CHAPTER 12

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Adjustable Platform for Scooter Board and Wheelchair Training

Designers: William Pierce and Lee Hudson
Therapist: Irma Riojas
Children's Center for Developmental Therapy
Supervising Professors: William A. Hyman and Gerald E. Miller
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INTRODUCTION

Therapy for some clients of the Children's Center includes therapy and play on scooter boards that can be used in a variety of postures. Training and exercise in the use of a wheelchair on sloped surfaces is also routine. A system was required that would provide a large ramp surface so that these activities could be made more challenging and more exciting. The requirements for this system were that there be a platform at one end, that the height of the platform be easily adjustable, and the platform and ramp be strong enough to support clients, therapists and parents.

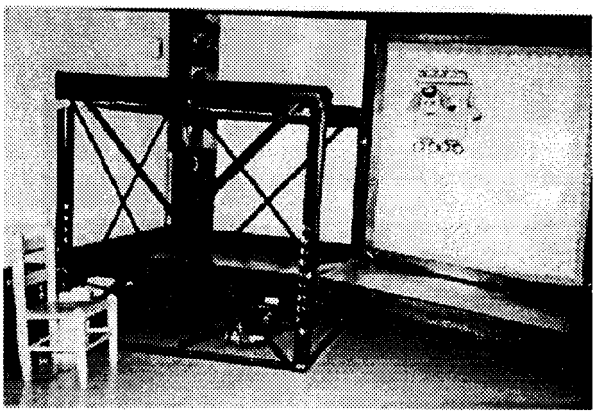
SUMMARY OF IMPACT

The completed platform is in active use at the Children's Center for Developmental Therapy. It partially replaces a much smaller, fixed height ramp that lacked the adjustments and strength offered in the new design. Children with various disabilities use the ramp while on prone scooter boards, which they propel with their hands. The ramp provides a gravity derived challenge in the uphill direction, and an exciting ride in the downhill direction. For young wheelchair users the ramp provides an adjustable practice surface for wheelchair control on an incline. The considerable strength and stability of the ramp and platform allow the therapists and parents to be on the device to assist the children in its use. The height adjustment mechanism is easy to use and facilitates quick changes so that the challenged can be varied during a single session.

TECHNICAL DESCRIPTION

The key design issues for this device where stability of the platform and ramp for any height adjustment, strength of the platform and ramp for multiple person and wheelchair loads, method of height adjustment, and overall physical safety.

The four vertical members of the platform support and guide were constructed from-barn door track. The associated door guide hardware, consisting of a dual axle trolley and hanger arm, was used with the hanger arm in a horizontal position. Although the configuration in which this equipment was used is different from the original intent, the anticipated loads are well under the ratings and use requirements of the equipment. In addition adequate strength was confirmed by direct calculation. The four hanger arms were secured to angle iron that formed the structural base for the platform. The track sections were cross drilled to



accommodate support pins that are manually placed in the selected hole corresponding to the desired height. The cross pinned were sized to accommodate the all the predicted loading, even though four pins are in use under normal conditions. The vertical members were integrated into a rigid assembly using angle iron at the bottom and top, and flat stock for cross bracing on the back and sides. Inside comer braces fashioned from angle iron were used at the top of the platform support. The angle iron base of the platform was covered with 3/4" plywood secured to the base with carriage bolts.

The ramp was also made from 3/4" plywood. Side rails made from 2"x4"s were secured to plywood to provide added rigidity and side stops to prevent the scooters or wheelchairs from leaving the ramp along the sides. Additional rigidity was provided by bracing the underside of the ramp with angle iron. The ramp was secured to the platform with heavy duty hinges. By attaching the ramp to the platform both parts of the system are raised or lowered simultaneously. A small hinged metal lip was added to the lower end of the ramp to eliminate the 3/4" lip of the plywood.

The lift mechanism was provided by a manual hydraulic automobile scissor jack. This provides ample lift strength in an off-the-shelf mechanism. The top support plate was modified to provide a protruding cylindrical tube fashioned from heavy duty PVC pipe. This tube mates with a coupling on the bottom of the platform so that the jack position is predetermined. To elevate the platform the jack is raised until the lower trolley wheels are above the desired cross hole in the track. The four pins are then each placed in the appropriate hole and the platform is then lowered onto the four pins. To lower the platform the jack is used to lift the weight off the pins so that the pins can be removed and repositioned in the desired lower holes. The jack is then used to lower the platform onto repositioned pins. Since the standard automobile jack does not have the total lift required, an accessory lift tube is provided for working at the higher heights. To insert the lift tube, the platform is raised to approximately midheight. The pins are then positioned to support the platform at this level, and the jack is lowered. The lift tube is then placed on the cylindrical protrusion at the top of the jack and the jack is then raised until contact is made with the platform. This allows height adjustments in the upper range. When lowering the platform from the upper to the lower range, the platform must be stopped in the midrange, the jack lowered, the extension removed, and the jack then repositioned for further lowering. Although this procedure is slightly cumbersome it is only necessary when large height adjustments are required. Raising or lowering the platform can be easily accomplished by one person. This was part of the design criteria. The intent and instructions are that the jack remain in position below the platform as a redundant support. In addition, the instructions require that there not be people on the platform during adjustment. However, there is ample lift strength available. The instructions also require the cross pins always to be used than to rely on the jack for support during use. This procedure is encouraged by the fact that the platform is slightly wobbly when supported by only the jack. Alternate and possibly more elegant lift mechanisms were considered including motorized screw drives, powered hydraulic jacks, and similar systems. These were rejected largely on cost although they did have other disadvantages such as total vertical lift and lowest available position. The latter would have required lifting from outside the frame and thereby require more elaborate horizontal stabilization to obtain a smooth lift. In addition such devices would be far more complicated and be difficult for the Center to replace. The upper front posts, the top rail, and the two back corner braces were padded and custom upholstered to protect against minor injury associated with direct contact with these surfaces. The platform and ramp surface were covered with continuous vinyl flooring to provide a smooth finish. The vinyl flooring bridges the gap between the platform and the ramp and was installed such that the flexibility of the vinyl accounts for the slight dimensional changes associated with the various ramp/platform angles.

The entire mechanism was originally assembled away from the Children's Center and repeatedly tested for stability in all positions with varying loads, and for ease of adjustment. In addition all surfaces were carefully inspected for rough edges or other possible injury mechanisms. The system was then minimally disassembled, transported to the Children's Center, and reassembled on sight. It was then briefly retested throughout its range of operation, and the Center personnel were instructed in its use.

Joy Stick Controlled Musical Keyboard

Designers: Laura Schneider and Andrew Barr
Client: Special Education Department, Bryan ISD
Supervising Professors: William A. Hyman and Gerald E. Miller
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INTRODUCTION

The modern electronic musical keyboard offers a broad performance capability in a small and inexpensive package. In a previous project we provided such a keyboard to an individual whose only motor skill was the use of a head pointer. This individual was able to quickly learn to play the keyboard and it became an important recreational outlet for her. Other less disabled individuals may have some hand/arm function but lack the ability to position and press individual keys. To enable these individuals to use a keyboard a unique instrument was designed in which a standard four switch, on/off joy stick was interfaced with an existing keyboard. This design allows any individual capable of using a joy stick to operate the keyboard.

SUMMARY OF IMPACT

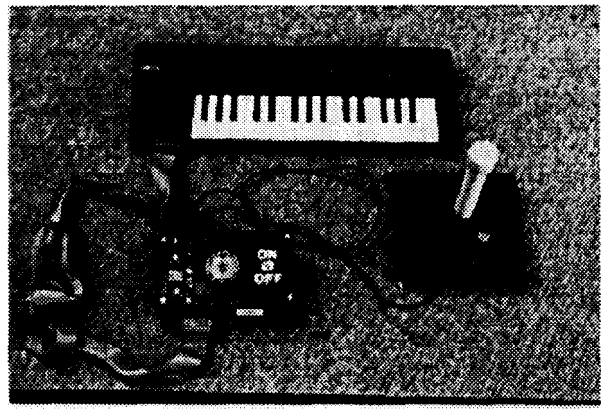
Music therapy has long had a place in the recreational and developmental activities of a wide range of individuals with handicaps. Traditional instruments have range of motion and force requirements that preclude their use by the more severely disabled. The new instrument designed for this project addresses the need for a low range of motion, low force instrument that produces a wide range of interesting musical capabilities. Furthermore, by using a standard commercial keyboard as the base technology, it works well in the integrated setting in which handicapped and able bodied students work and learn together. The design retains the full original operation of the keyboard for normal play either separately from the joystick input or in conjunction with it. The new design has also been attractive to the able bodied student for musical experimentation and this has led to the interesting experience of the handicapped individual's "instrument" being desired by the other students.

The new instrument is in use within the music therapy program of the Bryan (Texas) Independent School District.

TECHNICAL DESCRIPTION

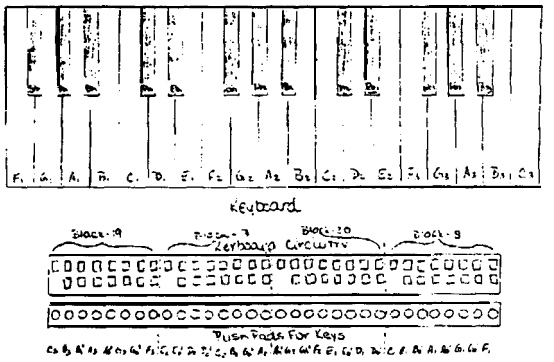
Providing a joystick interface to the existing keyboard presented two technical challenges. The first was to identify how the new inputs would best be physically connected to the existing circuitry. The second was how to convert the four switch joystick output into the eight unique signals that are available as individual switches and near neighbor pairs.

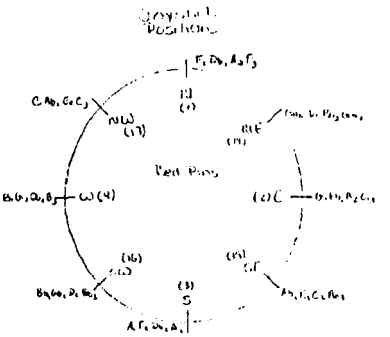
Several alternatives were explored for attaching new wiring to the existing electronics including interfacing directly at the keyboard contact points and interfacing to the printed circuit board. Both were identified as cumbersome and could interfere with normal play with the keys. The approach ultimately selected was to interface to the

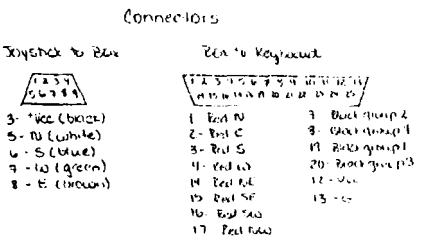


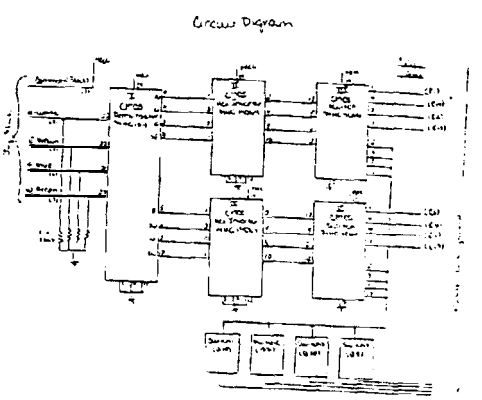
twelve conductor internal ribbon cable. Close inspection showed that there was sufficient room at the point where the ribbon cable entered the printed circuit board to solder a parallel cable in place without removing or cutting the existing cable. Direct experimentation was used to determine the relationship between key switch closures and cable signals. It was determined that in the instrument used (Yamaha PSS-130) each sequential group of eight keys corresponded to a unique black wire in combination with one of eight red wires. In the resultant design four switches on the interface box are used to select an eight key group (black wire) while the eight joystick positions select the key within that group. After designing the system, it was noted that up to two octave keys could be used simultaneously. This allows for a number of different dual note combinations.

To decode the joystick positions into eight unique signals the joystick switches were connected to a CMOS demultiplexer. Inverters were used to change the active low outputs of the demultiplexer to active highs. CMOS switches were then used to connect each of eight key outputs from the inverters to the corresponding red wire of the ribbon cable. Power for the circuit is drawn directly from the keyboard power source through the added connecting cable. This eliminated the need for separate batteries for the circuit, and allows use of a line powered transformer for primary power. The joystick can be disconnected from the interface box using the standard joystick connector. The added interface cable is connected to the keyboard using a ribbon cable connector that is permanently mounted on the instrument case. If this cable is unplugged the keyboard operates normally. If the box switch is turned on the keyboard also plays normally and can be played simultaneously with the joystick if desired.









Micturition Alarm

Designer: Giles Ballouz
Coordinator: Ruby Penigar-Taylor, Ft. Worth State School
Texas Department of MHMR
Supervising Professors: William A. Hyman and Gerald E. Miller
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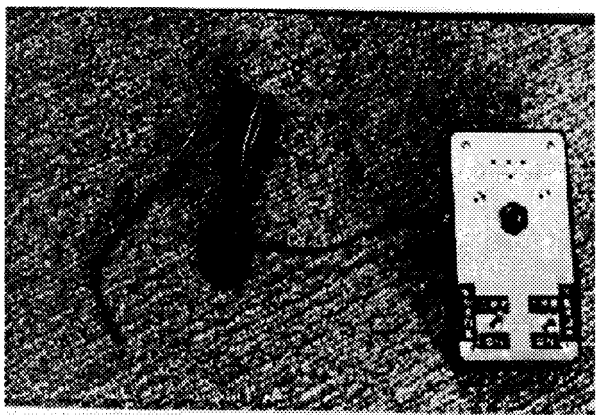
INTRODUCTION

Urinary incontinence is a common and significant problem for the resident clients of the Ft. Worth State School as well as for other chronic care individuals including the elderly. Many of the State School residents are unable to communicate to the attendant staff of the need to urinate, or **that** their absorbant pads need to be changed. Unchanged pads are associated with medical problems including cystitis, urosepsis, pressure sores and rashes (1). Periodic checking by the attendant staff has been the only reliable sensing technique and relies on staff attentiveness. In addition unnecessary assessment disturbs the individual and their routine. The sensor provided in this design provides a visual, and optional audible, signal to the attendant that pad changing is required. The sensor is easy to use, unobtrusive, and safe for the client.



SUMMARY OF IMPACT

A prototype sensor was designed and built and is currently in evaluation at the Ft. Worth State School. The immediate impact of the sensor is that it signals the staff when changing is necessary and therefore helps avoid the consequence of undetected and unaddressed urinary incontinence. A further impact will be the development of individual specific data on the frequency and period of urination in selected clients. This information could be translated into daily care plans for toileting schedules, skin care and overall management that could avoid the continued use of the sensor as a routine device. Following the evaluation period, additional units will be provided at low cost using direct funding from the School as needed.

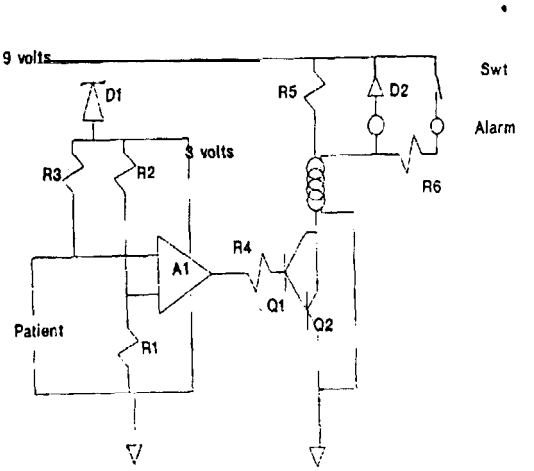
TECHNICAL DESCRIPTION

One of the key requirements for this design was that the sensor element be safe both mechanically and electrically. In addition the sensor had to be easily placed and operated. Hard wiring to a wheelchair mounted indicator/circuit box was adequate for the intended purpose, and helped to limit the cost of **the** unit. Cost considerations included the prospect of ultimately producing multiple units.

The operational principle of the sensor is that minimally conducting fluid, by itself or wetting a surface, provides continuity across the two terminals of the sensor. This continuity provides limited current flow to the operational amplifier that triggers the transistors Q1 and Q2, providing power to the relay A2. The energized relay completes the circuit for the indicator lamp and optional chime. For safety, the voltage available on the sensor side of the circuit is limited to 3 volts by the Zener diode. This maximum voltage, with the resistance values in the sensor circuit, results in a very low and therefore imperceptible current across

the sensor terminals. The sensor itself was made from speaker wire. A straight cut across the wire exposed the two conductor ends. A small bead of solder was attached to the ends for stability and smoothness. The sensor plugs into the circuit/output box with a standard miniature (1/8") plug. Therefore, the sensor can be separated for cleaning and is easily reproducible and replaceable by on site personnel. The safety of the sensor was repeatedly tested by measurement and against suitably sensitive skin surfaces. It can be noted that even in the unlikely case of total failure of all resistive and voltage limiting elements, if the device were still functional the available current flow would still be minimal.

The preferred placement of the sensor is within or on the outside of the absorbant pads. This helps prevent mechanical irritation by the sensor tip and wire as well as false alarms that could occur by direct contact with naturally moist skin. This placement also provides an additional measure of electrical safety in that the current density at the skin surface would be extremely small.



Q1	3 volt Zener diode
D2	6 volt Zener diode
R1	1 M
R2	1 M
R3	500 K
R4	320 K
R5	180
R6	180
Q1	2N2222
Q2	2N2222
A1	TLC251
A2	5 volt, 250 relay

REFERENCE

1. O'Donnell, P.D., Beck C., and Walls, R.C., Serial Incontinence Assessment in Elderly Men, *J. Rehab .Res.*, 27, 1-8, 1990.

Adjustable Shadow Switch for Postural Control

Designers: Laura Schneider and Cecilia Duarte
Coordinator: Ruby Penigar-Taylor, Ft. Worth State School
Texas Department of MHMR
Supervising Professors: William A. Hyman and Gerald E. Miller
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INTRODUCTION

Feedback for postural control is a common approach for self motivated improvement for wheelchair confined individuals with trunk and head instabilities. Various input modes have been used to trigger the feedback including client mounted tilt switches and wheelchair mounted mechanical switches. The former require attachment to the individual and typically hardwiring to the accompanying circuitry, although telemetry could be considered. However these devices require consistent placement on the individual to be effective. Mechanical wheelchair mounted switches can be effective provided the force to operate the switch, and the effect of the switch on the contacting skin surface, can be minimized. The alternate design of this project is the use of a head support mounted shadow switch that is recessed below the surface of the support. This design was initiated for a client for whom no physical pressure on a mechanical switch could be tolerated.

SUMMARY OF IMPACT

The shadow switch described here has been incorporated into an individual resident's wheelchair. The switch was designed with the sensor cable connected to the circuit/power box to facilitate placement by the adaptive equipment shop at the School. The sensitivity of the switch is adjustable such that amount of head/hair covering required to operate it can be carefully adjusted. When properly adjusted, the user can effect output switch closure without physical contact with the switch or even the headrest. A miniature (l/S") plug output is provided so that a variety of positive feedback devices can be employed. Two popular choices are a battery operated fan that provides an air flow stimulus, and a tape player/radio that operates when an external switch input is closed.

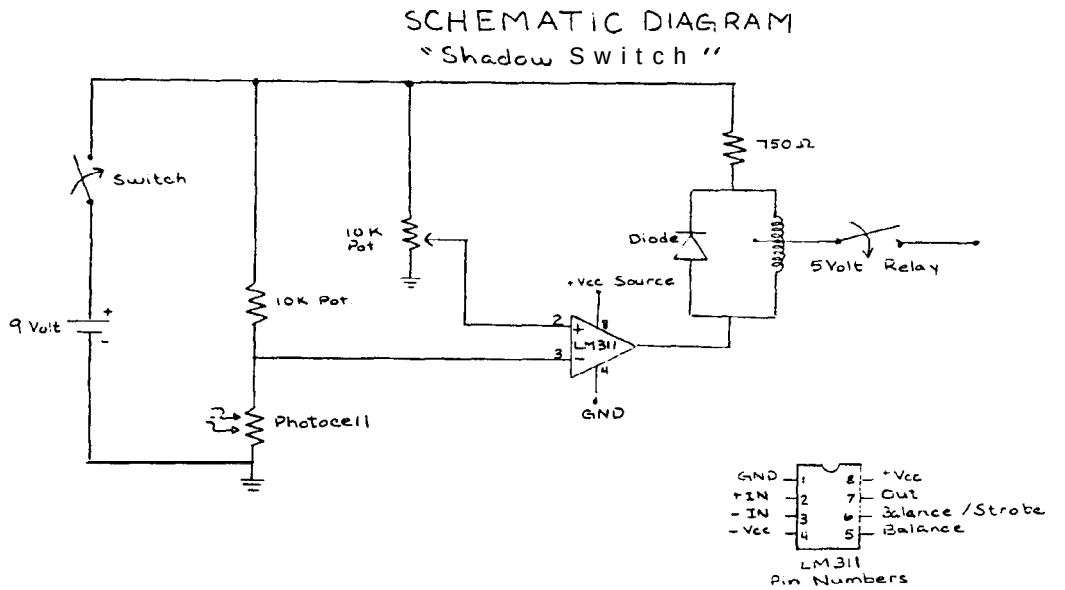
The switch as designed and installed is operable by the intended client and does serve to help her improve her posture. The same switch can be used to activate a variety of other devices and therefore also has potential as a communication device input.

TECHNICAL DESCRIPTION

The design is based on a light sensitive photocell that provides input to a LM311 comparator. The photocell is secured to a wooden support and is attached by cable to the rest of the system. The voltage level from the photocell circuit is partially set with an internal 10K potentiometer. The second input to the LM311 is derived from a 10K potentiometer that is manually adjusted by an external knob to achieve the desired sensitivity. This adjustment is critical to the application described here since the recessing of the sensor below the head rest surface produces relative darkness compared to ambient conditions. It is therefore necessary to assure that only the more intense darkness of the head covering the recess causes a response.

When the photocell is sufficiently dark, the comparator transmits and operates a relay. The output of the relay is connected to a miniature (1/8") jack. A plug in connecting cable is used to attach the control box to the desired feedback device.

This circuitry has also been used for a box mounted shadow switch in which a hand placed over the sensor is sufficient to effect external switch closure. In this latter application, sensitivity adjustment is not particularly necessary since covering the sensor with the hand produces a reasonable consistent dark level.



Finger/Hand Exercise with System With User Feedback

Designer: Larry Carrier
Therapist: Irma Riojas
Children's Center for Developmental Therapy
Supervising Professors: William A. Hyman and Gerald E. Miller
Bioengineering Program
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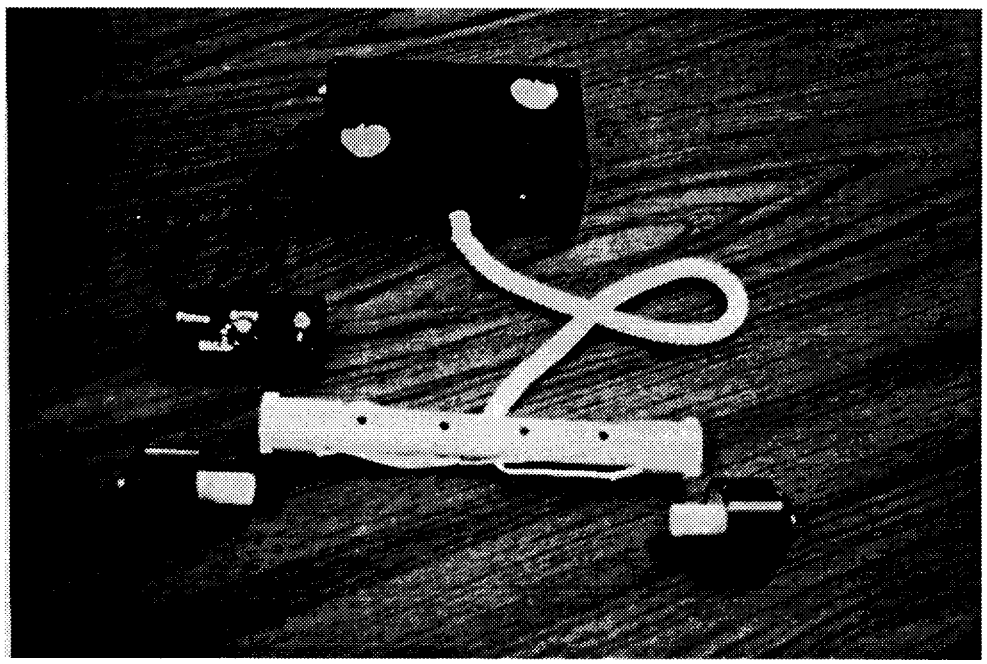
INTRODUCTION

This device provides a means for children to exercise their fingers and hands, and receive a visual and aural stimulus when a preselected force level is reached. The technology is based on the Interlink Force Sensitive Resistor (1) and the present application is one of several that have been reported using this component (2-4). The function of the device is enhanced by providing a "prompt" button for the therapists that allows for the stimulus to be triggered manually to reward subthreshold effort by the child. This concept has been provided in several projects developed for the Children's Center because of the importance of being able to provide adequate stimuli to the young clients of this facility.

SUMMARY OF IMPACT

The device described is currently in use at the Children's Center. It provides the physical exercise format desired, a variable and repeatable goal, and the feedback necessary to encourage active participation by the child in the therapeutic process. It can be used with opposed fingers, or with palms using the inserts provided. It also can be used with one finger or hand by bracing the device and providing the active end of the system to the child. The blinking light and chime feedback have proven to be attractive to the users without being overly startling or disruptive to other activities.



TECHNICAL DESCRIPTION

The active element in the design is the FSR. This component provides a variable resistance in response to applied pressure. In this design a 1/2" diameter circular FSR is placed at the bottom of the tube on one side of the unit. The FSR is accompanied by a parallel fixed resistor that forms a voltage divider. The divider output is fed to a comparator (LM311) with a threshold voltage selected by the therapist using the 50k ohm potentiometer. When the output from the voltage divider exceeds that from potentiometer the comparator is satisfied and the output is passed to a NO relay. The relay closure triggers four blinking LEDs mounted on the hand held component with a chime mounted in the circuit/power supply box. The adjusting potentiometer and the therapist prompt button are located on a separate small box that can be held by the therapist if desired. The hand held unit is made from PVC pipe.

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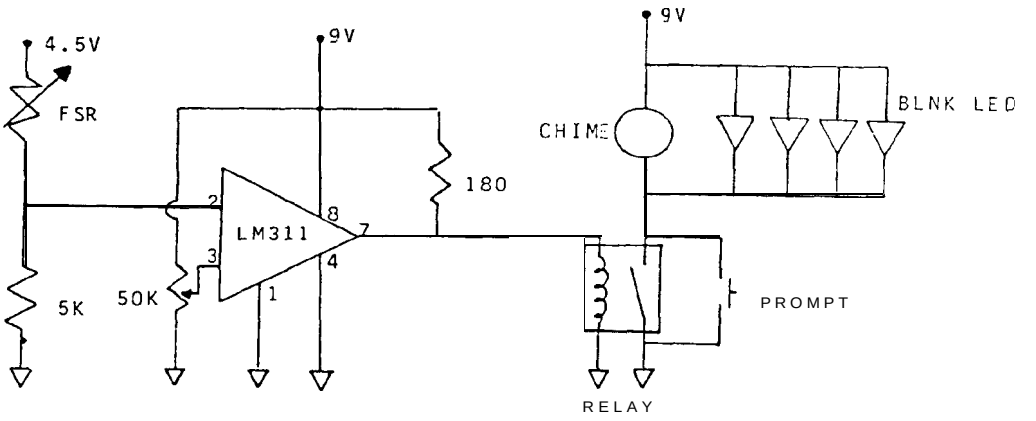

Adapted TV Remote Control for Limited Arm/Hand Function

Designer: *Scott Probasco*
Coordinator: Cheryl Wells, Denton State School
Texas Department of MHMR
Supervising Professors: William A. Hyman and Gerald E. Miller
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INTRODUCTION

The independent operation of a television via remote control has become a feature of life in our society. For the mobility handicapped individual this capability goes beyond being a luxury by providing the means to enjoy television without reliance on someone else to operate the television controls. In the residential setting this independence becomes even more valuable since the attendants may be too busy or inattentive to provide this service. The modern TV remote control readily addresses this problem for individuals with sufficient hand and finger dexterity. However the multitude of functions on most remotes, along with the very small buttons, renders this device unusable by many handicapped individuals.

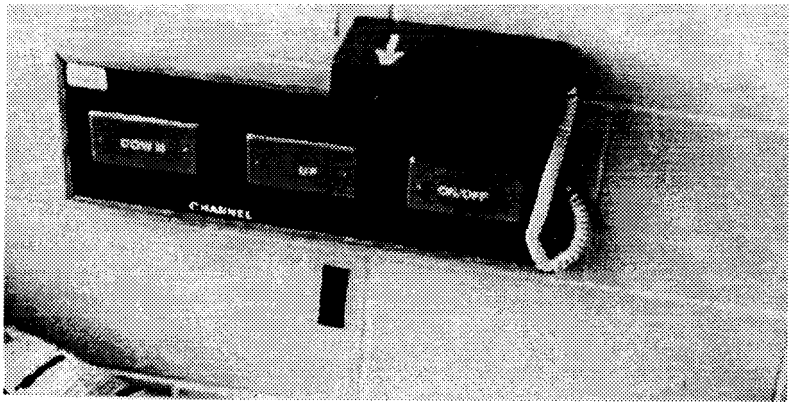
The objective of this design was to provide the key TV functions of on/off, and channel up/down, in an easily used, big switch device. A further objective was to separate the IR sender unit from the switch unit so that each switch unit could be placed for the convenience of the user, while the sender unit could be positioned to best operate the TV.

SUMMARY OF IMPACT

Television, for better or worse, is an important component of residential life for the handicapped. The individual currently using this design has relatively high cognitive function but is severely limited physically. He can operate a set of a few simple switches if they have a sufficiently large surface area. The system described here is currently in use by this individual for his personal TV in his sleeping area. In addition to providing the direct function of enabling him to turn his TV on and off, the unit allows the broader sense of independent life function that is desired by many handicapped individuals.

TECHNICAL DESCRIPTION

Although it would be feasible to design an IR sender from scratch, it is far more expedient, and ultimately less costly, to directly use an available TV remote unit, assuming the available television is remote compatible. The remote used can be the actual or duplicate unit that came with the TV, a "trainable" universal remote that can be

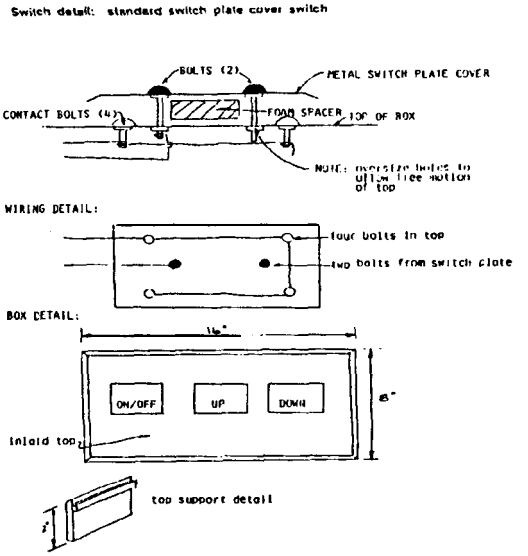


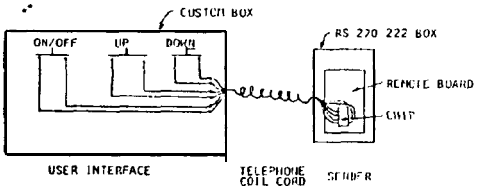
programmed to produce the signals compatible with the TV (e.g., Radio Shack 15-1902), or the newer multibrand remotes that can be set to operate a wide range of major brand equipment using internal dip switches (MAC 10 from Gemini Industries). Add on remote control units for cable TV are also available if the TV to be used is not remote compatible (e.g., Radio Shack 15-1287). In the latter case the on/off function may be compromised since on some televisions the front panel on/off function is reset to off when power is interrupted.

In the design described here, the original remote unit was used. This unit was disassembled, retaining only the circuit board and the IR sender.
To simplify the user interface, it was decided to provide only on/off (one button for this remote) and channel up/down. Volume is preset at the TV, while random access channel selection, flashback, and other functions were considered superfluous. The appropriate printed circuit elements to switch to achieve these functions were identified on the board and wires from a multiconductor cable were soldered to the board to accommodate the external switches. A five conductor telephone handset coil cord was used to connect the circuit board to the external switch unit. The circuit board and IR sender were mounted in a project box with batteries of greater capacity than originally supplied.

The switch unit consists of three large surface switches mounted linearly. The switches were constructed for this project from metal switch box cover plates. Two bolts hold each cover plate in position above the switch box surface. Under each cover plate four bolt heads protrude through the top surface. Inside the box the four bolts are wired together to provide one terminal of a momentary switch. The cover plate itself provides the other side of the switch through a wire connected to one of the bolts holding the cover plate in place. A small piece of foam under the cover plate provides the elasticity necessary for switch return. The travel of the cover plate is adjustable with nuts on the two positioning bolts. These nuts are under the box surface. Adjusting these nuts to tighten the system can result in a very low displacement switch that is sensitive over its entire surface. The tightness of the nuts, with the amount and type of foam used, controls the required force. The force can easily be set at a minimal value, or at a larger value, which can be useful to mechanically distinguish inadvertent switch **contact** from more deliberate switch contact.

Alternate styles of switches could easily be substituted for those described here. Capability to do this on the present unit was provided by incorporating a separate miniature (1/8") jack in parallel with each switch.





Note: Connections to remote chip determined by tracing applicable buttons on remote to chip connections. This will vary depending on specific remote used.

The number of conductors necessary will also depend on remote used.

A "universal" remote could also be used so that unit which came with TV is not destroyed. (e.g. RS 15-1902)

Sound/Voice Switch for Vocalization Training

Designer: Carolyn Schaff and Anthony Zerangue
Client: Children's Centerfor Developmental Therapy
Supervising Professors: William A. Hyman and Gerald E. Miller
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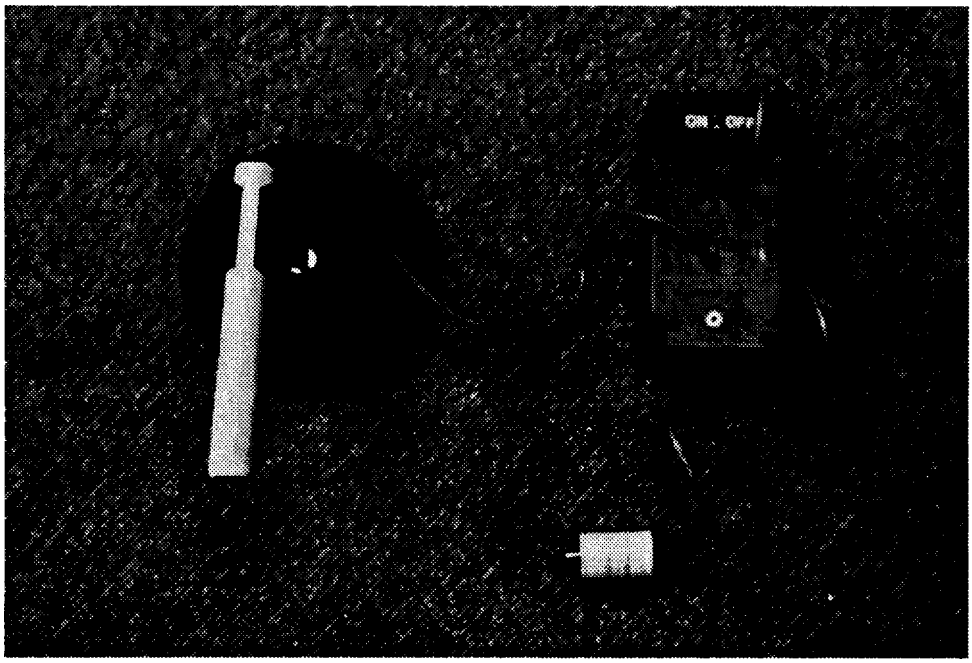
INTRODUCTION

One therapy goal for developmentally delayed children is the development of speech skills. In the early stages of this therapy vocal sounds rather than speech may have to be worked on. This project is intended to trigger a feedback response to the child during vocalization training sessions. The feedback can be in the form of any visually or aurally stimulated event that can be initiated from a momentary switch closure. This can be a toy modified for external operation, a radio or tape player similarly modified, or a device specifically intended for such stimulation. The input device consists of a sound operated momentary switch that is closed whenever above threshold noise is received at the microphone. The therapist has two additional controls available. One is a momentary off switch so that the system can be made not to respond while the therapist is talking. The therapist also has a "prompt" switch that allows the system to be manually triggered as reward for effort, even if the threshold sound level is not reached.

SUMMARY OF IMPACT

A variety of therapy aimed at young children benefits from the provision of feedback when the child does the required task, or the disguise of therapy as play. Some feedback can be provided directly by the therapist although this may eventually have limited interest to the child. Furthermore an automated system of feedback for performance of the required activity may allow independent use of the system by some children.

The device described here meets these goals and is in current use at the Children's Center. It allows the speech therapist to provide a variety of stimulating experiences to the child during the vocalization training session.



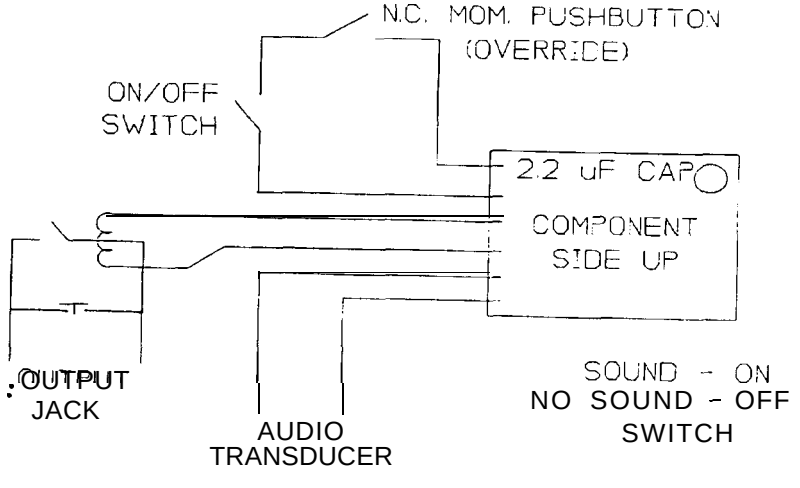
TECHNICAL DESCRIPTION

Although voice/sound triggered switches can be designed from "scratch", the approach taken for this project was to modify an already available commercial circuit that performed most of the desired function. This circuit, in the form of a single board was removed from a "dancing flower" that was widely available during the Christmas season, and could subsequently be purchased at close out prices. The dancing flower provided a mechanical response whenever adequate sound was provided at its microphone. This was close to the desired device but it lacked the ability to provide alternate outputs, the ability to conveniently turn it off momentarily, and the ability to trigger the response in the absence of sound. The circuit board was therefore removed from the device and modified by replacing the motor with a relay that closed a standard miniature (1/8") jack connector. A momentary off switch was also provided with a prompt button that independently closed the jack. Battery capacity was also increased over that provided in the original toy. The circuit board, relay and batteries were mounted in a standard project box. The microphone element was separated from the board and connected by wire to a holder mounted in a microphone stand that allows for placement close to the speaker. The momentary off button and prompt button were mounted on a small separate box so that it could be easily hand held by the therapist.

Although the original device did not provide sensitivity control, and none was added, the final system had sufficient range to accommodate the needs of all users.

A second similar device was constructed from a one channel color organ kit supplied by All Electronics (Van Nuys, CA). This device is line powered. Its output operates other line powered devices that can be subjected to voltage variation such as a lamp. An adjustment is provided that adjusts the intensity of the output. For a lamp an on/off or variable brightness response can be obtained.

The concept of adopting useful components from existing commercial devices is an interesting one in terms of expediency and total cost considerations, especially if the builder was being paid. Even though the circuit needed for this project was relatively simple, the real cost to design and build it from scratch would greatly exceed the cost of the device from which the circuit was taken. In this case the educational value of an original design task was balanced against the educational value of finding a quick and low cost solution to a technical problem,



Direct Reading Spot Meter for Interfacial Pressure

Designers: Giles Ballouz
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Supervising Professors: William A. Hyman and Gerald E. Miller
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INTRODUCTION

The direct measurement of interfacial pressure between tissue and supporting surfaces is an important component of pressure sore prevention. Such measurements are used as part of cushion prescription and design, and to spot check existing client cushions to detect undesirable pressure values. Large arrays of sensors have been reported as well as small spot meters. The latter have been of the pneumatic variety in which a small bladder is inflated until its expansion reaches a value that causes separation of contacts on either side of the bladder. The pressure at which this occurs is noted "on the fly". The value is recorded as the local interfacial pressure, although this is not strictly true under all conditions.

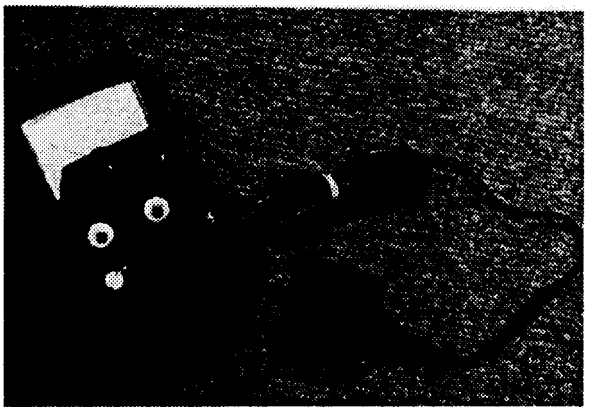
In the present design an alternate spot meter has been developed based on the Force Sensitive Resistor (FSR) available from Interlink Electronics (1). This device provides a direct and immediate measurement over the area of the sensor without manipulation of a pneumatic bladder. Thus the device is easier to use and the interfacial value is held on the meter.

SUMMARY OF IMPACT

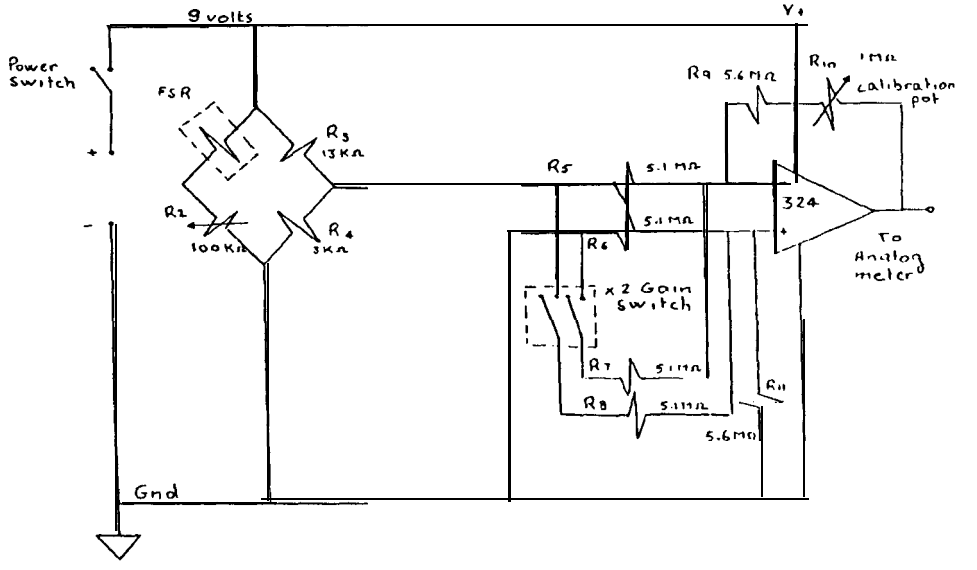
Prevention of pressure sores is a major issue in the management of immobilized and insensate handicapped individuals. Prevention is a multifaceted function that includes cleanliness, skin inspection, pressure relief, nutrition, and the provision of appropriate seating or other support surfaces. One aspect of seating design is the reduction of peak pressures, especially at the point of bony prominences or other vulnerable areas. One approach to controlling pressures at critical areas is the direct measurement of the actual pressure between the individual and the actual support surface. Such measurements are challenging because of the fundamental issue of measuring devices altering the phenomenon being measured. This is especially true for interfacial pressures when large, inflexible, or protruding measurement systems are involved. While it is in principle desirable to measure pressure contours over the entire contact area, for many individuals the areas at risk can be readily identified and therefore local, and less obtrusive and less costly, measurements can be adequate. In the latter case, a simple to use direct reading pressure monitor would facilitate rapid and frequent measurements. The present design, which is currently under evaluation as a therapeutic tool, is intended to provide such a meter.

TECHNICAL DESCRIPTION

The FSR has been previously used in a variety of rehabilitation applications (see report in this section on Finger/Hand Exercise System With User



Feedback, and its references). This device is a versatile low cost pressure/force sensor in the form of a thick film electromechanical system which resembles a membrane switch, but has the properties that its resistance varies with vertically applied force. A 2" diameter sensor was chosen for the current application. The sensor is covered with thin, relatively rigid surfaces to improve its ability to provide a response integrated over its area. The sensor is encapsulated to form an easily positional unit that is attached by cable to the supporting circuitry and meter. The necessary circuitry, in which the resistance change is in effect measured, is relatively simple, which is one of the advantages of the FSR. In the present application, the FSR is incorporated into a bridge circuit to improve sensitivity and linearity. The output from the bridge is provided to an amplifier that provides a proportional signal to an analog volt meter. The gain of the amplifier is switch selectable by a factor of two to improve the utilization of the voltmeter scale for low pressure readings, while also covering the high range. Initial calibration of the volt meter scale is by direct pressure application to the sensor and location of the corresponding meter output. Thus the meter scale is read directly as pressure. A zero adjustment and full scale adjustment are separately provided as time- of-use calibrations. The use of a directly calibrated analog scale allows for compensation for nonlinearities in the response. A further advantage of the analog display is that the danger area can be clearly marked on the display, and this is the key purpose of the device rather than highly accurate pressure measurements. To achieve nonlinearity compensation in a digital display a look-up table would have to be used to convert readings to pressure values. This is unnecessarily complicated for the present application, if in fact a digital readout would be more desirable. The analog output is also provided at a jack so that the measured values can be directly recorded if desired. This might be of interest in studied dynamic phenomena such as the effect of movement. It can be noted here that the pneumatic spot meters currently available are not suitable for even slow speed dynamic measurements.



Pressure meter. circuit Diagram

Braille Training Dominoes

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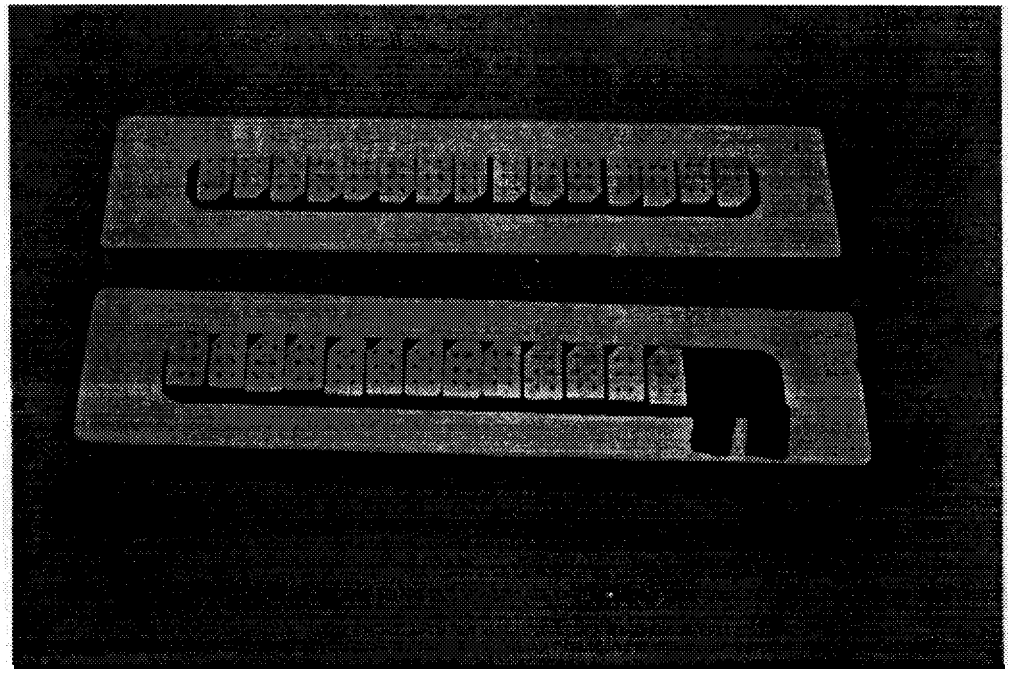
INTRODUCTION

The device described here is intended to facilitate the learning of Braille by individuals with both motor and cognitive difficulties. For such individuals the tactile identification of printed Braille, along with its comprehension, is difficult. The "domino" system provided here allows for the construction of individual Braille blocks as well as their placement in the jig in any desired order. Thus the learner can create letters for their name, or other simple words, and then arrange them to spell the word. This process emulates the early written language training of children, in a context that is suitable for an adult clientele.

SUMMARY OF IMPACT

Many blind and disabled individuals, especially with the added burden of possibly limited cognitive ability, may not have received appropriate early education. This problem is being addressed at the Denton State School through an aggressive training program, even for individuals who may be permanent residents. Last year we reported on the design of a training track that is being used to teach some of these individuals correct use of a guide cane. Other activities in the program include daily living activities. The present project was identified as an approach to Braille training for



individuals with sight, motor and educational handicaps, It is currently in use at the School for teaching Braille symbology through construction of the symbols using pegs on the individual blocks. The constructed letters can be used to build words by placing the blocks in the jig in the appropriate order. Once placed, the Braille symbols can again be touched as a reading function. In addition to the primary goal of teaching braille, this system also works on manual dexterity and general attentiveness skills. The project has recently been duplicated for the Ft. Worth State School.

This project illustrates our experience that there are a variety of needs that can be easily met, and at nominal cost, if the resource is available to help brainstorm the concept for a device and then construct it. It has also been observed that the presence of the engineering resource often serves an ad hoc consulting role, without a specific design project emerging. This role also has educational value for the participants. Despite the technical simplicity of such projects, they can make a significant impact on the needs of the handicapped individuals for whom they are intended. Small projects such as this type are only a fraction of any students overall design effort. This example is included because the idea is particularly interesting.

TECHNICAL DESCRIPTION

As can be seen in the photograph, the technology for this design is exceedingly simple. The blocks were fashioned from 1/4" thick wood. They are 1 1/4" tall and 3/4" wide. What should be the upper left hand corner is notched to identify proper positioning. Six holes are drilled in each block to accommodate markers. The holes are 1/4" apart in the vertical and horizontal directions. The markers are blunt pins with a spherical head that were found at a craft store.

The jig consists of 1 1/2" x 3 1/2" x 14" wood stock with a 1/4" deep by 1 3/8" x 12" groove milled in the top. The nap side of a Velcro strip is glued to the bottom of this groove and pieces of hook side Velcro are glued to the bottom of each block. The dimensions of the system could be readily altered to match the manual and language skills of the intended user.

Undoubtedly far more exotic systems could be conceived that would meet the objective of allowing for the construction and arrangement of Braille symbols. However the goal of the design as conceived here is not to achieve the most exotic design possible, but to achieve a simple and reliable design that can be easily used. Furthermore the design readily accommodates reproduction elsewhere.