CHAPTER 5
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THE POSTURE-RIGHT WALKER

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Client Coordinator and Caretaker: Mahvash Mozaffari, R.N.
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INTRODUCTION

A client with multiple physical problems, including osteoarthritis, spinal radiculopathy, degenerative joint disease, and poor blood circulation in her legs has had difficulty walking during the past few years. She has had three spinal fusion surgeries and is overweight. Exercise is the only element under her control that can improve her condition. Initial options included an exercise bike, free weights, a weight machine, a stretching machine, or a walker. The Posture-Right Walker was designed to promote exercise by making walking easier for her.

SUMMARY OF IMPACT

The Posture-Right Walker provides back support, promotes good posture, and transfers some of the weight load from her legs and back to her arms and shoulders. It is a novel design. Typical walkers available today are designed for a wide user pool but only help patients needing leg support. This new design incorporates features typically found in a walker in addition to back support and "rest anywhere seating" via a foldout seat. The walker has four wheels and is manually operated. This prototype provides a good means for the client to be able to walk around her own neighborhood and parks. Use inside a home or store is discouraged because of the large size.

TECHNICAL DESCRIPTION

The design of the Posture-Right Walker allows the user to push down with her arm, transferring weight from her legs to her arms and shoulders. The angled armrest is designed to force the user's trunk backward into the contoured backrest, providing vertical lift and the force necessary to push the walker forward. Conventional walkers are also pushed, but with the Posture-Right Walker the user also has full back support in a position conducive to correct posture. The base of the walker is maximized for good support, in an effort to prevent the walker from tipping over. The constraining

Figure 5.1. Posture-right Walker.

width is smaller than that of a standard door, so that the walker can easily pass through almost any doorway. The length is about 1.5 times the width. The height is customizable. A canvas seat can be stretched across the main lower body of the walker. Removing four horizontal beams that connect the left and right halves of the walker allow it to be broken down for transport. The walker was plasma arc welded together from 1" OD 1/8" wall T6061 aluminum tubing. The armrest, backrest, and seat were all custom built by a local medical supplies retailer with plastic canvas and medical grade foam padding.

Suggested improvements for future designs include:

- Rounding out corners and reducing bulkiness to make the device more conducive to indoor use,
- Angling legs of walker outward to not inhibit sideways steps, so that the user can avoid tipping over,
- Strengthening the hinging mechanism and support bars for the backrest,

- Incorporating a locking hand brake,
- Using softer wheels,
- Enabling the walker to adjust more easily, and fold more compactly, and
- Improving the way the seat engages (Currently, to transfer from walking to sitting positions, the user must exit the device, put the backrest down, then bend over, undo the Velcro strap, unfold the seat, then manually push 6 push pins through the left frame to secure the seat.) .

<u>Project Costs are listed as follows.</u>

Metal	$150
Machining and welding	$100
Cushion, backrest and seat	$250
Breakable castors	$ 50
Total:	$550

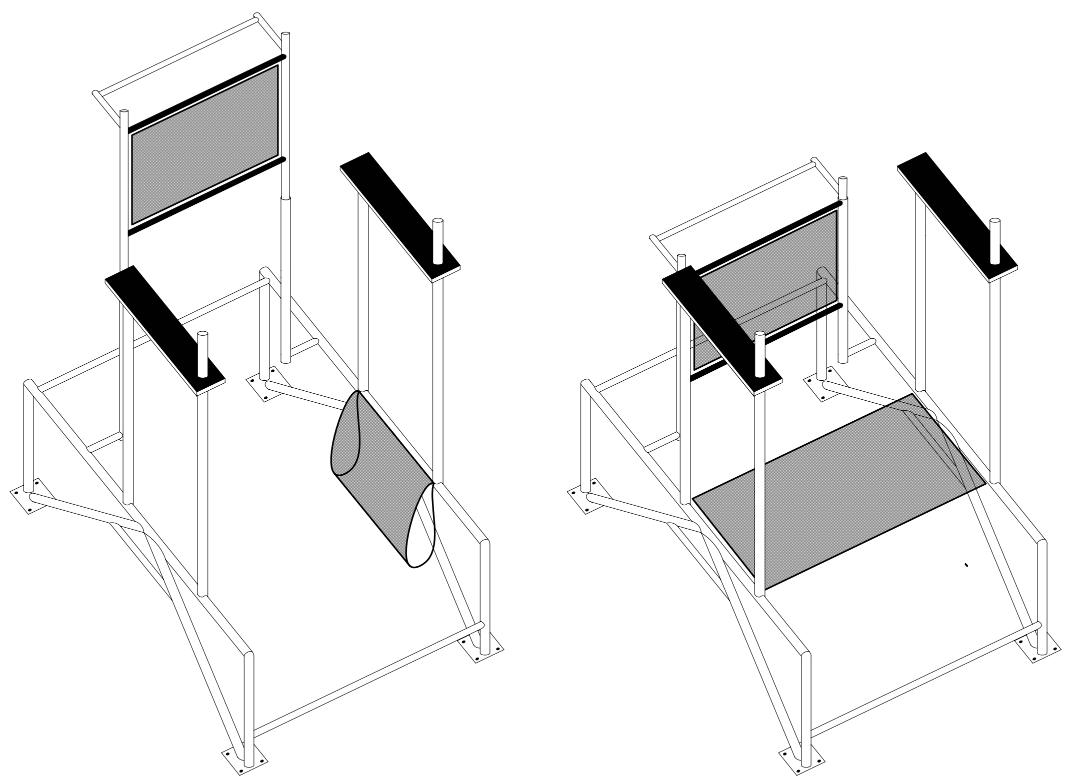

Figure 5.2. Diagrams of the Posture-Right Walker.

DETACHABLE ASSISTIVE WHEELCHAIR ACCESSORY

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INTRODUCTION

This wheelchair tray aids persons with limited hand use. The tray was specifically designed for a man with spastic quadriplegia due to cerebral palsy. The client needed a see-through tray that would connect to his wheelchair at a single point, easily swing out of the way when not in use, and allow reinstallalation without the aid of another person. He has partial usage of his right hand, and minimal to no usage of his left.

There are many wheelchair tray designs commercially available. Some have swivel trays; others have a support on both sides of the wheelchair arms, and others are hinged. However, none of these designs meet the needs of the client. Many were too heavy for him to operate, not detachable, or too complicated to maneuver with one hand. The swivel tray seemed to be the closest to his needs. Some modification was required for him to be able to disconnect it from his wheelchair.

SUMMARY OF IMPACT

The client is very independent and active. Even though he uses a wheelchair, he enjoys riding about, working on the computer, working with tools, visiting other people and socializing. The tray allows him to do more things, such as eating at a restaurant and reading books at the library. The tray facilitates his daily activities while increasing his independence because he can install and put away the tray by himself.

The main design requirements outlined by the client were that the device:

- Be able to sustain various magnitudes of weight,
- Be light enough for the client to lift by himself with his right hand,
- Be simple to attach and detach,
- Have a smooth surface that would not scratch or bruise his arms when bumped into,
- Be built or orientated around his right side,
- Have a bottom support that could be permanently fixed to his wheelchair, and
- Be stored on the right side when detached.

TECHNICAL DESCRIPTION

The wheelchair tray consists of four main components:

- The Lexan tray,
- The aluminum support plate, which is fixed to the tray,
- The aluminum support rod, and
- The bottom aluminum joint, which is fixed to the arm of the wheelchair.

The 12″x18″ tray is made of 3/8″ Lexan. A 3 ½″ X 4″ lip was placed on the right hand side with a slight bend for a rest of his right arm. The edges of the tray were smoothed to prevent scrapes. The aluminum plate is 3-½″ X 4″ X 3/16 ″ with a 1 ½″ piece of 1 ¼″ diameter aluminum welded to the center. This piece has a ¾″ inner diameter and was machined out near the bottom to act as guide, making it easier to set the tray on the support rod. The purpose of the plate was to disperse the stresses from the single load point and to provide a solid means of mating to the cylindrical rod. The support rod is made of ¾″ diameter (1/8″ wall) aluminum T6061 tube and had an 11 ½″ height, but was actually three pieces welded together. The top piece fit into the top support and the bottom fit in the lowest part. The bottom joint was manufactured from 1″ diameter T6061 aluminum rod with a key slot machined out of it; this was attached to the arm with aluminum clamps. A pin was placed on the support rod that fit into the key and held the tray in place and prevented unwanted rotation. A denim bag placed on his right side provided storage for the tray when not in use. In this location alone he is capable of accessing it without difficulty.

The tray is designed to support a 150 pound load placed anywhere on the surface. Aluminum components were used to keep the weight of the tray low. Lexan was chosen by analysis and comparing its properties to other clear plastic materials such as Plexiglas. Consideration was given to whether the tray could withstand the impact of being dropped onto a hard surface, and able to avoid fracturing if bent.

Physical strength tests were done by placing a portion of the designer's body weight on the tray when attached. The force was estimated to be at least 150 pounds and more than the patient would be capable of applying. The efficiency of the client's ability to assemble and disassemble the tray was also measured by timing him. He managed to accomplish connecting and then disconnecting all the parts and placing them aside within a time of one minute with little difficulty.

The final cost of the materials for the tray was approximately $40. This is calculated from the cost per unit volume of the various materials and outside parts. The material cost would be higher if the waste of the materials used was also taken into consideration.

There is a problem with the swivel joint. When the support rod swivels, the rod hits the wheelchair control box, thereby greatly reducing the swivel radius. At first, this was of concern. However, the time it took the client to detach, store, and reattach the tray was so brief that concern is unwarranted. Because of the relative speed with which the client can remove the tray, the swivel device is unnecessary.

Another final design concern was the stability of the arm that the bottom support was attached to. The arm is part of the wheelchair and is supported only by a few pins. It gives a little when forces are exerted on the far left side of the tray. This was not taken into full consideration before the design was implemented. The wheelchair arm should be better stabilized. The tray as made, however, was stable enough to meet the client's needs.

Figure 5.3. Detachable Assistive Wheelchair Accessory.

POWERED REHABILITATION STANDING FRAME

Student Designer: Heather L. Cullen
Client Coordinator: John Figy, Physically Challenged Recreation Program, ASU
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INTRODUCTION

A standing frame is a device used by people with paraplegia to go from a sitting to a standing position during rehabilitation. By standing at a frame such as the one developed, those with paraplegia can apply weight to their own limbs. The entire body receives benefits from these weight-bearing exercises. For instance, standing frames have been shown to reduce spasticity, slow osteoporosis and bone demineralization, improve circulation, and possibly reduce muscle atrophy.

The goal for this project was to make a powered standing frame that is suitable for use in a rehabilitation setting. Commercially available frames cannot be used by weak or heavy users. By redesigning the frame to have an automatic lifting mechanism, more users will be able to use the frame without increasing dependence or risk of injury. This frame uses an automated pneumatic cylinder to accomplish the initial phases of the lifting task.

SUMMARY OF IMPACT

The high cost of standing frames limits many people with paraplegia from using them. By adapting a frame that is suitable for a variety of users with different physical characteristics, the device becomes suitable for a rehabilitation setting where people with paraplegia and even some with quadriplegia can use the device independently.

TECHNICAL DESCRIPTION

The major design effort associated with this project is the addition of a pneumatic cylinder that spans the base of the frame to the lifting arms. This cylinder is attached to the frame with a hinged clevis mount, enabling it to rotate as the cylinder is pressurized. With pressurization, the piston within extends, pushing the lifting arms from their lowest point to an elevated position. The internal area of the piston is large, enabling even a heavy user to be lifted safely and smoothly.

A small portable air compressor is equipped with a remote on/off switch so that the user can activate the compressor without having to bend and reach the device. A manually activated toggle valve within the cylinder/compressor arrangement allows the user to bleed out air and lower himself to a sitting position after therapy. The toggle valve also allows the user to stop the lowering movement in case of an emergency.

The base was designed to be wide enough to allow the patient to pull himself up to the stand without interference. Once standing, the wide, flat surface enables the user to read or study while remaining in the standing position. The clear, see-through surface enables him to clearly see that their wheelchair is properly positioned before lowering himself back into it.

The total cost of the project is approximately $377. This includes the manufacture of the base and tray top. The major component that contributed to the cost was the lifting mechanism, at $155.

Figure 5.4. Photograph of the Powered Rehabilitation Standing Frame.

PEDAL POWERED COMPUTER-ACCESS WHEELCHAIR

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INTRODUCTION

The client is a person with cerebral palsy who uses a motorized wheelchair for movement outdoors. He finds the chair cumbersome within the confines of his apartment. He uses a standard wheelchair inside his apartment but finds it uncomfortable, non-adjustable, and impractical when working at the computer. This project involved designing and building a specialized computer access wheelchair appropriate for indoor use.

SUMMARY OF IMPACT

The standard wheelchair currently used has many shortcomings. The client slides forward to the edge of the seat and as a result, must adjust himself frequently. Long periods of time in the chair's unpadded, cloth suspension seat potentially lead to pressure sores. Since the patient moves the standard wheelchair by pushing against the floor with his feet, he can only move backwards. When he reaches his destination he is able to slowly turn the chair around. He cannot use his hands to push himself. The chair is also nonadjustable in height or inclination, so he has difficulty working on his computers.

The design objectives in this project were to make a more comfortable and more adjustable chair that the patient could get in and out of easily and could move with his feet while facing forward. Thus far, the chair has been made but the drive mechanism was as yet unsuccessful.

TECHNICAL DESCRIPTION

The chair was made of 1” OD x 1/8” wall T6061 welded aluminum tubing. The backrest is made to extend above the user's head by request, as the user has limited trunk control. Standard wheelchair bearings and wheels have been mounted vertically to increase maneuverability.

The drive mechanism utilizes a bicycle sprocket rigidly affixed to a wheel taken from a standard wheelchair castor assembly. A pedal drive is attached to the sprocket so that by depressing the pedal, the user can propel himself slowly from place to place. A spring returns the pedal upright, and allows the user to depress it again. However, the direct drive mechanism is not powerful enough given the limited strength of the client, and needs to be enhanced with gearing. Steering and backing capabilities need to be added so that the user avoids becoming boxed into an area.

Although this chair was designed according to the wishes of the user, in retrospect it is the opinion of the engineering participants that a more maneuverable electric chair would probably provide the user with greater mobility indoors, adjustability, and effectiveness.

Figure 5.5. Photograph of the Pedal Powered Computer-Access Wheelchair.

ULTRASONIC OBSTACLE DETECTION SYSTEM

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INTRODUCTION

The goal of this project was to design and build a cost-effective obstacle detection system using ultrasound technology that would improve mobility for persons with impaired vision.

SUMMARY OF IMPACT

There are many types of commercially available obstacle detection systems. Some of these devices work well, but were ultimately too expensive to be successful on the market. This project involved making an affordable ultrasound detection device. The device informs the user of obstacles in front of the user's head and/or chest and allows the user a range of detection that extends beyond a cane. The device is small, light, easy to handle, and easy to use. The device also uses minimal power, uses standard batteries, has a long battery life, and appears to be durable.

TECHNICAL DESCRIPTION

This device uses reflected ultrasound to detect an object that might present a hazard to an individual with vision impairments. When a sound wave traveling through space reaches a different medium, part of the wave will refract through the medium and part will be reflected. This reflected wave is what is used in obstacle detection. A practical and inexpensive way to produce an ultrasound wave is with a piezoelectric crystal. The crystal undergoes elastic deformation when stimulated by an electric current and emits a sound wave. A fluctuating electric current then creates a time varying deformation of the piezoelectric device, causing pressure wave variations in the air. These pressure waves propagate and reflect off objects.

If a reflected sound reaches a piezoelectric device, it causes a small deformation and creates a voltage potential. Thus, piezoelectric devices can both emit and detect sound waves. Plastic films can also be made to be piezoelectric by forming them in the presence of an electric field. Once expensive, the sensors and emitters used in such devices as the Sonic Torch (a costly device made in the 1960s as an obstacle detector for those with severe visual impairments) are now inexpensive and are available in readily usable forms, such as parking indicators. If properly installed in the garage, the Radio Shack parking indicator gives an audible warning when a vehicle is within a preset distance. This project entails a parking indicator within a user-wearable device to detect obstacles that might present a hazard to individuals with visual impairments.

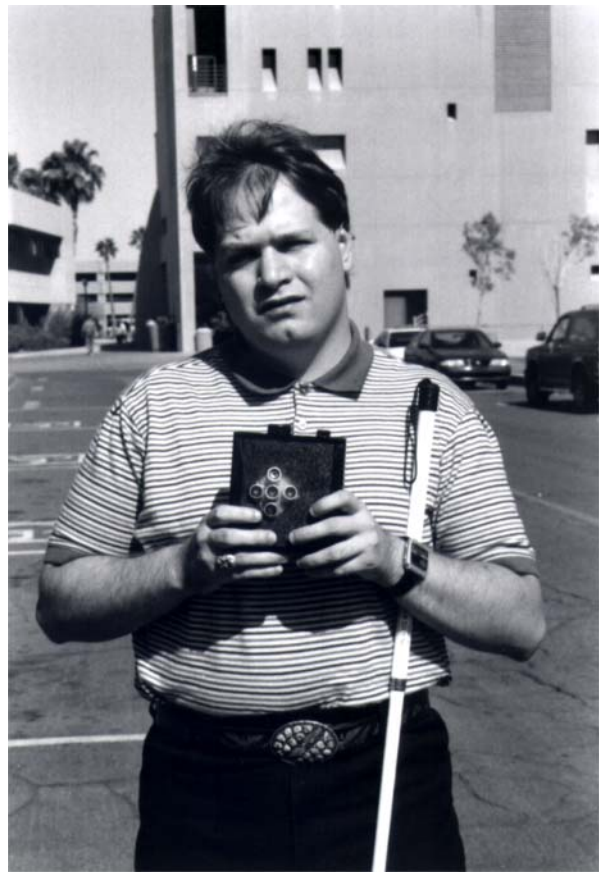

Figure 5.6. Photograph of the Ultrasonic Obstacle Detection System.

The sensors in the device were built to detect obstacles at a maximum of 1.5m. This range will allow the user to change direction when an object is sensed. The generated waves spread in a cone 2.5 degrees from the central emitter. Four sensors detect reflected waves, one at the face, one in the center of the torso, and one to each of the left and right sides.

The transmitters fire in a pulsed sequence in order to conserve energy. Detection frequencies are 10,000 Hz for the head, 5,000 Hz for the left side, 2,500Hz for the right side and 1,250 Hz for the torso center. Thus, with minimal training the user can differentiate between objects threatening the head from, say, the left side. Volume control for the warning signal can be implemented using a potentiometer, as the user would likely turn down the volume to avoid being conspicuous amid a crowd of people.

Total cost to manufacture the device was approximately $100.

Figure 5.7. Another Photograph of the Ultrasonic Obstacle Detection System.

HAND PUMP BICYCLE

Student Designer: Nicki Mylinski
Client Coordinator: Beckie Heffron, C.O., Prosthetic Orthotic Associates, Mesa, AZ
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INTRODUCTION

The charge of this project was to design a bicycle for a 12-year-old with physical disabilities. The bicycle is powered by a unique ratcheting system that allows the girl to use an up and down arm motion to drive the chain mechanism and back wheel. This design was chosen for ease of use for the cyclist and to keep the bicycle as close in appearance to a standard bicycle as possible.

SUMMARY OF IMPACT

This bicycle was designed to fit as closely as possible, the criteria specified by a little girl with big ideas. She does not have adequate function of her legs to pedal a standard bicycle (she must keep her legs straight and widely apart) and has limited function of her hands as well. However she has reasonable arm and shoulder mobility, and this was the key element in designing the bicycle.

TECHNICAL DESCRIPTION

The main obstacle in the design was to convert the linear motion of up and down shoulder/arm pumping to a rotational motion to turn the gears. The bicycle design was first converted to a bicycle with nonremovable rigid training wheels that provides platforms for her feet and prevents her from tipping over. The drive assembly can be divided into three major areas: handlebars, linkage and bell crank, and the ratchet gear assembly.

The cyclist has the greatest mobility and control in an up and down arm motion. It is this motion that is used to power the bicycle. The handlebars were designed to pivot up and down by attaching them to a 1″ aluminum bar via two risers. Aluminum spacers are used to keep the bars from moving horizontally. From the center of the handlebars is a power arm that extends down to a lever on the right side of the bell crank. Heim joints complete the attachment points and able the cyclist to steer. The linkage arm of the bell crank is set screwed onto a 3/8″ rod that extends through the center of the frame. This rod is able to rotate because it goes through 3/8″ ID bushings.

The left side of the bell crank has the same linkage arm attached with a Heim joint to another, longer power arm. This arm extends down to a single gear free wheel ratchet. An aluminum crank was screwed onto the ratchet gear and is connected to the power arm at another Heim joint. The sprocket is attached using a using an adapter and replaces the left pedal crank arm. When the rider pushes down on the handlebars the ratchet rotates down until it hits a stopper and turns the chain and gears. As the rider pulls on the handlebars, the ratchet returns to its original position.

The bicycle is equipped with a footrest and training wheels for easier and more comfortable riding. The left hand brake stops the front wheel. A parking brake on the rear wheel, which is controlled by a lever on the center frame, makes mounting and dismounting easier.

Total cost for the bike was approximately $500. This includes the bike itself, parts for the modification and new powder coat paint.

Figure 5.8. Photograph of the Hand Pump Bicycle.

TENNIS WHEELCHAIR #1

Student Designer: John Doe (name changed)
Client Coordinator: John Figy, Physically Challenged Recreation Program, ASU
Supervising Professor: Gary T. Yamaguchi, Ph.D.
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INTRODUCTION

The task for this project was to design a tennis wheelchair for an employee at a student recreation complex at a university. The wheelchair was designed specifically for the quick changes of direction necessary for competitive tennis, and for use by a variety of individuals. The chair needed to be light, strong, easily maneuvered, difficult to tip, and durable. It was also desired that this chair utilize something other than castor wheels, if possible, and that it have a low moment of inertia about a vertical axis so that it could change direction quickly. Also, a mechanism to steer to the right and left using the non-racket hand when making a final approach to the path of the ball was required.

This design was unsuccessful, and is included here as a case study.

SUMMARY OF IMPACT

The tennis wheelchair ideally allows competitors a better range of motion when playing tennis than a standard wheelchair. This chair was designed to enable wheelchair tennis to be taught to people with paraplegia and quadriplegia.

TECHNICAL DESCRIPTION

A wheelchair frame was designed from scratch to concentrate weight in the center and to utilize a newly designed anti-tip, non-castor-type rear wheel. The frame was constructed; however, the wheelchair design is considered unsuccessful as a series of design and material changes undermined the basic design. While the initial concepts were excellent, the design needs further development to be functional. The design followed a "Fast Track" design model in which the major components of the frame, anti-tip wheels, drive wheel supports and assembly, and seat were designed in parallel. Allowances were made for reasonable dimensions, and calculations were made using available materials.

Many concepts were worked through in an effort to design a non-castor type rear wheel. One disadvantage of a castor wheel is that it is difficult to change its direction by 180 degrees. In a wheelchair, this occurs often because a counterclockwise rotation followed by a clockwise rotation of the chair will cause the castor wheel to undergo a 180-degree change in direction. A castor wheel first must swivel about its vertical axis before it attains a stable rolling motion about its horizontal axis. Another disadvantage of a castor wheel is that it requires a great deal of vertical space to be mounted. A castor typically takes up the diameter of the wheel, some vertical clearance space, and some additional space to mount the vertical bearing.

The designer drew up many configurations for an alternative, but the designer and faculty advisor were unable to think of a configuration that could be manufactured, resisted dirt infiltration and fouling in a tennis court environment, was light weight, and was reasonable priced. Together, the student designer and faculty advisor decided that a castor wheel would have to be used.

Meanwhile, the design of the frame was set using a reasonable estimate of the clearance required for the anti-tip wheel. The novel frame design included a reduced seat inclination in order to provide good support and improved clearance for a better racquet swing. It was desired that the wheelchair frame be made from 1-1/2" OD thin wall chrome moly steel, for durability and lightweight properties. However, shop employees were unable to precision fit and weld thin walled steel tubing in the limited time available, and suggested that the student instead use 1/8" wall tubing. The student agreed but did not reduce the outside diameter of the tubing for the frame, and did not redraw the frame using the height required for the castor wheels.

The result of switching to a castor wheel and using large diameter, thick walled tubing was a heavy frame that did not enable all four wheels to touch the ground. In retrospect, this was probably too large of a project for one student to accomplish alone, especially as much time and effort was expended unsuccessfully to "reinvent the (castor) wheel". The steering mechanism, also, was never implemented due to time constraints.

Figure 5.9. Photograph of the Tennis Wheelchair #1.

TENNIS WHEELCHAIR #2

Student Designers: Kelly Byrne and Shaun Grams
Client Coordinator: John Figy, Physically Challenged Recreation Program, ASU
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INTRODUCTION

The design task was to develop a tennis wheelchair for an employee at a university student recreation complex. The wheelchair was designed specifically according to the criteria described for "Tennis Wheelchair #1.".

SUMMARY OF IMPACT

This chair was designed to enable people with paraplegia and quadriplegia to play wheelchair tennis.

TECHNICAL DESCRIPTION

A wheelchair frame was designed from scratch to concentrate weight in the center. 1" OD by 1/8" wall chrome moly tubing was used as the frame elements. By minimizing the lengths of the tubing required, the weight of the frame was also reduced.

A novel axle housing, which provides two angles of wheel attachment simply by reversing the housing insert, increases the chair's stability on court while still allowing it to fit through doorways when off the court. An anti-tip rear wheel mounted on a flexible titanium shaft maintains contact with the ground to reduce rattling and energy dissipation.

This wheelchair design was successful, but did not explore the number of novel improvements addressed by the previous (unsuccessful) wheelchair design. The success of this design can be attributed to having two students splitting the workload, not extending the design too far beyond the current state of the art wheelchairs and staying well within the manufacturing and welding capabilities of the shop personnel.

CLASSROOM WORKSTATION FOR A CEREBRAL PALSIED STUDENT

Student Designer: Kelley Calvert
Client Coordinator: Mickey Calvert, Principal, Sirrine Elementary School, Chandler, AZ
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INTRODUCTION

This project was designed for a student with cerebral palsy who is entering the first grade in a public school setting. A specially modified desk or workstation was needed so that the client could function as independently as possible within an inclusion classroom. The standard workstation available to students is a table with a tote underneath and a sled base chair. It was difficult for the student to seat herself, to bend down and reach the tote underneath to access her supplies, and to get back into position to use the work surface on the standard workstation. In performing each of these maneuvers, she was vulnerable to slipping off the chair and incurring injury at any time. In fact, she had fallen frequently while scooting her chair forward. Clearly, a modified workstation was needed to improve her safety and efficiency.

SUMMARY OF IMPACT

A more accessible and more stable workstation that enables the client to reach her supplies without difficulty, get into and out of the chair safely and easily, and once seated, move up to and away from her desk. It accommodates most of her physical needs so that she can concentrate upon learning, without being hindered by the workstation. In the past, the teachers had to spend a great deal of time with the children with special needs, helping them adjust to the traditional workstation and having them "learn" how to use the existing model. This was problematic because the teacher had to take time away from teaching the class to help a single child function in the classroom. This new workstation makes the client more independent and is far safer for her to use.

TECHNICAL DESCRIPTION

Several different designs were contemplated before the design was finalized. Adjustable armrests, different styles and placements of legs, different ways of attaching the chair to the track, and different designs of the track itself were all considered. Most of the options were explored but each had a problem associated with it that prevented it from being used in the final design. The final design was selected and created because it was able to eliminate several problems that the other designs were not able to do.

The design of the desk portion was modeled after the existing traditional desk used by the other students in the classroom. The desk was redesigned to be horizontal, and had armrests for balance purposes, book slots at a calculated angle so that the minimum force required to remove the books would be needed, a supply box, and a non-slip surface. The non-slip surface was a product called "Dycem Non-Slip Plastic" that allows the student to write on the surface without the paper, her hand, or writing utensils to move. The legs of the desk were designed to adjustable in vertical dimension up to six inches. The chair and track were designed so that the student could slide horizontally with minimal friction. A high performance, linear roller bearing with high torque resistance (NB Corporation) was purchased so that the chair would not bind when loaded asymmetrically. The track was housed completely within a slot milled into an oak board that was as wide as the chair and as long as the track. The oak housing tapered downward to each side so that it would be easy for the student to get in and out of the chair without tripping. An adjustable office chair was then selected based on its size, adjustability, and comfort level, and attached to the track via a shaft and bolted plate arrangement. This provided more than enough support for the chair without losing the adjustability of the chair. The track support fits between the legs of the desk tightly so that there is no shifting and accommodates all weight shifts in all directions.

The cost of the project depended on several things. These items included the cost of the track, chair, desk materials, non-slip plastic, and shipping and handling. Including taxes, the chair and workstation totaled $560.

The overall workstation was designed and built so that a cerebral palsy student going into first grade would be able to function as independently as possible and not be hindered by the workstation they have to learn in. The workstation was designed with several needs in mind and these needs were met. The track allows full forward and backward movement in and out of the desk with as little resistance as possible making it very easy for the student to use. The desk allows full availability of her supplies so that time is not wasted getting her materials and putting them away. Overall, the workstation will enable the student to be self-functioning, and will not restrict the learning level of the child.