CHAPTER 8
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Horsemanship: Equipment for Therapeutic Horsemanship

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INTRODUCTION

A series of designs are available to facilitate horseback riding by individuals with a variety of disabilities as a consequence of this design project. These designs are in use at the Texas A&M Therapeutic Riding Program and at EQUEST. The designs are a Biding Surcingle, a Portable Mounting Block, and prototype designs for Amputee Saddles. The Biding Surcingle (Figure 8.1) consists of a padded leather form with three leather covered rope handles. This form is attached to the horse by a western riding style girth and latigos. This surcingle is tightened into place over a riding pad to provide extra cushion for the rider. The Mounting Block (Figure 8.2) consists of a ramp and platform built on an axle and a set of wheels. The bottom part of the ramp can be flipped back in order to attach a tongue and hitch, allowing the mounting block to be moved as a street legal trailer. A set of steps is also provided to allow a helper to assist mounting from the opposite side of the horse. The Amputee Saddle designs are mockups for use by rider's missing one or both lower extremities.

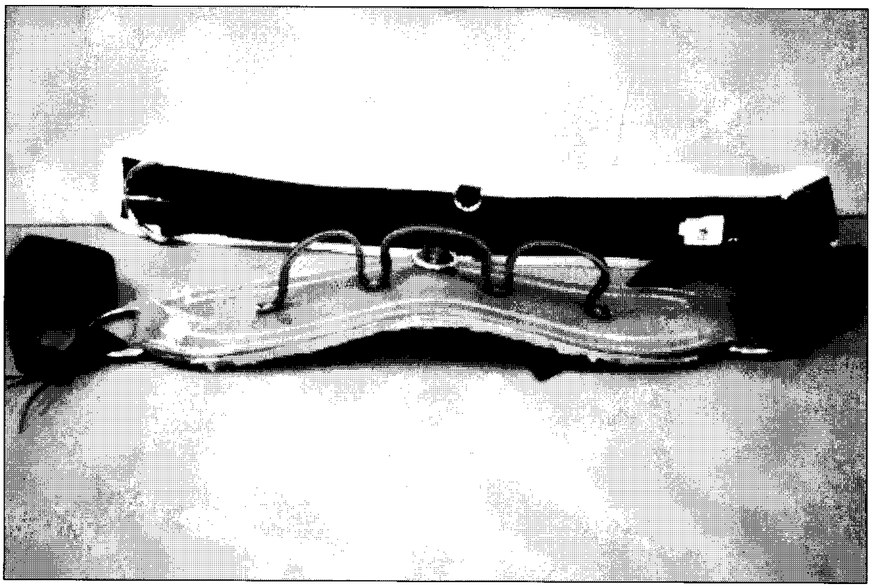

Figure 8.1. Surcingle.

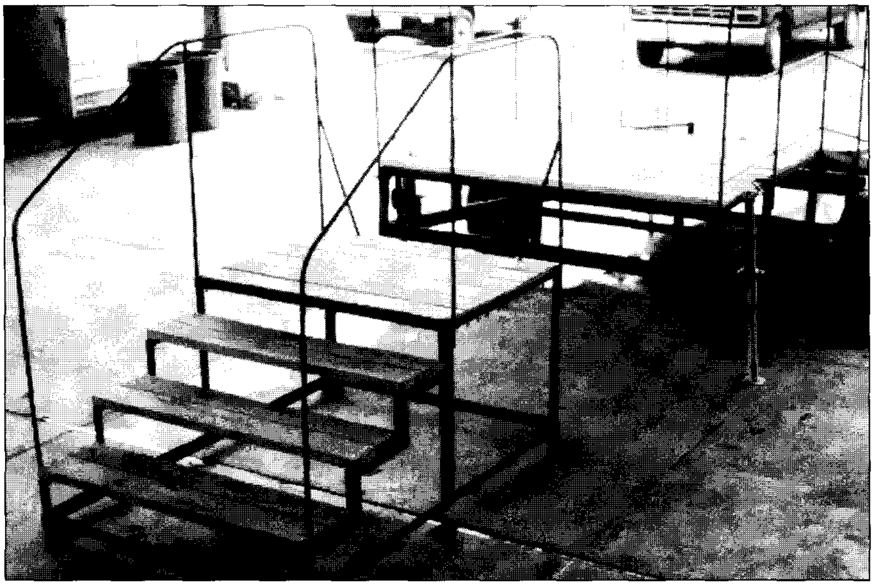

Figure 8.2. Mounting Block.

SUMMARY OF IMPACT

Therapeutic riding programs have been initiated throughout the world as a new form of physical therapy. The horse is used as a treatment modality much as therapy balls, bolsters and other equipment are used in the physical therapy clinic **setting.** Individuals who have benefited from therapeutic riding include those who are visually, hearing or speech impaired; those with learning disabilities; and those who are seriously emotionally disturbed, mentally retarded or multi-handicapped. The basis for the beneficial effect of horsemanship varies with the needs of the rider. Physically, the horse's motion imparts a smooth and rhythmic input to the rider. This **movement,** coupled with the warmth of the horse, is thought to be useful in reducing high muscle tone and promoting relaxation in rider's with spastic cerebral palsy. Riding can help to decrease fear of movement and reduce hypertonicity, while also requiring controlled contraction, joint stability, weight shifting and postural and equilibrium responses. The horse can also elicit a strong emotional response in many riders, and corresponding desire to reach riding goals. Much of the basis for these observations is presently anecdotal. One of the objectives of the association between Texas A&M and EQUEST is to investigate these benefits in a more rigorous manner.

Equipment used in most therapeutic riding should not interfere with the rider's balance, **movement** or **contact** with the horse. **Some** riders do not have enough strength in their leg adductor muscles to sit securely in a regular saddle. Riders with spastic Cl' must not have their leg's forced into position in the saddle in order to avoid undesirable muscle reflexes, although after mounting the warmth of the horse reduces these reflexes. Riders with postural problems may also be excessively challenged by standard equipment. For this reason, many riders should not use normal west-em or English saddles, and special riding equipment is therefore required. The completed surcingle and preliminary amputee saddle designs address these types of needs.

Mounting the horse can also present significant problems to the rider and their attendant. Permanent ramps and platforms can be provided at fixed locations. However in some settings, and for special events, a portable and road worthy system is desirable. The portable mounting block described here addresses this problem.

TECHNICAL DESCRIPTION

Surcingle.. The surcingle designed here is a replacement for another surcingle that had a single, hard handle. This handle allowed only one hand position. In addition, it had frequently injured riders who lost their balance and fell forward into it. Some riders had also deliberately banged their heads on it during self abusive behavior. Other special purpose surcingle (e.g. bareback riding, lounging, vaulting) did not address the goals of the new design, which are to not interfere with the rider's legs, to provide multiple soft handles that are at an easy grip height, to not slip side to side when the horse moved, and to provide a ring for an over rein that is used to keep the horses head up, and prevent the rider from feeling that they are going to be pitched forward. The leather form was approximately 7" wide and 2' feet long. It is padded with artificial sheep skin to protect the horse. Three handles, each 6" long and 4" wide, are attached to the form. The handles are made from manila rope covered in thin leather. An 0 ring is sewn onto either side in order to attach the latigos and girth. Two latigos are used so that the surcingle is adjustable from either side. Future modifications to the surcingle may include the addition of detachable and adjustable stirrups. This will allow beginning use of stirrups without requiring a saddle. The surcingle was initially tested by the designer who is an experienced rider. The handles are at a comfortable height and allowed various hand positions. There is no interference with the rider's legs and sideways slippage was no more than 1/2". Actual fabrication of the surcingle was by a saddle maker at a cost of $110 for materials and labor.

Mounting Block.. The requirements for the mounting block are (1) portability, (2) able to hold up to 650 lbs (three adults and wheelchair), (3) as light as possible, (4) 3' high platform large enough to maneuver a wheelchair, (5) a 12' ramp , (6) a 3' railing on both ramp and platform, and (7) 3' auxiliary steps. The unit is built on a 1500 LB axle and two 14" wheels. The ramp's bottom is 4' by 5' and is attached to the remaining 8' (by 6' wide) of ramp by a pipe hinge. The platform is made of treated 2" by 6" pine and is 5' by 6' and 3' high from the ground. There is a 1" square tube across the back of the platform which serves as a wheelchair stop. The detachable hitch is 48" wide and 42" long. A standard ball hitch is attached to a piece of heavy pipe. Three-inch channel iron braces on each side of the tongue, which is attached with 8 bolts to the platform frame. A 3' railing runs the length of the upper ramp and platform. The platform is stabilized in use by heavy duty jack stands in each comer. These jacks also allow use on uneven ground.

To haul the mounting block, the bottom portion of the ramp is flipped up and the hitch attached. The front is then raised with the jacks so that a vehicle can be backed into place. All jacks are then raised.

Rear lights are provided on the platform for use in trailering. The light-weight separate-steps for use on the opposite side of the horse, are constructed from an angle iron framework and 2" by 6" steps, with a hand rail and 3' by 4' platform. The steps can be loaded onto the mounting block for transport.

Professional assistance was required to construct this project and to assure that it could be legally hauled as a trailer. The total cost for parts and equipment rental was $1052. The labor was donated.

Amputee Saddles.. The basis for the saddle designs is an adaptation of the side saddle, where the saddle tree is altered to provide leg support. Padded outgrowth in the front and rear of the saddle and on the side of the missing limb is proposed to provide front to back stability. Straps with quick release buckles are used at the top and lower part of the thigh for additional help in staying in the saddle. This provides side to side stability that is normally provided by the rider's weight being carried in the heels. In the case of an accident, the buckles allow a quick, manual release of the leg from the saddle. A modified saddle tree would also be required, and weight balancing should be provided. A sketch of these modifications is shown in Figure 8.3.

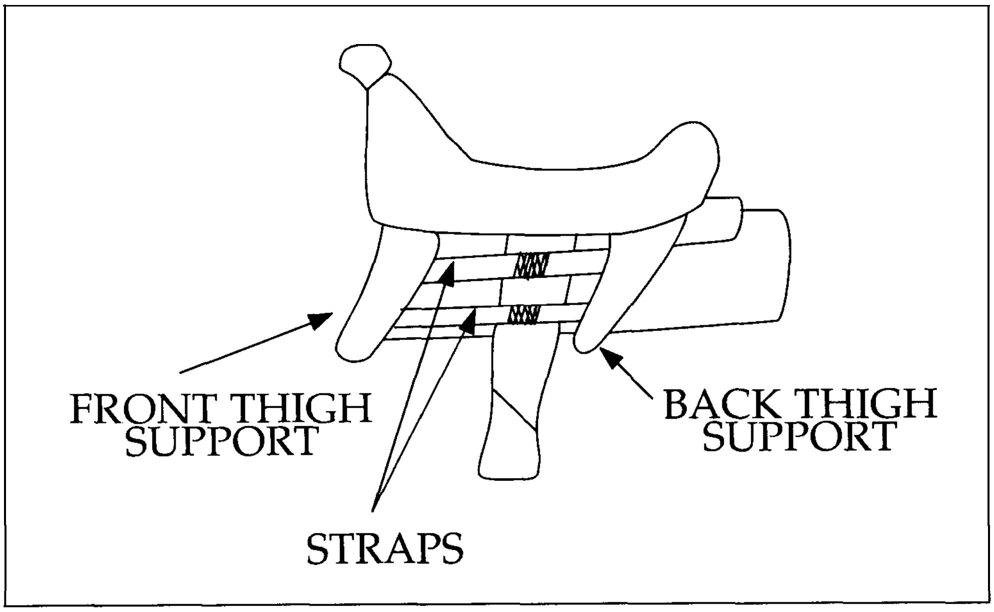

Figure 8.3. Sketch of Amputee Saddle Design.

Exercise Therapy: Equipment for Pediatric Exercise Therapy

Designers: Matt Collier and Kenneth Whitley
Client Coordinator: Greta Cheery
United Cerebral Palsy of Greater Houston
Supervising Professors: Drs. W.A. Hyman, G.E. Miller
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INTRODUCTION

Two exercise devices are described which are pediatric versions of common equipment. One is the pediatrack (Figure 8.4), which is similar to a scaled down and simplified Nordictrac. It provides for a skiing type motion, with fixed arm positions, for use by children 3-6 years old. Two plastic adjustable skates provide the foot contact, and a pulley-cable system forces the skates to move in opposite directions on a wood guide and base. The second device is a pediatric stepper (Figure 8.5). This device is a low and variable resistance, low impact machine designed for use by young children in developing leg muscles. These devices are being used in the physical therapy department at the clinics of the United Cerebral Palsy of Greater Houston.

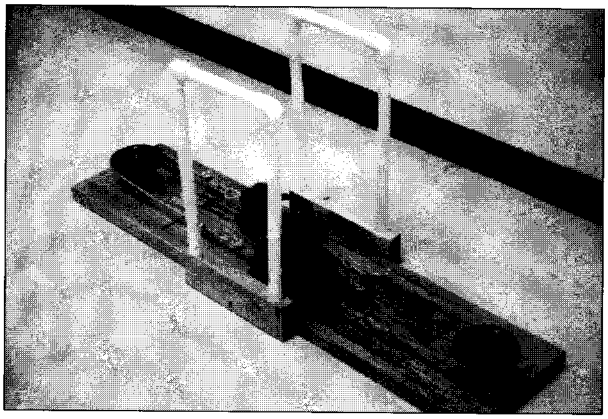

Figure 8.4. Pediatrack.

SUMMARY OF IMPACT

The design requirements are presented as the need for smaller and lower resistance versions or variants on well-known exercise equipment that was too difficult for the clients of the UCPGH to use in their exercise therapy programs. Although both aimed at the lower extremity, these two devices complement each other by exercising the muscles of the legs in different ways, and by requiring different directions of motion and coordination. These devices are currently in use with a variety of children and judged by the therapists to be effective.

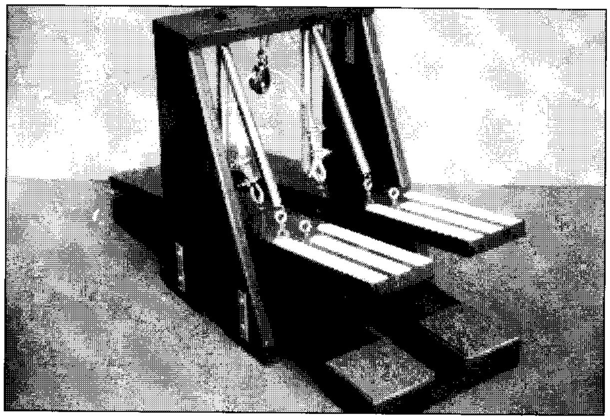

Figure 8.5. Stepper.

TECHNICAL DESCRIPTION

Pediatrack.. The base is constructed of 2” thick pine. Two $\frac{1}{8}$" deep grooves $\frac{1}{2}$" apart provide guides for the skates with a 2' range of motion. Two $\frac{1}{2}$" deep holes are present to hold the pulley's mount shafts. The skates used are Tyco No. 57 Roller Skates. Plastic coated $\frac{3}{8}$" diameter steel cable is run through each skate above the front axle and secured with U clamps. Two 5” diameter by $\frac{3}{4}$" nylon roller bearings sheaves are used in the pulley system. The arm railings are 16" in height and are constructed of $\frac{3}{4}$" PVC pipe. A schematic of the system is shown in Figure 8.6. The total cost of the device was about $50.

Stepper.. The stepper is made of pie with metal reinforcement and bracing. It has a 2' by 10" base with two vertical sides 1 $\frac{1}{2}$' tall with a horizontal top. The steps are hinged at one end using metal door hinges. Each step is suspended from the top piece at their center by two springs. The two springs are fastened to the step at two different points to distribute the spring load. The springs can be changed or their rest position moved to alter the resistance. A pulley is also suspended from the horizontal top piece. A metal cord stretches from one step, over the pulley, to the other step. This assures an alternating stepping motion. The length of the cord can be changed to adjust the height of the steps. The top surface of each step is covered with non-slip bathtub strips. To use the stepper the child stands with one foot on the free end of each step. As weight is put on one foot, that step goes down and the other step is raised. Shifting weight to the other foot, the corresponding step goes down while the other step again is raised. The exercise continues in this fashion. This device was built for approximately $20.

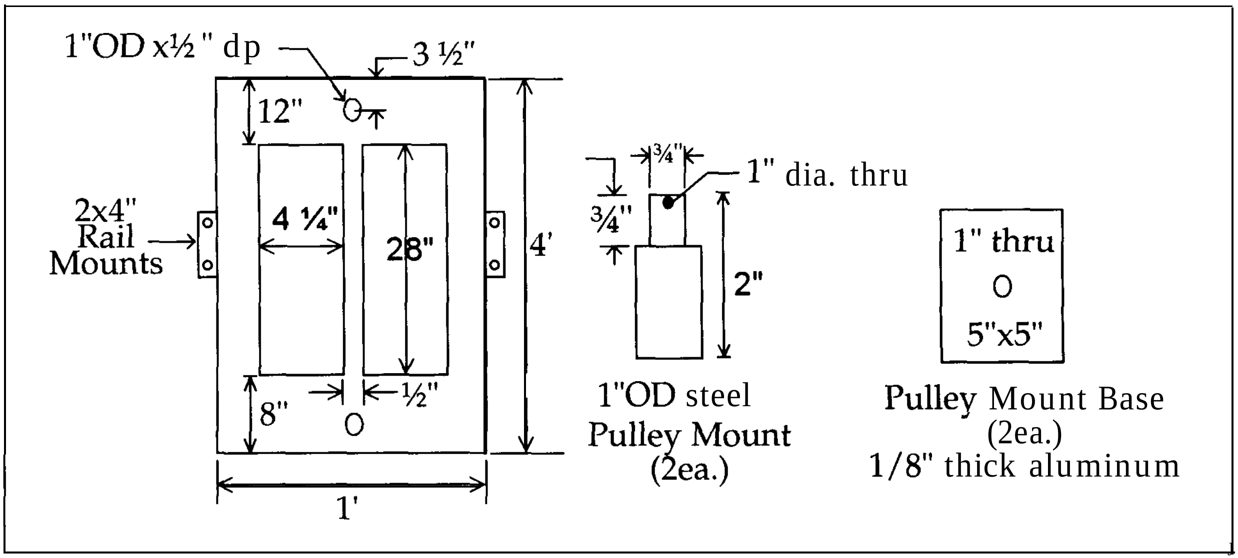

Figure 8.6. Pediatrack Components.

Foot Steps: Responsive Foot Steps for Pediatric Gait Therapy

Designer: Chris Sellers
Client Coordinator: Greta Cheery
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Supervising Professors: Drs. W.A. Hyman, G.E. Miller
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INTRODUCTION

This project is specified as a series of foot step targets that would produce audible feedback when stepped on by a subject, used at United Cerebral Palsy of Greater Houston as part of gait training for children with cerebral palsy. The system consists of a xylophone circuit encased in a metal box, pressure sensitive switches inside circular pads, amplified speakers, and connecting wires. Each pad is individually placed on the floor. When a pad is stepped on by the subject, an internal switch closure produces a corresponding tone from the xylophone circuit. The pads are easily relocated, and the whole assembly is easily moved or stored.

Figure 8.7. Foot Step System.

SUMMARY OF IMPACT

Many children with cerebral palsy do not have complete muscle control of their legs. Thus, ambulatory therapy is a common **treatment** modality. This treatment, when applied to young children, is significantly improved if mentally stimulating feedback is also provided for the child as the exercise is performed. This improves motivation to perform the exercise, and increases the duration over which exercise will be maintained. The system described here provides variable musical auditory feedback as each step is taken, thus meeting this goal. The **system** is in current use at the UCPGH.

TECHNICAL DESCRIPTION

The foot steps are designed for children with CP who are between the ages of two and five. The primary requirements are: (1) the system had to produce pleasant auditory feedback for each successful step, (2) the pads had to be movable, (3) the pads had to be visually attractive to stimulate targeting, and (4) the system had to be portable for transport to outreach centers and for storage. The system has four main components: the xylophone circuit inside the metal enclosure, the foot switches, the connecting wires, and the speakers. The front of the box contains connectors for the switches. The back of the box has a connector for the speakers. The xylophone circuit has 11 pins plus battery, and speaker connections. Pins 1-5 and 7-11 produce individual sounds, while pin 6 is the common ground. Zip wire is used to run from the box to the switch pads. This wire can be easily taped quite flat to the floor, thereby eliminating it as a trip hazard or impediment to walking in the area. The switch pads use normally open pressure sensitive switches, manufactured by TapeSwitch. These switches close at 2.5 pounds of force. The switches are enclosed in a larger target mat. The design of appropriate switch mats is a key component of the project, as they had to be low force and low profile to prevent tripping, yet easily movable. The latter requirement precluded the use of a walkway surface with embedded switches. External self-amplified speakers are used for strength and clarity of tone. A schematic of the xylophone circuit is shown in Figure 8.8. The **system** was tested for reliability of switch closure and durability before being deployed at UCP. The system cost approximately $150.

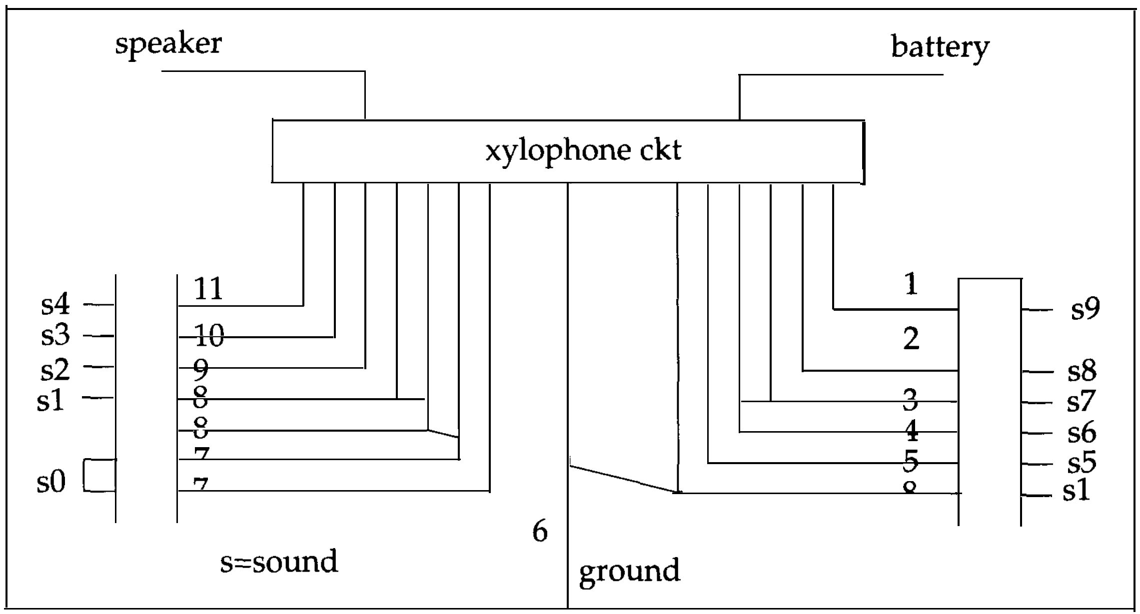

Figure 8.8. Circuit Diagram for Foot Step System.

Multisurface Walkway: A Multisurface Walkway for Children

Designers: Lindy Jordan
Client Coordinator: Greta Cheery
United Cerebral Palsy of Greater Houston
Supervising Professors: Drs. W.A. Hyman, G.E. Miller
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INTRODUCTION

Pediatric physical therapy at the clinic of the United Cerebral Palsy of Greater Houston includes a variety of mobility objectives, each requiring separate items of equipment, yet forming an integrated whole with respect to the spectrum of therapy required. Described here is one of several mobility projects, a multisurface walkway. This walkway provides four different types of surfaces, on four separate units that can be attached to each other in a variety of configurations. This provides a controlled environment for the development of walking skills.

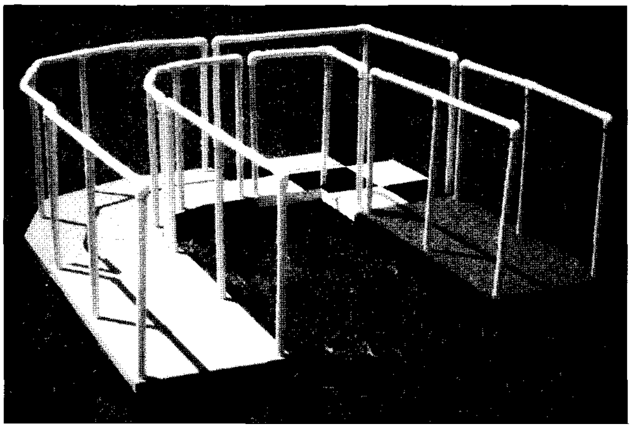

Figure 8.9. Multisurface Walkway.

SUMMARY OF IMPACT

Many children with cerebral palsy lack the muscle development and coordination required to stabilize when moving from one type of walking surface to another, and for walking easily and confidently on a variety of textures. This walkway provides four different surfaces, with the required transition from one to another. The surfaces vary from very soft, to medium soft, to smooth hard and rough hard. These represent such normal environmental surfaces as soft mud or sand, grass, tile or concrete. The walkway includes removable hand rails for additional support as required. The sections of the walkway can be arranged in a variety of patterns. This system is currently in use at UCP and has been found to be beneficial and to meet the objectives of the therapists in working with their clients.

TECHNICAL DESCRIPTION

The primary design requirements for the walkway are: (1) it had to be mobile so that it could be transported from indoor storage to outdoor patio use (limited space prevented continuous deployment), (2) it could not exceed twelve feet in length because of storage requirements, and (3) the surfaces had to be reasonably realistic and present a challenge to the children using it. The sections are of three shapes. Two are 18” by 36” rectangles. One is a 18” by 30" by 30” L shape. Another is a 18” by 36" by 36" curved shape. Dimensioned diagrams for each part are given in Figure 8.10. Each piece consists of a support base made from plywood and 2" by 4” lumber. To transition to the surface from the ground a two-step unit with approximately 9” treads with 2— " risers is provided. A ramp unit approximately 23” inches long is also provided. The four surface materials are tile, sponge, indoor/outdoor carpet, and flex stone, each attached to the plywood surface with an appropriate adhesive. Support rails for both sides of each unit are made from $\frac{3}{4}$" schedule 40 PVC pipe. They are set at a height of 21", and attached to the surfaces through holes. Each unit also has rollers to facilitate moving them. The units can be connected to each other using door hinges with removable hinge pins. The total cost of the system is $150.

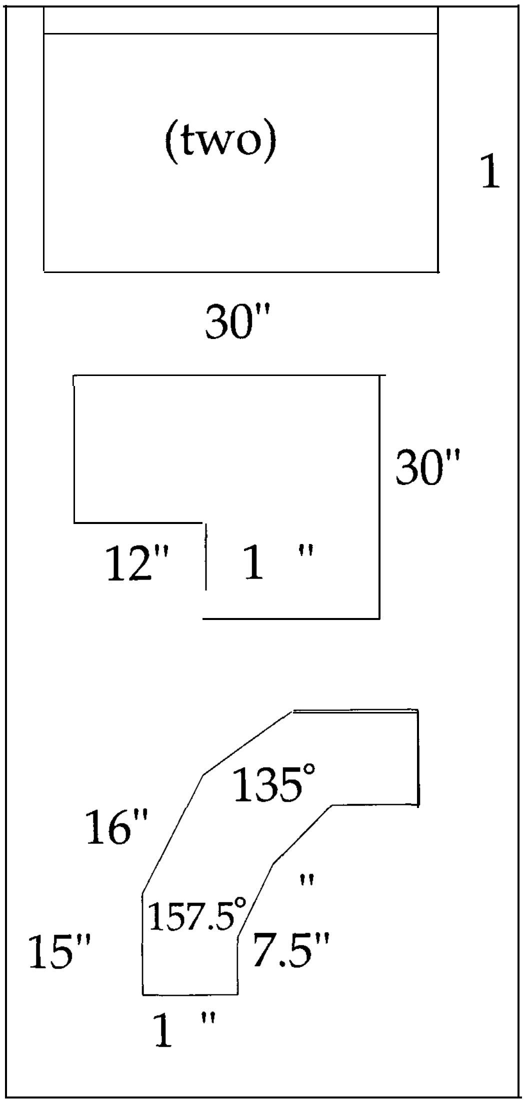

Figure 8.10. Dimensions of Units for Multisurface Walkway.

Crawlway: An Adjustable Transparent Crawl Ramp for Children

Designer: Anne Marie Chard
Client Coordinator: Greta Cheery
United Cerebral Palsy of Greater Houston
Supervising Professors: Drs. W.A. Hyman, G.E. Miller
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INTRODUCTION

In order to provide visual stimulation during crawling, the therapists at United Cerebral Palsy of Greater Houston requested a transparent surfaced, adjustable angle, ramp with an underlying mirror. The resultant device (Figure 8.11) allows the children to see themselves while crawling, thus adding enjoyment to the crawling task.

SUMMARY OF IMPACT

As with many projects developed for the therapists at UCP, the objective here is to combine an exercise regimen with stimulating feedback to the child to increase their motivation and extended compliance with the therapy task. In this case, the system provides a highly attractive and versatile device that includes the particular feedback of seeing oneself in a mirror. This makes the crawling endeavor highly amusing. This device is in daily use with children up to three years old in the physical therapy program at UCP.

TECHNICAL DESCRIPTION

The ramp consists of a plywood base which supports a wooden frame constructed from two-by-fours. The outer dimensions of the frame are 3' by 6'. The bottom of the frame is hinged at one end so that the frame can be raised or lowered at the other end. There are hand holds in the bottom of the free end so that the therapist can more easily control raising or lowering, and to protect the user's hands from inadvertent dropping of the frame. All of the wooden surfaces are finely finished and painted. The ramp is held in the up position by two metal bars which are rotated from a horizontal to a vertical position to support the raised surface. In the up position the ends of the bars fit into PVC end caps mounted to wooden blocks. In the down position clasps are provided to secure the frame to the base. This is helpful if the unit is tipped to the side for moving or storage.

A Plexiglas mirror is enclosed in the bottom frame and rests flat on the plywood base, secured by molding. Plexiglas was chosen for breakage resistance. The top of the frame, where the children crawl, is surfaced with 3/8" transparent Plexiglas. A wooden cross brace helps support the Plexiglas at the midpoint of the frame. This system is more than strong enough to support the weight of the intended users. A warning label is provided which reads "WARNING: 50 pound weight limit" to discourage adults from stepping on the ramp. However, even if persons weighing significantly more than 50 pounds were to do so, it would only result in cracking the Plexiglas, without presenting a significant risk of injury. A 9" tall PVC railing was provided so that children will not crawl off the sides or end of the ramp. An additional lower rail has since been added since 9" proved to allow too large a gap.

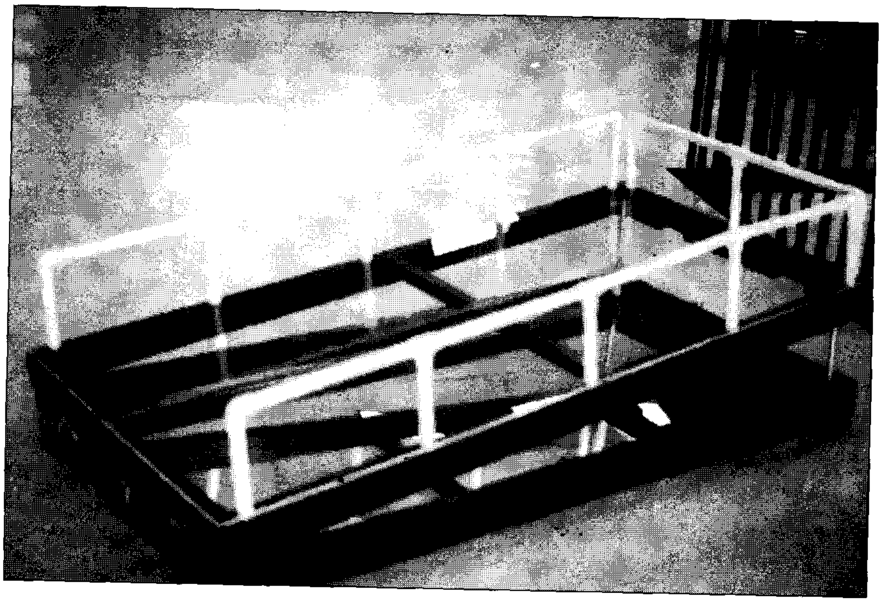

Figure 8.11. Transparent Surface Crawlway.

Door Opener: A Wheelchair Triggered Door Opener for a Private Home

Designer: John Laughlin
Client Coordinator: Beth Roberts
Franklyn Independent School District
Supervising Professors: Drs. W.A. Hyman, G.E. Miller
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INTRODUCTION

The design described here is a wheelchair triggered front door opener for a private home. The device is designed for a fourteen-year-old girl with muscular dystrophy who is confined to a wheelchair, and who receives her schooling at home. Limited upper extremity ability precluded the use of touch switches. Therefore floor mats which could be rolled over were selected as the triggers. It was also required that the swing arm not interfere with normal manual use of the door.

Figure 8.12. Installed Door Opener.

SUMMARY OF IMPACT

Being wheelchair dependent, and receiving her schooling at home, has presented challenges with respect to developing this client's sense of autonomy. The ability to exit from and return to her home by herself can therefore be a significant milestone that increases the scope of her everyday world, and reduces her dependence on family members. This system was installed at her home and is in daily use. It complements other projects completed for this client, which have included custom switches for operating her school computer.

TECHNICAL DESCRIPTION

This project consists of two main parts: the control electronics, and the swing arm and motor assembly. The control electronics begins with two pressure sensitive floor mats wired in parallel. When either mat is tripped, a mechanical timing relay is triggered. A 555 timer circuit is used to debounce the signal from the relay. The output from the 555 was set for approximately 6s so that the input from the back wheels would be ignored. The output is inverted using a transistor configuration, and then used as the clock source for a 7473 JK flip flop. Each clock pulse affects the state of the door opener as shown in Figure 8.13. Magnetic door contact switches are used to determine whether the door is open or closed. The signal from the open position and the Q output from the flip flop are NANDed together, as are the closed position switch and the Q output. The output from the NAND gates are fed into a current sink that operates two relays controlling the power to the motor, and its direction. Induced back EMF from the motor proved to be a significant design problem. Capacitors are used at all of the V_{cc} terminals to filter out this source of noise. All wires were shielded, and all relays are isolated from the logic circuit with optical isolators. The transistor invertor is used to keep the clock input of the JK flip flop at ground potential. The system is also equipped with a reset button that brings it to the closed door state. An on/off button is provided for the motor power. The motor and the control electronics are powered from a standard 120-V, plug-in source in the house. The motor drives a swing arm that pushes on the unlatched door from the push side of the door. The door end of the push arm is equipped with rollers. With this configuration, manual use of the door pushes it away from the swing arm and therefore the swing arm is uninvolved in manual use. If the system were to fail in the door open position the swing arm can be easily detached from the motor shaft.

Q	90°	0°	opening	closing	description
0	0	0	x	x	x
0	0	1	1	0	open, start closing
0	1	0	0	1	shut, stop closing
0	1	1	1	0	closing
1	0	0	x	x	x
1	0	1	1	0	open, stop opening
1	1	0	0	1	closed, start opening
1	1	1	0	1	opening

Figure 8.13. Logic Table for Door Opener.

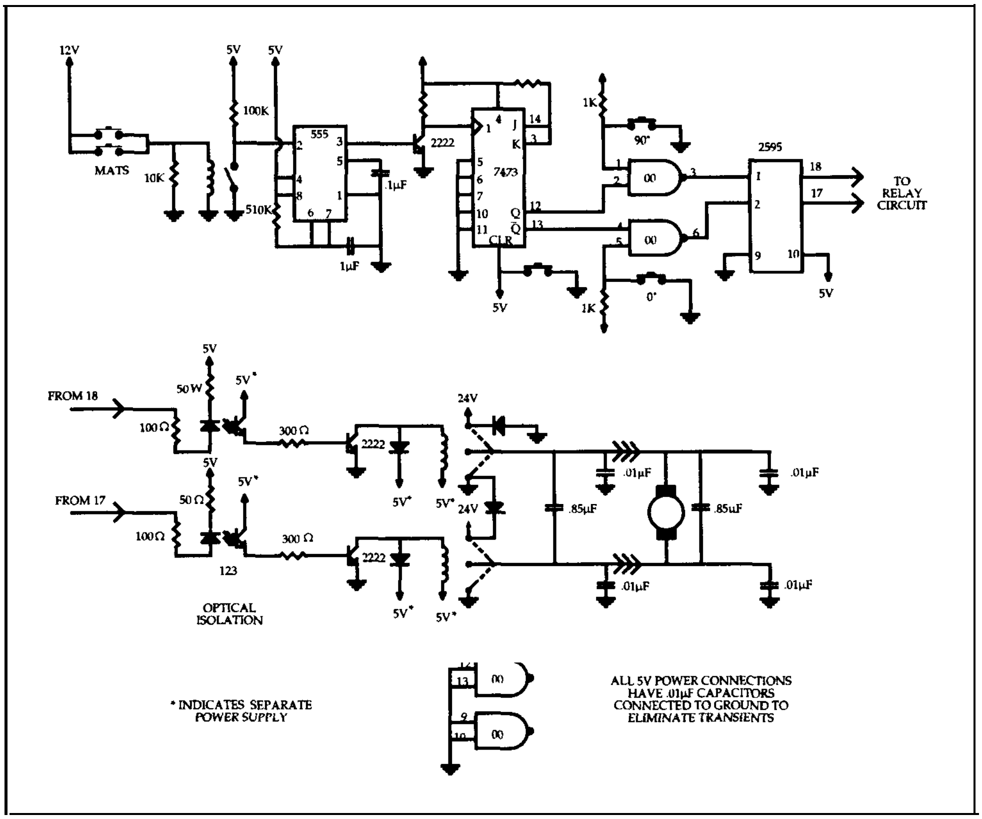

Figure 8.14. Schematic for Door Opener.

Exercise Table: A Customized Exercise Table

Designer: Anne Marie Chard
Client Coordinator: Beth Roberts
Franklin Independent School District
Supervising Professors: Drs. W.A. Hyman, G.E. Miller
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INTRODUCTION

This project involved the design of a customized exercise table for a 12-year-old girl who suffered from oxygen deprivation during her birth. She is able to stand with support and can walk with moderate assistance. She cannot talk or feed herself. A multipurpose rehabilitative exercise program was prescribed; the table described here is designed to meet the objectives of this program, which include strength and range of motion for various joints and muscle groups. The therapy is carried out by therapists and the child's mother. The finished device is shown in Figure 8.15.

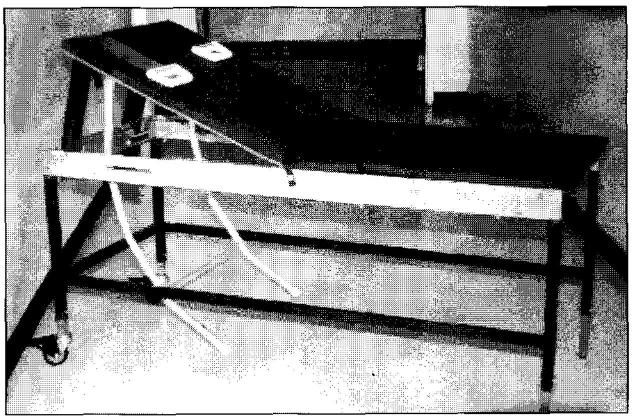

Figure 8.15. Exercise Table.

SUMMARY OF IMPACT

This exercise table is currently being used to increase the child's flexibility and build strength. The angle adjustment of the top allows a variety of sitting positions, with variable flexion at the hip. A partially supported standing position is also provided. Theraband exercise bands can be attached to the table edge at several points to provide active exercise. The table can also be changed as the child grows. It is expected that use of this table will provide a measurable improvement in body flexibility and strength.

TECHNICAL DESCRIPTION

The initial design process required discussions with the therapist with respect to what positions and motions had to be accommodated in the design. The metal frame is made from square iron tubing, welded as necessary. The legs telescope so that the height of the table can be adjusted from 30" to 37". The table is 24" tall without the lower legs. The legs at one end have polyurethane locking wheels, with ball bearings to facilitate movement of the table. The other legs have height adjustable gliders to allow for leveling. The metal frame supports the upper wooden portion of the table. The metal portion is finished with Rust-Fix, primer and paint. The wood $\frac{3}{4}$" plywood top is supported by a wood frame which is constructed of two-by-fours. All exposed wood is smoothly sanded, with rounded edges and finished with polyurethane varnish. The frame is attached to the base with screws. One end of the top can be raised and lowered, and fixed at angles of approximately 20, 40, 60 and 80 degrees. Bent aluminum tubing supports the top with self locking stainless steel pins used to fix it at the desired angle. Slots are provided for attaching Thera-bands with accompanying handles. Hand holds are provided to facilitate lifting the top. A hand stop was added to provide protection when the top is lowered. The other end of the top is composed of several sections that can be arranged in a variety of ways. These sections rest in a groove cut into the side beams and are held in place by locking bolts. Figure 8.16 shows the three major arrangements of the sections. In "A" this portion of the top is continuous and flat. In "B" the user's legs can hang over the end with the back either raised or flat. In "C" there is a space for the user to stand, with the angled portion either flat for a horizontal work surface or raised for an easel-like surface. The pads are made from 1" thick-covered foam. They are sufficiently flexible to conform to the various positions and uses of the top. The top is secured with straps and snaps. A removable seat belt is also provided. The total cost of the system was approximately **$280.**

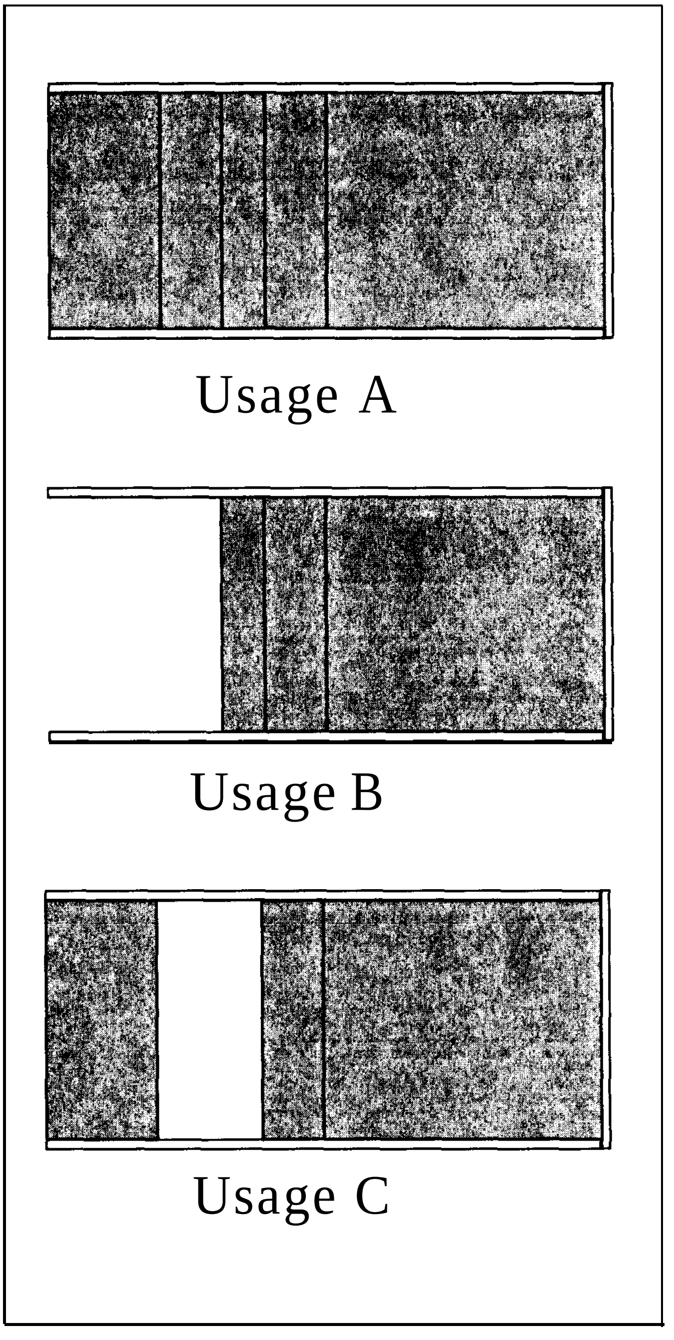

Figure 6.16. Various Arrangements of Top of the Exercise Table.

Laser Pointers: Second-Generation Head-Mounted Laser Pointers

Designers: Shem Isukh, Orlesia Duren
Fort Worth State School, Texas Department of MHMR; and
United Cerebral Palsy of Greater Houston
Supervising Professors: Drs. W.A. Hyman, G.E. Miller
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INTRODUCTION

A variety of non-verbal individuals can use a head-mounted light pointer as a communication device. Older versions of this technology used incandescent lights that have drawbacks associated with power consumption, heat, and focusing. Texas A&M has previously reported on the adaptation of laser pointers for head-mounted use. These provide a bright and sharply focused spot over a wide range of distances. This allows close pointing, as on a communication board, as well as distant pointing and **activation** of laser light sensitive ESU receivers such as those reported by us in 1992. The laser unit we have used was a cylinder approximately $\frac{1}{2}$" in diameter and $1\frac{1}{2}$" long. This was attached by coiled wire to a battery pack/power supply. Although rugged and quite effective, this unit was slightly heavy for some applications. It was therefore desired to design a new device in which the laser diode could be separated from the driver circuit, so that only the diode, lens and heat sink would have to be head mounted. Two such designs are presented. Each maintains the Class II output required for maximum safety.

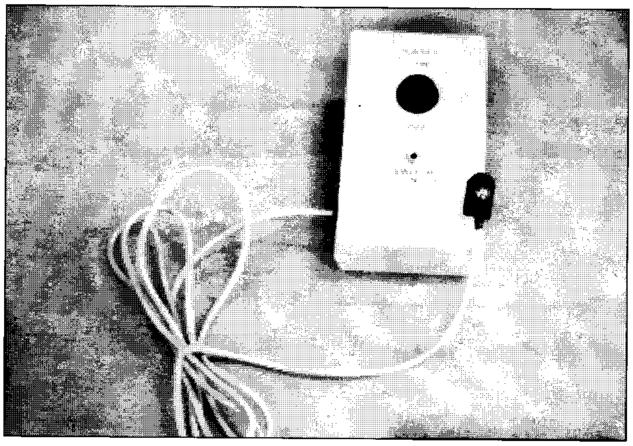

Figure 8.17. A Laser Pointer.

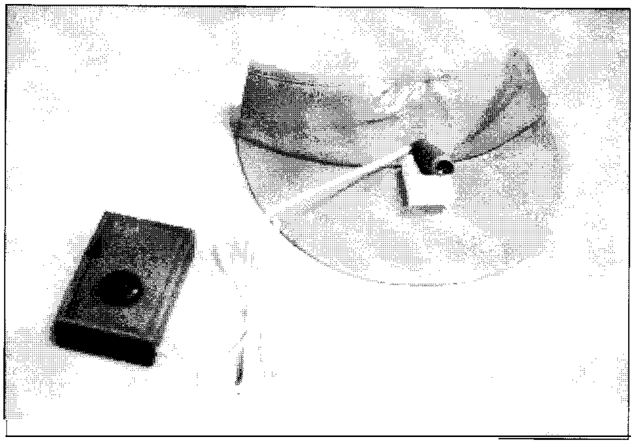

Figure 8.18. Another Laser Pointer.

SUMMARY OF IMPACT

The new designs are an improvement over our original model, which has been one of the single most popular devices we have designed, resulting in the construction of multiple units following the prototype. The subsequent units were provided at cost. The advantage of the new unit is that the head-mounted portion of the unit is much lighter and smaller. This eliminates some problems with excess weight causing glass-mounted units to slip. Construction of the new units is somewhat more labor intensive since more assembly is required.

TECHNICAL DESCRIPTION

Two approaches were taken, one using a pre-built driver circuit, and one in which the driver circuit was constructed at the component level. Use of the prebuilt driver circuit (Meredith Instruments LDP-214) was straightforward, involving soldering a three-lead wire between the diode and the circuit board that was mounted in a remote box with the battery and power supply purpose (Figure 8.19). The diode (VLD151) was mounted in a collimating lens intended for this

(Figure 8.20). This approach cost about $100, roughly equally divided between the diode, the lens and the drive circuit. The component level design is shown in Figure 8.21 using a TOLD 9200 diode and appropriate collimating lens. In terms of parts cost this approach saved about $30 since the drive circuit was built for about $5. In addition the component level design is repairable if necessary.

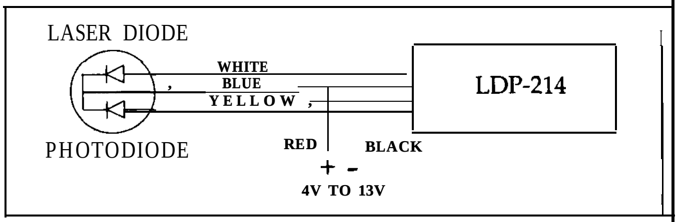

Figure 8.19. Board to Diode Wiring for Laser Pointer.

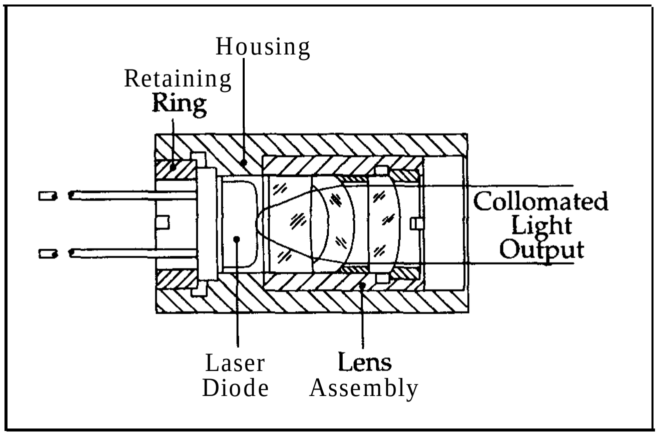

Figure 8.20. Screw Housing Collimating Lens for Laser Pointer.

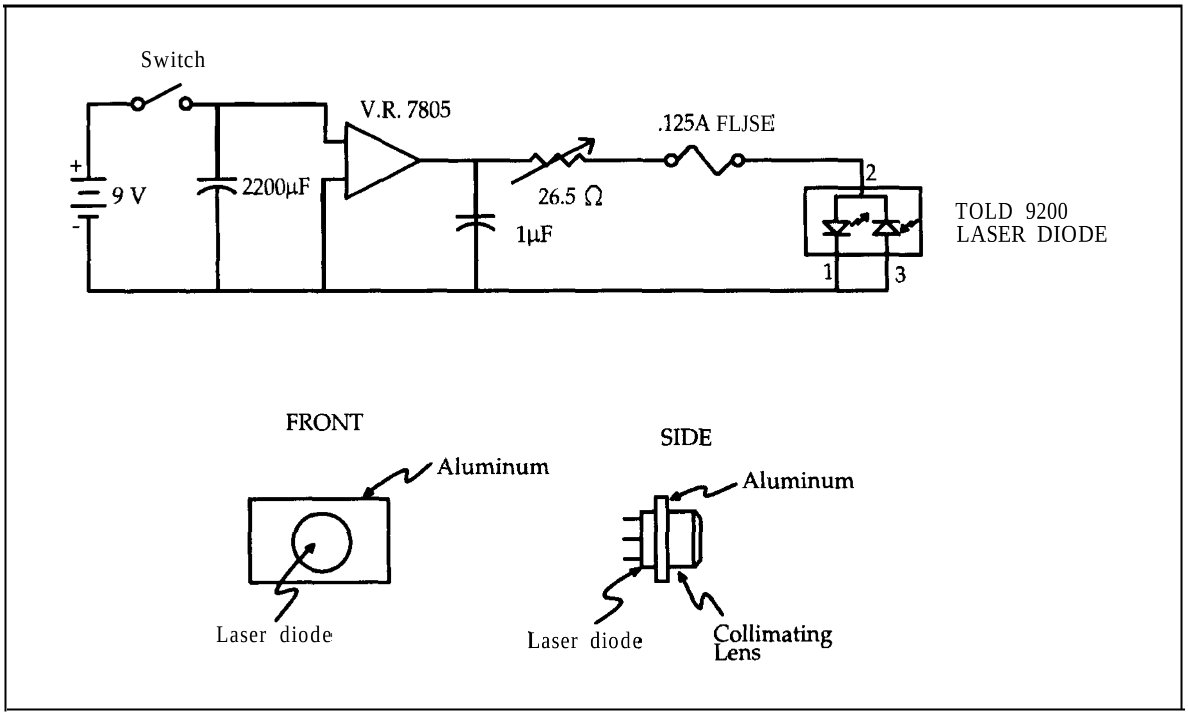

Figure 8.21. Component Level Design and Push-On Collimating Lens for Laser Pointer.

Laser Keyboard: Laser Pointer-Operated Musical Keyboard

Client Coordinator: Kathy Moody
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Supervising Professors: Drs. W.A. Hyman, G.E. Miller
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INTRODUCTION

A variety of non-verbal individuals use a head-mounted light pointer as a communication device. Texas A&M has previously reported on the adaptation of laser pointers for such use, including a report on a second-generation unit in this volume. Head-mounted laser pointers provide a bright and sharply focused spot over a wide range of distances. This allows close pointing as on a communication board, as well as distant pointing and activation of laser light sensitive ESU receivers such as those reported by us in 1992. The device described here is a modified electronic musical keyboard where the keys have been paralleled with a light sensitive circuit. In the current version (Figure 8.22), the light receivers are mounted in an attached accessory unit that does not interfere with manual use of the keyboard.

Figure 8.22. Laser Activated Musical Keyboard.

SUMMARY OF IMPACT

The provision of a musical keyboard for use by clients with limited extremity function has proven to be valuable in two ways. One is that it serves as an attractive training device for familiarization with the use of the head-mounted pointer. Secondly, it provides a recreational outlet for individuals with limited motor and verbal skills. It can also be useful in integration of the individual with disabilities into activities involving other children. In particular, at UCPGH, an effort is made to involve siblings in activities of the client being served in order to build on family relationships.

TECHNICAL DESCRIPTION

The light sensitive portion of the circuit consists of a photo transistor and potentiometer. When the laser beam is incident on the phototransistor, its resistance drops enough to create a closed circuit that parallels an individual key input (Figure 8.23). A circuit of this kind is provided for each key that will be played. In the current version, this is a sub-set of the keys provided on the basic unit. The potentiometer is used to adjust the light sensitivity of each receiver. However the system works best if high incident light levels are avoided such as by shading from overhead room lights. The attachment of the circuits to each key required finding locations in the base unit where individual attachments could be made without interfering with normal use of the keys. Although connections directly to the circuit board were possible, in the unit being modified, it was found that it was easier to make all connections at a ribbon cable junction where the key inputs were connected to other parts of the original circuit. A second version of the system is being developed in which the receiver unit is a separate item that can be detached from the main keyboard by a plug. This will improve positioning of the receiver, and increase the utility of the base unit. Alternative designs with a pulsed input and frequency sensitive receiver were considered in order to eliminate sensitivity to extraneous light sources. However for the prototype system this was rejected as unnecessarily complex. It would also not be compatible with our existing pointers. For some users, it might also be desirable to have time-delayed receivers so that the incident beam would have to be maintained for a predetermined period before the key closed. This would avoid inadvertent key activation during searching. This type of design was previously used in some of our ESU receivers. However this approach was also rejected for the first model of the keyboard because of its increased complexity and cost, and its uncertain need.

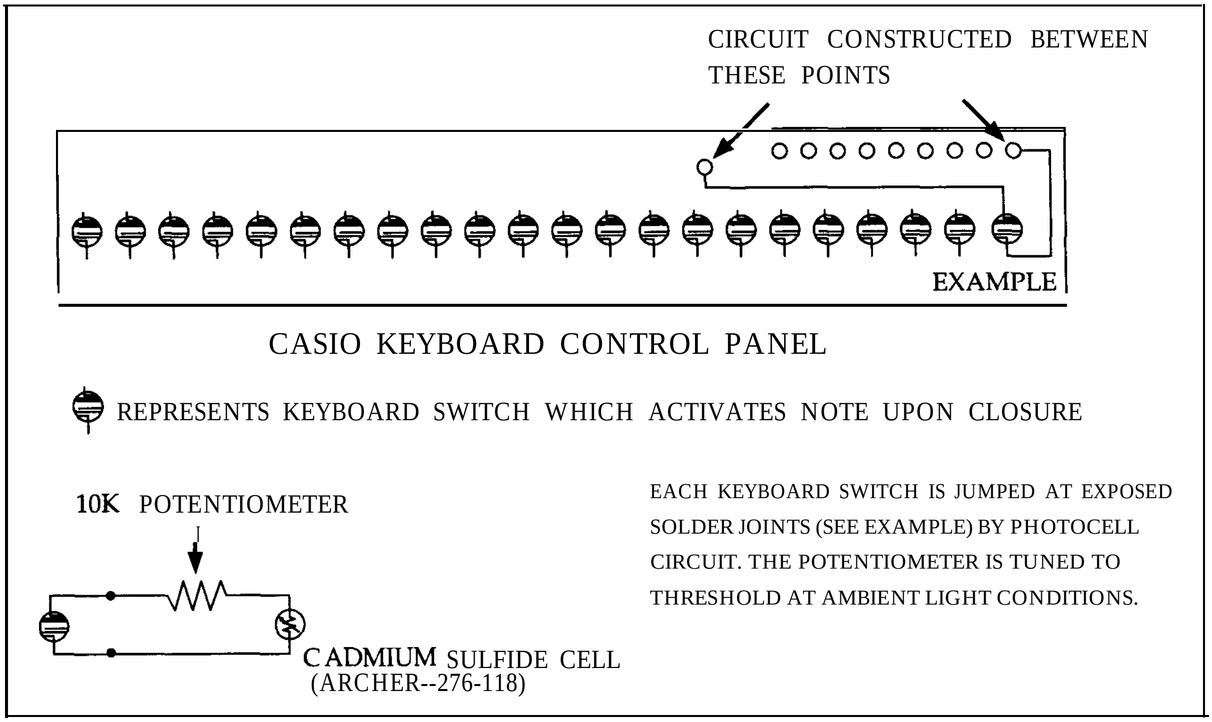

Figure 8.23. Schematic of Individual Key Circuit.

Three-Wheel Bicycle: A Three-Wheel Bicycle for a Child with Cerebral Palsy

Designer: Erik Manse11
Client Coordinator: Kathy Mennis
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INTRODUCTION

A three-wheel bicycle was designed for a child with relatively mild cerebral palsy. He is nine years old and has adequate leg strength to walk with the aid of a brace on his left leg. The custom bicycle was requested by his physical therapist after unsuccessful attempts with a normal two-wheel bicycle with training wheels. The latter was not sufficiently stable for the client, and had the social stigma of training wheels. The new design, shown in Figure 8.24, uses standard front and middle bicycle parts. An additional frame with two wheels is attached at the rear. With a uniform painted finish this unit has a favorable appearance and can be safely ridden by the client. A standard bicycle safety helmet was supplied with the bicycle.

SUMMARY OF IMPACT

The client attends public school and interacts well with other children. It was felt by the therapist, and by the user, that the bicycle should appear as normal as possible so that the child could fit in well with his friends, and have a bicycle that was attractive to them as well. It was not desired that the bicycle have any special supports or aids since the balance and posture required to ride would serve therapeutic goals. Early use demonstrated that some initial difficulty with keeping the feet on the pedals could be mastered, thereby contributing to further motor skill development by exercising the flexor muscles in the legs. The first demonstration of the bicycle was a great success, and it is currently being enjoyed by the client.

TECHNICAL DESCRIPTION

The bicycle was designed for a particular individual, but could be used by others with similar disabilities and abilities. The primary design requirements were: (1) good stability, especially given the motor and balance impairments of the user, (2) separate rear axles for stable maneuverability, and (3) the appearance of a recreational bicycle suitable for nine-year-old boy. Stability was obtained by using a 24" wheel base for the rear wheels. This is much more stable than training wheels because of the distance between the wheels and the fact that the outer wheels are always in contact with the ground. The wheel structure is also much more rigid and durable than training wheels. The need for separate rear axles was discovered during a prototype design. It was found that a solid driven rear axle made the bicycle very difficult to turn, and gave it a tendency to tip over. A differential type rear axle was considered and a prototype tested using a purchased differential. This approach caused considerable difficulty in mounting all of the rear end components. Development of this approach was therefore suspended in favor of testing what ultimately turned out to be the final design. In the final design only the right rear wheel is driven, while the left rear wheel coasts. This does not produce a noticeable tendency to veer left, and slight steering corrections maintain straight line travel. Rigorous testing was conducted by having a variety of small adults ride the bicycle under varying speeds, turns and surface conditions. These tests provided assurance that the bicycle provided a high degree of stability. A standard bicycle helmet was provided with the bicycle. The final cost of the bicycle was $200, most of which were for parts, welding and finishing.

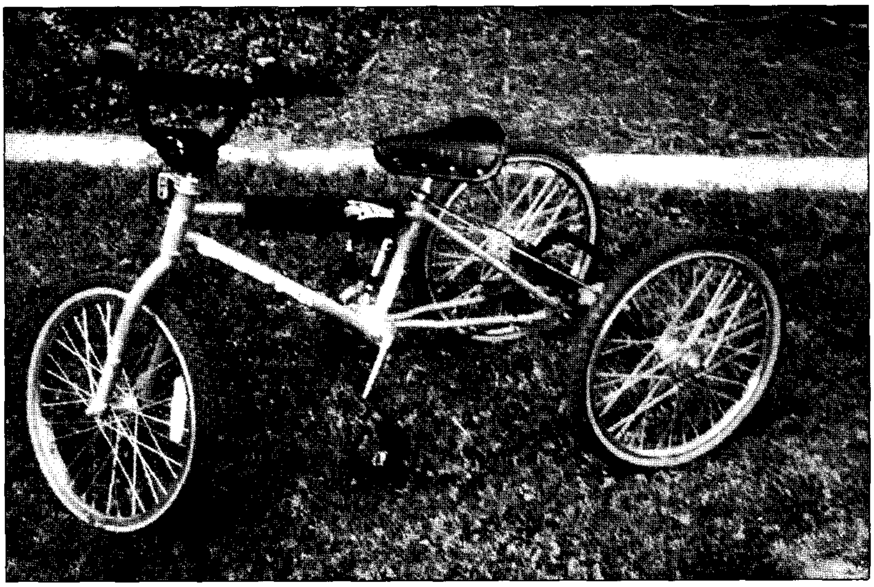

Figure 8.24. Three-Wheel Bicycle.