High Altitude Glider Project

Balloon photograph taken from 25km. Image credit: Paul Verhage

Motivation

- Space Systems Development Lab launching weather balloons for low cost flights to the edge of space
- Rocket Mavericks launching high powered sounding rockets
- Extra payload space available on both systems

Our Proposal

- Design an unmanned glider as a payload
  - Supplement radiosonde balloon launches by allowing more control over payload landing location
  - Flight testing in the thin upper atmosphere, similar to what can be found on Mars
  - Possibility of Rocket Mavericks competition entry

Purpose

- For students to gain experience in a multidisciplinary design project
- Collaboration between Aero/Astro labs and other departments/groups

Design Goals

- Targeted release altitude of 100,000 ft
  - First dropped from a helium balloon
  - Later deployed from high power sounding rocket
- Return to launch site autonomously
- Carry useful payloads
  - Video camera(s) to capture flight and deployment
  - Digital still camera for higher resolution photos
  - Optical Spectrometer
  - Cuvettes with Astrobiology experiments
  - Others yet to be defined?

Design Challenges

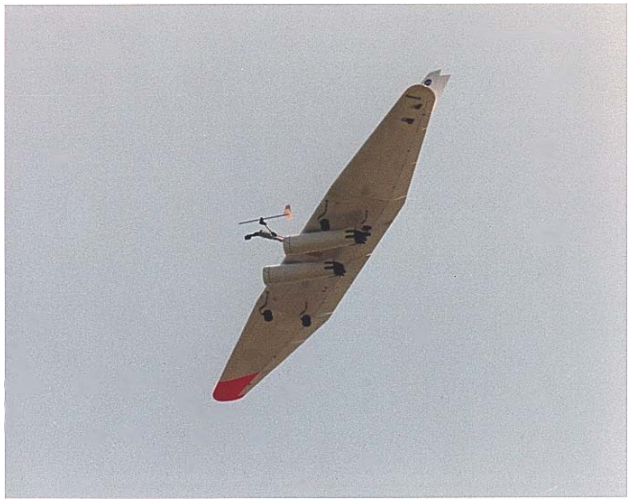
- Packaging - the UAV must fit in a 12 in diameter by 36 in long cylinder for rocket launch
- Low temperature and pressure environment – effects on sensors and other electronics
- Telemetry – Long range communications required (>100 miles from launch/landing sites possible), also must be small and lightweight
- Speed – need to be able to fly through jet stream
- Duration – Desired at altitude for science missions

Who's involved?

- Currently ~ 20 students and faculty advisors from the following groups:
  - Aircraft Aerodynamics and Design Group (ADG)
  - Space Systems Development Laboratory (SSDL)
  - NASA AMES Astrobiology group
- Still looking for more interested student participants
  - Amateur Radio Club members
  - EE and CS students with interest in long range communications or PCB design
  - Undergrads
- Other Groups
  - Rocket Mavericks – provide rocket launch platform

Aircraft Aerodynamics and Design Group

- Leading the project
- Will design and construct glider, integrate the payloads and telemetry
- Experience with building small research UAV's
- Small Autopilot w/ GPS, inertial measurement unit, etc..
- ~10 students involved



SSDL
Space and Systems
Development Laboratory

- Providing the balloon platform for most of the launches
- Expertise with telemetry and payload integration
- A number of students working closely with the project

BioLaunch B07a (March 11, 2007)

NASA Astrobiology Group

- Supply Science payloads – optical spectrometer, other experiments in small cuvettes to be exposed
- Help with integration of payloads into the UAV

Rocket Mavericks

- High powered rocketry group
- Launch sounding rockets out of black rock desert in Nevada

Photograph courtesy of Steve Jurvetson

To100k.org Test Flight #1 - Courtesy of To100K.Org

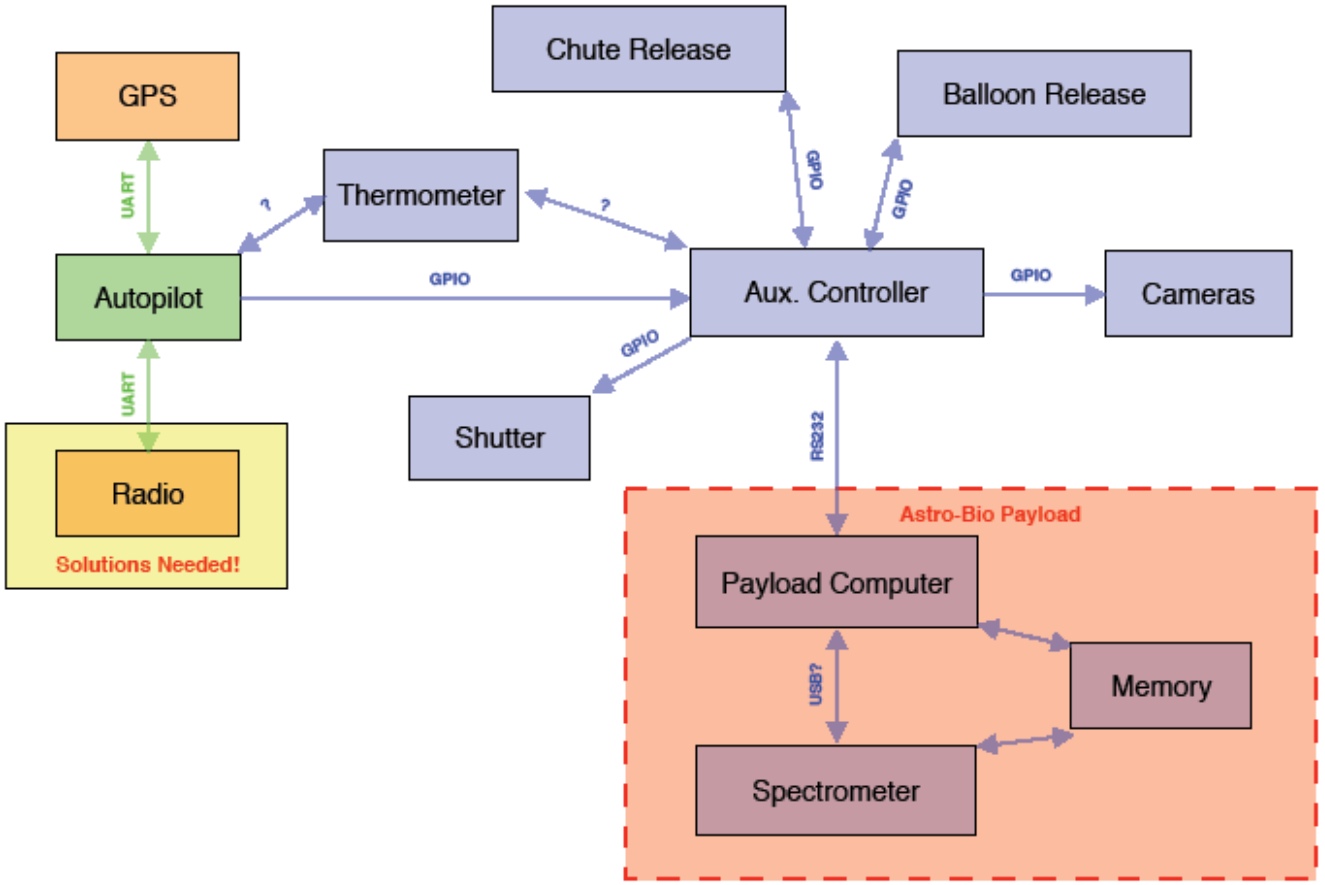
Schedule

- May 11th, 2007 – Balloon launch – test of autopilot at low temp/pressure, 1st telemetry test
- June 2nd, 2007 – Balloon launch – further testing of autopilot system and telemetry
- Summer – 2 balloon launches to test complete system
- October 18-21st – Mavericks launch in Black Rock

Current Airplane Configuration

- ~3’ wing span, 3’ length
- Pivoting wing
- Payload bay ~ 4” x 6” x 18”
- Max. systems weight = 4 lb (target 2 lb)
- Max. flying weight = 6 lb (target 3.5 lb)

Onboard Electronics Architecture



Radio Requirements

- Two way telemetry @ 9600 baud rate
- Range > 100 NM
- 4 hour nominal mission time
- Minimize weight and power consumption
- Maximum weight = 8 oz
- Maximum energy available = 6 W-hr
- UART communication desirable

Radio Considerations

- 0.2 W limit at 2.4 GHz (?)
- Ground Station – portability, affordability
- Off the shelf solution preferable
- Currently use MaxStream 2.4GHz XBee Pro radio with 6 m dish on ground
- More powerful modules available

Our Questions

- Can off-the-shelf radios meet specs?
- If not can we use a HAM radio?
- If so, what do we need to consider?
- If HAM possible, can you help us?
  - Use existing system
  - Build a new one
  - Technical and/or financial support

Questions?

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