Critical Design Review

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Team: 524PC - RoboBoat (2021)

Florida State University, Panama City

EML 4552C – Senior Design 2

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# Introduction

The goal of our project is to demonstrate the skills acquired through FSU-PC’s mechanical engineering program by constructing a boat that is capable of meeting the 2021 RoboBoat competition standards. Our team will primarily focus on assembling a maneuverable and buoyant boat for sensor integration by the FSU electrical students, constructing a lidar tilt mechanism, and designing a hot -swap propulsion system .

Now that the RoboBoat competition has passed, our priorities have shifted to producing a fully functional boat before the senior design deadline in July . Originally, we planned to manufacture our boat hull in the material’s laboratory at FSU-Tallahassee but due to time constraints, have now decided to do this at Gulf Coast State College. After hull assembly , we will then collaborate with the electrical team to integrate the sensors. Once the boat’s main sensors and propulsion system are mounted, we will begin testing in the lake beside our campus.

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# Revised Requirements

The scope of our project has changed in response to current progress and our anticipated final product. During the spring semester our group anticipated to enter in the RoboBoat competition as it was presented at the time. After the competition was changed to be remote the requirements for the competition changed, leading the team to prioritize hull design and material selection. Our initial final goal was to have an autonomous boat as per RoboBoat standards. With the current progress made the end goal has changed to reflect a more likely outcome of having a functional, RC capable boat by the end of the semester. Other current goals have remained the same, including putting final touches on the hull design, fabrication of the boat hull, and integration of electrical components into the fabricated hull.

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# Submissions

For the RoboBoat competition, there were three submissions: a technical design report, a skills video, and a website link. For the technical design report, the mechanical group and the electrical group worked on separate parts. This was so that each group could write about the things they were working on and be able to work independent of the other group. The mechanical portion covered the hull design and the design process. The electrical portion covered the electronic components of the RoboBoat. Since we were still in the prototyping phase of the project at the time the report was written, each team also talked about future plans for the project and how we planned to put together the final design.

For the skills video, the mechanical team decided to talk about the hull design and design process. The advantage of making a video is that it gives the capability to highlight things better suited for verbal demonstration. This way we could use our 3-D printed model of the boat to give demonstrations and reference during explanations. One example of this is when we talked about component placement, we could show how we used lead fishing weights as representative weights in the model to find where we wanted to place components. Another example is when we talked about the hatch in the lid of the boat. We were able to use the model to show how the hatch would work, as well as the approximate placement and size of the hatch.

Our final submission was the website link. For our website, we updated the existing SPEAR website by adding a new page for the 2020-2021 RoboBoat team. We added pictures of teammates and advisors, as well as a render of the RoboBoat design with a description. As the project progresses, we will be adding more to the website to give a more comprehensive view of the project.

# Current Design Review

***Hull Design***

We decided to go with a Catamaran style hull. This hull design gives ample storage space for component placement. Because of the available room, we will be able to attach 4 thrusters on the boat (2 along each pontoon). This boat style also gives us optimum stability and sits tall in the water. The 2019 RoboBoat team made a boat with the same hull design. However, they had a couple errors pertaining to their boat. The first thing is that their boat was not long enough resulting in the front of the boat being too light. Also, their thrust force was too much. Therefore, when they accelerated, their boat ended up flipping and not being able to compete. We decided to correct those mistakes in making sure our boat is long enough and will have enough weight at the front. Also, we added 4 thrusters to the boat (2 in the front and 2 in the rear), this allows the thrust force to be distributed more evenly and allow the bow of the boat to not come too far out of the water.

***Hatch Design***

The previous RoboBoat team stressed to us the importance of having easy access to the components inside the boat. In previous years either the whole top of the boat had to be disassembled or there was little room to move around or take out components. Because of this, our team set the hatch design as one of our top priorities.

Essentially, the lid of the hatch sits in a groove on the top of the boat lid and will be sealed with silicone. There will also be latches connecting the hatch and boat hull to hold the hatch down. With these measures in place the hatch should be waterproof and keep the components from getting wet or damaged in the event that the boat gets water on top of it or flips over in the water. The hatch should also be big enough to allow easy access to all components without the need to disassemble the hull.

***LiDAR Tilting Mechanism***

To ensure that the boat senses everything adequately we decided that being able to tilt the LiDAR would be a beneficial endeavor. By tilting the LiDAR we would be able to adjust the sensor on the fly, and be able to use it in the best configuration for our hull design.

***Propulsor Attachment***

In the case of a propulsor failing, how it is attached is an important aspect of how hard it is to fix. We have developed a hot swap propulsor attachment that allows for us to easily change propulsors in the event they fail. A track is mounted to the hull, and the propulsor is mounted to a fin on the track, if the need to change the component arises, we simply slide it off the track and mount a new propulsor.

***Prototyping***

Before finalizing the design with our theoretical values, we decided to make a 3D printed 1/16 volume scale model of the hull. By doing so, it allowed us to see a physical representation of how the full-scale model would float and allow us to scale down our weights and more easily see how component distribution would affect how the boat would float. It was 3D printed out of PLA in three parts, the hull, the hatch, and the hull lid. The scaled down component weights were represented by lead fishing weights at the appropriate scaled weight.

We will also be prototyping the LiDAR Tilt Mechanism and try to recreate/improve the propulsor hot-swap before June 20th.

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# Timeline

Below is a picture of the timeline of our project for the remainder of the semester. It is important to note that an initial prototype will be completed prior to the rest readiness review. Lastly, with the help of the electrical engineers, we will have a final and complete product by the end of the semester (July 30).

