CHAPTER 16

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
COLLEGE OF APPLIED LIFE STUDIES
DIVISION OF REHABILITATION EDUCATION
COLLEGE OF ENGINEERING
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Principal Investigator:

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"Voice Amplifier"

Designers: Heidi Blaumueller, John Connelly, Mike Kloos
Supervising Professor: Dr. Mark Strauss
Division of Rehabilitation Education and Department of General Engineering
University of Illinois at Urbana-Champaign
Champaign, IL 61820

INTRODUCTION

An amplifier/speaker was modified for use by an individual who is incapable of speaking above a whisper and who has quadriplegia. A phone headset was installed and the unit was adapted accordingly. The phone headset enables the individual to utilize a microphone without the use of his hands, and the proximity and sensitivity of the microphone prevents strain on his voice. In the initial unit, the switch to activate the amplifier was not accessible to him. A switch with a longer lever was installed in a more convenient location, enabling the individual to comfortably turn the unit on or off. This amplifier lets the individual communicate more easily. He can now participate in classroom discussions, making his thoughts better known to others.

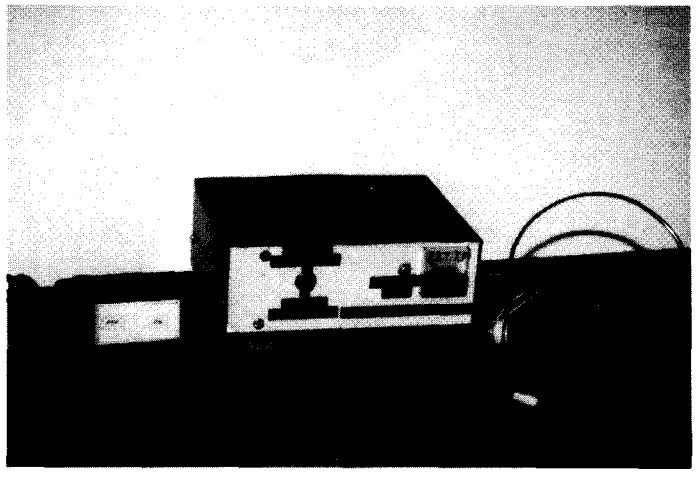
SUMMARY OF IMPACT

A 27 year old incomplete 5th cervical fracture, quadriplegic and legally blind student, was involved in a car accident in 1980. Also as a result of the accident, he sustained permanent damage to his vocal cords, which resulted on minimal voice projection.

He started at the University of Illinois in 1987 in the College of Liberal Arts and Sciences as a premed student in psychology. It was immediately identified in the social and academic settings that his ability to communicate only in a whisper was greatly hindering his performance and socialization. He could attend classes but was unable to take part in group discussions or have his responses or needs expressed without someone interpreting for him.

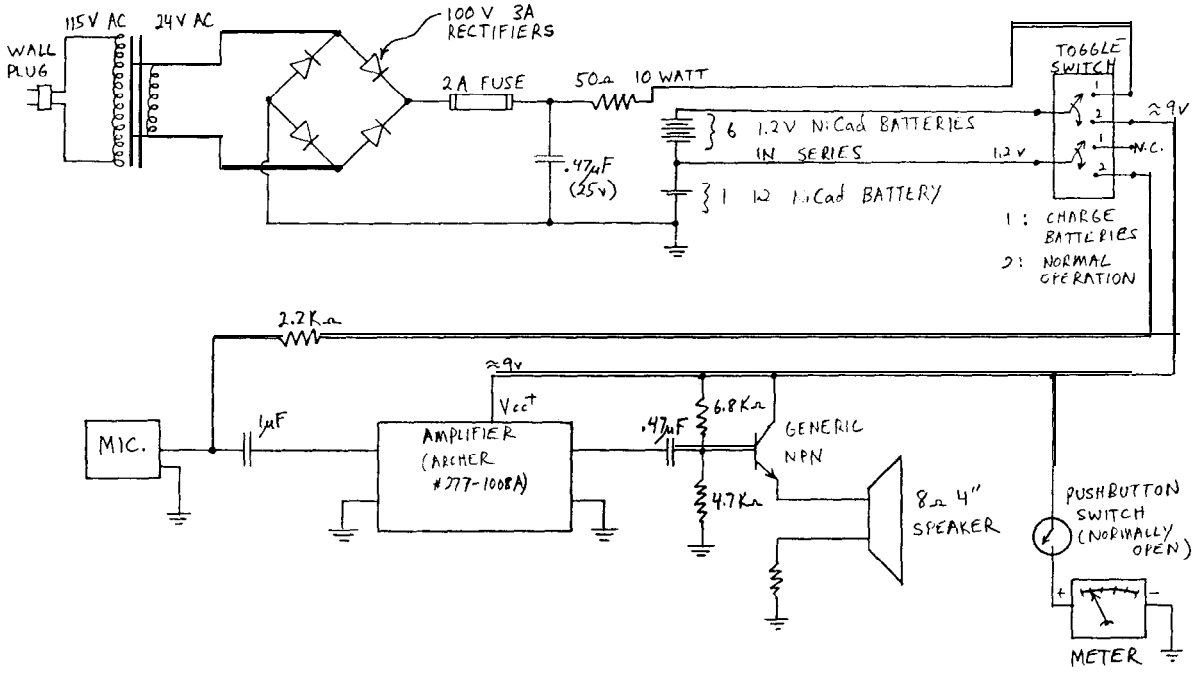
A voice amplifier was designed and built by the engineering students that now allows him to communicate in a normal tone of voice in the classroom and socially.

He will continue to be able to utilize the voice aide in his established profession to counsel clients and communicate with colleagues in the department of psychology.



TECHNICAL DESCRIPTION

An Archer mini amplifier/speaker (cat#277-1008A: $11.95) was modified for use by an individual who was incapable of speaking above a whisper. Additional circuitry was added so that an ultralight phone headset with an electret microphone (ACS Communications: Model#: SW52: $60.00) could be used with the unit. The electrical components added were a 2.2K ohm resistor ($.10), and a 1 microfarad capacitor ($.15) (See circuit diagram). Other added features were a rechargeable battery supply with charging circuit ($72.84) (see circuit diagram), a larger 4" 8 ohm speaker (~$5.00) and a current amplifier stage (-$2.50) (see circuit diagram). The output stage is better able to drive the larger speaker than the original amplifier alone and thus minimizes distortion. The entire unit was housed in a Radio Shack metal project box ($10,49). A 1/8" hole was drilled into the casing for the on-off switch, and a two conductor 1/8" mini phone jack (Archer: cat#274-251A; $.53) was installed. In addition, the power switch was replaced and moved. This was done for two reasons. Because the individual is a partial quadriplegic and has limited use of his hands, he was incapable of turning the unit on. A power switch with a longer lever was installed so that the individual could apply the same amount of force to the lever and cause a greater moment, thereby enabling him to turn on the switch. The recharging circuit consists of a step down transformer to change 115V AC into 24V AC. This is then run through a rectifier bridge and capacitor to change it to DC. This charges the battery pack when the switch is in the charge position. Also added was a voltmeter to test the battery voltage level. The amplifier/speaker needed to be mounted as far as possible from the microphone (to diminish feedback), but still accessible to the individual. It was attached with Velcro to the side of the wheelchair, and while feedback is still a problem, it is minimal.



Foot Control of a Cassette Player

Designer: Michael Kloos
Disabled Coordinator: Janet Floyd, University of Illinois
Supervising Professor: Dr. Mark Strauss
Division of Rehabilitation Education and Department of General Engineering
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Champaign, IL 61820

INTRODUCTION

Some blind and visually impaired students record their lectures using a tape recorder in place of taking written notes. One university student enrolled in the College of Law does this and then transcribes the voice recordings into braille in the evenings.

Using a brailler requires two hands. Starting and stopping the cassette player required the student to remove one of his hands from the brailler, locate the appropriate buttons on the cassette player, then transfer back to the brailler. These repetitious movements slowed down the brailling process almost to a point where the process of transcribing was not an effective use of his time.

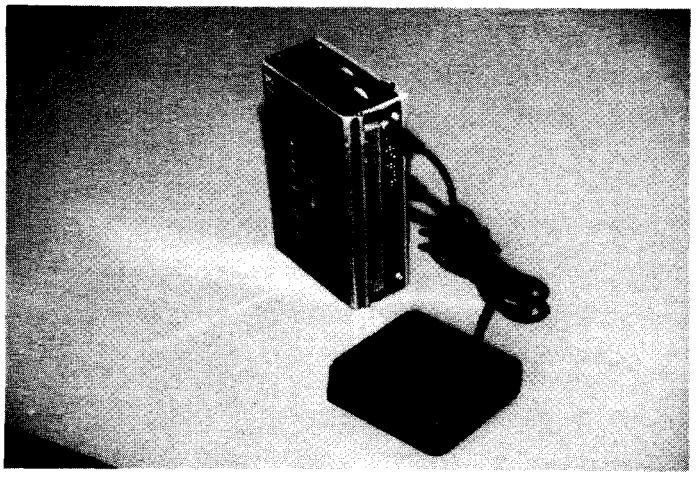
In order to make the transcribing process quicker and more efficient. a simple modification was added to the cassette player to pause the tape by foot activation.

SUMMARY OF IMPACT

A 29 year old man, legally blind since birth, and a law student at the University of Illinois was able to tape lectures but required some means of getting notes brailled. He found it too time consuming doing-it himself and sought assistance from the NSF Rehabilitation Engineering program.

An engineering student was able" to develop a foot operated on and off switch for his cassette recorder so he was able to have both hands free to braille.

This modification will continue to aid this individual in his profession once he has passed the bar exam by allowing him to prepare his briefs for the courtroom.

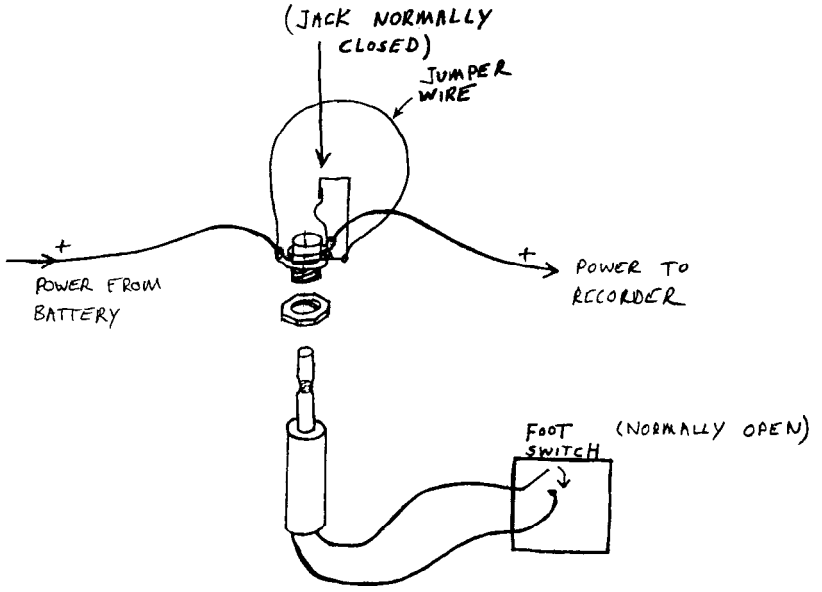


TECHNICAL DESCRIPTION

The blind individual was using a Panasonic RX S20 radio cassette player which had an electronic on/off pause control. Initially it was decided to connect an external switch in parallel with this pause control switch. When the cassette player was disassembled it was found that this switch is a double pole double throw variety, which made the anticipated simple modification more complex. Without being able to determine which of the terminals will be appropriate ones to connect an external switch to, the service manual was obtained from the Panasonic Company in order to study the schematic and make the appropriate decision. After receipt and study of the electronics diagram, it was decided that incorporating a simple external switch interfaced to the internal pause control switch was too difficult.

The final, simple modification was to connect an external single pole single throw foot-operated switch in series with the DC power supply. A jack was installed in the wall of the cassette player and wired so that normal operation would not be affected when the foot switch was not plugged into the jack. When the foot switch was plugged into the jack, power was disconnected when no foot pressure was applied to the switch. Power to the cassette player was present as long as the foot switch was depressed.

Both the jack and the foot switch can be obtained at a Radio Shack store. The total cost for this project was $4.



Microwave Oven Alert System

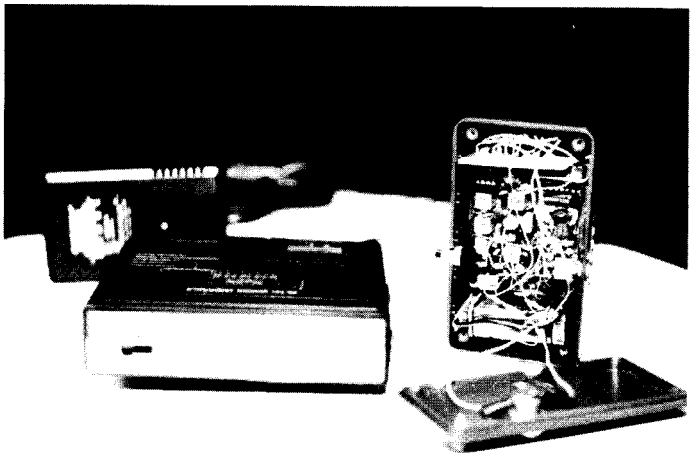
Designers: Bob Bryant, Bob Bucciferro
Supervising Professor: Dr. Mark Strauss
Division of Rehabilitation Education and Department of General Engineering
University of Illinois at Urbana-Champaign
Champaign, IL 61820

INTRODUCTION

This project was designed to help a hearing impaired person with the use of a microwave oven. The person, because of her hearing impairment, was unable to hear the buzzer that signaled the microwave oven had turned off. To solve this problem, a wireless alarm system was modified. A switch was installed on the microwave oven to detect when it had turned off. This switch activated the alarm transmitter which, in turn, signaled the receiver. The receiver, was small and portable and was modified with an additional circuit so as to flash a light when the transmitter signaled. This light would inform the hearing impaired person that the microwave oven had turned off.

SUMMARY OF IMPACT

For a deaf individual who lives by herself, the constant monitoring of the microwave oven during cooking restricted her from her other chores. Her request for a device which could notify her when her microwave oven's cooking cycle had ended has been implemented successfully. By carrying around a small 8 oz. receiver, she can be notified by a blinking light on the receiver that the microwave oven has finished its cooking cycle. This allows her to perform more of her tasks at a greater distance from her kitchen than she normally could without this design.



TECHNICAL DESCRIPTION

This project used a wireless alarm powered by an external twelve volt transformer. The transformer was connected directly to the power inputs on the back of the transmitter. The only other modification made to the transmitter was the connection of a long lever-type switch in parallel to the "page" button.

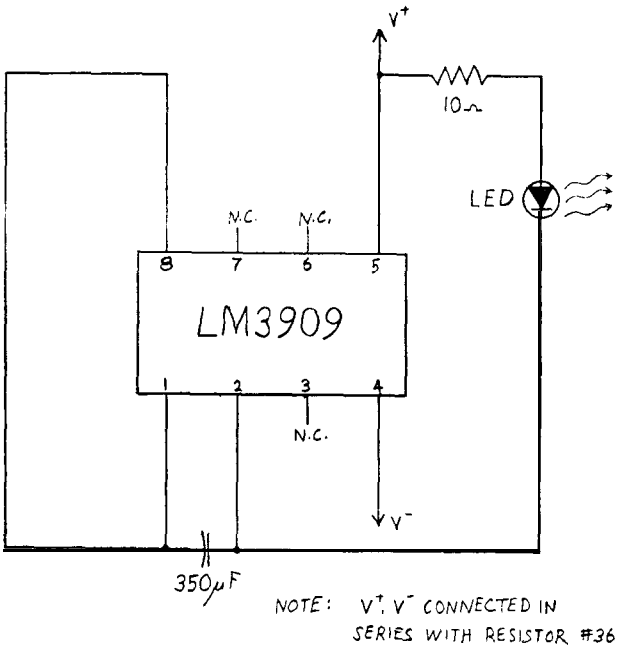
A LM3909 National Semiconductor integrated circuit was used to produce a flashing circuit. This circuit was spliced into the receiver circuit in series with resistor #36 which provided power for the flashing circuit. This connection in series with resistor #36 was used because when the receiver was triggered by the transmitter, there was a constant voltage and a constant current present across this resistor. The only other modifications to the receiver were to the switches. Due to the difficulties encountered when trying to remove the existing switches, a new on-off toggle switch along with a new "reset" momentary switch were connected in parallel to the old switches.

When the circuits were completed they were placed in a plastic design box. The new switches along with the LED were positioned in our design box where needed. A single nine volt battery, which powered both the receiver and strobe circuit, was also placed in the box. Hot glue was used to secure the circuits in place.

A unique feature of this project is its adaptability. The lever-type switch can easily be replaced by other switches, such as a pressure switch or a photoresistor, allowing the alarm to be used with other appliances.

COST OF PROJECT

Radio Shack #49-791 car alarm	79.95
Radio Shack #273-1653 transformer	19.95
Radio Shack #270-221 design box	1.99
470 ohm resistor	0.19
10 ohm resistor	0.19
350 mf-l6V capacitor	0.99
Radio Shack #275-624 SPST toggle switch	2.29
Radio Shack #275-1549 momentary switch	2.59
National Semiconductor LM3909 integrated circuit	1.69
Radio Shack #276-066a LED	1.19
TOTAL	**111.02**



Adapting Toys for Disabled Tots

Designer: Joe Flerlage
Disability Coordinator: Nancy Bradley, Sunnyside Center, Decatur, IL
Supervising Professor: Dr. Mark Strauss
Division of Rehabilitation Education and Department of General Engineering
University of Illinois at Urbana-Champaign
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INTRODUCTION

The Sunnyside School in Decatur, Illinois, has identified two severely disabled children who would benefit from toys which could be modified so that the children could learn cause and effect relationships and provide for them control of their environment. The Center had provided us with a motorized Santa Claus and a motorized helicopter which they requested external switches be adapted to.

SUMMARY OF IMPACT

Two battery operated toys were modified so that external switch activation would activate the toys. They are being used by two physically disabled students who are enrolled in our program for the severely and profoundly handicapped. They are in a wheelchair and are only able to use their hands for gross pointing or touching and cannot use them to do any activity that requires a fine hand coordination, such as playing with most toys. They are now able to reach out and push on the pedal switch that is mounted on the wheelchair tray to activate the toys.

Through the use of these switch activated toys, we are attempting to teach them the idea of cause and effect plus give them something to do during play time. The long range goal for teaching switch activation is to provide a means for them to activate a computer--for educational purposes and communication purposes.

TECHNICAL DESCRIPTION

In response to their request we installed a 1/8" phone jack in the body of each of the toys and installed the jack in series with the power supply of the toys with the jack in the normally closed position. With an external foot switch of the dimensions of 3x3" plugged into the jack, the children were able to activate the toys' movements and sounds by aiming for and successfully activating the switch. These were simple modifications but greatly appreciated by the recipients.

The cost estimate:

2 Radio Shack foot switches, model 44-610	7.00
2 1/8" jacks and plugs	4.00

A Wheelchair Lap Board Designed for Minimal Attachment and Removal Effort

Designers: Kent Harrison, Scott Lawrence, Ted Niezyniecki
Disability Coordinator: Bettina Sobieski, Occupational Therapist,
Illinois Children's School and Rehabilitation Center, Chicago, IL
Supervising Professor: Dr. Mark Strauss
Division of Rehabilitation Education and Department of General Engineering
University of Illinois at Urbana-Champaign
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INTRODUCTION

The purpose of this project was to design a lap board which can be attached to and removed from a wheelchair without assistance from an attendant and with minimal effort by the user. The apparatus was designed for use by a girl who has spinabifida and cerebral palsy. She has good strength and dexterity in her left hand but has poor control of her right hand. She uses an Everest and Jennings electric wheelchair (model P8NU26A-770-3VL) which has the joystick controller mounted on the left side.' The design consists of a clear plastic lap board, a stand which holds the lap board when not in use, and a permanently attached, magnetic interface which holds the lap board onto the wheelchair.

SUMMARY OF IMPACT

A special lap tray system has been designed so that a disabled individual can independently attach and remove the lap tray from a wheelchair. This person no longer has to wait for staff to find a free moment, during busy parts of the day, to attach/remove her lap tray. The special lap tray system allows for her to independently prepare meals, transport food, and eat. The disabled individual has expressed how nice it is to be able to complete these tasks independently. She feels, as do I, that the lap tray system has improved the quality of her life in making her more independent.

I thank you for opening up this engineering design program to the public. I also thank the engineering students involved in his project for designing a unique and practical lap tray system.

TECHNICAL DESCRIPTION

The lap board was made of 1/2" thick, clear acrylite and was cut to the dimensions shown in figure 1. A strip of plastic was glued around the edge of the board to prevent objects from sliding off. A small slot was cut out near the top of the board where a hook can be inserted. An L-shaped piece of metal was attached to the rear edge of each arm extension on the board so that it can be held to the wheelchair by magnets on the interface. The metal pieces were bent from a 1/8"x1-1/2" steel strip and were screwed into the board on the top surface.

The stand was made from 4, 4-foot sections of 3/8" galvanized pipe. The two forks, which hold the lap board when not in use, each have a downward bend at the end. Attached to the crossbar of the stand are two spring latches and a standard hardware hook which hold the board onto the forks. The stand was attached to a 15"x32",1/2" plywood base by 6 copper pipe-brackets which were screwed into the base. The front edge of the base was beveled to allow the front wheels of the wheelchair to run up on the plywood easily.

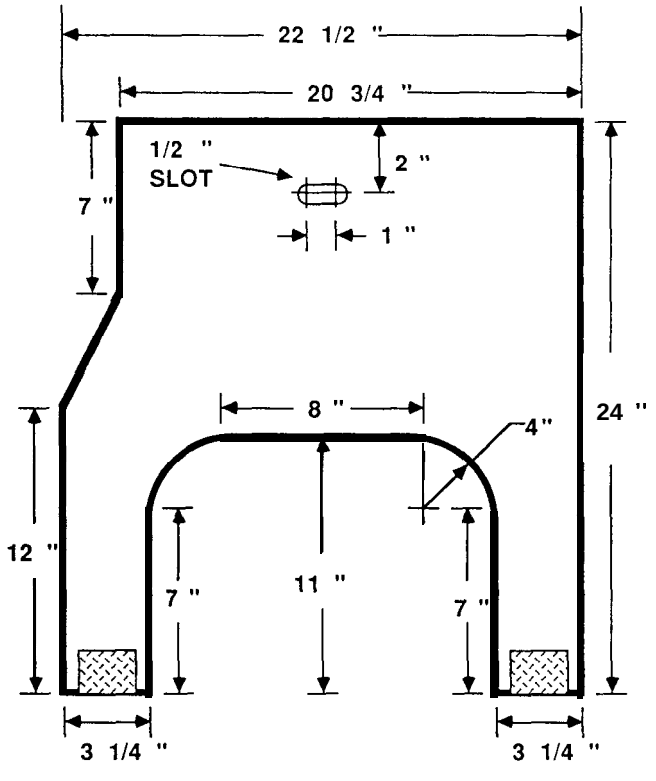
The interface, shown in figures 2 and 3, consists of two units. Each was made from a 3"x6"x1/8" aluminum plate with a magnet attached to each. The plate was bolted to a clamp and was attached to the rear armrest post on each side of the wheelchair so that the magnets lined up with the armrests.

To attach the board to the wheelchair, the user drives her chair under the board while it is held down on the forks. Once in position she removes the hook from the slot in the board and flips up the two spring latches. She then slides the board toward her until the magnets on the interface catch the metal strips on the board. When the magnets engage she can back away from the stand and use the lap board as desired.

To remove the board from the wheelchair for replacement on the stand, the user drives the wheelchair up to the stand so that the slot in the board lines up with the hook on the stand. As she approaches the stand, the board bumps into the curved front of the forks and begins to lift slightly. Once the board is all the way up on the forks, she inserts the hook in the slot and flips down the two spring latches. Since the front wheels of the wheelchair will be resting on the base of the stand, they will hold the stand in place as the wheelchair backs away, and the hook pulls the board away from the magnets.

The final cost of the project was approximately $225. A list of some of the special parts needed is given:

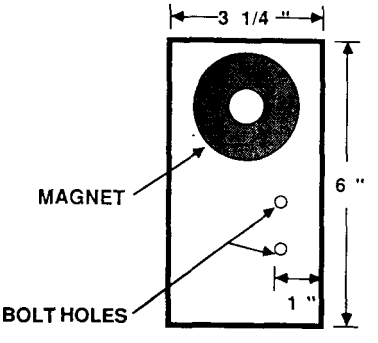
McMaster-Carr (312-833-0300) (#5685K32), 2 magnets
McMaster-Carr (#1302A11), 2 screen door latches.
Hardware store, 4-90 degree elbow fittings (3/8").
Hardware store, 2 "T" fittings (3/8").
Union fitting, (3/8")



1/2" THICK CLEAR ACRYLITE BOARD

LAP BOARD

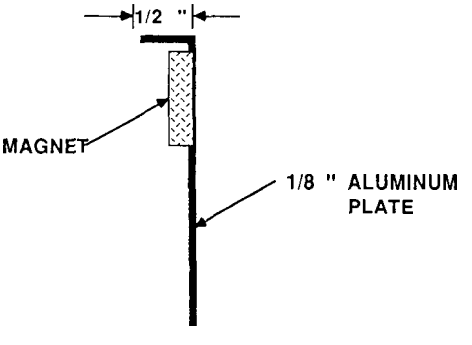
Figure 1



FRONT VIEW

INTERFACE

Figure 2



SIDE VIEW

INTERFACE

Figure 3

Wheelchair Training Device

Designer: Joseph Flerlage
Disability Coordinator: Nancy Bradley, Sunnyside Center, Decatur, IL
Supervising Professor: Dr. Mark Strauss
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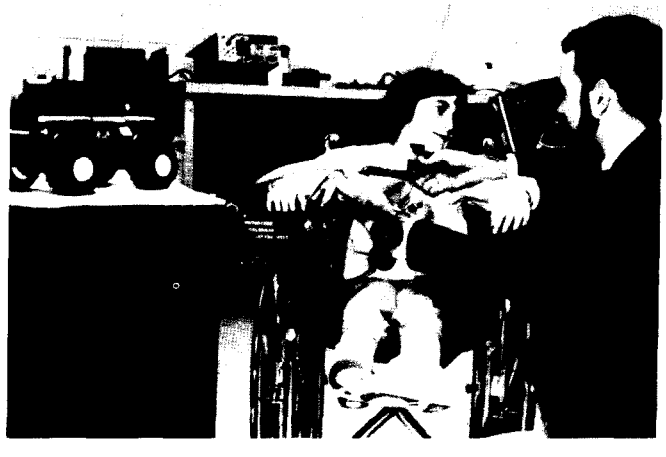
INTRODUCTION

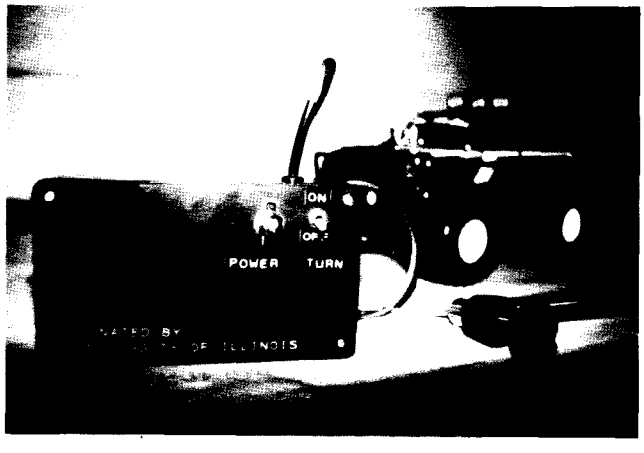
For many children who are physically disabled or mentally impaired, the task of learning how to drive a powerdrive wheelchair is a necessity. For this reason, we at the University of Illinois have developed a device which will help teach a young child with cerebral palsy cause and effect relationships between a wheelchair-type joystick and the corresponding movement in preparation for using a motorized wheelchair with chin control. In addition, the child will practice control of his head movement and have stimulating and entertaining control of his environment.

SUMMARY OF IMPACT

The chin controlled remote controlled car was designed for an 8 year old with severe cerebral palsy who is not able to use his hands for any fine coordination activities. However, he is able to move his head to activate a switch and is showing the ability to learn academic skills and to control his environment through switch activation.

With this remove controlled car, he is learning to maneuver the car operating the joystick with his chin. The primary long range goal for teaching this skill is to assess his ability to use a motorized wheelchair for independence mobility. Secondary goals for this item are to teach joystick activation of a computer for educational and communication purposes and to provide a leisure activity.





TECHNICAL DESCRIPTION

A remote controlled car (RC) was modified to be controlled by a short-throw chin controlled joystick. Most remote controlled cars are controlled by two joysticks or a trigger and a turn knob. On the other hand, wheelchairs are controlled by a single joystick. Our modifications were to basically integrate the two joysticks into one.

The circuitry from an inexpensive (RC) transmitter was mounted onto a bread board so that it would be easy to hardwire the additional electrical components necessary for the modification. The transmitter initially had two poor quality joysticks which had to be operated simultaneously. We removed these joysticks and replaced them with relays which were controlled by a single short throw 4-switch joystick. All of these relays are activated by the movement of the joystick. Four relays were needed in the new design. Because the original circuit required input from both the left-right and forward-reverse joysticks, the relays had to be cross wired so that different configurations were activated simultaneously in order to perform the correct function. A switch was put in series with the left-right relays which could disable them. This would allow only forward and reverse movement, if desired. The modified transmitter circuit is powered by a Ni-CAD rechargeable battery. No modifications were performed on the car itself.

The joystick was mounted to a semi-rigid gooseneck tube. This flexibility allows for easy position adjustment. The "gooseneck" was then mounted to a standard wheelchair control box clamp. With two allen bolts, the clamp is clamped to the frame of a wheelchair. A wrench was also attached to the clamp by a chain.

A wide suction cup was mounted to the joystick handle so that it would be comfortable to operate by the chin. A red dot on the joystick base indicates forward. The joystick can be rotated within its holder, allowing for positioning adjustment which is dependent on the gooseneck clamping location.

With this device a child with limited hand control or poor eye-hand coordination will be able to safely practice chin operated power wheelchair control. The child will be able to sit in a stationary chair while he/she receives entertainment feedback. This will hopefully save time as well as money.

Cost Analysis

Short-throw joystick, Dufco	240.00
Remote control car + transmitter, R.Shack 60-4057	44.95
Battery pack, R.Shack 23-230	24.95
Battery pack charger (control box), R.Shack 23-231	29.95
Experimenter box, R.Shack 270-223	2.99
IC Board, R.Shack 276-1395	1.79
Conductor plug, R.Shack 274-286	1.39
Enclosed jack, R.Shack 274-250	1.79
4PDT relay, R.Shack 275-214	4.69
(3) Mini SPDT relays, R.Shack 275-005 @2.99	8.97
Toggle switch, R.Shack 275-602	1.19
Submini switch, R.Shack 275-612	2.39
Velcro	1.89
Mounting clamp, E&J 90482290	48.90
(4) Nicad batteries (car)	20.00
1 24" Gooseneck, Moffatt Products, l-800-346-0761	15.00
AC to DC adapter (car), R.Shack 273-1434	11.95
TOTAL	442.79

Wireless Sip- and Puff- Appliance Controller

Designer: Michael Kloos
Disability Coordinator: Nancy Bradley, Sunnyside Center, Decatur, IL
Supervising Professor: Dr. Mark Strauss
Division of Rehabilitation Education and Department of General Engineering
University of Illinois at Urbana-Champaign
Champaign, IL 61820

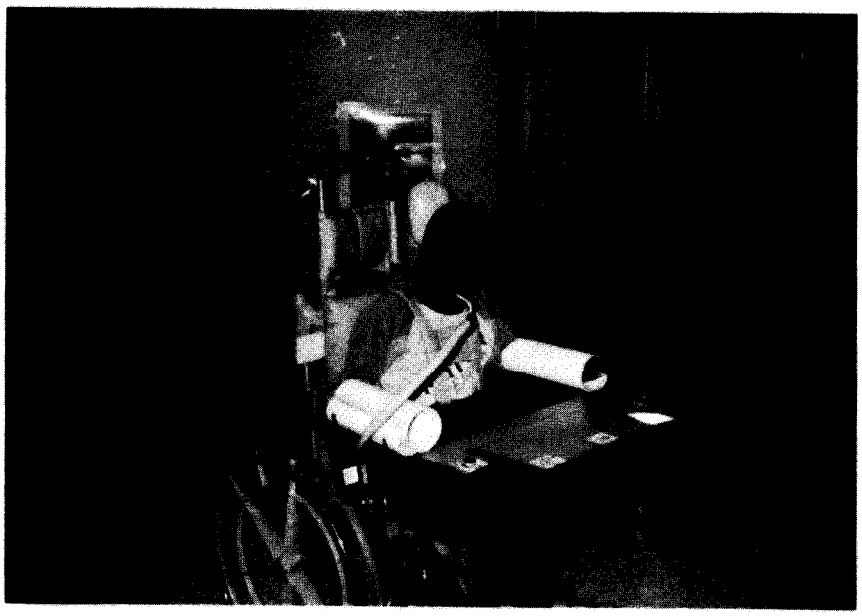
INTRODUCTION

This report describes the design of a wireless appliance controller to be used by people with severe physical disabilities. The design makes use of a commercially available wireless transmitter and the corresponding receiver/out-let. The transmitter was modified so that activation could be achieved by a sip and puff switch instead of pushbuttons. The transmitter is controlled from a single air tube via sipping or puffing action by the user. A puff on the tube turns the remote switch on and sipping on the tube turns the switch off. The device to be controlled is simply plugged into the receiver and the receiver is plugged in a wall outlet. The transmitter can also be used by a remote switch instead of using the air tube. There are two jacks on the side of the transmitter box for the switch input. When the external switch completes the connection for the jack labeled "ON," the transmitter turns the remote switch on. The jack labeled "OFF" works in a similar fashion. The transmitter unit is housed in a plastic box and connected to a gooseneck tube. The air tube runs from the transmitter box, up through the gooseneck, and out the top to a position near the user's mouth. Since the gooseneck is a semi-rigid tube, it can be bent and adjusted by hand to accommodate any user. A bracket is mounted to a wheelchair and has a socket for quickly disconnecting the transmitter gooseneck unit when not in use. This makes the device more convenient to use.

SUMMARY OF IMPACT

The designed remote controlled appliance controller allows a severely disabled child with cerebral palsy to turn electrical appliances on and off. With the sip and puff switch we will be assessing his ability to use this type of control for future use with other environmental control devices such as a motorized wheelchair.

The ability to activate the transmitter with other types of switches plugged into the transmitter unit also allows variety for this child. This project allows the child more independence, gives him a means of control over his environment, and allows us to use new ways of assessing his abilities for future educational purposes.



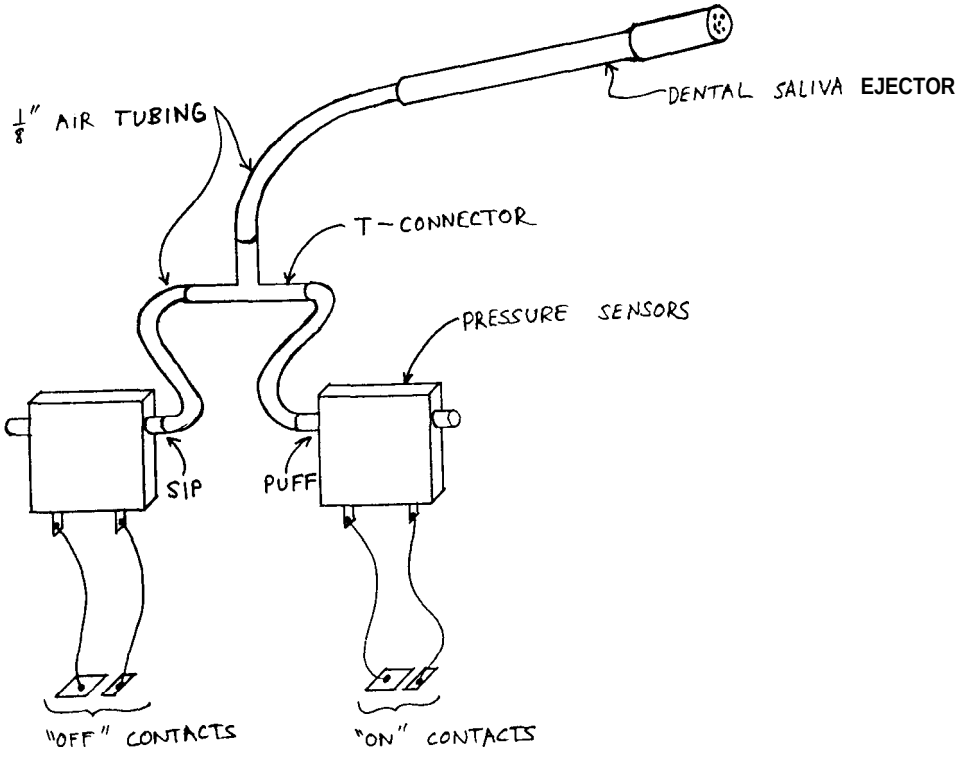
TECHNICAL DESCRIPTION

The transmitter used was a modified Radio Shack remote wireless switch (Cat. No. 61-2667). The on and off contacts from the transmitter were wired to 2 pressure switches manufactured by World Magnetics at 810 Hastings Street, Traverse City, MI 49648, model #8845 (616-946-3800). These were used as the sip and puff sensors. These two sensors were connected by 1/8" air tubing and a "T" connector, obtained at a tropical fish store. The tubing went to opposite inputs on the switches so that one would be triggered by sipping and the other by puffing. Parallel wires from the transmitter inputs were also run to 2 external 1/8" jacks and labeled appropriately. The jacks could accept input from external switches to activate the transmitter. The entire assembly was placed in a Radio Shack plastic project box with the pressure sensors hot glued to the bottom of the box. Holes were drilled for the external jacks as well as for the air tube. 1/2" x 1/16" parallel slots were cut in the top to allow the box to be attached to the gooseneck with a 3" hose clamp.

For ease of installation and removal from the wheelchair, the gooseneck had a quick release coupling which attached the gooseneck and transmitter to a mating male connector. The release male connector was mounted on an Everest & Jennings clamp #90482755 which was then mounted onto the wheelchair. A 1/2" piece of steel bent into an "L" shape and drilled was used to attach the clamp to the male connector. The total cost of the project was about $135.00.

Gooseneck tube in varying colors and end connector configurations can be obtained from:

Moffatt Projects, Inc.
22 Cessna
Watertown, SD 57201
1-800-246-0761



Apple Mouse Sip & Puff Modification for a Person with Quadriplegia

Designer: Heidi Blaumueller and Yuzo Shida
Disability Coordinator: Jann Floyd, University of Illinois Office for the Sensory Impaired
Supervising Professor: Dr. Mark Strauss
Division of Rehabilitation Education and Department of General Engineering
University of Illinois at Urbana-Champaign
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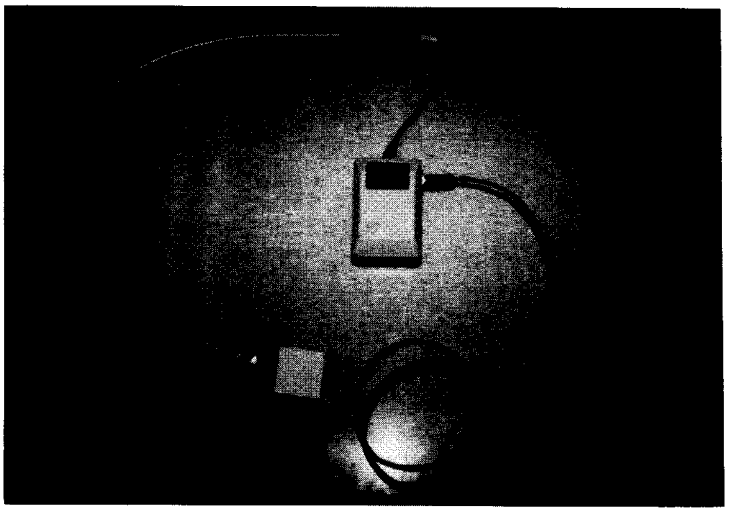
INTRODUCTION

An Apple Macintosh mouse was modified for use by an individual who has upper limb paralysis. This person needed to use the mouse to complete his class assignments but was unable to simultaneously push the mouse button and accurately move the mouse. In order to remedy this inaccessibility, an external sip and puff switch was installed so that the mouse could be moved with one hand while activated by the sip and puff switch via the mouth. Modifications were performed so that the mouse could be used by able-bodied and disabled people.

SUMMARY OF IMPACT

The significant quality, in practical application, of the "sip and puff mouse" is its ability to increase the capability for independent performance by a user who is severely (i.e., high level quadriplegic) disabled. This adaptive device allows an individual with extremely restricted movement capacity (range of motion) access to those functions normally completed by linger, hand and arm movement(s).

This device has since been accepted by many individuals with severe physical limitations, enabling them to be independent users of computer equipment in completing coursework requirements.



TECHNICAL DESCRIPTION

In order to allow dual operation of an Apple Macintosh mouse (Model number M0100) by able and disabled people, a sip and puff switch was installed in parallel with the switch in the mouse. This was accomplished by performing the followig modifications. The yellow wire from the mouse interface cable was cut at the mouse switch. The end going to the cable was connected to the common of a three lead jack (Archer: cat. no. 274-296: $1.89). The other end of the yellow wire was connected to the lead on the jack which allowed for a normally closed circuit. Another wire was soldered between the remaining lead on the jack and the connection between the internal switch and the rest of the circuit located on the backside of the printed cirucit board in the mouse. A quarter inch hole was drilled into the side casing of the mouse. The jack was inserted through the hole and screwed into place.

An 1/8" plug (Radio Shack #274-288, $1.39) was attached to a sip and puff switch (ComputAbility). When the plug is not inserted into the jack, the mouse switch can be used in the normal fashion. When the plug is inserted, the internal switch in the mouse is disconnected, and the external sip and puff switch is connected.

The plastic tube attached to the sip and puff switch was located near the user's mouth via a goose neck tube. The distal end of the goose neck was attched to a clamp which fastened the fixture to the table edge.

The result of this project is that the individual for which the project was performed could perform his computer assignments independently once the sip and puff switch was attached to the mouse. Accuracy in mouse selections and speed of assignment completion was improved.

Apple Macintosh mouse (Model number M0100)	60.00
Three lead jack (Archer: cat. no. 274-296)	1.89
1/8" plug (Radio Shack #274-288)	1.39
Pressure switch, 0.102 psi (ComputAbility - 201-882-0171)	99.95
TOTAL	**163.23**

The Design of a Rotating Filing System for a Person with Muscular Dystrophy

Designers: Joe Faron, Mark Kaufman, Ron Tamunday
Disability Coordinator: Maureen Kelly, Illinois Children's School & Rehabilitation Center, Chicago, IL
Supervising Professor: Dr. Mark Strauss
Division of Rehabilitation Education and Department of General Engineering
University of Illinois at Urbana-Champaign
Champaign, IL 61820

INTRODUCTION

The project involved an individual who works for the Illinois Children's School and Rehabilitation Center in Chicago, IL. This person has severe muscular dystrophy and uses a reclining motorized wheelchair. Her project request involved her need for a more functional work station. Previously, all files of work-in-progress and files that are. frequently referenced were kept in piles or stacks scattered among two long tables. Due to her condition, most of her strength lies in her ability to pull objects toward her. Dexterity was quite minimal and she could not rotate her hands. She predominantly uses her left hand for handling objects, and her right hand for balancing her upper body and operating the wheelchair controls. Her range of arm motion was limited since she cannot lift her elbows from the wheelchair armrests. Her reach ranged from 15" to 36" above the floor, with her optimal work height being 30". Her optimal work height defines the minimum height of a desk top under which her wheelchair could roll to allow her easy and comfortable access to her work.

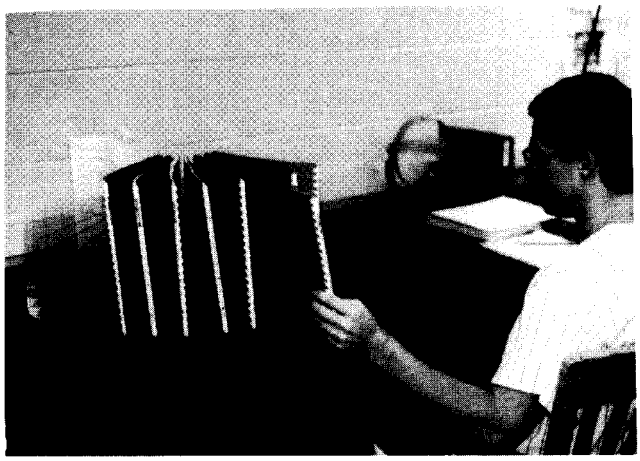
To alleviate a good portion of the work space that was taken up by the piles of stacks of paper, a vertical, rotating filing system suitable for her working environment was built. The tiles in this system can be accessed from the side, as opposed to from the top, making them accessible to someone using a wheelchair.

SUMMARY OF IMPACT

A person who has muscular dystrophy works for me in an administrative capacity. As her supervisor, I would "cringe" when I walked in her office. She always knew things were, but I never could find anything. I would spend hours looking through piles of files.

The lazy susan type of tiling system which the engineering students designed and build is extremely appropriate for the person it was designed for. It is very easy for her to turn and completely accessible to her limited reach and strength. This filing system holds many, many folders and really has expedited her production of work.

We at the State of Illinois Children's School and Rehabilitation Center appreciate the excellent work your students have done.

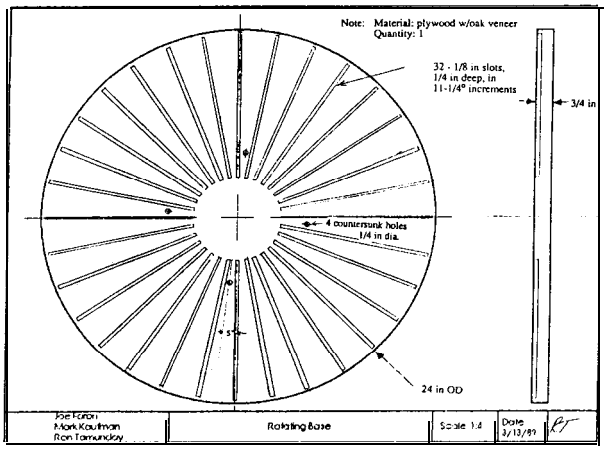


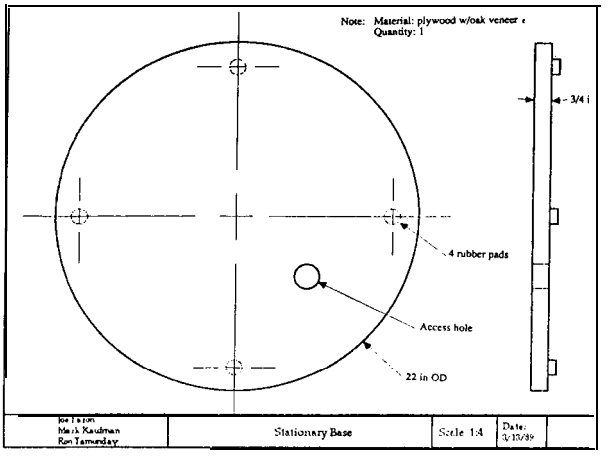
TIXHNICAL DESCRIPTION

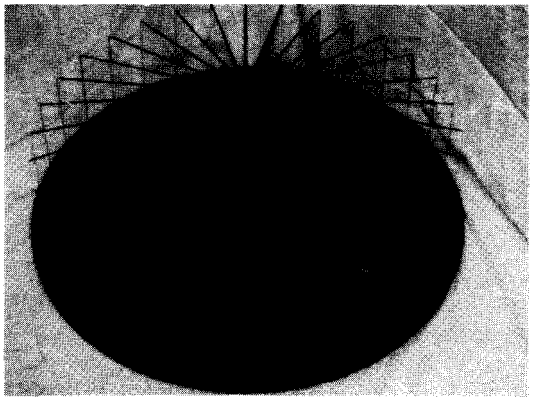
The rotating and stationary base are made of plywood with an oak veneer. The rotating base has an outside diameter of 24" while the stationary base has an outside diameter of 22". The center tube and dividers are made of 1/8" clear plexiglass. The center tube has an outside diameter of 5-1/2". There are 32 dividers equally spaced radially on the rotating base. These dividers have a trapezoidal shape with the base being 9" long and the sides having dimensions of 6" and 8-1/4". The lazy susan bearings used were purchased at a local Ace Hardware Store. The outside diameter of the bearing is 12". It has a loading capacity of 1000 lbs., using 140-1/4" bearings to support this load. 32, 1/8" slots, 1/4" deep were routed on the rotating base as well as a circular slot 1/8" thick with an outside diameter of 5-1/2". The dividers and center tube were secured to these slots by epoxy. The dividers were attached to the center tube with solvent cement, creating a transparent seal. The wood was finished with a polyurethane finish to protect the wood from moisture and to increase its durability. Total cost of the project was $134.43. These costs are summarized below.

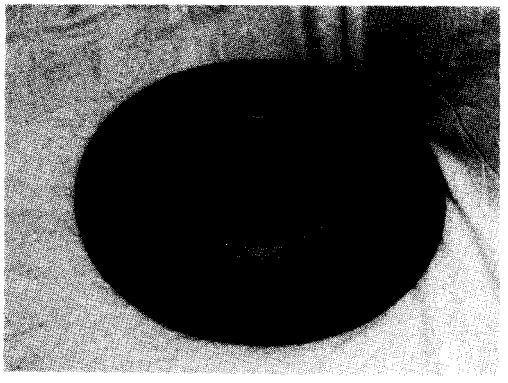
Modifications possible for this design include attaching a motor to friction drive the rotating base, and designing the dividers to be removable. If a motor is attached, the stationary base must be modified to accommodate the motor. A motor which can deliver at least 1.5 in-lb. of torque, would be required using the prescribed dimensions and assuming that the total weight of the files plus the rotating base equal 30 lbs. An appropriate motor and speed controller were found in the Bodine Electric Company Stock Catalog (312-478-3515). The prices and model numbers of the motor and controller' are included below:

Dividers and center tube		$75.00
Rotating and stationary base		40.00
Bearings		8.34
Polyurethane finish		6.00
Epoxy & solvent cement		5.00
Motor model no. 561		159.54
Speed controller model no. 901		146.08
	TOTAL	$439.96









Remote Computer Accessibility for a Person with Quadriplegia

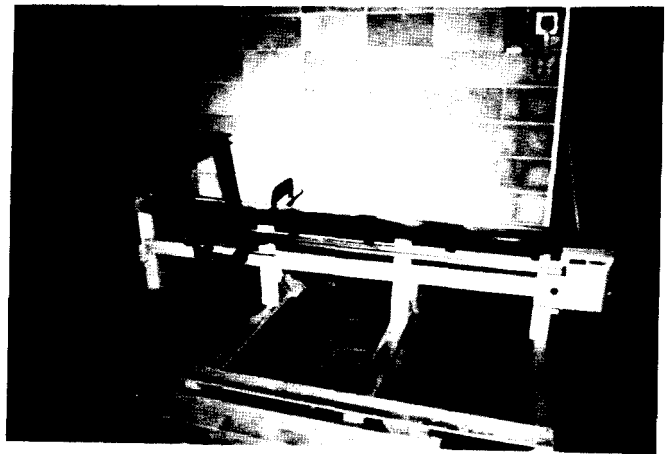
Designers: Bob Klunk and John Antanaitis
Disability Coordinator: James Keefe, Warren Achievement Center, Inc., Monmouth, IL
Supervising Professor: Dr. Mark Strauss
Division of Rehabilitation Education and Department of General Engineering
University of Illinois at Urbana-Champaign
Champaign, IL 61820

INTRODUCTION

A young man who had contracted a brain infection during high school had progressed to the point where this person is a high level quadriplegic. He is completely dependent on others for all tasks and cannot speak. This person's cognitive abilities have not been affected and he is probably above average in terms of intelligence. Prior to our involvement with him somebody had set him up with communications software and a computer so that he was able to communicate by creating sentences with a specialized word processor by using a single push-button. A nearby company has offered this person employment from his bed by using his computer and accessing the company's computer via modem. The client would be required to manipulate the data which, intellectually, he is capable of doing. We were asked to make him more independent by allowing him access to his computer at his convenience without being dependent on another person bringing the computer to him or him to the computer. Since this person has a mild visual deficit, the monitor needed to be within 15" from his eyes. The solution was to fabricate a table on which the monitor would come to the client and retract to its resting location at the client's desire. The project was successfully completed by performing the following design modifications.

SUMMARY OF IMPACT

Our client has high intelligence and a strong need to express his thoughts. Like all of us, his thoughts do not necessarily come only when someone has made his computer accessible for his use, but can come at any time of the day or night. He would never be able to call someone to position his computer at many of these times, which is why the computer monitor positioning table is an invaluable to this client's life. The design which the engineering students have implemented has made possible an independence in computer access not otherwise possible.



TECHNICAL DESCRIPTION

An 8-foot long Stanley garage door opener was used as the drive mechanism to move the table. The garage door mechanism was mounted on the wall parallel to the bed. A light weight table designed as a truss was used to hold the monitor. The table attached to the garage door opener lead screw, as would a garage door, and the truss came up at an angle approximately 30^{0} from vertical, attached to which the horizontal table surface was located. This would allow the table to pass over the client's trunk, legs, and feet during repositioning of the table.

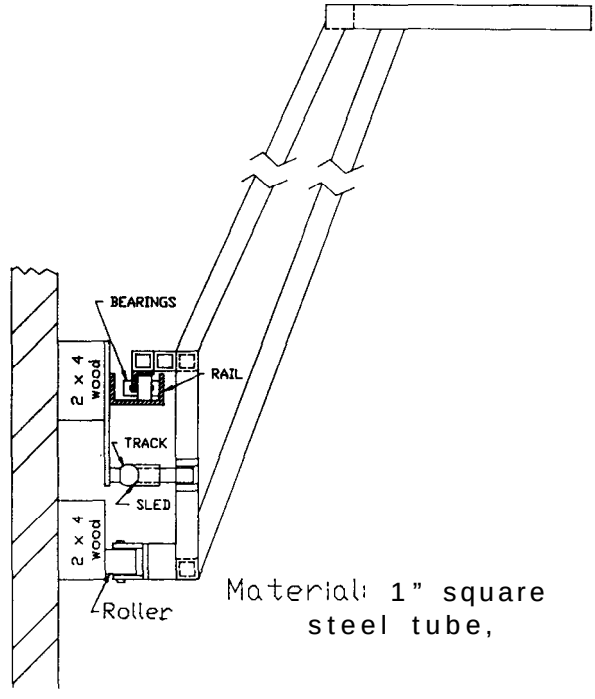
The garage door opening mechanism served only in the movement of the table/frame structure but provided no support for the weight of the structure. In order to hold the table upright, two tracks were fabricated. Channel iron was welded to steel plates and the plates were rigidly affixed to the wall 8" above the garage door opener and parallel to it. A narrow steel plate 3" wide and 8' long was mounted to the wall 8" below the garage door opener track and parallel to it. The lower end of the supporting structure for the table had cam followers and wheels which would interface to these two tracks in the following manner. A total of four cam followers, two positioned horizontally and two positioned vertically, were affixed to the table support and were slid into the channel iron. Two inexpensive rubber wheels were affixed to the lower end of the table support and rolled against the metal plate which was on the wall. The fabrication and alignment of the three tracks and the bearings and wheels was accomplished using a mock-up wall in the laboratory and was created from 2"x4" pieces of wood.

To finish the design a piece of 1/4" masonite was affixed to the tubing onto which the monitor would rest. Two 1/2" foam rubber typewriter mats were than adhered to the top of the masonite, which prevented the monitor from sliding off the table due to any sudden jarring of the table.

As a safeguard, the following materials were provided. The garage door opener was plugged into a timed outlet which provided power only during the hours that the client was awake. At night the power was off, which would preclude the inadvertent activation of the device by extraneous electrical interference emanating from outside the house, In addition, an emergency power shutoff button was mounted in an obvious location on the wall by the bed within easy reach of any caregiver. A doorbell button was also hardwired to the receiving unit which would allow caregivers to initiate table movement in either direction. The installation of the motorized track/table and timed outlet was performed by licensed tradesmen.

The design has been installed in the client's house and is currently being used successfully. The client need only press the remote transmitter which will bring the computer monitor to him or away from him as he so desires. The computer itself does not rest on this table but rests on the floor with the connecting cable running to the monitor. This design allowed for unobstructed access to to the client by his caregivers and the opportunity for this person to be employed. Approximate costs and materials used:

Typewriter mats	22.00
Garage door opener	190.00
8' channel iron and 8' of steel plate	20.00
4 cam followers	20.00
Hardware	10.00
2-3" diameter wheels	5.00
30' of 1" steel tube with a square cross-section	40.00
Timer switch,conduit,outlet box,misc.hardware	50.00
Total	357.00



Title of Project: An Exerciser for a Person with Multiple Sclerosis

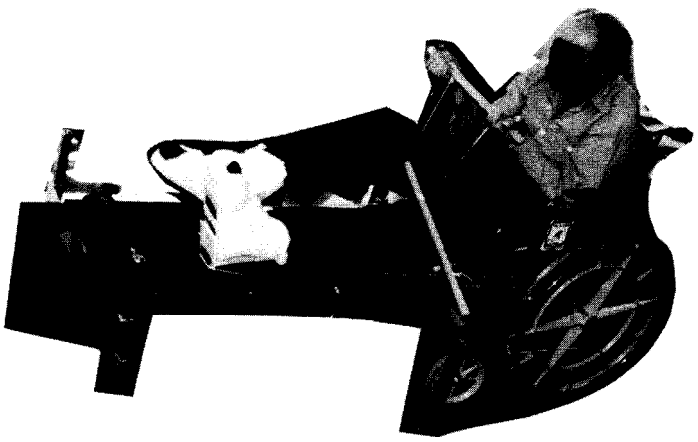
Designer: Heidi Blaumueller, John Connelly
Supervising Professor: Dr. Mark Strauss
Division of Rehabilitation Education and Department of General Engineering
University of Illinois at Urbana-Champaign
Champaign, IL 61820

INTRODUCTION

A middle aged man with multiple sclerosis is concerned about the deterioration of his muscles, especially his leg muscles. By exercising these muscles, he hopes to retard their deterioration. We were asked to design a machine which would enable him to stretch and exercise his limbs while remaining in his wheelchair. The resultant design is such that the user can roll his chair up to the exercise machine and place his feet in the "boots," securing them with velcro straps. By flexing his knees, the "skis" slide backwards in their tracks. If the user wishes, he can also exercise his arms by pulling up on the wooden handles which are attached to the "skis" via a set of ropes.

SUMMARY OF IMPACT

"I am very pleased with the adjustable leg exerciser that the undergraduate engineering students designed and built for me. During the short time which I have used it, the muscle spasms in my legs have eased plus I am getting exercise to my arms also." It is expected that regular exercise with this device will allow the user an increased quality of life due to daily exercise.



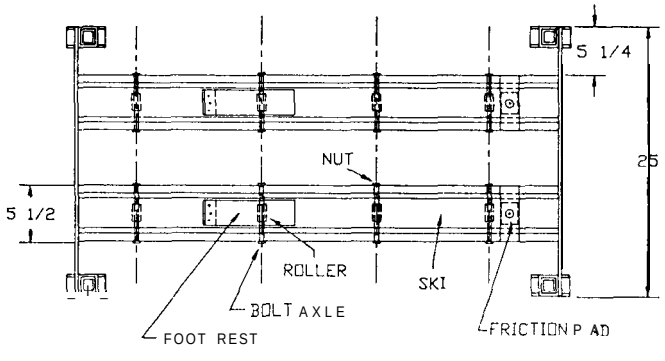
TECHNICAL DESCRIPTION

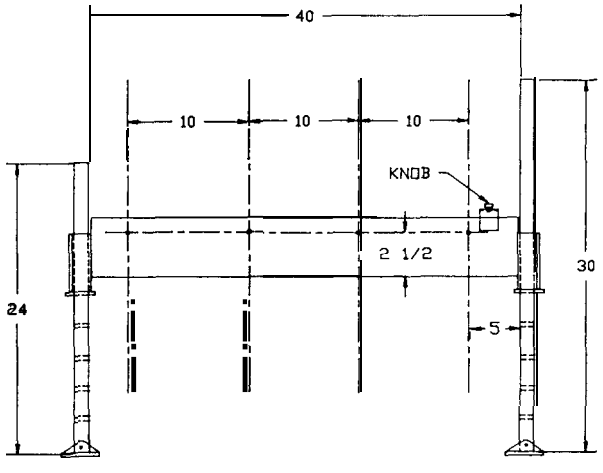
The exercise machine has two tracks, the sides of which are made of 48"x4"x3/4" walnut boards. Each track has a wooden "ski" down its center, supported by four, 2.5" long polyurethane rollers with an O.D. of 1.5" which rotate around a 1/2"x6" bolt. Each "ski" has an adjustable "Bunny boot" hinged to it, into which the user's foot can be placed and secured with velcro straps. A friction pad, made of a wooden block covered with felt, can be tightened at the end of each ski to increase the force (strength) needed to move the ski back and forth, which would therefore alter the exertion level. The tracks are connected by two 30"x4"x1/8" aluminum plates to which four 4" long square aluminum pipes with an inside diameter of 1.005" are welded. Through these pipes another set of square aluminum pipes are fitted with the original outside diameter of 1" being milled approximately 1/100 of an inch. These are used as the legs of the machine, with the front legs being 24" long, and the back legs 30" long. Through these legs 1/8" holes were drilled along the length of each leg at a distance of 2" apart. Four pins, one for each leg, were placed through a hole in each leg, at whatever height the user preferred. This setup made both the height and the angle of the machine adjustable. Ladder feet were bolted to the ends of all four legs to increase the stability of the machine.

A rubber tarp strap can be hooked around the legs of the exercise machine and attached to the wheelchair, keeping the two close together. Two ropes are attached to each ski, near the heel of each "boot." These are threaded through eye hooks and pulleys, leading up to two wooden dowel rods, one for the right ski, and one for the left. The user can pull up on the dowel rod, thereby using the strength in his arms to move the skis and stretch his leg muscles. These can be used to assist the legs if sufficient strength in the leg muscles is lacking.

Approximate costs and materials used:

Walnut boards	45.00
20" of polyurethane roller, McMaster Carr #2292T13	92.00
2-30"x4"x1/8" aluminum plates	
108" of 1" O.D. aluminum tube w/square cross-section	
16" of 1" I.D. aluminum tube w/square cross-section	120.00
4 ladder feet, McMaster Carr #8186T16	8.00
felt, varnish, brushes	5.00
"Bunny" boots	63.00
Misc. hardware	30.00
Welding	51.00
TOTAL	**414.00**





LEFT/RIGHT SYMMETRIC
ALL DIMENSIONS IN INCHES
ROLLERS LOCATED UNDER SKIS