CRITICAL DESIGN REVIEW
TEAM DURANGO

Fort Lewis College

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Mission Overview

- Primary Objectives
  - Measure speed of sound as it changes with altitude
  - Measure intensity of infrared and ultraviolet waves as payload gains altitude
  - Capture video of flight
    - 2 minutes of video every 5 minutes (alternating cameras)
  - Measure CPU computational speed as altitude changes
    - Only if we have time will we attempt this
- Secondary Objectives
  - Temperature
  - Pressure
  - Acceleration

Speed of Sound

- We expect to see that temperature is the only factor in the speed of sound as the payload gains altitude
  - since the change in pressure and the change in air density are equal and opposite factors of the speed of sound their effects will not be noticed
- Factors for Speed of Sound
  - Temperature
    - As temperature *increases* speed of sound *increases*
      - This is due to the increased activity (energy) of the air particles being disturbed as temperature rises
  - Pressure
    - As pressure *increases* speed of sound *decreases*
      - This is due to the decreased activity of air particles as pressure increases
  - Air Density
    - As air density *increases* speed of sound *increases*
      - This is due to the increased difficulty to accelerate particles as the density of the medium is increased

Infrared and Ultraviolet

- We expect to see a visible increase in infrared and ultraviolet intensity as the altitude increases
  - With less atmosphere to filter the sun's light rays at higher altitudes in the atmosphere the intensity of these rays will increase to such an extent that the change will be noticeable by the human eye.
- Factors of the Sun's Light
  - Reflection and Refraction
    - The light that reaches the surface of the Earth has made a long journey through a maze of atmospheric molecules that redirect light in every direction
      - The randomness of the light reflection and refraction is due to the varying indices of refraction (n) of atmospheric particles
  - Effects of UV and IR
    - UV light is most commonly associated with sunburn where skin cells absorb too many UV rays, but UV is useful for a multitude of applications such as sterilizing medical equipment or providing our bodies with bone strengthening vitamin D
      - Because not all the UV rays make it to the Earth's surface we should be able to see the effects a larger density of UV rays has on the Earth's atmosphere
    - IR rays exist in a wavelength on the other end of the light spectrum from UV. IR cannot be seen by the naked eye and thus has proven to be useful in everyday applications such as your home tv remote to military stealth missions

Video Capturing

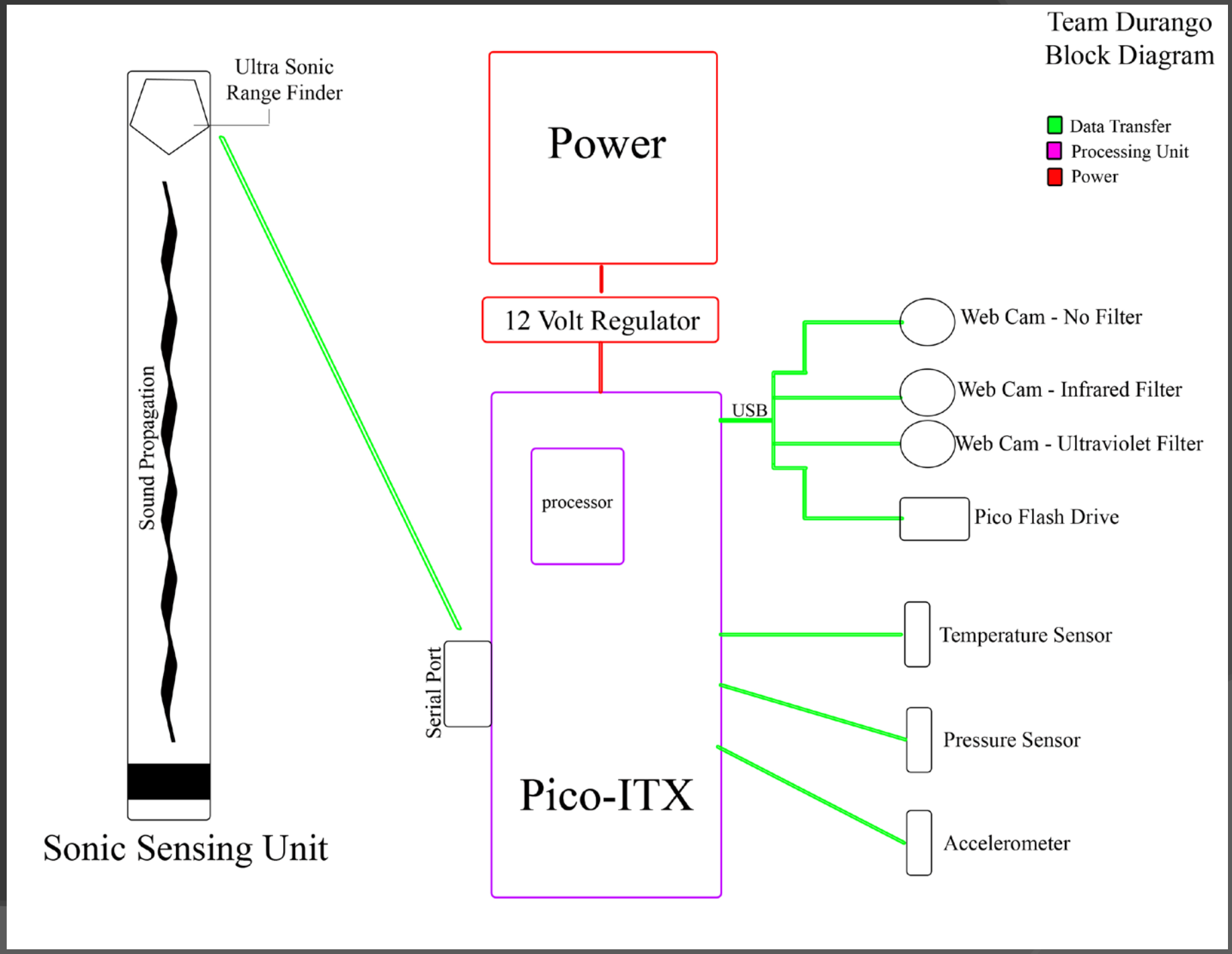
- Use Pico ITX board to capture as much video as the power and memory will allow
  - Video may help explain any odd data recorded
  - Integrating camera to Pico ITX is a current challenge
  - Entertainment

Mission Requirements Matrix

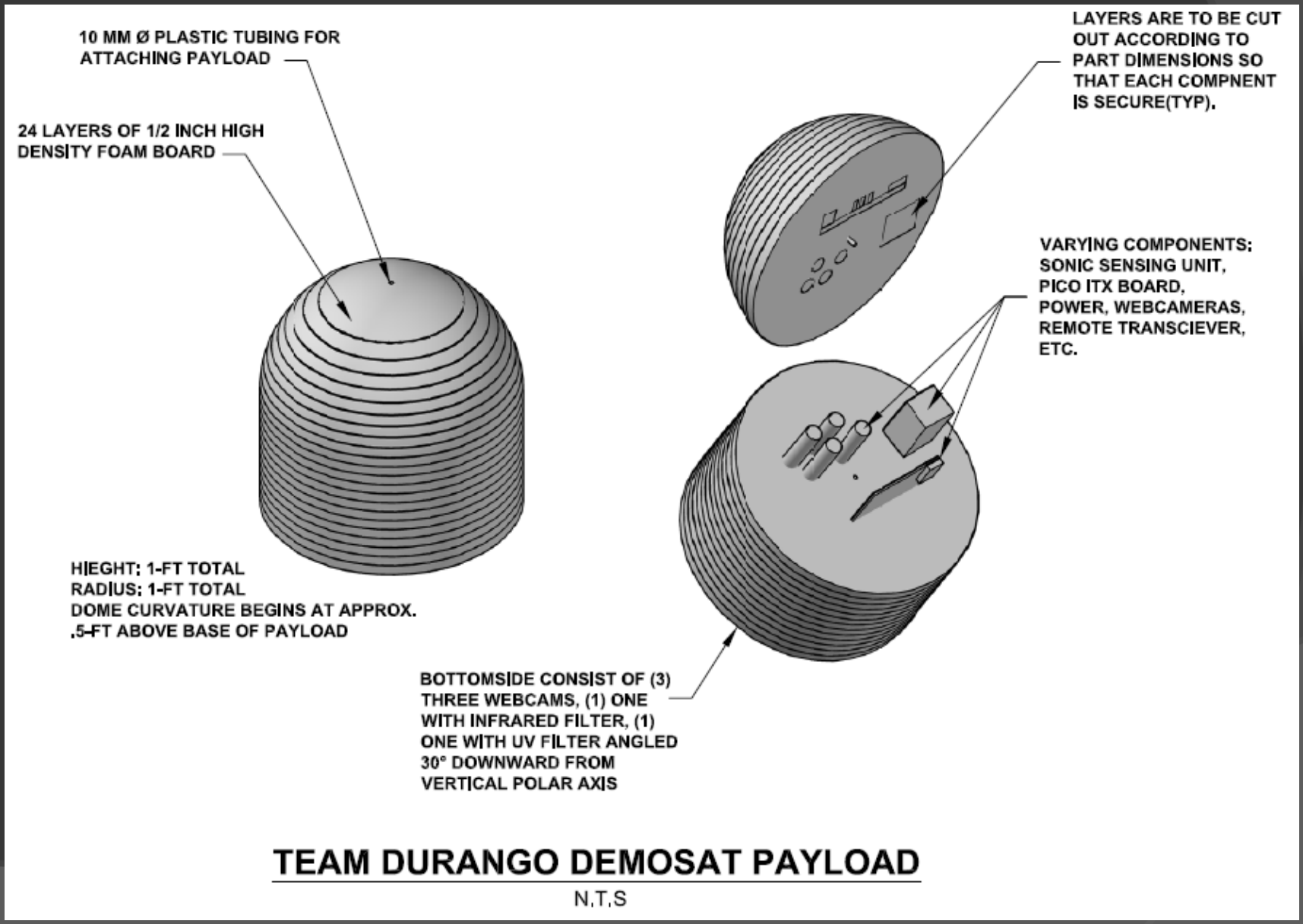
Requirement	Method	Status
The payload must not exceed a weight of 1.5 kg	Design, Test	
The payload must operate on 12V	Design, Test	
The payload must hold a PVC cylinder 8” long and ¾” wide	Design	
Cameras must be exposed to outside light	Design	
Pico ITX must support cameras	Design, Test	
Must not exceed memory limit of 16GB	Design, Test	
Speed of sound unit and CPU must be exposed to outside environment as much as possible	Design	

Subsystem Requirements

- Power
  - 12V
- Video and images must fit on 16GB flash memory
- *CPU used for speed testing* and *unit used for speed of sound measurement* must be as exposed to outside environment as possible (not insulated)


Team Durango
Block Diagram
Data Transfer
Processing Unit
Power
Ultra Sonic
Range Finder
Sound Propagation
Sonic Sensing Unit
Power
12 Volt Regulator
processor
Serial Port
Pico-ITX
USB
Web Cam - No Filter
Web Cam - Infrared Filter
Web Cam - Ultraviolet Filter
Pico Flash Drive
Temperature Sensor
Pressure Sensor
Accelerometer

Structural Diagram



Parts List

Part	Manufacturer	Weight	Cost	Description
Ultrasonic Sensor	Senix	8.4g	$109	For measuring speed of sound
Pico ITX	EPIA	250g	$250	Processing Unit
Cameras	Microsoft	90g	$105	For video and still images
Flash Drive	Super Talent	5g	$30	Stores OS, media and data
Pressure Sensor	Measurement Specialties	4g	Donated	Measures pressure
Thermistor	Fenwal Electronics	< 1g	Free (FLC owned)	Measures temperature
Accelerometer			Free (FLC owned)	Measures acceleration of unit
Battery	Great Planes Electrifly	233g	$90	Supplies 14.8V to payload
IR & UV Filters		< 1g	Free (FLC owned)	Filters to be placed on camera
Materials	Various	300g	$40	Materials needed for structure
Totals		**892g**	**$624**	

Week 1 (5/12/2009)	Week 2 (5/19/2009)	Week 3 (5/26/2009)	Week 4 (6/2/2009)	Week 5 (6/9/2009)	Week 6 (6/16/2009)	Week 7 (6/23/2009)	Week 8 (6/30/2009)	Week 9 (7/7/2009)	Week 10 (7/14/2009)	Week 11 (7/21/2009)	Week 12 (7/28/2009)
		Chris Gone			**Nick Gone**	**Hakes Gone**	**Justin Gone**				
Component Research											
	Buy Parts										
		Start assembly									
			assembly/debugging of breadboard								
					Structure/Design Working Breadboard						
						assembly	assembly				
								Vacuum Test	Vacuum Test		
								Cold Test	Cold Test		
								Drop Test	Drop Test		
										Final Testing/Repair	
											Travel
											Launch 8/1

Test Plans

- Vacuum Tube
  - This will simulate a low pressure environment and test our components in these conditions
- Power
  - We will run circuits to test the amount of power needed and for how long
- Filters
  - Resolution of camera
  - Filter effectiveness
- Standard Tests
  - Drop Test
  - Cold Test

Conclusions

- Issues and concerns
  - Speed of sound has many variables
    - Analyzing final data may be difficult
  - Direction of camera view will be inconsistent
    - Video will clarify directional changes
  - Video may take more memory than expected
    - Depends on camera
- Thank you!