Drone Simulation for Bistable Gripper

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Introduction

Flying drones only have a certain fly time due to their limited battery capabilities. To help the drones finish their job, they can maintain the same height using a perching technique. This can help the drone conserve it's energy and allow it to stay on the field longer. The purpose of this research is to create a simulation to test a perching of the drone.

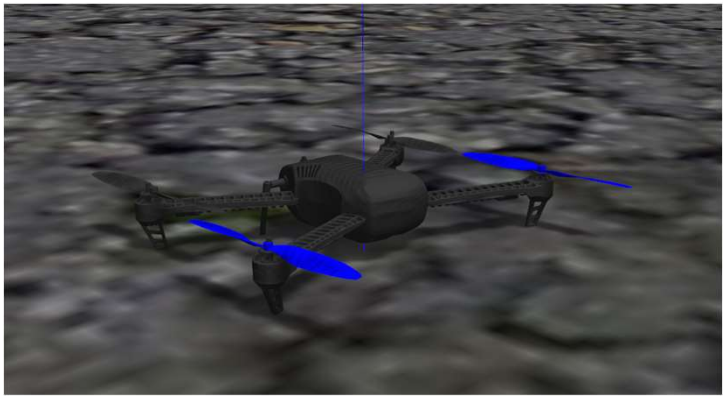


Figure 1: Iris Quadcopter used during simulations

ARDUINO

PX4 autopilot

ROS

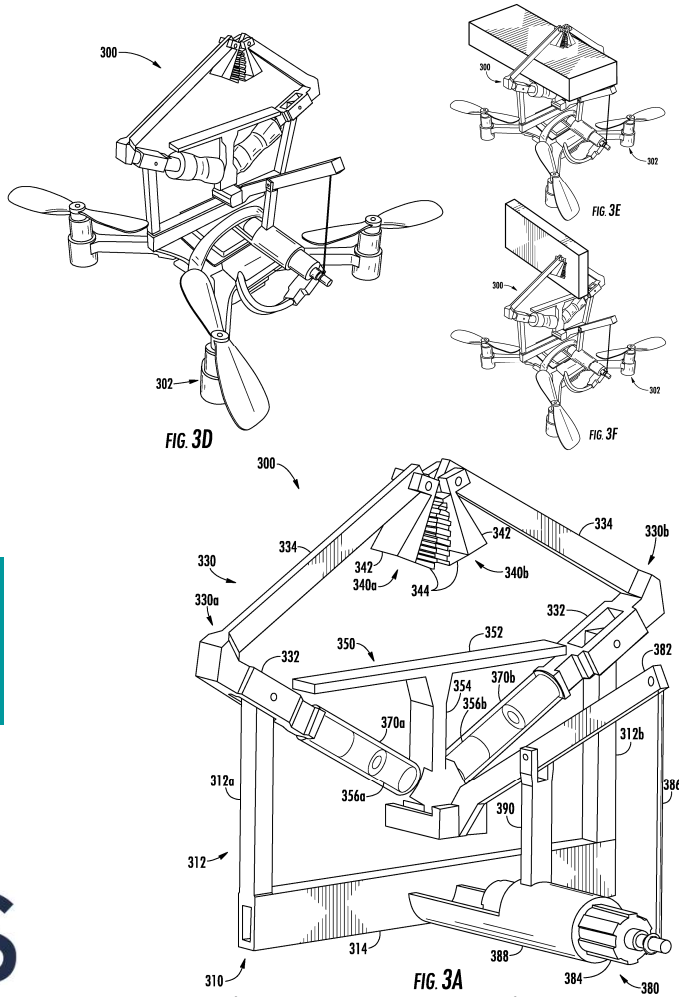


Figure 2-4: Dr. Zhang's Bistable Gripper Patent

Experimental Setup

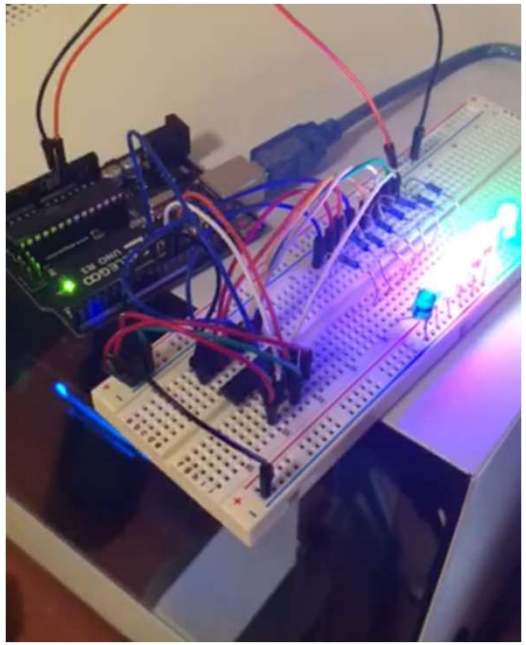


Figure 5: Arduino using script and hardware to control 8 LEDs with 3 connectors

I was first assigned to go through some Arduino tutorials to create scripts and use the hardware to understand the code that it. These scripts were simple to make and run as well as the hardware side

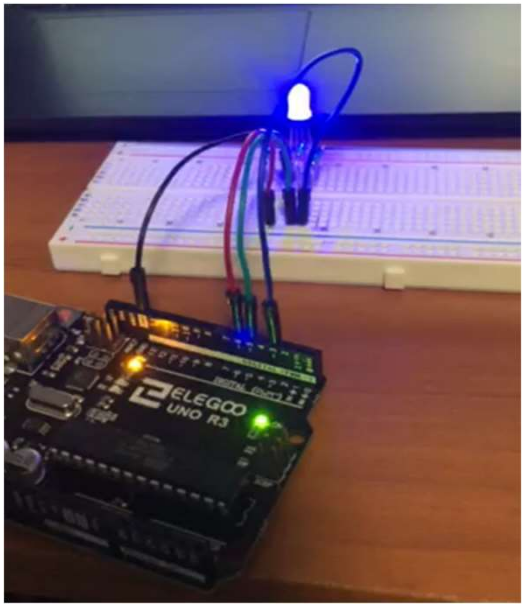


Figure 6: Arduino controlling rbg LED

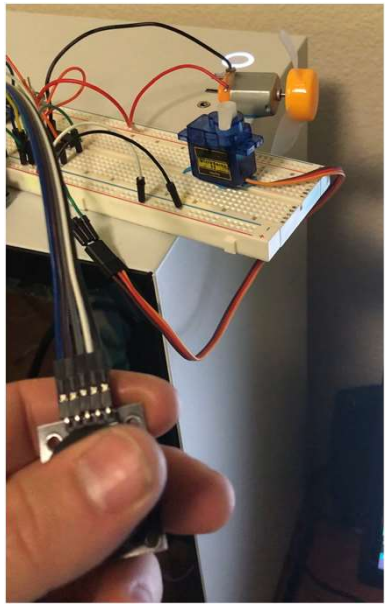
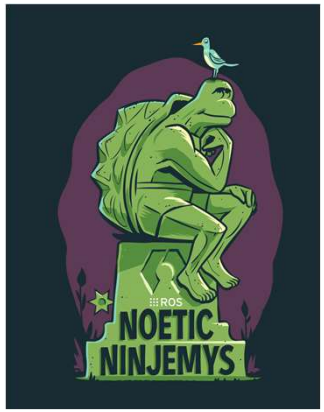


Figure 7: Arduino mini-project

After this I installed Ubuntu and ROS want was tasked to get familiar with them. I did this on ROS Noetic Ninjemys and this would be an issue later.



Experimental Setup

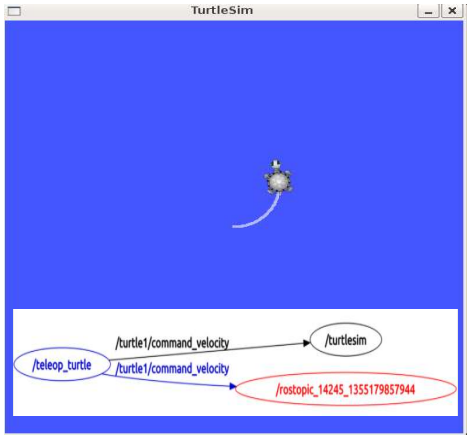


Figure 8: Turtle Sim with rqt graph

ROS tutorials were done so I could get familiar with the system as making cute turtles as well as monitor them

Later I had to switch to Ubuntu Bionic Beaver, and ROS Melodic. This is because MAVROS was not compatible in the Noetic version. I was then able to load the iris quad and simulation environment and connect it to ROS.

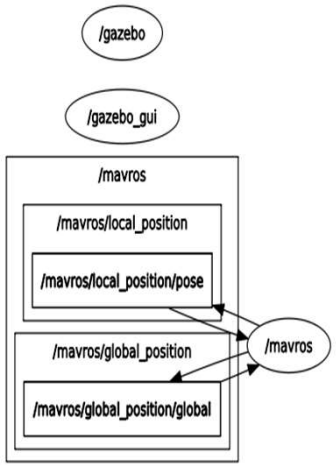


Figure 10: Gazebo simulator rqt graph

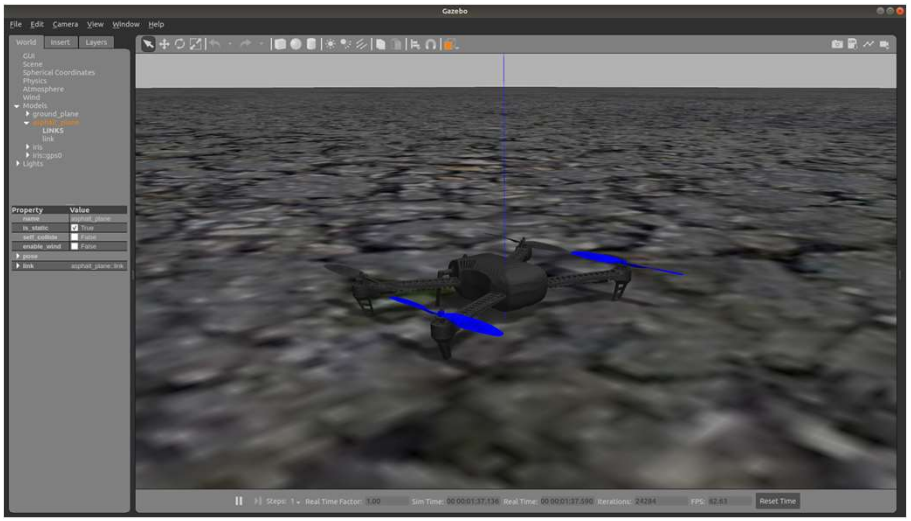


Figure 9: Gazebo simulator GUI with quadcopter

Results

I was not able to integrate everything I wanted to into the program but here is a short demonstration of where I am now

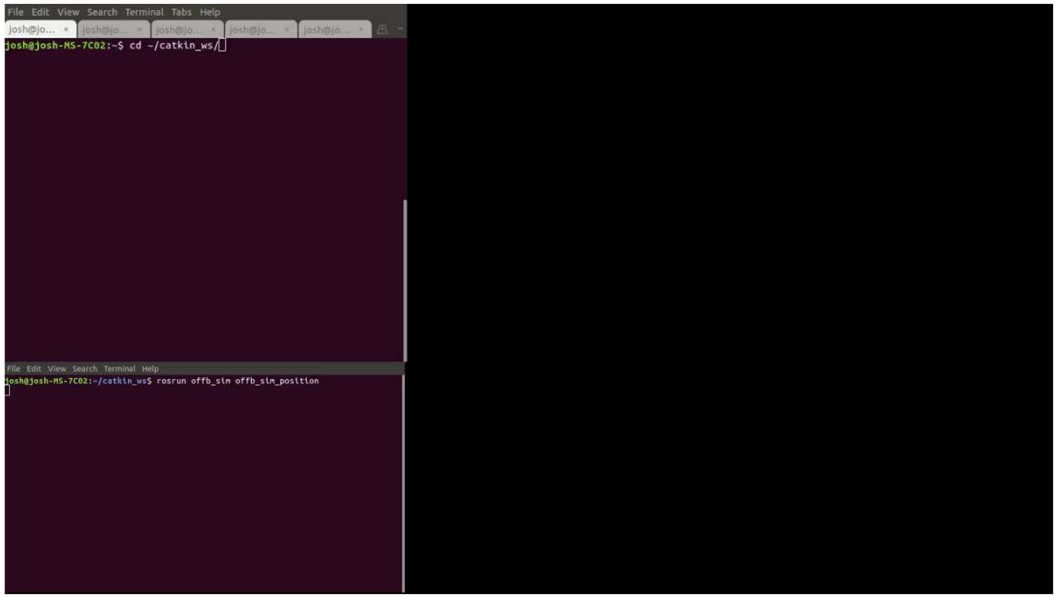
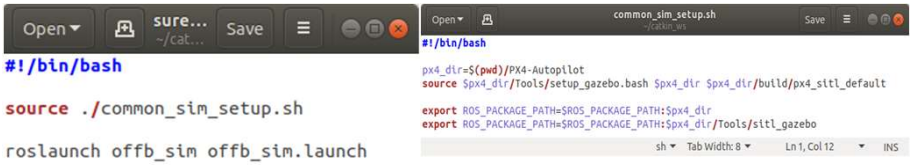


Figure 11: Demonstration of Sure_sim.sh

Everything is launched from a single Linux shell file shown below



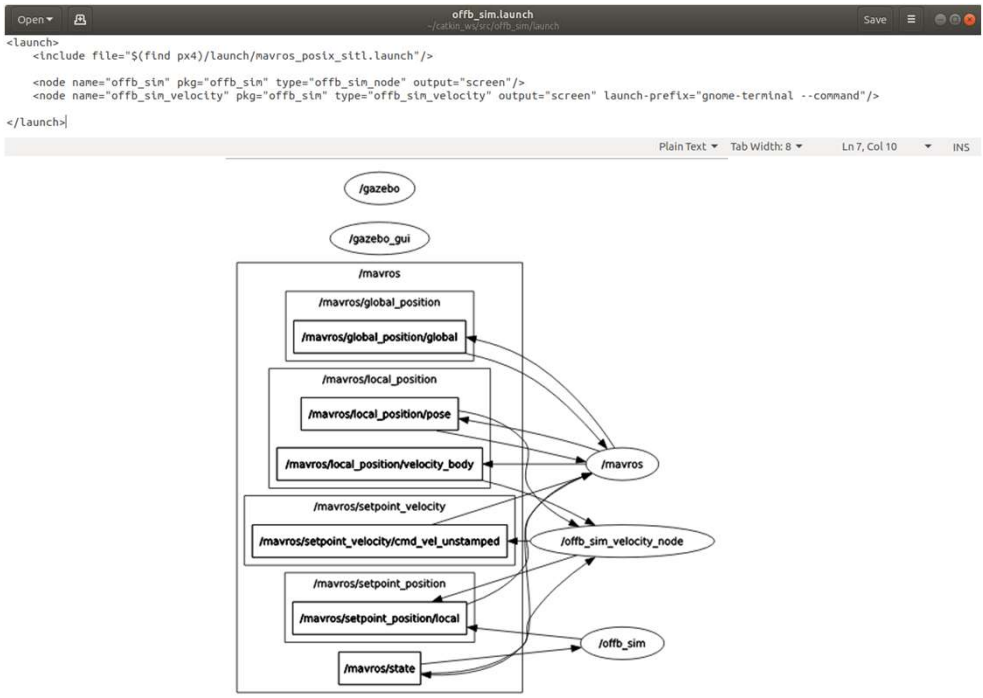


Figure 13: simulation rtq graph

Next Steps

- Use MAVROS to create flight plans for done
- Use Gazebo to model the Bistable Gripper
- Use MAVROS to create custom perch and release topics/nodes
- Model a Powerline for the quad to in the gazebo simulation
- Determine a baseline for energy draw when hovering at a constant altitude
- Compare that to gripping time at same altitude

Conclusions

- Lots of time and work is put into these kind of projects
- I have learned a lot about C++ program language through nodes in ROS
- The PX4 and Gazebo integrations for newer releases of Ubuntu don't mesh with MAVROS for ROS Noetic Ninjemys
- Create a simulation environment is very difficult in a one-man team even with Dr. Zhang guiding me, this is most likely why these type of things are left for teams of developer

What benefits did you get from you SURE experience?

- I got to learn a lot from Dr.Zhang about programming and the importance of tutorials
- I experienced different programming languages and methods using the opensource OS Ubuntu as well as in ROS
- This has given me insight that things happen, and projects get delayed
- I got to spend hours checking error logs and trying to trouble shoot programs

References & Acknowledgements

[1] Zhang, H. Zhao, J. SUN, J. (2019). Compliant bistable gripper for aerial perching and grasping (US10787259B2). Colorado State University. https://patentimages.storage.googleapis.com/53/a6/5b/d42189aa3649b0/US10787259.pdf

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Thank you

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