NASA Student Launch 2017

Preliminary Design Review Presentation

USF UNIVERSITY OF SOUTH FLORIDA.

SOCIETY OF AERONAUTICS AND ROCKETRY

November 10th, 2016

Vehicle Dimensions

Property	Quantity
Diameter (in)	6
Length (in)	133
Projected unloaded weight (lb)	39.38
Projected loaded weight (lb)	51.44

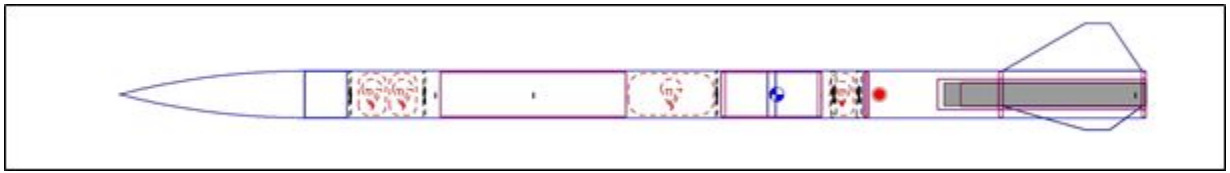


Figure 1: Overview drawing of launch vehicle assembly

Vehicle Materials. Part I

Part of Rocket	Brand	Model	Material
Nose Cone	Public Missiles	FNC-6.00	Fiberglass
Eye Bolt	Public Missiles	HDWE-EYE-1/8	Steel
Shock Cord	Public Missiles	--	3/8” Tubular Nylon (SkyAngle)
Main Section	Custom	--	G10 Fiberglass
Nose Cone Parachute	b2 Rocketry	CERT-3 Drogue	1.9 oz Ripstop Nylon (SkyAngle)
Main Section Parachute	Public Missiles	PAR-60R	Ripstop Nylon
Lander	Custom	--	Kraft Phenolic

Vehicle Materials. Part II

Part of Rocket	Brand	Model	Material
Lander Parachute	b2 Rocketry	CERT-3 Drogue - SkyAngle	1.9 oz Ripstop Nylon
Altimeter Bay	Custom	--	Fiberglass
Inner Bay	Custom	--	G10 Fiberglass
Altimeter Caps	Public Missiles	--	Carbon Fiber
Altimeter, Sled, and Batteries	Public Missiles	--	3/8” Tubular Nylon (SkyAngle)
Booster Section	Custom	--	G10 Fiberglass

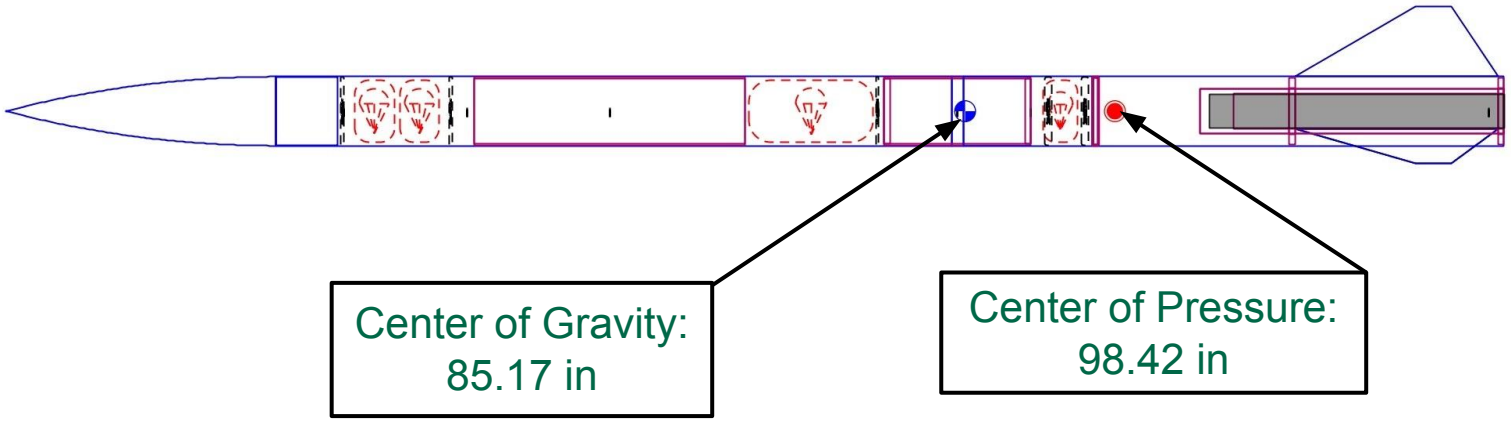
Vehicle Materials. Part III

Part of Rocket	Brand	Model	Material
Fin Set	Custom	--	Carbon Fiber
Outer Motor Mount	Custom	--	Kraft Phenolic
Centering Ring	Public Missiles	CCR-6.0-3.9 (was PML CCR-18)	Aircraft Plywood (Birch)
Main Parachute	b2 Rocketry	CERT-3 XLarge - SkyAngle	1.9 oz Ripstop Nylon
Large Shock Cord	Public Missiles	--	3/8” Tubular Nylon (SkyAngle)
Bulkhead	Public Missiles	CBP-6.0 (was CBP-15)	Birch
Motor Adapter	Giant Leap	SLIM98-76 SlimLine 98-76mm Adapter	6061-T6 Aluminum
Motor Mount	Custom	--	Kraft Phenolic

Vehicle Justifications

- Launch vehicle designed with 6 inch diameter tubing for optimal spacing.
- The booster is separated at apogee with drogue.
- At 1000 ft, the altimeter will deploy the main parachute.
- The SOAR Lander will follow after the main parachute deployment.

CP/CG Locations



Static Stability:
2.18

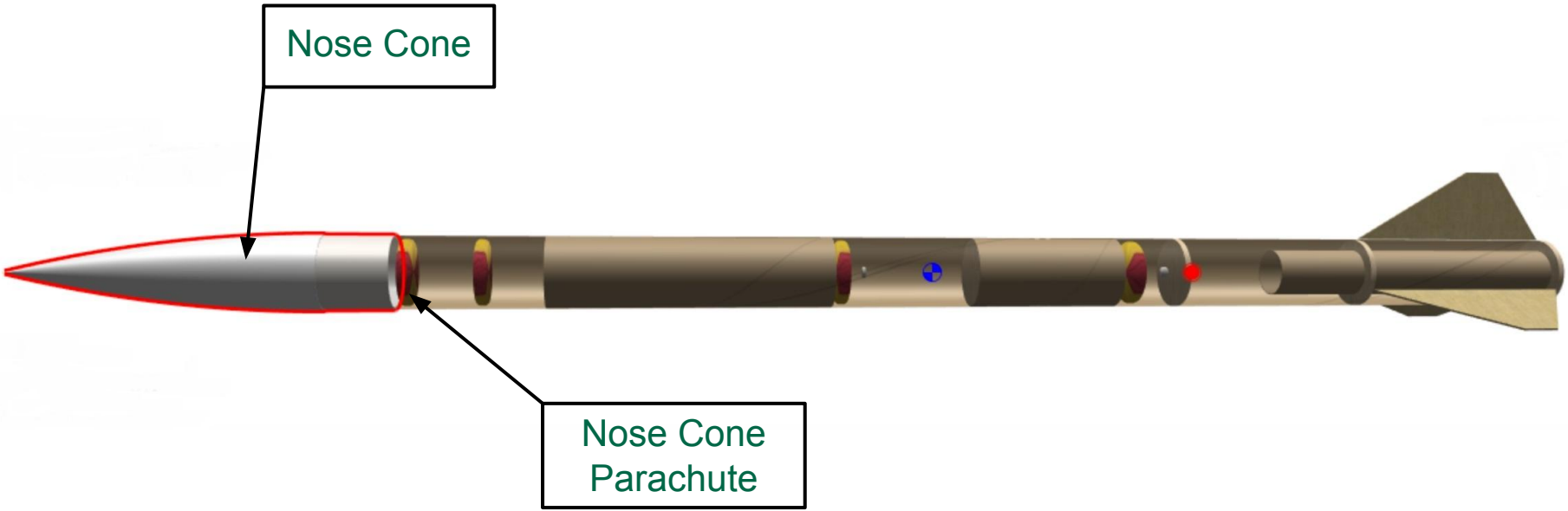
Preliminary Motor Selection & Justification

- The motor we have selected at this time is the L1090 from Cesaroni.
- This motor was selected for reaching the altitude closest to the 5,280 feet goal.

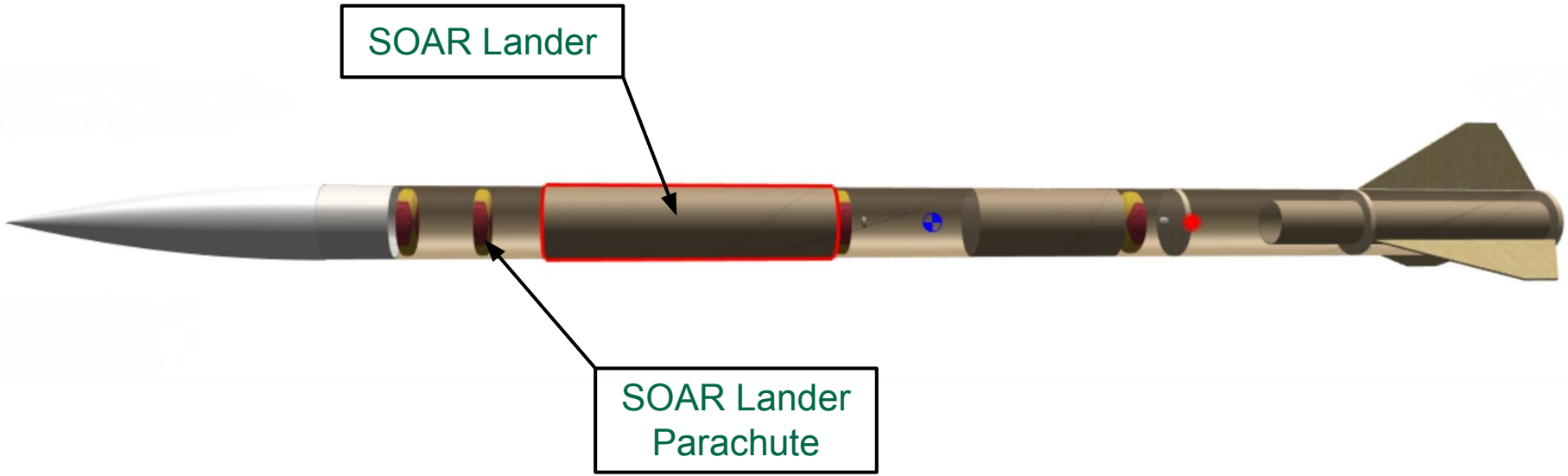
Characteristic	Value
Total Impulse (Ns)	4815
Burn Time (s)	4.4
Diameter (mm)	75
Length (cm)	66.5
Propellant Weight (g)	3440

Characteristic	Value
Thrust-to-Weight Ratio	4.78
Exit Velocity (ft/s)	35.4

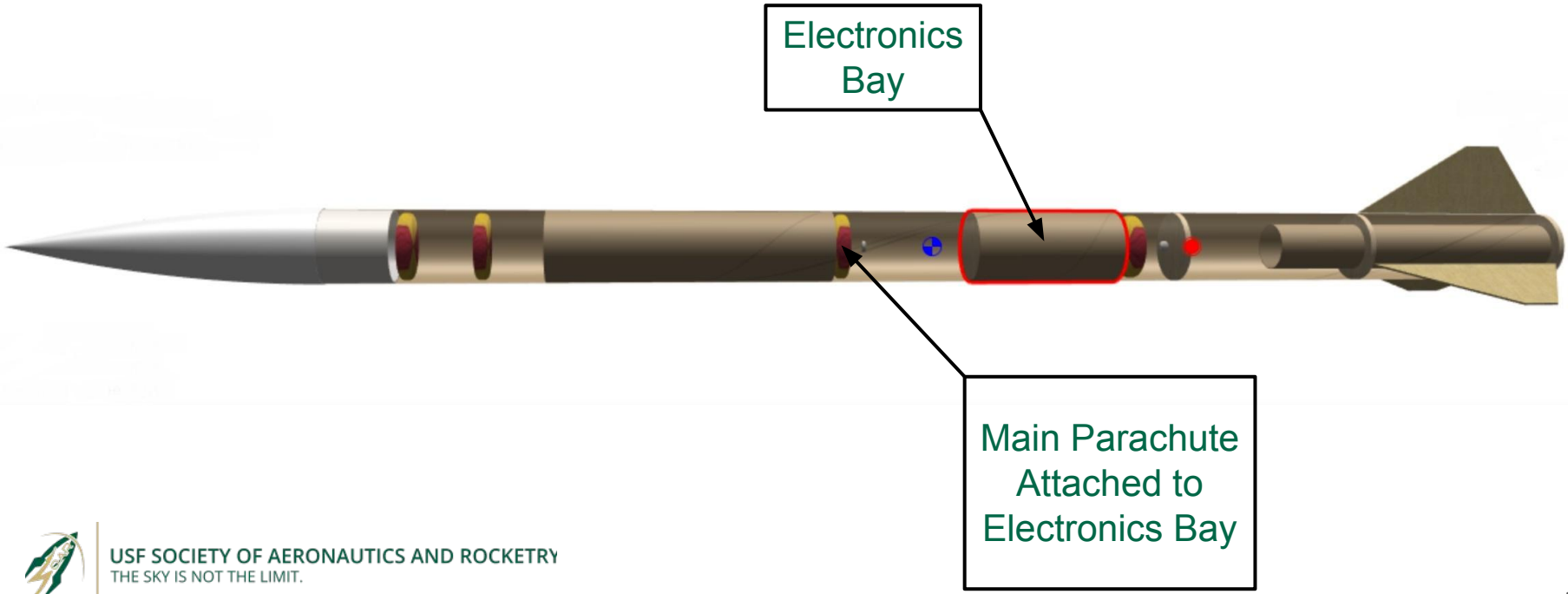
Launch Vehicle Section I: Nose Cone



Launch Vehicle Section II: Landing Module



Launch Vehicle Section III: Electronics Bay



Launch Vehicle Section IV: Booster

Overview of Preliminary Designs


Bi-Prop Design


Quad-Prop Design


Flap Design

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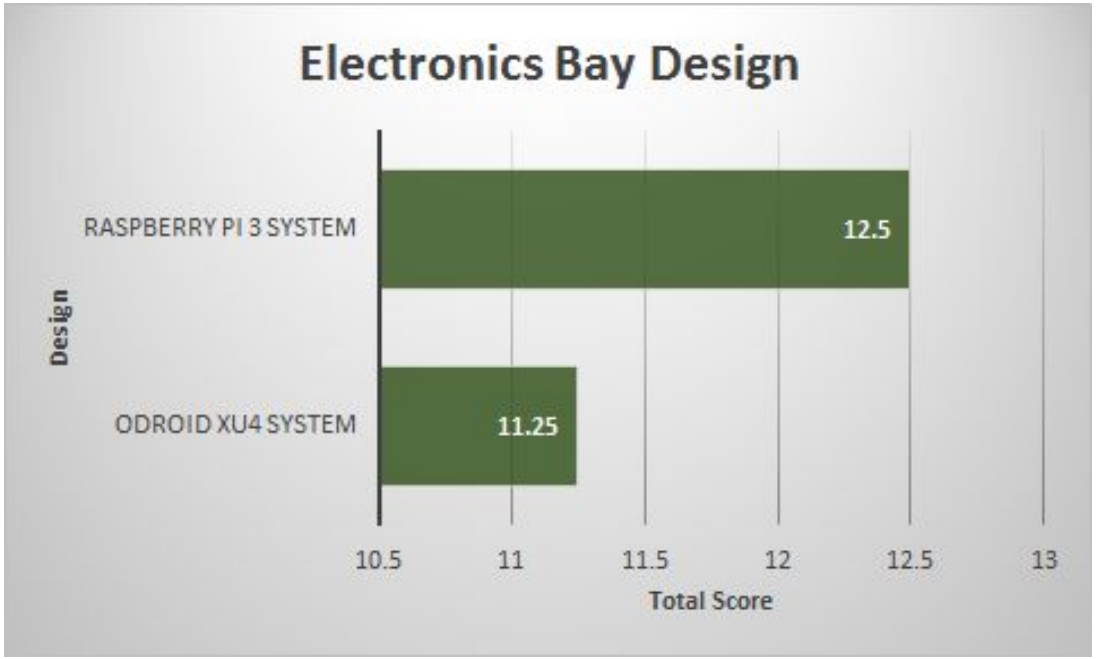
THE SKY IS NOT THE LIMIT.

Preliminary Payload Design: Steering System

Preliminary Payload Design: Landing Gear

Preliminary Payload Design: Electronics Bay



Preliminary Payload Design

Final Decision Based On Total Score:

- Steering system - bi-prop design
- Landing gear - spring cylinder legs design
- Electronics bay - Raspberry Pi 3 design

Landing Module Views

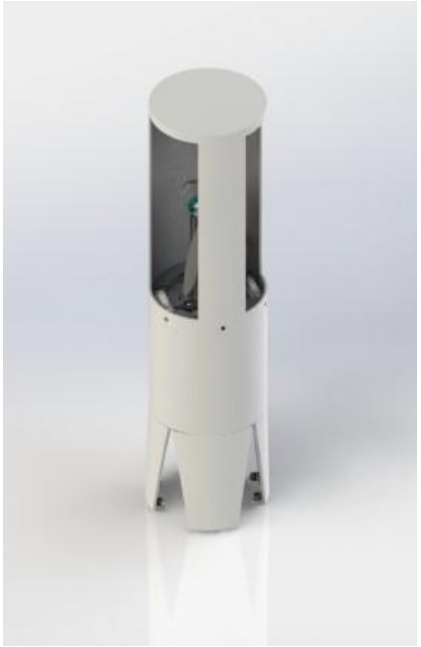


Figure 2: Overall Assembly Stowed

Figure 3: Overall Assembly Extended

Steering System

System Uses:

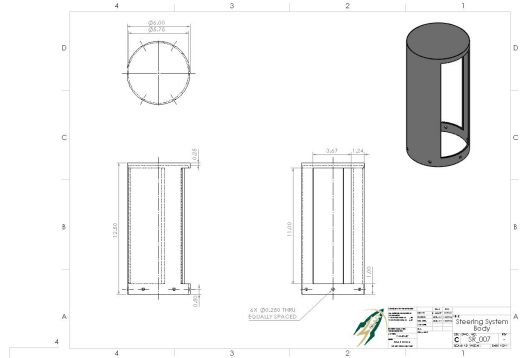
- Navigation
- Stability

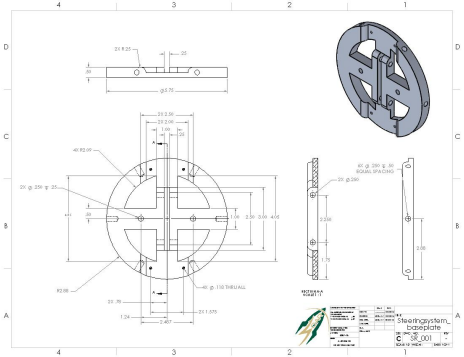
System Make up:

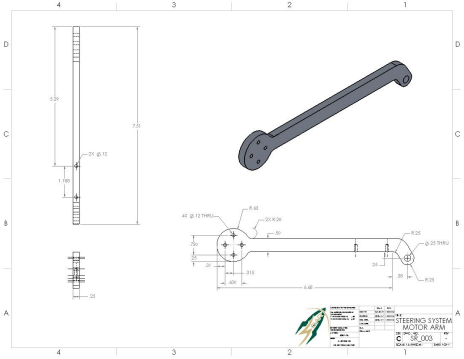
- Spring loaded system
- Magnetic catch
- Pin rotation

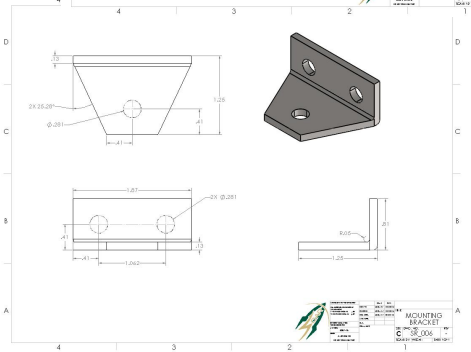
Figure 4: Steering System Isolated

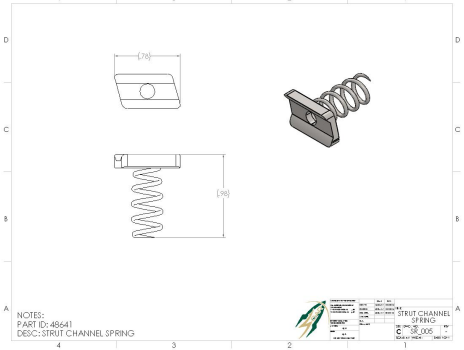
Steering System Components

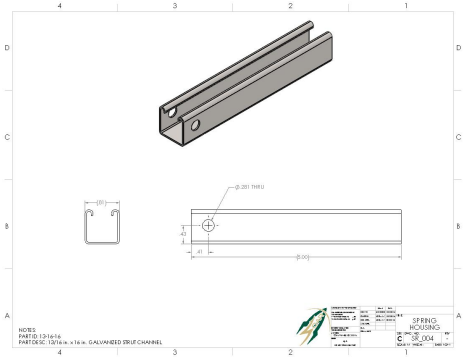




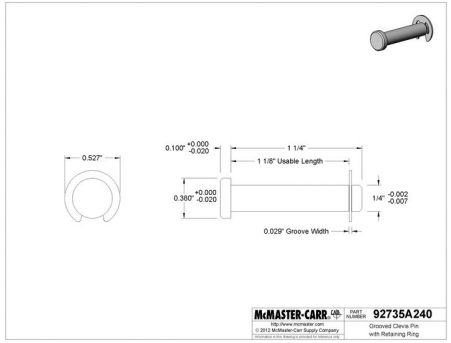








Steering System Components Cont.



Landing Gear

System Uses:

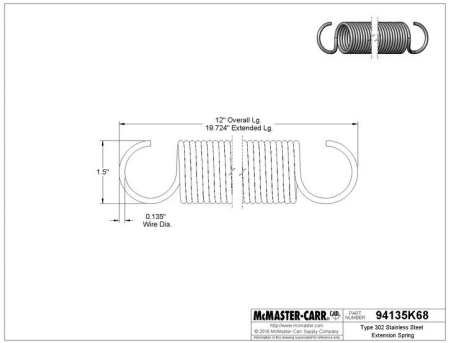
- Vertical upright landing
- Impact absorption
- Tipping prevention

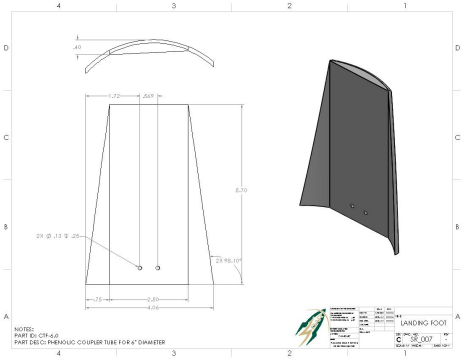
System Make up:

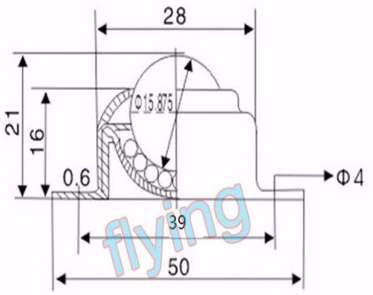
- Spring loaded hinges
- Wheels
- Extension springs

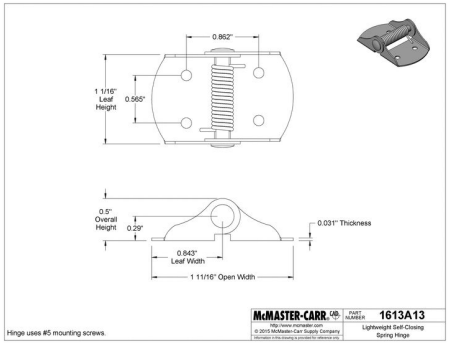
Figure 5: Landing Gear System Bottom View

Landing Gear Components









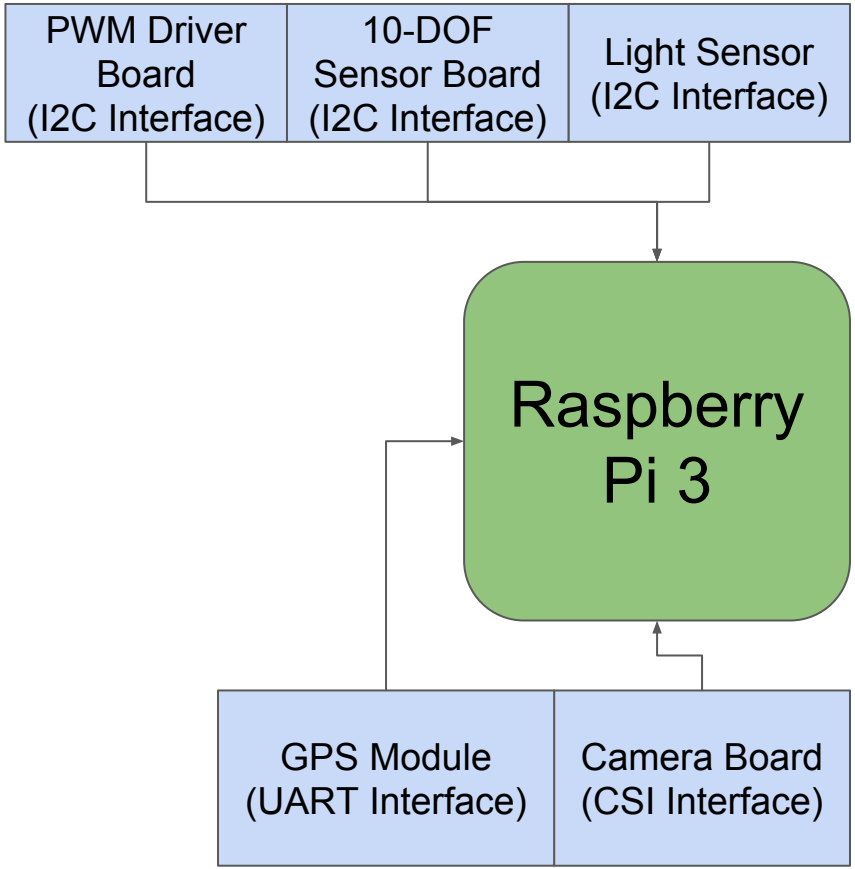
Electronics Bay

System Uses:

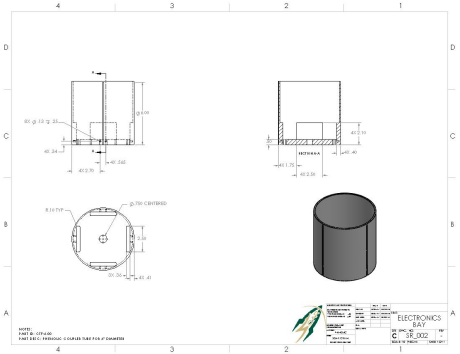
- Vision System
- Steering System Control

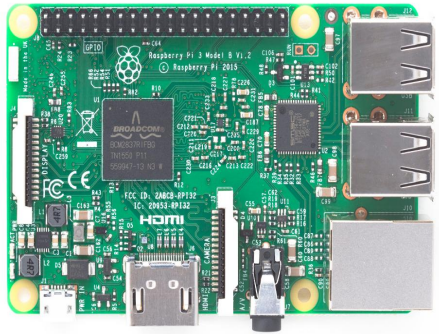
System Make up:

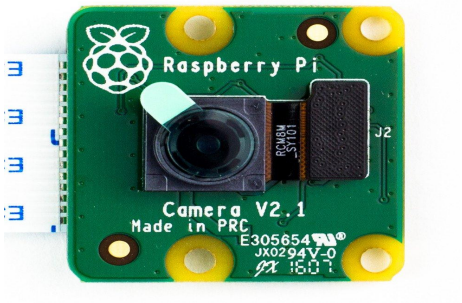
- Raspberry Pi 3b
- Raspberry Pi Camera
- GPS Module
- 10-DOF Sensor Board
- Light Sensor Board
- PWM Driver Board

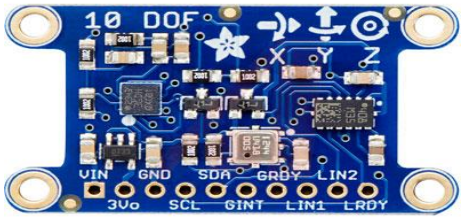


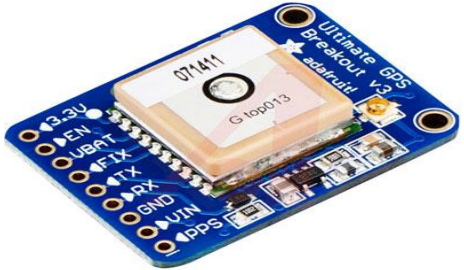
Electronics Bay Components

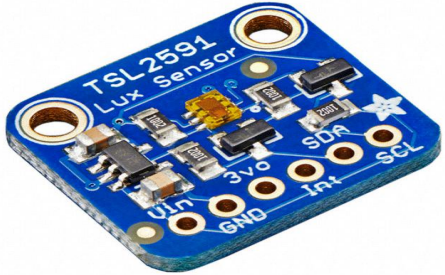




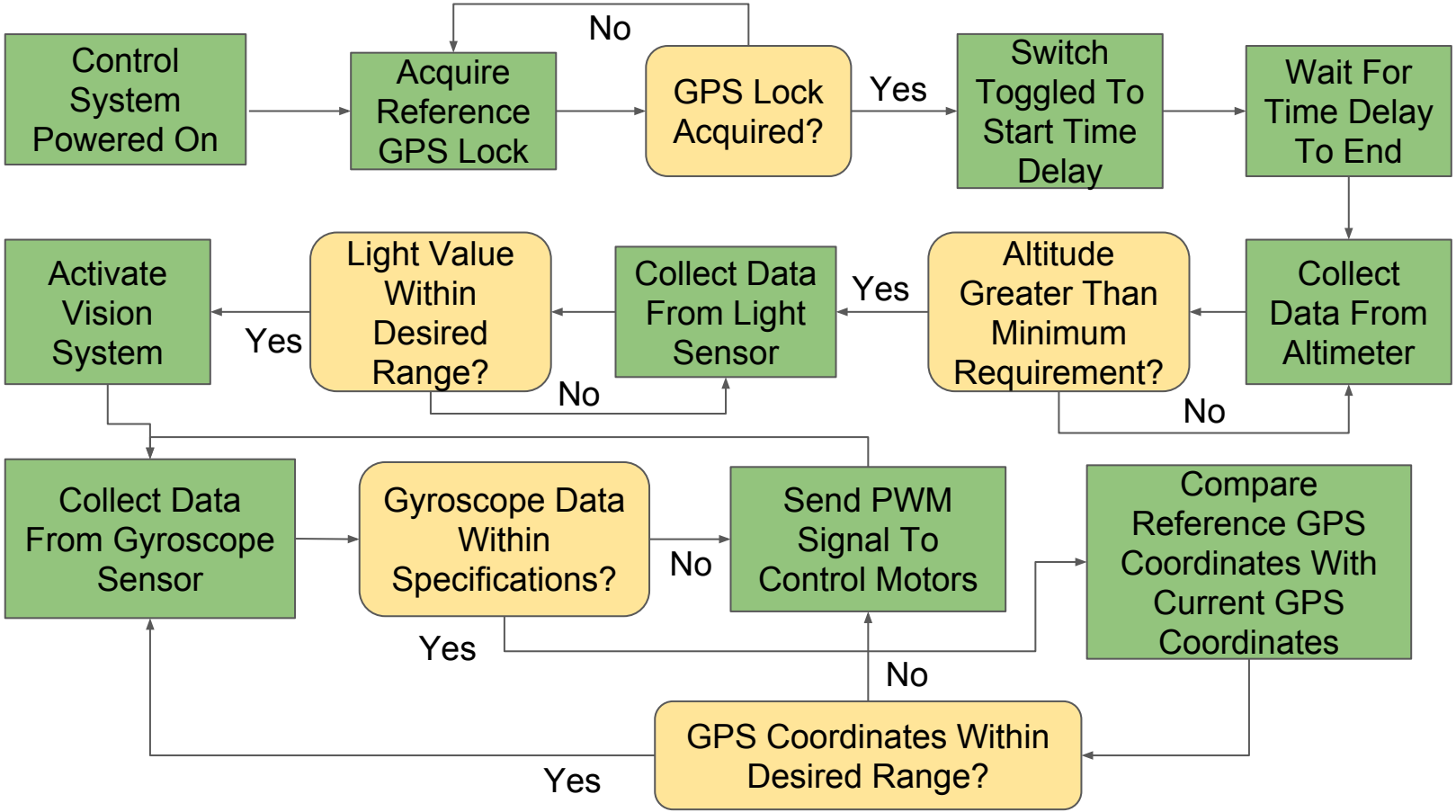








Steering Control System Sequence



Requirement Compliance Plan. Part I

Requirement	Method of Meeting Requirement	Verification
Data from the camera system shall be analyzed in real time by a custom designed onboard software package that shall identify and differentiate between the three targets.	An onboard computer *(Raspberry Pi 3b)* housed in the electronics bay of the landing module will process the captured images in real time. The computer will run a custom python program utilizing the Open CV computer vision library to differentiate between the three targets.	For verification, review data captured and analyzed by system once recovered after launch.
The launch vehicle shall be capable of remaining in launch-ready configuration at the pad for a minimum of 1 hour.	Power consumption calculations will be assessed and an appropriately rated battery will be selected to ensure the electronics system remains in nominal condition. Onboard sensors will keep the main processing computer in a low power mode until specific task are requested.	Computer System with onboard real time clock will log elapsed time of events from the moment it's turned on until the end of the flight.

Requirement Compliance Plan. Part I

Requirement	Method of Meeting Requirement	Verification
Section housing the cameras shall land upright and provide proof of a successful controlled landing.	An upright landing of the landing module will be made possible by using a landing gear system that will absorb the impact force of the overall system on touchdown and land on any terrain.	Angle of rocket upon landing will be captured and stored within onboard software for later verification.
The launch vehicle shall be designed to be recoverable and reusable. Reusable is defined as being able to launch again on the same day without repairs or modifications.	The launch vehicle will be designed to separate into 4 separate sections. Each section with its own recovery parachute to ensure the rocket body stays intact. The motor can be replaced within 1-2 hours after the casing has cooled. The landing module can be reset quickly by changing out or charging the battery, and relocking the motor arms in their upright positions.	Proper launch procedures and proper handling of the launch vehicles and its components will be followed. All vehicle preparations and launches will be overseen by a certified TRA member.

Questions?