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

Jad Lutfi
Andrew Prosory
Rob Hough
Rob Conant

High Altitude Research Balloon Overview

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Problem Statement

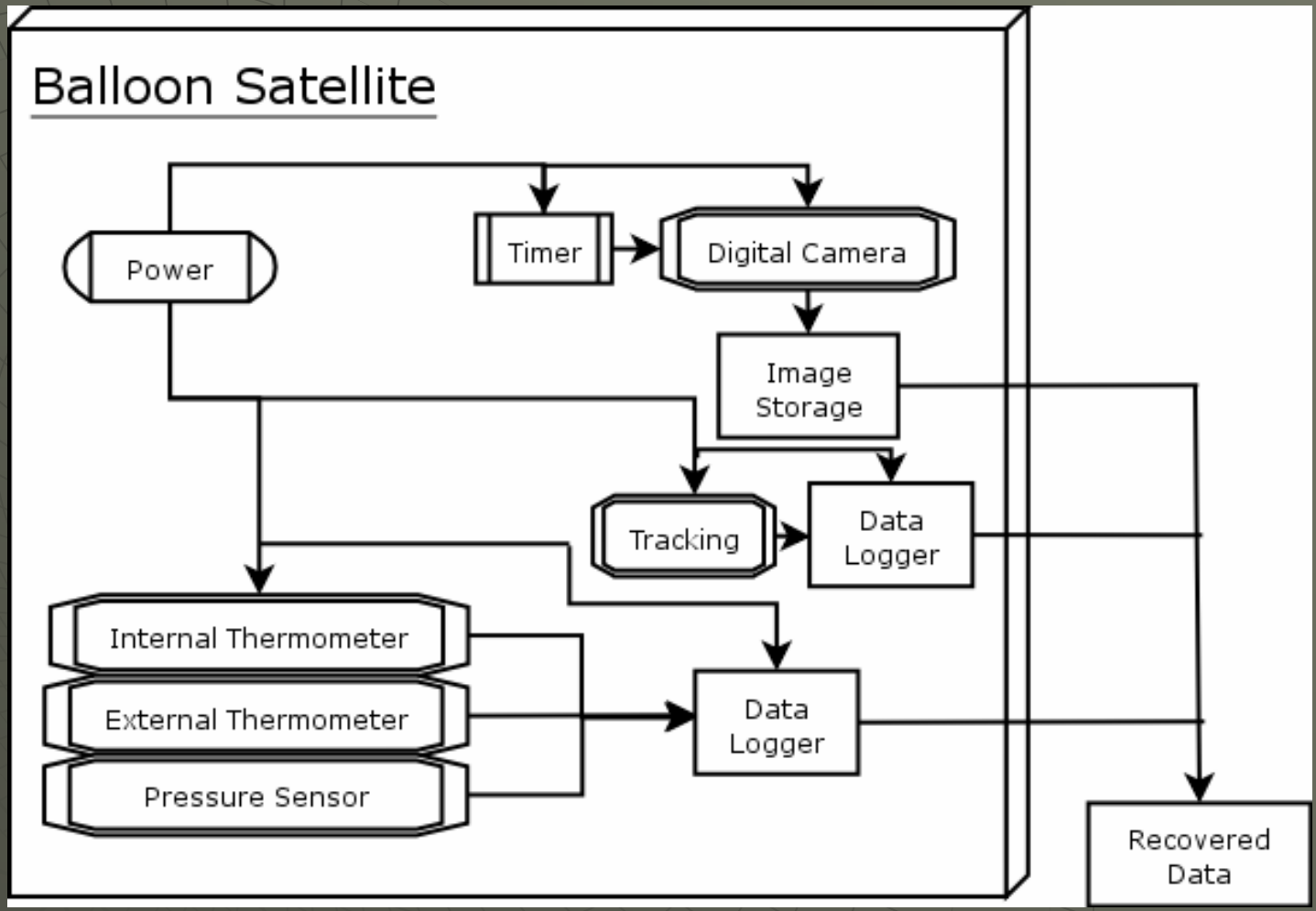
- The NAU/NASA Space Grant Administration has requested the design, launch and retrieval of a small payload on a high-altitude weather balloon.

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

Project Background & Benefits

- The Project is sponsored by the Arizona/NASA space grant to involve undergraduate students in a full design-build-fly-operate-analyze cycle of a space mission
- Mission Data and Images will help analyze the earth's surface features, atmosphere, cloud structure and curvature at specific locations

System Conceptual Diagram



Requirements & Specifications

Mechanical

- A container that contains all relevant components and satisfies all size and weight requirements
- The container should be able to facilitate a non-abrasive tether through the center mass of the container.

Requirement	Specification
Size of the container	1 cubic foot (1ftx1ftx1ft)
Weight of the container	2-3 pounds
The temperature range that the container should withstand	-80° to 90° F

Requirements & Specifications

Electrical

Requirement	Specification
Power	Minimum Battery life of 3 hours
Devices operation specs	Temperature range between -80° and 90° F
	Pressure range between 0 and 1 bar
Digital imager	Obtain a resolution of 3-5 Mega-pixels
	Capture an image each one minute
	A storage capacity of at least 1 GB (>180 images)
Temp. Sensor range	-80° to 90° F
Pressure Sensor range	0 to 1 bar
Tracking device altitude range	0 to 100,000 ft
Accuracy	Data correlation error between devices of < 10 min

Requirements & Specifications

Client Documentation

Requirement	Specification
Biweekly reports	What happened since last report
	Major Milestones for the next two weeks
	Critical problems
Final documentation	Design & detail descriptions of each sub-system
	Well recorded to facilitate repairs

Requirements & Specifications

Testing

Requirement	Specification
Testing period	Completed during the second one-third of the spring semester
Payload operation test	Simulate operation under high and low temperature
Battery test	Battery operation for at least 3 hours
Durability test	Simulate payload under vibration and shock
Camera functionality test	Appropriate correlation between timing and image capturing (i.e. 1 image per 1 minute)
	Enough memory space to capture > 180 images
Data loggers	Test storage of sensors data outputs

Requirements & Specifications

General

Requirement	Specification
Project budget	Payload should cost < $2000
Payload launch location	Maricopa City, AZ
Payload launch and recovery Date	Late April (28-29 April)

Design Approach

Subsystem Breakdown

- Electrical
  - Digital Imaging
  - Data-Logging
    - Temperature Sensors
    - Pressure Sensor
    - Latitude/Longitude
    - Altitude
  - Power
    - Batteries
    - Power Supply Lines
- Mechanical
  - Physical Container Design/Construction
    - Tether
    - Insulation
    - Device Installation
    - Heating

Design Approach

Team Organization

- Each subsystem will be assigned a Manager
  - Responsibilities:
    - The overall progress of their subsystem
    - Ensuring their subsystem's completion by deadline
    - Organize meetings and brainstorm sessions

Design Approach

Technical Challenges

- The team will be challenged by balancing the tradeoffs between functionality, weight, cost, and/or size
- Meet battery life requirements while staying under weight limit
- Correlating the data from the sensors and camera will be challenging as well
- Maintain Thermal Stable Environment

Deliverables

- First Satellite
- Biweekly Reports
  - Major technical milestones
  - Critical Problems
  - Recent accomplishments
- Vision and Mission Statement
- Full Design Report
  - Design Proposal
  - Budget

Schedule Highlights

- November 18, Participate in workshop to fly and retrieve a small payload

Individual tasks for next phase

- Rob Hough
  - Research battery and sensor options
- Rob Conant
  - Research environmental options for container
- Jad Lutfi
  - Research cameras
- Andrew Prosory
  - Research location tracking devices

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.

Questions/Comments

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