CHAPTER 8
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ASSISTIVE LEG REST FOR A DESK CHAIR

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INTRODUCTION

The Assistive Leg Rest for a Desk Chair was designed to allow the client, who has suffered a stroke and could only use their right side, to easily elevate their legs while seated at their desk chair. This was necessary as the client had developed edema in their lower left leg. Typical desk chairs with leg rests have leg rests that are difficult to elevate. Other chairs with leg rests, such as recliners, are much too bulky. With that in mind, a regular desk chair shown in Figure 8.1 was modified to have leg rest which was easy to elevate and also compact.

SUMMARY OF IMPACT

Those who need to keep their legs elevated and find it difficult to use traditional means for doing this will find the Assistive Leg Rest for a Desk Chair very convenient.

TECHNICAL DESCRIPTION

This device had several design requirements. The requirements for the overall system had to have a mechanical advantage between 3:1 and 6:1. In addition, it must be able to lift the weight of legs (approximately 30 lbs.) with a lever arm of 16 inches, and to also have a factor of safety of 3. This allows the client to easily lift their legs up in a short amount of time, achieved by using a drive train that consists of bevel and worm gears with a crank handle (modified ratchet) connected onto the original leg rest design.

Since the leg rest moved through an angle of 120 degrees, an overall gear ratio around 3:1 was chosen. This would allow the leg rest to be elevated completely in 6 to 12 cranks if the user cranks the handle between 60 and 30 degrees. The gear ratio was achieved by using a set of bevel gears with a 1:3 ratio connected to a worm gear set with a 10:1 ratio. This gives an overall ratio of 3.33:1.

Fig. 8.1. Assistive leg rest in the down position.

Fig. 8.2. Assistive leg rest in the up position.

The worm gear set chosen had a lead angle of 9° 28′ with a double thread. This ensures that the worm can drive the worm gear, but not the other way around. At the same time it doesn't compromise the required strength or desired gear ratio.

The crank handle was designed to be 16 inches in length to equal the lever arm of the leg rest. This ensures that the gear ratio provided by the drive train is the mechanical advantage for the system. The handle also has an extension for the ratchet switch. It is a long lever hinged at the middle so the distance traveled at the user end of the lever is the same as that at the ratchet switch. This allows for the ratchet direction to be easily changed without having to be changed right at the base of the ratchet.

On the ratchet there is also a brake lever. This brake lever is attached by a brake cable to rods with springs on them. Springs push the rods into the middle of the leg rest shaft when the leg rest is in the elevated position. The leg rest is then lowered by pulling the brake lever and then cranking down the leg rest. This brake helps to alleviate the stress on drive train and also ensures that the worm gear will not back drive the worm and cause the leg rest to descend unexpectedly.

A gear guard was also designed to ensure that nobody would be hurt by the gears in the drive train during operation.

The total cost for this project was $456.00.

Fig. 8.3. Gear assembly.

Fig. 8.4. Rear of the gear assembly

PORTABLE ASSISTIVE ELEVATION SEAT

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INTRODUCTION

The portable assistive elevation seat provides persons with disabilities the ability to stand up from a sitting position to the standing position. With some input from the user, the seat manually lifts the person using a lever on the right side of the seat. The maximum weight of the person is three hundred pounds. The Portable Assistive Elevation Seat can be used by a wide range of persons with disabilities who otherwise would stress their upper body while trying to stand. The person also has to provide enough force to trigger the hydraulic jacks. The force is not enough to strain the user in any way because of the design of the lifting subsystem. The other part of the lifting subsystem is the release device, which allows the user to release the hydraulic jacks from the lifting position. The clamping subsystem is designed as a portable seat so the user is able to attach the portable elevated seat on an existing seat such as a bench or chair. There are also two levers on each side of the clamping subsystem, which allows the person with disabilities to easily detach the portable assistive elevation seat. The third part of the portable assistive elevation seat is the actual seat assembly. The person with disabilities sits on an existing orange seat, which is be connected to the Plexiglas base plate.

SUMMARY OF IMPACT

The portable assistive elevation seat will help people in any situation where he or she wants freedom to sit where ever he or she wants. The portable assistive elevation seat does not restrict the person from only seating in designated spot in a sports arena to a restaurant. The best feature of this product is that it never runs out of power, or is bulky or heavy because it is using mechanical advantage innovation.

TECHNICAL DESCRIPTION

The portable assistive elevation seat has three main assemblies: a lifting mechanism, a clamping mechanism, and seat assembly. The three main parts are attached to the top in three different sections of 15.63 inches by 11.75 inches Plexiglas base plate.

Fig. 8.5. The lifting mechanism.

The front section of the prototype has the lifting mechanism. This mechanism consists of the two aluminum jacks, the lifting ratchet and the release mechanism. The two aluminum hydraulic jacks are attached together by welding an aluminum plate to the hydraulic jacks with a length of 3.42 inches and fastening it to the Plexiglas. The two aluminum hydraulic jacks are also pinned together with an aluminum bar with two different diameter dimensions. When the bar is acting as a pin for the hydraulic jacks, it has a diameter of .295 inches and the larger diameter in between the hydraulic jacks is .375 inches. The larger diameter of the aluminum bar has a diameter of .985 inches and length of 3.42 inches. The nylon bar sits on top of the larger piece of aluminum bar so that it rotates the hinge of the seat assembly. While the rotation is simple in design, it is the most effective way to allow the lifting mechanism to raise the user off a seat.

The ratchet device for the lifting mechanism consists of a hexagonal bar with a length of 11 inches connected to a rotating aluminum bar. The rotating aluminum bar has two parts, which are an aluminum round bar with a diameter of .386 inches and a hexagonal bar with a length of 8 inches. The longer part of the aluminum round bar is connected to the hexagonal bars with screw pins on the 11 inch hexagonal bar and the 8 inch hexagonal bar. The smaller part of the aluminum round bar is also connected with a screw pin to the hexagonal bar. The smaller part of the round bar has a length of 1.25 inches. The larger part of the aluminum round bar is 5 inches in length. The large aluminum block is located in the front and left side corner of the Plexiglas base plate. The large aluminum block has a width of 1.06 inches, a length of 1.62 inches, and a height of 2.45 inches. The smaller aluminum block has a width and length of .725 inches and a height of 1.45 inches. The original design used the aluminum hydraulic jack to trigger the hydraulic pump. This was modified by screwing onto an 8 inch hexagonal bar. The two pieces are placed at the correct distance from the horizontal and vertical direction on the bar to allow the most effective action in hitting the hydraulic pump. This allowed a simple way to pump the hydraulic jack and not have to completely redesign an existing design.

The release is the final component of the lifting mechanism. It was the hardest part of the design of the lifting mechanism because of the difficulty in rotating both releases on the hydraulic jacks simultaneously. The design consists of an elevated platform above the two hydraulic jacks. The hydraulic jacks have a circular aluminum disk with

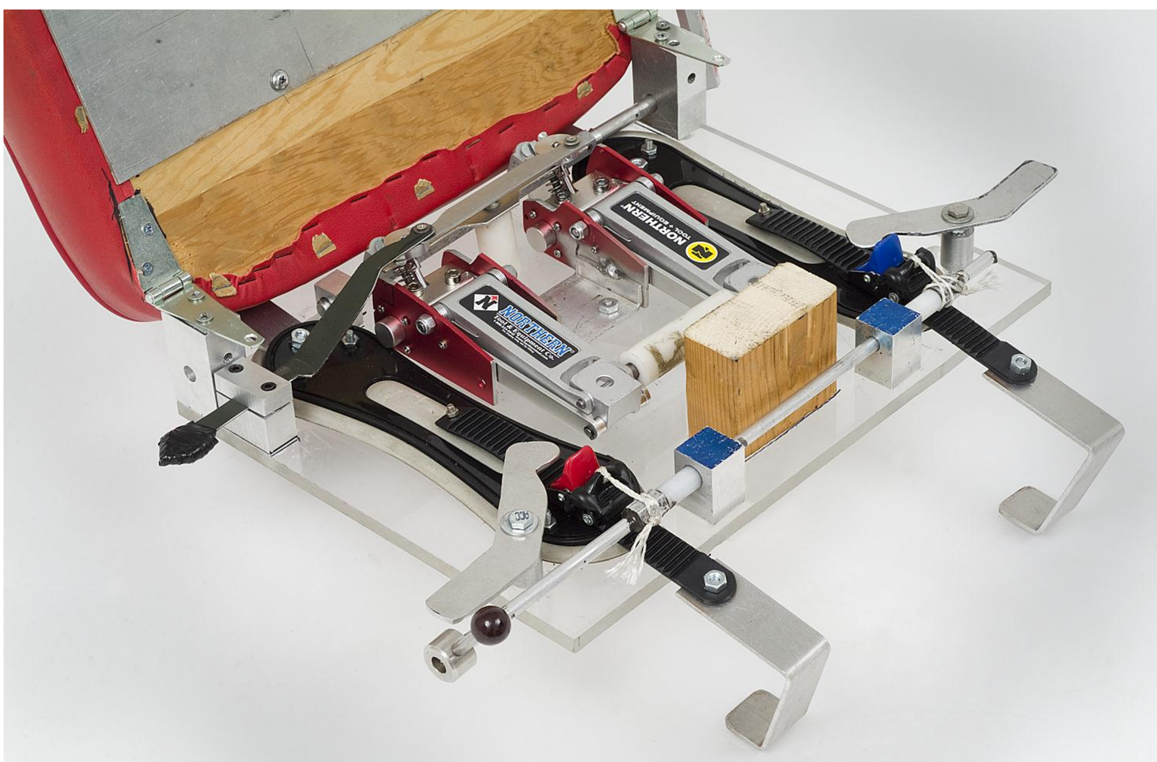

Fig. 8.6. The clamping mechanism.

a 1 inch diameter connected on the release mechanism. This allows both to turn to the right and left at the same time. The elevated platform has a rectangular aluminum plate with a length of 5 inches above the two circular aluminum disks, which allows both disks to rotate at the same time. There is also a rectangular aluminum plate with a length of 6.5 inches below the aluminum disks, which is screwed into the sides of the hydraulic jacks for support. The user pulls or pushes with a stainless steel lever, which has a length of 3.25 inches. The stainless steel lever and the rectangular aluminum plate are connected at the same point on the right circular disk. The stainless steel lever is supported by a small and large aluminum block. The design of the block has two separate blocks that allows the stainless steel lever to freely move in the horizontal direction, but not in the vertical direction. The large aluminum block has a width of 1.55 inches, a length of 8.23 inches, and a height of .92 inches. The small aluminum block also has a width of 1.55 inches and a length of 8.23 inches but a height of .460 inches.

In the back section of the prototype, there is the clamping mechanism. The clamping mechanism consists of the ratchet device and the release mechanism. The clamping mechanism uses a modified snowboard binding for the ratchet device and release mechanism. The ratchet device consists of a small steel bar with a knob that is connected to an aluminum round bar with a diameter of .32 inches and 17 inches in length. There are two hexagonal bars with a 1 inch length, which are inserted over the round bar diameter. The two hexagonal bars are also glued in place to only rotate with the round bar. The two hexagonal bars are the most important part because they are attached by a string to the snowboard bindings. When the user pulls back on the ratchet, the hexagonal bar rotates and pulls the snowboard binding tighter together. The hexagonal bars have a nylon bushing to allow it to rotate freely with minimum friction. The nylon bushing has a diameter of .475 inches. The round bar is supported by two aluminum blocks with a height of 1.38 inches, a width of 1.04 inches and a length of 1.04 inches.

The release mechanism is the easiest part of the prototype. The handle for each snowboard binding unit has a special handle that connects to the Plexiglas base plate. The handle is 1.32 inches above the base plate, which sits on an aluminum round bar with a diameter of .75 inches. The handle is located in front of the red or blue switch of the snowboard binding. The user easy rotates the handle to release the clamping mechanism.

The seat assembly is connected to the Plexiglas with two stainless steel hinges. The seat used in the prototype is an orange desk seat with a width of 16.875 inches and 12.75 inches in length. The seat rests on two aluminum blocks and a wooden block. The two aluminum blocks are in the front of the prototype with a height of 2.45 inches, a width of 1.06 inches, and a length of 1.62 inches. The wooden block is fastened to the Plexiglas base plate with a height of 2.75 inches, a width of 3.75 inches, and 1.635 inches.

Overall, the proof-of-concept adequately satisfied the design criteria. The total cost of the project was $133.00.

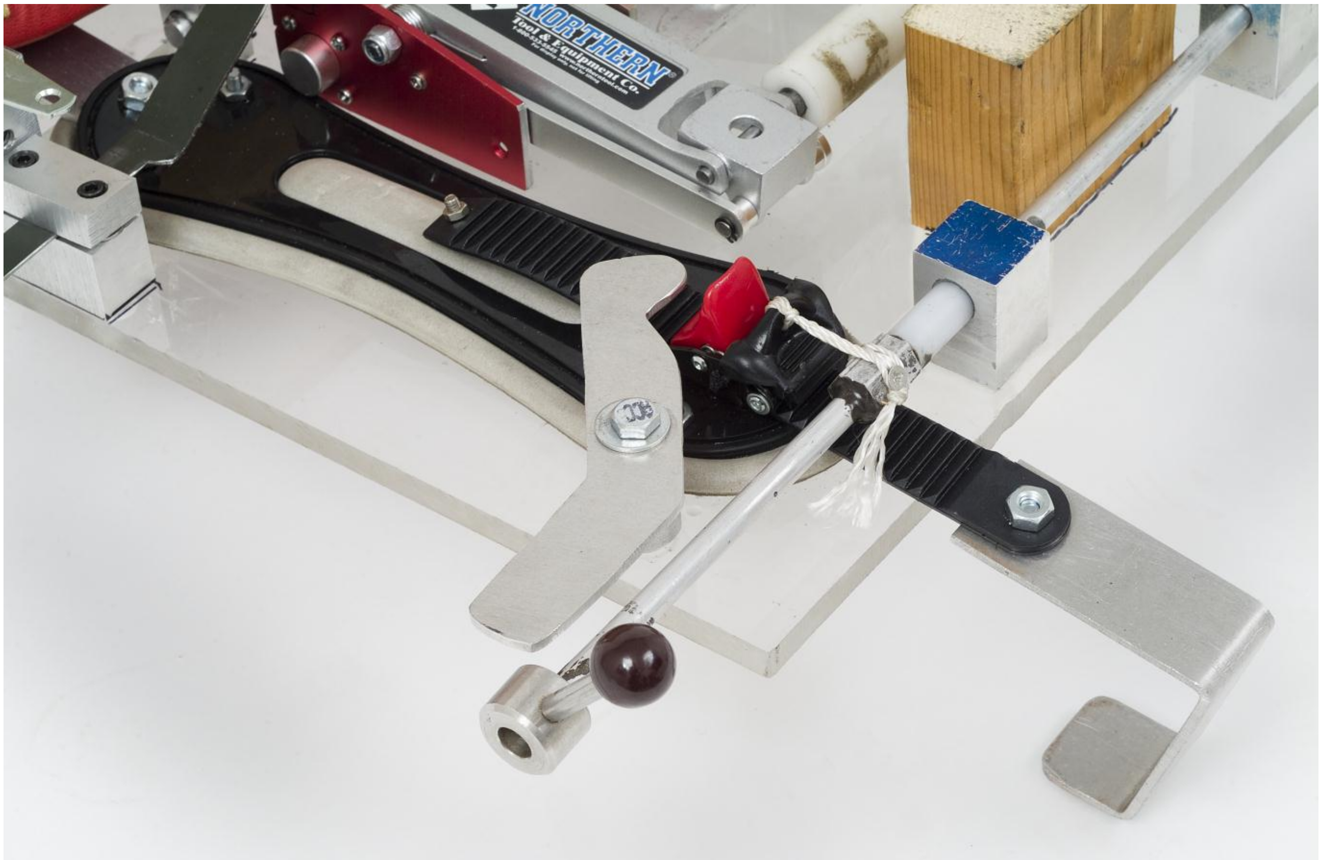

Fig. 8.7. The seat assembly.

AUTOMATIC RECLINER CHAIR

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INTRODUCTION

The Automatic Recliner Chair addresses the needs of elderly persons or those with other joint or muscle conditions that make it difficult to move from the seated position to the standing position in a rocking recliner chair.

SUMMARY OF IMPACT

In using this device, the person is moved from a seated position to a position with a forward angle, reducing the necessary force to remove oneself from the chair.

TECHNICAL DESCRIPTION

This design is intended to be integrated into the design of recliner chairs to allow for a vertical lifting motion in the back of the chair that increases the angle of the seated position. To facilitate this process, a pneumatic system is designed that allows for a linear motion to occur via a pneumatic cylinder with only the opening of a three way solenoid valve.

As the person rocks forward in the chair, a pneumatic cylinder with a 1 in. bore and 1 in. stroke presses against a kick-plate, and forces water into a series of pressure chambers. A spring located on the shaft of the cylinder then causes the cylinder to extend upon a backward rocking motion, allowing the cylinder to draw water from a reservoir in preparation for the next pressure cycle. Two brass check valves located on either side of the inlet to this cylinder prevent backflow, and allows for sequential repetitions of the cycle to build pressure in the pressure chambers. When the system is fully pressurized to a level of approximately 110 psi, two springs located at the cylinder bracket prevent further pressurization of the system while still allowing for uninterrupted rocking motion.

A three-way solenoid valve is used to connect the high pressure cylinders to the linear actuator, and the linear actuator to the reservoir. In the off state, the linear actuator is connected to the reservoir tank.

Fig. 8.8. Automatic recliner chair.

When the person desires to stand, the use of a wireless transmitter triggers the solenoid to the on position. This connects the high pressure cylinder to the linear actuator and causes the actuator to extend and the system settles to a pressure of approximately 75 psi. Coupled with the 2-inch bore of the actuator, this applies an upwards force of approximately 235 lbs. The actuator itself applies its force to a hinged plate mechanism located in the chair that then allows for the tilting motion to occur.

When the solenoid is switched off, the system then returns the water to the reservoir and remains pressurized at approximately 70 psi.

With exception to the actuation equipment, the hinge and bracket materials were made of 10 ga. stainless steel. The actuation cylinders were made of cast steel, and the flow control valves were made of brass. Piping consisted of flexible plastic tubing rated for use at 200 psi.

This system in total cost approximately $200.

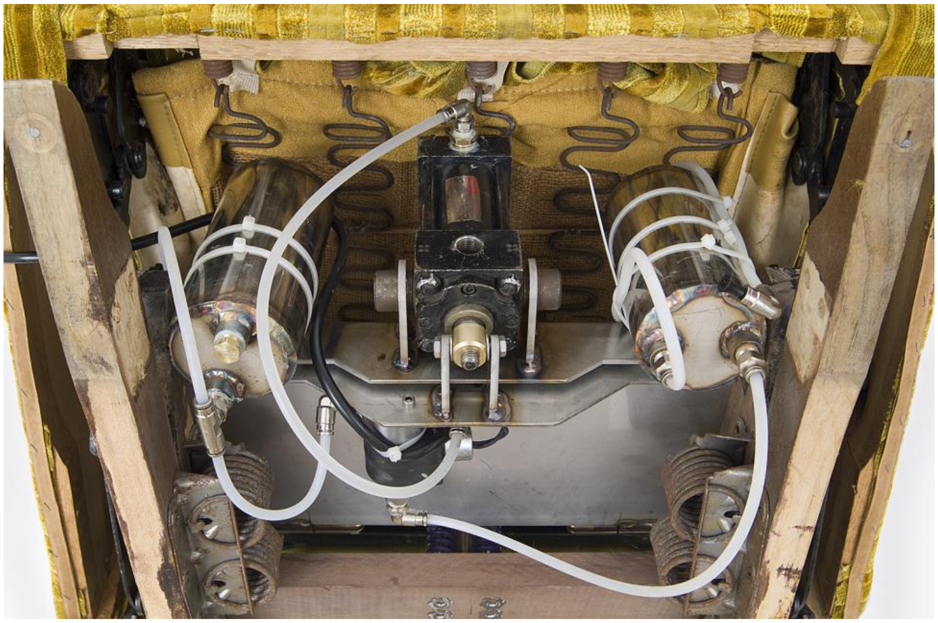

Fig. 8.9. Linear actuator and pressure chambers.

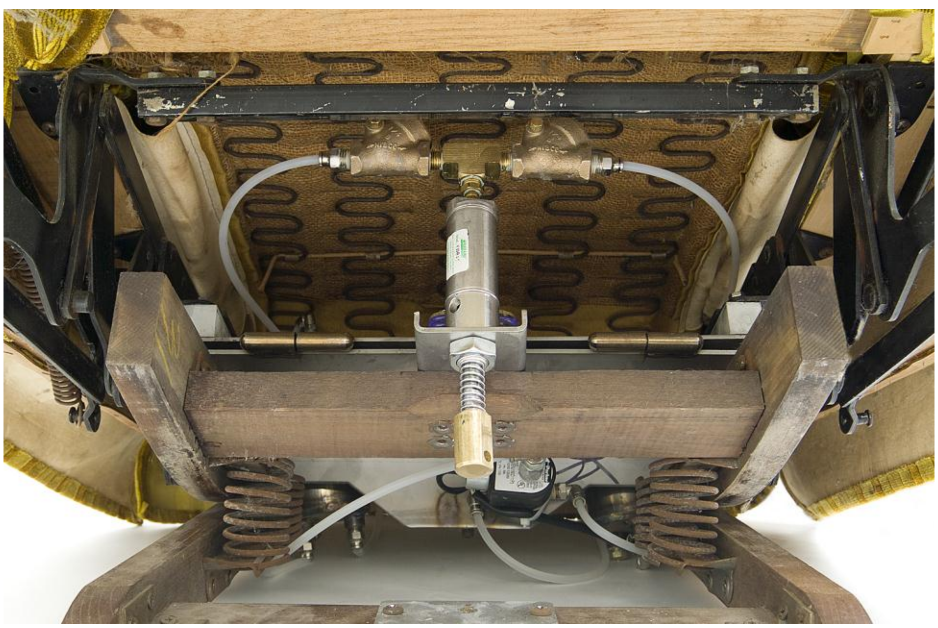

Fig. 8.10. Pneumatic cylinder.

ULTRALIGHT COMPACT WHEELCHAIR

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INTRODUCTION

This project's main concern was to create a wheelchair that is significantly lighter in weight and whose dimensions would be smaller than those of a conventional wheelchair design.

SUMMARY OF IMPACT

For wheelchair users, there exist various situations in which their wheelchairs are obtrusive or difficult to maneuver. Examples include smaller dorm rooms or living rooms, or in any building with tight corridors or limited space. The Ultralight Compact Wheelchair allows one to operate under these types of spatial constraints. Additionally, the light weight of the wheelchair aides in the ease of its transport for those with limited strength or agility.

TECHNICAL DESCRIPTION

Built for this course was a model of the Ultralight Compact Wheelchair, which differs from the actual product as it employs a different selection of materials. Inexpensive but sturdy PVC piping was used to build the frame of the wheelchair. The final product would actually be made from the extraordinary lightweight but strong carbon fiber tubes.

The wheelchair is 28 inches in height, 24 inches in width and 31 inches in overall length. It can safely

Fig. 8.11. Ultralight compact wheelchair.

support a 250 lb. person, with the availability to increase the load by increasing the diameter of the tubes of the frame, which are presently ¾ inch outer diameter. The model weighs 16.5 lbs., and the carbon fiber chair would be 2 lbs. heavier at 18.5 lbs.

Where the model's PVC piping is connected by manufactured joints, the carbon fiber tubes would be assembled together through the use of industrial strength epoxy. In addition to having a greater strength to weight ratio than steel, the carbon fiber tubes also have the benefit of being much more corrosive resistant to weather and other adverse conditions.

The specific design of this wheelchair eliminated the need for rear casters, which are usually included to prevent the chair tipping over backwards. The Ultralight Compact Wheelchair places the client's weight and center of gravity closer to the front of the chair and lower to the ground to provide additional security and a steadfast hold to stay upright in the face of opposing forces or momentum.

The cost of this project was $53.

Fig. 8.12. Rear of the ultralight compact wheelchair.

OUTDOOR STAND-UP/SIT DOWN LIGHT-IMPACT PEDDLING WHEEL CART

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INTRODUCTION

The Peddling Wheel Cart provides an easy way for a person with disabilities to move around outdoors. This is a new kind of design equipment for people who can't walk due to a certain disability they might have. This allows for a safer transition between a wheelchair and a walker. It is basically a cart that provides easy transportation from one place to another place. The Wheel Cart consists of: four wheels used for moving around; a seat, front frame with handle bars, and peddling system. The peddles are regular bicycle peddles, two wooden boards are attached on top of each peddle for a foot rest. The four wheels used are small bicycle wheels. The tubing used to make the chart is aluminum tubing, which is all welded together at each intersection. Brakes are used for the two back wheels, which locks them when the person comes to a stop. Sprockets are used to attach the chain to the front and back axles. The chain is covered with wooden box. Our main goal is that the rotational speed of peddles will be the rotational speed of the system.

SUMMARY OF IMPACT

Our main goal is to make the steering as efficient as possible so that it is easy to control. The peddling system is also another important part, since it is attached to the steering mechanism where both move simultaneously. The aluminum bars of the Front frame allow the person to steady himself. Most importantly, this allows the person to be in a standing position and imitate walking. This device is for outdoor use only.

TECHNICAL DESCRIPTION

The Peddling Wheel Cart's main mechanisms are the steering, and the peddling system. The peddling system is at the front of wheel cart. The primary propulsion system includes the peddles that are attached to a rotating axle, which has a main drive gear on it. This drive gear drives a roller chain that drives the secondary drive gear. This secondary drive gear is attached to the rear drive axle, which drives the rear wheels. Thus, this system propels the cart forward. The peddles are in an ergonomically pleasing position for the user.

Fig. 8.13. Light Impact peddling wheel cart sitting.

Fig. 8.14. Light impact peddling wheel cart standing.

The other main system of the cart is the steering system that allows the user to maneuver the cart, which is necessary for any moving vehicle. The steering system consists of the front wheels that are attached to the front steering spindles, which pivot at the front of the main frame. These pivot freely due to the bearings at the top and the bottom of the front steering pivot spindles. The left and the right steering spindles are linked together with a cross link. This cross link ensures that the left and right steering spindles turn together at the same rate. This steering mechanism is basically a rudder system of an airplane, but you move it with your right arm. You either push or pull on a lever to turn left or right.

*The overall price of the Peddling wheel cart is $590.00.

Fig. 8.15. The peddling and steering mechanism.

AUTOMATIC LOWER KITCHEN CABINET

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INTRODUCTION

The device shown in the picture is designed to fix a problem for the elderly and those with lower back and leg problems. This particular group of people has a hard time bending down to reach items in the bottom shelves, especially those items that are stored in the back of those shelves. This product solves that problem by bringing the items stored to you so that bending down is not required. This was designed assuming that the cabinet has one shelf, in addition to the bottom floor of the cabinet. To bring the items to a easier to reach place, the top shelf slides out on drawer slide and the bottom shelf slides out on an identical set of drawer slides. It also lifts up to meet or exceed the level of the top shelf.

Fig. 8.16. Automatic lower kitchen cabinet.

SUMMARY OF THE IMPACT

The device will allow the user to utilize this storage space without assistance or risking pain or injury.

TECHNICAL DESCIPTION

This is built to approximately a two-thirds scale as it is only a proof of concept design. The frame is made from 1″ x 2″ furring strips, and put together with aluminum flat and 90 degree angled brackets. The drawer slides are industrial strength and can hold a load of up to 100 pounds. Each shelf is designed to extend beyond the front plane of the system, and is extended with a rack and pinion system. A cog on the motor attaches to a cog on the pinion gear axle via a rubber cog belt. Attached to each shelf is a gear rack that lines up with pinion gear, and when rotated, the pinion gear pushes on the gear rack to extend and retract the shelf.

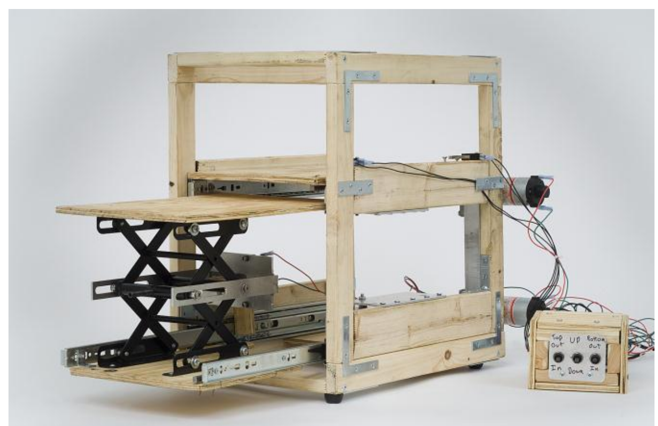

Fig. 8.17. Shelf extended and raised.

The lower shelf is equipped with a scissor jack system. The scissor jack is modified to house a hopper with an attached motor. The hopper is attached to the center pivot point, allowing the scissor jack to extend and compress, while keeping the motor stationary. The motor is attached to the drive screw of the scissor jack. This lifts the lower shelf up to meet or exceed the level of the upper shelf. There are three motors on the machine: one for each shelf and one for the scissor jack. All three motors are identical direct current gear motors. They are 12 volt motors that draw approximately 3 amperes and spin at 50 rpms at the maximum voltage. Supplying the power the motors is a 12 volt, 5 amperes power supply that is sufficient enough to power all three motors. The machine is only meant to run one motor at a time. Limit switches are attached to each shelf to stop the drawer extension and compression when needed.

Controlling the motors and the operation of the machine is a remote box that contains three double pole-double throw switches, one for each motor. The final product will not have this control box but will have the three switches mounted on the piece of wood that is found above the cabinets but underneath the counter. One drawback to this design is that it takes away from the actual storage space in the cabinet. This problem will be lessened on the full-sized model because a lot of the hardware on the scale model is the same hardware that will be used on the full-size. In proportion to the overall size of the larger model, the frame, motors, power supply and scissor jack will take up less space and leave more storage.

The total cost of the design was approximately $ 325.

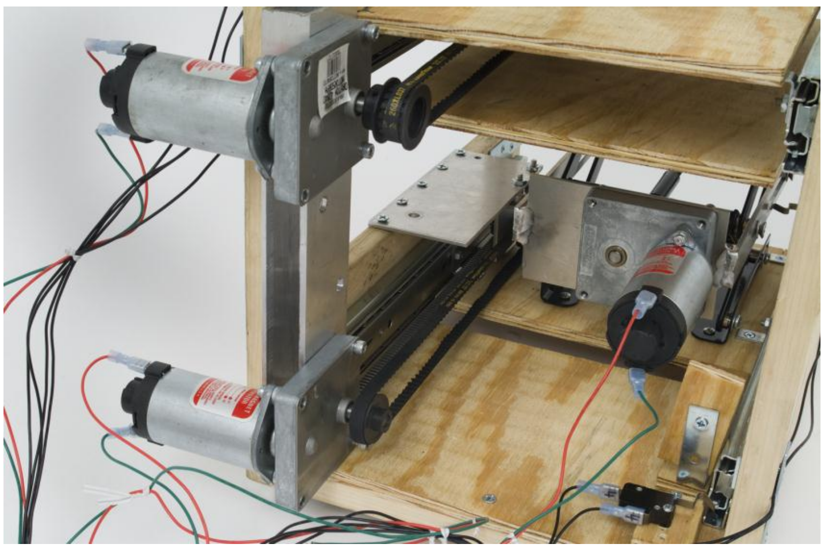

Fig. 8.18. Motors used to drive the system.

Fig. 8.19. Gear used to move a shelf.

PORTABLE HOME BASED LIFT FOR INACCESSIBLE AREAS

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INTRODUCTION

Lifts for people are only found in specialized areas such as hospitals. Other heavy duty lifts are found in factories. These devices are not practical enough to be used within a home setting. A 1:2 scale prototype of a portable lift was created to assist people at home to access areas at heights.

SUMMARY OF IMPACT

The target audience is people who have trouble climbing chairs and stools due to knee and muscle pain. The design is simple and portable, so that a user can move it and position it wherever he or she wants.

TECHNICAL DESCRIPTION

The device consists of a wide supporting base at the bottom and a moving car on top. A pair of ½ inch guide rods run through each end of the car, with the lower end attached to the base. The guide bearings sit in two holes in the car as shown.

The guide provides a low friction guide path for the lifting operation. A motor drives a system of two pulleys and steel cables that attach to the car through a pair of eye bolts. The drive system sits on a supporting platform above the base and car. Two non-marking wheels are provided at the lower back end of the frame, and two handles on each side of the motor and pulley casing, for tilting and moving the device. There are two support railings on the sides of the car for safety. A user operated switch actuates the motor is attached on one of the railings. Finally, four steel supports connect the base with the motor platform.

The base of the full scale design is 26 x 36", the car is 20x32" and the total height of the device from the floor to the top end of the motor is about 20". These dimensions were realized after considering comfort, size and portability issues. The total lifting height capability is about 30 inches.

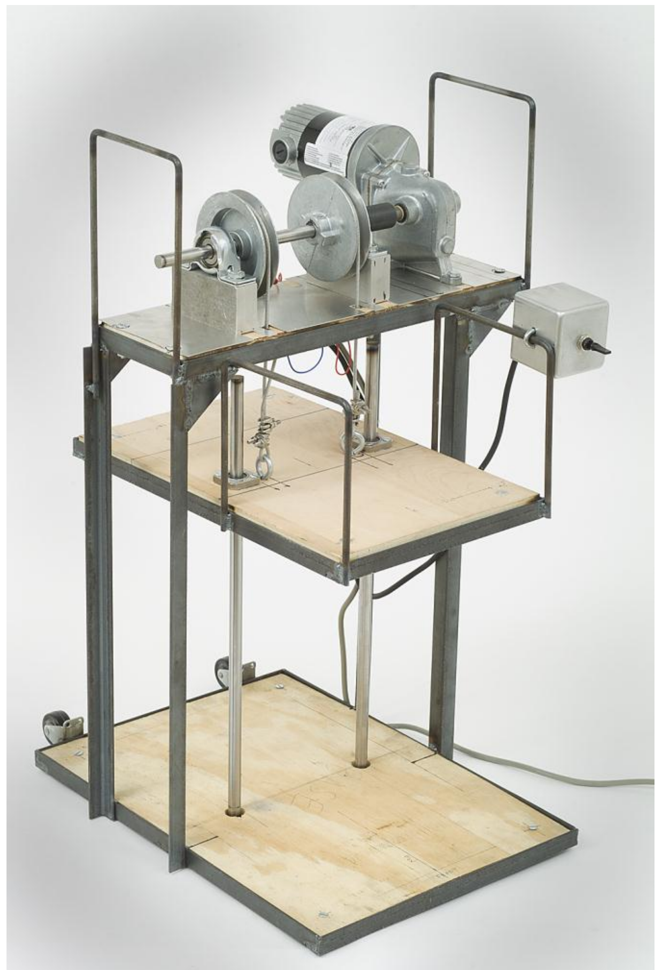

Fig. 8.20. Portable home based Lift.

A coupling connects the motor shaft with a rotary shaft onto which are placed two pulleys with setscrew type attachment. The motor is a 3 RPM, 250 lb.-in device that can lift a weight of 70-100 lbs. for purposes of a demonstration. The actual device is designed for a maximum load of 300 lbs. which includes a factor of safety of 2. This will necessitate the need for more powerful motor. The motor needs to be custom built so that it is compact enough for assembly.

The device has not been optimized for commercial use. The designers suggest: 1) improvement of the design of the frameworks more in terms of ease of manufacture and assembly, 2) the top ends of the two guide rods have to be limited in their lateral movement by clamping them to the supports or by having the ends sit in appropriate clearances in the platform, 3) a hemispherical casing for the motor assembly that can be opened and closed for protection and maintenance purposes, 4) two limit switches in the actual model to provide the top and lower end limits for motor operation, 5) a four way channeled system of pulleys to hold the car from the front and rear ends of the car rather than the middle section, 6) a counterweight to offset chances of the front end of the loaded car acting as a cantilever 7) more ergonomic handles and support railings and 8) a non-slip rubber surface for the loading end of the car.

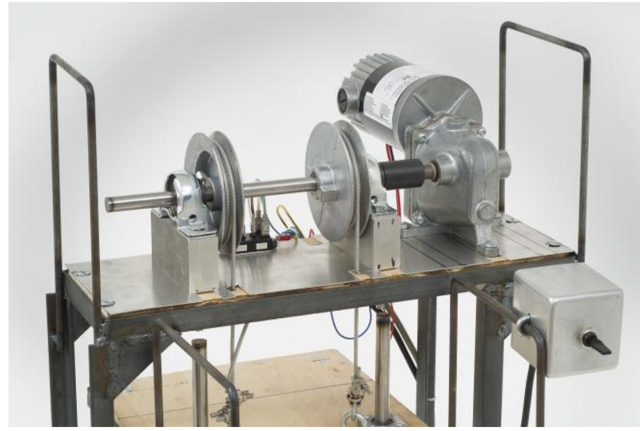

Fig. 8.21. Motor and pulleys.

Figure 8.20 is a pictorial representation of how the device will be used.

The total cost of this project was $40.

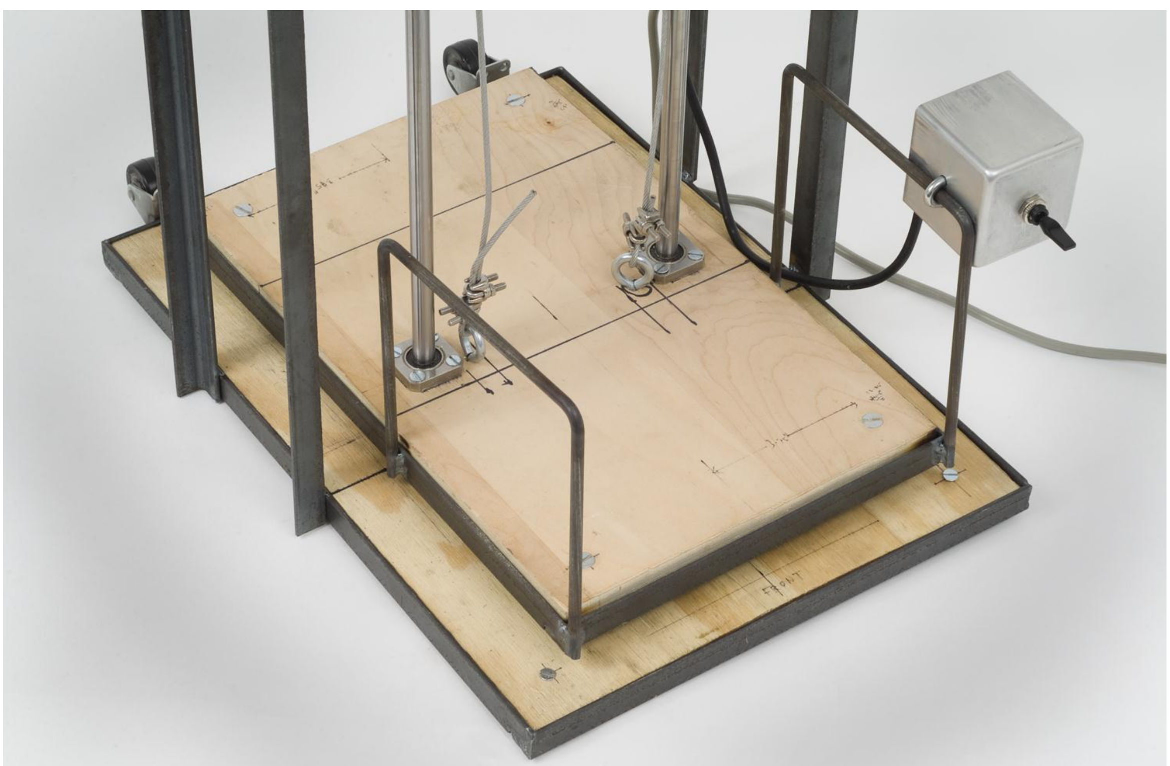

Fig. 8.22. Lifting platform and connections.

PLANTAR FOOT SELF INSPECTION SYSTEM

Designers: James R. Harris, and Tushar T. Patel
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INTRODUCTION

Diabetes is a leading cause of foot problems related to poor circulation in the extremities. These foot problems include gangrene, foot ulcers and poor healing of wounds. This is currently the leading cause of non-traumatic amputations in adults. With proper foot education and increased observation, severe foot problems can be reduced. Elderly and overweight people in particular have difficulty examining the plantar foot. The plantar foot self-inspection system, shown in Figure 8.23, provides a way to examine the plantar foot by reproducing the image onto a computer.

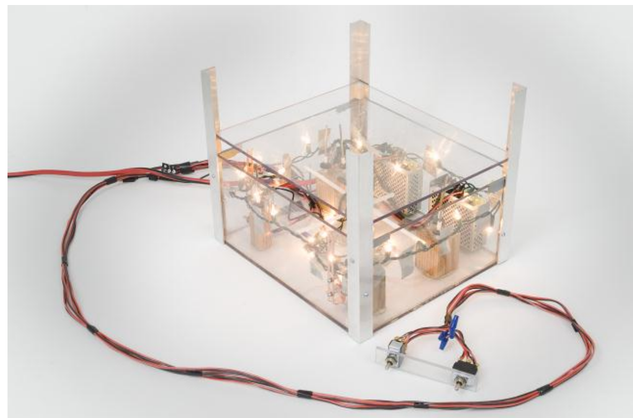

Fig. 8.23. Plantar foot self-inspection system.

SUMMARY OF IMPACT

This device will allow people an easier method to examine their plantar feet. This will increase observation of their feet, which will allow for prevention of the foot problem mentioned earlier. Overall, this will help to reduce the number of non-traumatic foot amputations.

This device will also be a benefit to medical personal in several ways which is a result of the need to be connected to a computer. The first method is the patient at home can complete a check of their foot and email the video and images of their self-examination to the doctor. The doctor can then examine the files and make recommendations. The second method is the doctor can use the device in his office to produce video documentation which can be used to track symptoms.

TECHNICAL DESCRIPTION

The Planter Foot Self Inspection System allows a patient to obtain video and pictures of the planter foot for self-inspection. It consists of a camera that looks at the bottom of a person's foot. This camera is then able to be moved in the x-y plane via a controller that is attached to the system. It is operated by placing either foot onto the top of the device and then moving the camera using the attached controller. The camera should automatically focus on your foot.

The outer shell of the device is a 12.5 inch wide, 14 inch long, and 8 inch high box that is made of ¼ inch Lexan. The camera that was used was a Logitech QuickCam Pro for Notebooks. The camera is connected to a pulley system that provides its movement. There was also a strain of 20 white mini Christmas lights that was added to enhance the lighting.

The motion is produced by two 12 VDC 30 RPM high torque gear motors. These motors will help move the camera up, down, left, and right. The motors and the pulley system can be seen in Figure 8.24. The motors are activated by moving either one of two toggle switches that are located on the controller the way you would like the camera to move. The camera can be seen in Figure 8.25. The power was provided by an AC to DC Transformer that had a 12 VDC output.

The approximate cost of this project was $350.

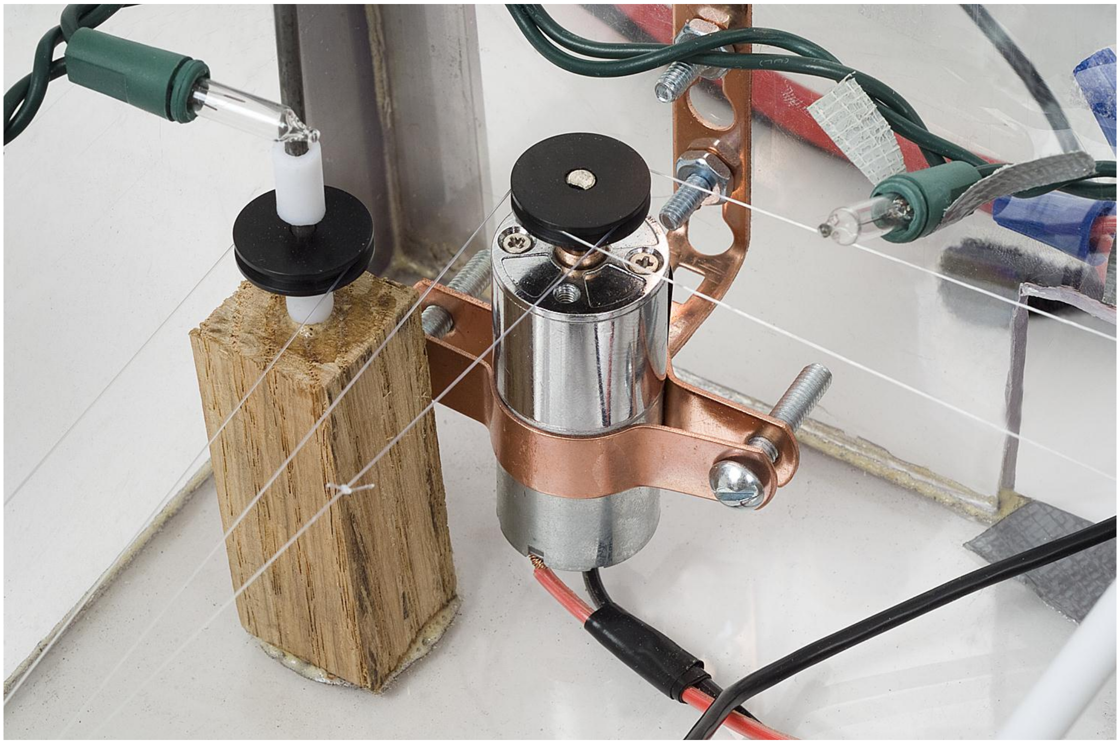

Fig. 8.24. Motors and pulley system.

Fig. 8.25. Camera.

SWIVEL SLIDE SHOWER CHAIR

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INTRODUCTION

The Swivel-Slide Shower Chair is designed to assist the elderly, temporarily and/or permanently disabled in accessing the shower. It is a universally customized bath chair. This device allows for the seat to be displaced from the center and then swivel providing easier access to the shower/tub than other conventional bath chairs.

SUMMARY OF IMPACT

The device is highly adaptable fitting most conventional tubs. The Swivel-Slide Shower Chair is constructed from noncorrosive materials to assure minimal maintenance and a long product life.

This product has been designed to be a better alternative to transfer bench shower chairs and typical bath seats. It allows for greater ease while bathing.

TECHNICAL DESCRIPTION

The key design objective of the Swivel-Slide Shower Chair was to reduce the chance of an injury taking place while entering or exiting the shower or tub. At the same time we wanted to design a chair that allowed for greater mobility while bathing. It was fabricated to withstand a force of 400 pounds at the base and 300 pounds at the axle.

This light weight product is constructed in three major sections for easy storage and portability. The first section consists of the seat and bushing. The second section is composed of a lift arm assembly that is held in place with a spring loaded push pin. Both of these sections can be easily removed from the base, which is the final section.

The sections of the chair are dismantled with such ease that it is a major advantage over other standard transfer benches and shower chairs that do not disassemble as readily.

The seat is constructed from extremely resilient blow molded plastic. The anchor plate and axle, which not only house the bushing but also supply the rigidity to the movable portion of the product, are made from machined aluminum. The bushing is machined Teflon. This material was chosen over ball bearings because of its low friction characteristics without lubrication, its high durability, and the small likelihood of corrosion.

Fig. 8.26. Swivel slide shower chair.

The base is made from lightweight aluminum tubing so that it can be effortlessly lifted and positioned as needed. The aluminum is also corrosive resistant, which is a highly favorable attribute for extended use in a partially submerged environment.

The seat slides which are made of galvanized steel allow the seat to glide easily from side to side. The lift arm attachment is connected to the slides. This placement permits it to travel with the seat and keep the arm in a position where it has little contact with the other items in or on the shower or tub. The bends in the arm keep it away from the individual once seated on the chair. The arm is centered when entering or exiting the seat and thus the torque on the assembly is minimized. This prevents any part of the product from lifting or moving.

The adjustability of the legs allows the chair to fit the height of several different sized tubs and each user's leg length. Additionally, the legs are fitted with high performance latex suction cups at the bottom to provide further stability to the chair.

The total cost of the project was $126.

Fig. 8.27. Shower chair turned and extended.

Fig. 8.28. Swivel chair slides.

REMOTE FAUCET ADJUSTER

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INTRODUCTION

People constantly use faucets without thinking about it. This device was created to assist people that have trouble using a faucet in its normal setup. People in a wheelchair or of short stature may have trouble reaching the controls of a normal faucet. Also, people who have arthritis may have trouble with a normal faucet. The remote faucet adjuster shown in Figure 8.29 is available to assist people in both of these situations.

SUMMARY OF IMPACT

The remote faucet adjuster will give people with disabilities the ability to sustain themselves without help from others. The remote allows people to adjust the faucet without having to reach the controls. The controls on the faucet are easy to adjust which allows people with arthritis to set the temperature and flow rate as they would like without causing them pain.

TECHNICAL DESCRIPTION

The remote faucet adjuster has two separate components. The main component is the faucet itself, which is attached to a normal faucet. The second piece of the remote faucet adjuster is the remote portion of the product.

The remote consists of a box made out of acrylic, the remote electronics, and the dials. The electronics for the system were taken from a remote control car. The case consists of a front plate of acrylic with two holes drilled in it for the dials, four clear walls cut from an acrylic sheet and then glued together and a back panel. The back plate is actually made of two pieces that interlock so that half of the back can be pulled off to replace the batteries. The two dials control the two handles. This allows the user to control the flow rate and temperature.

The base of the faucet is the part that actually controls the water. To build the faucet controller, a faucet was purchased and then partially

Fig. 8.29. Remote faucet adjuster.

disassembled. A box was build out of aluminum that holds the servos. When mounted, the countertop is located between the box and the top portion of the faucet. Crank arms replace the handles. There is one crank arm located on top of each valve. A rod from the servo to the crank arm allows the user to control the faucet. In addition to transferring the servo force to the valve, it also allows a normal person to use the use the faucet.

The handle engages and disengages the crank arm. This is done by having teeth on both the crank arm and the handle shaft, as shown in Figure 8.30. A spring located in the center disengages the teeth from each other there is. When someone uses the handles, they simply push down slightly and turn. There are brass pipes that connect the top faucet to the aluminum box. This brass pipe is adjustable to fit countertops of different thicknesses. Inside this pipe is a rod that connects the handles to the teeth that engage the crank arms. This rod is allowed to spin and move vertically. The servos are placed outside the aluminum box so that water has less of a chance of reaching them. The receiver was placed under the aluminum box for the same reason.

For this build, batteries are used instead of using a wall outlet. For testing the faucet, which lasted a few hours, the batteries were never replaced. In production the remote would use batteries but not the faucet itself.

The total cost for this project was $125.

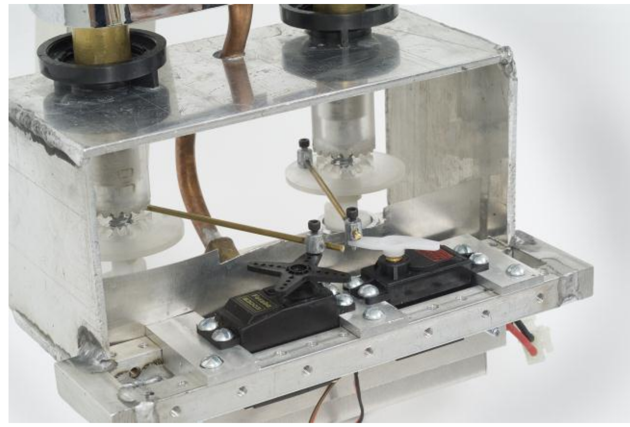

Fig. 8.30. Crank arm, handle shaft teeth, and electronic servos.

Fig. 8.31. Remote faucet adjuster.

ONE TOUCH EASY OPEN DOOR

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INTRODUCTION

Disabilities, such as carpal tunnel and arthritis, have a great impact on a person's life at home. This makes it more difficult to use everyday objects and perform common functions, such as opening a door. The one touch easy open door is designed to attach to an existing interior door with some modifications. By simply pushing or pulling on one of the sensors it actuates the latch. This eliminates the grasping and rotating motion, which would cause pain and discomfort to people with the above disabilities.

SUMMARY OF IMPACT

This device, when implemented, allows the user to easily open interior doors in their home without assistance from another person. This is important because a person should not have to sacrifice privacy just because they have a disability. Being able to easily open doors to a bedroom or a bathroom restores privacy and mobility.

TECHNICAL DESCRIPTION

To use the device, special handles are used that sends a signal to the switches. This is accomplished by adding two devices to the exterior surfaces of the door. A grab handle with switches is installed on the inside of the door. This handle is U shaped. Located at the outmost portion of the handle are switches with an additional moveable surface, so that when pressure is applied to this surface, it activates the switches. This handle also gives a means for the user to apply forces to open the door. Secondly, a panel switch is placed on the outside of the door. This portion contains a base, switch, and moveable face. The base attaches directly to the door and houses the switching mechanism. Then, by pushing on the face, the switch activates. The final component is the internal electro-mechanical for opening the door. This includes an electrical to mechanical transducer, a timer circuit, as well as a power source. The timer circuit is intended to receive the activation signal from the switches on the exteriors of the door. It then activates the transducer

Fig. 8.32. One touch easy open door.

through a relay so the latching mechanism, as well as the door knob is rotated to the open position, allowing for the door to be pulled or pushed open. The transducer holds the latch in the open position for a short duration to allow the user to enter/exit the room. This circuit is easily accomplished using a 555 timer IC, and a few other external components.

The power source consists of two 9 Volt batteries. The transducer for this prototype is a small direct current motor with a planetary gear system from a

Fig. 8.33. Grab handle and motors.

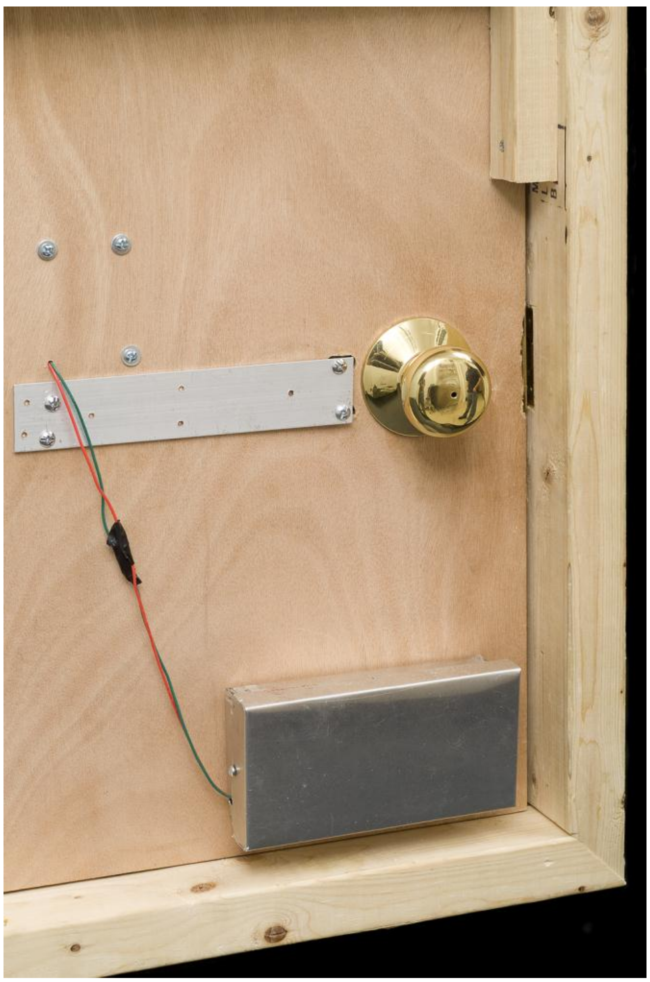

Fig. 8.34. Panel switch box.

small electric screwdriver. This is then coupled to the door knob via a bevel gear as well as three spur gears. The 555 timer is set up to hold the door in the latched position for approximately 10 seconds. A common reed relay is used to allow for a larger current be transmitted to the transducer.

The overall cost of this project was around $30.

MED-AIDE EZ-OPEN

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INTRODUCTION

The Med-Aide EZ-Open enables individuals to open medicine bottles. It was designed to allow someone, with weak hand strength, in particular someone with arthritis, to open child safe medicine bottles. People with arthritis find it hard to grip small bottle tops, push down, and twist all at the same time. The medicine in the bottles helps to relieve pain and discomfort caused by arthritis. If the individual cannot even open the bottles because of their disabilities, the medicine becomes useless. The aim of the Med-Aide EZ-Open is to give people the ability to easily open medicine bottles.

SUMMARY OF IMPACT

The Med-Aide EZ-Open gives someone of limited strength the ability to open medicine bottles. The Med-Aide EZ-Open turns the twisting motion into a much easier linear motion, and it has a large design, which makes holding it more comfortable.

TECHNICAL DESCRIPTION

The Med-Aide EZ-Open has a length of 20 inches and a main handle diameter of 1 ½ inches. The main handle is made of Polyvinyl chloride (PVC) tubing. The large diameter and lightweight PVC make the Med-Aide comfortable to use for people with arthritis.

The Med-Aide has the ability to open bottles with a lid diameter between 3 ¼ inches and ¾ of an inch. The Med-Aide has a conical shell design. This allows any diameter bottle lid to fit inside the limits previously stated. The conical shell is made of a plastic funnel. The funnel is lined with silicone rubber. The rubber lining is 1/16 of an inch thick. The silicon provides enough deformation so that the bottle lid can be gripped. The combination of the plastic funnel and silicon lining helps keep the device lightweight.

Fig. 8.35. The Med-Aide EZ-Open.

A bolt runs through the middle of the main handle and through its diameter. It connects the cone to the main handle. Inside the main handle, and attached to the bolt joining the cone, is a nylon gear. It has a 1 inch diameter. Next to the gear, and running parallel to the length of the main handle, is a nylon rack. The rack has the same pitch as the gear enabling them to engage smoothly. The rack is attached at one end of the main handle via a spring. The spring, in turn, is attached to a rubber stopper at the end of the main handle. The other end of the rack attaches to another piece of PVC tubing. This piece of tubing has a 1 ¼ inch diameter allowing it to slide in and out of the main handle. The end of this second piece of tubing has a 90 degree bend. This prevents it from sliding inside the main handle. Pulling this secondary handle outward pulls the rack over the gear. This turns the gear counterclockwise. Since the gear and the cone are on the same bolt, the cone rotates in the same direction. If a medicine bottle were underneath the cone, the lid would be spun and thus would be removable.

Just placing the medicine bottle on a countertop and using the Med-Aide in this fashion does remove lids. However, the bottle tends to spin at the same time and the top does not always spin off. In order to resolve this issue a sheet of the silicon used to line the funnel is placed under the medicine bottle. This provides enough friction and stability for successful removal of medicine bottle lids every time.

The total cost of the project was $30.

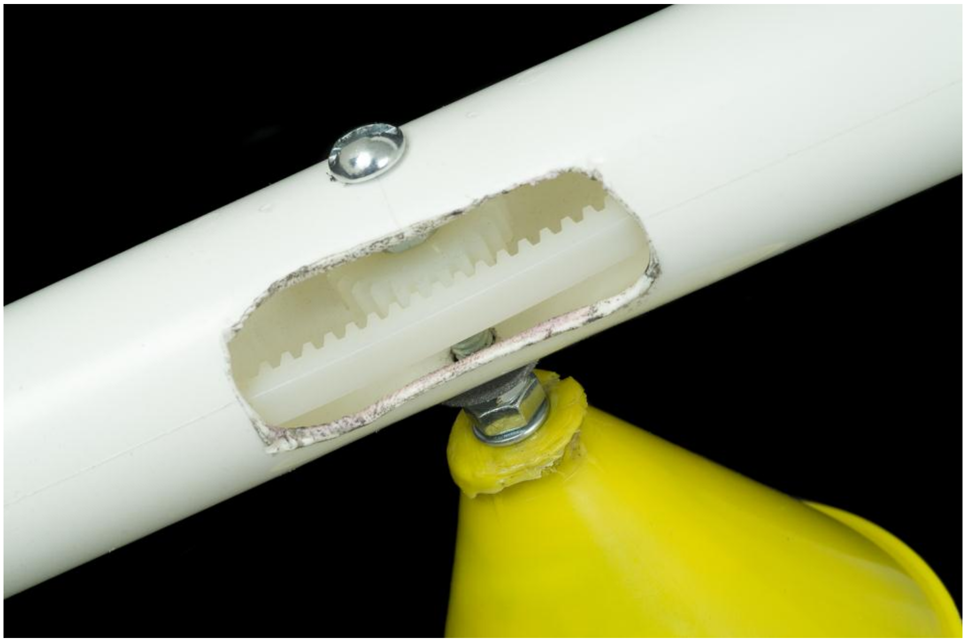

Fig. 8.36. Close up of gear assembly.

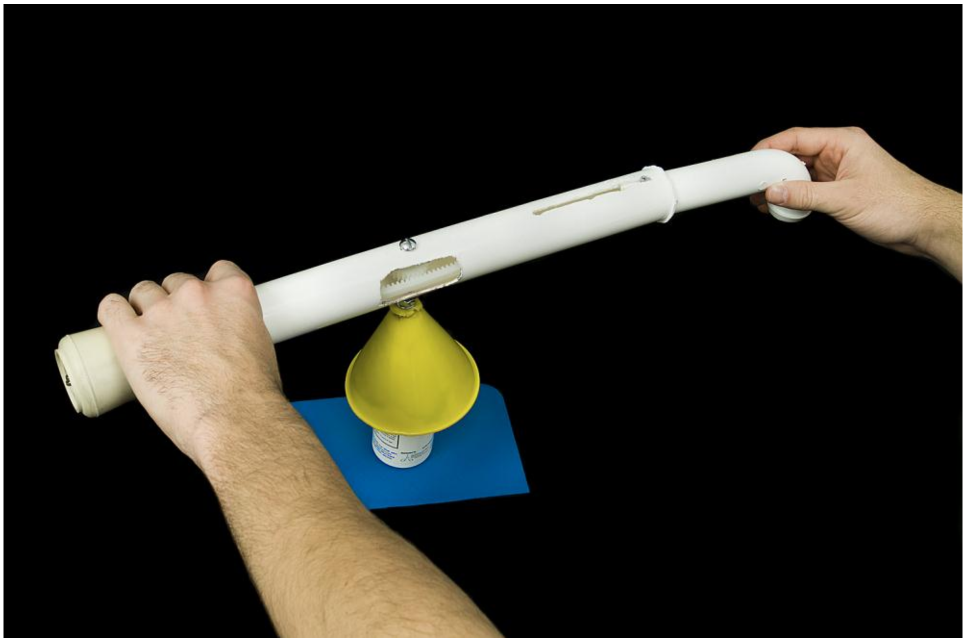

Fig. 8.37. Med-Aide Easy Open with bottle.

ASSISTIVE FEEDING DEVICE

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INTRODUCTION

There are individuals with mental or physical disabilities that have trouble feeding themselves. They rely on personal assistants for meal preparation and feeding. The assistive feeding device is designed to give the user independence to feed themselves, without relying completely on an assistant.

SUMMARY OF IMPACT

This portable, battery operated device, brings small and solid pieces of food to the user's mouth with the push of a button. When it is filled by an assistant, a user will simply have to approach the device and push a single button to use it.

TECHNICAL DESCRIPTION

This device uses two main components, a rotating Lazy Susan and a conveyor belt. The Lazy Susan rotates by using a rotating wheel attached at its base. The Lazy Susan has a 1" by 1" hole along its circumference. As it rotates, this hole aligns with the conveyor belt that sits directly below the holes. When the conveyor and the hole are aligned, one or more food pieces will fall onto the conveyor belt. The food pieces are then deposited onto a receptacle at the end of the conveyor. The upper part, the Lazy Susan, is angled during operation and lies flat on the base when being moved or stored. This device uses 4 AA batteries. The conveyor belt and the rotating wheel are made from plywood and parts salvaged from a toy tractor.

The total cost of this project was $50.

Fig. 8.38. The assistive feeding device

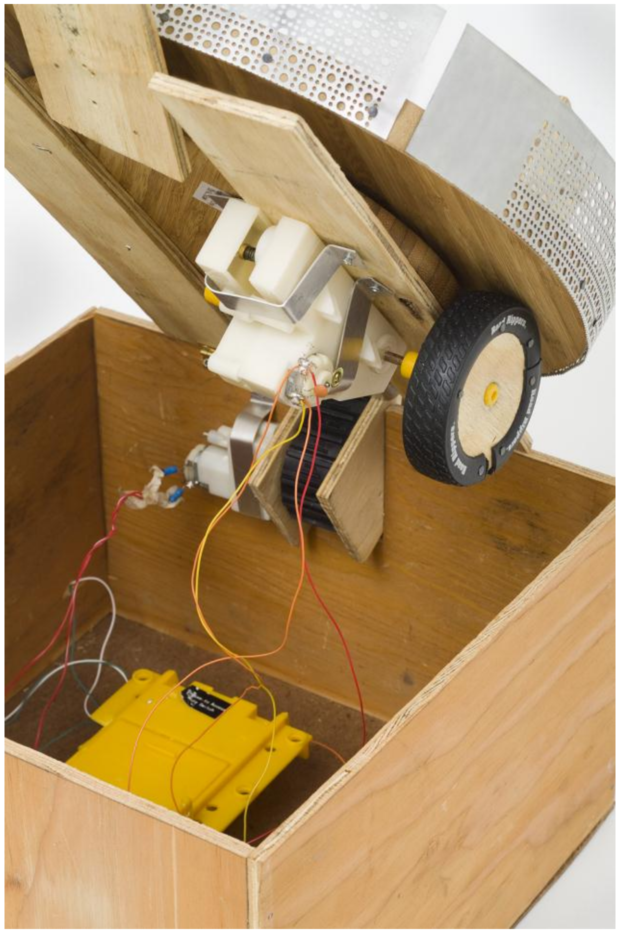

Fig. 8.39. The motor and method of rotating the Lazy Susan.

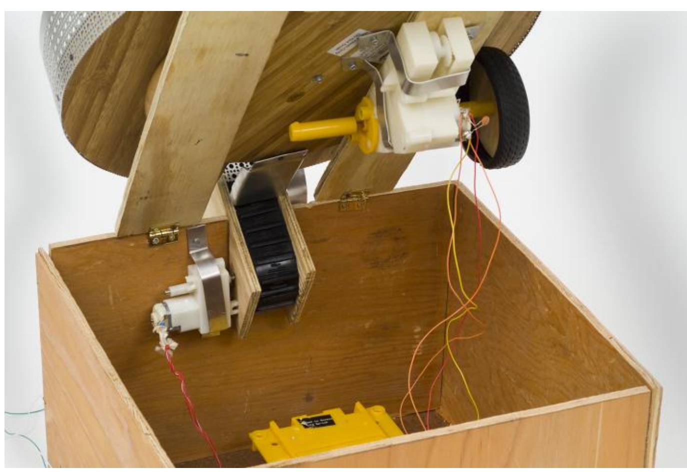

Fig. 8.40. The motor and conveyor belt.

OFF-ROAD WHEELCHAIR

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INTRODUCTION

The Off-Road Wheelchair is designed to cover rough terrains such as gravel, light snow, broken cement and dirt paths comfortably. This is an attendant propelled (requires a person to push) device for people who use a wheelchair. Standard wheelchairs have small front caster wheels and lack a suspension system which restricts the user's mobility. Other transportation devices have a high center of gravity and can easily tip over. The Off-Road Wheelchair addresses these issues by using 12 and 16 inch mountain bike tires, an individual wheel suspension system, and a lowered seat for stability. Additionally, the Off-Road Wheelchair is collapsible for easy transportation.

This device was designed to accommodate a specific client; if it were to be mass produced, specific components would need to be changed. These changes are noted throughout the report.

SUMMARY OF IMPACT

The Off-Road Wheelchair allows wheelchair users to participate in outdoor daily activities with ease; these activities may have been restricted due to lightly snow covered pathways, broken sidewalks, or lack of a solid, smooth path to travel on. It also allows wheelchair users to participate in recreational activities such as taking a ride through the woods.

TECHNICAL DESCRIPTION

The suspension system lays the foundation for the entire wheelchair. The left and right hand side are treated individually, but are identical in design. Each side has a central base which is made of 1-inch steel square tubing welded together. Square tubing is used for ease of manufacturing and to increase the strength of the welds that are used for the brackets. Square tubing is used for suspension components because it is easier to manufacture certain parts than with round tubing. Extending towards the front of the chair, from the lower front bracket, is a lever arm. This is attached to the bracket using a bolt and washer. This allows the arm to pivot.

Fig. 8.41. Off-road wheelchair.

The lever arm is welded to a wheel fork, which allows the front wheel to turn. For this preliminary design, the forks from two mountain bikes are used with slight adjustments. A steel bracket is welded to the fork to increase the trail of the wheel. This allows for easier turning of the wheelchair. If this were to be manufactured, the forks would be designed and built specific for the Off-Road Wheelchair.

Extending towards the back of the chair, from the lower back bracket, is another lever arm. This is attached in the same fashion as the front one. However, this lever arm is directly attached to the rear wheel.

For this preliminary design, both the front and rear wheels are from mountain bikes, and use the bolts and screws that are already attached to mount them to the wheelchair. If this were to be manufactured, machined wheels would be used to increase the strength and stability.

The front wheels are 12-inches in diameter. This size allows for wheel clearance when turning, and leg clearance when sitting. They are also large enough to overcome stepped objects. The rear wheels are 16-inches in diameter. This is also large enough to overcome stepped objects and to provide stability, but small enough for easy turning and maneuvering. The treads on the mountain bike wheels also help to increase control.

Each lever arm is connected to a 750 pound-force-per-inch bicycle shock. This shock is in turn, mounted to the central base. These mounting locations were chosen to maximize the cushion and travel of the spring. If this wheelchair is to be manufactured, a spring with a larger force-per-inch needs to be used to allow shock absorption for users of all sizes.

This suspension system allows for the free vertical movement of each wheel. This allows the Off-Road Wheelchair to overcome stepped objects with ease. The shocks absorb the forces from the terrain that provides a more comfortable ride for the user. Also, the wheelchair is designed to have a lower center of gravity, increasing the wheelchair's stability, while still maintaining better than average ground clearance.

The Off-Road Wheelchair uses a cross bar design for collapsibility. This design is similar to that found on manual wheelchairs. Two pieces of 1-inch square tubing are attached at the middle by a bolt and washers. This allows the cross beams to pivot with ease. The bottoms of these parts are welded perpendicularly to 1-inch steel round collars. This collar is bolted to the suspension base using brackets. This collar helps to increase the rigidity of the frame by preventing the two halves from twisting with respect to each other.

The top of the cross beams are welded to the seat rail. This is a piece of 1-inch round steel tubing. When the wheelchair is being used, these rails sit in steel catches. These catches are made from 1¼ inch steel round tubing cut in half, and welded to the suspension base. They are lined with padding which helps to absorb some force when opening the wheelchair. To help secure the seat rails into the catch, pins are used to hold the two together. If this device is to be manufactured, the catch needs to be designed to lock the seat rails in and would have a release mechanism when collapsing. Also, a four bar design should be used, instead of a simple cross-bar, to increase stability.

Riveted to the seat rail is the nylon seat. Nylon is used since it is lightweight, cheap, provides some give for shock absorption and it is waterproof. This is also used for the back of the seat, which is riveted to two pieces of 1-inch steel round tubing. This tubing is welded to the suspensions base and supports the back of the seat. The tops of these tubes have handles welded to them. The handles have rubber bicycle grips at either end. This is to allow the attendant to have a good hold on the wheelchair.

In order to allow the user to get in and out of the wheelchair easily, removable leg rests are used. Actual leg rests with calf pads from a manual wheelchair are used. New mounting joints are created out of steel and welded to the seat rail. When attached, the user's legs sticks out in front of them. The leg rests are adjustable so that they can range from 0 to 30 degrees below the horizontal. They are capable of going lower than this; however, they would interfere with the front wheels as they turn. This sitting position is similar to that of sitting in a lounge chair. It keeps the feet up and out of the way of stepped debris. The calf pads provide support for the legs so that the force is distributed over the entire leg, rather than just your feet. If this were to be manufactured, new leg rests should be designed. The calf pads on the current leg rests do not fold up out of the way. This should be changed, and the length of the leg rests should be adjustable to fit all users.

Arm rails are welded from 1-inch square steel tubing and attached to the suspension base. To provide comfort, they are wrapped in foam. If this were to be manufactured, there should be a cover over the foam and anchored down.

The wheelchair was spray painted to help prevent rust and for aesthetics. If this were to be manufactured, the parts would either be nickel plated or powder coated to ensure that the wheelchair would not rust.

The total cost of the Off-Road Wheelchair is $250, not including the donated leg rests.

Fig. 8.42. Suspension.

MOTORIZED WHEELCHAIR TABLET COMPUTER MOUNT

Student Designer: David Brugger
Client: David Jauch
Client Coordinator: Kris D. Schindler
Supervising Professor: Dr. Joseph C. Mollendorf
Department of Mechanical and Aerospace Engineering
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INTRODUCTION

This project (shown in Figure 8.43) is designed to address a mounting need for a tablet style laptop computer. The computer allows someone without the ability to speak to communicate audibly through the use of talking software. The mount has an arm that allows the computer to rotate away from the user when the computer is not needed through the use of an electric motor. The motor is powered through the wheelchair's battery system, eliminating the need for an additional power source.

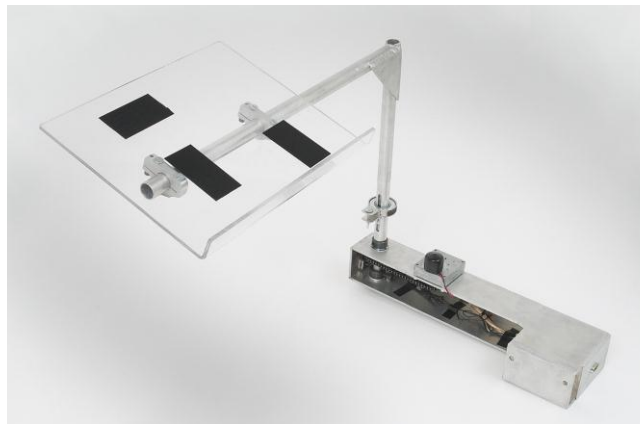

Fig. 8.43. Motorized wheelchair tablet computer mount.

SUMMARY OF IMPACT

This project was designed for a stroke patient with limited mobility and muscle strength in his arms. The present mounting systems available to mount his talking device are unsuitable for use because they all required manual force to move the device into position. The addition of a motor allows the patient to push a toggle switch and move the computer towards or away from himself without the assistance of an aide. This allows for increased independence, and having the computer easily accessible improves his communication.

TECHNICAL DESCRIPTION

The key components of the computer mount consist of an aluminum mounting base, an aluminum rotating arm, a motor, and an acrylic computer tray. The mounting base attaches to the wheelchair through the use of bolts and t-slot nuts installed in a channel on the right side of the wheelchair seat. The mounting base serves as a structural support for the rotating arm, and houses the motor, sprockets, and the chain connecting the motor to the rotating arm. The rotating arm is able to swivel approximately 180 degrees to allow the patient to be lifted from the wheelchair through the use of a vertical jack. Ball bearings installed in the mounting base ensure a smooth action. The arm is adjustable in height to allow a proper clearance between the armrest and the tray. The motor is a 12 volt DC geared type, with a speed of 1.5 RPM. This is linked to the rotating arm by two same sized sprockets and a chain. A detail of the transmission setup is shown in Figure 8.44.

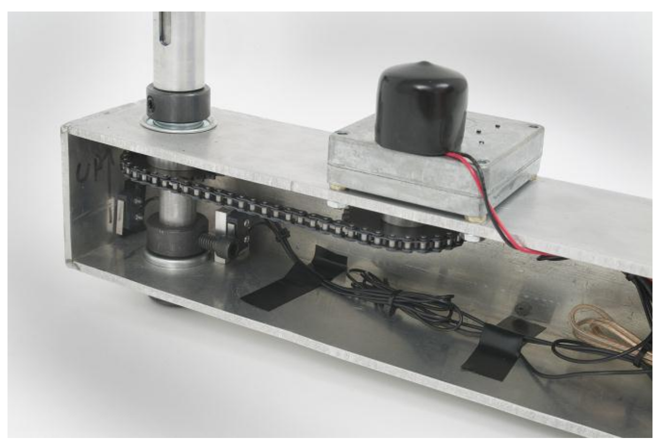

Fig. 8.44. Detail of the transmission setup for the arm.

The slow speed of the motor was chosen to keep the user and surrounding people from being hurt by the swinging arm. Limit switches mounted in the base, which are activated by a lever mounted on the arm shaft, prevent the arm from rotating too far in either direction. The toggle switch that actuates the motor is a double throw, momentary type to allow the motor to operate in both directions. The wiring from the switch and the battery to the mount is easily detachable from the base through the use of a serial port style connector. This allows for easy removal of the device without having to disconnect the wiring. The computer tray is made from bent acrylic, which can also be used to hold books, papers, and other items for convenience. The computer is held to the tray with self-adhesive hook and loop fasteners so that it does not fall off when the wheelchair is driven. To provide additional support and decrease deflections of the rotating arm while in use, a bracket containing a ball bearing attaches to the existing tray on the wheelchair and surrounds the arm.

The total cost of the project was $175.

Fig. 8.45. Mount attached to wheelchair.

Fig. 8.46. Tablet mount swiveled out of the way of the user.

ASSISTIVE TENNIS BALL LAUNCHER

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INTRODUCTION

The assistive tennis ball thrower is used to help wheelchair confined children, with limited hand movements, throw a ball with the pull of a lever. This device is designed to fit most wheelchairs on the arm and to accommodate both left and right handed children.

SUMMARY OF IMPACT

The intent of this device is to allow children with disabilities participate in outdoor activities with other children. Children love this device and find it very entertaining as they are now able to engage in outdoor activity with the other children. The glossy colors and designs on the device grab the attention of any child as they enjoy the look and functionality of the tennis ball launcher.

Along with using the device for playing with other children, the child can also use the assistive ball launcher to play with "catch" with their dog as well.

TECHNICAL DESCRIPTION

The device was designed with a strictly mechanical perspective, with no electronics. The concept is simple, yet, very effective. Following the release mechanism of a pinball machine, the assistive ball thrower is a spring loaded shaft attached to a smooth handle. The device is a 3'' diameter, 16'' length, plastic tube attachment to a wheelchair. Within the tube is a spring loaded apparatus that operates to push a ball out of the tube. The spring loaded apparatus consists of: spring, steel rod, two aluminum disks and a handle.

The spring is compressed against one of the aluminum disks that are bolted to the tube on top and bottom. A steel rod, with both ends threaded, lies in the center of both disks; one side of the rod is attached to an aluminum disk which moves within the tube, freely and pushes the ball out of the tube. Attached to the other end of the rod is a smooth, transparent plastic handle which is pulled back. Once the handle is pulled back, the spring is compressed and loaded. Then, once the spring is released the ball is launched. While there does exist devices such as these on the market, the uniqueness of this device is the attachment to a wheelchair. The attachment is on the side of the wheelchair, near the armrest, allowing clearance for operating the wheel and resting of the arm. The tube is held within a "horseshoe" clamp which is bolted to one of two "sandwich" plates and rest on top of a horizontal bar. One side of the clamp attaches a bar near the armrest of the wheelchair to the horizontal bar. The other side of the "horseshoe" clamp bolts the tube to the other side of the horizontal bar such that the horizontal bar provides a launching pad for the device.

Fig. 8.47. Assistive tennis ball launcher.

The total cost of this project was $30.

Fig. 8.48. Tennis ball launcher mounted to a wheelchair.

GUITAR ASSISTIVE DEVICE

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Supervising Professor: Dr. Joseph C. Mollendorf
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State University of New York at Buffalo,
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INTRODUCTION

The goal of the guitar assistive device, shown in Figure 8.49, is to provide a user with little or no fine motor control, or mildly impaired gross motor skills, a device to assist them in playing guitar. More specifically, the user is able to play commonly used chords so that the user would have a large variety of music to choose from. The two major distinguishing factors of the device include the power chord shape and the easy-to-use handle. The device also allows for the power chord shape to be modified to another shape, for example a minor chord or a seventh chord.

Fig. 8.49. Guitar assistive device.

SUMMARY OF IMPACT

Adaptive equipment for the person with disabilities has traditionally encompassed basic living needs, such as mobility, activities of daily living, and other practical activities. These individuals, however, are limited in their ability to participate in the arts and other forms of entertainment. It is only recently that technology began to address these issues. This device creates a new avenue, whereby a person with disabilities is able to actively engage in the display of fine arts.

This device addresses psychological and spiritual needs by creating an avenue for a disabled individual to express themselves through music. An individual with a disability, such as cerebral palsy or mental disabilities has decreased fine and gross motors skills; however, they often have emotional and spiritual needs that remain unmet. Music has proven to be vital in opening up avenues of expression. Allowing an individual to create music has a huge impact by improving their quality of life.

Fig. 8.50. Assistive device in power chord shape.

TECHNICAL DESCRIPTION

There are three major parts of the design. The mask in the front holds the positioning of the rubber used to hold down the strings. It is displayed in Figure 8.50 in a power chord shape, but allows for variant configurations.

The second part is the back brace and springs. The springs were originally designed as stiff bars. The reason it was modified is because too much strength was required to slide the device up and down the neck. The spring design allows some give, yet it retains a tight enough fit not to dampen the vibrations on the string. The back brace axis contains a rubber piece that is shaped to the neck of the guitar. Ideally, this piece should be larger to allow for better tracking on the neck of the guitar. Also, a desirable modification to the design is to put tracking rollers inside the springs to keep the mask from coming off-center.

The third major part of the device is the handle. This handle is designed to be easily held by someone with low grip strength. It ideally has a cylindrical cushion with a 1.5 inch diameter around the handle for easier gripping. It is wide enough so that most people should have no problem fitting their hand inside the handle.

When tested a total of 11 unique chords were able to be played including: E, E#/F, F#/Gb, G, G#/Ab, A, A#/Bb, B/Cb, B#/C, C#/Db, and D. Songs such as "Promises" by Eric Clapton or "Smoke on the Water" by Deep Purple can be played using only the aforementioned chords.

To get the device on the guitar, a screw is removed on one end of the back brace axis and the end of the spring is slid off. The device is then placed around the neck of the guitar and the spring is stretched and put back on the back brace axis. The screw is replaced and the mask is positioned properly on the strings. This process requires some help with the installation.

Most of the parts are machined from stainless steel or aluminum, depending on strength requirements. For example, the whole handle is aluminum to minimize weight but the back brace axis is stainless steel to maximize strength. There are 4 rubber pieces which are the sole points of contact between the device and the guitar. This helps to minimize wear on the guitar.

The total cost of the project was about $30.

Fig. 8.51. The guitar assistive device attached to a guitar.

HEIGHT ADJUSTING CHILD BATH SEAT

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INTRODUCTION

The Height Adjusting Child Bath Seat was designed for children with little or no muscle control. The purpose of the seat is to provide a support system for the child in order to make it easier for the parent/caregiver to bathe them. The height adjusting aspect allows the parent/caregiver to raise the seat, set the child down, lower it into the tub, bathe them and raise it back up when finished. The ability to raise and lower the seat acts as a preventative measure to reduce back and muscle injuries, a common result of repetitive lifting for the parent/caregiver.

The seat also helps keep the child a safe distance away from the water, preventing the possibility of water getting into their eyes, nose, or mouth. It allows the bath to be given by one person, eliminating the need to have one person support the child's body safely while the other gives them the bath. Reducing the efforts of one person allows for a more stress free environment, and in the case where the child is in a group home, it allows caregivers to take on other responsibilities.

Fig. 8.52. Height adjusting child bath seat.

SUMMARY OF IMPACT

Taking care of a child with little or no muscle control is very physically demanding. It often requires heavy lifting, low to the ground movements and severe strain on the upper and lower back. This bath seat tackles each of these problems. The height adjusting feature prevents the parent/caregiver from overextending their back from reaching over the edge of a bath tub. It also promotes correct lifting procedures by avoiding low to the ground movement.

The seat alone provides a secure and more comfortable place for the child to sit, as opposed to sitting on the hard bottom of a bath tub. It will help to release pressure that may have previously existed on the spine or neck from the lack of support. It also prevents the child from sliding in the tub and keeps their head in an upright position. It makes daily tasks go by faster, and with much more ease and convenience for both the child and parent/caregiver.

TECHNICAL DESCRIPTION

The child bath seat was designed to hold children weighing from 30 to 100 pounds. At its lowest position, the seat is approximately 10 inches off the ground and when fully extended can reach a height of 16 inches. This height could be made larger by adjusting the cylinder lengths. It can be operated by one person using a foot pump to pump it up and a simple shut-off valve to release the pressure and lower it down into the bath tub.

The bath seat is made of a PVC pipe frame with a strong mesh material. Attached via PVC reducers are four air cylinders also made of PVC piping. PVC piping is chosen because it is readily available and had a relatively low cost. It is also chosen due to the fact that the chair needed to be able to withstand a very wet environment, with varying temperature ranges. Also, sharp edges are eliminated that could have been a potential danger to the child.

There are two cylinders under the leg portion of the chair (the front cylinders) and two cylinders under the back portion of the chair (the back cylinders). The inside pipes to the cylinder are cemented at one end to the reducer which comes off of the frame via a tee and are sealed at the other end. This piece has an O-ring groove and O-ring near the sealed end. The outside pipes of the cylinder, made of the next larger size PVC than the inside pipes, are open at one end where they slide over the inside pipe and capped off at the other end.

The pipes are cut to a specific length so that when in the lowest position, the outside pipes are in contact with the reducers, leaving about a one inch high area inside to be pressurized. In order to get air into these areas, small holes were drilled and tapped into each cylinder. With the use of barbed connections and check valves, hoses are connected to all four cylinders. The hose is then connected to two bicycle foot pumps (the air source), attached together by a piece of wood, for simultaneous pumping. One pump provides air to the back cylinders and the other pump provides air to the front cylinders.

This system does not have to be powered using foot pumps. An electric pump is a viable option; however, it must be kept a safe distance away from the water. Another power source could have even been the water coming out of the faucet. The water could have been channeled into the frame to raise the chair with the use of water pressure.

Equal pressurization of the tubes was somewhat difficult to achieve. At first, there was only one pump that controlled the air input to all four cylinders. However, the back cylinders need to be made larger to support more weight. After sewing the material to the frame, the actual seat portion was slightly closer to the front cylinders, thus the center of gravity of the chair had changed, putting more weight acting on the front cylinders. This caused the cylinders to rise at different rates. This was the main reason for adding another pump so that the front and back cylinders were controlled separately.

Stability was also an issue with the chair. The chair originally only had barbed connections, and no check valves. If for some reason the chair went down on one side, the air pressure would just be transferred to another tube allowing the instability. This was the main reason for the check valves to be added to the system. This allowed air to enter into each cylinder separately and not transfer into the other cylinders.

The air exits through another set of check valves which are connected by hose to a single shut-off valve. The user can simply reach down and open the valve to release the pressure in the system and close it again when they want to pump it back up. It is important to note that the springs inside of the check valves are adjustable for persons of various weights to ensure that the chair descends in a uniform motion.

Another way to address the stability issue was the addition of braces that connected the cylinders. This meant that if one cylinder went up, then the other cylinder goes up as well. The braces are made from donated aluminum tubing. A more child-friendly and water resistant material could be used.

Holes just matching the outside diameter of the cylinders were put in the aluminum tubing, allowing it to slide over the cylinders with a tight fit. These braces connected the two front cylinders and the two back cylinders together. This greatly helped the stability of the system. Another addition is to connect the front and back braces via a strip of tubing down the middle.

A somewhat difficult task was to find the exact correct size for the O-rings that went inside the cylinders. This normally is a simple task; however, the insides of PVC pipes are not exactly smooth, making it difficult to create a good seal. The cheapest solution was to use a honing tool to take out small imperfections and use the O-rings. A more efficient solution might be to find prefabricated cylinders that are water resistant.

The last part of the seat is the safety strap that provides extra support to the upper half of the body. Here, an elastic band is sewn with Velcro on each end that stretches around the frame and the child. The strap is not sewn to the frame so that it is easily adjusted to the specific height of each user. It is also desirable to have additional head support and safety straps to go around the legs as well.

The total cost of this project was $110, not including the cost of the check valves or strips of aluminum tubing, which were donated.

Fig. 8.53. Child seat with a child in it and raised.

BOTTOM PANTRY CUPBOARD WITH ROTATING SHELVES INSERT

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INTRODUCTION

The purpose of this product is to make items commonly found in a pantry cupboard more accessible to someone in a wheel chair or with limited mobility. Often, people with such restrictions find it difficult to retrieve items in the back of a cupboard, or have trouble bending down to the level of the cupboard; this limits the usable overall area of the cupboard.

SUMMARY OF IMPACT

The bottom pantry cupboard with rotating shelves insert mitigates the problem of accessibility by rotating the items around inside of the cupboard and bringing them to the user, rather than the user having to reach for them. Other important features of this product are its ability to be inserted into a preexisting cupboard, its simple operation, and its ability to operate even when loaded improperly.

TECHNICAL DESCRIPTION

The Bottom Pantry Cupboard with Rotating Shelves Insert was designed to fit most standard residential cabinetry. The dimensions for the insert are 25″ x 25″ x 32″

These dimensions comprise the main exterior of the product and allow the entire insert to slip inside a conventional bottom cupboard with only a few modifications.

The Bottom Pantry Cupboard Insert is separated into two general compartments. The top compartment is where the shelves are located. The bottom compartment, which is just 6″ high, holds the motor and electrical components.

The products that the user puts in the cupboard sit on 4 shelves. Each shelf has a usable area of 6.5″ x 17″. These shelves are suspended beneath a cross rod. This arrangement allows the shelves to freely rotate on the cross rod as both the shelves and the cross rod rotate around a center axis. This configuration keeps the shelves always level so the product placed on them does not move as the shelves are rotating.

Fig. 8.54. Bottom pantry cupboard.

The cross rods are connected to two hubs on each side. Each of these hubs are interconnected and then connected again to a center hub that is welded to the center axis. This is the center of rotation. The center axis sits 15.5″ from the bottom of this compartment. It is supported by two triangular supports that have center hubs, which contain brass bushings as to allow the center rod to rotate freely inside of them. One end of the center rod has a sprocket attached by spring pins. This sprocket, when combined with the chain and motor, make up the drive system for this device.

The motor, which is housed in the lower motor compartment, is bolted to the exterior frame using counter-sunk 5/8″ carriage bolts. The motor is a 90V DC motor with 250 in-lbs. of torque. This motor consists of a worm gear transmission that gears down the speed of the motor to 3 rpms. The motor is connected via a 400 Volt 4 Amp bridge rectifier to a moment push button switch. This switch activates the motor when the user pushes it, and stops the motor when the user releases it. The switch and motor are connected to a fuse and then to a conventional 120 Volt three prong outlet.

This design has been tested and has performed well in both balanced and unbalanced loading conditions, as well as maximum loading conditions.

It has been determined that for the best operation of the rotational system, the shelves should always be loaded as evenly as possible. Also, no more than 15 lbs. should be placed on one single shelf at any given time.

Total cost of this project was $170.00.

Fig. 8.55. Shelves loaded with items.

AN INEXPENSIVE RECLINABLE WHEELCHAIR

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INTRODUCTION

The Inexpensive Reclinable Wheelchair enables persons with disabilities to have a relaxing experience in their own wheelchairs. This design allows people to recline the back of the wheelchair and move into a more comfortable position. The current models are expensive and putting the reclining position is done by someone other than the person using the wheelchair. Here, an existing wheelchair is modified so that it is reclinable. The Inexpensive Reclinable Wheelchair consists of incremental position hinges (turned into free moving hinges), gas springs, metal tubes (some with predrilled holes, some without), snap buttons, an aluminum bar, and anti-tippers. Using these items, any regular wheelchair can be modified to not only allow the user to be more comfortable but to also do the reclining themselves.

SUMMARY OF IMPACT

Two main concerns of the Inexpensive Reclinable Wheelchair are to make comfort more affordable and to help persons with disabilities avoid the associated health risks that come from spending long periods of time in a wheelchair. Current models of reclinable wheelchairs cost anywhere from four hundred dollars to one thousand dollars. The second concern is the health risks. Most people cannot sit in one spot very long and being unable to shift position makes it that much more uncomfortable. Using a reclinable wheelchair alleviates the uncomfortable factor, aides in avoiding bed sores and helps circulation.

TECHNICAL DESCRIPTION

The largest component of the Inexpensive Reclinable Wheelchair is the wheelchair. Modifications made to the frame allow the user to adjust the back of the seat. One of these modifications is the addition of hinges to the wheelchair frame. As mentioned above, the incremental position hinges are turned into free moving hinges by removing the springs inside that allows a smoother recline. Also the wheelchair's frame is cut apart and the hinges are placed over the end of the now open tubing. Once that is done, the hinge arms are bolted onto the frame.

Fig. 8.56. Reclinable wheelchair in the upright position.

Fig. 8.57. Reclinable wheelchair in reclined position.

The next modification is the addition of gas springs. These help control the speed of reclining. They are bolted onto the back of the wheelchair frame and to the anti-tippers. The anti-tippers function as a safety feature to prevent the wheelchair from tipping

Fig. 8.58. Position control tubes.

Fig. 8.59. Anti-tippers and back of the wheelchair.

backwards. Steel tubes are added to the end of the anti-tippers to ensure that the ability of the wheelchair to tip backwards is minimal (an inch or two at most). Another safety feature is the aluminum bar added to the back of the wheelchair near the handles to ensure that the back of the seat stays rigid enough to prevent buckling but not too rigid as to be uncomfortable.

After adding these items, the last modification is the addition of walker legs that contain predrilled holes and some steel tubes. The steel tubes are placed inside the walker legs and the snap buttons inside of those tubes. The entire assembly is then bolted to the side of the arm rests and the side of the back part of the wheelchair seat. Pressing the snap buttons down allows the user to push back on the wheelchair's back and move through all the predrilled holes (this creates an incremental recline).

The total cost of the design was $271.40.

TOURING TRICYCLE

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INTRODUCTION

Many people do not have the ability to use their legs have a restricted number of exercise options available to them, and even fewer choices in the sport of cycling. Of the options that are available, many follow the conventional hand-crank design and lack the superior maneuverability that exists in many mountain bikes. The goal of the Touring Tricycle, as shown in Figure 8.60, is to provide a fun and unique approach to traditional cycling for persons with disabilities, along with a dual suspension for additional riding comfort.

SUMMARY OF IMPACT

Once in the tricycle, the bike moves forward by pushing and pulling on two lever arms. This allows the person to engage in physical outdoor activity while enjoying a sense of independence. The main muscles worked include the biceps, triceps, chest, shoulder, and core muscles. The dual suspension of the bike also allows the rider to ride on rougher terrain than other human powered vehicles in its class.

Fig. 8.60. Touring tricycle.

TECHNICAL DESCRIPTION

There are three major components that allow the Touring Tricycle to move forward: the lever arms, steering system, and brakes. All these systems are designed around a dual suspension mountain bike frame.

The lever arms are the source of propulsion of the bike and take the place of an individual's use of legs. The lever arms rotate about an axle that extends through the frame of the bike, just in front of the seat through the use of ball bearings. The arms extend down below the axis of rotation and connect by way of a steel pin to another metal bar that attaches to the front sprocket of the tricycle as seen in Figure 8.61.

Ball bearings surround the connecting pins to provide for smooth movement in both the pushing and pulling directions of the arms. A simple fixed gear chain is used to help propel the tricycle as well.

The second major technical component of the Touring Tricycle is the steering assembly. Steering the bike is done by a system of conventional brake cables with housings that are typically used on most two wheeled bicycles. A throttle tube is placed on the top of each lever arms where the hands would be placed so that it is free to rotate by use of the wrists. One end of the cable secures into the throttle tube and the other end crosses the frame of bike and wraps around an aluminum steering disk before the cable is clamped to the front of the disk as shown in Figure 8.62. With this setup, rotating the right wrist inward turns the bike to the left, and rotating the left wrist inward turns the bike to the right.

Sufficient slack is given on the cables to allow for free movement in the full forward and back positions of the lever arms. The steering disk is an aluminum circular plate that clamps around the steering column of the bike to help guide the tricycle either way.

Keeping the cables taut is imperative to the proper operation of the bike. To make sure this always occurs; one cable tensioner for each lever arm is installed adjacent to the throttle tube handles as shown in Figure 8.63. The tensioner is a simple mechanism that holds the cable housing in place while providing overall adjustability by allowing the rider to tighten a screw that pulls the cable tighter if need be. A metal plate with two tapped holes secure the cable housing directly in back of the steering disk to keep the other end of the cable system taut as well.

Fig. 8.61. Lever arm assembly.

Fig. 8.62. Steering disk with cables.

The last major component of the device is the braking system. This system uses the existing brake handle from a mountain bike mounted on the right lever arm so that at any time, the user can grab it immediately without moving their hand away from their steering responsibilities. The brakes themselves are mounted on the front wheel of the bike. The fixed gear feature of the bike also provides a means of braking. By simply switching the direction of movement of the arms, the bike shifts its momentum in the opposite direction and brings the tricycle to a halt.

Some other details help make the bike more ergonomically pleasing to the user. A fully supported seat with side panels secures the user to provide maximum comfort and stability. To ease the user entering and exiting the device, the left lever arm can be removed by pushing in a push pin button and replaced in the same manner. Also, leg straps attach to the side of the seat so that a person may secure his/her legs by placing them over the lever arm axle and pulling the ankles backward to be secured in the leg straps, as shown in the overall view of the bike with user in position (Figure 8.64).

The total cost of the project is $172. It should be noted that the bike frame, seat, front wheel, and brake handle were all donated.

Fig. 8.63. Brake handle and cable tensioner.

Fig. 8.64. Overall view of the touring tricycle with rider.

FISHING ROD FOREARM SUPPORT

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INTRODUCTION

The fishing rod forearm support is designed to aid people suffering from Carpal Tunnel Syndrome. Traditionally while fishing, the forces endured from the use of a fishing rod are resisted by the hand and forearm muscles. This support transfers the force from the hand and forearm to the elbow and shoulder. The user simply fits their hand and forearm into the support and secures the strap over the forearm.

SUMMARY OF IMPACT

This device redistributes the forces associated with fishing from the hand and forearm, to the elbow and shoulder. The result is less pain and irritation, more control over the fishing rod, and a longer fishing experience due to less fatigue.

TECHNICAL DESCRIPTION

Two prototypes were made, one from aluminum sheet metal and one from carbon fiber for weight reduction. Both prototypes are identical in form and function, the only difference is that connections with the aluminum prototype were welded, and the carbon fiber prototype was glued.

The device consists of three main sections. The first section is the one that the fishing rod lays in. It is created from cutting a 1.375 inch tube in half-length wise. A section of pipe insulation foam is then cut and glued inside of the section to protect the cork on a fishing rod from damage.

The second section is the one that the forearm rests in. It is a 4 inch inner diameter section of rolled aluminum sheet metal. This section for the aluminum prototype is also used as a mold to wet lay the section for the carbon fiber prototype. The wet lay is done by impregnating layers of bidirectional twill carbon fiber fabric in the mold with epoxy. This section is covered with ¼ inch thick foam padding to provide comfort.

Fig. 8.65. Fishing rod forearm support attached to a fishing rod.

Fig. 8.66. Fishing rod support in use.

The last section is a ½ inch inner diameter tube that is connected perpendicular to the first section. The purpose of this tube is to provide structural support between the first and second sections. The tube is milled or “fish mouthed” at one end to the outer radius of the first section. This enables a proper weld or glue joint. The other end of the tube is cut to the angle of the second section which also enables a proper weld or glue joint.

Lastly an elastic strap is riveted on to hold the forearm into the support and attached with Velcro to the other side. Rivets also attach hose clamps that hold the rod into the device.

The cost of this device was $120.

Fig. 8.67. Rod forearm support without a fishing rod.

Fig. 8.68. Fishing rod forearm support.

ARM-MOUNTED CARRY ASSISTANT

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INTRODUCTION

The reason for designing and building this project is to make an individual's arm a useable platform if they lack adequate upper body strength or have lost use of an arm due to a stroke. A key feature to this design is that much of the weight of carried items is transferred to the hips and shoulders, allowing the equipped arm to exert little or no effort.

SUMMARY OF IMPACT

For an individual who has lost use of an arm resulting from a stroke, this device provides support for their weak arm. It does so by using the disabled arm as a foundation for the system, allowing them to carry items instead of performing all tasks with the strong arm. It has been found that many stroke patients tend to tuck their weak arm close to their body. By providing the arm with a task or function and requiring it to be moved away from the body, the system provides some therapeutic value to the patient.

TECHNICAL DESCRIPTION

The arm-mounted carry assistant consists of a cuff made out of Schedule-40 PVC for durability, which envelopes the patient's forearm and continues up the back of the elbow. It is split into semicircles and hinged on one side, allowing it to be easily equipped. The inside of the cuff has been lined with soft foam for comfort. The prototype has been equipped with a pair of steel hooks allowing the user to carry various items such as grocery bags, buckets or baskets, etc. If a load is too great, it may result in a large moment because the mass of the carried item is located away from the elbow. If this occurs, the hook attachment may be reversed by unscrewing the pair of wing nuts from the ¼"-20 x 1" carriage bolts and rotating the piece 180°, thus situating the load closer to the elbow. For production purposes, the product offers numerous attachments for a variety of situations that arise where a pair of hooks is not the best tool.

Fig. 8.69. Arm-mounted carry assistant.

Fig. 8.70. Arm mount with hooks.

The arm is not supposed to support the majority of the load; therefore the device has been designed to transfer it to the user's shoulders and hips. The patient wears a support belt that aids the load distribution. A strap from the opposite shoulder goes through a loop on the cuff to bear some of the load on the shoulder and also prevents the arm from swinging to the outside of the body under the weight. A female end located on the hip of the belt mates with a male feature found near the elbow on the cuff disbursing some of the weight to the hips. This feature also provides control of the arm, preventing it from moving aimlessly. There is also a post that goes from the cuff to the stomach of the belt to prevent the arm from swinging inwards.

Velcro is chosen as the closing feature for the cuff because it is simple, requires little effort as compared to a complex locking mechanism. With a load applied, it is highly unlikely that the Velcro will release because it has been applied over a radius. This means that when there is a force pulling downwards on the sleeve, the Velcro straps are being pulled in various directions over the top of the cuff rather than in one direction.

Fig. 8.71. The carry assistant attached to the body.

Fig. 8.72. The carry assistant in use.

SPRING LOADED, EXTENDING COUNTERTOP

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INTRODUCTION

Often times, the reach of those who are confined to wheel chairs or use walkers is limited when approaching a counter top because of the protrusion of their assistive equipment in front of them. The goal of this project is to create a mechanical system which allows for the extension of a counter top with relative ease to provide those individuals described above more working space in kitchens, bathrooms and any other areas in the house where counter tops are used.

SUMMARY OF IMPACT

This project utilizes compressed spring tension and a locking mechanism to propel the extending countertop section outward for the initial 3 inches of movement, allowing for easy access to the extending section by providing a large area for gripping during the full extension. It allows people to increase their productivity and greater organization while performing tasks that require countertop space.

TECHNICAL DESCRIPTION

This system utilizes 3 sub-systems in its operation.

The first subsystem is a pair of sliding rails on which the countertop slides. The rails are mounted to the sides of a section of counter top that is selected for extension (of any width, and with sliding rails of varying lengths as per the customer's wishes), and is connected to the sections of countertop which are to remain stationary; thus, creating an extendible working surface area.

The second subsystem is a spring located to the rear of the extending section. This spring is anchored to the wall, and when the counter is in the retracted position, the spring is compressed between the counter top and wall. There is a guide rail in place within the inner diameter of the spring in order to prevent the spring from bending out of position when a compressive force is applied to it. The guide rail inserts into a hole drilled horizontally into the extending section, as to not hinder the movement of the counter top inward and outward.

Fig. 8.73. Extending countertop retracted.

The third and most complex subsystem is a locking mechanism that prevents the counter top from extending when not in use. The lock is positioned at the front of the counter on the stationary section lock. The main body of the locking mechanism consists of a rectangular block of aluminum, with a square pocket milled on one side, and a handle mounted to the top. A square wedge (similar to a door knob wedge) is placed in the pocket of the main body. The purpose of this wedge is to protrude from the main body to intersect a striker plate that is in place on the sliding section when in the retracted position, thus preventing the extension of the countertop due to the spring. On the side of the body/wedge assembly is a plate anchored to the stationary counter, preventing the wedge from falling out of the body, and with a slanted cut on one side, contacts the wedge during retraction of the lock, sending the wedge into the body, and freeing the counter top to extend. The wedge is then forced back to the out position via a compression spring positioned between the wedge and the inner wall of the pocket, so that when the counter top is pushed back to the retracted position, the wedge will once again contact the striker plate and hold the countertop in position.

Essentially all that is required for operation of the countertop from the user is a pulling motion of the handle. This moves the locking mechanism forward about one inch, allowing for the countertop to be extended out via spring tension for the first 3 inches of extension. The user then pulls the countertop out the rest of the way, allowing them to use the space more effectively.

Thanks to many donations, the cost of the project was under 30 dollars.

Fig. 8.74. Extending countertop extended.

THE ASSIST IN STANDING CAR SEAT

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INTRODUCTION

The Assist in Standing Car Seat is created for those who have trouble exiting an automobile. Most automobiles are designed to cause as little wind resistance as possible. This means that when manufacturers are designing cars, they try to make them sit as very low to the ground. When the cars are made to sit low, it creates a very low entry and exit point for people. It is this point that causes many problems for people when they try to exit.

SUMMARY OF IMPACT

This device allows a person with a disability who owns a vehicle easier exit. If they already own a car that is too low to the ground, the seat provides an alternative choice to buying a new car. Since the seat has replaceable installation rails, the seat can be swapped in and out of cars as the owner bought different models.

TECHNICAL DESCRIPTION

This device is a compilation of three main components. The first component is a normal car seat with basic functions. This means that the seat still has the ability to slide back and forth and it maintains its tilt function to allow the seat to adapt

Fig. 8.75. Assist in standing car seat.

Fig. 8.76. Assist in standing car seat assisting the user.

to different comfort levels of passengers. The second component is a pneumatic device that fills an expandable container with air and then releases the air when the device is no longer in use. The third component is a plate system which is attached at one end, via hinge, to allow the plates to separate in an angular fashion.

The pneumatic system uses a 12 volt air compressor that is attached to a ball through a system of hoses. The hoses that connect the ball and the compressor are bisected by a release valve that allows the air to leave the ball. The ball of the pneumatic system is placed between two ¼ inch aluminum plates of the plate system. The plate and pneumatic system are both attached to the slightly modified car seat.

The system works by the user turning the pump on with a switch that has been installed in the upper part of the chair. When the pump is turned on, the ball expands and separates the two plates. This causes the seat the user is sitting on to tilt. This tilting motion allows the user to straighten their legs as well as raises their center of gravity, making it easier to stand. Once they are standing, they simply turn the system off, using the same switch, and the device readies itself for its next use.

With the sale of different sliders, which attach the seat to the car, the seat has the ability to be installed in a wide spectrum of vehicles.

The total cost of this device was $119.86.

Fig. 8.77. Air compressor and hoses.

Fig. 8.78. Ball inflated lifting the seat.

COMFORTABLE COLLAPSIBLE SAFETY CRUTCH

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INTRODUCTION

The Comfortable Collapsible Safety Crutch is a remodel of the standard crutch currently on the market by making it more stable and comfortable. Storage and transport are also recurring problems with the current models and are also considered in this device. Overall, this crutch encompasses multiple traits that benefit the user in comfort, convenience, and safety.

SUMMARY OF IMPACT

This product benefits anyone who uses crutches for any type of injury. It encompasses nearly all beneficial characteristics that a crutch entails. It is easier on the joints of the wrists and shoulders because it dampens the force of the pivoting which in turn allows a longer durations of use. It also creates a more stable crutch in case of slipping. The crutch also collapses for easier transport when in public areas or in areas of limited space.

TECHNICAL DESCRIPTION

This product is designed to improve the stability and comfort of a standard crutch. To address the problem with the safety, the rocking base was created. Most crutches just have the single pivot point. The broad rocking base is like walking with a wheel. If the crutch slips, it regains traction with a different part of the crutch. The base is constructed out of 5/8th steel tubing and bent with a 6-inch radius. It is also designed so that the base telescopes inside the original frame of the crutch. This structure is depicted in Figure 8.79.

The center pole is a guide for the spring and a place where the bottom collar clamp is placed. The collar clamp can be adjusted to different lengths to change the strength of the spring, or the spring can be completely changed. The spring compresses against another plate located at the bottom of the crutch frame. It consists of 2 collar clamps welded to an aluminum plate. There is a tension pin that goes through the center guide pole for the spring that

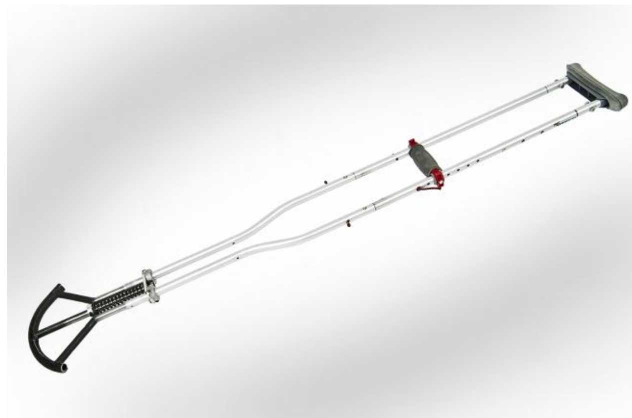

Fig. 8.79. Comfortable collapsible safety crutch.

Fig. 8.80. Crutch in collapsed position.

passes through this plate to keep the base from falling off.

The collapsibility was accomplished by cutting the original crutch frame in half and welding 5/8th aluminum tubing inside with an inch and a half protruding from the cut. Holes are then drilled and pushpins inserted as a means to keep the crutch structurally sound, while maintaining the ability to be broken down. Bungee cord was also strung through the crutch frame to help re-assemble and keep the pieces together, even when disassembled.

Lastly, since the adjustability is usually done at the bottom of the crutch where the springs and the rocking base are now, the adjustability aspect is moved to the top of the crutch. To begin with, the crutch frame is cut a couple inches below where the underarm support attaches. It was constructed using 2 lengths of 1 foot long 5/8th steel tubing. There are holes drilled through either end and pushpins are inserted in one end of each one and then inserted into the crutch frame. The crutch frame also had holes for the pushpin to lock into drilled out. The other ends of the tubing are bolted into the crutch. The following photo depicts the overall structure.

The overall cost of this project cost $60.

Fig. 8.81. Crutch in use.

Fig. 8.82. Crutch in use with springs compressed due to applied force.

HOSPITAL BED WATER DISPENSER

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INTRODUCTION

The Hospital Bed Water Dispenser is a device designed to provide water to people in a hospital or nursing home beds. The Hospital Bed Water Dispenser uses a pressure transducer that triggers the motor to pump when the patient applies a vacuum pressure to the end of the water tube. The controls located on the top of the water tank provide the doctors or nurses with the ability to control and monitor how much water a patient intakes. The goals of the water dispenser are to provide hospital or nursing home patients' easy access to water whenever they desire and to help doctors monitor a patient's water intake.

SUMMARY OF IMPACT

The Hospital Bed Water Dispenser gives patients easy access to a water supply and eliminates the need for a nurse to provide water to a patient whenever they are thirsty. The water dispenser also helps doctors to monitor the amount of water a certain patient drinks. The water dispenser helps patients consume water whenever they are thirsty and also limits the amount of time nurses spend providing water to their patients.

TECHNICAL DESCRIPTION

The Hospital Bed Water Dispenser is designed to be mounted onto a wall or hung on the rails of a bed. The total dimensions of the water dispenser are 12in x 9 in x 9 in. The approximate weight of the tank with water inside is 32 lb.

The water dispenser tank is made out of hard sterile plastic. The water tank also contains a Brita water filter to help purify the water. The top of the tank has a removable lid for easy access.

The hospital bed water dispenser pump is attached to the side of the plastic tank and enclosed inside the hanger of the water dispenser.

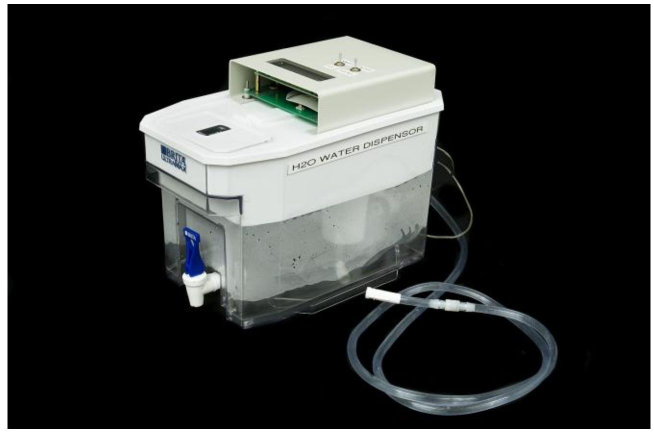

Fig. 8.83. Hospital bed water dispenser.

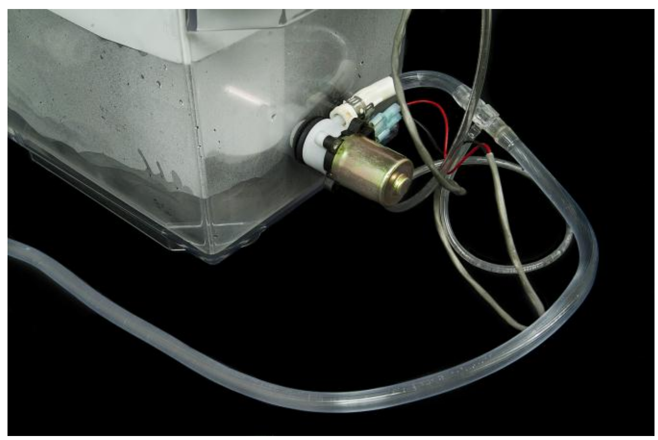

Fig. 8.84. Water pump with feeding tube.

Connected to the pump is a 6 ft. feeding tube with a nozzle on the end and power cords.

The circuit for the hospital bed water dispenser sits on the top of the tank. The control circuit consists of a circuit board with one 2 x 16 character display screen and 2 switches. The switches are used to select the amount of water that should be dispersed in units of mL. The circuit is programmed to display how much water has been dispensed and how much water left to be dispensed. When the amount dispensed reaches the limit amount, the display blinks. The display screen also has a sleep mode that can be activated that turns off the display.

The pump and pressure transducer are also connected to the circuit board. The pump is calibrated to pump in 50 ml increments and is activated by the pressure transducer. A small tube (1/8”) connects the pressure transducer to the feeding tube (1/4”). When a patient applies a vacuum pressure to the end of the feeding tube, it triggers the pressure transducer to activate the motor to flow water.

The total cost of the prototype project is $ 310.54. If mass produced, projected price is in the $150 range.

Fig. 8.85. Display panel for the water dispenser.

Fig. 8.86. Hospital bed water dispenser .

Fig. 8.87. Water dispenser in use.

SECURITY STORAGE ATTACHMENT FOR WHEELCHAIR

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INTRODUCTION

The goal of the security storage attachment is to build a security based storage compartment that can be attached onto a wheelchair. The purpose of building this attachment is to help wheelchair users secure their belongings while in motion. Traditionally, storage attachments for wheelchairs come with a lot of restrictions that makes it very difficult for wheelchair users. Also, many of these storage attachments are flimsy and not very safe. The security storage attachment for wheelchairs was built to eliminate these problems by providing easy accessibility that is secure and safe.

SUMMARY OF IMPACT

The security storage attachment is built to be attached to the space underneath the wheelchair seat. The storage slides out between the person legs. Once done removing or storing items, the storage can then be pushed back underneath the seat for safe storing. This design allows only the wheelchair user to have access to the storage compartment making it safe and also easily accessible.

TECHNICAL DESCRIPTION

The design of the wheelchair is based on a discussion with a local store dealing with wheelchairs. The storage attachment is designed to the specification of the store's most popular and best-selling wheelchair. The empty space underneath the wheelchair's seat is chosen as the best place to attach this storage. The storage is built using wood and is shaped like a box.

The dimensions of the storage attachment device are 10 inches long, 6.5 inches wide and 9.5 inches deep. These dimensions are calculated based on a few criteria. The width is calculated based on the distance of the foot pegs. This is so that when the storage slides out, it is not restricted by the user's legs. Next, the length is calculated to use up all the

Fig. 8.88. Security storage attachment for wheelchair attached to a chair.

Fig. 8.89. Storage attachment in extended position.

empty space and at the same time not stick out underneath the seat too much when stored. The depth of the storage attachment is based on two important restrictions: the front wheel of the wheelchair having a 360 degrees clearance and also an allowance space between the seat and the storage lid to avoid the user's bottom hitting the box when he or she sits down. Even with many restrictions, the dimension of the storage allows the user to keep multiple items in the storage such as wallets, cell phones, passports, medicines and many other things all at the same time. The storage is attached to the wheelchair via a platform that is attached to the stabilizing bars in between the wheels of the wheelchair. The platform is built using aluminum tubing. The storage compartment and the platform are connected by the two sliders that slide the storage in and out. Unlike traditional sliders that can remove the box from the platform, the sliders used for this storage attachment are commonly known as t-tracks. These sliders are much more stable than conventional sliders. Also, it comes with a stopping mechanism so the storage will not hit the wheelchair bars if accidentally pushed back too fast. In total the system weight is only 12.3 pounds and can carry up to 20 pounds safely.

The total cost of the project was $50.

Fig. 8.90. Rails used to extend the attachment.

Fig. 8.91. Storage attachment opened and in use.

TRI-BRID

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INTRODUCTION

The Tri-Brid offers users with limited use of their legs the ability to travel quickly in a recreational or professional sports setting using this a relatively inexpensive device. The Tri-Brid utilizes a pedal crank mechanism mounted where the handlebars are normally positioned, with the chain directed to a single geared freewheel mounted on the front wheel. A rear positioned seat is placed slightly over the rear wheels, with a chest-pad mounted to reduce weight transferred into the arms.

SUMMARY OF IMPACT

The sleek design is aesthetically pleasing, while providing a very ergonomic position for users who are serious about riding long distances or professional racing. The design allows users to travel farther and faster than traditional wheelchairs, keeping a bicycle-level height for traveling with regular bicycles, while keeping costs substantially lower than other hand powered tricycles.

TECHNICAL DESCRIPTION

The design is the modification of a traditional 26" bicycle and a 24" tricycle conversion kit. The bottom bracket for foot pedaling is removed and placed where the handlebars are traditionally located. The frame is reinforced where the bottom bracket was removed by replacing it with a square steel bracket. Moving the bottom bracket to the handlebar position enables the user to pedal using their hands, while still being able to safely and securely steer the Tri-Brid at higher speeds. A removable chain guard was mounted over the sprocket of the hand crank system to protect the user from unintentional contact with the metal teeth of the sprocket.

The braking mechanism is a traditional "v-brake" for bicycles mounted on the front wheel in the reverse position to allow room for the chain to transfer motion un-obstructed to the front wheel. The hand-brake is mounted just behind the front fork and directly below the user's arms, allowing for effortless accessibility at speed.

Fig. 8.92. Tri-Brid.

Two small steel plates are added to the bicycle where it connects to the tricycle conversion kit that prevents any loosening of the connection between the two, which in turn prevents it from disconnecting after continuous use.

Utilizing the mounting points for the rear brake on the bicycle, the seat was installed using aluminum bars and plate. The forward tilting position of the seat promoted a leaning forward body position to assist in keeping an efficient power transfer to the drive train.

The chest pad is placed using the opening intended for traditional 'saddle' seats on bicycles. Without this chest pad, a user carries the weight of their upper body through the arms, drastically limiting turning ability and the user's ability to remove one hand to brake while traveling. The chest pad provides weight transfer that allows the user to put as much or as little force into pedaling, and enabling them to brake comfortably.

The square bracket that replaced the bottom bracket is used to mount the foot platform, while the bolt holes traditionally used for a water bottle holder are used to mount ankle straps intended to hold the limited use legs of the user in place while in motion.

The total cost for the project was $183.24.

Fig. 8.93. Hand crank system with chain guard.

Fig. 8.94. Tri-Brid with a rider.

STANDING ASSISTANT / WALKER

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INTRODUCTION

From a sitting position, it is very difficult for individuals who suffer from back pain to stand up. Described here is a standing assistant that gradually aids a person to stand. The device also serves as a walker.

SUMMARY OF IMPACT

The final project consists of a standard aluminum walker with a set of handlebars connected to an electric lift. Ergonomically located where the right-hand thumb is positioned, the control switch is pressed up to move the lift up, and vice-versa. For someone using the device, they would simply situate the walker in front of the chair, grab the handlebars, lean slightly forward and press the control to be raised to the standing position.

TECHNICAL DESCRIPTION

The walker's lifting mechanism is a dual mounted linear actuator, with a maximum load capacity of 250 pounds. This is mounted on the front legs of the walker and is fully adaptable to be taken off or installed on another walker. Connected to the top of

Fig. 8.95. Standing assistant/walker.

Fig. 8.96. Handles retracted.

Fig. 8.97. Handle bars and controls.

the actuator is a set of aluminum handlebars clamped by a bicycle head stem that actually lifts the individual. The control for the actuator lift is mounted on the right side handle. With the use of an "on, off, on" switch, the actuator can be extended or retracted. The only other addition is the rear leg stabilizers for extra support when a load is applied.

Since the motor requires a 12V- 2 A power source, a rechargeable battery pack supplied. For weight restrictions, there are 10 AA batteries connected in series within this power supply that allows the device to run for about an hour with a load.

The total cost of the project is $62, which does not include the cost of the walker, or linear actuator. Without donations this project costs approximately $300.

Fig. 8.98. User sitting preparing to use the assistant/walker to stand.

Fig. 8.99. User standing with help from the assistant/walker.

VERSATILE GRIP ASSISTOR

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INTRODUCTION

The Versatile Grip Assistor is a device for use by persons who lack grip strength or grip traction. The device is light weight and durable. It is designed to easily fit in a purse, pocket, or hand bag. The goal of the grip assistor is to allow those who lack grip strength or grip traction to open jars, doors, and hold onto objects with finer motor skills than before. It needs to be light weight, easy to use, multifunctional, and aesthetically pleasing.

SUMMARY OF IMPACT

The object provides aid to those who need to open bottles, jars, and/or doors on their own without outside assistance. The device is able to adjust to fit objects from close to 0 inch diameter up to objects of diameters of 3 ½ inches. This range covers most household jars and bottles and fits over most doorknobs. In this way a person with limited grip strength has more leverage and grip when opening jars or bottles.

TECHNICAL DESCRIPTION

The device is primarily made from polycarbonate clear material. This material is very strong and durable. Also, when broken, the plastic does not

Fig. 8.100. Versatile grip assistor.

shatter or break into many shards.

It is equally used by right and left handed people. The entire device weighs less than one pound so it can easily be placed in a pocket or purse without burdening the carrier.

There are two main components to the device which are separated but will not fall apart unaided. The lower jaw can be adjusted to fit around the object to be gripped and then squeezed so the teeth lock into place. From here the user has more leverage on the object to be opened/moved/turned.

The lower and upper jaws each contain a grip material attached to them. This material can be any plastic or rubber that has a high friction surface. Superglue is used to secure rubber strips onto the jaws. This gave the device additional grip to assure no slipping when attempting to open/turn objects.

The shape of the inner jaws has two parts. The inner part, which makes up most of the jaw, is concave inwards on both jaws. This allows 4 points of contact when gripping a circular object as opposed to two points of contact with a straight surface. On the tips of each jaw is a flat section. This section allows for more precise grip on smaller objects such as socks, nails, electrical plugs.

The total cost of the project was $49.

Fig. 8.101. Grip assistor being used to open a bottle.