STATE UNIVERSITY OF NEW YORK AT STONY BROOK
School of Engineering and Applied Sciences
Department of Mechanical Engineering
113 Light Engineering Building
Stony Brook, New York 11794-2300

Principal Investigators:

Qiaode Jeffrey Ge (631) 632 8315
Fu-Pen Chiang (631) 632 8311

The Hand-driven Tricycle for a Disabled Student

Students: Angela Yuan and Kadiffe Samuels
Client Coordinator: Thomas Rosati, Forest Brook Learning Center, Oakdale, NY
Supervising Professor: Peisen Huang
Department of Mechanical Engineering
State University of New York at Stony Brook
Stony Brook, NY 11794-2300

(a) (b)

Figure 1: (a) The Hand-driven tricycle. (b) Kadiffe on the tricycle.

INTRODUCTION

The hand-driven tricycle is a mobile, physical therapy device. The goal is to create a device that will be fun and encourage young students to participate in their physical therapy. It will be a fun toy, while allowing the student to increase his strength and overall heath. The tricycle will also be a device for disabled students who want to be active. The vehicle will require the rider to have gross motor skills in the upper body. Students with little or no functionality in the lower body are the target user group.

SUMMARY OF IMPACT

The Hand-driven Tricycle will allow students who are only capable of using their upper-body to exercise and having fun. Our design differs from many other products that are mainly for adults and/or require the rider to use all of their limbs.

TECHNICAL DESCRIPTION

The Hand-driven Tricycle is a completely mechanical system. It utilizes linkages, sprockets and chain to perform all of its functions. The vehicle is powered when the rider performs a bench press motion that drives a chain ring located at the base of the arm. This chain ring then drives the sprockets at the rear wheel, moving the vehicle forward. The design of the rower arm allows the user to perform turns at any position during the stroke. The outer sleeve of the arm actuates the steering linkage via two links [the rabbit ears]. The steering and power generation systems were incorporated into one unit to facilitate our target users who would only have use of their hands and arms.

4130 Chromoly tubing was to construct the chassis. Some of the tricycle's features include: Ackerman steering geometry for better vehicle control; center-patch steering to reduce wheel scrub; self-centering steering; 6 strength settings to accommodate drivers with varying abilities; drum brakes in the front wheels and a seat belt for safety; and an inclined seating area to accommodate drivers of varying heights.

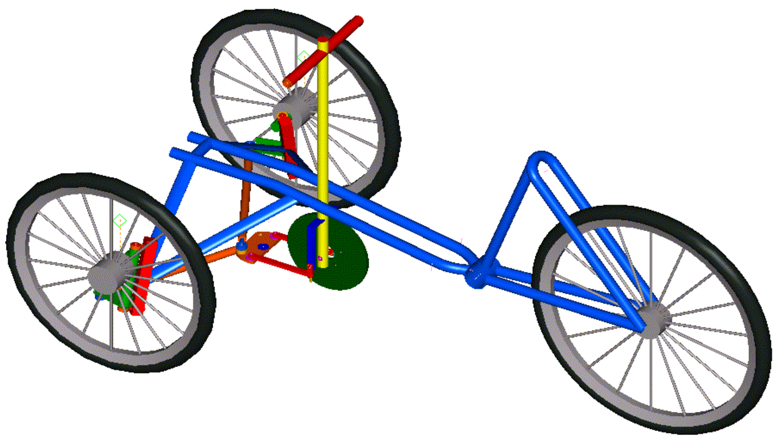


Figure 2 – 3D model of the Hand-Driven Tricycle

AirTherapy Reclining Wheelchair

Students: Richard Fenwick and Gregory Gunther
Supervising Professor: John Kincaid
Department of Mechanical Engineering
State University of New York at Stony Brook
Stony Brook, NY 11794-2300

Figure 1: AirTherapy Chair in various positions.

INTRODUCTION

The goal of this project is to develop a multifunctional wheelchair. It is usually difficult for a wheelchair user that is fully dependent on another individual, to be transported into or out of a chair. Many individuals that are dependent on others for care are fragile, but it also takes a great deal of strength to maneuver or transport them. This chair will allow its user to stay in the chair for many daily activities that he/she normally has to be transported out of. As a result there is less physical strain on both the user of the chair and the person providing care.

TECHNICAL DESCRIPTION

The seat, originally from a Saab, has plush leather covers on the back and bottom support surfaces as well as the headrest. The seat and back support of the chair is made up of foam and individual air cells that could be inflated or deflated. A small pump used for medical purposes and powered by a 12 volt-DC battery inflates the air-cells. A single toggle switch controls two solenoids per air-cell, one for intake and the other exhaust. Since the chair is made up of ten separate air-cell regions there is a total of 20 solenoids. When inflating an air-cell the pump is turned on and the intake solenoid is opened for the corresponding air-cell. When an air-cell is deflated only the corresponding exhaust solenoid is opened to allow air to vacate. The air cells will provide the user with proper positioning and corrective alignment. By alternating air pressure one can counter pressure points and thereby reduce the risk of tissue breaking down.

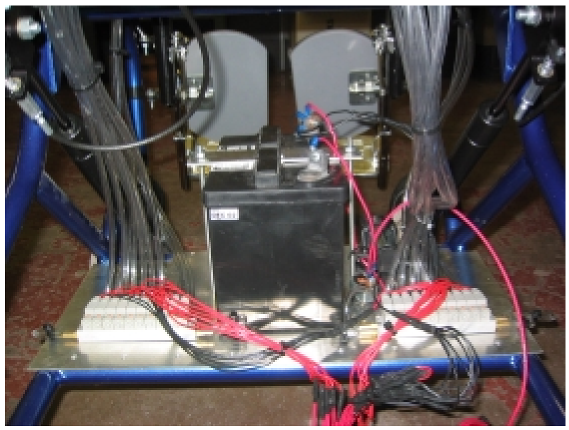


Figure 2: The solenoid assembly.

To optimize the seating further, the chair can recline, tilt and go into a lay-flat position. Two Bloco-lift gas springs will be used to assist in tilting the wheel chair. Each spring is mounted to the inner part of each side of the frame. The springs are connected on an angle to the bottom of the seat base. This setup provides optimum space for the air cell power components. The spring release is mounted to the respective side of the handle bar.

The idea of this design was inspired by the needs of a young man named Christopher Fenwick. The is designed for a larger individual to allow the designers to test its function ability.

A provisional US patent application has been filed for this design.

Portable Wheelchair Lift.

Students: Lincoln Aguirre, Nicholas Hanczor, Michael Lucas
Client Coordinator: Thomas Rosati, Forest Brook Learning Center, St. James, NY
Supervising Professor: Robert Kukta
Department of Mechanical Engineering
State University of New York at Stony Brook
Stony Brook, NY 11794-2300

Figure 1: The portable wheelchair lift.

INTRODUCTION

The purpose of this project is to design a portable wheelchair-lifting device for the Forest Brook Learning Center. On many occasions, it is necessary to bring a wheelchair up onto a stage in the auditorium. At the present moment, the schools faculty uses a wooden ramp over the main staircase to perform this task. Because of problems with the current lifting device, nearly half of the school's facilities can become restricted to a child in a wheelchair. A portable lift could be taken from the location where it is most widely used, and easily be adapted to lifting children onto the stage during special occasions.

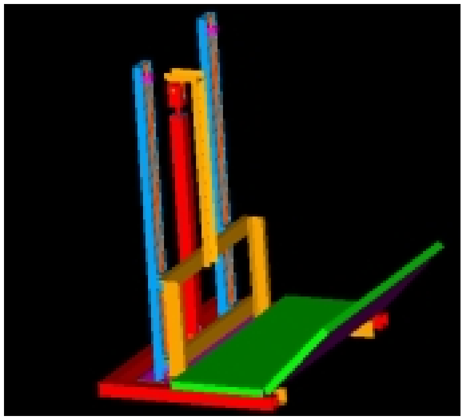
Operating the lift will need to be trouble-free and simple. The lift will need to be able to lift a maximum of 500 lbs. A vertical distance of approximately 30 inches and a horizontal distance of 40 inches are desired. It will need to be safe to operate. Maintenance required will need to be kept to a minimum.

SUMMARY OF IMPACT

This project assists a person in a wheelchair up a small flight of steps.

TECHNICAL DESCRIPTION

The lift is made up of three major components: A steel main frame, linear bearing system and a control system. The linear bearings connect the platform to the frame while the hydraulic and electric control system raise and lower the lift.



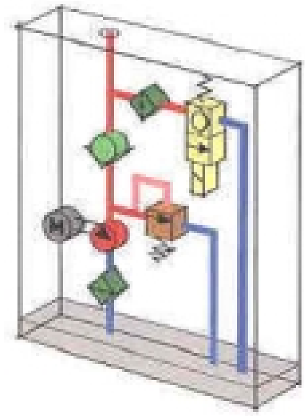


Figure 2: 3D model of the wheelchair lift. Figure 3: The power unit.

The power unit consists of a DC motor, hydraulic pump, and reservoir. Calculations were performed to determine the type of motor and hydraulic pump. A common pump displacement was used in determining the horsepower and Time. The area of the rod multiplied by its stroke length determines the minimum reservoir capacity.

Figure 4 shows an electric schematic of the electrical system. An 110V AC plug is connected to a 110V AC to 12V DC Power Converter. The power converter is connected in series to a 12V DC battery to provide power to the motor and to charge the battery. The battery provides the necessary power to run the motor when the power converter is not plugged in. The single pole double throw spring center switch is the switch used to raise and lower the platform. When the switch closes the circuit to the start solenoid the motor is activated and the platform is raised. When the switch closes the circuit to the solenoid dump valve, the dump valve opens and allows the platform to lower. The normally closed switch is to be placed so that when it is depressed (circuit opens) the platform is at its maximum height and the pump no longer runs.

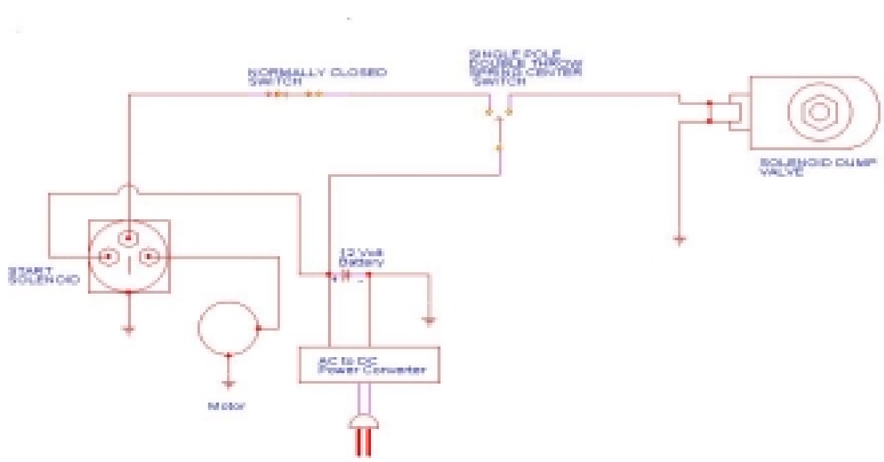


Figure 4: Electric Schematic of design

The total cost for the project was $1490. All the steel used for this project was donated and thus not calculated in for the total cost.

The LRD (Leg Rehabilitation Device)

Students: Michael Kamor, Wendy Lackner, and James Paola
Client Coordinator: Thomas Rosati, Forest Brook Learning Center, Oakdale, NY
Supervising Professor: Professor Raman P. Singh
Department of Mechanical Engineering
State University of New York at Stony Brook
Stony Brook, NY 11794-2300

Figure 1: The LRD is a power assisted Pedalo.

Figure 2: The original Pedalo.

INTRODUCTION

The purpose of this design project was to redesign the Pedalo. The Pedalo is a pedaling device, in which the user pedals against his own weight. This device is purely mechanical with no steering capability. Re-Design goals were to add steering capability and make it electrically powered and electronically controlled. Use of the original device requires that a supervisor have the user get off the machine in order to turn it around. Users of this device have little leg strength, so having them come off the machine every time it needs to turn around is difficult for both the user and the supervisor. The addition of a steering system eliminates this need. Through the use of a controller the supervisor is able to turn the device around with the user on the machine.

SUMMARY OF IMPACT

This project develops an electronically controlled steering system to turn a rehabilitation pedaling device.

TECHNICAL DESCRIPTION

The LRD is supported by a chassis made of aluminum square tubing. To this chassis three subsystems, pedaling, steering, and driving, are attached. The pedaling subsystem consists of the pedals and the mechanism by which they are supported. The support mechanism includes pedal bars hat rotate through bearings. These bars are similar to that which is used in a pedal boat. Attached to the pedaling subsystem is an activation motor (Figure 4). Turning of the pedals activates this motor which in turn activates the drive motors turning the wheels forward.

The steering is determined by the controller seen in Figure 3. The cylinder in the center controls the steering. The trigger allows pedal activation of the motors. The two buttons allow the supervisor to move the device forward and back without pedaling.

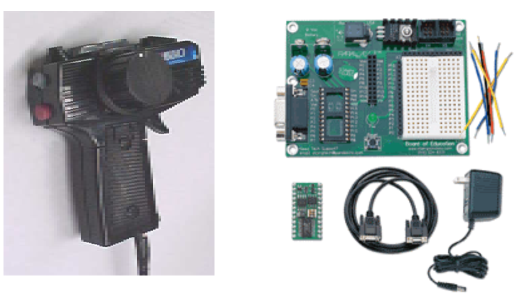


Figure 3: The controller and BASIC stamp.

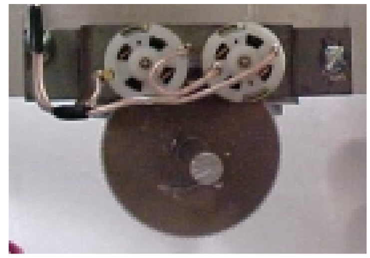


Figure 4: Pedal activiation.

Signals from the controller go to a BASIC Stamp microcontroller seen in Figure 3. The program written for the stamp includes safety commands. For example, the wheels are prevented from turning more than 45° when the motors are active to prevent the user from tipping over. The wheels can be turned 90° when the motors are off. Once they are turned the motors can be activated again allowing the device to turn around. The LRD automatically stops when there is no input from the controller or the pedals.

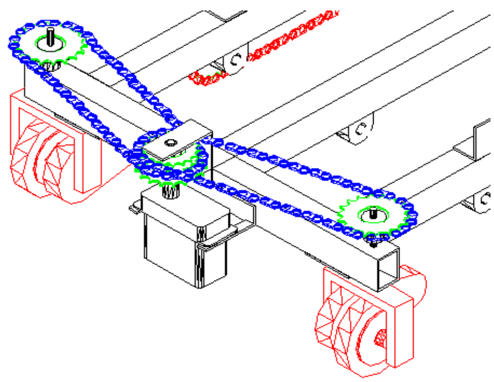


Figure 5: 3D model for the servo/gear system.

The LRD is powered by two six volt batteries mounted on each side of the chassis. The batteries are rechargeable through the use of a typical power cord that can be plugged into the wall. The supervisor simply allows the machine to charge, flips the power switch and it is ready for use.

All electronic and steering components are covered with a sheet metal exterior to protect the components as well as the user. Handlebars made from aluminum circular tubing were added to support the user. Figure 1 shows the LRD ready for use.

A Microwave Based Hot Water Heater with a Touch Pad Interface

Students: Matthew Lycke, Abraham Oonnoonny, Raymond Tricano
Supervising Professor: Dr. John Metzger
Department of Mechanical Engineering
Stony Brook University
Stony Brook, NY 11794

Figure 1: A prototype for the microwave based hot water heater.

INTRODUCTION

The objective of this project was to design and manufacture a working prototype of a digitally controlled faucet for assisting physically handicapped individuals. It would have had variable flow capability, enough power to increase the water temperature up to 100°F, a temperature range from 60°F to approximately 100°F, and an accuracy of +/-1°F. The user interface would have consisted of a touchpad, small enough to be mounted anywhere on the unit.

The unit will be designed to integrate an electromagnetic energy source, such as a microwave oven and hydraulic components, such as poly flexible tubing and plumbing fixtures, with electronic equipment, such as PLC controllers, thermocouples, solenoid valves, relays, a voltage adapter, and a user-friendly interface module.

The user will input the desired temperature into the operator interface/controller. The controller will open a valve for the cold water pipe only, and allow for a constant flow rate. At the same time, the microwave's magnetron will provide a sufficient amount of energy to heat the water passing through the microwave in order to achieve the user-defined temperature. This temperature change will be limited to 15-30°F. The thermocouple will read the output temperature and change the power provided by the microwave to achieve the desired temperature.

TECHNICAL DESCRIPTION

The operator interface chosen was a Unitronics Operator Panel & PLC Controller, MN: M-90. The teams choose this device for multiple reasons. The first reason was affordability. Programmable controllers are extremely expensive, however this device can be purchased for

$300, which includes all operating software. The second reason was the number of inputs and outputs. The team did not want a large and bulky controller.

This unit is very small having only 12 I/O's, which is more than adequate. The controller is powered with 12VDC, and draws 140mA. Two inputs can be converted into two analog thermocouple inputs. One thermocouple input will be used for the outlet temperature reading as a feedback sensor. This will establish the power consumption and high temperature limit.

The water heater cavity chosen was a 1300W Panasonic Microwave oven, MN: NN-S542BF. As an initial prototype, the team preferred to use a pre-designed cavity for safety reasons as well as the complexity in designing a cavity. The team is under qualified to perform such a task because of the lack of education and experience in that field. The microwave is 94.8% efficient, consuming 1370W and outputting 1300W. The microwave will have two holes in the cavity to allow for an inlet and outlet. Microwave safe tubing will be spiraled horizontally inside the cavity in a conical formation for complete microwave absorption and to eliminate interference from other coils. The team has experimented with several spiral designs for the tube system.

The electrical control box was required to transfer power from the controller to the microwave and the solenoid valve. The following picture illustrates the electrical box layout. 120VAC enter through the bottom. The high end (brown) is fused to protect the microwave, and then sent to the terminal block and the low end (blue) is sent to the terminal block. The ground (green/yellow is sent to chassis ground. 120VAC is sent to the 12VDC power supply, the 120-24VAC Transformer and the 24VAC relay. The output 12VDC (black/white, white) from the power supply (black/white, white) and the 24VAC from the transformer (red, green) return to the terminal block. 24VAC is sent to Ry1, which powers a 24VAC Solenoid Valve, and to Ry2, which powers Ry3, in turn powering the magnetron. Ry1 and Ry2 are energized with the 12VDC output from the PLC. Ry4 – Ry8 and 12 VDC relays that are soldiered to the PCB inside the microwave. When energized, the relays short out switches on the control panel which are required to power the microwave. See Figure 2 for the wiring diagram

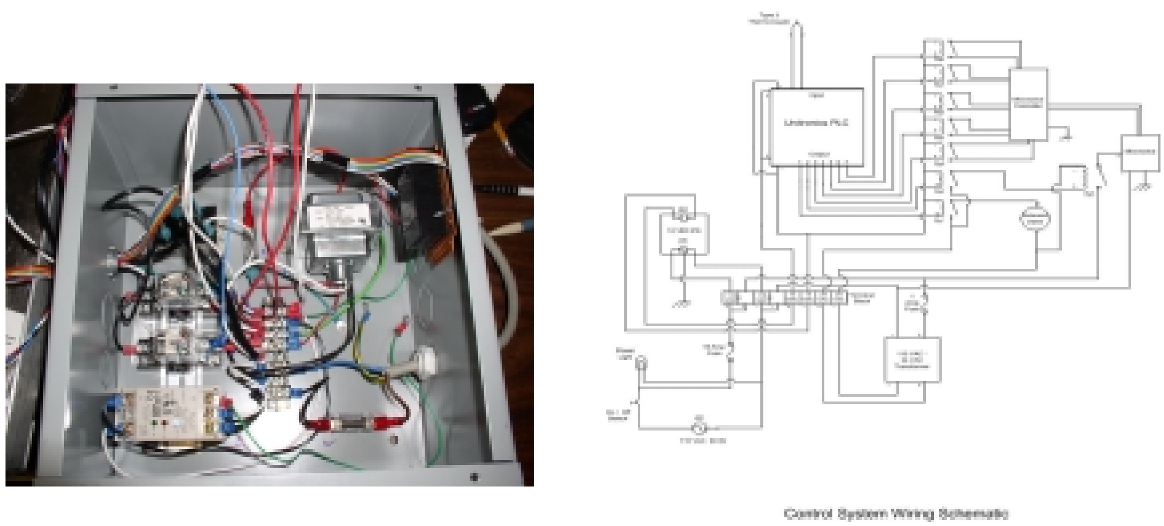


Figure 2: The control box and the wiring diagram.

Reclining Wheelchair

Students: Daniel Biro and Joo Hoon Choi
Client Coordinator: Thomas Rosati, Forest Brook Learning Center, Oakdale, NY
Supervising Professor: Jeffrey Ge
Department of Mechanical Engineering
Stony Brook University
Stony Brook, NY 11794-2300

Figure 1: The two positions of the reclining wheelchair

INTRODUCTION

A wheelchair that reclines allowing the user to be moved into a different position while remaining in the wheelchair, and thereby improving comfort, increasing circulation, reducing the risk of sores and transferring the center of mass to another location on the body.

SUMMARY OF IMPACT

This project develops a slider mechanism and guide rail system that permits a reclining range of motion for the user. This wheelchair is simple to use and inexpensive to build.

TECHNICAL DESCRIPTION

This wheelchair is composed of four systems. The slider and guide rail mechanism, leg support, back support and head and neck extension. The main feature of this wheelchair is the slider and guide rail mechanism (Figure 2).

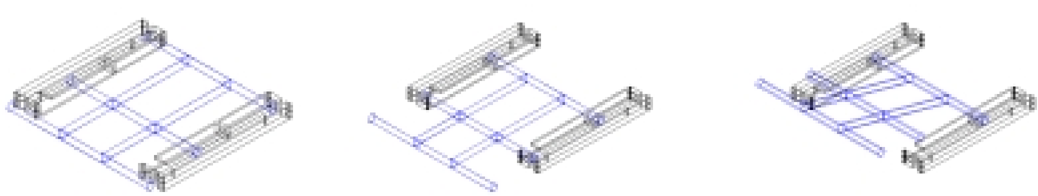


Figure 2: The slider and guide rail mechanism.

The slider is capable of sliding along the guide rail and rotating for the reclining motion of the back support (Figure 3). Both leg and back supports are attached to the slider using T-tubing. The leg support can rotate independently while the back support is designed to rotate as the slider shifts forward. Once the slider shifts to the end position rotation will occur. Figure 4 shows the 3D model of the reclining wheelchair.

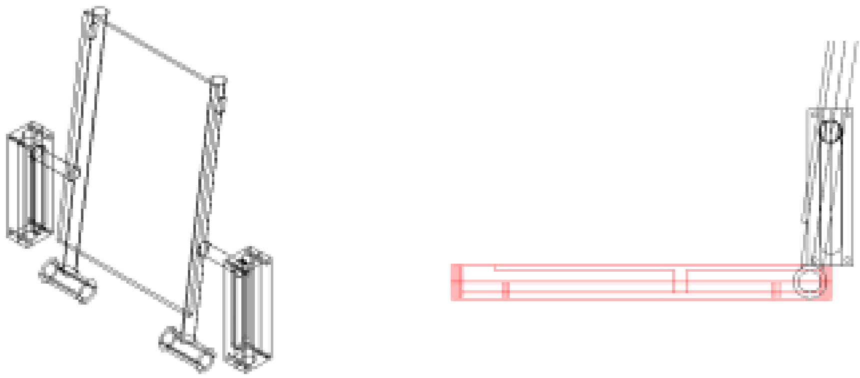


Figure 3: The back support mechanism (iso and side views).

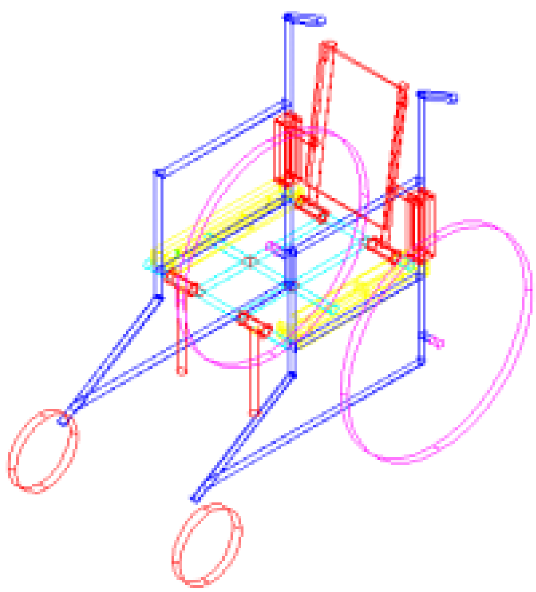


Figure 4: 3D model of the entire wheelchair.

Motorized Wheelchair with an Optical Guidance Sensor System

Students: Marlon Boodoo, Sam Zhang and Akil Alexander
Client Coordinator: Thomas Rosati, Forest Brook Learning Center, St. James, NY
Supervising Professor: Jeffery Ge
Department of Mechanical Engineering
State University of New York at Stony Brook
Stony Brook, NY 11794-2300

Figure 1: The 3D model of the wheelchair. Figure 2: The prototype.

INTRODUCTION

The purpose of this project is to construct a mechanism to aid in the mobility of physically disabled individuals and to assist those who help them. The idea itself came out of a previous project for a sensor guided remote controlled wheelchair, but it was never completed

The motorized wheelchair is an assisting device designed to aid a disabled child who is incapable of normal mobility. The device will incorporate a sensory system and a remote control. It will be designed for indoor use. The operator will be capable of traveling without requiring a great deal of physical strength. Its sensory system will alarm the operator to deviations from a predetermined track and stop if the deviation persists. The accompanying remote will allow the supervisor to control the wheelchair if desired. Like all children, those who are disabled desire to move about, but due to their physical impairments their range of motion is limited. In a school for disabled children, the ratio of children to teachers creates an environment difficult for supervision.

SUMMARY OF IMPACT

This project develops a wheelchair that can be controlled by guided sensors, a joystick and remote control. It is being built for disabled children that can't walk, but that have cognitive motion thinking.

TECHNICAL DESCRIPTION

The wheelchair is a normal sized wheelchair with that was custom made. The chair will have seating that suited the child needs and will be covered with rubber to eliminate sharp edges that can cause injury. The electrical components along with the batteries will also be covered to eliminate injury or contact with elements such as dust and rain. The sensor will be placed under the chair and when activated, it will guide the chair throughout a room or building. The joystick will be placed on one of the arm rest and will be also be used as a controlling device for the chair. The remote control is an optional safety device that will be used to override whatever command is give by the joystick. I is intended to be used be a supervisor or guardian of the child.

All the electrical components are controlled by BASIC Stamp. This component receives all the inputs from the respective controlling device and outputs the commands. The electrical schematic of the motor circuit is shown in figure 3 below.

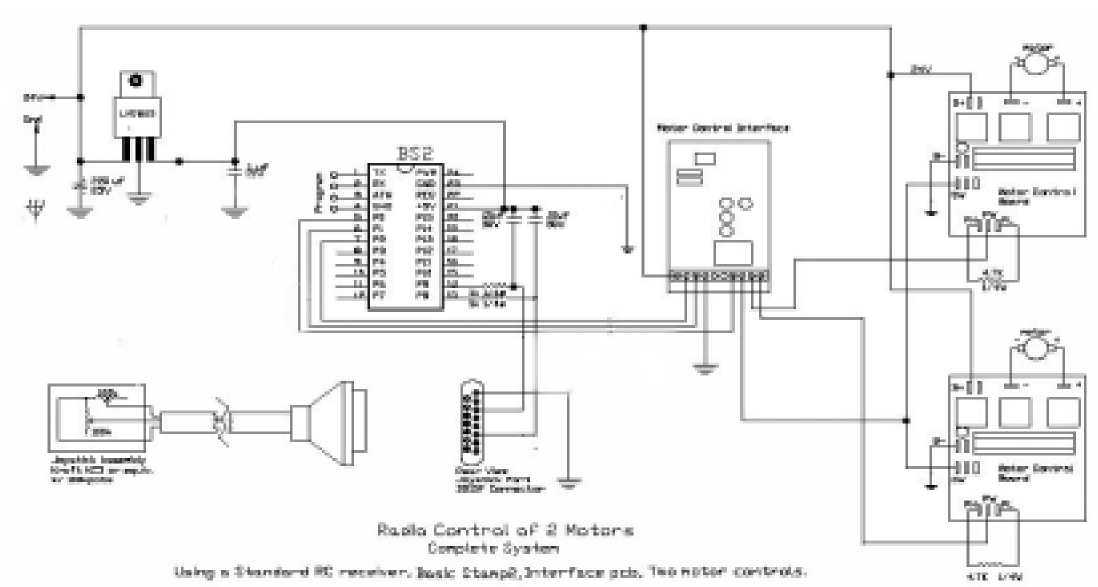


Figure 3: Electrical Schematic of Motor Circuit

The total cost for the project is $546.00. Because this project is a continuing project from last year; some of the components from last year’s design were salvaged. Other components were donated or built to cut down on cost.

Personal Workstation for the Handicapped

Students: Brendan Green, Stanislav Slivchenko, Stanley Pyram
Client Coordinator: Thomas Rosati
Forest Brook Learning Center, St. James, NY
Supervising Professor: Jeff Ge
Department: Department of Mechanical Engineering
State University of New York at Stony Brook
Stony Brook, NY 11794-2300

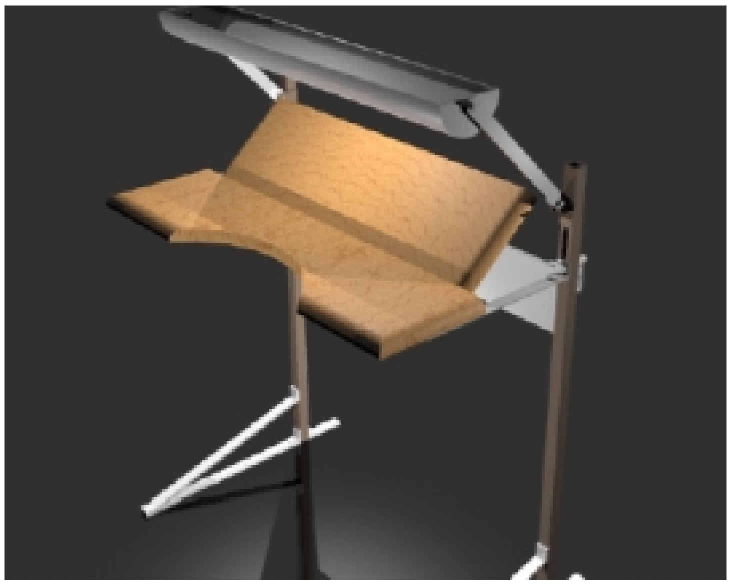


Figure 1: A personal workstation for the handicapped.

INTRODUCTION

The goal of this project is to design a personal workstation for a handicapped individual in a wheelchair, specifically a child at a school. The handicap of the user can range from being unable to move the lower half of their body to not having normal coordination and use of all of their limbs. The user of the workstation should require no additional assistance to use the device and they should be able to gain advantages that they can not find elsewhere from other workstations. These advantages include being able to modify the work area of the workstation as well as other components of the workstation. The workstation should be able to change to meet the needs on many users on a frequent basis.

A device like this should be judged on the success of the user when they interact with it. Aesthetics should also be addressed, but the true measure of the workstation should come from the satisfaction of the user and their production in using a safe and advantageous device. The overriding goal is to design a device that individuals with handicaps will want to use and to provide those users with advantages from using the device.

TECHNICAL DESCRIPTION

The chosen design incorporates three subsystems to generate its automation. The first moves the desktop vertically. The second system rotates the back half of the desktop to create a rest area for a book. The third system lowers and raises a shelf to the user to facilitate them in storing materials for work. The electrical components of the system are minimal. All working systems are controlled by two simple 3-position switches.

The total cost for the project is $527.36. It should be noted that Some of the components were donated. For example, the scrap metal used to make most of the prototype frame.

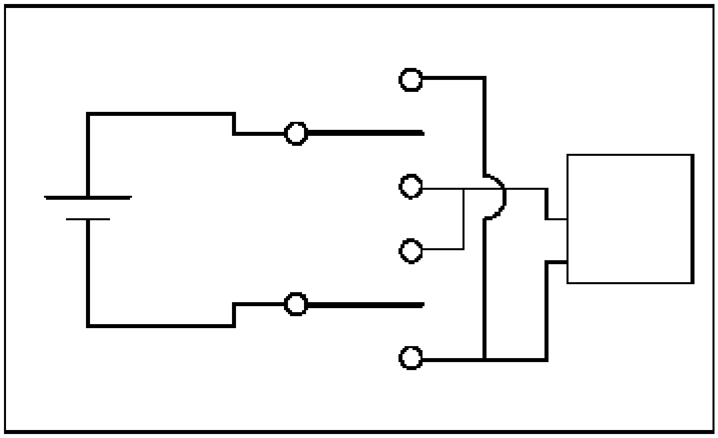


Figure 2: The electric diagram.

The Wheelchair Hoist

Students: Jason Cambridge and Alonzo Haughton
Client Coordinator: Thomas Rosati, Forest Brook learning center, St James NY
Supervising Professor: Dr. Michelle Nearon
Department of Mechanical Engineering
State University of New York at Stony Brook
Stony Brook, NY 11794-2300

Figure 1: The wheelchair hoist.

INTRODUCTION

The purpose of this senior design project is to design a lifting system that will allow a handicapped person to be removed from their wheelchair to a height of 1.5 meters or lower. The reason for designing such a system is to remove some of the burden from individuals who live and work with handicapped individuals. This system will greatly reduce the physical strains that are placed on such individuals since the mechanisms that will be developed will not require much physical strength or effort. Also, since this system is going to provide a reliable and safe means of transporting the person, the efficiency of transporting people from a wheel chair will increase for individuals who work with a large number of patients.

SUMMARY OF IMPACT

This project develops a lifting mechanism to lift a handicapped individual out of their wheelchair.

TECHNICAL DESCRIPTION

As shown in Figure 1, the mechanical design of the hoist composed of a lifting arm, a hydraulic jack, a base, an arm support and a body support. The lifting arm can be rotated in 360 degrees, it is 3.5 feet long and can be raised to a height of 8.5 feet. The base on the other hand is composed of three 4.8 long steel plates and a 22 by 22 inch square plate. The hoist is used by assuring the lifting arm is set within the desired dismounting position. The lifting arm is placed in the horizontal position and the wheelchair is then be locked. The handicap person's legs is then placed in the leg support (under knee caps) and then attach the arm support to the main lifting arm of the swivel arm. Once the arm support is placed comfortably under the patients armpits, pump the hydraulic jack, supportive for 3 tons or less, until the handicap person is lifted to approximately one to one and a half inches above the wheelchair. Unlocking the wheelchair and removing it to a secure place out of harms way, place the deluxe hanging chair on the swivel arm's end hook. Adjust the deluxe hanging chair securely under the handicap person and instruct the handicap person to release themselves from the confinements of the arm supports. The deluxe chair can support a weight up to 350 lbs hence the reason why this is the capacity of the hoist. Then remove the sling from the end hook of the swivel arm support. Pump the hydraulic jack until the handicap person is lifted to approximately 2 inches above the dismounting position. Slowly lower the handicap person on the platform.

The total cost of this project was $460 including the cost of shipping.

The Built-in Wheelchair Ramp

Students: Mathew Emigholz, Thomas Pilock
Supervising Professor: Professor Imin Kao
Department of Mechanical Engineering
State University of New York at Stony Brook
Stony Brook, NY 11794


Figure 1: The ramp in home and projected positions.

INTRODUCTION

The goal of this design was to produce a ramp mechanism, which allowed the average adult wheelchair to attain access to elevated areas when a handicap ramp is in absence. The ramp is to be entirely enclosed by the wheelchair and not prohibit regular usage of the wheelchair. It would be self projecting as incorporated into the design and permit easy retraction by the wheelchair occupant. This design does not require additional assistance to put the ramp down or retract the ramp. This allows the occupant ease of mind by not needing to find a handicap entrance ramp to gain access to an elevated surface such as a sidewalk. By permitting the occupant the ability to sooner enter an area, such as a sidewalk, may remove that person from a dangerous situation early. Also this relieves much unnecessary anxiety and associated stress from an already stressful situation. This ramp mechanism is being constructed as a fully mechanical device in its prototype phase. The addition of electronic controls and actuators will further enhance this device as an everyday asset. The ramp is also designed such that it may be rigged to any other wheelchair without gross adaptations.

TECHNICAL DESCRIPTION

The Wheelchair Ramp is to be a self contained mechanism that mounts to a preexisting wheelchair. This ramp does not require a special wheelchair to be built be will have limitations as the length and height of the wheelchairs undercarriage. The ramp is mounted to the wheelchair as shown in Figure 1. The ramping mechanism consists of two component systems. The first system is the self-projecting linkage. The second is a ratchet actuated cable retraction system. The self-projecting linkage is made up of gas charged struts that produce a linear force over a specific distance. A series of these links were used to produce the necessary path generation of the ramps. The wheelchair's occupant actuates the ramp on demand by releasing the retraction system ratchet. Once the ramps are in place the wheelchair may be rolled over the ramps and onto the elevated surface. At this point the cable ratcheting system then retracts the ramps, which are now behind the wheelchair but still connected. The cable ratchet system utilizes one cable to connect the ratchet to the connecting cable spool and one cable per ramp to connect to the connecting spool. The ramps are first folded from the horizontal position to the vertical position through the use of least resistive forces and leverage. Next the ramp assembly in the vertical position is pulled up and under the wheelchair. The occupant stops the ratcheting motion when the ramp is fully under the wheelchair as identified by the inability to further ratchet the cable. This position is in a design position which allows the links to project forward when the cable tension is released.

The Portable Wheelchair Ramp is adaptive to most wheelchairs and weighs very little. It does not hinder the occupant's ability to function the wheelchair and is composed of common materials. The total cost for the design is $488.