Welcome

Project Proposal Presentation

Team Robosub

Project Advisors:

Dr. Bruce Harvey Dr. Chiang Shih

Team Members

ECE

Antony Jepson
Lead PM

Ryan Kopinsky
Secretary

Hang Zhang
Treasurer

ME

Eric Sloan
PM

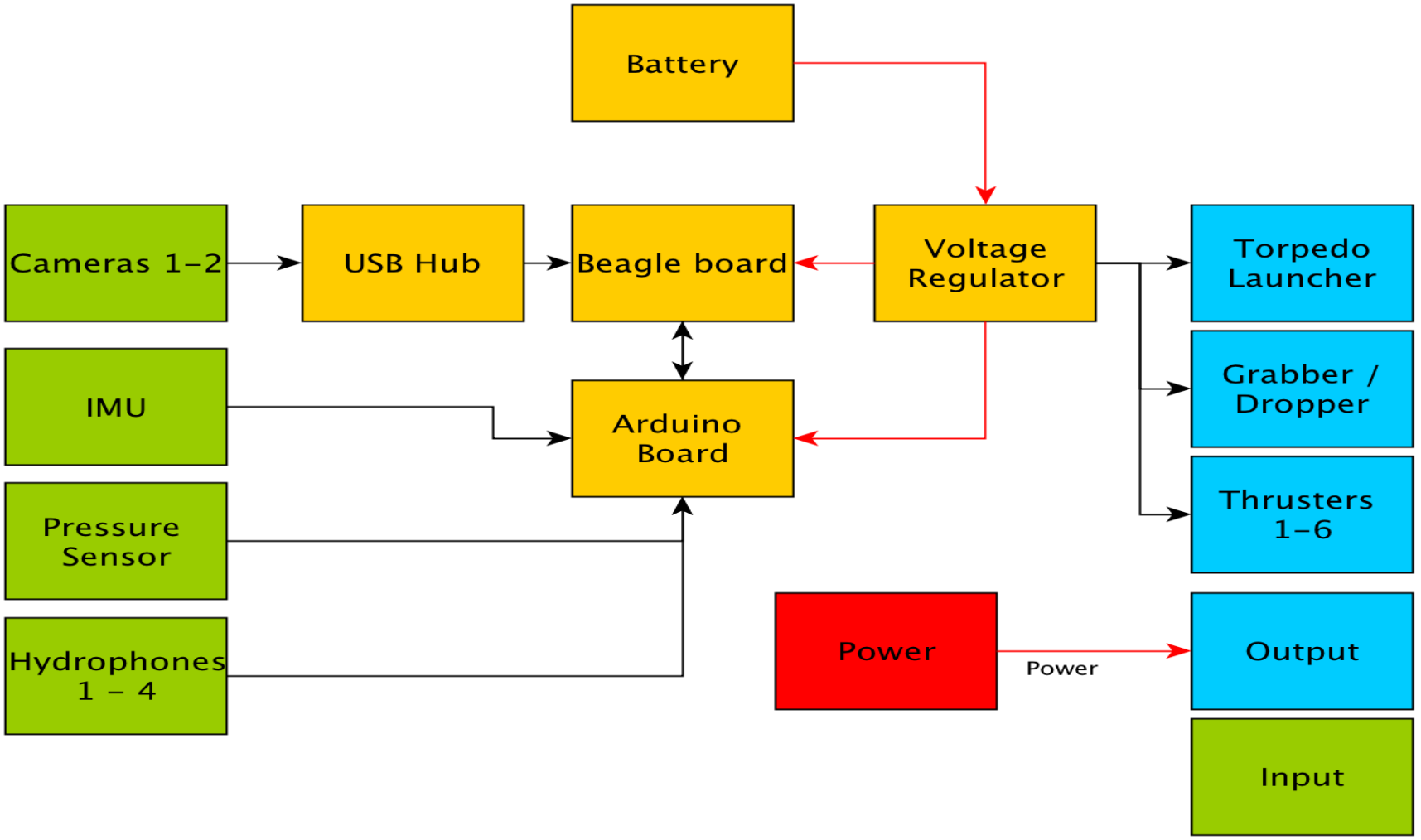
Kashief Moody
Secretary

Tra Hunter
Treasurer

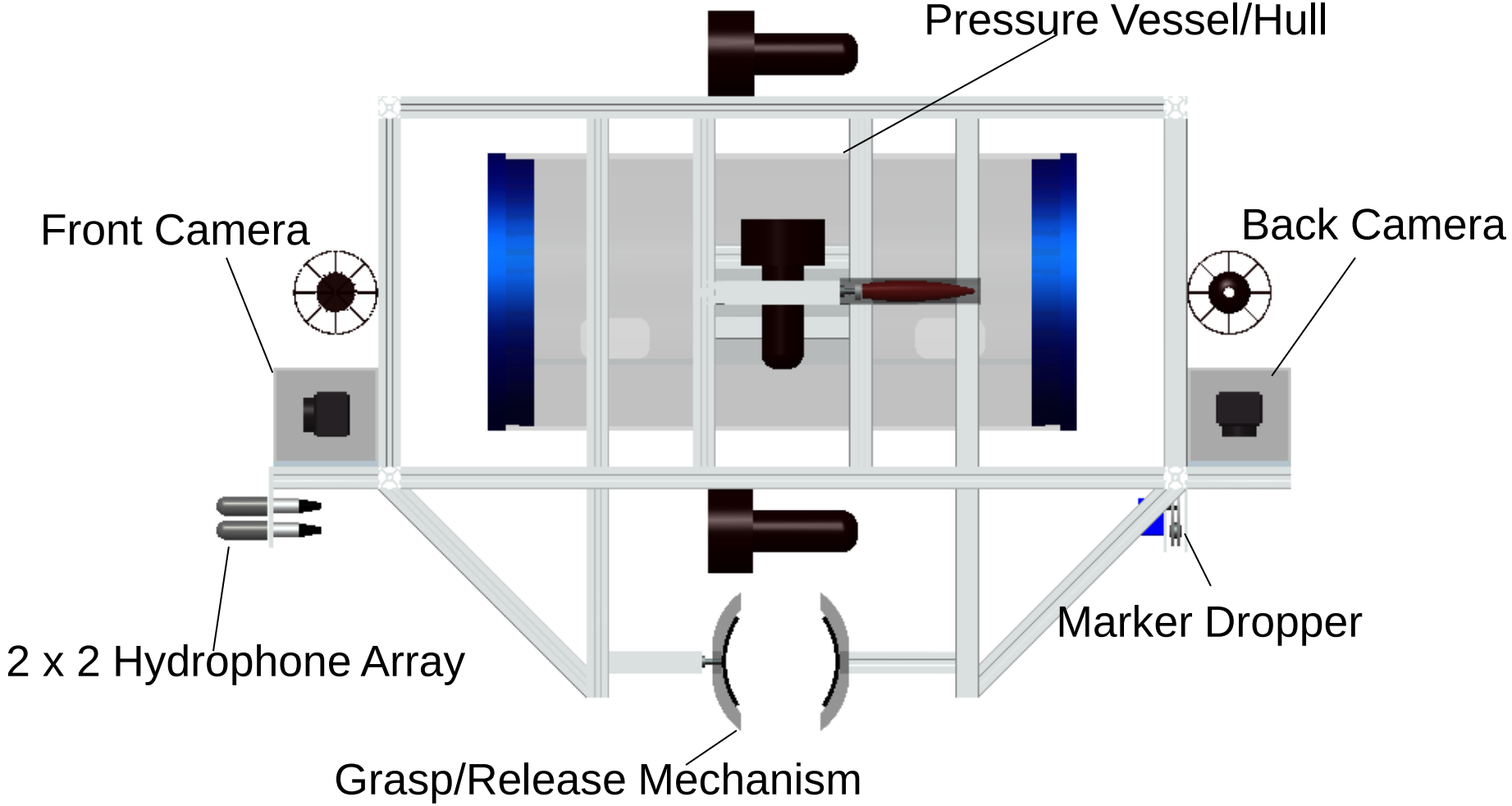
Problem Statement

- Design and develop an AUV that can complete the Robosub 2012 competition tasks. Must be capable of:
  - Autonomous operation
  - Complete underwater tasks

Presentation Outline



Presentation Outline



Guidance System

Antony Jepson

Guidance System Overview

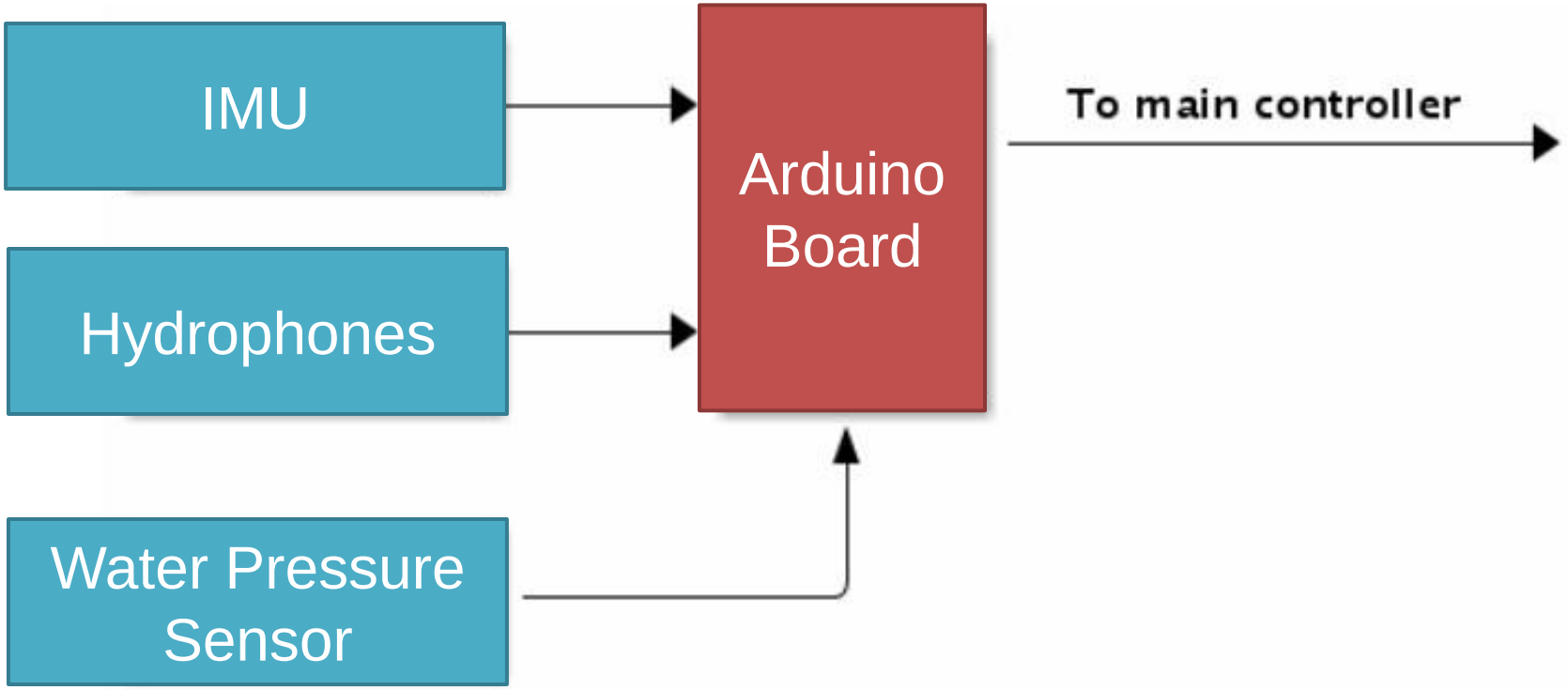
Objective

- Track vehicular heading and contribute to AUV's internal model of its position.

Requirements

- Measure
  - yaw, pitch, and roll
  - acceleration
  - heading
  - depth
- Locate Pinger

Guidance System Overview

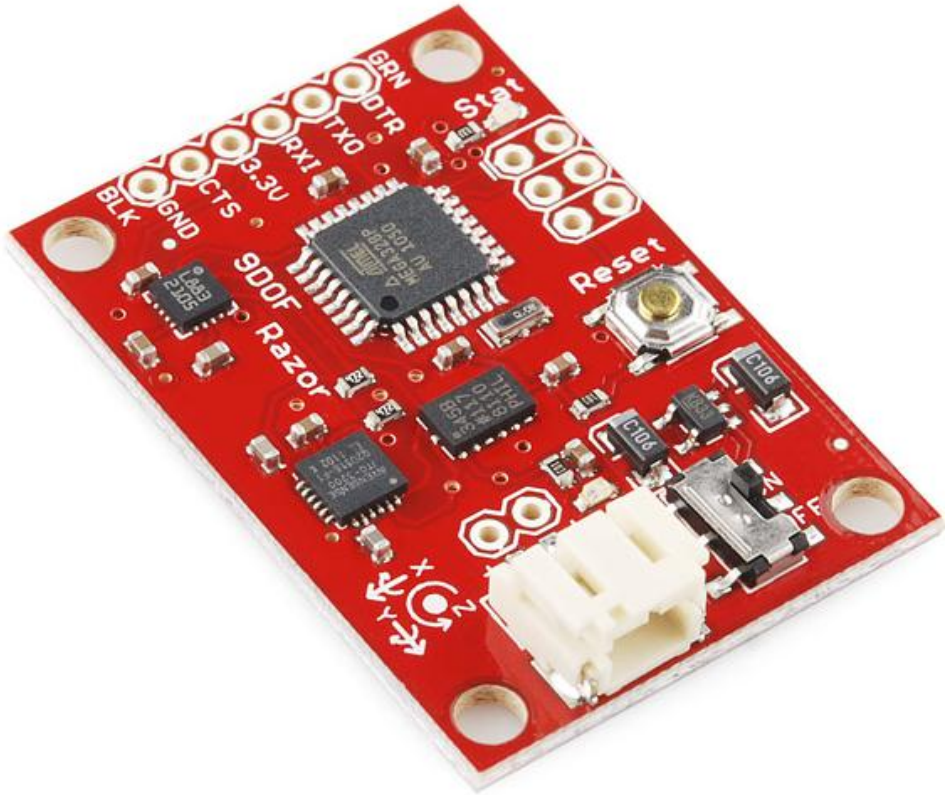


Arduino Board

ATmega328

- 16MHz clock
- 6 PWMs
- Serial TX, RX
- 32kB memory
- SPI

IMU



Razor 9DOF

- 3-axis gyro
- 3-axis accel.
- 3-axis magno.

Hydrophone

Reson TC4013

- 1Hz to 170kHz
- Omni-directional
- 75g
- 700m operating depth

Water Pressure Sensor

AMSYS MS5541

- 0 – 200 PSI
- 16-bit output
- Also measures temperature

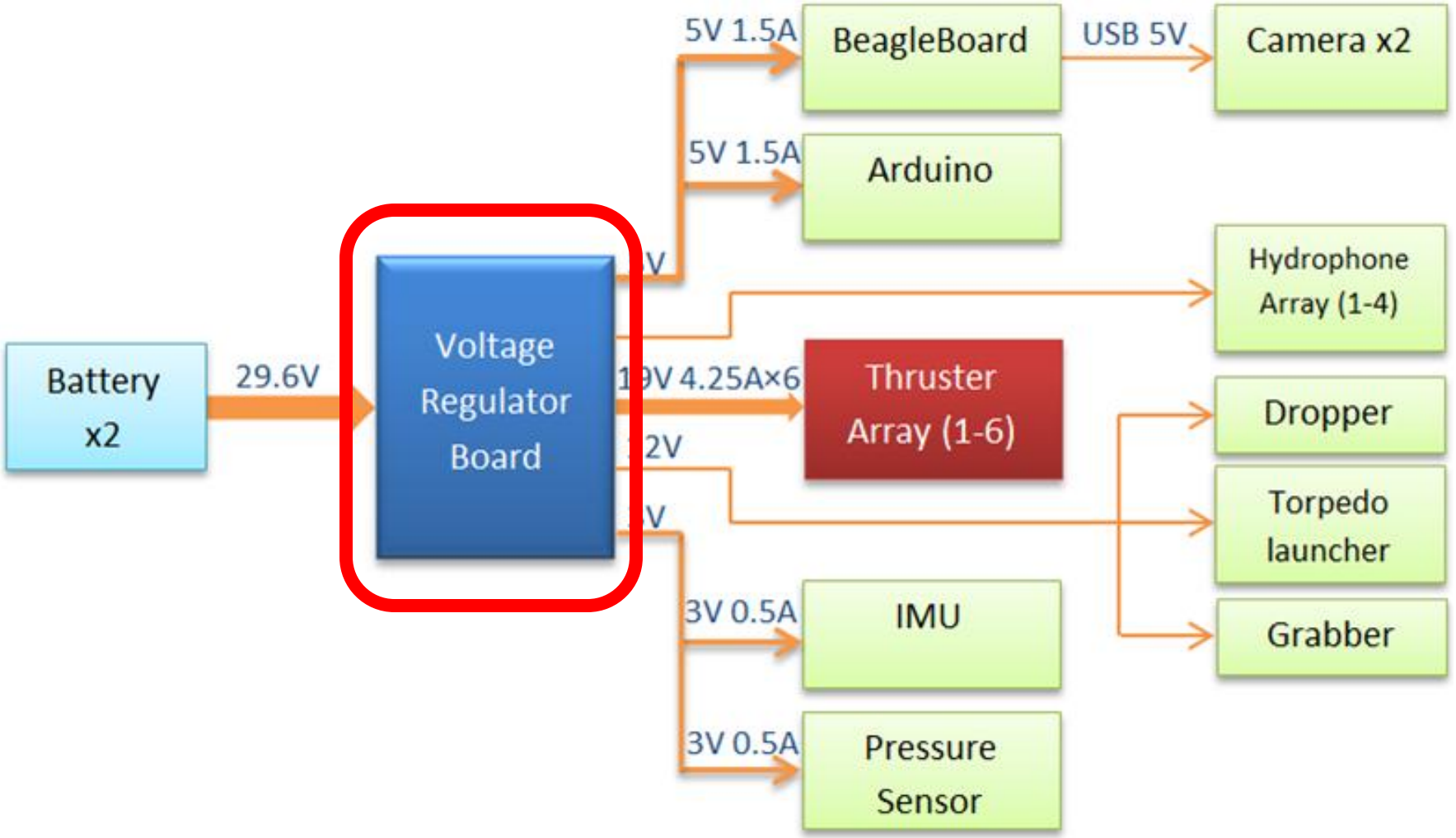
Electrical System and Main Controller

Hang Zhang

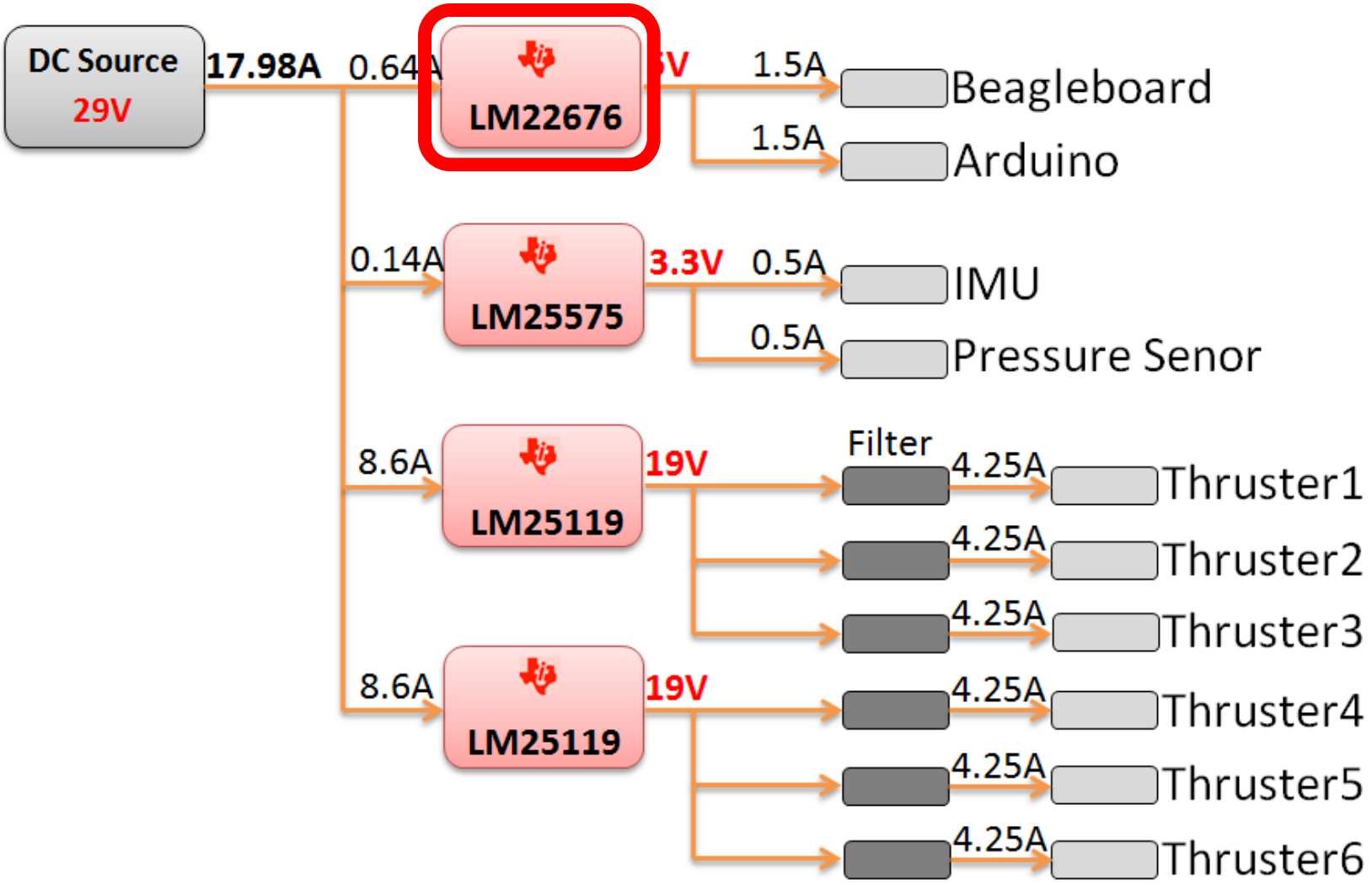
Power Supply

- Power supply: two polymer Li-Ion batteries in series
- Voltage and Capacity: 14.8V, 20Ah (296Wh)
- Max. Discharging Rate: 30A

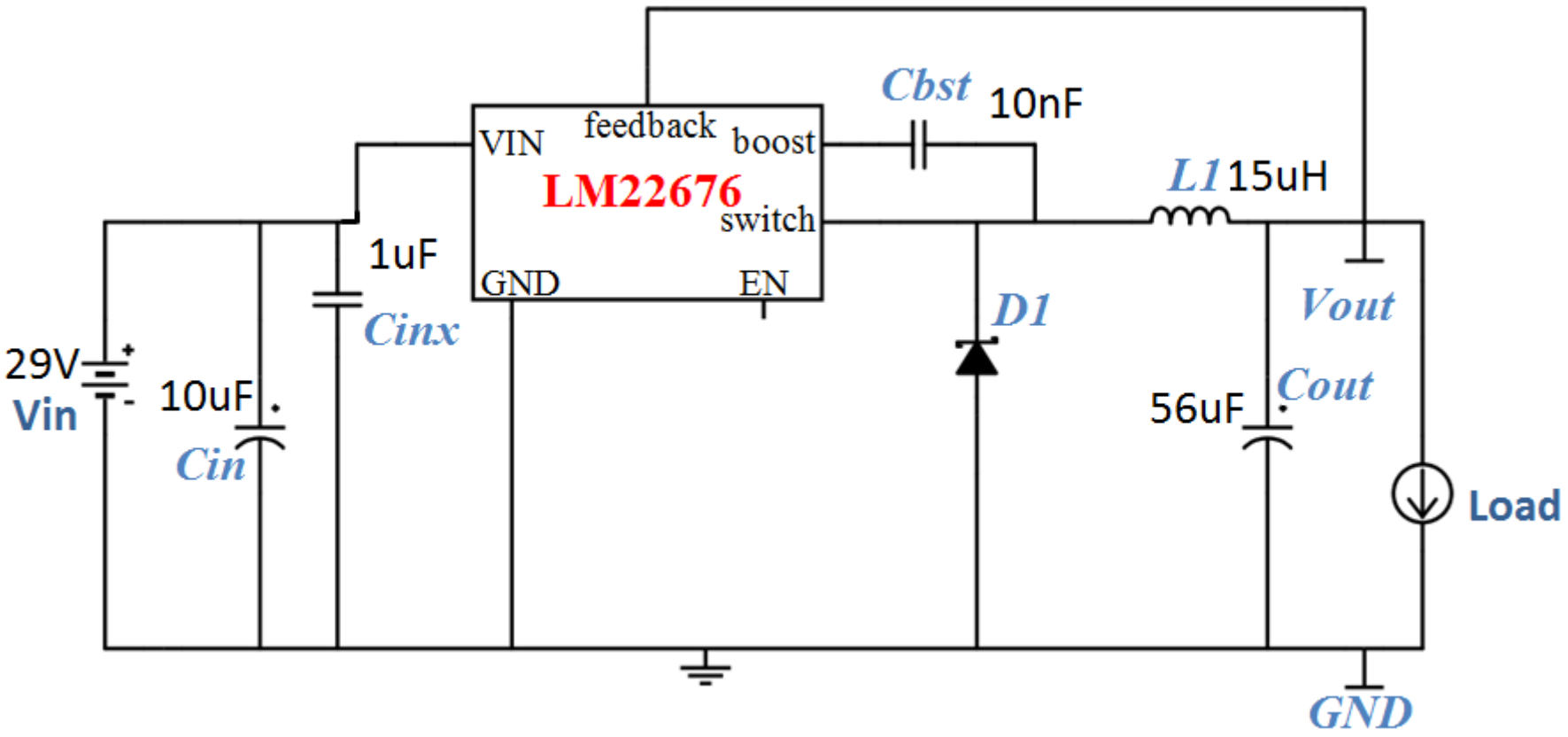
Electrical System Block Diagram



Voltage Regulator Board

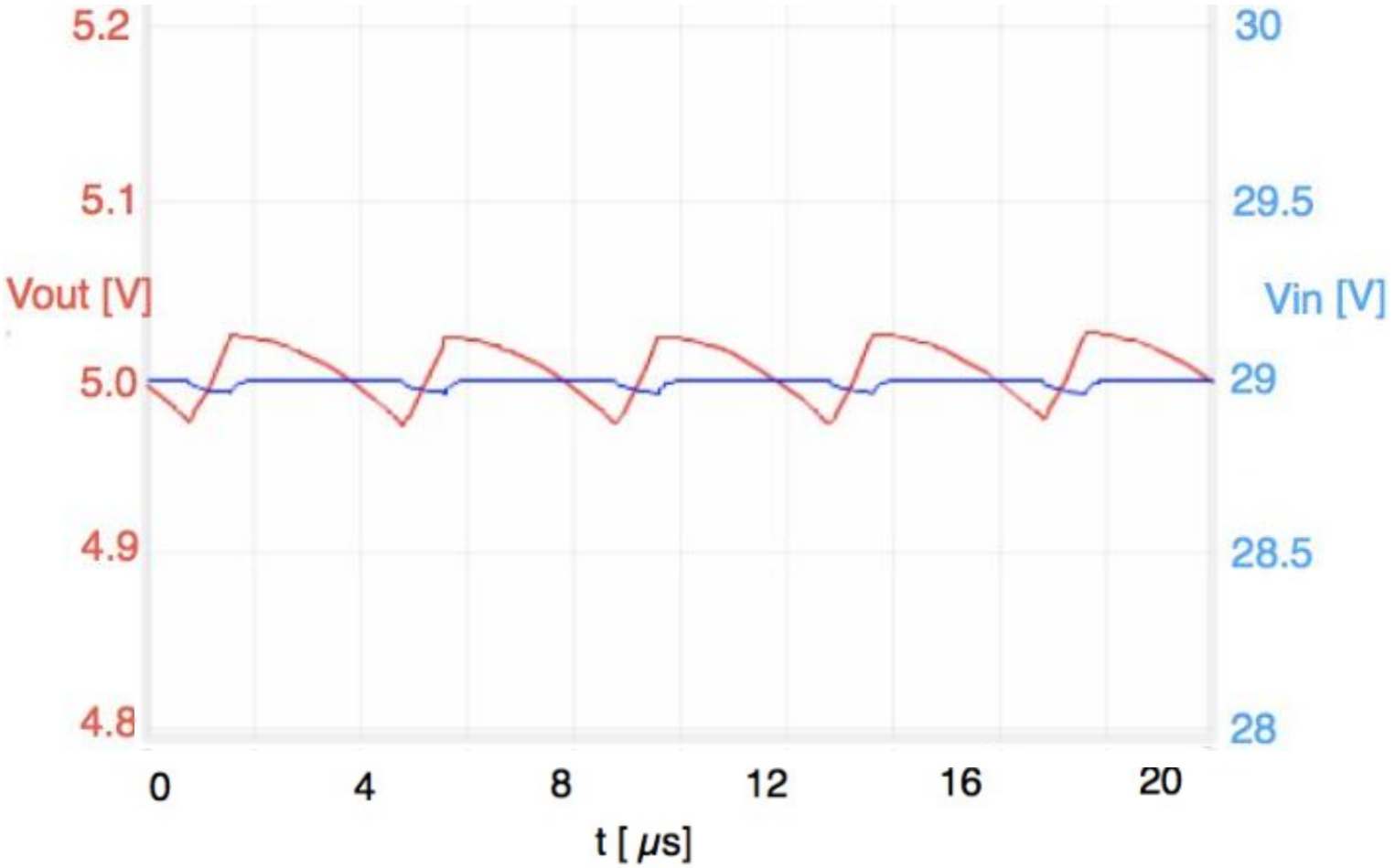


Switching Regulator Circuit



LM22676 Switching Regulator Circuit

Simulation Result



Designed and Simulated using: **WEBENCH®**

Main Control Unit

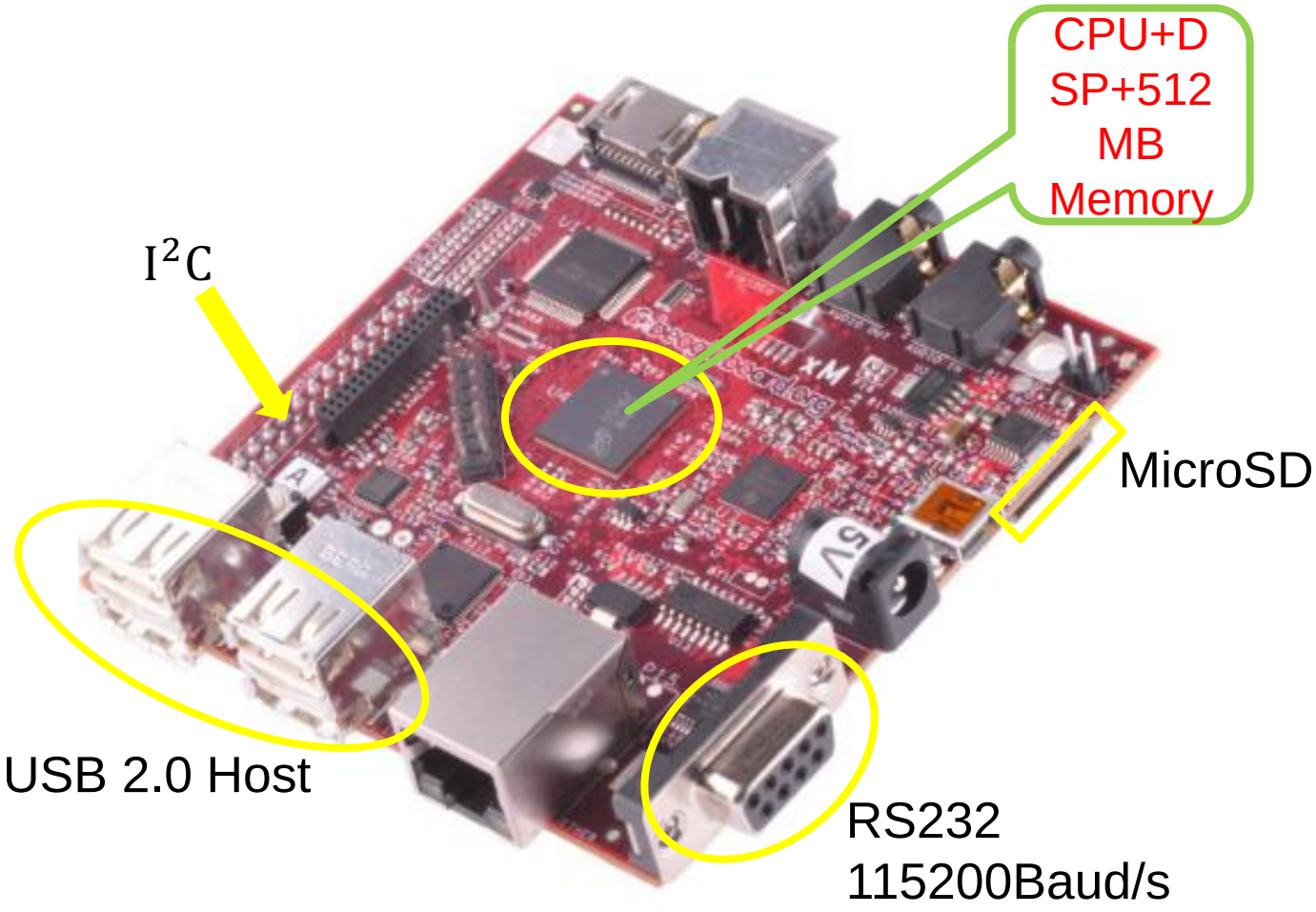
- The “brain” of the AUV
- Powerful enough for image processing and sensor controls
- Large onboard memory for fast data processing and storage
- Low cost
- Low power consumption, and heat dissipation
- Others: I/O functionality, Software system

Design Choices

	Beagleboard REV B7	Beagleboard XM	Intel Core i3 PC
Released Date	2008	2010	2011
Processor	OMAP 3530 600MHz	Texas Instruments Cortex A8 1GHz processor	Intel Core i3-2120T Sandy Bridge 2.6GHz 2 x 256KB L2 Cache 3MB L3 Cache
DSP	430MHz	800MHz	650MHz Intel HD Graphics 2000
Memory	128MB DDR (166MHz)	512MB DDR (200MHz)	3GB DDR3 RAM(1366MHz)
MIPS[4]	< 1,400 Dhrystone MIPS	> 2,000 Dhrystone MIPS	
Onboard USB Port	None	4	≥ 4
MicroUSB	Yes	Yes	No
SD	SD/MMC	MicroSD	SD/MicroSD/MMC
Ethernet	No	Yes	Yes
Power	5W	5W	104W
Cost	Free	$149.00/Free	> $300

- Electronics → Main Controller

Beagleboard-xM



Computer Vision

Ryan Kopinsky

Webcam Selection

Feature	Logitech QuickCam Pro 4000	Logitech WebCam Pro 9000	Logitech WebCam C615
Driver	PWC	UVC	UVC
Auto-Focus	No	Yes	Yes
Auto-Light	No	Yes	Yes
Mount	Stand	Stand	Tri-Pod
Cost	Free	$55	$55

Logitech WebCam C615

Proposed Design

- Hardware Design
- Software Design

Computer Vision Overview

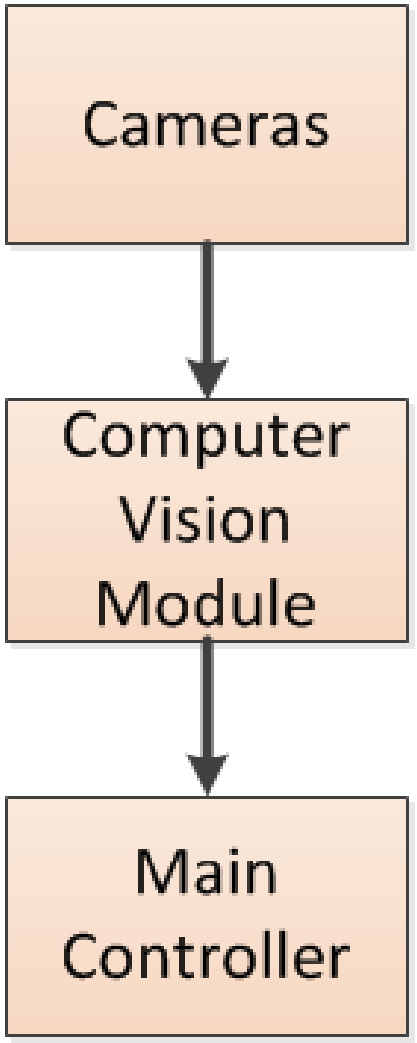
Objective

- Successfully design the Computer Vision module that will serve as the “eyes” of RoboSub

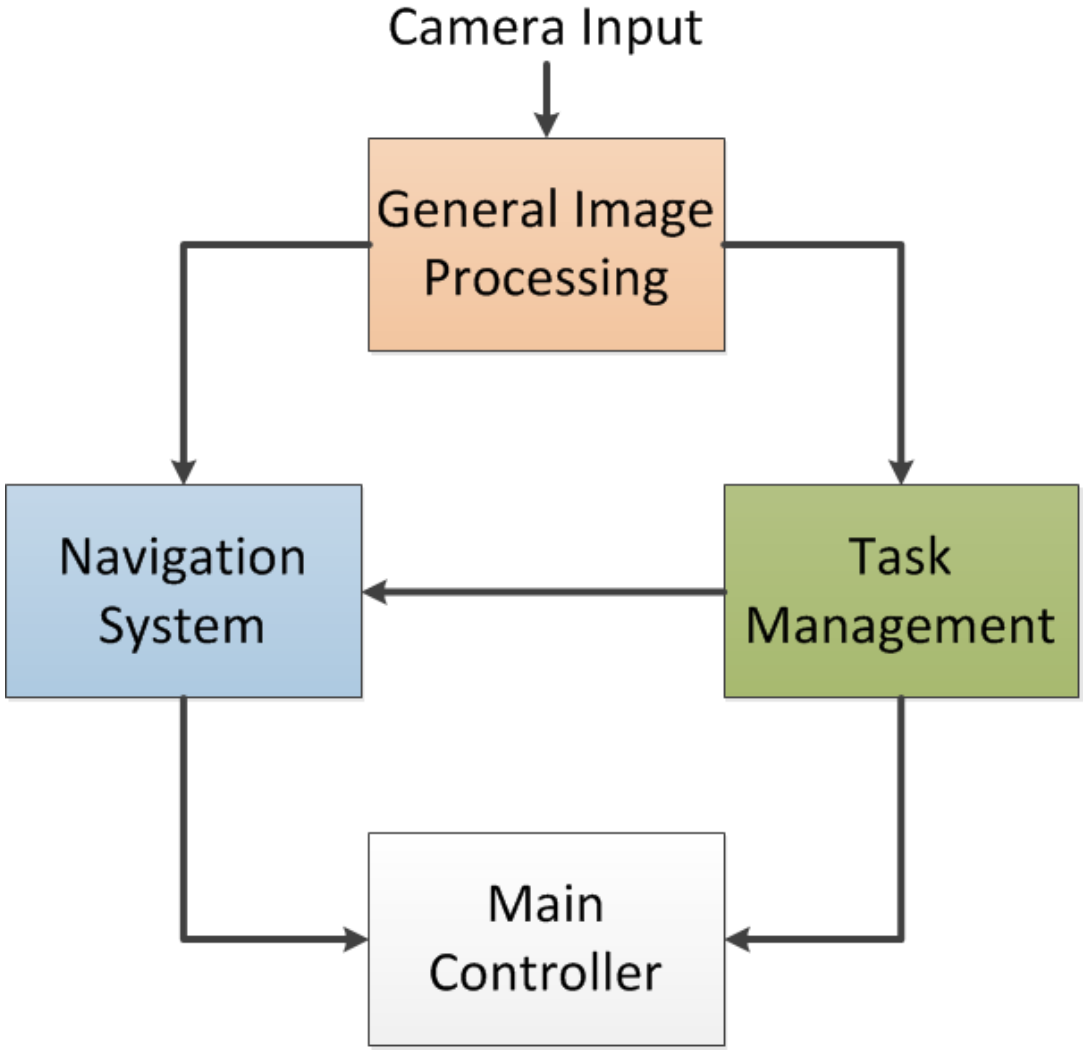
Requirements

- Identify the path for guidance through the course
- Identify the tasks in the obstacle course

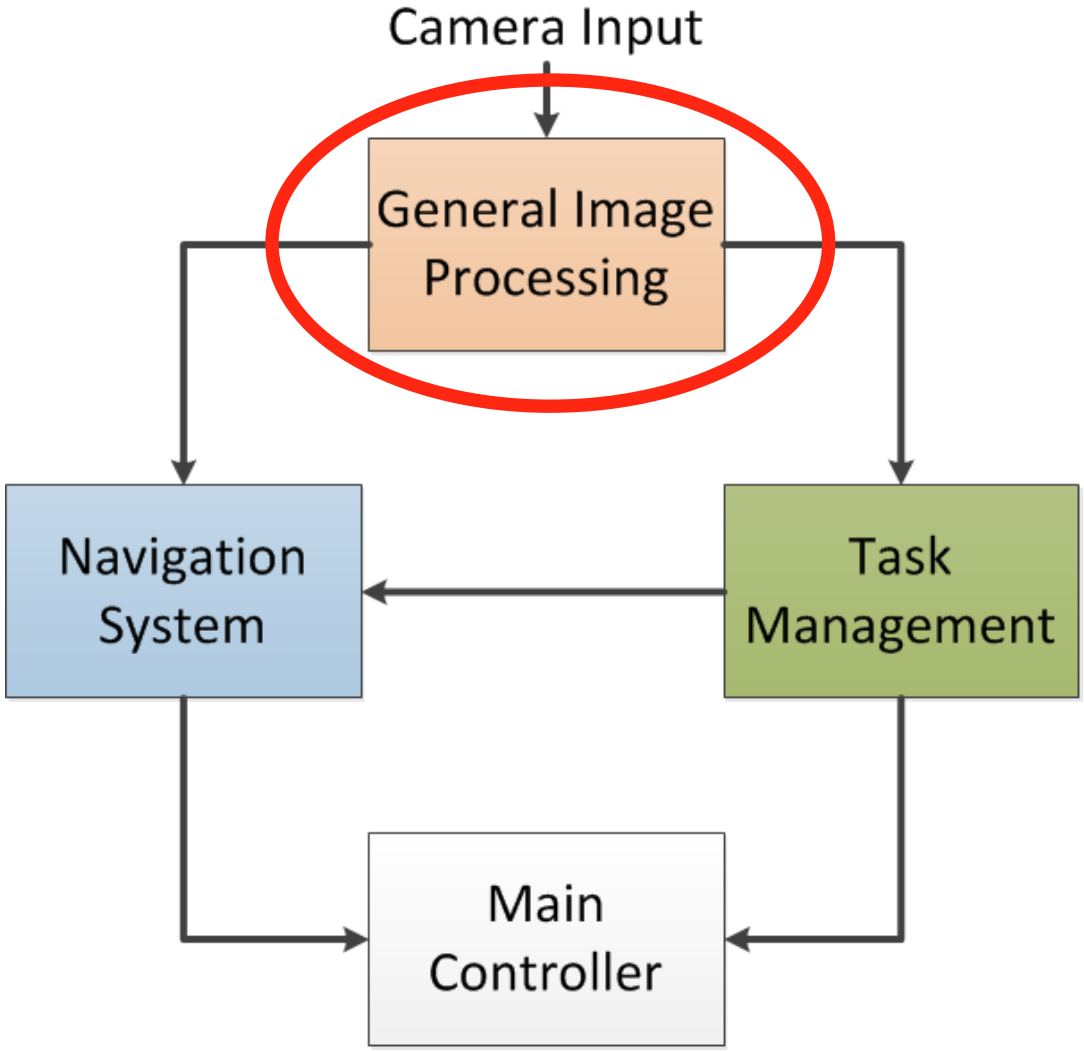
Hardware Design



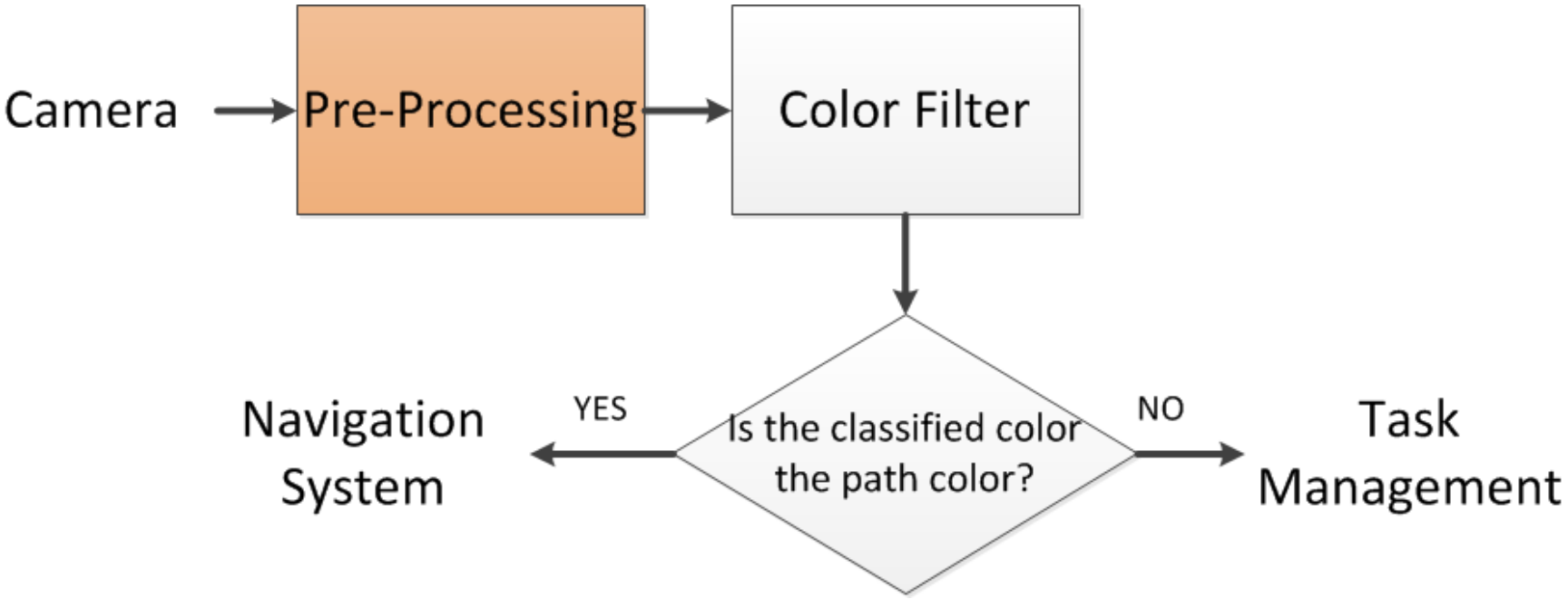
Software Design



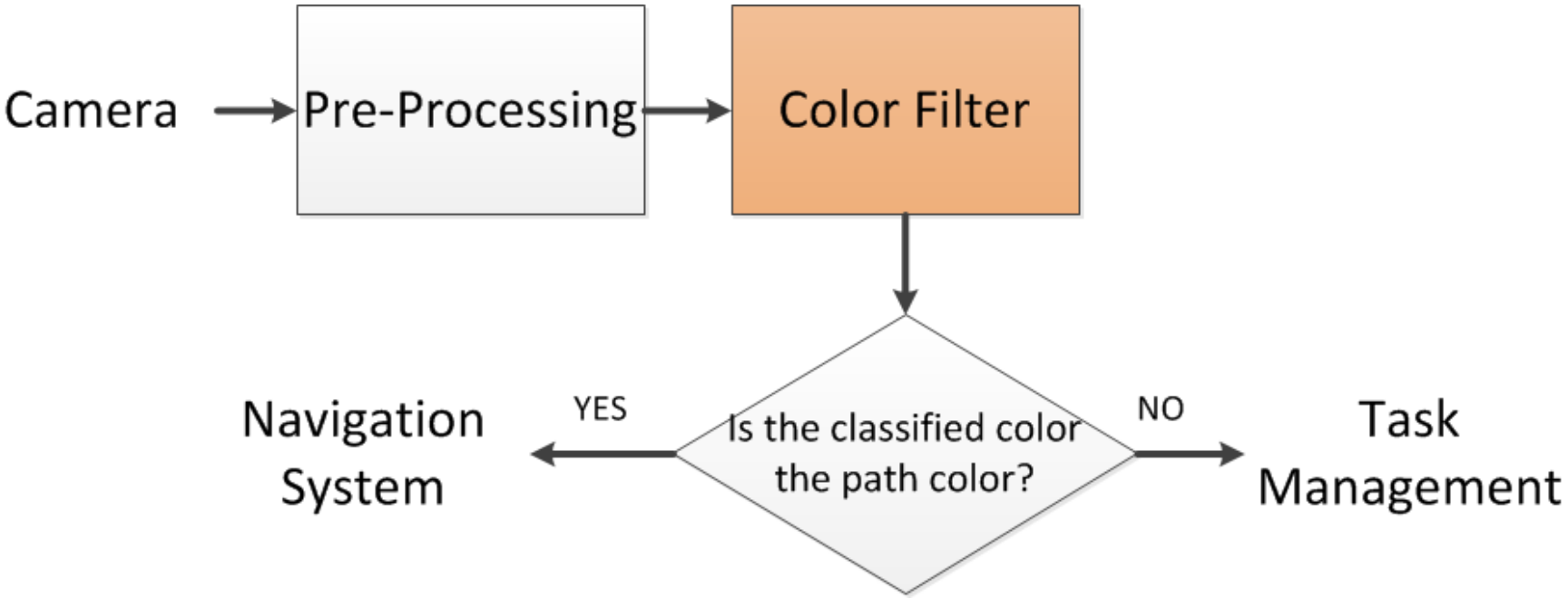
Software Design



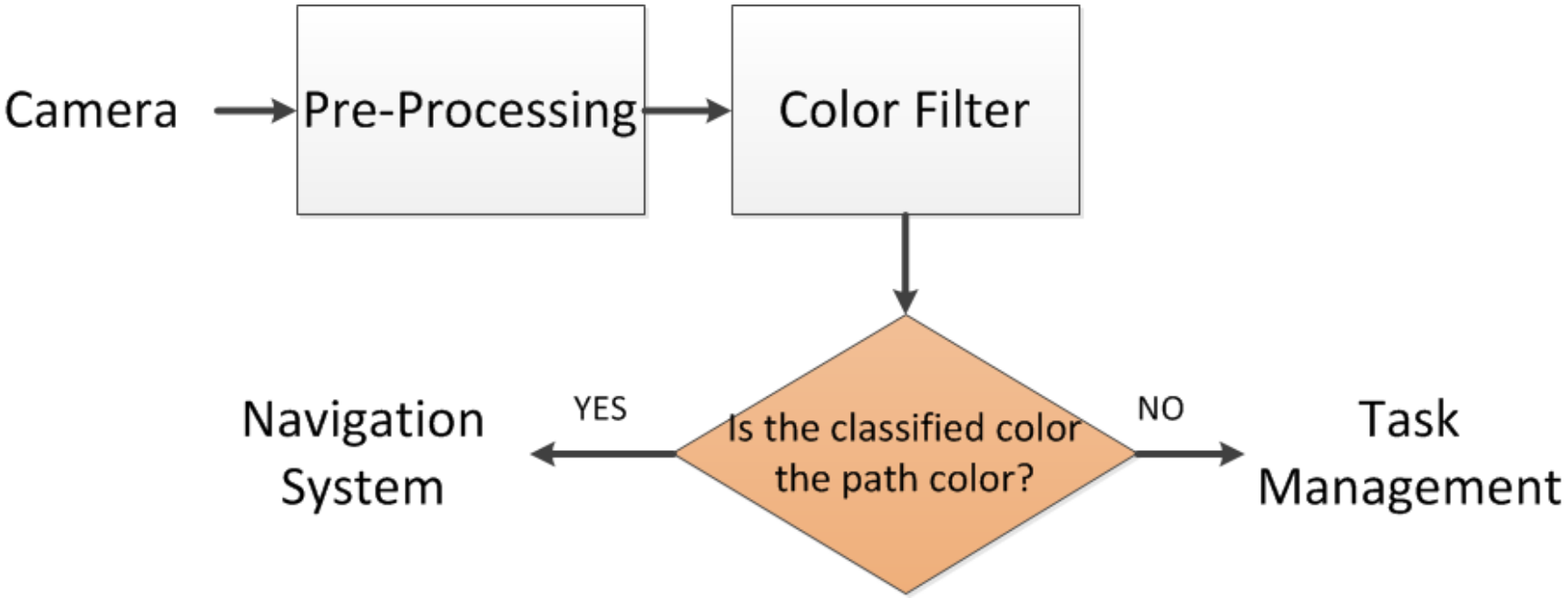
General Image Processing



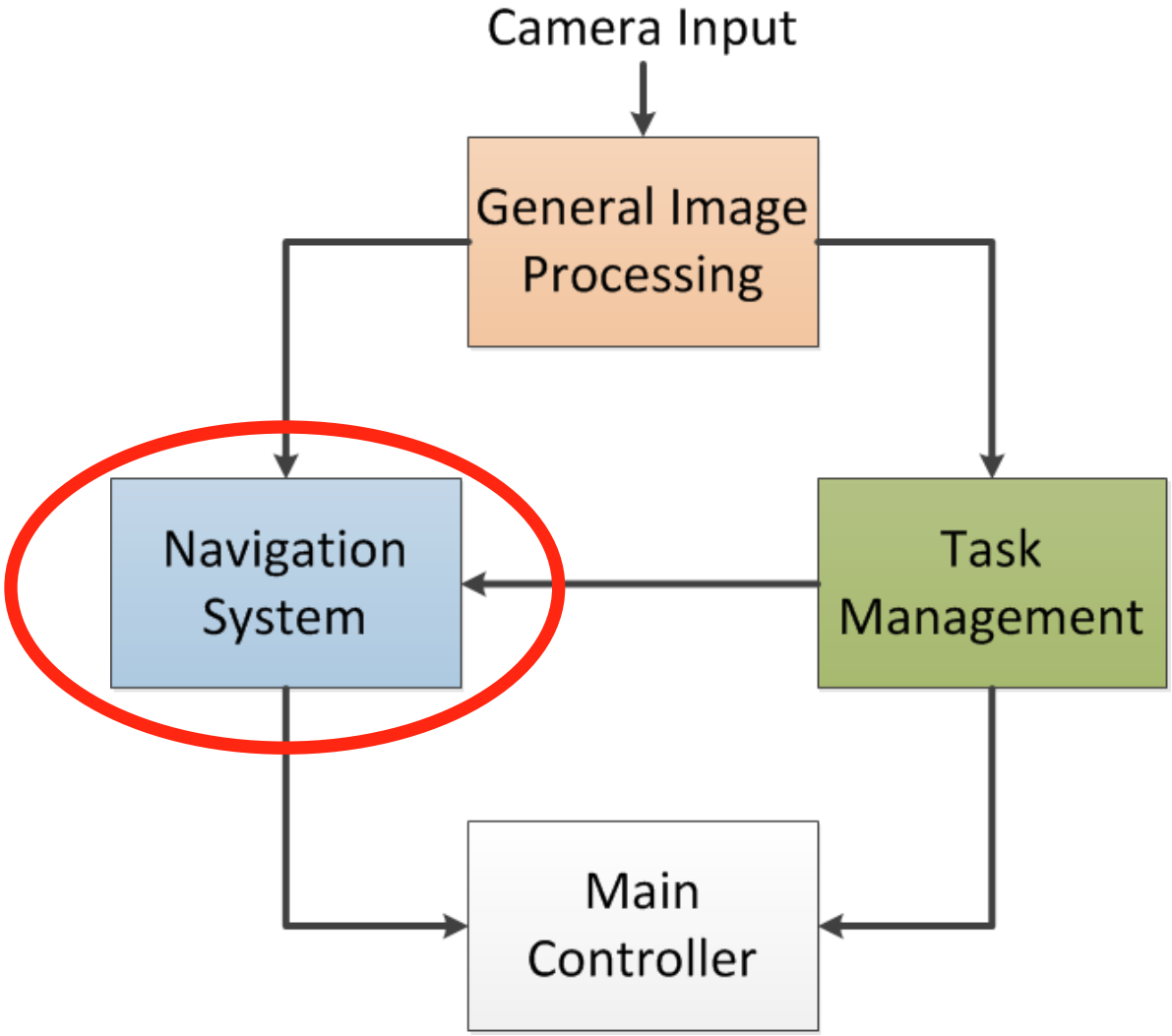
General Image Processing



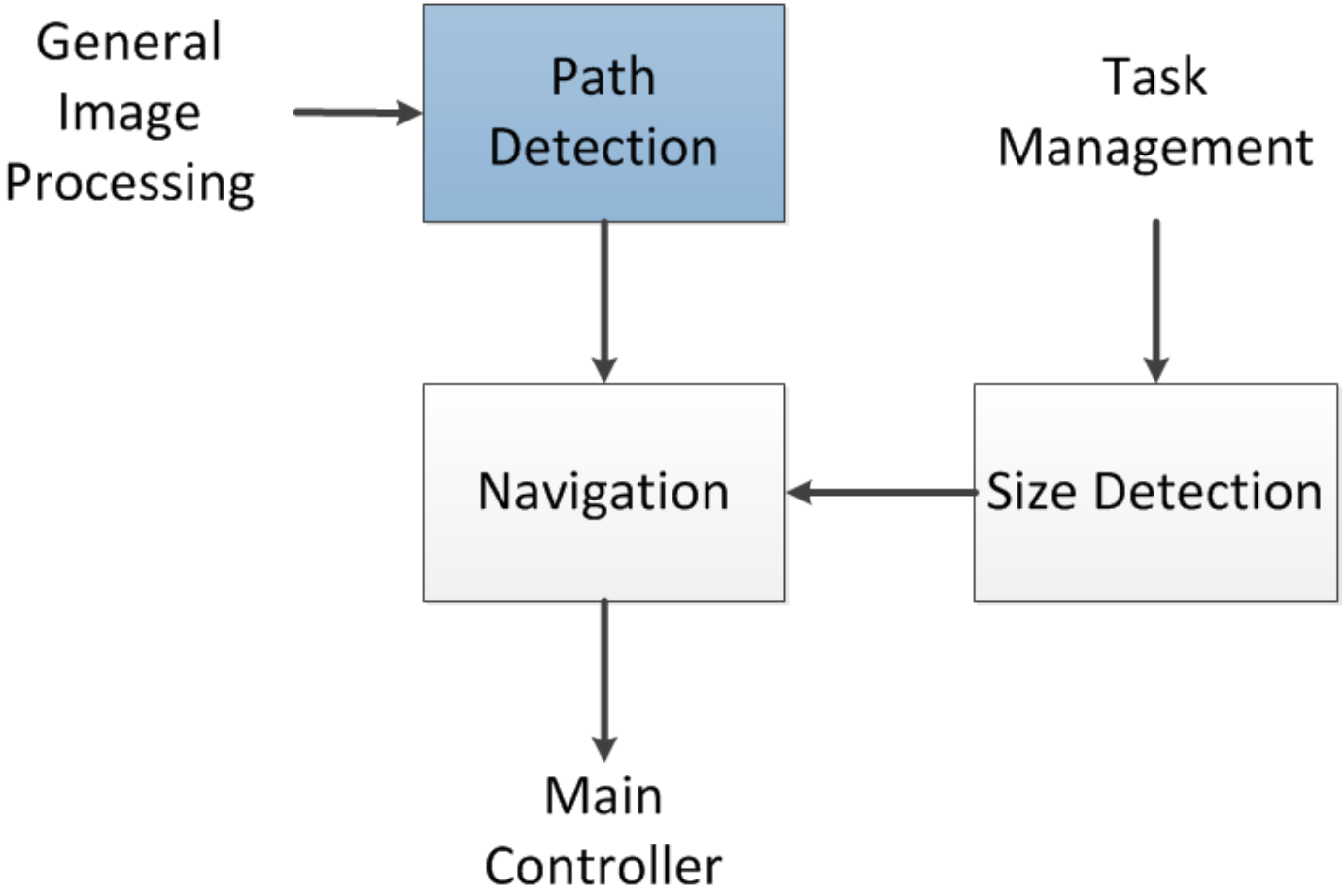
General Image Processing



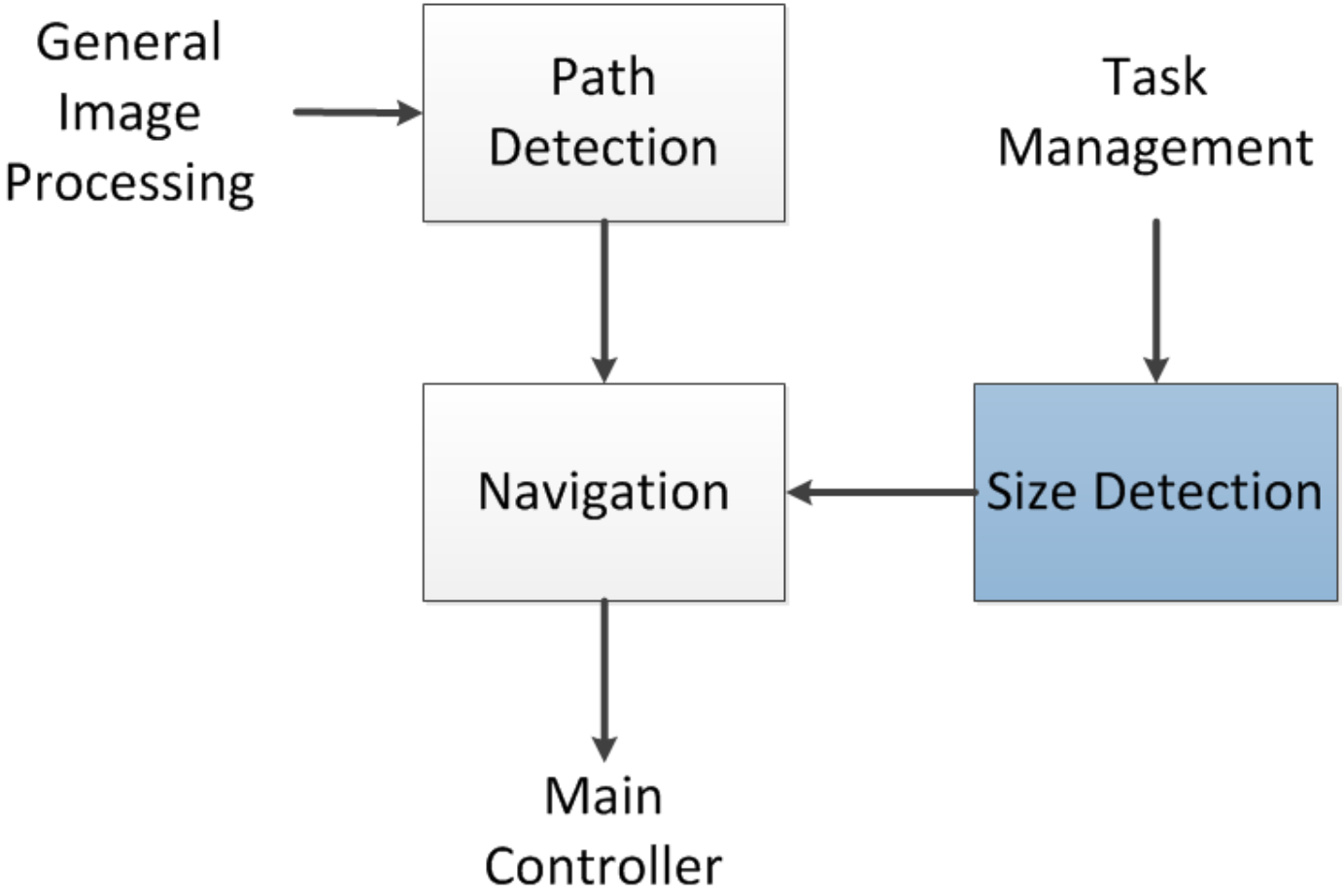
Software Design



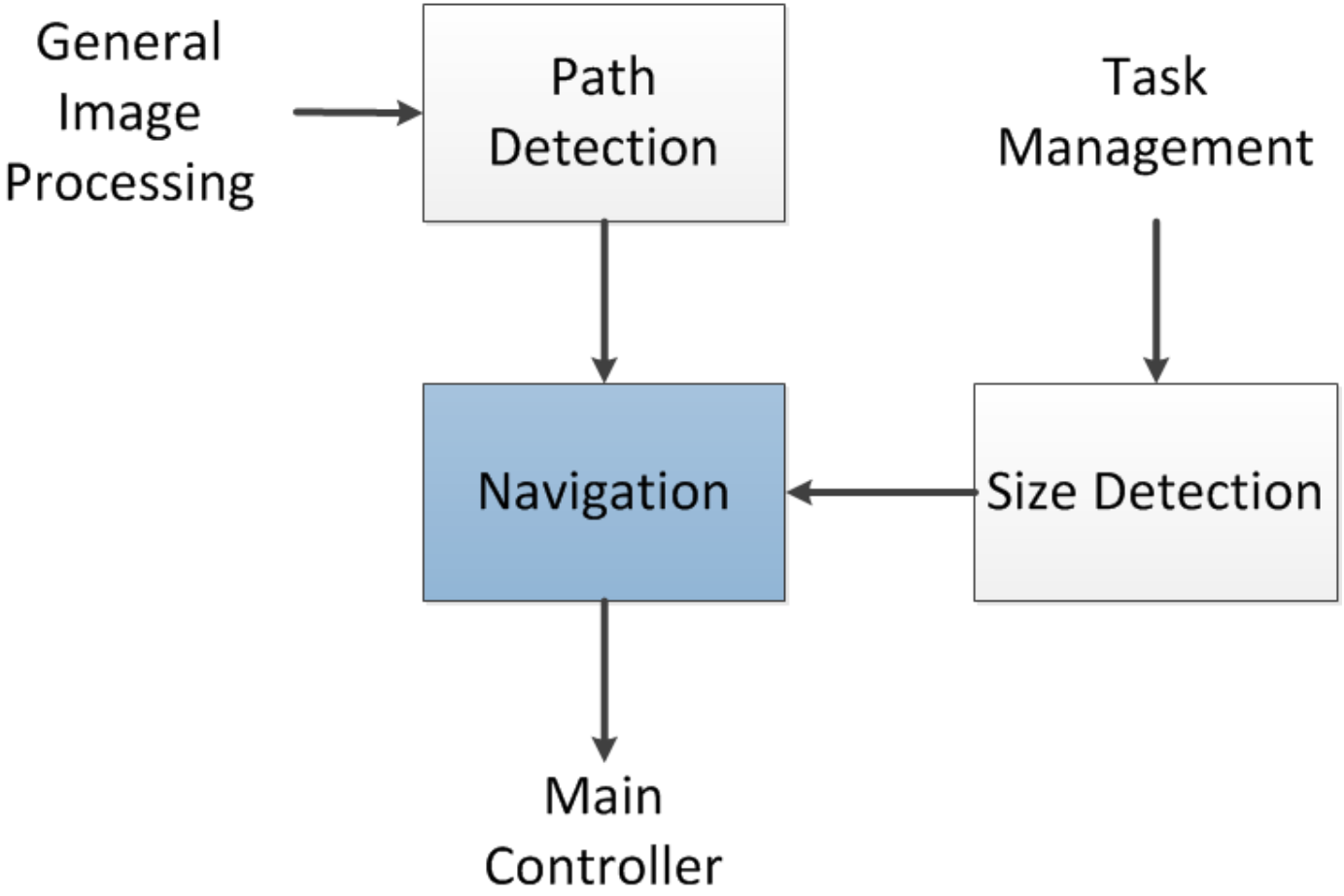
Navigation System



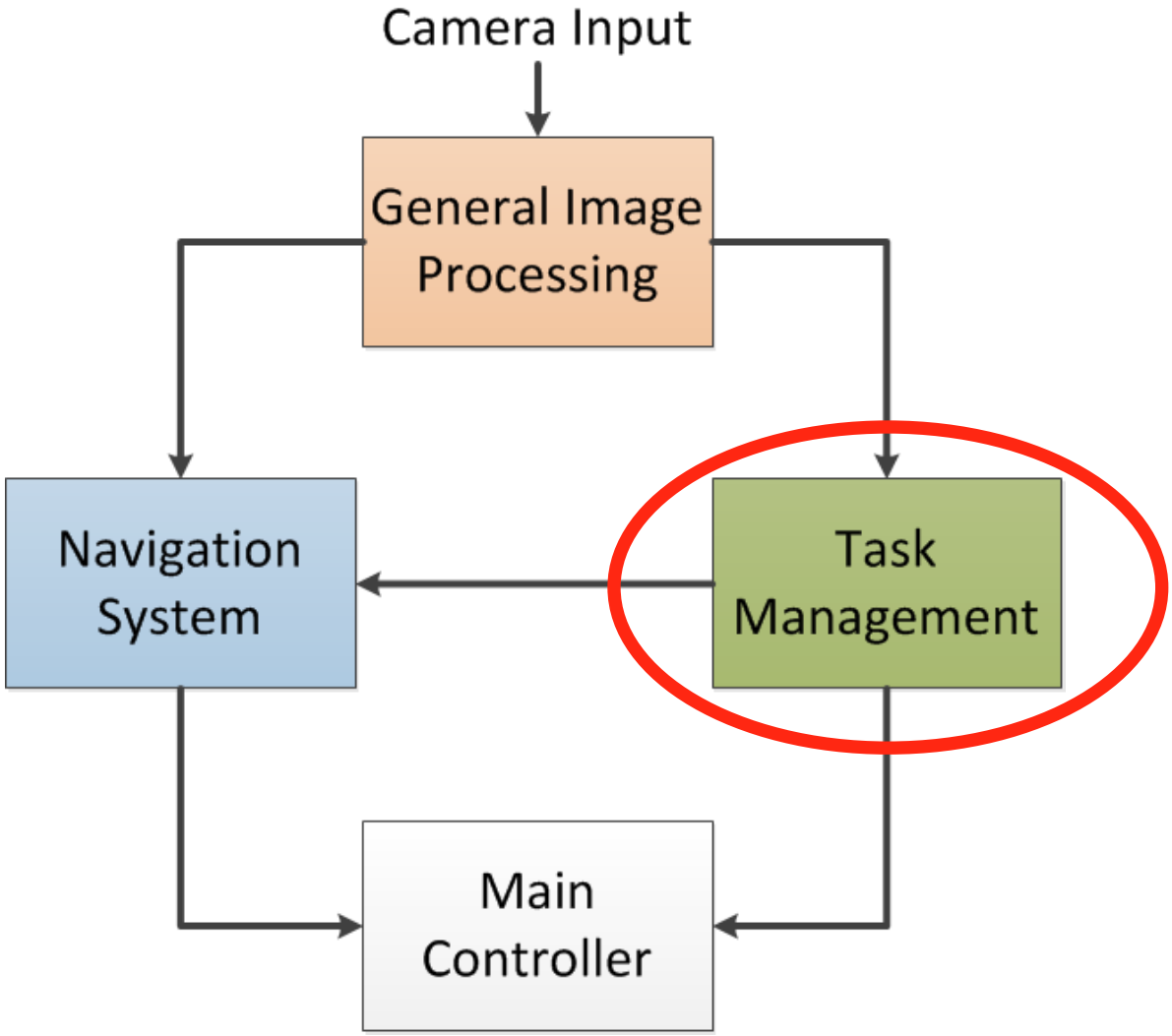
Navigation System



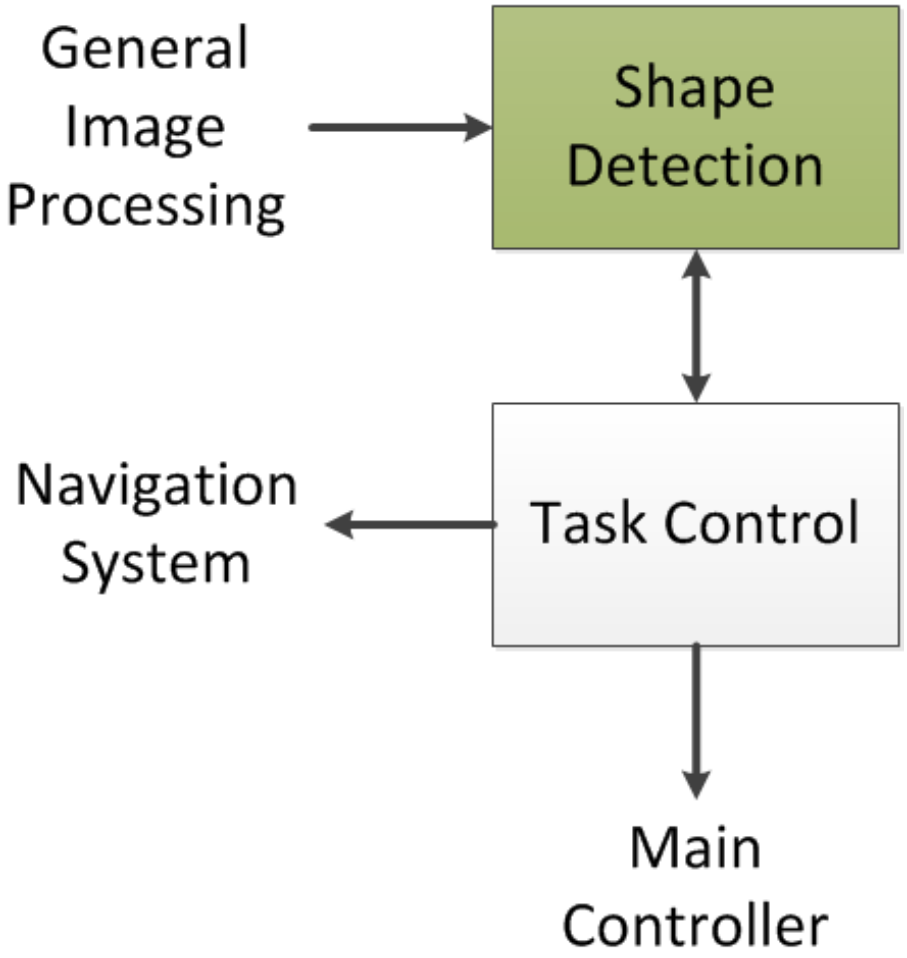
Navigation System



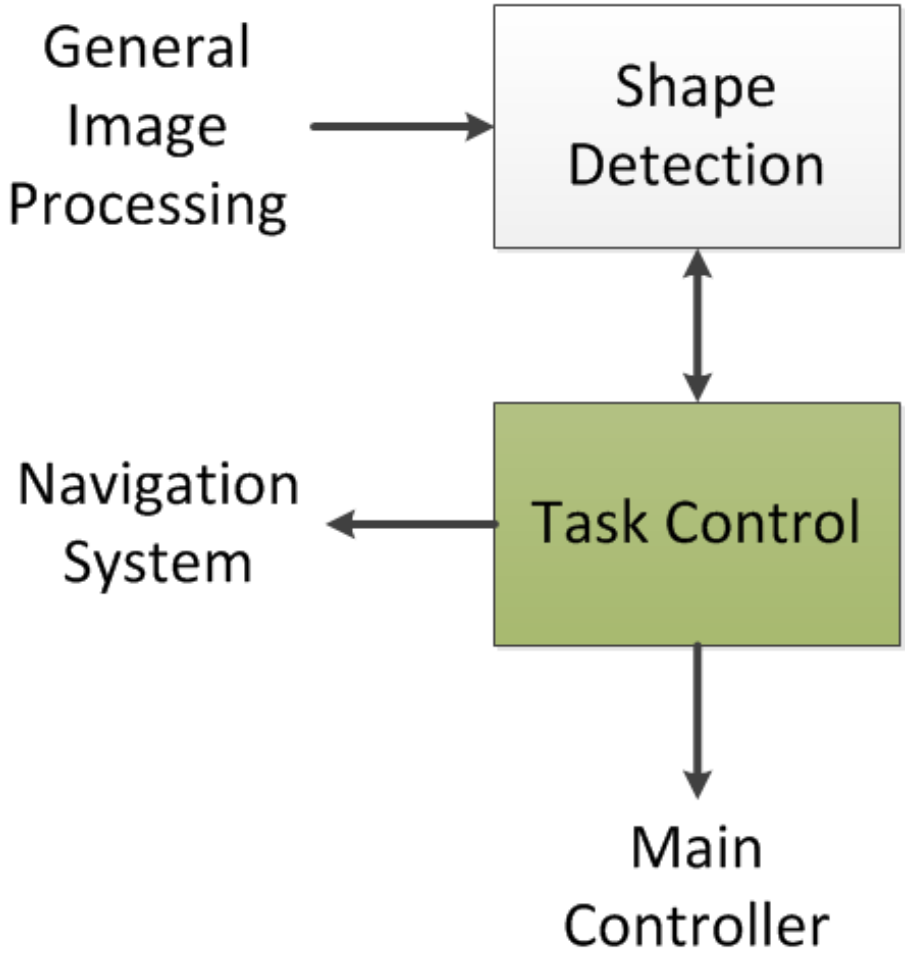
Software Design



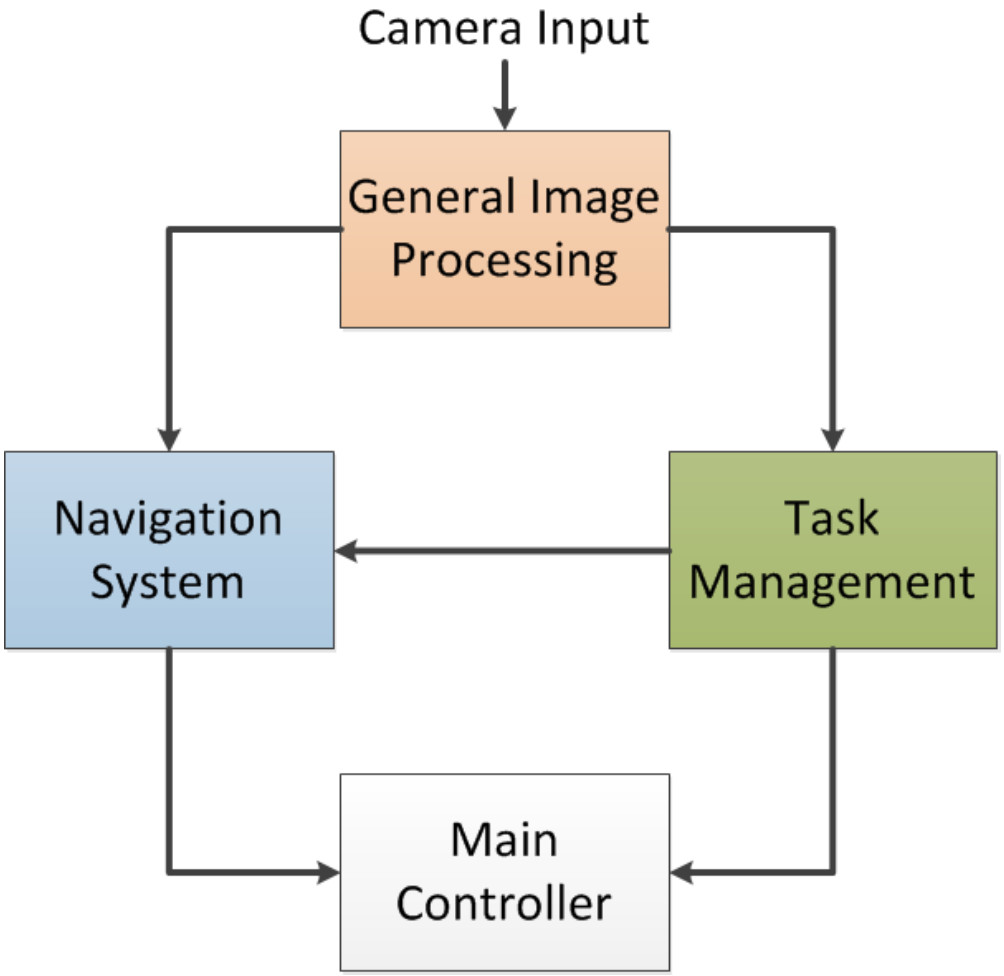
Task Management



Task Management



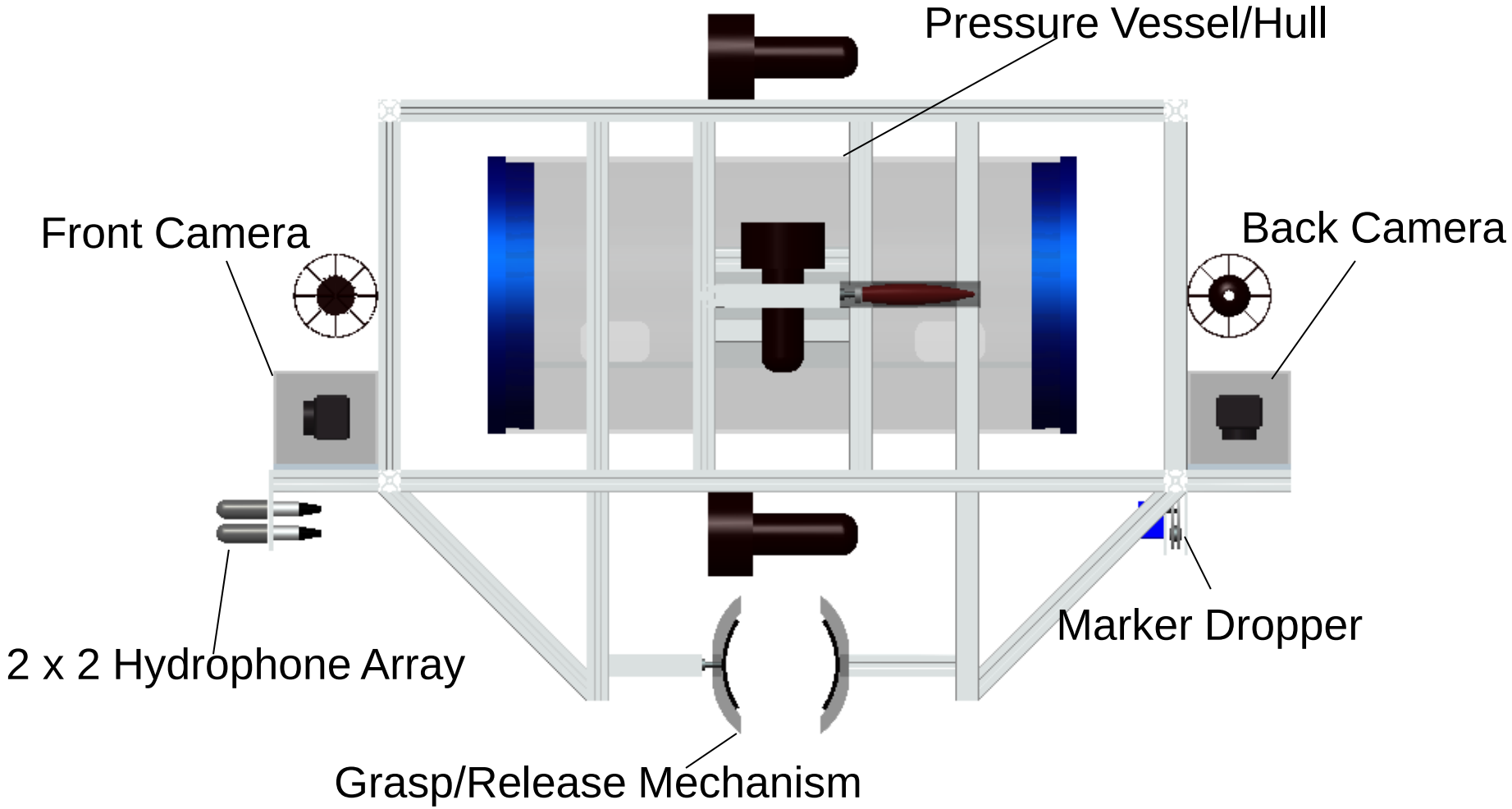
Software Design



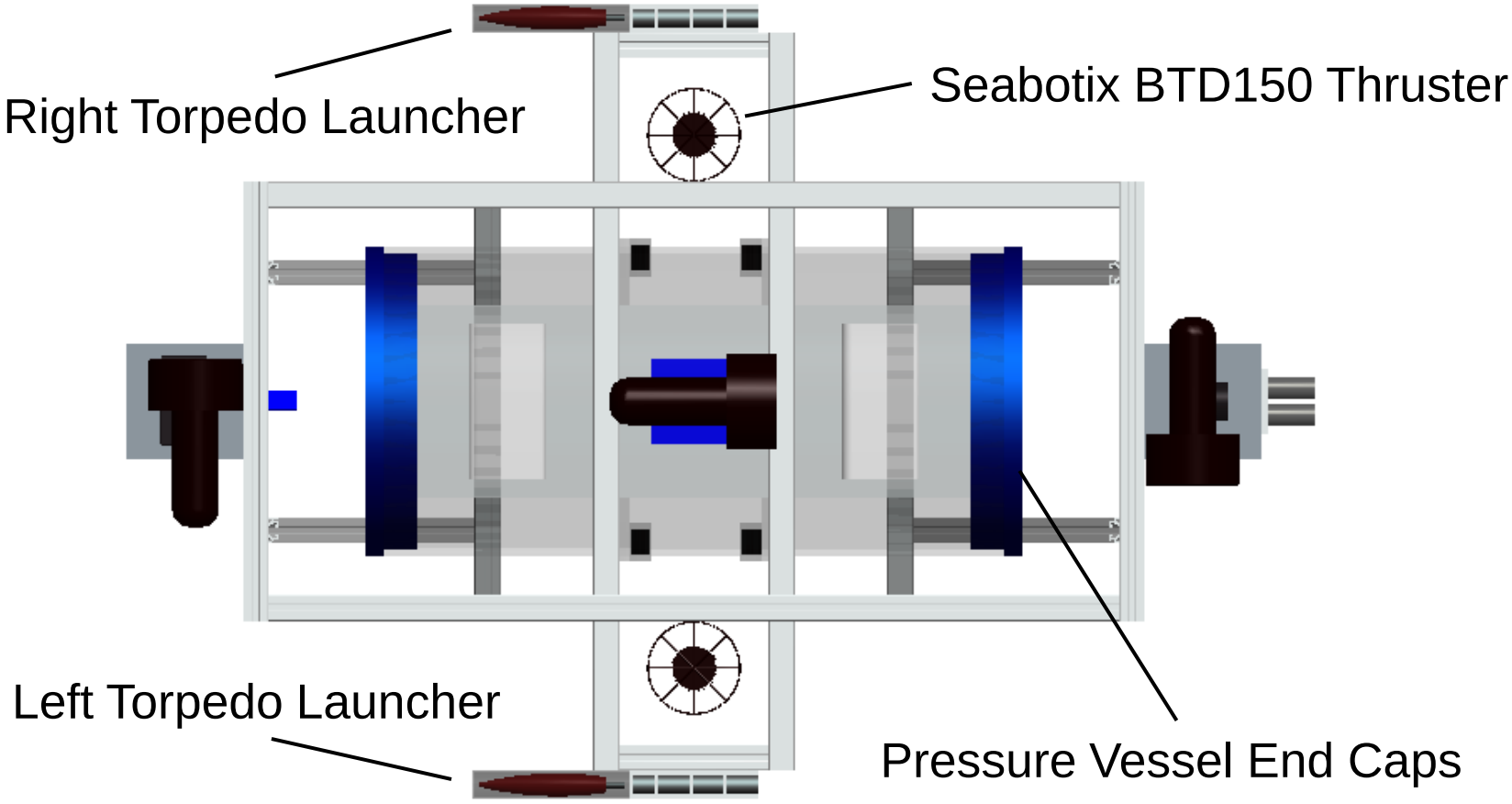
Hull / Frame and Vehicle Propulsion System

Eric Sloan

Overview – Side View



Overview – Top View

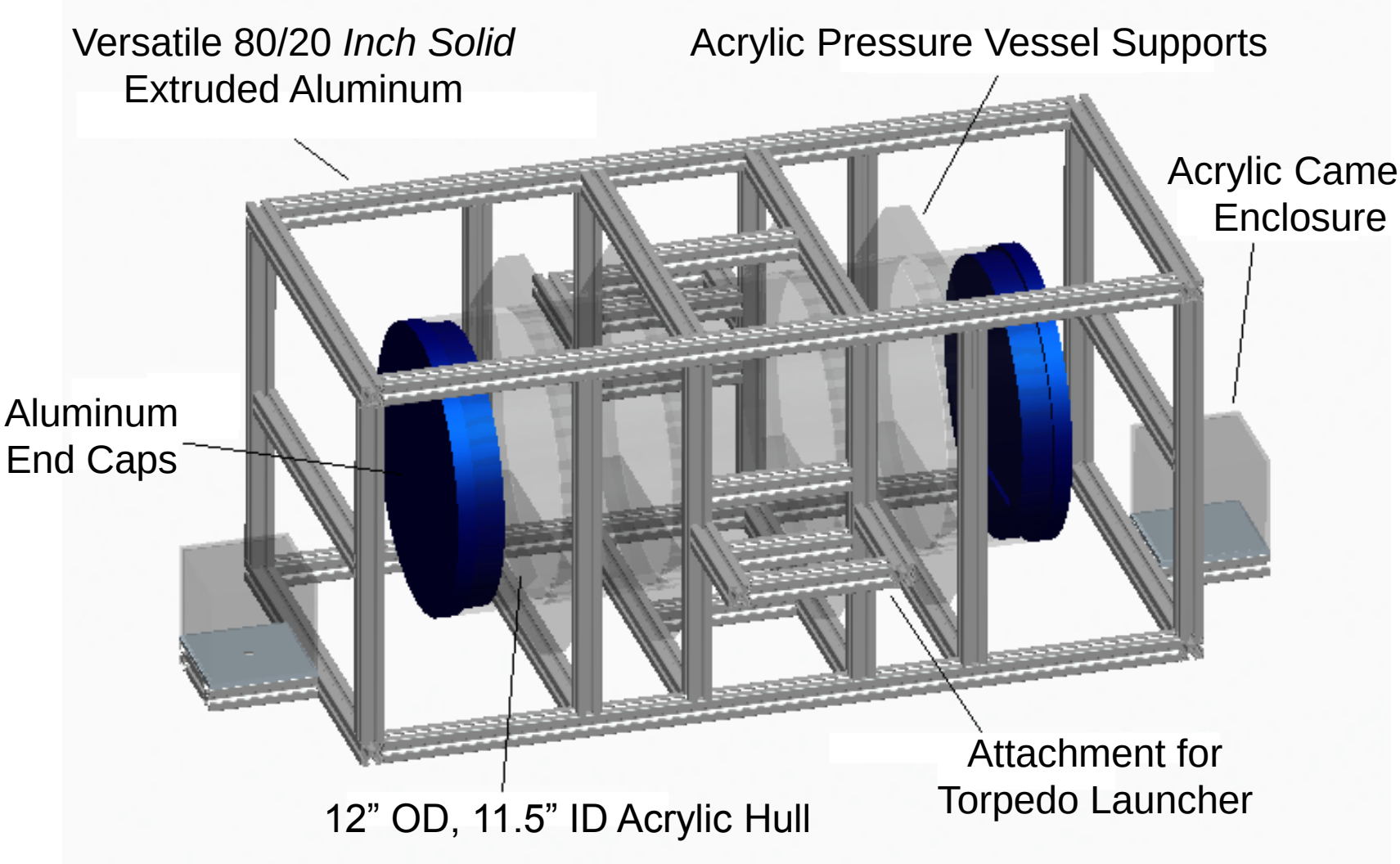


Hull / Frame

- Requirements of the Frame
  - Custom attachments for sensors and peripheral subsystems
  - Supports hull/pressure vessel
  - Symmetrical distribution of mass

- Requirements of the Hull
  - Completely watertight to protect the electronics
  - Attaches to the frame
  - Withstands maximum absolute pressure of ≈ 225 kPa (includes a safety factor of about 50%)

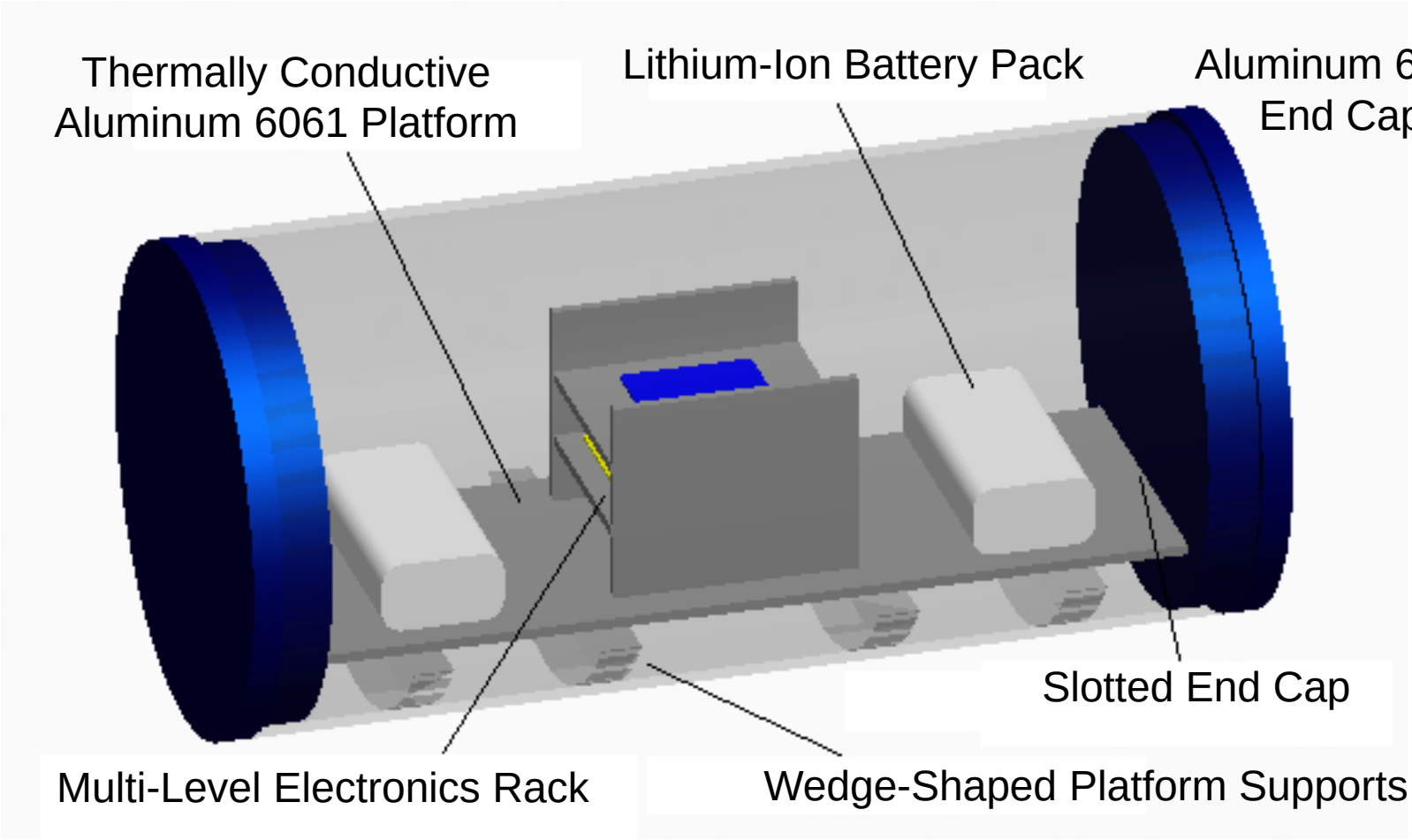
Hull / Frame


Versatile 80/20 *Inch Solid* Extruded Aluminum
Acrylic Pressure Vessel Supports
Acrylic Camera Enclosure
Aluminum End Caps
12” OD, 11.5” ID Acrylic Hull
Attachment for Torpedo Launcher

Interior Layout of the Hull

- Requirements of the Interior Hull
  - House electronics in a secure, easily accessible manner
  - Effectively dissipate heat away from the electronics and into the surrounding saltwater environment

Interior Layout of the Hull



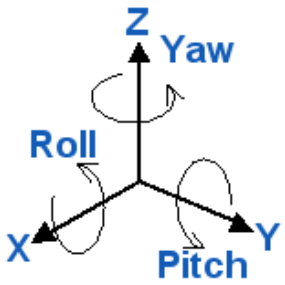
Test/Verification Plan

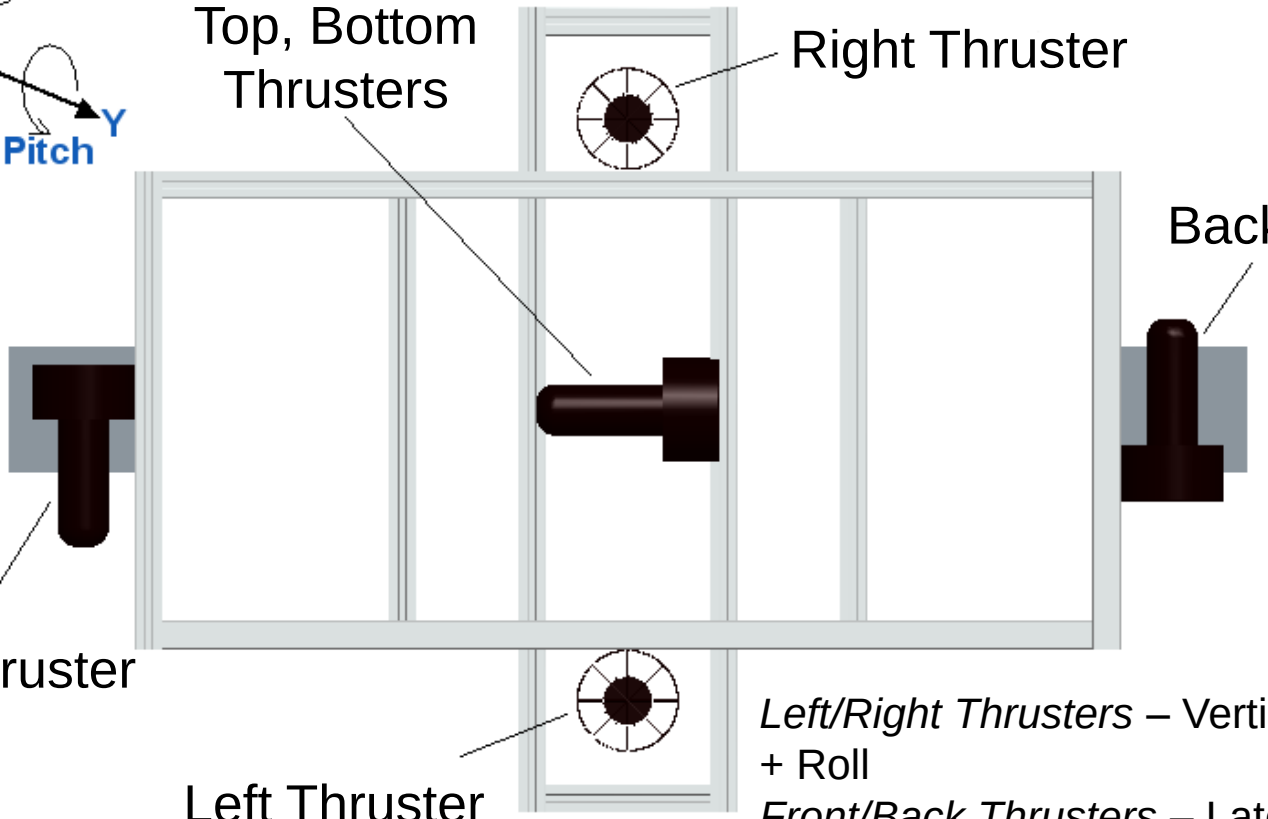
- FSU Morcom Aquatics Center
  - Submerge the pressure vessel at maximum pool depth of 17 ft
  - Wait for 20 minutes
  - Surface the pressure vessel and assess for leakage/plastic deformation of the material

Propulsion System

- Requirements of Propulsion System
  - Provide translation along each major axis
  - Provide rotation about each major axis
  - Variable thrust/propulsion force
  - Fast, repeatable actuation

Propulsion System





Left/Right Thrusters – Vertical Translation + Roll
Front/Back Thrusters – Lateral Translation + Yaw
Top/Bottom Thrusters – Longitudinal Translation + Pitch

- Hull / Frame

Pneumatic System and Torpedo Launcher

Kashief Moody

Pneumatic System

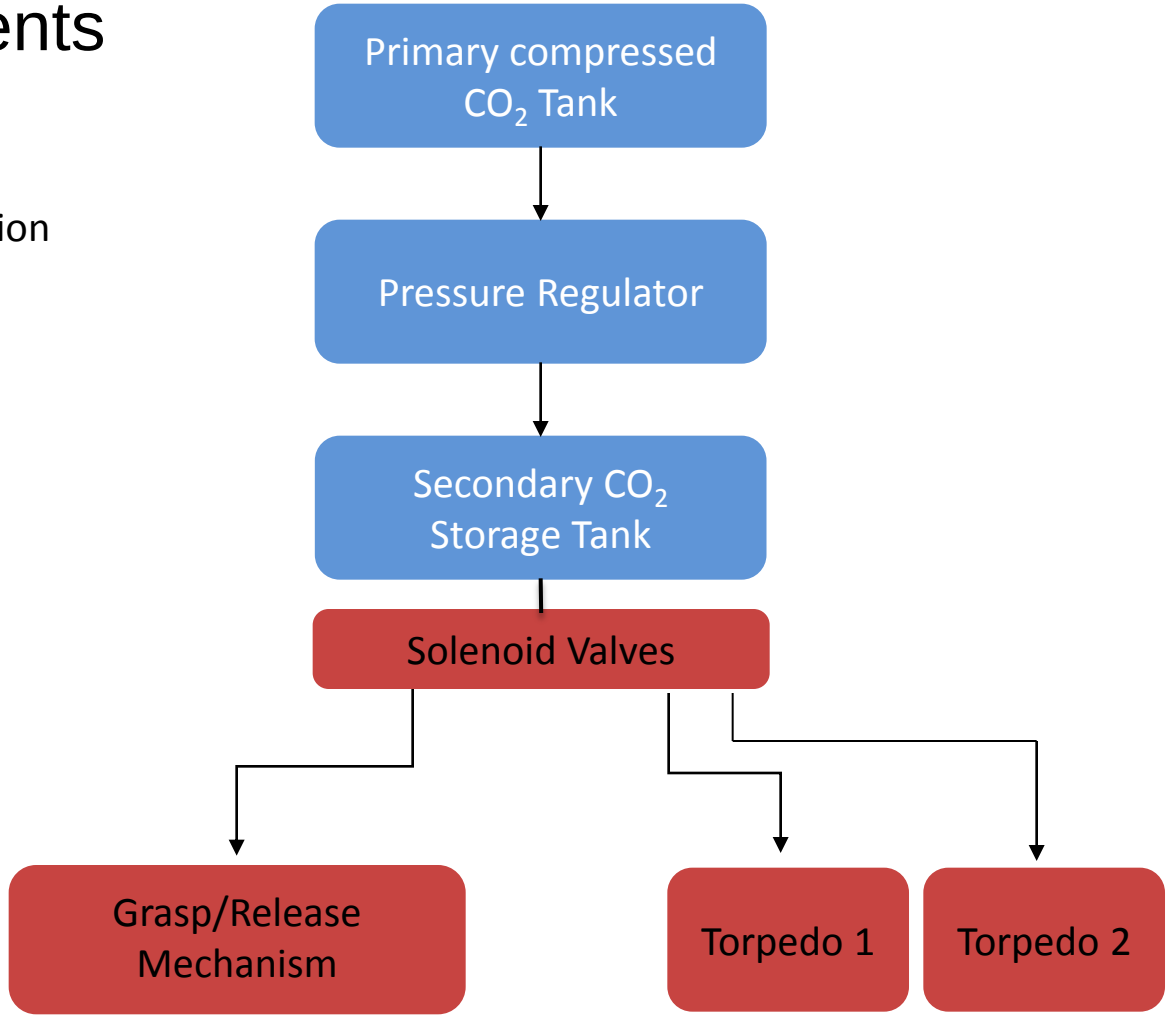
- Objective of the Pneumatic System
  - Distribute pressure-regulated CO_2 to the grasp/release mechanism and torpedo launchers upon command from the main control unit

Pneumatic System

- Requirements

Storage/Regulation

Distribution



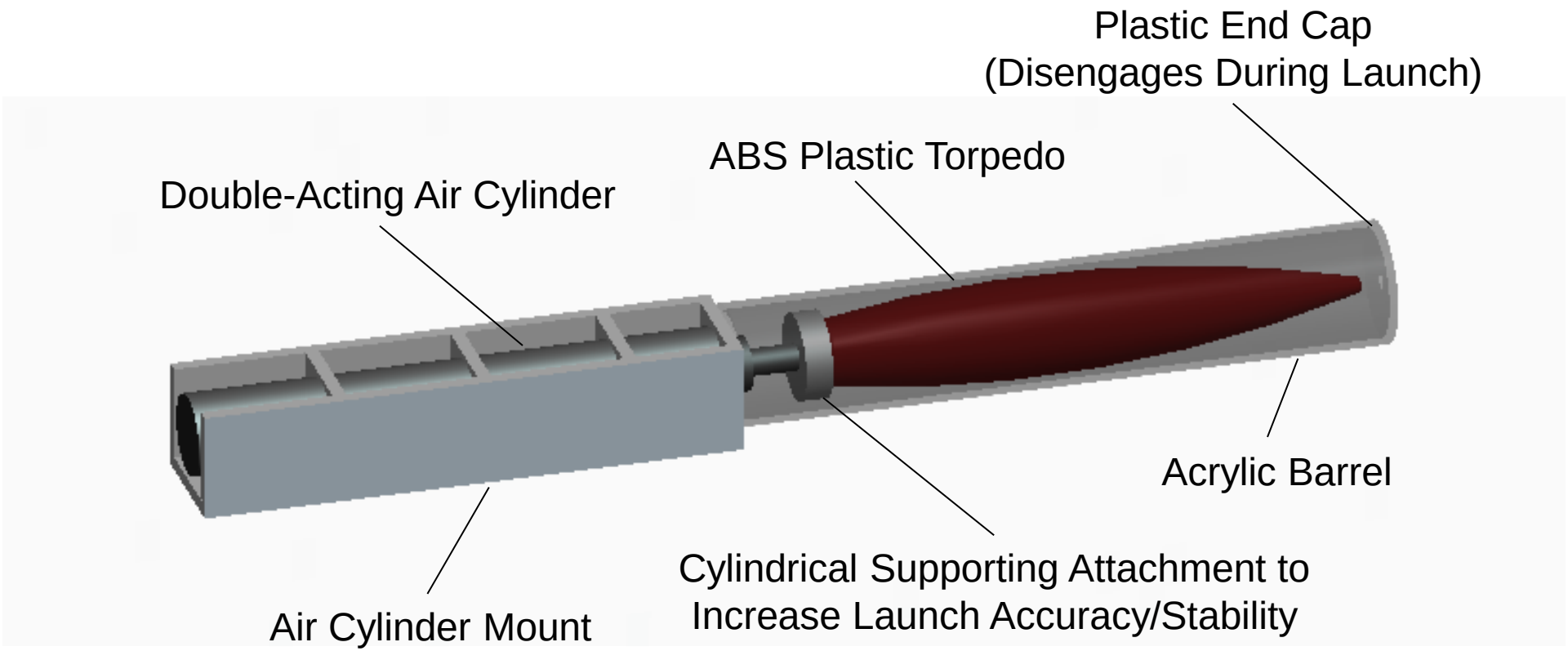
Torpedo Launcher

- Objective of the Torpedo Launcher
  - Secure the air cylinder and torpedo to effectively increase the accuracy of launching technique

Torpedo Launcher

- Requirements
  - Barrel
  - Stoppers
  - Air cylinder mount
  - Air cylinder
  - Piston attachment

Torpedo Launcher



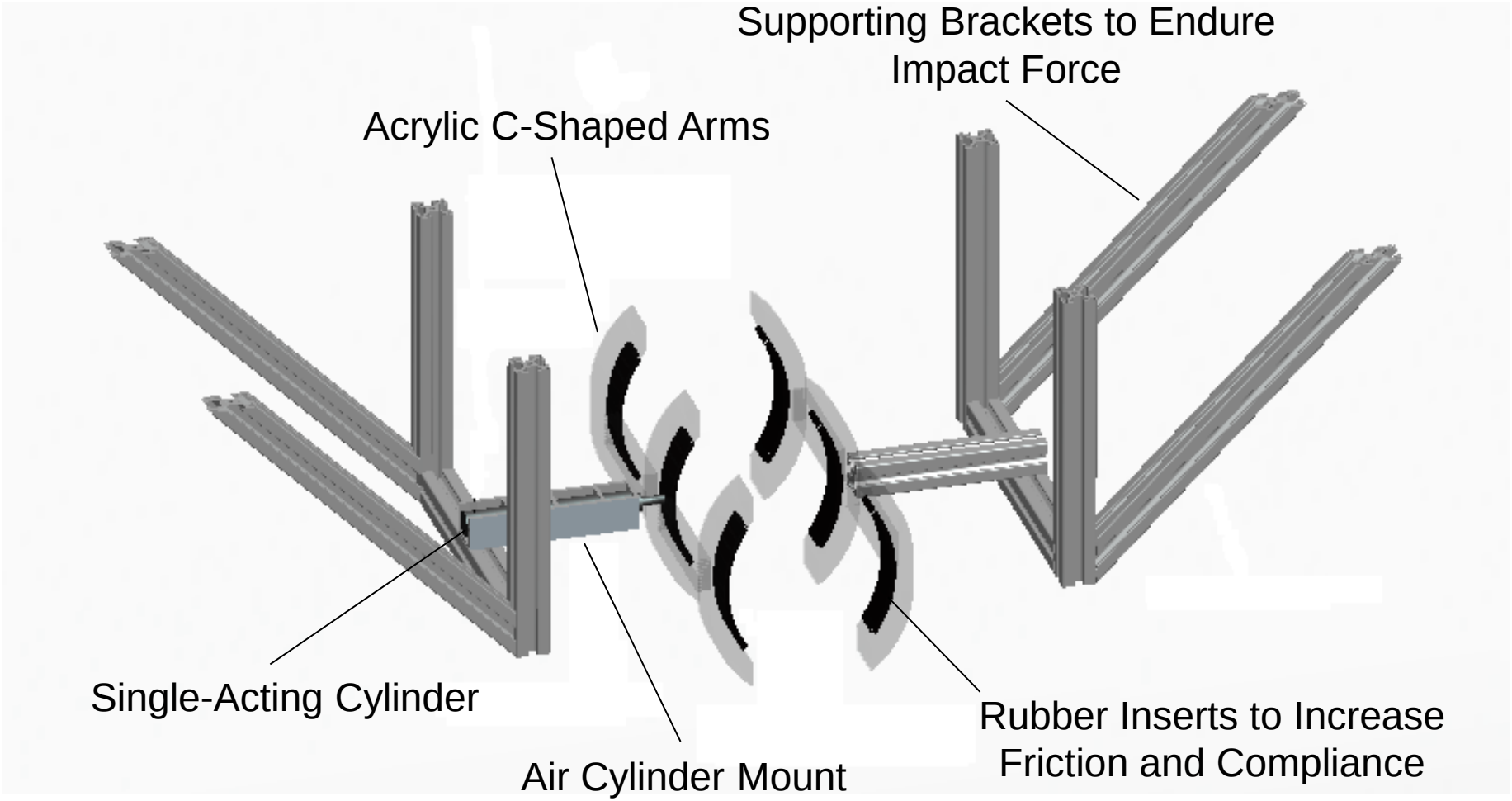
Grasp / Release Mechanism
Marker Dropper

Tra Hunter

Grasp / Release Mechanism

- Requirements
  - Grasp an identified object
  - Hold object while vehicle surfaces
  - Release object upon command after surfacing

Grabber/Release Mechanism



Grasp/Release Mechanism - Test/Verification Plan

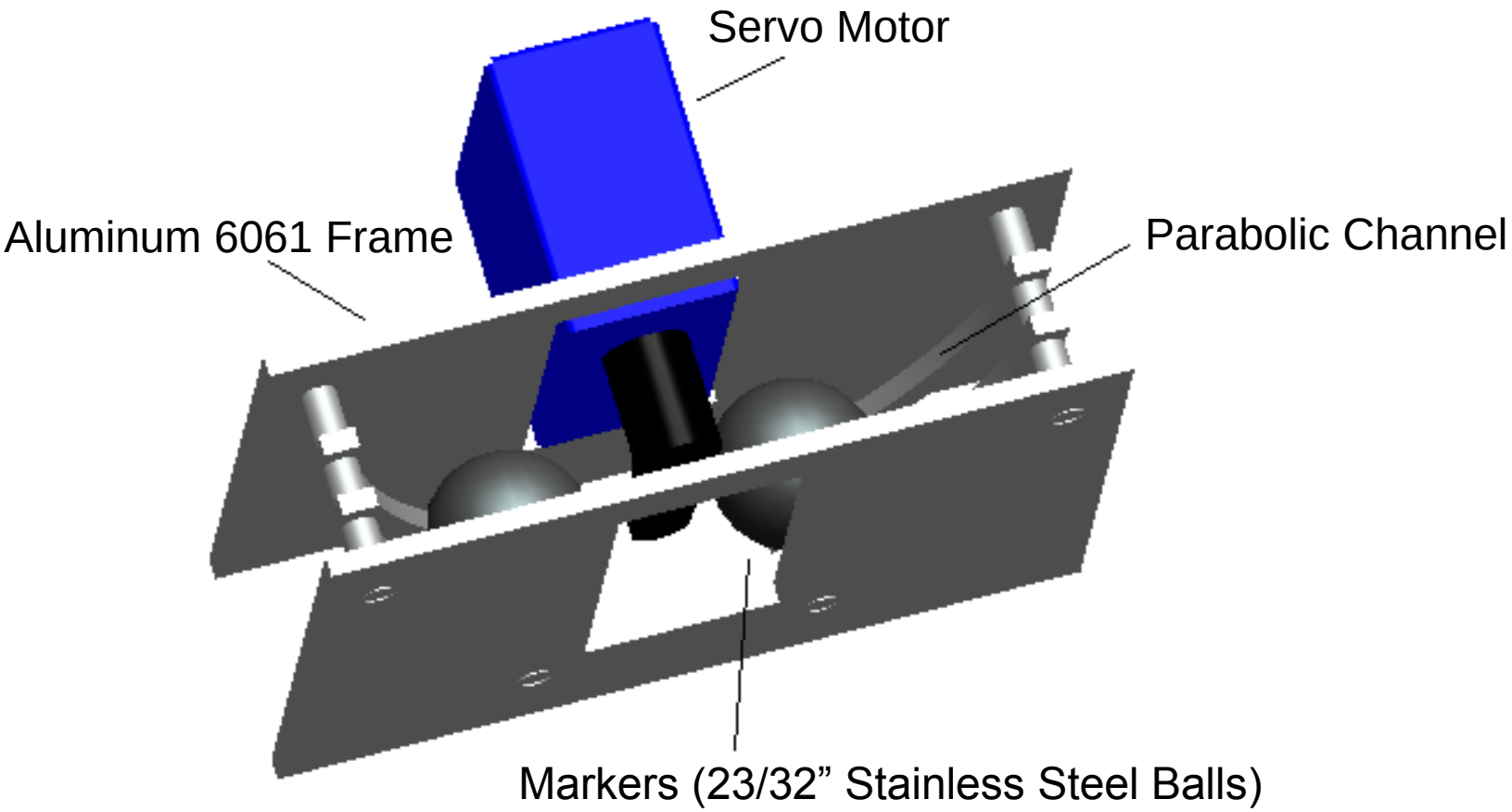
- Mechanical actuation via manual valves
  - Verify proper extension and retraction of C-shaped arms
- Electrical actuation via solenoid valves
  - Verify successful integration with main control unit

Marker Dropper

- Requirements of the Marker Dropper
  - Secure two markers until actuated
  - Drop the markers individually upon command

Stainless Steel Balls to be Used as Markers

Marker Dropper



Close-Up View of Marker Dropper

Marker Dropper

Marker Dropper from last year

Marker Dropper

- Test Verification Plan
  - Attach to frame of AUV
  - Connect Servomotor to BeagleBoard-xM
  - Program servo to rotate to individually drop each marker
  - Place a target directly below outlet of device, and analyze accuracy of drop

Budget

Tra Hunter

Budget

	Part	Total Price
Mechanical Parts	Hull/pressure vessel	$350
	Frame	$155
	Raw aluminum 6061	$340
	Acrylic/adhesive	$370
	SeaBotix BTD150 thrusters ×2	$1500
	Pneumatic Components	$730
	TOTAL	$3445
Electrical/Electronic Parts	Cameras	$110
	BeagleBoard-xM	$150
	Voltage Regulation Board	$50
	Hydrophones	$1200
	Inertial Measurement Unit (IMU)	$150
	Pressure Sensor	$155
	Miscellaneous : cables, adaptors	$50
	TOTAL	$1660
Travel Expenses		$4500
GRAND TOTAL		$9605
Remaining Balance		-$2172

Risk Assessment

Antony

Risk Assessment

- Administrative
- Timing issues
  - Logistical
  - Functional
- Hardware / software failures

Questions ?