Project Statement & Specifications

Projects for Elysa

TEAM #16

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Statement of Need:

Elysa’s parents want her to have more variety in her assist devices. They want her to have safe and less restrictive devices to learn different methods of moving. They asked us to make five different devices: a water bicycle, a zip line assisted walking apparatus, a stationary bicycle, an adaptive ski device and a specially designed saddle eating chair. These are meant to help stimulate her brain in different ways to assist in her developing the muscle memory required to do more activities on her own. Also they want to designs to be fun because most of her assist devices are not visually appealing.

1. Water Bike

1.1 Introduction and Overview:

Elysa and her family belong to a club that has a pool, and have expressed a desire for Elysa to safely enjoy the pool. The object of our design is to not only create a fun and safe environment for Elysa but Use this as an opportunity for physical therapy. For these reasons, we have decided on a modified water bike that Elysa can peddle and propel herself around the pool under her own will. A simple design is most appropriate with two floatation barrels on either side of a bucket chair. Using an enlarged chain ring should provide enough power to spin a propeller fast enough to move the bike through the water given the lack of muscle development. A rudder placed behind the propeller attached to simple steering controls will allow Elysa to direct herself through the water.

1.2 Realistic Constraints:

Elysa is a 6 year old girl with a lack of normal muscle development, obviously her safety in the pool are important and making sure there is no way she could fall into the water is essential. There must be restraints installed to prevent her from falling out of her chair. Also, it must be made impossible for the bike itself to flip over at any point in time. The water also provides some sustainability restraints. All components of the bike must be waterproof and be buoyant enough to stay afloat with a weight of up to 75 lbs on it. It is important to have an efficient design that Elysa can power. If it is too difficult for her to pedal around the pool the purpose is lost. Elysa is 36 1/2” inches tall and weigh 32 lbs. She has been known to be extremely rough with her toys so it is important the bike is durable, and can manage a lot of movement while staying afloat.

1.3 Other Information:

As previously mentioned previously this is meant to be fun for Elysa. For this reason appearance is important. We want her to feel confident and be comfortable using the water bike around her friends. We would like to make the bike bright and girly, as if to create a toy
any 6 year old girl would want. As Elysa lives almost an hour and a half away we have not yet met her in person so all of our designs to day are based on a lot of assumptions. Many of them will most likely change once we get to see her and the pool itself.

1.4 Questions:

How far back should the chair be placed in the design is a concern. If the weight is mostly distributed to the back this will create an upward slope to the barrels and create a more hydrodynamic flow to the design. However place the seat too far back and the bike will flip backwards. This will have to be experimented with before assembly. Also, a design using a propeller is not final. The possibility of using a ferry like propeller has been considered. Further experimentation will determine which design will be most efficient. Note: a ferry like propeller would have to create a new rudder steering system.

1.5 Operational Specifications:

The water bikes main focus is to entertain Elysa while simultaneously stimulating hydro physical therapy. The bike should be easy enough for Elysa to power as well as have a simple steering system. It should also look appealing to a six year old girl. Elysa will be in a sitting position with the pedals in front of her. Using a chain wheel the pedals will power the propeller under the seat. There should also be an adaptive handles so someone can assist Elysa to get her muscles moving in the proper motion.

1.6 Technical Specifications:

Type of material:

PVC frame, (potentially filled with foam)
Plastic Seat, Chainwheel, Chain, Propeller, Rudder

Mechanical:

Size: Roughly 4.5” x 3.5” x 2.5”
Weight: Roughly 12 lbs

Environmental:

Temperature: 55°F-80°F
Operating Environment: In Water

Safety:
Buoyant enough to support 75 lbs
Unable to tip
Safety harness to prevent falling out

Maintenance:
Minimal, keep clean

2. Saddle eating chair

2.1 Introduction and overview

Elysa now age 6 was born very prematurely. As a result her brain developed with a different set of inputs that has led to difficulties in developing motor functioning. She has trouble with the coordination of physical activities on her own. The muscles in her legs are weaker but her arm muscles are strong. Her muscles have the capacity to function completely normally she needs to have help to learn the motions and coordination involved to move independently. She has a strong will so her parents have been seeking new methods to aid her physical development and give her the playful atmosphere any 6 year old should have. They requested we build a saddle eating chair. The purpose was to allow her more physical freedom while eating or participating in activities at the table. Also this would aid in her hip abduction and general motion. Her mother wants this device to make Elysa feel supported but not restrained since she feels most devices made to aid Elysa are too restrictive. Her mother also said she would like this design to be fun and cheery unlike many of her other assistance devices which are rather drab.

2.2 Realistic restrictions

The biggest restriction is safety. If we want to make Elysa feel free then there will be less safety devices and harnesses. The drawback to this is that she needs the harnesses to be safe and supported and not fall off the chair. Also along safety lines the chair needs to not tip in any way. We must choose materials that are not too heavy so that the device can actually be mobile. We should make it simple as well so the parents can easily operate it and if it breaks for any reason a quick repair can be made. The other restriction might be heights. We may not be able to make the chair go between tables with 7 ½ inches of height difference.

2.3 Other information
Elysa can be very rough on her toys so all the parts in she can reach should be sturdy. Her parents will always supervise her

2.4 Questions:
How are we going to design this seat? The saddle must have ergonomic considerations (hip width so not to put too much pressure on her, cushioned, etc. don't want her to get injured from the use, bowed legs)
How do we make it comfortable?
What material to make seat out of?
What do we mount the seat on?
Control the height of the chair?
Make it mobile and stable?

2.5 Operational specifications

Her family wants Freedom of motion of arms and legs while providing core support. They want a Comfortable harness (zipper for harness). They require a Fun design, (decorations to look like a real saddle). It must Reach multiple table heights (28 ½ inch, 36 inch, 30 inch). We must Create a chair back so that harness can be attached and that will provide her core with support and neck support and provide a seat that she can’t slip out of. Also the seat must be easily sanitized if she drops food on it. And be resistant to liquids. The chair must be able to move from table to table. They require a Parental control mechanism for the chair height. It must have safety locking mechanism so it will stay at the height it is placed at and not slide down. The base must be wide so it cannot tip. The rollers on the base must be be able to lock so if she pushes on the table it will not slide away from it. It should also have some sort of pommel to keep her from slipping forward if necessary

2.6 Technical specifications

Physical:

Metal: stainless steel

Plastic cover seat over foam

Mechanical:

Reach multiple table heights (28 ½ inch, 36 inch, 30 inch)

environmental:

Operating temp: 65-75 °F
safety:

Harness

Locking wheels

3. Stationary bicycle

3.1 Introduction and overview:

Elysa has poor motor development and needs substantial core support for most activities. Her parents want her to have multiple methods to strengthen her muscles that are fun and motivating. The goal of the bike is to have motion that will aid her brain in processing and make it possible to move on her own. They desired a way for her to safely strengthen her leg muscles which are weak. Her muscles are not yet developed enough to propel herself in a bike and her parents think a stationary bike would be best. They want this bike to be motivating so they desire some kind of reaction to occur when she pedals like dolls moving or lights turning on.

3.2 Realistic restrictions:

Cost might be a realistic restriction. Her physical strength might limit this project. Also size may be an issue. I do not know how we are going to make it small enough to pack away.

3.3 Other information:

I think it would be important to know what her strength level is and information about angles of the device and seat placement to work different muscles in the legs. Need to know optimal positioning for desired effect. I would like to create a monitor or something that would play a video while she rode that interacted with her pedaling, something similar but more simple than the Wii video game system.
3.4 Questions:

How to integrate some sort or display with the pedaling motion either screen or toy movement?
What is the optimal positioning of the seat in relation to the pedals to most adequately work her muscles? Proper ergonomic position to be effective and safe for repeated use.
How do we make this adjustable to her height as she grows or gets stronger?
How do we make this storable?
Materials for the frame?
How do we add controls for the safety so she can’t pedal too fast or can slow down when she wants?

3.5 Operational specifications:

This is supposed to be similar to most stationary bikes. The only requirements that are different than any bike is that there must be some attachment so the parents can help move her legs. And they want a toy or lights to light up when she pedals to motivate her. She needs to have a harness to strap her in.

3.6 Technical specifications:

Physical:

   Stainless steel frame
   Plastic or woven seat

Mechanical:

   Adjust leg length
   Fit height: 33-35 in
4. Adaptive skiing gadget

4.1 Introduction and Overview:

Our client, Elysa, was born very prematurely, which affected her motor development. She has weak muscle and core muscle strength, therefore she has trouble with coordination and most of the actions she performs required some kind of physical support. Elysa’s parents want her to enjoy the outdoor activities such as skiing during winter, and therefore hoping us to design an adaptive skiing gadget for her to move around in the snow.

The purpose of this project is to create a sled that is suitable for our client, Elysa, to have fun skiing at their yard, and at the same time, the sled can support her body and help her build muscle strength. Elysa enjoys movement and sport related activities, and since the yard at Elysa’s house is slightly steep, her parents think it would be a good idea for Elysa to extend her fun to outside of the house.

The client’s parents want us to design an adaptive skiing gadget for Elysa with the following concerns. The primary concern, of course, is safety, since she cannot move freely without any support. Therefore the skiing gadget has to be seated to provide Elysa with the greatest support. The second concern is that the parents want Elysa to be able to control the direction that the ski is going, so that it can give her the feeling of independence; instead of just sliding straight down from the top of the hill, Elysa should be able to turn the ski to the directions she prefers and stop the ski whenever she wants. So a steering wheel or some kind of mechanism is needed to perform the above function. The third concern is that the gadget should be simple and not bulky, so her parents can easily make adjustment when needed, provide good maintenance, and store easily.

4.2 Realistic Constraints:

Economic constraint is important because the budget is limited; better quality materials generally priced higher. Also, we want the device to be affordable to other families with the same circumstance. The sustainability and manufacturability constraints are also important to be considered because Elysa’s parents want the devices to be simple and not bulky; the easier the device is to assemble, the easier her parents can maintain its quality. On top of that, we don’t want the device to be worn out easily since Elysa will be using it very often. The environmental constraint is important for us to design the appropriate device for her at the appropriate place, for example, skiing gadget for the snow and water bike for the pool. Health constraint is also important since the purpose of this project is to help Elysa to build muscle
strength while having fun. The device should provide Elysa as little support as possible, so she
can focus on standing straight and skiing on her own. Safety, of course, has always been the
primary concern for us and the family; we want Elysa to enjoy herself around her house safely,
therefore making her feels more independent doing things.

4.3 Questions:

What materials should we for the seat and the structure?

How to change the direction and how to brake?

How should the client control the direction?

Does the client want the ski to go up hill also?

How do we balance the client on the skiing gadget?

How big should the gadget be?

4.4 Operational Specifications

The skiing gadget needs to accommodate the client with limited motor development. It
should be designed only for outdoors and in the snow. It must have a seat and some kind of
body restraint like a seat belt to keep the client safely in place. The seat should be comfortable
for the client to sit on. The device should be simple and not bulky so the family can store and
maintain easily. The controlling mechanism should allow the client to control the device easily,
either changing the directions or hit brake when needed.

4.5 Technical Specifications

Physical:

Type of Material: Stainless Steel Tubular Bars, 3-point safety seat belts
straps, Existing pair of Skis, Foot straps

Mechanical:

Approximate Size: 39” x 22” x 35”

Approximate Weight: < 20 lbs

Passenger Weight: 40 – 70 lbs
Environmental:

- **Storage Temperature:** 10 - 150°F
- **Operating Temperature:** -5 - 42°F
- **Operating Environment:** Outdoors in the snow with small incline

Safety:

Elysa’s safety will rely on the device. The design of the device can prevent Elysa from rolling over. The safety seat belt strap can hold Elysa in place and avoid falling off from the device. The device can only be used for children and only one person at a time. The device is not designed for steep incline.

**4.6 Maintenance:**

The device should be stored indoor when not in use. Safety seat belt straps should always be checked for tears and the device should be adjusted before every use. Any damage found on the device should be replaced as soon as possible.

5. Zip line walking assist

5.1 Introduction and Overview:

As Elysa was born premature, her core and leg muscles are quite weak. While her muscles have the ability to function normally, she lacks coordination with them. This results in her needing to learn how to move and coordinate her muscles, so that she can be more independent. Her parents have been trying to help her to walk, but supporting her weight and keeping her feet forward simultaneously has been a challenge. The goal of this project is to build a zip line walking device that can be used to help Elysa get around more freely, as well as providing a way to strengthen her muscles in a safe manner. A harness would provide support for Elysa so she can stand upright, leaving her parents free to help her with the motion of walking. As she walks, the wheeled frame where the harness is attached to can glide along the wire. Her parents would like to have the zip line placed within their home and ideally not have it permanently installed in their home. The design should be lightweight and give her minimal support, without being bulky.

5.2 Realistic Constraints:

Safety is one of the most important aspects throughout all the projects. The frame where the harness is hanging from should strong enough to support her weight, without being
heavy or bulky and providing too much resistance to movement. The harness and straps should not be too tight or constricting, so movement is allowed, while providing sufficient support for the body. The zip line wire itself needs to be able to support the weight of the harness, frame, and Elysa. On top of that, as Elysa gets older, all the components will have to be able to accommodate her growing body so that the line does not snap from the extra weight. As the zip line would be used indoors, installing it is going to cause problems if it is not placed correctly. If it is installed too low, it can make getting around the house difficult and inconvenient for the rest of her family. If it is installed too high, while it would not give the rest of her family any difficulties getting around, depending on where Elysa is in the house, she might not be able to touch the ground.

5.3 Questions:

What is the budget for the project?
How heavy and big will it have to be to support her current and future height and weight?
What should the straps be made out of -- an elastic material or some sort of wire?
How thick should the zip line wire be to be able to support the frame, harness, and Elysa?
Should the wire be made out of a wire cable or a rope?
What is the frame going to be made out of?
Are there going to be any height issues with door clearances or abnormal ceilings?
What is the harness going to be made of?
How can the zip line be installed indoors without making getting around the house inconvenient for the rest of the family?

5.4 Operational Specifications:

The zip line walking device should be design for indoor use, as to allow the client to be able to walk around the house more freely. The harness will support Elysa’s waist and thighs, while keeping her limbs free to move. It will provide minimal support, but it should also be comfortable, without making her feel restrained and constrict her movements. A removable neck and back splint can be attached to the harness to provide additional support if needed. The rod support for the splint will be able to extend upward to adjust to Elysa’s growth. A swivel will be used in between the cable and metal bar, so device can be rotated as Elysa moves around. The cable where the frame will be guided along must be strong enough to support Elysa, as well the metal bar, splint, and harness.
5.5 Technical Specifications:

Physical:
- Type of Material: Stainless steel bar
  - Stainless steel cable or rope
  - Rock Climbing Harness
  - Stainless Steel Neck and back support frame with foam padding

Mechanical:
- Metal bar: 16” x 3” x 1”
- Zip Line Cable Length: 100’
- Zip Line Cable Thickness: 1/4”
- Total Weight: < 20 lbs
- Harness Weight Capacity: 100 lbs
- Zip Line Weight Capacity: 350 lbs

Environmental:
- Storage Temperature: 40-90°F
- Operating Temperature: 60-75°F
- Operating Environment: Indoors

Safety:
- Cable strength can weaken over time
- Improper use can shorten the life of the cable and harness

5.6 Maintenance:
- Checking on the cable to make sure that it is operational
- Adjusting the splint as needed to accommodate for Elysa’s growth