CAP-HAB
(Capstone-High Altitude Balloon)
EE 476

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High Altitude Research Balloon Overview

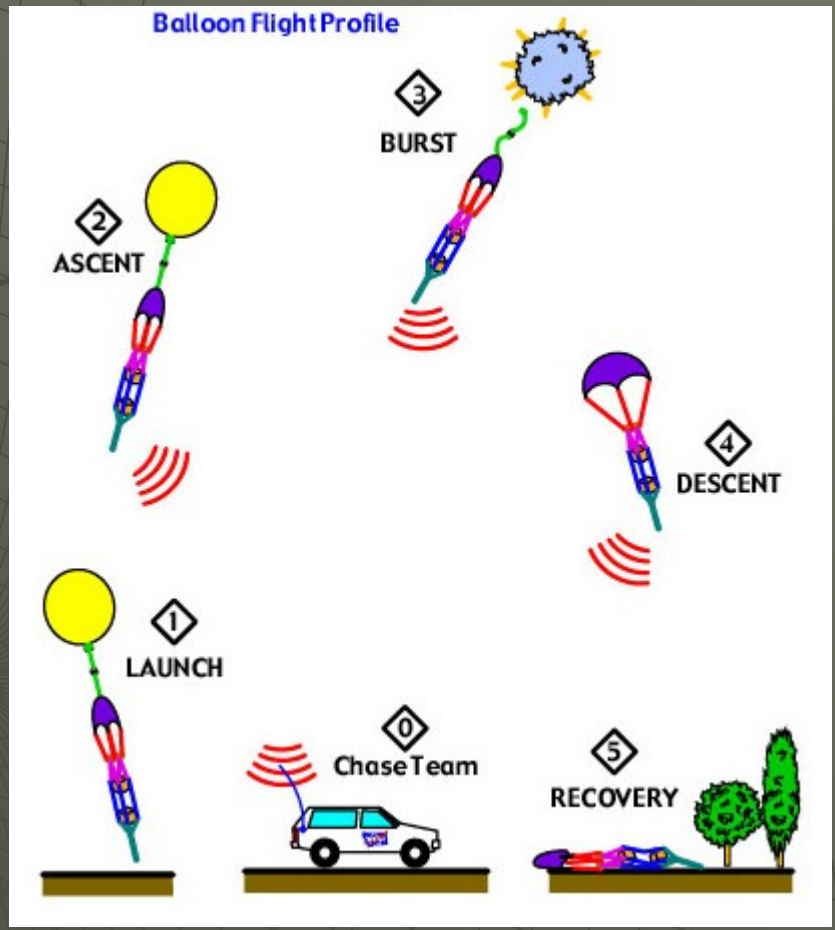
- Project Overview
  - Problem Statement
  - System Diagram
- Design Proposal
  - Subsystem Breakdown
- Schedule
- Budget Breakdown

Problem Statement

- The NAU/NASA Space Grant Administration has requested the design, launch and retrieval of a small payload on a high-altitude weather balloon.

- The payload satellite will be designed to measure various atmospheric parameters
  - Temperature of -80° to 90° Fahrenheit
  - Pressures 0 to 1 Bar
  - Altitudes of approximately 100,000 feet
  - Capture Images

System Conceptual Diagram

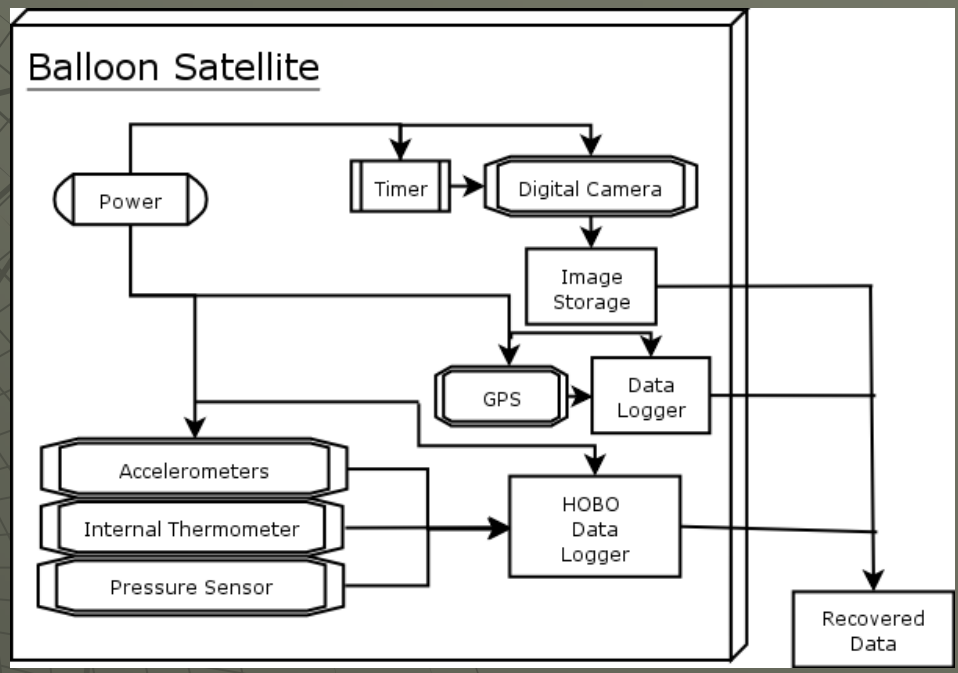


Document Changes

- Additional Requirement
  - Satellite must be able to withstand Two meter drop
- Design Plan Change
  - Cost Constraint

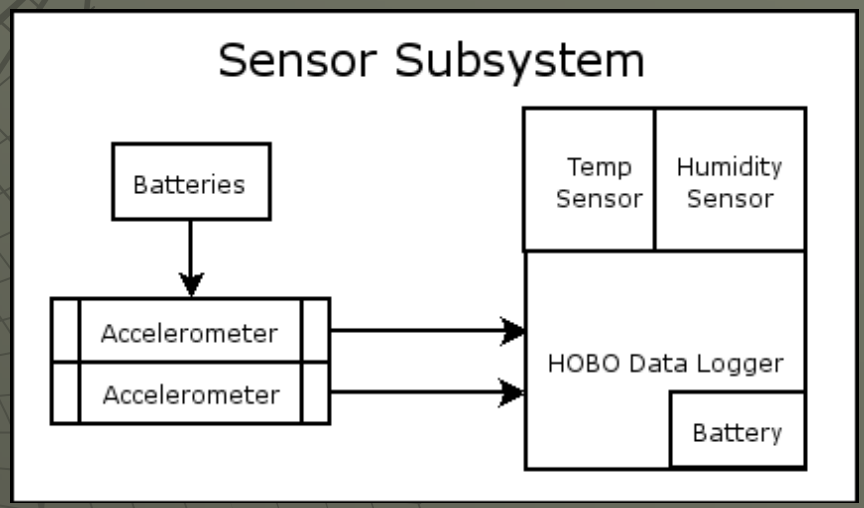
System Breakdown

- Sensor Subsystem
- Digital Imagery Subsystem
- Location Tracking Subsystem
- Satellite Structure Subsystem
- Power Subsystem



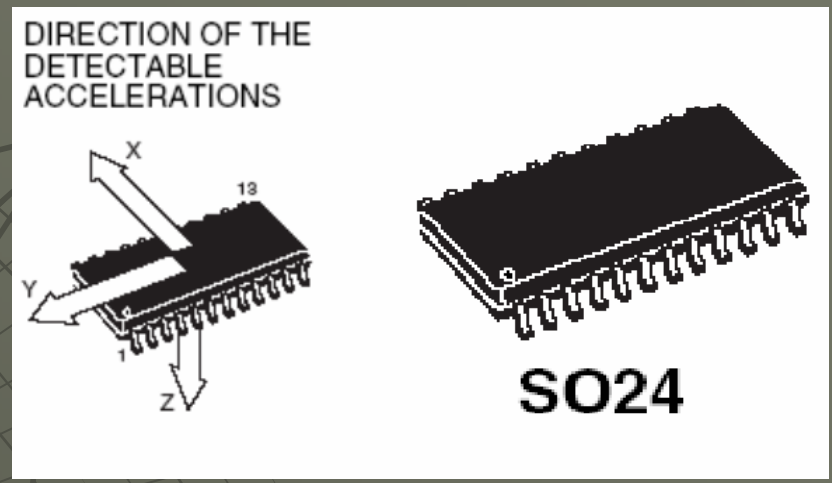
Sensor Subsystem

- Planned Sensors
  - 3-Axis Accelerometer
  - Temperature Sensor
  - Humidity Sensor
- Data Logger
  - Onset HOBO data logger



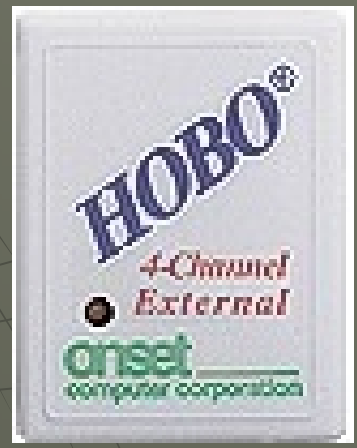
ST Microelectronics LIS3L02AQ 3-Axis Accelerometer

- Measures Flight G-Forces
- 3-Axis Accelerometer Surface Mount IC
- 3 Analog Outputs
- Ranges Include +-2g or +-6g



Onset HOBO

- Data Logger and Sensors Combined
- Battery operated
- 4 channels
  - 2 external
    - For the Accelerometers
  - 2 internal Sensors
    - Relative Humidity
    - Temperature
- Serial Interface
- Software Configured for data resolution and start delay
- Software Accessed to Recover Data



Digital Imaging Subsystem

- Constraints used to judge camera selection
  - Operation life, Weight, Quality, and Dimensions
- Camera Chosen with Decision Matrix

Camera Type	Weight (lbs)	Dimension (inches)	Picture Quality	Price	Batteries	Operation Life
Olympus C-55	0.75	4.3 x 2.6 x 1.9	5 Mega Pixels	$270 - $300	AA (4) batteries	340 min
Sony Cyber-shot T5	0.3	3.7 x 2.4 x 0.8	5 Mega Pixels	$250 - $350	Proprietary Lithium	128 min
Canon SD400	0.29	3.4 x 2.1 x 0.8	5 Mega Pixels	$250 - $350	Proprietary Lithium	108 min
Casio EX-Z50	0.33	3.4 x 2.3 x 0.9	5 Mega Pixels	$200 - $250	Proprietary Lithium	240 min

Digital Imaging Subsystem

Camera Type	Weight	Dimension	Battery Life	Memory	Feature/Quality	Totals
Olympus C-55	3	3	10	6	7	29
Sony Cyber-shot T5	9.5	9	4	6	5	33.5
Canon SD400	10	10	3	8	8	39
Casio EX-Z50	9	9.5	8	8	8	42.5

- **Our choice is the Casio EX-Z50**

Camera Actuator

555 Circuit – V-MK111

- Timer adjustable by changing Resistance and Capacitance
- Weighs .063 pounds
- .85” x 2.2” x 1.5” dimensions
- Worked successfully on first flight

Location Tracking Subsystem

Global Positioning System

- Garmin® GPS 35 TracPak
- Tracks above 60,000 ft
- Weighs .275 pounds
- Operation Temperature
  - -22F to 185F
- Dual Serial Port Interface

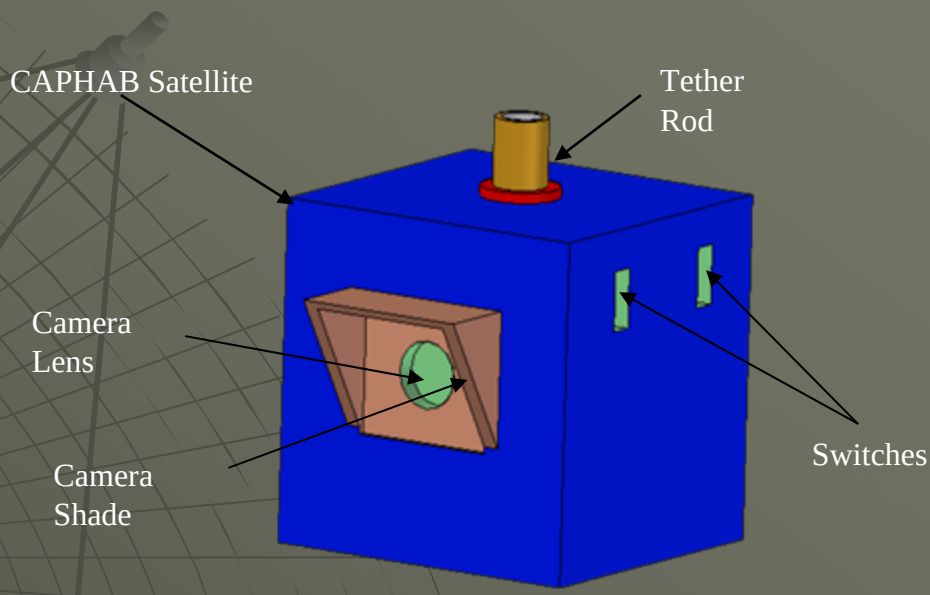
GPS Data Logger

- XL-25
- Stores over 50,000 GPS log points
- Serial Port Interface
- Weighs .085 pounds
- Dimensions:

  2.4" x 1.5" x 0.5"

Satellite Structure Subsystem

- 1 x 1 x 1 foot cube
- 1st Sat Constructed with
  - Mattboard
  - Polyethylene foam
- Ice Box test
  - Analyze differences between
    - Polyethylene foam
    - Polyurethane foam
- Camera Sun Shade



Power Subsystem

- Selection criteria
  - Weight
  - Voltage output
  - Power life
  - Dimensions
  - Space applicable

Nominal Voltage		3.7v
Standard Capacity		1400mAh
Dimensions	**Width**	1.2"
	Height	1.95"
	Thickness	0.45"
	Weight	1.5 oz
Temperature Operation		-20 to 40 C

Plans Until February

- Accomplished to Date
  - Build/Launched Prototype Satellite
  - Preliminary Subsystem Designs
- Reviewing/Finalizing the Design
  - Solidifying Details
  - Evaluation by NASA Advisors
  - Ordering Parts

Skeleton Plan

Spring 2006: Phase I (first 1/3 of semester)

- Finalize design of payload with appropriate documentation.
- Conduct design reviews.

Spring 2006: Phase II (second 1/3 of semester)

- Implement the design and build the payload.
- Payload undergoes extensive pre-flight testing.

Spring 2006: Phase III (Final 1/3 of semester)

- Launch and recover payload at weekend workshop in central Arizona.
- Review images and data acquired.

Budget Breakdown

- Project expenses covered by NAU NASA Space Grant including:
  - Travel, food, lodging and vehicles for two launch weekends
  - Tools and equipment, office space, office supplies
  - $2000 for the payload itself

Estimated Budget

- Total Budget - $900 (of $2000)
  - Imaging Subsystem - $350
  - Sensor Subsystem - $50
  - Location Subsystem - $400
  - Container - $50
  - Power - $50
- Remaining Budget - $1100

Questions/Comments