ECE RoboSub Senior Design

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October 23, 2015

Association for Unmanned Vehicle Systems International (AUVSI) RoboSub Competition

Using 2015 year
Competition Rules

- Under 125 lbs
- Find colored buoys
- Release markers
- Swim over obstacles
- Grab and carry a target
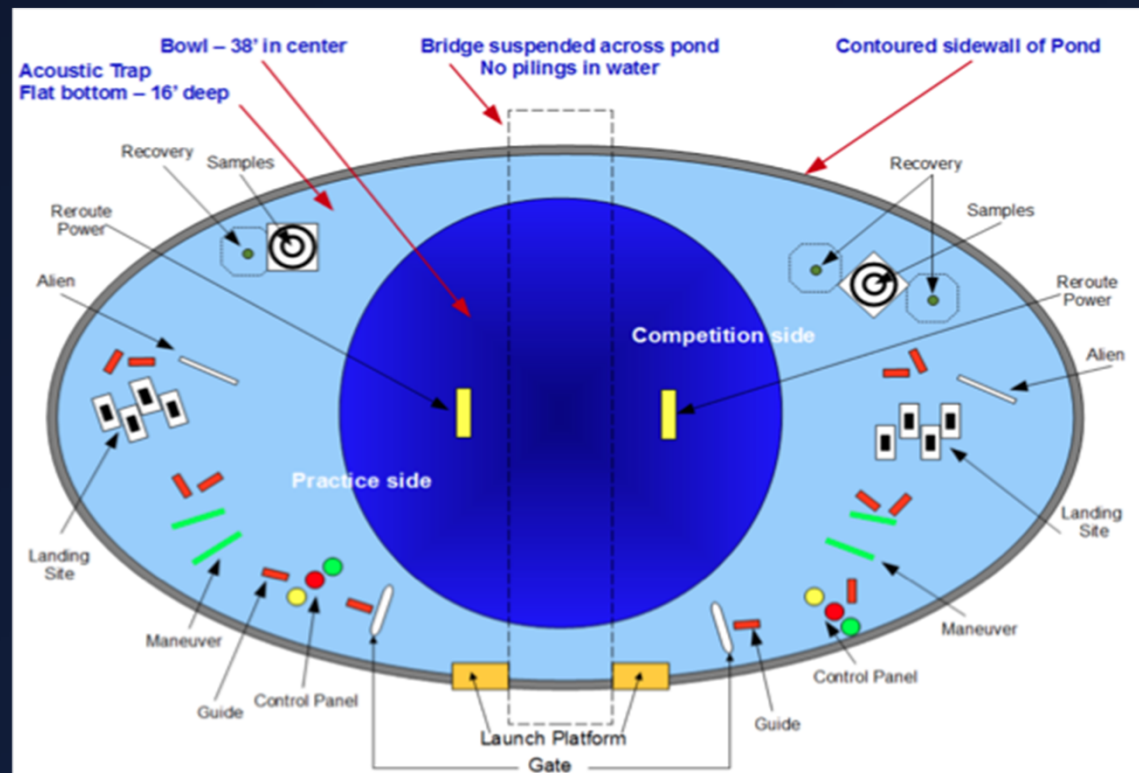- Fire torpedos
- Locate a pinger

Figure 1. Competition Setting

Objectives

- To Create a Robotic Submarine meeting the requirements of the annual AUVSI Competition
  - Under 84 lbs.
  - Identify the orientation and color of different shapes
  - Fire a torpedo at specific targets
  - Use a claw to pick up and move certain objects
  - Drop markers in certain containers

Previous Team's Work:

- A hull with a cubic design

- 6 thrusters to rotate, move up, down, forwards and backwards

- Cameras with code to identify orange lines

- A depth sensor

- Coding that implements navigation

What we have

- Sealed Frame
- Front and Bottom Cameras
- 6 Thrusters
- Zotac
- IMU
- 3 Motor Controllers
- Arduino Mega
- Arduino Uno

Figure 2. Current RoboSub

RoboSub Collaboration

- We are collaborating with the ME RoboSub team

- Two separate teams working on the same AUV

- Splitting different subsystems and tasks between groups

- Some tasks may overlap into work from both teams
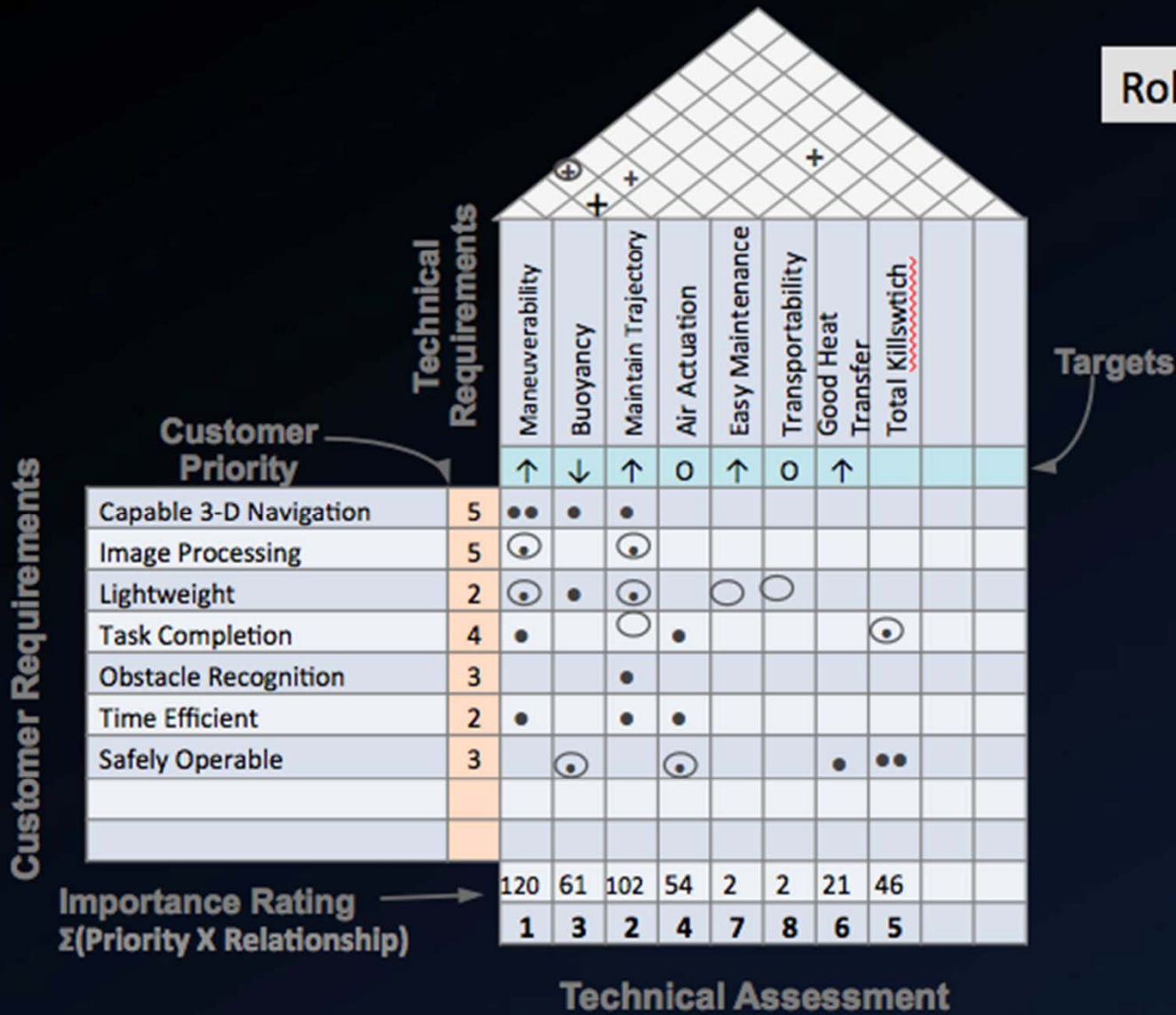
Design Tasks

Figure 3. Torpedo Design

ECE Tasks

- Navigation refinement
- New visual computation

ME Tasks

- Potential new hull design
- Remade torpedos
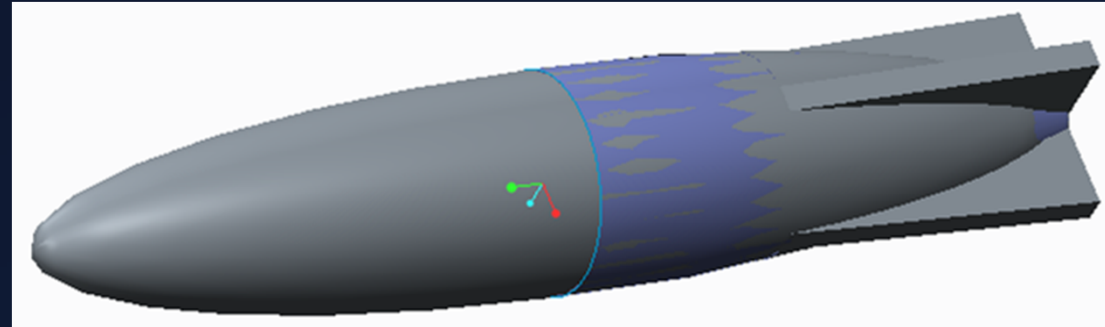- Marker distributer
- Gripper construction
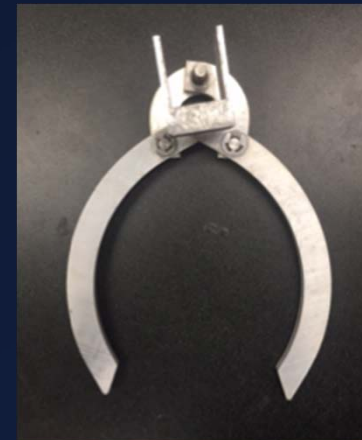
Figure 4. Previous Gripper

Status of Thrusters

- Failed out of water testing
- Debug code
- Stabilize maneuverability for testing
- Only forward, backward, up, and down

Figure 5. Seabotix Thrusters

Goals: Thrusters

- Get additional or rearrange current thrusters
- Optimize thruster placement for forward and lateral movement
- Implement prototype for y-based movement

Figure 20: Thruster Layout
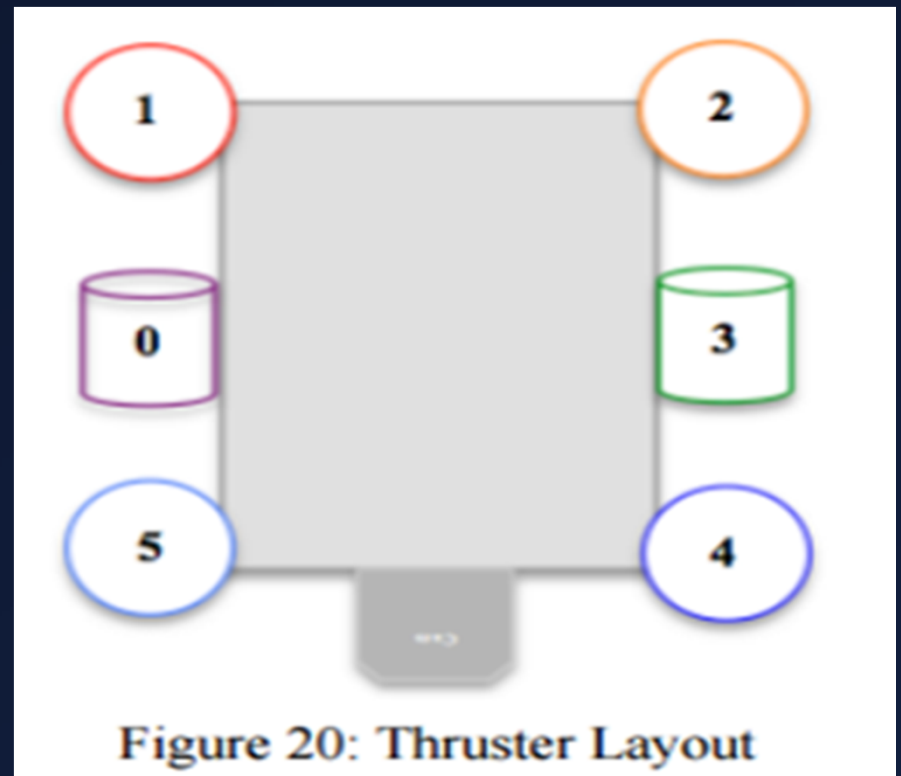
Figure 6. Current Thrusters Layout

Video Processing

- Finalize code allowing for multiple shapes and color recognition

  - Constant analysis of data

  - Implement image transformations

  - Determine the orientation of obstacles

  - Be able to identify the following colors:

    - Red, Orange, Yellow, Green, Purple

Line Orientation
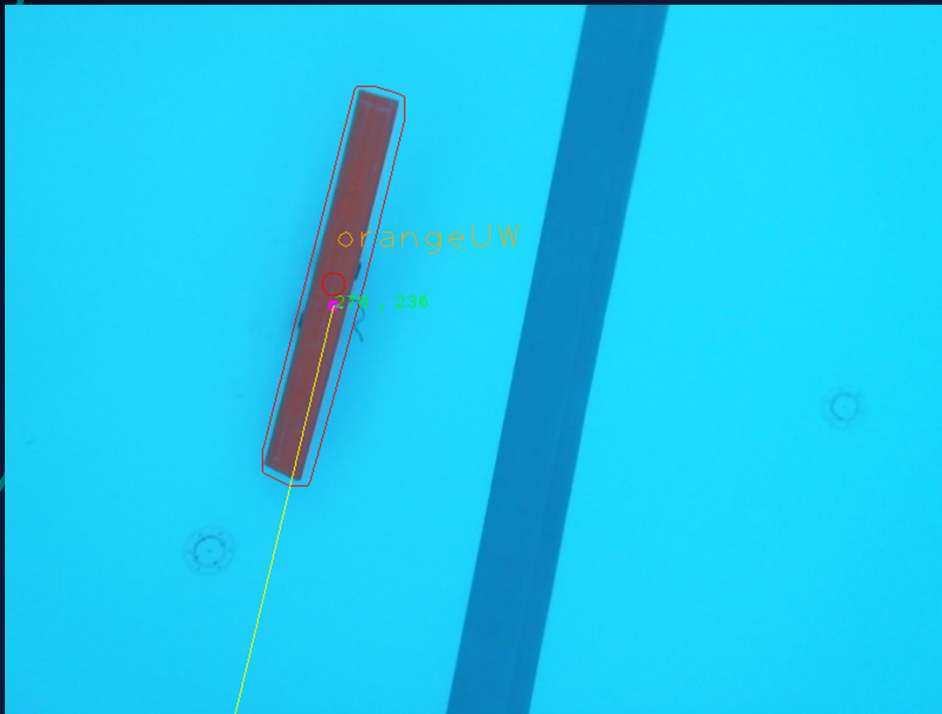
Figure 7. Old Robo Line handling
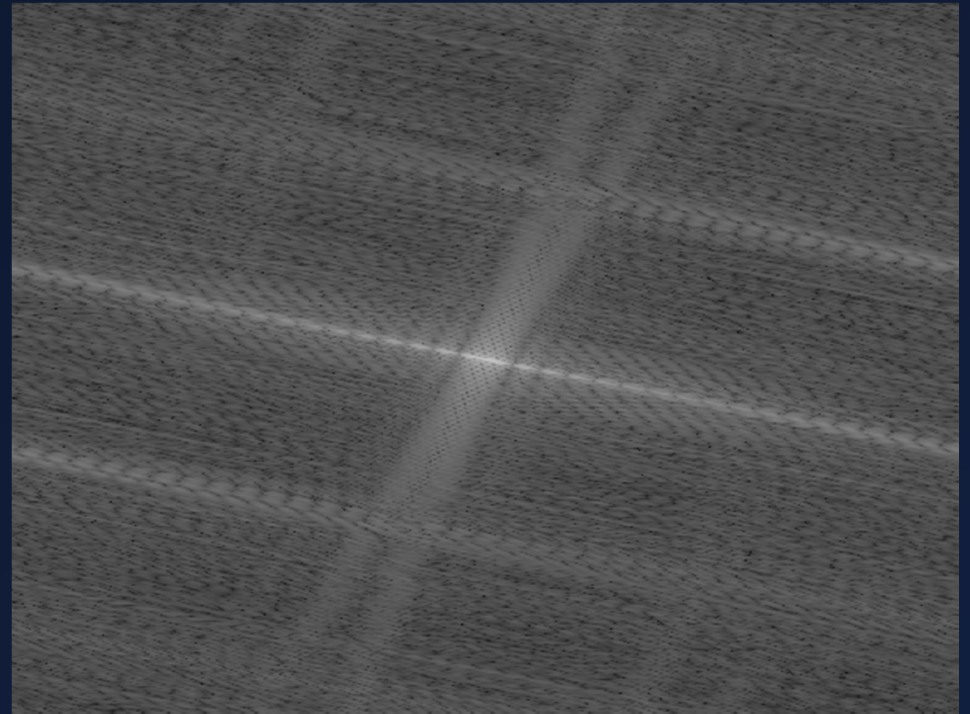
Figure 8. Fourier Transform of fig. 7

Gate Picture

Corresponding Fourier Transform

Figure 9. Actual Picture of Gate

Figure 10. Fourier Transform of Figure 9

Travis

10/23/15

13

Potential Risks/Problems

- Navigation debugging becomes lengthy
- New visual code setback
- Parts shipping slow
- Existing parts breaking down
- Interface between ME and ECE subsystems
- Potential water damage to internal parts

Gantt Chart

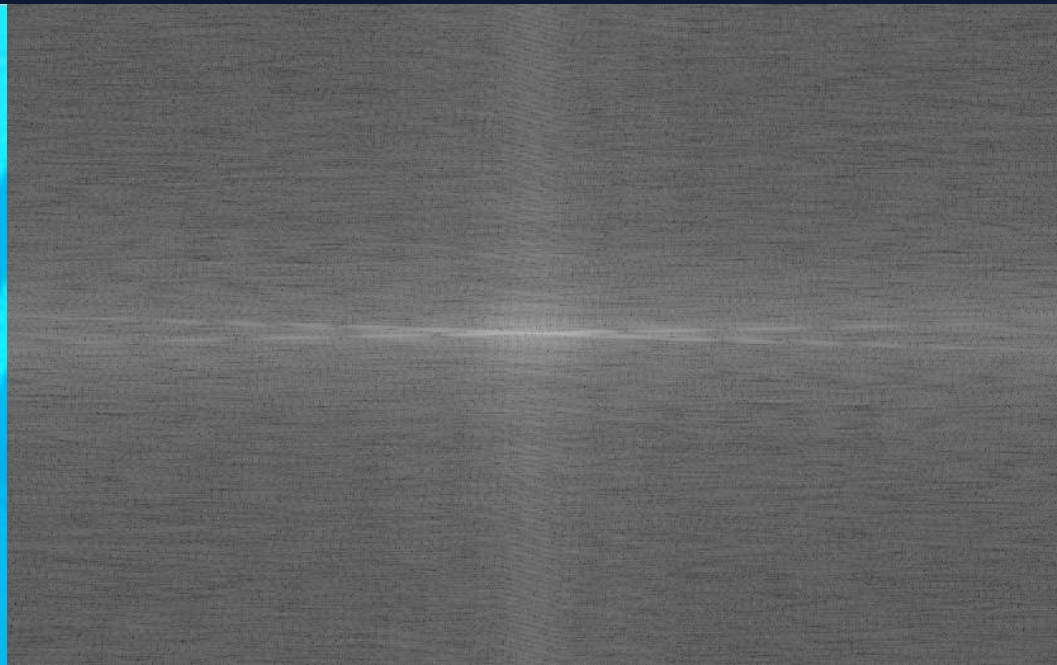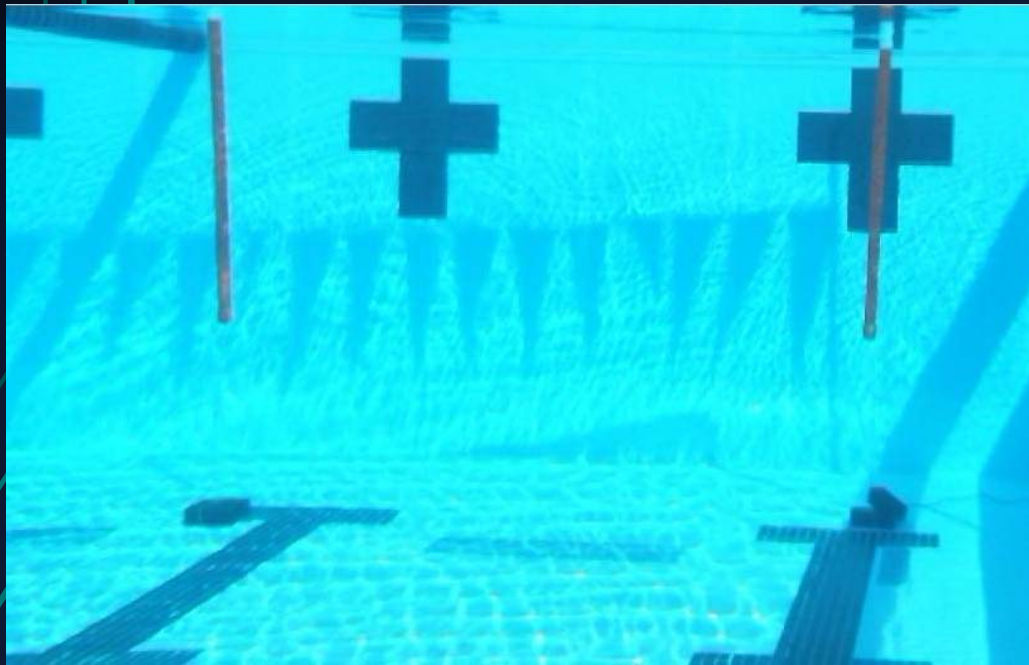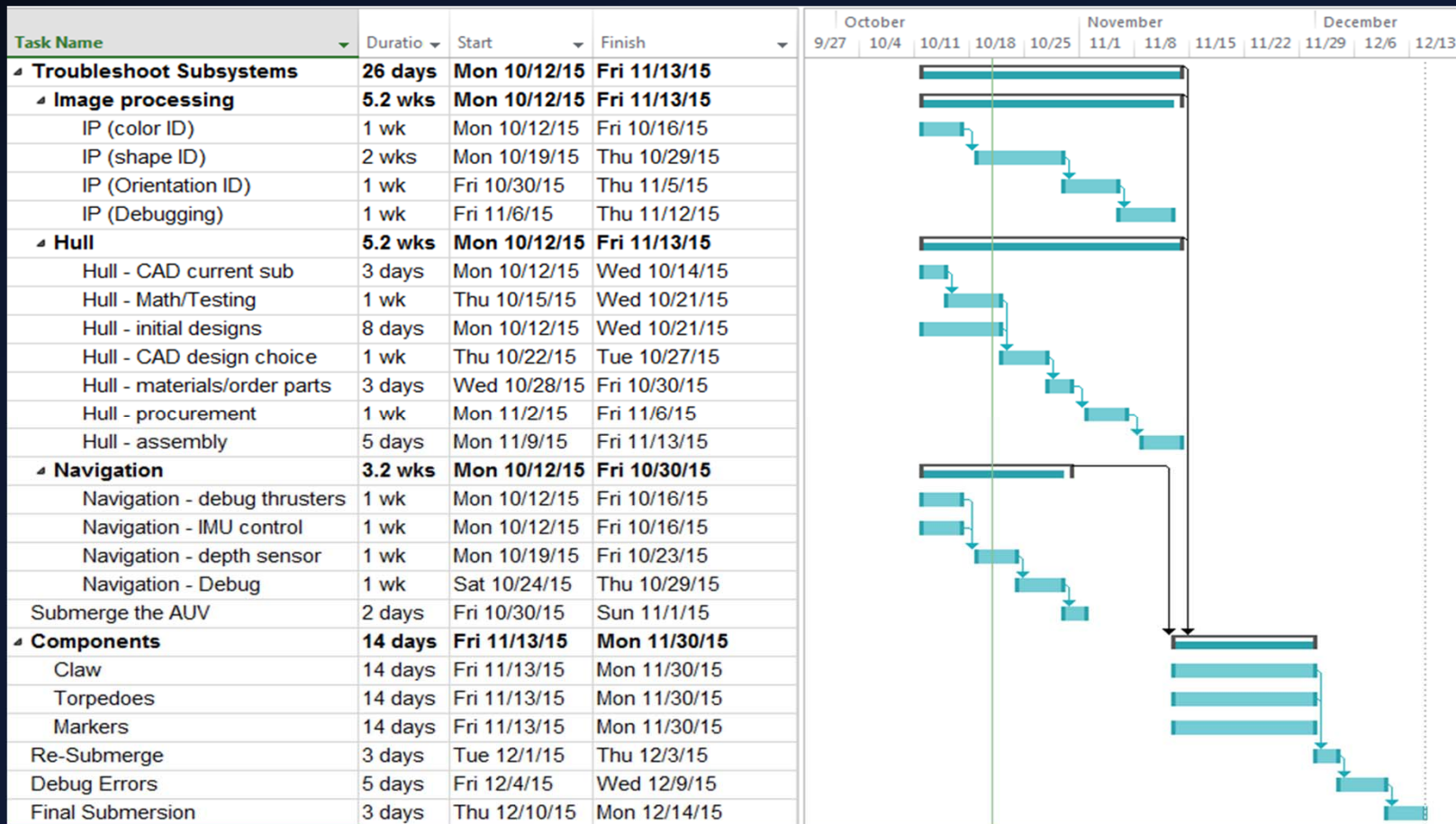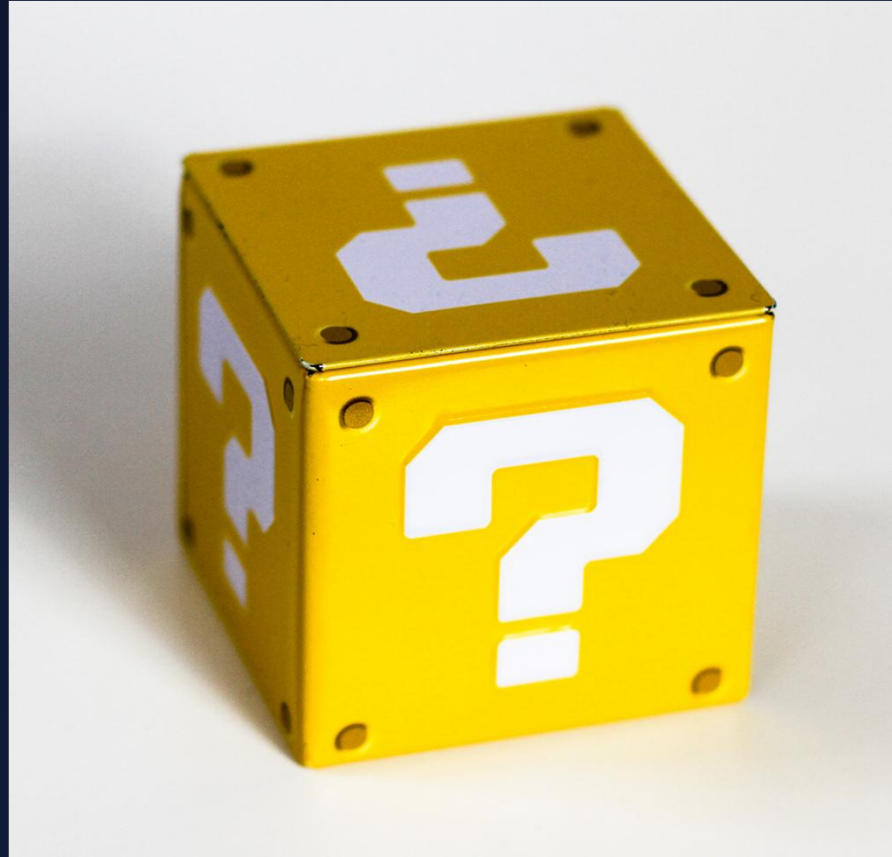| Task Name	Duration	Start	Finish
▲ **Troubleshoot Subsystems**	**26 days**	**Mon 10/12/15**	**Fri 11/13/15**
▲ **Image processing**	**5.2 wks**	**Mon 10/12/15**	**Fri 11/13/15**
IP (color ID)	1 wk	Mon 10/12/15	Fri 10/16/15
IP (shape ID)	2 wks	Mon 10/19/15	Thu 10/29/15
IP (Orientation ID)	1 wk	Fri 10/30/15	Thu 11/5/15
IP (Debugging)	1 wk	Fri 11/6/15	Thu 11/12/15
▲ **Hull**	**5.2 wks**	**Mon 10/12/15**	**Fri 11/13/15**
Hull - CAD current sub	3 days	Mon 10/12/15	Wed 10/14/15
Hull - Math/Testing	1 wk	Thu 10/15/15	Wed 10/21/15
Hull - initial designs	8 days	Mon 10/12/15	Wed 10/21/15
Hull - CAD design choice	1 wk	Thu 10/22/15	Tue 10/27/15
Hull - materials/order parts	3 days	Wed 10/28/15	Fri 10/30/15
Hull - procurement	1 wk	Mon 11/2/15	Fri 11/6/15
Hull - assembly	5 days	Mon 11/9/15	Fri 11/13/15
▲ **Navigation**	**3.2 wks**	**Mon 10/12/15**	**Fri 10/30/15**
Navigation - debug thrusters	1 wk	Mon 10/12/15	Fri 10/16/15
Navigation - IMU control	1 wk	Mon 10/12/15	Fri 10/16/15
Navigation - depth sensor	1 wk	Mon 10/19/15	Fri 10/23/15
Navigation - Debug	1 wk	Sat 10/24/15	Thu 10/29/15
Submerge the AUV	2 days	Fri 10/30/15	Sun 11/1/15
▲ **Components**	**14 days**	**Fri 11/13/15**	**Mon 11/30/15**
Claw	14 days	Fri 11/13/15	Mon 11/30/15
Torpedoes	14 days	Fri 11/13/15	Mon 11/30/15
Markers	14 days	Fri 11/13/15	Mon 11/30/15
Re-Submerge	3 days	Tue 12/1/15	Thu 12/3/15
Debug Errors	5 days	Fri 12/4/15	Wed 12/9/15
Final Submersion	3 days	Thu 12/10/15	Mon 12/14/15

Conclusion

- Much work present from previous years

- Aim to make the sub ready to compete

- ME and ECE teams are collaborating

- Redesigning some parts of the sub

- Hope to have parts of every system at some level by December

References

1. "Official Rules and Mission." AUVSI Foundation (2014). AUVSIFoudation.org. Web.

2. "RoboSub User Manual." COE RoboSub Senior Design Team (2014-2015). fsurobosub2015.weebly.com. Web.

Questions