Cansat 2011 CDR

Team 852

Team Gaganyaan

Presentation Outline

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Team Organization

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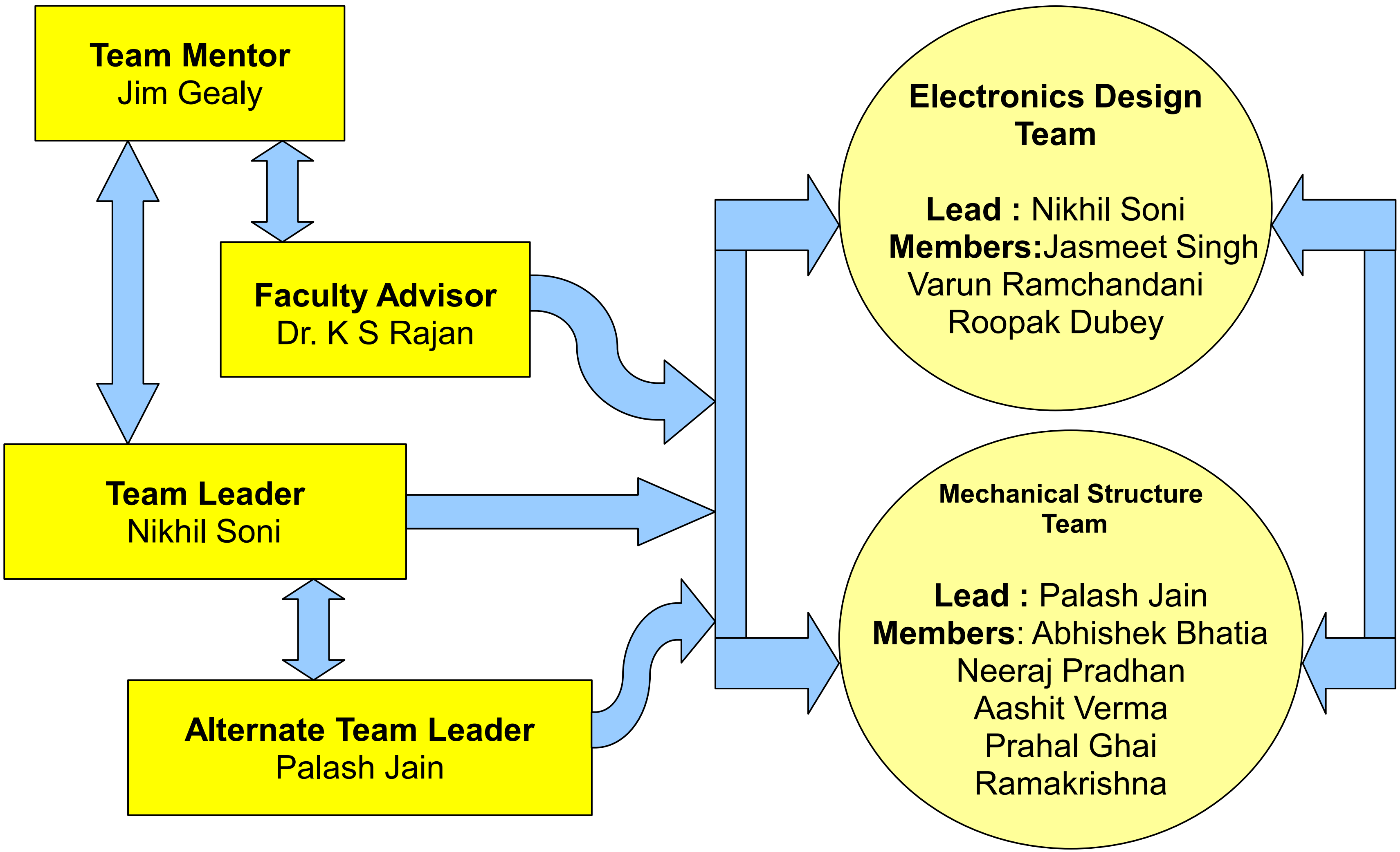
Internal Organization



Acronyms

➢**M**	Mission
➢**S**	Sensor
➢**MS**	Mechanical System
➢**DCS**	Descent Control System
➢**CDH**	Command and Data Handling
➢**EPS**	Electrical and Power system
➢**FSW**	Flight Software
➢GCS	Ground control station

❖A/D	Analog or Digital
❖ADC	Analog digital converter
❖CLK	Clock
❖CPU	Central processing unit
❖EEPROM	Electrically Erasable Programmable Read-Only Memory
❖FCC	Federal communications commission
❖g	Acceleration due to gravity
❖GHz	Giga hertz
❖GPS	Global positioning system
❖Hz	Hertz
❖ISM	Industrial, scientific and medical
❖Kbps	Kilobytes per second
❖Km	Kilometer
❖MHz	Mega hertz
❖NiMH	Nickel metal hydride
❖RF	Radio frequency
❖SPI	Serial peripheral interface
❖SRAM	Static random access memory
❖USART	Universal synchronous asynchronous receiver/transmitter
❖USD	US Dollar
❖INR	Indian Rupees

Systems Overview

Presenter's Name - Abhishek Bhatia

Mission Summary

Mission:

- The mission of 2011 Cansat competition is Egg Lander.

Objectives:

- To carry the hen's egg intact for the entire duration from launch to landing.
- To control the descent of the cansat carrier and maintaining the descend speed of 3-5 m/s.
- The Carrier should hold the Lander till deployment and after the carrier reaches 500 m after deployment, it should deploy the Lander containing the egg.
- To control the descent of the Lander after its deployment from the carrier at the descend speed of 4-7 m/s.
- To determine the descent rate of the payload before the separation and of both carrier and Lander after the separation using pressure sensor and record the data on-board.
- To predict the landing position of the Lander based on the GPS data.
- To send the telemetry data to a central ground station.

Optional Selectable Objective:

- To measure the force of impact of the Lander with the ground and store the data on-board.

Summary of Changes Since PDR

- ✓ Mechanical structure fabricated
- ✓ PCB fabricated
- ✓ Detachment mechanism finalized
- ✓ Accelerometer sensor changed to a new one (refer sensor subsystem) and procured
- ✓ Locator Device finalized and procured
- ✓ Telemetry Termination mechanism updated

System Requirements

ID	Requirement	Rationale	Priority	Parent(s)	Children	VM			
						A	I	T	D
SYS-01	Mass < 500 gms (excluding egg)	Competition requirement. Least mass structure gets bonus	HIGH		MS01 DCS02	X	X		
SYS-02	Cansat will fit in a cylindrical envelope of 72mm diameter and 279 mm in length	Payload restriction	HIGH		MS02,03 DCS 04	X	X	X	X
SYS-03	No protrusions from rocket payload	Payload restriction	HIGH		DCS-01,02,03	X	X	X	X
SYS-04	Cansat Carrier will descent with minimum rate of 3m/s and Lander at minimum rate of 4.5m/s	So that does not get drifted away by wind but has a safe landing speed	MEDIUM		DCS-01,02,03,04	X	X	X	X

System Requirements

ID	Requirement	Rationale	Priority	Parent(s)	Children	VM			
						A	I	T	D
SYS-05	Carrier descent with maximum rate of 5m/s and Lander at maximum rate of 6.5m/s	To know the Cansat state for taking appropriate decisions and to protect the Egg from a sudden jerk at the time of impact	MEDIUM		DCS-01,02,03,04	X	X	X	X
SYS-06	GCS will have external power control with confirmation from Cansat power state	To demonstrate external control capability	LOW				X		
SYS-07	Total cost of the Cansat will not exceed $1000	Every well managed systems has constraint, to have uniformity	MEDIUM			X	X		
SYS-08	During descent Cansat Carrier will send its position along with house keeping telemetry	To track the data captured by the Cansat and plot its trajectory	HIGH		S01 MS05 CDH 01,02			X	X

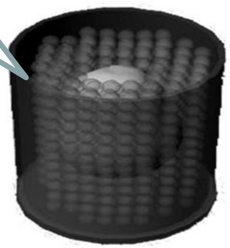
System Requirements

ID	Requirement	Rationale	Priority	Parent(s)	Children	VM			
						A	I	T	D
SYS-09	Cansat Carrier will stop transmitting telemetry upon landing and Cansat Lander will calculate the impact force with the ground as requirement of bonus objective.	To measure the impact force on the Lande so as to estimate the amount of maximum force that the Lander can sustain in order to save the egg.	MEDIUM		S01 MS05 CDH05			X	X
SYS-10	Cansat Carrier as well as the Lander should be recovered safely	To avoid damage to Cansat structure and components so that it can be reused and egg can be recovered	HIGH						X
SYS-11	Team will provide all saved telemeter data from both carrier as well as the Lander	As a part of Post Flight Review so as to analyze the telemeter data	HIGH		CDH06,07,08				X

System Concept of Operations

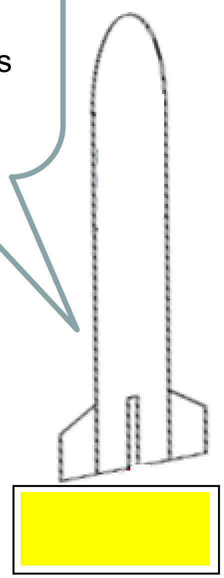
Egg is collected and properly packed into the lander.

Pre-launch



Cansat is placed in the launch vehicle payload region and compatibility is checked

Team Developed Ground Control Station starts receiving data packets as soon as the cansat is turned on.

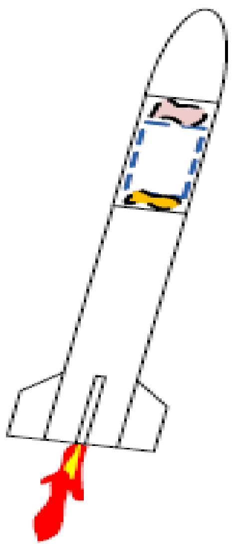


Structure is made ready by packing both the parachutes Appropriately and cansat is turned on

System Concept of Operations

Cansat rests on its parachute still inside the payload as the ascent starts. The nose cone parachute rests on top of the Cansat.

Launch

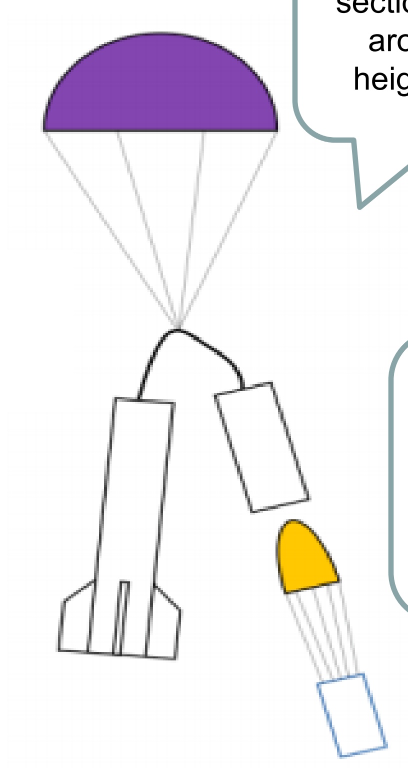


Team Developed Ground Control Station is receiving data during ascent and recording it for plotting the cansat trajectory

System Concept of Operations

Front section tips over and the cansat falls out of the payload section. The Cansat Carrier parachute inflates over the cansat. This cansat consists of both Carrier and the Lander right now.

Ejection charge separates payload section from rocket around approx height of 1100m.



Release From Payload

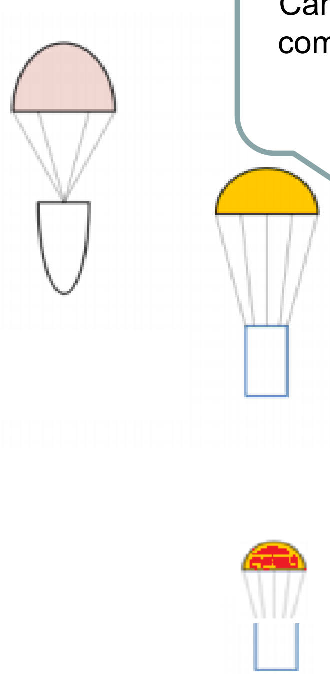
Cansat starts sending Descent Data Packets as soon as the parachute inflates.

Ground Control Station receives and visualizes Descent Data Packets

System Concept of Operations

Descent and Detachment

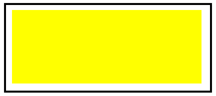
The Cansat, Nose cone and rocket descend under parachutes. The carrier and lander separate at 500m above ground.



Cansat carrier will communicate with the GCS

Ground Control Station receives and visualizes Descent Data Packets

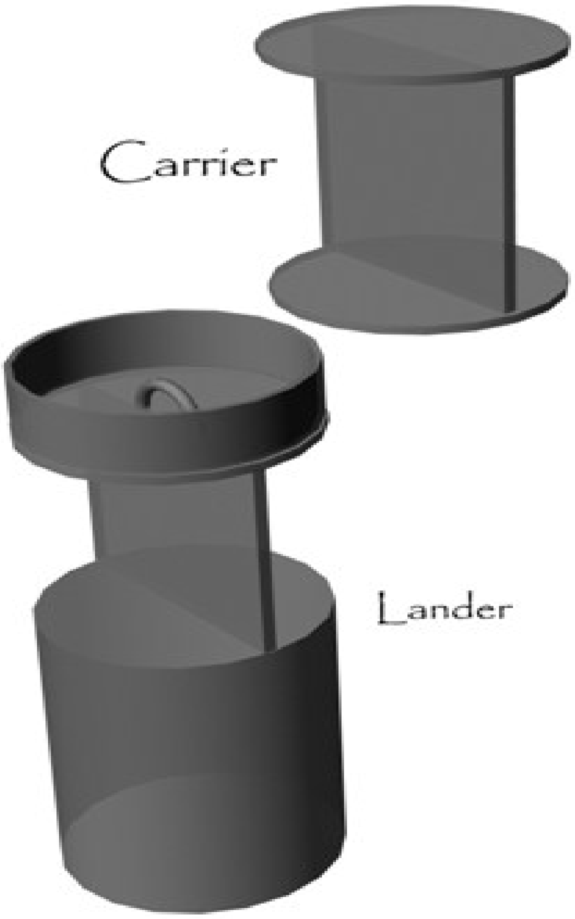
Cansat Lander will detatch from the carrier at 500 mts above the ground and will measure the ground impact force after landing.



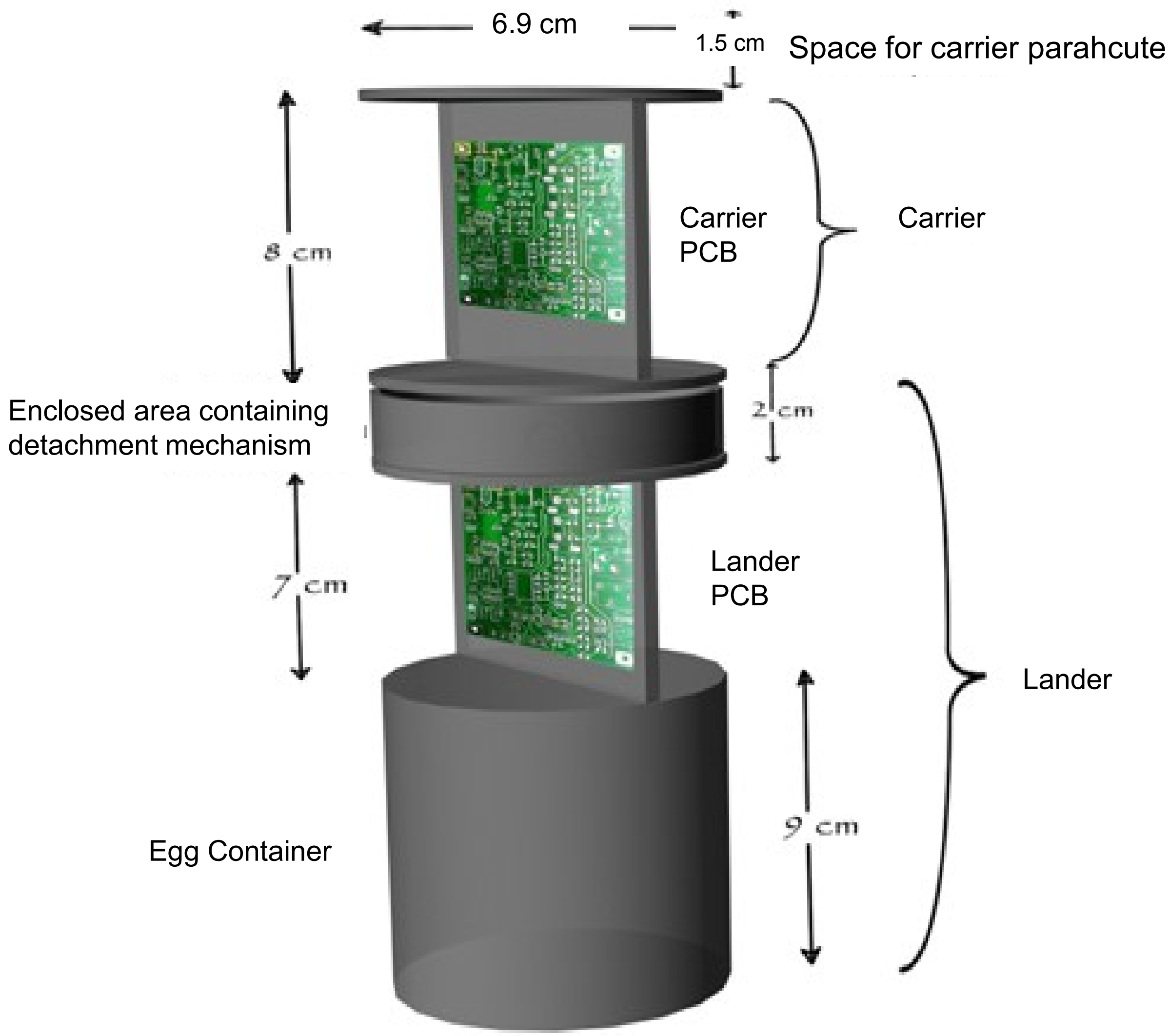
After landing, the carrier and lander are recovered using the locator device as said.
Egg is checked for safety.
Data is recovered from the on-board memory .

Post Landing

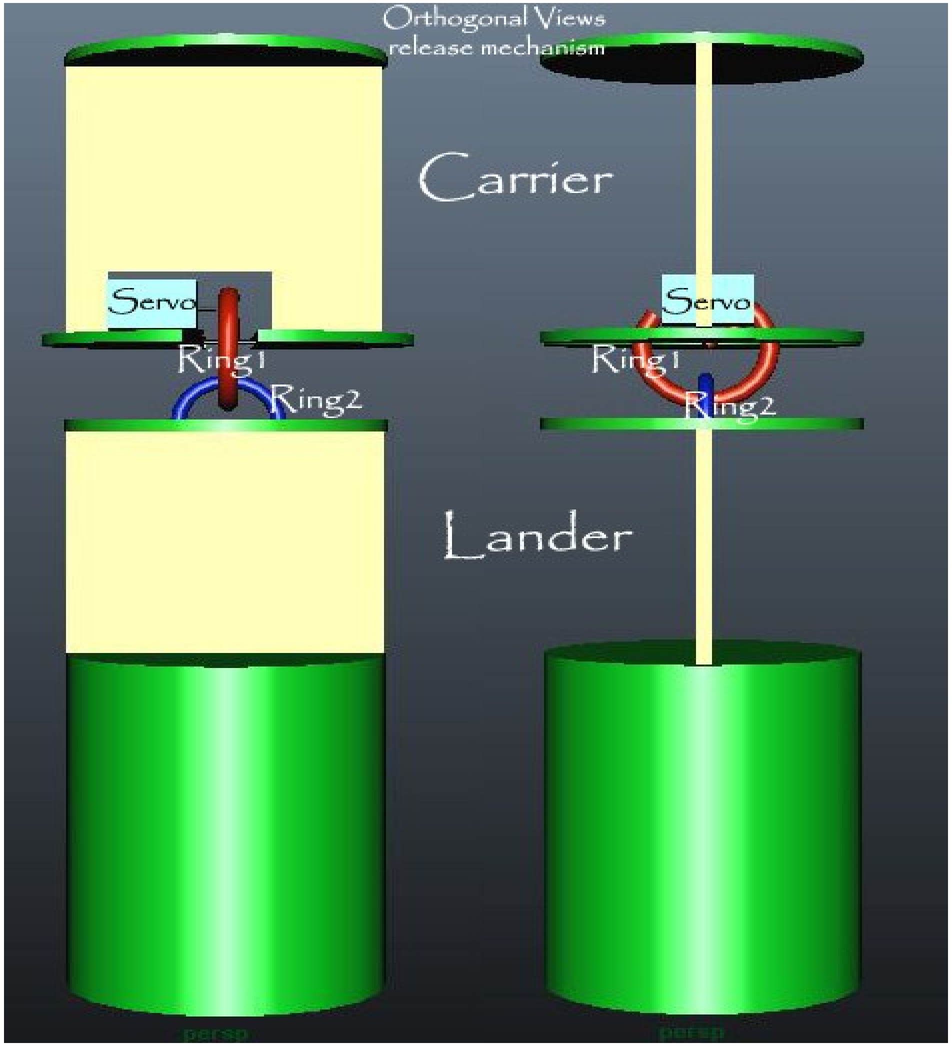
Physical Layout



Physical Layout



Physical Layout



A small Servo Motor controls the detachment of lander from carrier. Motor is controlled by the microcontroller, which uses GPS and pressure sensor data to decide when to detach the lander.

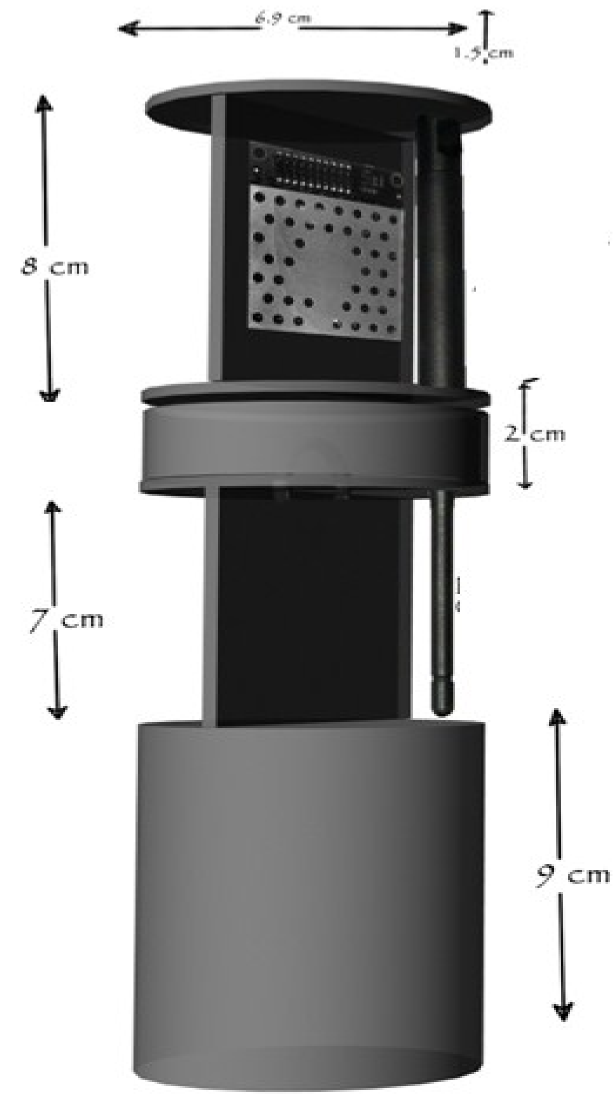
Launch Vehicle Compatibility

- Cansat structure is designed strictly keeping in mind the size and weight restrictions.

- Maximum diameter of the cansat is 6.9 cm which is 0.3 cm less than the payload section diameter, hence facilitates smooth deployment.

- Height of the cansat is 1.5+8+2+7+9=27.5 cm. Thus is well under the given limit of 27.9 cm, ensuring that cansat will not protrude out of the payload section.

- No electronic/mechanical control is employed to push the cansat out of payload and is assumed that once the rocket dismantles it will automatically slip out of the payload bay.



Launch Vehicle Compatibility

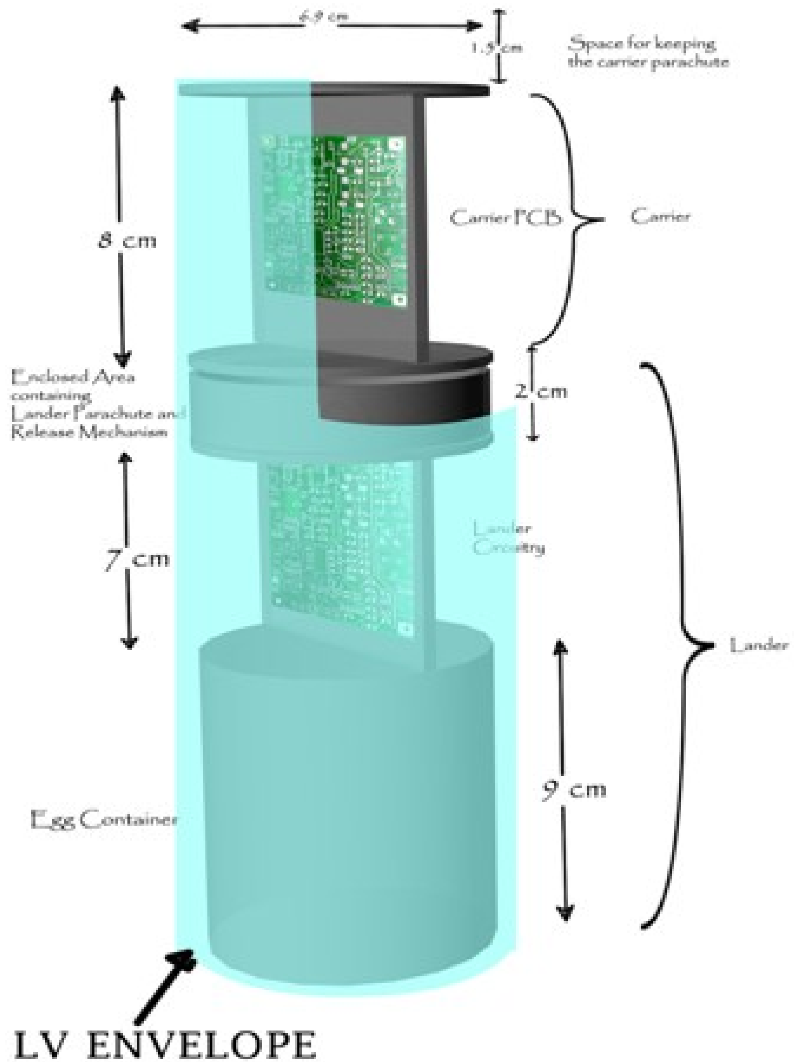
- To verify compatibility beforehand, the structure will be passed through a hollow pipe of the same size as the payload region and checked if there are any obstructions.

- The following layout shows the cansat fitted inside the Launch Vehicle Envelope.

- Height of payload available - 27.9 cm.
- Height of our Cansat - 27.5 cm

- Diameter of payload available -7.2 cm
- Diameter of our Cansat - 6.9 cm

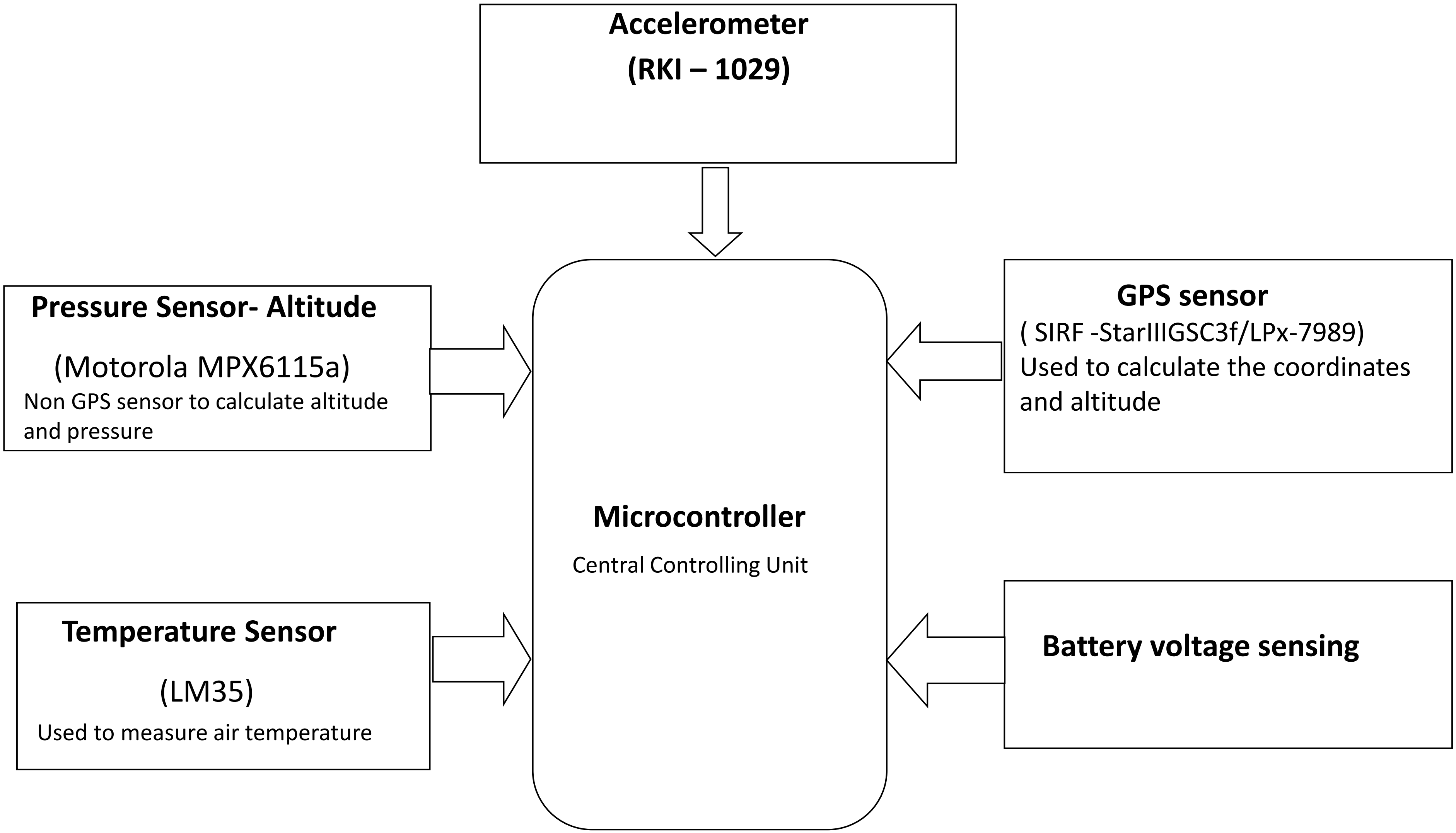
- Weight of our Cansat - 475 gms (excluding the weight of egg)



Sensor Subsystem Design

Presenter's Name- Varun Ramchandani

Sensor Subsystem Overview



Sensor Subsystem Requirements

ID	Requirement	Rationale	Parent	Range	Precision	Priority	VM			
							A	I	T	D
S01	Measurement of barometric altitude	It is a requirement for descent telemetry	SYS -08,09	100 kPa – 115 kPa	46 mV / kPa	HIGH	X			
S02	Measurement of air temperature.	It is a requirement for descent telemetry	SYS -08,09	-67F – 302F	+- 0.45 F	HIGH	X	X	X	X
S03	Measurement of Battery Voltage.	Requirement for Descent Telemetry and Housekeeping Data	SYS-08,09	---	0.008V	HIGH	X	X	X	X
S04	GPS Location data	Descent Telemetry and determination of Landing	SYS-08,09	60,000 ft	5m	HIGH	X	X	X	X
S05	Acceleration Sensor	Various events such as ejecting, mapping of motion and operational objective of landing data.	SYS – 08,09	10g	120 mV / g	MEDIUM	X	X	X	X
S06	Audio Beacon	It is required to retrieve the Cansat after it has landed.		---	---	MEDIUM	X	X	X	X

Sensor Changes Since PDR

Accelerometer has been changed, following table depicts the details.

PDR	CDR (changes)	Reason	Impact on system design
Initially decided on using Free Scale Semiconductors MMA7260Q as accelerometer	Using *RKI -1029* 2.5g/3.3g/6.7g/10g 3-axis Linear accelerometer	RKI-1029 more readily available and cheaper than MMA7260Q	NIL

Carrier GPS Summary

Manufacturer	Model	Dimensions	Accuracy	Mass	Power/voltage
SiRF	StarIII GSC3f/LPx-7989	Length:27mm, Width: 23mm	5m	10g	75mw/3.3v

NOTE - For trade and selection refer PDR.

- NMEA protocol used as per mission requirement.
- **Data Format:→**
  $GPGGA,161229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M, , , ,0000*18

Process:-

- Receive GPS value and store them in an array.
- Read the data array and parse the relevant 40 data bits.
- Receive extracted values and send them for transmission.

NOTE - GPS testing has been covered, refer Integration and test sub-system.

Carrier Non-GPS Altitude Sensor Summary

Manufacturer	Model	Accuracy	Mass	Power/voltage	Dimensions	A/D
Motorola	MPX6115a	+-1.5%	25g	0.5ma/5v	16.6 * 7.2mm	A

NOTE - For trade and selection refer PDR.

Process:-

- Collect continuous analog data from Pressure Sensor.
- Take the analog values and find the pressure using formula:

P = 22.222 * V + 10.556 – (22.222*EF)

- Now we take the analog values and convert them to digital values using ADC and then calculate height.

$$h(feet) = 1.4544 \times 10^5 \times \left(1 - \left(\frac{P(\mathrm{kPa})}{101.325\mathrm{kPa}}\right)^{0.1902}\right)$$

NOTE - Pressure and altitude testing has been covered, refer Integration and test sub-system.

Carrier Air Temperature Summary

Product	Type	Operates in region	Accuracy
LM 35	Analog	- 55 deg C -- 150 deg C	+- 0.5 deg C

NOTE - For trade and selection refer PDR.

Process:-

- Collect continuous analog data from Temperature Sensor.
- Amplify the sensor data using LM358 single opamp by 10 times.
- Accept the analog values from ADC and convert it to centigrade from digital values obtained.

NOTE - Air Temperature testing has been covered, refer Integration and test sub-system.

Lander Pressure Sensor Summary

Manufacturer	Model	Accuracy	Mass	Power/voltage	Dimensions	A/D
Motorola	MPX6115a	+-1.5%	25g	0.5ma/5v	16.6 * 7.2mm	A

NOTE - For trade and selection refer PDR.

Process:-

- Collect continuous analog data from Pressure Sensor.
- Take the analog values and find the pressure using formula:

  P = 22.222 * V + 10.556 – (22.222*EF)

- Now we take the analog values and convert them to digital values using ADC and then calculate height.

$$h(feet) = 1.4544 \times 10^5 \times \left(1 - \left(\frac{P(\text{kPa})}{101.325\text{kPa}}\right)^{0.1902}\right)$$

NOTE - Pressure and altitude testing has been covered, refer Integration and test sub-system.

Lander Impact Force Sensor Summary

Model	Dimensions	Voltage/ current Normal mode	Current Power saving mode	Range	Accuracy	Sensitivity Due to temp	A/D
Robokits RKI - 1029	28mm*23mm	2.6 V- 5 V /500uA	Yes	± 10g	±1%	±0.03%/° C	A

NOTE - For trade and selection refer PDR.

Process:-

•Accelerometer can measure acceleration along 3-axis X, Y, Z.

•The sensitivity along each axis can be selected as 2.5g/3.3g/6.7g/10g.

•The output is analog which needs to be converted into digital value using Microcontroller on ADC.

•Cansat may not land on any particular axis perfectly so we measure acceleration in all 3 directions and take resultant= $\sqrt{(ax^2 + ay^2 + az^2)}$

NOTE - Lander impact force testing covered in Integration and Test.

Descent Control Design

Presenter's Name - Prahal Ghai

Descent Control Overview

- Descent will be controlled using Parachutes of appropriate sizes.
- **Radius of Carrier chute – 28 cm , Radius of Lander chute– 25 cm.**
- **Carrier velocity desired - 4 m/s , Lander velocity desired - 5.5m/s .**
- Each parachute will occupy certain allotted space before they inflate, so as to not mingle with other parts.
- After deployment carrier parachute will support the descent of whole structure until separation of carrier and lander.
- At the time of separation, lander parachute will take care of lander descent.
- A **spill hole** at the top(3cm radius) of both parachutes for stabilizing the structure and minimizing drift.

Note - All calculations have been shown in the descent rate estimation slide.

Descent Control Changes Since PDR

- ✓ **Two sets of parachute for lander and carrier have been manufactured.**
- ✓ **They have been tested with appropriate weights in place of carrier and lander.**
- ✓ **Desirable Velocity was obtained.**

Descent Control Requirements

ID	Requirement	Rationale	Parent	Children	Priority	VM			
						A	I	T	D
DCS01	carrier and lander chutes occupy their allotted space, whatever be the orientation of the payload.	to ensure a tangle free separation, and proper fitting while in payload.	SYS – 04		HIGH	X	X	X	X
DCS02	carrier chute size such that descent rate ~4m/s	Competition requirement	SYS- 01,04		HIGH	X	X	X	X
DCS03	Lander chute size such that descent rate ~5.5m/s	Competition requirement	SYS- 04		HIGH	X	X	X	X
DCS04	Materials used to be light and flexible.	To minimize mass and volume requirements.	SYS- 02		MEDIUM	X	X	X	X
DCS05	The descent control system shall not use any flammable or pyrotechnic device.	Safety.			MEDIUM	X	X	X	X

Descent Control Hardware Summary

For descent control of our structure we are not using some specific sensors but the mechanical structure is made in such a way that it takes care of the Descent requirement.

The basic hardware consists of 2 parachutes, one for both carrier and lander.

We are using parachute as-
- It is easy to design and attain required speed.
- Acquires low space.
- Total weight of parachute is 50 gm (Carrier parachute: 26 gm, Lander parachute: 24 gm)

Material selection for parachute:

Rip stop Nylon cloth will be used due to: -
- High strength
- Good air blocking
- Good elasticity
- Easy availability
- Light weight

Descent Rate Estimates

As both our carrier and lander are working on a parachute based descent mechanism, the size of the parachutes is fixed by calculation from the following relation.

$$r = \mathrm{sqrt}(\ (2\ m\ g) / (\boldsymbol{\pi}\ p\ \ C_d\ v^2)\ )$$

where,

π = 3.14159265359

ρ = 1.146 kg/m^3 (density of air at 35 °C)

C_d =1.5 (drag coefficient of the chute for a hemisphere chute)

v =terminal velocity achieved (from mission required)

r = radius of the chute

g = acceleration due to gravity

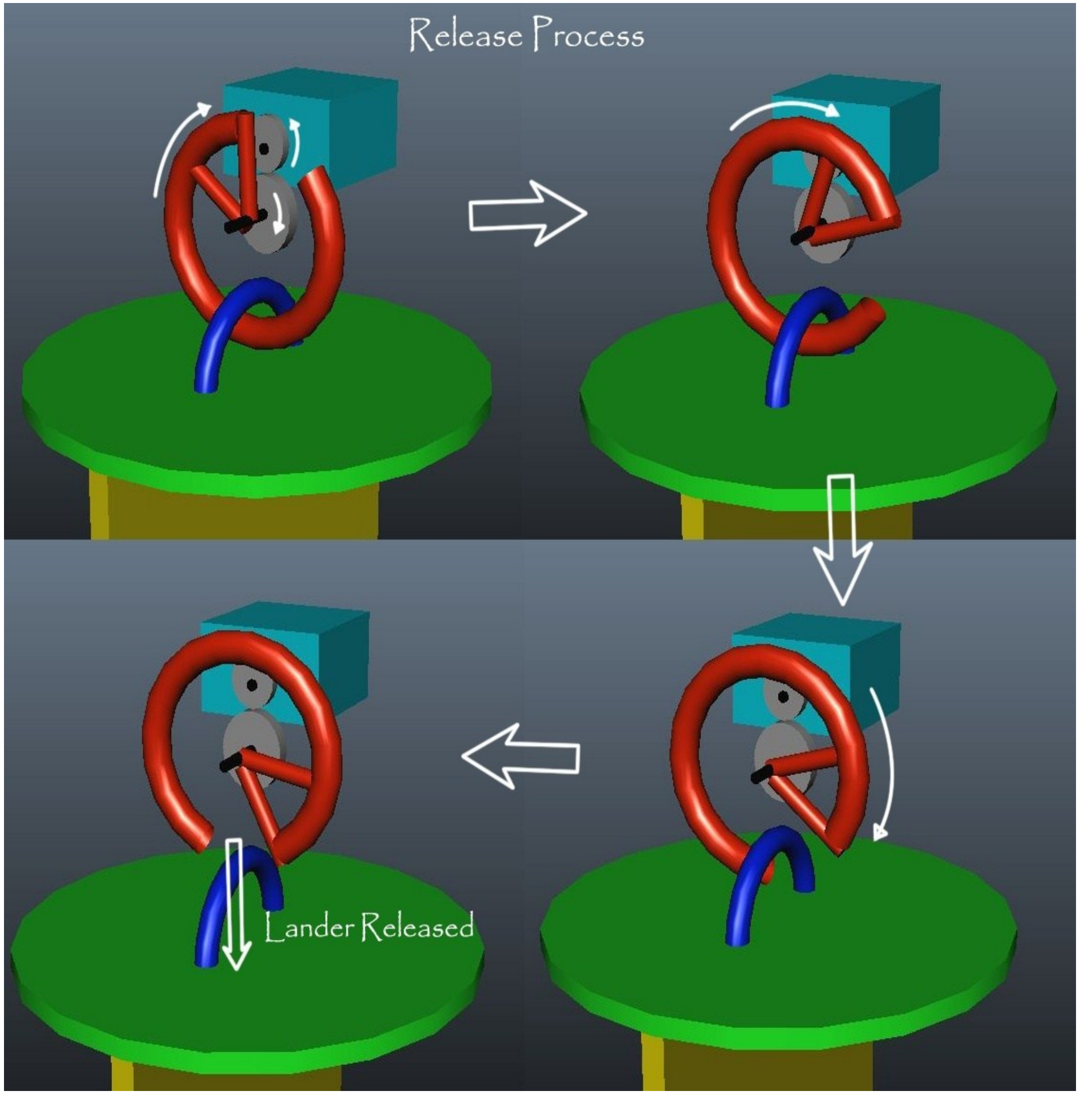
Descent Rate Estimates

RESULTS

Component	Mass (excluding the weight of parachute)	Velocity	Radius(before spill hole consideration)	Final radius(after spill hole, C_d consideration)
Carrier	212gm	3 to 5 m/s	17 to 28cm	28 cm
Lander	263gm	4.5 to 6.5m/s	15 to 23cm	25cm

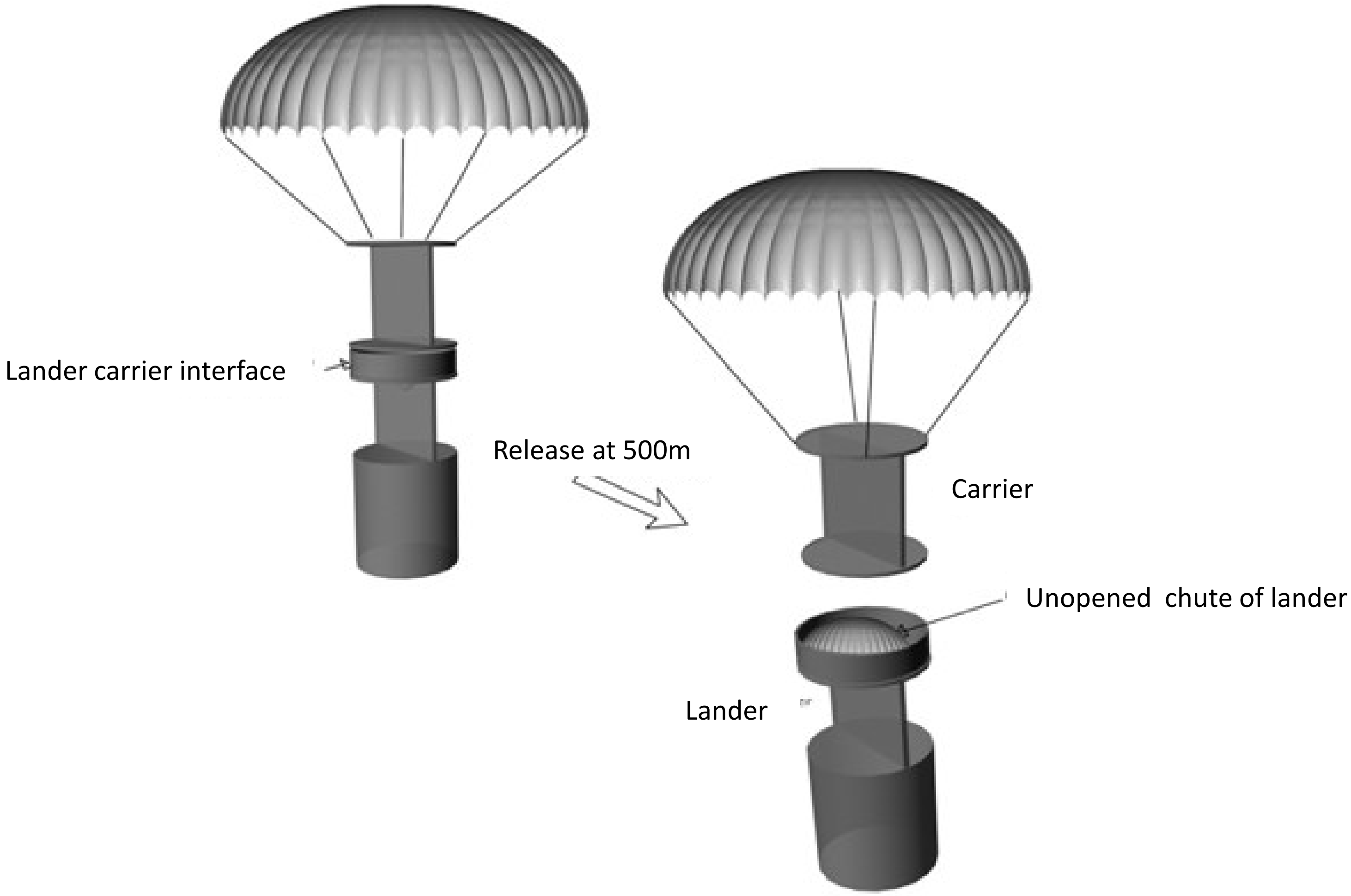
- C_d will not be 1.5 as parachute will not be completely hemispherical.
- Introduction of spill hole stabilizes the cansat by allowing air to flow but increases the rate of descent hence, maximum radius of parachutes is being preferred.
- The radius of the spill hole(3cm) has been finalized by some tests performed from a height of ~50m and some extrapolation such that it will work well at a height of ~1500m as well.
- Before separation both the carrier and lander will be supported by the carrier parachute, mass **'m'** will be **(212 gms +287 gms) is 499 gms** (Total Weight of our Cansat excluding that of Carrier parachute + Weight of Egg) and thus, the descent velocity will be **6.5 m/s.**

Lander detachment strategy



Lander detachment strategy

The image below shows position of the parachutes at different times during the flight.



Mechanical Subsystem Design

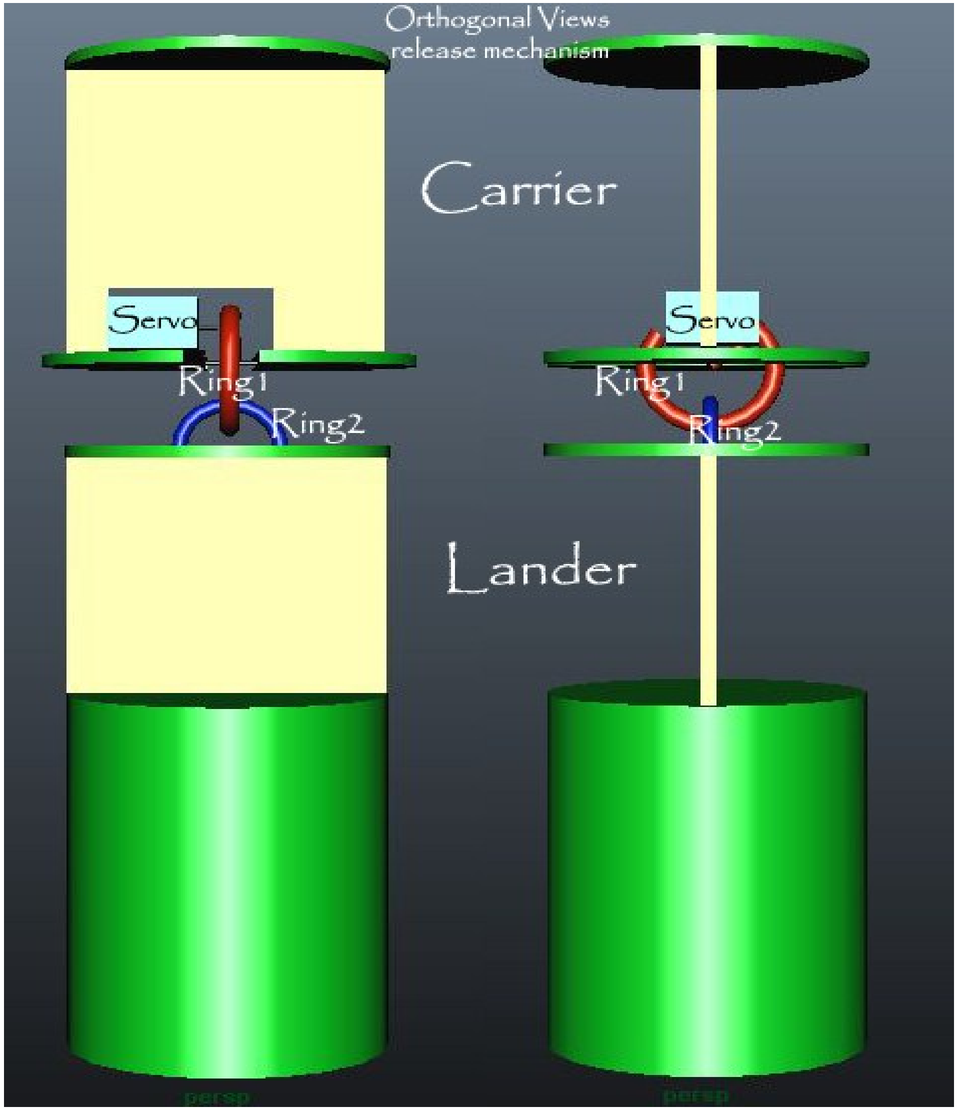
Presenter's Name – Ramakrishna Vedantam

Mechanical Subsystem Overview

- Mechanical Structure made up of **<u>Aluminium</u>**
- Detachment Mechanism using motor-hook system (refer next slide)
- Carrier Skeleton mass = 52 gms
- Lander Skeleton mass = 130 gms
- Total Structure weight = 475 ± 18 gms (excluding the weight of egg)
- Carrier chute resides on the top of the carrier(1.5cm space provided) and similarly for Lander (2cm)
- Structure can be viewed as a cylinder of height 27.5cm and diameter 6.9cm(well under payload limits) – **Testing Done**

Mechanical Subsystem Changes Since PDR

- ✓ The design has been fabricated and no major change since PDR is introduced the design.
- ✓ Final decision has been made regarding placement of the motor hook detachment system and is shown in the Fig.



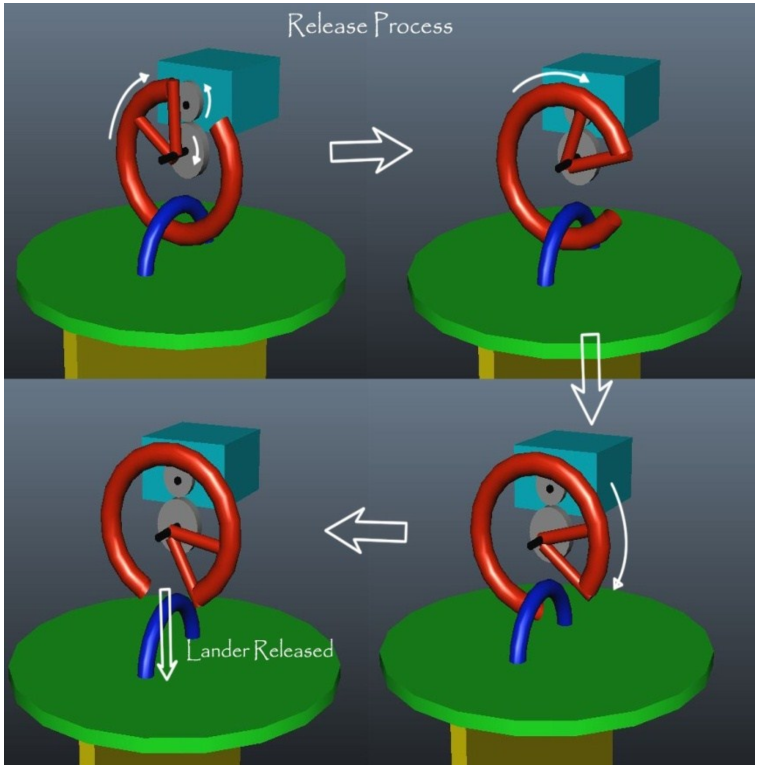
Mechanical System Requirements

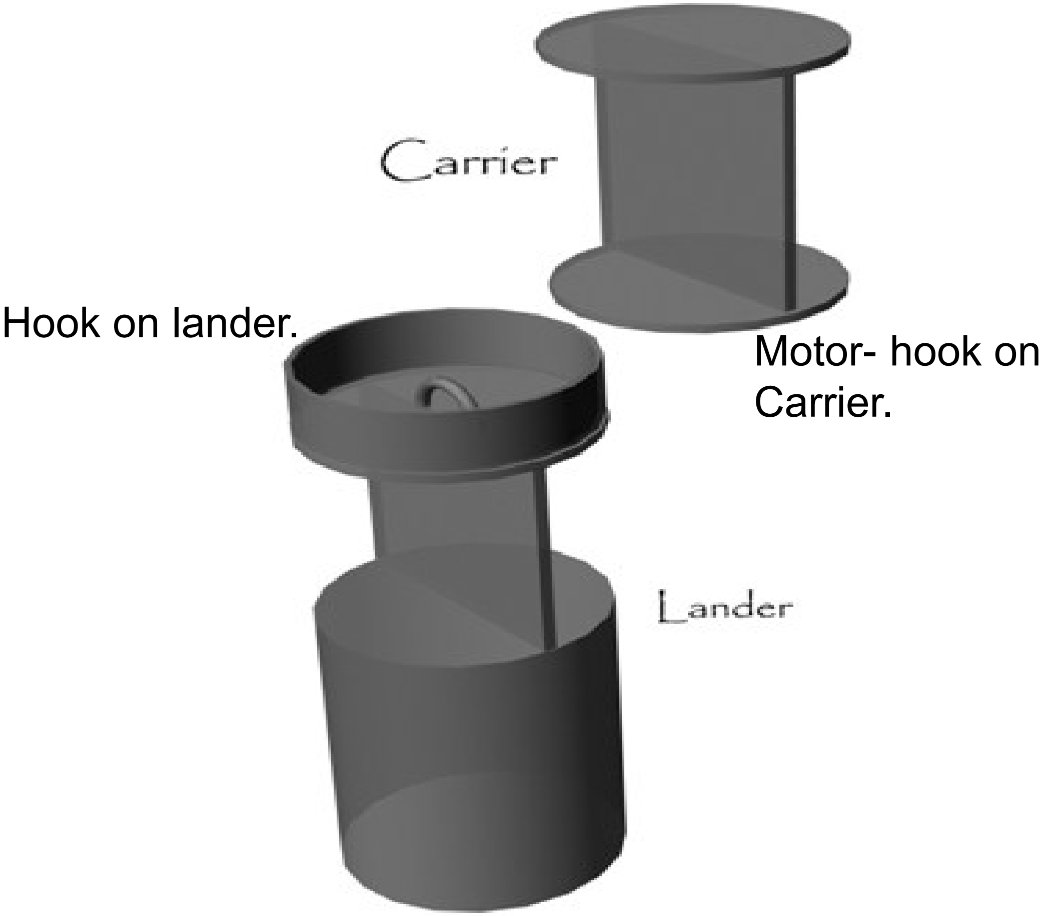
ID	Requirement	Rationale	Parent	Priority	VM			
					A	I	T	D
MS01	Mass < 500gms	There is always a finite limit of the mass that can be put into space	SYS -01	HIGH	X	X	X	
MS02	Cansat should fit in payload	Payload structure dimensions are influenced by launch vehicle characteristics	SYS -02	HIGH	X	X	X	X
MS03	No protrusions	Payload structure dimensions are influenced by launch vehicle characteristics	SYS -02	HIGH	X	X	X	X
MS04	Cansat and egg placed inside should be recovered safely.	Structure should be able to withstand vibration shocks and protect the egg from breaking.		HIGH	X	X	X	X
MS05	Sensor Placement	Placement of Sensors and Antennas have to be appropriate for proper Transmission and Reception	SYS-08,09	MEDIUM	X	X	X	
MS06	Smooth Detachment Mechanism	Mission requirement		High	X	X	X	X

Egg Protection Overview

- Egg(assumed to be 5.5 cm x 4.5 cm) will be placed in a **cylindrical container of height 9cm and diameter 6.9cm.**
- This gives us (9-5.5)/2 = **1.75 cm** space on the top and bottom and (6.9-4.5)/2 = **1.2 cm** space on either side of the egg for stuffing cushioning material.
- Container is made up of Aluminum to provide sufficient strength.
- **Polystyrene balls** are chosen as cushioning material because they were used in last years Cansat design and were successful and have also been tested this year.

Mechanical Layout of Components



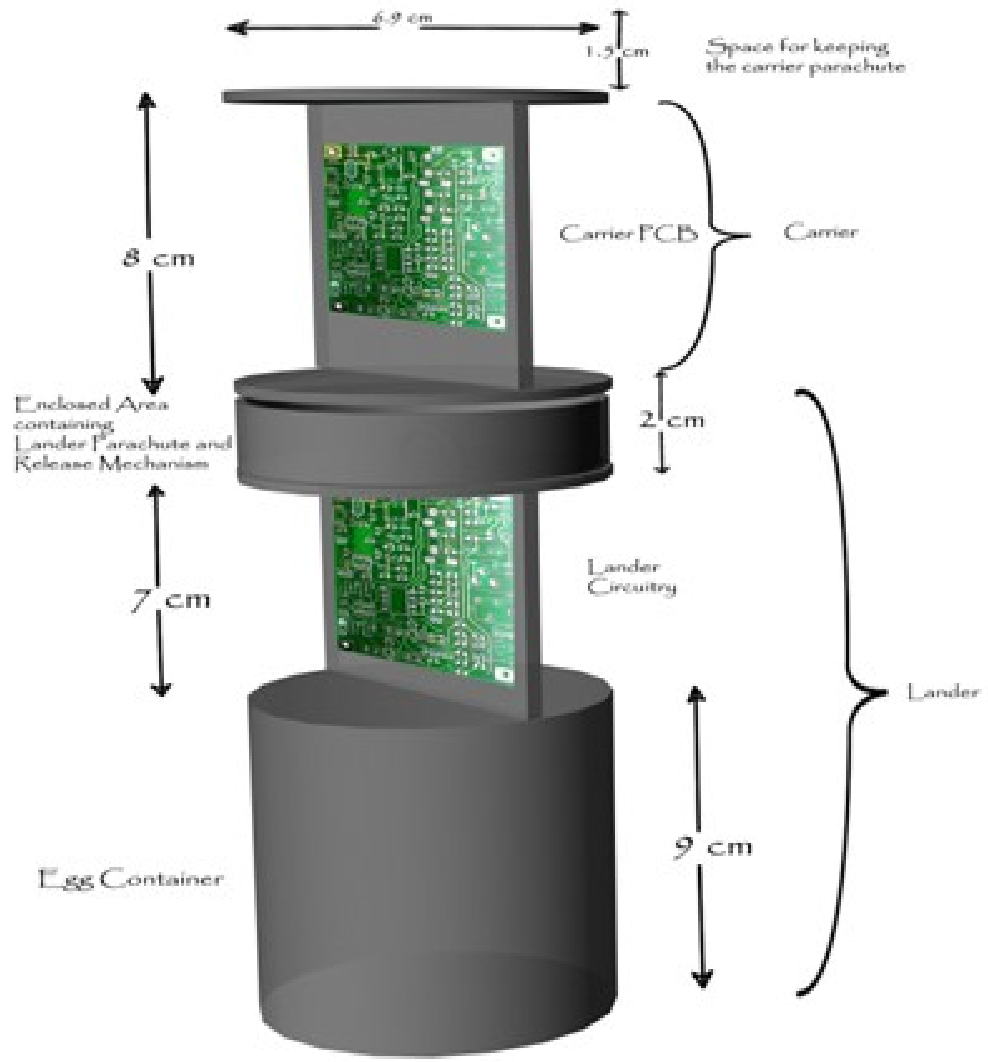


NOTE - Detachment testing has been done thoroughly and is working desirably.

Mechanical Layout of Components

<u>Overall Design Specs:</u>
Height – 27.5 cm(allowed is 27.9cm)
Width – 6.9 cm (allowed – 7.2 cm)
So 0.3 (0.15 cm on either side) is left out for easy sliding out of the Cansat from payload.

Component Placement :-
Carrier PCB on one side of the carrier frame battery and transceiver on the other. Antenna at the top.
Lander PCB on one side of lander frame and battery on the other.
Egg container at the bottom.



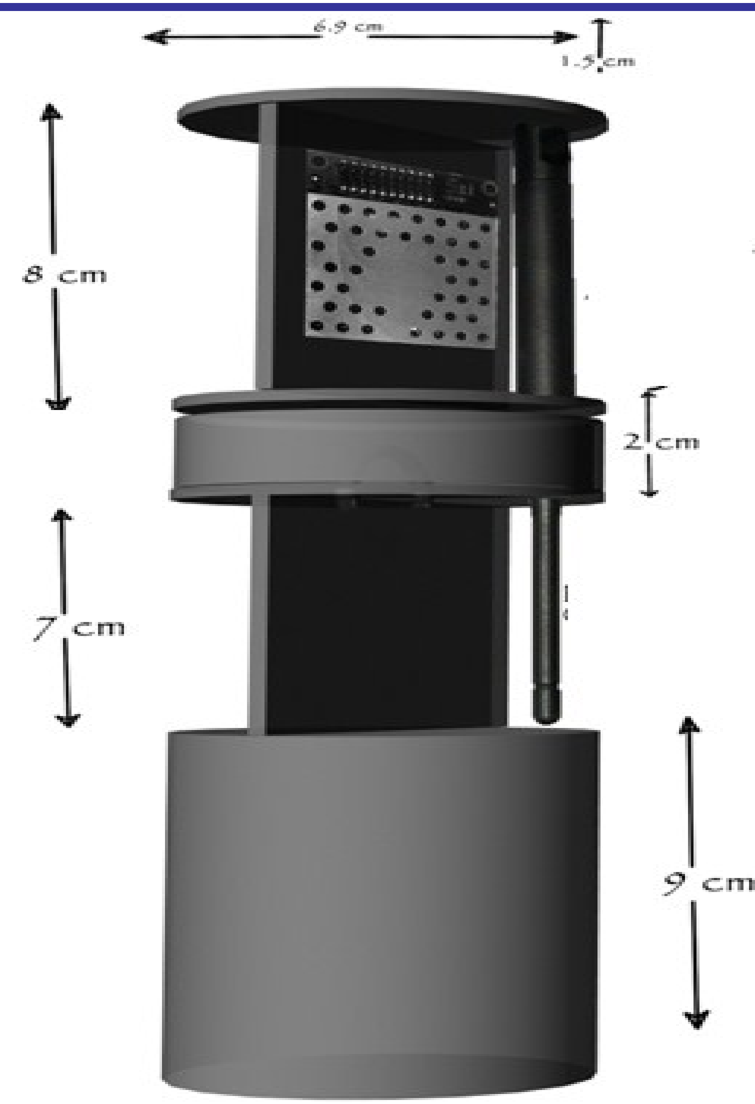
Mechanical Layout of Components

Other Side of the CANSAT shown Component Placement :-

Transceiver and antenna and battery are shown for carrier, which are not visible in the previous slide.

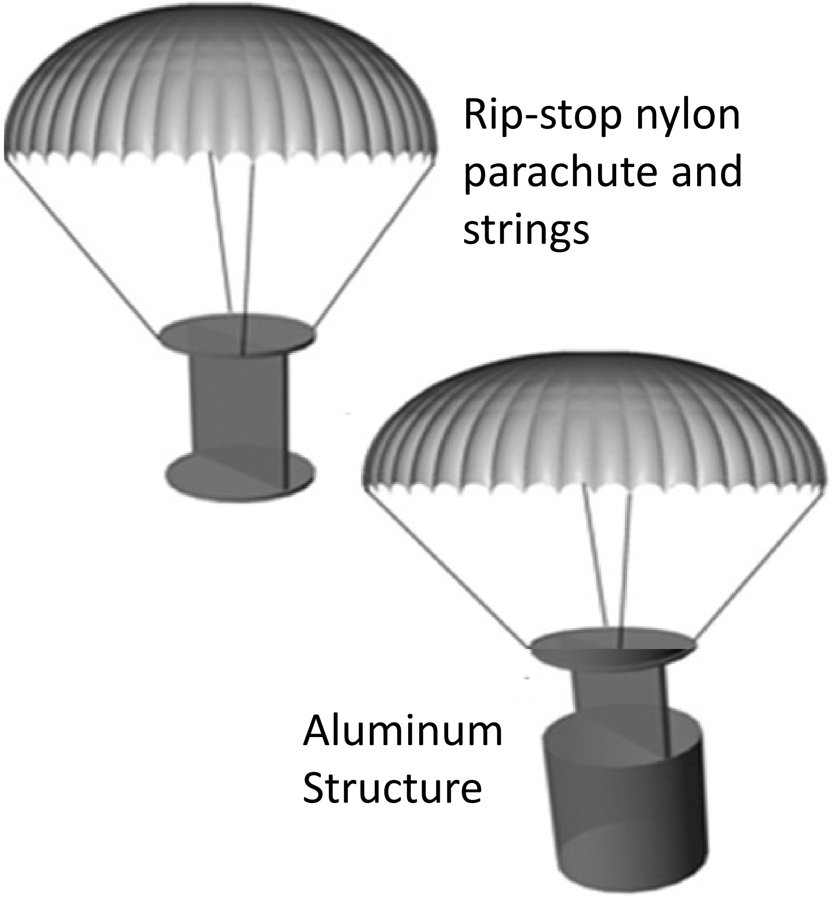
Lander battery module on one side of lander frame and PCB on the other which is shown in previous frame.

Egg container at the bottom.



Material Selections

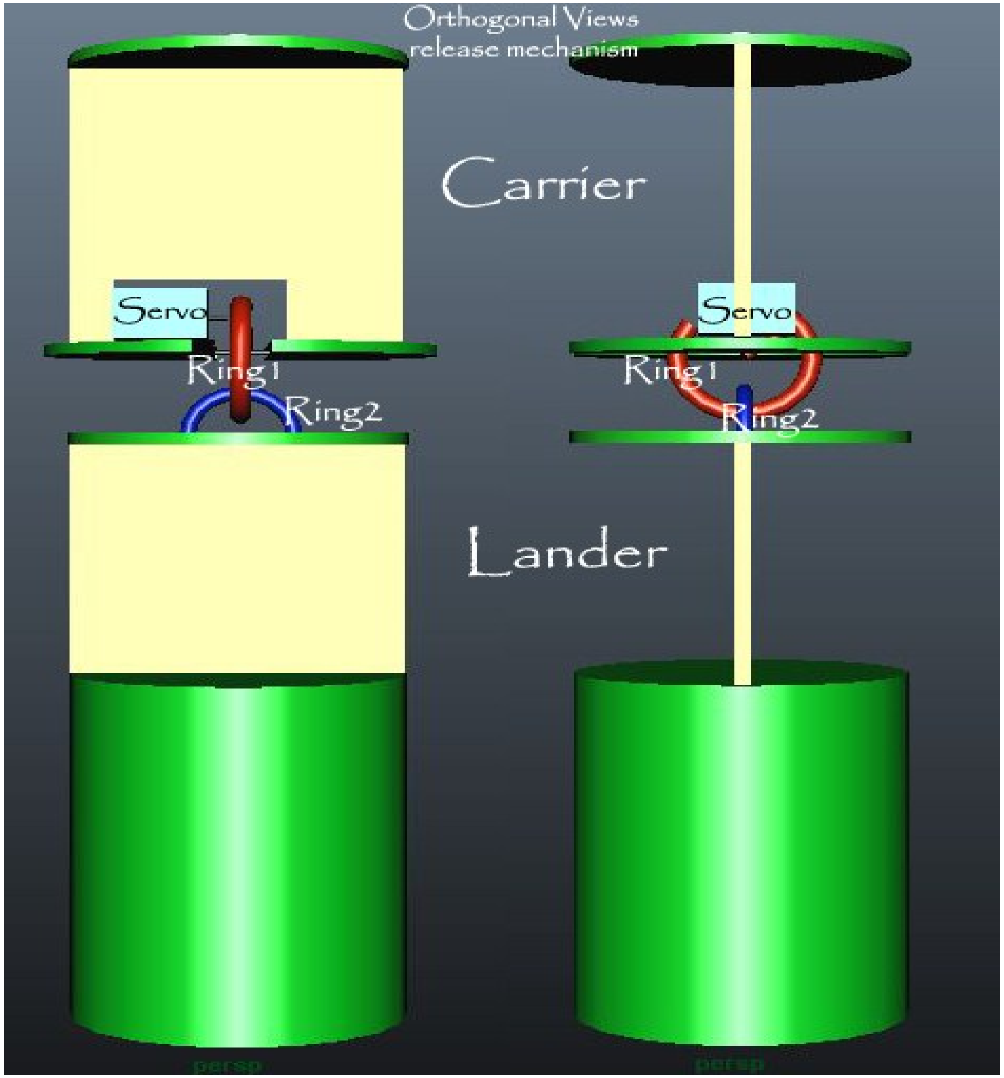
- Whole structure is made using **Aluminum** because of its **strength** and **less density** (Shown in PDR material selection and trade).
- Hook that goes in the axle of the motor in the carrier is also made of aluminum.
- Parachutes and its strings are made of **Rip-stop nylon** (trade mentioned in PDR).



Carrier-Lander Interface

- The lander will be connected to the carrier via a hook oriented horizontally. The hook will be moved using the servo when the release sequence is to be performed.

- The release of the hook results in the opening of lander parachute.



Estimated Mass Budget

Carrier	Weight (gms)	Margins Kept/Precision in measurement	Source
mass of skeleton (carrier)	52	±1	Measured after fabrication
mass of pcb(including microcontroller, temp.sensor)	23	±1	Estimated based on last years PCB.
total mass of electronics	84	±4	Various datasheets
Battery	53	±1	Measured
parachute	26	±1	Measured
Total Carrier mass	238	±8	

Estimated Mass Budget

Lander	Weight(gms)	Margin kept/Precision in measurement(gms)	Source
mass of lander skeleton	130	±5	Measured after Fabrication.
mass of electronics	25	±2	Estimated based on last years PCB.
Parachute	24	±1	Measured
Egg and cushioning	55	±1	Measured
Battery	53	±1	Measured
Total Lander mass	287	±10	

Total Mass	525 ± 18
Total mass (excluding egg)	475 ± 18

Communication and Data Handling Subsystem Design

Presenter's Name - Jasmeet Singh

CDH Overview

- **Carrier**
  - **Processor: AtMega 128** (As Central Processing Unit of the Carrier; sensing, processing, transmitting, storing telemetry data)
  - **Memory: Atmel0736** (For storing telemetry data onboard for backup in case of communication failure
  - **Radio Transceiver: Larid AC4790** Transceiver (For transmitting data to ground station once every 2 seconds)
  - **Antennae: S467XX-915S**
- **Lander**
  - **Processor: AtMega 128** (As Central Processing Unit of the Lander; sensing, processing, storing sensor data)
  - **Memory: Atmel0736** (For storing sensor data onboard the lander for post processing)

CDH Changes Since PDR

- ✓ **Selection of Antenna** was reconsidered due to size issues but a better antenna with comparable range is not available so we have to proceed with it.
- ✓ **Data Packet definition** for all sensors included in the CDR.
- ✓ **Method for terminating transmission updated**(refer to transmission termination part).

CDH Requirements-1 (Carrier)

ID	Requirement	Rationale	Parent	Priority	VM			
					A	I	T	D
CDH01	One USART Interface for telemetry	To be Transmitted every 2 seconds	SYS-08 CD-01	HIGH	X		X	X
CDH02	One USART Interface for GPS Sensor	Descent Telemetry	SYS -08 CD-01	HIGH	X	X	X	X
CDH03	One ADC Interface for Pressure Sensor	Descent Telemetry	SYS-08 CD-01	HIGH	X	X		X
CDH04	One ADC Interface for Temperature Sensor	Descent Telemetry	SYS-08 CD-01	HIGH	X	X	X	X
CDH05	One ADC Interface for Voltage Measurement	Descent Telemetry	SYS-08 CD-01	HIGH	X	X	X	X
CDH06	Terminate Telemetry	Do so within 5 minutes of landing.	SYS-08,09 CD-01	HIGH	X	X		
CDH07	One SPI Interface for Memory	Post Processing	SYS-11	LOW	X	X		

CDH Requirements-2 (Lander)

ID	Requirement	Rationale	Parent	Priority	VM			
					A	I	T	D
CDH08	One ADC Interface for Pressure Sensor	For Storage and Post Processing	SYS-11	HIGH	X			
CDH09	One ADC Interface for Voltage Measurement	For Storage and Post Processing	SYS-11	HIGH	X	X	X	X
CDH10	Three ADC Interface for Accelerometer	For Storage and Post Processing	Selectable Objective	HIGH	X	X		
CDH11	One SPI for Memory	For Storage and Post Processing	SYS-11	HIGH	X	X		

CDH Requirements-3 (CanSat System)

ID	Requirement	Rationale	Parent	Priority	VM			
					A	I	T	D
CDH12	One USART Interface at each end i.e. Carrier and GCS	Descent Telemetry	SYS-08	HIGH	X		X	X
CDH13	One USART for Post Processing of Lander Data	Lander Telemetry Data to be processed after Retrieval of Lander	SYS-11	HIGH	X		X	X
CDH14	Proper Link between GCS Transceiver and Laptop.	Analysis of Received Data	SYS-11	MEDIUM	X	X	X	X

Processor Selection (Carrier)

Carrier: AtMega 128

- **Processor Speed :- 16 MHz (external)**
- **Data Interfaces:**
  - USART:- 2 (Used-2)
  - SPI:- 1 (Used-1)
  - ADC PORTS:- 8 (Used-3)
- **On chip Flash Memory: 128 Kb (additional memory used for storage)**
- **SRAM / EEPROM: 4 Kb**
- **Supply Voltage: 4.5V – 5V**

Other Options Considered:

- AtMega 16 (Rejected due to less flash memory: 16Kb)
- AtMega 32 (Rejected because only 1 USART available)
- Altera DE1 FPGA Board (Rejected due to size constraints)

Processor Selection (Lander)

Lander: AtMega 128

- **Processor Speed :- 16 MHz (external)**
- **Data Interfaces:**
  - USART:- 2 (Used-0)
  - SPI:- 1 (Used-1)
  - ADC Ports:- 8 (Used-5)
- **On chip Flash Memory: 128 Kb (additional memory used for storage)**
- **SRAM / EEPROM: 4 Kb**
- **Supply Voltage: 4.5V – 5V**

Memory Selection (Carrier & Lander)

- If 5 minutes of Descent Telemetry(carrier) sampled at 2 seconds

  5* 60 * (50 bytes) / 2 ~= 7.5 Kb
- For Lander, 5 minutes of height and battery voltage data sampled at 2 seconds:

  5* 60 * (10 bytes) / 2 ~=1.5Kb
- If Acceleration Data is calculated with 100 samples per second:

  5 * 60 *100 ~= 30 Kb

Results

- **Memory Required for Carrier Storage = 7.5Kb**
- **Memory Required for Lander Storage = 31.5Kb**
- **Memory Chip**

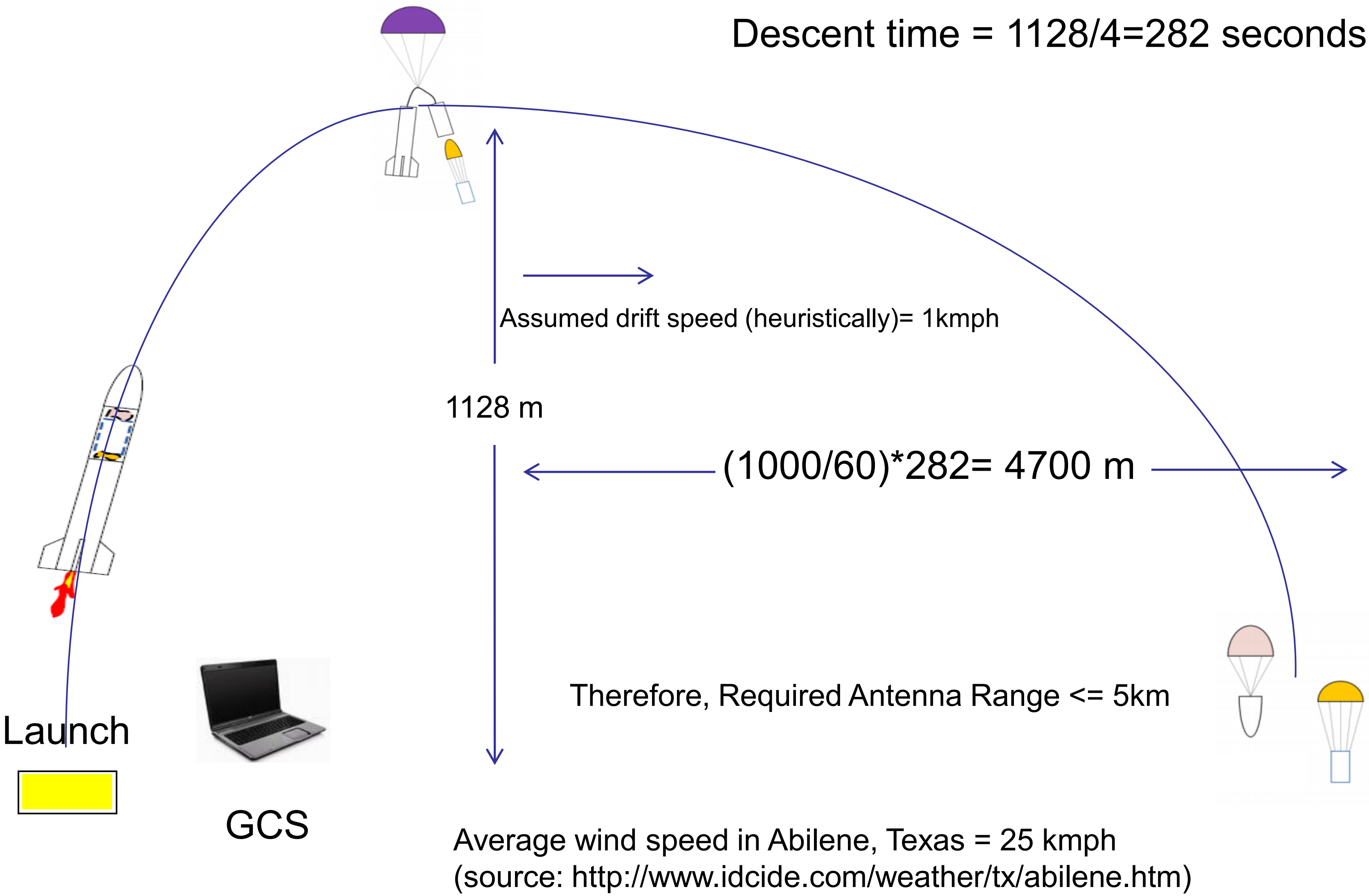
  - 8 MB, SPI Mode, Chip Select Available (8Mb>7.5Kb and 8MB>31.5Kb)
- **The same memory chip is to be used for Carrier and Lander**

Carrier Antenna Selection

Name	Range	Gain	Radiation Direction	Mass
Antenova B58124	1 Km	1.8dB	Omni	2g
S467XX-915S	**5 Km**	**2.0dB**	**Omni**	**21g**

- Range Required - 1.5Km at least
- 1st Choice does not do well on range requirement hence 2nd chosen.
- Power Requirements of 2nd Antenna are well under affordable limits.

Carrier Antenna Selection- Range Requirement



Data Package Definitions

- **Radio Transceiver:**
  - Uses USART. Baud rate = 57,600 bps
  - Programmed to work in API mode
- **GPS:**
  - Uses USART. Baud rate = 38,400
  - Data Bits:8, Stop Bits: 1
  - NMEA protocol used
- **Altitude Sensor, Temperature Sensor:**
  - Uses 10-bit ADC (values from 0-1023). Sampled at 50 kHz
- **Battery Voltage:**
  - Uses 10 bit ADC (values from 0-1023). Sampled at 50 kHz

Data Package Definitions

- **Accelerometer (Impact Force Sensor):**
  - Uses 3,10-bit ADCs (values from 0-1023). Sampled at 50kHz
- **Memory:**
  - Uses SPI interface (Serial Parallel interface) of microcontroller.
  - Memory chip acts as slave and microcontroller as master.

Communication Configuration

Transceiver EEPROM programmed to enable API control Mode

The system in API mode set at fixed baud rate and channel transmits and receives through a 3 byte MAC address which can either be hard coded on the EEPROM or sent dynamically.

Fixed baud rate of 57600 bps , channel 0 in Receive mode for query wait

Transmit when asked for a query, through UDR buffer

Data sent to the transceiver over he USART channel will be of the following format :

Packet Element	Value	Size (Bytes)	Description
API Start	0x81	1	This byte is a fixed header. Does not change
Data Length	0x01 – 0x78	1	This byte is set based on the number of bytes in the data field
Session Count Refresh	0x08	1	Byte is a fixed value
Transmit Retries/ Broadcast Attempts	0x04	1	Byte is a fixed value
Ground Station MAC	<MAC2>, <MAC1>, <MAC0>	3	This is the MAC address of the ground station or relay radio that the data packet is to sent to. These values will be provided prior to the competition.
Data	<Data>	0x01 – 0x78	Descent Telemetry, Image Packets, or Impact Data Packets.

Carrier Telemetry Format

Element	Description
GPS Time	GPS time to 1 second resolution
GPS Latitude	Copy Direct from NMEA message, include N/S
GPS Longitude	Copy Direct from NMEA message, include E/W
GPS Altitude	Copy from NMEA message
Number of Satellites being tracked	Copy direct from NMEA message
Altitude via non GPS sensor or data to derive altitude	Specify in meters or notify competition ground team if sending unprocessed sensor data.
Air Temperature	Units in C to 1 degree resolution
Battery Voltage	Unit in volts to 0.1 volt resolution

Example: ‘161229,3723.2475N,12158.3146W,3120.3,7,3109.4,29,8.4,‘

Time , lattitude , longitude , altitude ,satellites ,barometric altitude, air temperature , B voltage

Autonomous Termination of Transmissions

- **Telemetry Termination :**
  - **Primarily decided by GPS data**.
  - **Pressure sensor** for verification of termination decision.
  - **How to decide?**
    - GPS data will be compared against previous GPS data, if no change in altitude is observed for a period of time then termination packet sent to GCS and terminated.
  - **Special termination packet** will indicate end of telemetry to GCS.

Carrier & Lander Locator Device Summary

Name	Size	Power consumption	Cost	Availability
CMS0341KLX	3.4cm x3.4cmx1.5cm	20 W	7 $	Easily available
JS-666	**0.8cm*3cm*3.8cm**	**0.5W**	**10$**	**Facility identified**

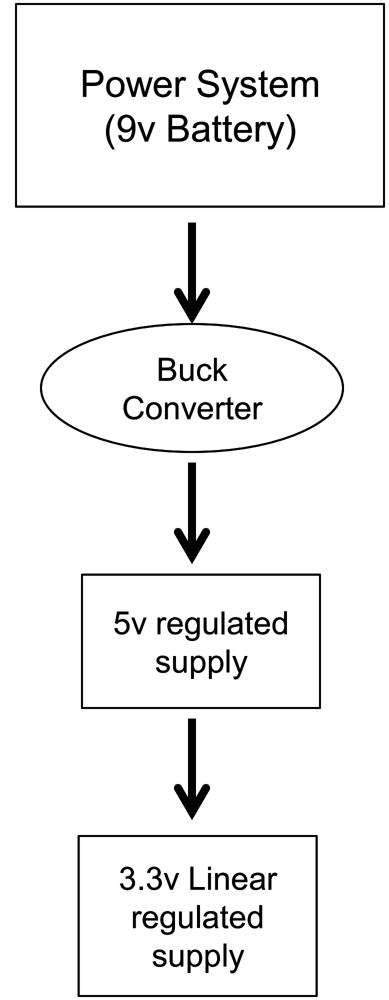
- **Device Selected**: JS-666
- **Criteria for selection**: Power consumption.
- Power required by 1st are not under affordable limits.
- **Activation Trigger**: PWM from microcontroller.
- **Audible Range: 20m** (Human audible range)
- Both carrier and Lander shall have same locator device.

Electrical Power Subsystem Design

Presenter's Name - Jasmeet Singh

EPS Overview

- **Design Considerations**
  - All the power and electrical requirements are met by using a 9V battery.
- **Voltage Regulation**
  - Level-shifting and voltage regulations for using two different voltage regulators each corresponding to 5v and 3.3v are used for various purposes.
- **Power Monitoring**
  - Done by additional hardware. The Total Power Budget has also been calculated and has been shown latter.



EPS Changes Since PDR

- ✓ The Locator Device(JS666) has been finalized. Its requirements have been added in the power budget.
- ✓ Servo Motor(SG90) has been finalized.

EPS Requirements For Cansat System

ID	Requirement	Rationale	Parent	Priority	VM			
					A	I	T	D
EP01	Voltage Requirement (5V, 3.3V)	• 5V required for MicroController and Pressure, Servo, Temperature Sensor, Locator Device. • 3.3V for Memory, GPS and Transceiver.	-----	MEDIUM	x	x	x	x
EP02	Battery Requirement (9V)	To be able to provide adequate power for the whole period of flight.	EP01	MEDIUM	x	x	x	x
EP03	Measurement Accuracy and Resolution (0.008V)	Voltage has to be measured and stored.	-----	MEDIUM	x	x	x	x

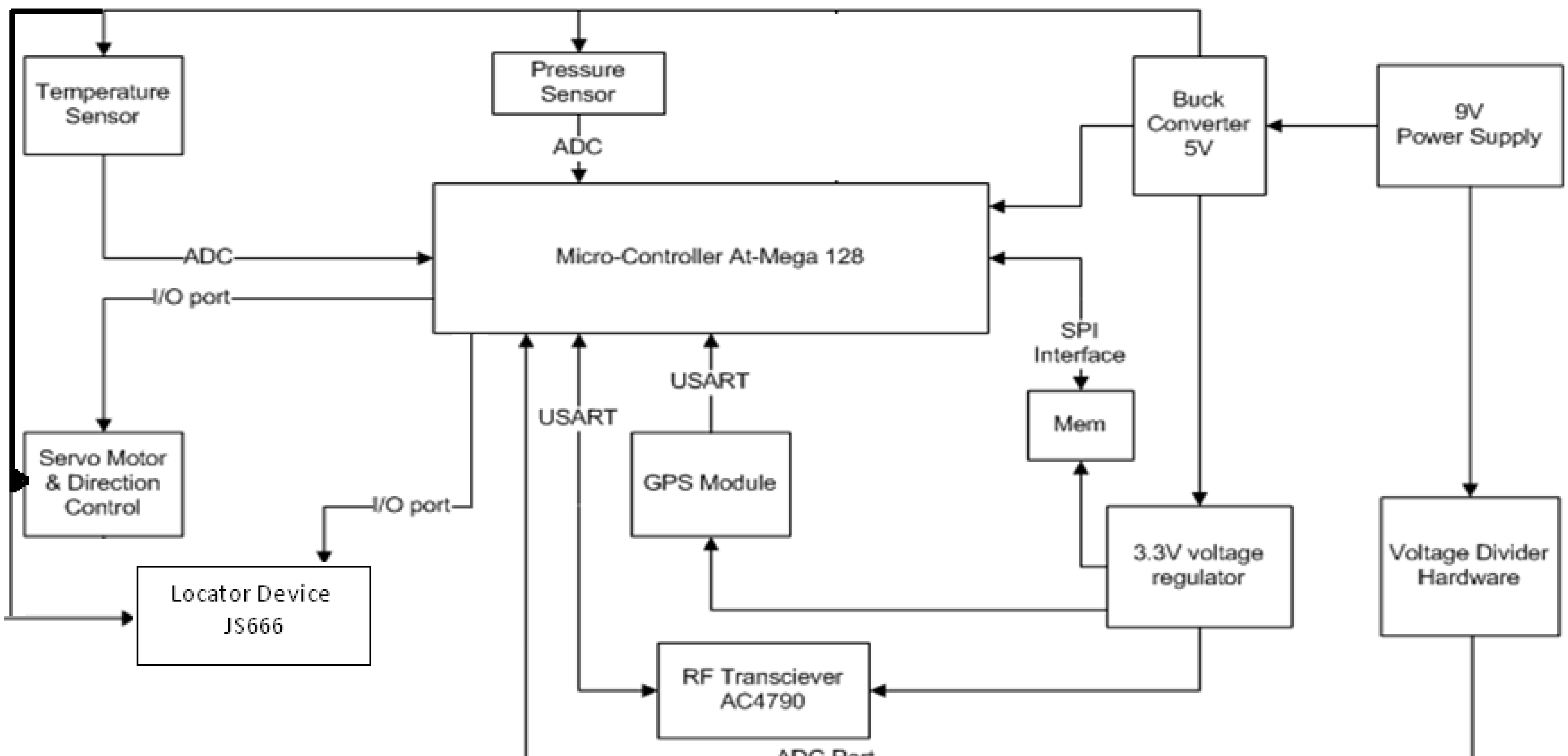
EPS Requirements For Carrier

ID	Requirement	Rationale	Parent	Priority	VM			
					A	I	T	D
EP01	Voltage Requirement (5V, 3.3V)	• 5V required for MicroController and Pressure, Servo, Temperature Sensor, Locator Device. • 3.3V for Memory, GPS and Transceiver.	-----	MEDIUM	x	x	X	x
EP02	Battery Requirement (9V)	To be able to provide adequate power for the whole period of flight.	EP01	MEDIUM	x	x	x	x
EP03	Measurement Accuracy and Resolution (0.008V)	Voltage has to be measured and stored.	-----	MEDIUM	x	x	x	x

EPS Requirements For Lander

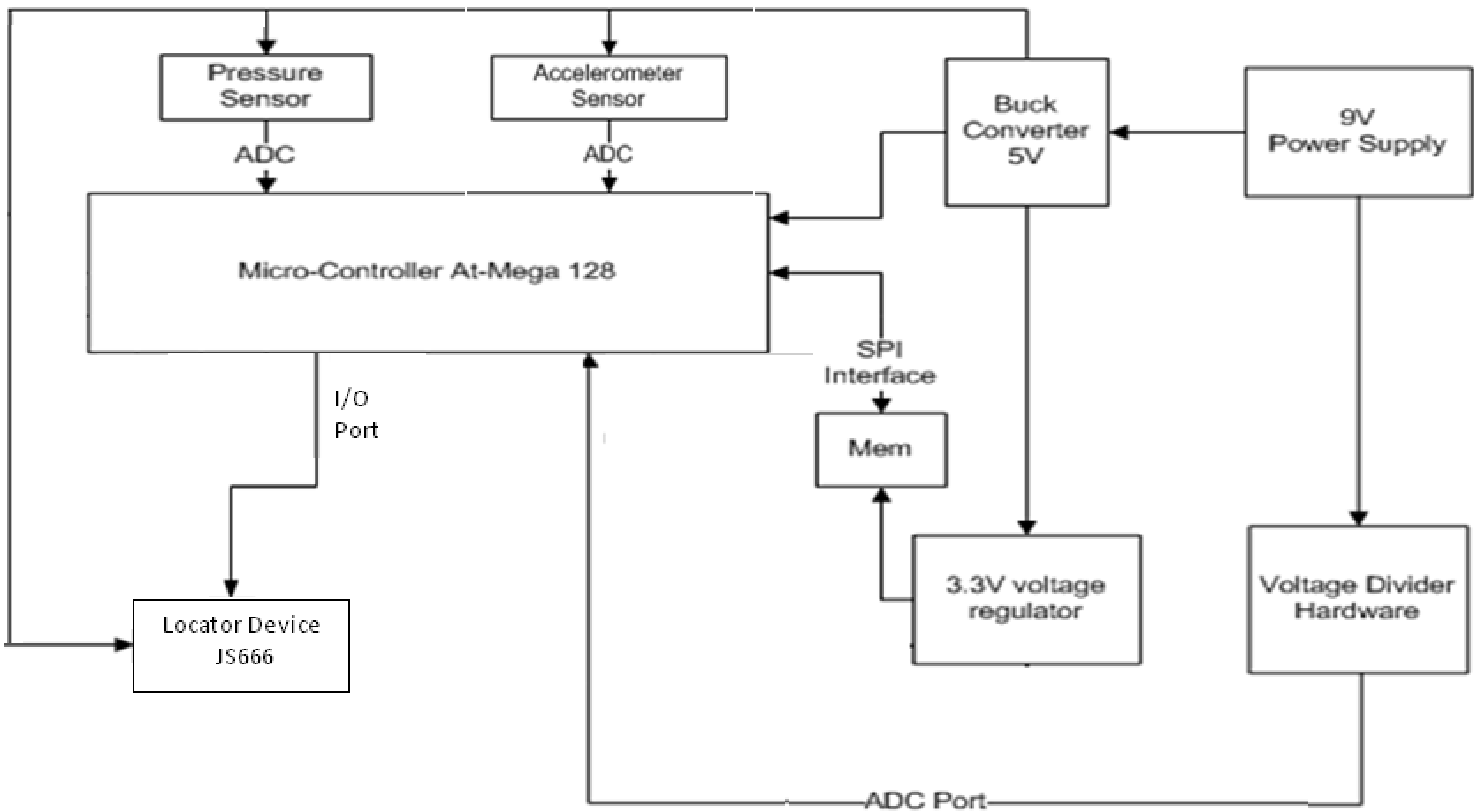
ID	Requirement	Rationale	Parent	Priority	VM			
					A	I	T	D
EP01	Voltage Requirement (5V, 3.3V)	• 5V required for MicroController and Pressure, Temperature Sensor, Locator Device. • 3.3V for Memory.	-----	MEDIUM	x	x	x	x
EP02	Battery Requirement (9V)	To be able to provide adequate power for the whole period of flight.	EP01	MEDIUM	x	x	x	x
EP03	Measurement Accuracy and Resolution (0.008V)	Voltage has to be measured and stored.	-----	MEDIUM	x	x	x	x

Carrier Electrical Block Diagram



External Power Switch will be present to control the power flow in the system. Battery Voltage will be read using microcontroller.

Lander Electrical Block Diagram



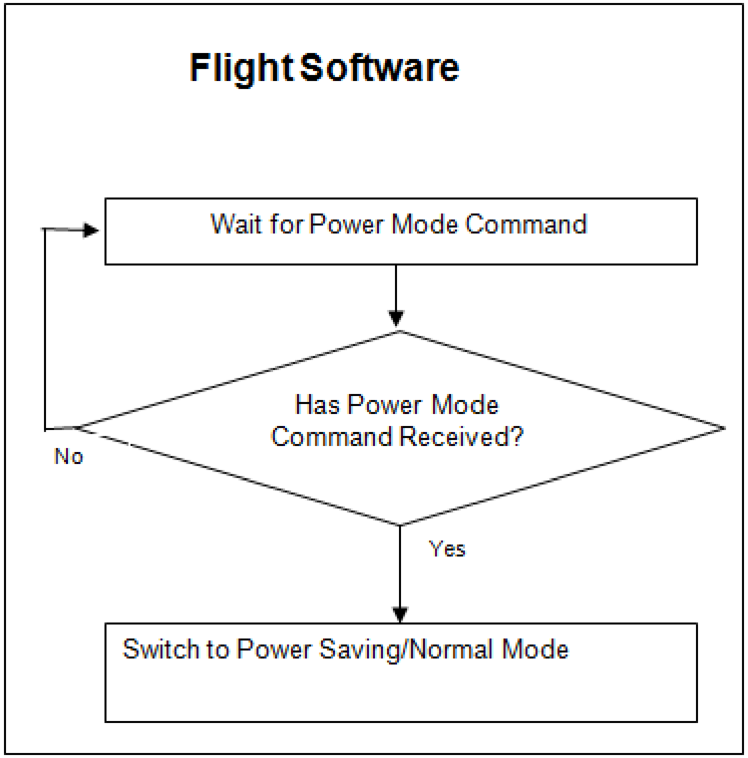
External Power Switch will be present to control the power flow in the system. Battery Voltage will be read using microcontroller.

External Power Control without disassembling CANSAT

- Idle Mode: In this mode of the processor would disable the CPU and the MEMORY by switching off the clk_cpu and clk_flash but the USART, ADC and SPI keep working which would save power.

- Power down Mode: In this mode we can switch off the ADC clock and the USART locks to save power.

- Simple LED indication of power on/off status with an external push button may be added



Carrier Power Budget

Device	Average Power consumption (Watts)	Voltage	Average Current	Usage in 3.5hrs
GPS	72.64mW	3.3v	22.7 ma	100%
Pressure Sensor	2.5mW	5v	0.5ma	100%
Temperature Sensor	5mW	5v	1ma	100%
Transceiver RF	0.214 W	3.3v	65ma	100%
Microcontroller	0.11 W	5v	28ma	100%
Flash memory	71.5mW	5v	14.3ma	100%
Buck Convertor 5v		9v	**92% eff**	100%
Linear converter 3.3v		5v	**90% eff**	100%
Voltage divider H		9v	**Negligible**	100%
Servo Motor	10mW	5v	2ma	**One Time**
Locator Device	0.5W	5v	100ma	**After Landing Till Recovery**

Lander Power Budget

Device	Average Power consumption (Watts)	Voltage	Average Current	Usage in 3.5hrs
Pressure Sensor	2.5mW	5v	0.5ma	100%
Microcontroller	0.11 W	5v	28ma	100%
Flash memory	71.5mW	5v	14.3ma	100%
Buck Convertor 5v		9v	**92% eff**	100%
Buck converter 3.3v		5v	**90% eff**	100%
Voltage divider H		9v	**Negligible**	100%
Locator Device	0.5W	5v	100ma	**After Landing**

Total Power Budget

- **Total Power used by main components is 985.64mWh(Carrier) and 684mWh(Lander).**
- **Voltage loss of 90% efficiency in 3.3v and 92% in 5v for Buck Convertors**
- **Battery life: 3.85 hours (approx.) for lander and 3.5 hours for carrier**

Power Source Summary

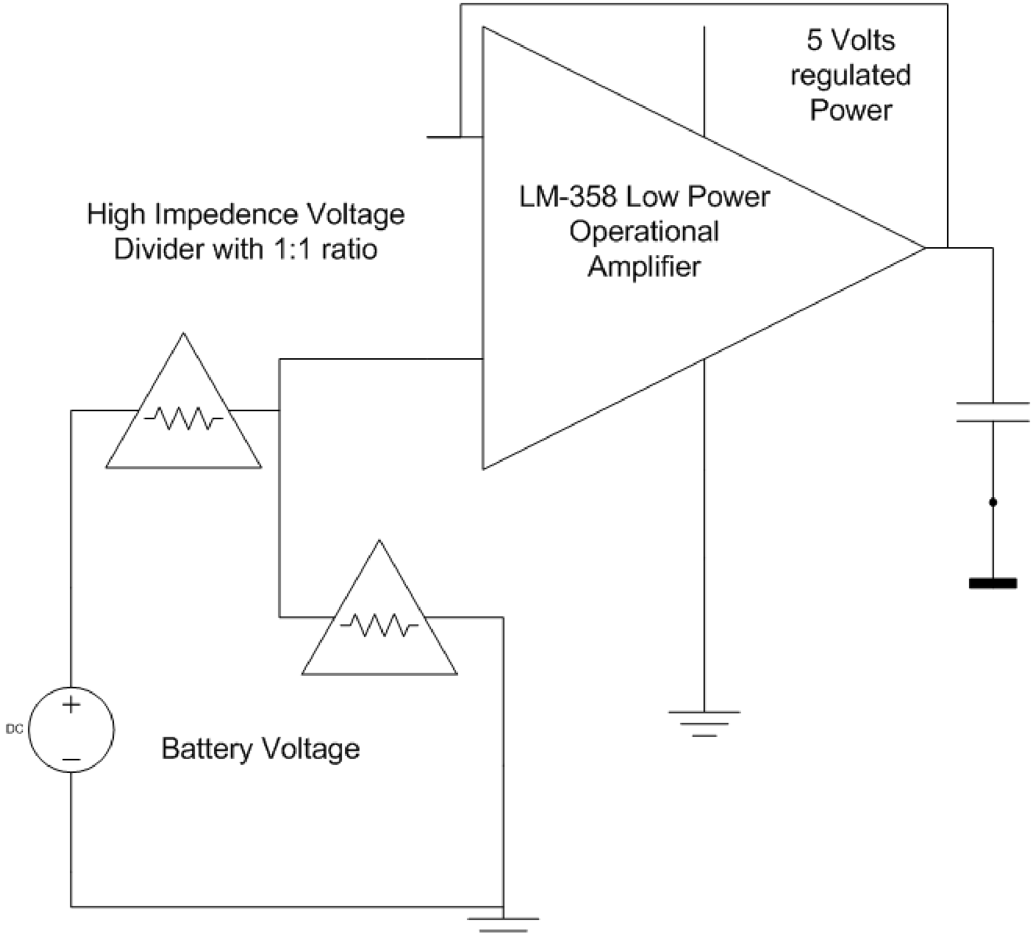
Name	Voltage/Power	Type	Mass
6F22 Heavy duty	9v / 500mah	Alkaline	45g
UBP 001	3.7v/1800mah	Lithium Ion	41g
Dura Cell	**9.6v/ 230mah**	**Ni Mh**	**47g**

We are using Dura Cell for both Carrier and Lander as it is most easily available and Highly efficient for the purposes required.

Although we are thinking of switching to CR2430 Lithium Button Rechargeable Cells for Lander.

Weight of 3V CR2430 = 4 grams. For 9V, net weight would be 12 grams, which is much less than the Duracell battery.

Battery Voltage Measurement



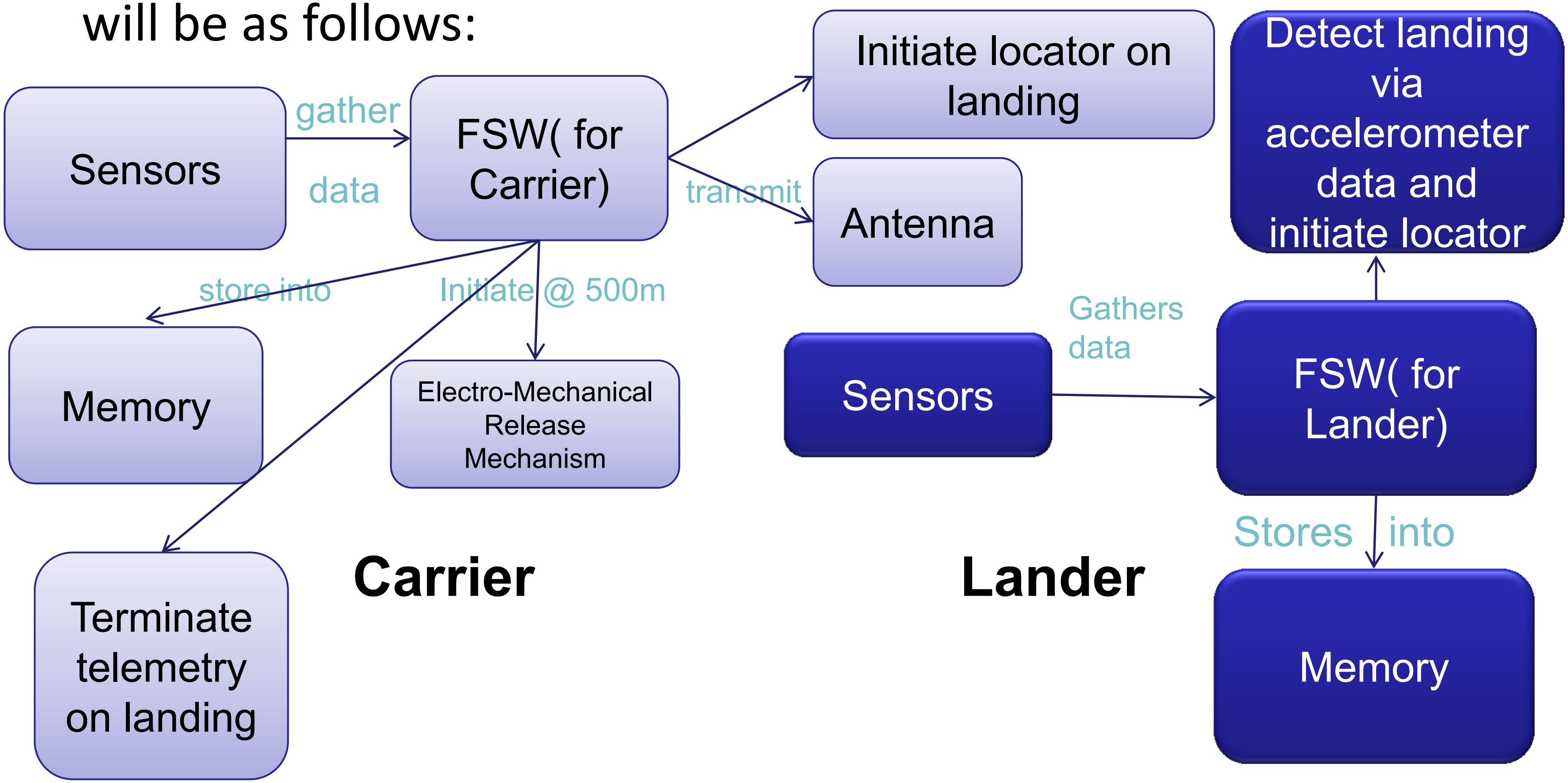
- Battery Voltage is measured by giving a high impedance voltage divider with outsourcing and then interfaced to the ADC port.
- We use the same circuit for both Lander and Carrier.

Flight Software Design

Presenter's Name - Nikhil Soni

FSW Overview

- The FSW will work in a Microcontroller(Atmega128). There will be separate FSW's for the lander and the carrier. Its basic structure will be as follows:



FSW Overview

- **FSW coordinates with various sensors, composes the telemetry packets and sends it transceiver for transmission and also stores it for post processing.**
- **Controls Detachment Mechanism.**
- **Controls Telemetry termination.**
- **Controls Locator Device** function.
- **Calculates Impact Force** (selectable objective) on Lander.
- **FSW is developed in C , compiled using AVR GCC.**
- **AtMega 128 Processor** used to run FSW on Carrier and Lander.

FSW Changes Since PDR

- ✓ Corrections have been made since PDR and FSW now also includes telemetry termination conditions for Carrier.
- ✓ Carrier FSW also initiates the locator device on landing now.
- ✓ Lander FSW also initiates the locator device on landing.
- ✓ Changes have been made in the software flow diagrams to accommodate above steps.
- ✓ Valid Data check included – It checks for garbage value of the sensor.

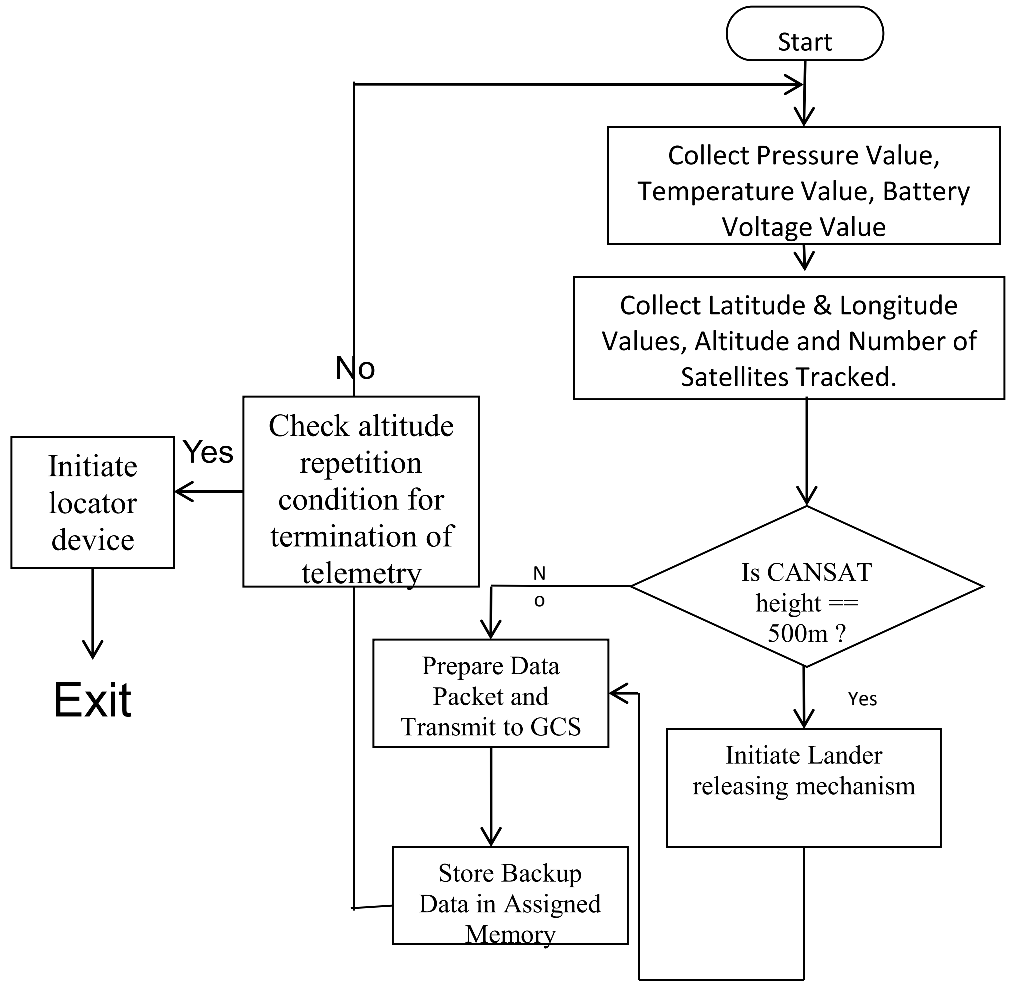
FSW requirements (Carrier)

ID	Requirement	Rationale	Parent	Priority	VM			
					A	I	T	D
FSC01	Collection of Sensor data in processor (1USART, 3 ADC ports)	Reception of data values from sensors and analysis in firmware to produce data packets	CD01	HIGH	X	X	X	X
FSC02	RF Transceiver (1 USART port)	Packet sent for Transmission to Relay	CD01	HIGH	X	X	X	X
FSC03	Data backup (1 SPI port)	Packet also sent to memory for Data-packet backup.	CD01 CD04 CD06	LOW	X	X		
FSC04	Detachment Mechanism (1 PWM port)	So that the lander can be released at height of 500 meters	CD03	HIGH	X	X	X	X
FSC05	Terminate telemetry (1 USART port)	To use the power for the locator device rather than transmission		MEDIUM	X	X		
FCS06	Initiate locator device (1 PWM port)	So that the Cansat can be recovered easily after landing		MEDIUM	X	X	X	X

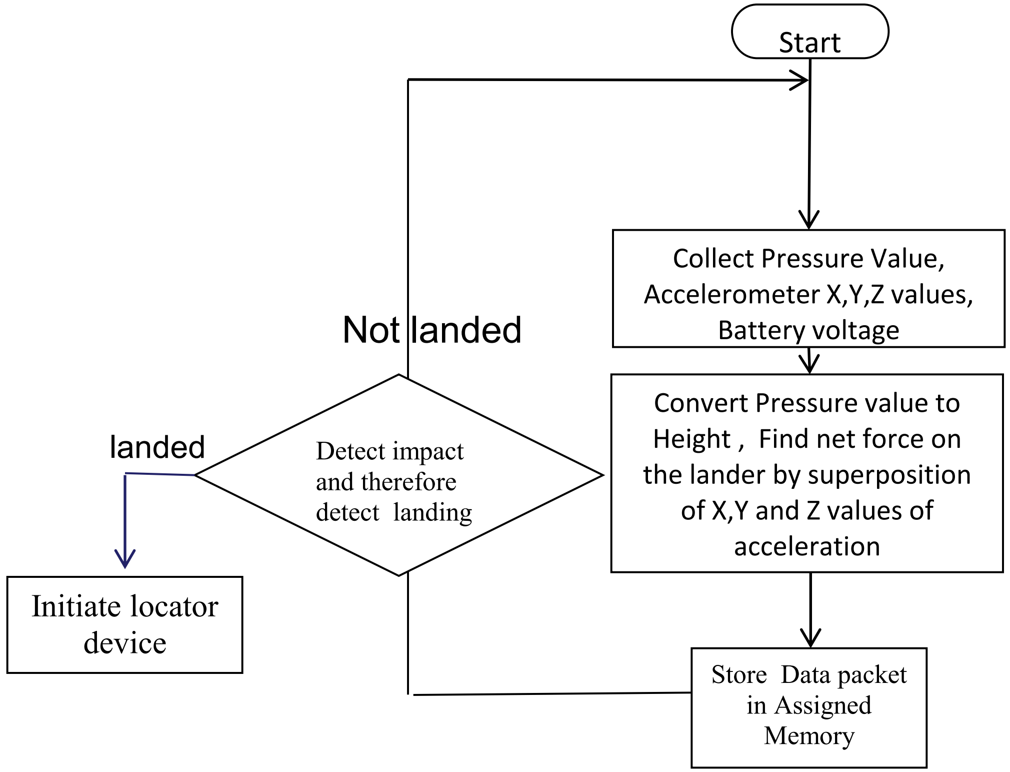
FSW requirements (Lander)

ID	Requirement	Rationale	Parent	Priority	VM			
					A	I	T	D
FSL01	Collection of Sensor data in processor and formation of packet (Requires 5 ADC ports)	Reception of data values from sensors and analysis in firmware to store heights and impact force	CD01	HIGH	X	X	X	X
FSL02	Packets stored as onboard memory. (Requires 1 SPI port)	Data can be retrieved from memory for later analysis.	CD01 CD04 CD06	HIGH	X	X		
FSL03	Detect impact force on landing and initiate the locator device (Requires 3 ADC port)	So that the lander can recovered after landing		MEDIUM	X	X	X	X

Software (Carrier) flow diagram(High Level)



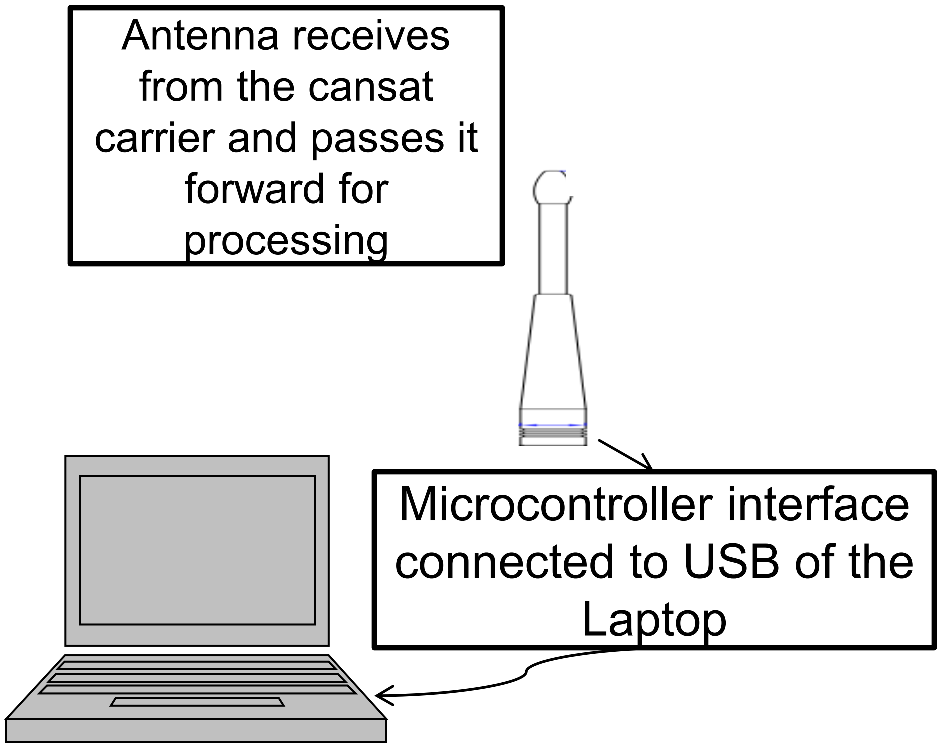
Software (Lander) flow diagram(High Level)



Ground Control System Design

Presenter's Name – Nikhil Soni

GCS Overview



GCS uses the data received to populate various tables and plot graphs. The software clearly indicates the phases of flight, i.e. pre-launch, moving upwards, deployment, coming down, landed etc..

GCS Requirements

ID	Requirement	Rationale	Priority	Parent	Children	VM A	VM I	VM T	VM D
GCS01	Antenna placement : Antenna must point upward, towards the cansat	For better signal reception.	Medium	None	GCS02 GCS03	X	X	X	
GCS02	Computational requirements : Data is received at 0.5 Hz.	Computational speed is not a big issue. (Assuming GCS laptop has a reasonably fast processor)	Low	GCS01	None	X	X	X	
GCS03	Power Requirement : Should be able to receive and display data for about 4 hrs.	GCS has to be ready always for the communication. Not a big issue as ample power is available.	Medium	GCS01	GCS05	X	X		

GCS Requirements

ID	Requirement	Rationale	Priority	Parent	Children	VM			
						A	I	T	D
GCS04	Analysis Software requirements : Should support Java, C/C++.	To be able to run analysis software.	High	None	None	X	X		
GCS05	Mission operations : Includes the detection of various phases by the GCS	To be able to distinguish between various states of flight.	Medium	GCS03	None	X	X		
GCS06	DATA PROCESSING : Data string obtained must be processed to extract meaningful data for graph plotting and flight analysis.	For flight analysis	Medium	None	GCS02 GCS03	X	X		

GCS Antenna Selection

Name	Range	Range observed at the time of testing	Gain	Radiation Direction	Mass
Antenova B58124	1 Km	0.5 km	1.8dB	Omni	2g
S467XX-915S	**5 Km**	**2.8 km**	**2.0dB**	**Omni**	**21g**

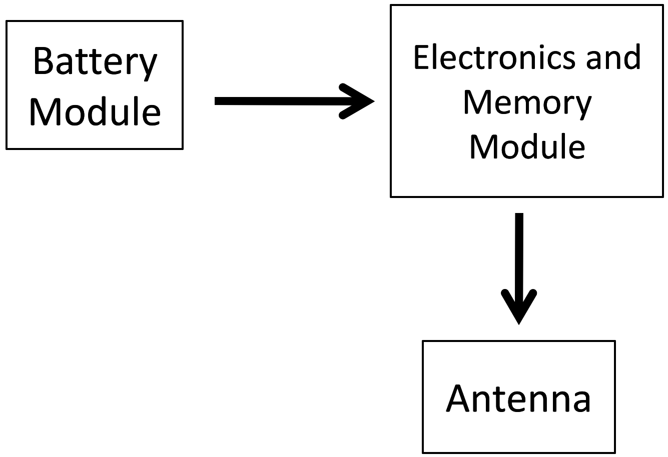
Range requirement : **914 meters -1128 meters**

Above mentioned two antennas were considered in trade and selection but **second one is selected** because of range requirements(Clearly first one does not satisfy the needs). Intuitively also since one can afford large power consumption requirements in GCS, hence one would like to use a stronger antenna to compensate for low power antenna at the transmitter end.

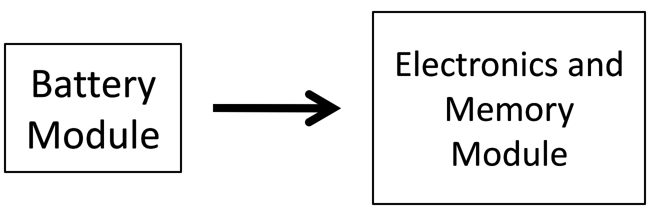
CanSat Integration and Test

Presenter's Name - Palash Jain

- **Integration of Carrier and Lander**
  - We used a servo motor to control a hook that holds the Lander and the Carrier.
- **Integrations in Carrier**
  - EPS, SS, CDHS and DC - It is just like a frame. One side of the frame has the electronics that is PCB while the other side has the battery along with the transceiver while the antenna is hanging from the top.



- **Integrations in Lander**
  - EPS, SS and DC - It is also a frame just like Carrier but will also have the egg container attached to it at the bottom. The frame will have PCB on one side and battery on the other.



Sensor Subsystem Testing Overview

GPS Testing (Done)–

- **Mission :** To ensure correct working of GPS.
- **Test environment :** Atmega 16 test kit used. Done in open field. Results verified using a working GPS phone.

Location	Latitude		Longitude		Height		Satellites	
	Mobile GPS	Our GPS	Mobile GPS	Our GPS	Mobile GPS	Our GPS	Mobile GPS	Our GPS
1	17°26’43.09”	17°26’73.15”	78°21’1.4”	78°21’02.08”	613m	624m	10	8
2	17°26’47.3”	17°26’78.68”	78°20’58.2”	78°20’97.69”	616m	620.8m	8	7

- **Pass/Fail criteria :** correctness of data (reasonable precision).
- **Conclusion : GPS working with reasonable accuracy.**

Note :- vibration testing was also performed but exact data (measurement of amount of vibration introduced) could not be gathered due to lack of test equipment. Although sufficient amount of vibrations were introduced by the means of shaking and throwing.

Sensor Subsystem Testing Overview

Temperature Sensor test (Done) –

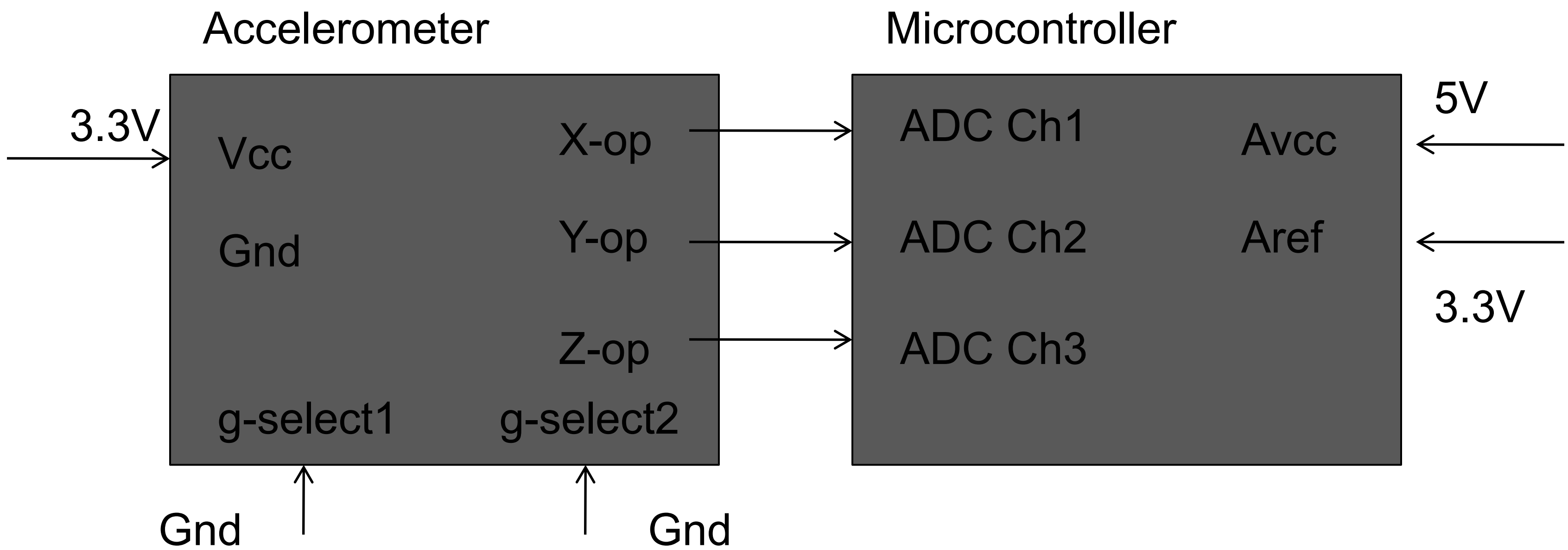
- **Mission:** Ensure correct working of temperature sensor.
- **Test environment :** Air temperature measured, verified using display of Air Conditioner.

S No.	Temperature Sensor Reading	Actual Reading	Error (%)	Source of Actual Reading	Remarks
1	21.4	21	1.9	Air Conditioner Display Panel	Acceptable
2	41	40	2.5	Air Conditioner Display Panel	Acceptable

- **Pass/Fail criteria :** 1^{o} accuracy needed.
- **Conclusion : Temperature sensor is working with desirable (1^{o}) accuracy.**

Note :- Possible vibration testing done and successful.

Lander Impact Force Sensor Testing



- The accelerometer Vcc=3.3V
- Microcontroller ADC Vcc=5V
- ADC Reference voltage is Aref=3.3V as accelerometer is powered from 3.3V all outputs as wrt to 3.3V
- Both g-select pins are grounded to select 2.5g mode to get maximum sensitivity.
- **Status : Being Done**

DCS Subsystem Testing Overview

Parachute testing (Done) –

- **Mission :** To get desirable velocities for carrier and lander.
- **Test environment :** 16 stories building (50mts). Appropriate weights (232 gms for carrier and 293 gms for lander) were used.
- **Parachutes** :
    - Carrier - 28cm , spill-hole diameter – 6cm
    - Lander - 25 cm , spill-hole diameter – 6cm

Sr.No.	Carrier			Lander		Speed (m/s)	Wind velocity
	Time taken	Drift	Speed (m/s)	Time taken	Drift		(miles/h)
1.	11.78s	3.9m	4.26	8.54s	2.9m	5.79	59.2
2.	10.34s	4.5m	4.84	7.83s	3.4m	6.38	63.4

- **Pass/Fail Criteria** : 4±1 m/s for carrier , 5.5±1 m/s for lander (less than 10% drift.)
- **Conclusion :** Pass.

Mechanical Subsystem Testing Overview

Egg container material was done before PDR.

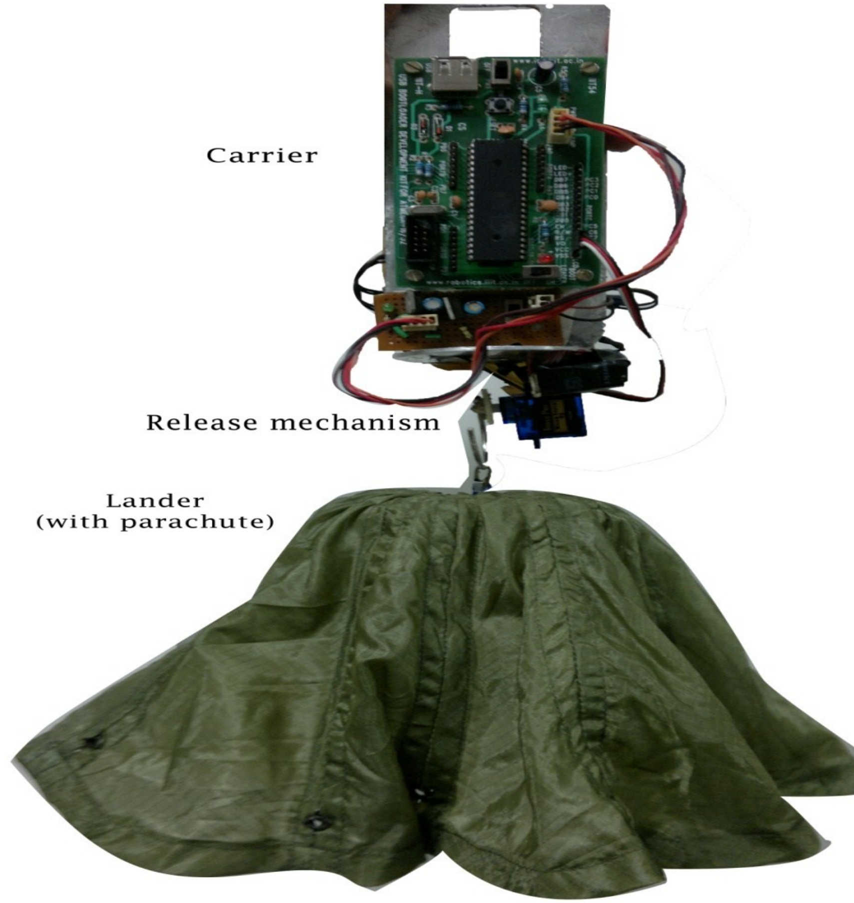
Detachment testing (done) –

- **Mission :** Achievement of detachment at various angles.
- **Test bed :** Servo motor is controlled using Microcontroller and appropriate weight is used in place of lander.

S No.	Angle of lander wrt carrier (degrees)	Remarks
1	0	Detachment Achieved
2	20	Detachment Achieved
3	60	Detachment Achieved
4	90	Detachment Achieved

- **Pass/Fail criteria :** If detachment at various angles is achieved then pass else fail.
- **Conclusion : pass.**
- **Note – Angles above 90^{o} are not possible since the design is so.**

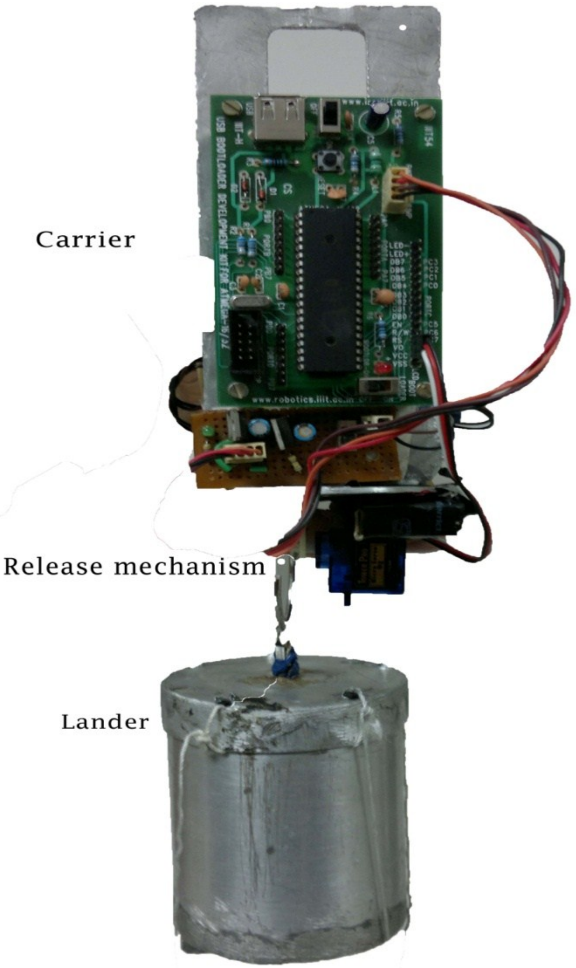
Mechanical Subsystem Testing Overview



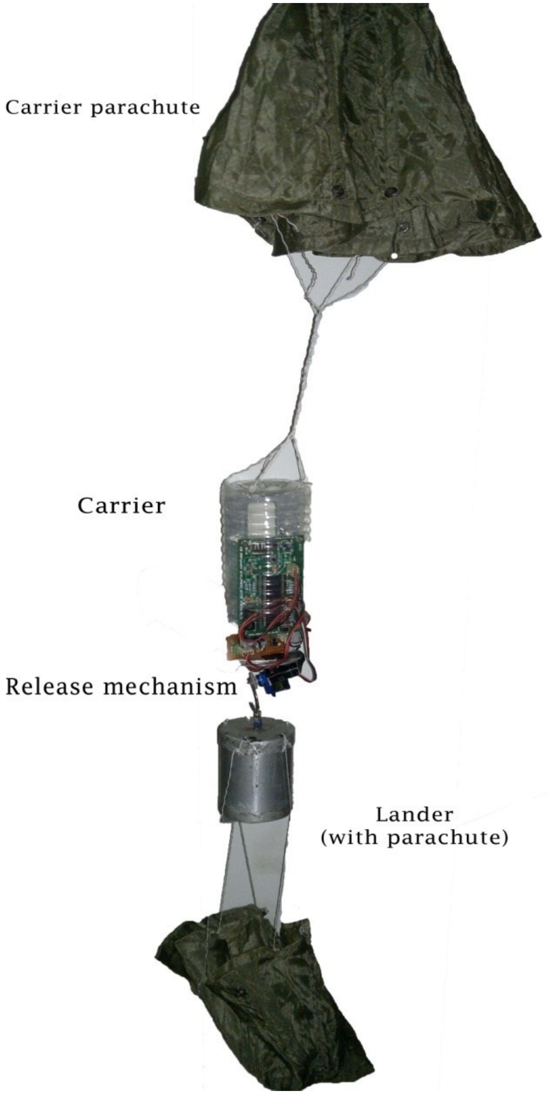
Testing Structure

Note:- Video link for Release Mechanism :- http://www.youtube.com/watch?v=K3-GfaWVPYU

Mechanical Subsystem Testing Overview



Testing Structure



CDH Subsystem Testing Overview

Communication testing (done) –

- **Mission :** Ensure correct working of the antenna and transceiver.
- **Test conditions :** done using Atmega 16 kit with AC4790 (transmitter) at one end and laptop with AC4790 on the other(receiver).
- **Pass/Fail Criteria :** Take considerable no. of observations and verify correctness.
- **Conclusion – Pass.**

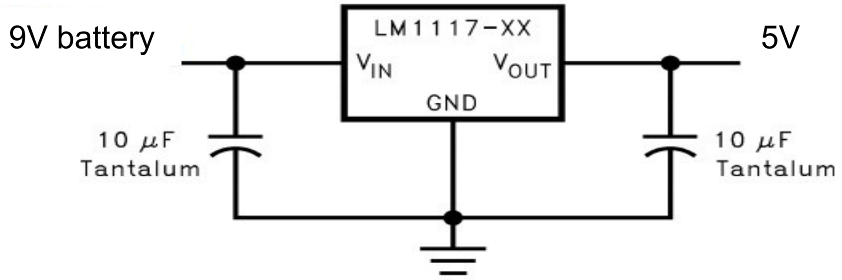
Range Testing (being done) –

- **Mission :** To get desirable range.
- **Test conditions :** to be done in a large ground/road so as to give us range of about 1.5 Km.
- **Pass/Fail criteria :** Take observations, rotate antenna, vibrate and observe the range till which communication link is not broken.

EPS Testing Overview

Regulator testing (done) :

- **Mission :** Obtainment of desired DC voltage levels from a 9V battery.
- **Test conditions :** Linear Regulator(LM1117) used. 9v battery used.



- **Observation :** Efficiency = 75% - 80 %.
- **Pass/Fail criteria :** stable 5V at the output for a duration of about 1Hr. Fulfillment of current requirements and power requirements mentioned in EPS.
- **Conclusion : Pass.**

Note :- Regulator for 5V-3.3V has also been tested in the same way.

EPS Testing Overview

Voltage Measurement testing :-

- **Mission :** Proper measurement of the voltage and operation of system in various power control modes when necessary.
- **Test Environment :** Measurement of battery voltage (9V) using ADC port. Resistance bridge used to scale down. Circuit diagram given in EPS.

S No.	Actual voltage using Multimeter	As measured by Microcontroller	Error (%)	Remarks
1	8.98 V	8.90V	0.92	Acceptable
2	8.34V	8.18V	1.9	Acceptable

- **Pass/Fail criteria :** Measurement of Voltage with less than **5%** error.
- **Conclusion : Pass.**

FSW Testing Overview

FSW testing (To be done) –

- **Mission :** Correctness of FS. Fault recovery testing, Fail safe testing, Ensure synchronous transmission and termination of data.
- **Test bed :** Software is developed in C and compiled using AVRgcc.
- **Pass/Fail criteria :** FS must be able to gather data from various sensors and store as well as transmit it to the GCS. Smooth termination achievement.
- **Status : Flight software being developed.**

GCS Testing Overview

GCS software testing (To be done) –

- **Mission :** Correctness of GCS software.
- **Test bed :** Matlab will be used to acquire data from USB port and process it to plot real time graphs for velocity, altitude and other data.
- **Status – GCS software being developed.**

Cansat Integration and Test Overview

- **System level tests yet to be performed :-**
  1. **PCB Testing**
  2. **Complete System testing**
  3. **Antenna Range testing**

Mission Operations & Analysis

Presenter's Name - Roopak Dubey

Overview of Mission Sequence of Events

Arrive at the Launch site well in-time

Locate the workspace

Layout the team's equipment

Put up the team's banner.

Collect the launch time schedule

Assemble the CANSAT carrier and lander.

Setup GCS.

Verify communication between CANSAT and GCS.

Collect and place the Egg in its container

Place the CANSAT in the payload section of the rocket and switch it on

Post Launch –
Run all the GCS operations

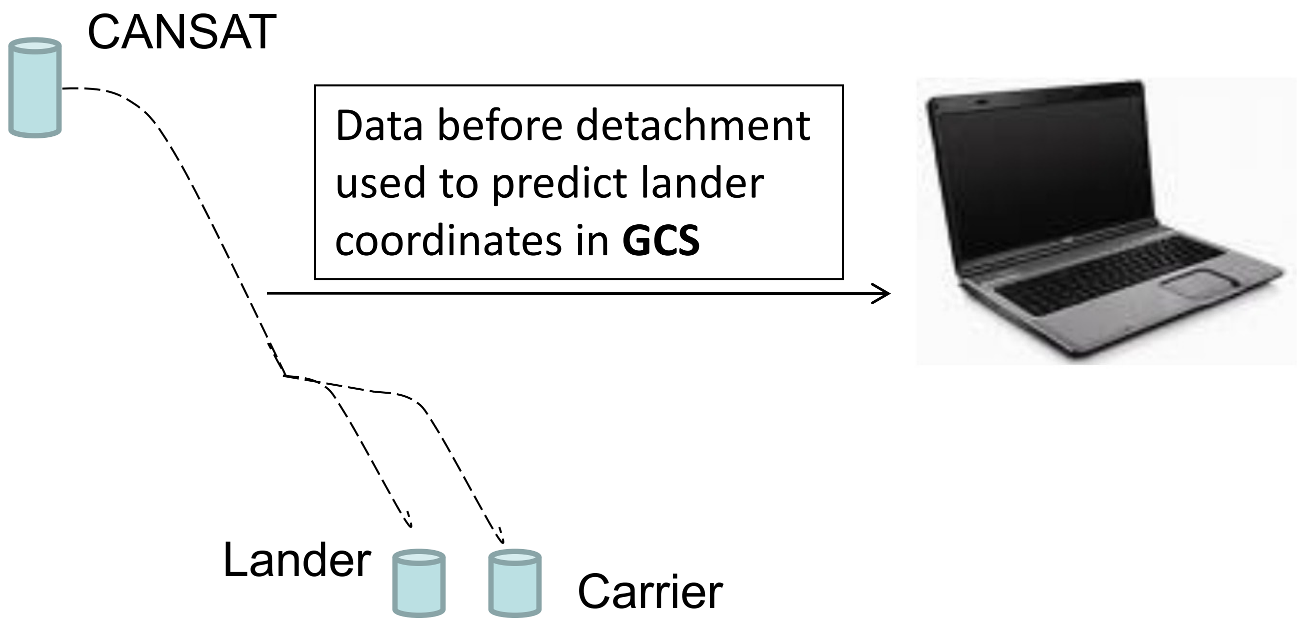
On successful landing of CANSAT, proceed for recovery

Pack up and leave the Launch site

FLOWCHART OF SEQUENCE OF EVENTS

Lander Landing Coordinate Prediction

- GPS data received by GCS before detachment will serve as basis for prediction of lander coordinates. The process is described below.
- Prior to detachment the GPS data received by GCS will help in estimation of wind variation with altitude and calculation of initial velocity.
- Further Trajectory of lander can be estimated by extrapolation of this trajectory.
- Further data from carrier after detachment can be used to verify and modify our predicted coordinates.



Cansat Location and Recover

- **Lander Recovery**
  - Coordinates are predicted in GCS that will help in Lander recovery.
  - Shiny Parachute for visual recovery.
  - Audio beacon (locator device).

- **Carrier Recovery**
  - Telemetry data received by the GCS towards the end (when the cansat has landed) will also be used to discover the location of the carrier.
  - Audio beacon (locator device).
  - Shiny Parachute for visual recovery.

Mission Rehearsal Activities

- **Major Mission rehearsal activities :-**
  - Ground system radio link check procedures
  - Loading the egg payload – Practiced using polystyrene balls and Egg.
  - Powering on/off the Cansat – Switch system made. (done).
  - Loading the Cansat in the launch vehicle – Verified with our structure and a payload size can.
- **Description of written procedures developed/required**
  – GCS : Being developed in Matlab
  – FS : Being developed in C. Many modules have been written and compiled using AVRgcc, some modules are under development.

Management

Presenter's Name - Roopak Dubey

Status of Procurements

Name	Status	Order Date	Arrival Date
Pressure Sensor	Ordered	20/03/11	Expected on 01/04/11
PCB	Manufactured	12/03/11	26/03/11
Mechanical structure	Fabricated	15/03/11	22/03/11
GPS sensor	Ordered	10/03/11	15/03/11
Locator device	Procured	10/03/11	10/03/11
Parachutes	Manufactured	15/02/11	17/02/11

Note – Other sensors viz. Temperature sensor, Accelerometer and transceiver and antenna are being reused from the last year's design and hence they are already available.

Cansat Budget – Hardware

Component	Quantity	Unit Price (in USD)	Cost (in USD)	Source
Atmega128 microcontroller	2	6.8	13.6	http://in.element14.com/
Temperature Sensor	1	0.7	0.7	
Accelerometer	1	20	20	
Battery	2	10	20	
Mini Servo Motor	1	5	5	
Circuit Fabrication	2	10	10(original) + 2(Replicate)	
GPS Equipment	1	108	108	
Electronics system			71.3	
Structure material and Fabrication		60	60	
Locator device	2	5	10	Local vendor
Rip-Stop Nylon	3	18	54	
Miscellaneous		20	20	
Margin	15%	41.3	41.3	
Total			360.7	

Cansat Budget – Other Costs

Component	Cost (in USD)	Source
Ground Control Station	1140$ (for laptop(1000$) and AC4790(80$) + antenna(60$))	http://search.digikey.com/scripts/DkSearch/dksus.dll?Detail&name=AC4790-1000M-ND
Test facilities and equipment and travel expenses	50$ till now	
Rentals	Nil	
Travel to Texas and return	1200$ x 4 = 4800$	
Travel expenses in TX	50$ x 4 = 200 $	
Total	6190 $	

Note - Any external financial support for the project is not yet available.

Program Schedule

Electronic Subsystem

1/1/2011 to 7/1/2011	8/1/2011 To 10/1/2011	11/1/2011 To 15/1/2011	15/1/2011 To 24/1/2011	21/1/2011 To 31/1/2011
TASK-1	TASK-2	TASK-3	TASK-4	TASK-5

1/2/2011 To 15/2/2011	15/2/2011 To 15/3/2011	15/3/2011 To 25/3/2011	25/3/2011 To 29/3/2011	1/4/2011 To 10/4/2011
TASK-6	TASK-7	TASK-8	TASK-9	TASK-10

11/4/2011 To 25/4/2011	25/4/2011 To 5/5/2011	6/5/2011 To 15/5/2011	16/5/2011 To 5/6/2011	6/6/2011 To 11/6/2011
TASK-11	TASK-12	TASK-13	TASK-14	TASK-15

Program Schedule

Index of Tasks for Electronics Subsystem on last page

- Task-1 : Recognition of Tasks
- Task-2 : Allocation and Division of Tasks
- Task-3 : Identification of systems and System Architecture
- Task-4 : Testing of available components from previous year
- Task-5 : PDR Report and Presentation
- Task-6 : Hardware Procurement Begins
- Task-7 : Basic System integration
- Task-8 : Work on image sensing and orientation
- Task-9 : CDR
- Task-10: Accelerometer Interfacing
- Task-11: Flight Software Development
- Task-12: Testing of Prototype
- Task-13: Fabricating of Final PCB (if necessary)
- Task-14: Field Testing of Hardware with System
- Task-15: Flight Operation Preparation

Mechanical Team Schedule

1/1/2011 to 15/1/2011	16/1/2011 To 20/1/2011	23/1/2011 To 25/1/2011	25/1/2011 To 27/1/2011	27/1/2011 To 31/1/2011
TASK-1	TASK-2	TASK-3	TASK-4	TASK-5

1/2/2011 To 15/2/2011	16/2/2011 To 25/2/2011	25/2/2011 To 5/3/2011	5/3/2011 To 15/3/2011	15/3/2011 To 15/4/2011
TASK-6	TASK-7	TASK-8	TASK-9	TASK-10

15/4/2011 To 1/5/2011	1/5/2011 To 10/5/2011	10/5/2011 To 25/5/2011
TASK-11	TASK-12	TASK-13

Mechanical Team Schedule

Index of Tasks for Mechanical Subsystem on last page

- Task-1 : Recognition of Tasks
- Task-2 : Egg Canopy Design
- Task-3 : Egg landing test on materials
- Task-4 : Mechanical Structure Design
- Task-5 : PDR Report and Presentation
- Task-6 : Descent Control hardware
- Task-7 : Designing Descent Control
- Task-8 : Integrating Descent Control with Egg Canopy
- Task-9 : Testing of Structure for Operation
- Task-10: Make necessary changes in Descent or Egg mechanism
- Task-11: Testing with changes
- Task-12: Fabrication of final structure
- Task-13: Testing with integrated hardware

Conclusions

- **Major Accomplishments :**
  - PCB has been ordered according to final design.
  - Locator Device acquired.
  - Mechanical structure fabricated.
  - Release Mechanism tested.
  - Communication testing done.
- **Major Unfinished Work :**
  - FSW code has to be written (under development).
  - GCS code has to be written (under development).
  - Range testing
  - Complete system testing.
- **Flight Software Status**

  The Flight Software design is in process.

Thank You!

Comments and Questions Welcome