# Needs Analysis and Requirements Spec

Team FFSUB

Tuesday 27 September, 2011

# Introduction

Antony Jepson

# The Team - ECE

## Antony Jepson

- Lead PM
- Computer Engineering

## Ryan Kopinsky

- Lead Secretary
- Electrical Engineering

## Hang Zhang

- Treasurer
- Computer Engineering

# The Team - ME

## Eric Sloan

- PM
- Mechanical Engineering

## Kashief Moody

- Secretary
- Mechanical Engineering

## Tra Hunter

- Lead Treasurer
- Mechanical Engineering

# Background

AUVSI foundation
ASSOCIATION FOR UNMANNED VEHICLE SYSTEMS INTERNATIONAL

ONR
Office of Naval Research

SPAWAR

July 2012, SSC Pacific TRANSDEC, San Diego, CA

# Goals

- Learning and outreach
- Education in system design

# Point System

- Most points = WIN
- Points based on
  - Documentation
  - Design verification
  - Performance

# Customer Needs Analysis

Eric Sloan

# Customer Needs Analysis

- Statement of the Problem
  - Design and Construction
    - Autonomous Underwater Vehicle (AUV)
  - Documentation
    - Journal Paper
    - Video

# Required Capabilities

- AUV
  - Operate autonomously
  - Complete the six required underwater tasks
  - Submerge and remain submerged during mission (unless specified by a particular task)
  - Waterproof electronics
  - Kill Switch
  - Slung on harness during transportation (safety purposes)

# Required Capabilities

- Journal Paper
  - Describe each aspect of our design
  - Provide reasoning for design choices
- Video
  - Introduce design team and approach to the event

# Desired Capabilities

- AUV
  - Lightweight
  - Fast/Efficient
- Journal Paper
  - Clear and concise
  - Include images of Pro/Engineer model of device and components/subsystems
  - Include images from simulations and testing environment

# Desired Capabilities

- Video
  - Clear and concise
  - Convey strong team cohesiveness
  - Convey enthusiasm about both the design and competition

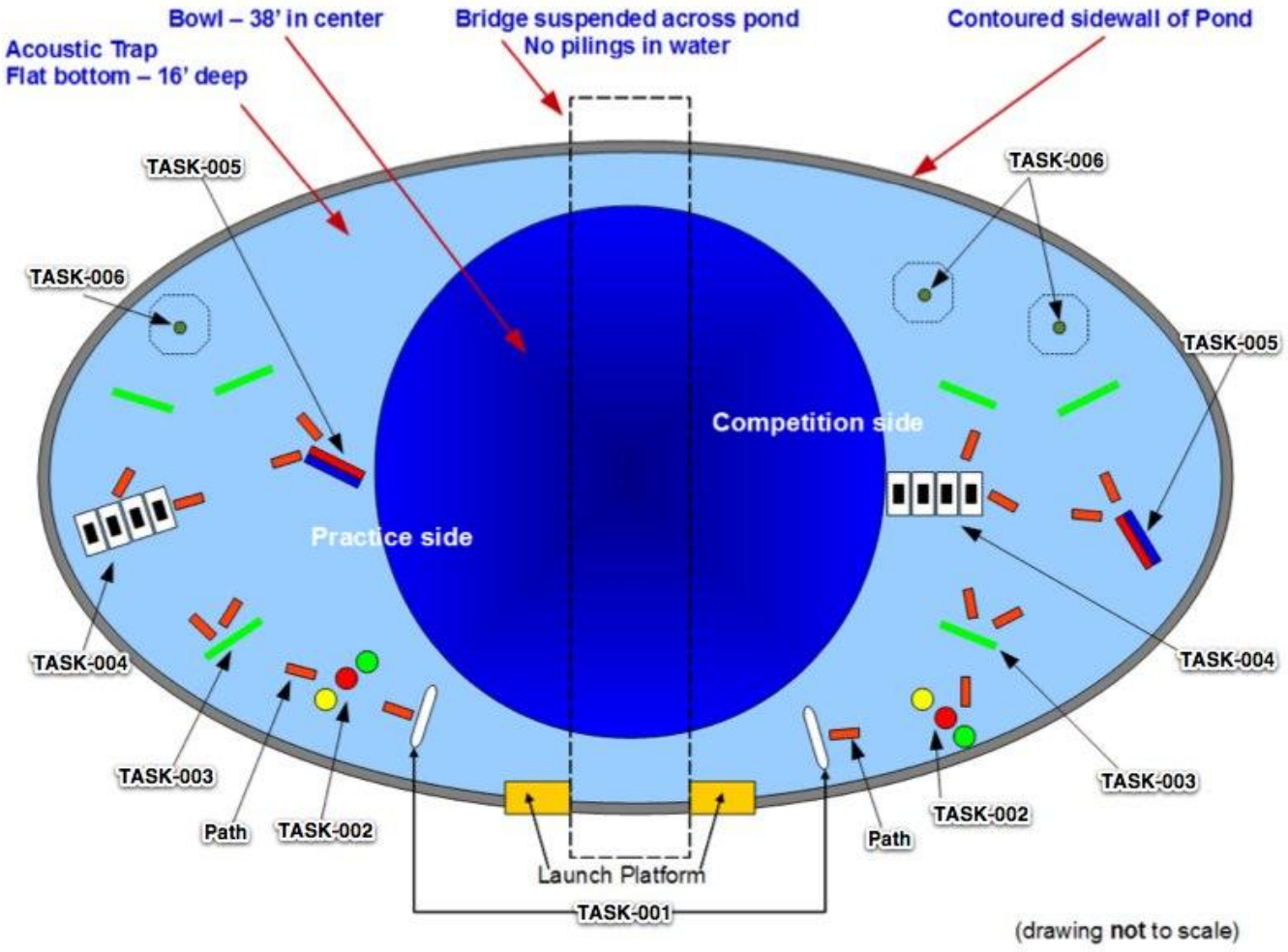
# Operational Description

- Sense surrounding environment
  - Colors, shapes, and sounds
- Sense the dynamics of the vehicle
  - Position, velocity, acceleration, and orientation
- Interpret sensory information via a central control unit
- Design a control system to
  - Propel the vehicle in the proper direction
  - Stabilize the vehicle during the mission
  - Achieve the desired depth of the vehicle
  - Complete the six required tasks

# Obstacle Course

Ryan Kopinsky

# Obstacle Course

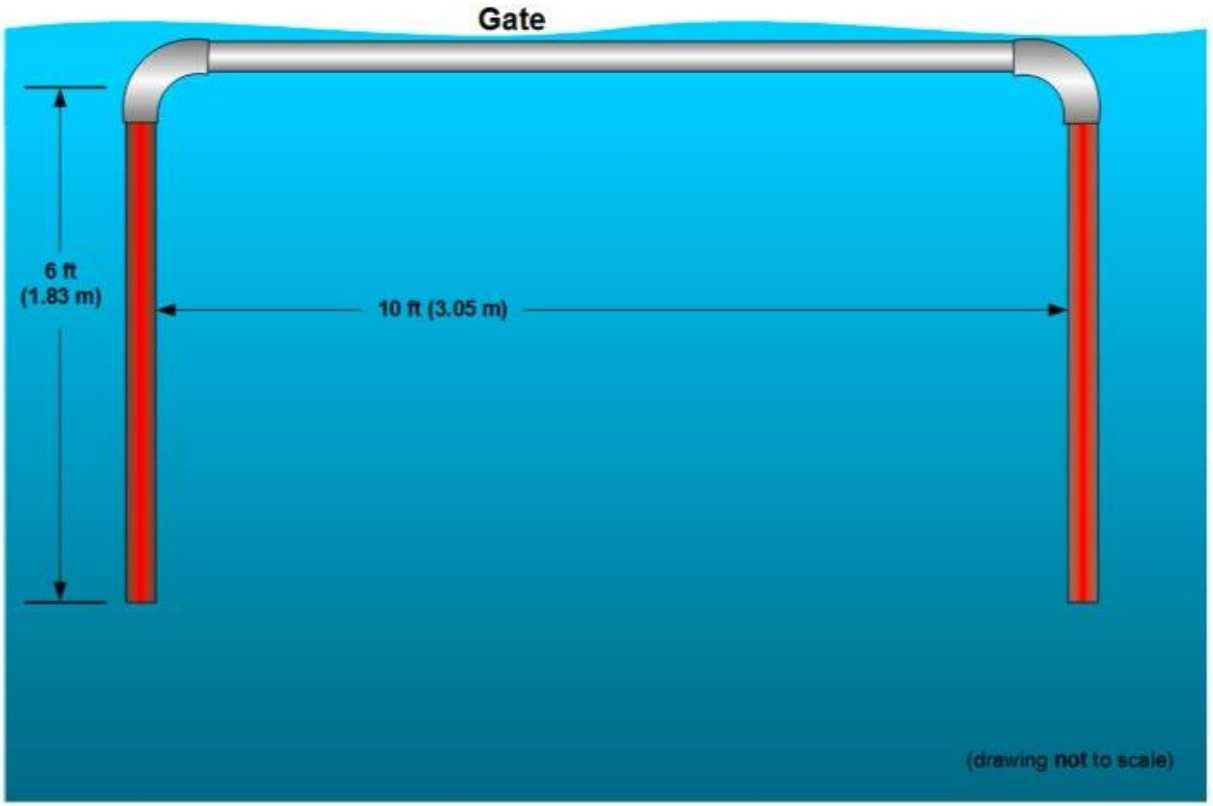


# Path Tracking

- PVC Line Segments
- Guide through Obstacle Course
- Relative angle between segments ≤ 90º

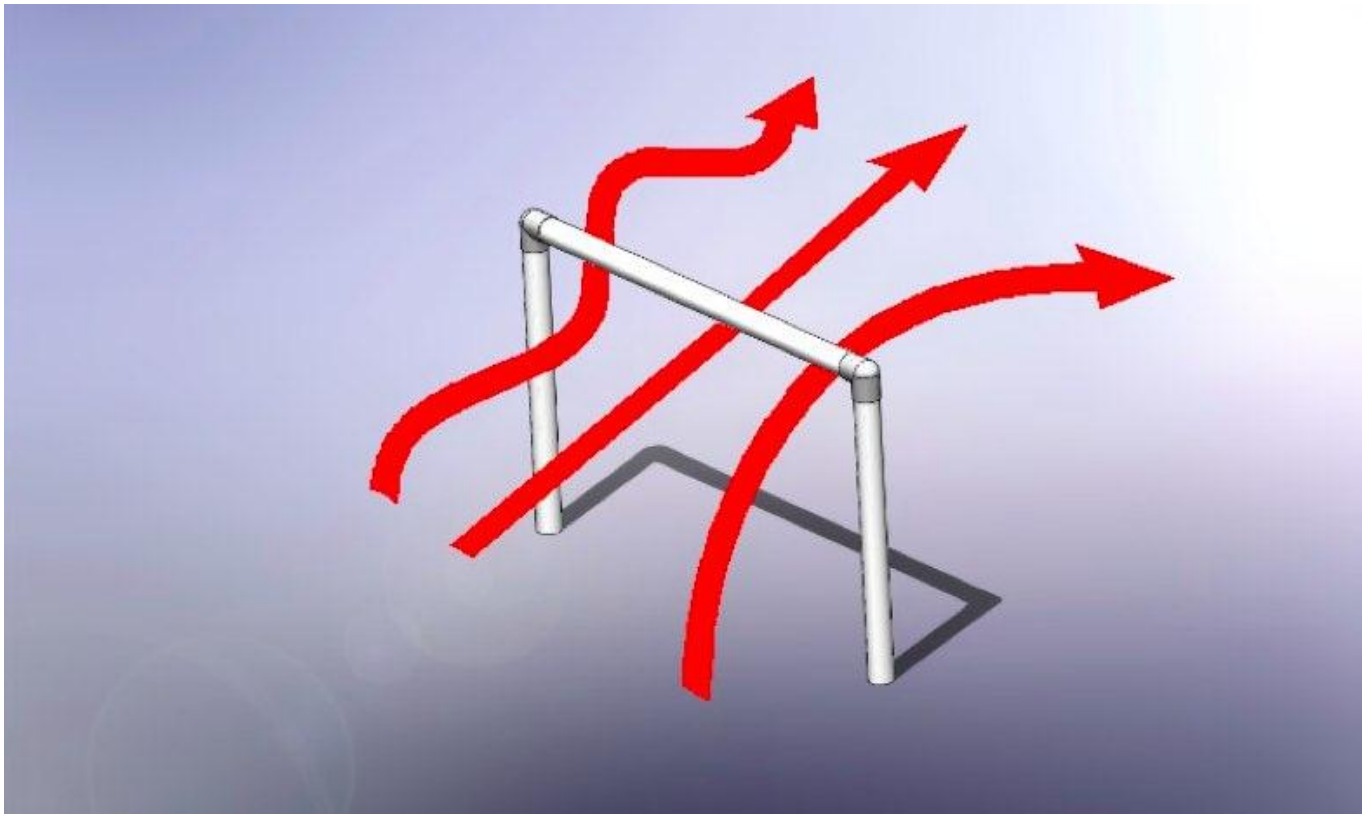
# Gate

Navigate through Gate



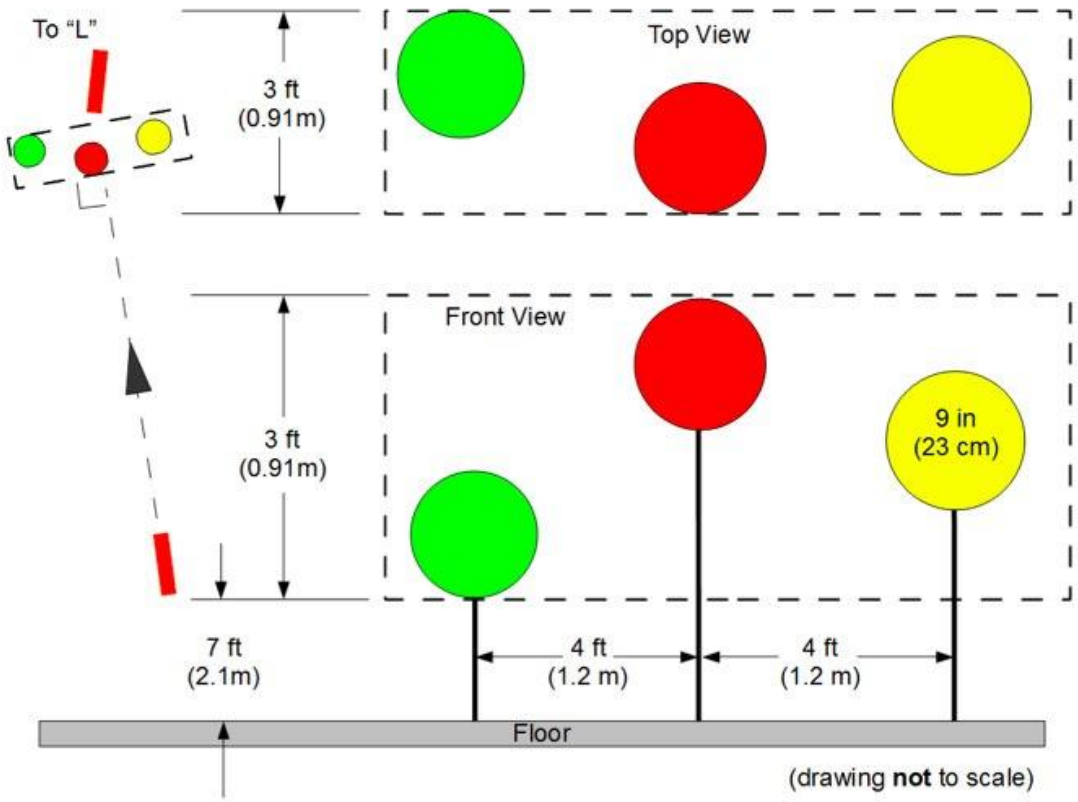
# Gate

Navigate through Gate



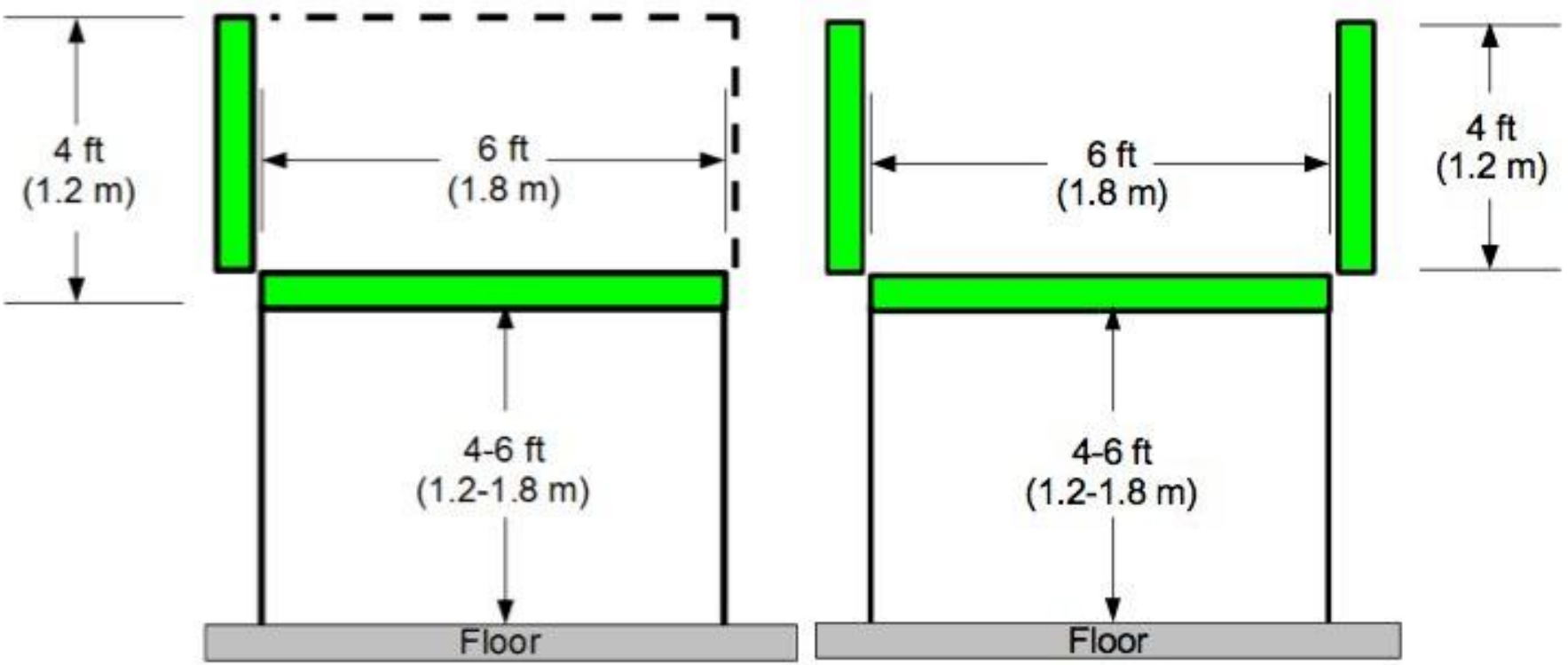
# Buoys

Hit Specified Buoys



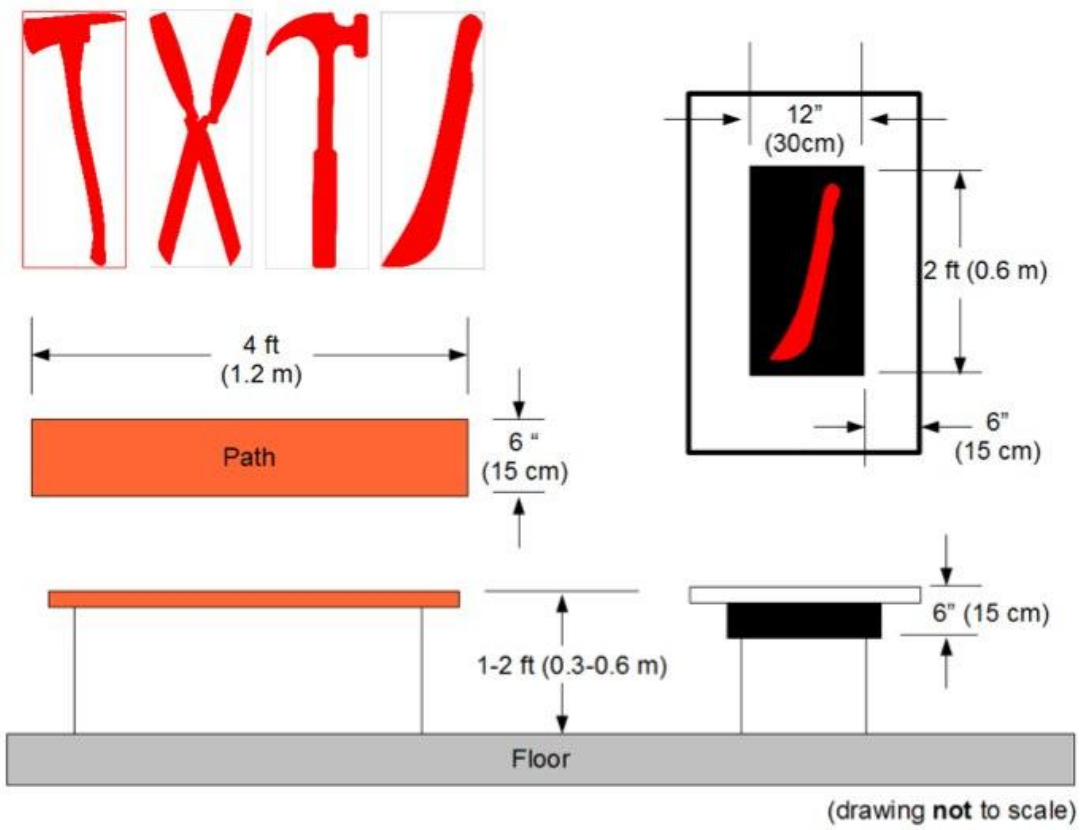
# Box Crossing

Pass through Box



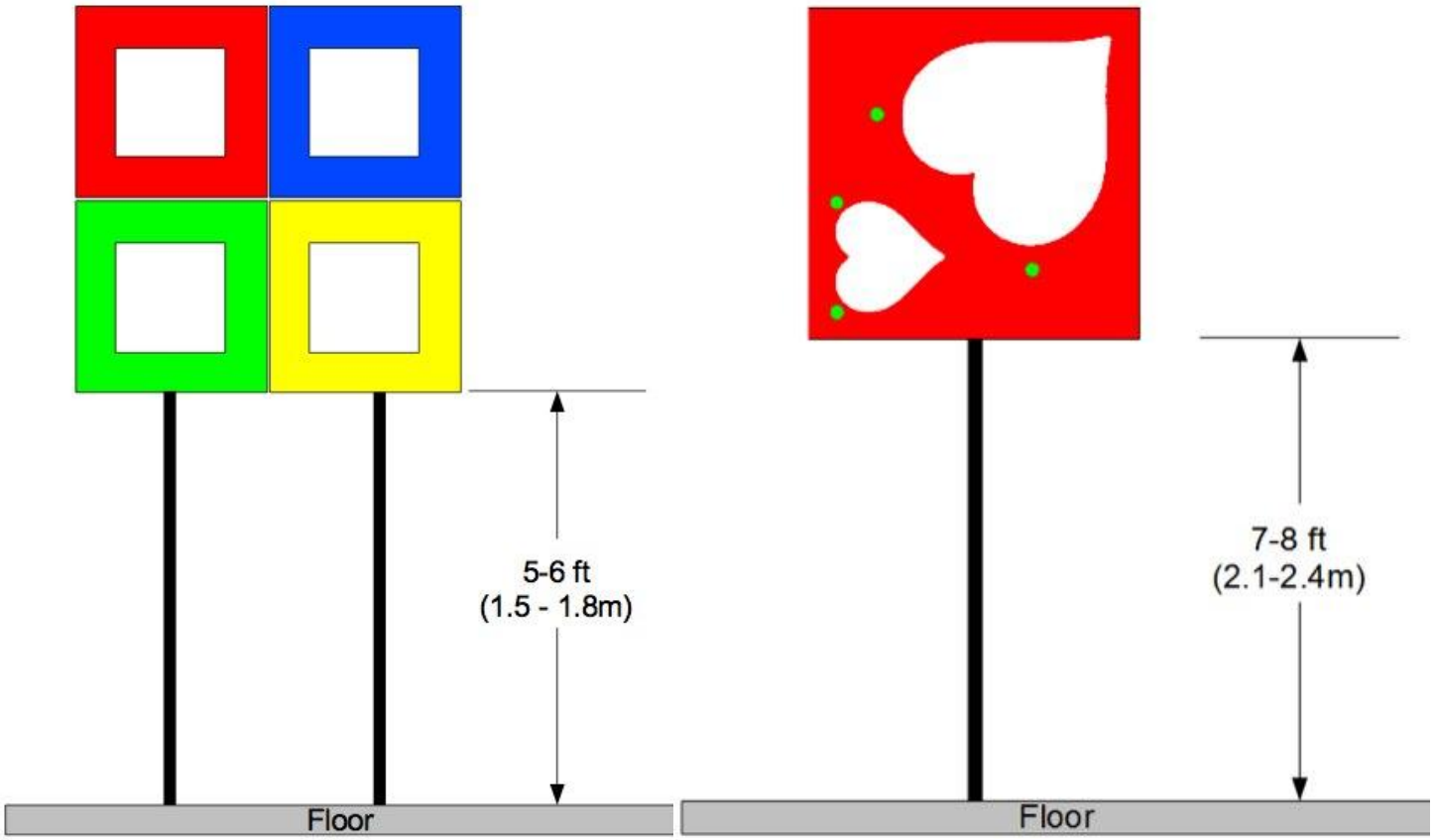
# Drop-in-bin

Drop Markers in Specified Bins



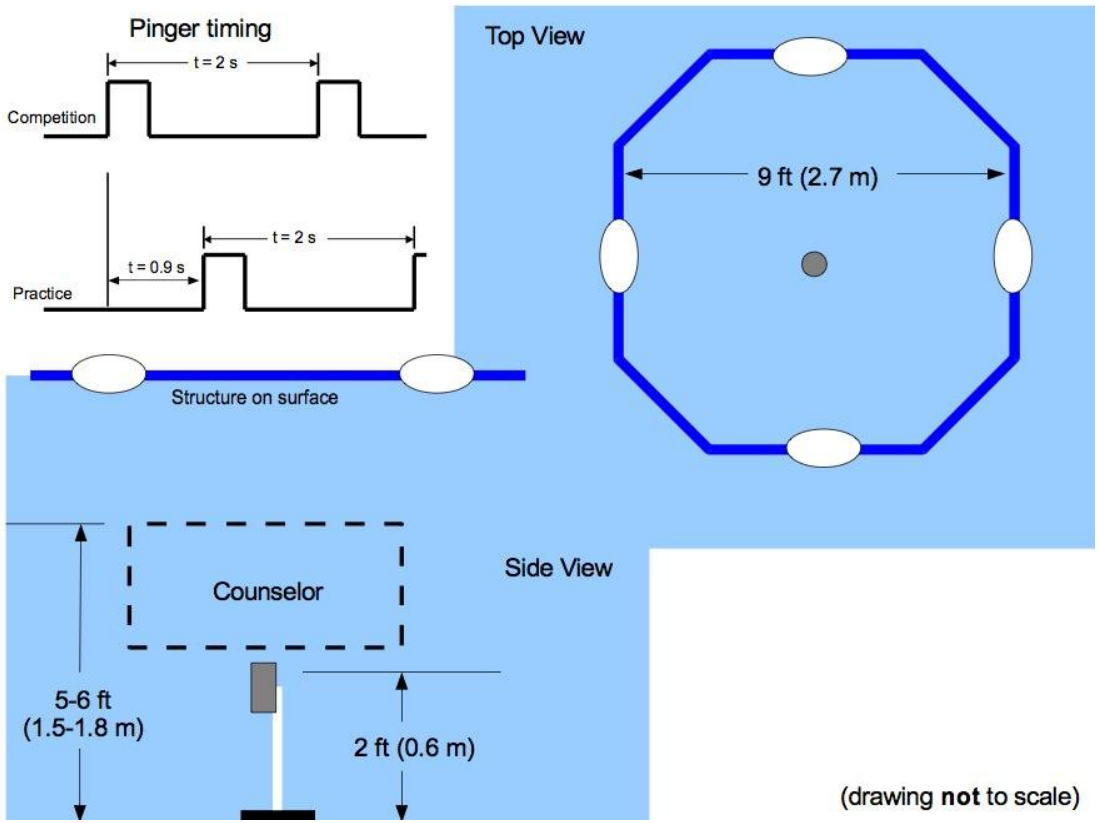
# Fire Torpedoes

Fire Torpedoes through Cut-outs



# Locate and Recover

Surface, Recover, Transport and Drop-off



# Eng. Requirements / Wants

Hang Zhang, Kashief Moody

# Functional Requirements

- Mobility
  - Thrusters
- Hardware Interfaces
  - ARM and/or x86 processor
- Software Interfaces
  - Process multiple data streams simultaneously

# Functional Requirements

- Obstacle recognition and path tracking capabilities
  - Based on cameras and image processing
- Sensing
  - Velocity
  - Orientation
  - Acceleration
  - Depth
- Depth processing
  - Input: Data from sensors
  - Output: Proper mechanical function


IMU

# Functional Requirements

- Timing
  - 15 minutes  to complete all tasks
  - Reasonable speed required
- Kill switch
  - Clearly marked
  - Disconnect the batteries
- Buoyancy
  - ≥ 0.5% of its mass
- Marker and torpedo
  - 1.5” x 1.5” x 6” (3.81 cm x 3.81 cm x 15.24 cm)
  - < 1.5lbs (0.68 kg) in air

Torpedo

# Non-Functional Requirements

- Typically some form of constraint or restriction that must be considered when designing the solution
- Differs from functional requirements by defining how a system is supposed to be, rather than what it is supposed to do

# Non-Functional Requirements

- Vehicle must be battery powered
- All batteries must be sealed
- Batteries may not be charged inside of sealed vessels
- Open circuit voltage of any battery (or battery system) should not exceed 60 VDC
- All propellers must have a shroud with a minimum 2” spacing
- No materials may be released by the vehicle into the waters of the arena
- Vehicle must complete the competition in 20 minutes

# Constraints

- Team-implemented limitations placed on the development of the system

# Constraints

- The device should not have any sharp corners / edges
- The production and travel expenses cannot exceed the donated funding amount

# Engineering Wants

- Data Logger
- Custom Control Dashboard
  - Remote Control Capabilities
- Cooling Management
- Aesthetics

# Test Plan

Tra Hunter

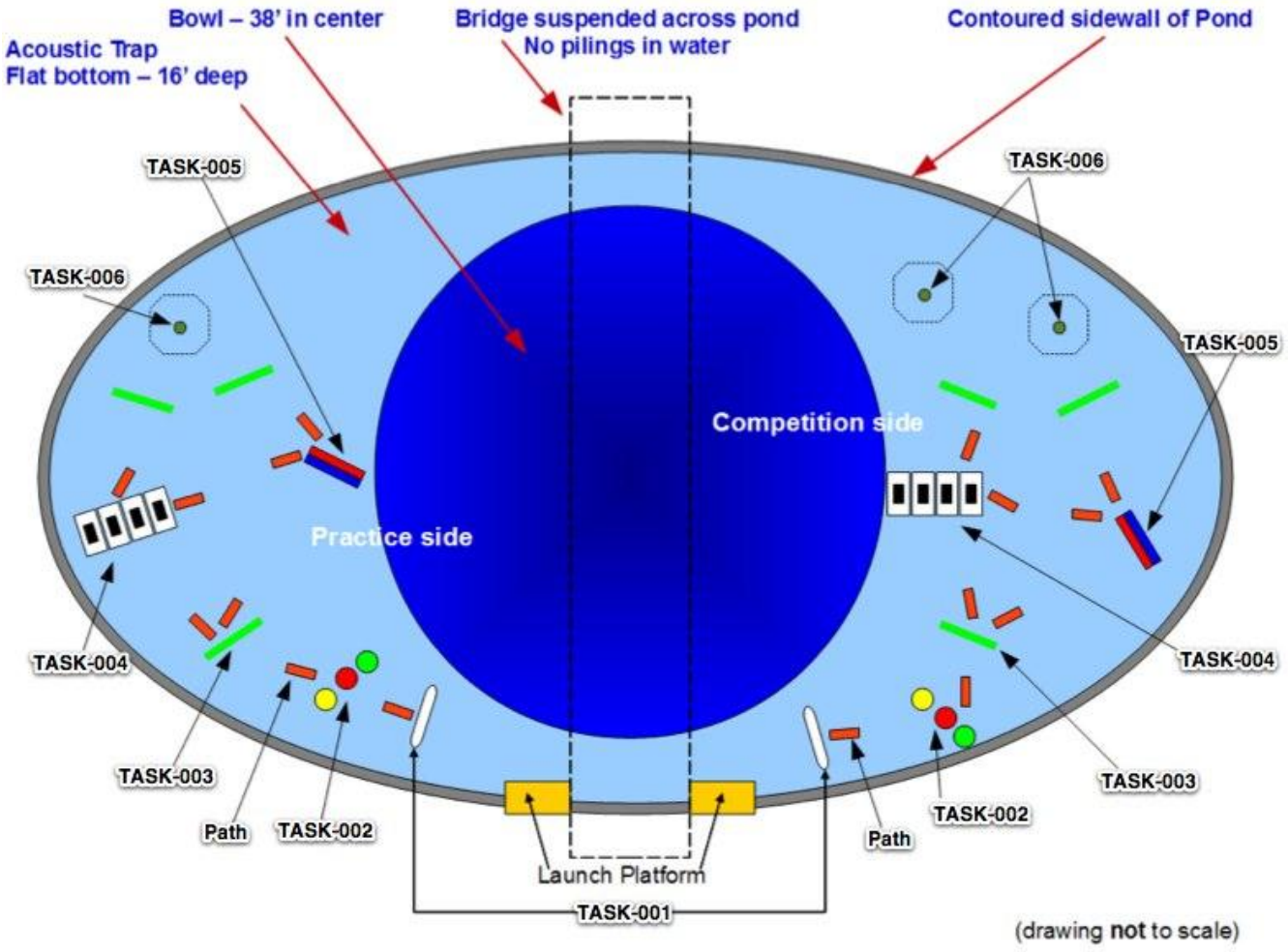
# Waterproof Test

- Electronics Enclosure
- Test Plan

# Unit Testing

- Grabbing Arm
- Launching Mechanism
- Object Release
- Thrusters
- Buoyancy Control
- Codes/Subsystems


# Competition Tasks



# Design Verification

- Performance Testing
- Reliability Testing
- Compliance Testing

# Conclusion

Antony Jepson