UHABS-5 Mission Zeppelin

Team Members:
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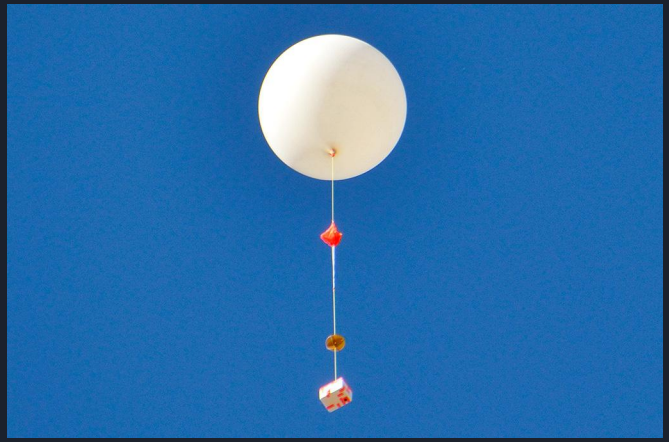
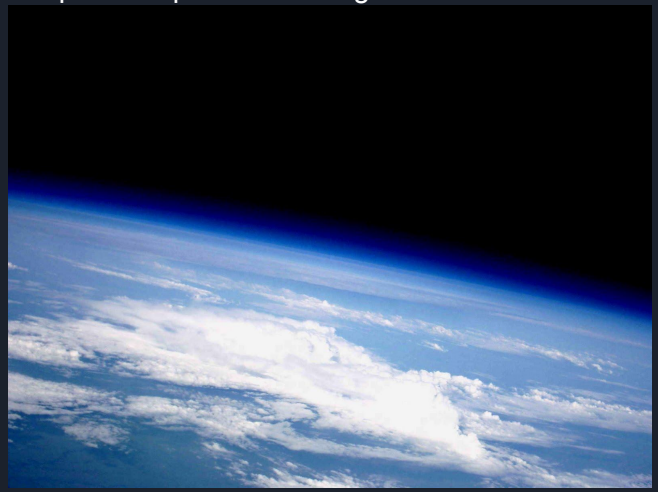
Introduction

- What is a BalloonSat?
  - An unmanned weather balloon that is launched into the stratosphere that usually carries a payload
  - They are often used to conduct research in near-space conditions



http://nearspaceballooning.com/LAUNCH-6/



https://nearsys.blogspot.com/2011_10_01_archive.html

Problem Statement

https://c1.staticflickr.com/6/5677/30056234264_b5c51acf6c_b.jpg

https://upload.wikimedia.org/wikipedia/commons/2/24/View_from_Diamond_Head_Rim_at_Hawaii.jpg

http://www.picserver.org/images/highway/phrases/eco-friendly.jpg

https://upload.wikimedia.org/wikipedia/commons/thumb/c/c8/Seal_of_the_United_States_Federal_Aviation_Administration.svg/1024px-Seal_of_the_United_States_Federal_Aviation_Administration.svg.png

https://upload.wikimedia.org/wikipedia/commons/1/12/Birders_visit_Fort_Indiantown_Gap_150527-F-ZT651-001.jpg

Mission Statement

The UHABS-5 mission shall provide a reliable high altitude test platform in a balloon satellite that will be operated with the COSMOS software, will collect environmental data in a near-space environment and upon safe descent onto the ocean, autonomously propel itself to a designated recovery site.

Objectives and Success Criteria

Task 1:

https://c1.staticflickr.com/3/2665/3705306228_5184a89319_b.jpg

http://dryu.co.uk/wp-content/uploads/2015/08/DRYU_Waterproof_Icon_2015.png

https://twistedsifter.files.wordpress.com/2015/04/nasa-earth-day-gallery-6.jpg

https://media.defense.gov/2017/Jun/26/2001768807/670/394/0/170426-F-ZZ999-418.JPG

https://pixabay.com/p-157172/?no_redirect

Objectives and Success Criteria

Task 2:

https://cdn.pixabay.com/photo/2016/07/29/18/24/water-1555170_960_720.jpg

https://i.pinimg.com/736x/65/9a/ef/659aef03b6a626bc2eceee2000aede2c--pirate-treasure-maps-diy-treasure-map.jpg

http://s3.amazonaws.com/digitaltrends-uploads-prod/2014/07/Solar-cells.jpg

Constraints

- **Technical Constraints**
  - Location
  - Altitude
  - Weather
- **Federal Regulations**
  - Federal Aviation Administration (FAA)
    - FAA Part 101 and 14 CFR Part 48
      - Operation Limitations
      - Registration
  - Federal Communications Commission (FCC)
    - FCC 22.925
      - No onboard cell phone devices be operating during flight

Top Level Requirements

Functional Requirements:

- Periodic communication and data transmission with ground station
- Engineering measurement data and images over 100,000 ft altitude

Operational Requirements

- Operational from time to launch until retrieval
- Usable prototype within 6 months
- Final product within 8 months

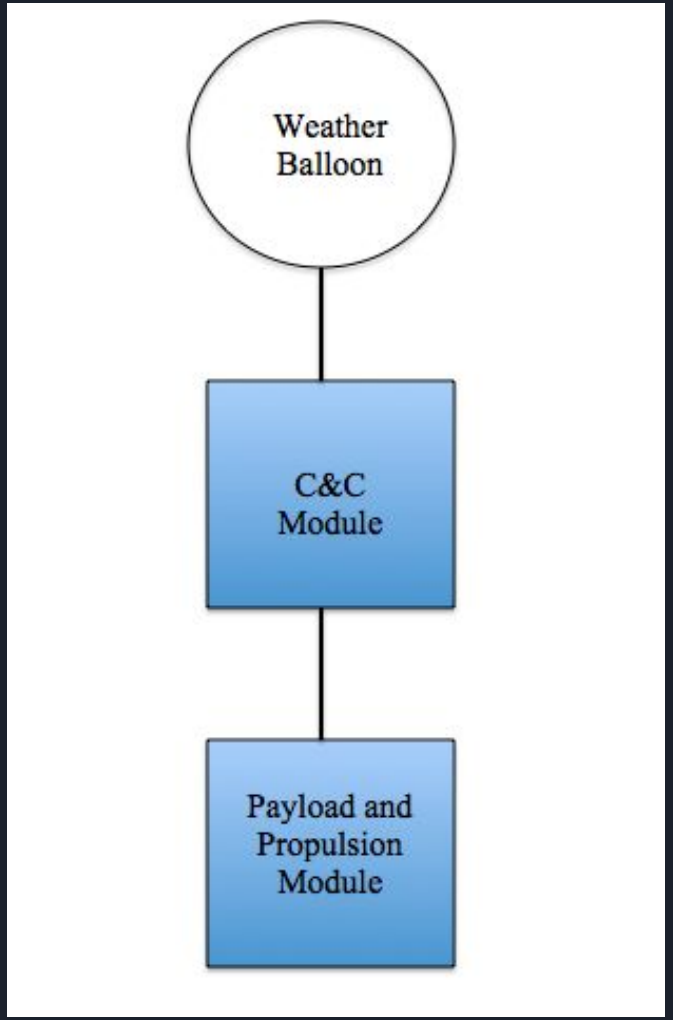
Constraints

- Existing materials must be used.
- Cost must be held at a reasonable level
- Must operate within FAA regulations

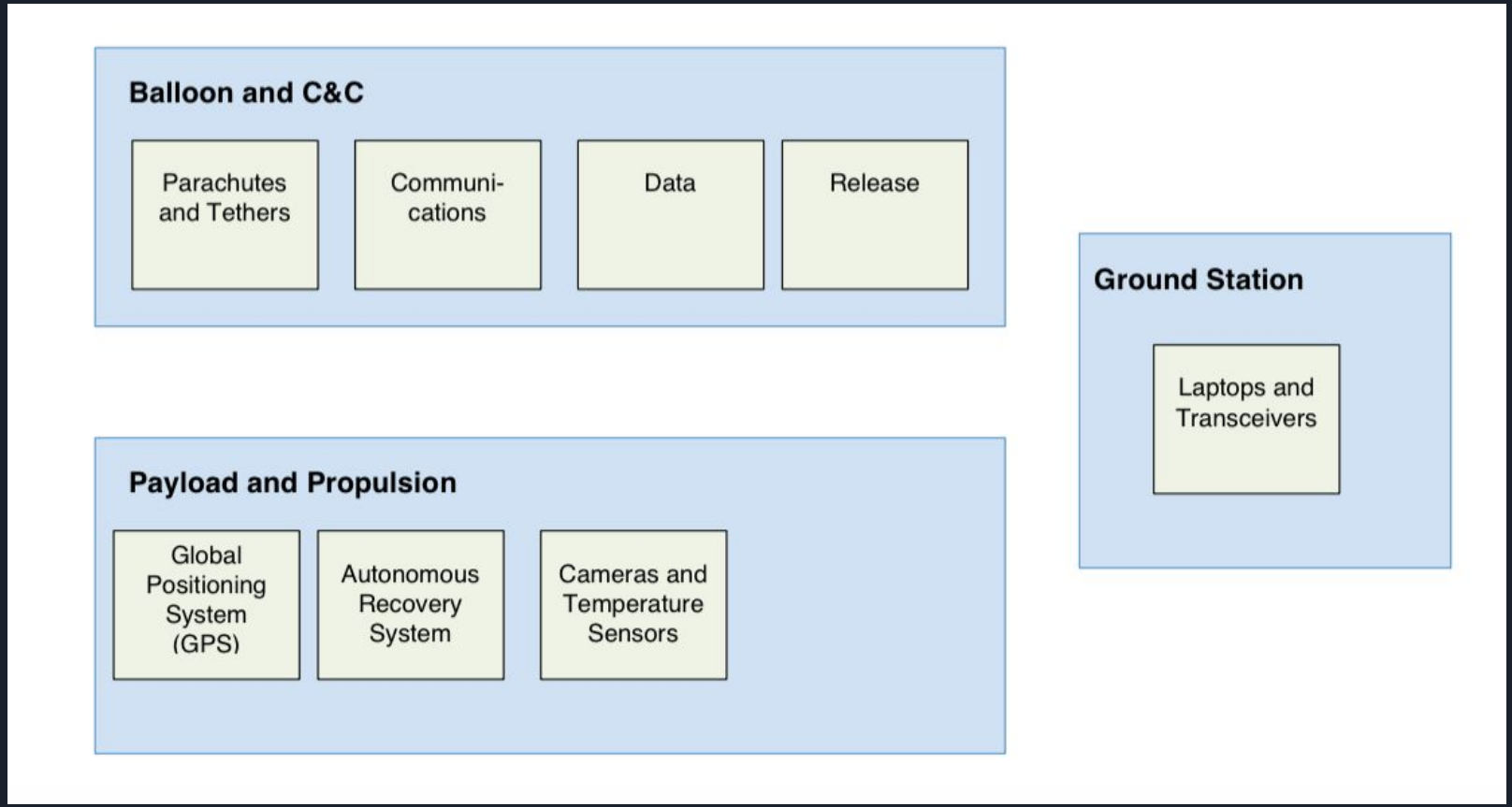
Technical Overview

Subsystem breakdown:

- Balloon and C&C Module
- Payload and Propulsion Module
- Ground Station



System Overview (Diagram)



Team Breakdown

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: Kanekahekilinuinanaueikalani Clark	Ground Station Lead: Jace Yamaguchi
Emanuel Valdez	Andrew Bui	Jake Torigoe
James Yang	Likeke Aipa	Ka Chon Liu
	Cyrus Noveloso	

Balloon/Command & Control Module

- Objective: Transportation for the payload
- C&C Module will be a cube shape
  - Waterproof
  - Insulated
- COSMOS Software
  - Relay commands from the ground station
- Raspberry Pi
  - CPU of the module
  - Capable of running multiple programs at once

Payload and Propulsion Module

- Payload
  - Contains avionics
  - Maintains contact will ground control during return
  - Able to translate GPS coordinates into usable input to navigate
  - Equipped with thermocouples, camera, and microphones
- Propulsion module (special feature)
  - Responsible for maneuvering control module within recoverable distance to Oahu

Special Features

Self Propulsion System

The module will autonomously propel itself to a designated, retrievable location. This will be possible with paddle wheels attached to a motor, a rudder for steering, and battery pack & solar panel combination to provide constant movement.

The module will be programmed on a Raspberry Pi since the module will be asked to control more than 2 tasks simultaneously. We will be using COSMOS software and hardware tools to manage this feature

The Ground Station Subsystem will have constant communication with the propulsion module. Information, such as GPS location, magnitude of the module, camera footage, power and battery life, will be sent to Ground for data handling.

Avionics (C&C + P&P) - Parts

Telemetry

- XTend 900 MHz Long-Range RF Module x2 (C&C)
- Gumstix AeroCore 2 (GPS module) (C&C)

Data Storage

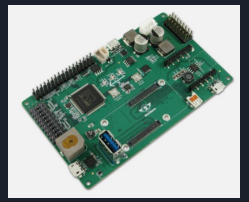
- microSD breakout board (P&P)

Microcontroller

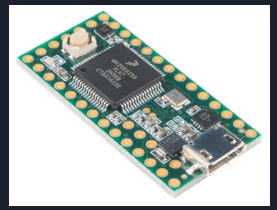
- Teensy 3.2 development board x2 (C&C + P&P)

Data

- Triple-axis gyroscope (orientation) (P&P)
- Thermocouples (temperature) (P&P)
- GoPro camera (images) (P&P)

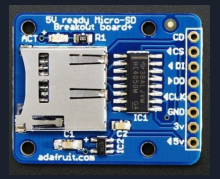


Gumstix AeroCore 2

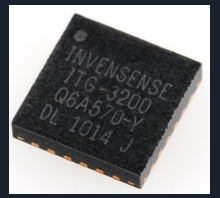


Gumstix AeroCore 2

XTend 900 MHz RF Module



microSD breakout board



Triple-axis gyroscope

Avionics (C&C + P&P) - Power Budget

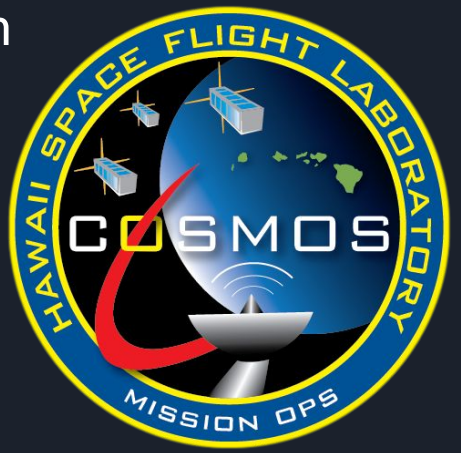
Component	Power
XTend 900 MHz Long-Range RF Module x2	2.8-5.5 V RX: 35 ma @ 5.0 V TX: 710 mA @ 30 dBm
microSD breakout board	3.3 V 100 mA
Teensy 3.2 development board	1.71-3.6 V 39 mA @ 3.0 V
Triple-axis gyroscope	2.1-3.6 V 6.5 mA
Gumstix AeroCore 2	3.1-16.0 V 500 mA @ 3.3 V
Thermocouples (2 interior, 2 exterior)	TBD
GoPro camera	Internal Battery - 1160 mAh 1080p/30fps - 2h 30m

TBD: solar cells, battery, & EPS/charging circuit

Total: > 1.3905 A

Ground Station

- Uses COSMOS software for flight and ground ops
- Monitors data before, during, after mission
- Runs system diagnostics to ensure all parts are working before launch
- Reports on state of health during the mission
- Sends appropriate signals during flight
    - Descent, parachutes, recovery, etc



Launch Operations and Permissions

- Team members will meet with local FAA officers
- Write a Notice to Airman Letter (NOTAM)
- Create a list of basic information for launch day

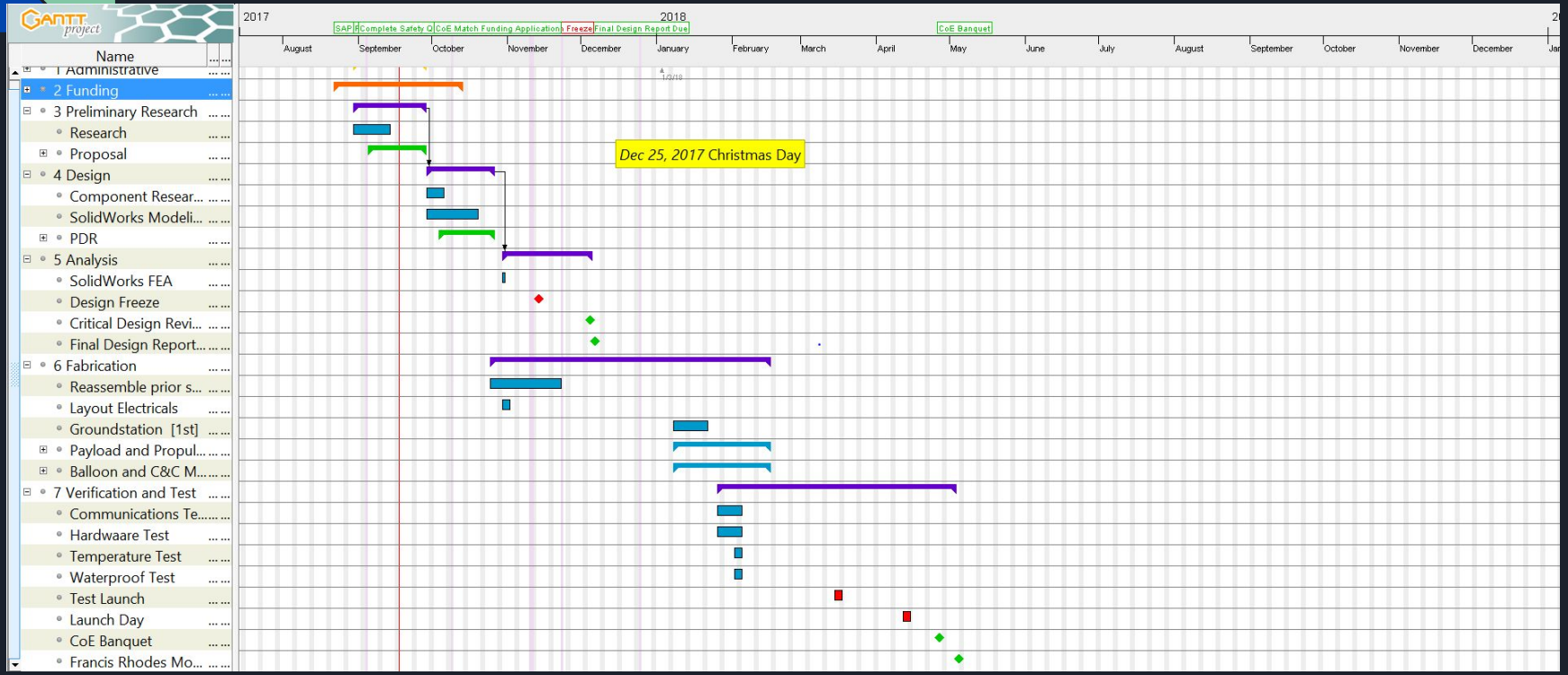
FAA restrictions

- No person may operate an unmanned free balloon-Unless otherwise authorized by ATC, in a control zone below 2,000 feet above the surface, or in an airport;
- At any altitude where there are clouds or obscuring phenomena of more than five-tenths coverage;
- At any altitude below 60,000 feet standard pressure altitude where the horizontal visibility is less than five miles;
- During the first 1,000 feet of ascent, over a congested area of a city, town, or settlement or and open-air assembly of persons not associated with the operation;
- In such a manner that impact of the balloon, or part thereof including its payload, with the surface creates a hazard to persons or property not associated with the operation

Safety

- All members must have completed safety training sessions
- All guidelines in the UH ME Safety Handbook will be followed
- Personal protective equipment must be worn at appropriate times and settings
- Group members will attend workshops for necessary machining processes
- In the event of an accident, campus safety then Dr. Sorensen will be contacted immediately

GANTT Chart


GANTT project
Name
1 Administrative
2 Funding
3 Preliminary Research
Research
Proposal
4 Design
Component Resear...
SolidWorks Modeli...
PDR
5 Analysis
SolidWorks FEA
Design Freeze
Critical Design Revi...
Final Design Report...
6 Fabrication
Reassemble prior s...
Layout Electricals
Groundstation [1st]
Payload and Propul...
Balloon and C&C M...
7 Verification and Test
Communications Te...
Hardwaare Test
Temperature Test
Waterproof Test
Test Launch
Launch Day
CoE Banquet
Francis Rhodes Mo...
2017
2018
SAP
Complete Safety Q
CoE Match Funding Application
Freeze
Final Design Report Due
CoE Banquet
August
September
October
November
December
January
February
March
April
May
June
July
August
September
October
November
December
Dec 25, 2017 Christmas Day

Budget

Scope of Work	Quoted Estimate
Electrical	$1000
Mechanical	$700
Hardware	$250
Structural	$250
Total Quoted Estimate	$2200

Electrical

Major Components	Estimated Cost
Arduino/Raspberry Pi MotherBoard Kit	$25.00 - $60.00
XTend 900 MHz Long-Range RF Module	$179.00
Gumstix AeroCore 2 (GPS)	$149.00
Camera (Very Tentative)	$100 - $200
Teensy 3.2 development board	$19.95
Receiver with Long range Antenna	$200 - $300
Analog to Digital Convertor	$25 - $30
Approximate Projected Cost for Major Components	$698 - $938

Mechanical

Major Components	Estimated Cost
Helium Tank	$100
Motor for autonomous aquatic vehicle	$70 - $150
Thermal Insulation	$50
Landing Gear	$100 - $150
Approximate Projected Cost for Major Components	$320 - $450

Hardware

Major Components	Estimated Cost
Epoxy, Springs, Mechanical Fasteners, Washers etc.	$100
Parachute (6ft)	$50
Weather Balloon	$60 - $100
Approximate Projected Cost for Major Components	$210 - $250

Structural

Major Components	Estimated Cost
Large Cubic Styrofoam Container	$50 - $100
ABS Plastic	$20
Nylon	$20
Approximate Projected Cost for Major Components	$90 - $140

Funding

Options are being explored to assist in the funding of this project. The list of funding programs that the balloon satellite project is currently exploring are listed below

1. SAPFB
2. UROP
3. COE Match Funding

The option of starting a fundraiser is also a consideration in the funding plan.

Questions?

References

- https://c1.staticflickr.com/3/2665/3705306228_5184a89319_b.jpg
- http://dryu.co.uk/wp-content/uploads/2015/08/DRYU_Waterproof_Icon_2015.png
- https://pixabay.com/p-1555170/?no_redirect
- https://upload.wikimedia.org/wikipedia/commons/thumb/c/c8/Seal_of_the_United_States_Federal_Aviation_Administration.svg/1200px-Seal_of_the_United_States_Federal_Aviation_Administration.svg.png