

Week VII Report

Advisor(s): Gary Tuttle

Client: NASA Marshall Space Flight Center

Members (Roles): **Isaac Johns**-Team Communicator, **Ryan Bissett**-Team Communicator, **Tom Henry**-Webmaster, **Luke Dahlman**-Team Leader, **Anh Ho**-Key Concept Holder, **Dustin Pierce**-Key Concept Holder, **Antjuan Buffett**

Project Title: Remote Deployment Circuit and Mechanism for Lightweight CubeSat Solar Panels

Weekly Summary

In the last week we acted upon the design of our “scissor jack”. We decided to go ahead and make a prototype of the scissor jack boom design we came up with that deploys and retracts through the use of our “screw drive”. Though the scissor jack system works one of the welds in the test structure broke and now becomes something more we need to consider in the design. This is only a small hurdle we need to overcome with stronger welds being the possible solution. Having built the structure we can now analyze the torque of the system which is necessary for determining what type of motor we would like to use. Interfacing the motor to our scissor jack has started to be discussed. Right now it seems that the group would like to interface using gears versus directly driving the bolt as to not put continued stress on the motor holding the scissor jack in place due to spring tension that would retract the solar panels in that version of our design. We are also beginning to consider sensors and how to implement them. We began looking at controllers for interpreting sensors using these interpretations to run the motor. The digital logic truth table has been constructed and input/output equations have been setup and simplified into Some of Products (SOP) form. We were able to program our logic into a PLC in the Digital Logic lab (CprE 281) and receive different values for varied inputs. It was found that a fourth feedback is needed to consider varying inputs that are not currently considered. In the coming week we plan to continue working and refining on our respective areas which can be found at the end of this report.

Meeting Notes

From our weekly meetings:

- John Carr got back to us on some of our pending questions. A big question we had was where exactly we’re mounting this system. From John’s email it seems that they would like us to mount the motors and circuitry on the inside of the spacecraft, so we can now adjust to that.
- John also mentions that “the boom, supporting structure and solar cells will then be external to the spacecraft”, so we may also take this into consideration for our design.
- Now that that the scissor jack had been made and proven to work we can move forward into driving the system with a motor. To drive the system we need to determine how to

interface the system with the motor. Currently a gear interface seems to cause less stress on the motor.

- We are planning to construct a 1 x 1 x 1 ft. wooden box for our mock design as a stand-in for the satellite's hull.
- In the meeting we talked about what type of motor we would like to use. Currently we are unsure of whether we would like to use a stepper motor due to its lower torque capabilities as compared to regular motors.
- The size of the motor is of high importance due to the space constraints. Because we need to consider the size of the motor we need to choose one that we give us acceptable torque output to size ratio.
- Before we can make any final decisions on motors we need to determine the amount of torque in our system. It was mentioned that SolidWorks has a feature that may allow for torque analysis, and/or we can simply use a torque wrench.
- We discussed controllers for interpreting sensor information and acting upon it interfacing with the motor. Arduino to driver to motor options have been found in both low voltage and high voltage variations.
- The material VESPEL has been mentioned for use as washers due to its extreme durability and low coefficient of friction.
- We have also began coming up with ideas of how to interface the PLC to the motor.

10/20/2014 Group Meeting to Decide Course of Action

Duration: 1hr **Members Present:** Isaac Johns, Ryan Bissett, Tom Henry, Luke Dahlman, Anh Ho, Dustin Pierce

The group meeting on Monday (10/20) was to get the team as a whole on the same page as well as get our advisor Gary Tuttle up to speed. Everyone in the group briefly talked about where they were at in respect to their weekly tasks and we discussed what direction we're going to take in the coming week. From John Carr's email it seems that we are ahead of where he expected us to be, so continuing at this pace we may create a better system than originally thought.

10/20/2014 Group Meeting to Discuss Ideas

Duration: 1hr **Members Present:** Ryan Bissett, Tom Henry, Luke Dahlman, Anh Ho, Dustin Pierce

Purpose and Goals

- Get the group as well as our advisor Gary Tuttle on the same page.
- Discuss our individual weekly progress and progress as a group.
- Discuss motors for driving the boom system and how to interface the motor to the scissor jack.

- We also needed to discuss a controller for the system that will interpret sensors and interface with the motor.

Achievements

In this last week the group took a big step forward. We first created a truth table for a PLC and created our Boolean logic for the system. After creating our equations we simplified them into Sum of Products (SOP) form. With our equations we went into the Digital Logic lab (CprE 281) and programmed them into the PLCs in the lab. We find that we get different values for nearly every input/output relationship with some issues that need refining. The scissor jack was made with one fixed end and the other end floating for the opening and closing with the bolt. With the scissor jack made we can start analyzing torque on the system and from there figure out what type of motor is required to drive our system.

Pending Issues

- A weld broke on the scissor jack system needing a re-weld.
- Torque on the system must be figured out so that the motor type and model can be determined.

Plans for Next Week

- Luke: Contact Professor Tuttle and John Carr as well as work on 4th feedback, circuit interface to motor, wooden cube
- Isaac: Weekly Group Report, help with digital logic, and continue looking into sensors or switches and how to implement them
- Ryan: Weekly Group Report edits, research on regular motors versus stepper motors considering torque, and materials (VESPEL)
- Anh: Keep group on task, SolidWorks design for simulation
- Dustin: Keep group on task, research on regular motors versus stepper motors considering torque
- Tom: Manage Google Docs and Weebly site, help with digital logic, scissor jack, wooden cube
- Antjuan: Controllers for the motor, how to interface controllers with the motor

Individual Contributions This Week

- Luke: Organized meeting, attending meeting, SolidWorks prototype, logic planning and programming

- Isaac: Wrote weekly report, attended meeting, logic planning and programming, research with group and individually on Saturday 10/18, researched IR sensors, bump sensors, and roll lever switches
- Ryan: Edited weekly report, attended meeting, research with group and individually on Saturday 10/18/14
2hrs - Individual Research into Materials
- Tom: Updated online media, dimensional drawings for construction, looking through materials and components, logic planning, Monday meeting
- Dustin: Attended meeting, motor research, torque sensors, weight of the two, finding out what all is needed if we use a stepper motor (still working on this one).
- Anh: Attended meeting, kept group on task, and currently working on SolidWorks design for simulation
- Antjuan: Attended meeting, pitched ideas, researching implementation of different drivers for stepper motors and how they interface between motor and PLC

Total Contributions for this Project

1 – 1 hour meetings

- Luke: 11 hrs
- Isaac: 10 hrs
- Ryan: 6 hrs
- Tom: 15.33 hrs
- Dustin: 6.5 hrs
- Anh: 4 hrs
- Antjuan: 2.33 hrs