2.1.1: Alternate Designs

Zip Line Walking Device

Alternate Design 1:
This design will maximize the area which Elysa will be able to travel across by a system of poles and wheels, as shown in Figure 1. She will be able to walk across the room, as well as side to side. The zip line will be an Aluminum tube that will provide a lightweight “zip line” for which Elysa will be able to move across. As one, continuous long tube running across the room would most likely bend in the middle due to its weight, the “zip line” will be made up of several pieces of Aluminum tubing.

These tubes will be connected together with screws, which will allow for easy assembling and disassembling when not in use. Two stainless steel cables, one on each side of the room, will be mounted to the wall and is where the wheels that are attached to the tube will glide along as Elysa moves around the room. The harness set up will be like the one that was mentioned in the proposals, which can be seen in Figure 2.

![Figure 1: Top View of Alternate Design 1](image1.png)  ![Figure 16: View of Harness Structure](image16.png)
Alternate Design 2:
The zip line part of this design is very similar to the design that was mentioned in the proposal. Instead of having a single line that the pulley is moving across, there will be two lines, which therefore, will have two pulleys moving on the two lines. The two pulleys will be connected to the hooks on the metal bar by two pairs of carabiners, which cannot be seen in both Figures 3 and 4. Three hooks are on the bottom of the bar, which are where three adjustable straps will connect to the harness.

The straps will be attached to the shoulders and back of the harness to maximize support and stability. As an added support feature and something that Elysa can hold on to, are a set of handlebars. The bottom section of the handlebars will be wrapped with bike grip wrap, which will make holding the bars easier. The harness itself will be a modified kids full body rock climbing harness. More padding will be added to make the harness more comfortable for extended use. The finished harness should look similar to a suspension trauma harness, seen in Figure 5. This type of harness would be perfect for this device, but there are two problems: a) it only comes in adult sizes and b) it is expensive.
Alternate Design 3:
This design has a similar structural set up to Alternate Design 1. Instead of having the two zip line cables mounted to the wall, two Aluminum tubes will take its place and will be attached by two pairs of standoff hangers or another type of hanger, which can be seen in Figure 6. As the aluminum tubes are in place of the cables, flanged track wheels will move along the tubes much easier than the zip line pulleys. The moving tube is where the flanged track wheels will be attached to and the tube itself is the exact same set up as in Alternate Design 1. The harness set up is like that of Alternate Design 1, minus the lanyard, and the bar will be attached to the pulley by carabiners. Like Alternate Design 2, the harness will be a modified kids full body rock climbing harness, instead of the harness that was mentioned in the proposal, as shown in Figure 7 below. Unlike that design, there will not be any handlebars.
Adaptive Skiing Device

Alternate Design 1:
This has structure similar to the assisted walker device, shown in Figure 8. Its main structure consists of four poles perpendicular to the ski, where each pole is rounded off on top for protection. There are also two bars parallel to the ski between two perpendicular poles for better support of the whole structure, as shown in Figure 9. Elysa can enter from the opening at the back.

A full-body safety harness, shown in Figure 10, is needed for this design since there is no back support. The full-body safety harness needs to be attached to the four poles for stability, and it has to be high enough for Elysa to remain in standing position. Some advantages for this design are that it is simple and does not need require many parts to build it. One of the disadvantages is that in order to secure the full-body safety harness, the poles have to be high enough to hold the upper part of the harness, which would make the design really bulky.

Also, the full-body harness would restrict Elysa’s freedom while using the skiing device. Even though that’s what the harness does, her parents are hoping that the device can provide minimum support and have as less restriction as possible while she is on the device.
**Alternate Design 2:**
Alternative Design 2 has completely a different structure than Alternate Design 1. Design 2 consists of a back support and arm rest for each arm, as shown in Figure 11. The structure of the back support is a combination of many horizontal bars, so safety straps such as seat belt can be tied on to the bars. Cushion can also be tied to the back support, so it is more comfortable while Elysa is operating the skiing device.

Cushion can also be placed in the U-shaped arm rest for maximum comfort. Rubber grips are used to cover the handle bar for better grip. To support Elysa’s body, a 3-point safety harness, as shown in Figure 12, can be placed about her waist area to keep her in standing position and secure her position.

The advantage of this design is that the straps and harness can keep Elysa secure while operating the ski, and the arm rests and cushion can keep her comfortable. The disadvantage about this design is that she has to stay in standing position the whole time, but the 3-point safety harness can relieve her stresses when she feels tired or keep her from falling off the device. Overall this design provides less restriction but same amount of supports compared to Alternative Design 1.
Alternate Design 3:
Alternative Design 3, shown in Figure 13, has pretty much the same design as the Alternative Design 2. The only difference between these two designs is the lower part of the back support; some horizontal bars are taken away and the lower part of the back support can be turned into a chair. While Elysa is standing, the chair acts as a part of the back support, so Elysa’s can still lay on it. But if she feels tired and wants to sit down, instead of just letting the 3-point safety harness to support her, her parents can easily turn the lower part of the back support into a chair by twisting the knob on the side, and lock it when the chair is in position. The advantage is that Elysa can now sit down if she is tired and still enjoy the ride, but on the other hand, her 3-point safety harness needs to be released in order for her to sit comfortably, which can be troublesome and time consuming.
Recumbent Stationary Bike

Alternate Design 1:

Figure 14: Recumbent Stationary Bike – Alternate Design 1

This is very similar to any normal stationary recumbent bicycle, as shown in Figure 14. The seat will slide towards to pedals and lock into place by adding a pin that locks in place through the machined holes in the frame. Inside the housing for the pedals a magnetic sensor will sense the inner fly wheel spinning. When the magnetic sensor detects motion this will set the electrical components housed in the box to drive the toy that will be placed on top of the housing component to move and light up.

The other addition not shown here will be a handle added to the pedals to help Elysa’s parents help her move the pedals at first. The chair will be padded more for her comfort and head supports will be added. The same harness will be used as was used for the saddle eating chair to keep her in place. A hinge will be placed where the base attaches to the frame the chair rests on. This hinge will allow the base behind the seat to fold underneath and make the bike smaller for easier storage. Also straps will be added to the pedals to keep her feet.
Alternate Design 2:

![Figure 15: Recumbant Stationary Bike – Alternate Design 2](image)

For this design, shown in Figure 15, we simply have the pedal system and the housing component that contains the fly wheel and sensor for the monitor. When the pedals move the sensor will be activated that will then activate the monitor. The advantage of this design is that she can use this for more than just strengthening her legs. Components like this are used in physical therapy so one can strengthen coordination in her legs, as well as arms.

She can be placed in her normal chairs or a chair that can be on the floor. This could be placed at the appropriate distance for her legs easily. The particular design will take up less space in the house. The attractiveness of this is that she will never outgrow it. This will have more than just use in strengthening her legs. It is also a compact design. We don’t have to worry about her falling and this component is light so if she did tip it she would not injure her foot if she rolled it on herself.
**Saddle Eating Chair**

**Alternate Design 1:**

![Figure 16: Multiple Views of the Saddle Eating Chair](image)

This design is based off a regular barber chair, as shown in Figure 16. The wheel components would be mounted underneath the base. We think it would be best to house the wheels in recessed machined sections under the base. This would keep the chair bottom lower to the ground and make it less likely to tip. The chair would have the typical hydraulic component to make the seat go up and down. The seat has the proper shape for the saddle and we decided based upon the size the diameter of the seat will be eight inches. The similar chair made by achievement products has this sized diameter for a girl Elysa's size.

In the final chair the seat will have the added padding to appear more like a saddle that will be positioned over this seat. We thought it was best to show the main structural components without the added decorations. A pommel would be best to ensure Elysa does not slip off the end when sitting closer to the table as well as aiding her posture and helping position her to sit up. The chair back will also have additional padding to make this more comfortable. Where Elysa's head will be will have additional padding to help keep her looking forward. We will attach the harness on the chair back.
This harness, shown in Figure 17 will be attached at the appropriate height to ensure Elysa’s comfort. This design allows a sturdy structure as well as easy of adjustment. The seat height can be changed while Elysa is still in the seat and can be adjusted more precisely.

**Alternate Design 2:**
The main difference between this design and the first is the base, which can be seen in Figure 18 below. The same harness, back padding, and extra seat cushioning will be added on this design as well.

Six wheels will be attached underneath this base component. one will be under the very front rod. One wheel will go right beneath the rod that attached the chair. Four wheels will be placed under the back section. At the very end of the bent rods one wheel will be placed under both/also where the back T section joins the bent pieces a wheel will be placed under both those junctions. The other different in this chair is the seat height adjustment mechanism.
The chair will move up and down by the rods sliding past each other similar to adjustments in exercise equipment. Several holes will be machined in the rod beneath the seat and a pin will be inserted through both rods that will hold the seat at the selected height. The seat will also be able to be tipped forward or backward by a similar mechanism. Hinges will be placed at every point where the chair posts join the base frame.

As the rod in front of the main post is shortened or lengthened by the same hole and pin mechanism as the chair height is controlled, the seat will tip forward or backward respectively. The back rod can be adjusted in the same manner. The advantages of this design are that it has a less bulky base overall, so that the chair will be lighter and the base should be more stable. The disadvantage is the seat height adjustment will be more difficult as it requires the seat height be adjusted before putting Elysa in the chair.

Alternate Design 3:

![Figure 19: Saddle Eating Chair - Alternate Design 3](image)

This design, shown above in Figure 19, has the same barber chair base but underneath we used a similar base as Alternate Design 2. This point of this design is to try and mix the good components from each. Here, we still have the ease and precision of changing the height as well as the stable base. This design will also use the same harness and same chair padding that is used in the other two Alternate Designs.

Water Bike

Alternate Design 1:
The first design we have decided on for our water walker and our current front runner for implementation is a recumbent bike that is submerged halfway under water. The Bike will work
similarly to a normal recumbent exercise bike but instead of having a wheel to create resistance the pedals on this bike will be slowed by water resistance. The water tension will not create a great deal of resistance but the point is not to strengthen Elysa’s leg muscle but rather create a muscle memory.

The bike will be supported by two barrels on either side that will keep the majority of the seat and Elysa’s body submerged in the water yet keeps her head afloat. The barrels will be filled with polyurethane foam that will create more than enough buoyancy to keep the device afloat with a person much bigger than Elysa. The seat will have some restraints but leave room for Elysa to wear her personal floatation device she uses during a normal visiting the pool. The pedals will have handles off the side to allow someone to assist Elysa at first so she can get used to the correct motion of the bike. Below in Figure 20 is a rough CAD of what the project will look like.

![Figure 20: Water Bike – Alternate Design 1](image)

**Alternate Design 2:**
This design is closer to the design from the proposal, using ideas from the Honda dry land walker. Elysa will be wearing small nonrestrictive harness around her midsection that will be attached to the water walker. She will also be attached to the walker just below the knee and above the ankle. There will be hinges at the hip knee and ankle that work similarly to the joints in the leg. The design will allow for a free kicking/swimming motion however will not allow for irregular movement.

The idea is to still allow Elysa to move on her own but again try and create a muscle memory that will continue without the aid of the water walker. One setback to this design is that it does not allow for assistive handles, meaning Elysa will be completely on her own with this device. Figure 21 below is a CAD of the frame that would be built and attached to the harness. Note* this device does not have a floatation device. Elysa will be supported by her normal Personal Floatation Device (PDF) she is currently using.
Alternate Design 3:
The third design is a spin-off of Alternate Design 2 but creates the option for assistive handles. Again Elysa will be in a small nonrestrictive harness around her midsection. However, instead of the frame being on the inseam of Elysa’s legs it will be moved outward and attach to the harness on the outside of her hip. The same basic principles are applied from this point.

The frame allows for back and forth kicking/swimming motion. There will be four handle off the device that allow someone to assist Elysa until she gets the motion on her own. Again the device would once again be attached below the knee and above the ankle. Figure 22 below shows the frame to be built if the design is chosen. Again Elysa will use her own PFD to stay afloat.