CubeSat Mission Concept Document

1. Mission Overview

Mission Name: CanOrbitCubeSat-1
Objective: Demonstrate a low-cost CubeSat platform for educational outreach and Earth observation using a visible-spectrum camera. **CubeSat Size**: 3U
Orbit: Low Earth Orbit (LEO), 500 km altitude, sun-synchronous.
Mission Duration: 1 year (minimum success: 6 months).
Stakeholders: University research team, local high schools, commercial launch provider.

2. Mission Objectives

- **Primary**: Capture and downlink images of Earth's surface for educational use.
- **Secondary**: Demonstrate student-built CubeSat subsystems (ADCS, EPS, OBC).
- **Success Criteria**:
    - Minimum: Capture and downlink 10 images with 1-meter resolution.
    - Full: Capture and downlink 100 images, operate all subsystems for 1 year.

3. Concept of Operations (ConOps)

- **Launch Phase**: Deploy via a CubeSat deployer on a commercial launch vehicle.
- **Initialization**: Deploy solar panels, establish communication with ground station.
- **Operational Modes**:
    - Imaging Mode: Payload captures images during daylight passes.
    - Data Downlink Mode: Transmit images to ground station.
    - Safe Mode: Low-power state for anomaly resolution.
- **Ground Segment**: University ground station with UHF/VHF communication.

4. System Architecture

- **Form Factor**: 3U CubeSat (10 cm x 10 cm x 30 cm, max 4 kg).
- **Subsystems**:
    - **Payload**: Visible-spectrum camera (1-meter resolution, 100 MB/image).
    - **ADCS**: 3-axis stabilization, ±0.5° pointing accuracy, reaction wheels.
    - **Communication**: UHF/VHF transceiver, 9.6 kbps data rate.
    - **Thermal**: Passive control (MLI blankets), operating range -20°C to +50°C.
    - **EPS**: Solar panels (10 W), Li-ion battery (20 Wh).
    - **OBC**: 32-bit microcontroller, 1 MB storage for image data.
- **Interfaces**: I2C for inter-subsystem communication, 3.3V power distribution.

5. Preliminary Requirements

- **Payload**: Capture 1 image per orbit, store 5 images onboard.
- **ADCS**: Slew rate of 1°/s, stabilize within 30 seconds.
- **Communication**: Downlink 1 image per ground pass (5 minutes).
- **Thermal**: Maintain components within operational temperature range.

- **EPS**: Provide 5 W continuous power during imaging mode.
- **OBC**: Process and store image data, manage subsystem commands.

6. Feasibility Assessment

- **Orbit**: Sun-synchronous orbit ensures consistent lighting for imaging.
- **Mass Budget**: Estimated 3.5 kg (within 4 kg limit).
- **Power Budget**: 10 W generation, 8 W peak consumption.
- **Cost**: Estimated $50,000 (components, testing, launch).
- **Launch**: Compatible with standard CubeSat deployers (e.g., P-POD).
- **Risks**:
    - Risk: Camera failure. Mitigation: Use COTS camera with flight heritage.
    - Risk: Power shortfall. Mitigation: Include redundant battery pack.

7. Next Steps

- Develop detailed System Requirements Specification.
- Conduct subsystem trade studies (e.g., COTS vs. custom ADCS).
- Establish ground station infrastructure.
- Secure funding and launch provider agreement.

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