



CanSat 2021

Critical Design Review (CDR) Outline

Version 1.1

1231
UCASAL



Presentation Outline



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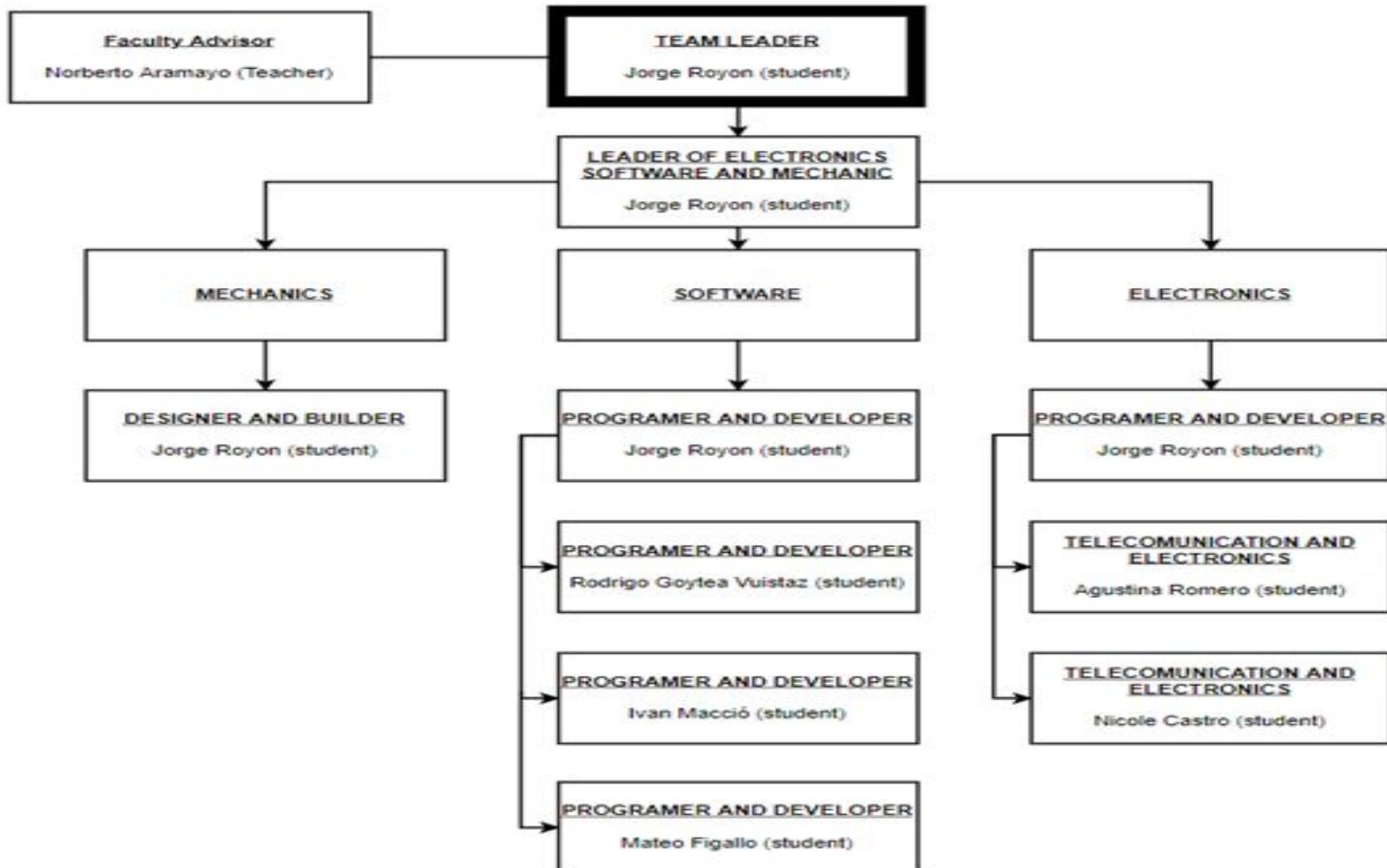
Presentation Outline



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Team Organization





Acronyms



Acronyms	Analysis
CDR	Critical design review
Hz	Frequency
DCS	Descent Control System
FRR	Flight Readiness Review
GCS	Ground Control Station
CG	Center of gravity
LCO	Launch Control Officer
RPM	Revolution per minute



Systems Overview

JORGE ROYON



Mission Summary



Main Objectives

The mission will explore the use of two auto rotating maple seed science payloads. The container shall contain electronics to release the payloads and relay data from the payload to a ground station.

- Just after container is deployed from rocket, container shall open a parachute
- The descent rate shall be kept at 15 meters/sec till 500 meters.
- At 500 meters, the container shall release one auto rotating maple seed science payload. At 400 meters, the container shall release the second auto rotating maple seed science payload.



Mission Summary



Main Objectives

- Transmit data at 1 sample per second before released.
- The payloads shall descend after being released and spin rapidly enough so its descent rate is less than 20 m/s.
- The science payloads shall transmit for five minutes after being released.



Mission Summary



Bonus Objective

- Installation of a integrated video camera in the container and that point toward the ground. The camera shall capture the release of both science payloads and capture the descent of the science payloads.
- The video shall be spin stabilized with the view not rotating more than +/- 30 degrees.



Summary of Changes Since CDR



- Container top hatch is modified
- Voltage divider is implemented
- A new team member was added
- Payload is hingue is removed and secured with CA glue
- Container battery is changed



System Requirement Summary



RQ	Description
1	Total mass of the CanSat (science payloads and container) shall be 600 grams +/- 10 grams.
2	CanSat shall fit in a cylindrical envelope of 125 mm diameter x 400 mm length. Tolerances are to be included to facilitate container deployment from the rocket fairing.
3	The container shall not have any sharp edges to cause it to get stuck in the rocket payload section which is made of cardboard.
4	The container shall be a fluorescent color; pink, red or orange.
5	The container shall be solid and fully enclose the science payloads. Small holes to allow access to turn on the science payloads is allowed. The end of the container where the payload deploys may be open.
6	The rocket airframe shall not be used to restrain any deployable parts of the CanSat.
7	The rocket airframe shall not be used as part of the CanSat operations.
8	The container parachute shall not be enclosed in the container structure. It shall be external and attached to the container so that it opens immediately when deployed from the rocket.



System Requirement Summary



RQ	Description
9	The Parachutes shall be fluorescent Pink or Orange
10	The descent rate of the CanSat (container and science payload) shall be 15 meters/second +/- 5m/s.
11	All structures shall be built to survive 15 Gs of launch acceleration.
12	All structures shall be built to survive 30 Gs of shock.
13	All electronics shall be hard mounted using proper mounts such as standoffs, screws, or high performance adhesives.
14	All mechanisms shall be capable of maintaining their configuration or states under all forces.
15	Mechanisms shall not use pyrotechnics or chemicals.
16	Mechanisms that use heat (e.g., nichrome wire) shall not be exposed to the outside environment to reduce potential risk of setting vegetation on fire.
17	Both the container and payloads shall be labeled with team contact information including email address.



System Requirement Summary



RQ	Description
18	Cost of the CanSat shall be under \$1000. Ground support and analysis tools are not included in the cost.
19	XBEE radios shall be used for telemetry. 2.4 GHz Series radios are allowed. 900 MHz XBEE radios are also allowed.
20	XBEE radios shall have their NETID/PANID set to their team number.
21	XBEE radios shall not use broadcast mode.
22	The science payload shall descend spinning passively like a maple seed with no propulsion.
23	The science payload shall have a maximum descent rate of 20 m/s.
24	The wing of the science payload shall be colored fluorescent orange, pink or green.
25	The science payload shall measure altitude using an air pressure sensor.



System Requirement Summary



RQ	Description
26	The science payload shall measure air temperature.
27	The science payload shall measure rotation rate as it descends.
28	The science payload shall transmit all sensor data once per second.
29	The science payload telemetry shall be transmitted to the container only.
30	The science payload shall have their NETID/PANID set to their team number plus five. If team number is 1000, sensor payload NETID is 1005.
31	The container shall include electronics to receive sensor payload telemetry.
32	The container shall include electronics and mechanisms to release the science payloads.
33	The container shall include a GPS sensor to track its position.
34	The container shall include a pressure sensor to measure altitude.



System Requirement Summary



RQ	Description
35	The container shall measure its battery voltage.
36	The container shall transmit its telemetry and the payload telemetry received once per second in the format described in the Telemetry Requirements section.
37	The container shall stop transmitting telemetry when it lands.
38	The container and science payloads must include an easily accessible power switch that can be accessed without disassembling the cansat and science payloads and in the stowed configuration.
39	The container must include a power indicator such as an LED or sound generating device that can be easily seen or heard without disassembling the cansat and in the stowed state.
40	An audio beacon is required for the container. It may be powered after landing or operate continuously.
41	The audio beacon must have a minimum sound pressure level of 92 dB, unobstructed.
42	Battery source may be alkaline, Ni-Cad, Ni-MH or Lithium. Lithium polymer batteries are not allowed. Lithium cells must be manufactured with a metal package similar to 18650 cells. Coin cells are allowed.



System Requirement Summary



RQ	Description
44	An easily accessible battery compartment must be included allowing batteries to be installed or removed in less than a minute and not require a total disassembly of the CanSat.
45	Spring contacts shall not be used for making electrical connections to batteries. Shock forces can cause momentary disconnects.
46	The Cansat must operate during the environmental tests laid out in Section 3.5.
47	The Cansat shall operate for a minimum of two hours when integrated into the rocket.
48	The flight software shall maintain a count of packets transmitted, which shall increment with each packet transmission throughout the mission. The value shall be maintained through processor resets.
49	The container must maintain mission time throughout the whole mission even with processor resets or momentary power loss.
50	The container shall have its time set to UTC time to within one second before launch.



System Requirement Summary



RQ	Description
51	The container flight software shall support simulated flight mode where the ground station sends air pressure values at a one second interval using a provided flight profile csv file.
52	In simulation mode, the flight software shall use the radio uplink pressure values in place of the pressure sensor for determining the container altitude.
53	The container flight software shall only enter simulation mode after it receives the SIMULATION ENABLE and SIMULATION ACTIVATE commands.
54	The ground station shall command the Cansat to start transmitting telemetry prior to launch.
55	The ground station shall generate csv files of all sensor data as specified in the Telemetry Requirements section.
56	Telemetry shall include mission time with one second or better resolution. Mission time shall be maintained in the event of a processor reset during the launch and mission.
57	Configuration states such as if commanded to transmit telemetry shall be maintained in the event of a processor reset during launch and mission.



System Requirement Summary



RQ	Description
58	Each team shall develop their own ground station.
59	All telemetry shall be displayed in real time during descent on the ground station.
60	All telemetry shall be displayed in engineering units (meters, meters/sec, Celsius, etc.)
61	Teams shall plot each telemetry data field in real time during flight.
62	The ground station shall include one laptop computer with a minimum of two hours of battery operation, XBEE radio and a hand-held antenna.
63	The ground station must be portable so the team can be positioned at the ground station operation site along the flight line. AC power will not be available at the ground station operation site.
64	The ground station software shall be able to command the container to operate in simulation mode by sending two commands, SIMULATION ENABLE and SIMULATION ACTIVATE.
65	When in simulation mode, the ground station shall transmit pressure data from a csv file provided by the competition at a 1 Hz interval to the container.



System Requirement Summary



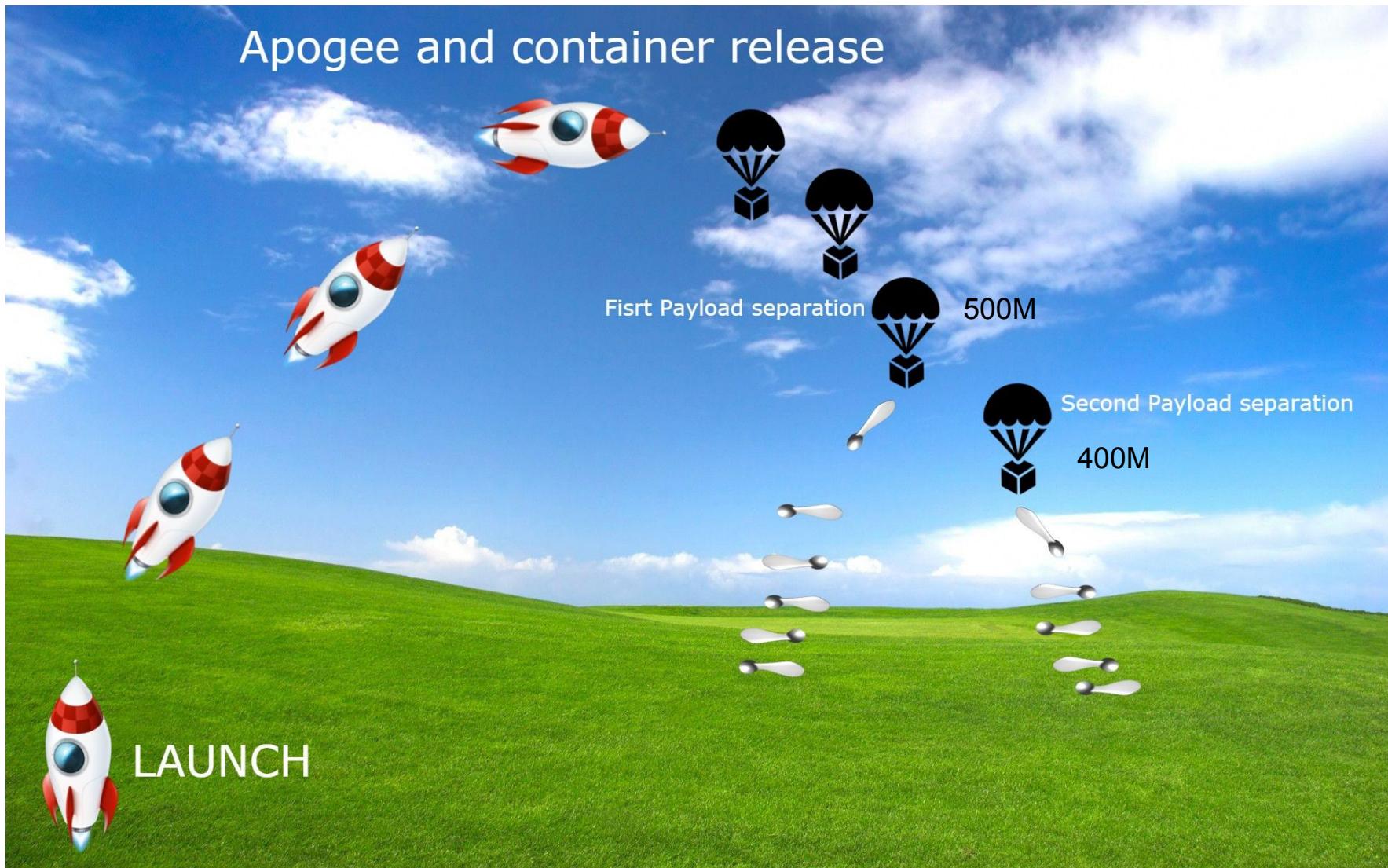
RQ	Description
66	The science payloads shall not transmit telemetry during the launch, and the container shall command the science payloads to begin telemetry transmission upon release from the container.



System Concept of Operations (CONOPS)



Apogee and container release





System Concept of Operations (CONOPS)



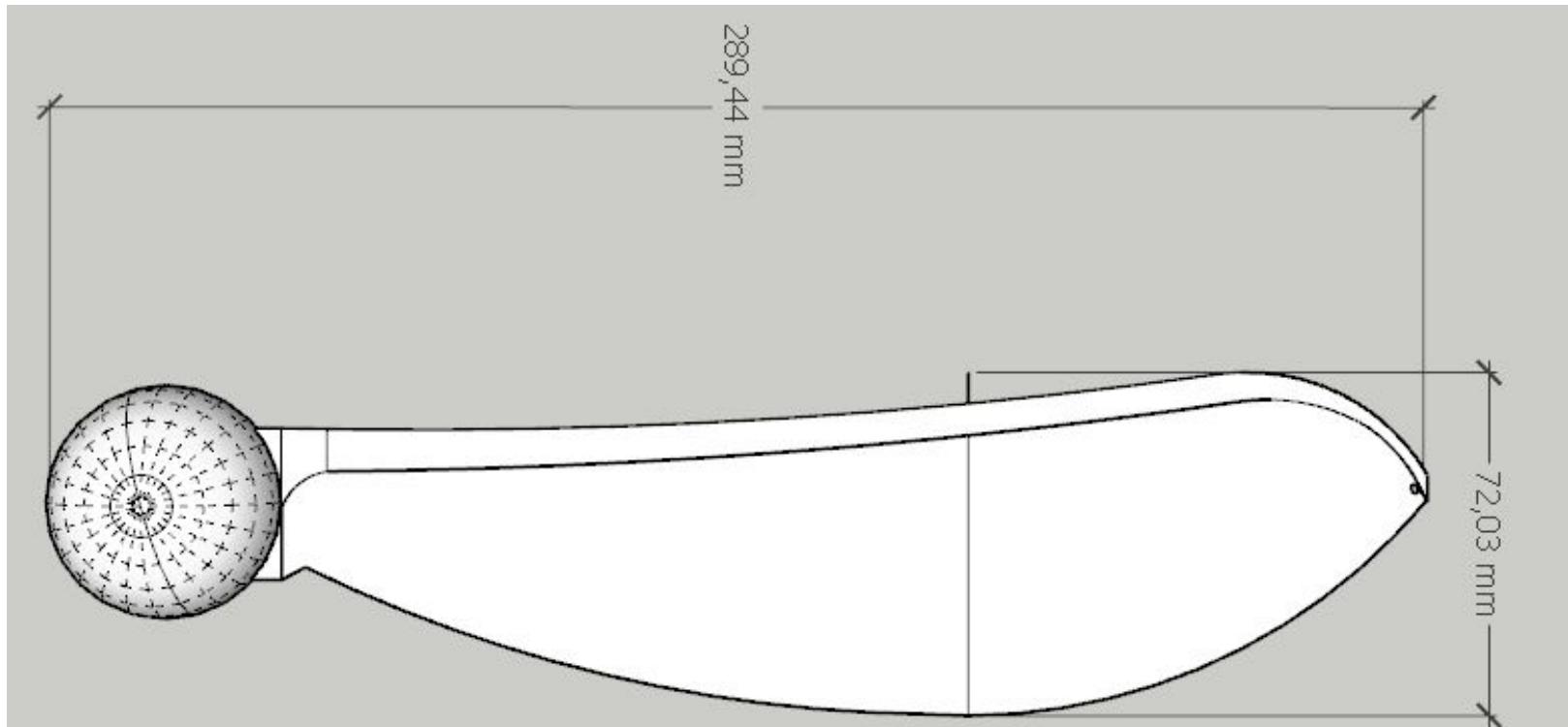
- Competition area arrival
- Team briefing
- Checklist of materials
- Deploy Ground Control Station
- Last check of fully integrated CanSat
- Placement of CanSat into the rocket payload section

- Launch CanSat.
- Container deploy.
- First Payload deploy.
- Second Payload deploy.
- Record telemetry.

- Recovery of Payload and Container
- Analysis of sampled data
- Preparation of the PFR
- PFR presentation and delivery

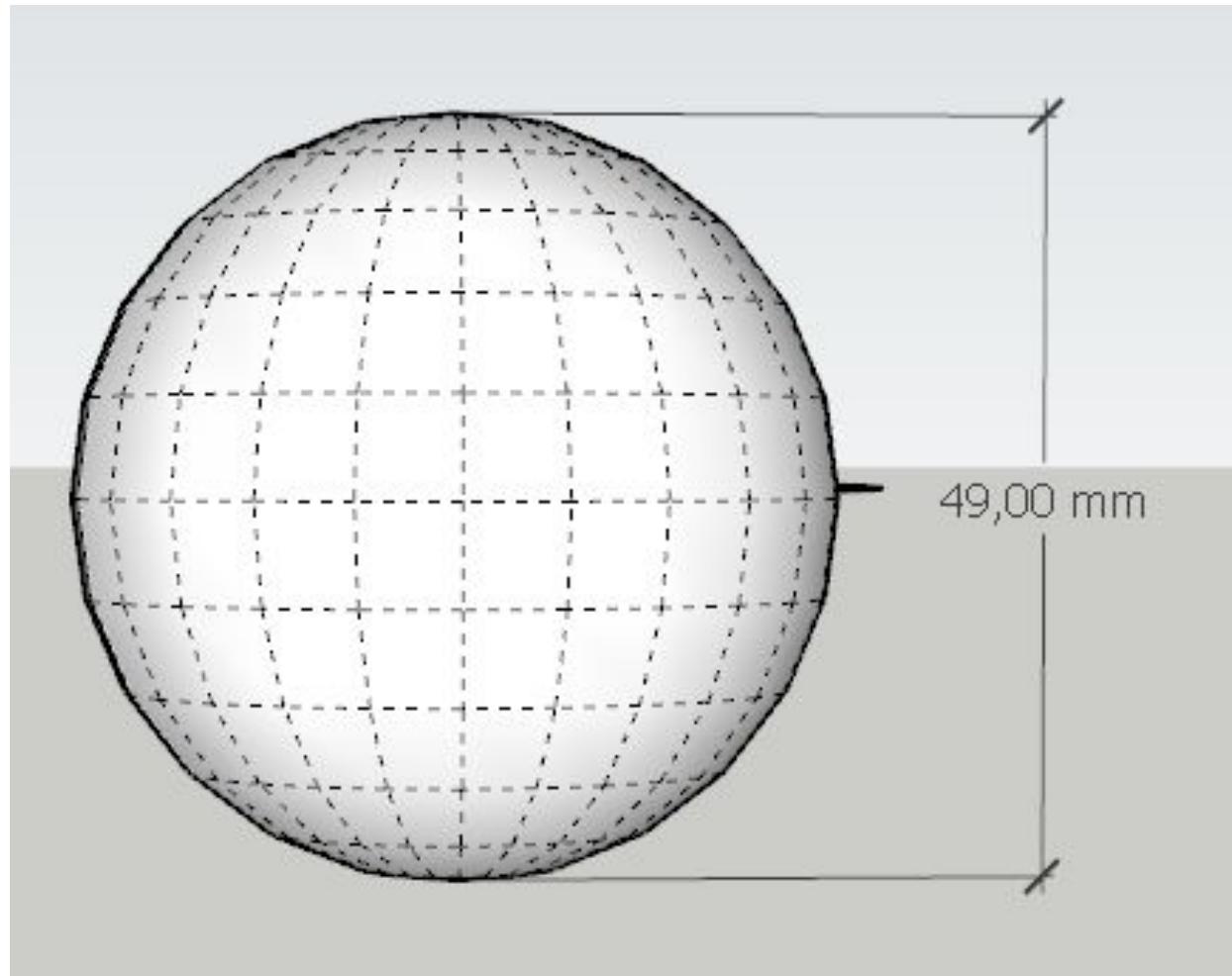


Payload Physical Layout



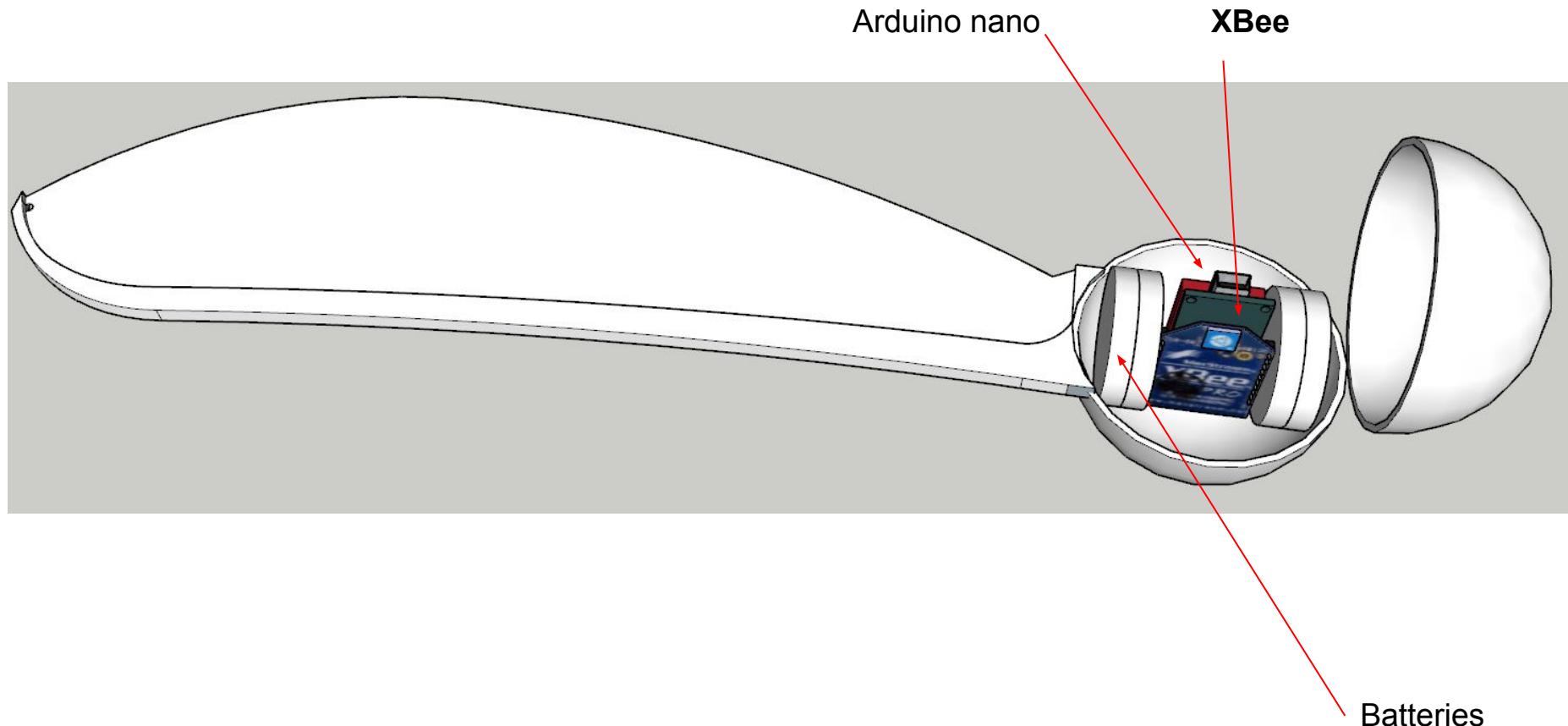


Payload Physical Layout





Payload Physical Layout

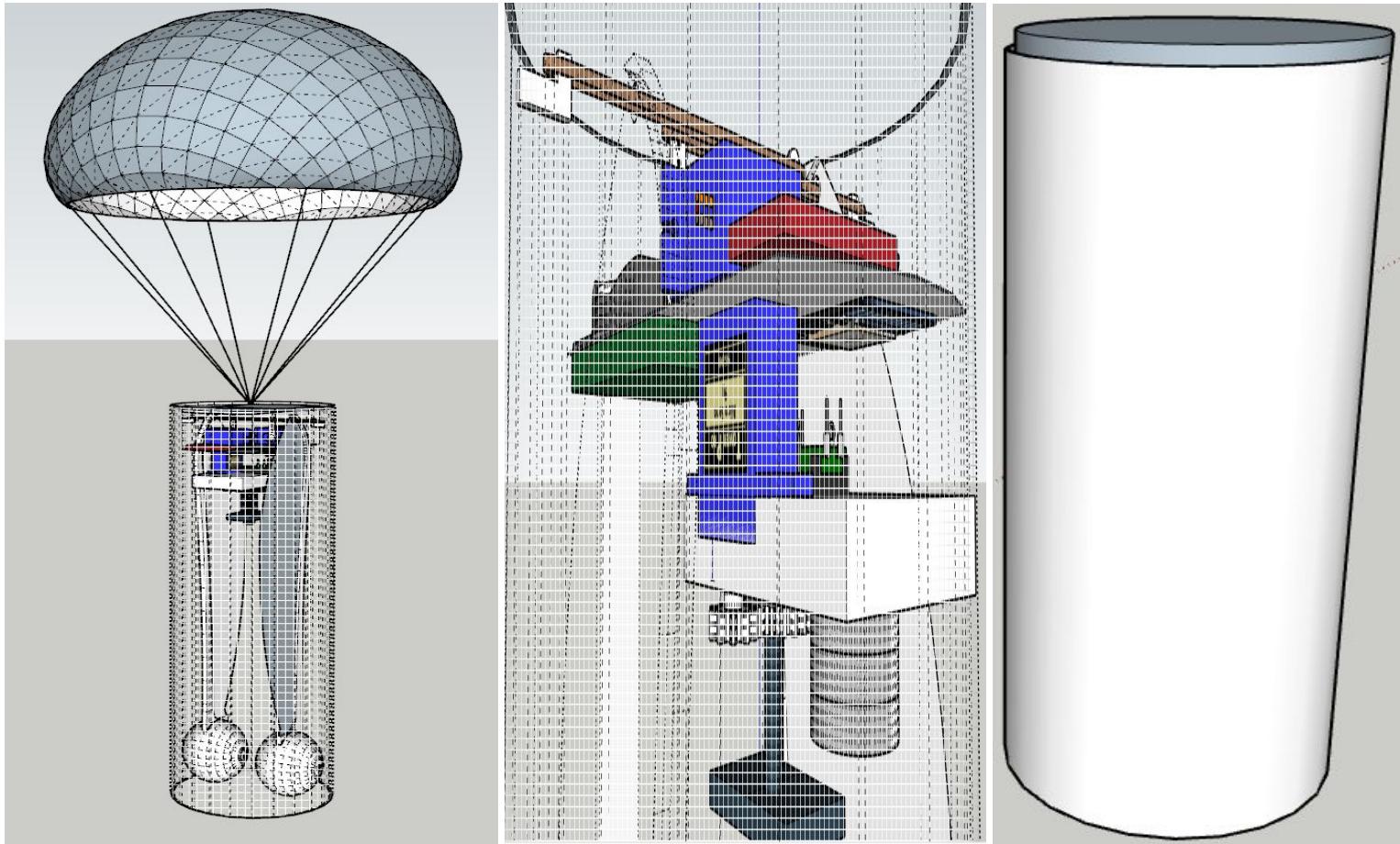




Payload Physical Layout

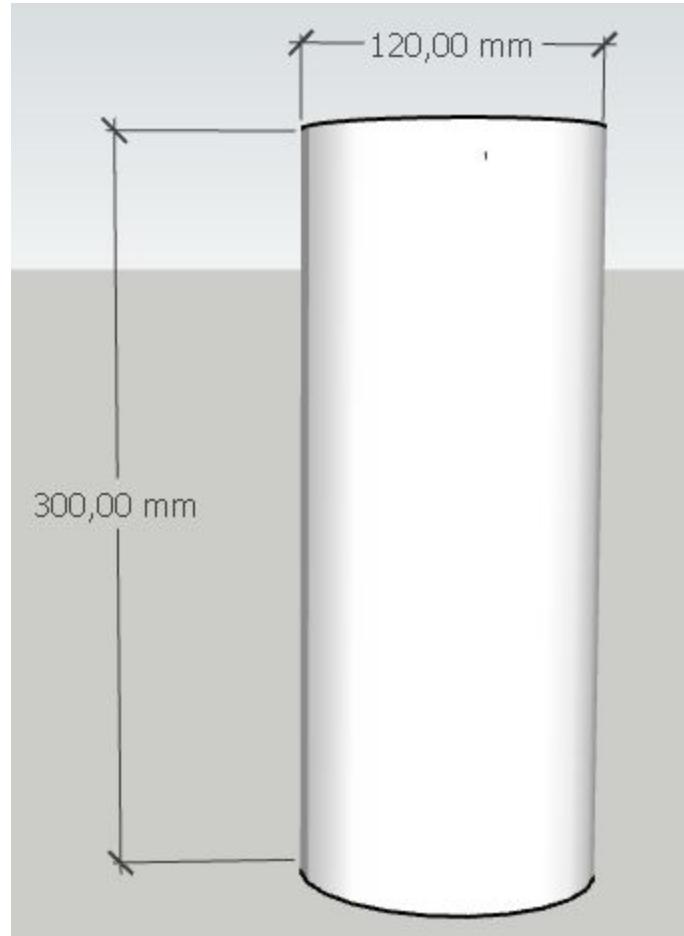


Container with payload





Payload Physical Layout

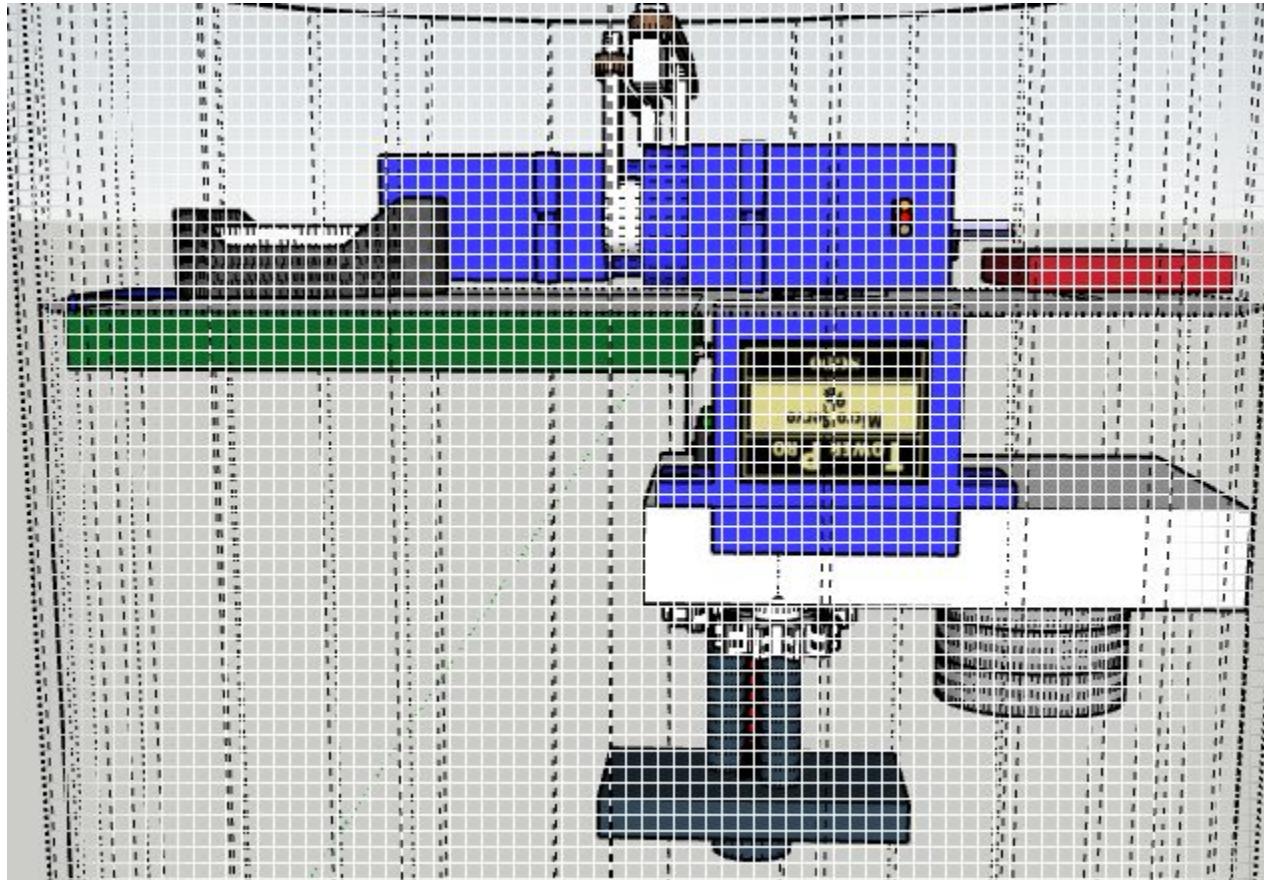




Payload Physical Layout



Internal view of container components

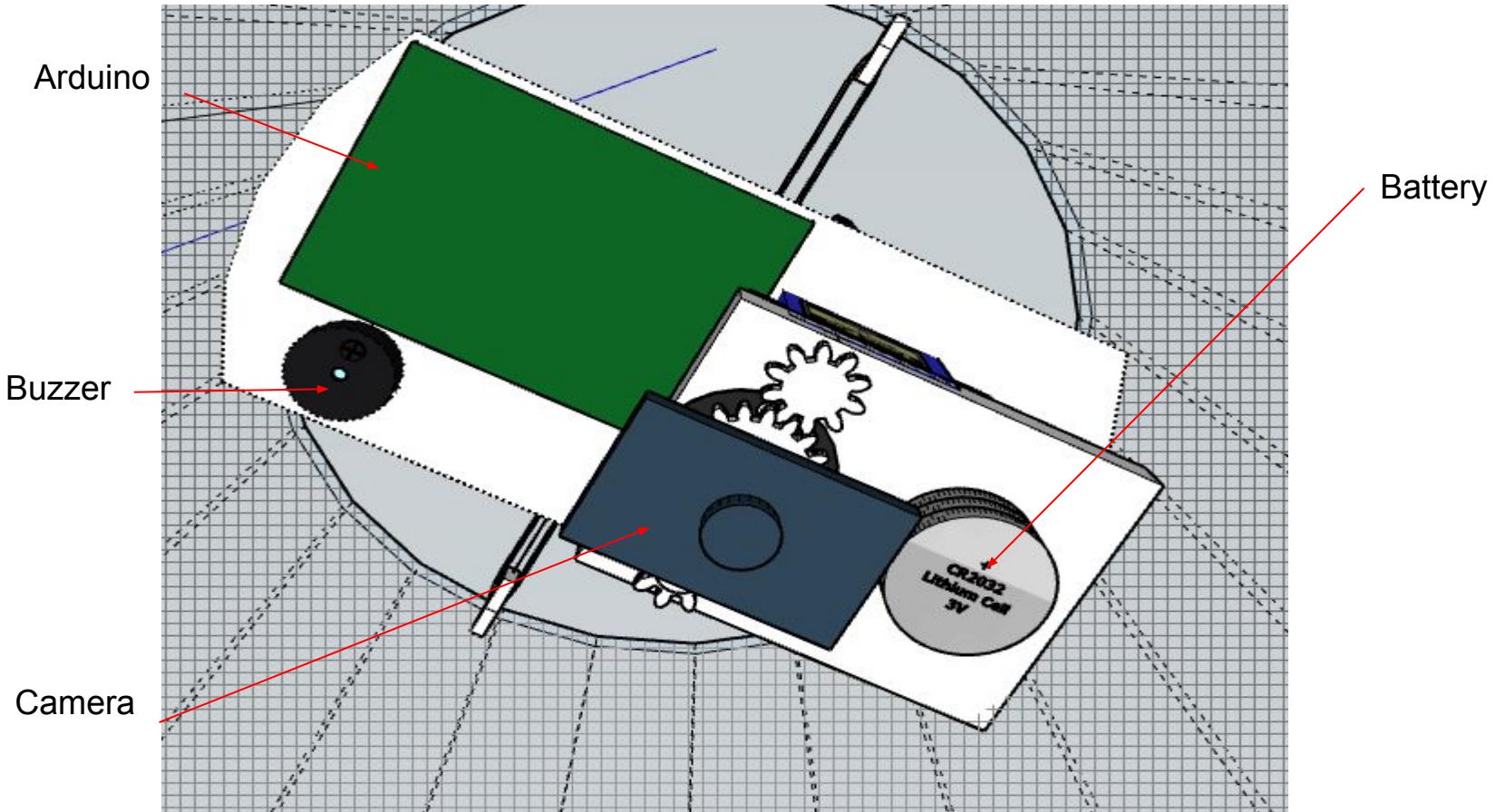




Payload Physical Layout



Bottom view

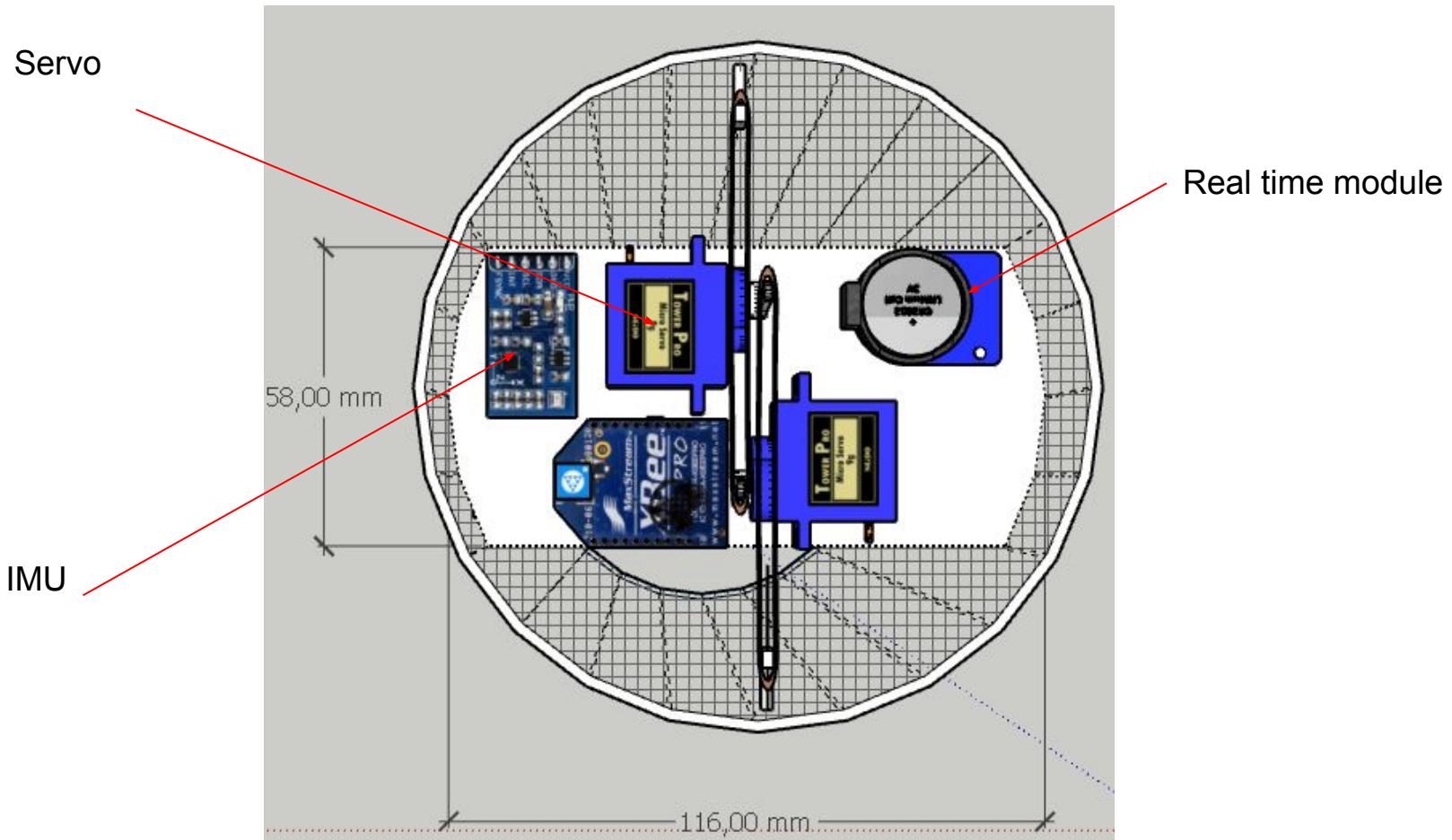




Payload Physical Layout



Top view





Launch Vehicle Compatibility



★Rocket payload section dimensions based on Mission Guide:

- Height: 310 mm
- Diameter: 125 mm

★CanSat dimensions:

- Height: 300 mm
- Diameter: 120 mm

★Payload dimensions:

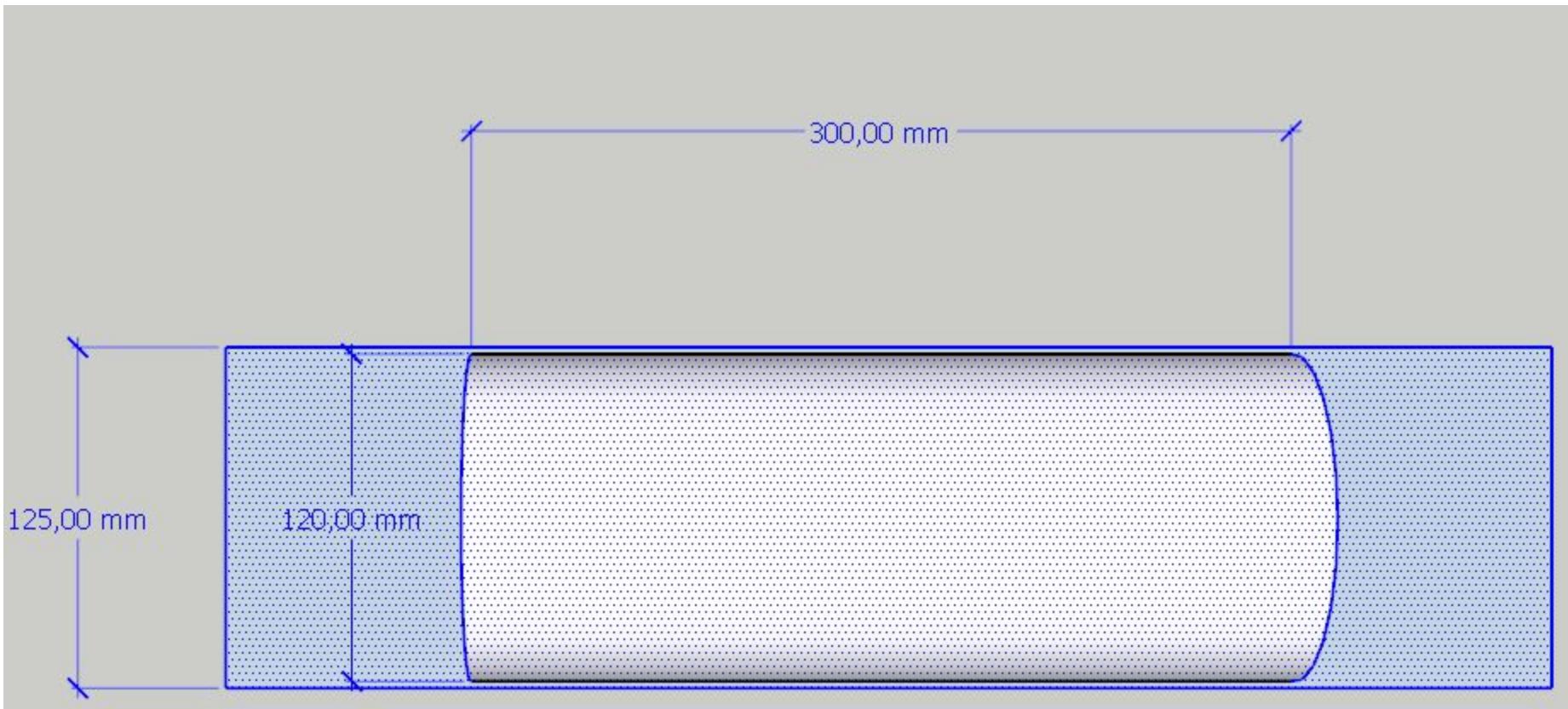
- Wing span: 240mm
- Length: 290 mm

★Parachute dimensions:

- Diameter: 190 mm
- Spill Hole Diameter: 42.56 mm



Launch Vehicle Compatibility



There's sufficient margin allow the container slide freely inside the rocket payload



Sensor Subsystem Design

Nicole Castro



Sensor Subsystem Overview

- **Container**

Sensor	Model	Purpose
Air Pressure	BMP280	measure air pressure
GPS Sensor	Adafruit Ultimate GPS Sensor	get gps position
Voltage Sensor	Arduino ADC pin	measure voltage

- **Payload**

Sensor	Model	Purpose
Air Pressure	BMP280	measure air temperature and pressure
Air Temperature	BMP280	measure air temperature and pressure
Rotation Sensor	MPU9250	measure rotation



Sensor Changes Since PDR



- Voltage divider is implemented



Sensor Subsystem Requirements



ID	Requirement	Rationale	Priority
25	The science payload shall measure altitude using an air pressure sensor.	CReq	High
26	The science payload shall measure air temperature.	CReq	High
27	The science payload shall measure rotation rate as it descends.	CReq	High
28	The science payload shall transmit all sensor data once per second.	CReq	High
29	The science payload telemetry shall be transmitted to the container only.	CReq	High
31	The container shall include electronics to receive sensor payload telemetry.	CReq	High
33	The container shall include a GPS sensor to track its position.	CReq	High
34	The container shall include a pressure sensor to measure altitude.	CReq	High
35	The container shall measure its battery voltage.	CReq	High



Payload Air Pressure Sensor Summary



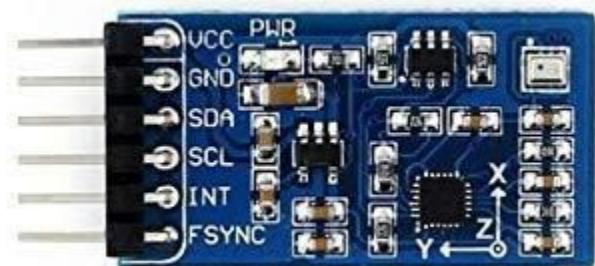
MODEL	INTERFACE	RANGE	ACCURACY	SIZE	MASS
Waveshare 10 DOF IMU with bmp280	I2c	300 hPa / 1100 hPa	± 1 hPa	31.2 mm x 17 mm x 3 mm	2gr

DATA PROCESSING

```
#include <Wire.h>
#include <SPI.h>
#include <Adafruit_BMP.h>
sensors_event_t pressure_event;
  bmp_pressure->getEvent(&pressure_event);
  Serial.print(pressure_event.pressure);
```

OUTPUT

1018
1018
1016





Payload Air Temperature Sensor Summary



MODEL	INTERFACE	RANGE	ACCURACY	SIZE	MASS
Waveshare 10 DOF IMU with bmp280	I2c	-40 °C/85 °C	± 1°C	31.2 mm x 17 mm x 3 mm	2gr

DATA PROCESSING

```
#include <Wire.h>
#include <SPI.h>
#include <Adafruit_BMP.h>
sensors_event_t temp_event;
  bmp_temp->getEvent(&temp_event);
  Serial.print(temp_event.temperature);
```



OUTPUT

25
25
25



Payload Rotation Sensor Summary



MODEL	INTERFACE	RANGE	ACCURACY	SIZE	MASS
Waveshare 10 DOF IMU with bmp280	I2c	2000 °/s	±3%	31.2 mm x 17 mm x 3 mm	2gr

DATA PROCESSING

```
#include <Wire.h>
#include <Adafruit_Sensor.h>
#include <Adafruit_L3GD20_U.h>
sensors_event_t event;
gyro.getEvent(&event);
Serial.print(event.gyro.z);
```

OUTPUT

6
25
31





Container Air Pressure Sensor Summary



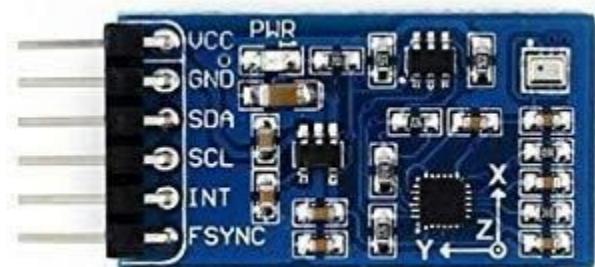
MODEL	INTERFACE	RANGE	ACCURACY	SIZE	MASS
Waveshare 10 DOF IMU with bmp280	I2c	300 hPa / 1100 hPa	± 1 hPa	31.2 mm x 17 mm x 3 mm	2gr

DATA PROCESSING

```
#include <Wire.h>
#include <SPI.h>
#include <Adafruit_BMP.h>
sensors_event_t pressure_event;
  bmp_pressure->getEvent(&pressure_event);
  Serial.print(pressure_event.pressure);
```

OUTPUT

1018
1018
1018





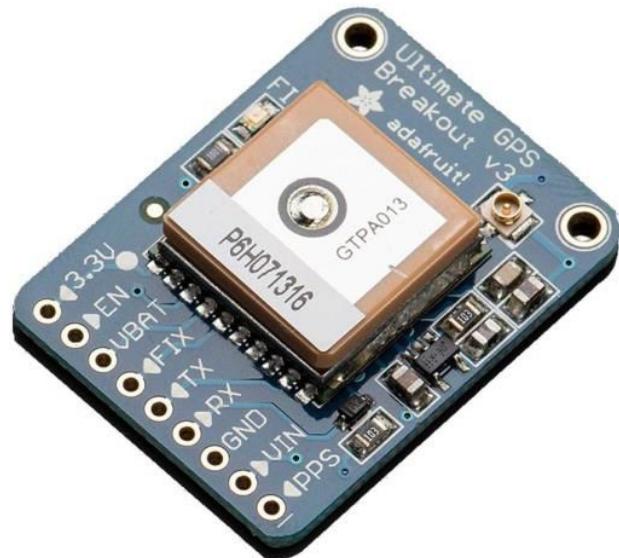
Container GPS Sensor Summary



MODEL	INTERFACE	ACCURACY	SIZE	MASS
Adafruit Ultimate GPS	UART	± 1.8 m	25 mm x 35 mm x 6.5 mm	8,5g

DATA PROCESSING

```
#include <Adafruit_GPS.h>
#include <SoftwareSerial.h>
if (GPS.fix) {
    Serial.print(GPS.latitude, 4);
    Serial.print(GPS.longitude, 4);
    Serial.println(GPS.altitude);
    Serial.println((int)GPS.satellites);
}
```



OUTPUT

```
-24.716760 -65.419992 1152.40 4
-24.716760 -65.419992 1152.40 4
-24.716760 -65.419992 1152.40 4
```



Container Battery Voltage Sensor Summary



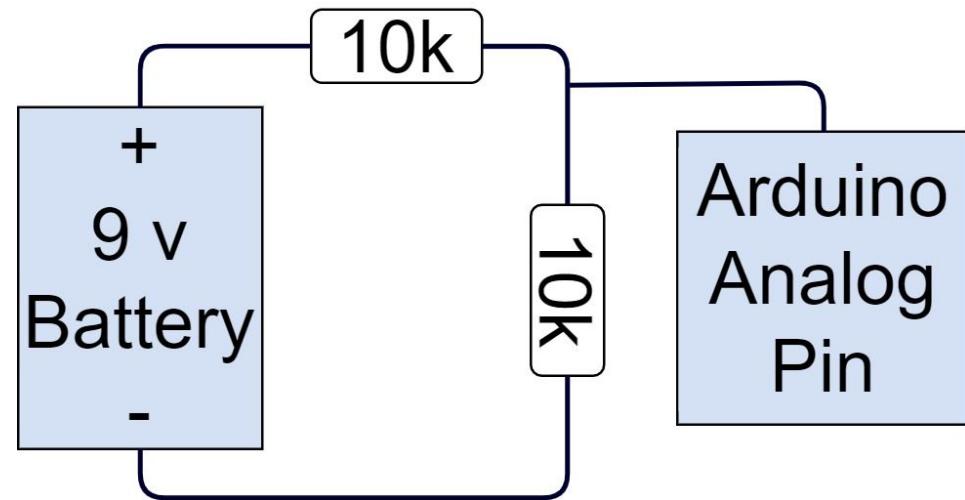
MODEL	ACCURACY	SIZE	MASS
Series Resistor on Arduino analog pin	$\pm 0.0049v$	5 mm x 1,5 mm	<1g

DATA PROCESSING

```
val=analogRead(A1);  
voltage=val*5.0/1023;  
Serial.println(voltage*2);
```

OUTPUT

8, 97
9, 10
9, 02



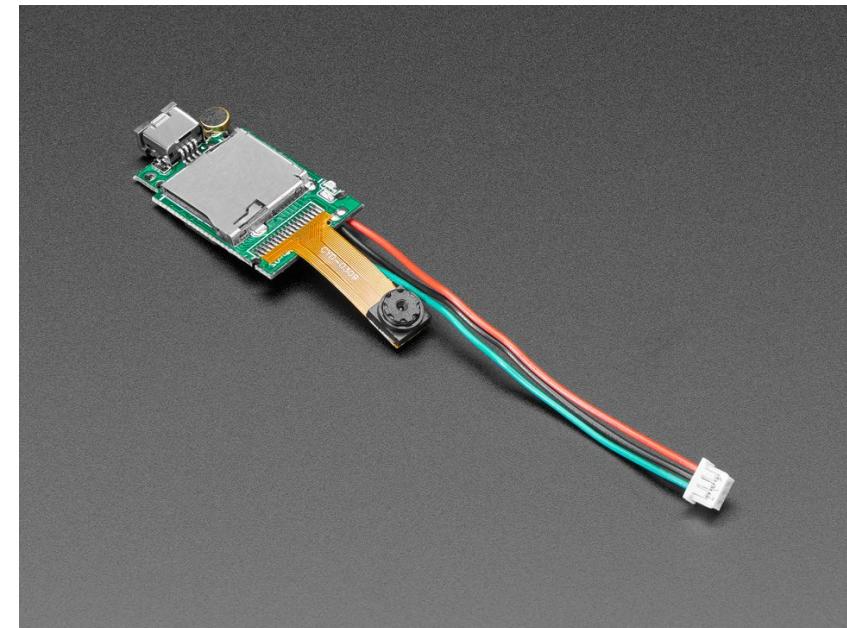


Bonus Objective Camera Summary



MODEL	INTERFACE	RESOLUTION	SIZE	MASS
Adafruit MINI SPY CAMERA	USB/ANALOG	640x480	28.5 mm x 17mm x 4.2mm	2.8g

The adafruit camera is activated via an analog pin and record video in the required format for the mission





Descent Control Design

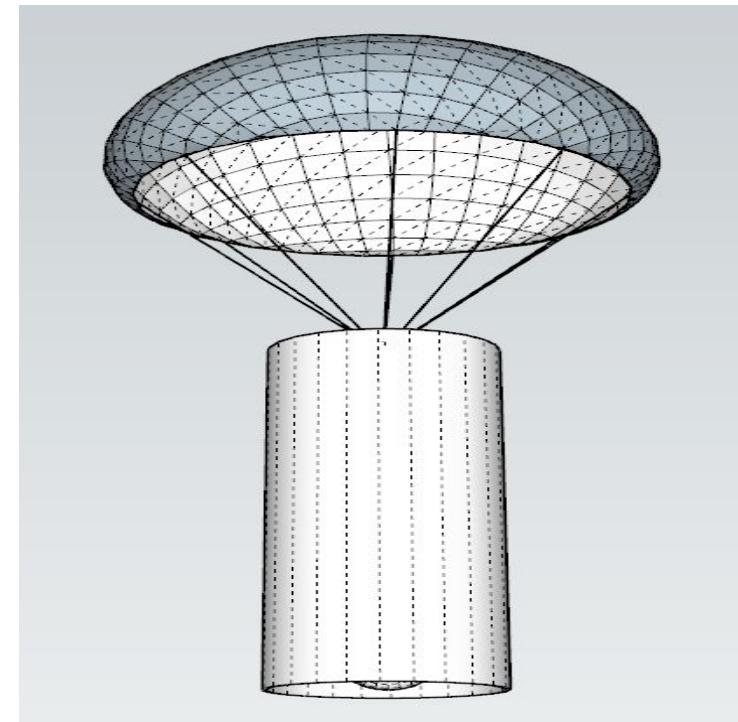
Jorge Royon



Descent Control Overview

Container Descent Control System

The parachute has 19 cm diameter to reach 15 m/s. It has been made from plastic and it has 2.28 cm radius spill hole to stabilize container during descent



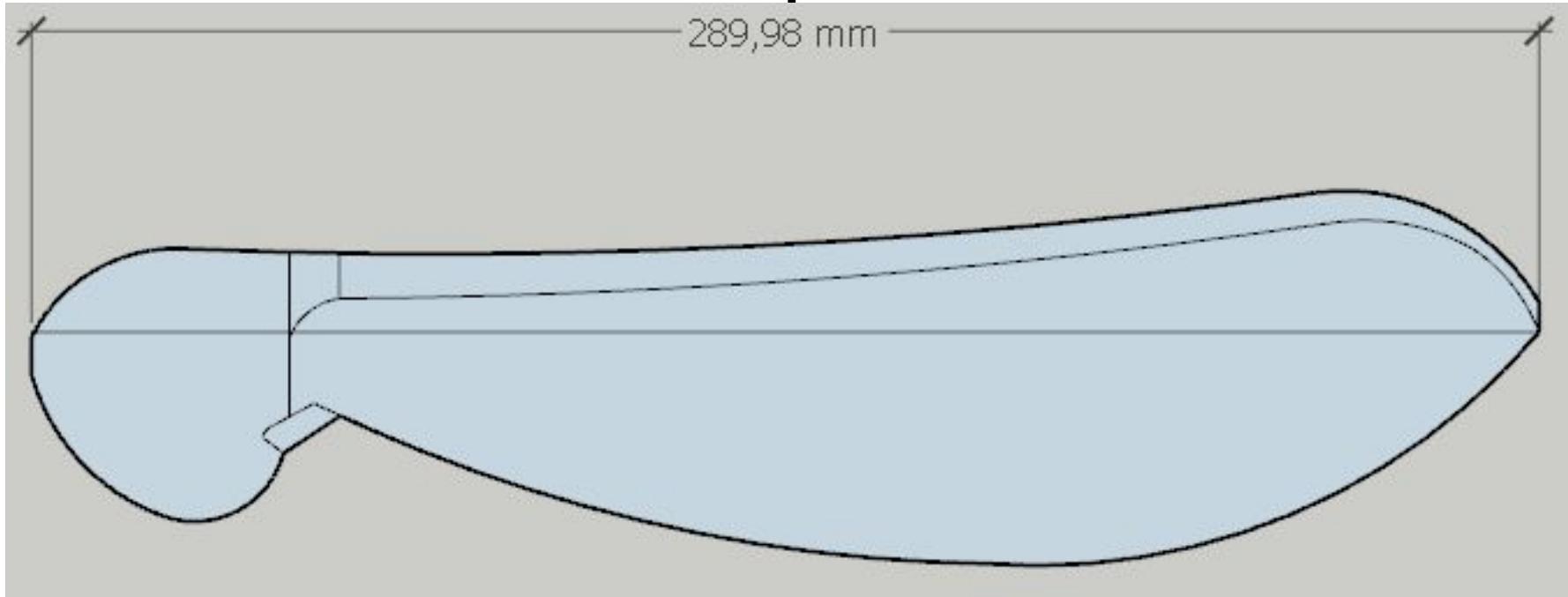


Descent Control Overview



Payload Descent Control System

The payload is a auto rotating scaled samara seed, it's autostable by design and descent is achieved in a passive way, when enter in autorotation the wing generate a lift force that slow down the descent speed

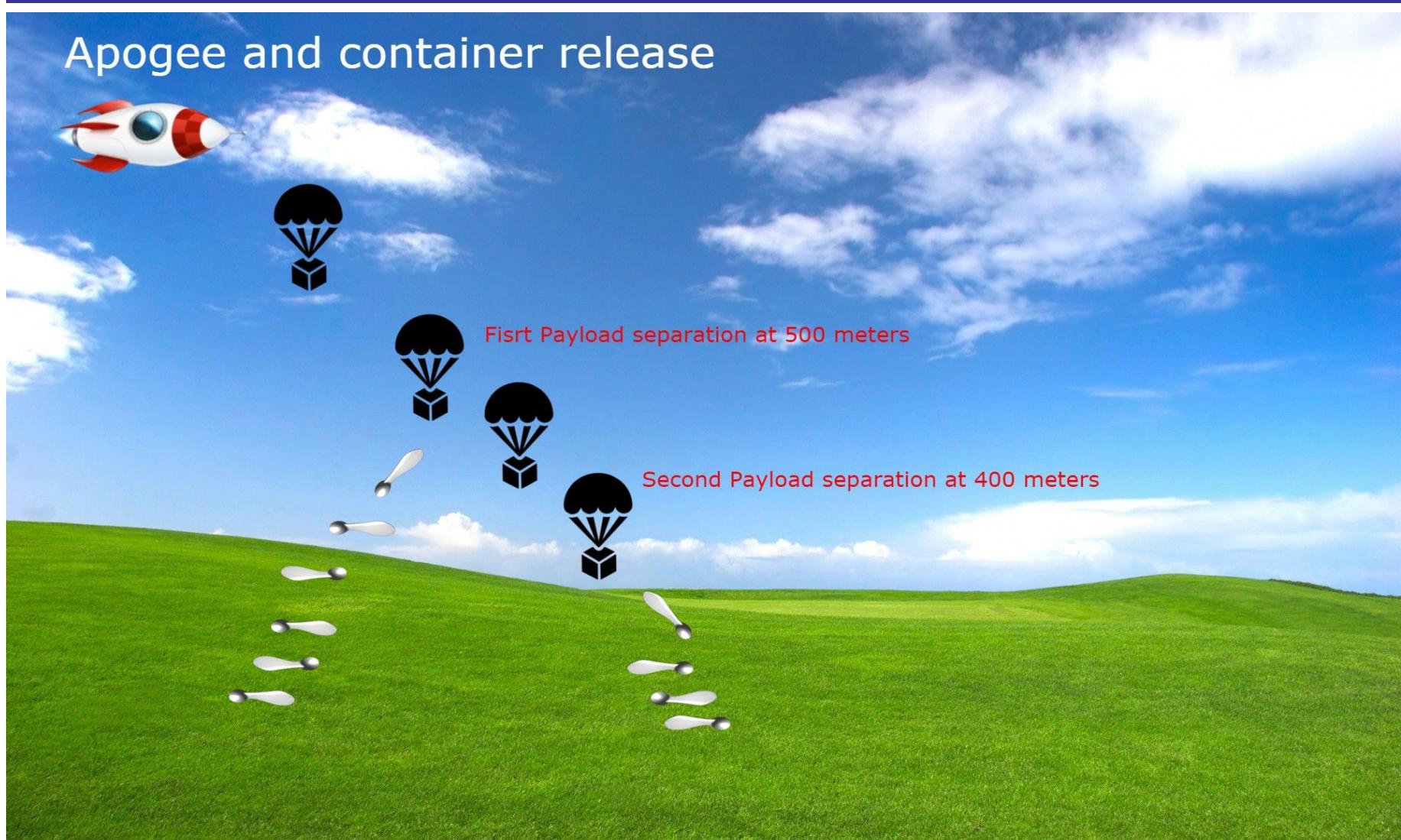




Descent Control Overview



Apogee and container release





Descent Control Changes Since CDR



- No changes since PDR



Descent Control Requirements



RQ	Description	Rationale
2	CanSat shall fit in a cylindrical envelope of 125 mm diameter x 400 mm length. Tolerances are to be included to facilitate container deployment from the rocket fairing.	CReq
3	The container shall not have any sharp edges to cause it to get stuck in the rocket payload section which is made of cardboard.	CReq
6	The rocket airframe shall not be used to restrain any deployable parts of the CanSat.	CReq
7	The rocket airframe shall not be used as part of the CanSat operations.	CReq
8	The container parachute shall not be enclosed in the container structure. It shall be external and attached to the container so that it opens immediately when deployed from the rocket.	CReq
9	The Parachutes shall be fluorescent Pink or Orange	CReq
10	The Parachutes shall be fluorescent Pink or Orange	CReq
11	All structures shall be built to survive 15 Gs of launch acceleration.	CReq
12	All structures shall be built to survive 30 Gs of shock.	CReq



Descent Control Requirements



RQ	Description	Rationale
22	The science payload shall descend spinning passively like a maple seed with no propulsion.	CReq
23	The science payload shall have a maximum descent rate of 20 m/s.	CReq

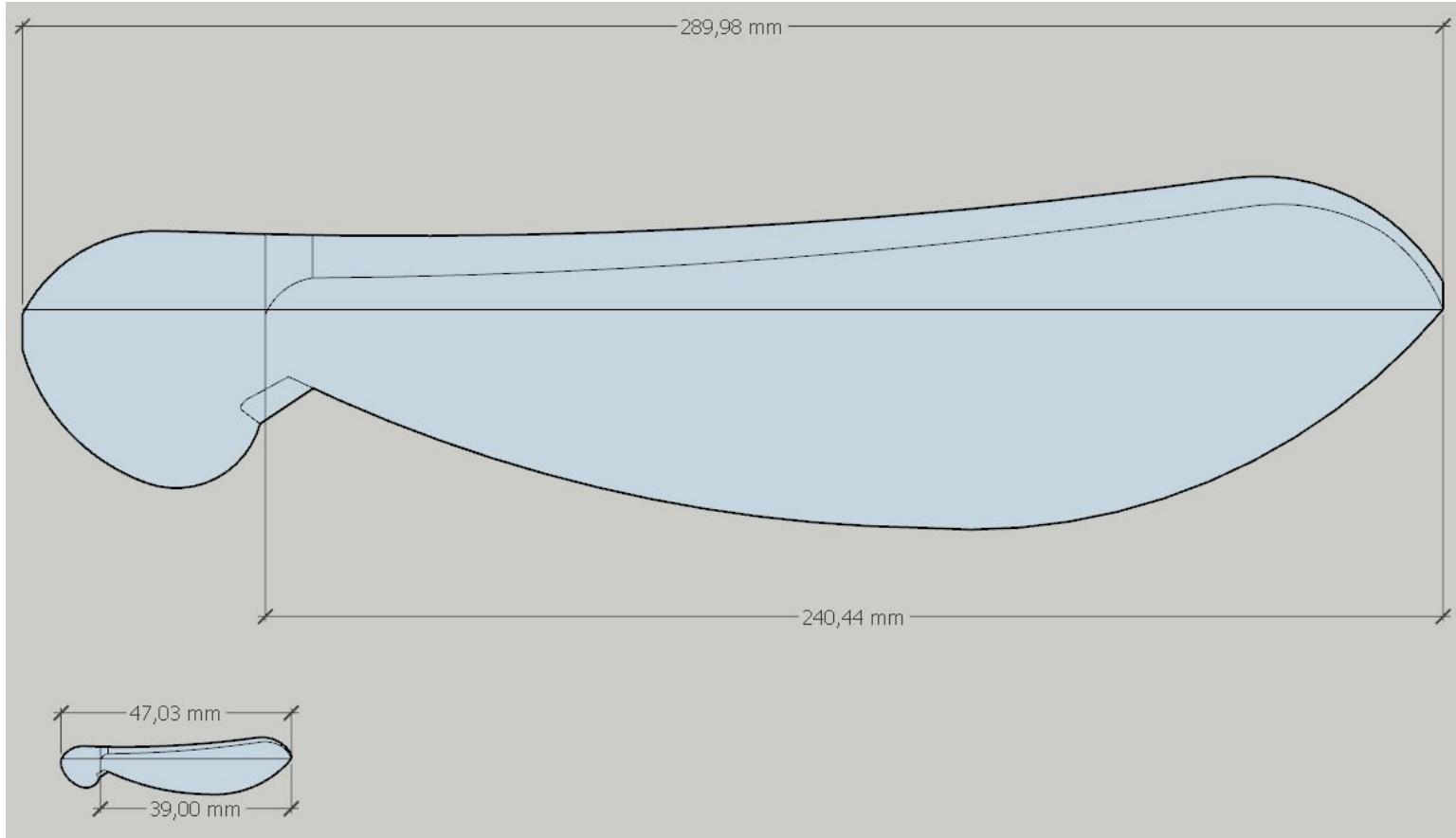


Payload Descent Control Hardware Summary



Payload Descent Control Hardware

The descent system is passive and it is based on a scaled samara seed



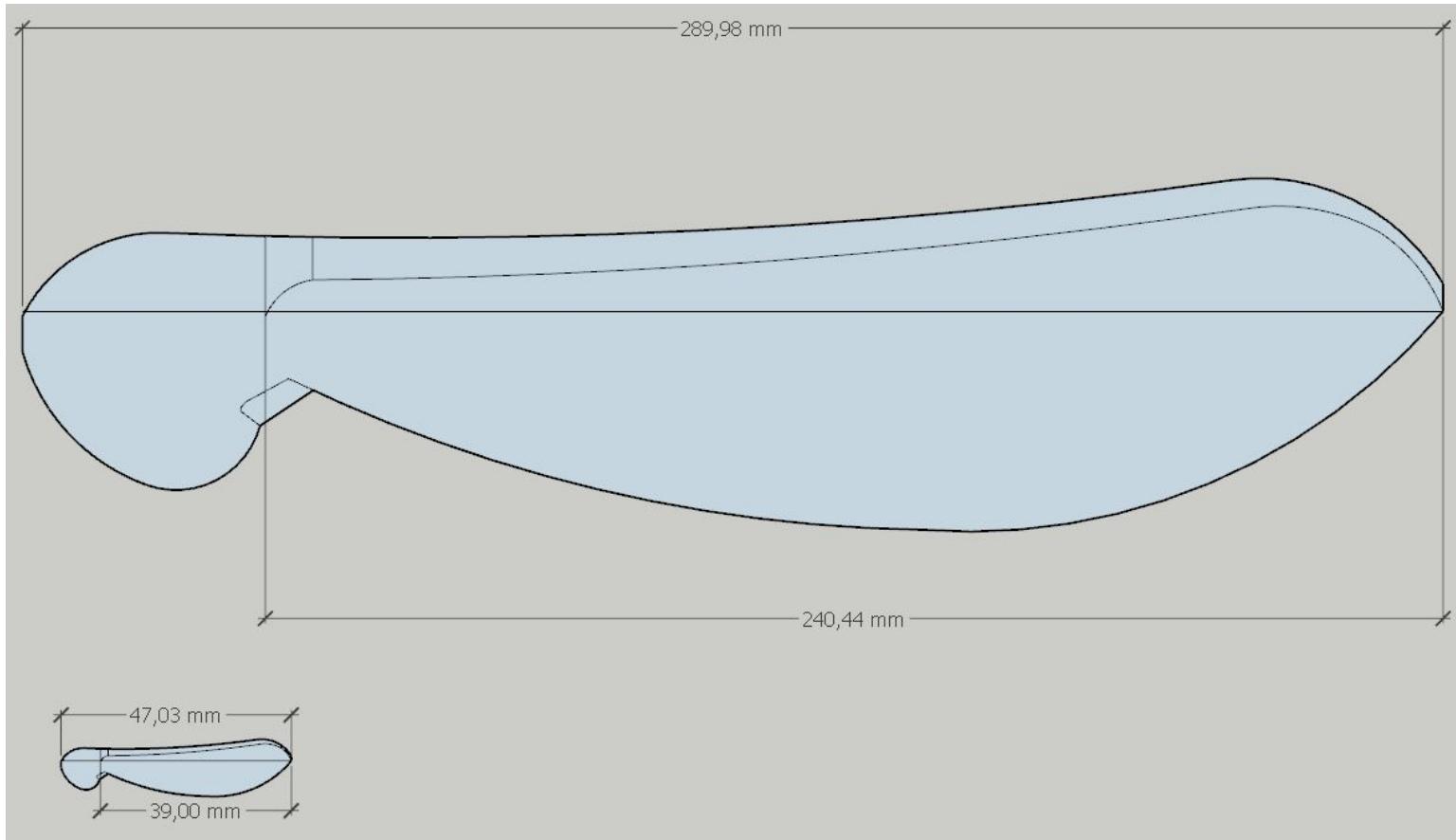


Payload Descent Stability Control Design



Payload Descent Stability Control Hardware

The descent stability system is passive and it is based on a scaled samara seed



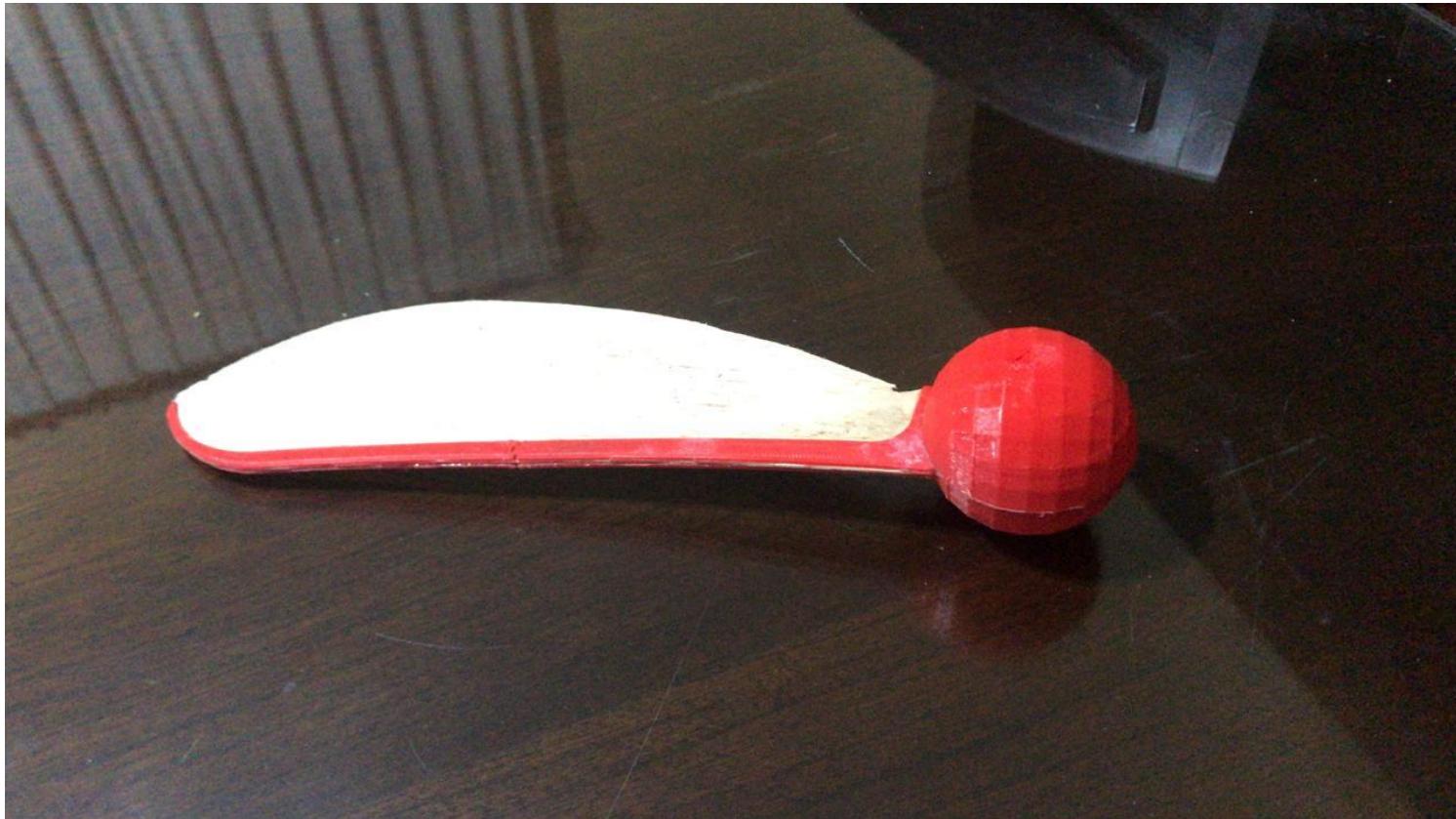


Payload Descent Stability Control Design



Payload Descent Stability Control Hardware

A prototype was built and tested by hand launch and show acceptable performance, wing will be painted to match requirement





Container Descent Control Hardware Summary



Container Descent Control Hardware Summary

The container descent control consist in a pre made parachute of Apogee model 29126, that comes with cotton lines and everthing needed for instalation in the container





Descent Rate Estimates



Container Descent Rate Estimate

The area formula of a parachute with spill hole is

$$S_p = \frac{2 \times m \times g}{\rho \times V^2 \times C_D}$$

where

S_p = Area of the parachute with a spill hole (m^2)

D = The diameter of the parachute mm

V = Descent speed m/s

CD = 1.5 Drift coefficient of parachute

ρ = 1.225 kg/m³(Air density at +15 C from sea level)

m =0.600kg Container+Payload

$g=9.81m/s^2$

$S_{(s_H)}$ =Spill hole area

s_Hr =Spill hole radius



Descent Rate Estimates



Container Descent Rate Estimate

Replacing the data gives the following results

$$S_p = \frac{2 \times (0,6\text{kg}) \times (9,81 \frac{\text{m}}{\text{s}^2})}{(1,225 \text{kg/m}^3) \times (15 \frac{\text{m}}{\text{s}})^2 \times 1,5}$$

$$\textcolor{red}{Sp=0.02847\text{m}^2}$$

The diameter can be calculated from the formula

$$S_p = \frac{1}{4} \pi D^2$$



Descent Rate Estimates



Container Descent Rate Estimate

Clearing terms and replacing the data give us

$$D = \sqrt{\frac{4 \times S_p}{\pi}} = \sqrt{\frac{4 \times 0,02847m^2}{\pi}} = 0,1904036m = 190mm$$

The spill house area is chosen to be 5% of the total parachute area

$$S_{sH} = S_p \times 5\% = 0.02847m^2 * 0.05 = 0.0014235m^2$$



Descent Rate Estimates



Container Descent Rate Estimate

The spill house radius can be determined by

$$S_{Hr} = \sqrt{\frac{S_{SH}}{\pi}} = \sqrt{\frac{0,0014235\text{m}^2}{\pi}} = 0,0212864\text{m} = \mathbf{21,28\text{mm}}$$

This give us a parachute of a 190 mm in diameter with a spill house radius of 21,28 mm



Descent Rate Estimates

Container Descent Rate Estimate

Now we can estimate the descent speed of the container with the two payloads

$$V = \sqrt{\frac{2 \times F_{Drag}}{\rho \times S_P \times C_D}}$$

$$V = \sqrt{\frac{2 \times (0.6\text{kg}) \times (9.81\text{m/s}^2)}{1.225\text{kg/m}^3 \times (0.02847\text{m}^2) \times (1.5)}} = 15\text{m/s}$$

With these result we accomplish the mission requirements



Descent Rate Estimates



Container Descent Rate Estimate

Now we can estimate the descent speed of the container after release of the first payload

$$V = \sqrt{\frac{2 \times (0.494 \text{kg}) \times (9.81 \text{m/s}^2)}{1.225 \text{kg/m}^3 \times (0.02847 \text{m}^2) \times (1.5)}} = 14 \text{m/s}$$

Now we can estimate the descent speed of the container after release of the second payload

$$V = \sqrt{\frac{2 \times (0.389 \text{kg}) \times (9.81 \text{m/s}^2)}{1.225 \text{kg/m}^3 \times (0.02847 \text{m}^2) \times (1.5)}} = 12 \text{m/s}$$



Descent Rate Estimates



Payload Descent Rate Estimate

Samara wing are simply auto rotating mechanism with billions of years of evolution, however the physic of their flight are very complex. We had collected several samara seed and study them.





Descent Rate Estimates



Payload Descent Rate Estimate

After several test we choose the best flyer





Descent Rate Estimates



Payload Descent Rate Estimate

Samara seed flights are difficult to predict, there's a lot of variables that changes the flying pattern and descent speed like air temperature, and there's some important factors that are almost impossible to predict like air speed driven by the weather of the day launch. However it's possible to estimate the descent rate basing some assumptions:

- Constant temperature
- No horizontal wind
- Vertical release of the payload from repose

A high definition camera and a white wall where used to record videos of the launches of the samara wings, after we choose the best performer we made some other launches and we were able to collect important data.



Descent Rate Estimates



Payload Descent Rate Estimate

This was our setup, a little mark on the wall was marked with a pen to had a reference tof drop point





Descent Rate Estimates



Payload Descent Rate Estimate

Property	Value	Units
Mass	50	mg
Span	0.047	m
Max chord length	0.0106	m
Swept disk radius	0.023	m
Swept disk area	0.0017	m ²
descent velocity	0.71	m/s



Descent Rate Estimates



Payload Descent Rate Estimate

According to A. Azuma, K. Yasuda, Flight performance of rotary seeds, Journal of Theoretical Biology 138 (1) (1989) 23–53 and Gessow and Myers Aerodynamics of the Helicopter, Frederick Ungar, 1952 researches in samara seed flying characteristic had establish a relationship between the falling speed V, mass G, air density ρ , and area described in descent flight without horizontal wind A

$$v = \sqrt{\frac{2mG}{\rho A}}$$

After replacing the data of the selected samara wing we get very approximate results, some difference can occur due human error factor in taking the samples

$$\sqrt{\frac{2 * 0,00005kg * 9,8 m/s^2}{1,225kg/m^3 * 0,0017m^2}} = 0,68m/s$$



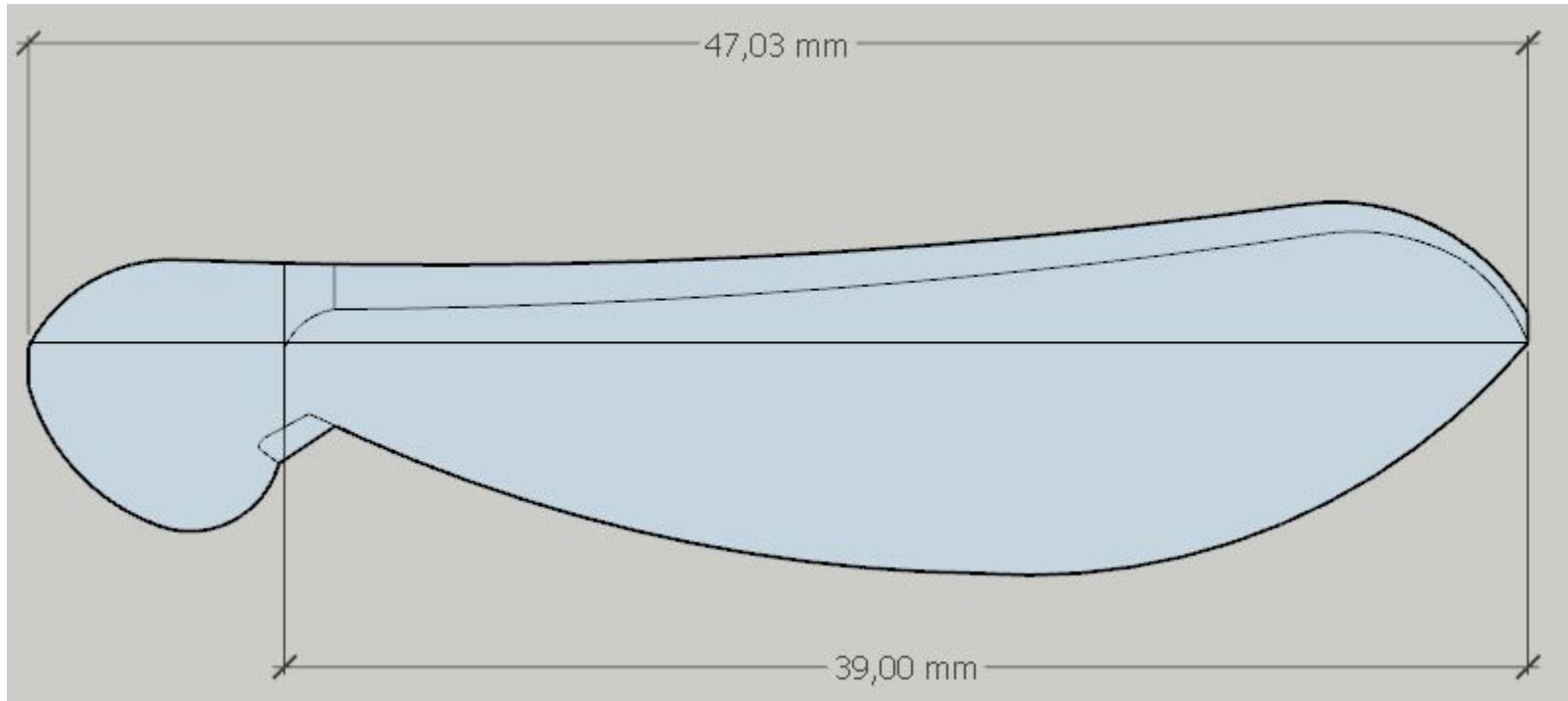
Descent Rate Estimates



Payload Descent Rate Estimate

Now given the container size restriction we come to the conclusion that the maximum length must be 290mm of length, taking the original samara seed and scaling it up taking by reference the wingspan this give us a scale of 6,16.

Original samara seed



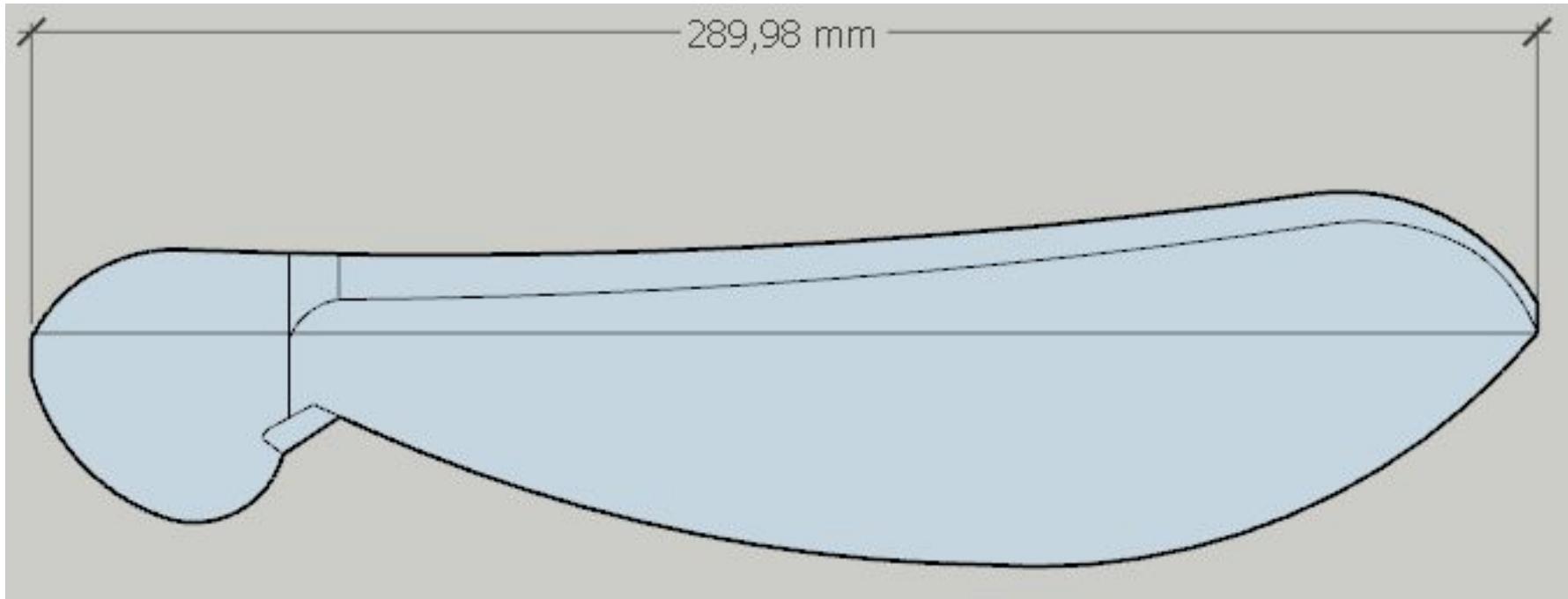


Descent Rate Estimates



Payload Descent Rate Estimate

We scale it up and draw the profile in a CAD software.



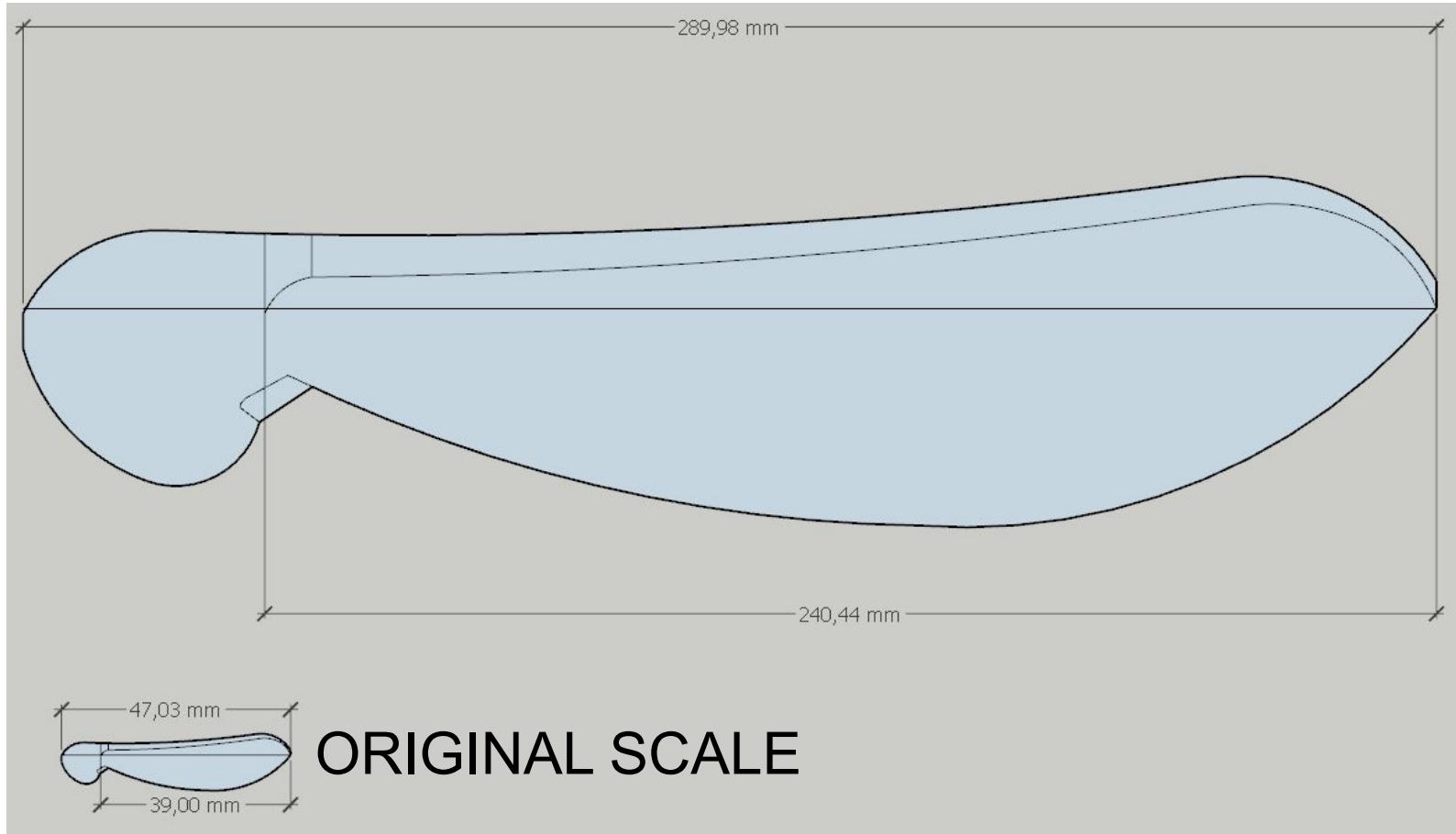


Descent Rate Estimates



Payload Descent Rate Estimate

Scaled samara seed





Descent Rate Estimates



Payload Descent Rate Estimate

Assuming that the scaled wing seed will be performing similarly in proportion of 6,16 we can assume that the swept area would be 6,16 times either, so using the previous equation we can estimate the descent velocity of the scaled model.

$$V = \sqrt{\frac{2 \times (0.1052 \text{ kg}) \times \left(9,81 \frac{\text{m}}{\text{s}^2} \right)}{1.225 \frac{\text{kg}}{\text{m}^3} \times (0.010472 \text{ m}^2)}} = 12,68 \text{ m/s}$$

With this results we accomplish mission requirements



Mechanical Subsystem Design

JORGE ROYON

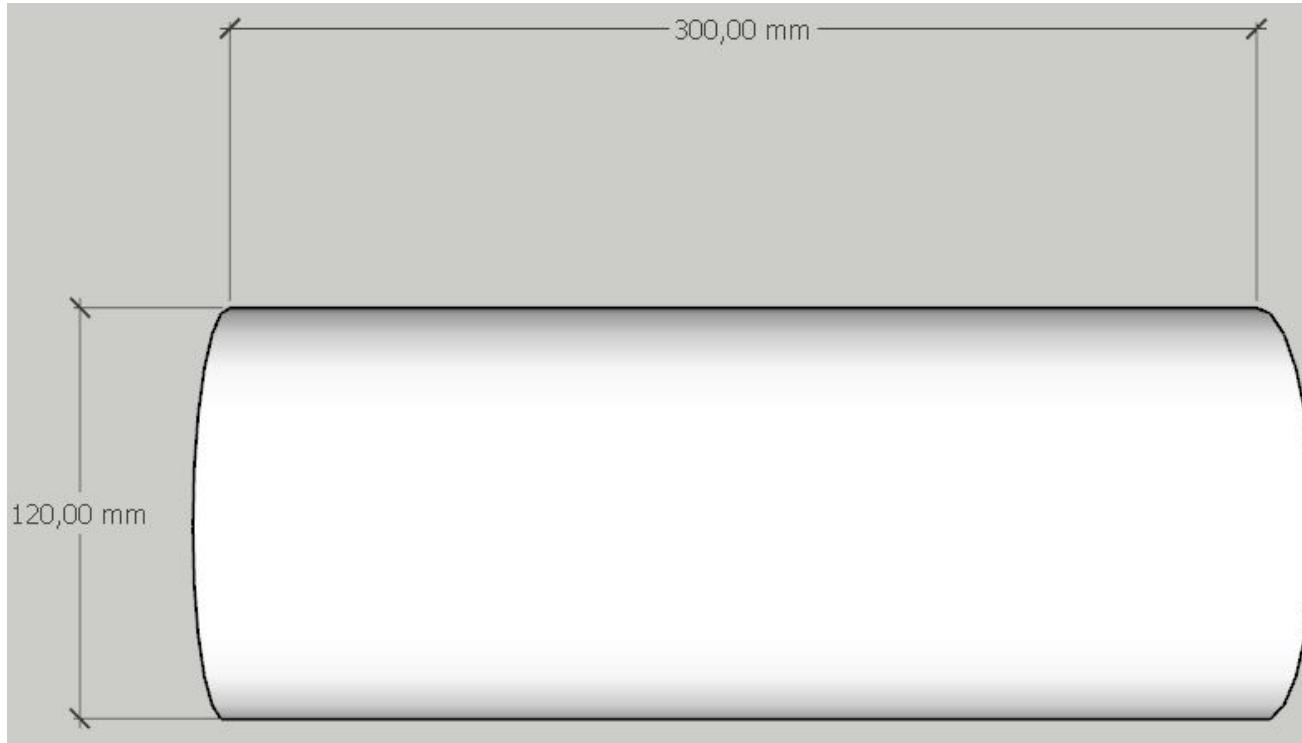


Mechanical Subsystem Overview



Container

- **12 cm diameter by 30 cm length**
- **3D printed in pla in thin walls of 0,8mm**
- **Estimate weight of 207,5gr**

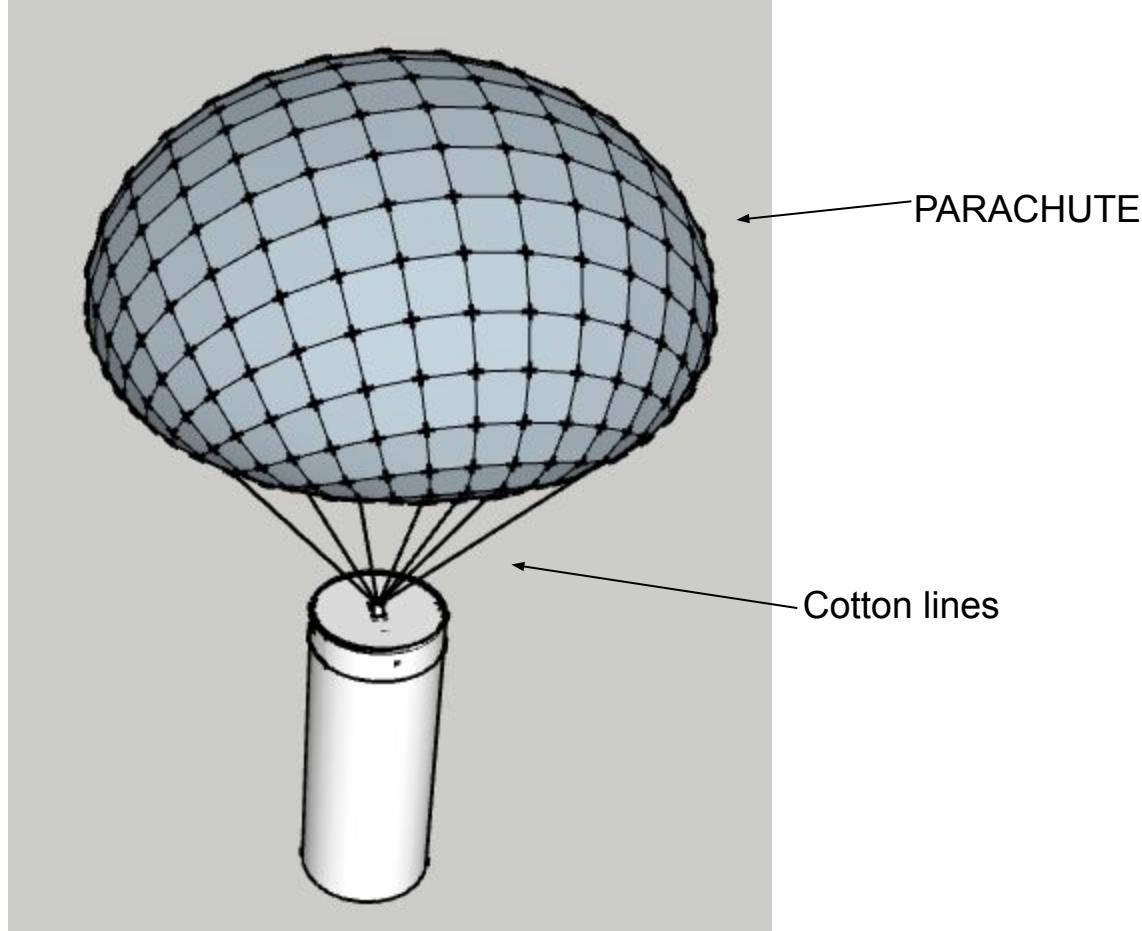




Mechanical Subsystem Overview



Container

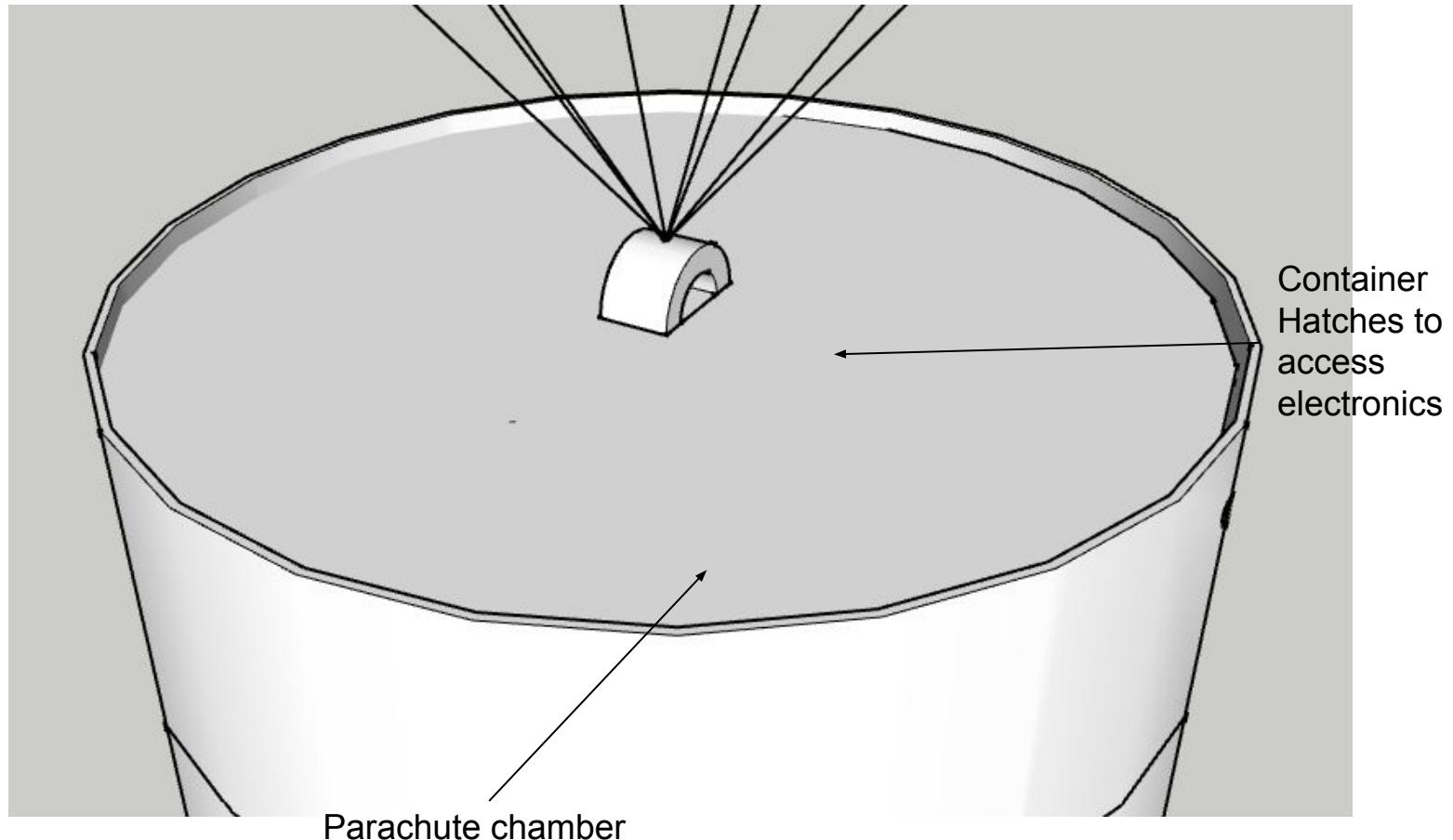




Mechanical Subsystem Overview



Container





Mechanical Subsystem Overview



Container

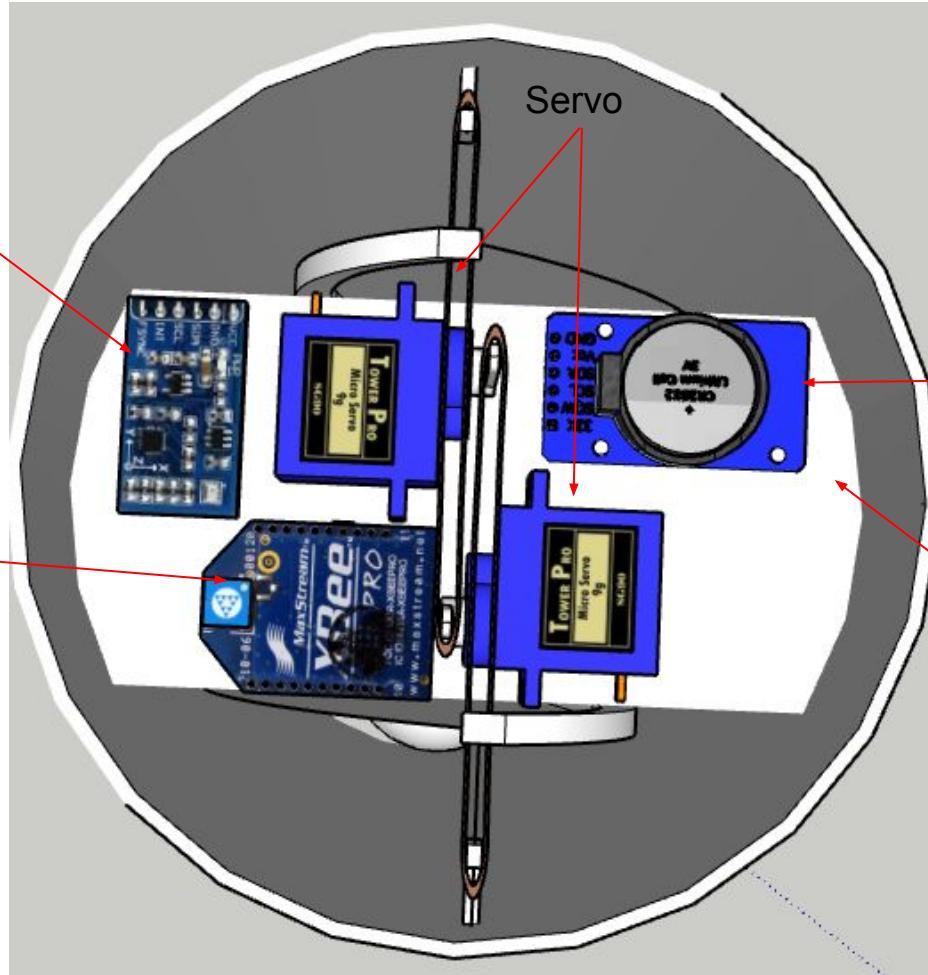
Rotation sensor

Servo

XBEE

Real time clock

Top electronics bay



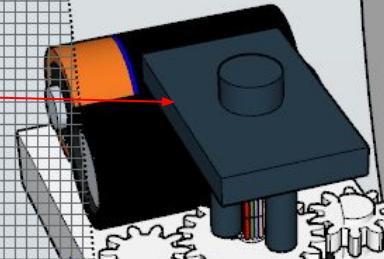


Mechanical Subsystem Overview

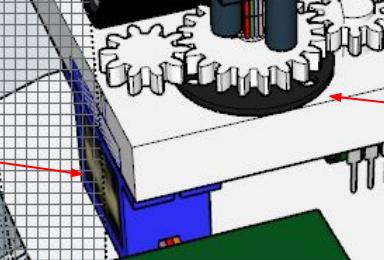


Container

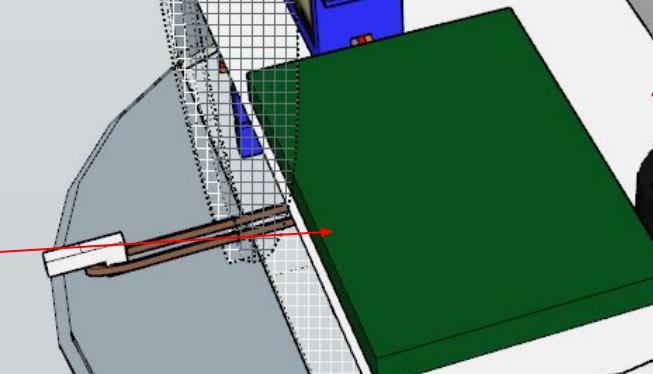
Camera



Servo



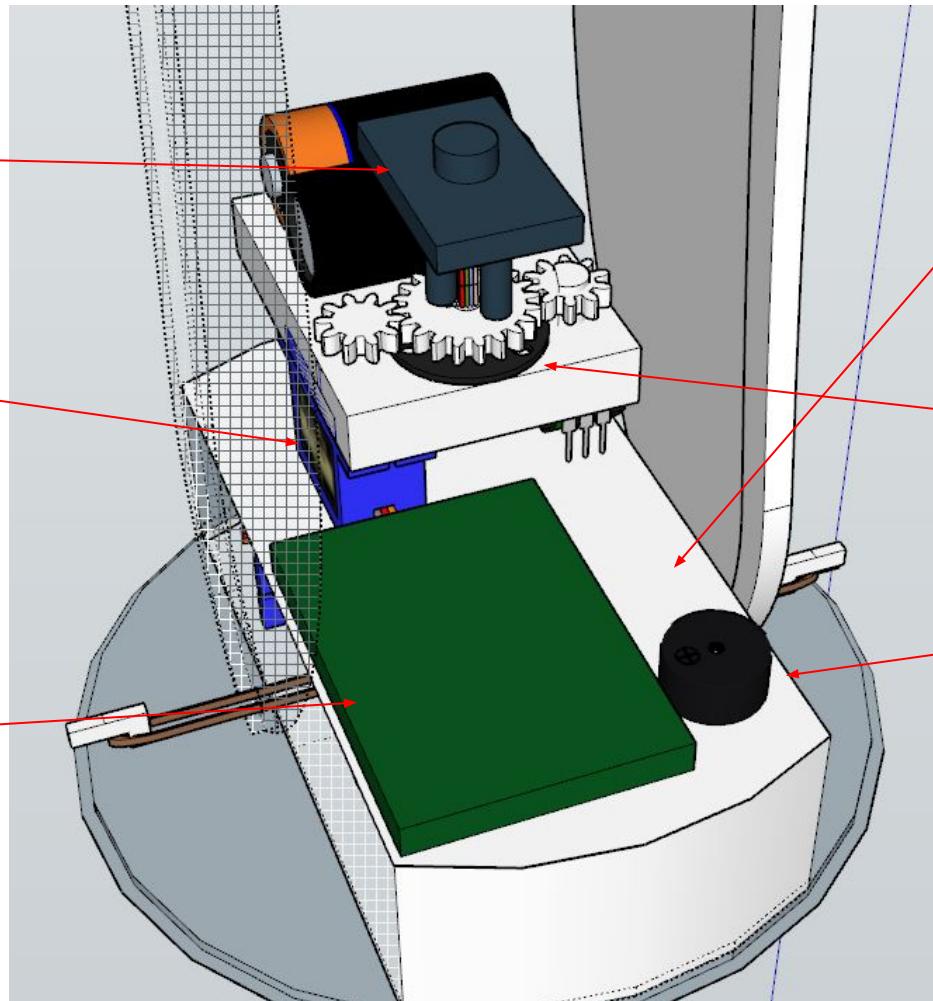
Arduino
mega
2560 mini



Bottom electronics bay

3D printed gears for rotate the camera and the encoder in concordancy driven by the servo

Buzzer

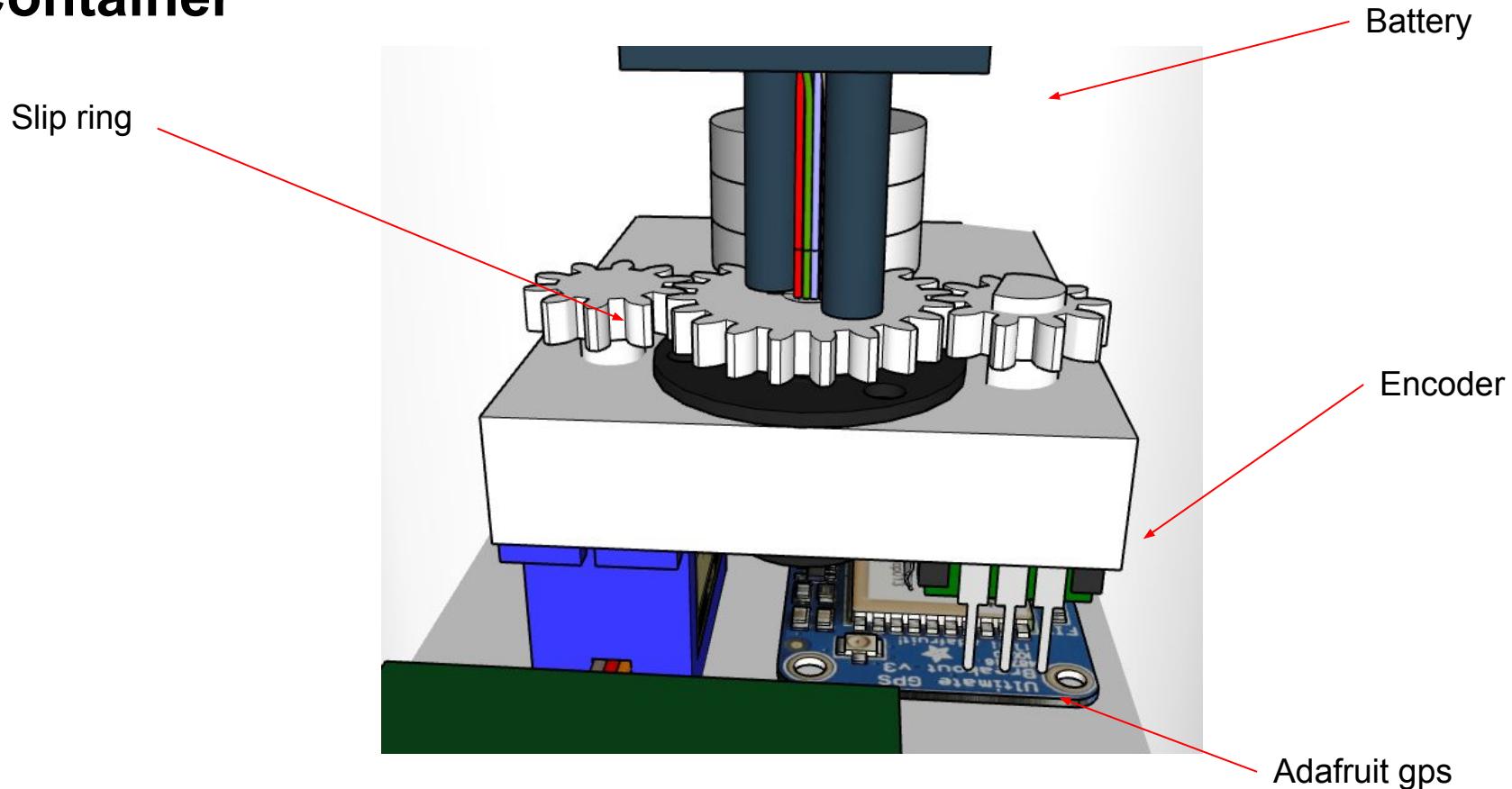




Mechanical Subsystem Overview



Container

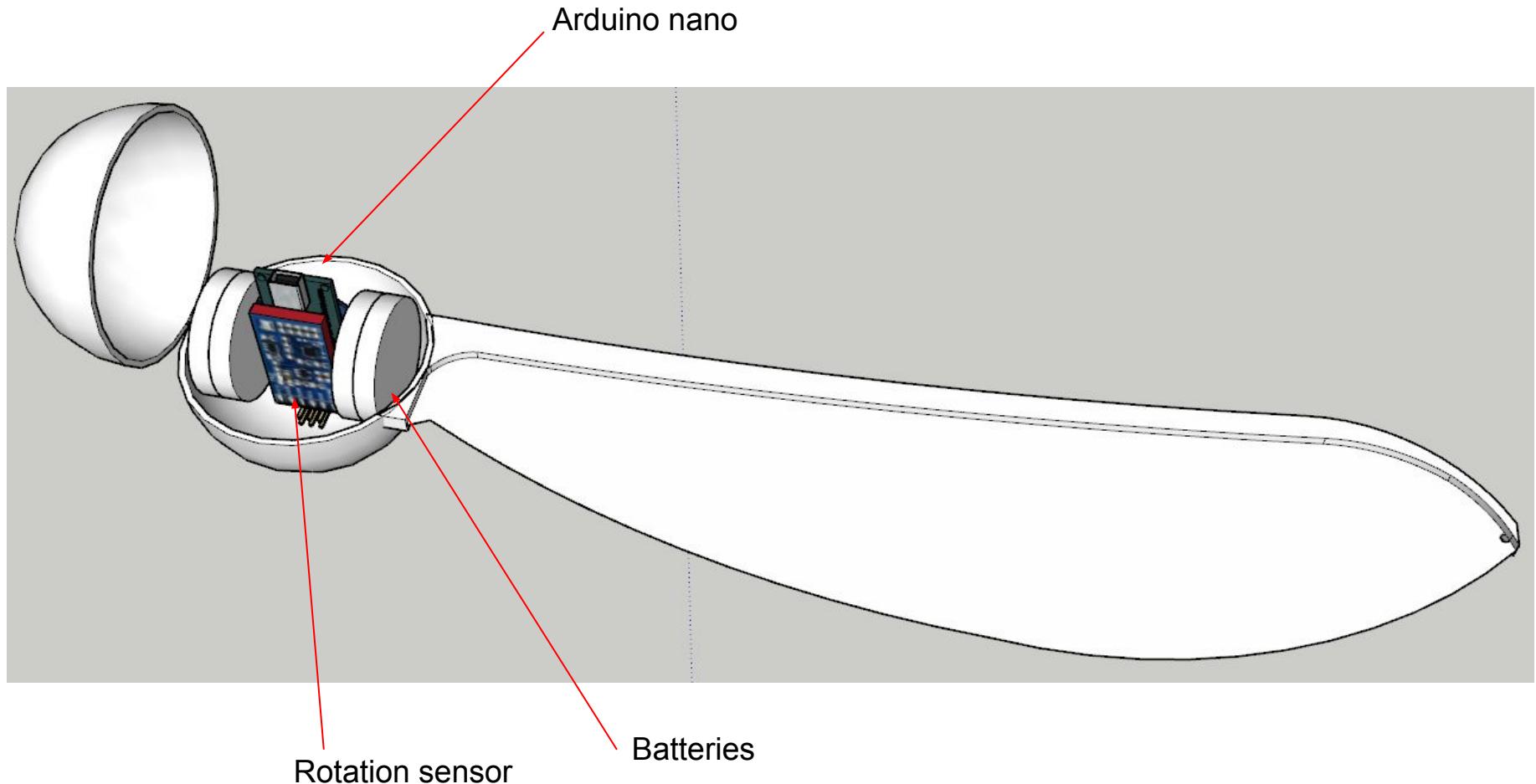




Mechanical Subsystem Overview



Payload

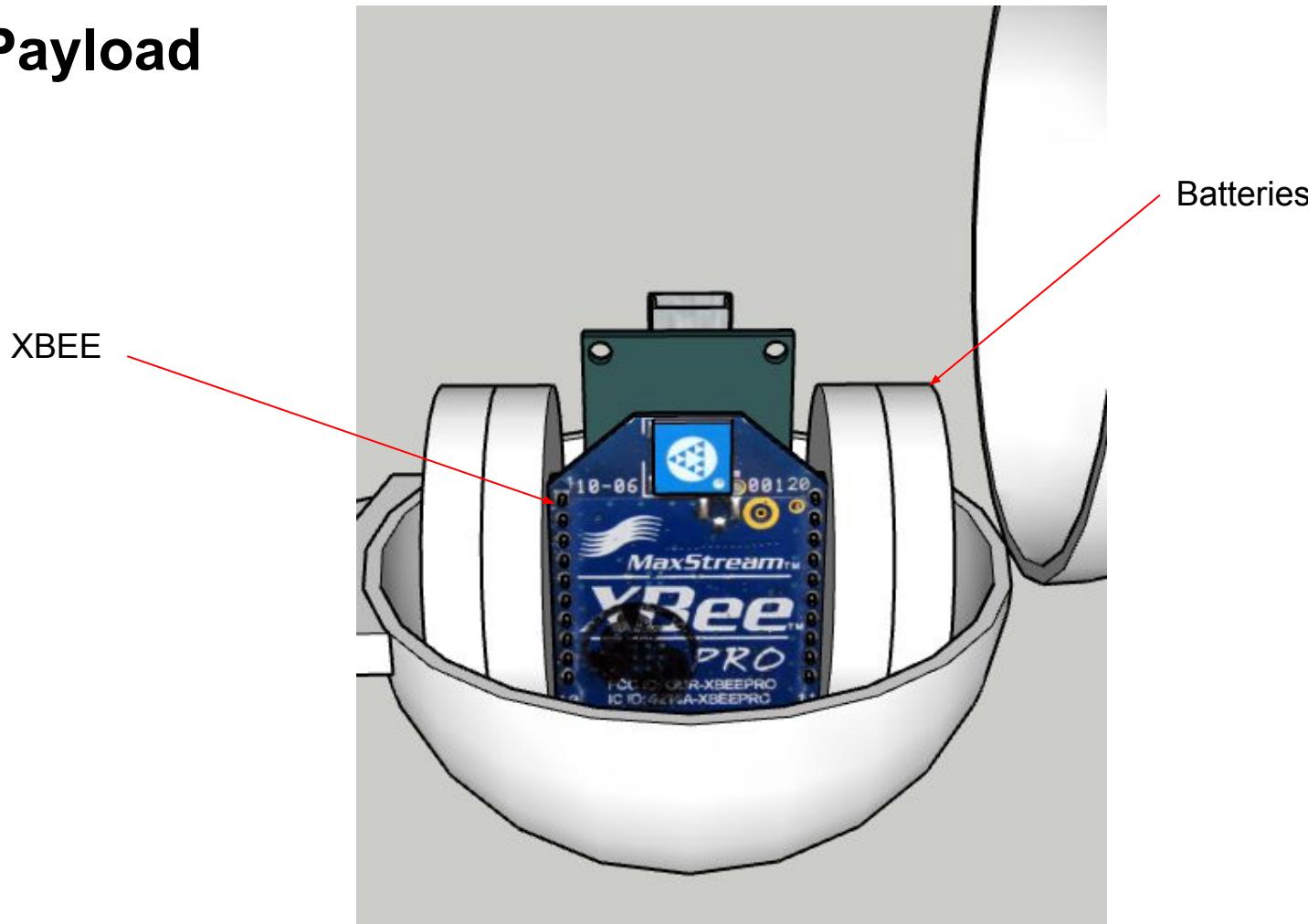




Mechanical Subsystem Overview



Payload





Mechanical Subsystem Changes Since PDR



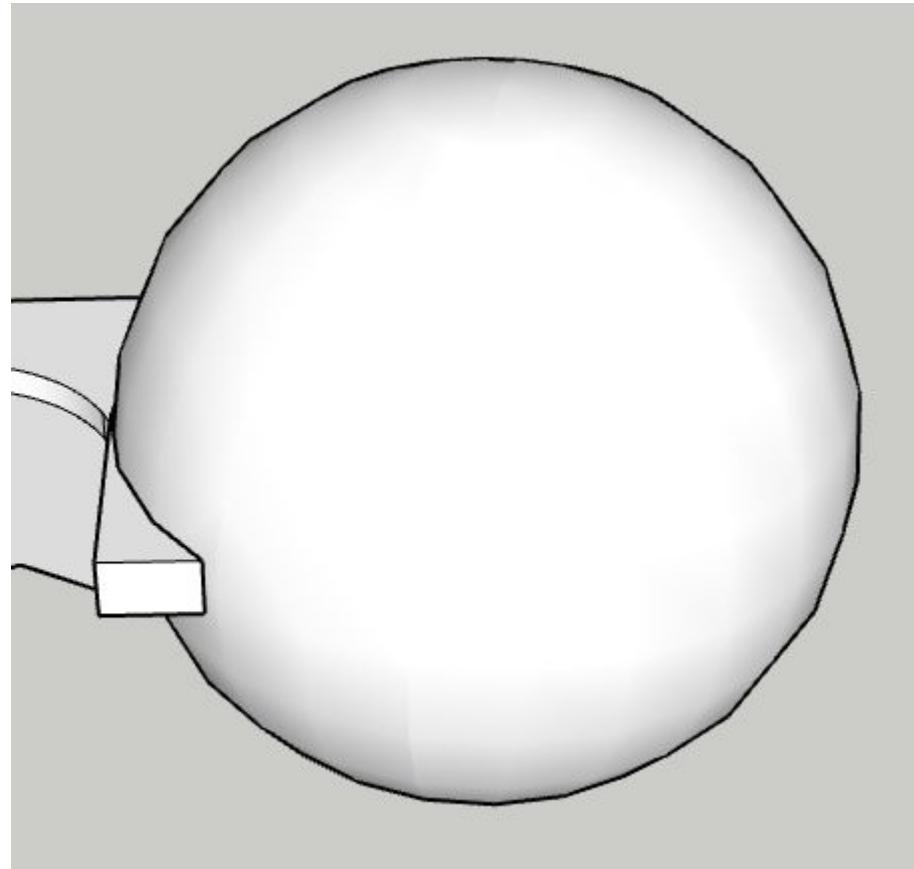
- Hingue of the payload is removed and is closed using CA glue and opened with CA debonder



Mechanical Subsystem Changes Since PDR



- Hingue of the payload is removed and close with CA glue and open with CA debonder





Mechanical Sub-System Requirements



RQ	Description	Rationale
1	Total mass of the CanSat (science payloads and container) shall be 600 grams +/- 10 grams.	CReq
2	CanSat shall fit in a cylindrical envelope of 125 mm diameter x 400 mm length. Tolerances are to be included to facilitate container deployment from the rocket fairing.	CReq
3	The container shall not have any sharp edges to cause it to get stuck in the rocket payload section which is made of cardboard.	CReq
5	The container shall be solid and fully enclose the science payloads. Small holes to allow access to turn on the science payloads is allowed. The end of the container where the payload deploys may be open.	CReq
6	The rocket airframe shall not be used to restrain any deployable parts of the CanSat.	CReq
7	The rocket airframe shall not be used as part of the CanSat operations.	CReq
8	The container parachute shall not be enclosed in the container structure. It shall be external and attached to the container so that it opens immediately when deployed from the rocket.	CReq
11	All structures shall be built to survive 15 Gs of launch acceleration.	CReq



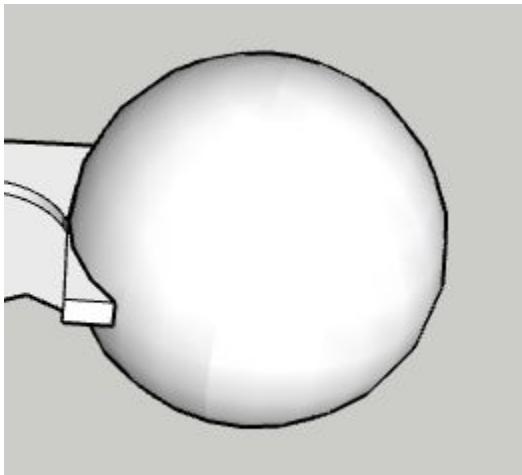
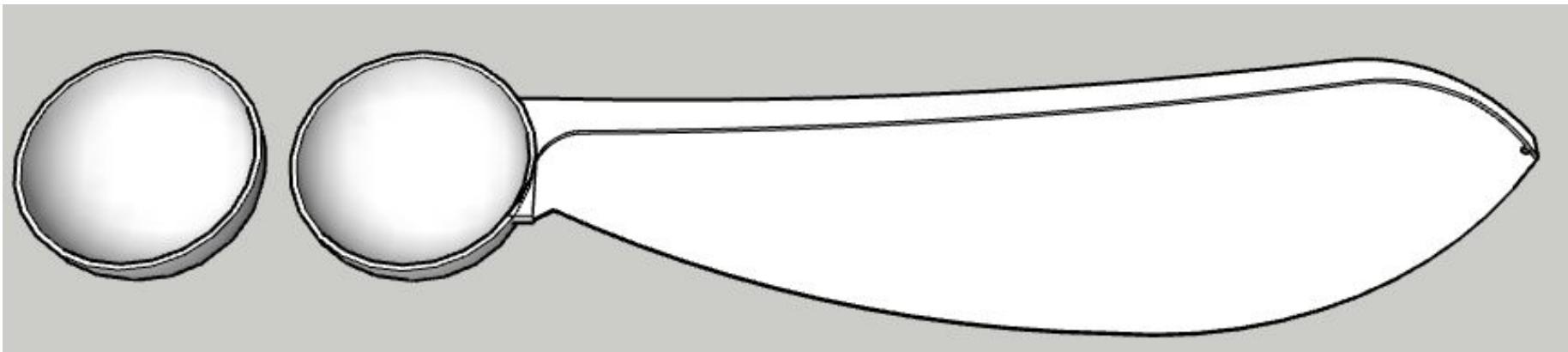
Mechanical Sub-System Requirements



RQ	Description	Rationale
12	All structures shall be built to survive 30 Gs of shock.	CReq
14	All mechanisms shall be capable of maintaining their configuration or states under all forces.	CReq
15	Mechanisms shall not use pyrotechnics or chemicals.	CReq
16	Mechanisms that use heat (e.g., nichrome wire) shall not be exposed to the outside environment to reduce potential risk of setting vegetation on fire.	CReq
44	An easily accessible battery compartment must be included allowing batteries to be installed or removed in less than a minute and not require a total disassembly of the CanSat.	CReq
45	Spring contacts shall not be used for making electrical connections to batteries. Shock forces can cause momentary disconnects.	CReq



Payload Mechanical Layout of Components



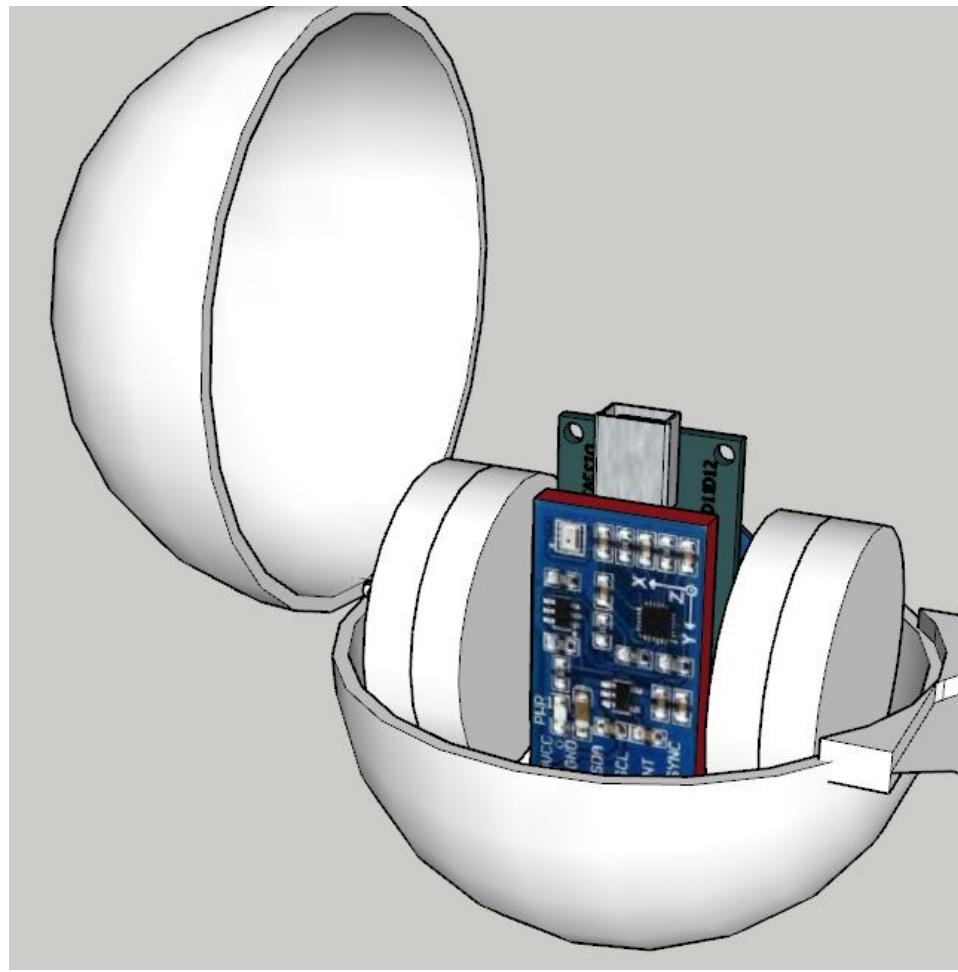
Payload is composed of 3 parts:

1. 3D printed semi sphere with hinge
2. 3D printed semi sphere with hinge
3. Wing made of balsa wood

When parts are ready for assembly we glue the wing to a semi sphere and the sphere parts, and when disassembly is needed CA debonder is applied



Payload Mechanical Layout of Components



Electronics are placed inside the semi sphere in a vertical way and secured with rubber foam cut to shape with the batteries attached to its laterals with double foam tape and CA glue



Payload Mechanical Layout of Components



Materials

Component	Material	Pros	Cons
Semi sphere	ABS	Slight lighter than PLA	Difficult to print
		Stronger and durable	Tends to warp and deform in printing process
		Easy to glue	

For the Semi sphere we choose to 3d printed in abs because is lightweight and easy to glue



Payload Mechanical Layout of Components

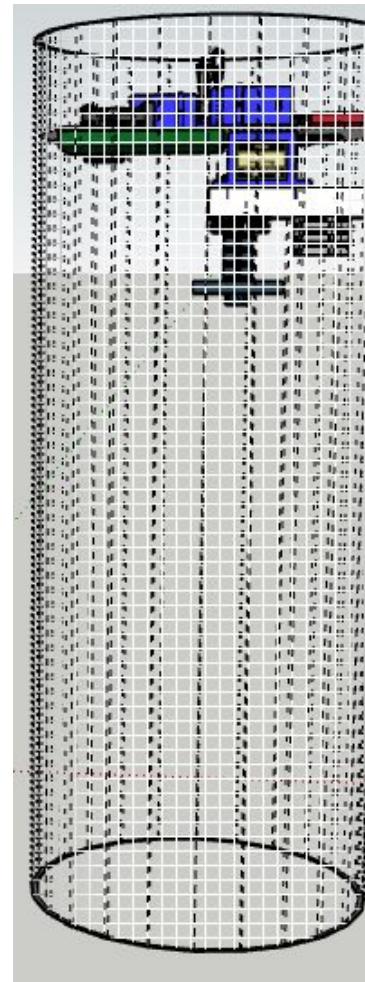


Materials

Component	Material	Pros	Cons
Wing	Balsa wood	Very lightweight	Weak
		Easy to work it	Time consuming
		Easy to glue	



Container Mechanical Layout of Components



Container has a top compartment with a removable hatches for access electronics



Container Mechanical Layout of Components



Container Materials

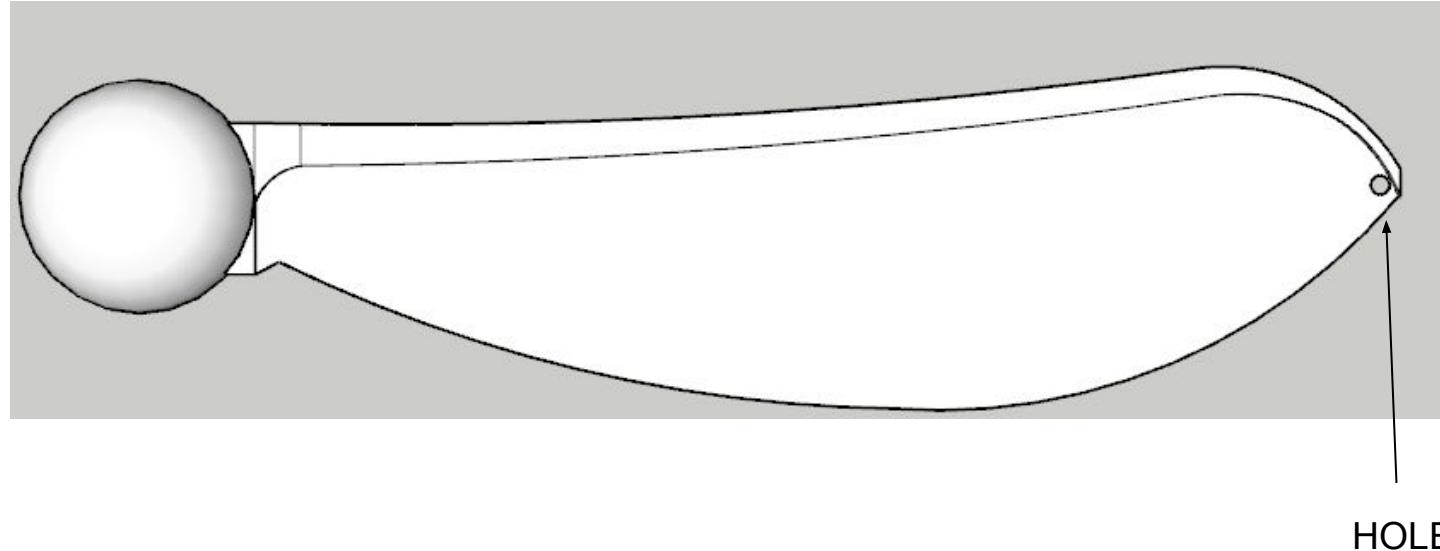
Material	Pros	Cons
PLA	Easy to print	Heavy
	3D printed, tight tolerances is easy to achieve	Relative weak



Payload Release Mechanism



Payload has a small hole in the wing that allows a rubber band to pass

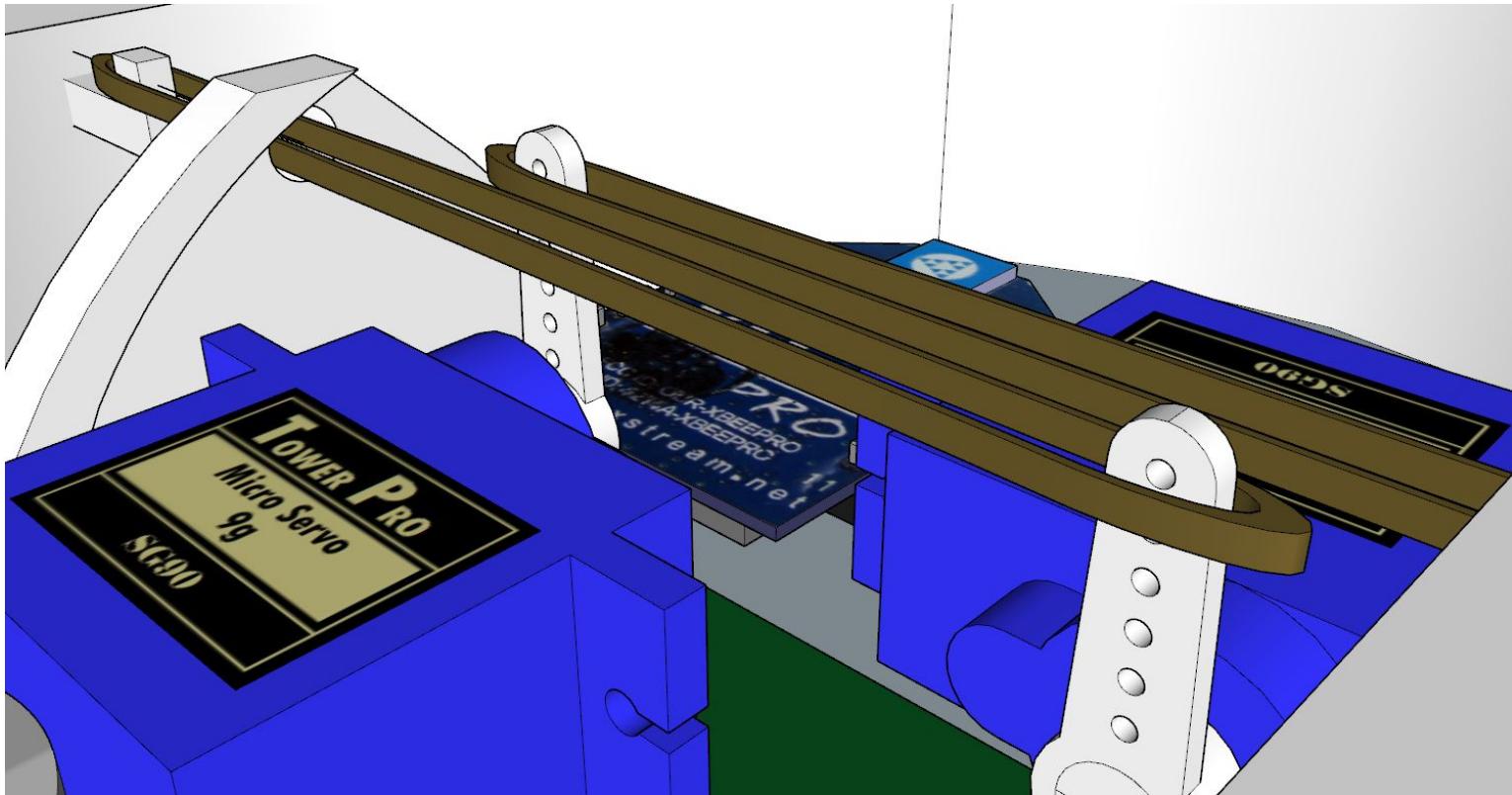




Payload Release Mechanism



The container has a hook in a inner wall, then a servo is used to lock the rubber band

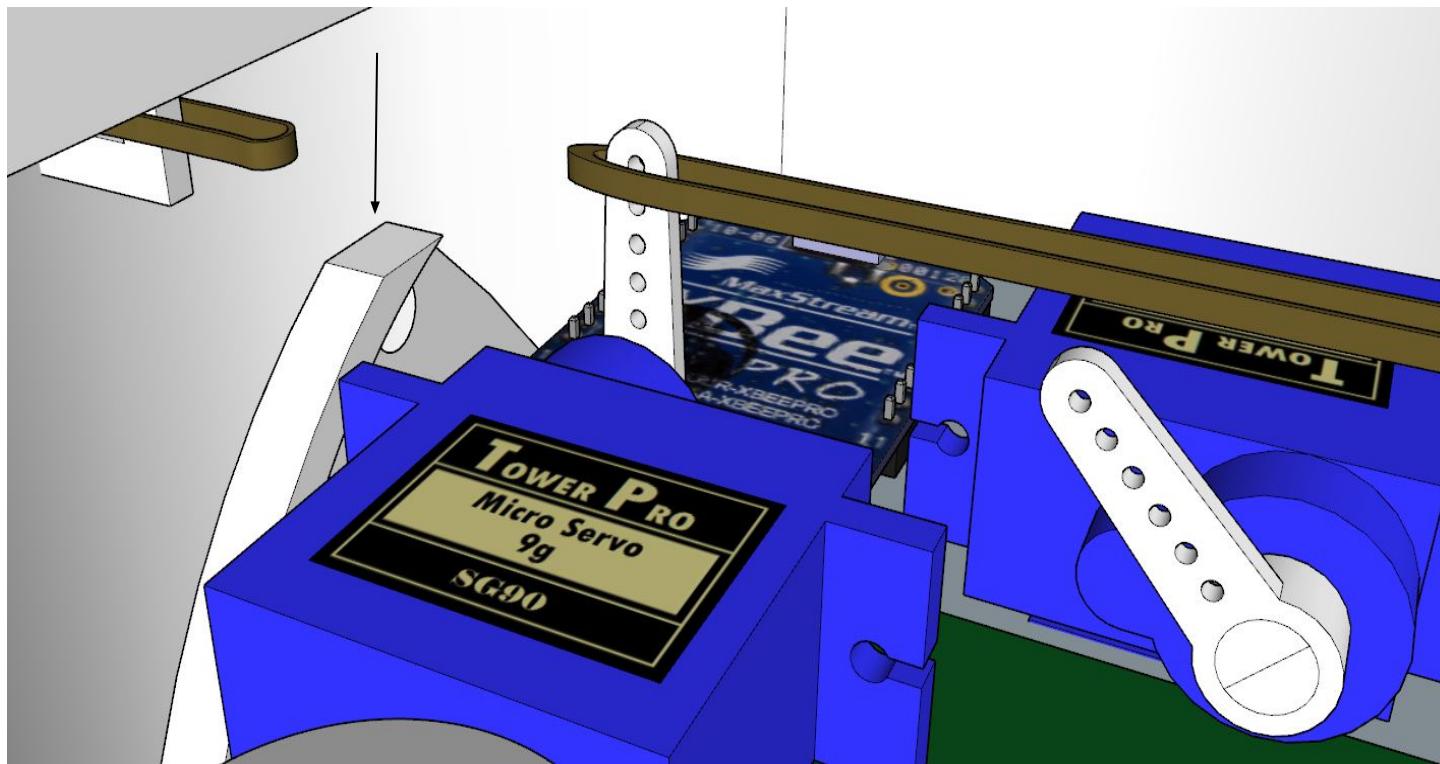




Payload Release Mechanism



Then the servo move the arm and release the rubber band that causes the release of the payload form the container that falls from his own weight

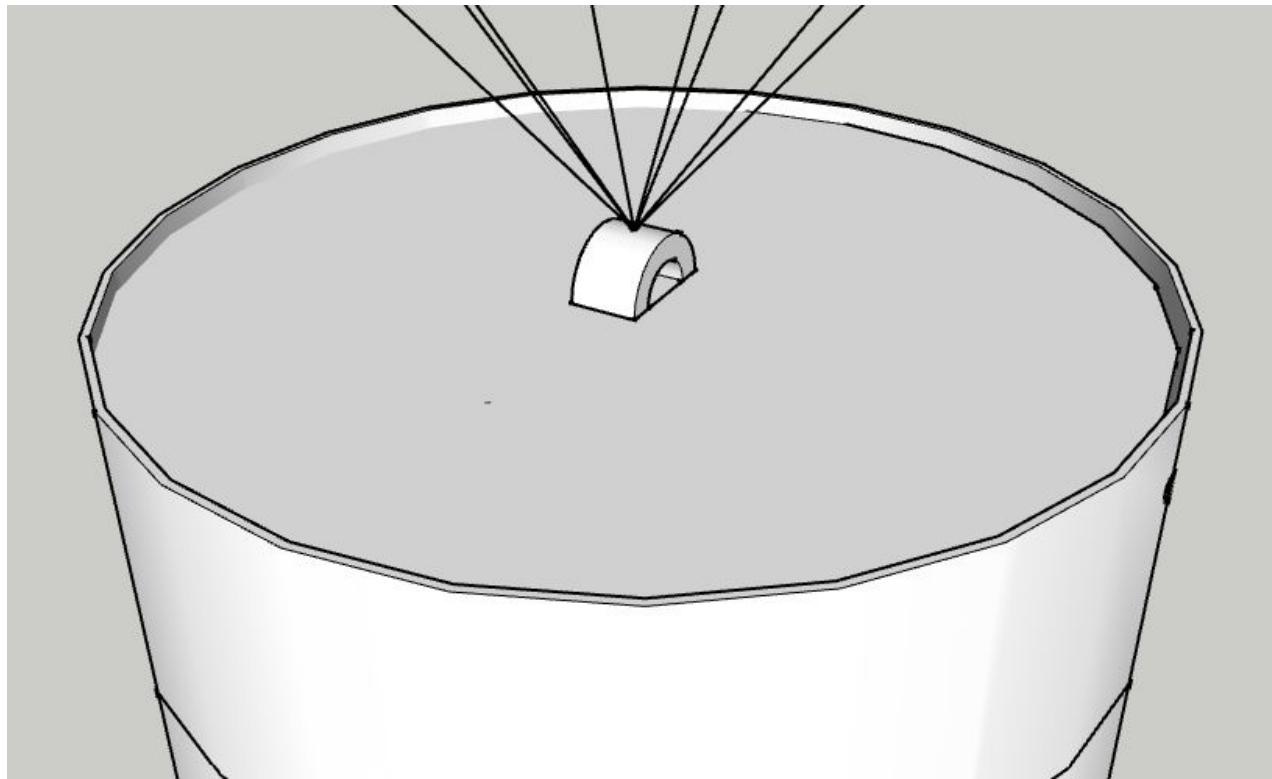




Container Parachute Attachment Mechanism



The container hatches has a small hook to attach the cottom lines of the parachute

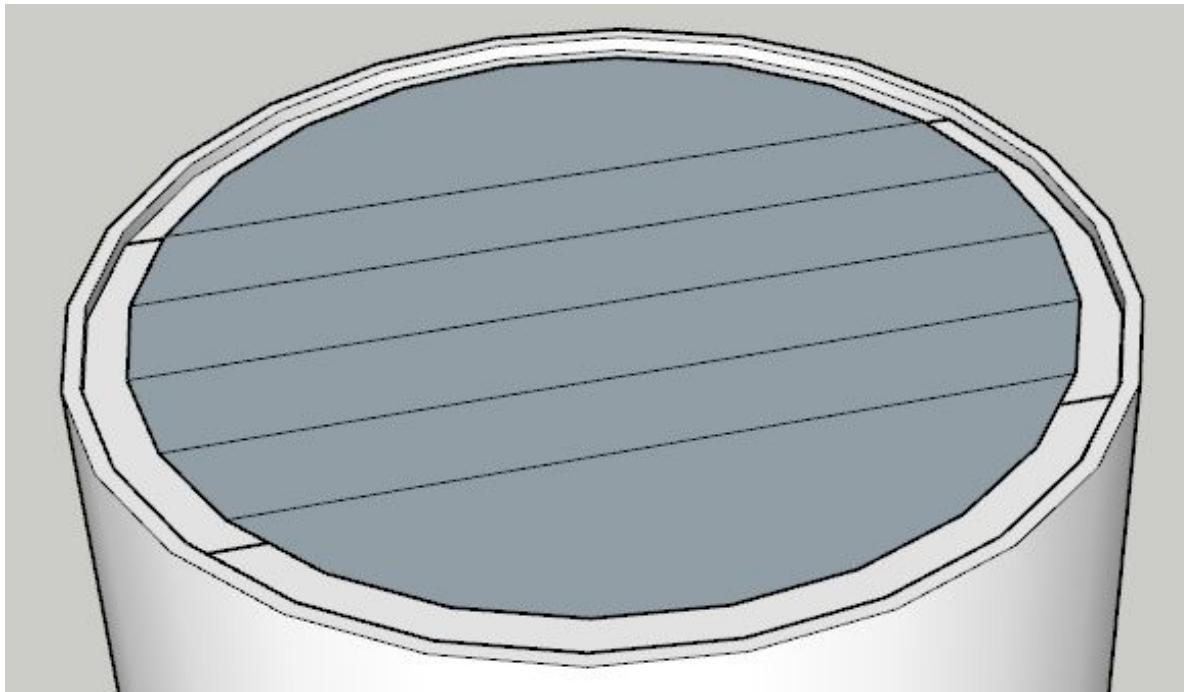




Container Parachute Attachment Mechanism



The parachute is packed in and put in the top of the container





Structure Survivability



Securing Electrical Connections

- Depending on the connection components, proper methods for securing will be used.

Electrical connection methods are:

- Soldering
- Cyanoacrylate
- Electric tape
- Thermo contractible tube
- hot glue



Mass Budget



PAYOUT MASS

PART	mass gr	Data type
XBee	40	D
10 DOF IMU Sensor	4	D
Arduino nano	7	D
lir3048 (x4)	29.2	D
Air frame	25	E (based on volume and material theoretical density)
TOTAL PAYLOAD MASS	105.2 gr	

D:Datasheet
E:Estimated



Mass Budget



CONTAINER MASS

PART	mass gr	Data type
XBee	40	D
10 DOF IMU Sensor	4	D
Arduino mega 2560 mini	5	D
CR123A (x2)	33	D
Frame	207,5	E (3D software estimation)
Container parachute	11	E (Based on material theoretical density)
Adafruit Ultimate GPS	8,5	D
Servo	9	D
Camera	13	D
Buzzer	15	D



Mass Budget



CONTAINER MASS

PART	mass gr	Data type
3D printed parts	3	E (3D printer software estimation)
Encoder	4	D
misc, (cotton wires, screw)	8	E (Hard to calculate, measure was taken with a scale)
Real time clock	8	D
TOTAL CONTAINER MASS	369 gr	



Mass Budget



CANSAT MASS

PART	Mass gr
PAYOUT 1	105.2
PAYOUT 2	105.2
CONTAINER	369
TOTAL	579.4



Mass Budget



CANSAT MASS

Total mass of the cansat is estimated in 579.4 gr, to reach the 600 gr mark we can add little plumbs in the container, and if its too heavy we can made holes in the lateral walls of the container and cover them with MONOKOTE to reduce weight

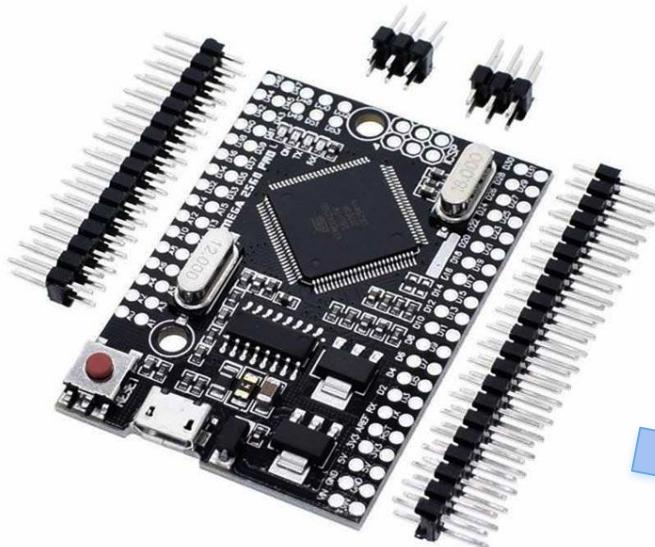


Communication and Data Handling (CDH) Subsystem Design

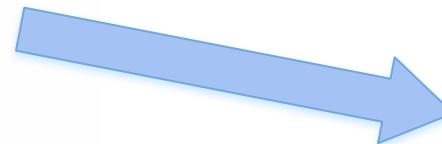
**Agustina Romero
Nicole Castro**



Container Command Data Handler (CDH) Overview



Arduino 2560 mega mini: A *Arduino mega*, is used to get data from sensors, transmit it to the XBee PRO S2C and control the container.



XBee PRO S2C: A *XBee PRO S2C module* is a transceiver. It is used to transmit and receive data between the payloads and the ground station.





CDH Changes Since PDR



- No changes since PDR



Container CDH Requirements



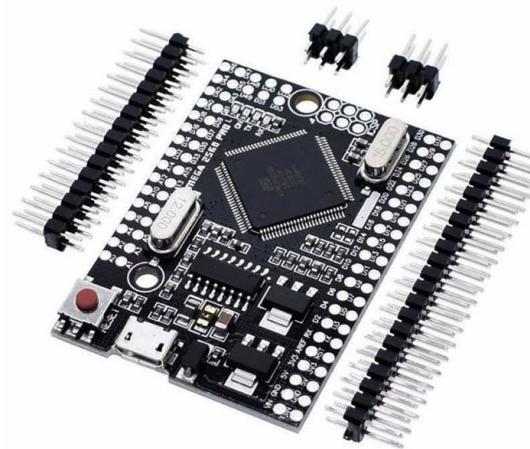
RQ	DESCRIPTION	RATIONALE	PRIORITY
19	XBEE radios shall be used for telemetry. 2.4 GHz Series radios are allowed. 900 MHz XBEE radios are also allowed	CReq	High
20	XBEE radios shall have their NETID/PANID set to their team number	CReq	High
21	XBEE radios shall not use broadcast mode	CReq	High
31	The container shall include electronics to receive sensor payload telemetry.	CReq	High
32	The container shall include electronics and mechanisms to release the science payloads.	CReq	High
33	The container shall include a GPS sensor to track its position.	CReq	High
34	The container shall include a pressure sensor to measure altitude.	CReq	High
35	The container shall measure its battery voltage.	CReq	High
36	The container shall transmit its telemetry and the payload telemetry received once per second in the format described in the Telemetry Requirements section.	CReq	High
37	The container shall stop transmitting telemetry when it lands.	CReq	High



Container Processor & Memory Selection



MODEL	BOOT TIME	PROCESSOR SPEED	I/O PINS	INTERFACES	MEMORY STORAGE REQUIRED	SUPPLY VOLTAGE
Arduino Mega 2560 mini	3.50 s	16 MHz	Analog In[16] PWM [14] Digital[70]	I2C [1] SPI [5] UART [4]	Flash-256 KB SRAM-8 KB EEPROM-4 KB	5V-12V





Container Real-Time Clock



MODEL	TYPE	VOLTAGE	CURRENT	ACCURACY	RESET TOLERANCE
Arduino RTC DS 3231	Hardware	3,3V	200 µA	±2 ppm	In reset condition external clock continues keeping time

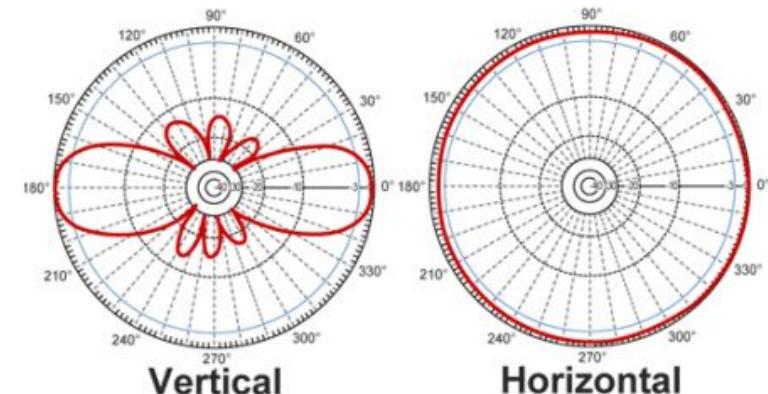




Container Antenna Selection



MODEL	CONNECTION TYPE	FREQUENCY	DIRECTION	GAIN	BEAM WIDTH HORIZONTAL/VERTICAL
Generic 2.4GHz	RP - SMA	2.4 GHz	Omnidirectional	2dBi	360°/32°





Container Radio Configuration



- **XBEE radio selection:** XBee PRO S2C
- **NETID:** 1231
- **TRANSMISSION CONTROL:** The XBee in the container is set as Coordinator and the XBee in the ground station is set at Endpoint In all of the mission phases the Coordinator transmits the telemetry data to the Endpoint. In addition, the coordinator in the container receives the data from the modules in the payloads while they are in flight and sends it to the ground station.
- **Data rate:** The xbee in the container is set to transmit de data to the ground station at 1 Hz transmission rate
- Both xbees communicate in unicast mode



Container Telemetry Format



DATA FORMAT	SAMPLE DATA	DESCRIPTION
<TEAM_ID>	1231	Is the assigned team identification.
<MISSION_TIME>	08:12:55	Is UTC time in format hh:mm:ss, where hh is hours, mm is minutes, and ss is seconds.
<PACKET_COUNT>	1485	Is the count of transmitted packets, which is to be maintained through processor reset. One count is used for transmission of all packets, regardless of type.
<PACKET_TYPE>	C	Is the ASCII character 'C' for Container telemetry, characters 'S1' for Science Payload 1 (deployed first) relayed telemetry, and characters 'S2' for Science Payload 2 (deployed second) relayed telemetry.
<MODE>	F	= 'F' for flight (the default mode upon system start) and 'S' for simulation
<SP1_RELEASED>	R	= 'N' for not released and 'R' for released
<SP2_RELEASED>	N	= 'N' for not released and 'R' for released



Container Telemetry Format



DATA FORMAT	SAMPLE DATA	DESCRIPTION
<ALTITUDE>	84.2	is the altitude in units of meters and must be relative to ground level. The resolution must be 0.1 meters.
<TEMP>	24.3	is the temperature in degrees Celsius with a resolution of 0.1 degrees C.
<VOLTAGE>	4.45	is the voltage of the CanSat power bus. The resolution must be 0.01 volts.
<GPS_TIME>	08:12:55	is the time generated by the GPS receiver. The time must be reported in UTC and have a resolution of a second.
<GPS_LATITUDE>	25.0458	is the latitude generated by the GPS receiver in decimal degrees with a resolution of 0.0001 degrees.
<GPS_LONGITUDE>	-160.5804	is the longitude generated by the GPS receiver in decimal degrees with a resolution of 0.0001 degrees.



Container Telemetry Format



DATA FORMAT	SAMPLE DATA	DESCRIPTION
<GPS_ALTITUDE>	84.2	is the altitude generated by the GPS receiver in meters above mean sea level with a resolution of 0.1 meters.
<GPS_SATS>	6	is the number of GPS satellites being tracked by the GPS receiver. This must be an integer number.
<SOFTWARE STATE>	SP1_RELEASE	is the operating state of the software. (e.g., LAUNCH_WAIT, ASCENT, ROCKET_SEPARATION, DESCENT, SP1_RELEASE, SP2_RELEASE, LANDED, etc.)
<SP1_PACKET_COUNT>	1065	is the count of relayed telemetry packets from Science Payload 1
<SP2_PACKET_COUNT>	1200	is the count of relayed telemetry packets from Science Payload 2
<CMD_ECHO>	CMD1000SIMP10 1325	is the fixed text command id and argument of the last received command with no commas.



Container Telemetry Format



- **Data format**

```
<TEAM_ID>,<MISSION_TIME>,<PACKET_COUNT>,<PACKET_TYPE>,<MODE>,
<SP1_RELEASED>,<SP2_RELEASED>,<ALTITUDE>,<TEMP>,
<VOLTAGE>,<GPS_TIME>,<GPS_LATITUDE>,<GPS_LONGITUDE>,
<GPS_ALTITUDE>,<GPS_SATS>,<SOFTWARE_STATE>,
<SP1_PACKET_COUNT>,<SP2_PACKET_COUNT>,<CMD_ECHO>
```

- **Telemetry data file name for the Container:**

- for Container: Fligth_1231_C.csv
- Data from payload shall transmit continuously at 1Hz sample rate



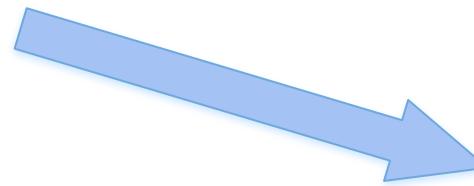
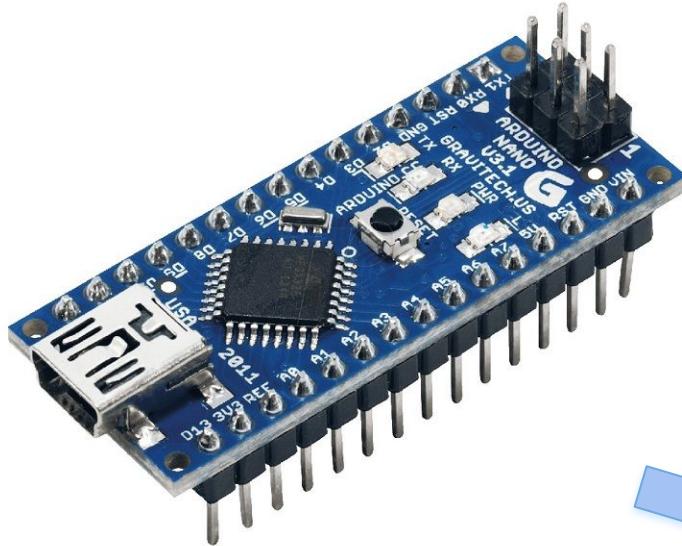
Container Command Formats



COMMAND	DESCRIPTION	DATA INCLUDED	DATA SAMPLE
CX	Container Telemetry On/Off Command	<ON_OFF> is the string 'ON' to activate the Container telemetry transmissions and 'OFF' to turn off the transmissions.	CMD,1231,CX,ON
ST	Set Time	<UTC_TIME> is UTC time in the format hh:mm:ss where hh is hours, mm is the minutes and ss is the seconds.	CMD,1231,ST,13:35:59
SIM	Simulation Mode Control Command	<MODE> is the string 'ENABLE' to enable the simulation mode, 'ACTIVATE' to activate the simulation mode, or 'DISABLE' which both disables and deactivates the simulation mode.	CMD,1231,SIM,ENABLE
PX	Science Payload Transmission On/Off	<ON_OFF> is the string 'ON' to activate the Science Payload transmissions and 'OFF' to turn off the transmissions	CMD,1000,SP1X,ON
SIMP	Simulated Pressure Data	<PRESSURE> is the simulated atmospheric pressure data in units of pascals with a resolution of one Pascal.	CMD,1000,SIMP,101325



Payload CDH Overview



Arduino nano A *Arduino nano*, is used to get data from sensors and transmit it from the XBee³ to the container.



XBee³: An *XBee³ module* is used to transmit data to the payloads and to the ground station.



Payload CDH Requirements



ID	DESCRIPTION	RATIONALE	PRIORITY
19	XBEE radios shall be used for telemetry. 2.4 GHz Series radios are allowed. 900 MHz XBEE radios are also allowed.	CReq	High
20	XBEE radios shall have their NETID/PANID set to their team number.	CReq	High
21	XBEE radios shall not use broadcast mode.	CReq	High
22	The science payload shall descend spinning passively like a maple seed with no propulsion.	CReq	High
23	The science payload shall have a maximum descent rate of 20 m/s.	CReq	High
24	The wing of the science payload shall be colored fluorescent orange, pink or green.	CReq	High



Payload CDH Requirements



ID	DESCRIPTION	RATIONALE	PRIORITY
25	The science payload shall measure altitude using an air pressure sensor.	CReq	High
26	The science payload shall measure air temperature.	CReq	High
27	The science payload shall measure rotation rate as it descends.	CReq	High
28	The science payload shall transmit all sensor data once per second.	CReq	High
29	The science payload telemetry shall be transmitted to the container only.	CReq	High
30	The science payload shall have their NETID/PANID set to their team number plus five. If team number is 1000, sensor payload NETID is 1005.	CReq	High

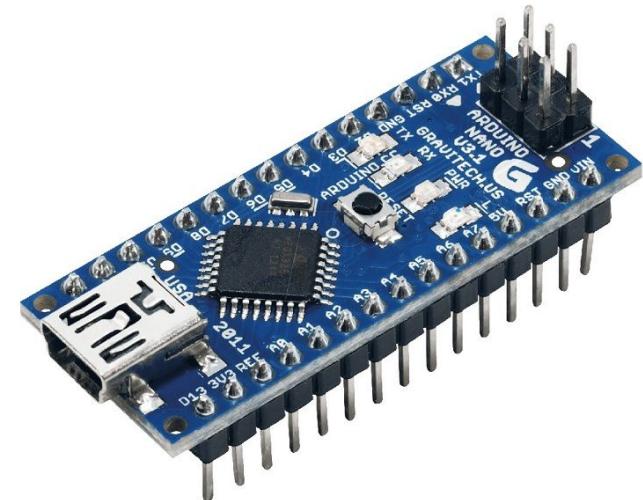


Payload Processor & Memory Selection



MODEL	BOOT TIME	PROCESSOR SPEED	I/O PINS	INTERFACES	MEMORY STORAGE REQUIRED	SUPPLY VOLTAGE
Arduino Nano	4.84 s	16 MHz	Analog In[8] PWM [6] Digital[62]	I2C [1] SPI [1] UART [1]	Flash-32 KB SRAM-2 KB EEPROM-1 KB	5V-9V

Arduino nano onboard memory it seem to be enough for the mission.

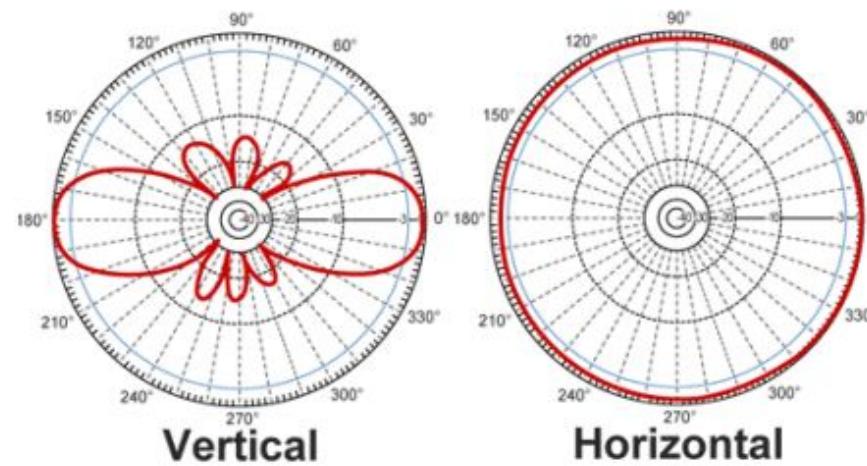




Payload Antenna Selection



MODEL	CONNECTION TYPE	FREQUENCY	DIRECTION	GAIN	BEAM WIDTH HORIZONTAL/VERTICAL
Antenna of XBee ³ module	-	2.4 GHz	Omnidirectional	2dBi	360°/32°





Payload Radio Configuration



- **XBEE radio selection:** XBee³
- **NETID:** 1236
- **TRANSMISSION CONTROL:** The XBEEs in the Payloads are set as Endpoint and the XBee in the container is set at Coordinator. In all of the mission phases the Endpoints transmit the telemetry data only to the Coordinator, while they are in flight and then, the Coordinator sends it to the ground station.
- **Data rate:** The XBEEs in the Payloads are set to transmit data to the container at 1 Hz transmission rate
- All the XBEE communicate in unicast mode



Payload Telemetry Format



Data Format	Sample Data	Description
<TEAM_ID>	1236	Is the assigned team identification.
<MISSION_TIME>	10:22:16	Is UTC time in format hh:mm:ss, where hh is hours, mm is minutes, and ss is seconds.
<PACKET_COUNT>	1684	Is the count of transmitted packets, which is to be maintained through processor reset. One count is used for transmission of all packets, regardless of type.
<PACKET_TYPE>	S1	Is the ASCII character 'C' for Container telemetry, characters 'S1' for Science Payload 1 (deployed first) relayed telemetry, and characters 'S2' for Science Payload 2 (deployed second) relayed telemetry.
<SP_ALTITUDE>	84.1	Is the altitude in units of meters and must be relative to ground level. The resolution must be 0.1 meters.
<SP_TEMP>	28.5	Is the measured temperature in degrees Celsius with a resolution of 0.1 degrees C.
<SP_ROTATION_RATE>	120	Is the science payload rotation rate around the axis perpendicular to the center of the rotor in RPM.



Payload Telemetry Format



- **Data format**

<TEAM_ID>,<MISSION_TIME>,<PACKET_COUNT>,<PACKET_TYPE>,<S
P_ALTITUDE>,<SP_TEMP>,<SP_ROTATION_RATE>

- **Telemetry data file name:**

- for Science Payload 1: **Fligth_1231_SP1.csv**
- for Science Payload 2: **Fligth_1231_SP2.csv**



Electrical Power Subsystem (EPS) Design

**Agustina Romero
Nicole Castro**



EPS Overview (1 of 3)



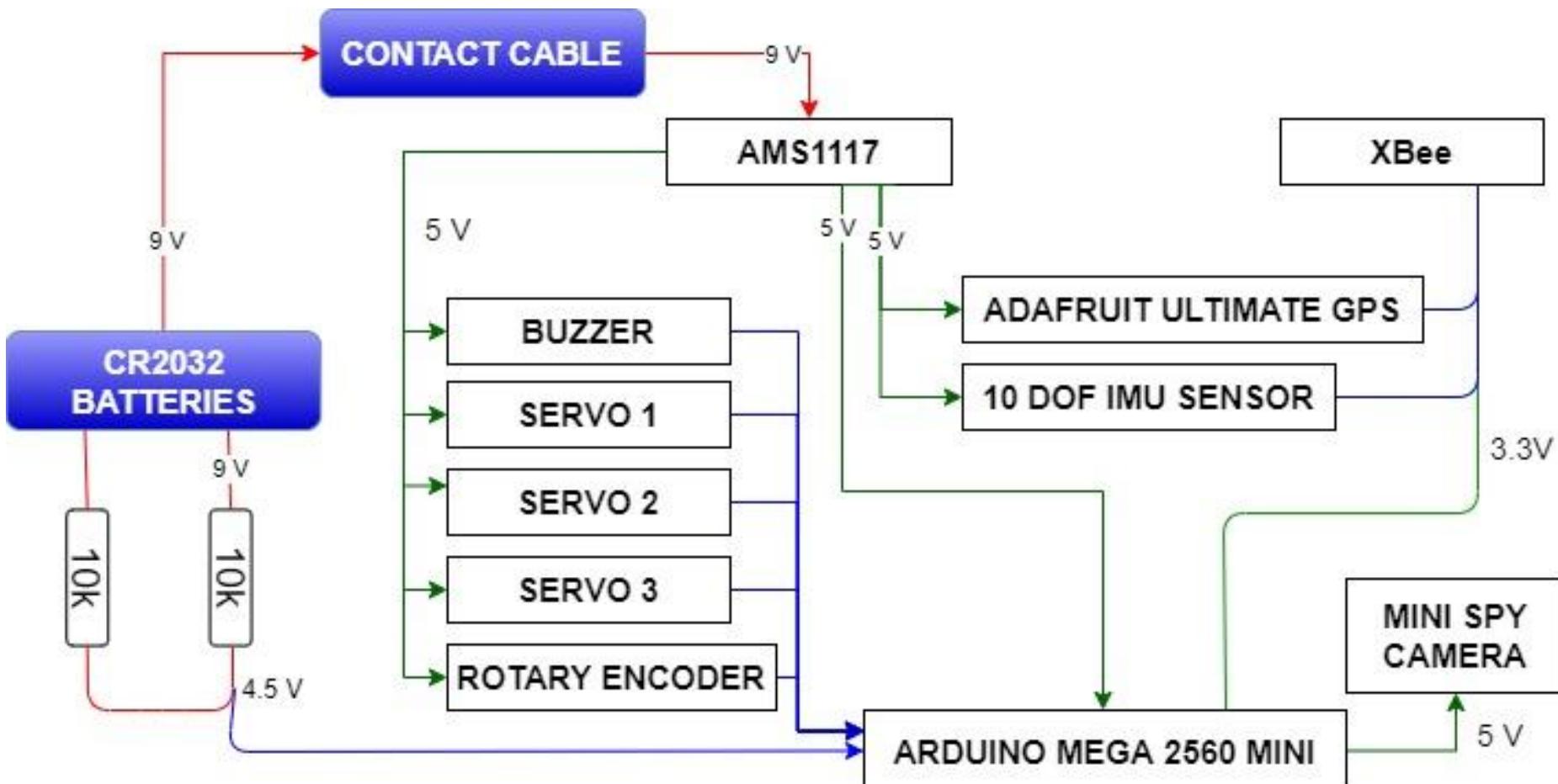
COMPONENT	PURPOSE
Energizer CR123A	Power source
AMS1117	Provides clean 5 volts supply
XBee RX	Radio communicator
10 DOF IMU Sensor	Stabilization, navigation, temperature and pressure sensor
Adafruit Ultimate GPS	GPS Sensor
Mini Spy Camera	Bonus objective



EPS Overview (2 of 3)



Container overview



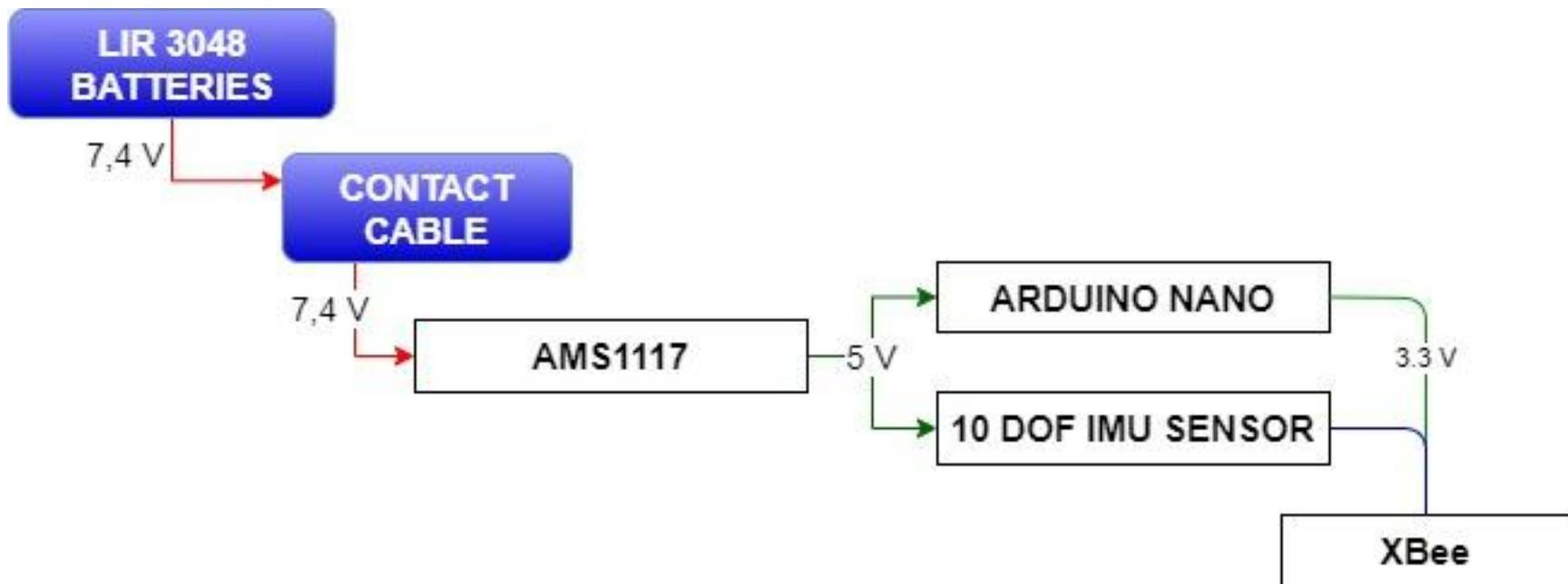
AMS117: Arduino voltage regulator



EPS Overview (3 of 3)



Payload overview



AMS117: On board Arduino voltage regulator



EPS Changes Since PDR



- Voltage divider is implemented
- Container battery changed



EPS Requirements



RQ	DESCRIPTION	RATIONALE	PRIORITY
1	Total mass of the CanSat (science payloads and container) shall be 600 grams +/- 10 grams.	CReq	High
13	All electronics shall be hard mounted using proper mounts such as standoffs, screws, or high performance adhesives.	CReq	High
31	The container shall include electronics to receive sensor payload telemetry.	CReq	High
32	The container shall include electronics and mechanisms to release the science payloads.	CReq	High
38	The container and science payloads must include an easily accessible power switch that can be accessed without disassembling the cansat and science payloads and in the stowed configuration.	CReq	High
39	The container must include a power indicator such as an LED or sound generating device that can be easily seen or heard without disassembling the cansat and in the stowed state.	CReq	High



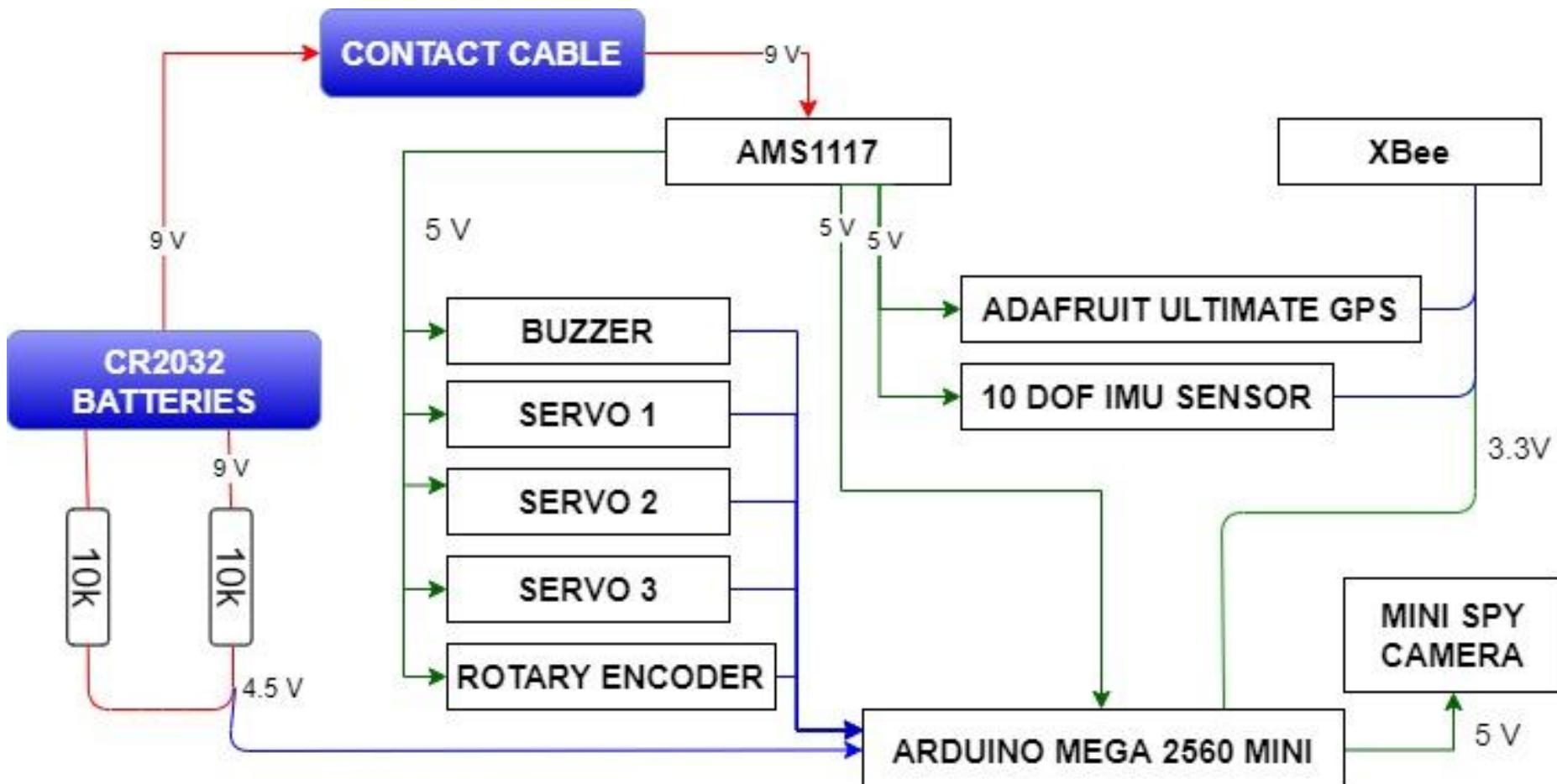
EPS Requirements



RQ	DESCRIPTION	RATIONALE	PRIORITY
40	An audio beacon is required for the container. It may be powered after landing or operate continuously.	CReq	High
41	The audio beacon must have a minimum sound pressure level of 92 dB, unobstructed.	CReq	High
42	Battery source may be alkaline, Ni-Cad, Ni-MH or Lithium. Lithium polymer batteries are not allowed. Lithium cells must be manufactured with a metal package similar to 18650 cells. Coin cells are allowed.	CReq	High
44	An easily accessible battery compartment must be included allowing batteries to be installed or removed in less than a minute and not require a total disassembly of the CanSat.	CReq	High
45	Spring contacts shall not be used for making electrical connections to batteries. Shock forces can cause momentary disconnects.	CReq	High
47	The Cansat shall operate for a minimum of two hours when integrated into the rocket.	CReq	High



Container Electrical Block Diagram





Container Power Source



MODEL	VOLTAGE (V)	CURRENT (mAh)	WEIGHT (g)	DIMENSION (mm)	BATTERY CHEMISTRY
ENERGIZER CR 2032	3	235	3,3	20mm x 3,2mm	LiMnO2





Container Power Budget

COMPONENT	POWER CONSUMPTION (wh)	CURRENT (mA)	VOLTAGE (V)	DUTY CYCLES (hr)	SOURCE
Arduino Mega 2560 mini	0,0051	0,51	5	2	Datasheet
Adafruit Ultimate GPS	0,2	20	5	2	Datasheet
10 DOF IMU Sensor	0,42	42	5	2	Datasheet
Mini Spy Camera	0,055	110	5	0,10	Datasheet
Servo 1	0,052	650	5	0,016	Datasheet
Servo 2	0,052	650	5	0,016	Datasheet
Servo 3	0,10725	325	5	0,066	Datasheet
XBee	0,1518	23	3,3	2	Datasheet
Rotary Encoder	0	0,001	5	0,10	Datasheet

(Servo 1 and Servo 2 hold payloads in container)



Container Power Budget



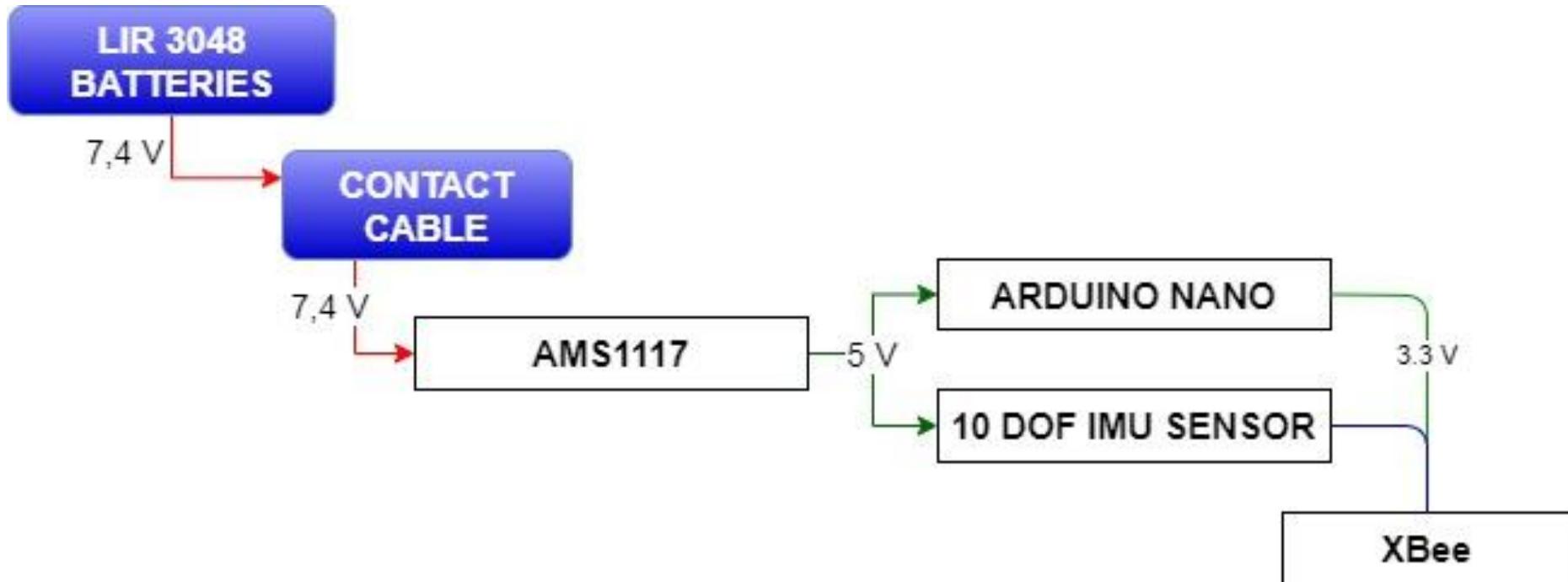
COMPONENT	POWER CONSUMPTION (wh)	CURRENT (mA)	VOLTAGE (V)	DUTY CYCLES (hr)	SOURCE
Buzzer	0,04	500	5	0,016	Datasheet
AMS1117	0,12	10	6	2	Datasheet
Arduino Mona DS3231	0,002	0,2	5	2	Datasheet
Total	1,20515				

AVAILABLE TOTAL POWER CAPACITY (for two batteries)	TOTAL POWER CONSUMED (for two hours)	MARGIN OF POWER CONSUMPTION
2,115 wh	1,20515 wh	0,90985 wh

Conclusion: Our batteries are enough to power all components for two hours



Payload Electrical Block Diagram



AMS117: On board Arduino voltage regulator



Payload Power Source



MODEL	VOLTAGE (V)	CURRENT	WEIGHT (g)	DIMENSION (mm)	BATTERY CHEMISTRY
LIR3048	3.7	200mAh	8.30	30mm x 4.8mm	Li-ion





Payload Power Budget

COMPONENT	POWER CONSUMPTION (wh)	CURRENT (mA)	VOLTAGE (V)	DUTY CYCLES (hr)	SOURCE
Arduino Nano	0,002	0,2	5	2	Datasheet
10 DOF IMU Sensor	0,42	42	5	2	Datasheet
XBee	0,1518	23	3,3	2	Datasheet
AMS117	0,12	10	6	2	Datasheet
Total	0,6938				

Each battery provides 0.74 wh

AVAILABLE TOTAL POWER CAPACITY (for two batteries)	TOTAL POWER CONSUMED (for two hours)	MARGIN OF POWER CONSUMPTION
1,48 wh	0,6938 wh	0,7862 wh

Conclusion : Our batteries are enough to power all components for two hours



Flight Software (FSW) Design

Ivan Maccio



FSW Overview



Programming Languages:

- C/C++

Development environments:

- Arduino IDE

Summary of FSW tasks:

- To collect sensors data and convert it to a value that complies with CanSat requirements.
- Send data to the Ground control station and store it to an onboard backup EEPROM.
- Monitor altitude changes to trigger payload releases.
- Activate audio beacon after landing.
- Activate mechanisms in the correct time
- Ensure telemetry frequency is 1Hz
- Design a software architecture such that the processor can fully
- Recover from a sudden power loss that might occur in any time during the mission and for arbitrary duration



FSW Overview



FSW Task:

Container	Payload
To collect sensors data and convert it to a value that complies with CanSat requirements.	To collect sensors data and convert it to a value that complies with CanSat requirements.
Send data to the Ground control station and store it to an onboard backup EEPROM.	Send data to the container and store it to an onboard backup EEPROM.
Monitor altitude changes to trigger payload releases	Ensure telemetry frequency is 1Hz
Activate audio beacon after landing	Recover from a sudden power loss that might occur in any time during the mission and for arbitrary duration
Activate mechanisms in the correct time	
Ensure telemetry frequency is 1Hz	



FSW Overview



FSW Task:

Container	Payload
Recover from a sudden power loss that might occur in any time during the mission and for arbitrary duration	Recover from a sudden power loss that might occur in any time during the mission and for arbitrary duration



FSW Changes Since PDR



- No major changes since PDR



FSW Requirements



RQ	Description	Rationale
25	The science payload shall measure altitude using an air pressure sensor.	CReq
26	The science payload shall measure air temperature.	CReq
27	The science payload shall measure rotation rate as it descends.	CReq
28	The science payload shall transmit all sensor data once per second.	CReq
29	The science payload telemetry shall be transmitted to the container only.	CReq
30	The science payload shall have their NETID/PANID set to their team number plus five. If team number is 1000, sensor payload NETID is 1005.	CReq
36	The container shall transmit its telemetry and the payload telemetry received once per second in the format described in the Telemetry Requirements section.	CReq
37	The container shall stop transmitting telemetry when it lands.	CReq
48	The flight software shall maintain a count of packets transmitted, which shall increment with each packet transmission throughout the mission. The value shall be maintained through processor resets.	CReq



FSW Requirements



RQ	Description	Rationale
36	The container shall transmit its telemetry and the payload telemetry received once per second in the format described in the Telemetry Requirements section.	CReq
37	The container shall stop transmitting telemetry when it lands.	CReq
48	The flight software shall maintain a count of packets transmitted, which shall increment with each packet transmission throughout the mission. The value shall be maintained through processor resets.	CReq
49	The container must maintain mission time throughout the whole mission even with processor resets or momentary power loss.	CReq
50	The container shall have its time set to UTC time to within one second before launch.	CReq
51	The container flight software shall support simulated flight mode where the ground station sends air pressure values at a one second interval using a provided flight profile csv file.	CReq
52	In simulation mode, the flight software shall use the radio uplink pressure values in place of the pressure sensor for determining the container altitude.	CReq



FSW Requirements



RQ	Description	Rationale
53	The container flight software shall only enter simulation mode after it receives the SIMULATION ENABLE and SIMULATION ACTIVATE commands.	CReq
54	The ground station shall command the Cansat to start transmitting telemetry prior to launch.	CReq
55	The ground station shall generate csv files of all sensor data as specified in the Telemetry Requirements section.	CReq
56	Telemetry shall include mission time with one second or better resolution. Mission time shall be maintained in the event of a processor reset during the launch and mission.	CReq
57	Configuration states such as if commanded to transmit telemetry shall be maintained in the event of a processor reset during launch and mission.	CReq
59	All telemetry shall be displayed in real time during descent on the ground station.	CReq
60	All telemetry shall be displayed in engineering units (meters, meters/sec, Celsius, etc.)	CReq
61	Teams shall plot each telemetry data field in real time during flight.	CReq



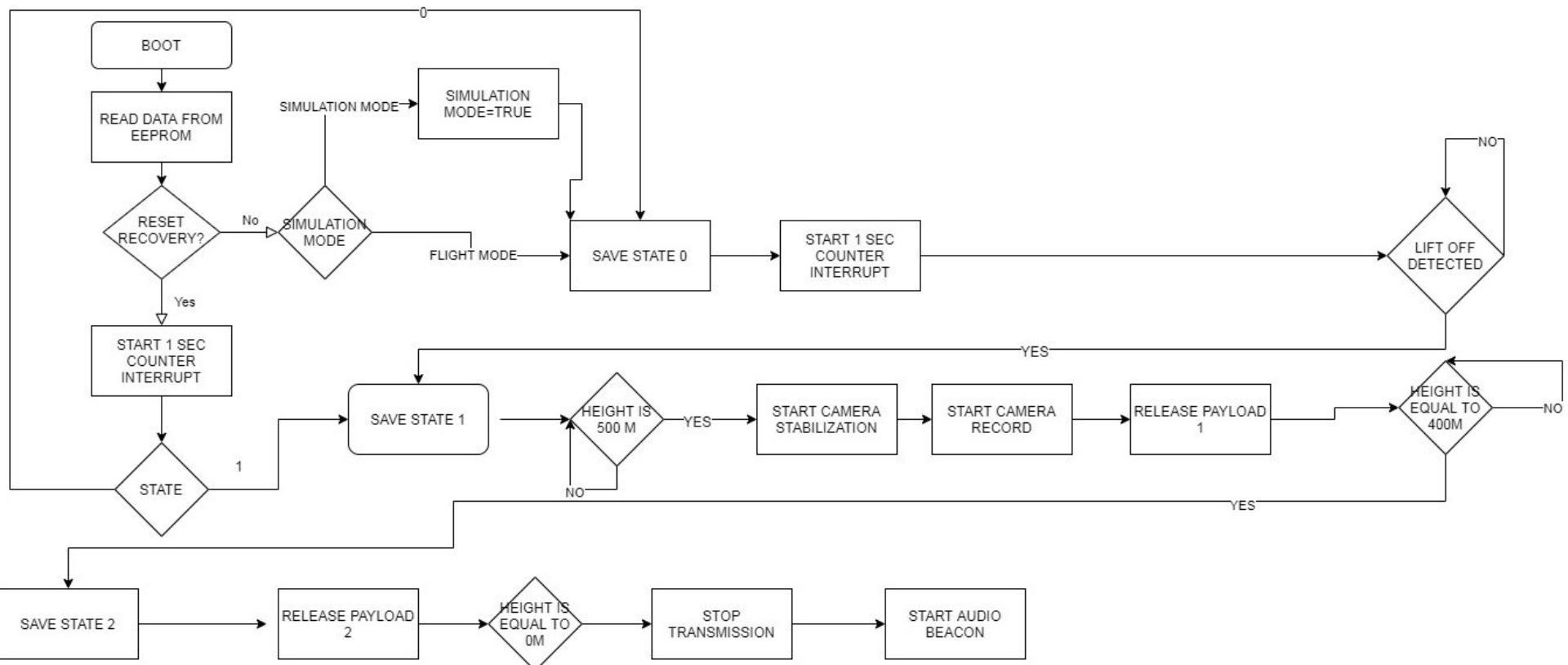
FSW Requirements



RQ	Description	Rationale
64	The ground station software shall be able to command the container to operate in simulation mode by sending two commands, SIMULATION ENABLE and SIMULATION ACTIVATE.	CReq
65	When in simulation mode, the ground station shall transmit pressure data from a csv file provided by the competition at a 1 Hz interval to the container.	CReq
66	The science payloads shall not transmit telemetry during the launch, and the container shall command the science payloads to begin telemetry transmission upon release from the container.	CReq

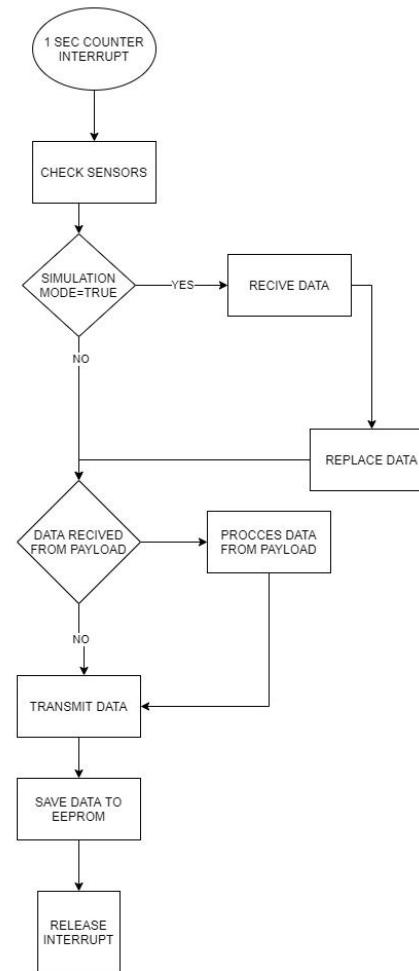


Container CanSat FSW State Diagram



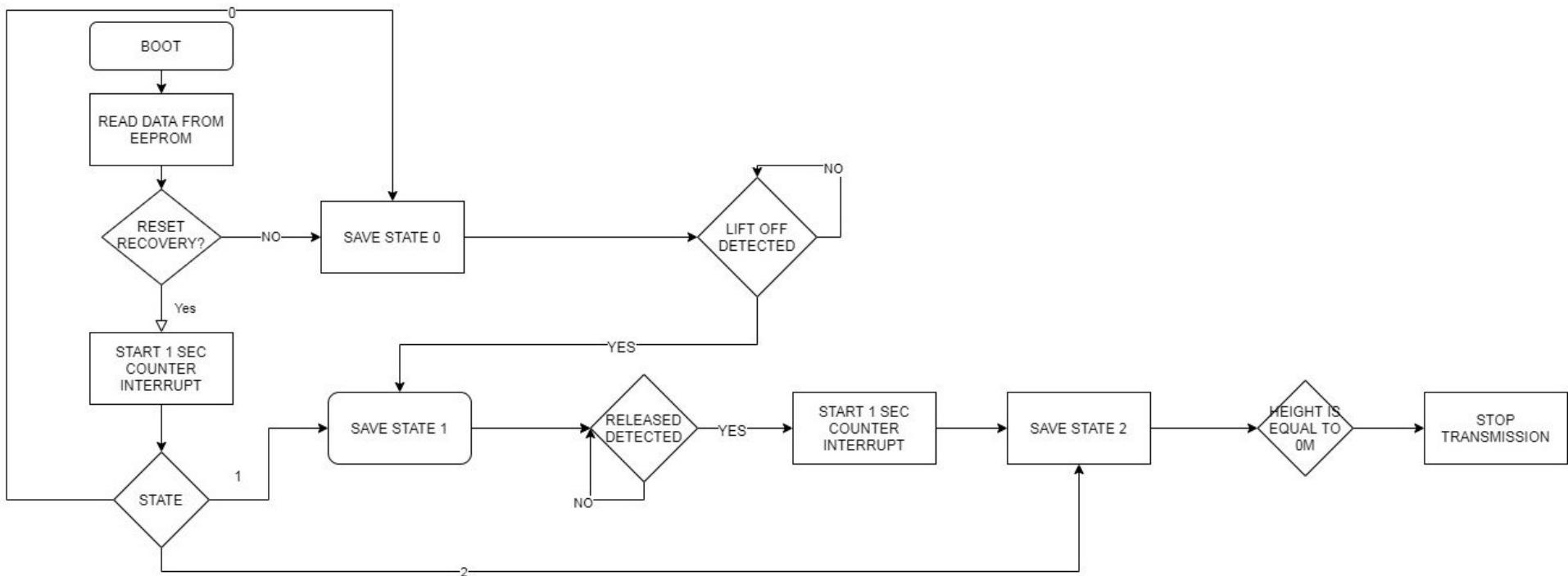


Container CanSat FSW State Diagram



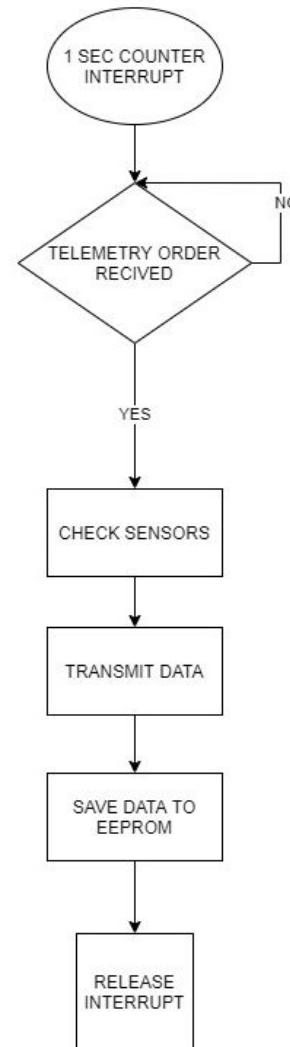


Payload CanSat FSW State Diagram





Payload CanSat FSW State Diagram





Simulation Mode Software



Simulation mode

The ground station will receive a file with the simulated data, then the data is transmitted to the container where the container firmware would calculate the altitude with the supplied data, then it will be formatted to complain requirements and transmitted to the ground station

Simulation commands

The simulation commands are:

- CMD,<TEAM_ID>,SIM,<MODE>

Where: 1. CMD and SIM are static text.
2. is the assigned team identification.

3. is the string 'ENABLE' to enable the simulation mode, 'ACTIVATE' to activate the simulation mode, or 'DISABLE' which both disables and deactivates the simulation mode.

Example: Both the CMD,1000,SIM,ENABLE and CMD,1000,SIM,ACTIVATE commands are required to begin simulation mode.

- CMD,<TEAM ID>,SIMP,<PRESSURE>

Where: 1. CMD and SIMP are static text.
2. is the assigned team identification.

3. is the simulated atmospheric pressure data in units of pascals with a resolution of one Pascal.

Example: CMD,1000,SIMP,101325 provides a simulated pressure reading to the Container (101325 Pascals = approximately sea level).



Software Development Plan



Software development plan

Component	Description
Ground station	Program interface
	Program Xbee
Container	Program arduino for each sensor
	Servo module
Payload	Simulation module
	Program Xbee
Final integration	Program sensors
	Full test of all function

Green parts were successful developed since PDR

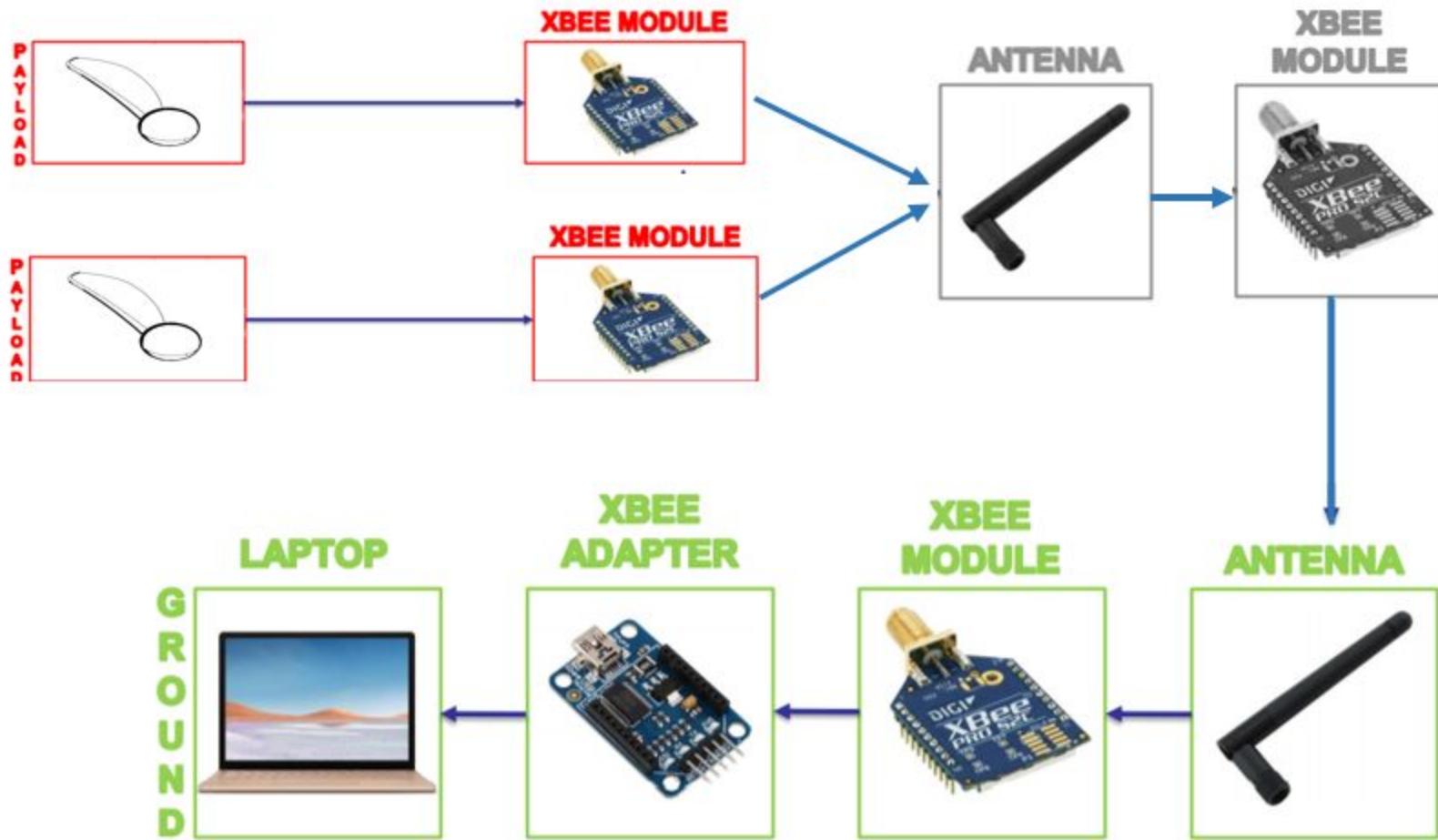


Ground Control System (GCS) Design

**Iván Macció
Mateo Figallo**



GCS Overview





GCS Changes Since PDR



- No major changes since PDR



GCS Requirements



RQ	Description	Rationale
51	The container flight software shall support simulated flight mode where the ground station sends air pressure values at a one second interval using a provided flight profile csv file.	CReq
55	The ground station shall generate csv files of all sensor data as specified in the Telemetry Requirements section.	CReq
58	Each team shall develop their own ground station.	CReq
59	All telemetry shall be displayed in real time during descent on the ground station.	CReq
60	All telemetry shall be displayed in engineering units (meters, meters/sec, Celsius, etc.)	CReq
61	Teams shall plot each telemetry data field in real time during flight.	CReq
62	The ground station shall include one laptop computer with a minimum of two hours of battery operation, XBEE radio and a hand-held antenna.	CReq
63	The ground station must be portable so the team can be positioned at the ground station operation site along the flight line. AC power will not be available at the ground station operation site.	CReq



GCS Requirements



RQ	Description	Rationale
64	The ground station software shall be able to command the container to operate in simulation mode by sending two commands, SIMULATION ENABLE and SIMULATION ACTIVATE.	CReq
65	When in simulation mode, the ground station shall transmit pressure data from a csv file provided by the competition at a 1 Hz interval to the container.	CReq



GCS Design



ANTENNA



LAPTOP



XBEE Adapter will be connected to Laptop using USB cable and the communication will be established with serial connection

**XBEE
MODULE**



The connection between XBEE Module and XBEE Adapter will be through slots



**X
A
B
D
E
A
P
T
E
R**



GCS Design



• Specifications

- Battery: The Ground Control Station Laptop can operate 3 hours with battery.
- Overheating Mitigation: There will be an umbrella to avoid direct sun exposure
- Auto update mitigation: The option of auto update will be disabled before the launch

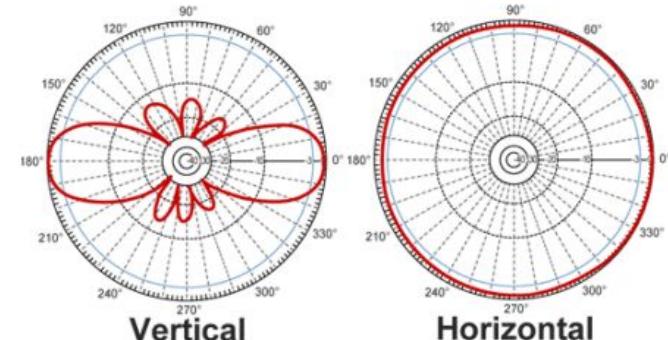


GCS Antenna



Model	Connection Type	Frequency	Direction	Gain	Beam Width Horizontal / Vertical	Price
Bingfu Dual Band WiFi 2.4GHz	RP-SMA	2,4 ghz	Omnidirectional	9dBi	360°/ 32°	\$ 7,99

We choose the BingFu antenna because it can receive in all directions and the Xbee Pro s2c has enough outdoor range and power output to work fine with stock antennas

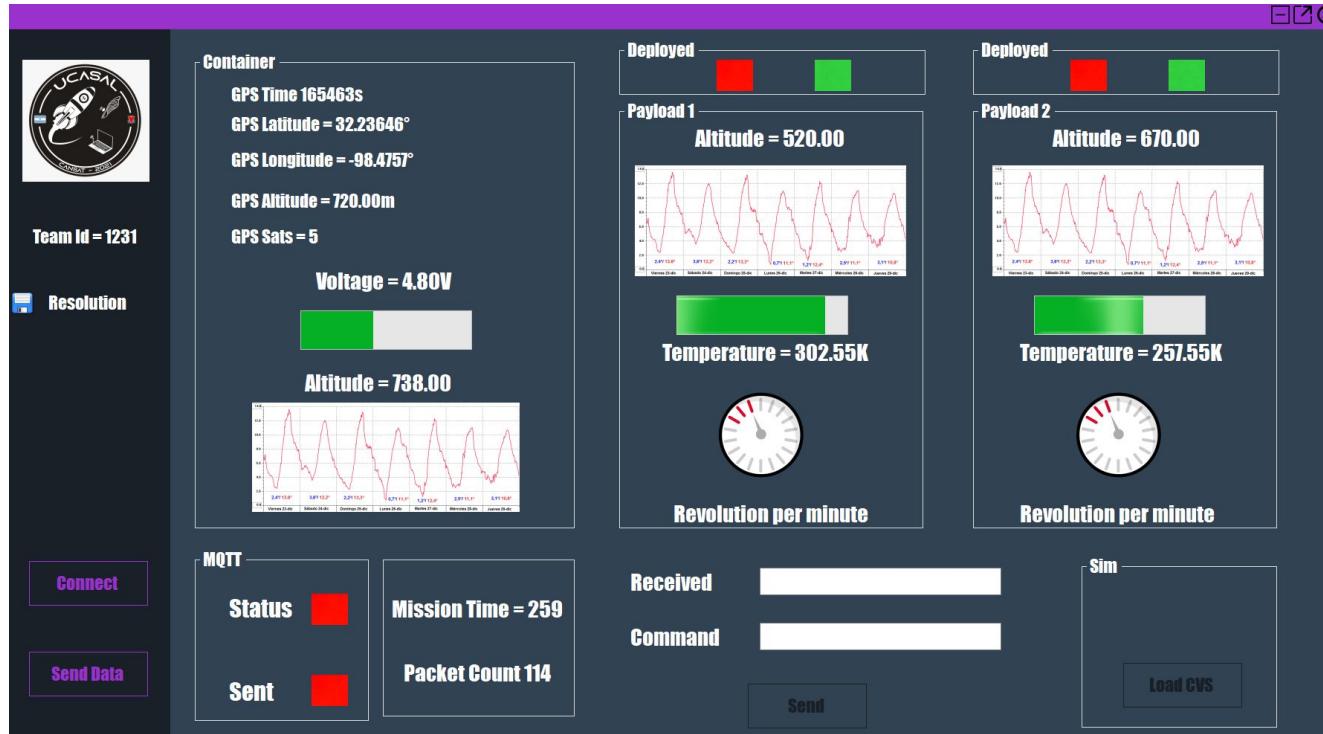




GCS Software



- Telemetry display screen shots



- Commercial off the shelf (COTS) software packages used
 - MATLAB GUI Package for Visual Studio 2015



GCS Software



- **Real-time plotting software design**
 - GCS Software will be designed with MATLAB GUI Package for Visual Studio 2015
 - The software will receive data from XBEE Module through USB cable
 - The received data will be displayed on the real time plots
- **Command software and interface**
 - The Ground Station will send the following commands from the container:
 - CX - Container Telemetry On/Off Command
 - Generic one: CMD,<TEAM_ID>,CX,<ON_OFF>
 - Example of command to be sent: CMD,1231,CX,ON, where:
 - CMD and CX are static text
 - ON is set to activate the Container telemetry transmissions. OFF would be used to turn off the transmissions
 - ST - Set Time
 - Generic one: CMD,<TEAM_ID>,ST,<UTC_TIME>
 - Example of command to be sent: CMD,1231,ST,13:35:59, where:
 - CMD and ST are static text
 - 13:35:59 is the parameter -in UTC format- which sets the mission time to the value given



GCS Software



- **Command software and interface**
 - The Ground Station will send the following commands from the Ground Station:
 - SIM - Simulation Mode Control Command
 - Generic one: CMD,<TEAM_ID>,SIM,<MODE>
 - Example of command to be sent: CMD,1231,SIM,ENABLE, where:
 - CMD and SIM are static text
 - ENABLE enables the simulation mode. 'ACTIVATE' activates the simulation mode, and 'DISABLE' both disables and deactivates the simulation mode.
 - PX - Science Payload Transmission On/Off
 - Generic one: CMD,<TEAM_ID>,SP1X/SP1X,<ON_OFF>
 - Example of command to be sent: CMD,1231,SP1X,ON. This will trigger the Container to relay a command to the Science Payload 1 to begin telemetry transmissions.
 - SP1X and SP2X are static text indicating to control telemetry for SP1 and SP2, respectively
 - SIMP - Simulated Pressure Data (to be used in Simulation Mode only)
 - Generic one: CMD,<TEAM ID>,SIMP,<PRESSURE>
 - Example of command to be sent: CMD,1231,SIMP,101325, which provides a simulated pressure reading to the Container (101325 Pascals = approximately sea level)



GCS Software



- Ground station software is nearly finished and ready for real testing with simulated and real data in a few days.



MQTT Integration



Once the ground station is turned on, we will proceed to connect it with the MQTT server:

```
Client.connect("mqtt://username:password@cansat.info");
```

When the ground station software saves a data line to a file, that line will be sent to the broker (1 line per second):

```
mqttc.publish("teams/1231", "<TEAM_ID>,<MISSION_TIME>,<PACKET_COUNT>,<PACKET_TYPE>,<MODE>,<SP1_RELEASED>,<SP2_RELEASED>,<ALTITUDE>,<TEMP>,<VOLTAGE>,<GPS_TIME>,<GPS_LATITUDE>,<GPS_LONGITUDE>,<GPS_ALTITUDE>,<GPS_SATS>,<SOFTWARE_STATE>,<SP1_PACKET_COUNT>,<SP2_PACKET_COUNT>,<CMD_ECHO>");
```

At the end of sending all the lines, the client will be disconnected from the server:

```
Client.disconnect();
```

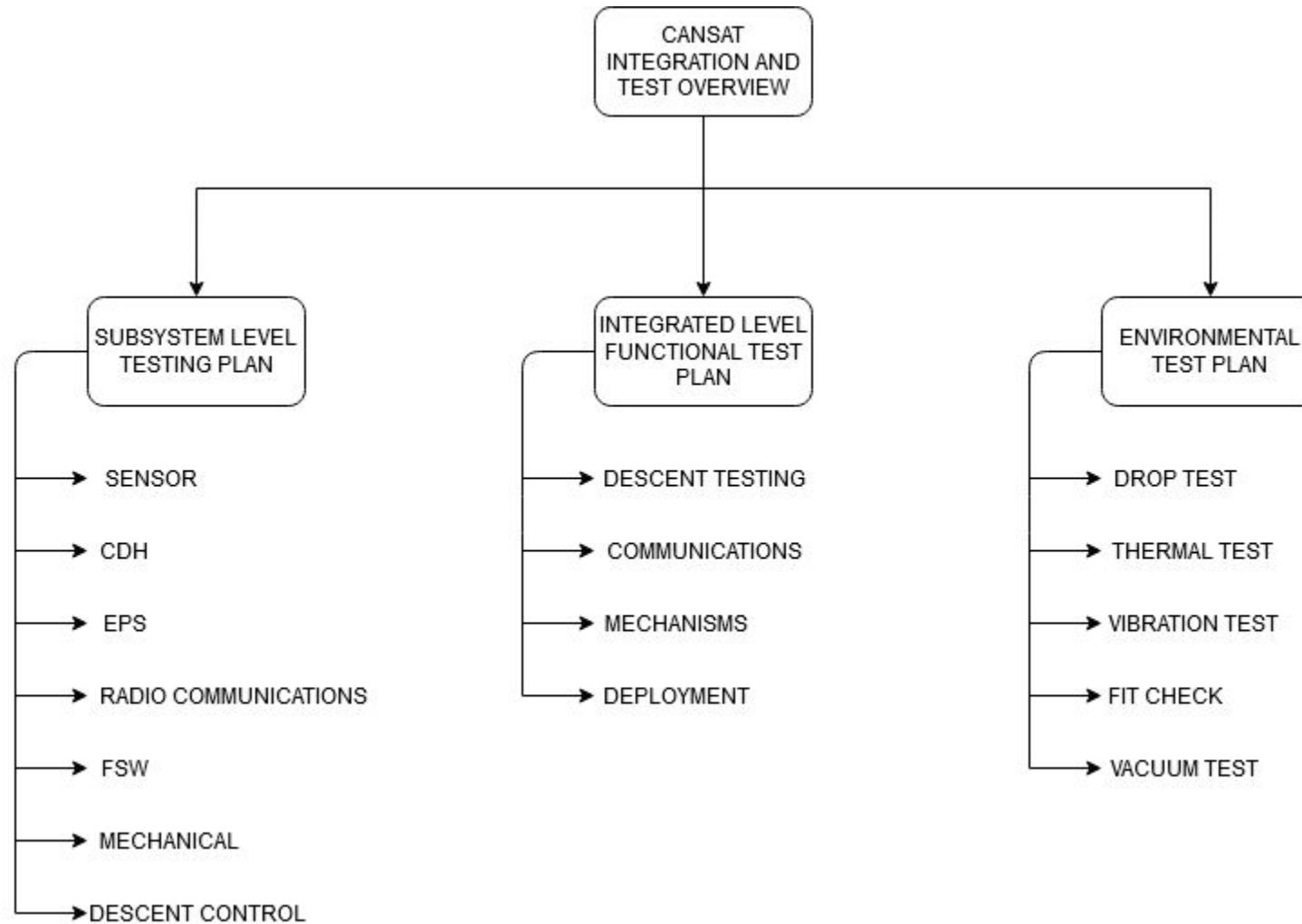


CanSat Integration and Test

Ivan Maccio



CanSat Integration and Test Overview





Subsystem Level Testing Plan



In order to make sure everything works as designed, a series of tests will be conducted:

- We are planning to test every sensor alone with an Arduino mega.
- Then, we are going to test the sensor in additive way, meaning that when we finish testing all sensors individually, we are start to test two sensors at once, then three sensors at once, then four, etc., until full integration is completed.
- In parallel we are going to make mechanical tests to the seeds.
- We are going to drop it from a drone and fly it like a normal seed.
- There will be a Flight Software test as well, which consists in simulating all possible processor shut down -in any period of time- and check if the software works correctly in the facing of mentioned situation.
- The sending of data in the correct order will be tested
- We will check the accuracy of the received data from sensors



Integrated Level Functional Test Plan



Integrated Level Functional Test Plan

Container

Mass test.
Free fall test with parachutes.
Test descent rate with chronometer.

Electronics sensors

Test each sensor individually with an arduino uno.
Test xbee configuration with one arduino and a arduino pc adaptor.
Xbee modules should had radio link in ground of about 120 m to ensure air link.

Ground station

Simulate payload data in excel and compare results.
Repeat the simulation with an xbee connected with an arduino that only transmit the simulation data.



Integrated Level Functional Test Plan



Integrated Level Functional Test Plan

Seed

Test free fall by launching the seeds from a drone.
Test descent rate with chronometer.

Flight software

Cut the power in different states and check proper recovery.
Verification of the state machine operation.
Verification of the activations of each mechanism at the time in the state machine



Environmental Test Plan



The tests are going to be executed as suggested in the mission guide, for the drop test we are going to use a non flexible string of the spec detailed in mission guide ,for the thermal test we are going to build a isolated foam box and use a hair dryer or a heat gun with temperature regulation for rise the temperature.

For the vibration test we had an orbital sander, we are going to 3D print a locking mechanism to hold the CanSat to the sander.



Test Procedures Descriptions



DROP TEST

Test Procedure	Test description	Rqmts	Pass Fail Criteria
1	Power on		Pass if CanSat turns on. Otherwise fail.
2	Verify telemetry is being received	28,36	Pass if data is received on the GCS. Otherwise fail.
3	Raise CanSat by the attached cord, so that the attachment points of the cord, on the eye bolt and the parachute, are at the same height.		-
4	Release the CanSat.		-
5	Verify the CanSat did not lose power.	56,57	Pass if power is still on. Otherwise fail.
6	Inspect for any damage, or detached parts	11,12,14	Pass if parts are still intact. Otherwise fail.
7	Verify telemetry is still being received.	48,46	Pass if data is still being received by GCS. Otherwise fail.



Test Procedures Descriptions



THERMAL TEST

Test Procedure	Test description	Rqmts	Pass Fail Criteria
1	Build a foam box and heated up with a heat gun with temperature control and heat the box to 60 degrees		
2	Put powered on CanSat in the box and wait for two hours	47	Pass if Cansat powers on and sending data to GCS. Otherwise fail.
3	Inspect mechanical and structural to ensure everything is intact	14	Pass if everything is intact. Otherwise fail.
4	Verify that CanSat is still sending data to GCS	48	Pass if CanSat is sending data to GCS. Otherwise fail.



Test Procedures Descriptions



VIBRATION CHECK

Test Procedure	Test description	Rqmts	Pass Fail Criteria
1	Power on Cansat		Pass if CanSat turns on. Otherwise fail.
2	Verify accelerometer data is being collected	46	Pass if accelerometer data is received on the GCS. Otherwise fail.
3	Power up the sander		
4	Once the sander is up to full speed, wait 5 seconds		
5	Power down the sander to full stop		
6	Inspect CanSat for damage and functionality	11,12,14,18	Pass if CanSat is damage free and still functioning. Otherwise fail
7	Verify accelerometer data is still being collected	28	Pass if accelerometer data is received on the GCS. Otherwise fail.



Test Procedures Descriptions



FIT CHECK			
Test Procedure	Test description	Rqmts	Pass Fail Criteria
1	Measure CanSat dimension	2	Pass if CanSat dimension is < 125mmx400mm. Otherwise fail.
2	Visually inspect for sharp edges that will prevent it from deploying out of the rocket	2	Pass if no sharp edges. Otherwise fail
3	Test the cansat inside the rocket payload	3,6	Pass Cansat enter and exit freely



Simulation Test Plan



The tests are going to be executed as suggested in the mission guide.

We are going to use dummy data to test that the ground station correctly sends the data to the MQTT server. Corroborating them from cansat.info/plot.html.



Mission Operations & Analysis

Rodrigo Goytea Vuistaz



Overview of Mission Sequence of Events



Event	Duties and Responsibilities
Arrival at the simulation site	<ul style="list-style-type: none">• All team members will have to put their own facemasks• Ground Control Station, Container and Payload will be assembled and checked.
Setting up	<ul style="list-style-type: none">• Antenna will be checked.• Xbee communications will be checked as well.• Fit check and mass measurement.• Container release mechanism check.• Inspection of electronics.• Battery charge check.• Radio links check.
Pre launch	<ul style="list-style-type: none">• Review of the checklist.• Team leader approval in order to proceed.
CanSat preparation	<ul style="list-style-type: none">• Integrate payload and container.
Final checks preparation	<ul style="list-style-type: none">• Team approval.
Rocket integration	<ul style="list-style-type: none">• Integrate CanSat with the rocket.



Overview of Mission Sequence of Events



Event	Duties and Responsibilities
Launch	<ul style="list-style-type: none">• Take photos• Record• Stream
Recovery	<ul style="list-style-type: none">• Recover CanSat
Data presentation	<ul style="list-style-type: none">• Prepare data• Print / graph results• Deliver results• Save the equipment



Field Safety Rules Compliance



Mission Operations Manual

1	2	3	4	5	6
GCS Configuration	CanSat Preparation	Rocket CanSat Integration	Launch Preparations Procedure	Launch Procedure	Removal Procedures

- **Mission Operations Manual will include checklists for the each of the topics mentioned above.**
- **Each member will familiarize themselves with the manual before launch day. Safety of each person on launch day is paramount.**
- **The document has been downloaded from CanSat competition website and had been modified to include our instructions. It will be updated as we encounter changes before launch day.**



CanSat Location and Recovery



- We will use a drone with a camera to an easier detection of container and payload.
- Container color will be chosen from red, Pink or orange.
- Team Leader's phone number and email address and team's number will be labeling on both container and payload



Mission Rehearsal Activities



- **Description of mission operations rehearsal activities including:**
 - Details of activities rehearsed to date
 - Ground system radio link check procedures
 - Powering on/off the CanSat
 - Launch configuration preparations (e.g., final assembly and stowing appendages)
 - Loading the CanSat in the launch vehicle
 - Telemetry processing, archiving, and analysis
 - Recovery
- **Description of written procedures developed/required**



Mission Rehearsal Activities



Ground system radio link check procedures

- Assembly of components, testing and troubleshooting Powering on/off the CanSat
- Visual verification of loose electronic components before turning on
- Turn on container
- Turn on the two payload in sequential order
- Wait for the container send telemetry indicating the two payload working properly

Launch configuration preparations

- Visual verification of mechanical system
- Installation of the payload in the container and locking with rubber bands
- Close the container top hatch
- Stowing the parachute on top of container to ensure deployment

Loading the CanSat in the launch vehicle

- Installation of the Cansat into the rocket payload section

Telemetry processing, archiving, and analysis

- Reading graphs and indicators on GCS GUI • Verification of CSV file

Recovery

- Audio beacon distinct sequence familiarization to locate our container
- Use the drone to locate the payloads



Requirements Compliance

Jorge Royon



Requirements Compliance Overview



RQ	Description	Comply	Slides
1	Total mass of the CanSat (science payloads and container) shall be 600 grams +/- 10 grams.	Y	98,99
2	CanSat shall fit in a cylindrical envelope of 125 mm diameter x 400 mm length. Tolerances are to be included to facilitate container deployment from the rocket fairing.	Y	31
3	The container shall not have any sharp edges to cause it to get stuck in the rocket payload section which is made of cardboard.	Y	31
4	The container shall be a fluorescent color; pink, red or orange.	Y	53
5	The container shall be solid and fully enclose the science payloads. Small holes to allow access to turn on the science payloads is allowed. The end of the container where the payload deploys may be open.	Y	25
6	The rocket airframe shall not be used to restrain any deployable parts of the CanSat.	Y	25
7	The rocket airframe shall not be used as part of the CanSat operations.	Y	25
8	The container parachute shall not be enclosed in the container structure. It shall be external and attached to the container so that it opens immediately when deployed from the rocket.	Y	25



Requirements Compliance Overview



RQ	Description	Comply	Slides
9	The Parachutes shall be fluorescent Pink or Orange	Y	53
10	The descent rate of the CanSat (container and science payload) shall be 15 meters/second +/- 5m/s.	Y	58
11	All structures shall be built to survive 15 Gs of launch acceleration.	Y	163-173
12	All structures shall be built to survive 30 Gs of shock.	Y	163-173
13	All electronics shall be hard mounted using proper mounts such as standoffs, screws, or high performance adhesives.	Y	94
14	All mechanisms shall be capable of maintaining their configuration or states under all forces.	Y	1-173
15	Mechanisms shall not use pyrotechnics or chemicals.	Y	1-173
16	Mechanisms that use heat (e.g., nichrome wire) shall not be exposed to the outside environment to reduce potential risk of setting vegetation on fire.	Y	1-173
17	Both the container and payloads shall be labeled with team contact information including email address.	Y	1-173



Requirements Compliance Overview



RQ	Description	Comply	Slides
18	Cost of the CanSat shall be under \$1000. Ground support and analysis tools are not included in the cost.	Y	195
19	XBEE radios shall be used for telemetry. 2.4 GHz Series radios are allowed. 900 MHz XBEE radios are also allowed.	Y	151-162
20	XBEE radios shall have their NETID/PANID set to their team number.	Y	151-163
21	XBEE radios shall not use broadcast mode.	Y	151-162
22	The science payload shall descend spinning passively like a maple seed with no propulsion.	Y	43-69
23	The science payload shall have a maximum descent rate of 20 m/s.	Y	43-69
24	The wing of the science payload shall be colored fluorescent orange, pink or green.	Y	52
25	The science payload shall measure altitude using an air pressure sensor.	Y	32-42



Requirements Compliance Overview



RQ	Description	Comply	Slides
26	The science payload shall measure air temperature.	Y	32-42
27	The science payload shall measure rotation rate as it descends.	Y	32-42
28	The science payload shall transmit all sensor data once per second.	Y	32-42
29	The science payload telemetry shall be transmitted to the container only.	Y	32-42
30	The science payload shall have their NETID/PANID set to their team number plus five. If team number is 1000, sensor payload NETID is 1005.	Y	100-120
31	The container shall include electronics to receive sensor payload telemetry.	Y	151
32	The container shall include electronics and mechanisms to release the science payloads.	Y	90-91
33	The container shall include a GPS sensor to track its position.	Y	40
34	The container shall include a pressure sensor to measure altitude.	Y	39



Requirements Compliance Overview



RQ	Description	Comply	Slides
35	The container shall measure its battery voltage.	Y	41
36	The container shall transmit its telemetry and the payload telemetry received once per second in the format described in the Telemetry Requirements section.	Y	144-145
37	The container shall stop transmitting telemetry when it lands.	Y	144-145
38	The container and science payloads must include an easily accessible power switch that can be accessed without disassembling the cansat and science payloads and in the stowed configuration.	Y	74
39	The container must include a power indicator such as an LED or sound generating device that can be easily seen or heard without disassembling the cansat and in the stowed state.	Y	75
40	An audio beacon is required for the container. It may be powered after landing or operate continuously.	Y	75
41	The audio beacon must have a minimum sound pressure level of 92 dB, unobstructed.	Y	75
42	Battery source may be alkaline, Ni-Cad, Ni-MH or Lithium. Lithium polymer batteries are not allowed. Lithium cells must be manufactured with a metal package similar to 18650 cells. Coin cells are allowed.	Y	75



Requirements Compliance Overview



RQ	Description	Comply	Slides
44	An easily accessible battery compartment must be included allowing batteries to be installed or removed in less than a minute and not require a total disassembly of the CanSat.	Y	74
45	Spring contacts shall not be used for making electrical connections to batteries. Shock forces can cause momentary disconnects.	Y	74
46	The Cansat must operate during the environmental tests laid out in Section 3.5.	Y	163-173
47	The Cansat shall operate for a minimum of two hours when integrated into the rocket.	Y	131
48	The flight software shall maintain a count of packets transmitted, which shall increment with each packet transmission throughout the mission. The value shall be maintained through processor resets.	Y	135-149
49	The container must maintain mission time throughout the whole mission even with processor resets or momentary power loss.	Y	135-149
50	The container shall have its time set to UTC time to within one second before launch.	Y	135-149



Requirements Compliance Overview



RQ	Description	Comply	Slides
51	The container flight software shall support simulated flight mode where the ground station sends air pressure values at a one second interval using a provided flight profile csv file.	Y	135-149
52	In simulation mode, the flight software shall use the radio uplink pressure values in place of the pressure sensor for determining the container altitude.	Y	135-149
53	The container flight software shall only enter simulation mode after it receives the SIMULATION ENABLE and SIMULATION ACTIVATE commands.	Y	135-149
54	The ground station shall command the Cansat to start transmitting telemetry prior to launch.	Y	135-149
55	The ground station shall generate csv files of all sensor data as specified in the Telemetry Requirements section.	Y	150-162
56	Telemetry shall include mission time with one second or better resolution. Mission time shall be maintained in the event of a processor reset during the launch and mission.	Y	150-162
57	Configuration states such as if commanded to transmit telemetry shall be maintained in the event of a processor reset during launch and mission.	Y	150-162



Requirements Compliance Overview



RQ	Description	Comply	Slides
58	Each team shall develop their own ground station.	Y	150-162
59	All telemetry shall be displayed in real time during descent on the ground station.	Y	150-162
60	All telemetry shall be displayed in engineering units (meters, meters/sec, Celsius, etc.)	Y	150-162
61	Teams shall plot each telemetry data field in real time during flight.	Y	150-162
62	The ground station shall include one laptop computer with a minimum of two hours of battery operation, XBEE radio and a hand-held antenna.	Y	150-162
63	The ground station must be portable so the team can be positioned at the ground station operation site along the flight line. AC power will not be available at the ground station operation site.	Y	150-162
64	The ground station software shall be able to command the container to operate in simulation mode by sending two commands, SIMULATION ENABLE and SIMULATION ACTIVATE.	Y	150-162
65	When in simulation mode, the ground station shall transmit pressure data from a csv file provided by the competition at a 1 Hz interval to the container.	Y	150-162



Requirements Compliance Overview



RQ	Description	Comply	
66	The science payloads shall not transmit telemetry during the launch, and the container shall command the science payloads to begin telemetry transmission upon release from the container.	Y	150-16 2



Management

Rodrigo Goytea Vuistaz



Status of Procurements



Component	Status	Quantity	Date ordered	Date Received
Arduino nano	Ordered	2	18/2/2021	4/4/2021
Waveshark imu	stock	3	-	-
Lir3048	stock	8	1/2/2021	18/3/2021
Adafruit spy camera	stock	1	-	-
Parachute	stock	1	-	-
Servos	stock	3	-	-
Arduino mega	stock	1	-	-
Xbee pro s2c	stock	2	-	-
Xbee 3	order	2	15/2/2021	6/4/2021
Rotary encoder	stock	1	-	-
2.4 ghz antenna	stock	3	-	-



Status of Procurements



Component	Status	Quantity	Date ordered	Date Received
Real time modole	Ordered	1	18/2/2021	4/4/2021
Energizer CR2032	Stock	3	-	-

Items without date where in stock before the PDR

We suffer some delays in our orders due the COVID and local regulations and due the economic crisis of our country some internet payments methods are canceled or delayed.
But we are going to be able to finish the project without major problems.



CanSat Budget – Hardware



Component	Quantity	Unit Price (\$)	Total (\$)	Status
Waveshare 10 DOF IMU C	3	17.99	53.97	NEW
Adafruit Ultimate GPS	1	12.99	12.99	NEW
Arduino mega 2560 mini	1	8.84	8.84	NEW
Arduino nano	2	3.78	7.56	NEW
TowerPro sg90 servo	3	2.42	7.26	NEW
Adafruit spy camera	1	12.5	12.5	NEW
Xbee Pro S2C	2	32.56	65.12	NEW
Xbee Pro 3	2	32.56	65.12	NEW
Parachute Apogee 29126	1	3.74	3.74	NEW
2.4 ghz antenna	3	2.7	8.1	NEW
Buzzer	1	5	5	NEW
3D printed parts	6	7	42	NEW



CanSat Budget – Hardware



Component	Quantity	Unit Price (\$)	Total (\$)	Status
LIR3048	8	9	72	NEW
Energizer CR123A	2	1.5	3	NEW
Real clock module	1	2.1	2.1	
Total				369.3\$

The total cost to develop and build the CANSAT is 367.2\$ US dollars



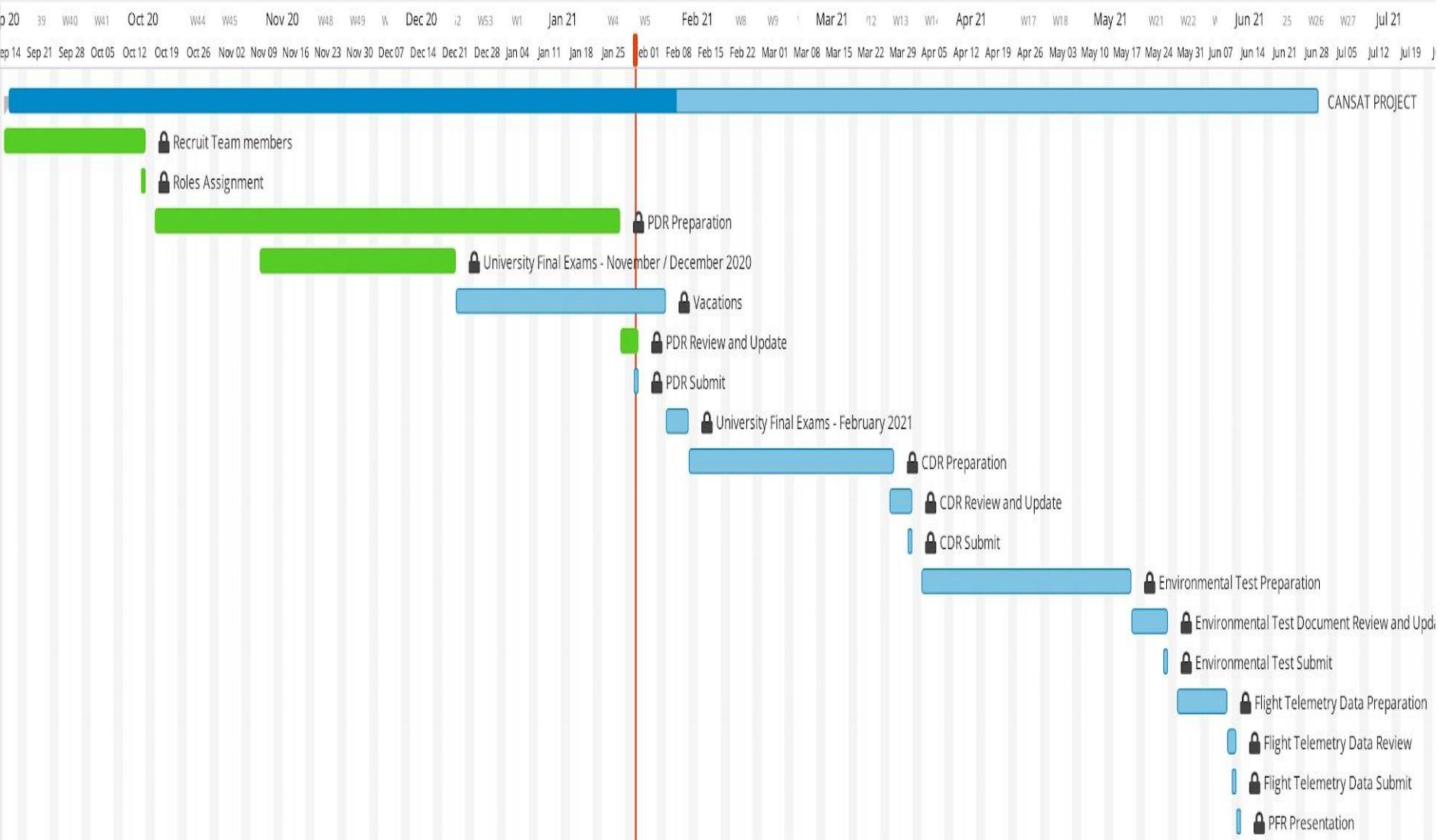
CanSat Budget – Other Costs



Due the pandemic, it's impossible to determinate and know if it would be possible to travel, so there's no way to predict other associated cost.

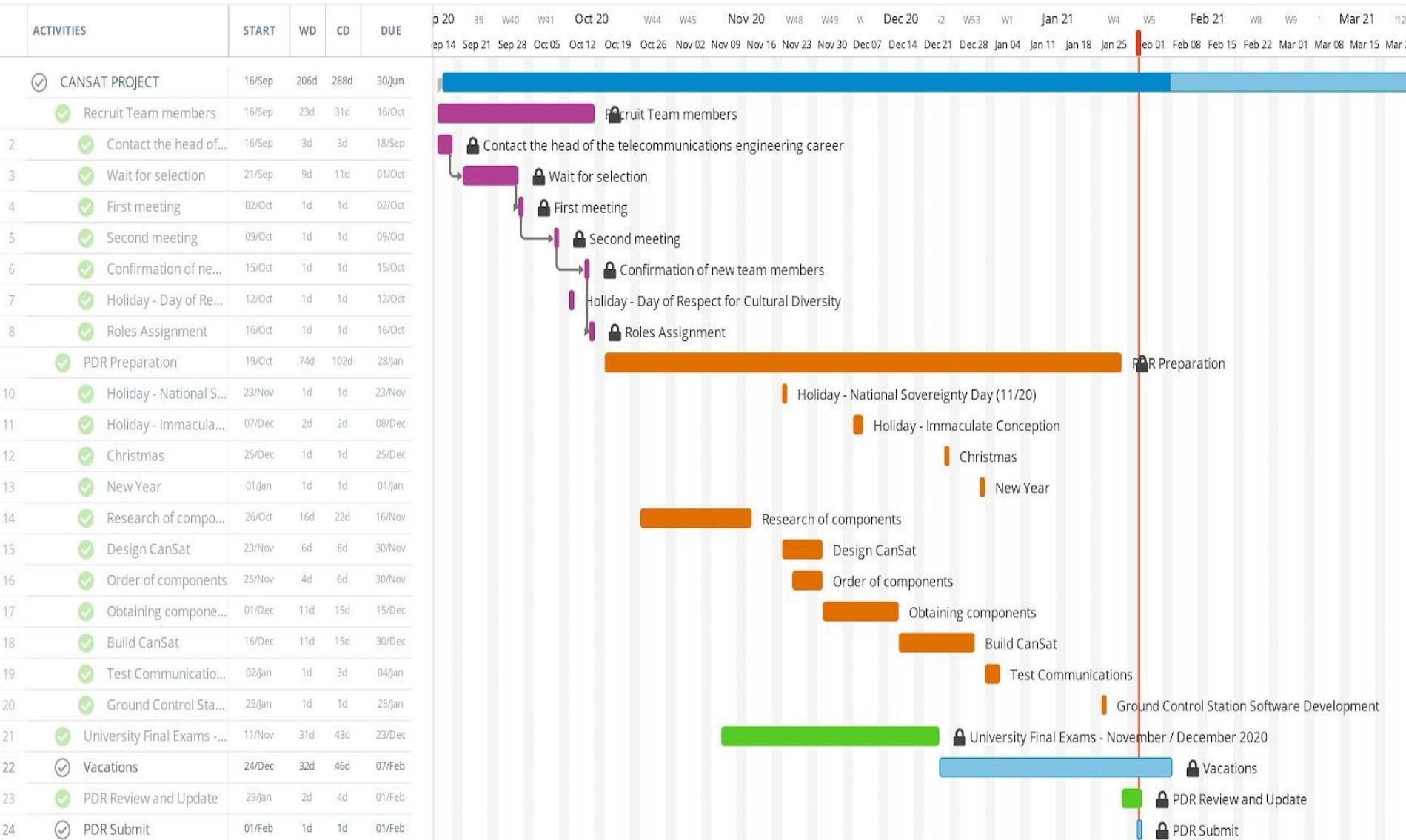


Program Schedule Overview





Detailed Program Schedule





Detailed Program Schedule





Mission Rehearsals



Mission Rehearsals

- Team members and roles

TEAM MEMBER	ROLE
Jorge royon	Mechanical builder
Ivan Maccio	Environmental tester and software developer
Agustina Romero	Electronic developer and tester
Nicole Castro	Electronic developer and tester
Rodrigo Guyteaz	Software developer
Mateo Figallo	Software developer



Mission Rehearsals



Mission Rehearsals

- **Mission dry-runs**

25/5/2021-Full simulated test and error correction if any has occurred, then retry the test until all is performed as it should
Criteria of pass: No error glitches in telemetry, no physical damage or loose components, check telemetry data and ensure coherent results.

1/6/2021-Repeat the full simulated test to ensure everything is ok

Criteria of pass: No error glitches in telemetry, no physical damage or loose components, check telemetry data and ensure coherent results.



Conclusions



**We are close to finish the prototype and start testing,
we had a good time advantage and trust that our model
will accomplish every mission requirement**