2. Optimal Design Water Bike

Introduction

The water bike was chosen from the first of the alternate designs. The idea is to have the majority of Elysa’s body sitting under the surface of the water with just enough above for her to be comfortable. It will work similarly to an exercise bike, but with a few modifications. The bike will be built from a PVC frame that will give it durability and buoyancy that will prove beneficial in a water environment. The design is simple as to avoid large problems from arising. Two larger PVC tubes will be on either side of the frame that will keep it afloat. The frame itself will be attached to the side tubes in the front and back of the bike and will consist on thinner PVC tubes. The seat and pedals will run parallel between the two side tubes and perpendicular to the connecting tubes. The tubes will all be connected using either PVC connections or nuts and bolts. The seat itself will be mesh which will allow the entire unit to dry quickly outside of the water. Figure 1 below is a diagram of what the finished product may look like.

![Figure 2.1. Water Bike Optimal Design](image-url)
2.1 Components

2.1.1 Seat

The seat we are planning on using we will purchase from The Neat Marketplace. It is already fabricated to the specifications we need. The frame is some form of PVC piping and is already fitted with a mesh material as the actual seat. This will be ideal for the water bike because it will be completely water resistant. There are already holes used to connect the seat to another PVC frame, so it should be no problem to transfer this seat to our new frame. The only addition that will need to be made is the attachment of a small slightly restricting belt. We simply want to keep Elysa in the chair, however if she does fall out her personal floatation device (PFD) will keep her afloat. The idea of the belt is to help Elysa stay in the chair but not necessary keep her there. Figure 2. Below is an image of the chair sitting at the neat marketplace.

2.1.2 Pedals

The pedals will go right through the frame of the center frame of the bike. They will work similarly to the pedals on any regular exercise bike but will have no need for any sort of resistance. The water itself will cause a certain amount of resistance but the idea is not to strengthen Elysa’s legs but rather get them familiar with the motion of using the exercise bike. There are two unique features about the pedals on the exercise bike. First is that there will be handles on each of the two pedals facing outward. The purpose of this is so somebody can stand in front of the bike and help guide Elysa into the correct motion. The second adaptation is between the handles and the pedals themselves will be a set of arms extending upwards to just below Elysa’s knee joints. There will be an extra strap here to wrap around her calf and add more support to the entire leg not just the feet. The arms will be attached but still allow the pedals to rotate freely. This should make the bike motion easier to learn. Figure 3 below is the basic concept for the pedals and how they will be installed on the bike.
2.1.3 Frame

The frame itself is very simple. It will consist of 1 ¼” PVC tubing. PVC is ideal for the frame assembly for a number of reasons. First and foremost it is waterproof and will float. It also comes in a variety of sizes and allows for unique assemblies with many different parts. It will be durable enough for our design and it is also relatively inexpensive in comparison to other options. The two side tubes will consist of 4” PVC and will be roughly 3 ½’ long. These will be filled with expanding Polyurethane foam for added buoyancy. When the foam has dried one cubic foot is enough to support roughly 60 lbs of weight in water [1]. With roughly ¾ a cubic foot of foam in addition to the tubes natural buoyancy staying afloat should not be a problem. Figure 4 is a diagram of the frame assembled with the pedals and chair.
2.2 Realistic Constraints

The water bike has a number of constraints we must consider. Obviously safety is the number one priority here. When Elysa is in the pool we want to make sure there is no way she can get hurt. The first safety feature is her personal floatation device which will keep her afloat if she comes free of the bike. The bike itself must be impossible to sink. Elysa will be strapped in at multiple points so every precaution must be taken. The bike itself must be waterproof and not degrade over time and repeated use. For this reason PVC is the best option. This also helps with any manufacturability restraints because PVC has a huge selection to choose from as far as parts and connections. Also, it is affordable and will keep the budget low.

2.3 Safety Issues

As stated earlier in realistic restraints. Safety is of the utmost importance when it comes to this design. Water will create a fun and enjoyable environment for Elysa but this also creates that safety issue. Each tube will have to be completely sealed and if necessary filled with polyurethene foam. The bike should be able to support a person much larger than Elysa, as far as weight. Also there should be no possibility of tipping even if waves occur in the pool. The large side tubes should prevent this but thorough testing in real aquatic conditions will be done prior to any actual use.