CHAPTER 12
TULANE UNIVERSITY

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Wheelchair Control Systems

Client Coordinator: DeeDee Vansant
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INTRODUCTION

Cerebral palsy (CP) interferes with normal motor skills. This makes it difficult for CP patients to move about on their own and have a sense of freedom and independence.

Two individuals with Cl' want to control a motorized wheelchair. Neither client is able to use the standard joystick controller, even with direction limiting overlays. Other methods of wheelchair control include head, chin and push button controllers, but the commercial devices require more muscle and limb stability than the two clients possess and are unable to compensate for their spasticity.

We designed specialized control interfaces that include visual and auditory indicators for direction and problem diagnosis: **The Enterprise Control Panel** and **The TFNS Wheelchair Control System.**

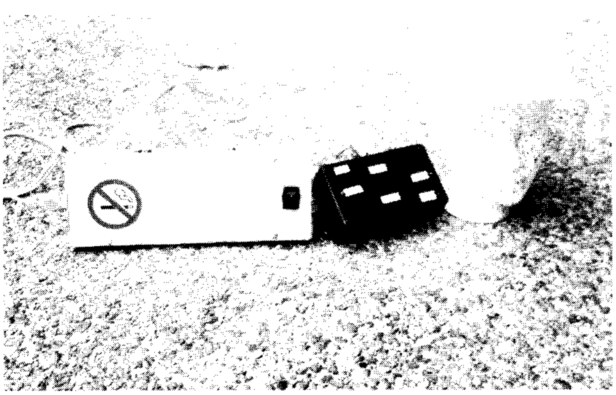


Figure 12.1. TFNS Wheelchair Control System.

SUMMARY OF IMPACT

The devices have been successfully demonstrated on a borrowed wheelchair and used by the clients' therapists. The control systems will be fitted when the clients' personal wheelchairs arrive.

The TFNS Wheelchair Control System

Designers: Steven Evans, William Gunter, Laura Miller, Hien Tran

DESIGN CONSTRAINTS

Our client is a 25 year old with cerebral palsy who is confined to a wheelchair. She has no control of her legs and limited control of her arms, but almost full control of her head and neck. She wants to have more control of her motion and activities, and a motorized wheelchair seems to be the answer. A head control for the wheelchair was proposed, but the controls on the market use a backward motion of the head to initiate movement, which poses a problem. Her panic response is to throw her head backwards, so if she were startled, she could accidentally start her chair moving. We decided on a head controller designed especially for our client.

TECHNICAL DESCRIPTION

The system consists of three parts: the control unit; the switch unit; and the indicator unit. The control unit is the heart of the system and integrates and processes signals from the switching unit. A Motorola 68HCll microprocessor follows a control program stored in ROM. This program includes delays and inputs verification routines that are tailored to the client's characteristics. The program can be modified as needs change.

The switching unit contains five mercury switches, four of which control motion and the fifth that acts as an emergency shut-off if the unit should overturn. The unit is worn on the head and is covered with a hat.

The indicator unit is a box in which are mounted six LEDs and two small speakers. When a movement command is detected, the speakers beep and the LEDs indicate which direction or mode is chosen.

When the head is tilted forward, left or right, the appropriate switch engages and the control unit orders the chair to move in that particular direction. Reverse is a little more complicated. To account for our client's panic response, a "reverse-gear" was incorporated into the design. When the head is tilted backwards, the system is toggled into reverse-gear, and a speaker in the indicator unit starts beeping. Then, if the head is tilted forward, the chair moves in reverse. Another backwards tilt of the head toggles the chair out of reverse-gear.

A delay is incorporated to reduce the occurrence of accidental motion from random head movements. An emergency stop switch is provided for attendants.

The total cost of parts and machining for the wheelchair control system is approximately $110.

The Enterprise Control Panel

Designers: Helion W. Cruz, Michael Fraai, Tu Tran

BACKGROUND

Our client is a twenty-nine year old with cerebral palsy. He has never been able to operate a wheelchair, electric or otherwise. He has tried a joystick controlled wheelchair, but his hands lack the control and accuracy necessary to operate such a device. He can, with great effort, move his hand to specific locations when required to, and he understands how to operate a switch. For this reason, we opted for a wheelchair control design with sensitive buttons that only requires him to place his hand over the button in order to operate the device. The need for precision is kept to a minimum by spacing the buttons widely and designing circuitry that makes the wheelchair stop all movement if more than one button is pressed at the same time. The weight of the hand is enough to keep the mechanism activated.

TECHNZCAL DESCRZZTION

The tray control panel for our client's electric wheelchair consists of a polycarbonate tray with four directional control buttons, and lights for feedback laid out on its surface. Enclosed beneath the tray is the circuitry, reverse buzzer, and a power switch. The tray is designed to be clamped to the armrests of a wheelchair and interface with the external control unit of an invacare wheelchair. The tray features sturdiness and durability, removability, spill resistance, optimal button placement for left hand access, simplicity for better visibility and ease of operation, and a panic button for emergencies. Relay circuitry provides the control function that enables the system to handle activations by the user.

The total cost of the tray control device was approximately $150.

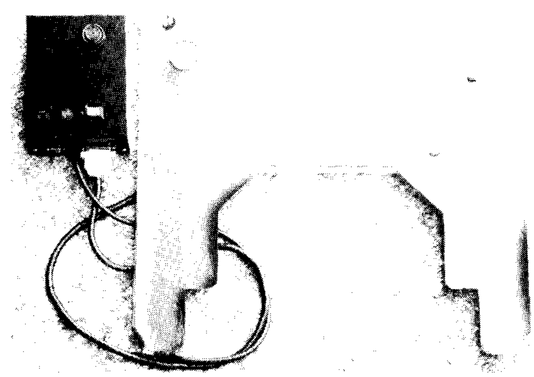


Figure 12.2. Enterprise Control System showing Tray and Control Box.

Hand Assisting Devices

Client Coordinators: Liza Alexander, Charles J. Colton Junior High School; Kathy Kilgore, Special Education
*New **Orleans** Public Schools*
Supervising Professor: David A. Rice
Department of Biomedical Engineering
Tulane University
New Orleans, LA 70118

INTRODUCTION

Congenital schizencephaly and cerebral palsy can cause partial paralysis. Two clients with this condition wanted a device to enable using the hand to grasp objects. The two design teams used very different approaches: **The Hand Helper** and **The Coleman Cock-Up Wrist Splint** were designs completed for the two clients.

The Coleman Cock-Up functions as an orthotic assist; The Hand Helper provides auxiliary tongs for grasping.

SUMMARY OF IMPACT

Both splint designs were tested with the clients and proved to be very effective. The Hand Helper was delivered to the client and her mother, both of who were very excited. The client was able to open and close the device despite her weak fingers, which will strengthen with usage. The cock-up wrist splint has been tested successfully.

The Coleman Wrist Cock-Up Splint

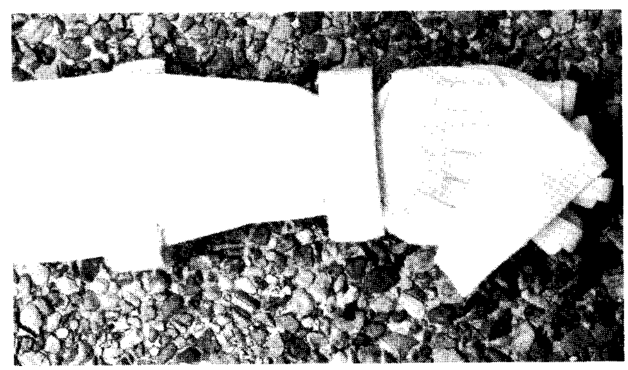
Designers: John Coleman, Roger Coleman, Matt Headrick, Chris Lege

DESIGN CONSTRAINTS

Our client is a young female with congenital schizencephaly, resulting in paralysis of the wrist and finger extensors of her left hand. She favors her right hand in all of her activities - using her left hand only when necessary for pushing or holding objects. In order to improve the functional use of her left hand, we have developed The Coleman Wrist Cock-Up Splint. It is a glove with an insertable wrist support that can be easily removed for cleaning. The various applications of the splint forces her wrist to a more functional position, instead of just lying limp. Not only will the device enable her to use her left hand more now, but hopefully at a future occupation as well.

TECHNICAL DESCRIPTION

The design is based on a ladies evening glove. The fingertips are cut off and elastic is sewn in for a snug fit about the first finger joint. Attached to the back of each finger, including the thumb, are adjustable elastic bands that provide tension to replace the missing extensor function. Tension is adjusted using the hook and loop fasteners on the back. A cotton coverlet covers the elastic bands.



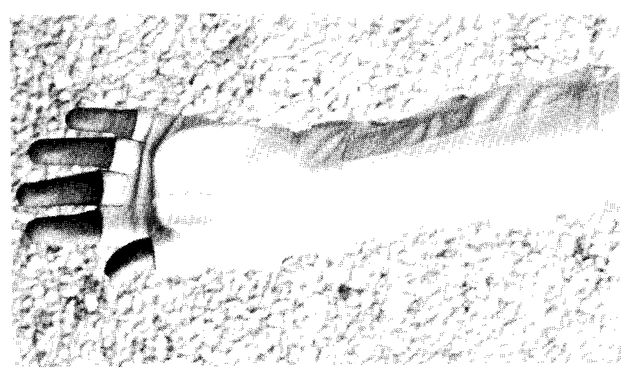


Figure 12.3. Wrist Cock-Up Splint. Top: Backside showing elastic straps.
Bottom: Palm view showing splint outline.

The splint consists of a molded Orthoplast™ material custom fitted to the arm of the client. Attached to the splint are adjustable, nylon straps to allow for best fit and comfort. The splint is lined with foam padding and is encased in a cotton cover that absorbs perspiration. The cover is easily removed for cleaning.

All tailoring to the device was done professionally with heavy nylon thread to increase the life of the splint. The device can also be completely disassembled for easy cleaning.

The total costs of the Coleman Wrist Cock-Up Splint were approximately $40 without labor and tailoring fees, as they were donated. Special thanks go to Betty Ellis for her superb needlework.

The Hand Helper

Designers: James Winfield, Erica Diggs, Brian Meyer, Sharee Major

DESIGN CONSTRAINTS

Our client is a 14–year–old girl with cerebral palsy. She is only able to move her middle and ring finger flexors slightly and has no control of her thumb. Her fingers stay in a semi-clenched position. We devised a clasping device, "The Hand Helper", that allows her to pick up objects like paper so she can obtain a clerical job when she leaves school. This device will also strengthen her arm and hand because she will use it more often.

TECHNICAL DESCRIPTION

The Hand Helper is a glove-like device which fits over the forearm and hand. It provides tongs for object grasping. It operates by balancing the elasticity of the grabbers against the stronger finger flexors. The Hand Helper uses light-weight and inexpensive materials. The rigid shell fits over the client's arm and hand. It is made of Orthoplast™ and measures 9" in length. The tongs are closed by a loop of cable encased in a clear plastic tube. The tongs are made of a thin, flexible steel sheet. Their natural position is open. By pulling on the wire loop, our client can close the grabbers and pick up objects, including paper and other office supplies.

A soft liner inside allows for a comfortable fit. We have covered the device with a pink non-toxic paint and colorful cartoon characters, as requested by our client.

The total cost of constructing The Hand Helper was approximately $55.

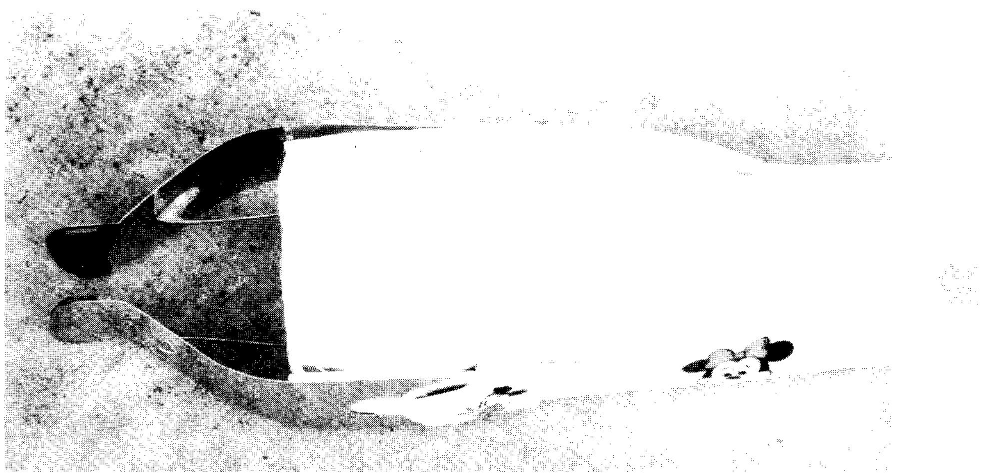


Figure 12.4. View of the Hand Helper showing the Loop Closing Mechanism.

Walking Aids

Client Coordinators: Evie Morriss, Carrie Simpson, Liza Alexander, Joseph A. Craig School; Kathy Kilgore, Special Education, New Orleans Public Schools
Supervising Professor: David A. Rice
Department of Biomedical Engineering
Tulane University
New Orleans, LA 70118

INTRODUCTION

Children with disabilities affecting their legs need both motivation and help to walk. These two devices were designed for clients that have difficulty walking. Both design teams modified existing walkers. This is a more cost-effective and better quality method than designing and building the entire walker from scratch.

The first design, **"Where's the Fire?", is** a **walker** with a fire engine attached to increase the client's motivation to walk. The second design, **Kewan's Walker,** is a folding walker with brakes, wheels, and a stowable seat.

SUMMARY OF IMPACT

Both of the designs have proven to be very effective and successful with the clients. The two walkers have been delivered to the clients and have been in daily use. **Kewan's Walker** has allowed its client to shop at the grocery store, walk to school with her books, and has allowed her to stop and sit when she gets tired. **Where's the Fire?** has also had positive results with its client. He preferred to crawl, but loves the lights and siren and will walk with the walker.

"Where's the Fire?" A Motivational Walker for Children

Designers: Pam Kenney, Lisa Laycock, Debby Nemecek, Tamara Wittke

BACKGROUND

Our client is a five-year-old boy with cerebral palsy. He is also mildly retarded and just beginning to explore his environment. Our goal was to promote his independent mobility and develop his cognitive skills. We attached a PLAYSKOOL fire truck to the front of the walker. When our client walks forward with the walker, the light flashes and the siren sounds. We also made modifications to encourage the client to hold onto the handles when walking and to prevent him from leaning too far forward and locking his legs. We placed switches in the two handles which, when pressed, turn on a string of lights placed along the front support bar of the walker. These modifications will motivate our client to walk and to hold the walker properly.

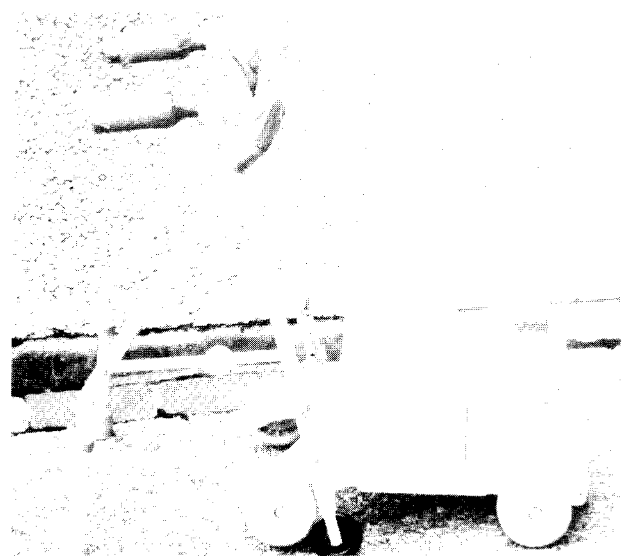


Figure 12.5. "Where's the Fire?", a Motivational Walker.

TECHNZCAL DESCRIPTION

The motivational walker has two main components that are bolted together. The front piece is the PLAYSKOOL "Sound N'Light" walker and the back piece is a traditional Guardian youth walker with front wheel attachments. The siren of the PLAYSKOOL walker operates on two AA batteries and has a control switch on the bottom. The front bar of the traditional walker is completely covered with eight LEDs that are operated by four switches in the two handles. They are operated by a 6 volt lantern battery attached to the bottom of the PLAYSKOOL walker. All the wires from the LEDs and switches are completely enclosed in the frame of the Guardian walker. Vinyl coverings have been placed on the handles and the front bar to further protect the electronic components from drool and spills. The vinyl handle coverings are sewn and the front bar covering is attached with Velcro.

The device is lightweight (under 10 pounds) and durable. All exposed surfaces are water and stain resistant. The modified walker does not differ significantly from a traditional walker in weight or height or structure. The front end of the walker is 18 inches longer because of the PLAYSKOOL fire truck. The PLAYSKOOL fire truck is securely attached to the traditional walker so as not to significantly hamper the client's mobility. However, it is recommended that the walker be reserved for classroom use.

The total cost of the modified walker was approximately $175.

Kewan's Walker

Designers: Van Lam, Miguel Sosa, Vu Mai, Muu Nguyen

BACKGROUND

Our client is a fourteen year old with scoliosis, hip deformity, limited use of her right hand, and one leg shorter than the other. She uses her arms to help balance herself when she walks, but when she is carrying things in her arms, she loses this balance and tends to tire quickly. Thus, our walker design with wheels, brakes, a book pouch, and a collapsible seat provides her with all of the necessities to make walking easier.

TECHNICAL DESCRIPTION

We constructed a folding seat and attached it to the walker. Whenever the client tires from walking, she can unfold the seat from its stowed position. The uniqueness of this design is that once unfolded, the seat will telescope and slide to its operating position, where the child can sit on it safely. When the seat is stowed, the walker can be folded and rolled on its wheels. This feature permits use on a school bus.

The seat has two components, the seat frame and the seating surface. The frame consists of four 1" aluminum tubes which are attached to the walker frame, and upon which the coated plywood seat is located. Along the bottom of the two long tubes of the seat frame were milled slots that run the length of the tubes. Through each slot a brass bolt was screwed into a bronze bearing. This bearing fits snugly inside of the tube and can slide freely along the slot at the bottom of the tube. Smaller bearings allow the seat and frame to rotate up or down. These allow the seat to be rotated down and locked in place at the side of the walker, or the seat can be lifted up out of its storage place and slid across the walker in order to be used.

The total cost of the modified walker was approximately $600, of which $300 was for machining seat parts.

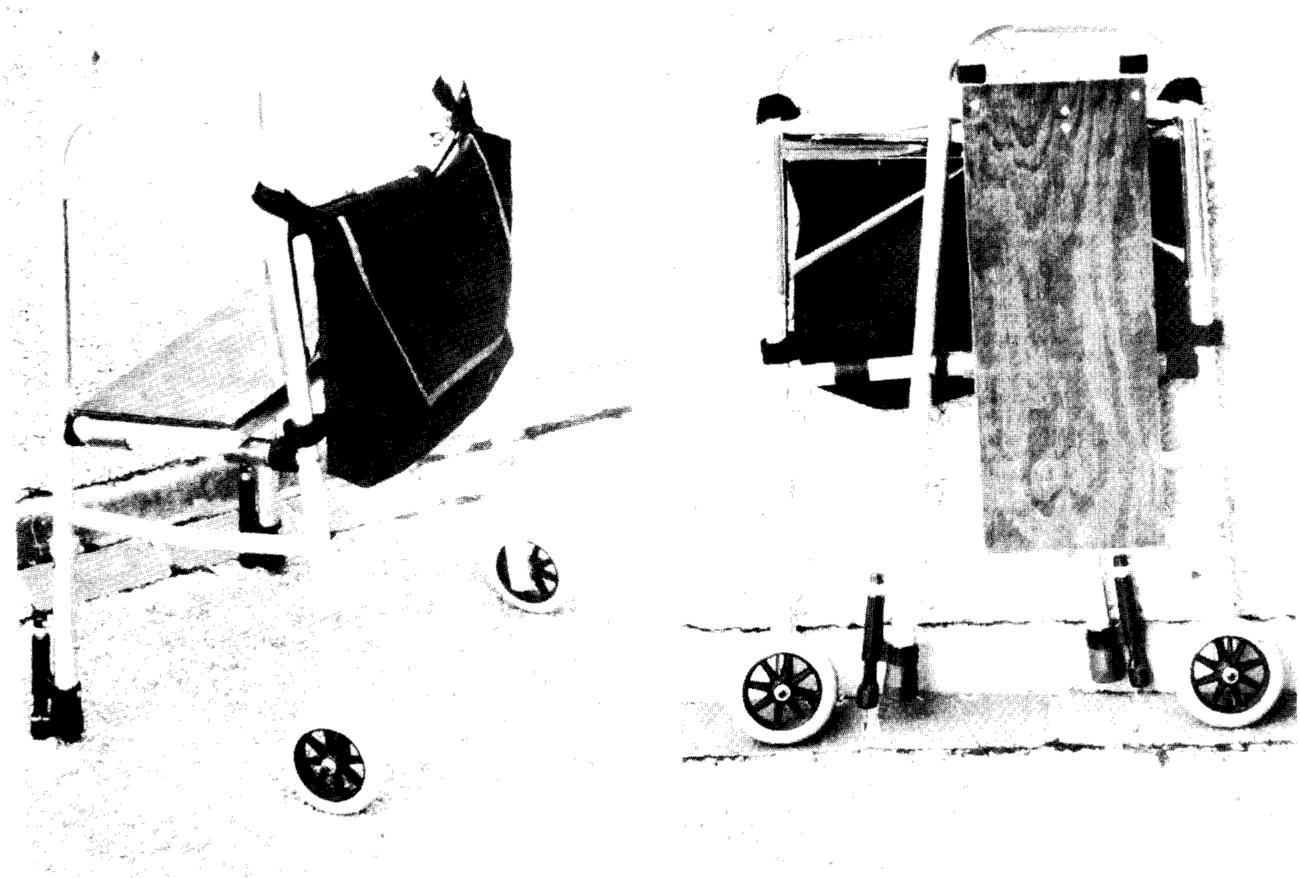


Figure 12.6. Kewan's Walker: left open postion, right folded position.

Devices for Leg Exercise

Client Coordinators: Vivian Michaels, McDonogh 31 School; Kathy Kilgore, Special Eduation, New Orleans Public Schools
Supervising Professor: David A. Rice
Department of Biomedical Engineering
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New Orleans, LA 70118

INTRODUCTION

Lack of movement of limbs and muscles can result in muscle atrophy and loss of joint mobility. This can keep a person from being able to walk. If the patient is paralyzed, lack of movement may result in poor circulation, blood pooling and muscle atrophy. Two products were designed with these problems in mind. The first design, **The Standing Chair,** was designed for a quadriplegic client who needed a device to exercise his legs and knee joints and to hold him in a standing position. The second design, **The TLETC Exercise Bicycle for Non-Ambulating Children,** is for a young girl who has never learned to walk. The motion of the bicycle will build up her leg muscles and strengthen her knees, preparing her for walking.

SUMMARY OF IMPACT

The bicycle was tested with the client and her therapist, who was very excited about the device. It took a few minutes for the client to familiarize herself with the bicycle, but when the music was turned on, she brightened right up. Her feet stayed on the pedals, and she rode for quite a few minutes.

The standing chair was shown to the client, who expressed much enthusiasm. A few minor changes need to be made before it can be delivered to the client, but he is looking forward to using the device. With it, he will feel much more independent and self-confident.

The Standing Chair

Designers: Kearny Robert, Walter Liebkemann, Erica Shalow, Joseph Cooper, Angela Rust, Michael Roberts, lrina Rubinshtein, Nghia To, Ravi Kongara

BACKGROUND

Our client is a 20–year–old quadriplegic student. Exercise therapy for larger quadriplegic patients can be very difficult since more than one therapist is required to support the patient. The standing chair will support the client in an upright position and allow limb exercises to be performed by only one therapist. Patients confined to a sitting position also experience venous pooling and a lack of organ settling. The chair will allow the client to place himself in a standing position often and for long periods of time, which will improve circulation and encourage organ settling. Besides assisting the client physically, the chair will improve his self-esteem by allowing him to stand under his own power to greet friends and family.

TECHNZCAL DESCRZPTZON

The standing chair was designed to meet the specific needs of our client. The main design requirements of the chair were: 1) the linear actuator needed adequate force to lift the client from a sitting to a standing position; 2) the frame had to be strong enough to support the weight of the client without tipping; 3) the support system had to be able to keep the client from sliding or falling out of the chair; 4) the motion of the chair had to be under the client's control; 5) there had to be adequate padding to prevent pressure sores; 6) it had to provide various safety features such as a manual over-ride switch and a lock-out key switch.

The seat, back and base assembly are all welded frames constructed of $1\frac{1}{2}$" x $1\frac{1}{2}$" steel tubing. The seat is connected to the back and to the vertical legs of the base assembly via a continuous steel hinge with a $\frac{1}{4}$" pin. The back of the chair is maintained in a nearly vertical position throughout the range of motion of the chair through the use of a four bar mechanism. The four bar mechanism consists of the vertical legs of the base assembly, the seat, two vertical legs that extend down and remain in line with the back, and a bottom set of bars, which approximately parallel the seat, running from the end of the back vertical bars to the bottom of the vertical bars of the base.

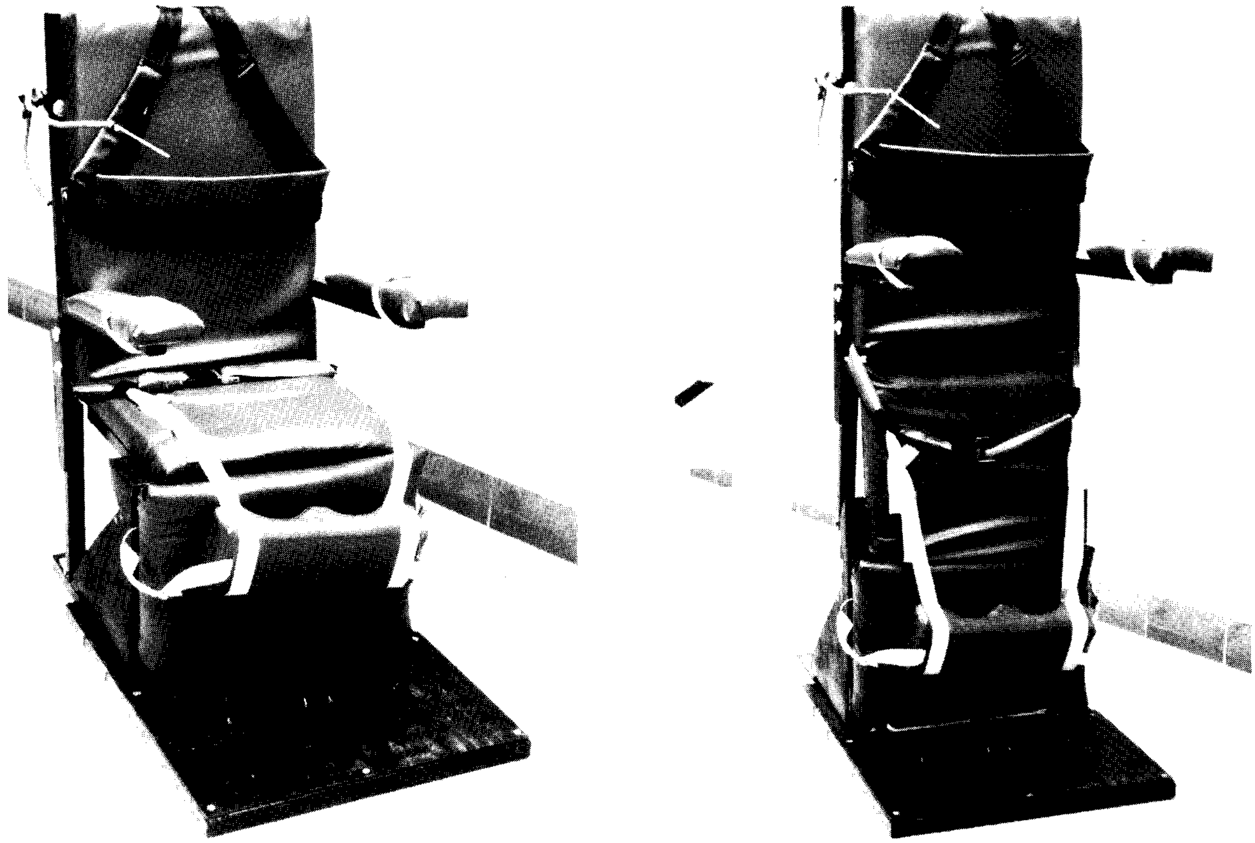

Figure 12.7. left: Chair in sitting position. right: Chair in standing position.

The two bottom bars which parallel the seat are pinned on both ends with a $\frac{3}{8}$" stainless bolt surrounded by a $\frac{3}{8}$" ID x $\frac{1}{2}$" OD Delrin bushing with $\frac{1}{8}$" Delrin spacers on both sides of the bar. An electric 24-volt linear actuator, rated for 880 lbs., is pinned on both ends to both the seat of the chair and bottom assembly with a $\frac{3}{8}$" stainless bolt surrounded by a $\frac{3}{8}$" $\times \frac{1}{2}$" Delrin bushing and Delrin side spacers. Shakeproof stainless locknuts and stainless washers were used in all pinned connections.

The chair is operated by the client using sip and puff switches. These switches activate the control circuit to run power from a 24-Volt power supply to the electric linear actuator. When powered, the actuator pushes the seat up or down (depending on if the client sips or puffs) to bring the client to either a sitting or standing position.

Support straps are placed over the shoulders, chest, knees, feet and waist to assure securement during motion. Straps are also included over the client's arms in the likely occurrence of muscle spasms.

The total cost of the standing chair was approximately $1300.

TLETC Exercise Bicycle for Non-Ambulating Children

Designers: Michael Hirsh, Jon Hoffberger, Shari Meyerson, Nicole Sockwell

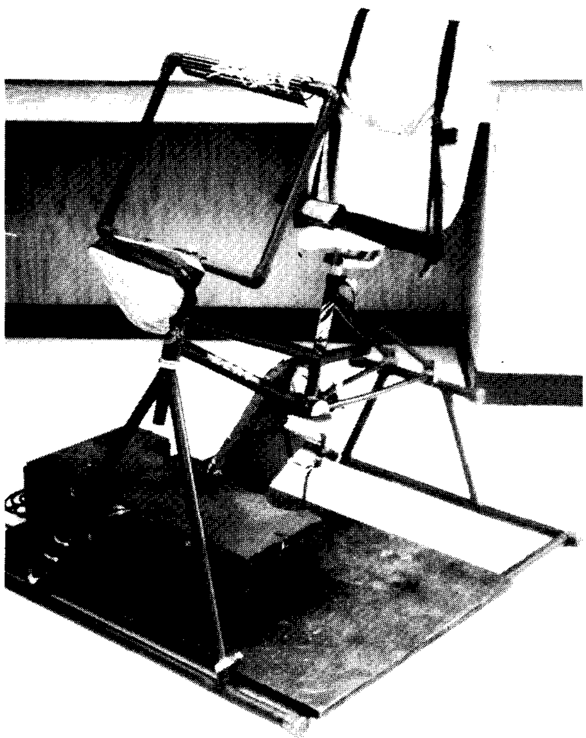

Figure 12.8. The TLETC Exercise Bicycle.

BACKGROUND

Our client is a seven-year-old with mild cerebral palsy and congenital scoliosis. In addition, the client suffered a traumatic injury to her right leg at the age of two, resulting in fixation of the head of the femur with a pin. Although the injury healed, it occurred at a critical period when most children are learning to walk. These problems have resulted in our client never learning to walk.

A passive motion exercise bicycle has been designed to introduce knee flexion and build muscle strength and endurance in our client. Although physically she does have the capability to someday walk, the client's leg muscles have atrophied to the point where she cannot reliably support her weight. If the client is placed in a standing position, she feels that her stability is threatened and immediately locks her knees. One goal of this project is to make the client comfortable with the idea of bending her knees. The other main goal is to build muscle strength and endurance. Both of these goals can be reached using the TLETC exercise bicycle. The bicycle operates in two distinct modes. The first is the passive motion mode. In this mode, the pedals are motor driven with a variable speed controller to introduce the idea of knee flexion. Once the client has developed a level of proficiency and comfort with the bicycle, the bicycle can be switched to active mode. In this mode, the client pedals the bicycle against a variable resistance. As the client develops muscle strength, the resistance can be increased. A major problem with our client is a lack of motivation. To encourage use of the exercise bicycle, we included a radio that operates only when a set minimum speed is achieved.

TECHNICAL DESCRIPTION

The frame for the exercise bicycle is based on a child's bicycle. The bicycle frame is attached to a custom designed frame made of 1" diameter mild steel pipe welded to provide a stable base. The base is attached to the bike frame by 1 inch bolts in the back and a support collar in the front.

The passive motion is created by a 1/30 horsepower motor with a maximum speed of 32 RPM. The speed can be reduced to 5-6 RPM using the speed controller while the child is first learning to use the bicycle. The motor is attached to the standard chain that came with the bicycle. During active motion the motor is in neutral and a potentiometer provides the variable resistance. The motor is equipped with shear pins that will snap if a torque of over 40 ft-lbs is applied. This prevents anything such as a child's foot from being damaged if it should become caught in the pedal mechanism. The chain and sprocket are completely covered by a chain guard to minimize dangers such as curious fingers. The motor and all of the electrical components are enclosed in a motor casing that sits on a sturdy base.

The child is held securely on the bike in a specially designed seat with an adjustable padded seat back. Cross-chest straps secure the client to this portion of the seat while maintaining proper posture to avoid exaggeration of her congenital scoliosis and a seat belt prevents slipping off the bottom of the seat. To keep her feet from sliding off the pedals and becoming caught in the pedal mechanism, toe clips are added to the pedals. Adjustable handlebars provide the client with a feeling of security and also encourage proper posture. The estimated cost of the exercise bicycle is $900.

Aids to Daily Living

Client Coordinators: Mae Reed, Sarah T. Reed High School; Carolyn Fittere, Charles Bryan Financial Group
Supervising Professor: David A. Rice
Department of Biomedical Engineering
Tulane University
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INTRODUCTION

People with disabilities often have problems performing everyday tasks. Often simple modifications or adaptations make everyday items useful, under extraordinary circumstances, or provide independence not otherwise obtainable. Three clients wanted devices to assist them in their daily activities. We designed products with cost-effectiveness and the client's needs in mind. Four products were developed: **A File Access System, An Elimination System, An Adapted Feeder,** and **A Foot Pedal Remote Control.**

SUMMARY OF IMPACT

The four devices were shown and tested with the clients, and all four proved to be successful. The clients showed much excitement and anxiousness over the designs. The file access system was installed in the client's office and has been of great assistance to her. The elimination system needs a few minor adjustments and will be delivered to the client very soon. The feeder control panel was tested and approved by the client and his family. The foot pedal remote control has been in use for a year, assisting data entry in a study of learning in young children.

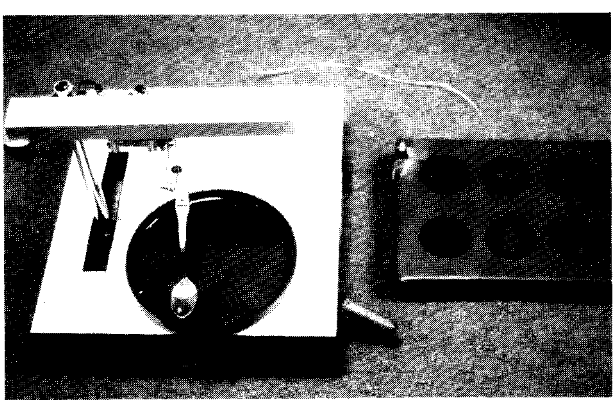

Figure 12.9. View of the Adapted Feeder and Control Panel.

An Adapted Feeder

Designer: Roger Coleman

BACKGROUND

My client is a nineteen-year-old with cerebral palsy. He and his parents want a mechanical feeder that he could control himself. My client has the ability to move his arms, but the movement is spastic and uncoordinated. He can move his arms up or down and can also press down on objects mainly using the top portion of his palm. I decided to modify an existing feeder by integrating a new control panel especially designed for my client. The buttons have to be large, spread out, and easy to operate.

TECHNICAL DESCRZPTZON

The feeder I decided to use for this project is a modification of the Co. Jones Feeder built previously at Tulane [National Science Foundation Engineering Senior Design Projects To Aid The Disabled, 1989, p178-179]. After visiting with the client, we found that it was easiest for him to use momentary push buttons rather than a bi-directional toggle switch. The control panel consists of a wood frame onto which is bolted a panel of polycarbonate. Six holes are cut into the polycarbonate under which the momentary contact switches are placed with aluminum mounts. The switch levers lift slightly a continuous vinyl fabric covering of the board. The vinyl is washable and is stenciled to show the switch locations.

The bottom of the control panel is sealed with an aluminum cover to protect the switch wiring. A detachable multiconductor cable connects the control panel to the feeder.

The total cost of this project was approximately $50, excluding the cost of labor and the feeder.

Urine Elimination System for the Wheelchair Bound

Designer: Irina Rubinshtein

BACKGROUND

My client is a quadriplegic female confined to a wheelchair. She leads a full and active lifestyle as a member of the professional work-force and possesses several devices to help her succeed in her daily activities. Unfortunately, the elimination of waste remains a serious barrier. My client is forced to resort to dehydration by restricting fluid intake throughout the day in order to avoid using the restroom facilities at work or while traveling. This stems from the fact that very limited assistance is available at her workplace. A urine elimination system that I designed especially for my client will enhance her freedom by removing her dependence on the constant presence of a caregiver and will improve health by permitting appropriate hydration.

TECHNICAL DESCRIPTION

The main component of this design is the air cushion. It covers the seat of the wheelchair. A Brey vane air pump takes approximately 25 seconds to entirely inflate the cushion. Since the pump is reversible, no valves or pneumatic controls were necessary. The pump is powered by the wheelchair battery system.

When the pump inflates the mattress, the client is lifted $2\frac{1}{2}$" from the seat. A space is left between her legs for the waste container. It is a container that can hold 18 ounces of liquid. Inside the container is a splash suppressor made of a synthetic gauze material.

During a test with the client, it was observed that her legs tended to roll inward and inhibit her use of the system. I am now working on provisions for holding her legs apart and modifications of her undergarments in order to make the elimination system as simple as possible for the client to use.

The total cost of this project was approximately $200. The price of the pump was the largest expense at $131.

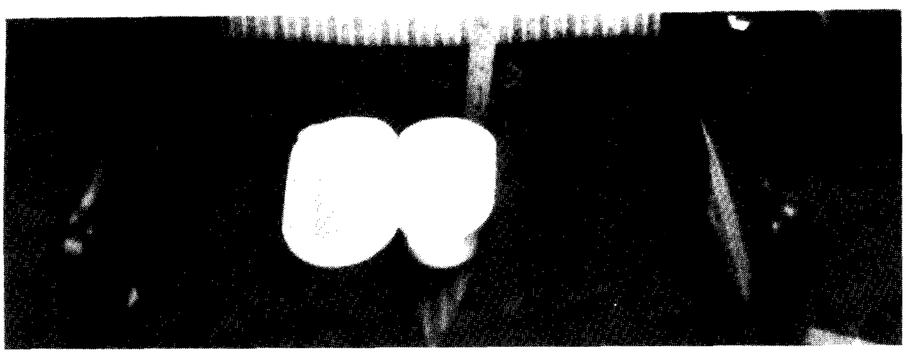

Figure 12.10. Wheelchair Urine Elimination System including Inflated Cushion and Waste Container.

A File Access System for a Quadriplegic

Designer: Michael Roberts

BACKGROUND

My client is a quadriplegic professional. She has some movement in one arm and is confined to a wheelchair. She finds it very difficult to use a standard type of file cabinet. I decided to design a desktop file system that allows my client to access her files in a quick and efficient manner. This includes a storage compartment for small articles. Existing conditions and aesthetics were extremely important, and are met in my design.

TECHNZCAL DESCRIPTION

The system was to fit into a pre-existing desk. The files use standard hanging file folders. They are located underneath the surface of the desktop. The files are covered by a hinged acrylic sheet that is flush with the rest of the wooden desktop when it is closed. Clear plastic provides the visibility my client requested, and tests showed that scratching would not be a significant problem. In order for the top to be easily operated, a counterbalance mechanism is required. This keeps the cover open by itself, a feature my client requested. To close the cover, a small force pushing down on the front of the glass cover must be applied until magnetic cabinet catches secure it.

A box the size of a shoe box provides storage space for small items. This box is fitted with file hanger hardware that holds it on the same track as the rest of the files. This allows positioning at will.

Costs for this project were approximately $150.

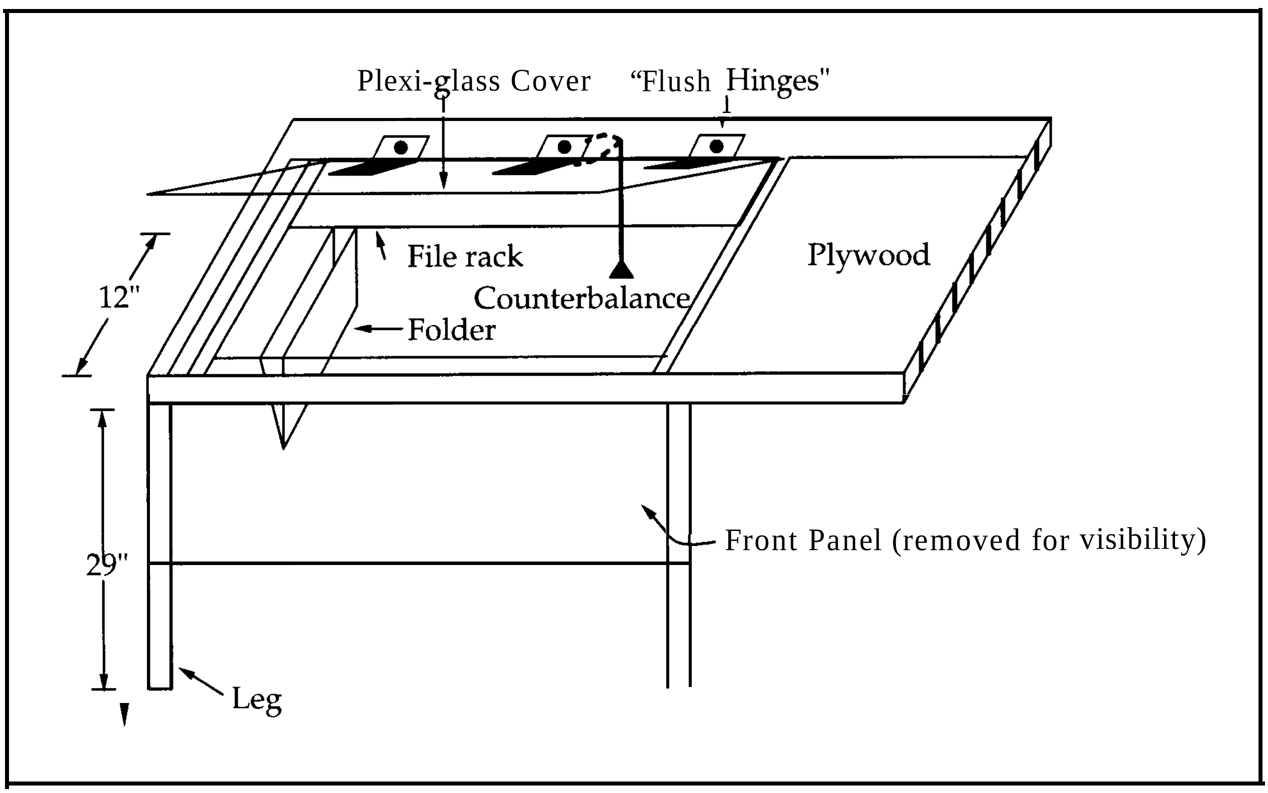

Figure 12.11. The File Access System.

A Foot Pedal Remote Control

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BACKGROUND

The Foot Pedal Remote was designed to meet the needs of researchers who need to keep their hands free for data entry while operating a VCR. The foot pedal remote is also useful for those who have a disability that makes it difficult to use a hand-operated remote.

TECHNICAL DESCRIPTION

The remote is controlled by depressing one of four foot pedal switches. Each foot pedal switch can be programmed to control any equipment that can be controlled by an infra-red remote controller.

The prototype uses wood beams as pedals on a plywood frame with a steel rod serving as the axis of rotation for the pedals. Wedge-shaped foam pads act as the return springs for the pedals after they contact a micro-switch. A telephone cord connects each switch to the circuit board conductors in parallel with the contacts of a button on a Universal Programmable Remote Control. Depressing the switch activates the function that has been programmed for its corresponding button. Programming the remote is accomplished following the manufacturer's directions, except that the foot pedal is used rather than a button.

The device is modular in construction. It uses standard 8-lead modular telephone connectors to connect the base to the remote. This allows the universal remote to be used with any set of switches designed to accept a modular male 8-lead jack. Power for the remote is supplied by its internal batteries.

Total cost is $75, including $50 for the programmable remote control.

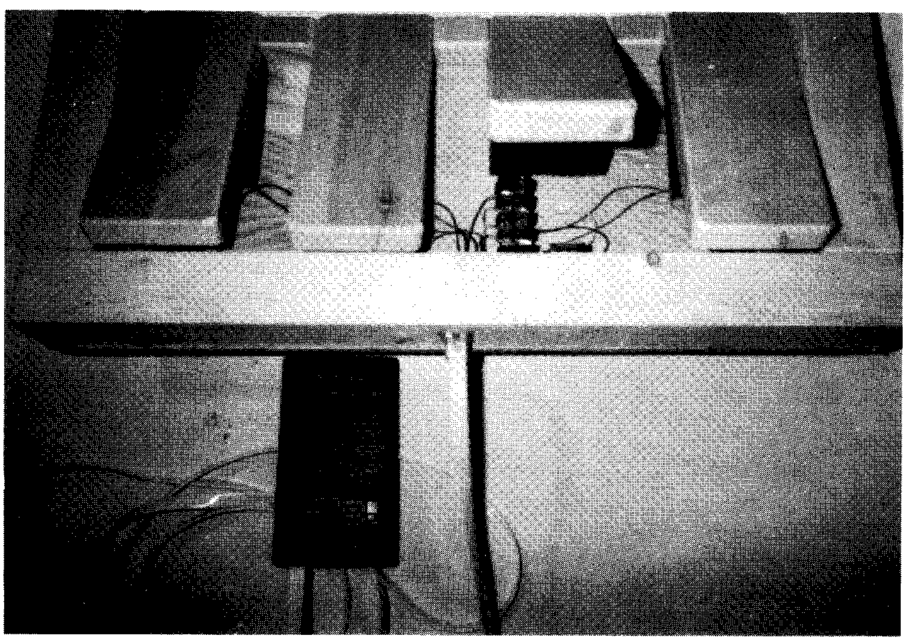

Figure 12.12. The Foot Pedal Remote Control.