Projects for Nathan Lamb

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**Mobile Stander**

The goal for this project is to modify an existing stander, provided by the school, to suit Nathan’s needs. Each design will use the same frame, but will be controlled by a different means, but since Nathan only has full use of his left hand, the stander will need to be propelled by some form of one-arm drive. The universal design will utilize four casters, two to the front and two to the back, as a stabilization mechanism. They will provide sufficient support to prevent capsize, and do not impair the movement of the user.

The mobile stander will have foot stands as well as padding for the legs, hips and torso. An adjustable strap harness system will be implemented to keep the client in place. The stander will also have a retrofitted seat from Nathan’s previous mobile stander for when he would like to sit, as well as for additional support. There will also be a tray for Nathan to use for art, books, eating, or homework.

**Design 1, Double Hand-rim Mechanism**

The first design will be a mobile stander with a mechanical one-arm drive. The driving mechanism will be on the left wheel to accommodate Nathan’s sole use of his left arm. The mechanism will be a double hand-rim system, and for propulsion, gripping one rim will turn the wheelchair left or right, while gripping both will propel the wheelchair forward or reverse. Most current designs of this mechanism that are on the market are designed for folding wheelchairs, but can be implemented without a problem.

One potential problem for this mechanism will be finding a one-arm drive wheel set that is large enough for Nathan to be able to grasp the hand-rim comfortably while he is standing in the device, as most existing one-arm drive wheels have a maximum diameter of 26 inches. Additionally, turning both of the hand-rims at the same time or stopping both of the hand-rims once the chair is in motion, will require a fair amount of grip strength,
which may render this design unusable for our client.

**Design 2, Lever Drive Mechanism**

The second design also uses a mechanical one-arm drive. The driving mechanism will be implemented through a lever. The lever will be connected to the front casters as well as have connections to the rear wheels. The lever will have neutral, forward, and reverse settings. In the neutral setting the wheelchair can be pushed by a caretaker. In the forward and reverse settings, the lever can be pumped forward and back to move in the set direction. The lever also has two grip-brakes, similar to a bicycle, which will allow the user to steer and stop. To turn, one of the brakes must be gripped, and that will impede the motion of one of the wheels, causing the device to turn. To brake, the lever would have to be set in the neutral position and pulled back to lock the wheels, or both brake levers compressed. This model will be using the same general design as the previous model as it will have the same restraint system as well as padding, foot stands, and holding tray.

The brakes will be simple disc brakes, as used on a bicycle. The wheels will be attached to the axle via a ratcheting mechanism set to a fairly low torque, so when the brakes are implemented, the wheels will not turn, and will not put unnecessary wear on the brake pads.

One possible problem for this design will be in the user interface. The lever controls are not as intuitive as the wheel-based hand-rim design. However, the force required to propel the device is less, as well as the grip strength required to manipulate the controls.

**Design 3, Electric Power-Stander**

The third design will use a motorized one-arm drive. A joystick will be used to propel and steer the rear wheel drive stander forward or in reverse. For steering, one of the rear wheels will be fed less power, causing it to turn at a slower rate. There will also be a lever on the joystick when Nathan wants to slow down or brake. There are current designs on the market that fulfil these requirements with minimal modifications.

The mobile stander will use two electric motors to propel itself, one mounted on each of the rear wheels. The device will be powered by a
deep-cycle battery, so it will be rechargeable and maintain a charge for a longer period of time.

The biggest problems with this option would be affordability and mobility. The electric standing chair is much heavier than the mechanical designs will be, and even before modifications is likely to cost much more. Since the chair is so heavy, it will not be as portable as the clients would need it to be.

**SmartKart**

The goal for this project is to fix last year’s design. The majority of the problems that need to be fixed are electrical, or need to be determined by further testing once the kart is on-premises. One of the client’s higher priorities is to allow Nathan to be seated in the kart safely and easily. Once the go-kart has been fixed of all necessary problems, Nathan’s seat will be modified to reflect these desires.

**Design 1, Scissor lift**

This design will have a scissor lift underneath Nathan’s seat. When the client wants to put Nathan in the seat, they can use the controls to lift up the seat and place Nathan in. Once the scissor legs are closed, the seat will be lowered to a normal height. The hydraulic scissor lift will be using an electric motor with a button switch control to raise and lower the lift. The engine will This design poses a few problems. One being a power source. In order for the lift to work, it needs to be powered. The kart would either need an extra battery or the motor would be hooked up to the battery that’s already in use. The latter would use up a lot of the battery’s energy. Adding a new battery would add

**Design 2, Flip-down Ramp**

This will be the simplest option. The side of the go-kart will be augmented so that it can flip down, this will allow the client to wheel Nathan on to the go kart and place him in the seat. The ramp will be secured in place with several latches to reconnect it to the rest of the kart.

The main problem with this is the integrity of the design. Although a ramp seems like a good idea, any extra loose parts means extra maintenance. Since it will be used outside, the
locking mechanism will have to either be under maintenance or rustproof; if not, the ramp could fail, which could be dangerous to Nathan. Additionally, cutting into the side of the go-kart will greatly decrease the strength of the current design.

**Design 3, Rail Guided Seating**

The seat will be placed on a rail guided system. The seat will be held in place by quick-release pins. Once the pins are removed, the seat can be moved along the rails. The seat would then be higher up and closer to the edge of the cart, which would make it easier for his parents to lower him into the kart. The seat is then guided back to it’s original position and the pins are used to lock it in place.

This system will also require quite a bit of maintenance, even more so than the flip-down ramp. If the rail system is not properly maintained, the lock mechanism that keeps the seat in place could fail. Although Nathan would still be strapped into the seat, the probability of injury is increased.

**iHome remote**

The purpose for this project is to design an iHome remote Nathan can properly use to change music in his iPod as well as turn the lights in his room on and off. The remote itself will have large, color-coded buttons so that Nathan can choose what he wants to do. Per the client’s request, the remote will be large enough for Nathan to use. The remotes will...

**Design 1, Wireless Remote**

This design will be using multiple bluetooth chips to communicate between the remote, the iHome, and the light switch. The Blue tooth microcontrollers would have to be programmed to effectively communicate with the iHome as well as the augmented light switch in Nathan’s room. The blue tooth micro-controller would also be physically wired to Nathan’s iHome, in order to communicate with the device and the iPod.

This design specifically meets what the client wants. It would be enough so that Nathan would not break it and would be easy enough for him to use. The main problem is that this would not only be the most time consuming option, but also the most expensive. The programming would take up time that can be used to ensure that the other projects will meet the client’s
needs.

**Design 2, Wired remote**

In the second design, the remote will not be wireless. A physical wire will connect the iPod remote to the iHome. This will increase ease with which the remote will communicate with the iHome, as we will not have to spend as much time coding a wired transfer of information. However, the part of the remote that controls the lights will still be wireless.

Some problems with this design include the portability of the remote and the difference between the product and the client’s specifications. The remote would only be able to go as far away from the iHome as the connecting wire is long, and once the wire is taut, any excessive movement of the remote could cause the iHome to fall off of the dresser upon which it is currently situated. Furthermore, the wire would be a safety hazard, as it could cause someone to trip, or it could wind around someone’s neck were they not being careful.

**Design 3, iPad app**

Our clients told us it would be a possibility to write or find an iPad app to control the music and lighting in Nathan’s room. He already uses the iPad, and there are already means available to easily have wireless communication with the iHome, such as the Airport.

With the iPad and Airport wirelessly networked, the user can choose the Airport as the audio output for the iPad. The Airport has an auxiliary cable port, which could be used along with a 3.5 mm stereo male-male cable to connect it to the iHome. This would make the iPad control the output of the iHome.

Additionally, there are currently apps that allow the user to interface with household devices, such as light-switches, televisions, etc. Using these apps as a guide, as well as purchasing the iPad, the program interface would resemble the remote design with three buttons to coordinate playlists, one button to start and stop the music, and one button to turn the lights on or off. Since there are fewer parts and less fabrication needed in this design, more

**Swing**

The main objective of this project is to design a swing for Nathan to use. The client informs us that Nathan desires movement, but rarely gets the chance to do so. The swing will be designed taking the client’s house into consideration, as when we
met with them, the ability to move the swing into the house was greatly desired.

There will be three different designs with varying modifications regarding the frame holding up the actual swing. The bench of the swing will be the same for all three designs and will be able to seat two or more persons. The seat will be reinforced and padded to accommodate our client, and part of the seat will have a harness so that Nathan can swing safely without falling out and risking injury.

**Design 1, Ceiling Swing**

The first design will have the seat attached to the ceiling of the deck by chains that connect to the bottom of the seat. On each side, two chains would converge to a single ceiling hook. The ceiling hooks would be attached to the I-beams in the roof of the deck. The chains would be able to support at least 400 lbs of weight.

Although this would be the easiest to implement in theory, there are still a few problems with the design. One being mobility; with this design the client will not be able to bring the swing inside. Since the swing would be attached with chains, there will not be anything to keep the swing secure at rest. This could make it difficult to put Nathan in the swing.

**Design 2, Glider**

The second design will be similar to a glider chair or sofa. The seat of the swing will be attached to the base through a double rocker parallelogram 4 bar linkage. To provide a rocking or swinging motion, the glider will be using non-parallel suspension bars, which will simulate a rocking motion. The glider will be on casters in order to conveniently move the glider from the deck to inside the house. Additionally, telescoping supports would be attached to the base, giving the device more stability. The main problem with this design would be with the stability of the glider. The glider will exert a lot of force on the supports we add, which will make it difficult to find the proper material that is light enough but

**Design 3, A-frame Swing**

The third design will be more of a conventional swing. Like most swings, it will have an A-frame to support the swing. The bench will be
supported in the same way the ceiling swing would be supported. Instead, the ceiling hooks would be attached to the main horizontal support beam.

The problems of this model are very similar to the problems with the ceiling swing. Although it is not attached to the ceiling, once this design is assembled, it will be very difficult to move around. Essentially it will be stationary. In addition, since it is suspended by chains, it will be more of a hassle to put Nathan into his seat and secure him.