Nautical Autonomous System with Task Integration

(code name NASTI)

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Advisors: Dr. Gary Dempsey, Nick Schmidt

Outline

* Background Information
* System Overview
* Sub-Systems
* Review of Completed Work
  * BeagleBoard
  * Communication
  * Image Processing
  * Path Planning
  * Chassis Design
* Schedule
* List of Equipment

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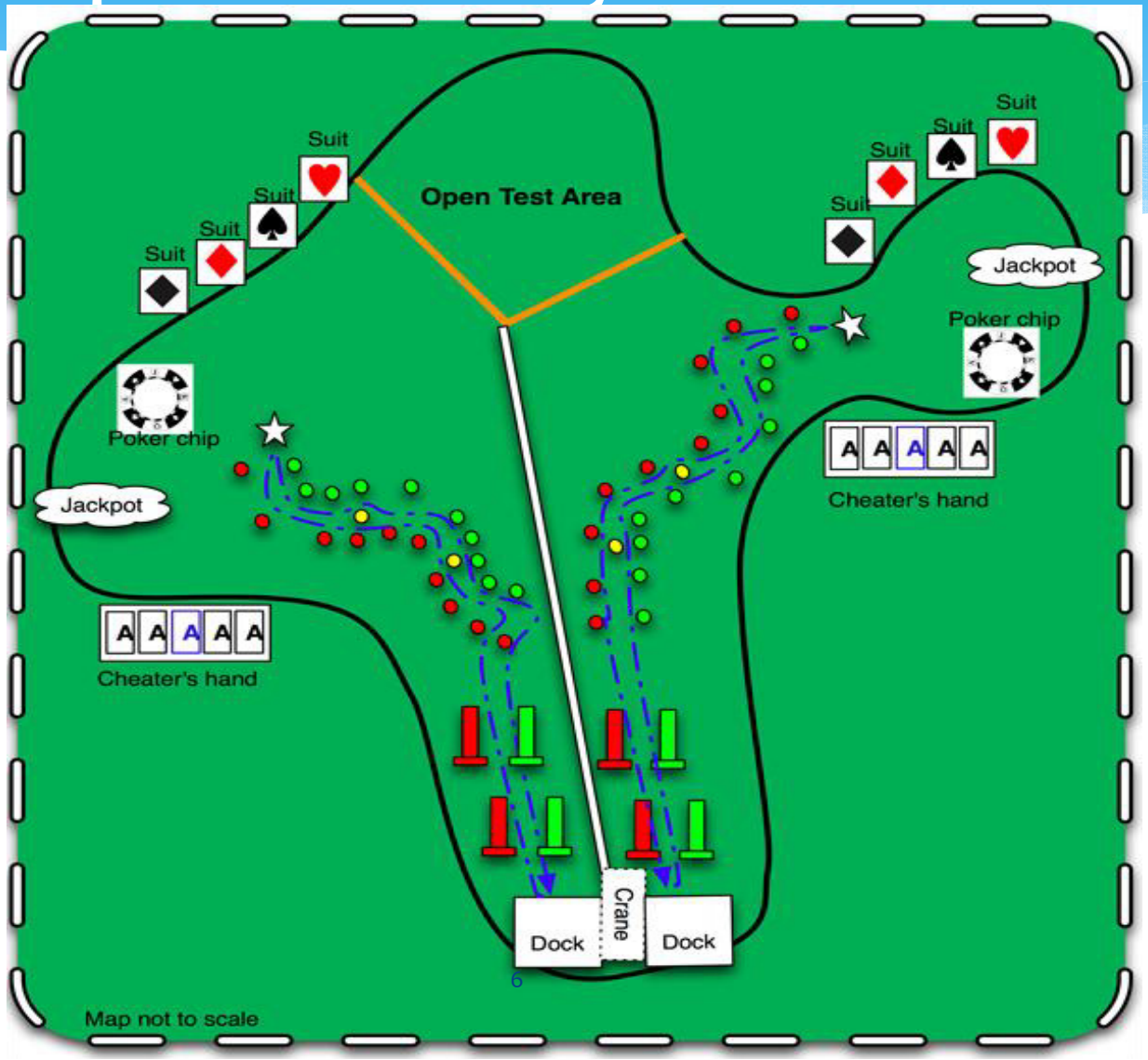
Background Information

* Intend to compete in AUVSI's Annual International RoboBoat Competition
* All previous teams have used a conventional catamaran style hull
* A lighter, faster, more maneuverable hovercraft should provide a competitive edge
* Most teams have between 12-20 people and a budget $10,000+

Background Information

* UCF Catamaran style hull
* Total Cost : $16,000

Competition Layout & Rules



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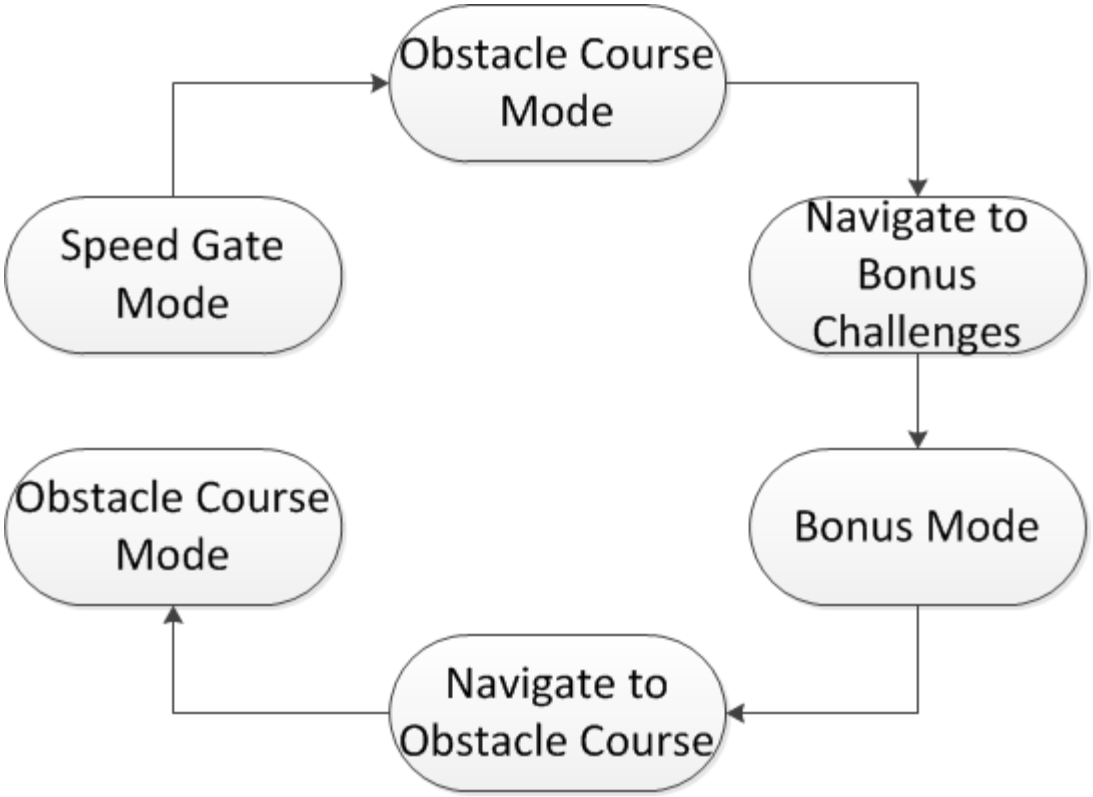
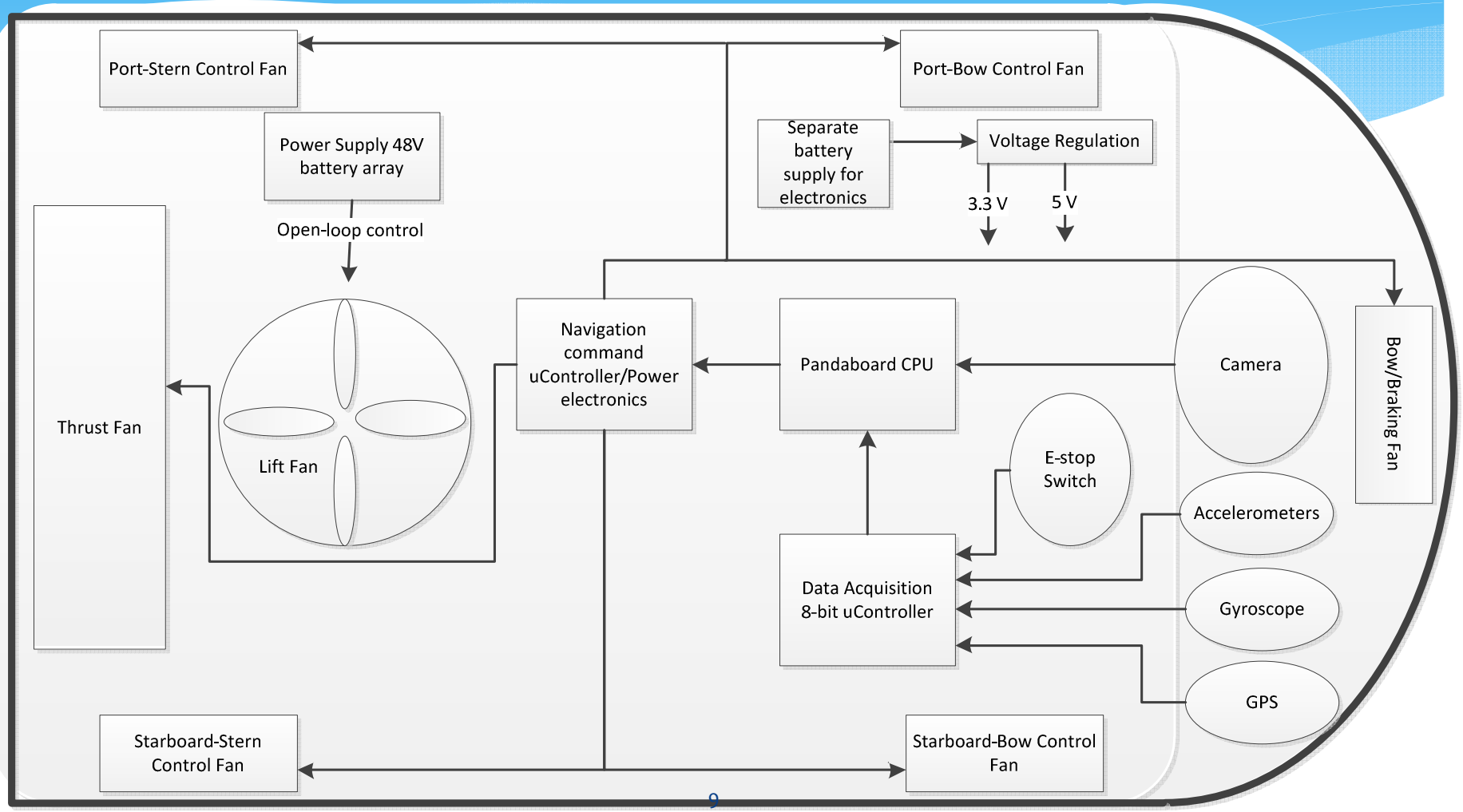
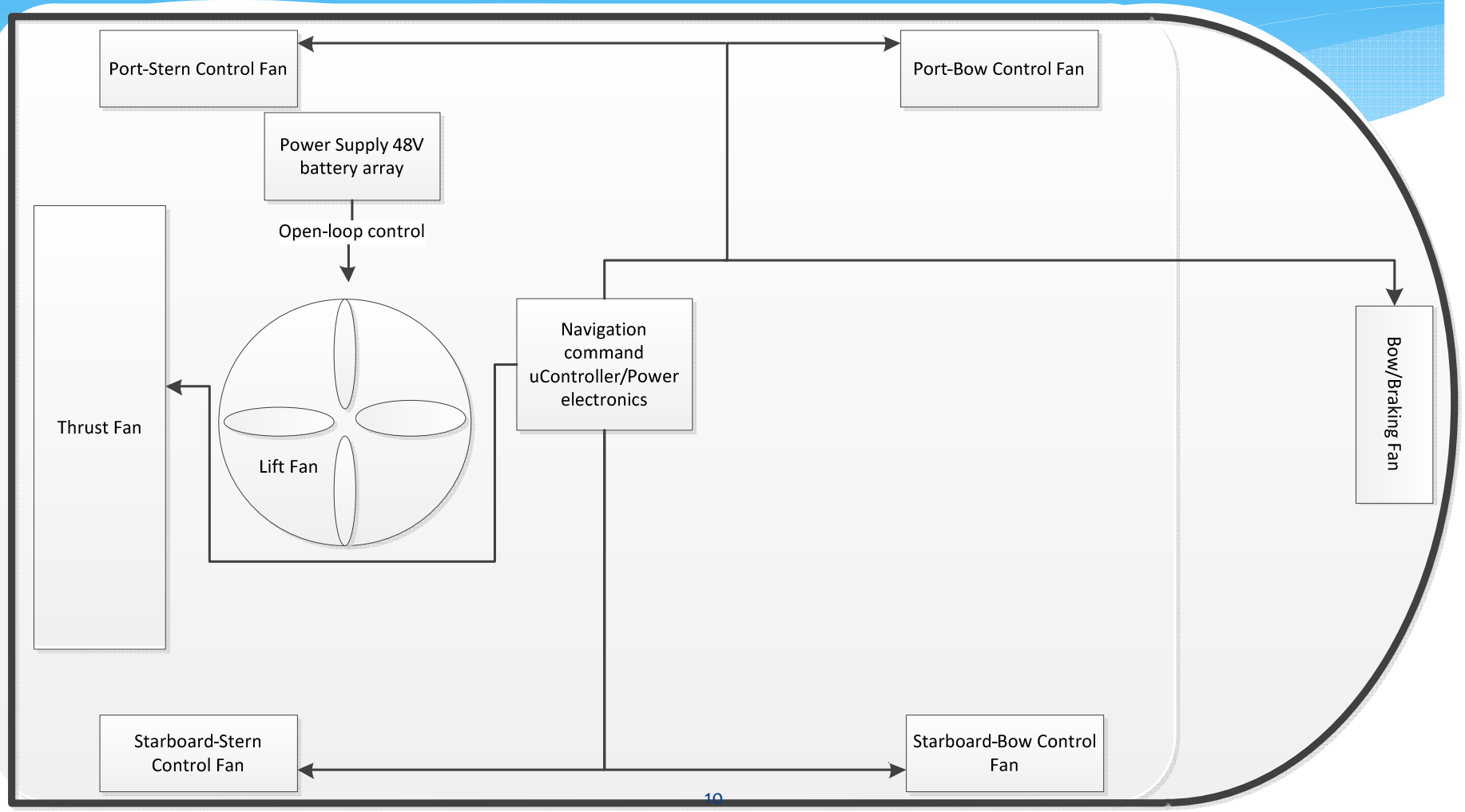
State Diagram



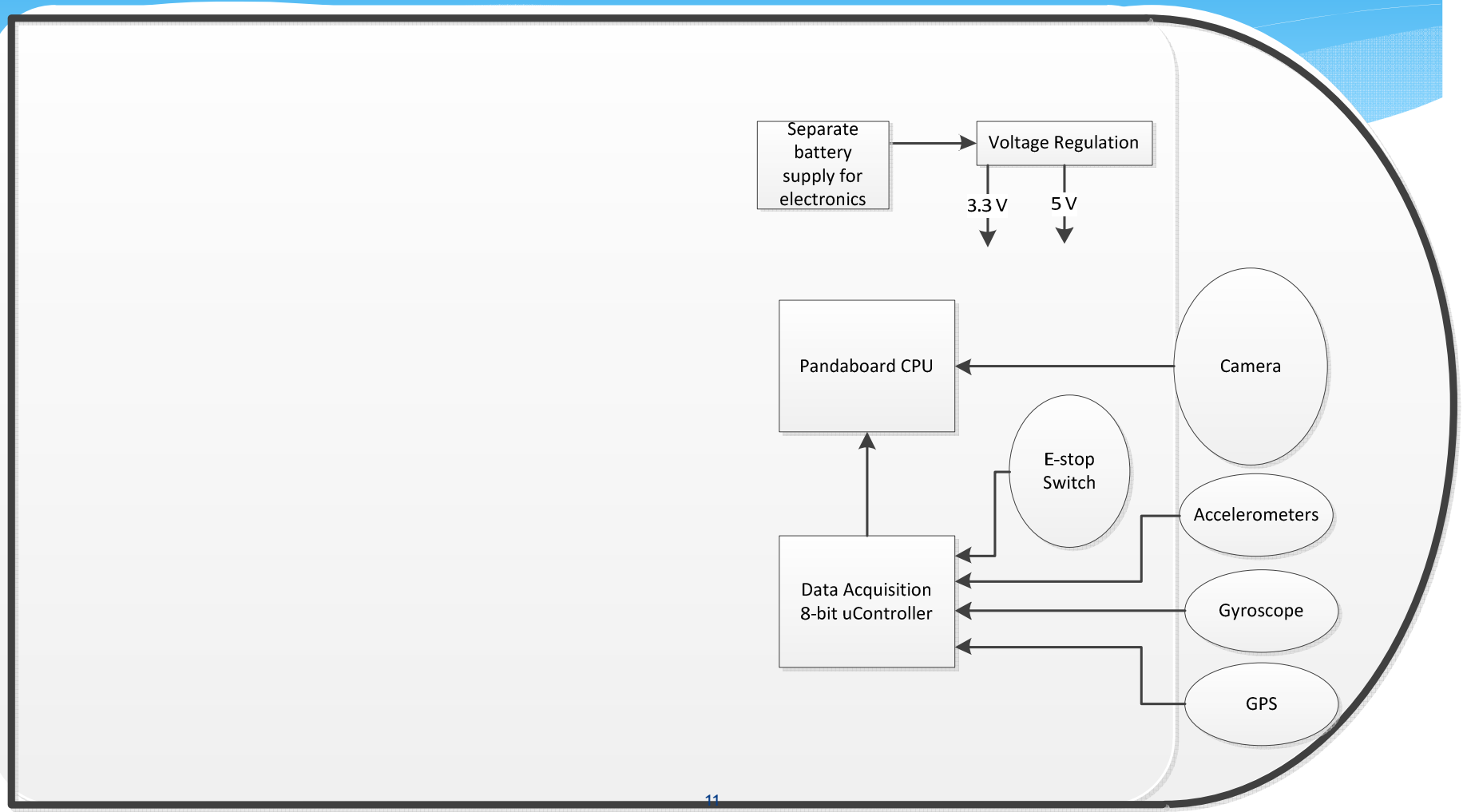
System Overview



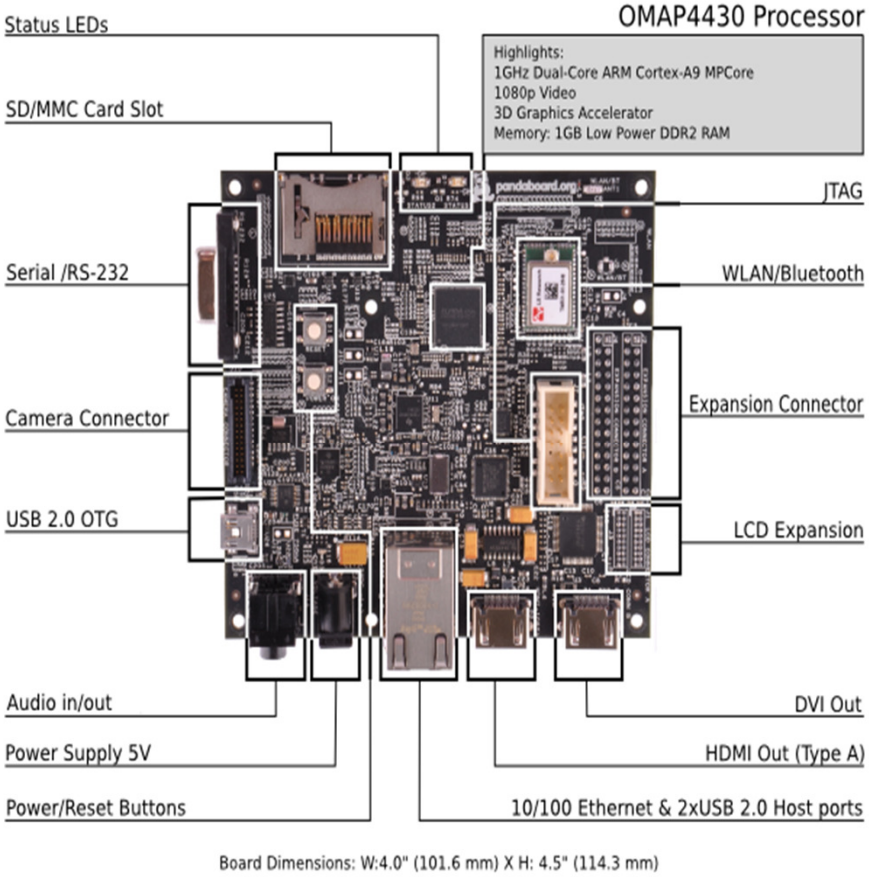
Mechanical

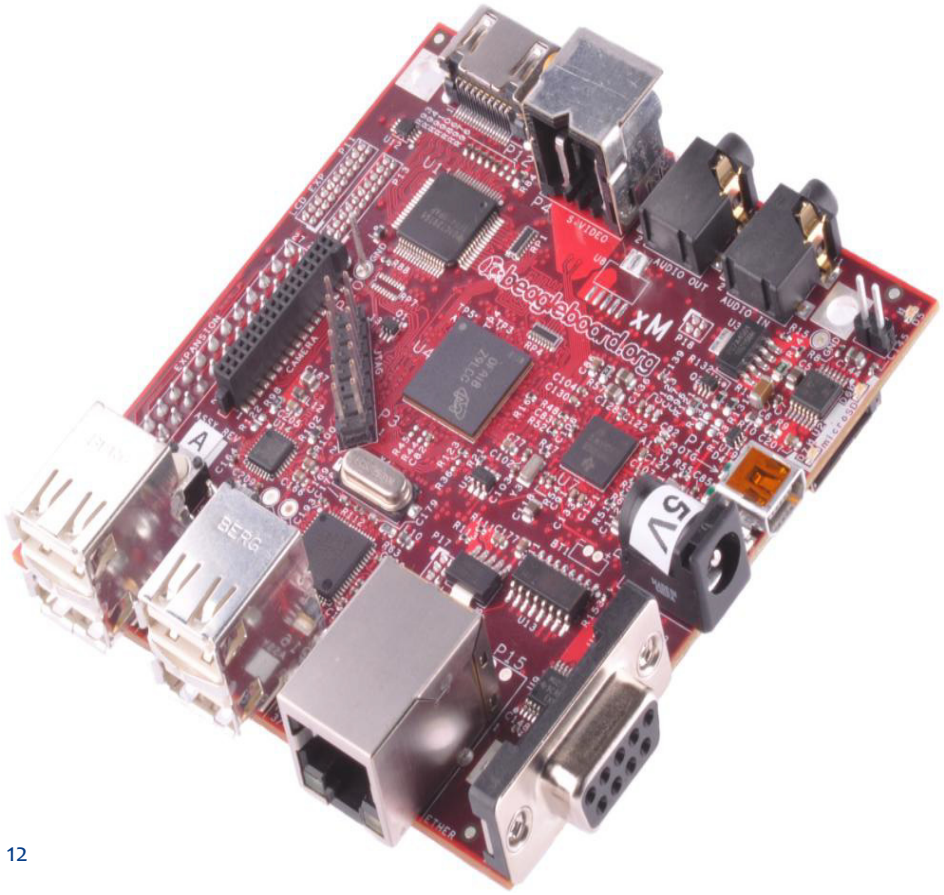

Port-Stern Control Fan
Port-Bow Control Fan
Power Supply 48V battery array
Open-loop control
Thrust Fan
Lift Fan
Navigation command uController/Power electronics
Bow/Braking Fan
Starboard-Stern Control Fan
Starboard-Bow Control Fan

Data Acquisition

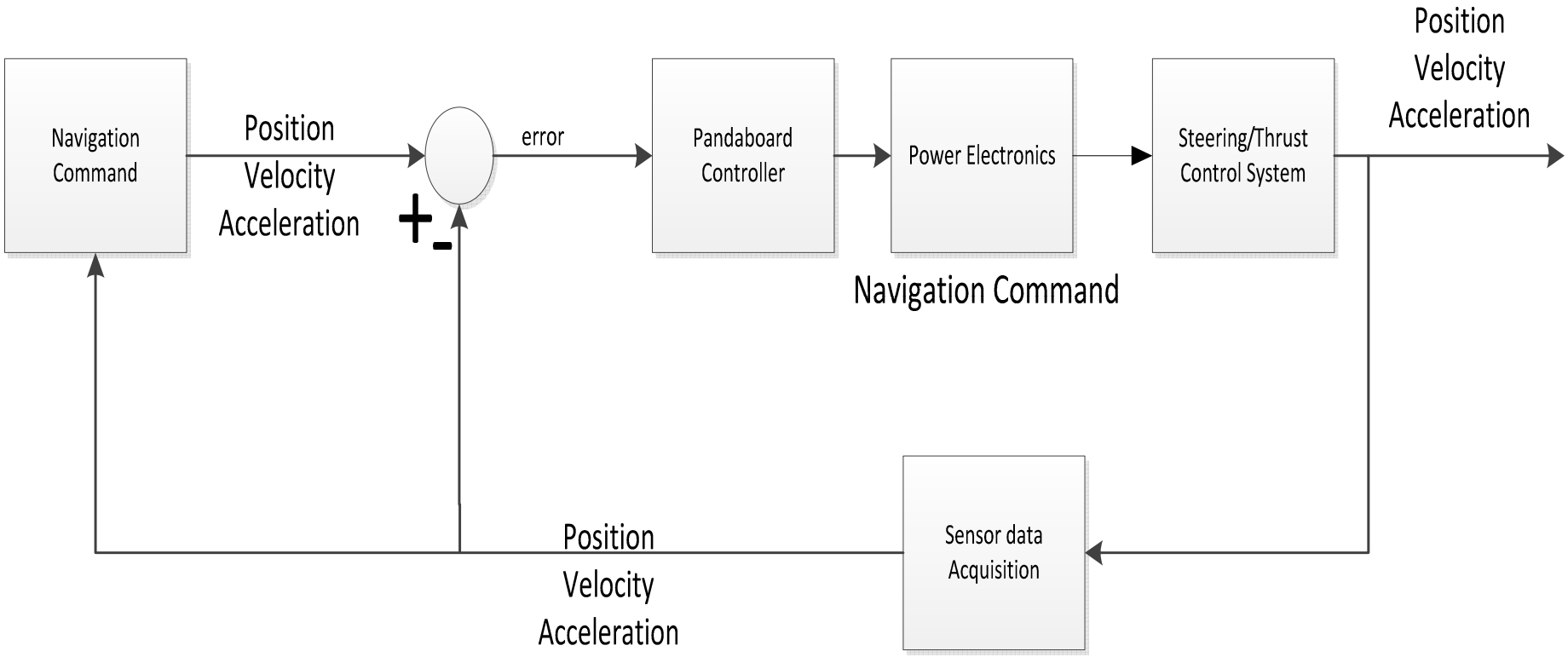


Software Environment





Control System



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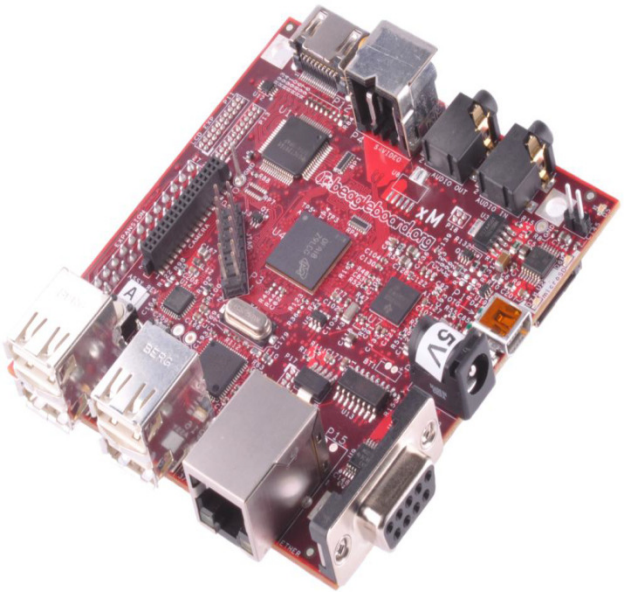
Work Done so Far Beagleboard

* Compiled and linked openCV libraries with projects
* Configured Angstrom on BeagleBoard
* Established communication between host pc and Beagleboard
* Configured BeagleBoard environment



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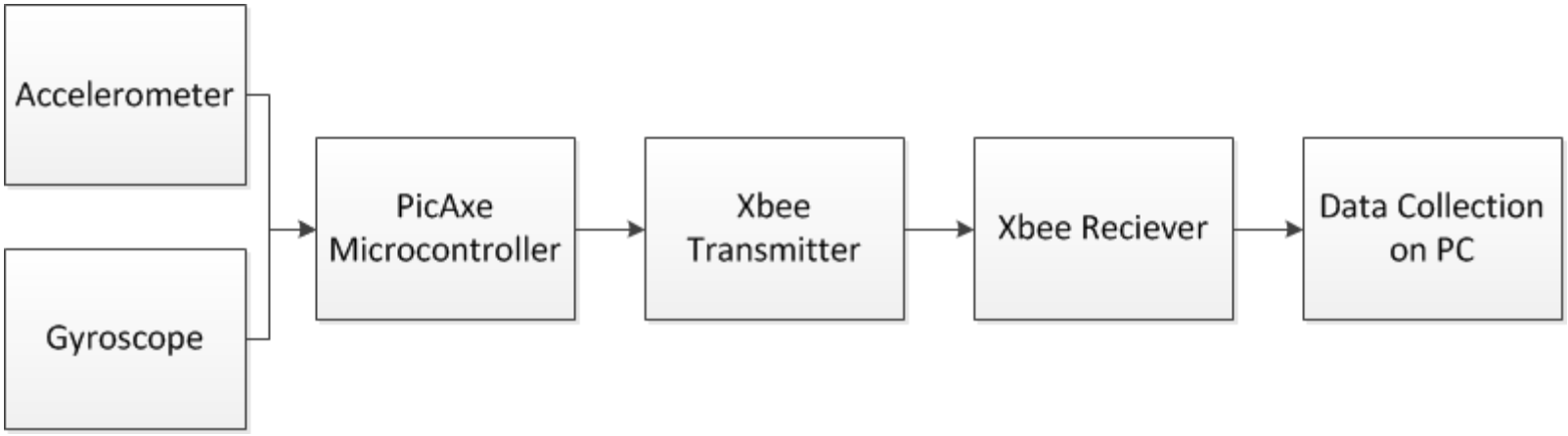
Work Done so Far
Communication

* Established wireless communication between data acquisition elements and uController



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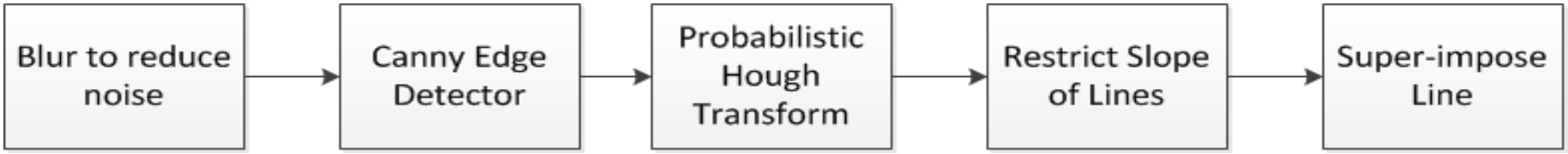
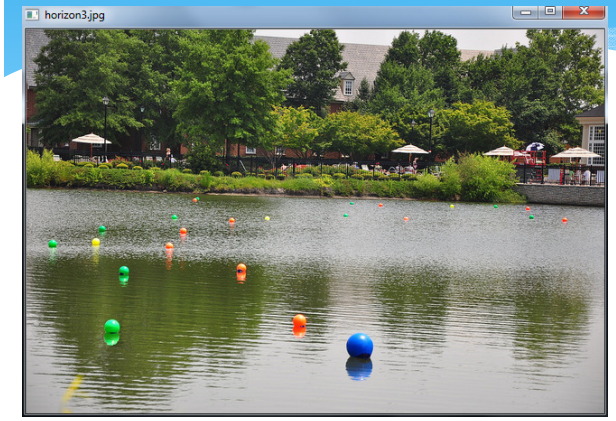
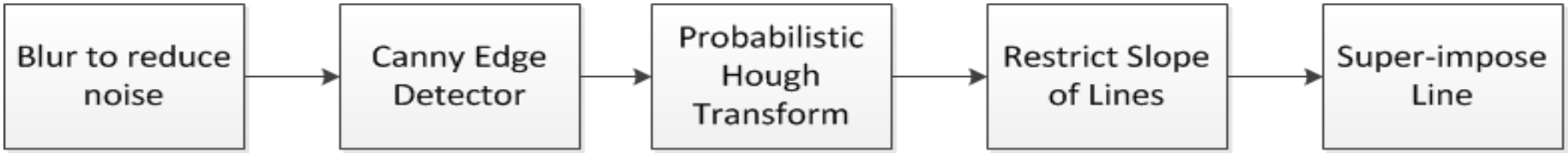
Work Done so Far
Horizon Detection

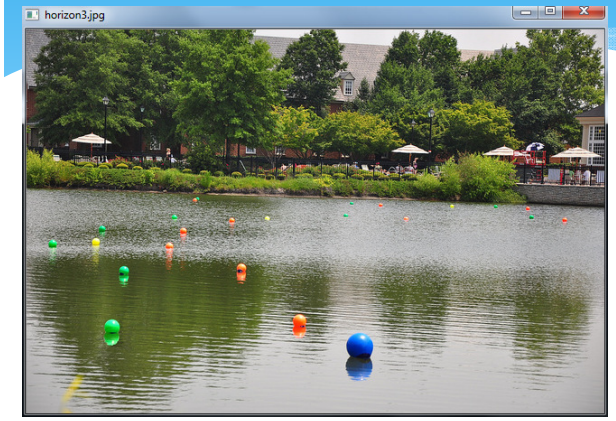


Work Done so Far
Horizon Detection



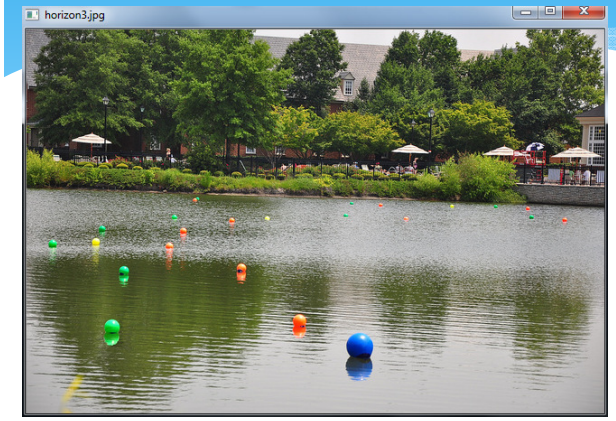


Work Done so Far
Horizon Detection



Blur to reduce noise → Canny Edge Detector → Probabilistic Hough Transform → Restrict Slope of Lines → Super-impose Line

Work Done so Far
Horizon Detection



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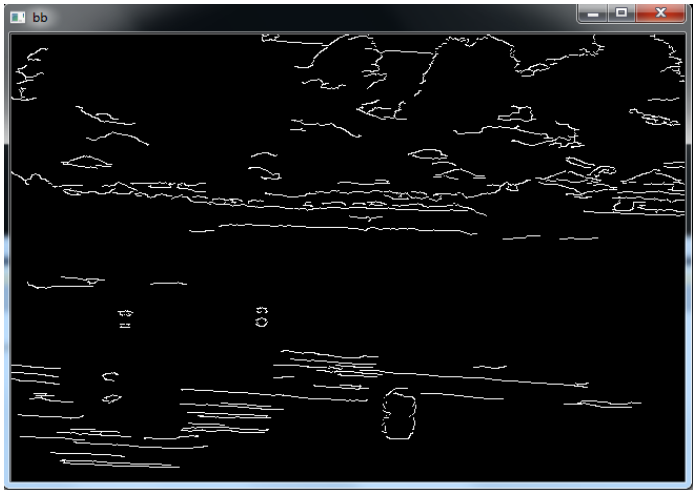
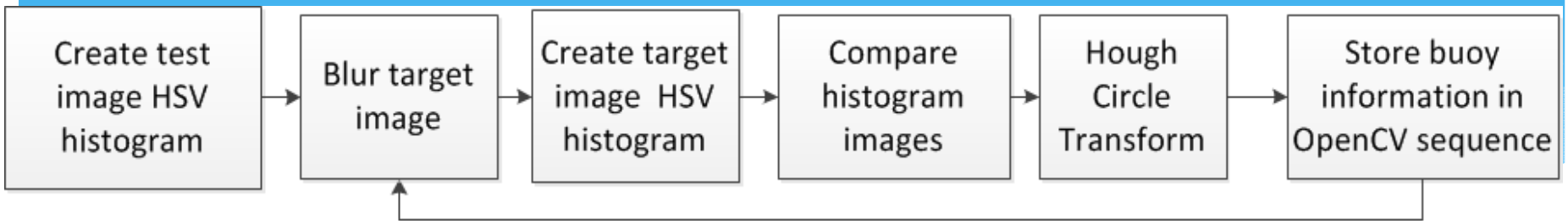


Buoy Detection



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Path Planning

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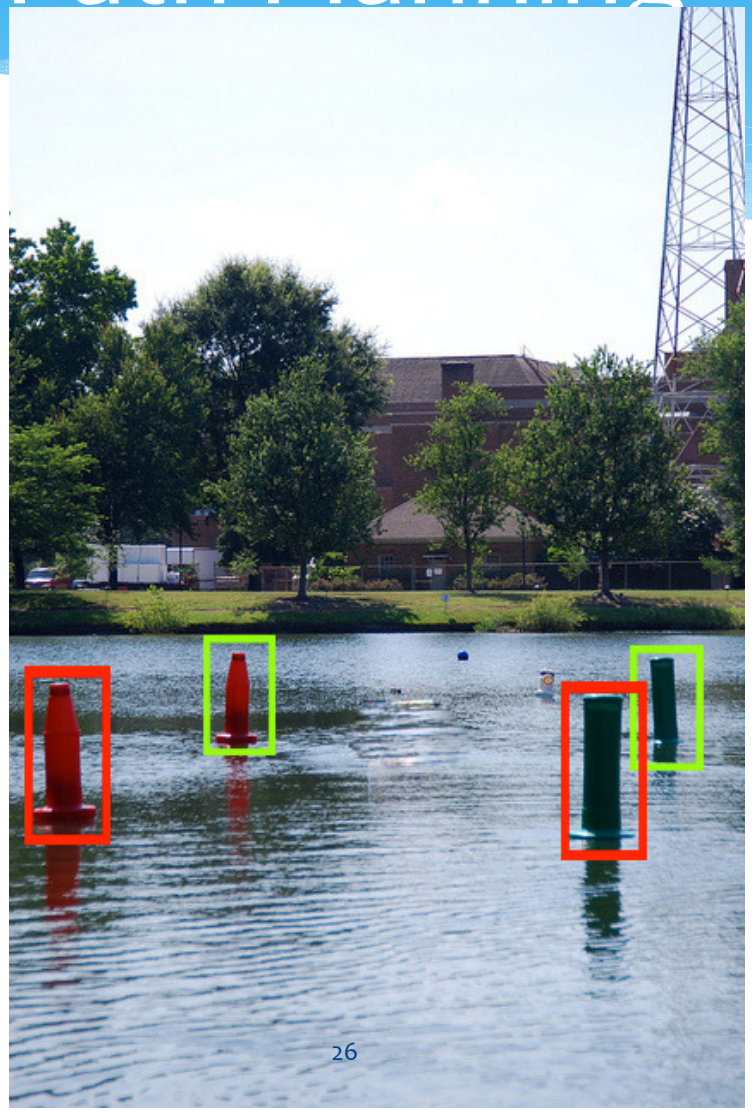
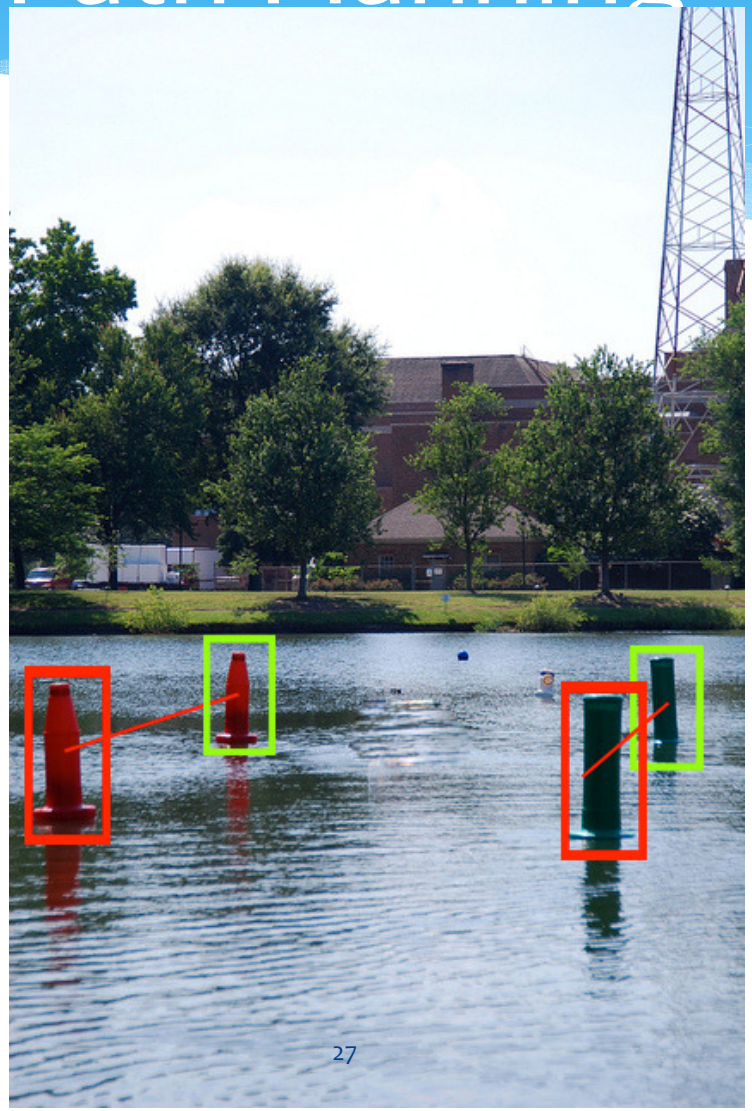
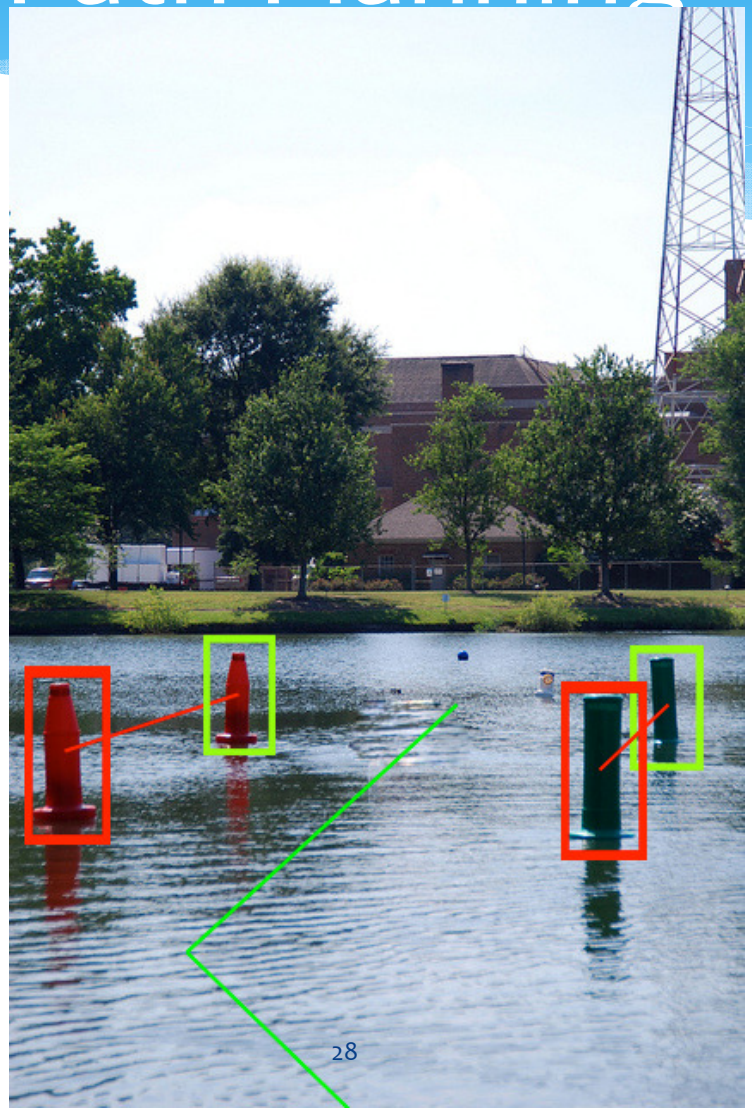


Path Planning



Path Planning



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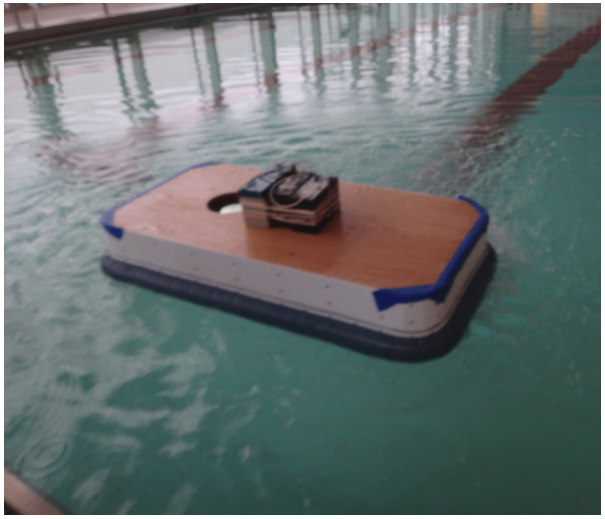
Work Done so Far
Boat

* Initial hovercraft prototype completed
* Mechanical Calculations



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Schedule

Weeks	Major Deliverable
13-Nov	
	Finalize BeagleBoard environment
	Have a prototype buoy detection program
	Begin design of communication channel between uC and BeagleBoard
	Perform mechanical testing on Mark 1 prototype (drag, acceleration, weight restrictions)
20-Nov	
	Gyroscopes and accelerometer communication channel finished
	Begin construction of communication channel between uC and BeagleBoard
	Continue to evaluate Mark 1 prototype

Schedule

Weeks	Major Deliverable
27-Nov	
	Decide whether to improve hovercraft platform or switch to a catameran platform
	Begin developing PID stabilization for craft
	Begin devoping path planning algorithm using buoy/horizon detection
Dec-Jan	
	Continually tune and develop path planning/stabilization controls. Finish high level command system.

Schedule

Weeks	Major Deliverable
Feb	
	Begin actual testing of fully integrated platform.
March	
	All high level designs will be done at this point. The controls and vision algorithms will be continually improved. Begin developing designs for bonus tasks.
April	
	Complete the design for any bonus tasks and begin the testing of these systems
May	
	Be able to demonstrate path planning and stable navigation for final presentation

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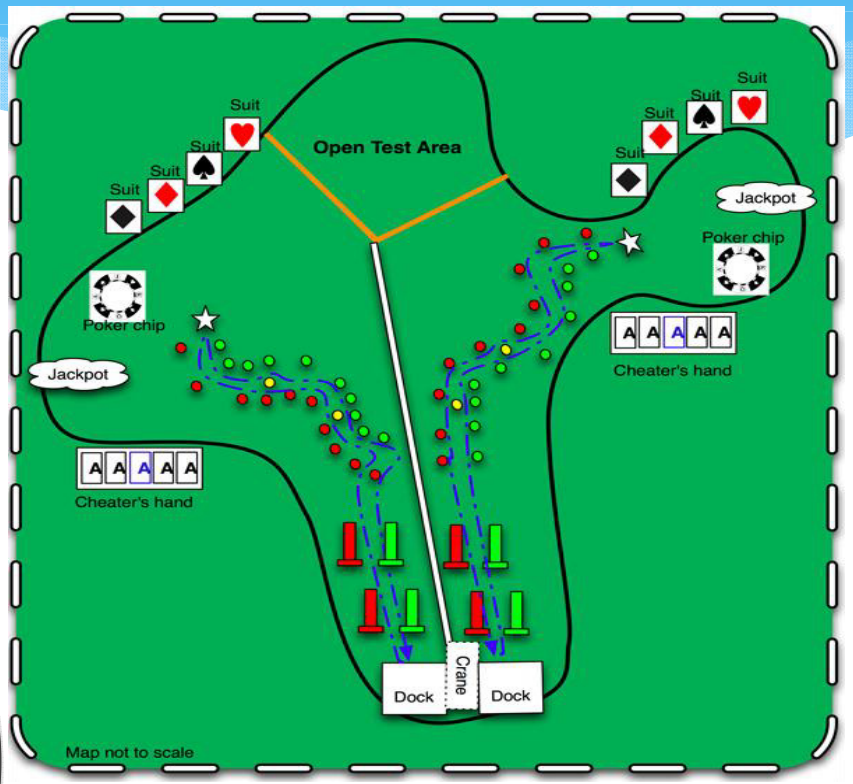
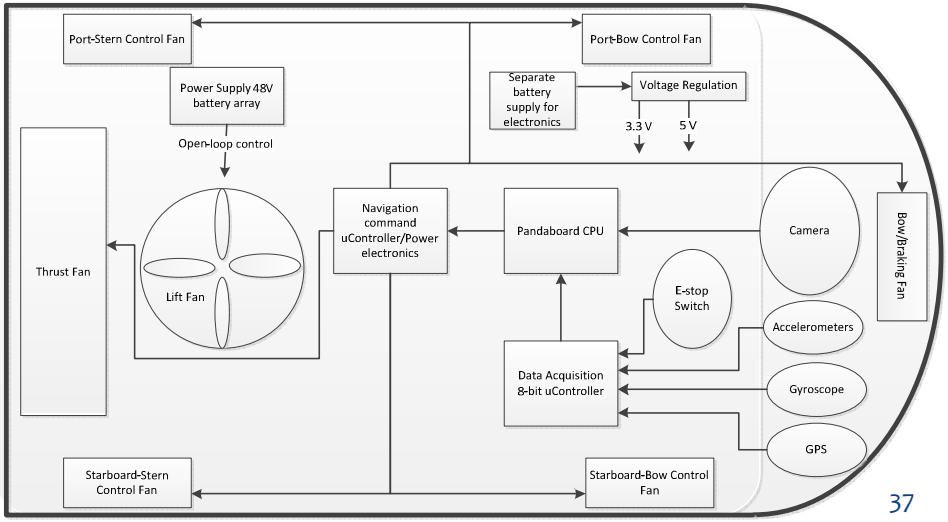
Equipment

* Lift Fan
* Main propeller for thrust
* 4x small thrust fans
* BeagleBoard
* 2x 8-bit microcontrollers
* X-Bee wireless adapters
* Camera
* Gyroscope
* Accelerometers
* Materials for final body of hovercraft

Questions?

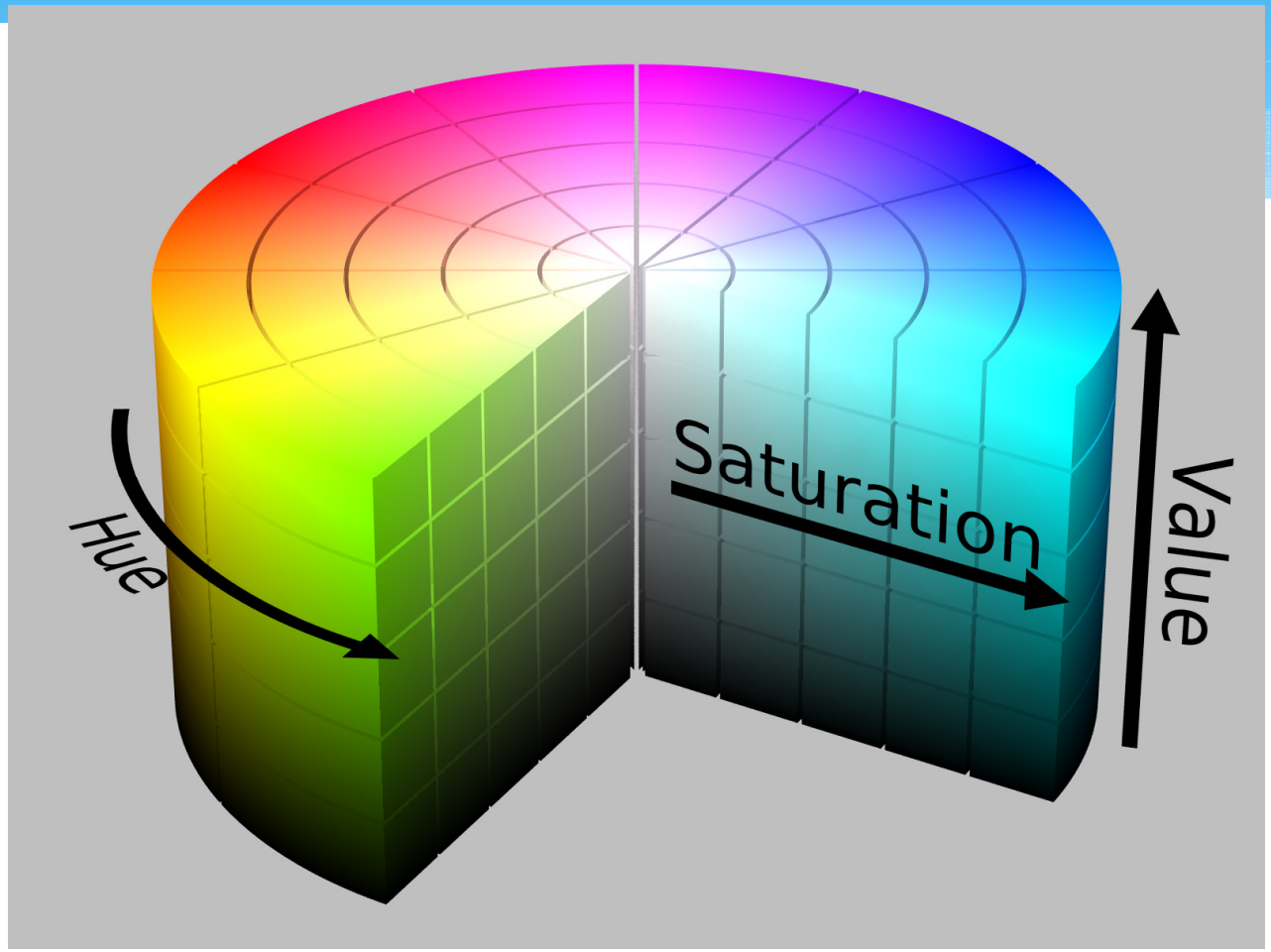

Open Test Area
Suit
Suit
Suit
Suit
Suit
Suit
Suit
Suit
Jackpot
Poker chip
Poker chip
Jackpot
A A A A A
Cheater's hand
A A A A A
Cheater's hand
Dock
Crane
Dock
Map not to scale


Port-Stern Control Fan
Port-Bow Control Fan
Power Supply 48V battery array
Separate battery supply for electronics
Voltage Regulation
3.3 V
5 V
Open-loop control
Thrust Fan
Lift Fan
Navigation command uController/Power electronics
Pandaboard CPU
Camera
Bow/Braking Fan
E-stop Switch
Accelerometers
Data Acquisition 8-bit uController
Gyroscope
GPS
Starboard-Stern Control Fan
Starboard-Bow Control Fan

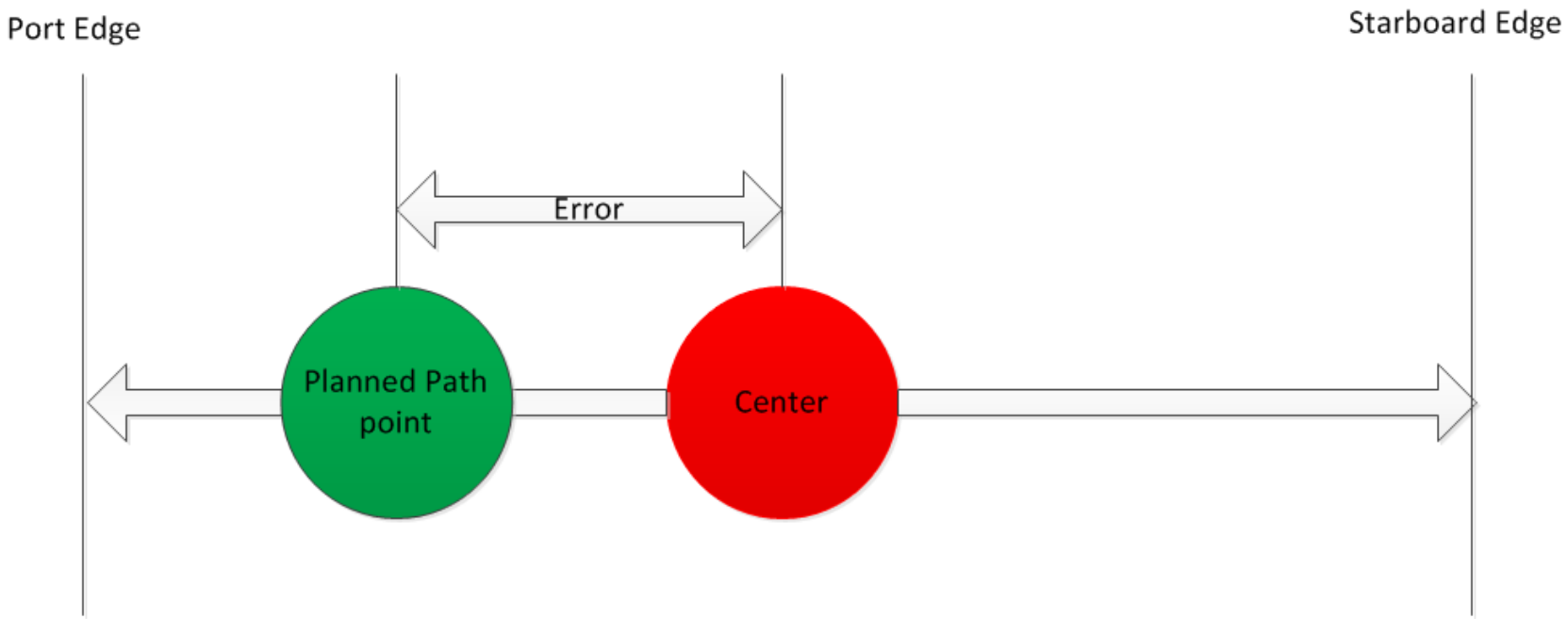
Sources

* [1] *"The Five Card Draw" 5th RoboBoat Competition - Preliminary Rules* Arlington, VA: AUVSIfoundation. PDF.

HSV chart



Control Signal



Control Signal