Software Pool Test Guide

NCSU Underwater Robotics

Rafael Esteller

11/2/201

Table of Contents

Table Of Figures

Executive Summary

Foreword

This guide provides an easy to follow list of steps for operating the robot, Seawolf, at a pool or tank test. By following the steps outlined in this guide Seawolf should function flawlessly at the test. Failure to follow steps in the order outlined can result in software malfunctions and for the process to be restarted, but it is unlikely that any irreversible damage will be made. In addition the appendix includes trouble shooting instructions for common errors.

Summary

Operating Seawolf's software at a pool test consists of seven simple steps. First, a computer with a Linux partition that contains the code for the robot must be running. Second, connect to Seawolf through ssh. Third, run the start-autonomous-seawolf.sh file that is located in the+ ~/seawolf directory. Fourth, calibrate the imu. Fifth, test the thrusters. Sixth, select the missions you want to run in the run.py file in the ~/seawolf/mission-control directory. Finally, run the run.py file to perform the mission(s).

Introduction

Members of the software team of NCSU's Underwater Robotics Club should be aware of how to operate the software of the robot, seawolf, for pool and tank test and ready to do so when necessary. Through reading this guide, you should gain an understanding of how to operate Seawolf at a pool test. The only talent needed to perform the tasks outlined are confidence in your ability to operate a computer, and the patience to dutifully follow the instructions. The guide consists of the essential steps needed to successfully run the robot in the order that they must be performed.

The guide only consist of only the software needed to operate Seawolf as the mechanical and electrical steps should be performed by the mechanical team and electrical team. You will have to coordinate with the other teams in order to successfully run the robot, but your task will just be to follow the steps outlined in this guide once the other teams finish their tasks.

The rest of the report consist of the steps required to run the robot in sequential order with extensive details on how to perform each step. By following the guide you will successfully operate the robot, if you do not follow the guide step by step you will likely run into issues that will set back the whole test. It is recommended that you look over the guide when performing a pool test to assure you do not miss a step and can easily refer back to forgotten information.

Safety/Cautions/Hazards

Before you get started, you must account for the following hazards and address them in the manner described:

- ***Assure the Mechanical Team has properly sealed the end caps before the robot is placed in the water.***
- ***If booting from a flash drive assure that your computer is in place where the flash drive will not be bumped into.***
- ***Assure there is a swimmer watching the robot at all times***

Materials and Equipment

To operate the robot you will need a laptop computer that runs on a Linux operating system, has all of the robots code installed on it, and an Ethernet port. If you do not have a Linux boot on your computer, you may boot your computer with the club flash drive. Instructions for doing so are included in this document. In addition to the computer you will also need the tether, a 100ft long Ethernet cable with a Fischer connector on the other end. The Logitech controller is also useful but it is not a necessity.

Material List

- Laptop computer with club software and Ethernet port
- Tether
- (Optional) Club flash drive
- (Optional) Logitech controller

Procedure

Booting Computer with Club Software (Follow if booting form club flash drive)

If you have a Linux machine, computer, with the necessary software skip this step.

To boot from the club flash drive first insert the flash drive into an USB port in your computer, preferably and USB3 port, then you must enter your computer's BIOS menu. Then, you must go to the BIOS menu which allows you to select which storage device the computer boots from, select the SanDisk option as this is the club flash drive. The procedure for entering and changing options on a computer's BIOS changes by manufacturer and model so google how to perform the tasks listed for your computer. The instructions below explain exactly how to boot from the flash drive when using a Lenovo T540P laptop computer.

When using a Lenovo T540P laptop you can enter BIOS by following these steps. These steps may or may not work for other computers. First, turn off your computer by pressing and holding the power button for ten seconds. Next, insert the flash drive into the USB port closest to you on the left side of the computer when you are facing the computer screen. Now, turn on the computer and hold the F12 when the Lenovo screen pops up. The boot menu in BIOS should open up, if the computer proceeds on a regular boot, reattempt the process above and be sure to press the F12 button when the computers prompts for input to interrupt the regular boot process. In the boot menu select the SanDisk flash drive.

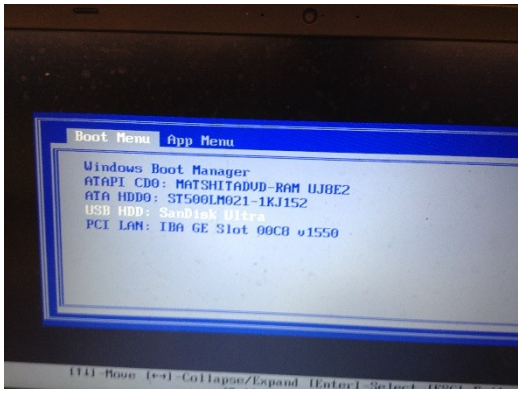

Figure 1: BIOS menu for LenovoT540P

After the computer boots, log in using the club password *******.

Editing Ethernet Connection

Click on the Wi-Fi icon on the top right of the screen then scroll down to the edit connection option at the button of the menu and click on it. A new window should pop in the center of the screen which lists the connections.

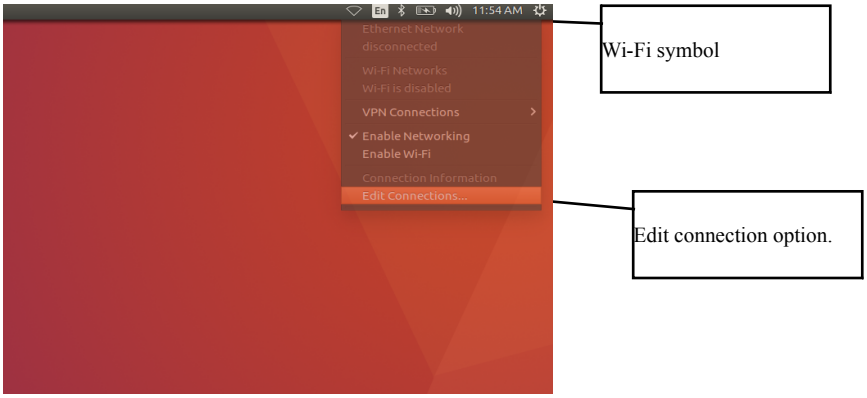

Figure 2: Wi-Fi menu. Select edit connection.

If only wired connection one ("Wired connection 1") shows up skip the rest of this section. There is no need to edit the connection as you were probably the last person/computer to use the club flash drive. If two wired connections show up. Delete wired connection two ("Wired connection 2") by clicking on the line which reads "Wired connection 2" then clicking the delete button on the right side of the window. The "Wired connection 2" option should go away now.

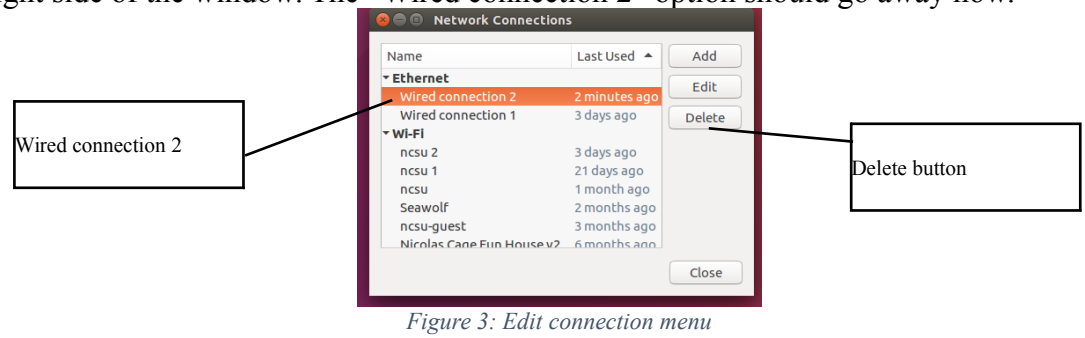

Figure 3: Edit connection menu

Now, select “Wired connection 1” then press the edit button. The window should change to an editing wired connection one window. Click on the down arrow on the text box to the right of the Device: text. Select the bottom option on this menu then press save and close the edit connections window. The connection is now set up.

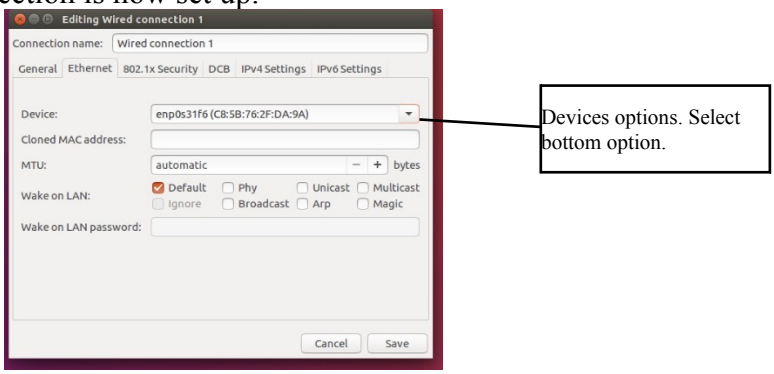

Figure 4: Edit wired connection 1 window. Change Device.

Connecting to Seawolf

Connect the Ethernet side of the tether to your computer. If your computer has lights on the Ethernet port, check that the light is on. If the light is not on the Ethernet cable is malfunctioning. Wiggle your end of the wire, and wiggle the Fischer end as well. If this does not fix the issue ask the electrical team for help.

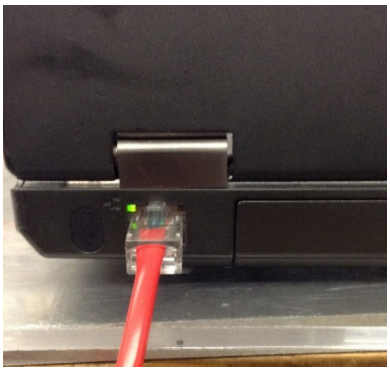

Figure 5: Ethernet Connection Light

Next check the connection type icon on the top right of the screen. It should have the symbol for a wired connection.

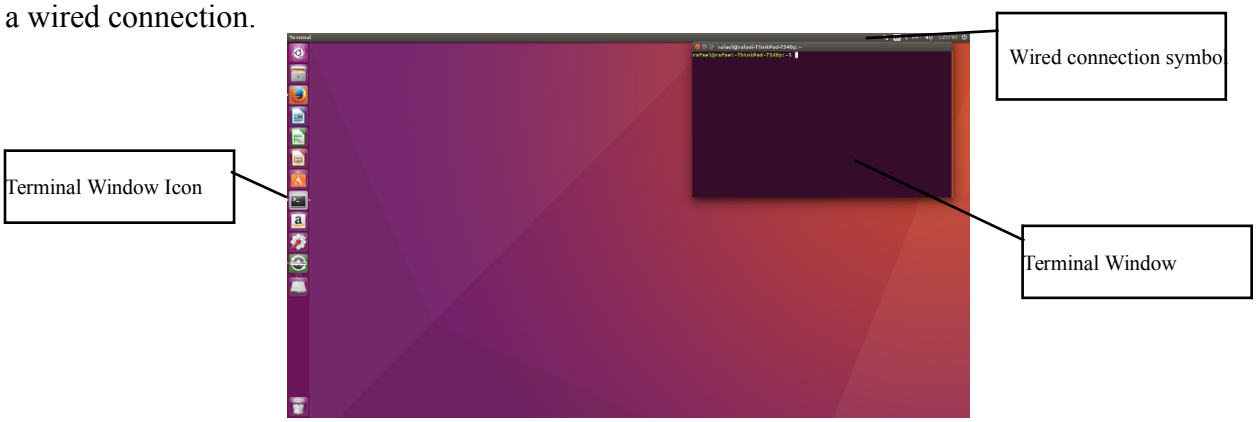

Figure 5: Wired Connection Symbol and Terminal Window

Now open a terminal window by clicking on the terminal window icon and type the following in it. "ssh –Y seawolf@192.168.1.2". It will take around 30 seconds (a worryingly long amount of time) for the password prompt to come up, be patient. Type the password for Seawolf, ******. Note that the screen will not change as you type in the password.

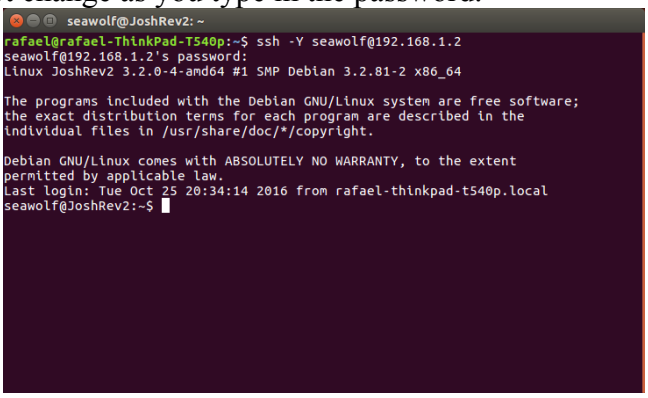

Figure 6: Connecting to Seawolf

Start Autonomous Seawolf

Type "cd seawolf" into the terminal window, press enter. Now type "sh start-autonomous-seawolf" into the terminal window, press enter.

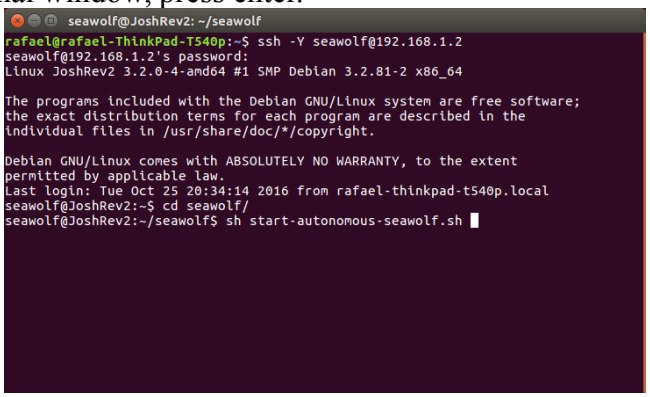

Figure 7: start-autonomous-seawolf.sh

To check that this operation worked, press and hold the following key in the order written "ctrl a Shift " ". This extremely finicky. Try pressing "ctrl a" first then quickly pressing "Shift " ". Your terminal window should look like this. This is the screen option menu. Another option is just press "ctrl a" then typing the name of the windows listed below then enter.

Figure 8: ctrl a Menu

Scroll using the up and down arrows, until the marker is over the line which reads “0 hub” press enter. Your window should resemble the screen below.

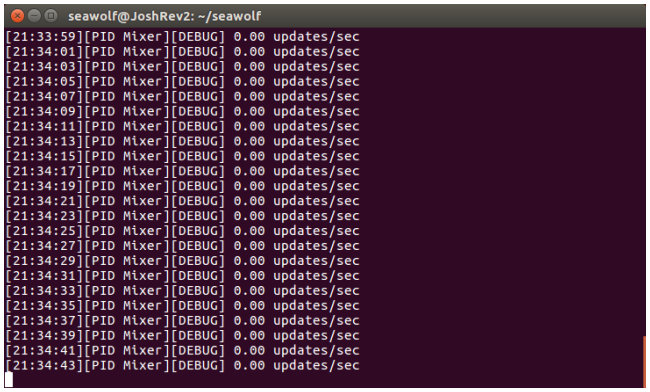

Figure 9: Screen 0 hub

Repeat the process above for each of the options in the screen option menu. Each individual option should resemble the example image for the screen below.

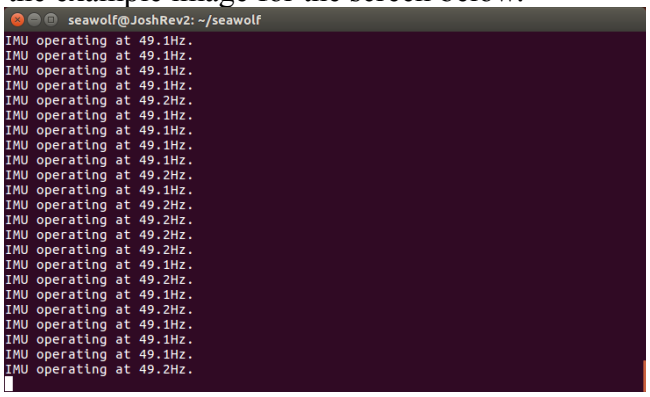

Figure 10: Screen 1 serialapp

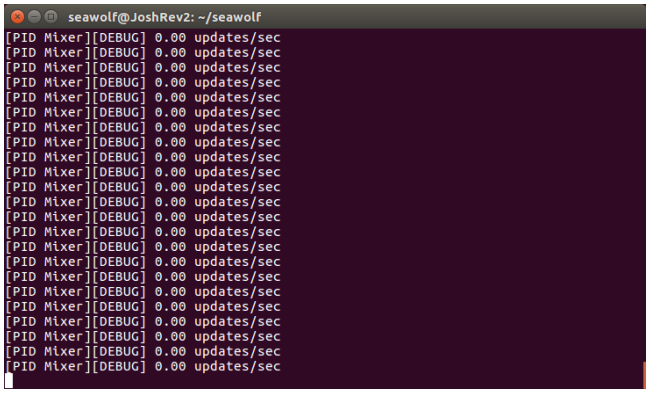

Figure 11: Screen 2 suite

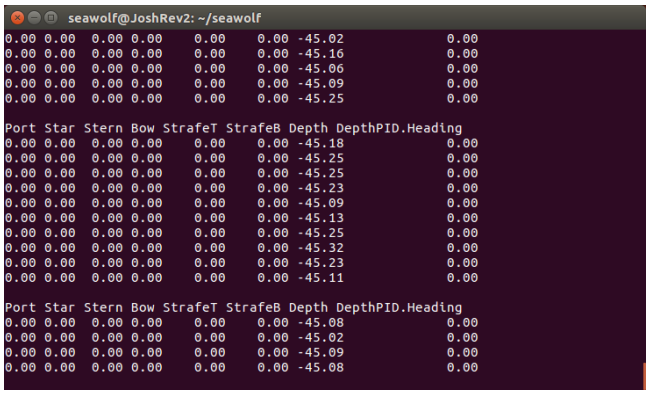

Figure 12: Screen 3 watchvars

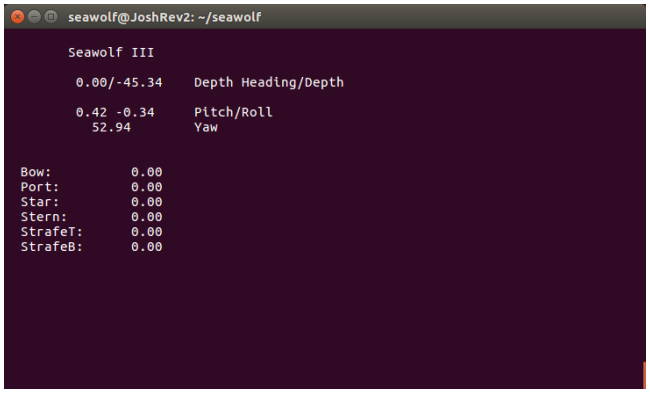

Figure 13: Screen 4 HUD

Calibrating the IMU

The IMU needs to be calibrated before the robot goes in the water. To calibrate the IMU go to the serial screen in through the screen option menu. Press “ctrl c” twice in this window. The serial code should no longer be running. Press the up arrow on your key board, the line on the terminal window should read “./bin/serialapp” press enter to rerun serial code. Look at the screen and make a note of which USB port corresponds to the IMU. Now kill the serialapp code again through the method described above. Type “arduino” into the command window and press enter. An Arduino GUI should now appear on your computer screen. Click on the tool tab located at the

top of the Arduino GUI, select the serialPort option, then select the USB port which the IMU is plugged in.

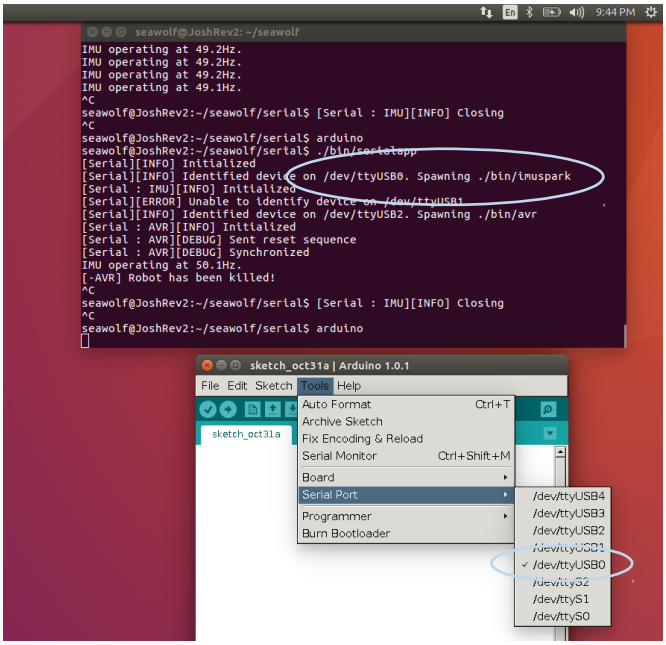

Figure 14: Identifying IMU USB

Now select the Serial Monitor option in the Tools tab. Another window should appear. In the top bar in the new window, type "#oc", then click on send. Next type "#on" into the same bar and hit enter until the window looks like the one below. This is the Gyro calibration mode on the IMU. Note that the average values will more than likely be different every time.

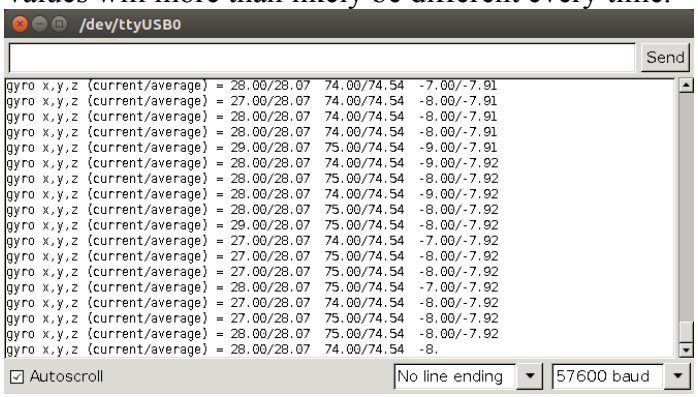

Figure 15: IMU Gyro Calibration Window

Go back to the original Arduino GUI. In the File tab, select the open file option. Go to and select the "seawolf/../razor-9dof-ahrs/Arduino/Razor_AHRS.ino" file. Go to the 247 line in the file and update the values to the ones you see in the searial communication file under the avg column.

Now go to the tools tab again. Select the board type option and make sure it is set to Arduino Pro or ProMini(3.3V.8Mhz) w/ ATmega328. Now go to the serial port option in the tools tab, make sure it is set to the IMU's USB port.

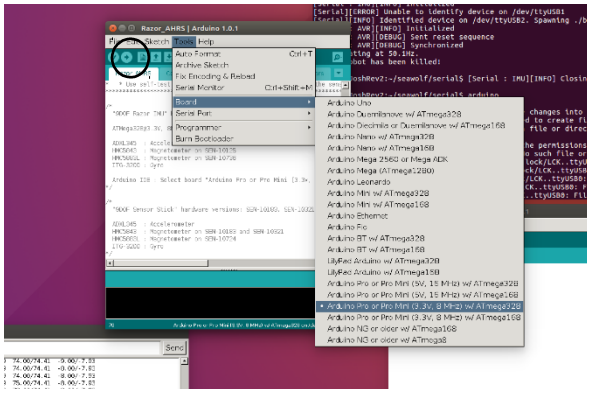

Figure 16: Setting IMU Board Type

Hit the export button, the arrow next to the check mark, make sure the code does not throw an error.

Now go to the original terminal window. Press ctrl and “c”. All of the Arduino windows should now be closed. Press the up arrow twice the line in the terminal window should read “./bin/serialapp” hit enter. Serial code is operational again. Make sure the IMU frequency value close to 50Hz. If it is close to 100Hz serial code needs to be killed and restarted.

Go to the screen menu again and select the HUD screen and check the value for the yaw heading to confirm a successful calibration. The value should not be exactly zero (if it is have someone rotate the robot) and it should be somewhat stable. Then tenth place might be moving but the ones place is constant.

Testing the Thrusters

Before Seawolf is lowered into the water the thrusters must be tested. To the test the thrusters go to one of the bash screens in the screen option menu. In this window type “cd ~/seawolf/test” press enter. Now type “python test_thrusters.py” in the terminal window and hit enter. The terminal window should resemble the one below.

Figure 17: Testing Thrusters

The thruster called out by the code should be the one getting power, if a different thruster receives power ask the electrical and mechanical team to assure each thruster is connected to the correct port.

In addition to the test file the thruster should also be tested through the Logitech joystick. First connect the joystick to an open USB port on your computer, preferably opposite the side of the club flash drive if it is in use. Next open a new terminal window by right clicking on the terminal icon. In this window type “cd ~/Robotics/seawolf/applictions” if you are using the club flash drive. If you are using your own computer go to the “seawolf/applications” folder. Now type “./bin/joystic_controller_acrobatic --depthHold” press enter. Your terminal window should resemble the one below.

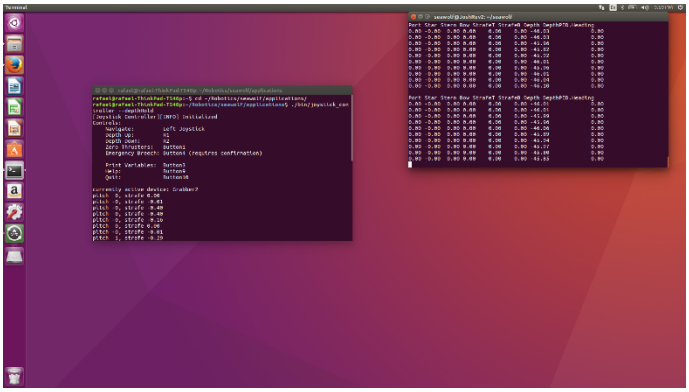

Figure 18: Joystick

By moving the left stick around you operate the starboard and port thruster. L1 and L2 set the depth and operate the bow and stern thrusters. The rick stick operates the strafeT and strafeB thrusters as wells as bow and stern. The joy stick can be used to manually direct the robot in the pool. Button1 on the joystick zeros the thrusters, check that this works. In addition the kill switch should be tested playing with the joystick while the kill switch is turned on and off. When the kill switch is flipped the thrusters should stop moving.

In addition the pneumatics system can be checked through the joystick by following the instructions in the terminal window for the joystick.

Running the Cameras

To start the cameras first go to cams screen through the screen menu. In this screen type “svrd” press enter.

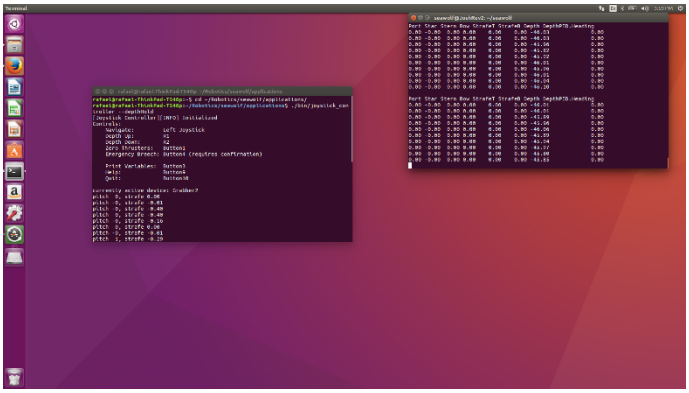

Figure 19: svrd screen

Now go back to the screen menu and select one of the bash screens. In this screen type “cd ~/seawolf/camscripts” press enter. Then type “sh start-cams.sh” press enter. After you perform

the steps above, open a new terminal window on your computer by left clicking on the terminal icon. In the new terminal window type “svrwatch -as 192.168.1.2” press enter. Two windows which show what the camera sees should now be on your screen.

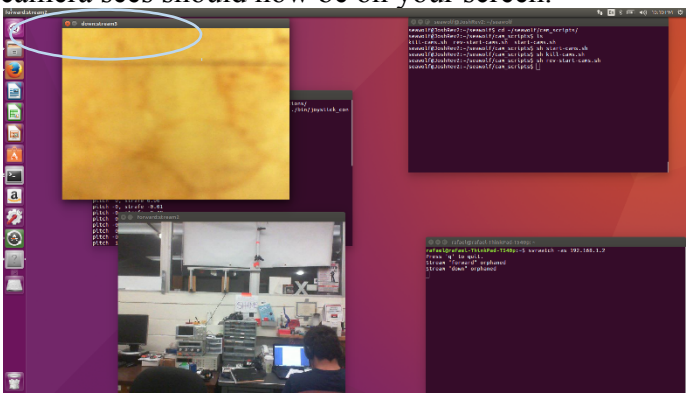

Figure 20: Running Cameras

Assure that the camera window labeled down matches the view of the down camera. If it does not go back to the terminal window that is connected to the robot and type “sh kill-cams.sh” press enter. The two camera windows on your screen will freeze, close them. Now in the same window type “sh rev-start-cams.sh” press enter. New camera view windows should open on your computer screen with accurate tittles.

Running mission code

Through the use of the screen menu go to one of the bash screen on the terminal window connected to the robot. In this screen type “cd ~/seawolf/mission_control” press enter. Now type “vim run.py” into the same window and press enter. Use the up and down arrow keys to move the pointer to line 88. Now press the “i” key and edit the line to include the missions you want to run. After the desired missions have been selected, press the esc button. Now hold the shift key and press the “;” key, then type “wq” press enter.

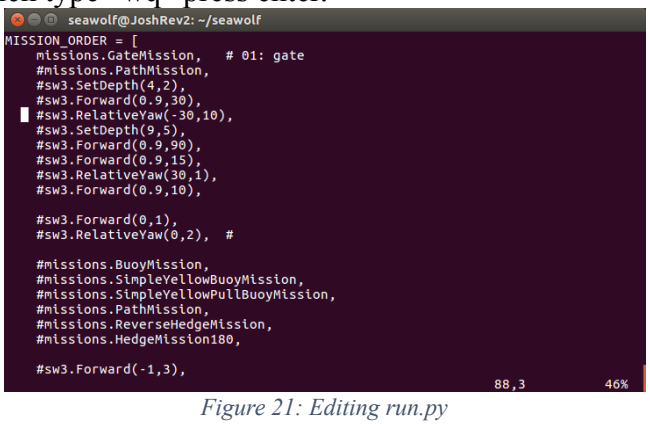

Figure 21: Editing run.py

Conclusion

As far as software is concerned Seawolf is ready to go in the water. Remember when Seawolf is in the water you can direct it through the use of the joystick if the joystick code is running. For Seawolf to operate autonomously, mission code must be ran. To do this, go to one of the bash screens through the screen menu in the terminal window connected to the robot. In the window type “cd ~/seawolf/mission_control” press enter. Now type “python run.py” in the same window. New camera streams that are edited should open up and Seawolf should perform the mission.

To change the mission(s) being run, revert back to the running mission code section of the guide.