EE CprE 491 – Fall 2019
MicroCART Senior Design Team
Weekly Report 7

Nov 4th - Nov 11th

Faculty Advisors: Phillip Jones, Matt Cauwels, James Talbert

Team Members:

Evan Blough -- Technical Team Lead, Embedded Software Lead
Kynara Fernandes -- Ground Control Station Lead
Aaron Szeto -- Controls Lead
Joe Gamble -- Embedded Hardware Lead
Shubham Sharma -- Crazy Fly Implementation Lead, Website Manager
Jacob Brown -- Physical Hardware Lead

Summary for Progress this Week

This week we continued to research our respective development areas. We made documentation for a couple issues. The second quad should fly by the end of this week.

Past Week Accomplishments

- Setup ROS crazyflie for autonomous flight on the ground station. - Shubham
- Added VM crazyflie development.
- Talked with James and learned about current software support for quad modularity - Evan, Joe
- Made a release tag for the working version of last year's code - Evan, Shubham, Kynara
- Made slides about drone support for modular control algorithms (WIP) - Evan (See Appendix)
- Downloaded and tested log files with data tool- Aaron
- Tested second drone flight capabilities and manual flight was unsuccessful - Evan, Joe
- Soldered Lidar - Jacob
- Made documentation for current draw - Jacob (See Appendix)
- Wire harness creation - Joe
- Identified frame solutions - Joe

Pending Issues

- Need to update GCS to catch up with functionality of quad software
- Most of the coding for the modular software is done, but it still needs to be tested and integrated with the GCS
- Cannot install Oracle VM VirtualBox Extension Pack as it requires Super User privileges which we do not have. Ask ETG / Dr. Jones. This extension provides support for USB 2.0 and USB 3.0 devices, VirtualBox RDP, disk encryption, NVMe and PXE boot for Intel cards.
- When test log file has a 5 digit sample size Data tool slows down heavily and sometimes doesn't work
- We have to debug the functionality/connection of the Second drone boards more in depth

Individual Contributions

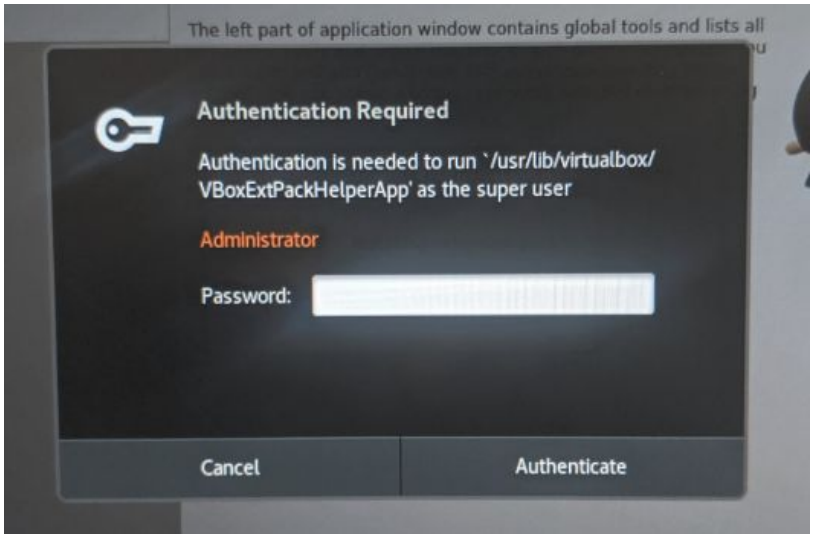
Team Member	Contribution	Week 3 Hours	Total Hours
Evan Blough	Talked with James and learned about current software support for control modularity. Worked with Joe and Jacob to test second drone platform.	9	71
Kynara Fernandes	I worked on implementing the new GUI features	7	59.5
Joe Gamble	Talked with James and learned about current software support for control modularity.	9	58
Jacob Brown	I soldered the lidar connector and made documentation for the current draw.	6	40
Aaron Szeto	Download past years test flight logs and tested them with Data tool. Found issue with logs with 5 digit sample sizes causing Data tool to lag.	8	48
Shubham Sharma	Setup ROS crazyflie for autonomous flight on the ground station. Added VM crazyflie development.	3	49

Plans for Coming Week

- Troubleshoot drone flight issue with debug in XSDK
- Test autonomous and manual drone flight
- Work on updating GCS station features, (Error Display, Logging functionality, Parameter Save, Modular Control)
- Expand the VM to support all the CF libraries.
- Resolve the superuser issue with Virtualbox

Appendix:

- Need Super-User privileges for installing VM VirtualBox Extension Pack. ‘ucart’ credentials does not work.


The left part of application window contains global tools and lists all
Authentication Required
Authentication is needed to run `/usr/lib/virtualbox/VBoxExtPackHelperApp' as the super user
Administrator
Password:
Cancel
Authenticate

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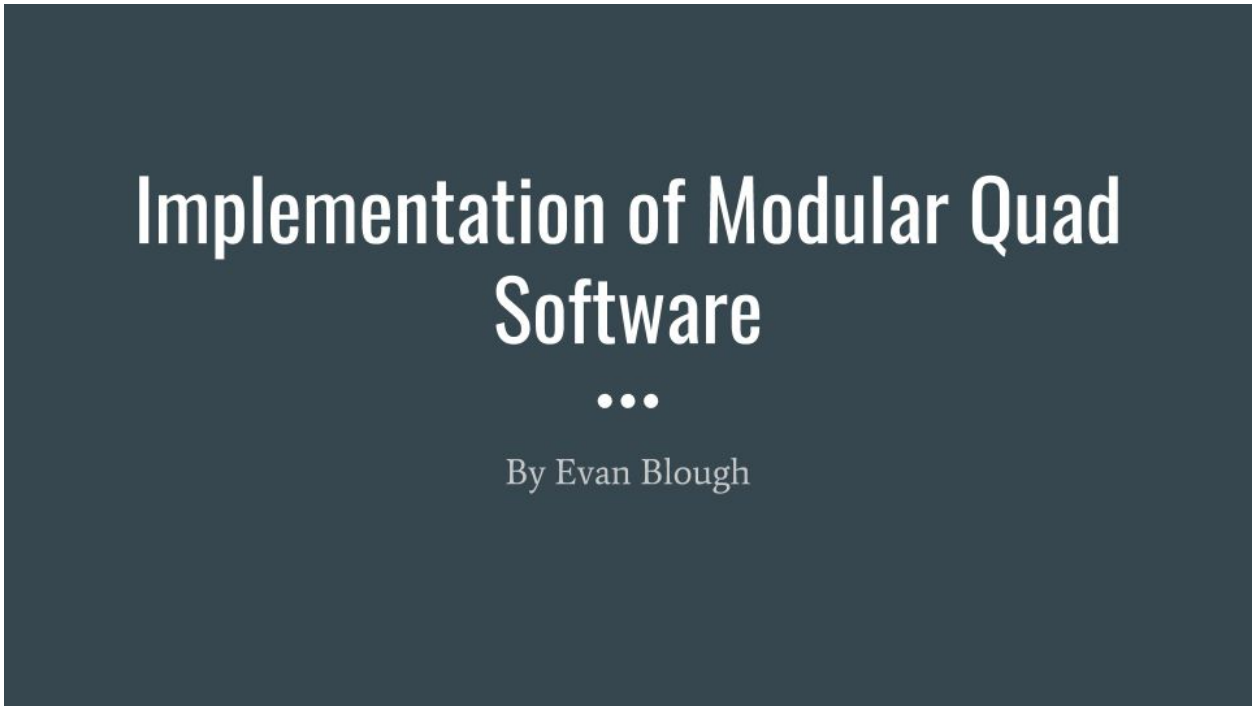
- Slides for modular software (I’m not going to paste the whole thing because it is several slides long, If you want to see it I can pull it up on my phone during the meeting)

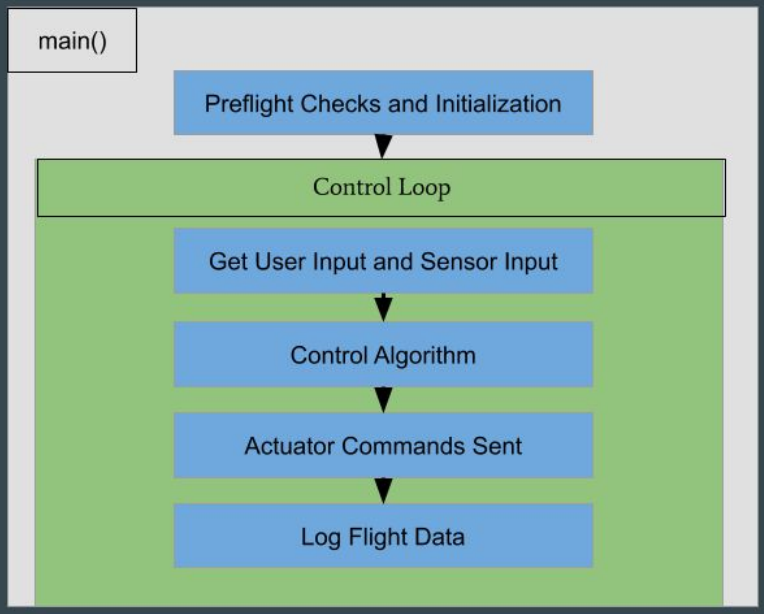


Quad Software Structure - Compilation

- Software Deployed on Zybo 7020 Board
- Software Compiled using XSDK
- Compiled into .bin image file
- File flashed onto 32GB SD
- Zybo reads .bin file and creates appropriate hardware and software
- Upon startup main() is ran

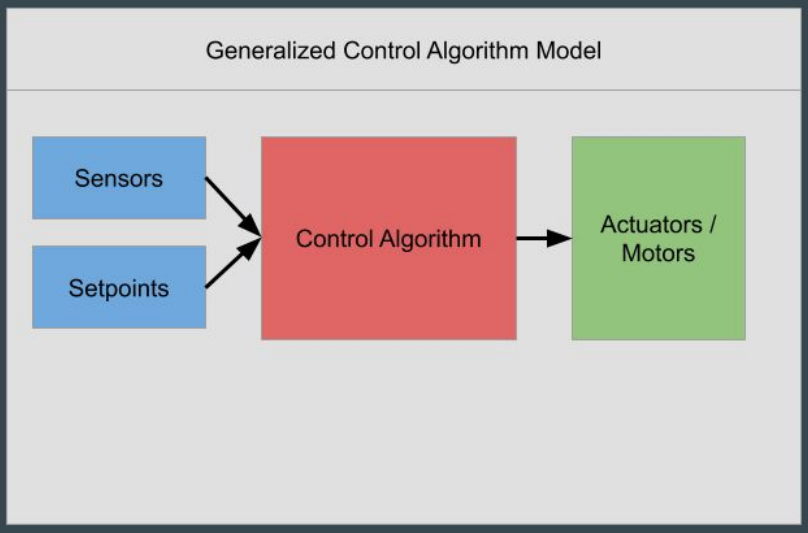
Quad Software Structure - High Level Flow Diagram

- Initializations and setup before operation to initialize all sensors, and variables
- After Initializations enters Control loop
  - Process input
  - Control algorithm calculates actuator output
  - Actuator commands sent
  - Logs flight data



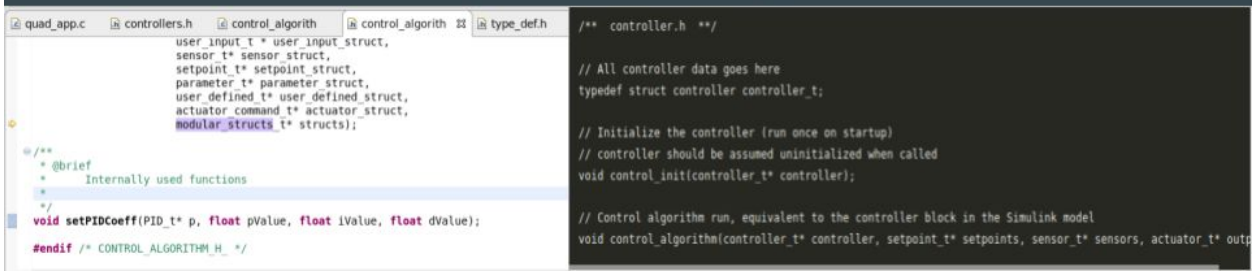
Swappable Control Algorithms

- Control Algorithms
  - Process Inputs
  - Generate Output to achieve ideal function
- Grad students and future developers want modular control
- Modular Control
  - Easily replace one control algorithm with another
  - Can achieve this functionality with a defined interface



Current Controller Model

- Master Branch:
- Current control algorithm implementation does not support swapping
- Ex: Lower Left
- setPIDCoefficents() is specific to PID control, but a new controller.c would have to implement it
- Get rid of this method and provide interface on right



Testing and Integration to be done

- Test manual and autonomous flight mode logic without updated ground station and debugger
- Add Setpoint commands to GUI
- Test actual flight performance with minimum of two people and locked in stand

- Current Draw Documentation

Testing the Current Draw from the Quad

1) Test the resistance of the motor. This can be done by Ohm testing between the leads of the motor. Test point should be on the wire between the power supply and the drone.

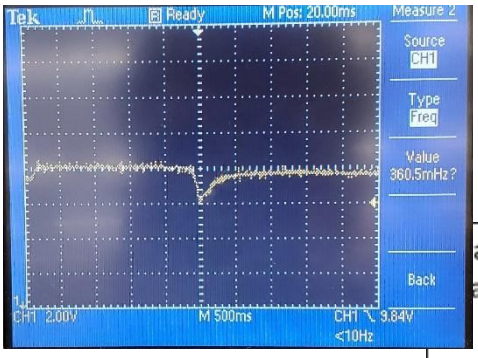
2) Disconnect all motors except for one, as it is only necessary to test current drawn by one motor and multiply by the number of motors being used. Similar motors draw similar current. Current draw by the FPGA is negligible

3) Connect drone to test point and turn on power supply.

4) Connect oscilloscope probe to the test point and grounding clamp to ground. Set oscilloscope to “trigger mode” and set the trigger point just below the ambient voltage level.

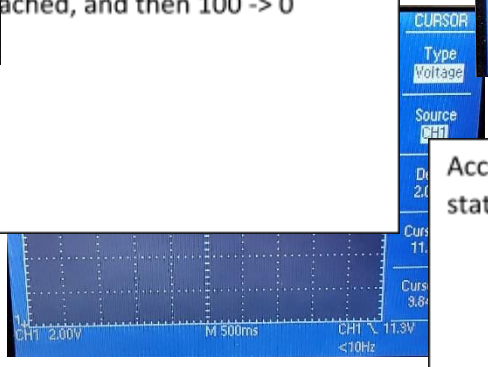
5) Use throttle on controller to set motor from no throttle to max throttle and then back down, depending on the test desired. Maximum current draw can be found when the motor is quickly changing from stopped to max throttle.

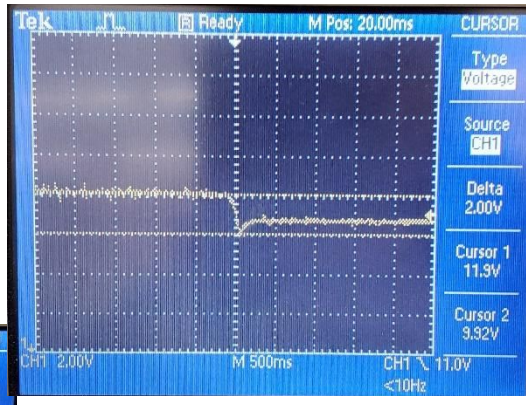
6) Calculations – the maximum change in voltage can be taken across the resistance of the motor to get the change in current flow. (I = V/R)
7)
8) My test yielded: V = 2.08V, R = 0.200 Ohms -> I = 10.4A maximum current draw. Which means all motors acting together would draw 41.6A



Quick acceleration from 0 -> 100 -> 0

aw from 0 -> 100, steady state
ached, and then 100 -> 0





Acceleration from 0 -> 100 and steady state condition observed