UHABS-5 Mission Zeppelin

Team Members:
Likeke Aipa, Drex Arine, Andrew Bui, Karen Calaro, Kanekahekilinuinanaueikalani Clark, Ka Chon Liu, Cyrus Noveloso, Reagan Paz, Yun Feng Tan, Jake Torigoe, Emanuel Valdez, Jace Yamaguchi, James Yang

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Introduction

- Balloon satellites (BalloonSats) consist of Helium-filled weather balloon to launch payloads into stratosphere, can potentially reach altitudes up to 100,000 feet
- Used to conduct research, collect atmospheric data (altitude, pressure, temperature, descent speed, other SOH data), and record video/photos
- Once landed, should be recovered to retrieve its stored data and analyze its condition post-mission
- UHABS-5 incorporates autonomous recovery system where the module will propel itself to a designated area for retrieval

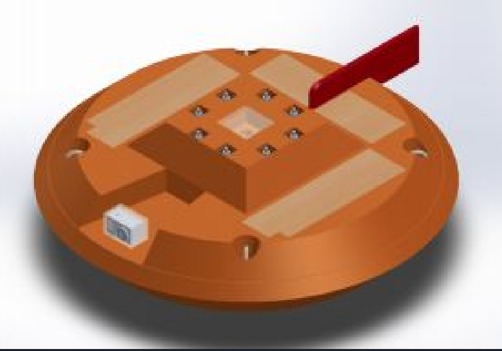
Motivation and Purpose

- Low-cost, quick deploying
- However, difficult to predict where it will land
- If likely to land in body of water, difficulty for recovery is magnified: can cause data loss and severe damage
- Therefore, BalloonSat should be able to survive a descent from high altitudes, land in marine environment, and have ease of recovery
- Allows for a larger array of experiments/data collection to be conducted in the stratosphere and ensure data is not lost or damaged
- Can potentially lead to breakthroughs in space travel and technology, as they are prevalent in day-to-day (communications, transportation, logistics)

Overview of Previous Projects

- 4 previous UHABS done as ME 419 Astronautics projects, UHABS-5 will be first ME 481/482 project
- UHABS-1 and 4 launched successfully
- UHABS-3 and 4 attempted autonomous recovery
- Each project had different successes and difficulties and will largely assist in developing UHABS-5

UHABS-1



UHABS-2

UHABS-3

UHABS-4

Mission Statement

The UH ME 481 team will successfully develop the UH Advanced BalloonSat System mission #5 (UHABS-5) which will be capable of carrying payloads to a near-space environment and return to safely to Earth for intact recovery. If it lands on the ocean, the BalloonSat will autonomously propel itself to a designated target for recovery.

Primary Objectives

1. To develop a reliable, high-altitude BalloonSat system capable of carrying small payloads in a near-space environment.
2. To develop a recovery system for UHABS-5 that will enable the BalloonSat to safely land on land or ocean with means to enhance its recovery.
3. To develop a recovery system that in the event of an ocean landing shall autonomously propel itself to a designated destination for recovery.
4. To use and test Hawaii Space Flight Laboratory (HSFL) technologies including communication system and Comprehensive Open-architecture Solution for Mission Operations Systems (COSMOS) for flight and ground software.

Top-Level System Requirements

1. Mission			
TM-014	1.1	UHABS-5 shall consist of a parachute, command and control (C&C) module, a payload and propulsion (P&P) module and any necessary ancillary equipment and structure.	Mandatory
TM-016	1.2	Team shall design the UHABS-5 system, procure required parts and materials, design and build modules, integrate and test the system, launch and operated the system, recover the system if possible, and analyze and report the data from the mission.	Mandatory
TM-017	1.3	Instrumentation for the module shall be accommodated in the UHABS-5	Mandatory
5. Testing			
TM-008	5.1	Generally, testing shall be required to prove UHABS-5 can meet the functional, environmental, and operational requirements	Mandatory
TM-009	5.2	A test run on a secluded area of the ocean shall be required to prove the ability of UHABS-5 to home in and reach a designated target	Mandatory
TM-010	5.3	Testing shall be required to prove the ability of UHABS-5 to release the parachute when it approached the surface	Mandatory

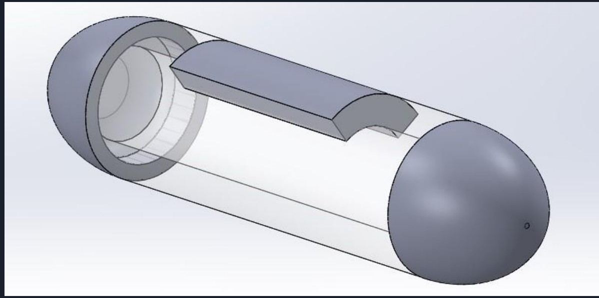
Constraints

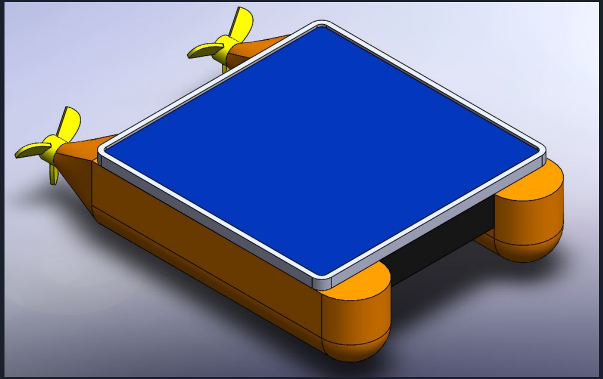
- Time constraint
  - Designed by December
  - Built, tested, launched, and recovered by May
- Federal Aviation Administration (FAA) and Federal Communications Commission (FCC) Regulations
  - Weight restriction: limited to 6 lbs each module, 12 lbs total
  - Cannot use a rope or device that requires impact force of over 50 lbs to suspend payload
  - FAA Part 101 and 14 CFR Part 48: Registration and marking requirements for small unmanned aircraft
  - FCC 22.925: Prohibition on airborne operation of cellular telephones
- Funding
  - Expenditures shall not exceed those set in the budget

Team Organization

Project Manager: Karen Calaro		
Systems Integrator: Reagan Paz		Financial Advisor: Drex Arine
Balloon and C&C Module Lead: Yun Feng Tan	Payload & Propulsion Module Lead: Kanekahekilinuinanauei kalani Clark	Ground Station Lead: Jace Yamaguchi
Emanuel Valdez	Andrew Bui	Jake Torigoe
James Yang	Likeke Aipa	Ka Chon Liu
	Cyrus Noveloso	

Conceptual Design





Changes since proposal:

- Selected the structural design of both modules
- Selected avionics, electronics, and materials
- Determined which parts go in which modules
- Finalized requirements and objectives for specific subsystems

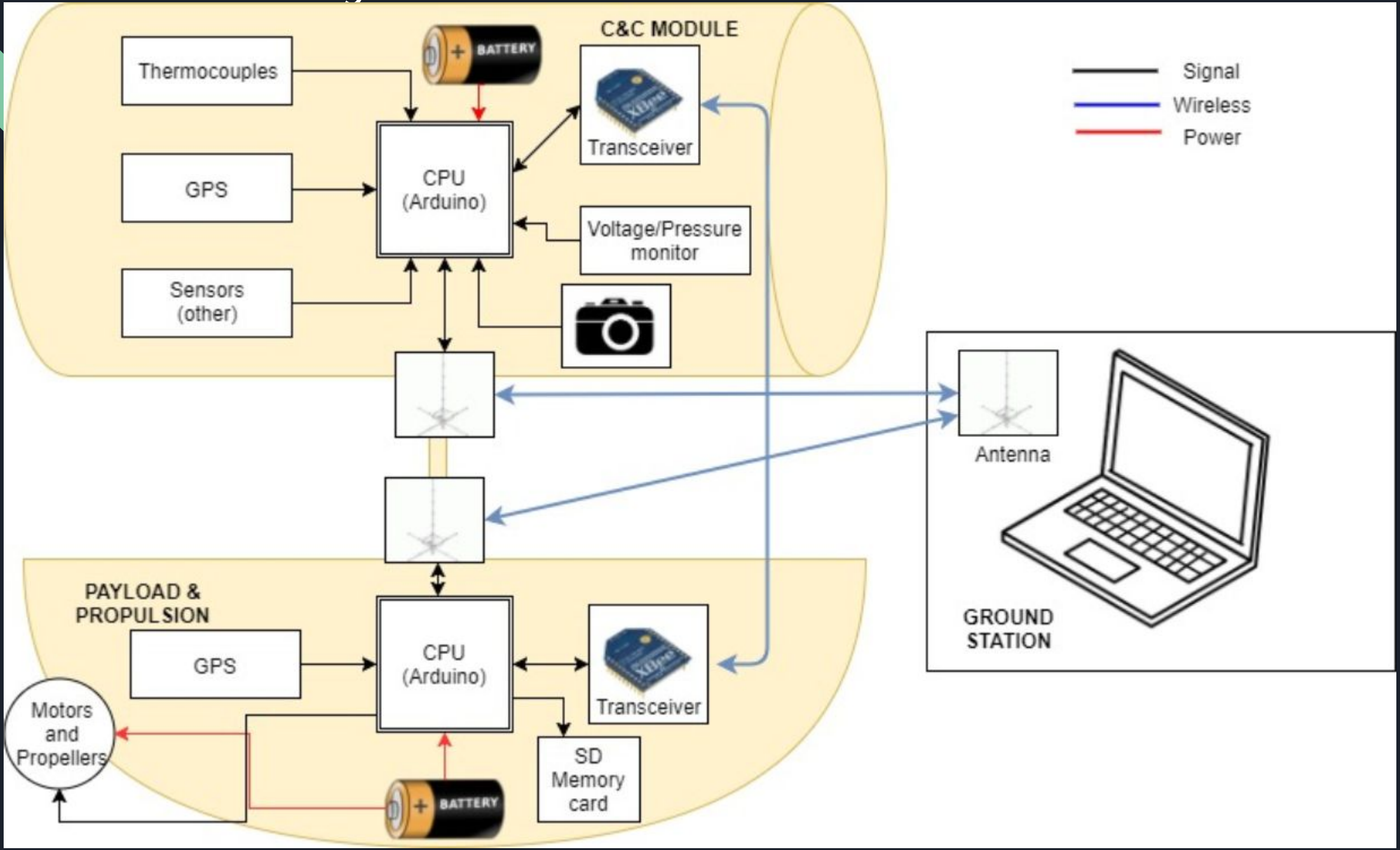
Trade Study and Design

C&C Module - Contains all of the hardware and sensors for the data, such as Data Acquisition software (DAQ), thermocouples and cameras as well as the parachutes and tethers to slow the descent.

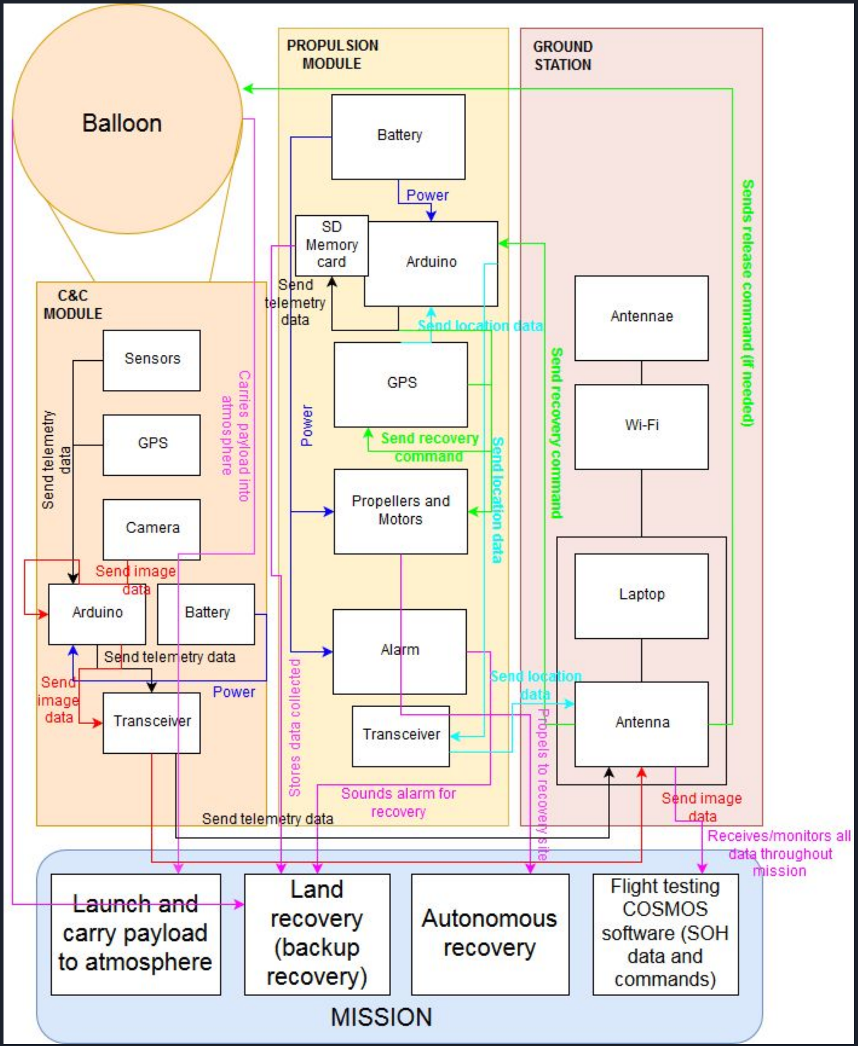
P&P Module - The payload and propulsion module will consist of the autonomous recovery system. The recovery system should function similarly to an autonomous boat. In case the C&C module cannot be recovered, all data will be stored on an SD memory card in this module.

Ground Station - Responsible for monitoring the real-time data from the BalloonSat (such as state of health and location) and sending commands.

Overall System Architecture



Overall Functional Flow Block Diagram

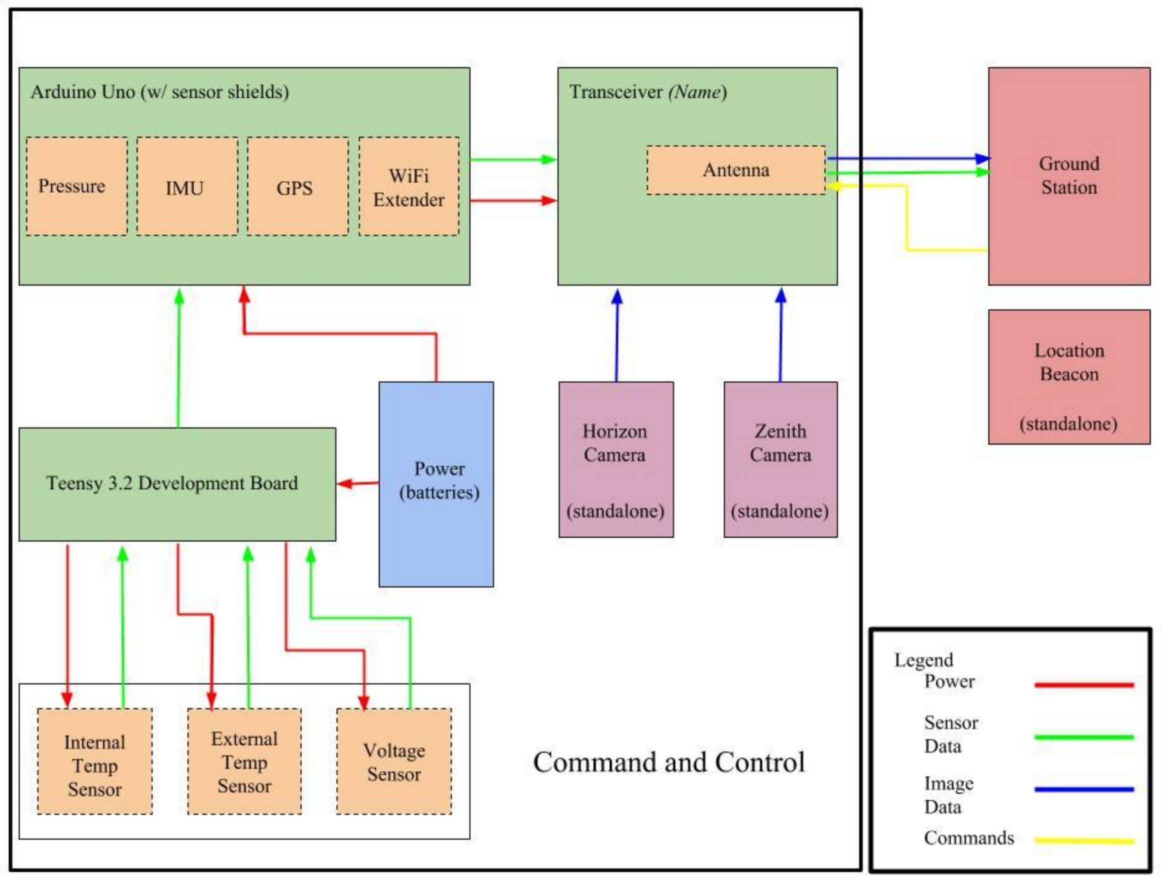


Balloon and C&C Module

Team Members:

Yun Feng Tan, Manny Valdez, and James Yang

System Architecture



Subsystem Team Roles & Responsibilities

Yun Feng Tan is currently the Balloon and C&C Module team lead and is responsible for working on the structure of the C&C Module. This includes the design and material selection for the Balloon and C&C Module.

Manny Valdez is a member of the Balloon and C&C Module team and is responsible for the Avionics portion of the C&C Module. This includes the telemetry sensors and equipment needed to maintain constant connection with the ground station.

James Yang is a member of the Balloon and C&C Module team and is responsible for installing the payload cameras of the C&C Module. This includes the camera for the still photo and the camera which maintains a constant recording in the zenith position.

Top Level Requirements & Constraints

Requirements

1. Shall be able to reach an altitude of up to 100,000 feet.
2. Shall have real time communication with Ground Control for data transmission during flight.
3. Shall capture still photos and live video feed.
4. Shall release Balloon on command when data is sufficient and balloon has not burst.
5. Shall deploy a parachute after separation with the balloon & reach a landing speed up to 15 ft/s.

Top Level Requirements & Constraints

Constraints

- FAA regulation of not exceeding 6 lbs
- FCC regulation of prohibition on airborne operation of cellphones
- Time Constraint of having complete and optimal design set by December 2017

Derived Requirements

- From (1): Shall withstand the temperature change ~(-59℃) and pressure change ~(1 kPa) at high altitudes
- From (2) and (3): Shall have sufficient power to cover the needs of avionics and cameras throughout flight
- From (2) (4) and (5): Shall have sufficient radio signal to remain connected to the ground station until descent
- From (4): Shall have a watertight module to prevent water damage to avionics
- From (5): Shall survive an impact at the speed of 15 ft/s and remain structurally intact

Major Trades - Exterior

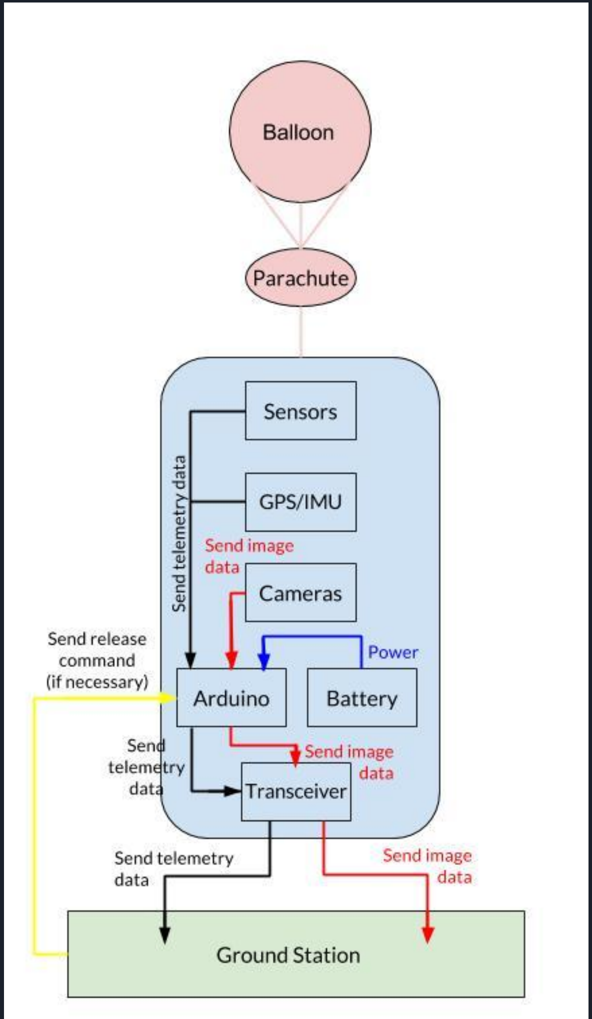
	Space for Avionics	Drag (Low = + HIgh = -)	Structural Integrity
Cube	YES	NO	YES
Catamaran	YES	YES	NO
Capsule	YES	YES	YES

- Began with a styrofoam cube since it'll be simple to house and organize the avionics, but was disregarded for producing too much drag and would be difficult to tow.
- Second Design involved a catamaran design for resolving the drag issue of the first design, but landing at 15 ft/s on water would be a high cost to design a solution.
- Final design is a capsule with structural integrity, sufficient space for avionics, and it's shape would have a low enough drag to tow.

Requirements vs Implementation

Requirements	**Implementation**
Shall reach an altitude of up to 100,000 feet	Balloon of calculated size filled estimated amount of helium
Shall maintain real time communication with ground station	Onboard transceiver used at the same frequency of the ground station
Shall capture still photos and live video	GoPro or approved-equal will be installed on the side of the C&C Module and in the position facing downwards
Shall have the ability to release the balloon on command	COSMOS software will be relaying commands to the transceiver for the action of detaching the balloon
Shall deploy a parachute to reach a landing speed of up to 15 ft/s	A parachute with a release mechanism will be attached to one side of the C&C Module in preparation for deployment

Functional Flow Block Diagram



Power Budget

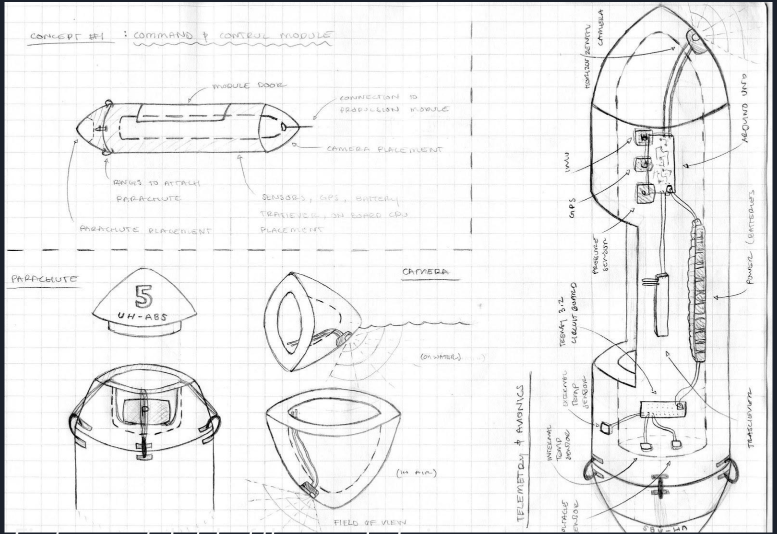
- At a 1,066.2 mA total current draw, 9-10 hours of power is to be expected.

Component	Current Draw	Voltage
Battery Pack	10,000 mAh	5.0 V
Arduino Uno	125 mA	5.0 V (Regulated)
GPS Shield	56 mA	5.0 V (Arduino)
IMU Shield	56 mA	5.0 V (Arduino)
Pressure Shield	2.2 mA	5.0 V (Arduino)
XTend 900Hz Transmitter	800 mA	5.0 V (Regulated)
Teensy 3.2 Development Board	27 mA	5.0 V (Regulated)
Temperature Sensors	0.050 mA	1.5 V (Teensy)
Voltage Sensors	0.050 mA	1.5 V (Teensy)
Cameras (standalone)	200 mA (x2)	8~9 V [9V battery] (x2)
Total (per hour; excluding cameras)	1,066.3 mA	33 V
Remaining	8,933.7 mA	

Mass and Volume Budget

Type	Description	Volume (in^3)	Mass (lbs)
Total Allowable		384.0	6.00
Insulation	Styrofoam;	384.0	0.69
Structure	Acrylonitrile butadiene styrene (ABS)	35.0	1.33
Power Supply	10,000 mAh Li-Ion	7.45	0.40
Electronics	Arduino Uno, Arduino sensor shields, Teensy 3.2 Development Board, temperature, and voltage sensors	10.23	0.36
Cameras	Yuntab Action Cameras (GoPro substitute)	3.26	0.34
Misc. (+30%)	Adhesives, wires, spacing, beacon	16.78	0.94
Total		72.72	4.06
Remaining		311.28	1.94

Balloon, Parachute, and Structure



First concept sketch of the capsule design

Balloon & Parachute

- 600g latex balloon
- 115 in. diameter circular parachute

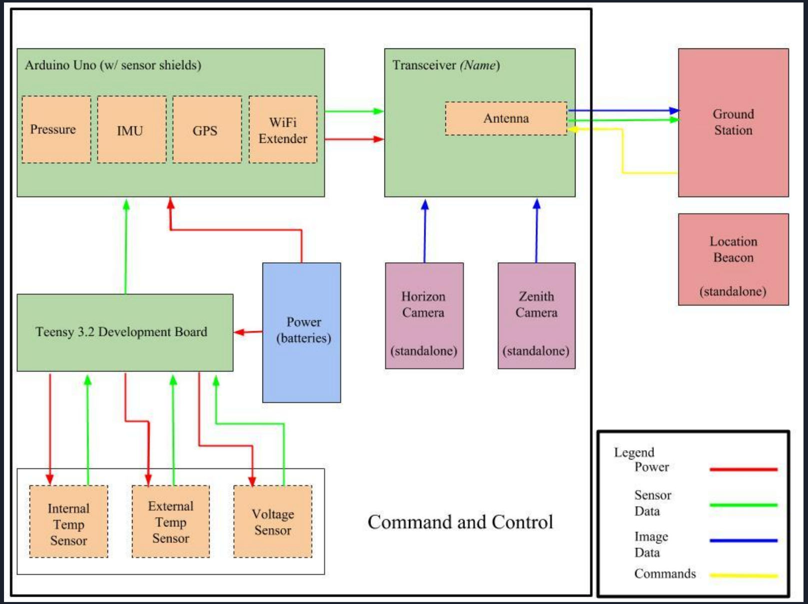
Materials

- Styrofoam with a 3D printed internal structure made of ABS.
- Steel rings to link the parachute and balloon.

Structure

- Airtight, capsule shaped module to minimize drag while maximizing space and structural integrity.
- ABS webbing in the internal walls with cross beams displaced throughout the module
- A thin tube to adjust to pressure change

Avionics

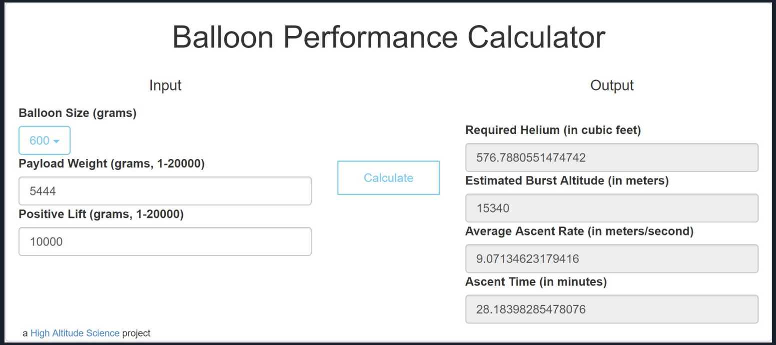


- Arduino Uno is the main CPU where the sensor data is gathered and sent to the transceiver.
- The XTend 900MHz Transceiver receives data from from the Arduino and transmits sensor and camera data to Ground Station.
- Data includes: Internal and External Temperature, Pressure, Voltage, GPS, IMU, and Camera.

Results of Analyses

Balloon

- 600g latex weather balloon
- Estimated 600 cubic ft of helium



Parachute

- 115 inch diameter circular shaped parachute
- Calculations were made in consideration of the maximum weight limit of 12 lbs
- Wind Resistance Force equation $F_d = \frac{1}{2} \cdot \rho \cdot C_d \cdot A$

Design of the exterior shell

- Cylindrical capsule

Testing Plan

Balloon and Structure

- Structure integrity of exterior shell (shock from impact, waterproofing)
- Release mechanism

Avionics

- Individual sensors
- Integration
- Communications and downlink to the Ground Station

Payload

- Video camera
- Still-Image Camera

Subsystem Schedule using WBS and Gantt Chart

In the time period of prototyping from September 25th to December 3rd the Balloon and C&C subteam will determine and formulate:

- Structure of the C&C Module
- Size of latex balloon
- Size of parachute
- Release mechanisms for parachute
- Wiring of sensors
- Helium requirement for positive lift

Remaining Issues and Concerns

Structural Design of C&C Module

- Must provide least amount of resistance for the propulsion module to drag

Parachute Deployment

- Have to research on parachute release methods

Insulation

- Have to provide enough protection for impact, pressure difference, and temperature difference

Camera Placement

- Have to take a still photo after considering movement during flight

Payload and Propulsion

Description

The propulsion module will consist of the autonomous recovery system, a GPS system, and temperature sensor. It will transmit its location to the ground station and will be able to propel itself to a designated recovery site.

- Autonomous recovery system initiates after landing.
- On board GPS for navigation and ground control tracking.
- Motor and propellers for propulsion and travel to extraction location.
- Solar cells for extra power.
- Body designed to withstand and navigate through ocean waters.

Subsystem Team Roles & Responsibilities

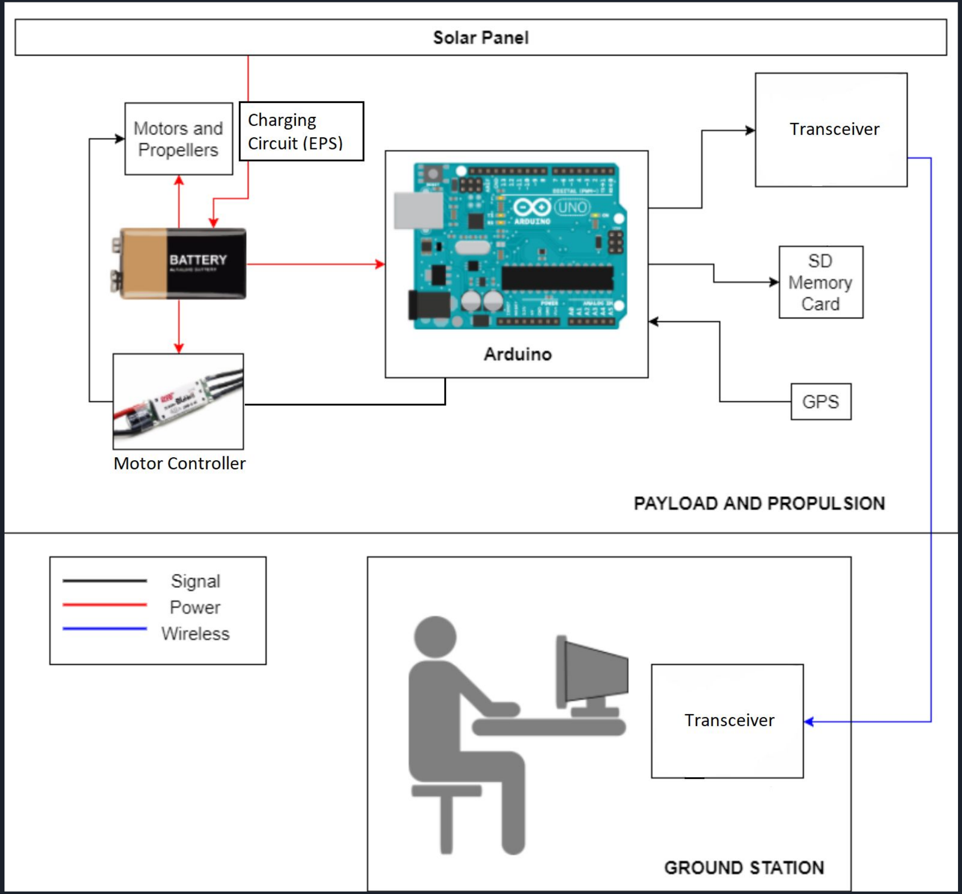
Kahekili Clark - team leader and member responsible for the programming and navigation systems within the propulsion module.

Andrew Bui - team member responsible for the design and assembly of the motor system within the propulsion module and assisting with the design of the body

Likeke Aipa - team member responsible for the design and assembly of the body of the propulsion module

Cyrus Noveloso - team member responsible for the electrical design of the propulsion module

Payload and Propulsion Architecture



Top Level Requirements & Constraints

Top Level Requirements:

1. The P&P module shall initiate the autonomous propulsion system after landing and traverse to a predetermined location, where it shall standby for retrieval

2. Shall possess the means to periodically communicate its position to the ground station.

3. Shall have an audible location beacon capable of producing an audible signal through 100 yards of scrub.

4. Internal temperature shall be regulated to the operating limits of its internal components at all times

Constraints:

- FAA Regulations
- Total mass constraints
- Total volume constraints
- Total power constraints

Derived Requirements

Derived Requirements:

- From (1): Propulsion module shall be sufficiently powered to prevail over oceanic wind and waves during the navigation.
- From (4): Shall be watertight to protect internal components from corrosive and electrical damage.
- From (1) and (2): Shall initiate automatically after descending to back to sea level.
- From (3): Audible beacon shall be waterproof and remain operative for a minimum of 24 hours

Major Trades - Hull Material

Polyurethane Foam

- Insulation for ascending flight
- Buoyancy
- Ease to shape

Fiberglass cloth /Kevlar/Carbon Fiber

- Strengthen hull design

Resin/Epoxy

- To bond the fiberglass to foam
- Polishable to create smooth surface - reducing drag

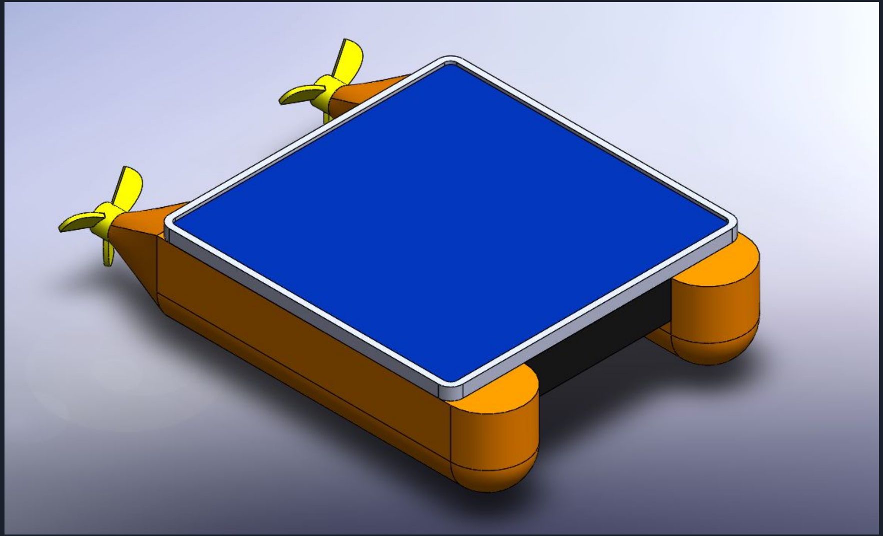
Major Trades - Hull Material

	Easy to shape	Drag (Low = + HIgh = -)	Strengthens hull design
Polyurethane foam	YES	NO	NO
Carbon Fiber	NO	YES	YES
Resin	YES	YES	YES

Major Trades - Hull Shape

Catamaran design

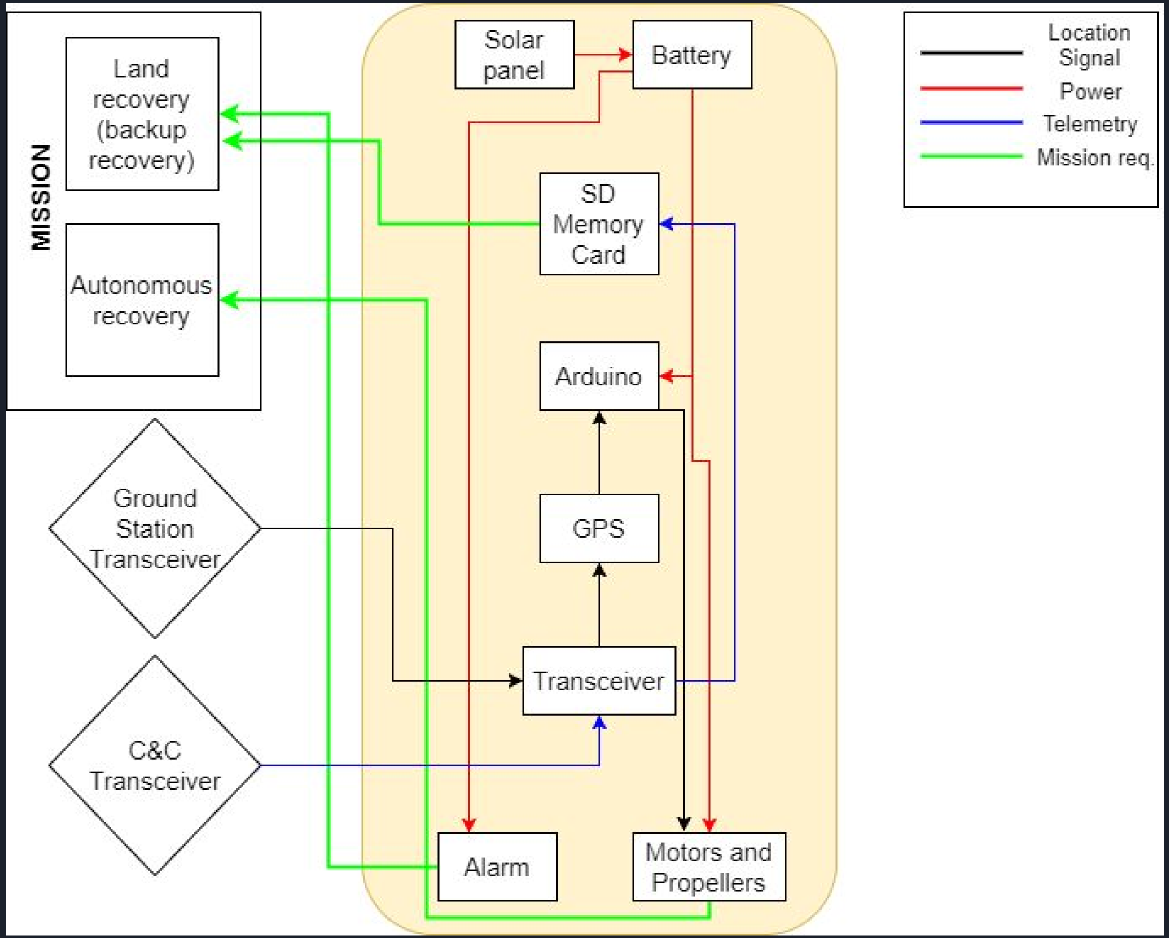
- Minimized hydrodynamic resistance
- Stability against heeling and capsizing
- Large usable surface area for solar panels



Requirements vs Implementation

Requirements	Implementation
Shall initiate the autonomous propulsion system after landing and traverse to a predetermined location, where it shall standby for retrieval.	The propulsion module will be ready to activate propellers to return to land
Shall possess the means to periodically communicate its position to the ground station.	The communication between propulsion module and ground station will be activated.
Shall have an audible location beacon capable of producing an audible signal through 100 yards of scrub.	A working signal will be emitting from propulsion module.
Internal temperature shall be regulated to the operating limits of its internal components at all times	There will be a temperature gauge providing real time temperature readings

Functional Flow Block Diagram



Mass and Volume Budgets

Component	Description	Mass (lbs)	Volume (cubic inches)
Hull	Two hulls connected by a centerpiece	3.01	81.67
Electronics	Arduino, GPS, Transceiver, SD Card, & Beacon	0.42	0.46
Power system	Lithium Polymer Batteries	0.40	7.45
Propeller	Elec. Motors and Octura blades	0.68	6.39
Misc (20%)	Misc wiring, sealant, screws, etc	1.2	19.19
	Total	5.3	115.16

Power Budget

Total Current Draw: 106 A

Component	Quantity Needed	Current (each) [A]	Voltage (each) [V]
Motor	2	100 (max)	14.5
Speed Controller	1	5	5.0-34.0
Arduino Chip	1	0.2 mA	1.8-5.5
GPS	1	0.500 @ 3.3 V	3.1-16.0
XTend Transmitter	1	0.710 @ 30 dBm	2.8-5.0
SD Card Circuit	1	0.100	3.3
Battery	2	135	14.8
Solar Cell	TBD	TBD	TBD

Result of Analyses

Calculated Drag

- 1 knot travel speed in 4 knot head current
- Reynolds of 15 x 10^4
- Cd - 1.05 cube & 0.42 half sphere
- Resulting Drag Force - 26 N (6.0 lbf)

Remaining Issues and Concerns

1. Propulsion module could potentially be insufficiently powered for ocean conditions.
2. Navigation software from point A to B could be insufficient in the face of obstacles.
3. Unidentified Floating Object (UFO)
4. Heat generated by electric motors could surpass acceptable upper limit of internal component operation temperatures.
5. Waterproofing with openings for pressure adjustments

Testing Plan

Waterproof- Module will be completely submerged into a body of water for a 24 hour period and the checked for any penetration of water into the interior of the hull.

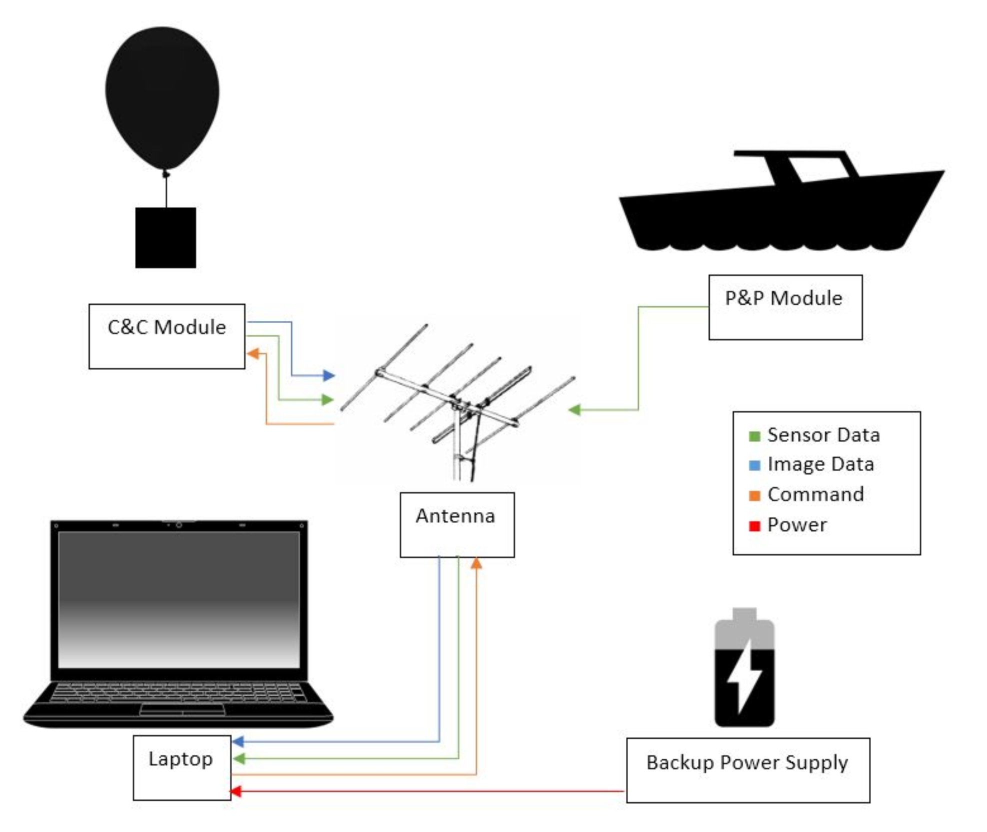
Thermal Insulation - Module will be placed into a freezer unit at -18℃ for 6 hours. Within the module a thermometer will track the interior temperature.

Propulsion - Propulsion module will be held in place by a cable within a body of water. A strain gage will be attached to the cable. The module will then operate with a maximum capacity and the resulting force produced will be measured.

Navigation - Preliminary testing of the navigation system onboard will be to test simple routes off the coast of Oahu.

Ground Station

Ground Station Architecture



- http://www.publicdomainpictures.net/pictures/40000/velka/black-balloon.jpg
- https://upload.wikimedia.org/wikipedia/commons/thumb/c/c6/Ic_battery_charging_80_48px.svg/2000px-Ic_battery_charging_80_48px.svg.png
- https://cdn.pixabay.com/photo/2014/11/16/16/28/laptop-533595_960_720.png
- https://upload.wikimedia.org/wikipedia/commons/7/74/Yagi_TV_antenna_1954.png
- http://www.publicdomainpictures.net/pictures/200000/velka/boat-silhouette-symbol-logo.jpg

Team Roles & Responsibilities

Jace Yamaguchi - Ground Station Team Leader/COSMOS lead programmer

- Subsystem team management
- COSMOS mastery

Ka Chon Liu - Hardware Management

- Antenna, laptop, and backup power
- Communicate with C&C and P&P transceivers

Jake Torigoe - Site Facilitator

- Site selection
- Communication with City and County and FAA

Top Level Requirements & Constraints

(1) Shall provide two-way communication with the C&C Module during the entire mission from pre-launch activation through system shut off and retrieval.

(2) Shall use COSMOS Operations to monitor and report UHABS-5 State-of-Health (SOH) and command emergency release of balloon if needed.

(3) Shall receive, process, and display all SOH telemetry and atmospheric data received from the UHABS-5 in near real-time.

(4) Shall receive a live feed from a down facing camera while the satellite ascends.

(5) Shall command an emergency balloon release in the case of unfavorable situations.

(6) Shall receive the location of the propulsion system during recovery.

Derived Requirements

From requirements (1),(2),(3) and (5): To Established a stable two-way communication connection with a range of 100,000 ft. between Ground Station and C&C Module.

From requirements (3) and (5): To have sensors and release mechanisms to continue to function despite the dramatic change in temperature (as low as -59 °C) during its ascent.

From requirement (4): To have a live feed camera that would be capable of transmitting a minimum 144p video quality back to ground station.

From requirement (6): To construct a GPS with an additional backup GPS to locate the propulsion system during its recovery phase.

Requirements vs Implementation

Requirements	Implementation
(1) Ground Station Shall provide two-way communication with the C&C Module during the entire mission from pre-launch activation through system shut off and retrieval .	Ground Station will maintain constant communication with C&C module using transceiver with appropriate frequency.
(2) Ground Station Shall use COSMOS Operations shall monitor and report UHABS-5 SOH during the mission.	A laptop running the COSMOS software will serve as the hub of the mission.
(3) Ground station Shall receive, process, and display all SOH telemetry and atmospheric data received from the UHABS-5 in near real-time.	Laptop running COSMOS software will be programmed and set up to grab and display all data derived from sensors included in the payload and C&C modules.
(4) Ground Station Shall receive a live feed from a down facing camera while the satellite ascends.	Separate receiver and antenna will be utilized solely for live feed from balloon satellite.
(5) Ground Station Shall command an emergency balloon release in the case of unfavorable situations.	COSMOS software will be programmed to send a signal to the balloon module in case of undesirable conditions.
(6) Ground Station Shall receive the location of the propulsion system during recovery.	Transceiver will communicate with GPS aboard C&C module to obtain relevant position during recovery phase.

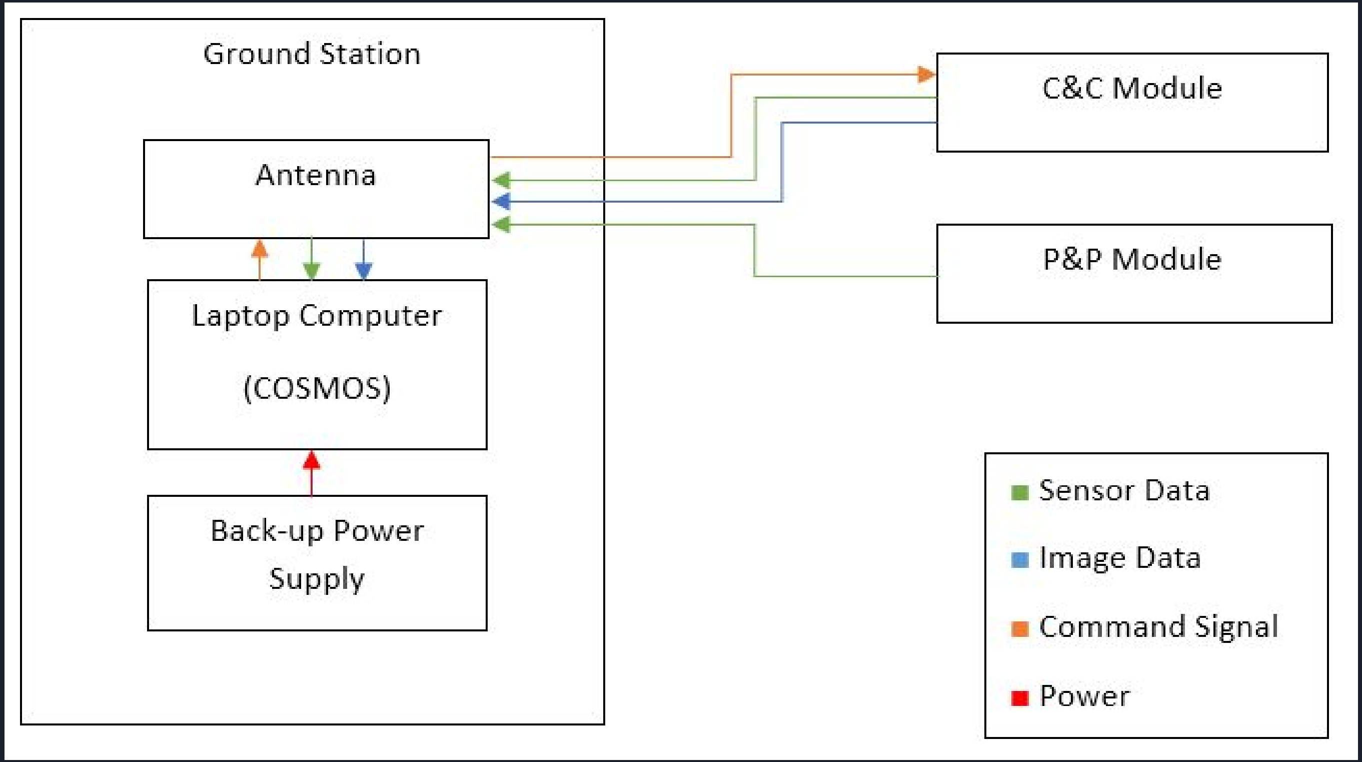
Major Trades (Antenna Design)

Turnstile Antenna

https://en.wikipedia.org/wiki/Turnstile_antenna#/media/File:Satellite Antenna-137MHz_closeup.jpg

- Orientated in axial mode (circularly polarized)
- Not sensitive to relative orientation of the spacecraft's antenna
- Lower gain loss than omnidirectional antennas
- Often used in satellite and missile communications

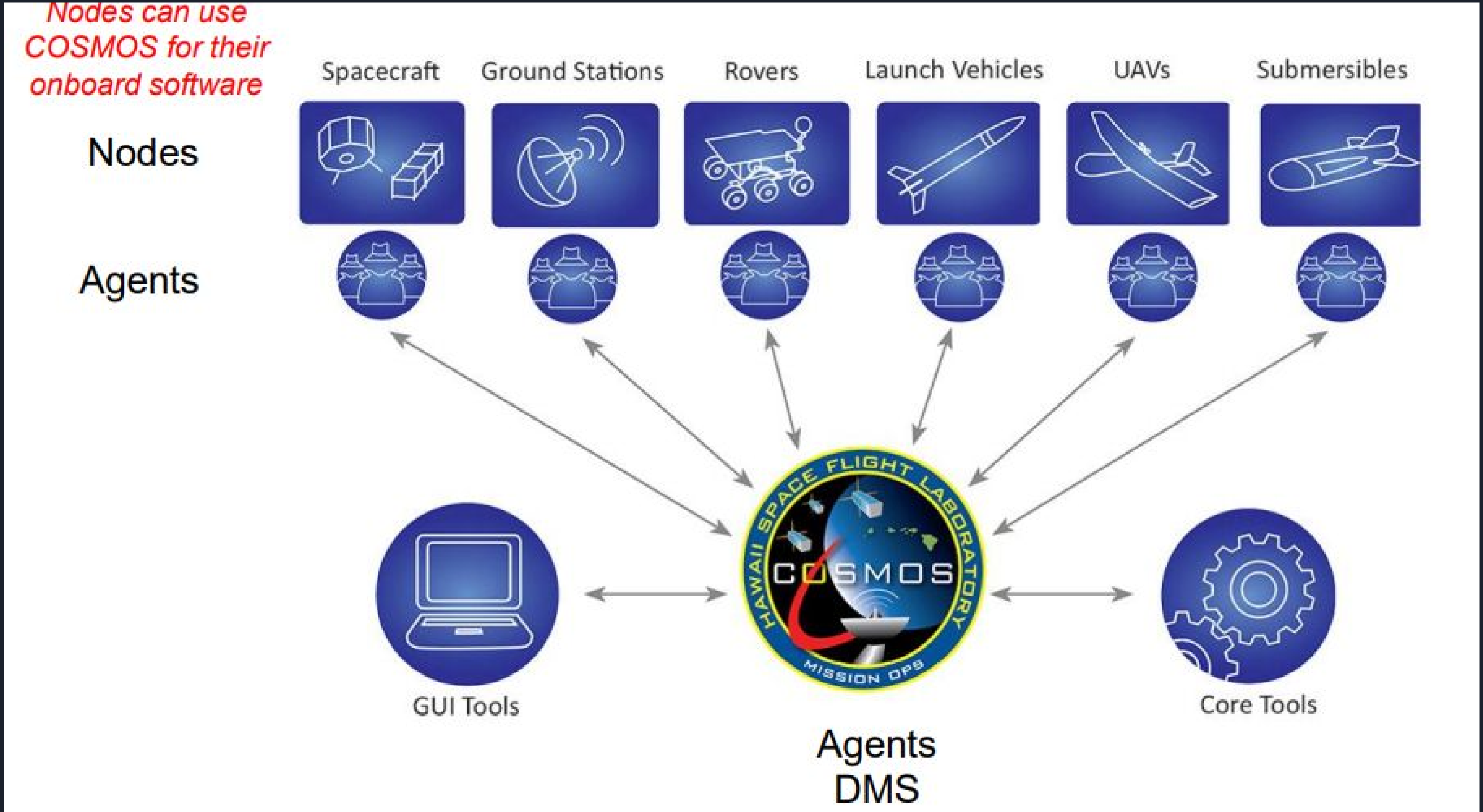
Functional Flow Block Diagram



Description of Ground Station

The ground station will comprise of a laptop computer with a back-up power supply and an antenna. The antenna will allow long range communication between the C&C module and the laptop during flight and receive telemetry data from the P&P module during the recovery phase. The back-up power supply will extend the battery life of the laptop during operation.

COSMOS will be implemented in the ground station to communicate with each of the modules. The C&C will be treated as a spacecraft node and P&P will be treated as a submersible node. The nodes use agents to communicate accessed by the GUI (general user interface) tools from the ground station.   The ground station will receive sensor data and image data from the C&C module during the flight and will have the ability to command a manual release of the balloon and a manual release of the parachute in the case that the automated system does not work. The ground station will also receive GPS location of the P&P module during the recovery phase.



Nodes can use COSMOS for their onboard software
Spacecraft
Ground Stations
Rovers
Launch Vehicles
UAVs
Submersibles
Nodes
Agents
HAWAII SPACE FLIGHT LABORATORY
COSMOS
MISSION OPS
GUI Tools
Core Tools
Agents
DMS

Site Selection

- Weather
  - Wind
  - Precipitation
- Trajectory approximation
  - Theoretical landing site
- FAA & FCC regulations
- Away from population
- No obstruction with air traffic
- Communication with City and County
- Communication with FAA

Testing Plan

- Testing will be done during and after the fabrication phase.
- The antenna will be tested over variable ranges on the ground.
- An ideal site for this testing with the C&C module would be an open distance with little to no obstructions.
    - The test will be successful if a connection can be established and data can be transmitted to and from the ground station to the C&C module.
- The antenna will also be tested when the P&P module is tested in the water to confirm it receives the GPS data during the recovery phase.

Ground Station Schedule using WBS and Gantt Chart

- In the time period of prototyping from September 25th to December 3rd the ground station team will decide which antenna should be used for communication with both the C&C and P&P modules.
- Basic training for COSMOS will be learned during this time through a workshop and supplemental tutorials with HSFL mentors if needed.
- Contact with FAA and City and County regarding site selection will be done week 1 of 2018 for basic information and a final date and location will be chosen week 11

Remaining Issues and Concerns

- Programming and understanding the limitations of the COSMOS software
  - Integrating the telemetry, sensor data, and live feed from sources
  - Awaiting COSMOS workshop
- Determining the range and reliability of the transceiver and receiver setup
  - All components are in working condition
  - Testing giving accurate results

Integrated System Testing

Integrated Testing Plan

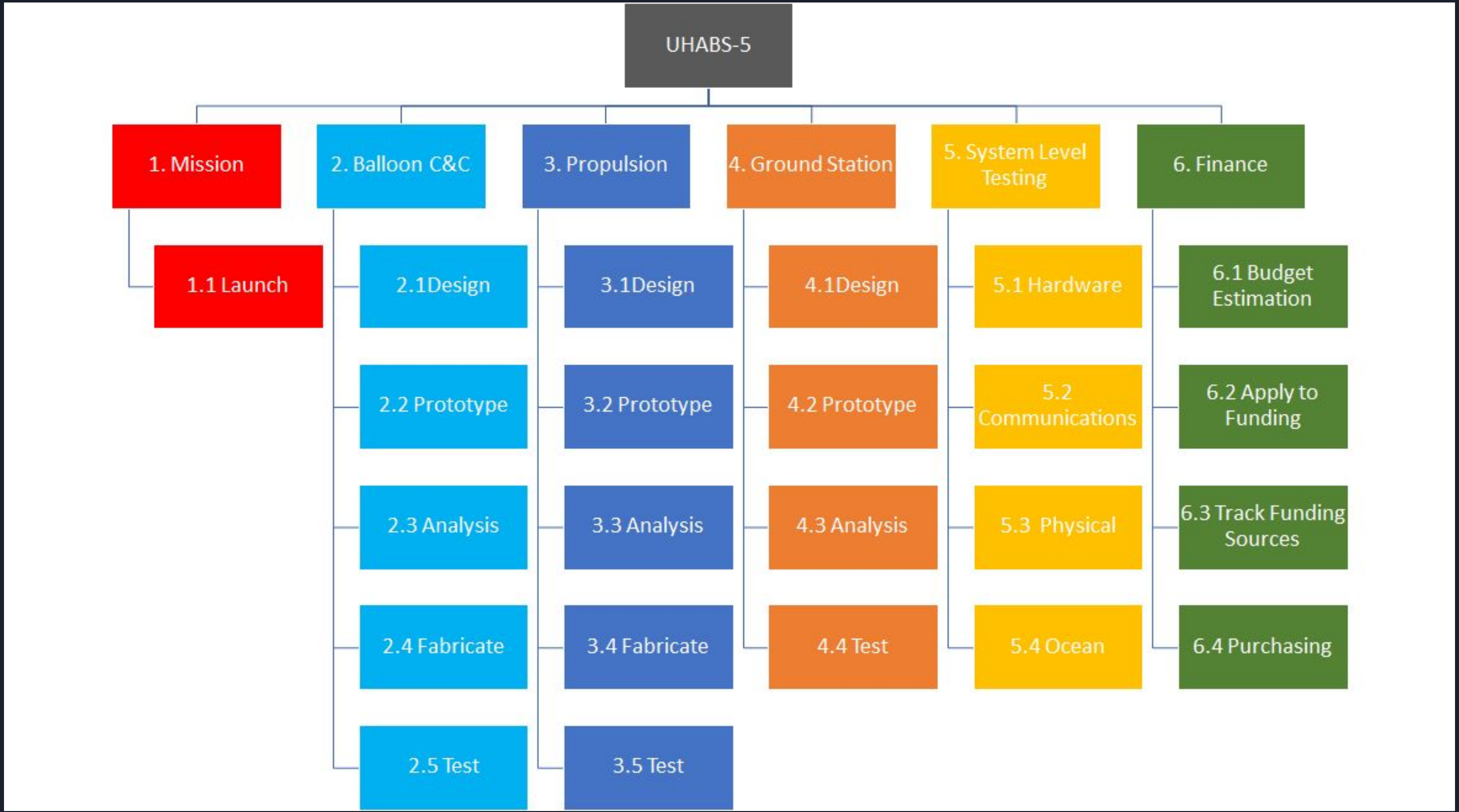
- Check individual subsystems
- Test C&C Module and GSO
  - Vary ranges to verify telemetry and location data are being received
  - Vary ranges to verify module receives commands from GSO
- Test P&P Module and GSO
  - Vary ranges to verify location data being received
  - Alarm test for landing
  - Vary distances for module to travel to designated site
- Test entire system
  - Vary ranges/distances for data collection and storage
  - Impact/Drop tests
  - Test launch (if budget allows)

Configuration & Change Management

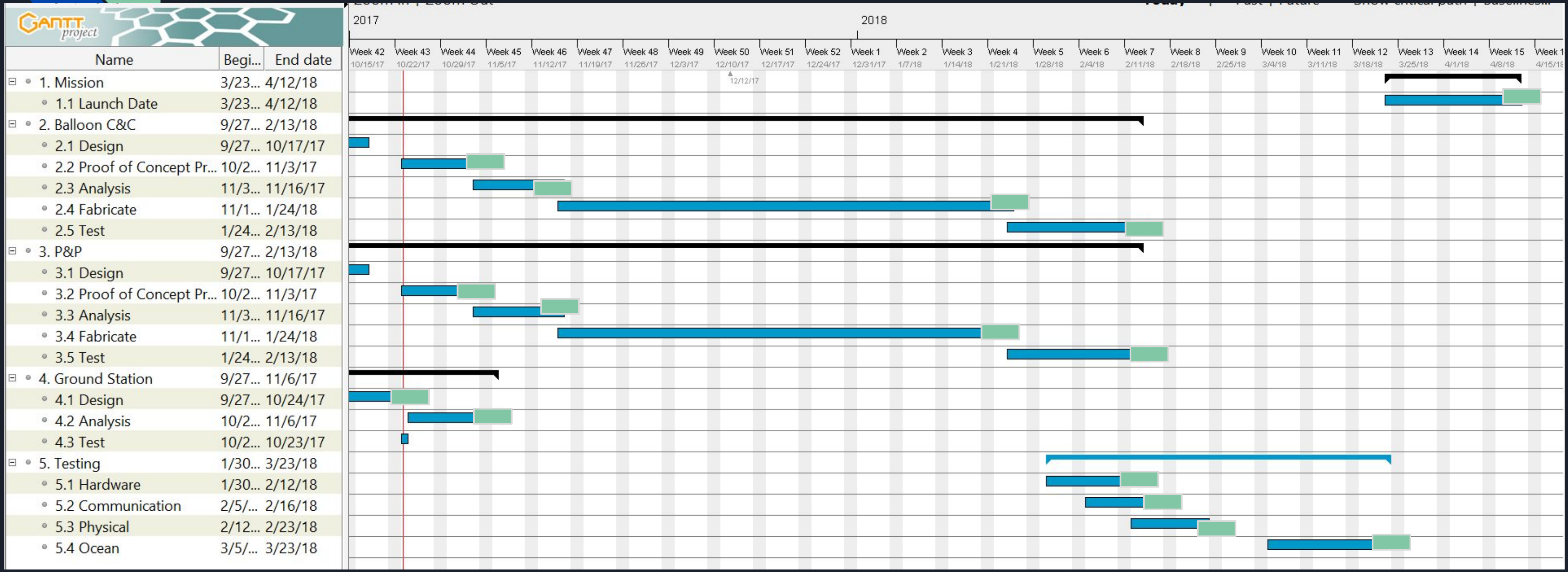
- No major changes to be made after design freeze
- Any changes after design freeze need to be approved by project manager, systems engineer, and financial advisor
- Teams must provide detailed budget, schedule and reasoning to make major changes
- Approval will be given only if there is enough time and budget to implement the change

Project Timeline

WBS


UHABS-5
1. Mission
2. Balloon C&C
3. Propulsion
4. Ground Station
5. System Level Testing
6. Finance
1.1 Launch
2.1Design
2.2 Prototype
2.3 Analysis
2.4 Fabricate
2.5 Test
3.1Design
3.2 Prototype
3.3 Analysis
3.4 Fabricate
3.5 Test
4.1Design
4.2 Prototype
4.3 Analysis
4.4 Test
5.1 Hardware
5.2 Communications
5.3 Physical
5.4 Ocean
6.1 Budget Estimation
6.2 Apply to Funding
6.3 Track Funding Sources
6.4 Purchasing

GANTT Chart


GANTT project
Name
Begi...
End date
1. Mission 3/23... 4/12/18
1.1 Launch Date 3/23... 4/12/18
2. Balloon C&C 9/27... 2/13/18
2.1 Design 9/27... 10/17/17
2.2 Proof of Concept Pr... 10/2... 11/3/17
2.3 Analysis 11/3... 11/16/17
2.4 Fabricate 11/1... 1/24/18
2.5 Test 1/24... 2/13/18
3. P&P 9/27... 2/13/18
3.1 Design 9/27... 10/17/17
3.2 Proof of Concept Pr... 10/2... 11/3/17
3.3 Analysis 11/3... 11/16/17
3.4 Fabricate 11/1... 1/24/18
3.5 Test 1/24... 2/13/18
4. Ground Station 9/27... 11/6/17
4.1 Design 9/27... 10/24/17
4.2 Analysis 10/2... 11/6/17
4.3 Test 10/2... 10/23/17
5. Testing 1/30... 3/23/18
5.1 Hardware 1/30... 2/12/18
5.2 Communication 2/5/... 2/16/18
5.3 Physical 2/12... 2/23/18
5.4 Ocean 3/5/... 3/23/18
2017
2018
Week 42 10/15/17
Week 43 10/22/17
Week 44 10/29/17
Week 45 11/5/17
Week 46 11/12/17
Week 47 11/19/17
Week 48 11/26/17
Week 49 12/3/17
Week 50 12/10/17
Week 51 12/17/17
Week 52 12/24/17
Week 1 12/31/17
Week 2 1/7/18
Week 3 1/14/18
Week 4 1/21/18
Week 5 1/28/18
Week 6 2/4/18
Week 7 2/11/18
Week 8 2/18/18
Week 9 2/25/18
Week 10 3/4/18
Week 11 3/11/18
Week 12 3/18/18
Week 13 3/25/18
Week 14 4/1/18
Week 15 4/8/18
12/12/17

Hardware Acquisition Status/Plan

- Use what parts already in inventory
  - ABS Plastic, Polystyrene, SD Memory Card, hand warmers, solder wires, glue
- Obtain as many parts on-island as possible (no shipping/lead time required)
- Parts that need to be ordered should be ordered immediately after design freeze and aim to arrive no later than the first week of the spring semester

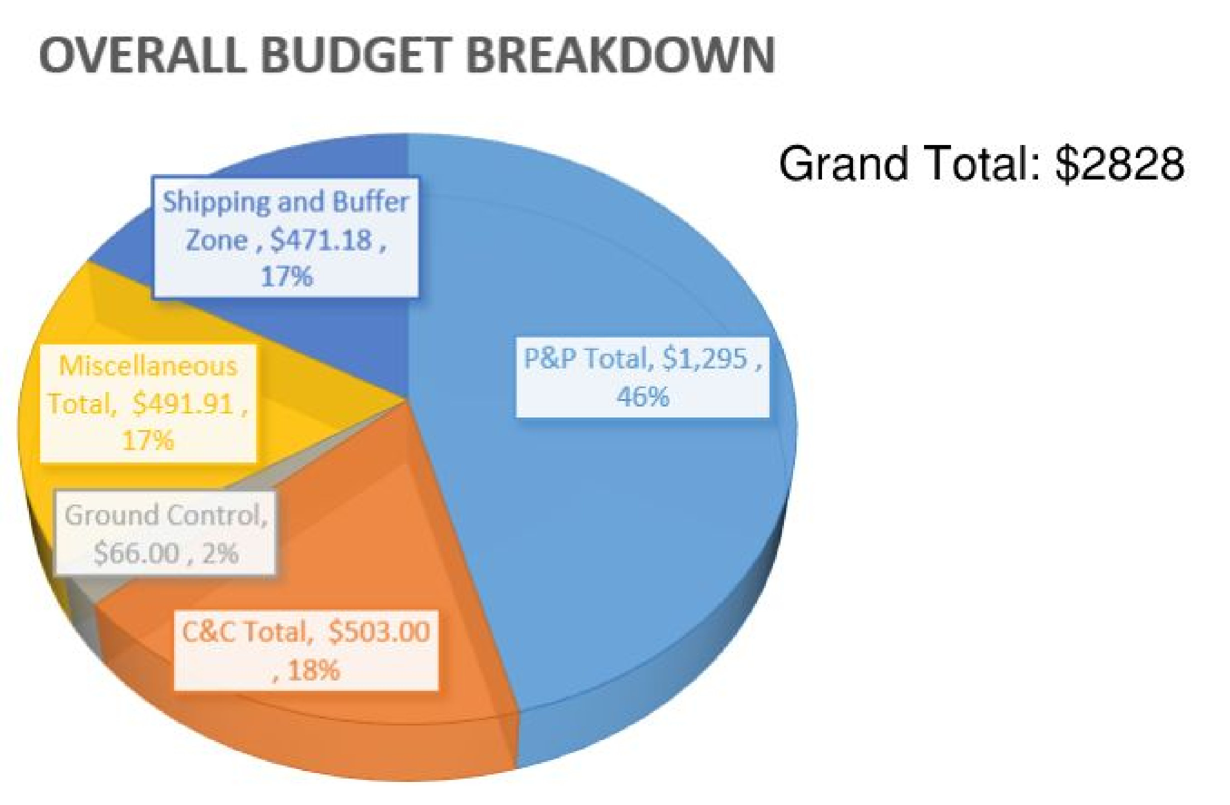
Hardware Acquisiton			
Component	Status	Availability	Deadline
Yuntab Action Cameras	Complete	$32.00	01/12/18
Voltage Sensor	Complete	$8.00	01/12/18
TMP36 Temp. Sensor	Complete	$3.00	01/12/18
Teensy 3.2 Development Board	Complete	Online	01/12/18
Solder wires	Complete	Online	01/12/18
Screws/bolts/washers	Complete	Online	01/12/18
Rubber washers and Gaskets	Complete	Online	01/12/18
RF Modules Xbee-Pro 900HP	Complete	Online	01/12/18
RF Modules Xbee-Pro 900HP	Complete	Online	01/12/18
Radio Receiver	0.50	Online	01/12/18
Propeller	0.50	Online	01/12/18
Pressure Shield	0.50	Online	01/12/18
Parachute	0.00	Online	01/12/18
Large Styrofoam Cube	0.00	Online	01/12/18
IMU Shield	0.00	Online	01/12/18
High Gain long range antenna	0.00	Online	01/12/18
Helium Tank	0.00	Online	01/12/18
Hand Warmers	0.00	Online	01/12/18
Gumstix	0.00	Online	01/12/18
Grainger Warning light Beacon	0.00	Online	01/12/18
GPS Shield	0.00	Online	01/12/18
Gorilla Glue	0.00	On Island	01/12/18
Electric Motor	0.00	Online	01/12/18
Class 10, 32GB Micro SD Card	0.00	On Island	01/12/18
bolts/nuts/screws	0.00	On Island	01/12/18
Battery 10000mAh Li-ion	0.00	On Island	01/12/18
Arduino Uno shield	0.00	Online	01/12/18
Arduino Uno	0.00	Online	01/15/18
ABS Plastic	0.00	Online	01/13/18
2" Construction Grade Polystyrene	0.00	Online	01/17/18

Risk Management

Risk Identification	Level	Risk Mitigation (blue = proactive, red = reactive)
Insufficient Power for P&P module to navigate to designated location	high	-optimize design to reduce drag -select higher performing motors -optimize design of propellers -move less critical components to C&C
P&P Module Heavier Than Budgeted	Medium	-optimise design -use lighter more expensive materials
Insufficient funding to complete project	low	-Apply for multiple funding sources -Set up fundraisers -Make adjustments to scope to allow for a cheaper balloonsat
Majority of team members in Zeppelin have never worked with satellites before	medium	-recruit people who have worked on satellites before -Arrange assistance from mentors who have participated in UHABS in the past -Build complete models with past iterations before prototyping and design -Change scope of mission to allow for cheaper less complex satellite
Majority of team members in Zeppelin have little experience with programming and hardware	medium	-Recruit EE students to help with the project and teach other members the basics -have designated members go through tutorials to master software and hardware -Utilize EE students and engineering faculty expertise to help solve problems

Cost, Budget, Funding

Budget Breakdown by Trade



P&P Module	Quantity	Cost Per Unit	Total Current Market Value 2017
Large Styrofoam Cube	2	$20.00	$40.00
ABS Plastic	1 roll	Currently Have	0
Arduino Uno	Currently Have	Currently Have	$0.00
Arduino Uno shield	1	$15.00	$15.00
2” Construction Grade Polystyrene	Currently Have	Currently Have	0
GPS Shield	1	$27.00	$27.00
Propeller Octura x435	2	$11.00	$22.00
Inspire 90 Motor 1509/2Y 6.7:1	2	$365.00	$730.00
Floureon 2 Pack Li-Po Battery (Motor)	2 Pack	$63.00	$126.00
Castle Creations Hydra ICE 240A XL 33.6V w/Switching BEC	1	$290.00	$290.00
Alarm/Buzzer	1	$20.00	$20.00
High Gain long range antenna	1	1	$25.00
Class 10, 32GB Micro SD Card	Currently Have	Currently Have	$0.00
P&P Total			$1,295.00

C&C Module	Quantity	Cost Per Unit	Total Current Market Value 2017
Hand Warmers	Currently Have	Currently Have	0
Arduino Uno	1	$22.00	$22.00
Battery 10000mAh Li-ion	1 Pack	$33.00	$33.00
Arduino Uno shield	1	$15.00	$15.00
TMP36 Temp. Sensor	2	$1.50	$3.00
Teensy 3.2 Development Board	1	$23.00	$23.00
Voltage Sensor	1	$8.00	$8.00
Yuntab Action Cameras	1	$32.00	$32.00
GPS Shield	1	$27.00	$27.00
IMU Shield	1	$25.00	$25.00
Pressure Shield	1	$20.00	$20.00
RF Modules Xbee-Pro 900HP	1	$41.00	$41.00
Gumstix	1	$169.00	$169.00
High Gain long range antenna	1	1	$25.00
Grainger Warning light Beacon	1	$60.00	$60.00
C&C Total			$ 503.00

Ground Control	Quantity	Cost Per Unit	Total Current Market Value 2017
RF Modules Xbee-Pro 900HP	1	$41.00	$41.00
High Gain long range antenna	1	1	$25.00
Ground Control Total			$66.00

Miscellaneous Total

Miscellaneous	Quantity	Cost Per Unit	Total Current Market Value 2017
Parachute	1	Included	0
Helium Tank	1	1	$486.91
Gorilla Glue	1 Bottle	Currently Have	0
bolts/nuts/screws	Currently Have	Currently Have	0
Rubber washers and Gaskets	1 pack	$5	$5
Solder wires	Currently Have	Currently Have	0
Miscellaneous Total			$ 491.91

Documentation List

Document Name	Assigned
Action List	Karen Calaro
BC&C Mass and Volume Budget	James Yang
BC&C Power Budget	Manny Valdez
Budget	Drex Arine
Design Change Log	Reagan Paz
Funding Sources and Awards	Drex Arine
Gantt Chart	Karen Calaro
Mission Requirements Document	Karen Calaro, Reagan Paz, Drex Arine, Kahekili Clark, Jace Yamaguchi, Yun Feng Tan
P&P Power Budget	Andrew Bui
P&P Mass and Volume Budget	Kahekili Clark
Team Calendar	Karen Calaro
Website	Reagan Paz
Work Breakdown Structure	Karen Calaro

Conclusion

- The mission is to design a high altitude test platform with the capability of self-navigating to a retrievable area in the case of a landing in the ocean.
- The Zeppelin team is split into three major subsystems, each gearing towards the success of a different objective:
    - Balloon and C&C
    - Payload and Propulsion
    - Ground Station
- UHABS-5 will cost around $2668 to fabricate.
- Many balloon satellite teams are done in the mainland United States, providing easier retrieval to their balloon satellites.
    - In Hawaii the chance of the balloon landing in water is almost certain thus showing the importance of the need of a successful retrieval device.
- In order to successfully retrieve the payload of UHABS-5 the C&C Module is designed as a capsule shape and the P&P is designed as a catamaran

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Section Professor: Dr. Trevor Sorensen
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TA: Grant Takara

Mentor: Miguel Nunes
Assistant Mentor: Yosef Ben Gershom

Questions?