CHAPTER 11
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"ASSIST TO EXIT," TILT-LIFTAUTOMOTIVE SEAT

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Faculty Designers: Gary Olson (Machine Shop)
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INTRODUCTION

Kugelberg-welander disease is a genetic disease that originates from the inheritance of a rare recessive gene. The pairing of two of these particular recessive genes from each parent leaves the child with a progressive lifetime upper girth muscle atrophy of the arms and legs. The muscles affected are the quadriceps, hamstrings, biceps, and triceps. Without the functional use of the formerly mentioned muscles, a person has extreme difficulty rising and lowering from a seated position. The objective of the "Assist to exit," tilt-lift automotive seat, shown in Fig. 11.2, is to provide our client with an ease of raising or lowering himself safely into or out of a car from a seated to a standing position, or vice versa.

SUMMARY OF IMPACT

This device can aid in increasing the capabilities of clientele in their daily activities and lives, while providing them with safe independence, with an aesthetically pleasing and unimposing assistance. The device offers stability and may also offer rehabilitation qualities as well. The "Assist to exit," tilt-lift automotive seat meets limitations with convenience.

TECHNICAL DESCRIPTION

This device is designed with care and a researched understanding of all existent requirements of the client with considerations pertaining to relevant engineering specifications of an automobile. The tilt-lift itself is an Acme power screw, chain, and sprocket driven scissor lift that is designed with one side hinged in order to facilitate tilt. The drive train system's mechanisms are run by an electric 12 V DC custom 5-1 geared motor to the mechanical lift. Total travel speed of the system as an output is approximately 12-16 seconds, differing slightly due to differences in weight of the users. Furthermore, the torque of the system generates enough force to

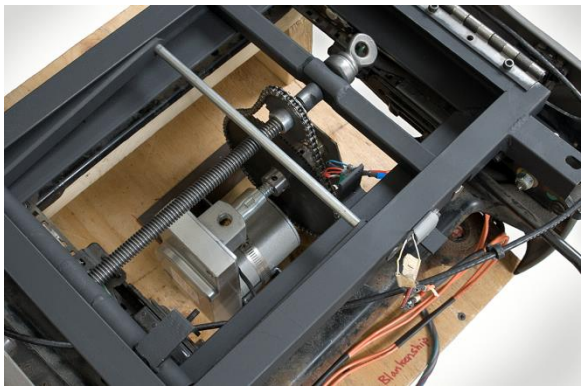

Fig.11.1. Interior Mechanical Components.

Fig.11.2. Seat at 45 Degrees.

support the users' weight. The range of motion of the devise is from 0 degrees to 45 degrees.

Ergonomically, 45 degrees was found to be the optimum rotation angle of tilt for the seat to effectively achieve stated objective while sufficiently supporting/relieving negative pressure to the lumbar vertebrae.

There were many considerations of embodiment of design utilized in the lift design prototype. Assembly deliberations made the device fully capable of being disassembled for maintenance or ease of repair. Parts are fastened using cotter pins, nuts and bolts, set screws (sprockets), and clamps (motor to the mount). Furthermore, materials for certain parts are selected based on functionality properties. The lift frame is mainly constructed of cold rolled steel for the mechanical properties of strength and ease of machining and welding. Nylon wheels are used in the moving parts for their ability to easily roll on steel with low amounts of friction. Brass is used as a low friction bushing material for support of the steel motor shaft.

Additional stability and maintenance of functionality as well as safety are key factors in this design. Limit switch electrical components are utilized to set the extreme maximum and minimum bounds of the systems rotation of tilt. These limit switches are triggered by micro-adjustable fine thread bolts. The advantages of tight tolerances on individual components were also utilized to create a successful design.

The total price of the project is $90.33. Weibert's Auto Place of Youngstown, NY donated the automotive seat.

Fig.11.3. Seat in Down Position While in Use.

Fig.11.4. Seat in Upward Position While in Use.

SOAP DISPENSING WASHCLOTH MITTEN

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INTRODUCTION

The Soap Dispensing Washcloth Mitten eliminates the need to directly handle soap and body wash while in the bath or shower. The washcloth can be worn on either hand. Inside the washcloth is a refillable bladder that dispenses liquid soap to the palm of the hand when pressure is applied.

SUMMARY OF IMPACT

This design allows the user to reapply soap as needed without using a separate bar of soap or body wash container. People with hand pain or poor dexterity using wet and soapy materials in the shower can be difficult. If one of these slippery items were to fall to the floor, people with back or neck pain may find it difficult to retrieve them. These problems are solved by combining the soap and washcloth into one easy to use item.

TECHNICAL DESCRIPTION

The soap dispensing system consists of just a few key components. A two-tube infant blood pressure bladder is used to hold the soap. It is made of a soft and flexible neoprene material with two long tubes extending from it. On the end of one tube is a threaded male adapter with a screw on cap. With the cap unscrewed, the soap is easily squeezed into the bladder using a plastic bottle. The second tube, used for dispensing the soap, runs over the fingertips and ends at the palm of the hand. A check valve is placed along this tube to only allow for flow away from the bladder. The valve also provides the necessary resistance to keep the soap from leaking, allowing an applied pressure to force the soap out.

This soap dispensing system fits into the washcloth mitten through a flap on the back of the hand. The mitten is made of two separate pieces of washcloth material. The first is a rectangular piece, sewn together on three sides to form the mitten. The second piece, whose purpose is to house the dispensing system, is sewn on the outside of the first piece. Once in place, the dispensing tube runs through a passage to the palm of the hand. The filling attachment protrudes through an opening on the back of the hand for convenient access. A button closes and opens the flap, allowing for the removal of the dispensing system if necessary. The design of the mitten is such that it can be worn comfortably on either hand.

Fig. 11.5. Washcloth Being Filled.

Fig. 11.6. Backside of Unassembled Device.

The total cost of this project is $53.

Fig. 11.7. Washcloth Mitten Soap Dispensing Front Side.

BATH SEAT WITH ASSISTED CLEANING SYSTEM

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Supervising Professor: Dr. Joseph C. Mollendorf
Engineering Machine Shop Design: Gary Olson
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INTRODUCTION

The object of the shower chair is to provide an easy solution for independent personal hygiene for individuals who are unable to stand for extended periods of time. The chair is specialized to help persons whom have difficulty washing their backs. The back washer is a runoff water power that has been rerouted from the shower plumbing, spinning the turbine and engaging a scrubber.

SUMMARY OF IMPACT

The project adds ease to showering by eliminating the need to reach around to scrub difficult to reach areas of the back. It provides the ease and comfort of a shower chair while also providing another service that would be beneficial for those who have difficulty reaching their back. This allows the user to still enjoy independent hygiene while being able to clean more area of the body in an efficient manner.

TECHNICAL DESCRIPTION

The bath seat with assisted cleaning system consists of a stool, a back rest and the turbine driven back washer. The back washer is built into the backrest. The back washer turbine is driven by water rerouted from the pipe attached to the shower. The backwasher consists of loofah attached to a dish which is spun by the turbine. The spinning motion moves the loofah which assists in cleaning the users back. It can easily be operated by a switch which the user can reach from a seat position on the stool. The switch has multiple settings depending on the speed and power preference of the user.

The stool seat is made of a hard plastic with drainage holes. The plastic was also molded with a handle to make carrying easier for the user. The plastic seat is mounted to steel legs which are adjustable for user preference and height needs. Each of the chair leg bottoms is equipped with a one inch diameter suction cup for easy attachment to the bath floor. They provide extra safety and stability during use as well as while entering and exiting the chair.

Fig. 11.8. Full View of Device.

The chair rest is attached to the stool through prefabricated holes located on the plastic seat. The backrest prototype is constructed of one inch PVC piping. The mounting system was constructed by inserting solid PVC with internal threading into the hollow PVC pipe and inserting a screw to connect the back rest to the stool. The back washing system is located between and slightly backset from the

upper and lower back supports. The lower backrest support is adjustable and each support is covered with pipe insulator for added comfort. The back washing system is backset keeping the user from putting full weight on the back washer during motion or while the chair is in use. The turbine system is mounted on a sheet of polycarbonate which is held in place by two PVC rods. Each rod is cut open to slide in the polycarbonate sheet for added support. An extra brick of solid PVC is used to construct housing for the tube of the turbine system to prevent excessive vibration and motion during use.

The backwashing system is created by remodeling a car washing brush. The turbine and gear ratio allow for the proper power and speed. A disk is made from polycarbonate which mounts to the spinning plate from the car brush and also serves as the base to attach the loofah. The polycarbonate washing disk consists of three holes to help drain moving water from the system. The loofah is sewn to the disk with fishing wire and a series of holes. The disk is connected to the spinning plate with screws and fasteners. The backside of the turbine housing is attached to the polycarbonate sheet with screws and locking nuts.

The device works with the water outflow of a typical household plumbing system. It provides the users with the force and speed required to help in back washing. The chair design is limited to the size of the users back it can reach since the disk is eight inches in diameter.

The total cost of the chair is $82.62; it does not include the plumbing system for the chair.

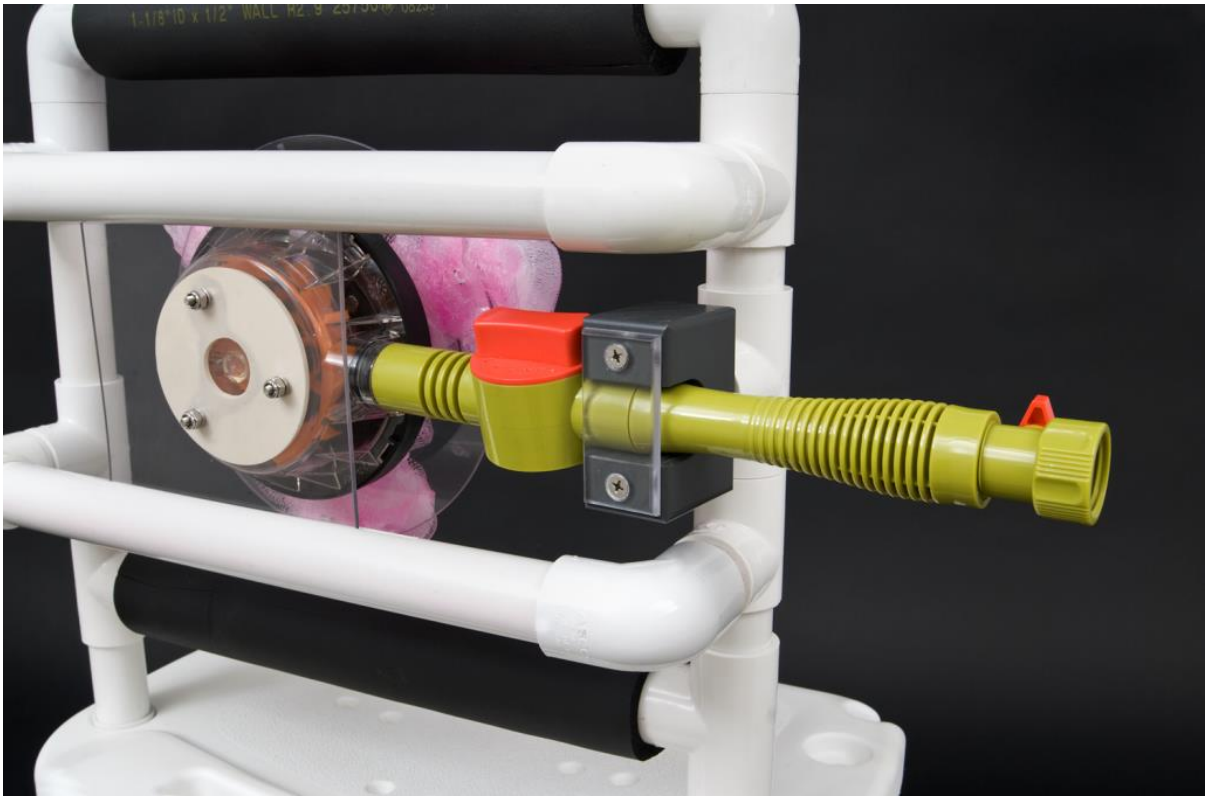

Fig. 11.9. Close Up of Back of Device.

PORTABLE OBJECT DETECTOR FOR VISUAL IMPAIRMENTS

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INTRODUCTION

The existing white cane for the blind has a few problems that limit mobility of its users. Oftentimes visually impaired people have to swing their white cane in order to detect what is in front of them. The user has to worry about hitting people or objects with the cane. It lacks the ability to detect a moving particle. Also, the cane cannot detect objects that are located above a certain height. The goal of the Portable Object Detector for Visual Impairments, shown in Fig. 11.10, is to provide the visually impaired with better mobility and an enhanced safety than exists with the white cane.

SUMMARY OF IMPACT

The Portable Object Detector for Visual Impairments allows individuals who use this device to navigate independently with minimal contact with obstacles. The implementation of ultrasonic sensor technology to detect objects can minimize the risk of injuries during the contact. Also, the pitch given off by the piezoelectric transducer allows the user to sense how far the obstacle is located. This device can locate objects without fear of collision and avoids embarrassing cane contact with other pedestrians. Also, this device decreases any entrance restrictions, like those of restaurants and vehicles. This device offers the all the benefits of the white cane with better mobility and safety.

TECHNICAL DESCRIPTION

The Portable Object Detector for Visual Impairments consists of four main electronic parts including an ultrasonic sensor, a piezoelectric transducer, a power supply, and a microcontroller board. The spatial position of an obstacle can be measured using the ultrasonic sensor (see Fig.11.11). The ultrasonic sensor transmits a pulse and measures the traveling time of echoes that are reflected from the obstacle. This device receives advanced knowledge of a clear path for up to three meters in front of

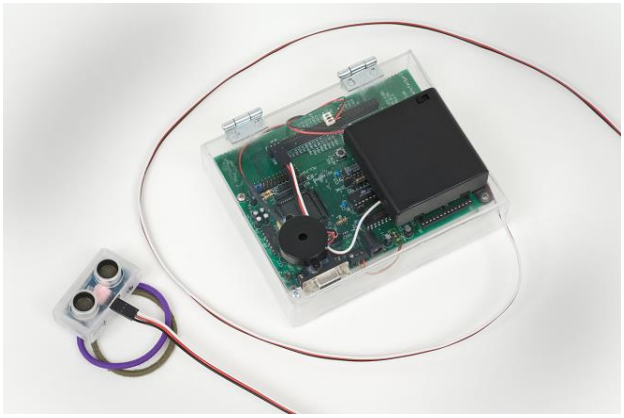

Fig. 11.10. Portable Object Detector for Visual Impairments.

Fig. 11.11. Ultrasonic Sensor.

sensor. Under the control of the microcontroller, the sensor emits a short 40 kHz burst. This burst travels through the air, hits an object and then bounces back to the sensor. The sensor provides an output pulse to the microcontroller board that will terminate when the echo is detected. The travel time of the pulse corresponds to the distance to the target object. The ultrasonic sensor is mounted in a palm size case with two bands attached to it. The user can wear the sensor around their hand. The connecting

cable which connects the ultrasonic sensor to the microcontroller board is 1.7 meters long. This connecting cable is capable of being placed inside of the shirt so as not be visible to bystanders (see Fig.11.12). The sensor is capable of detecting objects up to 3.3 meters away. However, the device is programmed to respond to the object from one centimeter up to three meters. The piezoelectric transducer is used to alert the user by producing an audible sound. The high pitch and low pitch indicate close and far objects respectively. The microcontroller board is installed in an acrylic case which has the dimensions of 12.5 cm by 15 cm by three cm. The battery holder has an on or off switch and holds four AA batteries which can power the device for up to thirty hours of constant use. Temperature can have an effect on the speed of sound traveling through the air. However, for the typical use of this device, the effect is not significant.

The total cost of the prototype is $140.

Fig. 11.12. Complete Portable Object Detector for Visual Impairments in Use.

EYEGLASSES WITH ADJUSTABLE BRIDGE AND TEMPLE

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INTRODUCTION

These eyeglasses are designed for children with Down syndrome. The glasses are made to be adjustable at the temple length, bridge width and the lens angle. They are adjustable at three points to accommodate many users. The objective of the design is to be unobtrusive, safe, reliable, inexpensive, easy to use, and comfortable.

SUMMARY OF IMPACT

The design of these glasses will improve the vision, comfort and ease of use for any person that has trouble with common glasses, including children with Down syndrome. Many children with Down syndrome have an increased risk of eye and vision disorders. It is therefore beneficial to offer a pair of eyeglasses that can be easily adjusted so that they fit comfortably and function properly.

TECHNICAL DESCRIPTION

The design of the glasses is developed based on the realization of the inconvenience common eyeglasses are for children with Down syndrome. Research shows that these children with Down syndrome are prone to vision disorders and have slightly different facial anatomy compared to unaffected children. The distance between their face and ears is shorter, the ears tend to bend outward, and a smaller nose is usually observed.

The design of these eyeglasses is convenient for many users as it is adjustable at the length of the temple, lens angle and width of the bridge. The adjustable temple piece is taken from an existing pair of safety eyeglasses which has this feature. The lens of the eyeglasses can tilt and uses small clutches

Fig. 11.13. Full View of Eyeglasses.

Fig. 11.14. Adjusting the Tilt Angle.

that are attached to both the temples and the sides of the lenses to allow angle changes. The width adjustable bridge consists of a threaded middle piece. Two threaded rods are screwed into the middle piece creating the bridge. As the user turns the middle piece, the bridge width will extend and retract depending on the turned direction.

Fig. 11.15. Eyeglasses Being Used.

PORTABLE LOWER BODY STRETCHING STATION

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INTRODUCTION

Recovery from lower body injuries can require an extremely long time. Usually therapy involves a lot of patience and constant stretching exercises to heal. The Lower Body Stretching Station is designed to assist people with temporary lower body disabilities or injuries in performing various physical therapy stretching exercises at one station. The station can be accommodated by users of virtually any size. The technology can also be used by healthy person as a form of stretching or exercise. The goals of the stretching station are that users can complete a stretching workout in a station which is inexpensive, user-friendly, portable, efficient and durable.

SUMMARY OF IMPACT

Stretching exercises such as a hamstring stretch, hip stretch, split squatting, and others can be done using the stretching station. By using the station, the amount of time required to do the different stretching exercises is greatly reduced. The users also have better form while stretching on the stretching station. Moreover, the stretching station is portable. Parts can be easily stored in the pipes container and carried around.

TECHNICAL DESCRIPTION

The stretching station consists of two parts; the exercise foam mats and the stretching supporter. The foam mats are ½-inch thick interlocking gym mats. The interlock function increases the flexibility and portability of the stretching station. Two layers of thin fiberglass plates are added to the top and bottom of the foam mats to spread the stress along the fiberglass plate area. This increases the strength of the foam mats to prevent damage or failure at critical points. Three interlocking foam mats are used to form the base. These mats are joined together by resistance tubes to form a handle so that they can be transported. Another function of the resistance tubes is for the stretching exercises. Both

Fig. 11.16. Full View of the Assembled Design Prototype

Fig.11.17. View of Unassembled Design Prototype.

the foam mats and stretching support are attached using threaded flanges. Therefore, they can be removed when they are not needed.

The stretching support is made from one-inch and one and a quarter-inch PVC pipes. The material is selected because it is inexpensive compared to metal, lightweight, durable, and readily available. In addition, most of the pipes are joined using male and female threaded fittings so that they can be detached and stored in a long round container. The container is made out of a round paper box with an

adjustable length shoulder strap. The portability of the stretching station makes it perfect for transfer and storage. The stretching supporter is also height adjustable. It is created by sliding the one-inch pipe into the one and a quarter-inch pipe. Five inches of height range is provided. The adjustable pipes are locked using spring-loaded pins. It accommodates most individuals for stretching with the stretching station.

The top of the stretching supporter is used for balancing while doing either the hip or split squat stretching. It can also be used to do hamstring stretching where the back of the heel rests on the top of the pipe. The two grip handles, located in the middle of the stretching supporter, are then used to pull the leg toward the body. It works as if the user is trying to pull the back of the thigh toward the body using the hand. An extra layer of rubber insulation is added around the pipe to increase the comfort level while resting the heel or gripping the pipe.

The stretching supporter is adapted to the base to allow users to perform more stretching exercises. More adapters can be designed and added to increase the number of possible stretching exercises.

The total cost of this project is $75.

Fig. 11.18. Picture of Stretching Exercise.

Fig. 11.19. Showing Portable Design.

ELECTRONIC LIFT CHAIR

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Laboratory Equipment Designer (Electronic): Roger Krupski
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INTRODUCTION

The Electronic Lift Chair is designed primarily for a person with a leg disability or the elderly who has difficulty standing up from a seated position. Typical chairs do not meet the height of the table. Such individuals have difficulty in adjusting the chair since they experience weakness in their legs and are unable to hold themselves in a sitting position while the chair is rising. Usually a chair is adjusted by hydraulics, but this is a poor solution for people who cannot lift themselves. Therefore, this design is based on electric power.

SUMMARY OF IMPACT

People with a disability may experience difficulty in reaching the height of the table due to the inconvenient design of a common chair. This device is specifically designed to solve the problem by providing a convenient height control mechanism for these individuals. The device is also fitted with wheels so it can be easily transported.

TECHNICAL DESCRIPTION

The device is made of three major parts including the base, the scissor jack and the seat. The base of the device includes wheels, a supporting frame and an adaptable base which attaches the scissor jack. The supporting frame and wheels are parts from the original purchased chair. The adapter is made from a ¼ inch steel plate which is machined to increase its stability, and is bolted to the base of the scissor jack.

Fig.11.20. Full View of the Device.

Fig. 11.21. View of Maximum Height of the Device.

Fig.11.22. View of the Minimum Height of the Device.

The most challenging part of the design is the scissor jack which powers the whole device by a motor. A motor that fits the required torque and RPM based on calculations is included in the design. The threaded rod of the scissor jack is connected to the shaft of the motor by a coupling, which was machined from the machine shop. A set screw is placed to turn the threaded rod by the motor shaft. The motor is attached to the scissor jack by an L-bracket which is clamped by a two pipe clamp.

Another challenge of the project is to determine a suitable location for the limit switches. The purpose of the limit switches is to open the circuit when the chair reaches its maximum and minimum height to avoid damage to the motor. The maximum height is six inches from the minimum point. The seat for the device is obtained from the original purchased office chair and is attached to the scissor jack by an adapter. The adapter is made by a U-bracket which enables the bracket to be bolted onto the top of the scissor jack.

The total cost of the project is $218.99.

HEIGHT ADJUSTABLE HANDLE FOR A CANE

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INTRODUCTION

The Height Adjustable Handle for a Cane is designed to aid people in standing up from a seated position. Other similar devices do not allow for quick and easy use. With these other devices, adjusting the handle takes considerable time. Therefore, it takes a long time to get up from a seated position. The purpose of this project was to design a handle that can be used on a standard cane and be moved to any height on the shaft of the cane.

SUMMARY OF IMPACT

While using a standard cane people with disabilities struggle while trying to get up from a seated position. The various height range of the handle will allow the user to get up from a variety of seated heights. The user can get up with ease by adjusting the handle to any height quickly.

TECHNICAL DESCRIPTION

The Height Adjustable Handle for a Cane consists of a cane, an adjustable component from a pipe clamp, a handle, a handle grip, and two mounting bolts and nuts. The aluminum cane has a 7/8 inch outside diameter and a height of 43 inches. The adjustable component of the pipe clamp is used for locking the handle at a desired height. The part of the pipe clamp is made of a cast-iron housing, three hardened steel tabs, and a spring. The diameter of the cast iron housing is drilled to a diameter of 15/16 inches to fit the shaft of the cane. The diameters of the three tabs from the pipe clamp are cut to 15/16 inches. The handle of the cane is made from ½ inch galvanized steel pipe cut to a length of six inches. The mounting end is flattened using a vice and then mounted to the top surface of the adjustable component of a pipe clamp's housing with two bolts and nuts. A handle grip rests over the galvanized pipe for comfort. The adjustable handle is painted. The height adjustable handle locks into place with the use of the pipe clamp. Three tabs and a spring on the part use friction to hold it at the desired height on the cane. When the three tabs are compressed, the handle slides freely up and down the shaft of the cane. When the tabs are released the handle locks into place. The handle's range of motion is from the top of the rubber bottom of the cane to where the handle of the cane starts. The handle can travel 34 inches and locks in at any position on the shaft of the cane. A person using the cane can adjust the handle by squeezing the tabs together and moving the handle to any location in its range of motion. This is easily accomplished from a seated position. Once the person is up they can adjust the handle again to the desired height for walking or rotate the handle off to the side to be out of the way.

Fig. 11.23. Entire Device.

Fig.11.24. Height Adjustable Handle.

The cost of the project is $60.

Fig. 11.25. Cane in Use.

FOLDABLE AND SITTABLE FOREARM CRUTCHES

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INTRODUCTION

The foldable and sit-able forearm crutches are designed to replace standard forearm crutches. Standard forearm crutches are designed for people who have leg disabilities. The sole feature of this device is to assist people with leg disabilities and not only provide enhanced mobility but also offer an easier way to store and use the crutches like a seat when not needed for walking.

The crutches provide additional features from standard crutches as they are foldable and provide a seat. Both crutches can fold into three pieces. The crutches can also be joined with a piece of cloth to provide a seat.

SUMMARY OF IMPACT

This device allows the user to fold the crutches in order to easily store them. The fabric hooks on both crutches allow the user to sit down. These features assist with placement of the crutches inside a car or when carrying in a narrow place. With the addition of the fabric cloth, users can enjoy another attribute of the modified crutches, which is sitting between the crutches. Therefore, these tailored crutches will offer those with disabilities in their legs many solutions and added features over standard crutches.

TECHNICAL DESCRIPTION

This entire device consists of a pair of crutches, eight pieces of short aluminum plate, four pieces of long aluminum plate, eight pieces of medium aluminum plate, eight bolts, fourteen nuts, six hooks and a piece of fabric cloth. The crutch is cut into three bars and assembled with multiple pieces of aluminum plate and joined with bolts and nuts. The eight pieces of short, medium and long aluminum plates are bolted on the crutches and tightened with nuts. The center part of the crutch is attached with three

Fig. 11.26. Entire Device.

Fig.11.27. Device Configured for Sitting.

hooks and used to hold the fabric cloth. The eight pieces of medium aluminum plate add strength. The four pieces of long aluminum plate act as a connector for holding the two crutches together and also strengthen the supporting point. The eight pieces of short aluminum plate provide joints along the crutch that was cut into three pieces which allow for folding.

The total cost of this device is $40, excluding the pair of crutches which was donated by Sheridan Surgical.

Fig. 11.28. Device in use as crutches

WHEELCHAIR SHOPPER

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INTRODUCTION

The Wheelchair Shopper is designed to assist wheelchair users in a supermarket environment. A typical power driven supermarkets cart allows a person to move through the store, but limits them to only the lower shelves. This product allows an individual to shop unaccompanied without the limitation of not being able to reach the top shelf. Also, after the desired item is selected, there is increased storage space so that all desired items may be transported at once.

SUMMARY OF IMPACT

This device enables wheelchair users to have more independence while shopping. Also, supermarkets may observe an increase in shoppers, due to the increased convenience and opportunity that this product provides for a wider range of people.

TECHNICAL DESCRIPTION

This device consists of two main components that can be attached to any standard wheelchair. These components are a pneumatic lift system and a storage rack system.

The pneumatic lift system works in the same way as one would operate a barber chair. There is a foot operated pump and release, for raising and lowering the chair, respectively. This system is attached to the underside of the seat and has the capability of lifting the whole wheelchair and storage system off the ground. The total lift that can be achieved with this chair is about eight to nine inches.

This system is constructed using an old salon chair. The lift is attached to ¾" plywood, which in turn is attached to the seat of the chair with ¼" bolts. The size of the base of the salon chair is extensively modified to fit between the wheels.

Fig. 11.29. Wheelchair Shopper.

Fig. 11.30. Close up of Pneumatic Lift System.

Fig. 11.31. Fully Raised Lift System.

This cast iron base is cut down on almost all sides, but still provides good support and balance when the lift is extended to its maximum height. Cutting down the thick cast iron base also helps in reducing the overall weight of the device. Since the base accounts for the majority of the weight, this enhances the mobility of the device.

Another modification to the base is the addition of metal rods, which extend through vertical supports on the wheelchair. They prevent the base from rotating while the chair is moving. This also increases the overall rigidity of the device.

The base is mounted with slider disks to reduce the effort required to move the chair. These disks also help ensure that the base does not damage the floor.

The second system, the storage system, is used for placing items while shopping. A shopping basket can easily be attached to the racks, as well as numerous bags, through the use of sliding hooks.

This system is constructed using standard ½" PVC pipe and various fittings. ¾" Tees are used to slide along the ½" track with minimal resistance, even with bags attached. The rack is supported with cross bracing PVC. The product was tested to about 50 pounds of force successfully.

The cost for this project is $50.

Aside from the applications that this product can be applied to in a supermarket, this wheelchair may be used in a home without the storage system. This would allow for its users to reach higher cabinets and drawers that would normally not be accessible. It can be used for cleaning purposes as well. Overall, it will offer wheelchair users more independence.

FOLD-AWAY PORTABLE ACCESS RAMP

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INTRODUCTION

For people with limited mobility, stairs can prove to be a challenge. The goal of the Fold-Away Portable Access Ramp is to create an easily-accessible ramp that can be used almost anywhere with minimal setup time. Traditional wheel chair ramps are usually permanent constructions and are not always available. The Fold-Away Portable Access Ramp can be used anywhere, giving users access to places they may not have been able to previously go.

SUMMARY OF IMPACT

This device will make it convenient for someone who needs to roll an object, such as a wheelchair, hand-truck, or cart, up a set of stairs where there is no permanent ramp available. The folding design allows for convenient storage, occupying a minimal amount of space.

Future designs could make use of lighter composite materials which would make the ramp more light weight. This would allow the ramp to be carried on the back of a wheel chair.

TECHNICAL DESCRIPTION

The device is composed of five 2 x 1 foot rectangular segments. Each segment is made of four pieces of 1 x 1 inch aluminum square tubing, which are welded together to form a frame.

Inside the frame there are five pieces of 2 x ¾ x 11 inch pine that support the plywood ramp surface. The ramp surface is made from ¼ inch plywood that is fastened to the five pieces of pine with wood screws. The surface is painted with a textured paint to prevent slipping on the ramp.

Hinges are placed between each adjoining ramp segment on opposite sides. This allows the ramp to fold like an accordion. The ramp utilizes two sliding lock mechanisms between each segment of the ramp to lock the ramp in its unfolded position. The locking mechanisms are made of ¾ x ¾ x 6 inch

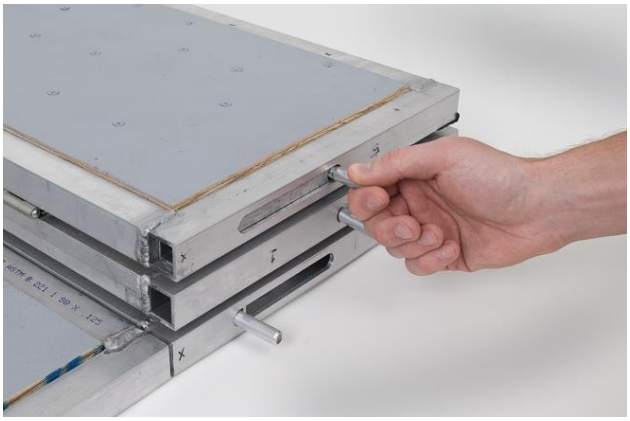

Fig. 11.32. Locking Mechanism Collapsed.

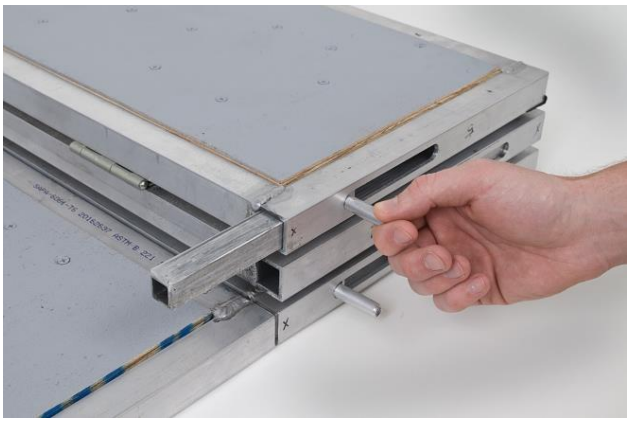

Fig. 11.33. Locking Mechanism Extended.

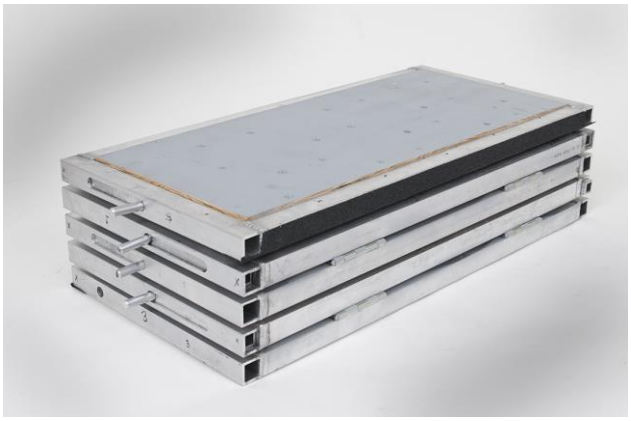

Fig. 11.34. Folded Ramp.

aluminum square tubing with an aluminum rod for a hand grip. The locking mechanisms are located coaxially in the frame pieces and in a slot that is milled in the rectangular frame.

The recommended improvements of this project are to make use of lighter materials such as plastic, aluminum, or a composite material for the ramp surface, to reduce weight. In addition, the sliding lock mechanisms could be made from steel to allow for easy sliding inside the aluminum square tube.

The total cost of this project is $131.

Fig. 11.35. Ramp in Use.

EXERCISE MOBILE

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Faculty Designers: Gary Olson, Kenneth Peebles, Roger Teagarden
Other Designers: Russell Boedo
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INTRODUCTION

The goal of the Exercise Mobile is to allow a person with limited leg mobility to experience the sensation of running. Traditional wheelchairs can be used for exercise but the users are restricted to a sitting position while moving the wheelchair. The Exercise Mobile gives a person a great upper body and cardiovascular workout along with the feeling of running or walking.

SUMMARY OF IMPACT

The Exercise Mobile provides a means of upper body and cardiovascular workout while giving people with limited or no leg mobility the feeling of running. The person is assisted into the machine and suspended from the frame. Their legs are strapped in the foot holders, which hold their legs in place while they drive the machine forward. The Exercise Mobile can not only improve and maintain an individual's physical health, but it can also enhance a person's mental well-being. The exercise simulates what it would be like to have full leg mobility while getting an upper-body and cardio workout. This could help the physical and mental health of the users, and it also has the potential to give the person a longer and happier life. The gearing system on the Exercise Mobile allows for one speed output.

The device is a slow moving prototype. In actual production, the Exercise Mobile would have a range of gears so that the person can travel at higher speeds if desired. To slow down the machine the user uses a brake handle on the left arm of the machine that is connected to a brake band and drum. This allows the user to slow down or stop the Exercise Mobile without trouble.

Fig. 11.36. Exercise Mobile.

TECHNICAL DESCRIPTION

The Exercise Mobile is comprised of four main components including the chassis, brake system, the suspension system, and the drive system. The frame of the chassis is made from pieces of 2x6 lumber. In actual production, aluminum would be best because it is lightweight and doesn't rust.

The rear and drive wheels are 10 inches diameter, while the front of the chassis is equipped with three inch casters for stability. The rear wheels each have a collar that connects the wheels to the rear axle. The rear axle is connected to the chassis by two self-aligning pillow bearings. The rear axle is also where the brake system is located. The brake system consists of a brake band and drum. The brake band is connected to a brake line, which is connected to a brake handle. When the user presses down on the handle it compresses the band on the drum and slows down the machine.

The chassis is also connected to the suspension system, which consists of three main components including a safety harness, a cage, and adjustable chains. The safety harness is connected to the cage by the adjustable chains. Adjustable chains allow people of different sizes to easily use the machine. The cage of the Exercise Mobile is made up of a two inch exhaust pipe. The user must be assisted into the device.

The main system of the Exercise Mobile is the drive system. It consists of an old exercise machine, a set of gears, and a standard bike chain. The modified exercise machine is called the Fitness Flyer. It allows the user to get a leg and upper body workout in a stationary position. It is modified so it can be connected to the chassis with ease. The user's feet are strapped onto the footrests of the Fitness Flyer. Their legs move back and forth when driving forward.

In order to keep the machine moving forward at all times 16 toothed free wheel sprockets are used and connected to the gearbox. This allows the user to push the handles forward and backwards without resistance when driving the machine. There is a sprocket connected to each side by pillow bearings. They connect the free wheel sprockets and drive sprockets on the drive wheels. They also give a higher gear ratio which allows the machine to move at a fast pace. The drive sprockets are directly connected to the drive wheels. The drive system is also used to turn. By pumping one arm only the machine can be turned like a Bobcat turns. One wheel or side stays stationary while the other drives, causing the machine to rotate to the users desire.

Fig. 11.37. Exercise Mobile in Use.

This machine is revolutionary as it allows the user to drive the vehicle forward while getting an upper body workout, cardiovascular workout, and the sensation of running.

The total cost of the project is $193. The Exercise Mobile's weight, without the user, is 86 pounds which may be reduced if a lighter material is used.

UNIVERSAL RAILING RUNNER

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INTRODUCTION

The objective of this project is to design and build a device capable of carrying a moderate payload up or down a staircase. It is intended for a person with a disability who may find it unsafe or impossible to accomplish without aid. The resulting design, named the Universal Railing Runner, is comprised of a compact electrically driven runner and a specially designed railing. The railing and the runner fit together intricately to provide a safe, precise, stable, and smooth railing aid. A small motor powers a drive-wheel that mounts on the top of the runner. It is designed to carry up to 25 pounds. Additional assistance and safety is also provided to the users by a mounted arm protruding away from the handrail, which allows for easier gripping. The design allows for the universal railing runner to be mounted on any staircase. Therefore it is extremely versatile and provides benefits for a wide range of customers.

SUMMARY OF IMPACT

This product will be very advantageous for customers who have difficulty climbing staircases while carrying their belongings. Example payloads include laundry, groceries, and packages. The design allows the user to grasp to the runner while the belongings are carried alongside them. The universal railing runner makes it extremely easy for the user to move objects up and down the staircase because it requires minimal effort by the user. Also, by allowing a grip for the user to grab, support is provided for the user as they move with the runner, providing a safe and easy way to go up and down the stairs.

TECHNICAL DESCRIPTION

The runner resembles a U-shaped bracket that envelopes the top and both side surfaces of the custom railing. Eight bearings give the runner the necessary moment and thrust support for carrying a payload suspended toward the center of the staircase. There are four bearings at either end,

Fig. 11.38. Four Bearings.

Fig. 11.39. Universal Railing Runner in Use.

mounted to the runner that rides along the precisely cut surfaces of the railing. The railing cross-section looks something like an X shape. The four bearings at either end of the runner make contact with the 45 degree angle surfaces on both sides of the railing. The X-shaped cross-section with four bearings gives complete moment and thrust support to the runner in every direction.

The motor-house assembly is mounted to the side of the runner. It provides space for a directional switch and a power button. The user can switch between forward and reverse, as well as turn the motor on and off as they move up the staircase with the payload. There is also a grip mounted to the runner

for support as the user moves with the runner. The motor housing is constructed to prevent the motor from spinning inside the housing to eliminate the risk of not providing any drive to the wheel. The support pins and drive shaft are very intricately manufactured.

The railing dimensions need to be precise enough to match the forty-five degree angle of the pins. This provides complete moment counteraction in order to avoid slip between the runner and the railing. This allows for the most surface contact between the pins and the railing. It was understood that depending on the slope that existed between the bearings and the railing, more or less weight would be able to be carried. By aligning the pins and railing perfectly, we were able to move twenty-five pounds up the staircase.

The total cost of the Universal Railing Runner is $101.

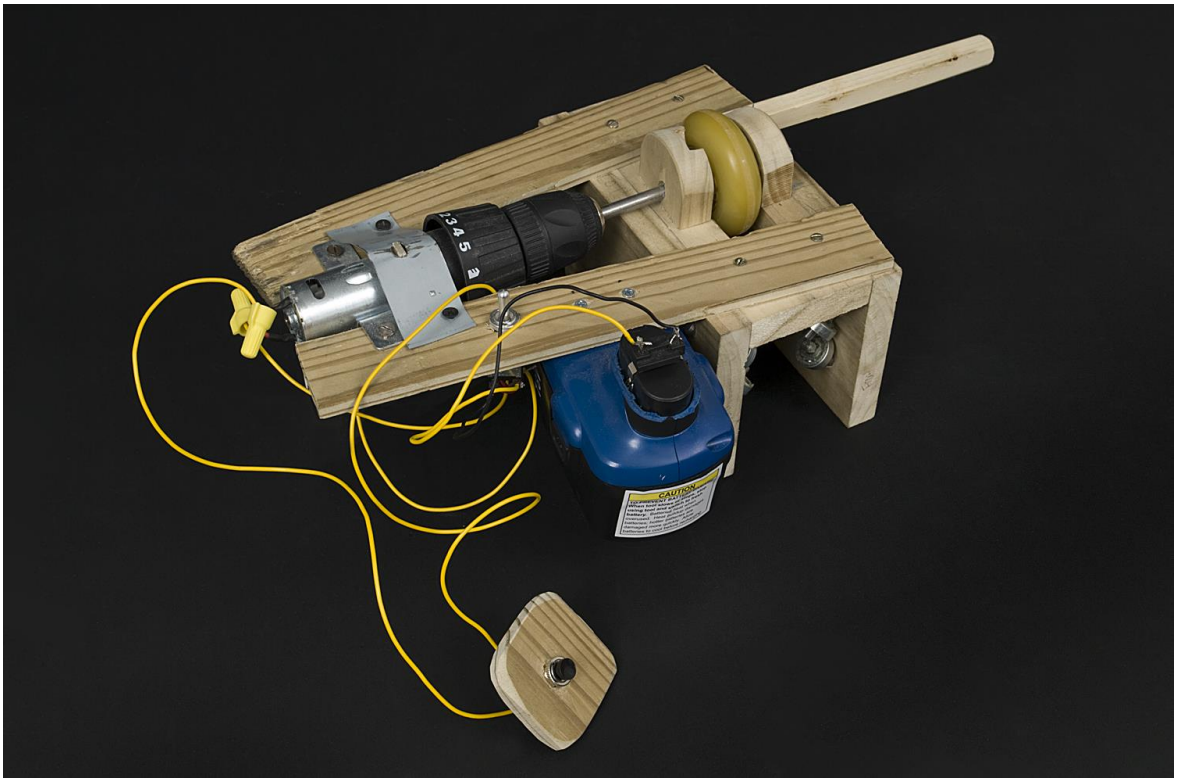

Fig. 11.40. Railing Runner Device.

THERMALLY CONDITIONED THERAPEUTIC KNEE BRACE

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INTRODUCTION

The goal of the Thermally Conditioned Therapeutic Knee Brace is to provide a user with limited dexterity or motor functions the means to effectively rehabilitate a knee injury without risking further harm to the knee. By combining the rehabilitative functions of thermo-electric heating and cooling with the protection and support of a knee brace, the user is able to rehabilitate an injury without ever having to remove the protection provided by a knee brace or support. The goal of the device is to effectively integrate heating and cooling elements into a knee brace without compromising support.

SUMMARY OF IMPACT

The convenience of this device will benefit not only those with limited dexterity, but any patient recovering from a knee injury. By combining rehabilitative functions with knee support, the healing process is not only easier, but faster. The ability of this device to ice and then heat the knee in rapid sequences allows inflammation and swelling to be easily managed, thereby promoting faster, more complete healing.

TECHNICAL DESCRIPTION

The knee brace consists of two main components; the heating and cooling mechanism and the knee brace mechanism. The heating and cooling mechanism, when described at the point of skin contact, is a thermally conductive gel-filled pack comprised of polyethylene that surrounds the knee. The motion of the user provides convective flow in the gel that helps to maintain a constant temperature distribution throughout the knee brace. Mounted to the outside of the gel pack are six thermo-electric coolers. These components, known as Peltier coolers, function on the principle of the Peltier effect. This phenomenon occurs when a thermo-electric device, supplied with a voltage, creates a temperature

Fig. 11.41. Knee Brace on User.

difference on either side of the component. The thermo-electric coolers used are mounted with the cold side down so as to remove heat from the knee when a voltage is applied. With a reversal of the polarity of the coolers, the heat flow switches direction, supplying the knee with heat. In this manner, the knee can be both heated and cooled using the same mechanism with only a reversal in polarity required. However, in order to remove heat to cool the injured joint, heat must be dissipated

from the hot side of the thermoelectric units. This requires a heat sink and forced air convection. Therefore, heat sinks are mounted to each thermo-electric cooler and placed inside a length of square stock aluminum in order to direct air flow. Opposite the heat sink, a fan is incorporated to move air over the thermo-electric cooler at high velocity. This removes enough heat to cool the injured knee and to prevent the thermo-electric units from overheating.

Both the thermo-electric coolers and fans operate off of a 12 volt DC current, supplied by an outside power source. However, the possibility of powering the unit by battery is attainable as the current draws could be supplied by a variety of battery power sources. By powering the knee brace using batteries, the thermally conditioned therapeutic knee brace would be more portable. This would allow the user to wear it at all times, providing more convenience.

The knee brace component of the design incorporates many of the characteristics of commercially available knee braces. These include mechanical bracing and stiffening to support the knee to prevent further injury to the joint. This is accomplished by using materials like neoprene and elastic to provide comfort and support. The features unique to this knee brace are the elastic strapping to keep the thermo-electric coolers in constant contact with the user.

This enables an increase in the amount of heat removed or supplied, and increases airflow passages

Fig. 11.42. Fans for Brace.

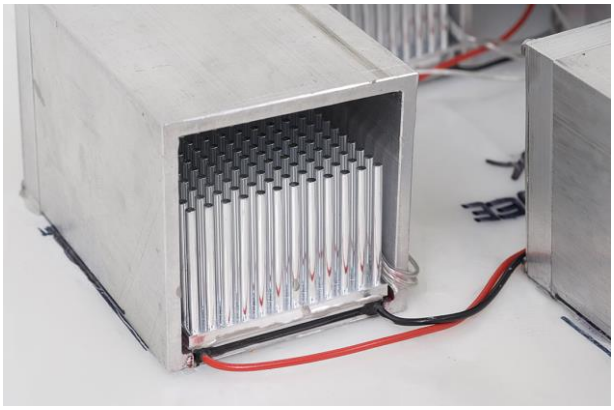

Fig. 11.43. Peltier Coolers.

to allow excess heat to be easily and efficiently dissipated.

The total cost of this project is $250.

GOLF BALL TEE-UP AND PICK-UP AID

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INTRODUCTION

The Golf Ball Tee-Up and Pick-Up Aid is a device that uses a two-step process to pick up a golf ball off the ground and then tee it up on a golf tee. The device is targeted towards individuals who have back pain or disabilities.

SUMMARY OF IMPACT

Golf is a very popular game with an estimated 50 to 60 million players in the country. The game is enjoyable for many different people with varying skill levels and physical capabilities. Some individuals who lack the ability to bend over due to back pain or disability would benefit from a device that helps them tee up and pick up a ball without bending over. The goal of the design is to meet the needs for a golfer with a back disability. This device allows more people with disabilities to stay active and participate in golf.

TECHNICAL DESCRIPTION

There are two main components to this device. The first component is the ball picker mechanism. The design of this attachment is in the shape of a C with a circular profile. The component has a slightly smaller diameter than the diameter of a U.S. standard golf ball of 1.68 inches. This device is used by either pressing down on the ball which then "pops" the ball up through the C shaped device or by scooping the ball. The material used to make this attachment is polycarbonate, due to its flexible nature. Other plastics may also be acceptable for full-scale production.

The second component of this device is the tee-up attachment. The attachment's shape has a slanted slot that allows for the fitting of different diameter tees. However, most golf tees have a shaft diameter of approximately 1/8". The user takes a golf tee and places the thicker portion of the tee against the bottom of the shaft. Then by pushing the tee into the slanted tee holder, the tee will lock in place. When the device secures the tee, the user holds the shaft vertically, perpendicular to the ground, and press the shaft downward to insert the tee in the ground. When the tee is in the ground, the user can then remove the tee from the device by simply moving it horizontally. The friction between the tee and the ground will hold the tee in place.

Fig. 11.44. Ball Picker Attachment.

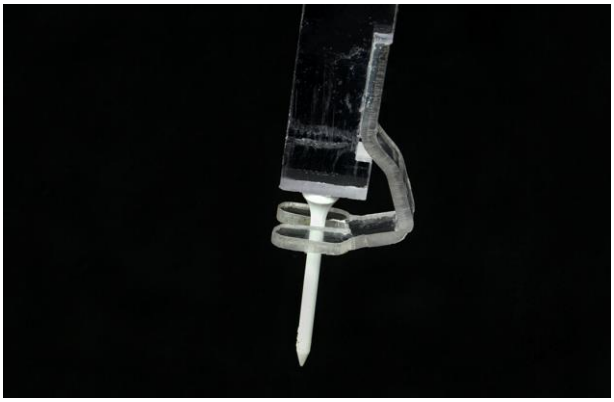

Fig. 11.45. Tee-Up Attachment.

The tee-up procedure is a two-step process:

1) Lock the tee into place by sliding the tee into the "wedge" and applying pressure inward and against the butt of the shaft. The user then inserts the tee into the ground by thrusting the shaft downward.

2) Use the ball picker to "pop" the ball into place by applying pressure downward on the ball. The ball will rest on top of the picker and then is placed on top of tee.

Both attachments are made from a polycarbonate sheet of 3/16″ thickness. The different designs of the attachments are drawn and analyzed on CAD software and then machined using a band saw. The shaft of the device is 41″ long and ½″ by one inch. The widths of both attachments are also ½″ in order to make a perfect fit with the side of the shaft. The shaft is also made from polycarbonate.

The straight ends of the attachments are bent using a heat gun. Methods that are more precise may be used in automated manufacturing. The shaft is milled to 3/16″ and attached using acrylic solvent for a strong flush fit. The weight of the device is one lb. and fits nicely in a golf bag.

The total cost of the project is $32.25

Fig. 11.46. Ball Tee-Up Demonstration.

MECHANICAL COAT RACK

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INTRODUCTION

The goal of the Mechanical Coat Rack is to give a user with limited reach the ability to easily access items within the closet. Standard closets are built with the clothing rack and shelving at a height that is well within reach for someone who is standing. However, this can be strenuous for different groups of people, including wheelchair users and children. Permanent bars and shelves built at a lower height with the intention of providing an easier reach presents the problem of poor utilization of vertical space. This device addresses both issues by allowing the clothing rack and shelving to be lowered to the user's desired height. Once in the desired location, the clothing rack will rotate like a carousel. These two combined features allow for a much more efficient use of closet space.

SUMMARY OF IMPACT

This device can reduce time and aggravation for a person with a height disadvantage. The idea of the device is to create a "One-Size Fits-All" closet, which can be used by anyone. This device can be equally suitable for many different users with varying heights and levels of ability. This ultimately gives the user full control of desired height levels of the shelving and clothing.

TECHNICAL DESCRIPTION

There are two isolated systems within the device. The first is the vertical motion of the clothing rack and the second is the carousel rotation of the clothing. A motor turns the drive shaft, which is connected to a gear. The gear is meshed with a second gear that is welded to a #35 martin sprocket and permanently attached to a ½" threaded rod. A #35 chain runs across the closet and connects to a second thread rod assembly. Due to the fact that the distance between the two rods is a very long, an idler sprocket is added at the midway point to create the proper tension on the chain. A ½" nut and plate assembly is threaded onto the rod and acts as a mover. When the motor is turned on, the threaded rods spin, which allows the nut and plate assembly to move vertically up or down, depending on the motor direction. The threaded rods are mounted in ball bearings to reduce friction and to provide stability. The motor is wired to a momentary switch to prevent the device from constantly running. In addition, there is a three-position switch that gives the motor the "Reverse-Lock-Forward" position.

Fig. 11.47. Mechanical Coat Rack.

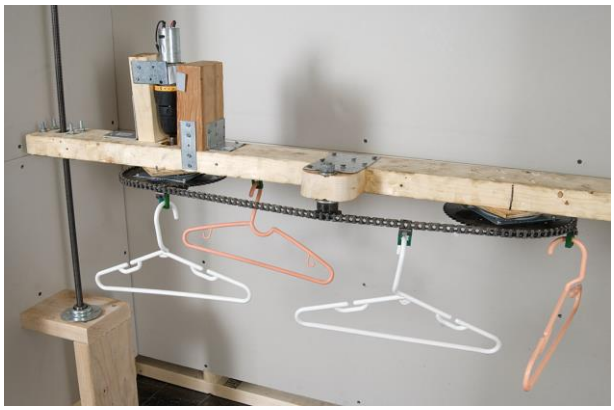

Fig. 11.48. Rack at Lower Accessible Height.

The second system is the carousel rotation feature. A second motor drive shaft is set-screwed to a ½" sprocket hub. The hub is permanently welded to the 6" diameter #35 sprocket. Once again, an idler sprocket is added to create the proper tension on the

chain. There are special chain linkages added into the chain that allow for mounting hangers onto the carousel. This motor is wired to an "On-Off" switch, which will simply allow for the rotation of the carousel in one direction.

Fig. 11.49. Coat Rack at Regular Position in Prototype Closet (Not actual Height).

INTERFACE FOR ADAPTIVE AND RETROFIT CABINETRY

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INTRODUCTION

The focus and objective of this project is to design and build kitchen cabinets that have adjustable heights in order to become more accessible and convenient for anyone who has trouble reaching tall objects. Tens of thousands of cabinets are installed every year in kitchens and bathrooms, sometimes for tens of thousands of dollars. Our system allows people of every height to have access to all items they store without the clutter of step stools or extension grabbers.

SUMMARY OF IMPACT

Our device involves a motorized two-dimensional pivoting cabinet system that attaches to many types of preinstalled cabinets, and allows a simple one-touch user interface for easy accessibility. The cabinet may be lowered to a desired height with the touch of a switch, and remain there until the user wishes to raise the cabinet back into its resting place.

The factor of safety has been addressed in material choices including the four square tube extension arms, u-joints, and brackets, which are all made of 1/8" steel. The full scale model will also have a cable run to the motor so customers will not have to fear the system being weak, under built, or capable of falling. This is a low cost, easy to use product that will allow all users an easier, safer way of getting items from out of reach places in kitchen cabinets.

TECHNICAL DESCRIPTION

The cabinetry system is made up of three main components including a cabinet, pulley system, and motor device. The cabinet that is used for the model is a half scale representation of a cabinet used in a kitchen. The cabinet is what holds the contents. It utilizes a shelf which effectively doubles the surface to store its contents. The dimensions of our half scale model are 12"x15"x6". The material used to construct the cabinet is half inch plywood, with half inch gussets for support in the corners. The half inch plywood is also used to mock up a wall surface for convenience. In normal operation, the cabinet device would be mounted securely to a wall.

Fig. 11.50. Motor to Move Cabinet.

The pulley system is comprised of four steel square tubes used as arms to raise and lower the cabinet into position. Four tubes are used to ensure that there is no binding and that the cabinet had sufficient support when in operation. The square steel is connected to the wall and cabinet with U-

Fig. 11.51. Full Cabinet.

Fig. 11.52. Raised Cabinet.

brackets. This optimizes the range of motion of operation which allows the cabinet to mount flush to the wall when in the upper most position. The cord which connects to the cabinet is looped around the "wall" and connected to the motor. When the motor is activated the cord begins to unravel or ravel on a shaft depending on whether the device is being lowered or raised.

For ease of fabrication, the motor is simply a battery operated power drill. The use of a power drill provides an economic package including the motor, switch, and power to operate the device. It also has the ability to easily connect a shaft. The power drill is mounted to the back of the wall. Shaft and support are also mounted to the wall in a fashion that securely fastens the shaft in a horizontal position. The drill has the ability to reverse direction which provides the easy vertical function of the cabinet.

In normal production, the cabinet would be a full size scale similar to what the customer has in their kitchen. The system has the ability to be retrofitted in the existing cabinetry so the customer does not need to buy new cabinets. An AC motor system would also be a bit more complex. The switch would be placed into a position with easy access and plugged into a wall socket.

The total cost of the project is $60.

SEAT ATTACHMENT FOR WALKER

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INTRODUCTION

This purpose of this project is to provide assistance to individuals with disabilities through use of a walker. There are also users who are in varying types of rehabilitation phases and may need to rest after a tiring workout that would also benefit from this device. The goal is to provide users with a walker to assist in walking, and also a seat for whenever they may require one. The design must be safe and easy to use for users with restricted mobility.

SUMMARY OF IMPACT

The seat attachment for a walker allows the user to sit on the walker itself without having to carry a chair or portable seat. The seat is designed to attach onto a walker without changing the structure of the walker. Another goal of this feature is to protect the original strength of the walker in order to maximize safety for the user. Existing users of walkers do not need to purchase a new walker that comes with an attached seat, like many that are being offered on the market. This design can be used on most standard walkers, and is less expensive than other similar solutions. Users are only required to complete one step to sit and two steps to walk with the walker.

TECHNICAL DESCRIPTION

The design consists of four metal holders, four sets of bolts and nuts, and two lightweight aluminum tubes. A seat is hand sewn and made from heavy duty fabric.

The metal holder is made from an aluminum 6061-T6 square bar measuring 1 x 1.4 x 2 inch. The square bar is cut, drilled, and machined into a U-clamp like metal holder. It is used to clamp the aluminum tubes onto the four corners of the walker. A total of four metal holders are placed on the corners of the walker. The aluminum tubes that are used to hold the left and right sides of the seat are locked horizontally by the metal holders on the aluminum

Fig. 11.53. Walker with Seat Attachment.

tube's ends. The tube has two through holes with ¼ in. diameter at both ends. They are centered and 0.4 in. away from both the ends. The locking mechanism is created by inserting a ¼ x 9/5 in. bolt through the metal holder and aluminum tube. The bolt is held in position by a washer and an acorn nut. The aluminum tubes are 12.5 in. long and have one inch outer diameter. The wall thickness is measured at 0.065 in. to give better strength.

According to ASTM B221, the 6061-T6 metal holder has 95 Brinell hardness, 45 ultimate KSI, modulus of

Fig. 11.54. Walker Seat in Use.

Fig. 11.55. Seat in Position for Walker Use.

elasticity at 10,000 KSI and ultimate shear strength at 30 KSI.

The seat is made from canvas material. It measures 28 x 11 inches before sewing. After sewing, it measures 20 x 11 inch where the eight inches are distributed equally on both sides. This creates two through-holes to allow aluminum tube insertion. Two sticky ties are sewed measuring 23 in. long. Each sticky tie is inserted into the seat's hole. When the seat is in use, the position is locked by using the sticky ties that tie on the walker's tubes.

The seat can support up to 190 pound applied load. For an increase in weight support, the seat material needs to be stronger. However, the weaker material is used because it is affordable and easier to process using hand sewing. A stronger fabric requires machine sewing and can be seen on most portable chairs or director's chair. Machine sewing also increases efficiency for mass production purpose.

The total cost of this project is $59.00.

PORTABLE STEP-STOOL

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INTRODUCTION

The purpose of this project is to provide a means for any person with limited ability to reach objects at tall heights. A simple stool to slightly increase height would serve to remedy most of these difficulties. This portable step stool will allow individuals, who need a bit of extra height, a portable and non-obstructive stool. Acting as a cane when not in use, it is simple to carry and store, and does not draw unnecessary attention to its user.

SUMMARY OF IMPACT

The device provides greater independence for any person with a height disadvantage. No longer will help be needed to reach simple objects, like a clothing rack or kitchen cabinet. The slim, lightweight design will not hinder the normal routine and can easily be brought along to work or a store to compliment daily tasks. Typical collapsible step stools collapse flat, into a bulky, "crushed box" shape. The aesthetically pleasant form of the cane will appeal to potential customers not wishing to draw undue attention, as it is not immediately clear that the device also serves as a step stool. The quick conversion between cane and step stool can be accomplished in mere seconds, and the reversal requires nothing more than grasping the handle and picking it up.

TECHNICAL DESCRIPTION

The Portable Step-Stool is 26 ¾" tall when being used as a cane, and 14" high when being used as a step stool. The legs are made from 5/8" and 11/16" steel tubing and 5/8" aluminum rod, while 1" aluminum plate is used in the end supports, and ½" aluminum plate is used for the step and handle. The fasteners consist of 20 rounded head 8-32 screws, four sunken 8-32 screws, and on ¼-20 sunken screw. Permanent fastening is accomplished via eight spring pins located in the center joints. Also, 20 nuts are employed to hold the 8-32 screws, with an additional four used to stabilize the legs in the stool

Fig. 11.56. Device as a Cane.

Fig. 11.57. Device in Stool Form.

configuration. A modified rubber cane tip is employed at the base, to make contact with the floor without slipping.

When being employed as a cane, the user simply needs to grasp the handle and push the end into the ground. To convert to a step stool, the cane must be turned upside down. This will cause the metal sleeves to drop, exposing the center joints. Then, the user must guide the legs in folding outward, into a pyramid shape. Holding the stool in this configuration, it needs to be flipped back over and placed on the ground. Then the user may step onto the stool, either with or without the use of a stabilizer (such as a desktop, counter, or wall). To return to the cane configuration, the user picks up the stool by the handle, and the metal sleeves fall back into place, locking the center joints against folding.

This device is constructed using several donated and scrap materials. As a result, the final cost was $10.00.

Fig. 11.58. Device in Use as a Stool.

CRANK-DOWN CLOSET COAT RACK INSERT

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INTRODUCTION

People who use wheelchairs may experience limited reach due to the fixed height of their wheelchairs. The objective of this project is to design and build a coat rack which could be rotatable 90 degrees and inserted into a closet. The purpose for the Crank-down Closet Coat Rack Insert is to lower the rack to a position where it is easier for wheelchair bound people to hang their clothes in a closet. This device can be operated with one hand by two installed bicycle crank sets. The crank sets may be built for either right or left hand use.

SUMMARY OF IMPACT

The Crank-Down Closet Coat Rack Insert is easy to install. It is hand-operated, which saves electrical energy for home use. It assists wheelchair users who live independently. The cost for building this device is inexpensive, making it an affordable solution for a wide variety of people.

TECHNICAL DESCRIPTION

The device is comprised of six main components including a 21.5" x 28" x 16" wooden frame, a U shaped rack, a removable handle bar, two 4.5" long springs, two different dimension crank sets and a roller chain. The two different dimension crank sets each have their own handle, and the crank sets are connected by a roller chain. To operate, the handle of the small crank set is rotated, which is followed by the rotation of the larger crank set.

The U shaped rack is made by welding three different lengths of aluminum pipe, which have a one inch outer diameter and an 0.865" inner diameter. Cranking down of the small crank set brings the rack down to the user. 1.375" outer diameter roller bearings are inserted into the holes drilled behind the crank sets to reduce friction.

The removable handle bar is another feature of this device. It is covered by a leather cover to reduce slippage. The removable handle bar is stored in the aluminum box located in the right bottom corner of the wooden frame. The removable handle bar can screw into the handle of the small crank set, making the crank down movement easier to operate.

Two springs are connected between the right side of the U shaped rack and the wooden frame. The spring force helps the rack to return and stay at its original position if the hanging clothes are too heavy. The prototype of Crank-Down Closet Coat Rack Insert can support approximately 25 to 30 pounds of clothes. The total weight of this device is approximately 15 pounds, not including the weight of the wooden frame, and total cost is $74.

Fig. 11.59. Crank-Down Insert Device.

Fig. 11.60. Device Lowered.

HEIGHT AND TILT ADJUSTABLE MOBILE TABLE

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INTRODUCTION

The Height & Tilt Adjustable Mobile Table enables people who use a wheelchair the ability to use a table anywhere they want inside a house. Unlike most movable tables, this mobile table not only can be used for conventional purposes such as eating and writing, but can also be tilted at different angles for ease of reading and drawing. In addition, the height adjustable feature can easily transform this table into an over-bed table not only for persons with disabilities but for seniors as well.

SUMMARY OF IMPACT

This table is height adjustable, which makes it compatible with people of all sizes as well as different models of wheelchairs. The table is also tilt adjustable, which provides users with the most comfortable angle to read and draw. There is a detachable holder, which is stored under the table when not in use which can be attached to the table top to prevent books or drawing pads from slipping off the table top when the table is tilted. Since the table is movable, it has the tendency to move away from users in wheelchairs when pressure is applied; thus the two bungee cords at both ends of the table are intended to hook on the two armrests of a wheelchair to counteract this movement.

TECHNICAL DESCRIPTION

The device is comprised of three main components including the base, the vertical support, and the table top. Each main component was built separately and assembled at the end for design simplicity and ease of shipment.

The base is constructed of three sections of 2" by 4" lumber, two 20"long and one of 34" long. Connections between sections are made using several metal brackets which also strengthen the critical locations of the base. Four casters are mounted with screws to each corner of the base to provide mobility for the table.

Fig. 11.61. Table at Lowest Position.

Fig. 11.62. Table at Its Tallest Position.

The vertical support is composed of two sections of aluminum pipes, each 22″ long. The lower post has an outer diameter of 1.5″ and an inner diameter of 1.25.″ The upper post has an outer diameter of 1.3″. In order to implement the pin-and-hole insert mechanism which provides the height adjusting feature, the upper post was turned down using a lathe to an outer diameter of 1.248″. Ten 0.25″ holes were drilled on the upper post with 2″ spacing and one 0.25″ slot is grooved on the lower post. The height of the table is adjusted by inserting a 0.25″ pin into the hole that gives the desired height and the slot of the lower post holds the table in the particular height by securing the pin. This design allows a height adjustment from 24″ to 42″. The lower post is welded to a 3.5″ by 4″ aluminum plate which serves as the surface of contact with the base.

The table top is cut out from a piece of 0.5″ thick plywood to a dimension of 20″ by 34″. It is mounted with two pipe clips to an aluminum pipe with a length of 34″ and an outer diameter of 1.3.″ This acts as the support as well as the pivoting point of the table top. One end of the pipe is welded perpendicularly to a short section of aluminum pipe, having the same dimension as the lower post. The other end is welded to a 4.5″ square aluminum plate. A series of 0.25″ holes are drilled on the square plate in the pattern of a quarter-circle. Different tilt angles are adjusted by pinning the table top to the different holes.

The assembly of the table is done easily by connecting the bottom plate of the vertical support with four #20 bolts. The short pipe that is welded to one end of the table top support is inserted into the top of the vertical support. A 0.25″ pin is used to lock in place. One end of a bungee cord is hooked to the upper post while the end of the other bungee cord is attached to the square plate. This provides the counteracting force to resist the movement of the table when the hooks are connected to the armrests of a wheel chair. The detachable holder is made out of a 2″ by 11″ plywood and is stored under the table top with Velcro. Two small pins are embedded inside and the holder is attached to the table top perpendicularly by inserting the pins into the pre-drilled holes on the table top.

Fig. 11.63. Table Turned Flat.

Fig. 11.64. Table in Use.

The total cost of the project was $60.

PORTABLE OBSTACLE COURSE FOR CHILDREN WITH DISABILITIES

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INTRODUCTION

Many occupational therapists' clientele includes children with mental disabilities. A wide variety of exercises are used that tailor to the mobility issues of their patients. Several of these exercises involve bulky equipment, which makes transportation an issue. The purpose of this project is to combine four commonly utilized exercises into one portable piece of equipment.

SUMMARY OF IMPACT

Occupational therapists (OT's) that work with children with disabilities have a need for portable and effective therapeutic devices. With this device, OT's can have the advantage of an entire obstacle course designed for easy transportation and effective therapeutic treatment. In addition, the obstacle course allows the patients to become more engaged in the treatment process, while having fun at the same time.

TECHNICAL DESCRIPTION

The Portable Obstacle Corse consists of four main components: the steamroller, the agility ladder, a tunnel and the equilibrium balance board.

The walls and base of the steamroller are constructed out of pinewood, with cylindrical rollers that are constructed from 2" and 3/2" PVC piping. The compressive force the rollers generate is accomplished by two 6" bungees attached between the top and bottom rollers providing 20 pounds per inch of force. In addition, the rollers are able to expand beyond the constraints of the sidewalls by employing extension supports. This adds an additional 10'' of maximum height.

The agility ladder is constructed from 1¾" PVC pipe and braded rope. The ladder design is unique because the height of the rungs is adjustable. This provides a more challenging task for the patient. In order for the height to be adjusted, a custom support brace, made of wood, is used to allow the PVC pipe to stack on top of one another.

Fig. 11.65. Entire Device Ready to Move.

Fig. 11.66. Entire Obstacle Course.

The tunnel obstacle is six feet long and nineteen inches in diameter and was purchased as such.

Fig. 11.67. The Tunnel.

Fig. 11.68. The Agility Ladder.

The final component of the obstacle course is the equilibrium board. This is constructed from a 21″ square piece of ¾″ plywood attached to two, 2″ by 20″ rockers. The two rockers allow the board to move in the lateral direction. Attached to the top of the board is a piece of 8″ by 12″ maple wood. Carved into the wood is a snake-like maze, deep enough to fit a small marble. The task for this obstacle is to navigate the marble through the maze by moving back and forth in the lateral direction. The maple is cut so that its height decreases with a slope of roughly 4.75° allowing for the marble to move down in the vertical direction, without assistance from the user.

Fig. 11.69. Balance Board.

WHEELCHAIR HAND-CRANK TRICYCLE CONVERSION ATTACHMENT

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INTRODUCTION

The objective of this project is to develop a non-permanent hand-crank tricycle attachment for a wheelchair that is fully controlled with a user's upper body. This device allows individuals with lower-body limitations to have more mobility, speed and maneuverability. It also may be used as an attachable recreational device. Another use would be to offer individuals who require upper-body physical therapy a more enjoyable alternative to current traditional rehabilitation methods.

SUMMARY OF IMPACT

This device is designed for individuals who have physical limitations or are confined to a wheelchair. Some scenarios this device may be used for include traveling longer distances, such as several city blocks to get to work or through a large park. It may also be used for disabled children, providing them with a way to ride a bicycle with their peers if they are unable to pedal with their feet. This device may also be used by individuals who need upper-body physical therapy. The tricycle attachment offers an enjoyable alternative to the traditional stationary hand-pedaled devices, or Upper Body Ergometers (UBE's) that are commonly used in physical therapy today.

TECHNICAL DESCRIPTION

The tricycle conversion attachment is constructed of steel tubing and several components found on standard bicycles. A unique feature of this device is that installation does not alter the wheelchair frame in any way. The tricycle attachment clamps over the cross-brace of the wheelchair, located below the seat. This is accomplished by using two pieces of steel pipe; placing one on top and one below the cross support and securely clamping the device on by tightening the two sets of nuts and bolts.

Fig. 11.70. The Hand-crank Tricycle Conversion Attachment.

The attachment is also divided into two parts including an under-seat component which can remain attached to the wheelchair, and the hand-crank or wheel component which can be removed or attached as desired. Two clevis pins are used to attach the two components together to allow for a quick and easy conversion from wheelchair to tricycle. When the tricycle attachment is in use, the two front caster wheels of the wheelchair are lifted off of the ground by approximately two inches. This allows the user to control the tricycle more easily.

There are several components of the tricycle attachment that are completely adjustable. On the clamping device that attaches to the wheelchair, there are several bolt holes. This allows for adjustments to make the tricycle comfortably fit the user's arm reach and height. Adjustments can be made by either moving the attachment forward or backward, as well as up or down. This is done by adjusting which bolt hole is used. Similarly, the tricycle conversion attachment also features an adjustable foot rest. A bolt can be loosened and the footrest can be swung outwards to either accommodate longer leg lengths, or so the user can instead use the footrests on the wheelchair. These

adjustments make this device user friendly for adults and children.

This device is controlled through a combination of hand-pedaling and steering. Steering can be done by turning the hand-crank mechanism left or right while pedaling. Like a standard bicycle, the user is propelled by completing full 360 degree forward rotations. By backpedaling, the user will initiate the coaster break. If for some reason the user needs to go in reverse while using this device, the two wheels of the wheelchair can be used. Chain guards are installed to prevent any hand injuries due to the close proximity of the hand-crank mechanism and the chain. Several reflectors are also installed as precautionary safety measures.

If this product were to be manufactured commercially, it would be beneficial to have adjustable gearing so the user can select a gear ratio that is customized to their personal comfort and ability level.

The total cost of this project is $26. The wheelchair used for this project was generously donated by Sheridan Surgical, Inc.

Fig. 11.71. Tricycle Conversion Attachment in Use.

PORTABLE LIGHTWEIGHT SEAT-LIFT AID

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INTRODUCTION

The objective of the Portable Lightweight Seat-Lift Aid is to provide assistance for people who have difficulty getting to a standing position from chairs. The device is designed to be lightweight so it can be moved from chair-to-chair with relative ease. Lift-chairs do exist on the market but most are immobile and the few portable models that exist typically require an electrical power supply. The Portable Lightweight Seat-Lift Aid relies on air power to provide the necessary lift. The prototype is designed to fit many different seat sizes.

SUMMARY OF IMPACT

Many individuals have difficulty moving from a seated position to a standing position for various reasons. This device is designed to "inflate" the user into a standing position so that there is less stress on the body while getting up. This device is light and portable so it is suitable for everyday use in a variety of locations.

TECHNICAL DESCRIPTION

The prototype is constructed primarily from angle iron, flat steel, and plywood. The body of the prototype consists of two main parts including the base frame and the lifting arms. The base frame consists of two pieces of angle iron fastened with bolts to a cut of flat steel. The 1" wide flat steel additionally serves as a handle for the device. The bottom of this base frame is constructed out of plywood.

The lifting arms are connected to the base frame with a long threaded rod which enables hinge-like movement. The lifting arms contain the seat of the device, which is made of plywood. The seat is padded with 3" polyurethane foam. The high height of the foam helps prevent the user from sinking into a chair which may make standing even more difficult.

Fig. 11.72. Deflated Device in Use.

Fig. 11.73. Inflated Seat-Lift in Use.

Fig. 11.74. Device Inflated.

Fig. 11.75. Device.

The device is powered by an "Air-Wedge" bladder that requires manual hand pumping. The bladder is located under the lifting arms and remains flat while deflated. Squeezing the attached bulb inflates the bladder which is then filled and the device's seat begins to rise. At maximum inflation the user is in a less stressful position to rise out of their seat. The seat is lowered by pushing the bladder's release valve.

The total cost of the prototype is $62. The prototype is limited by the size and availability of suitable air bladders. Currently the prototype uses a bladder that inflates to a height of approximately 3". Future prototypes should include a bladder twice as large.

INTRAMUSCULAR AUTOMATIC INJECTOR

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INTRODUCTION

The goal of the Intramuscular Automatic Injector is to provide patients diagnosed with Multiple Sclerosis who are prescribed Interferon beta-1a, an easier process to administer their medication. Typically, these patients are required to self-administer their medication by means of an intramuscular injection either in the Vastus Lateralis muscle or the Deltoid muscle. In some cases, the patient may wish to have another individual provide the shot that is trained in administering intramuscular shots. The delivery of these shots can be a stressful event. The device designed in this project attempts to provide MS patients with an easier way to administer their medication.

SUMMARY OF IMPACT

Many patients suffer from anxiety with regard to self-injection, a mild form of Trypanophobia commonly referred to as "needle phobia". As a consequence, the individual is unable to administer their own medication. This device addresses that issue. By shrouding the needle and automating the injection procedure for intramuscular shots, an "out of sight, out of mind" effect is created. This relieves the patient from the anxiety that is induced from the sight of the needle and the anticipation of the insertion. It also makes it easier for a second party to administer the shot as it is automated.

TECHNICAL DESCRIPTION

The automatic injector consists of three major components including the frame, the drive system, and the carriage. The frame is fabricated from a 7" long, 2" x 1" rectangular aluminum tube. The frame provides support for the carriage and carriage release mechanism, and shrouds the needle prior to injection. Groves are cut into the frame to allow access to the carriage to insert the syringe for use, and to guide and provide limit stops to the carriage. Limit stops are required on the carriage to prevent the needle from injecting too deep or with excessive force during the intramuscular injection procedure.

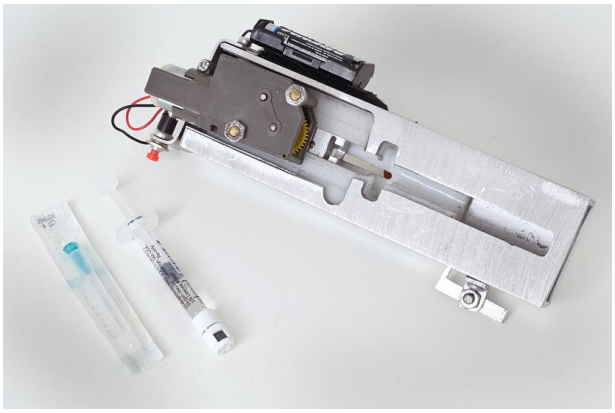

Fig.11.76. Front of Injector.

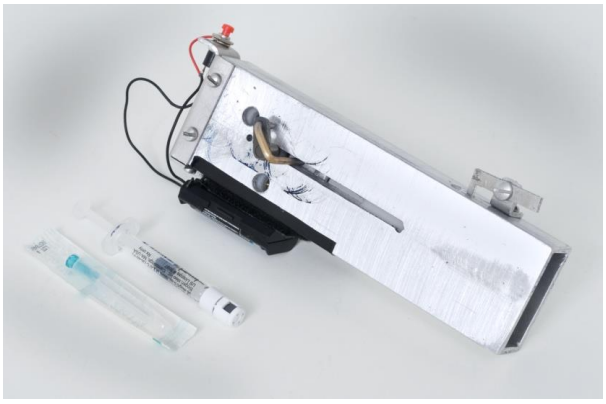

Fig. 11.77. Back of Injector.

The drive system consists of a 4-Speed Crank Axle Gearbox from Tamiya set to a 441:1 gear ratio and FA-130 Mabuchi drive motor. The motor provides sufficient torque to transfer rotational force that is converted to linear motion, to drive the plunger on a syringe outward for aspiration and inward to administer the medication intramuscularly. Electric power is provided by two AAA batteries.

The carriage is a 4-3/4" long, 1-3/4" x 3/4" Teflon block with the main function of housing the syringe. It also holds the mechanical parts that provide linear motion. Additionally, it supports the drive system. Prior to administering the injection the carriage is drawn back against a resisting spring force and held

in place by the carriage release mechanism. Upon initiation of the injection, the carriage release is depressed and the spring force drives the carriage forward, inflicting the needle protrusion.

The total cost of the project is $14.98.

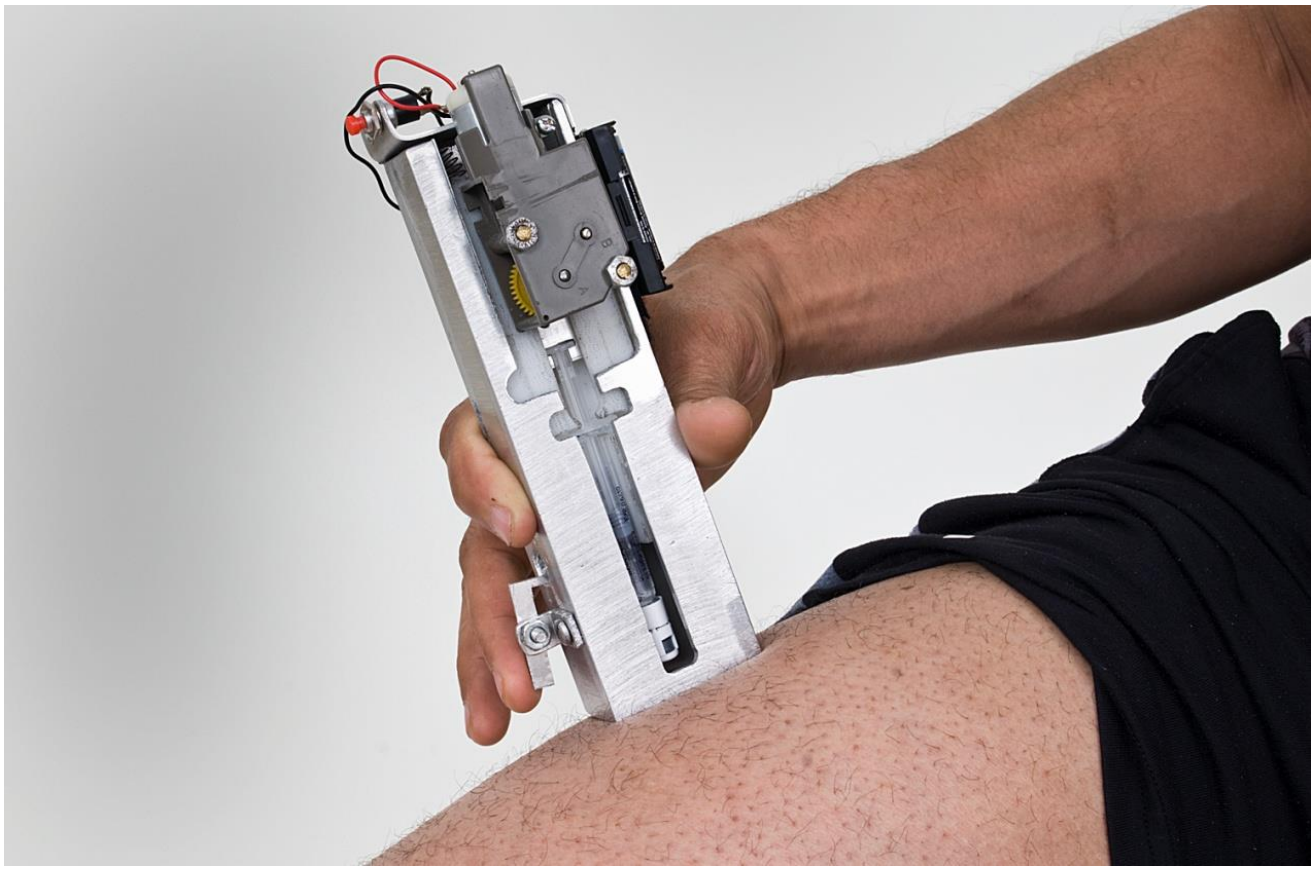

Fig. 11.78. Injector in use.

ERGONOMIC CRUTCHES

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INTRODUCTION

The purpose of the Ergonomic Crutches is to reduce the discomfort associated with traditional crutches. Due to the design of standard crutches, the user usually experiences some pain and discomfort in the muscles, irritation on the skin of the underarm as well as joint pain in the wrists. Due to the cost and production limitations faced by crutch manufacturers, modern crutches are simple, cheap, and offer great support. They do exhibit extremely poor ergonomics and cause much user discomfort. By utilizing current crutch designs and adding new features to add to user comfort, the final product aims to make a person's time spent on crutches a more tolerable experience.

SUMMARY OF IMPACT

Reducing the discomfort that a person experiences while on crutches can allow the user to spend more time being mobile, reduce the time spent nursing the irritation produced by crutch discomfort, and spend more time attending to the injury that is causing the use of crutches in the first place. The reduction of stress on the user's wrists has a significant effect on comfort. This is especially important for people who are constantly on the move, such as students, athletes, and those working in the professional world, such as in an office.

TECHNICAL DESCRIPTION

Since the purpose of this project is to improve the design of existing crutches, a pair of standard aluminum crutches has been used as a starting point. Although wooden crutches are slightly easier to machine to accept the new hardware, aluminum crutches are lighter than wooden units. To allow the handgrips to slide up and down with a range of approximately four inches, a slot is machined in each side of each individual crutch using a milling machine. Unfortunately, by removing material from the already thin aluminum tube, the overall strength of the tube is lowered, making the tube much less resistant to lateral bending when the weight of the

Fig. 11.79. Device in use.

Fig. 11.80. Additional Cushioning.

Fig. 11.82. Collapsed Handgrip

Fig. 11.83. Extended Handgrip

Fig. 11.81. Moveable Handgrip

user is applied. A set of machined and polished steel pipes is added to the structure to compensate for this weakness and to add strength to the overall structure. To accommodate the movement of the handgrip, a slot equal in dimensions to the slot cut in the aluminum tube is machined in each pipe. Finally, a set of holes is drilled in each pipe and secured to the aluminum tube using ¼"-20 hardware, an industry standard. This reduces costs and is used to prevent movement. Due to the milling process, the edges of the slots are slightly sharp. To prevent user injury, a few additional "sleeves" are machined from aluminum to act as a sliding barrier between the user's skin and the edges of the slots. All surfaces on the pipes and sleeves are sanded smooth and polished on a lathe to increase visual appeal and reduce abrasion. Heavy duty storm door return springs are adapted to be used on the handgrips, and are extremely cost effective.

Adjustability for users of various heights is retained through the normal push-button adjustment for height. Handgrip height is also adjustable by moving the upper mounting point of the spring to a different notch in the aluminum tube, similar to the original design. To reduce underarm abrasion, a pair of soft foam sponges is cut to size and secured to the original hard foam pad. These can easily adapt to the shape of the user's underarm.

The total cost of this project is $23.11

CANOPY ATTACHMENT FOR WHEELCHAIR

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INTRODUCTION

The canopy attachment for a wheelchair is an attachment device that provides protection for users from different kinds of weather that attaches on the back of a traditional wheelchair. The main objective for the attachment design is to provide protection to suit users of different sizes and ages. A secondary objective is to be easily attachable with little time needed to install. The attachment is also very easy to use and inexpensive to acquire.

SUMMARY OF IMPACT

The canopy attachment is designed to protect wheelchair users in different kinds of weather conditions. The canopy is attachable and detachable to a traditional wheelchair without damaging its original structure. The attachment is designed to be placed on the designated location on the back of the wheelchair. It uses the handles of the wheelchair as the base and support for the entire attachment. For its implementation, the users first sit on the wheelchair. To adjust the height of the canopy, the buttons are depressed from the two adjustable bars and the height of the whole canopy attachment can be adjusted by raising or lowering the two bars. For the adjustable bars to be placed to the desired height, they have to be adjusted to the same height. For example, the users have to adjust the height of the canopy by adjusting four supporting bars of the walker. The users also can adjust the length of the canopy by pushing or pulling the aluminum bar which is attached to the back of the canopy. This allows varying canopy heights to satisfy different heights and user preferences. This mechanism also allows the users to adjust the length of the canopy according to the weather conditions.

TECHNICAL DESCRIPTION

There are six adaptive parts that form the adjustable and extendable canopy. The first adaptive part is assembled by using two l-braces to serve as the base. They connect the adjustable bars to the handle of the

Fig. 11.84. Connecting Mechanism.

Fig. 11.85. Extending Mechanism.

wheelchair. The handle serves as the support for the weight of the attachment. The l-brace is screwed to the bar and to the handle of the wheelchair.

The second part of the attachment is the adjustable bar, which allows the canopy to be adjusted. This bar is similar to the adjustable portion of crutches that have holes and pins to adjust them. In order to connect the adjustable bar to the aluminum height increment bar, two plastic hollow connectors were used. A plastic material is used in the design because it is light weight and low in cost. The plastic connectors are also easy to shape and drill.

For the third part of the attachment design, two aluminum bars are used to adjust height increments and the displacement bars were used to allow for extension. There are four holes on each aluminum bar which connect them to the displacement bar. Aluminum is used because it is lightweight.

After the increment bar, the fourth adaptive part of the attachment design is the extendable mechanism for the length adjustment of the canopy. This mechanism is made of steel and purchased entirely from the Swiss furniture store. The mechanism is in a crossed steel pattern to make the mechanism easy to extend and close. In order for smooth operation during extension, lubricant oil is used in the intersection to decrease the friction.

A pair of aluminum bars is attached in between the two adjustable bars. These two bars serve as a constraint to stabilize the entire design. These bars act as the backbones of the attachment.

An aluminum bar is attached to the canopy which serves as the push handle to extend or close the canopy. Tablecloth material was chosen for the canopy material because it is low in cost, lightweight, and is aesthetically pleasing.

Fig. 11.86. Extended Canopy.

This design was tested under different weather conditions including wind and rain. The canopy was stable and firm while testing under windy conditions.

The total cost of this project is $ 40.00.

VISUALLY IMPAIRED SMART CANE OR WALKER

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INTRODUCTION

The goal of this project was to aid people that use walking sticks as a means for mobility. The daily use of walking sticks was taken into consideration and improvements are made to enhance the user's ability to navigate through a human rich environment. This unit was made to be as portable as a normal walker but with sensors added to read the heat signatures of bodies next to or ahead of the user.

SUMMARY OF IMPACT

The "Visually Impaired Smart Cane or Walker" is versatile in nature. Depending on the user's main needs, the cane or walker can be adapted to different environments. The parameters of this cane are based on the need to know where a body is positioned based off the user's reference frame. The body could be human or an animal like a cat or dog. This walker will enable its user to get approximated locations of any living body. Living with a pet will now be a little more comfortable for the visually impaired.

TECHNICAL DESCRIPTION

The walker system consists of the main skeleton of the system. The main skeleton is the removable aluminum cylindrical shafts used as the main component for mobility while using the walker. It comes in three pieces. All three can be separated if necessary. There is also a fourth piece used to help those with hand function limitations. These removable parts allow for easy storage and portability. Also, the bottom of the walker is assembled with an irremovable smooth hard plastic spherical bottom to compensate for various surfaces.

Unlike other walkers, there is a small body added at the lower end of the walker on the lower removable part. This is the housing for the passive inferred sensors, PIR, that are employed in the design. These sensors are to detect changes in body heat. If a heat source is registered to the sensor, an output signal is given off in a range of up to five volts. If no signal is output, then the signal is left as zero volts.

Fig. 11.87. Leading Tip of Smart Cane with Sensors.

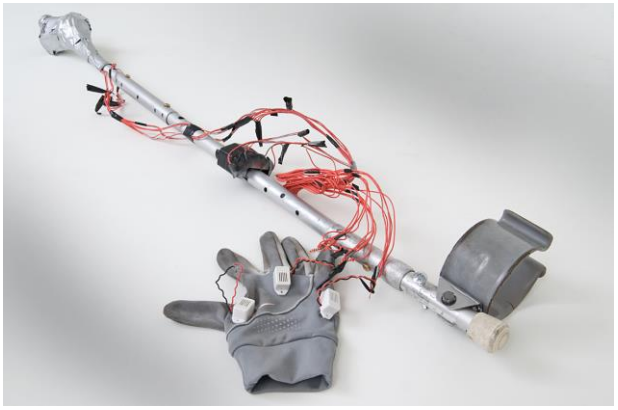

Fig. 11.88. Entire Smart Cane Device.

To finish the system, sets of wires are used along with three nine volt batteries and a buzzer. They are used to complete the circuitry and allow for the sensors to work. The system gives an output signal that is converted by the buzzers into auditory signals. Each sensor is set to a certain sensitivity level based off the variable resistor located on the circuitry of the sensors.

Fig. 11.89. Smart Cane in Use.

PILL HOLDER FOR SPLITTING

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INTRODUCTION

The goal of this project is to assist in the splitting of prescription pills. The device is designed to help hold pills securely in place while the user splits them. Splitting pills accurately with a conventional pill splitter can be difficult to do, due to the fact that the pill has a tendency to move while it is being split. This design also compensates for a variety of different pill sizes.

SUMMARY OF IMPACT

Pill splitting has become a very popular way for people to save money on prescription medications. This is due to the fact that drug companies charge similar prices for varying doses of medication. For example, a popular online pharmacy charges $90.00 for 30 tablets of 10 mg of Lipitor and $124.00 for 30 tablets of 20 mg of Lipitor. If the lager dose is purchased and simply split in half, the patient could save a great deal of money. Although this is a popular practice, it does come with its risks. While splitting a pill with a conventional splitter it is possible to split the pill unequally, resulting in an overdose one day and an under dose the other. This device ensures equal dosage by holding the pill steady during splitting.

TECHNICAL DESCRIPTION

The design of the holder is based on a store bought pill splitter. The splitter is mounted on a wooden base, which is machined to have a raised flat portion that is of equal height to the pill splitter's cutting platform. A machined metal slider is placed on this raised platform and is held in place by a cover that slips over the base. There is a very small gap left for the slider to slide back and forth between the base and the cover. The metal slider is then used to hold pills in place as it slides in and out of the "V" shaped cutting platform of the pill splitter.

Fig. 11.90. Full View of Holder.

The metal slider has two ends to it. The end that the user pushes and pulls from is wide and easy to grip, with smooth, curved edges. The other end is the part that holds the pill. It comes to a point which is bent at a 90° angle and has a slit down the middle of it. The end is bent so that it evenly pushes the pill into place. The slit is present to allow for the blade of the pill splitter to pass fully through the pill.

The entire project weighs approximately one pound and costs $7.00.

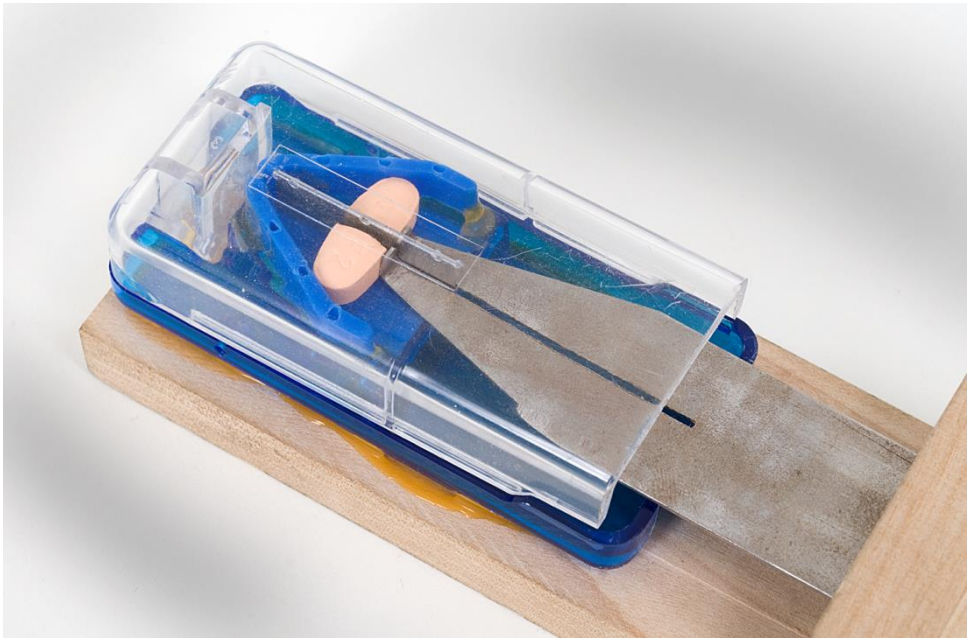

Fig. 11.91. Pill Splitting Process.

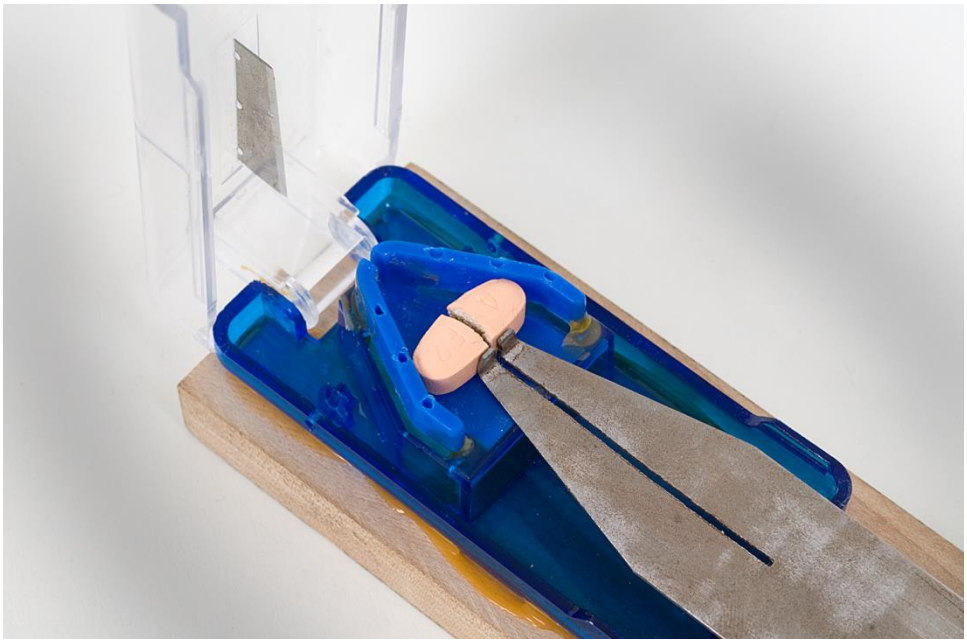

Fig. 11.92. Close Up of a Split Pill by Device.

STORABLE WHEELCHAIR DESK

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INTRODUCTION

It can be very difficult for a wheelchair user to find an area of a table that is accessible to them. Whether there is no desk available in a classroom or the lack of a hard surface in varying locations, the Storable Wheelchair Attachment addresses this problem. The Storable Wheelchair Attachment is a desktop that is attached to the back of the wheelchair and can be easily accessed whenever the user desires. The device allows to a hard surface whenever needed.

SUMMARY OF IMPACT

The Storable Wheelchair Attachment allows wheelchair users' access to a hard desktop surface at all times. They can write on paper, set down a drink and even type on a laptop without the hassle of finding a surface that can accommodate their wheelchair. When the desktop is not needed, it is stored behind the wheelchair, which allows for normal use of the wheelchair. Therefore, the user will always have access to a desktop surface while still being able to use the wheelchair without interference.

TECHNICAL DESCRIPTION

The design of the attachment is based around three main points including allowing for a sufficient amount of surface space, creating a device that is as lightweight as possible and creating a device that does not hinder normal wheelchair function when not in use.

To address the first issue of having a sufficient amount of surface, a typical L-shaped school desktop is used for the hard surface. This allows for a proper sized workspace. The shape of the desktop enables the device to act as an armrest as the hard surface covers the right armrest of the chair.

It also wraps around the rider for a close fit, which allows for easy reach of the entire surface. When the surface is not in use it can be moved to the side, folded down, pushed around to the back of the wheelchair, and attached by magnet to the backrest.

Fig. 11.93. Device in its Storage Spot.

In order to make this device as light as possible two aluminum bars are used. One bar is connected to a backrest that is attached to the wheelchair. The backrest is connected to the wheelchair at four points. The top two points are loops that go over the back handlebars of the chair. The bottom two points are connected to the side bars of the wheelchair's backrest. This backrest has a piece of soft foam on the front for the user's comfort. The bar that is connected to the backrest is in a horizontal position. The second bar is connected to the desktop by a continuous hinge that runs 21 inches of the 25-inch aluminum bar. A pull pin attaches these two aluminum bars to each other. When the desktop is not in use, the second bar closes and is in a horizontal position above the first bar. In order to keep the second bar in the closed position a magnetic plate is screwed on to the bar. The plate catches a magnet that is attached to the backrest. This design allows the wheelchair to function normally when the surface is not in use, as the entire device is stored behind the wheelchair.

To use the desktop, the user reaches around the back and pulls on it. The desktop swings around the right

side of the wheelchair on the aluminum bar. Then the desktop is lifted up from the vertical position to a horizontal position and moved over the armrest. In order to lock the desktop in the horizontal position there is a small piece of wood attached to the bottom of the desktop. This piece is rotated 90° and is then pressed against the aluminum bar, which stops the desktop from folding down along the hinge.

The cost of this project is $42.

Fig. 11.94. Full View of Device.

HEARING AID BATTERY INSTALLER

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Client: Walter Burns
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INTRODUCTION

The Hearing Aid Battery Installer is intended for users who are both hearing impaired and have arthritis. There exist many individuals who experience joint pain and also have varying levels of hearing loss. Installing a hearing aid battery can become a very challenging, frustrating and even a painful task. This device eases this process tremendously by allowing the user to relax their hand to a more natural position, and to pick-up and place the battery without ever having to flex their joints. In order to further simplify the process, a custom mold of the hearing aid is made in order to hold the hearing aid while the battery change is completed. The device also uses a bright LED to light the workspace, increasing the ease of use for those that have vision problems.

SUMMARY OF IMPACT

This device simplifies a task that can be extremely difficult. Making a tool like this available to the public at an affordable cost could make life, for someone with arthritis, easier and more independent.

TECHNICAL DESCRIPTION

This device works on basic DC circuitry, electromagnetic principles, and most importantly, ergonomics. The device has two main components; one which holds the hearing aid and a second which lifts and inserts the battery.

In order to hold the hearing aid, a custom mold is made of a hearing aid with molding clay. The mold is simply an impression of the hearing aid with its battery tray is left open. Once dried, the mold allows the user to easily insert the battery into the hearing aid. On the bottom of the mold are four rubber feet to avoid slipping in any direction.

The device to lift the battery serves two functions. It allows the user to lift the battery with an electromagnet probe while lighting the workspace with a bright LED. The DC circuitry is organized in a parallel fashion to perform these two functions. One branch of the parallel circuit is formed with the bright LED and a 220 Ohm resistor. The resistor creates a large enough voltage drop to safely light the LED. The other branch of the circuit is made of the electromagnet with a 10 Ohm resistor. The 10 Ohm resistor limits the current flow of the overall circuit. The electromagnet is made with a five inch machined cylindrical iron-rubber compound wrapped in 40 feet of 36 gauge magnet wire. The

Fig. 11.95 Hearing Aid Battery Installer.

Fig. 11.96. Device in use with LED On.

iron-rubber compound allows the electromagnet to completely demagnetize when there is no current through the wire. This is important due to the small weight of the battery. The electromagnet is covered in electrical tape in order to protect the wire wrapping. The circuit is powered with a 7.5 volt, two amp DC power supplies with the two functions wired in parallel.

The outer casing of the device is made with PVC piping. The case contains the entire circuit described above. Protruding from the front of the device is the electromagnet probe. This is what is used to pick up the magnet. Branching out of the side of the device is gooseneck tubing to help guide the LED to the workspace.

The red button on the top of the device activates both the LED and the electromagnet. The device, as mentioned earlier, is powered by the DC power supply at the back of the device.

A key focus to this design is ergonomics. The invention is easily cradled by a right handed user and the button is perfectly placed for the thumb. The gooseneck tubing doesn't interfere with the user's hand and easily bends to the desired location. Another important consideration with regard to ergonomics was the design of the mold. The mold allows the user to place the hearing aid easily in a custom fitting while restricting motion in any direction during battery installation. Overall, the device is easy to operate and puts much less stress on the user.

UNIVERSAL MOUNTING ACCESSORY TRAY SYSTEM (UMATS)

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INTRODUCTION

Persons with disabilities use their wheelchairs or walkers for many hours during the day. As a result, they perform many daily tasks in a seated position. The objective of this project is to design and fabricate a mechanism to aide in the mobility of an individual with disabilities. The device is designed to be used in many settings, and is ideal for a rehabilitation center. It will help to increase the independence of wheelchair users as well, helping them to carry out daily activities without assistance. The Universal Mounting Accessory Tray System helps to overcome some of these problems by providing a simple work station which is easily mounted and removed from a conventional wheelchair or walker. Another objective is that the system be lightweight and provide a tray which can be pivoted to a variety of angles and positions. The device is vertically adjustable to accommodate many users and then swivels out of the way for easy exit from the wheelchair or walker. The individual using the device requires no additional assistance and gains advantages they would not otherwise have when using a simple desk. This workstation is specifically tailored for simple and efficient use with a wheelchair.

SUMMARY OF IMPACT

The device enables wheelchair users to gain more independence by being able to more easily to perform day to day activities in different environments. Such daily activities may include reading a book, using a laptop, and eating or preparing snacks. Most importantly, the system is lightweight, durable, and portable. It is designed to assist the user in everyday tasks, allowing them to become more active in their everyday lives.

TECHNICAL DESCRIPTION

The system consists of four main components including a tray made of wood which may also be fabricated from polycarbonate, a frame aluminum clamp which is designed to fit on any pole or bar on a wheelchair or walker frame, two double end rod swivel joints, and a telescoping aluminum tube which provides the custom height adjustment. The universal head allows the user to attach other components such as an umbrella.

Fig. 11.97. UMATS Connected to Wheelchair.

The Universal Mounting Accessory Tray System is easily mounted and removed from any existing wheelchair without major modifications. The system is made to be adapted and mounted before or over the arm of any wheelchair or walker using the swivels for multi-pivotal motion. The desired

Fig.11.98. UMATS in Use.

Fig.11.99. UMATS with an Umbrella Attached.

location is locked via the lever operated screws. The height adjustment for displacement is made vertically by means of a telescoping tube and pin assembly, and then locked in the desired position. The unit uses a tray, mounted and supported by a swivel joint, which is able to be vertically and angularly adjusted about its axis via a nut locking assembly which is activated when turned counterclockwise.

The system also incorporates several different linkages to automate motion in various directions. The first is that the desktop is able to move vertically via universal swivel arms. The second rotates the system back and forth to create a suitable angle to read a book or other work. The third lowers or raises a locked tray to the user's preferred height for eating or other tasks that may require different heights. All work performed by the system is manual. The total weight of the system is approximately 3.5 pounds.

Total cost of project is $25.00

ABDUCTOR PILLOW WITH BUILT-IN HEEL FLOATERS

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Client: Tadeusz Anthony Zyrek
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INTRODUCTION

The objective of this project is to design and build an abductor pillow with built-in heel floaters for patients with hip replacements. An abductor pillow with no straps and incorporated heel floaters will provide pressure relief to both heels. A built-in heel floater design is easy to use and will maximize patient compliance.

SUMMARY OF IMPACT

This product is convenient and easy to use. This one piece device eliminates the need to improvise in order to reduce pressure on the heels during recuperation. It is simple, durable, lightweight and easier to use than currently available devices. Materials chosen for the design are durable, and the top and bottom of the pillow can be cleaned with soap and water. The sides of the pillow and heel floater covers are coated with sheep skin which is a natural material and will aid in pressure and shear force reduction where skin comes in contact with the pillow and bedding. As a result, the sheep skin will help protect the skin from abrasions and blistering, thus aiding in patient recovery. It will also prevent future complications and minimize the cost and time of recovery. The pillow may be used for patients undergoing hip replacement in a hospital, rehab centers or even in a home setting. To use this pillow, the patient needs to be in a supine position lying in bed. Both lower extremities should be abducted approximately one foot apart at the heel. The cushion should be placed with the heel floaters against the mattress, and the smaller end towards the pelvic area in such a way that the wider end of the cushion is horizontal with the soles of both feet. The heels should be placed on top of the heel extenders and adjusted for patient comfort.

Fig. 11.100 Abductor Pillow.

TECHNICAL DESCRIPTION

Materials considered for the design are a high density foam cushion cut in a T-shape, marine quality vinyl and sheep skin. The prototype is constructed from materials available through donations. The body of the pillow is shaped from the cushion. The heel floaters consist of two foam pool noodles, joined together for added stability. The foam noodles are threaded via the center opening with a one centimeter vinyl tube. This tube runs throughout the length of heel floaters and the body of cushion. Duct tape is used to join all surfaces and mimic marine vinyl. The sides of the cushion and heel floaters are coated with sheep skin, which is attached to the prototype pillow with sewing glue. For the final product, the sheep skin is washable, and attached with Velcro. The final dimensions of the six pillow parts are as follows a total length of 57 cm, width of 79 cm, height of 16 cm, a heel floater of 20 in length, width of 15 cm for the heel floater, and heel floater height of 10 cm.

The total cost for this prototype is $0.00 due to donations.

Fig. 11.101. Abductor Pillow in Use.