CHAPTER 8

TEXAS A&M UNIVERSITY
COLLEGE OF ENGINEERING
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COLLEGE STATION, TEXAS 77843

Principal Investigators:

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Audiovisual Stimulation Center

Designers: Gayle Karamonos, Teresa Appeddu, and Michael Thorn
Therapist: Greta Cheery, Children's Center for Developmental Therapy
Supervising Professors: William Hyman and Gerald Miller
Bioengineering Program
Texas A&M University
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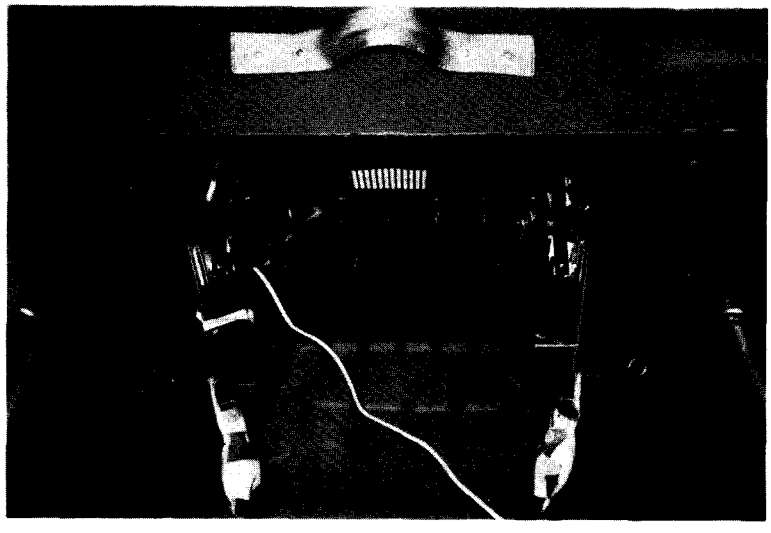
INTRODUCTION

The midline reach development center was built to serve as a rehabilitation aid for the correction of asymmetrical tonic neck reflex, the inability to keep one's head facing forward while moving the arms inward. The objective was to provide a high degree of visual stiumlation at the midline so that the child would be attracted toward a central orientation when the required arm motion was initiated. The device consists of a plexiglass box mounted on adjustable PVC legs. The visual feedbacks include an arrangement of Christmas tree lights and an elctronically controlled mirror which becomes reflective when power is applied. Audio feedback is provided by a standard cassette deckwhichprovidesthe flexibility of playing any desired music. The child operates the system by pressing control arms in toward the midline. The therapist can select any combination of outputs as well as choose whether both levers must be activated, either lever or only the left or right levers.

SUMMARY OF IMPACT

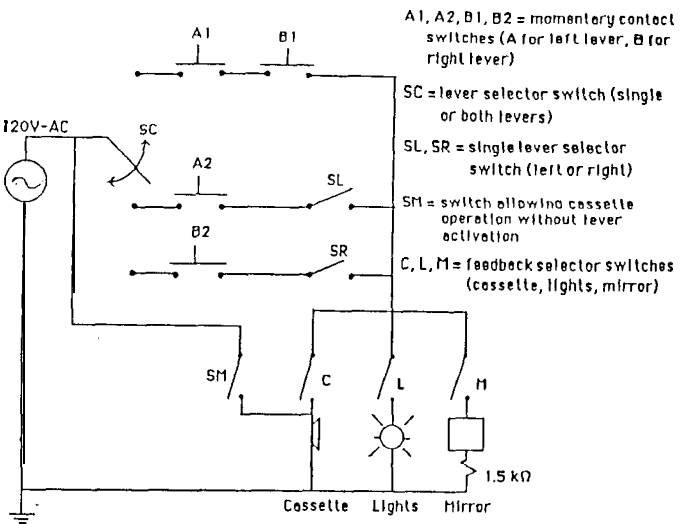
This device has been succesfully used at the Center to provide the desired therapy and physical response by the user. It provides therapy for children from infancy to age three who have Cerebral Palsy and experience asymmetrical tonic neck reflex. The therapy is given to the children during their Center visits for 15 to 30 minutes weekly. Initially, the therapist provides light and music stimulation to develop the child's head midline orientation. As motor development occurs, the therapist incorporates lever activation of the stimuli to train the child to accomplish lateral arm movement to the midline with the desired head orientation. The therapists have reportedvery positive results in correcting abnormal midline reflex. This therapy will eventually allow the children to maintain proper midline orientation/movement leading to future development of neuromuscular reflexes for higher skills such as eating, dressing and writing.



TECHNICAL DESCRIPTION

The midline development center's main component is a rectangular plexiglass box measuring 28"x22"x6". The box contains the circuitry, output components, and amounting for the mechanical components. The box is supported by adjustable legs made of nesting 1" and 1 1/4" PVC pipe. The inner, top pipe is attached to the box by 1" metal flanges. The feedback stimuli are provided through lights, a cassette player, and an electronic shutter which exposes a mirror. The shutter (Edmund Scientific) is a plastic sheet whose opacity can be varied by the application of voltage. An external speaker which faces the child was interfaced to the cassette player. The player itself is mounted in the top of the box which provides complete access to its controls for the therapist. An additional switch is provided which allows continuos use of the cassette player if background music is desired. Also on the top are switches for the therapist which are used to select which stimuli are to be active, and the required input lever motions. The latter can be selected to be both simultaneously, either one, or only the left or only the right. The entire system is powered by 120 VAC.

The child's input levers are 12" by 1 1/2" plexiglass padels affixed by metal hinges to 3" long, square, hollow plastic tubes suspended from the bottom of the box with L-brackets. The tubes pivot on the L-brackets which provides adjustment of the angle of the levers, and thereby the distance between them. The free ends of the levers are covered with colorful toy soldier pads. The levers make contact with push button switches on the plastic tubes.



Electrical Circuitry for Midline Reach Development Center.

Stationary Exercise Tricycle

Designers: Steven Miller and Mark Pfaff
Therapist: Greta Cheery, Children's Center for Developmental Therapy
Supervising Professors: William Hyman and Gerald Miller
Bioengineering Program
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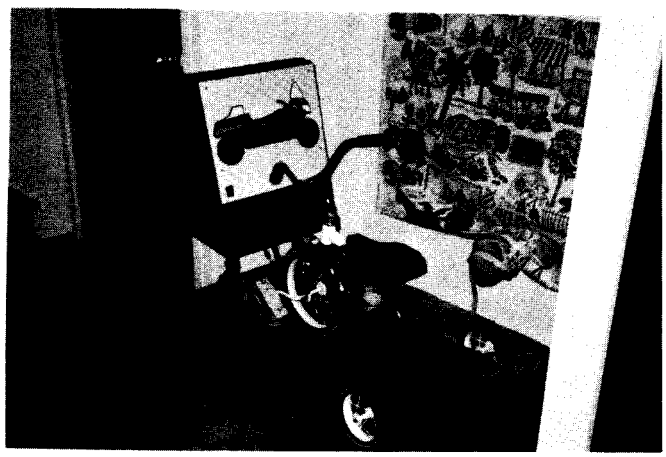
College Station, Texas 77843-3120

INTRODUCTION

This project provides a stationary tricycle for therapeutic exercise. The resistance can be varied by adjusting a roller which presses against the front wheel. Rotation of the front wheel also drives a moving electronic display of lights on the wheels of a motorcycle figure. The objective of this device is to provide an exercise program using a familiar child's toy, while also giving the user a visual feedback which encourages compliance with the exercise goal.

SUMMARY OF IMPACT

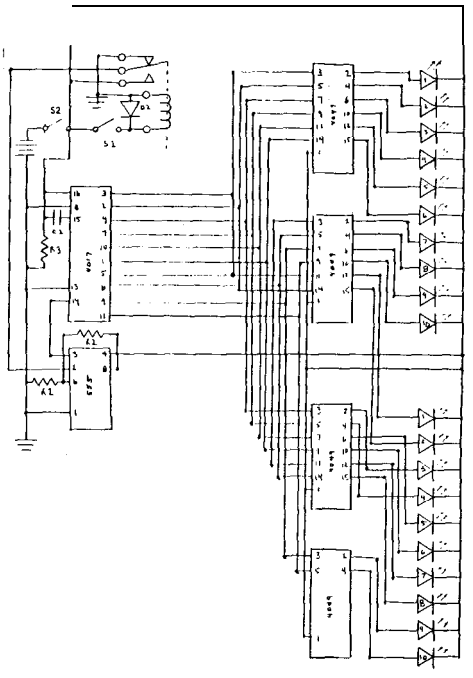
A number of the clients of the Children's Center for Developmental Therapy are unable to provide enough leg force to pedal a standard tricycle. For other clients a stationary exercise system was desired in which the work required to pedal could be normal, or above normal. For each group it was desired to use an apparatus that the child would be familiar with, and one in which the physical skills learned and developed could be directly translated into routine play. The design criteria was therefore to provide an exercise system based on a standard tricycle which would provide a leg strengthening exercise regimen in which the resistance to pedaling could be varied from very low, through normal, to above normal. A further goal was to provide a stimulating visual display so that pedaling in place would not be overly oring. Since this device is for permanent use in the facility, a number of children have benefited from its use and the therapists have accepted the system as a routine and desirable additiontotheirphysicaltherapy regimen.



TEHNICAL DESCRIPTION

The basic components of this system are a standard, commercial child's tricycle, an adjustable mechanical resistance unit adopted from a commercial bicycle trainer, a custom base, a hand painted display unit, and a stepping circuit which drives a sequential display of LED's located on the wheels of a motorcycle figure. The full tricycle was used, including the back wheels, for convenience and to retain the familiarity of the device. The tricycle is mounted to the 1/2" plywood base with four U bolts around the rear axle and a'support pipe which extends from under the seat to the base. The resistance unit is also secured to the base with U bolts. The base is strengethened with a skirt of 2x4's and the entire unit is on casters so that it can be easily moved. The display unit is contructed of plywood and is secured to the base. The rear of the display unit has an access door to the circuitry and batteries. The wooden base and the display unit are covered with carpeting to improve the appearance of the system and provide a cushioned, splinter free surface.

The front of the display unit has a picture of a motorcycle which was hand painted on white plexiglass. The main power switch is also on the front of the display. Each wheel of the motorcycle has 10 LED's uniformily placed around the rim of the wheel. The front wheel of the tricycle has four equally spaced horizontal pegs which can close a momemtary switch which extends from the bottom of the display unit. The switch provides input to a stepping circuit. Each closure of the switch advances by one which LED is enabled. The two Led's which are lighted at any time are set at matching positions around the rim of the motorcycle "wheels". Since the LED's advance once per switch closure, and the switch is closed four times per revolution, the LED's advance four steps per revolution. The use of four pegs was selected so that even a modest pedaling speed would produce a lively display. The stepping circuit used in this application is illustrated below. An alternative, and much simpler, display could be substituted in which a single light, group of lights, or other output device was activated with each switch closure. This design is available at the center for parents who would like to duplicate the device using a simple circuit.



CIRCUIT DIAGRAM

An Auditory Stimulation System to Interface to an Exercise Bicycle for the Visually Impaired

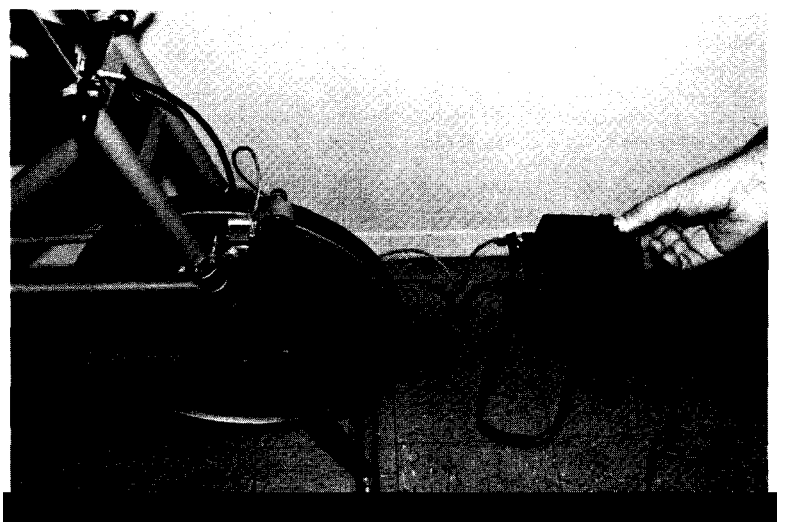
Designers: Edgar Chucle, Mark Sullivan, Robert Stonestreet
Disabled Coordinator: Marcia Willson, Denton State School
Texas Department of Mental Health and Mental Retardation
Supervising Professors: Gerald Miller and William Hyman
Bioengineering Program
Texas A&M University
College Station, TX 77843-3120

INTRODUCTION

A positive feedback music system was developed to motivate visually impaired individuals to utilize an exercise bicycle in the Sullivan Center at the Denton State School. The system provided music from a tape player once the bicycle wheel was set in motion. The system can also be set so that very little motion up to large wheel motion would elicit the music feedback.

SUMMARY OF IMPACT

An exercise bicycle is utilized to increase mobility and enhance muscle tone in disabled individuals. However, thoseindividualswith visual impairments who have never seen or experienced an exercise bicycle may feel disoriented and ill at ease in its use. The use of positive feedback through music allows a visually impaired individual to feel more comfortable on the bicycle and to be motivated in its use. Only when the bicycle is operating does the music play. Thus, when the client stops pedaling, the music stops as well. The system can be adjusted to require a particular level of pedaling beforethemusic is initiated, thus motivating the client to pedal harder to achieve the desired music feedback.

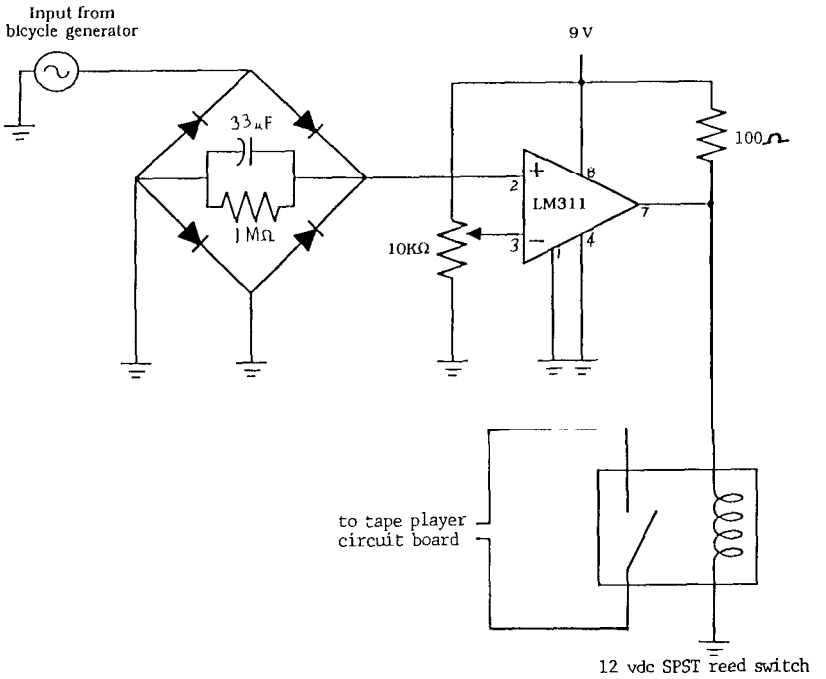


TECHNICAL DESCRIPTION

The system utilizes a standard battery operated tape player, bicycle generator, and supporting electronics. The generator voltage is rectified into a DC voltage and compared to a reference voltage in a comparitor circuit. The reference voltage can be changed by the user by turning a potentiometer knob. This allows the system to be tuned to a particular rate of wheel movement and would require the client to pedal at a certain rate to achieve the music output from the tape player.

When the generator voltage exceeds the reference voltage, a relay switch is closed which allows power to be supplied to the tape player. The tape player is always in the **"play"** mode, but will only operate when the relay switch is closed.

The components include a battery operated tape player, I.24311 comparitor, full wave bridge rectifier, reed relay, resistors, **100K trim** potentiometer, capacitor, slide switch, mounting box, battery holder, and 9 volt battery. A circuit diagram is shown below. The system components cost $100.



A Sensory Stimulation System for the Profoundly Handicapped to Teach Cause and Effect Relationships

Designers: Mark Benden, Rebecca Huggins, Bill Pierce, Ed Thomas
Disabled Coordinator: Marcia Willson, Denton State School
Texas Department of Mental Health and Mental Retardation
Supervising Professors: Gerald Miller and William Hyman
Bioengineering Program
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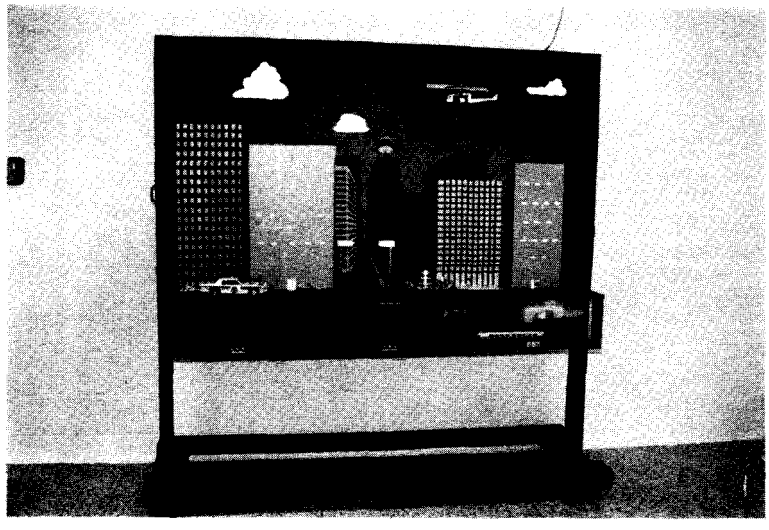
INTRODUCTION

A large portable sensory stimulation wall was designed to teach cause and effect relationships to profoundly handicapped individuals at the Denton State School. The system acted as a stimulation and training aid which could be operated by handicapped clients under the supervision of staff and therapists. The system had to be sufficiently dazzling in order to motivate these individuals to utilize the system and to remain attentive. The cause and effect relationships had to be direct and provide considerable auditory, visual and motion feedback to the clients.

SUMMARY OF IMPACT

Many profoundly handicapped individuals who are served at state rehabilitation facilities are self centered and dwell in their own worlds. It is difficult to motivate these individuals to function in even the simplest terms in such areas as communication, ambulation and cognition. A system which can jointly stimulate and educate such individuals would be of considerable benefit. Such a system was developed and consisted of multiple cause/effect stations blended together into a normal street scene. The overall effect was to arouse the profoundly disabled clients into participating in the system operation, train them in the use of switches to elicit a cause/effect relationship and familiarize them with an everyday scene such as that on a busy city street.



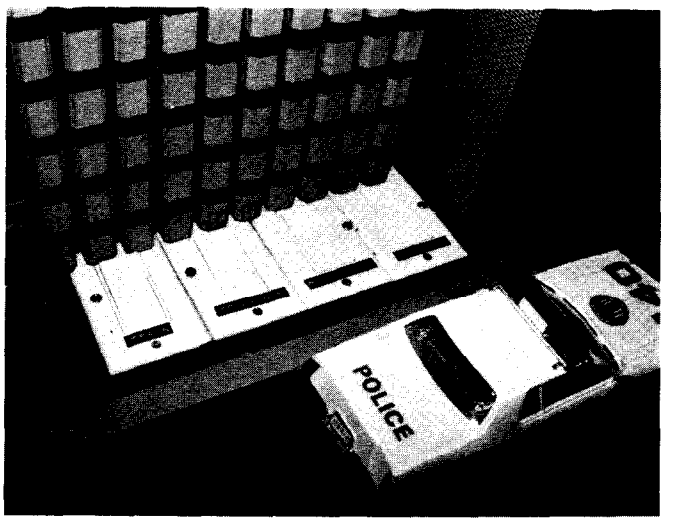
TECHNICAL DESCRIPTION

The overall system was built onto a portable wooden platform which measured 6 feet wide, 6 feet high and 2.5 feet deep. The frame was built from 3/4" plywood with 2 by 4" and 2 by 6" support beams. The overall size was similar to that of a portable blackboard. A street scene was displayed on the front of the wall by means of various background paintings as well as with foreground 3-D objects and devices which provided auditory, visual and motion feedback (see figure).

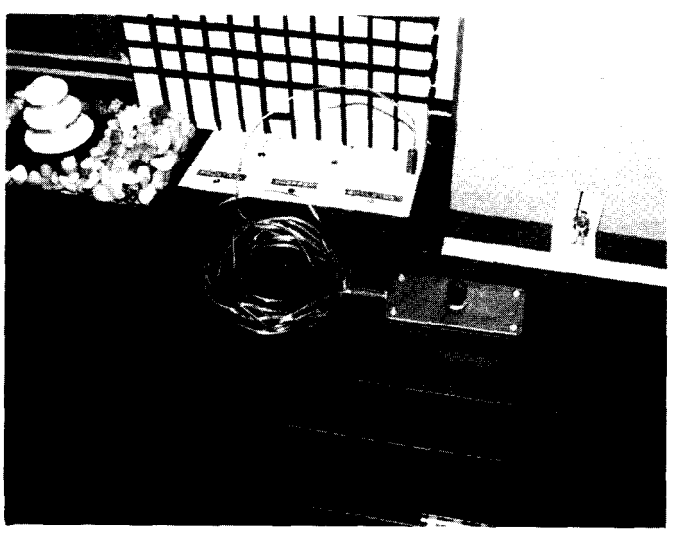
The various feedback stations included two buildings which could light up, street lights which could light up, a subway car which could move back and forth along a submerged (underground) track (seen via a plexiglass panel), a police car whose siren could blair and whose lights could flash, a street fountain which could spew water in the air (a few inches), and a helicopter which could rotate its blades and project taped aircraft sounds.

All of these devices can operate via switches mounted on the wall itself. A jack input was provided next to each switch. Remote, boxmounted, latching switches could be attached via the jack and extension wire to control any or all devices from 10 feet away. Thus, the clients could operate a station at the wall or remotely. Since there are several stations, many clients could utilize the system simultaneously.

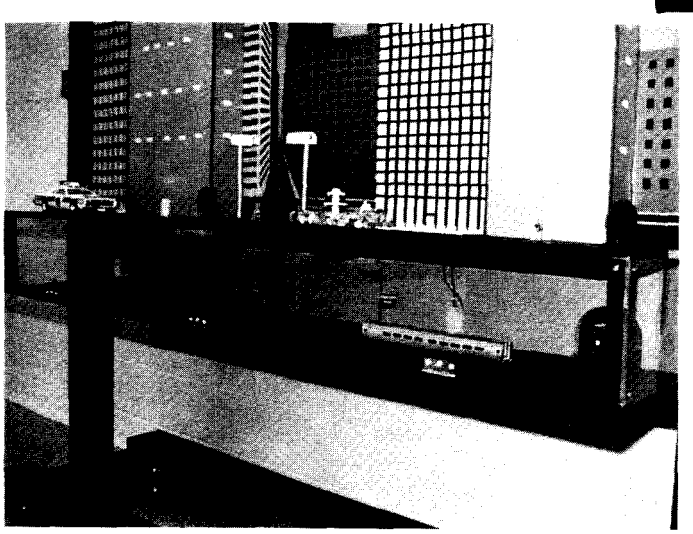
The devices were DC powered but were connected to AC line power via transformers hidden in panels in the rear of the unit. The system was built on casters to allow it to be moved about. The depth is 2.5 feet to allow it to travel through doorways.



DETAIL - ROCKERSWITCHES FOR EACH DEVICE



DETAIL - EXTERNAL SWITCHES



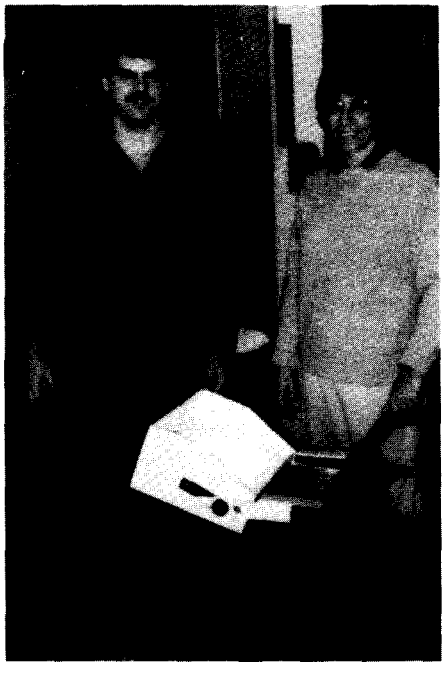
DETAIL - "SUBWAY" WITH SELF REVERSING

Custom Backlit Wheelchair Tray

Designers: Steven Gard and Scott Probasco
Therapist: Irma Riojas, Children's Center for Developmental Therapy
Supervising Professors: William Hyman and Gerald Miller
Bioengineering Program
Texas A&M University
College Station, Texas 77843-3120

INTRODUCTION

The wheelchair tray in this design offers several features which are not available in commercial devices. These include custom fitting to an ultralight wheelchair, easy on/off, high edges to help retain toys or other objects being used on the tray, and backlighting so that concentrated but diffuse lighting is provided to a low vision user. The angle of the tray is also readily adjusted. An additional design criteria was that the design should be reproducible by parents or others with a minimum of wood working skills. Complete working drawings are provided by the Center to interested parents.

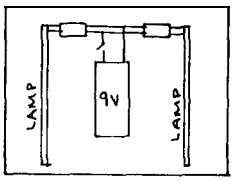


SUMMARY OF IMPACT

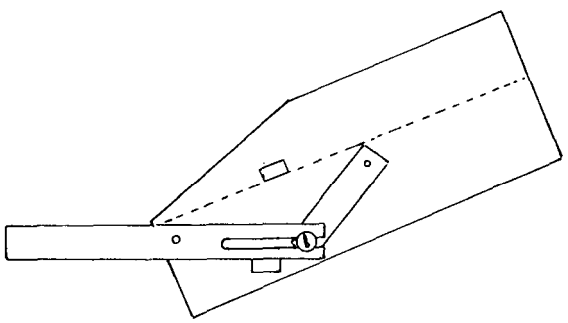
This device provides a work and play space forwheelchairconstrained children with low vision. It is often not convenient or desirable to reposition some potential users of this device and therefore the wheelchair mount, and easy portability are distinct advantages. It has been used at the Center for several clients both during waiting periods and directly in occupational and speech therapy situations utilizing object manipulation.

TECHNICAL DESCRIPTION

The basic unit was constructed using plywood for the back, sides and bottom. The tray top is translucent white plexiglass which provides a diffuse and evenly lit surface. The plexiglass tray slides into retaining grooves in the two sides from the rear and fits into a similar groove in the front surface. The tray is retained in the unit by a rotating clip at the rear. This provides easy access to the lights and batteries. The lighting system was adapted from two commercial flourescent single tube flashlights. These flashlights were disassembled to obtain the tubes, tube holders and curcuitry. A 6xD cell battery holder provides power to both lamps. An on/off rocker switch is provided in the bottom of the unit. The arms of the tray were also built from plywood. A simple cup is provided at the ends of the arms which mate with the wheelchair arms were they are secured with velcro straps. Rotation of the tray is provided through the use of two pivot points on the sides of the unit, with a slot in the arms engaging a screw attached to a 1" piece of flat steel stock. The screw is secured with a wing nut. This provides more secure positioning than could be obtained with a single pivot point. Further details of the constuction are shown in the accompaning figures. Additional information is available from the supervisors.



CIRCUIT DIAGRAM



CONSTRUCTION DETAIL OF TILT MECHANISM

A Cane Swing Training Ramp for the Visually Impaired

Designers: William Pierce and Winston Marshall
Disabled Coordinator: Marcia Willson, Denton State School
Texas Department of Mental Health and Mental Retardation
Supervising Professors: Gerald Miller and William Hyman
Bioengineering Program
Texas A&M University
College Station, TX 77843-3120

INTRODUCTION

Many clients at the Sullivan Center for the Visually Impaired at the Denton State School are children and young adults who have never learned to use a cane properly during walking. A cane training systemwas designed to allow such individuals to learn the proper cane swinging technique during walking. The training could be accomplished under the tutelage of therapists and staff. A modified cane with a stopper on the bottom was developed for insertion into the training walkway.

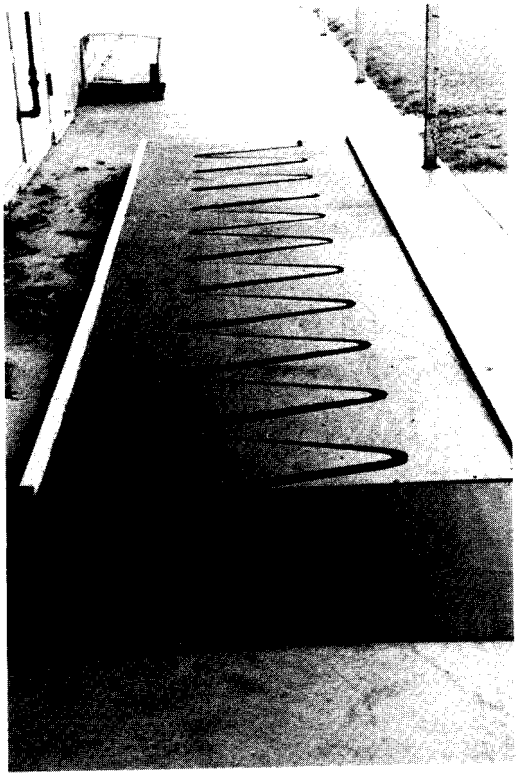


Figure 1 ASSEMBLED WALKWAY

SUMMARY OF IMPACT

Individuals who have been recently blinded and who have not been trained in the proper use of a cane during ambulation are severely limited in their ability to be reasonably independent of their therapists and support staff. In addition, many individuals who suffer from multiple disabilities may have never been taught the proper use of a cane as well.

A training system was developed to allow such individuals to be instructed and to practice in the proper use of a cane during walking. The system utilized a walkway with a sinusoidal cutout and a modified cane with a hinged disk on the bottom. During ambulation along the walkway, the client would move the cane along the sinusoidal cutout which would enforce the side to side movement of a cane required during normal ambulation. Thus, disabled clients could learn the proper method of cane swing which would allow them to move freely throughout the facility.

TECHNICAL DESCRIPTION

The cane movement training system consisted of a 16 foot by 4 foot walkway which was developed in four sections for ease of transportation, storage and setup. There were two separate ramps placed at each end to allow the clients to gradually step onto the walkway. The walkway was built from 3/4" plywood with standard 2 by 4 posts used to create a frame. A sinusoidal path was cut into the plywood sheeting, 3/4" wide, with the sinusoid repeating every 2 feet.

The four pieces were built so that two sections would lay on top of the other sections. Handles were placed on each side of all pieces for easy manipulation and clasps were placed on the sides to attach all four pieces together during use (see figure). A raised 2 by 4" rail was placed on either side of the walkway to prevent a client from accidently walking off the side of the path. A standard cane was modified by attaching a hinged plexiglass disk to the bottom. The materials, including wood, hardware, plexiglass, sanding and painting materials cost $200.

A client would enter the walkway through one ramp, place the training cane into a hole in the ramp (which was aligned with the walkway cutout), and begin to walk down the path while moving the cane in front. The cutout would allow the cane to traverse a side to side movement, typical of normal cane motion during walking.

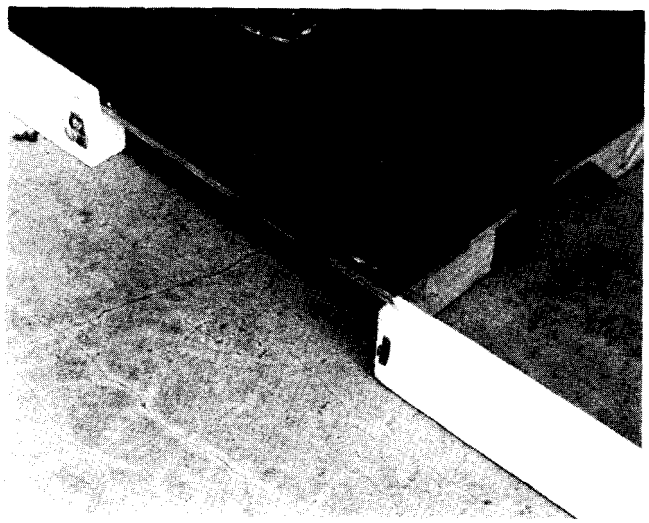


Figure 3 ASSEMBLY DETAIL - LATCHES

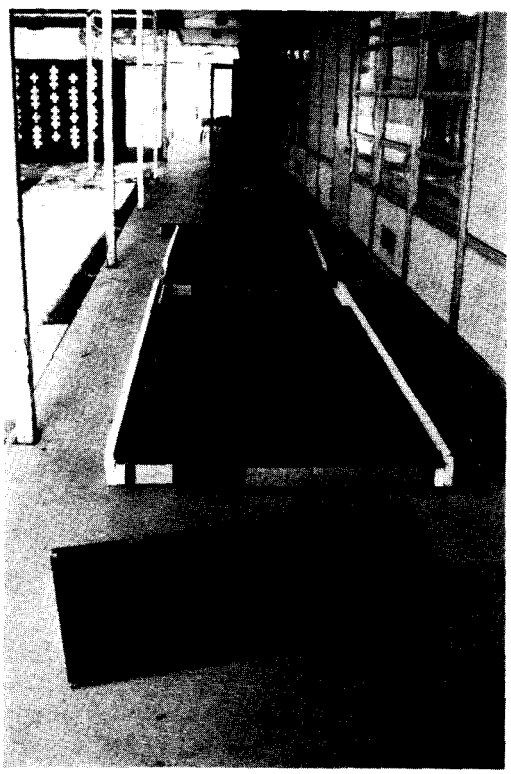


Figure2 WALKWAY COMPONENTS

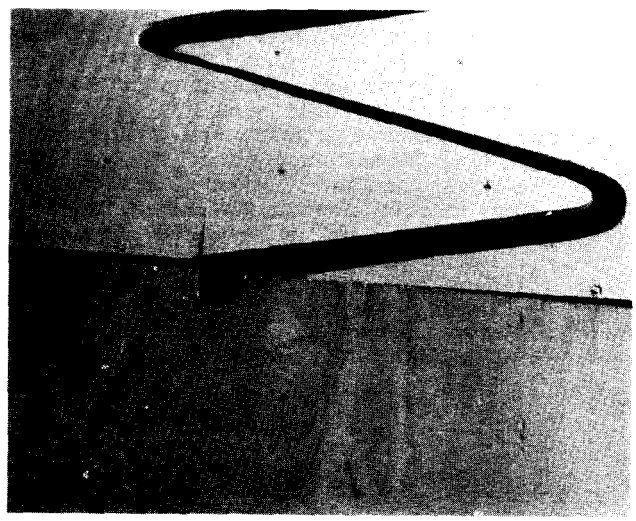


Figure 4 ACCESS HOLE FOR CANE TIP DISK

Keyboard Overlay and Software for Music Therapy

Designer: Jay Harrison
Client: Richmond State School
Texas Department of Mental Health and Mental Retardation
Supervising Professors: William Hyman and Gerald Miller
Bioengineering Program
Texas A&M University
College Station, Texas 77843-3120

INTRODUCTION

This system consists of a computer keyboard overlay and custom music training software. The overlay easily attaches to a standard computer keyboard, hiding the original keys, and providing the appearance of a simulated piano keyboard. Pressing the appropriate locations on this cover is directly translated into pressing one or more underlying keys. Through software control groups of neighboring keys perform the same function. The objective of this design is to limit the keyboard appearance to only a small number of contact areas. The same design, with different patterns, can be used for other commercial or custom software for which only a limited number of keyboard entries are required. The advantage of this design is that it is of mimimal cost, is highly flexible in its application, and it does not require an electronic interface. The accompaning music software was designed to provide training in basic music skills such as tone and notation recognition.

SUMMARY OF IMPACT

The original user of this system was a residential client of the Richmond State School whose only communication or physical output is through the use of a head pointer. An earliar design project had produced an adjustable wheelchair tray which accommodated a voice synthesizer. It was subsequently suggested that an electronic musical keyboard could also be accommodated on the tray system and that such a device would provide this woman with a highly capable and multifunctional system for a creative outlet and self entertainment. When such a keyboard was provided, the client was immediately able to understand the necessary action, and she quickly developed capabilitytousethis instrument. It was therefore decided that some musical training would be appropriate that could be delivered in a very limited physical format, but which could be directly used by the client. The result of this need was the system described here.

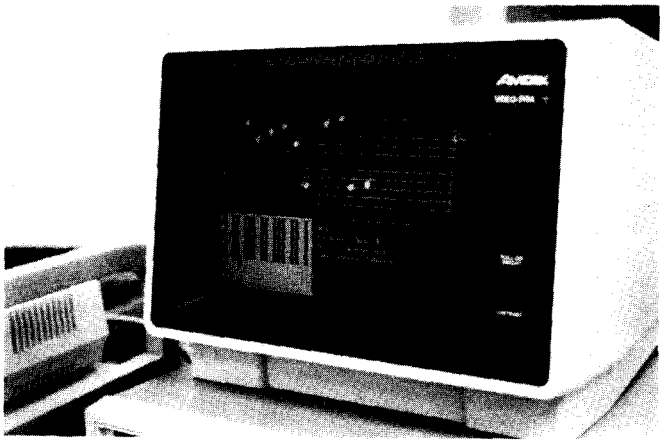
SYSTEM OVERVIEW SHOWING KEYBOARD COVER

It is noteworthy that the original user of this project is severely involved physically, non- verbal, and a fulltime resident of the School. Her prospects for significant habilitation to the external world are very limited, and she therefore requires a complete regimen of institutional activities. The fact that she demonstrates a reasonable level of cognitive ability further challenges the staff to occupy her with things that will be both entertaining and beneficial. While music therapy is a long recognized specialty, its use with severly involved individuals has been limited by the user's ability to interact with a musical device. The enormous capability, at modest cost, in a small package, makes the modern electronicmusical keyboard ideal to address this need. In this case the use of such a keyboard suggested that additional music education would be an appropriate activity for this individual. The system also provides an orientationtowardcomputeroperationswhich could be expanded into other activities.

TECHNICAL DESCRIPTION

The keyboard portion of this system consists of a rubber sheet stretched over dowels at each end. The dowels are secured in a wooden frame which fits over a standard computer keyboard. Areas corresponding to piano keys and areas for related functions are indicated on the top of the rubber sheet. Pressing the rubber sheet with a head stick, other object, hand or finger, directly presses the underlying keys. Through the software all of the computer keyboard keys under an indicated area perform the same function. This allows for large functional contact areas, while masking the rest of the keyboard. The basic design used here could be adopted to any other commercial or custom software which required the use of a limited number of keys or inputs from the keyboard.

The software provides a series of musical educational activites in the form of games. Each game displays the music staff, locations of notes, instructions, prompts after wrong answers, and musical tones corresponding to the keys pressed. The program is written in Basic using high resolution graphics.



DETAIL OF SCREEN DISF'LAY

A Telephone Answering Training System for the Cognitively Handicapped

Designers: Steven Gard, Gloria Dominguez, Scott Probasco
Disabled Coordinator: Sara Atkins, Gulf Coast (TX) MHMRA
Supervising Professors: Gerald Miller and William Hyman
Bioengineering Program
Texas A&M University
College Station, TX 77843-3120

INTRODUCTION

A telephone conversation training systemwas developed to instruct cognitively disabled individuals to communicate to their doctor or to a police emergency number. The system consisted of a push button telephone, tape player and supporting electronics. The system was portable and battery powered such that a client could utilize the system at a training facility or at home.

SUMMARY OF IMPACT

Many cognitively disabled individuals who live at home with their families are at times left alone. Even those disabled individuals living in semi-independent living facilities are at times left unsupervised. Should the need arise for a medical or other emergency, these individuals may not have the appropriate skills to contact or communicate with the appropriate authorities.

A training system was developed to allow such individuals to learn how to dial the telephone and speak to either their physician (at the doctors office) or with the police (via 911). Once properly trained, these individuals can be more safely left unattended and can lead a more independent lifestyle.

TECHNICAL DESCRIPTION

The **system** consists of a push button telephone, a tape player, and supporting electronics. The system operates under the direction of a client user. Once the receiver is picked up, a dial tone is heard. This is accessed from the telephone circuitry. When the user **"calls"** a seven digit number, a tape of a ringing phone line is heard through the receiver. After two rings, a conversation begins between the tape player and the disabled user. There is a pre-recorded conversation on the tape system which is activated in sections through the VOX input. As the disabled speaker pauses after speaking, the tape player then plays its portion of the conversation. The "conversation" simulates a situation where the client desires to schedule an appointment with the physician. A different tape was developed for the police 911 number. In that case, the user **"calls"** 911 and is led through a conversation with the **"police".** A switch on the side of the unit is used to select either 911 or a seven digit number. The tape player automatically rewinds thetapetothe beginning of the conversation after each session. The conversations can be tailored to an individual client's needs by allowing a therapist or family member to record the simulated conversation. A training manual was developed for that purpose and to assist in operation of the system. The **system is** powered by 4 **"C"** cell batteries.

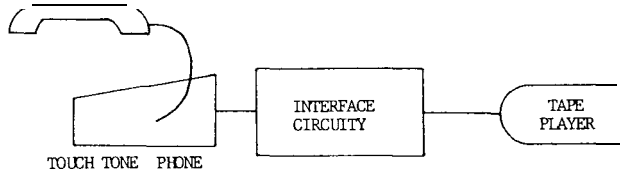


Figure 1 SYSTEM OVERVIEW

The system circuitry is shown below. The parts consist of a counter, AND gate, timers, OR gate, NOT gate, NAND gate, analog MUX, 741 quad amps, operational amps, relays, resistors and capacitors. The dial tone circuit is independent of the other circuits and functions only when the counter is set to zero. The touch tones are always active and are monitored through the OR gate, debounced, and used to start the timer. When the appropriate count is reached (from the switch - 3 or 7 digits), the multiplexer provides power to the relay circuit which causes the pause loop allowing the tape player to operate. The microphone input is amplified and sent to a RC timer and on to a comparitor. When the comparitor is active, the pause circuit is activated, which stops the tape player. Thus, while the user is speaking, the tape player pauses: when the user stops speaking, the comparitor goes "low" and the pause control is inactivated, allowing the tape player to "speak" its part of the conversation.

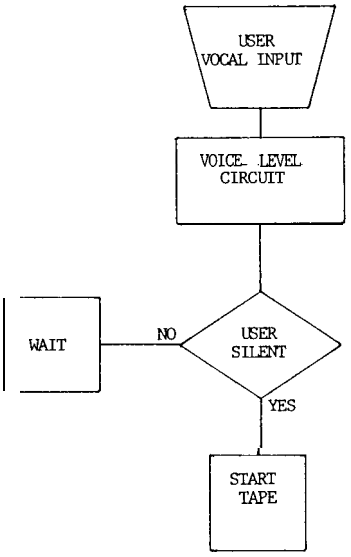


Figure 3 CONVERSATION MODE

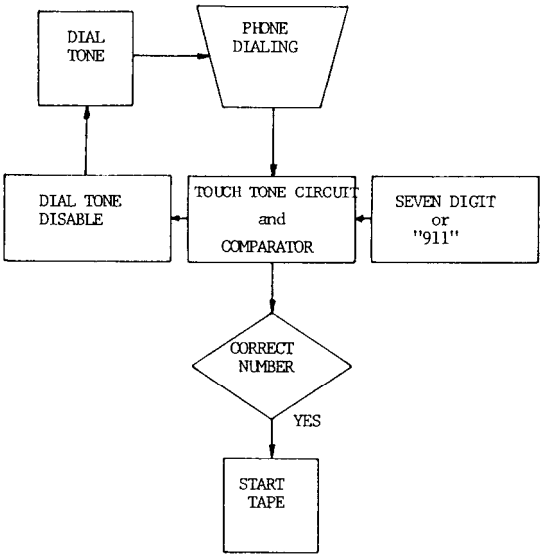


Figure 2 INITIATION MODE

Vertical Pole Walkway

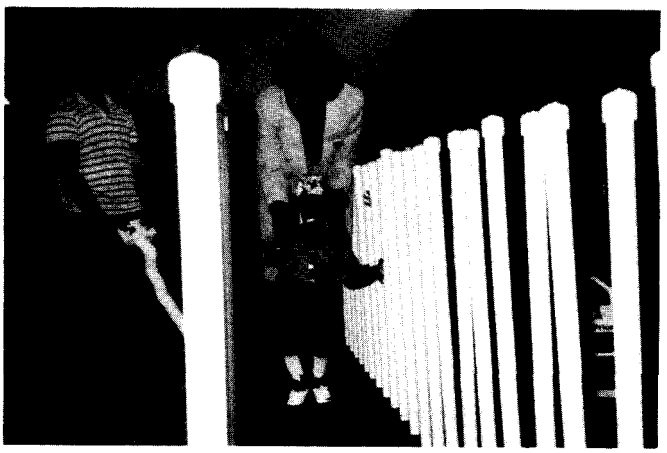
Designers: Paul Slater and Rainer Fink
Therapist: Greta Cheery, Children's Center for Developmental Therapy
Supervising Professors: William Hyman and Gerald Miller
Bioengineering Program
Texas A&M University
College Station, Texas 77843-3120

INTRODUCTION

A standard device in physical therapy is parrallel bars which are used to provide manual supportduringtraining or retraining in walking. One drawback of parrallel bars is that the horizontal bars can provide continuous support which reduces the need for the user to provide proper weight shifting as they ambulate. The device described here substitutes two rows of vertical bars for the two horizontal bars. With vertical bars hand support must be released and repositioned as the user progresses down the walkway, more closely simulating unsupported walking. The system also provides for the therapist to energize lights at the top of each pole. These lights can be used to provide a moving target as well as encourage a head up posture.

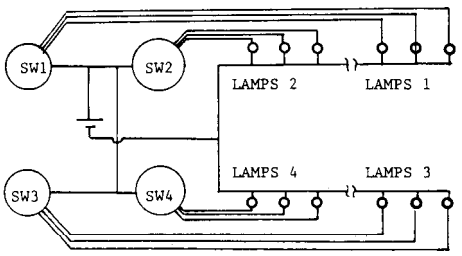
SUMMARY OF IMPACT

This device is a permanent piece of equipment in the physical therapy department of the Center and therefore serves many clients. It can be used in place of horizontal parallel bar training, or after the use of horizontal bars becomes too easy for the client, but support is still required. Experience with this device to date has demonstrated that it provides a very useful transition or adjunct in ambulation training.

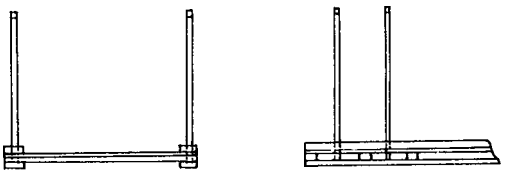


TECHNICAL DESCRIPTION

The system consists of a wooden base with side **stuctures** which provide support for two rows of 24 equally spaced vertical poles. The base of the walkway is **3/4"** plywood and side rails are assembled from **2x4's** above and below the walkway deck. Additional **2x4's** provide cross supports under the walkway for added strength. The poles are made of PVC pipe which fit into holes which penetrate the side rails. The top of each pole is capped with a standard PVC end piece into which is fitted a small lamp. Each lamp is wired to a control box and a power source consisting of a large lantern battery. The wires are contained within the PVC pipe and under the walkway so that there are no exposed wires. The control box contains four multiposition switches, two for each side of the walkway. For each side one switch controls sequentially the first 12 lights and the second switch controls the next 12 lights. Typically these **swiches** are used sequentially so that one lamp is lit on each side in a progressive manner as the user traverses the walkway. Use of the lights is optional. Selected poles can also be removed and the wiring unplugged so that the spacing between the poles can be increased in **descrete** increments. Construction andwiring details are provided in the **accompaning** figures.



WIRING SCHEMATIC



CONSTRUCTION DETAIL

Hand and Arm Exercise Systems

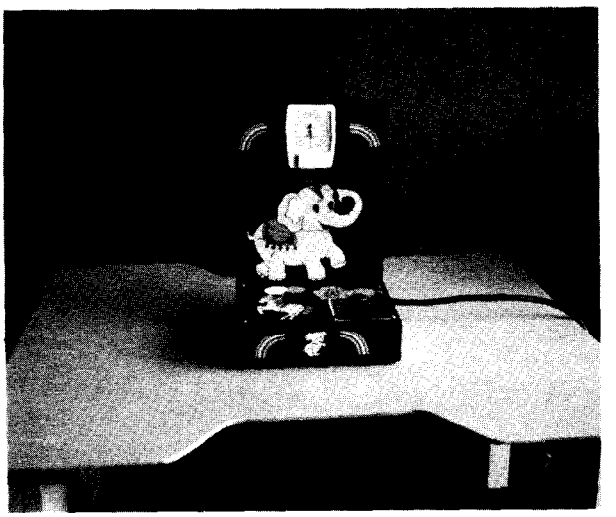
Designers: Larry Carrier, Rebecca Huggins, Christy Tock, Florence Dabney, William Pierce and Cecilia Duarte
Client: Children's Center for Developmental Therapy
Supervising Professors: William Hyman and Gerald Miller
Bioengineering Program
Texas A&M University
College Station, Texas 77843-3120

INTRODUCTION

Two projects for occupational therapy of a child's hand are described here. The first involves a hand squeeze motion with the child's interface being a rubber bulb. The second is for finger extension. In it the child raps their hands around a bar and the required motion is to extend the fingers upward toward a hand flat position. In each case the exercise device is initially attractive to the user as well as providing a strong visual or audio- visual feedback when the desired force or extension is achieved. Each apparatus is also adjustable by the therapist to the physical condition of the user. The feedback in the hand squeeze device is an array of LED's which flash when a preset pressure in the bulb is achieved. This devise also provides a continuous visual indication ofthepressure obtained during the exercise and a therapist override which can be used to activate the flashing LED's as a reward for a strong, but subtrigger grip, by the user. The hand extension device triggers a battery powered mechanical toy each time the desired extension is obtained. The particular toy used here provides physical motion as well as musical sounds, although any battery powered toy could be substituted.

SUMMARY OF IMPACT

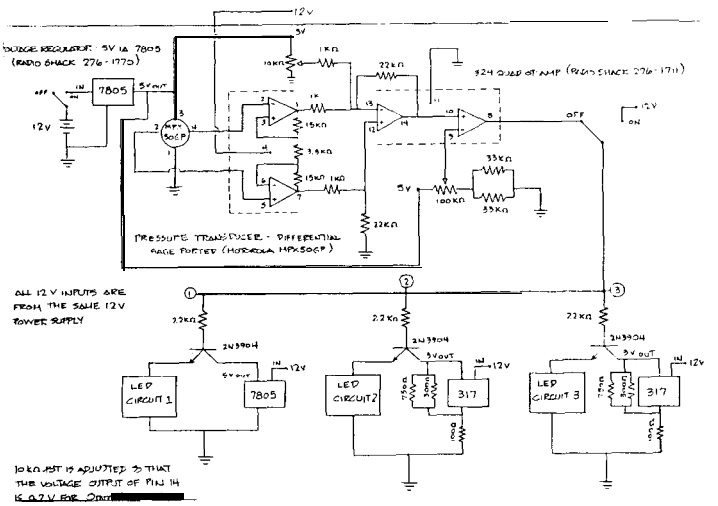
A continuing challenge in occupational and physical therapy for young children, especially in the case of developmental disabilities, is appropriate motivation to the child to perform the desired activity. In order to achieve this goal an apparatus which is attractive and entertaining can add to the user's motivation to participate. In each of the devices described here the therapists defined the action required and the designer's task was to incorrporate these actions into a suitably stimulating device. In addition it was required that the devices be easily portable so that they could be used both at the Center and in outreach programs. Both of these devices have found continuous use by the Center's staff and clients following their delivery. Their use has demonstrated an increased ability to motivate the children requiring hand therapy to actively participate in the desired exercise.



HAND SQUEEZE SYSTEM

TECHNICAL DESCRIPTION

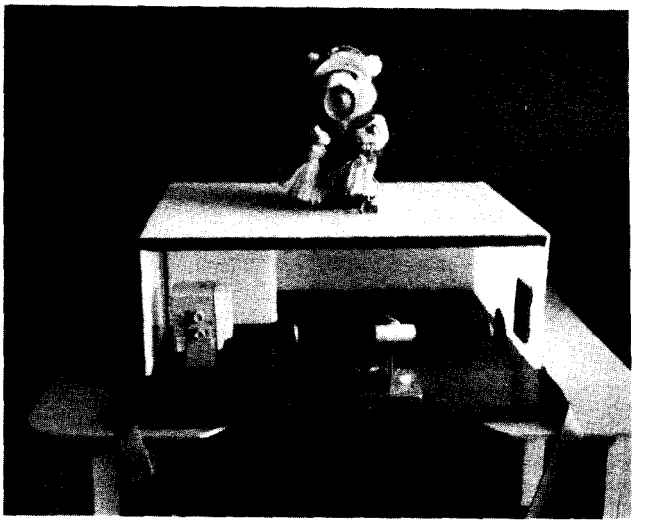
Hand Squeeze. The child's interface to the hand squeeze unit is a rubber bulb from a blood pressure appartus. The pressure generated in the bulb is displayed on an analog pressure guage and compared to a preset pressure goal using a pressure transducer (Motorola MPX50GP) andadjustable comparator circuit. The external appearance of the device is a highly decorated black plexiglass display unit incorporating the circuitry, manometer, calibrated pressure adjustment, therapist override switch, main power switch, and LED's. Self' flashing LED's (e.g. Radio Shack 276- 030) and external flasher (Radio Shack 276-1705) driven LED's (e.g. Radio Shack 276-066) were used to provide a variety of colors and flashing performance. The entire unit is battery powered to enhance portability and safety. Twelve volts are provided using 8 AA batteries. The squeeze bulb is attached to the device with flexible tubing. These components, along with the manometer where obtained from a commercial home blood pressure unit (Sunbeam). A schematic of the mechanical and electronic circuitry is provided in the figure below.



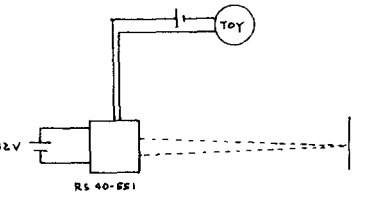
CIRCUIT DIAGRAM - HAND SQUEEZE SYSTEM

Finger Extension. In this device the child initially grips a 1" diameter PVC pipe positioned at the open end of a plexiglass box. The hand grip has a central support and end disks to help keep the child's hands on the unit. The hand grip can be moved in and out and up and down to adjust its position relative to the pulsed infrared beam sensor (Radio Shack 49-551). When the child extends the fingers to break the infrared beam, the sensor closes an output switch which activates a battery powered toy located on top of the unit. As supplied, the sensor provides 3 seconds of output for a momentary interruption of the beam. The 3 second duration can be modified by changing a single capacitor in the sensor if desired. The sensor is battery powered.

For portability the toy can be removed from the top and stored inside the box. A carrying strap is also provided since the unit is relatively bulky. A schematic of the component layout is provided in the figure below.



FINGER EXTENSION SYSTEM



SYSTEM DIAGRAM - FINGER EXTENSION SYSTEM

Applications of Stepping Circuits For Communication Devices

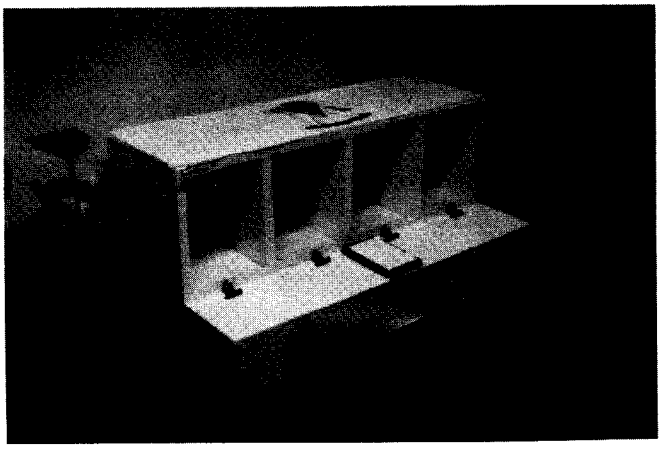
Designers: Fabian Pollo, Scott Probasco, Steven Gard, Steven Miller, Winston Marshall, and Jacque Haynes
Clients: Children's Center for Development Therapy and Harris County MHMRA
Supervising Professors: William Hyman and Gerald Miller
Bioengineering Program
Texas A&M University
College Station, Texas 77843-3120

INTRODUCTION

Many developmentally delayed children with limited motor function require technical aids for early training in communication skills, switch activation, cause and effect perception, and word picture association. Each of these needs can be met through the use of communication devices which emply a stepping circuit which allows successive closure of a single switch to step through a number of output selections. Three systems employing stepping circuits are described here. The first is a self contained unit with four compartments which have individual lights. As the single switch mounted on the unit is pressed, the lights are energized in turn. A toy or other object can be placed in each compartment, or a picture or word can be placed in front of a compartment in whcih case it would be back lit. In the second unit a single switch is connected by wire to an interface box. The interface unit allows the stepping circuit to be varied from one to four outputs before. Each possible output is jack connected to appropriate output units such as individual light boxes or battery operated toys to which a jack controlled power interrupt has been added. The third unit is for visual stimulation and consists of four groups of different colored LED's. As each group is energized a random twinkling of the lights in that group takes place. While the child uses only the single switch input, the therapists has available a control box which can also be used to step through the system. In addition the therapist can combine the light groups into different patterns, and/or select whether or not there is an all lights off step. The therapist can also energize one or more of the light groups independently from the output status of the stepping switch.

SUMMARY OF IMPACT

The develomentally delayed child has considerable need for devices that they can operate which are visually stimulating while providing training in higher levels skills associatedwithswitchuse, action/reaction, comprehension, and communication skills. The devices described here are for therapeutic rather than permanent use by individual clients. There are in continuos use at the respective agencies in working with a large number of children. They are easily portable and are also used by the therapists in outreach programs. The therapists have reported to us that these systems are enjoyed by the children using them whcih aids significantly in the therapeutic process. The therapists also believe that they are making a meaningful contribution the the development of these childrenthatwas not obtainable using other appraoches.

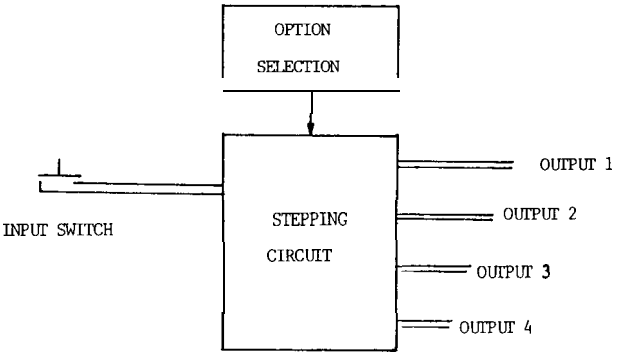


UNIT 1 - FOUR COMPARTMENT ITEM SELECTION

TECHNICAL DESCRIPTION

The outside of units one and three are constructed from plexiglass. The input switch in each case is a large flat plate which contacts a momentary push button switch underneath the plate. EWach unit is battery operated and uses the same stepping circuit design. Unit three folds for portability. The therapist switch unit for these unit uses toggle switches for mode control and a momentary push button switch for stepping these are mounted in a standard electronic project box.

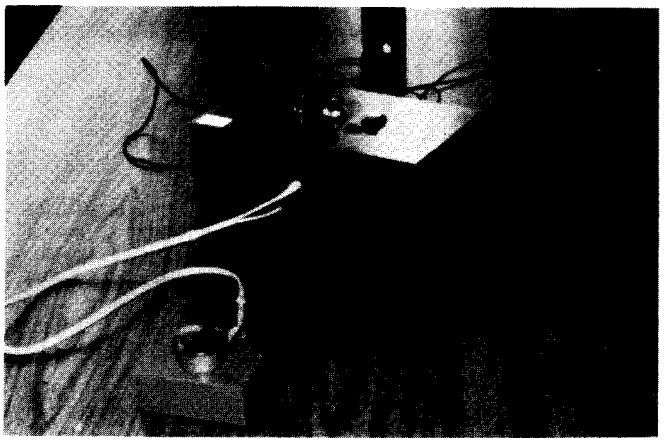
For unit two the input switch is a momentary contact push button switch with an enlarged wooden button. It is mounted in a project box. The interface unit is also a project box. It contains the stepping circuitry, an on/off switch, and a rotary switch which is used to select one, two, three, or four output steps. In this application relays were used to interface the output from the stepping circuit to the switch closures within the jacks. This design was necessary to isolate the ouputs from the control circuitry since the output power requirements were not fully specified so that flexibility in type of output device was rtetained. The output devices illustrated contain colored lights and a jack input for connection to the interface box. These units are self powered with the interface box providing only a switch closure. With this design any other self powered device could be substituted such as a battery operated toy. If the chosen device did not have an external switch capability one could easily be added bv hardwiring or by using an external interrupt loop in the battery compartment. Although three specific applications of stepping circuits are illustrated by these projects, the stepping circuit is a highly versitile interface and it has also been used by us in other similar projects. In one other case input via foot switch was provided for a client whose only useful volitional motor output was of a kicking nature.



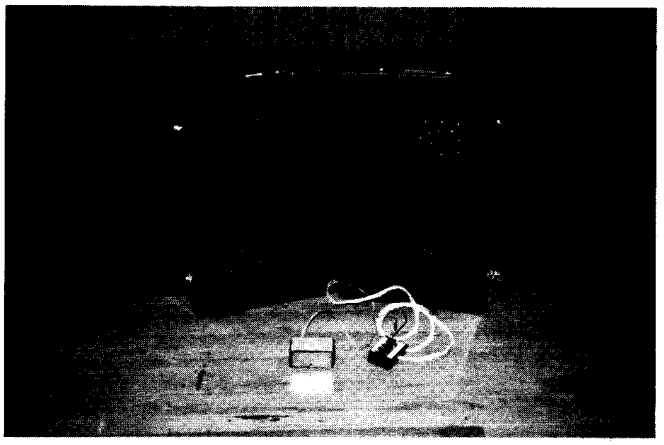
NOTES: 1. Outputs powered from stepping circuit or switch closures using relays

2. Option Selections
Unit 2: One, two, three or four outputs is switch selectable
Unit 3: Alternate stepping switch
Alternate individual ouput switches
Pattern alteration

Figure 1 GENERIC SYSTEM DESIGN



UNIT 2 - STEPPING SWITCH WITH ONE, TWO, THREE OR FOUR OUTPUTS



WIT 3 - VISUAL STIMULATION SYSTEM

Communications Devices for the Physically and Cognitively Impaired

Designers: Fabian Pollo, George Tures, Camie Erickson, Scott Probasco
Coordinating Facilities: Richmond State School, Denton State School
Texas Department of Mental Health and Mental Retardation
Supervising Professors: Gerald Miller and William Hyman
Bioengineering Program
Texas A&M University
College Station, TX 77843-3120

INTRODUCTION

A variety of communication devices were developed to aid children and young adults with cognitive and physical disabilities under the supervision of therapists and teachers. Thesedevices allowedthe disabled individuals to learn words, to piece together phrases, or to communicate at all for those clients who were completely non-communicative.

SUMMARY OF IMPACT

The ability of non-verbal disabled individuals to communicate affects many aspects of their daily lives. Tasks such as eating, drinking, bathroom, movement, need for staff intervention and many others may be severely limited if the client cannot function independently. The use of communication devices can serve two important purposes: it can allow the disabled clients to learn more about the process of communication, and it can serve as a vehicle for contact to a caregiver.

TECHNICAL DESCRIPTION

Several devices were designed for state schools and local school districts. These included a 5 push button selection communication system, a push button form-a-phrase communication system, and a word/phrase key card communication system. These will be described separately.

Push Button Selection System

This system consisted of a plexiglass box with five large latching switches. Above each switch was a panel where a word or object (picture) could be placed. When a button is pushed, the panel lights up and a buzzer momentarily sounds. The device was utilized by non-verbal clients in two ways. Firstly, it could be used in conjunction with a therapist to learn to associate spoken words and phrases to objects or written words on the board. Secondly, it could be used to communicate needs (food, water, bathroom, etc) to a nearby caregiver without requiring the caregiver to continually hover around the client. This unit consisted of 1/4" plexiglass, SPST switches, 6 volt small lights, diodes, and 4 D cell batteries. The unit is shown in figure 1 below.

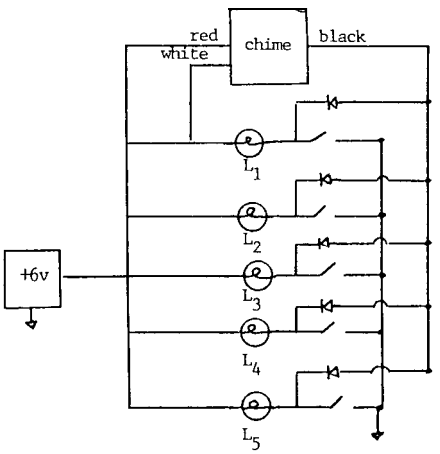


Figure 1 PUSH BUTTON ITEM SELECTION

Form-a-Phrase System

This system consisted of an aluminum chassis box with a series of pushbuttons and associated panels. On each panel was a word or phrase. When a button beside a word or phrase was pushed, then a light next to that panel would be lit. The client would light those words or phrases necessary to create a sentence or logical phrase. The choices were logically encoded within the box so that once a proper sequence was pushed, a chime would sound. If no proper sequence was pushed, there would be no sound and the system would be reset (by a reset switch). Such words and phrases as "please", "I", "thank", "want", "need", "help", "you", "a drink", "to go to the bathroom*', and "me" were utilized. However, the therapist could use blank panels to create new words or phrases. Instructions were written to add new items for potential new encoded phrases or sentences. Thus, a client could create the sentence "I - want - to go to the bathroom", and the chime would sound. However, if "I - want - need - me" were pushed, there would be no sound produced, since that phrase is not appropriate.

This system consisted of two 7" by 10" chassis boxes, a hinge, cabinet latch, handle, panel mount rocker switches, latching push button switches, LED's, PC board, chime chip, and a 9 volt battery and clip. The unit schematic is shown in figure 2.

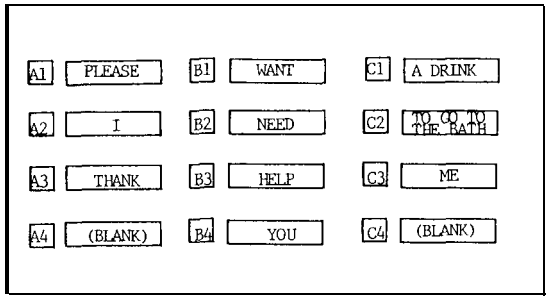


Figure 2a FORM-A-PHRASE USER INTERFACE

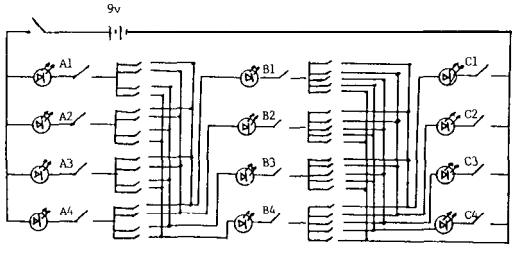


Figure 2b FORM-A-PHRASE CIRCUIT DIAGRAM

Key Card Communication System

This unit consisted of a wood box with 12 buttons and associated LED's and panels. On each panel would be a removeable word or picture. Below each light/panel on the side of the box was an associated slot for insertion of a key card. Thus, there were also 12 slots: one for each light. The key cards would also have a word or object on the card. Thus, if there was a word on the card, there would be an associated object on the panel above a light, so that the client could associate words with objects. Or there would be words on both the card and light panel to allow simple communication and sentence structure.

When a card is placed in its proper slot, the associated light would be lit and stay lit until a master reset switch is thrown. If the card were not placed in its proper slot, no light would be lit (each card is encoded so that it only corresponds to a single slot and associated light and panel). The electronics of this system consisted of momentary push button switches, an on/off button, LED's, 7400 NAND gates, IC sockets, PC boards, 9 volt battery and holder, a 5 volt-l amp voltage regulator, and various resistors. The cards were plastic with encoded notches to push a coded set of inlaid switches inside each slot. The unit is depicted in figure 3 below.

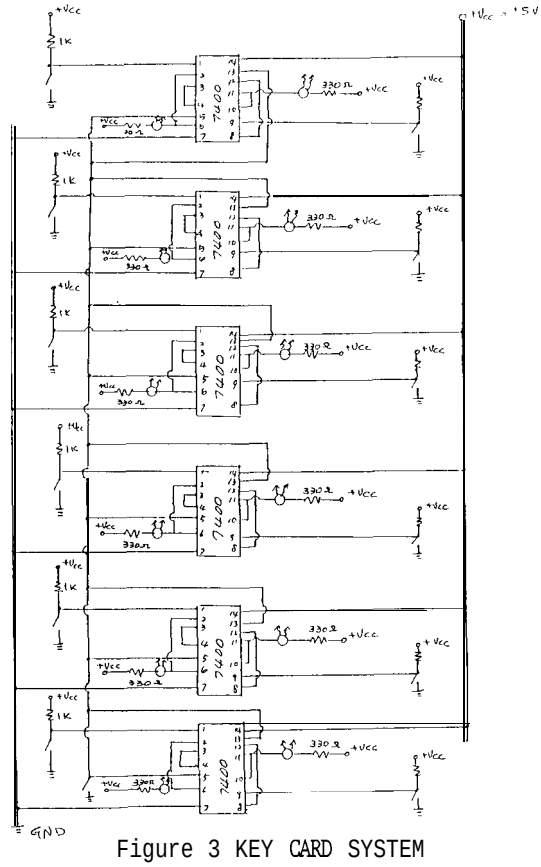


Figure 3 KEY CARD SYSTEM

A Modified Motorized Miniature Jeep for Pre-training of Children in the Use of Joystick Controls

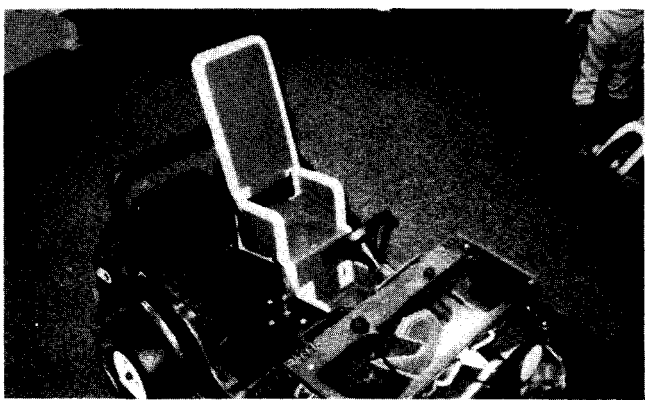
Designers: Scott Probasco and Fabian Pollo
Disabled Coordinator: Donna Honea, Harris County (TX) MHMRA
Supervising Professors: Gerald Miller and William Hyman
Bioengineering Program
Texas A&M University
College Station, TX 77843-3120

INTRODUCTION

A training system forphysicallyhandicapped young children was developed to teach them the use of a joystick controller so that they could later operate a motorized wheelchair control. The joysticktrainerwas placed into a motorized miniature jeep which was furthermodifiedwith appropriate safety and auxiliary control systems.

SUMMARY OF IMPACT

Many extremely young children with physical handicaps will eventually utilize a motorized wheelchair. For paraplegic individuals, a joystick control is commonly employed on powered wheelchairs. However, such a control is not well understood by small children. Although it is possible to train children in the actions of a joystick via computer games and motorized toys, the effect of self movement via joystick control cannot be adequately simulated by these means. An adapted motorized miniature vehicle would allow the disabled child to be seated inside and to operate the vehicle by joystick, in much the same fashion as a wheelchair controller. Thus, the disabled children would be adequately prepared to operate their ownmotorizedwheelchairs once they can be properly fitted.



TECHNICAL DESCRIPTION

A Sears miniature jeep was modified to incorporate a joystick control instead of the foot pedal operated controls. The joystick was mounted to the side of the driver's seat and was connected to the pedal control wiring. The pedals were removed and the holes covered over. A special seat and seat belt was developed for infants and was placed into the driver's seat cavity. Padding was placed around the exterior of the jeep. The jeep and padding were colorfully decorated to motivate the users of the vehicle.

There were initially two speed controls for the vehicle. However, the fast control was disabled to avoid any high speed accidents and the speed control knob removed. The joystick control was spring loaded so that when the control was let go, it returned to a neutral position and the vehicle stopped via friction. The original brake was disabled to avoid sudden stops by the user.

A power override switch was placed in the exterior of the jeep with a remote switch connected via a jack and a 6 foot lead. Thus, a therapist could walk behind the jeep and could disable the power if an accident was imminent. The override switch was hidden behind a cover plate so that only a therapist could start the unit, not any small child.

The system was powered by a 6 volt battery which came standard with the original jeep. A Radio Shack joystick, external switch, and connectors were used in this project. The total cost of the jeep and all components including electronics, hardware, paint and decorations was $300.

A Hand Grip Training Device with Auditory Feedback to Serve as a Pre-Vocational Training System for the Profoundly Disabled

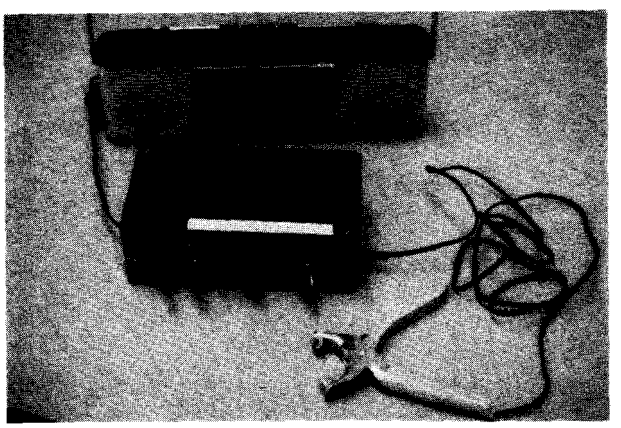
Designer: Steven Stoycos
Disabled Coordinator: Marcia Willson, Denton State School
Texas Department of Mental Health and Mental Retardation
Supervising Professors: Gerald Miller and William Hyman
Bioengineering Program
Texas A&M University
College Station, TX 77843-3120

INTRODUCTION

A motor skills and cause-effect feedback device was developed to enhance the skills of profoundly handicapped individuals and allow them to be phased into a sheltered workshop setting. The device consisted of a squeeze switch which operated a tape player. The switch was interfaced to a timing circuit so that a staff member could adjust the duration of squeezing required to initiate the feedback music.

SUMMARY OF IMPACT

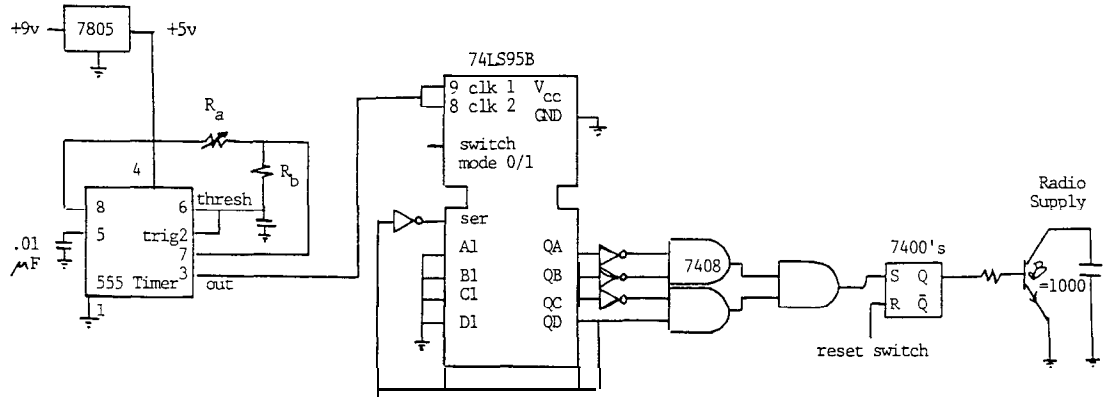
Many profoundly handicapped individuals who could be candidates for shelteredvocational workshops lack the motor skills to manipulate objects that will be encountered in a vocational setting. In addition, they may lack the attention span and motivation necessary to complete a desired task. A squeeze switch and music feedback system would alleviate both problems. The squeeze action would build hand strength and enforce a manipulating action that might be encountered later in a vocational workshop. The music feedback with variabletimerwould enforce the attention andmotivation aspects of this task.



TECHNICAL DESCRIPTION

A spring loaded pair of pliers was utilized to provide squeezing action. Small contacts were placed on each end of the pliers and attached by hidden wire (within the plier frame interior) to the control circuit. When the pliers were closed, the circuit was also closed so that the following events occurred: a shift register initiates the timer circuit, whichwhen complete (compared to a preset period) resets a flip-flop, which saturates a darlington transistor, which then closes the voltage supply circuit to power the tape player. The timer can vary the delay from O-5 seconds. The action is momentary, so that the music plays only while the switch is closed.

The system consists of an 555 timer, 7495 shift register, 7805voltage regulator, 7404 hex inverter, 7408 AND gate, 7400 NAND gate, darlington transistor, 100K trim pots, single pole-double throw switches, jacks, and 9 volt batteries. The unit is shown in the figure below with the accompanying circuit diagram.



Prevocational Counting Trainer

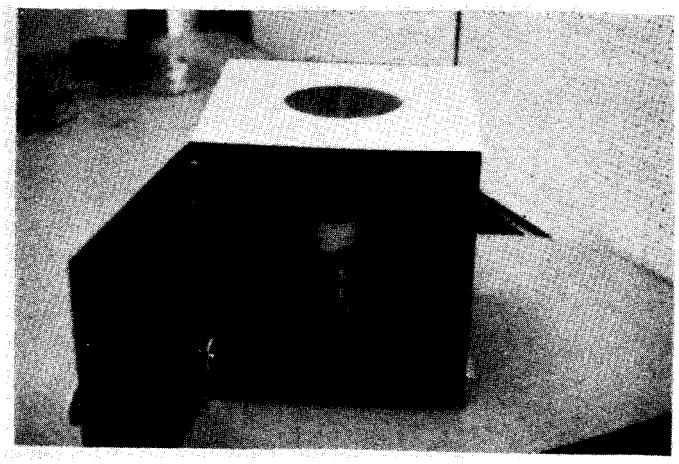
Designers: Ed Thomas and George Tures
Client: Denton State School
Texas Department of Mental Health and Mental Retardation
Supervising Professors: William Hyman and Gerald Miller
Bioengineering Program
Texas A&M University
College Station, Texas 77843-3120

INTRODUCTION

The prevocational counting trainer was designed for use in a program for resident clients of the Denton State School in which they are being prepared for subsequent work in the school's vocation sheltered workshop. Clients in the prevocational program have a variety of severe disabilites for which the training goals start with attentiveness to simple repetitive tasks. It is desirable in this setting for training tasks to resemble future work tasks, with the addition of visual or audible feedback to indicate task compliance or completion. In this case, the training goal is associated with counting of industrial type objects where a variable number of repeats would provide the desired feedback. In the system described here large metal balls are counted into a funnel. The trainer can preselect the number of balls required before the output buzzer sounds indicating successful completion of the task. The trainer can then reset the system. The goal is to initiate counting activity and to gradually increase the number of items that must be counted to trigger the system.

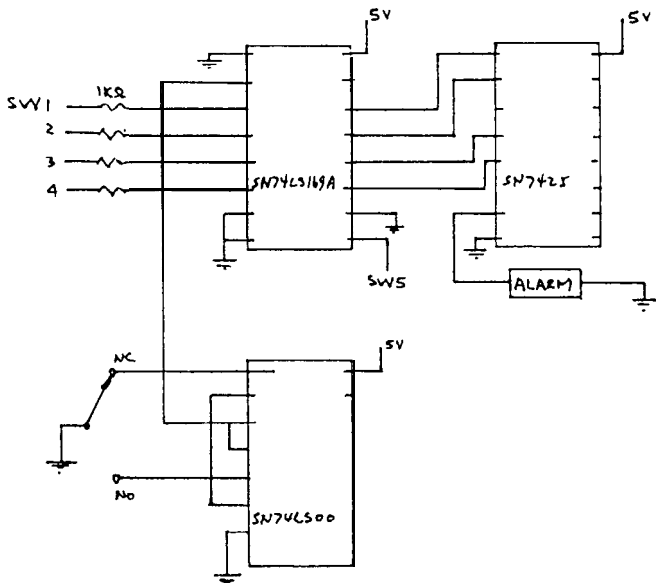
SUMMARY OF IMPACT

The sheltered workshop environment is used to either train clients for outside employment, or to provide a permanent place of employment for resident clients who are unable to progress to outside work. The work setting provides necessary daily activities, a feeling of accomplishmnet and self worth! and an income to the clients. At a facility like the Denton State School there are clients who are not ready for the workshop environment, but who could be educated toward the behavioral and skill requirements to function in the workshop. The device described here is currently in use in the prevocational training program toward reaching this goal.



TECHNICAL DESCRIPTION

The unit consists of a plexiglass cube with 12 inche sides. On the top of the cube is a circular opening which provides access to a funnel which is secured to the top from inside the box. The funnel accommodates the placement of 1 inch diameter balls which fall through the funnel into a container inside the box. The rear of the box is hinged to provide access to the collected balls and the switches which are used by the therapist to control the device. As each ball falls through the funnel itmechanicaly closes a switch which drives a counting circuit. When a preset number of counts is recorded a buzzer is energized. The therapist can then reset the counter using a switch, and then rearm the counter at which time the task can be repeated. The therapist can also select the number of balls (1 to 12) which must pass through the system before the buzzer is sounded. A binary switch logic circuit is used to set this number. The details of the circuit are contained in the accompaning figures.



CIRCUIT DIAGRAM

Devices to Enhance Productivity for Disabled Workers in Sheltered Vocational Workshops

Designers: George Tures, Winston Marshall, Ed Thomas, William Pierce, Steven Stoycos, Mark Benden
Disabled Coordinator: Marcia Willson, Denton State School
Texas Department of Mental Health and Mental Retardation
Supervising Professors: Gerald Miller and William Hyman
Bioengineering Program
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INTRODUCTION

A variety of devices were developed to increasetheproductivity of cognitively and physically disabled clients in a sheltered vocational workshop. These clients suffered from visual impairments, muscular and motor impairments, and limited cognition. Various tasks were supportedwhichwere created from contractual arrangements between the state school and area industries.

SUMMARY OF IMPACT

Individuals with visual disabilities or motordysfunctionlackthehand coordination and strength or the hand-eye coordination to quickly assemble items which are contracted with a vocational workshop. As a result, productivity is stalled in such a setting since the construction tools, jigs and systems are ill suited for handicapped individuals. A series of assistive devices was created to increase the disabled workers productivity by designing the system to meet the specific disabilities of the users.

TECHNICAL DESCRIPTION

Several different systems were developed to assist various tasks in the sheltered vocational workshop. These include a jig and collection system for a tablecloth holder task, a jig and collection system for a film unwinding task, a system to hold and organize a tie hanger assembly task, and a jig to assist in the assembly of tie racks. These will each be described separately below.

Tablecloth Holder Assembly System

Clients were given the task of assembling plastic tablecloth holders by attaching velcro strips to the ends of each plastic piece. Twelve of these were to be built and placed in small bags for later marketing. However, the clients were unable to manipulate the plastic pieces, were unable to properly apply the adhesive velcro strip, and were unable to accurately determine how many of these items had been built for insertion into a bag. A jig was created to alleviate all of these problems. The jig consisted of a plexiglass frame with twelve slots on a tilted plane hinged to the frame. The slots were of the proper size to insert the velcro pad and a plastic tablecloth holder. Once all 12 slots had been filled, the assembly was tilted down to allow the completed holders to slide into an assembly bag. This unit is shown in figure 1 below.

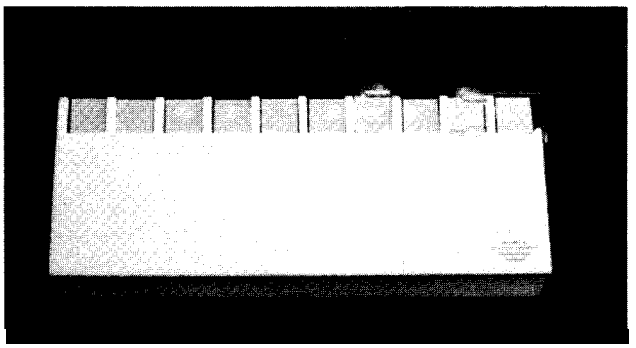

Figure1 TABLECLOTH HOLDER ASSEMBLY

Film Removal System

A task to remove photographic film from reels utilized physically and visually impaired individuals. The clients would manually unwind film from a reel, discard the film, and place the reels in a storage box to be returned to the contracting agency. Many of the clients had the use of only one hand and could not easily manipulate the reels to unwind them. A jig was created to allow one handed unwinding of multiple reels. The jig consisted of a horizontal post which held up to 6 reels. The film leaders were placed into a roller crank assembly. The rollers were rubberized

to hold the film. A slot was located beyond the roller assembly so that the unrolled film could drop into a waste box located below the jig. Once the film had been unwound, the reel holder post could be rotated out from the support post and the empty reels slid off into a storage box. The components to this system consisted of 2" by 6" wood framing posts, aluminum stock, rubber tubing, a metal handle, and wooden dowels. The unit is shown in figure 2 below.

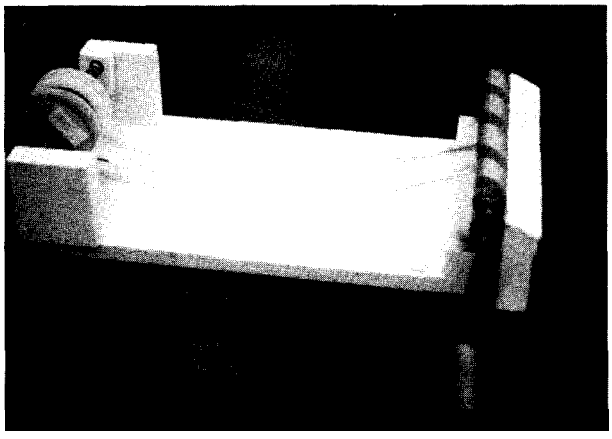

Figure2 FILM REMOVAL

Tie Hanser Assemblv System

Cognitively and physically disabled individuals were to take 12 plastic necktie holders from a large supply box and place them into an individualized bag for later stapling, labeling and marketing. However, these individuals could not count to 12 and thus, could not place the proper number of items into the small bags. A counting and assembly system was created to assist in this task. The unit consisted of a metal post which could swing into place within a series of 12 wooden slots on a wooden frame. The client would take a new holder and place it on the post within one of the slots. Once all of the slots were full, the post could swivel out so that all of the hangers could be slid off the post into a small bag placed at the end of the post. The components of this unit consisted of 2" by 4" wooden frames, a 1/4" unthreaded aluminum rod, plywood, hinges, and associated hardware. This unit is shown in figure 3.

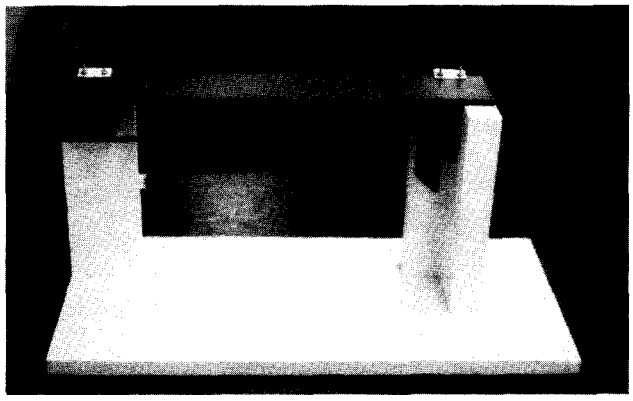

Figure 3 TIE HOLDER ASSEMBLY

Tie Rack Assembly System

A contract to build tie racks was developed by the vocational workshop. These racks consisted of a wooden frame with swiveling metal posts which held neckties. The assembly of these racks was quite involved since each metal post required insertion into a two part wood and metal frame. A jig was used to hold the frame and allow alignment and insertion of the metal posts in a two part process. However, since the workers who used this jig were visually impaired, they could not see the holes in the frame well enough to insert the posts. An add-on jig was developed to assist insertion of the posts into the frame. This new jig attached to the original jig and served as a guide for insertion of the posts. It consisted of a series of countersunk holes which would align with the proper slots in the frame to allow insertion of the posts. The new jig was made of brass and was built in pairs which were screwed onto both sides of the original jig (figure 4). The users now can feel for the next countersunk hole and ease a post into it.

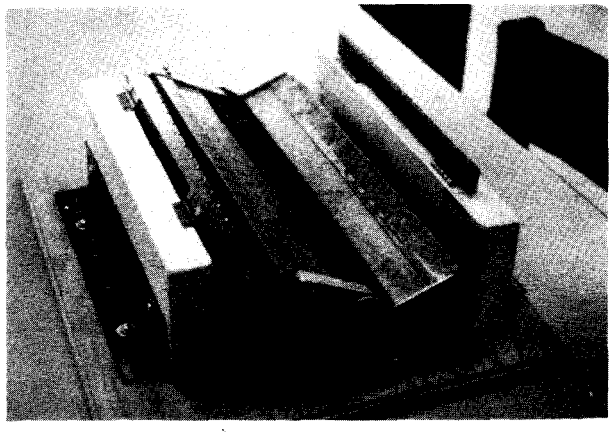

Figure 4 TIE RACK ASSEMBLY