ECE ROBOSUB SENIOR DESIGN

Midterm II Presentation

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AUVSI ROBOSUB

Objective: To design an autonomous underwater vehicle (AUV) meeting the requirements of the annual AUVSI RoboSub competition

- Using rules for 2015 competition until official rules released for 2016 in December
- Collaborating with the ME RoboSub team to design subsystems and complete AUV

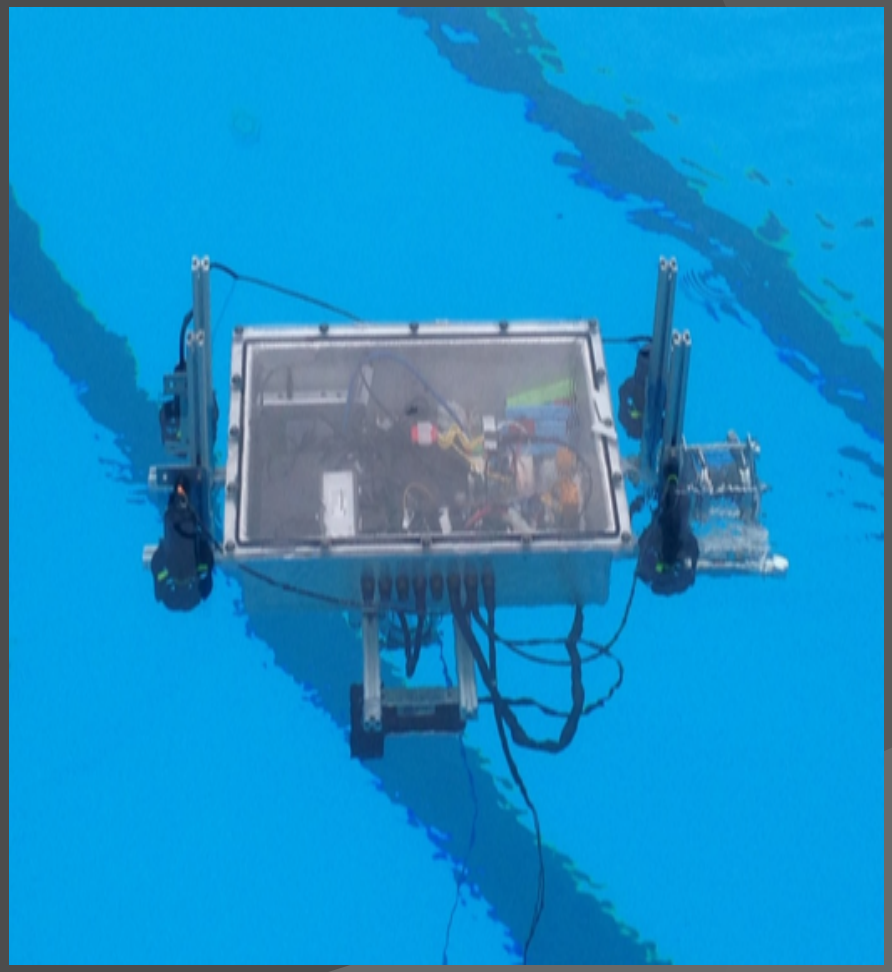


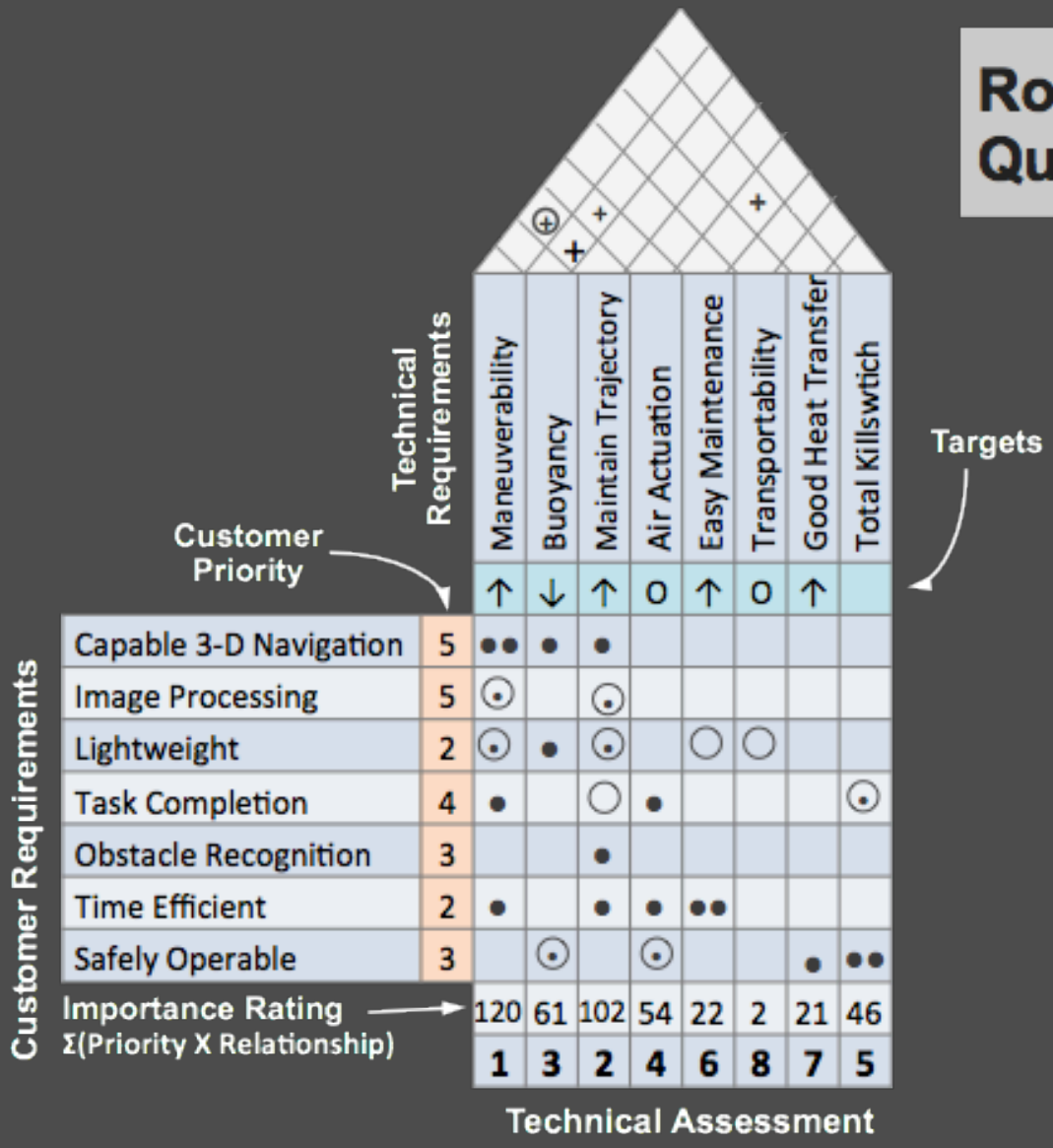
Figure 1. RoboSub submerged

Presenter: Brandon Anderson

PREVIOUS TEAMS WORK

- Hull with cubic design
- 6 thrusters for horizontal, vertical, and angular movement
- Cameras with code to recognize orange lines
- Code that implements simple navigation
- Depth sensor
- IMU
- Zotac
- Mega and Uno Arduino

RoboSub House of Quality



Correlations:
- ⊕ Strong Positive
- \+ Positive
- ⊖ Strong Negative
- \- Negative

Relationships:
- •• Strongest= 10
- • Strong= 7
- ⊙ Fair= 4
- ○ Weak= 1

Presenter: Brandon Anderson

PREVIOUS CHALLENGES

- Thrusters not working properly
- IMU not giving values to Zotac
- Segmentation fault when running navigation code

SOLUTIONS

- Replaced Motor Controller – Thrusters all working
- IMU interface fixed – IMU sending values to Zotac
- Navigation refinement – Code runs and sub functioning

ME ROBOSUB TEAM

- Building new sub with same general design
- Smaller dimensions to reduce buoyancy and optimize space usage
- Using same frame currently present
- Purchasing new air tank for pneumatics
- Purchasing new battery for Zotac
- Implementing new Servo motor and interface for marker dropper

TORPEDO DESIGN

- Redesigned from previous years
- 3D printed
- Fired via pneumatic piston impact system

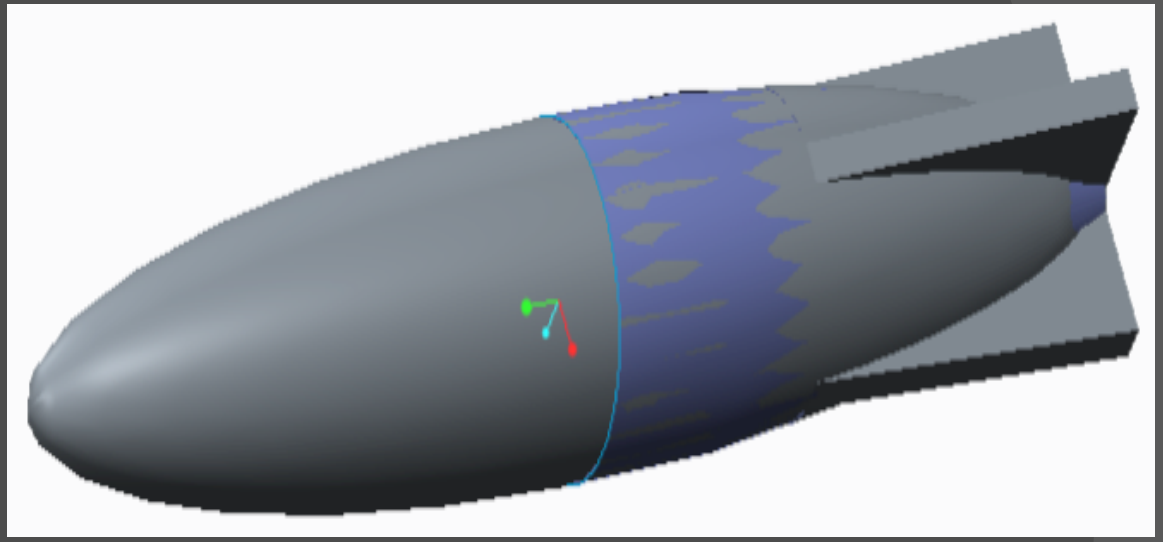


Figure 2. Torpedo Design

Presenter: Brandon Anderson

CLAW DESIGN

- Mounted to front of sub frame under front camera
- Airtac double acting pneumatic gripper
- PVC pipe mounting to frame holds gripper
- Claw mounted to gripper fingers
- Can be modified when official rules are released

Figure 3. Pneumatic Gripper

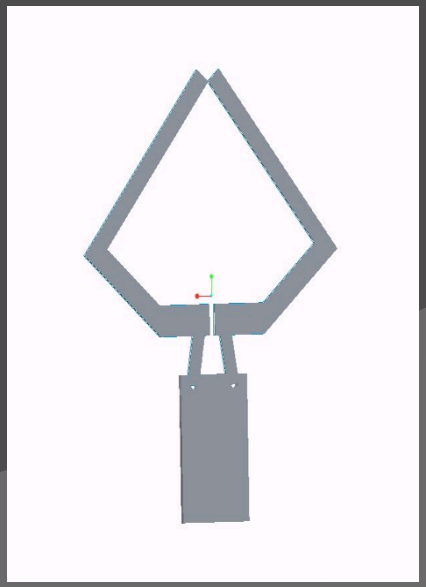


Figure 4. Claw Design

IMAGE PROCESSING

- Previous code is now in good, working condition
- It has the capability to identify some colors
- It can identify gates

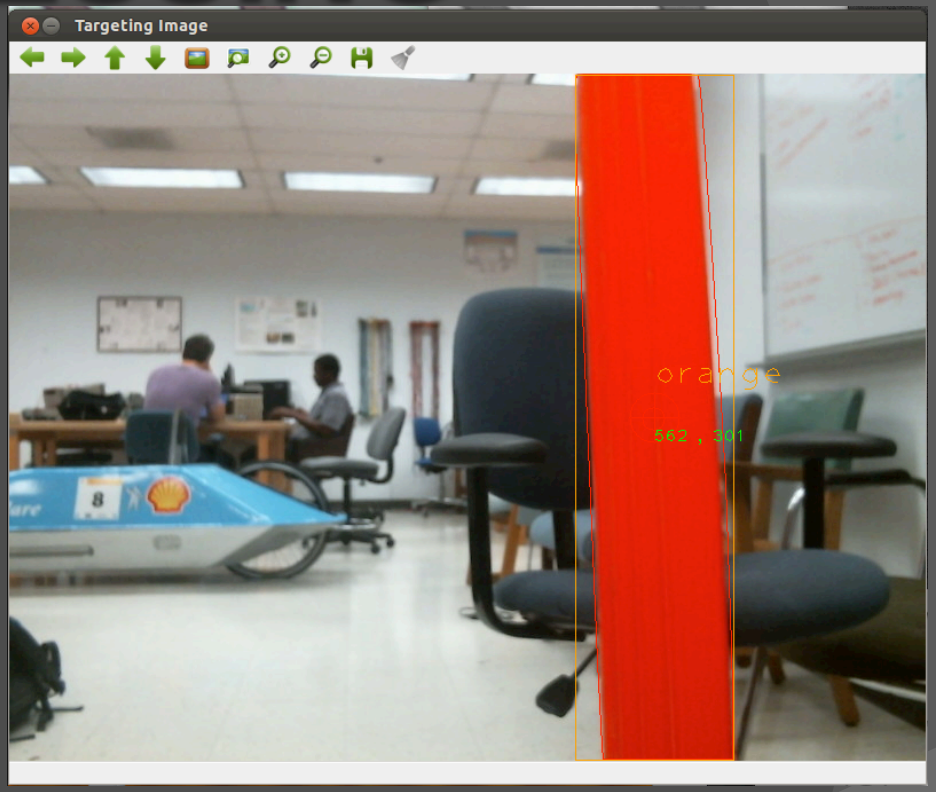


Figure 5. Current Image Processing

IMAGE TRANSFORMATIONS

- Fourier transform has been implemented
- Orientation of the sub can now be much more easily changed
- Provides assistance determining the number of sides of shapes
- Can be used to remove sinusoidal noise

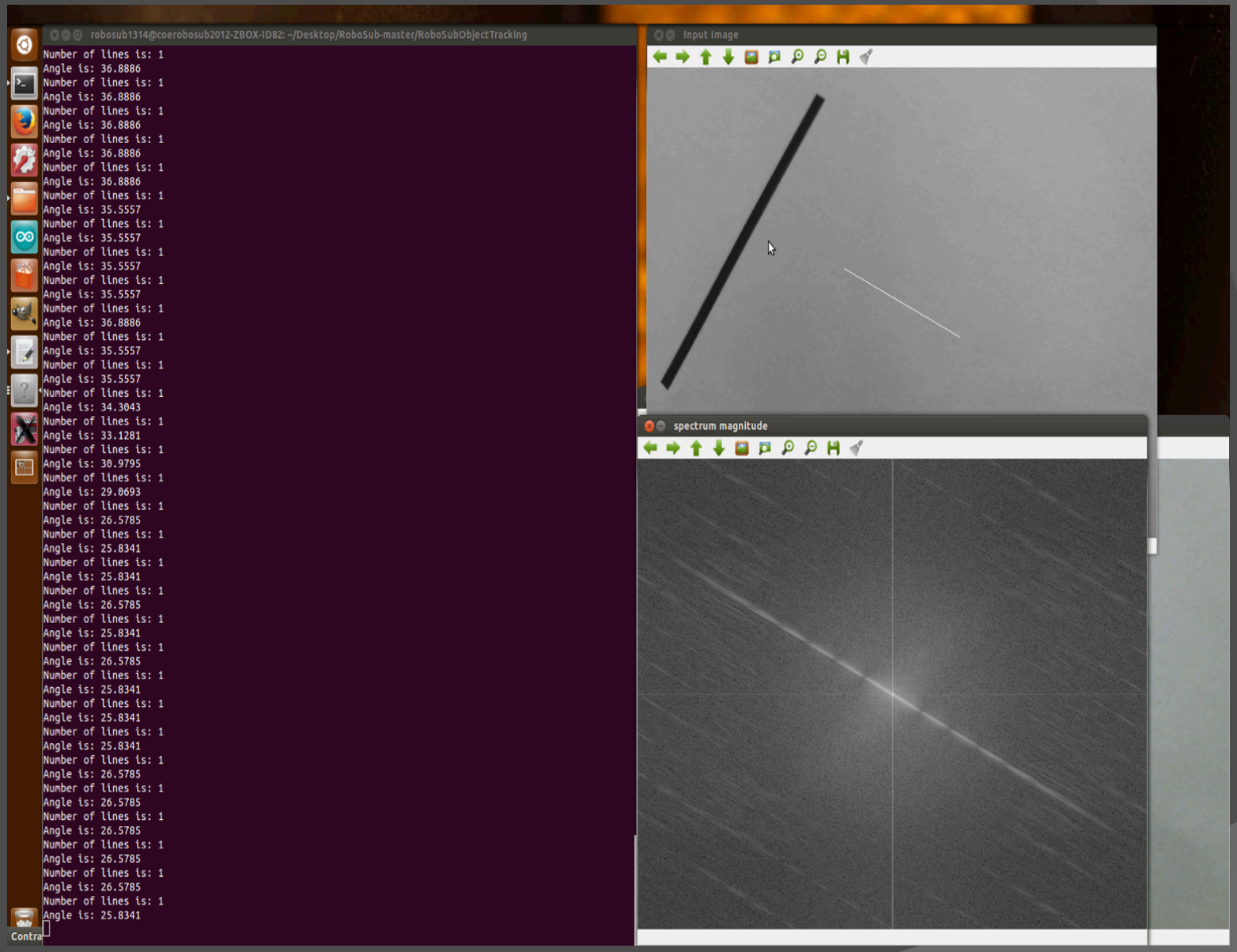


Figure 6. Fourier Transform

INTERFACING: THRUSTERS

- Improve and stabilize movement for testing
- Current movement is linear
- Goal is to have fluent movement
- Want sub to consistently read data and make decisions
- Currently only makes one decision at a time

Figure 7. Thrusters

INTERFACING: HARDWARE

- Debug code from previous years
- Interfacing between the IMU & Thrusters
  - Razor Inertia Measurement Unit
- Arduino sends PWM signals to Motor Controllers which takes data and delivers duty cycle to thrusters

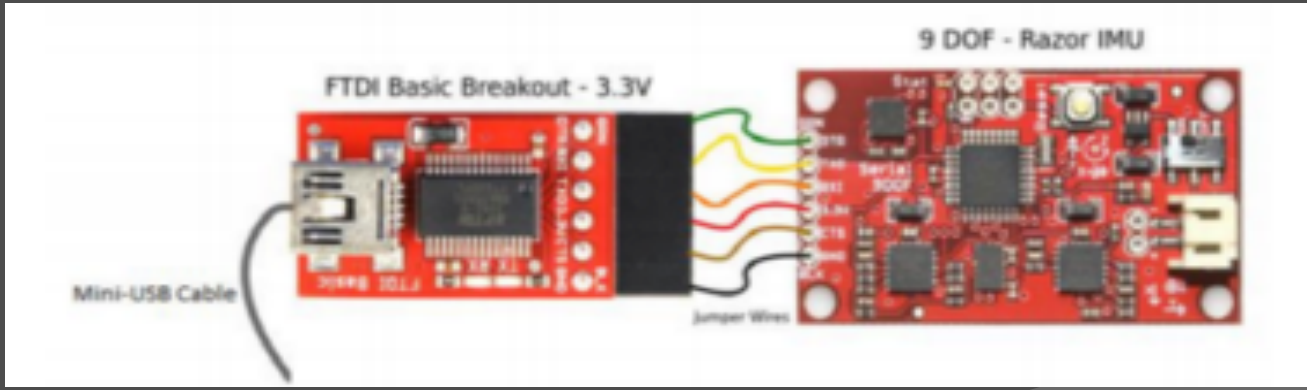


Figure 8. IMU

MODULARITY

Problems:

- Code was very hard to read
- Code was all over the place
- Navigation along with the Video Processing wasn't very efficient

Solutions:

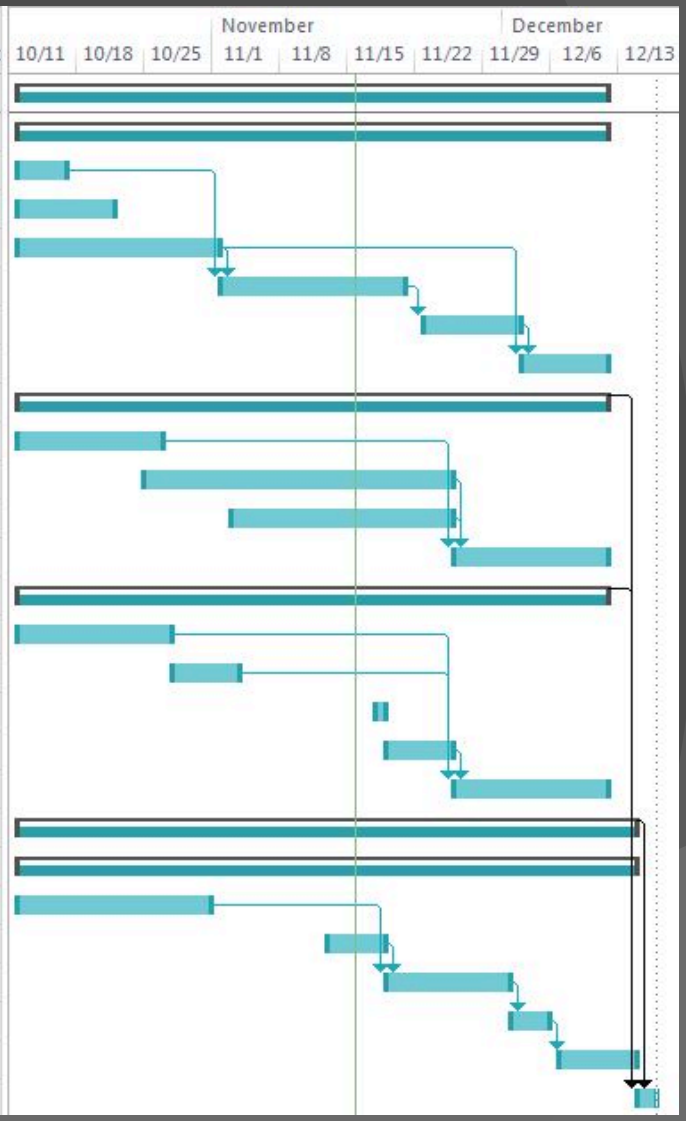
- Code much simpler to follow
  - Comments for following years
- Modular design allows for more structured, and efficient code
  - Makes parameter passing simpler

FUTURE WORK

- Submerge current sub
- Refine designs once official rules released
- Manufacture Torpedos, Claw, New Hull
- Finish Image Processing
- Task recognition and implementation
- Test subsystems on current hull
- Attach Claw, Marker Dropper, and New Hull to frame

GANTT CHART

	Task Name	Duratio	Start	Finish	Predecessc
1	**Troubleshoot Subsystems**	**49 days**	**Mon 10/12/15**	**Fri 12/11/15**	
2	**Hull**	**9.8 wks**	**Mon 10/12/15**	**Fri 12/11/15**	
3	Math/Testing	1 wk	Mon 10/12/15	Fri 10/16/15	
4	Initial designs	8 days	Mon 10/12/15	Wed 10/21/15	
5	CAD current sub	17 days	Mon 10/12/15	Sun 11/1/15	
6	CAD modified hull	3.4 wks	Mon 11/2/15	Fri 11/20/15	5,3
7	Materials/Order parts	8 days	Mon 11/23/15	Wed 12/2/15	6
8	Assembly	8 days	Thu 12/3/15	Fri 12/11/15	7,5
9	**Image processing**	**9.8 wks**	**Mon 10/12/15**	**Fri 12/11/15**	
10	Orientation ID	2.4 wks	Mon 10/12/15	Mon 10/26/15	
11	Color ID	5.2 wks	Sun 10/25/15	Wed 11/25/15	
12	Shape ID	3.8 wks	Tue 11/3/15	Wed 11/25/15	
13	Debugging	2.6 wks	Thu 11/26/15	Fri 12/11/15	12,10,11
14	**Navigation**	**9.8 wks**	**Mon 10/12/15**	**Fri 12/11/15**	
15	Debug thrusters	2.6 wks	Mon 10/12/15	Tue 10/27/15	
16	IMU control	1 wk	Wed 10/28/15	Tue 11/3/15	
17	Submerge current AUV	1 day	Wed 11/18/15	Wed 11/18/15	
18	Depth sensor	1 wk	Thu 11/19/15	Wed 11/25/15	
19	Navigation - Debug	2.6 wks	Thu 11/26/15	Fri 12/11/15	15,16,18
20	**Redesign Subsystems**	**50 days**	**Mon 10/12/15**	**Mon 12/14/15**	
21	**Gripper/Torpedoes**	**50 days**	**Mon 10/12/15**	**Mon 12/14/15**	
22	CAD torpedo designs	17 days	Mon 10/12/15	Sat 10/31/15	
23	CAD claw	6 days	Fri 11/13/15	Wed 11/18/15	
24	Order parts	9 days	Thu 11/19/15	Tue 12/1/15	22,23
25	Assembly	4 days	Wed 12/2/15	Sat 12/5/15	24
26	Attach and Integrate	6 days	Mon 12/7/15	Mon 12/14/15	25
27	Re-Submerge	2 days	Tue 12/15/15	Wed 12/16/15	9,14,20



Presenter: Gabriel Mendoza

CONCLUSION

- Navigation refined
- Sub now operational
- Finishing Image Processing
- General design for all subsystems
- Final design when rules released in December
- Testing and refinement in current hull
- Starting manufacture of new hull

REFERENCES

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

QUESTIONS