that we want to accomplish. In this process, we are realizing how much time needs to be spent becoming familiar with the current set-up and the theory needed to accomplish our objectives, in addition to starting to take measurements and perform simple tasks to help our project progress.

Plans for Coming Week

- Continue reading Matt's thesis - Brendan Bartels, Andy Snawerdt, and Tara Mina
    - Finish chapter 2 of thesis - Mathematical and Physical Framework
        - Become familiar with different reference frames

        - Read derivation of different matrix transformations for changing coordinates
        - Learn about different rigid body dynamics equations for the quadcopter
- Take measurements of moment of inertia - Brendan Bartels, Andy Snawerdt, and Tara Mina
    - Schedule a time to work with Ian in the lab
    - Take some basic measurements with the equipment and software data-acquisition tools for the moment of inertia in the yaw direction of rotation
    - Do several tests for good data
    - Perform analysis on the data acquired to determine our best estimation of the moment of inertia of the quadcopter about the yaw axis
- WiFi Communication - David Wehr
    - Determine if TCP adds substantial delay
    - Decide whether to switch to WiFi
        - If so, plan what needs to be done to accommodate the switch

Summary of Weekly Advisor Meeting

This week with our team, we summarized what we did the past week to become more familiar with the platform, we discussed some general processes in the testing procedure, and we listed some general objectives we want to start getting accomplished.

- Documents to look at and read through, if we have not already:
    - Read last year's final report front to back
    - Go through documentation
- Things to do:
    - Create a good report on safety procedure, with the following general stages of making changes to the quadcopter and testing them:
        - Stage 1: Upload to the extra Zybo board
            - Test as much as you can on that board first, before uploading to the actual quadcopter
        - Stage 2: Upload software to the actual Zybo board without the battery
            - Can upload to the actual board on the quadcopter
            - But make sure the motor battery is not connected
            - This way, the quadcopter cannot start moving out of control and damage itself if something went wrong
        - Stage 3: Turn on the quadcopter while holding the quadcopter down
            - Make sure the tether connecting the quadcopter to the ground under the mats is very secure
            - Turn on the quadcopter with your hand on the center pushing it down firmly, in case it suddenly starts flying
            - Make sure you and your arms are clear from the blades, in case they start rotating
            - This way, the quadcopter cannot start flying out control, without any inputs from the RC controller, in case something went wrong
            - For emergency shutdown: one person should stay at the RC controller to take control if needed
            - Extreme emergency! Unplug the quadcopter from the battery
        - Stage 4: Regular flight testing

            - Still keep the quadcopter tethered down
            - Still make sure the throttle on the RC controller is all the way down
    - As we go through the tutorials, update/improve/rewrite things as needed
    - Learn how to fly the quadcopter
        - Learn the different controls available on the RC controller
        - Practice on the small quadcopters first
        - Everyone should have a basic understanding of how the quadcopter works
    - Need to take measurements of the quadcopter to make a mathematical model
    - Need to create an input/output description of the Zybo board
        - A representation of the data flow
        - Information put on powerpoint slides with good detail
        - Explain the flow between software and hardware
    - Eventually: change our communication method between the base station and the quadcopter from Blutooth to Wifi
    - Schedule a tour with Ian and Paul to learn how to use the equipment in the lab
    - Get a general understanding of what PIDs are
- Safety concern noticed:
    - Exposed wire at the leads to the battery
    - As a result, decision made by team to eventually rewire everything!
- In general, everyone should have some involvement and familiarity with the different parts of the design process that are not part of their main sub-project
    - For example: the controls people should be involved with the design process of the GUI to see what information would helpful for testing
    - For example: the software people should be familiar with top-level representation created by the controls people to represent the mathematical model of the quadcopter
- A common issue with past teams of MicroCART: not willing to go high - fear of damaging the quadcopter and getting out of control