

CHAPTER 13
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GOLF GENIE TO ENABLE A PERSON WITH DISABILITIES TO PLAY GOLF

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INTRODUCTION

The Golf Genie was designed to allow individuals with lower-body motor disabilities and normal upper body strength to participate in golf. The design incorporates two belt tensioner springs for power storage and delivery. It uses a formed PVC club to deliver the force to the golf ball, which currently travels an average maximum of 77 yards. A more powerful design is currently under construction.

SUMMARY OF IMPACT

The Golf Genie will enable people who are unable to walk to play golf. The mechanism weighs about 20 pounds and is easily removed or attached to the platform, which is attached to the wheelchair via wing nuts. The platform weighs approximately five pounds and is attached to the wheelchair with clamps. The Golf Genie requires no modification to the wheelchair itself.

To operate the device, the loft of the club head is adjusted for the desired height to distance ratio. Next, the club slides into the mount and the bolts are loosely tightened. Then club is angled at the target and the bolts are completely tightened. The chair is positioned so the club is behind the ball. Finally, the unit is cranked to the desired power (between five and 10 clicks). The crank is removed and slid over the release lever, then pulled and held. For putting situations the crank remains on the release lever, and the operator can swing the club manually.

Although the Golf Genie is pictured on a manual wheelchair, the platform design is easily adaptable to most types of powered wheelchairs. With a motorized wheelchair and the proper inflatable off-road tires, the Golf Genie will not cause any damage to the golf courses on which it is operated. In addition, the holes dug as a result of a normal chip shot are not created when using the Golf Genie. The



Figure 13.1. Golf Genie.

current 77 yard average maximum distance would require the golfer to play on smaller courses.

TECHNICAL DESCRIPTION

The mechanical components of the Golf Genie are simple in design. The power-input device is a ratchet with a 9/16" square socket connection. The club mount is a set of two clamps to hold the club in place and is welded to a frame. The frame is connected to a tube that bolts to the power shaft. The internal mechanism is set up like a winch. However, instead of winding a cable, it winds two springs. The springs and their housings were

originally diesel engine belt tensioners made by Deutz. These tensioners hold one end of the spring in the housing and the other end through the diameter of a centralized shaft. To adapt the springs to the mechanism, the two shafts were replaced with one long shaft that powers the mechanism. A gear fixed to the power shaft is held by a catch that stores the spring tension until the crank handle is used to release the mechanism. A 90-degree head is used to minimize club flex. The club was constructed from a straight length of PVC tube with a 90-degree elbow fixed at one end. The club head was made from a short piece of PVC tubing that was heated and flattened at one end. All steel plates used in assembly are 1/8" thick, and the power shaft was

machined from a 3/4" bar of cold rolled steel. The gear and catch were made from hardened steel and created by a heavy-duty winch. The platform legs were made from 3/4" galvanized steel tubing, and the club was made from 3/4" PVC or aluminum tubing with a 90-degree elbow connected to a flattened tube club head. The total cost of The Golf Genie was approximately \$250.00.

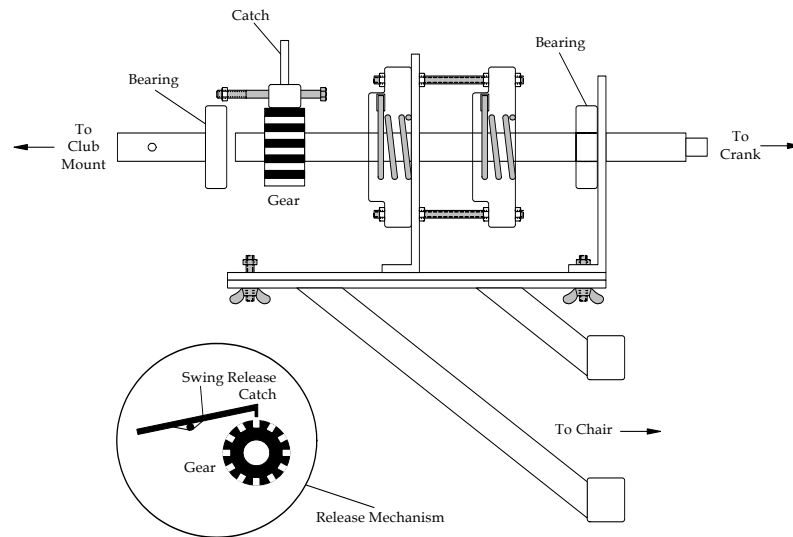


Figure 13.2. Schematic of the Power Input Device.

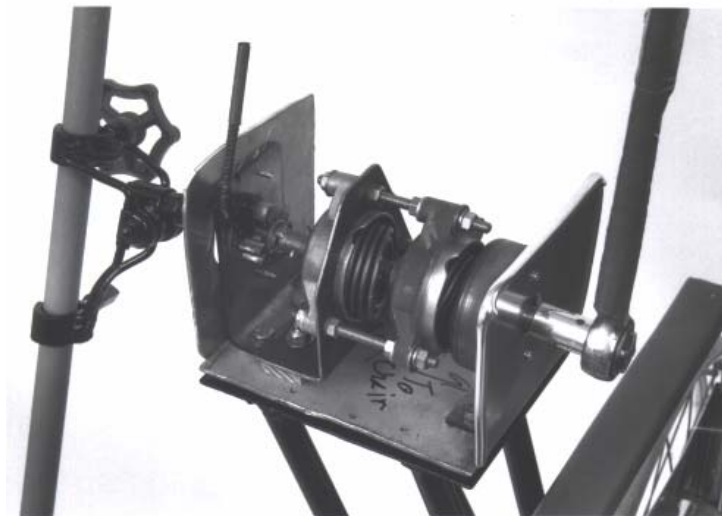


Figure 13.3. Power Input Device.

WHEELCHAIR CURB NEGOTIATOR

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INTRODUCTION

This project addresses the problem faced by some people who use wheelchairs when they encounter a curb. Wheelchairs are not equipped to travel over curbs, and many sidewalks do not have the appropriate modifications.

The curb negotiator would allow a person to travel up or down from the curb of a sidewalk without relying on pre-constructed ramps. The focus of this project is to allow a person who uses a wheelchair to be more self-sufficient. Several similar devices exist on the market. However, these devices are large, heavy, and expensive. In addition, these portable ramps require an additional person to help deploy them. People who use wheelchairs can operate the curb negotiator with no assistance.

SUMMARY OF IMPACT

The device consists of two aluminum ramps and a simple storage rack that attaches under the wheelchair. The ramps are positioned separately and are raised and lowered by an attached cord. The ramps are lightweight but require users to have suitable upper body strength to position and propel themselves. The ramps are compatible with motorized wheelchairs, provided that the user is assisted in the deployment of the device. After use, the ramps are easily retrieved by means of the attached chords and stored out of the way under the seat. The device is kept simple and unobtrusive so it does not interfere with the original functions of the wheelchair.

TECHNICAL DESCRIPTION

The two ramps are made of ¼-inch thick diamond plated aluminum. Each ramp has dimensions of 40 inches x 4 inches x 1 inch. The 1-inch height was produced by bending the ramp on each side to an angle of 90-degrees. The 1-inch bend running the length of the ramp helps prevent the ramps from flexing, and it also keeps the wheels of the

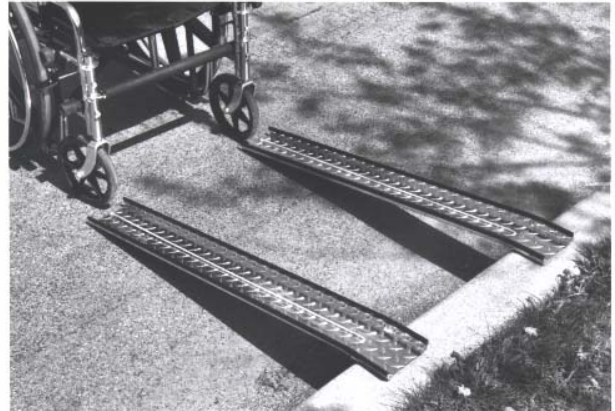


Figure 13.4. Deployed Ramps.

wheelchair from rolling off the ramp during use. A 10-degree bend was built into the ramp. The bend is 4 inches in length. This bend was produced by cutting the 1-inch sides, bending them by hand, and welding the gap produced by the bend.

Each one of the ramps is equipped with a rope that runs the length of the ramp and attaches to the bottom of the ramp with a small hook. These ropes enable users to lower the ramps and then attach the hooks to the wheelchair, thus allowing free hand movement as they go up the ramp. After they are up the ramp, they are then able to retrieve the ramp. After the ramp is retrieved, the rope is connected to the bottom of the ramp.

The storage system consists of one-inch diameter PVC piping. One piece of the piping is fixed across the front of the wheelchair. A small piece of bungee cord is placed over the ramp to pin it down on the piping. In the back, the PVC piping is set up in an upside down U shape. The piping on the back of the wheelchair is used to support the ramp. Both pieces of PVC piping are attached with wing nuts. This allows the wheelchair to collapse after use.

The total cost of the project without the cost of the wheelchair was about \$70, and \$220 when the cost of the wheelchair was included.



Figure 13.5. Stored Ramps (Front View).



Figure 13.6. Stored Ramps (Rear View).

HAND CADDY FOR THOSE WITH CARPAL TUNNEL, ARTHRITIS, AND OTHER DISABILITIES OF THE HAND

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INTRODUCTION

Many people do not have complete functionality of their hands and fingers. Whether they lose this ability over time or have a sudden accident, disabilities of the hand can drastically change the way people live their lives. The Hand Caddy can be used to improve everyday living by allowing users to hold items of light to moderate weight. Some examples of these items would be handbags, purses, and grocery bags. An important aspect in creating The Hand Caddy was to keep it concealed so that users would not feel awkward while wearing it.

SUMMARY OF IMPACT

This device enhances independence. People who are recovering from an accident resulting in a temporary disability can also use this device.

TECHNICAL DESCRIPTION

An important design criterion was being able to shift the weight of an object from a person's weaker fingers to their stronger forearm. To accomplish this, a holding device was first constructed. This is a solid Plexiglas hook that can hold a range of handle sizes. A flexible joint that improves the maneuverability of the hook while allowing free movement of the wrist and hand was also included. Inside the joint are thin woven steel cables that are used to transfer the weight from the hook into the forearm cuff. The forearm cuff contains a lightweight aluminum bar, which distributes the weight evenly throughout the cuff. This results in the weight being distributed throughout the forearm.

To keep the device concealed, a clear finger-contoured form-fitting holding hook was used where the fitted flexible joint presses tightly across the palm region of the hand. Finally, a cuff similar



Figure 13.7. Hand Caddy.

to an orthopedic wrist brace was used as the forearm mass-distributing device.

The maximum carrying weight is approximately 10 lbs. This limit is sufficient for school bags, pocket books, and groceries. Hand Caddies capable of

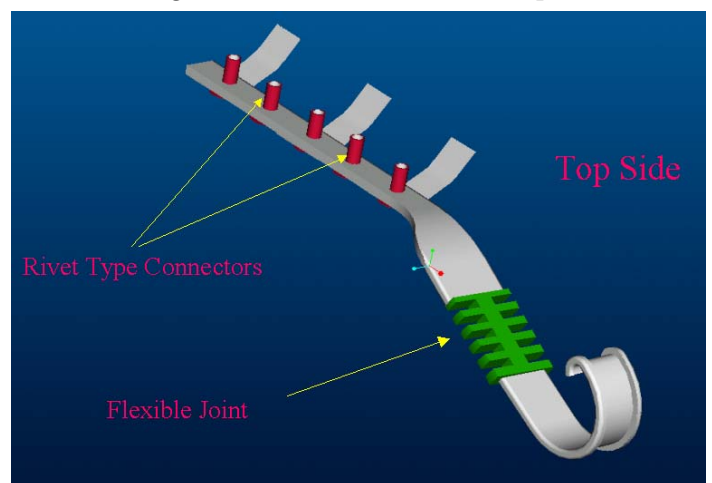


Figure 13.8. Computer Generated Regeneration of Linkage of Aluminum Bar to Cuff.

withstanding higher weight could be built using stronger materials.

The total cost of the Hand Caddy was \$40.



Figure 13.9. Wearing the Hand Caddy.

FOOT MOUSE: FOOT-OPERATED COMPUTER INPUT DEVICE

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INTRODUCTION

The mouse and the keyboard are the most frequently used of all computer components. However, grasping a mouse and moving it can be difficult for people with certain disabilities. A foot mouse was created to help people who have problems moving their hands. People without disabilities might choose to utilize this device as well.

SUMMARY OF IMPACT

This device consists of three parts: the mouse unit, the buttons, and the mouse pad. The buttons and the mouse pad are combined together so people with disabilities can use them more effectively. A thin wire connects the mouse and the button unit.

TECHNICAL DESCRIPTION

This project was divided into two parts: the mouse and the box (buttons and mouse pad) unit. The box unit was designed first. The angles for the two buttons were 20 degrees. The final dimensions of the box unit were 0.75m x 0.40m x 0.205m. The hinges were attached to the buttons on the box unit for maintenance purposes. Handles were also attached to the box unit to allow easy opening. Attaching hinges was the most effective way of mounting the button pads. Hinges were attached between the box unit and the button pads from the inside of the device. After mounting the two button pads (right and left), the mouse was constructed. The mouse had to be disassembled in order to

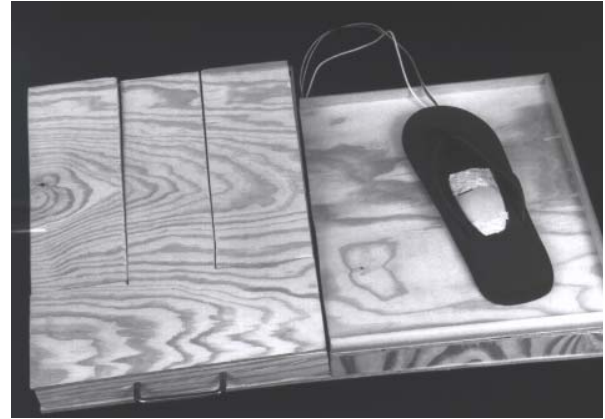


Figure 13.10. Finished Unit.

analyze its contents. The mouse mechanism was simple, and it was determined that the wires could be attached beneath the circuit panel without removing the existing buttons inside the mouse. First the wires were attached to the circuit panel with a soldering iron, and then they were connected to the buttons. The final part of the construction of the box unit was installing the buttons inside the box. The positions of the buttons were set, and the buttons were then mounted inside of the box unit. The last part of the project was embedding a mouse inside a sandal. Silicon was placed on top of the mouse to fill gaps between the sandal and the mouse. Finally, the device was coated with polyurethane spray for protection.

The total cost of the project was \$ 145.

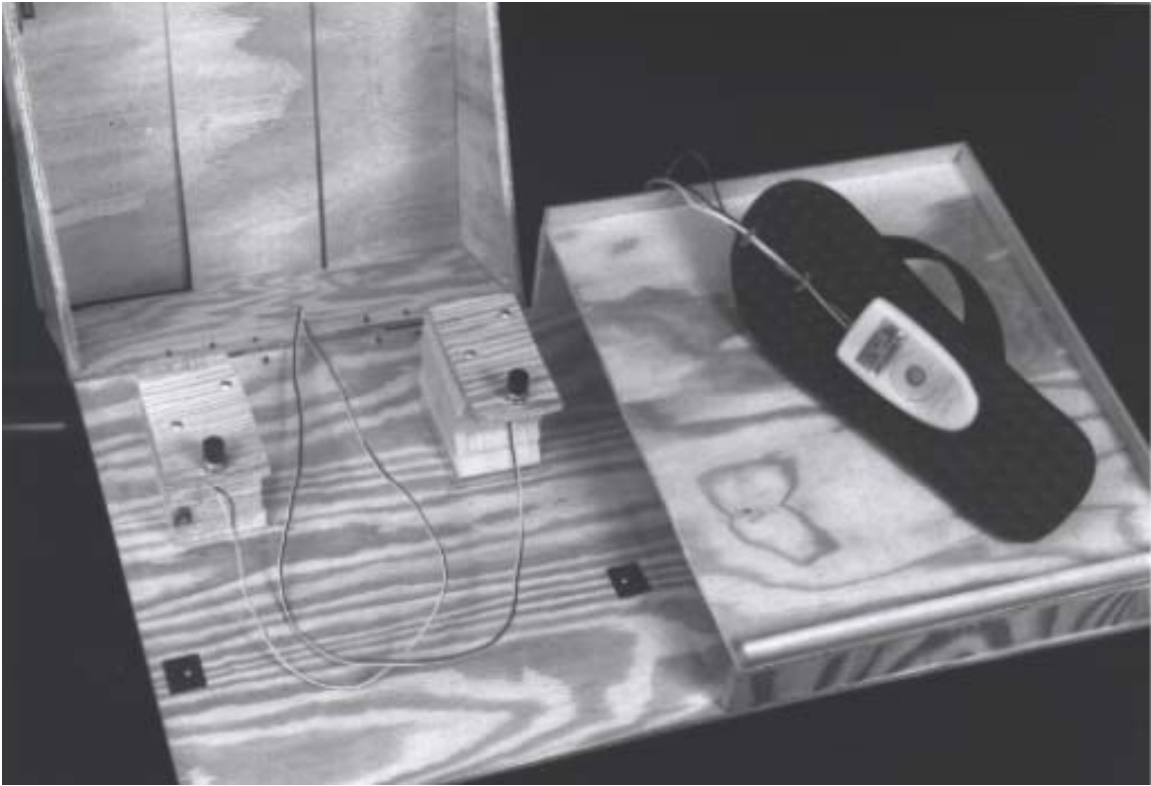


Figure 13.11. Inside View of the Box Unit.

JAR OPENER

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INTRODUCTION

This device facilitates the removal of jar lids by keeping the lid stationary while the user turns the jar. It mounts under a cupboard and slides forward for use and backward for storage. The device relies upon mechanical advantage rather than electrical power, and may accommodate jars with lids up to 5.25" in diameter. It was developed to assist people with limited grip strength or limited range of motion due to arthritis, tendonitis, or any other physical disabilities.

SUMMARY OF IMPACT

Many daily tasks become difficult for people with arthritis and other disabilities that restrict range of motion and strength in the wrists and hands. This device eliminates the need to grasp onto a lid when opening a jar. Both hands may be used instead of one to turn the jar, and this provides a much larger area for the user to grasp.

TECHNICAL DESCRIPTION

A drawer slide allows the user to mount the device underneath a cupboard or cabinet. The device, which consists of a slender brass base and two aluminum grips, is mounted to the drawer slide. Each aluminum grip is assembled from two separate pieces of aluminum plate. The pieces are stacked at a 90-degree angle and fastened with machine screws. The brass base features a stepped-slot,



Figure 13.12. Close-up of Jar Opener.

which is milled longitudinally. One of the grips is mounted at one end of the base. The other grip slides along the milled slot and may be locked into place anywhere by a standard bicycle quick-release seat post binder. The grips are designed to pass over one another, thus accommodating for very small lids. Rubber strips bonded to the gripping surfaces provide friction to help open the jar. When the moveable grip is closed around a lid and locked into place, the user may turn the jar while the lid remains stationary, thus opening the jar.

The total cost of this project was \$42.



Figure 13.13. Jar Opener with Fully Extended Lever Arm.

MODIFICATION OF AUTOMOTIVE ROOFTOP CARRIER: TO FACILITATE RIGID WHEELCHAIR USE

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INTRODUCTION

Assistive devices allow people who use wheelchairs to drive automobiles. While driving they need a place to store their wheelchairs. The Chair Topper™. (by the Braun Corporation) lifts a folding wheelchair and stores it on the roof of a car. However, many people who use wheelchairs prefer to use a rigid wheelchair due to the extra comfort and support this type of chair provides. Unfortunately, the Chair Topper™ doesn't accommodate rigid wheelchairs. Therefore, it requires users to travel with a foldable wheelchair. The new device is a replica of the Chair Topper™ with modifications to accommodate a rigid wheelchair.

SUMMARY OF IMPACT

This device will give people who use wheelchairs a choice to use a rigid or foldable wheelchair when they drive. With this device they can choose the wheelchair they want without the hassle of storage while driving. Accessories are provided for both foldable and rigid wheelchair storage.

TECHNICAL DESCRIPTION

Some major changes were implemented to allow a non-foldable wheelchair to fit into the compartment overhead. The fiberglass cover was raised 1 foot off the base to allow the extra room needed. Aluminum was used in the prototype because it was highly available. It would be more efficient and sturdy if a new fiberglass mold were made, and one solid piece were assembled.

Next, the portion of the frame used to tilt the foldable wheelchair parallel to the car had to be transformed into a rigid upright fixture. The bolts holding the frame were removed, and the electrical wires used to control the motor were extended. The bottom of the folding frame was welded to the



Figure 13.14. Closed Mechanism Next to Rigid Wheelchair.

bottom of the rigid frame using steel "L" brackets. 12-inch steel bars were welded at a 45-degree angle on either side to give more support to the top-heavy structure. The motor and chain assembly that lifts the chair are located at the top of the frame. The chain is stored in triangular steel boxes. These chain boxes interfere with the wheel of the rigid chair when lifted, because the chair is wider when unfolded. To eliminate this problem, the entire chain-motor assembly was disconnected and moved back until the chain box was flush with the front of the frame. The assembly was re-welded with additional supports. The area where the chains descended had to be modified next. Previously, the chains dropped straight down from the chain box over a set of sprockets that were attached to the motor. Since the motor was moved back and the center of a folded chair extends further than an unfolded one, the chain drop point was extended 13 inches horizontally. Aluminum plates bolted on to the outside of the old assembly were used. In addition, holes were drilled at the drop point where the bearings were installed. A steel rod was passed

through these bearings, and a new set of sprockets was attached to the bar. The switch that transfers power between the chain motor and the closing motor had to be relocated. A piece of plastic tubing was placed on the end of the switch to extend the length of it by 2 inches.

The hook that lifted the folded chair was no longer able to lift the rigid chair. Small pieces of steel were welded to the hook, and eyeholes were drilled into

the steel pieces. Wires were slipped through the holes, and a plastic coated steel hook was attached to each end. This created four hooks in the four corners of the chair. This was ideal for a balanced lift.

The total cost of this project was \$650.



Figure 13.15. Mechanism closing with wheelchair inside.



Figure 13.16. Interior view of device showing modifications

MECHANISM TO LOWER A CUPBOARD TO AN ACCESSIBLE HEIGHT

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INTRODUCTION

The objective of this project was to design and create a cupboard that is easily accessible to people with disabilities. This ease in accessibility is possible because the cabinet is lowered and extended outward over the existing countertop. This device was designed for people using wheelchairs or walkers and people with limited arm movement.

This cupboard was designed to appear as a regular household cupboard. The device is driven by a hydraulic system that enables the cupboard to operate smoothly. This mechanism is powered by a 12-volt battery but may be converted to operate from household electricity as well.

SUMMARY OF IMPACT

This mechanism allows people with disabilities more independence, because it eliminates the need for assistance from another person to obtain materials directly out of reach. This mechanism also allows people with disabilities to utilize more kitchen space. Another benefit is that the cupboard is brought down to eye level, thus allowing a closer inspection of the items contained in the cabinet.

TECHNICAL DESCRIPTION

The hydraulic system used to actuate the cupboard-frame assembly is composed of three main components. These three components are a pump, a solenoid, and a dump assembly. The other smaller components include a 12-volt battery, a cylinder, a three-way switch, wiring, and hoses.

The pump used in the system was originally intended for snowplowing. This type of pump was used to because its principal use was similar in application. The hydraulic pump drives a head of fluid from the reserve tank to the cylinder. A check valve was used at the pump output to prevent the fluid from flowing back into the pump head. The head gearing determines the velocity of the fluid

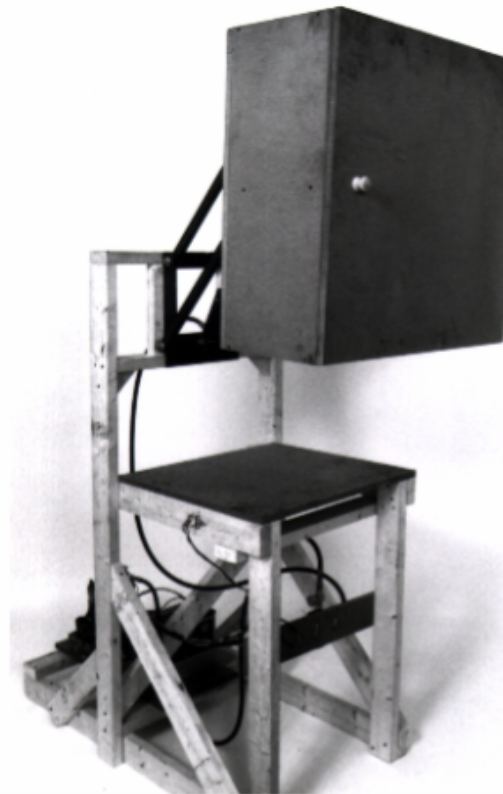


Figure 13.17. Movable Cupboard.

flow. The pump used in this system was geared to move the fluid at a slow speed, which worked well for this application.

The 12-volt solenoid used in the system is a switch to activate the pump motor. The solenoid has three positions. The first is the neutral position, which occurs when no current is passed through the solenoid. The other two positions occur when a current is passed through the solenoid. The direction of the current determines which position is activated, either the pump or dump assembly. The solenoid uses a magnetic field to close the circuit, which in turn activates one of the assemblies. A

second switch is used to send a current through a coil to create the field.

The fluid only flows from the pump to the cylinder because a check valve was used. Another method must be used to allow the fluid to flow back into the reserve tank. A dump assembly was used for this purpose. The dump assembly has three ports and a solenoid actuator. The normal position of the dump assembly, without current, leaves ports one and three open and port two closed. This allows the output from the pump to be connected to port one, and the hydraulic cylinder to be connected to port three. The second position of the dump assembly connects to a port in the reserve tank to allow the fluid in the cylinder to flow back into the tank.

The normal position (the switch in center position) occurs when the system is inactive. When the switch is moved to the upward position, it activates the solenoid and allows current to flow to the pump. This elevates the cupboard. Then the switch returns to the normal position upon release. When the



Figure 13.18. Mechanical Linkage.

switch is moved to the downward position, the dump assembly is activated. This allows the fluid to flow from the cylinder back to the reservoir tank, thus lowering the cupboard. The switch returns to the original position upon release.

The total cost for this project was \$530.

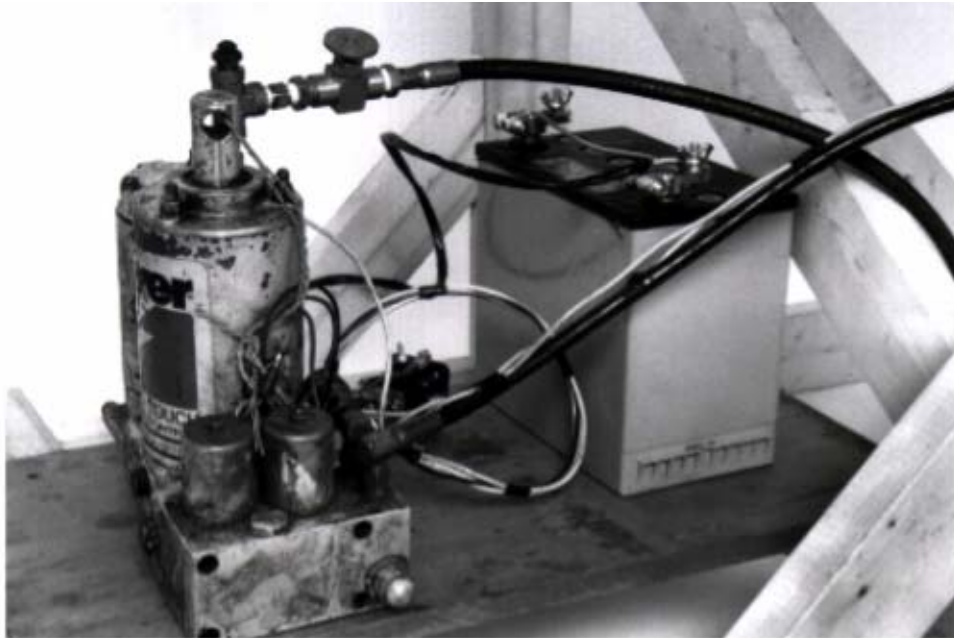


Figure 13.19. Hydraulic Assembly.

HEIGHT ADJUSTABLE CHARCOAL GRILL

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INTRODUCTION

Individuals who use wheelchairs sometimes have difficulty with outdoor grills due to grill height. An extension was developed to raise and lower an outside cooking grill.

SUMMARY OF IMPACT

This grill is not limited for use only by individuals with disabilities. It may be used anytime safety is a concern.

TECHNICAL DESCRIPTION

This device utilizes an AC motor in conjunction with a rotating machine screw. A collet is threaded onto the machine screw and attached to the grill. The motor delivers torque to the machine screw and causes rotational motion. The non-rotating collet is forced to move along the axial direction. The non-rotating collet is attached to the machine screw at one side, and it is also fixed to a static assembly, which includes the grill. The static assembly moves on adjacent posts, creating a dynamic support system. The support system has two purposes. The first purpose is to prevent the grill from spinning, and the second is to create a very rigid structure. As the machine screw is rotated, the collet moves up and down the screw and thereby raises and lowers the grill. The grill is equipped with a larger than normal handle and a locking mechanism for the lid for when the grill is in the open position. Finally, an



Figure 13.20 Completed Grill.

enlarged temperature gauge is placed in the middle of the lid, making it easier to read the numbers.

The overall cost of materials and supplies for the project was approximately \$150.



Figure 13.21. Non-Rotating Collet.



Figure 13.22. Dynamic Support System.

WHEELCHAIR SEAT HEIGHT AND RECLINE ANGLE ADJUSTMENT

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INTRODUCTION

It can be difficult for people who use wheelchairs to exit their chairs without help. This project was designed for an individual who uses a wheelchair and is capable of pumping a hand pump. The pump extends a hydraulic cylinder, which raises and tilts the seat of the chair forward. The user is then in a comfortable and safe position to exit the chair.

SUMMARY OF IMPACT

This wheelchair modification project concentrated on aiding individuals in exiting a wheelchair from a seated position. This was done by raising and tilting the seat forward so the user can safely and effectively exit the chair without putting excessive strain on his or her legs and back.

TECHNICAL DESCRIPTION

When the hand pump is engaged, hydraulic fluid is supplied to the cylinder. This enables the piston to provide an upward force to the bottom of the wheelchair seat. The upward motion of the seat is restricted by a set of 6-bar linkages mounted on each side of the seat.

The utilization of linkages makes this project unique compared to similar designs in the past. Previous designs have a hinge on the front of the chair that acts to tilt the chair only forward. A hinged connection was chosen because of collapsibility constraints; previous designs could not develop a linkage that would fully collapse. Collapsibility is necessary because the seat rests upon the surface of the linkages. If the linkages did not collapse, the seat would rest in an undesirable tilted position.



Figure 13.23. Chair in Collapsed Position with Near Armrest Removed.

The top and bottom links to the linkage were constructed of 1½-inch aluminum C-channel. After the C-channel was machined, the interior two bars were able to fit in between the top and bottom links, thus enabling a completely collapsible linkage. Figure 13.24 illustrates the extreme positions of the linkage.

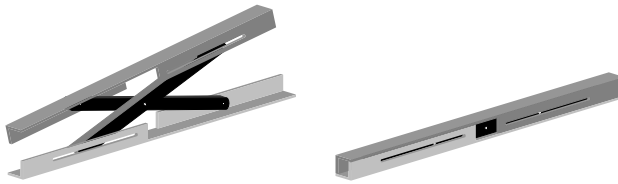


Figure 13.24. Extended Position of Linkage and Collapsed Position of Linkage.

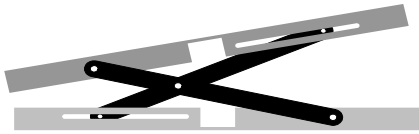


Figure 13.25. Side View of Extended Link.

Another benefit of using these linkages is the control they allow over the range of motion of the seat. These linkages tilt the seat to an angle of approximately 45 degrees and also displace the front of the seat 4 inches upward. The back of the seat is raised 9 inches. This produces a more comfortable and safer position to exit the chair (See Figure 13.25).

Each set of linkages consists of two slotted pieces of C-channel, two solid links, five pins, and two sliders. The linkages were constructed of aluminum for a lightweight design. The interior links were constructed of $\frac{1}{2}$ -inch aluminum to prevent bending. They were mounted on each side of the chair, and the seat was mounted on top of the linkages.

The hand pump was mounted on the left-hand side of the chair and requires a downward force of 20 pounds at maximum position. It requires nine pumps to lift the seat to its maximum tilted position,



Figure 13.26. Chair in Extended Position with Near Armrest Removed.

although the chair may be exited before the linkage is fully extended. It was important while filling the cylinder and hoses with hydraulic oil to prevent air from entering the system. If this occurred, the air would be compressed before the fluid could displace the piston. This would cause the user to waste extra pumping strokes.

The hydraulic cylinder has a maximum stroke of 9 inches. A $1\frac{1}{2}$ -inch cylinder was designed to lift a load of 300 pounds. The inner diameter of the cylinder is 1 inch; therefore the maximum pressure developed by the cylinder is approximately 240 psi. The cylinder was pinned to the bottom of the seat by a clevis and to the bottom of the chair by a U-bolt. This allows the cylinder to have flexible movement while the seat is raised.

The total cost of parts was approximately \$498.

WHEELCHAIR TURNTABLE DEVICE TO FACILITATE POSITIONING OF A WHEELCHAIR IN A VAN

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INTRODUCTION

Many wheelchair accessible vans are small, and positioning a wheelchair in these vehicles can be difficult. In addition, rotating the wheelchair within the confines of a vehicle is troublesome. Reducing the difficulty of this task would increase mobility for people who use wheelchairs. The device is designed as a retrofit to an existing mini-van. With some modifications, the design may be incorporated into the new construction of a van as it is being converted for wheelchair use.

SUMMARY OF IMPACT

This unit encourages the use of transportation for individuals with disabilities by creating more accessibility for them and making it easier for an assistant to position a wheelchair in a vehicle.

TECHNICAL DESCRIPTION

An electric chain-drive mechanism is used to power the unit. The smooth operation of the unit can be attributed to the single row ball bearing support and 1/4" thick aluminum plate construction. The low profile design of the unit makes egress effortless. Countersunk fasteners, rotation limit switches,

hand-free operation, and a non-skid surface are safety considerations incorporated into the design. The unit has dimensions of 33" x 33" x 1.75". A voltage requirement of 12 volts and a current draw of 5 amps are required for the motor. The rotating platter of the unit is supported by eight single row ball bearings, with one additional bearing in the center of the platter to provide alignment. The electric motor utilizes a worm gear-drive that rotates the platter. This combination assures positive stops at any position. The worm gear-drive motor operates a chain that has attachment points on the underside of the platter. These attachment points serve as a trigger for the limit switches. Therefore a 90-degree rotation of the platter position is accomplished. The unit is attached to the floor of the vehicle with bolts. This method of attachment provides a secure mount without sacrificing structural integrity. The foot-operated switch can be positioned for easy access near the ramp position. A 12-gauge stranded wire from the battery to the vehicle ground is required. Both the cost of the components and the ease of installation were considered in the design process. The end result is a functional and relatively inexpensive device.



Figure 13.27. Wheelchair Turntable.

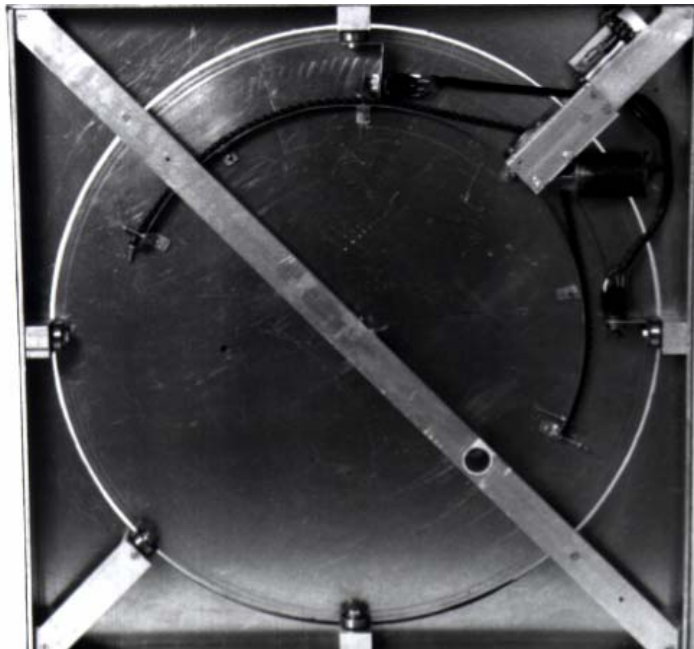


Figure 13.28. Close-Up of the Drive Mechanism.

A TIME TELLING DEVICE FOR INDIVIDUALS WITH VISUAL IMPAIRMENT

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INTRODUCTION

The objective of this project was to design and build a device that people with visual impairments could use to tell time. This type of device already exists, but these devices announce the time out loud. The purpose of this project was to design something that people with visual impairments could use discreetly.

The design integrates a computer board, a timepiece, and sixteen solenoids to form a Braille pattern from which the user can read the time. The timepiece is battery powered. The user can activate it whenever he or she wishes to know the time by flipping the on/off switch.

SUMMARY OF IMPACT

The timepiece will have an impact on the quality of life for people with visual impairments in that the user may privately, discreetly and independently know the time.

TECHNICAL DESCRIPTION

The project is divided into two parts. The first is the electronic design of the computer board, and the second is the final assembly of the parts. The microprocessor (an EVBU board) controls the timepiece. A Dallas Semi-Conductor time-keeping unit was attached to the microprocessor. This unit maintains real time within the timepiece. Computer code (written in machine language) was used to transfer the time from the time unit to the microprocessor. 16 electric circuits (consisting of resistors, transistors and electric latches) were made on a daughter board and plugged into the EVBU board. This extra circuitry was necessary to accommodate the plug-ins for 16 solenoids (7/16" in diameter), because the EVBU board was only equipped with three plug-ins. The 16 solenoids were attached to the EVBU board through the use of the plug-ins. Eight 1.5-volt batteries power the



Figure 13.29. Outside View of Timepiece.

computer board, because the solenoids are 12-volt intermittent duty solenoids.

The solenoids were connected to pins that protrude through a plastic face located on the top of the timepiece. These pins form a Braille grid for four numbers. When the user activates the switch, the computer board reads the time and relays the message to the appropriate solenoids. The solenoids then form the pattern of time in Braille for the user to feel by pulling their respective pins down. The time is given for 5 seconds, after which the solenoids return to their default position (all raised). The solenoids used are pull-type solenoids. Rubber bands were attached to the solenoids to allow the pins to return to their normal position at the end of the 5 seconds. Time is read off in military style. The outside dimensions of the timepiece are 9.5" x 8.5" x 8.5". It was constructed from poplar wood.

The total cost of the project was approximately \$605.

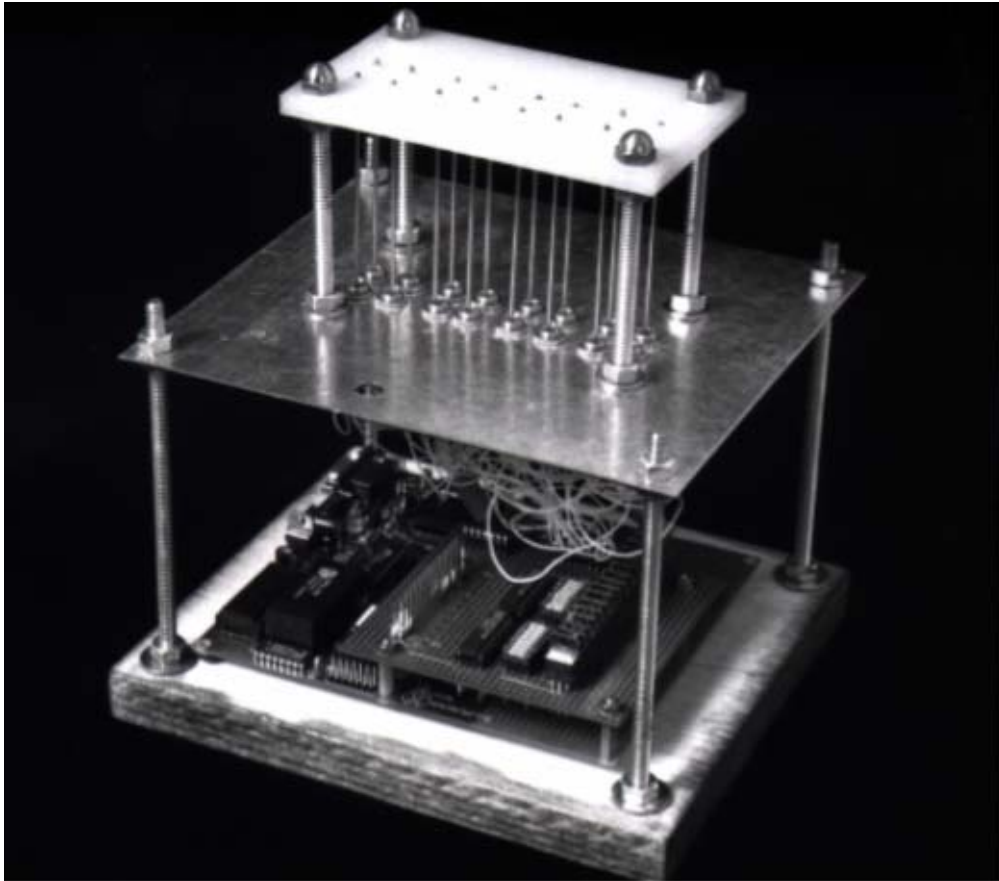


Figure 13.30. Inside Circuitry of Timepiece.

STAIR CLIMBING WALKER

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INTRODUCTION

The common walker is lightweight, foldable, and offers stable support to the user. However, in order to climb stairs, the user must lift the walker up each stair before climbing. The stairs must also be modified to allow the entire base of the walker to be supported. This device eliminates the need for lifting of the walker and modification of the stairs.

The design utilizes a motorized, chain-driven mechanism and a rechargeable battery that allows the user to proceed up a flight of stairs at his or her own pace. When activated, the motor rotates a linkage that conforms to the stair and lifts the walker. The only required effort of the user is to push the walker forward on the stair in order to maintain an upright position.

Safety and reliability were the primary aspects considered in the design of the stair-climbing walker. Other considerations were weight, cost, and the operation time period.

SUMMARY OF IMPACT

With the assistance of the stair climbing walker, the mobility and independence of the user is increased. The design eliminates the need for specialized staircases and the help of a caretaker for household mobility.

TECHNICAL DESCRIPTION

The linkage chosen to lift the walker is a three-piece 1-inch square aluminum bar formed to mold to the stair. In order for the linkage to move in the desired square path, a chain drive mounted on Plexiglas was used. The drive system uses 40-roller chain with 1/2-inch pitch-type S-2 connecting pins and 1.61-inch diameter sprockets.

The motor utilized to drive the mechanism is a 50 in-lb, 90-degree, 12-volt DC gear motor. To minimize the loss of interior walker space, the motor is



Figure 13.31. Finished Unit.

mounted in between the upper-front sprockets, and it is connected to the sprockets via a 1/2-inch aluminum shaft. The power supply used is a rechargeable 12-volt gel cell battery. The final weight of the stair-climbing walker is 30 lbs. The user activates the lifting mechanism by depressing and holding a micro-switch located on the handgrip. If extra support is required during operation, the user may stop the mechanism when it has reached 3/4 of its revolution to offer maximum support. The total cost of the project was \$520.

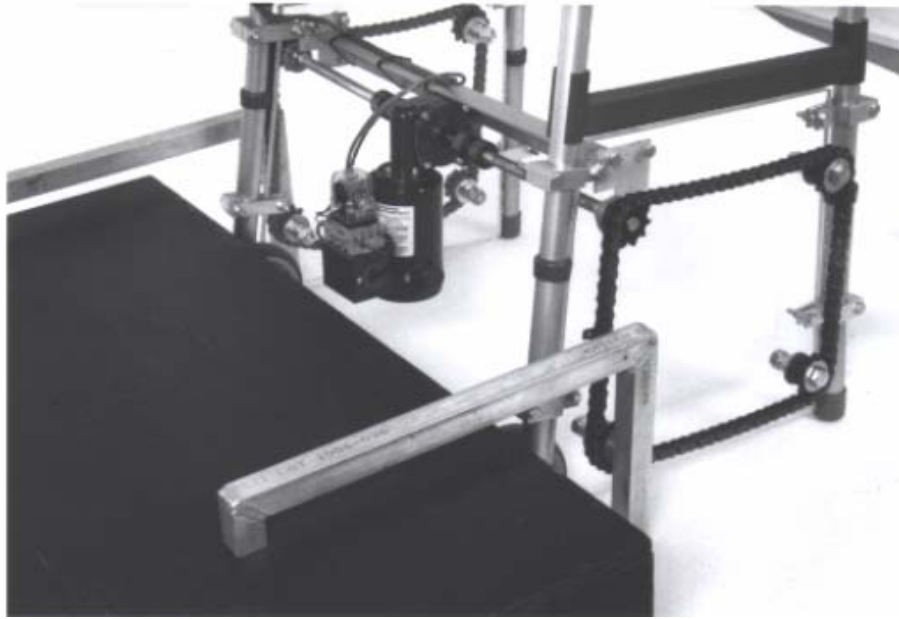


Figure 13.32. Drive Mechanism.



Figure 13.33. Walker On Stair.

WHEELCHAIR PROPULSION DEVICE

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INTRODUCTION

The objective of this project was to design an accessory for wheelchairs that allows the user with a minor back injury to remain sitting upright while propelling himself forward.

SUMMARY OF IMPACT

This device offers an inexpensive alternative to motorized wheelchairs in the marketplace. It is simple to use and easy to maintain.

TECHNICAL DESCRIPTION

A project goal was to create a design that could easily be adapted to fit any wheelchair. Therefore, the new propulsion system was mounted directly to the wheel utilizing the holes previously used for the handrails. An aluminum plate was made with a bolthole pattern identical to that of the wheelchair. This plate is the only part of the accessory that attaches to the wheelchair. All other parts mount directly to this plate.

The next step in the design was to find a way to transmit the torque applied by the handles to the shaft mounted on the aluminum plate. To accomplish this, an overrunning clutch-bearing assembly was utilized. This allows the torque to be transmitted in one direction while moving freely in the other. In the selection of this clutch-bearing assembly, cost and torque were considered. For this design, a Torrington clutch-bearing assembly was chosen because of its high torque capabilities (840 lbs/in) and its relatively low cost.

The next step was to design the shaft. The clutch-bearing assembly requires that its mating surface have a hardness of 53 Rockwell C. To meet this requirement, a cold-rolled 4140-alloy steel was selected. The clutch-bearing assembly was pressed



Figure 13.34. Finished Unit Mounted On A Wheelchair.

into a coupling made of 1040 annealed carbon steel. The handles were then welded to this coupling.

In order to allow the user to stop, a brake system was created. A disc made of aluminum was used as a rotor. The calipers used were bicycle brakes. The brake controls were mounted at the top of the handles.

The authors express appreciation to Kenneth Peebles and Roger Krupski for assistance in manufacturing of the shaft and coupling.

The total cost of the project was \$365.



Figure 13.35. Close-Up of Handle Assembly.

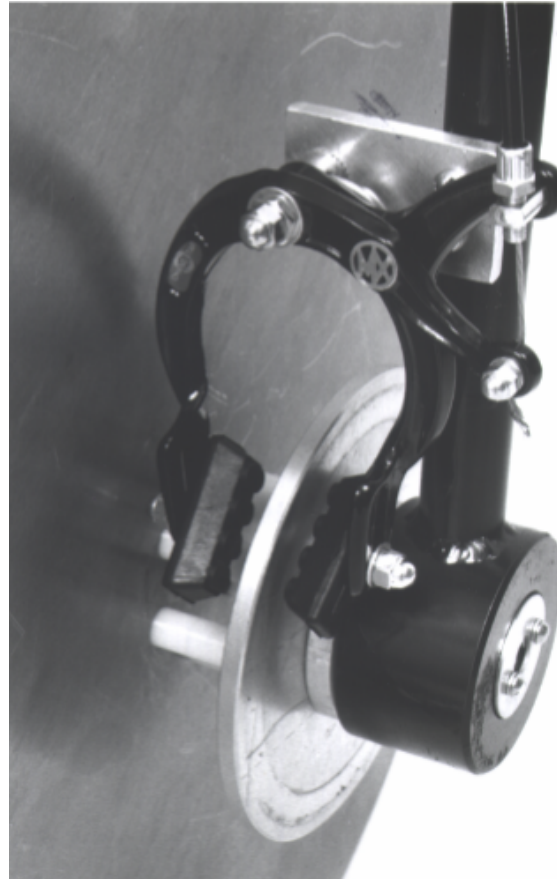


Figure 13.36. Close-Up of Brake System.

MOVABLE SEAT CHAIR TO FACILITATE SITTING AND STANDING

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INTRODUCTION

A movable seat system was designed to facilitate sitting down and standing from a chair. The device was to be simple to operate. A seat was designed that attaches to hinges, and these hinges pivot by means of a piston placed on the end of the seat. An electrical switch that triggers the lifting mechanism operates the seat.

SUMMARY OF IMPACT

This device will make standing up and sitting down a more pain-free experience. It will also give the user greater independence, because he or she will no longer need assistance to sit down or stand up from the chair.

TECHNICAL DESCRIPTION

The basic design uses a linear actuator with a trailer ball in its shaft hole. The ball moves along a wooden, smooth, curved slider that is fitted to the dimensions of the trailer ball. The close-up view of the trailer ball sliding in the slider is shown in Figure 13.39.

The linear actuator is a shaft that moves up electrically and is operated by a control switch. The actuator operates on a screw mechanism with a motor attached to it, as opposed to a hydraulic piston cylinder assembly. The control switch is a joystick positioned on one side of the chair accessible to the user. When the joystick is shifted upward, the actuator screw pushes the shaft upward. This causes the trailer ball to slide up along the slider and move the seat upward. The seat is supported on one end by hinges attached to the



Figure 13.37. Front View of the Device in the Relaxed Position.

vertical columns, and the other end is free. The process is reversed when the joystick is shifted down.

The device works on a tractor battery that would eventually run out of power after continuous usage. Possible options for a power source may be a 12-volt DC source, similar to the power source used in a computer. Another option is to include a battery charger in the unit, which could be plugged in to recharge the tractor battery.

The authors thank Mr. Peebles, the machine shop technician, and American Wheelchairs, who provided the actuator at a subsidized cost.

The total cost of this project was \$650.

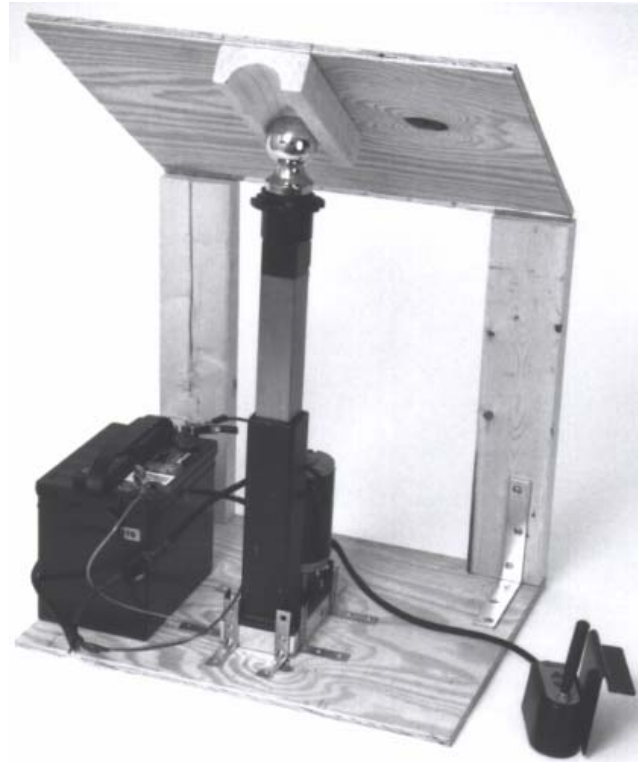


Figure 13.38. Back View of Device with Seat at Maximum Height.

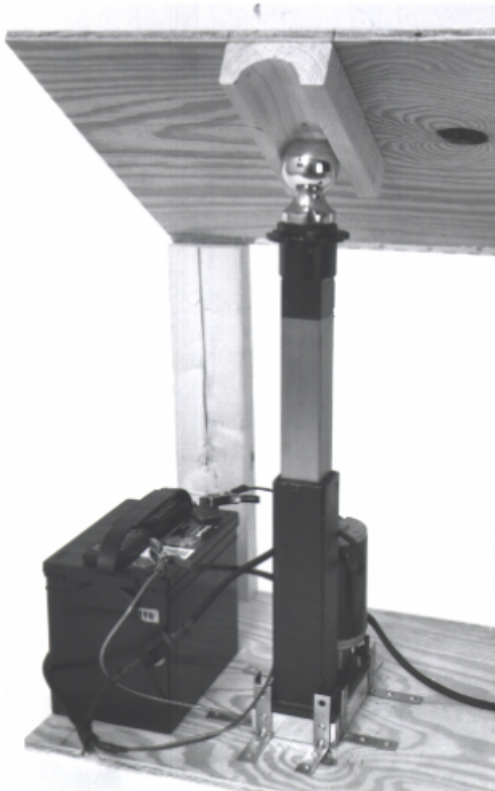


Figure 13.39. Close-Up View of Slider.

WEATHER-SHIELD DEVICE FOR WHEELCHAIRS

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INTRODUCTION

The objective of this project was to design a device to be used as an accessory on wheelchairs. The device is a canopy that shields people who use wheelchairs from adverse weather conditions. Existing wheelchair canopies were designed to protect only from the sun. This device will also protect the user from rain and snow.

Safety, reliability, cost, size, and weight were the main concerns considered in the design process. Once mounted, the Weather-Shield does not affect the comfort of the person using the wheelchair. It also does not interfere with the maneuverability of the wheelchair. It is retractable, which allows the canopy to be assembled and disassembled with ease.

SUMMARY OF IMPACT

The Weather-Shield combines comfort and efficiency into one. Its design offers more autonomy to people who use wheelchairs. It is safe, easy to assemble, and fits any wheelchair.

TECHNICAL DESCRIPTION

The Weather-Shield is a waterproof canopy with a supporting structure made of PVC pipe. It has a truss-like arrangement that can be easily assembled and mounted onto the wheelchair. The PVC makes the structure very light. The upper portion of the canopy extends outwardly in a curved position. The size of the canopy is 46" x 30". It covers a surface area of 840 sq. in.

The total cost of the weather-shield was \$90.10.



Figure 13.40. Assembled Weather-Shield.



Figure 13.41. Disassembled Weather-Shield.

