CHAPTER 21

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Exercise Bike

Design Group: R. Moon, K. Adkins, M. Clem, G. Ghewzawi
Disabled Coordinator: Dee Phillips, Arlington House
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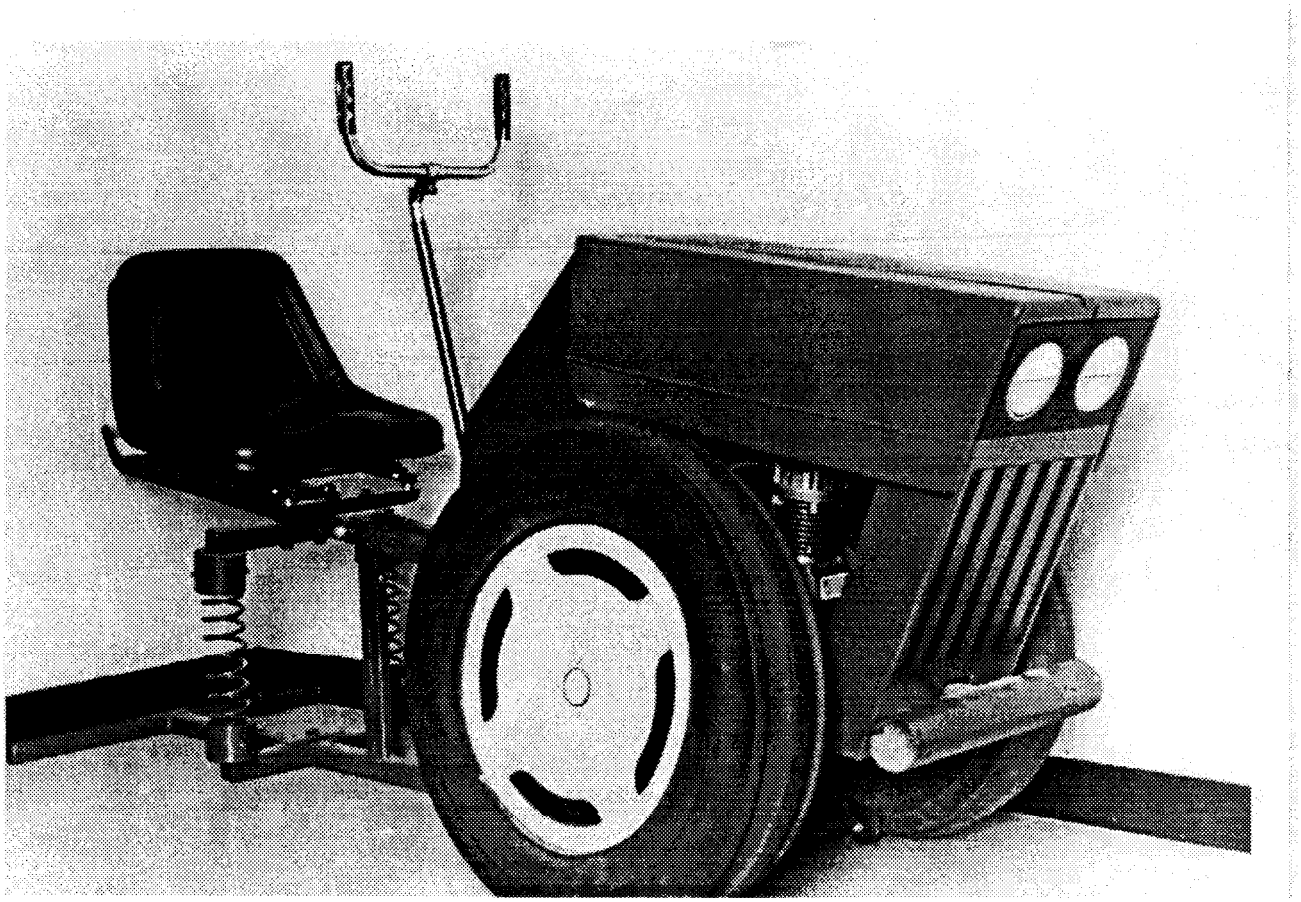
INTRODUCTION

The body of the device is made out of sheet metal to resemble a tractor. The user sits in the seat, an actual tractor seat, and pedals the bike. The pedalling motion activates an air pump that pressurizes the air shocks. When the air shocks fill with air the front of the bike lifts. The hand lever controls the rocking motion of the bike. By moving the lever to the left, the left shock decompresses and when moved to the right, the right shock decompresses. If the lever is moved forward both shocks release air allowing the front of the bike to tip forward.

SUMMARY OF IMPACT

The Exercise Bike was designed for a person with Down's Syndrome. This person is characterized as being hyperactive and finds enjoyment in motions such as rocking and bouncing.

The movement of the hand lever allows the user to experience a rocking motion. In order for the user to maintain air in the shocks he must continue pedalling, therefore, he is also receiving a workout.

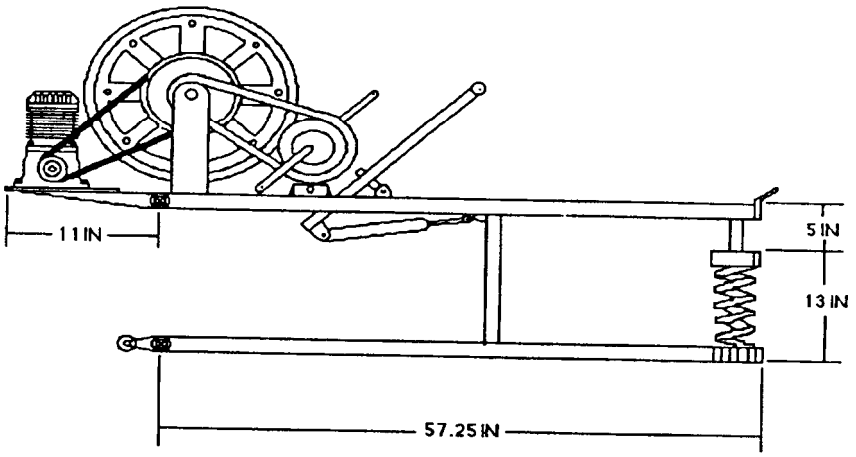


TECHNICAL DESCRIPTION

The "exercise bicycle" measures approximately 68 inches long, 28 inches wide, and 30 inches tall. This device deviates from the standard exercise bicycle in both appearance and operation. The outward appearance of the device is similar to a tractor. The standard bicycle pedals are geared up to run a small air compressor that in turn pressurizes two "auto" type air shocks, raising and lowering the front of the bicycle in response to input provided by the operator via a joystick control. The first stage of gearing consists of an Bin. bicycle crank/sprocket, chain, and a 3in. sprocket. The second stage is a combination of a 9.25in. motor sheave , belt, and a 4.67in. motor sheave. This powers the 1/4hp air compressor. The bike frame is supported by a pivot point, a front linkage assembly and a set of suspension springs. The front of the frame is supported by the linkage. The linkage is backed up with two air shocks that provide lift for the system. The rear is supported with a coil suspension spring set. This supports the rear while adding a bouncing/teetering effect. A universal pivot joint, fixed to a rigid support, is located near the center of the frame. This reduces the side loads to the shocks while still allowing the bike to pivot. The steering system is operated by a steering joy stick. The joy stick will turn left and right, and move front and back. The joy stick, when turned, activates pressurr relief valves that exhaust the pressure from the designated shock, which in turn, causes the shock to drop.

Critical to the operation of the device and originally overlooked by the design team, was the inclusion of a flywheel in the gear train. Initial test of the device without the flywheel proved that the device was nearly impossible to operate because of the force necessary to overcome the compression stroke of the compressor. Utilizing the fact that the time dependent force required at the compressor is a positive half sinusoid with the magnitude equal to the pressure times the area of the piston, the equations necessary to determine the input force were established. By plotting the force requirements through a full compressor cycle as a function of time, the maximum input force requirements were determined. A spreadsheet was set up that allowed for different mass moments of inertia to be used. From this data, the proper flywheel size was determined and incorporated into the design. The flywheel assembly should be a fly wheel of approximately 19" in diameter and a weight of 35 lbs. A 3" sprocket, and a 10" V pulley should be fixed onto a bearing axle with the flywheel. The bearing assembly should allow the flywheel to "free spin" independently of the sprocket so that a person may stop pedaling safely even though the flywheel may still be spinning. This can be achieved by using a single speed bicycle rear axle/hub assembly with pedal brake. The bike hub must be inserted in the center of the flywheel.

The "exercise bicycle" cost $402.55 to build and should provide the client with years of enjoyment in addition to providing him with an outlet for excess energy.



Shape To Voice

Design Group: E. Harker, L. Effendi
Disabled Coordinator: Dee Phillips, Arlington House
Supervising Professor: Dr. *Ed McMahon*
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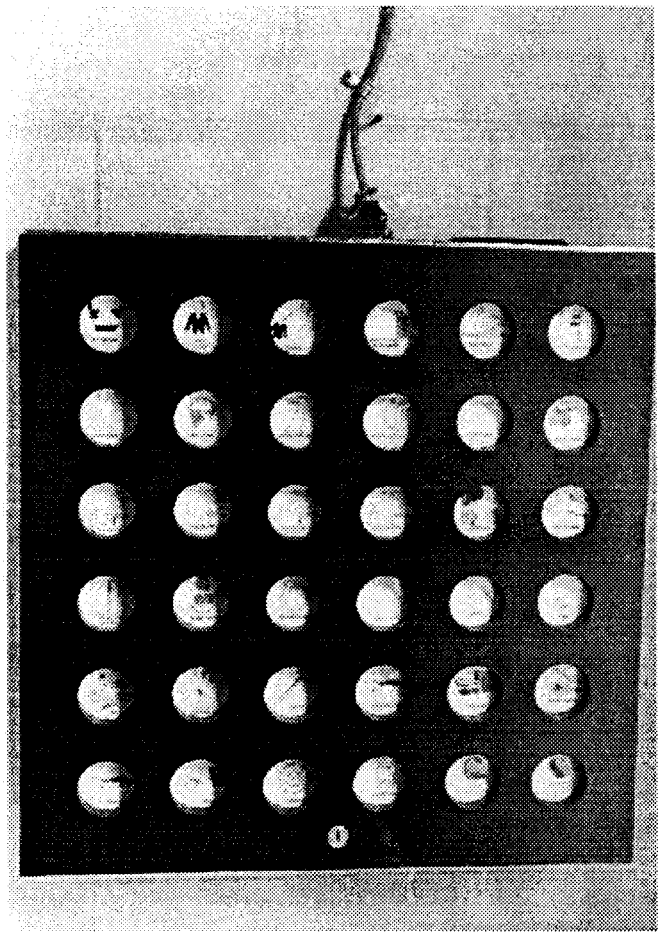
INTRODUCTION

There are two keyboards, each made out of 2' wide by 2' long by 6" high birch cabinets. A lid with 36 holes, 2 1/2" in diameter, cover the buttons that are connected to the switches. Overlays with pictures of certain needs are placed under the lid on top of the 2 1/4" buttons. This allows the overlays to be changed easily. When a button is pressed a voice response is heard describing the need pictured. There are eight overlays per keyboard and the commands for each overlay are programmed in the device.



SUMMARY OF IMPACT

The "Shape to Voice" device is a keyboard to help a certain individual communicate with others. This person is non - verbal and has a hard time communicating her needs.

The determining factor that two keyboards would be constructed is by the location intended for most need in communication skills. The two desired locations were the eating area (Dining room) and the hall area (Bathroom). These locations are where the most inner action takes place between supervisor and resident. At the time of delivery, the device was programmed for 288 phrases with the corresponding key overlays. There is the capacity to expand the phrase library of the device to a maximum of 500 phrases. This device provides the non speaking client with verbal communication via a synthesized voice activated by choosing a picture that corresponds to the desired command.

The user can communicate her needs to others by pressing the appropriate button. These needs will range from wanting a drink of water to getting dressed to brushing teeth.

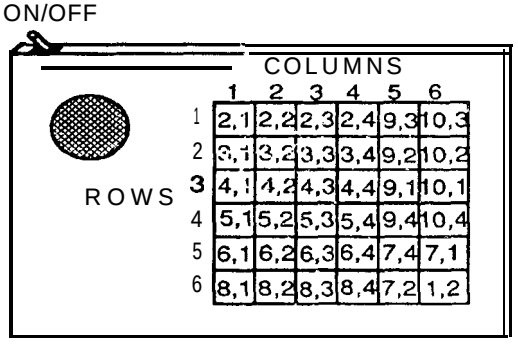
TECHNICAL DESCRIPTION

The "Shape to Voice" device consists of two twenty-three inch by twenty-four inch remote keypad stations connected to a central processing device. The central processing device is a preprogrammed unit sold under product name of "WOLF" by Texas Instruments. The desired phrases for the WOLF device were determined with the help of the residence staff.

The WOLF consisted of a matrix keypad of 6x6 squares each with its own programmed desired function, word, or sentence. The WOLF could be programmed with up to 500 words in 36 pages of memory that are nonvolatile. The link between the two keyboards and memory was through an address decoder and a PIA chip. The keypad lines are tied into fourteen lines via the PIA chip. From there it is decoded through its address decoder and fetched from memory. It is then transferred to a Voltrax voice synthesizer, amplified through a two stage inverting amp and transmitted through an eight ohm, three inch speaker. The two fabricated keyboards were linked in parallel to the PIA chip. From there the original matrix could be duplicated on a larger scale with fourteen lines as the master control lines. At this point the operation of the two fabricated keyboards would be by single pole single throw normally open momentary switches. This means that there will be seventy-two lines tied into fourteen master control lines per fabricated keyboard. The link between the fourteen lines per keyboard of the two fabricated keyboards and the fourteen lines of the WOLF product will be through a twenty-five conductor shielded cable with male and female twenty-five position D-Subs, one on each end of the cable. The maximum length from the WOLF device at which we would operate one fabricated keyboard was under one hundred feet. The test devised was to build a prototype fabricated keyboard and stretch a shielded cable one hundred feet long between the WOLF and the prototype keyboard. The test was satisfactory where no response was lost and timing between the two devices was not a factor, since it is less than a second for a reaction. This proved that switch debouncing was not a factor in the design analysis for up to one hundred feet.

Some other factors were to provide sound at each fabricated keyboard and if time permitted a separate on/off switch for activation. The adaptation of two speakers would be wired in parallel to the speaker jack with matching impedance so that the same output level would be attained at each fabricated keyboard. The impedance used by the WOLF was eight ohms so if two keyboards were made two sixteen ohm speakers would have to be wired in parallel to the speaker jack to transmit the same output level the WOLF operates at. Another alternative would be to provide a two stage inverting amp between each fabricated keyboard with the original eight ohm speakers used by the WOLF product. The decision was to use two sixteen ohm speakers.

The costs of the "Shape to Voice" device came to $684.44 including the cost of the WOLF product.



Matching Puzzle

Design Group: Bassem Rustom , Issam Sbinati
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INTRODUCTION

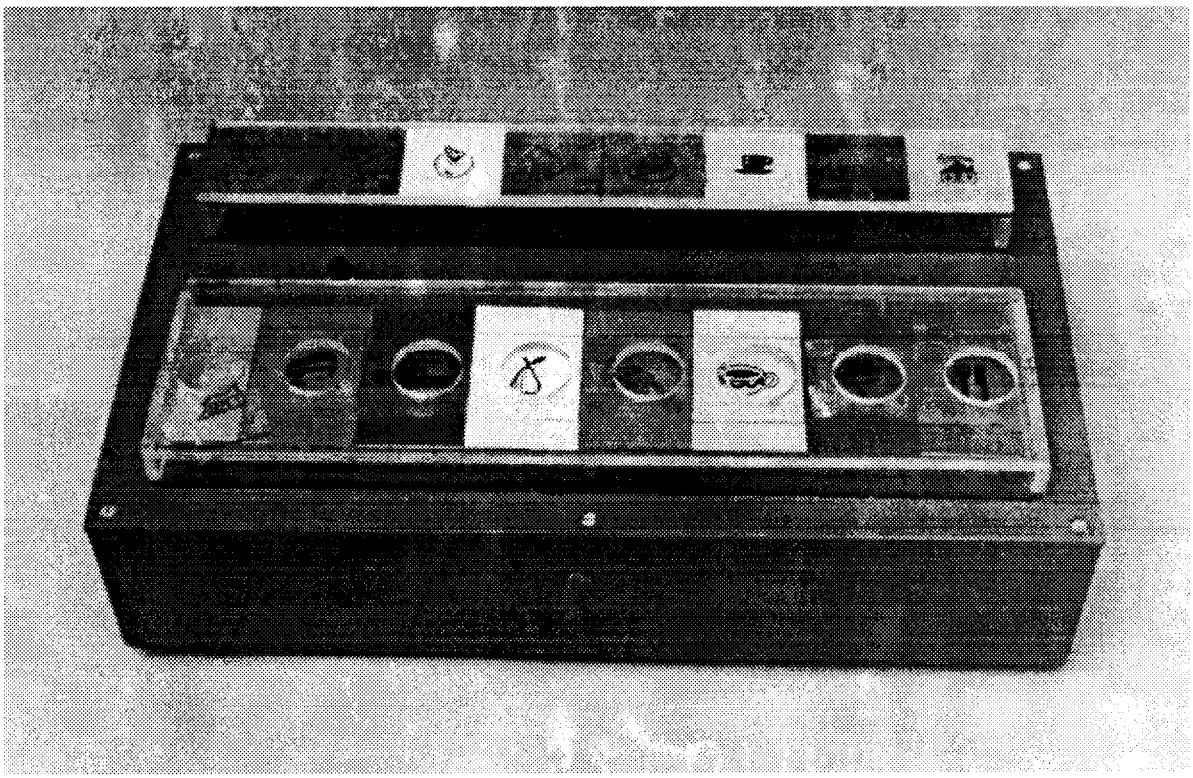
This design consists of a rectangular box that has a top row of lights and a bottom row of switches. A plate is placed above the switches with a transparency above it but under Plexiglass. The transparency has a picture on it, such as a dog. The buttons have pictures on them that will correspond to transparencies on the lights, such as a bone. When the reset button is pressed on of the lights are activated. The user needs to press the button that has the picture on it that corresponds to the picture on the light. If the right button is pressed the user will be rewarded with music.

The user will accomplish the puzzle if he presses the button that corresponds to the picture that is lighted. Music will begin playing continuously until the reset button is pressed again.

SUMMARY OF IMPACT

The Matching Button Puzzle was designed for an individual who enjoys puzzles. He enjoys being praised when he can accomplish a puzzle. The idea for this puzzle was to reward the client for matching either a picture or a color. When the reset button is pushed a picture/color is randomly selected. When the client pushes the button corresponding to the picture/color music begins to play and plays until the reset button is hit again.

This skill may be beyond the client's ability at this time. Others in the group home where the puzzle is located are more able to operate the puzzle.



TECHNICAL DESCRIPTION

The size of the housing is 18 x 10 x 3.5 inches . The idea for having two plates on the top part of the box was eliminated. Off-the-shelf switches were used instead of providing a switching mechanism of our own. The switches and LEDs were mounted directly on the surface plate. A rectangular box of Plexiglass was inserted vertically through two open channels in the upper plate to cover the lights. On top of this transparent box, different colors and transparencies were attached.

Rectangular pieces of hard plastic with different colors were glued on each switch to increase the surface of the switch. Underneath each piece and around each switch foam was installed to prevent the plastic from breaking when not pushed in the middle. These plastic pieces and foam were covered by a rectangular box of Plexiglass inserted in the same manner trough open channels in the upper plate of the box with a lower height than the one covering the lights. The top plate of the box has six screws that screw on the body of the box to allow access to the circuit and batteries. Holes were drilled in the side of the box to allow the sound of the speaker to get through.

This circuit for the sequencing of the buttons is shown below. The circuit produces an output of 3.5 volts when the matching switch is pressed. A low cost music chip like the type used in greeting cards was used for the musical reward. The music chip used requires a DC supply of 1.5 volts. A voltage divider using two resistors was used. The output of the music chip was found to be 0.15 volts. An audio amplifier circuit was designed using a LM386 audio amplifier with a gain of 20. The amplifier output drives an 8 Ohm speaker that is to be installed to the side of the box. Four type "C" batteries were used to supply 6 volts to the circuitry. These batteries are located inside the box, next to the circuit board. The cost for the materials to build the matching puzzle was $261.32.

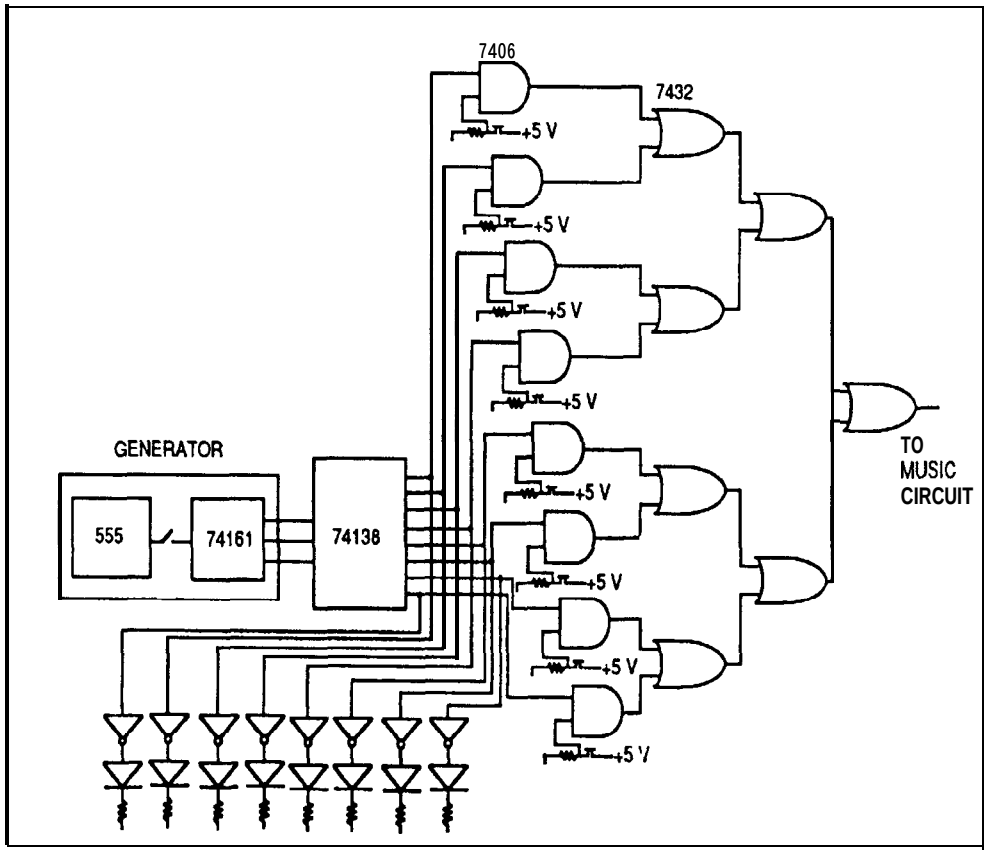


Fig. 1. Schematic Circuit for the color matching puzzle.

Indestructible Radio

Design Group: Rob Theiman, David Lively
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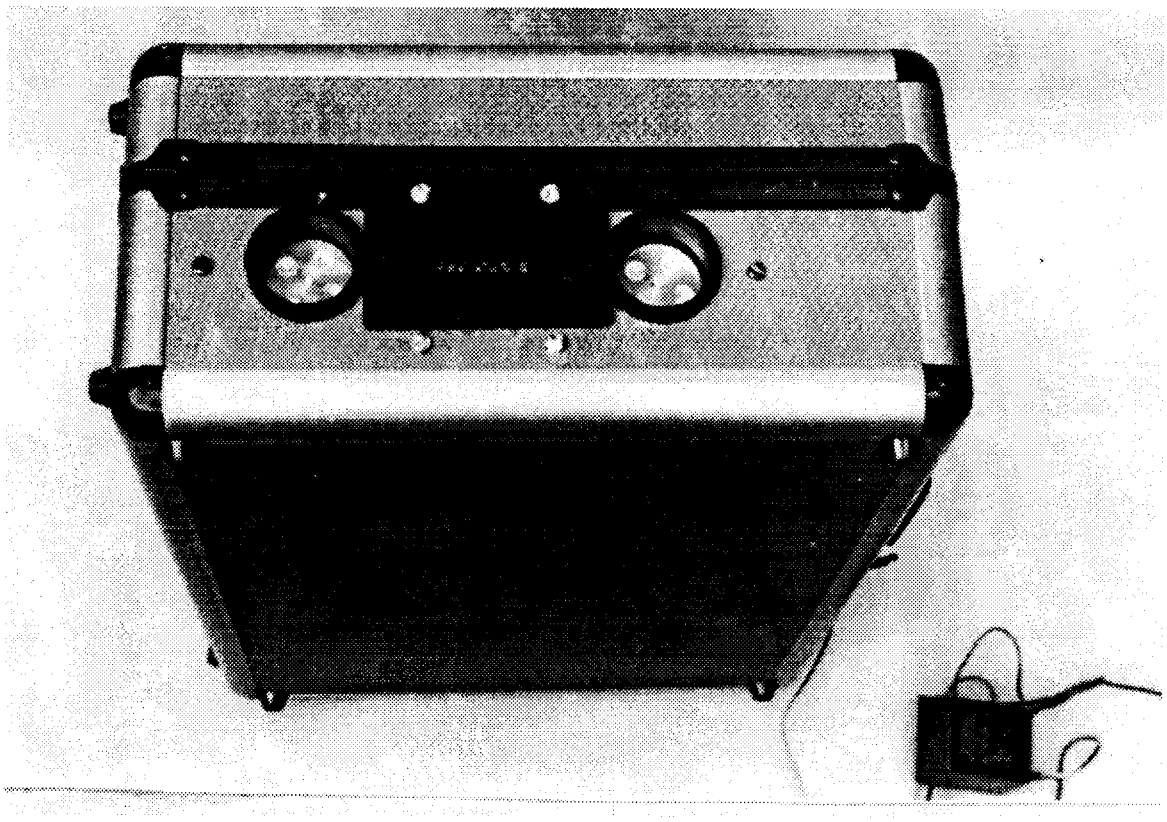
INTRODUCTION

The radio is an off the shelf model (#12-1928) bought at Radio Shack. It was placed in a Solidex Camcorder Case with the radio facing the left side of the case. Batteries are placed inside the case on the right side to balance it. Foam was placed inside around the batteries and radio to help absorb any shocks. Speakers are rigidly fixed to the top of the case where small holes have been drilled to allow the sound to escape. Looking at the left side of the case from the outside, a window the same size as the radio face has been cut. The radio face is recessed into the box so that the user can see and touch it but cannot pull it out or destroy it. Two circular holes, which will be the volume control on the left and the tuning control on the right of the radio face, have also been cut through the case. The knobs are also recessed and are flat with indentions. These indentions enable the user to place his finger on one and turn the flat surface of the knob. The recessed radio in the encasing should increase its lifespan by keeping the actual radio out of the hands of those that may accidently destroy it but still allow them to enjoy the playing the music they like.

SUMMARY OF IMPACT

The "Indestructible Radio" was designed for the use by a person who enjoys listening to music, especially on his own radio. The tape players that this person has owned in the past do not have a very long lifetime. The other members in the residence that tend to destroy them by breaking the doors.

This device is one of the most popular devices in the residence. It is portable and durable and therefore can be taken on trips. The device is enjoyed by all fourteen of the residents in the group home.



TECHNICAL DESCRIPTION

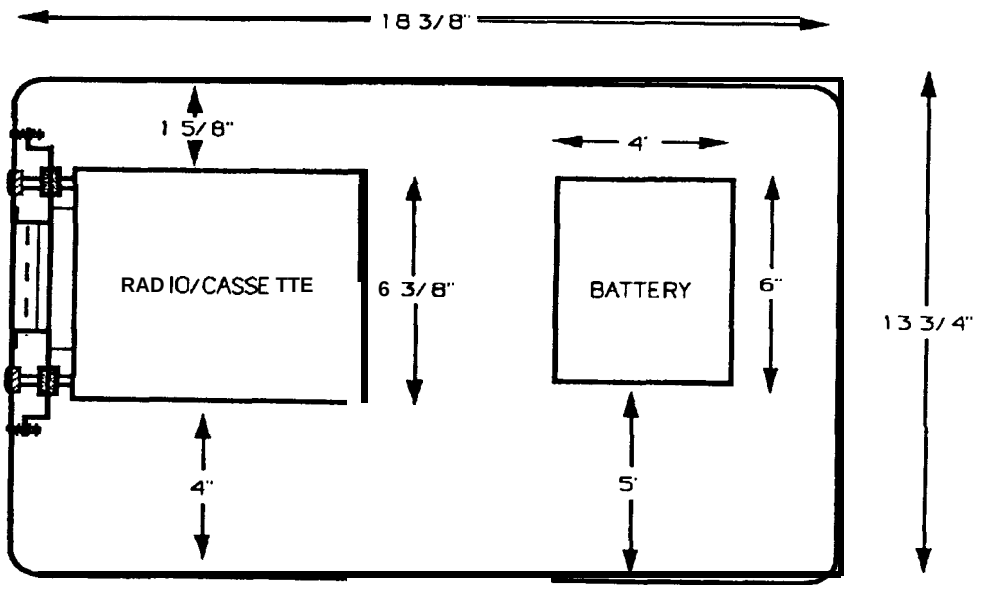
The components of the "Indestructible Radio" are housed within a protective case measuring 13 3/8 inches tall, 18 5/8 inches long, and 7 inches deep. The control panel for the radio and the tape access slot are located on one end of the protective case. To prevent unauthorized entry into the protective case, thus exposing the vulnerable components of the radio, a locking mechanism was included. An AC adapter plug is also located on the outside of the case for periodic recharging of the batteries.

Because of the aggressive behavior of several of the clients, it is critical that the radio be able to withstand shock brought on by impact with foreign objects (i.e. being slammed into a wall). Because few commercially available radios could withstand such an impact, the protective case and urethane foam were employed to isolate the radio from destructive impacts.

To aid in the selection of the foam, an accelerometer connected to an oscilloscope was employed to measure the amplitude of the wave brought on by dropping a test radio, covered with different types of foam, from a predetermined height. The foam with the lowest wave amplitude was chosen for use in the protective case.

To further isolate the radio from impact, the radio chassis is spring-mounted within case. Non-linear springs are used to isolate the front of the radio from the case. The use of non-linear springs was necessary because the force of impact that the case may be subjected to is unknown.

The "Indestructible Radio" cost $324.22 to build. Because of the measures taken to protect the radio/tape player, the unit should provide the client with many hours of listening pleasure and dramatically reduce the need for continual replacements.



Mobility Device

Design Group: M. Mahmoudieh, N. Wallace, M. Knauss
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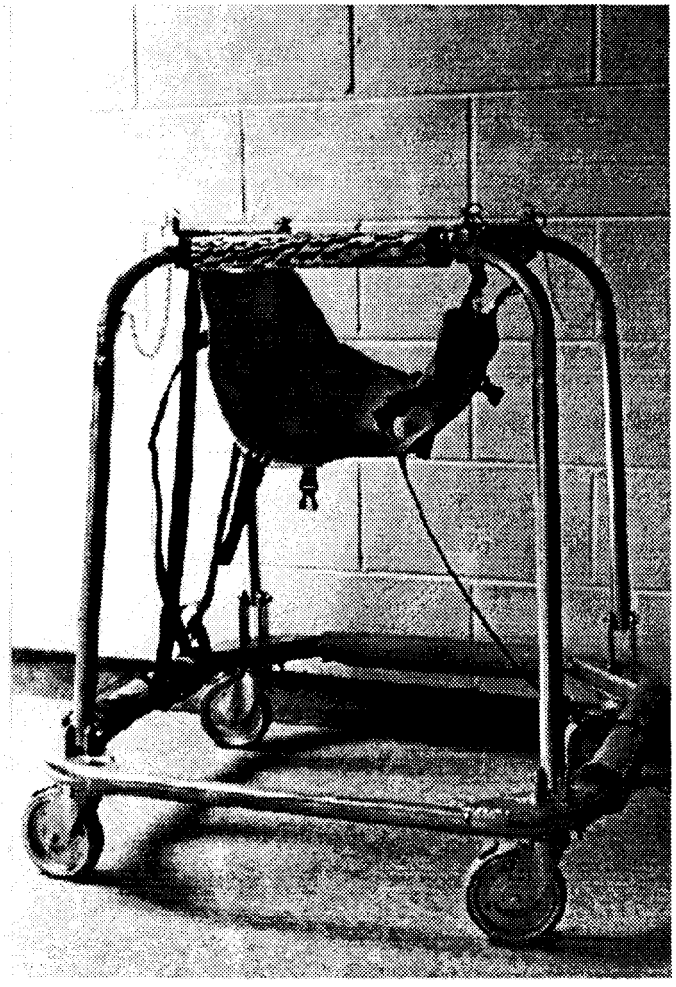
INTRODUCTION

This device is similar to a baby walker that is used to support the young children to give them the necessary balance for walking. The dimensions and the materials used in the device was picked carefully to ensure the safety of the user and the people who are in contact with the user. The mobility device can be used in all the places with standard doorways and floor surfaces similar to those that are used with a wheelchair.

The top bar on the back side of the frame can be removed for easy entrance and exit. A cloth padded seat is strapped to the frame and the user is strapped into the seat. The seat can be moved in the vertical direction to be adjusted for the height of the user. There is a wheel at each corner of the device that can be locked when the user enters and exits the device. The device also can be folded to provide an easy transportation.



SUMMARY OF IMPACT

The "Mobility Device" was designed to assist a person with stability problems in walking and standing. The person it is designed for does not have the strength or the balance to walk unassisted.

The significant advantage of this device over a wheel chair or other commercially available device is that it allows the client to fully utilize (exercise) his lower extremities and to take advantage of equipment designed for everyday use (such as the sinks, mirrors, etc.).

TECHNICAL DESCRIPTION

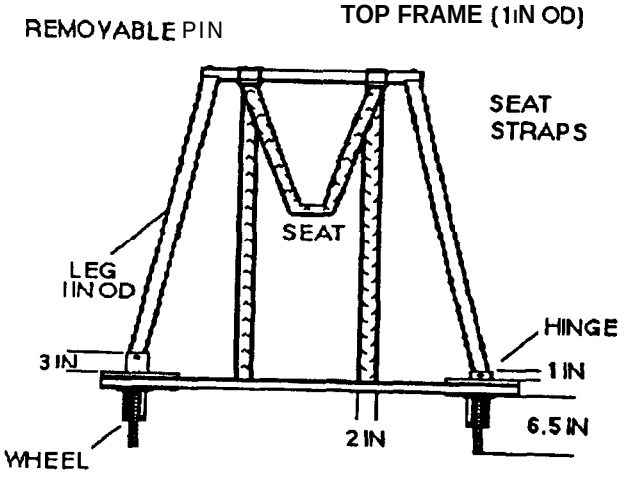
The dimensions of the base of the "Mobility Device" were limited to thirty-one inches square to allow the device to fit through standard doorways. To keep the cent& of gravity of the device and occupant as low as possible, the height was set at thirty-six inches.

Finite element analysis was utilized to evaluate the merits of various construction materials (square and round aluminum tubing, steel, etc.). It was determined that one inch, thin wall, galvanized steel tubing would be adequate for the frame members and didn't require exotic joint welding methods. Black steel pipe (3/4 inch ID) was used for the corners of the frame for rigidity and ease of bending. The bending was done using a hydraulic pipe bender. The ends of the black pipe in each comer were inserted to the ends of the steel conduit and welded. Eight steel plates (1/8 inch thickness) were welded on the top and bottom parts of each comer. The hinges for the legs of the top frame were welded on top plates and the wheels were connected by pins to the bottom plates.

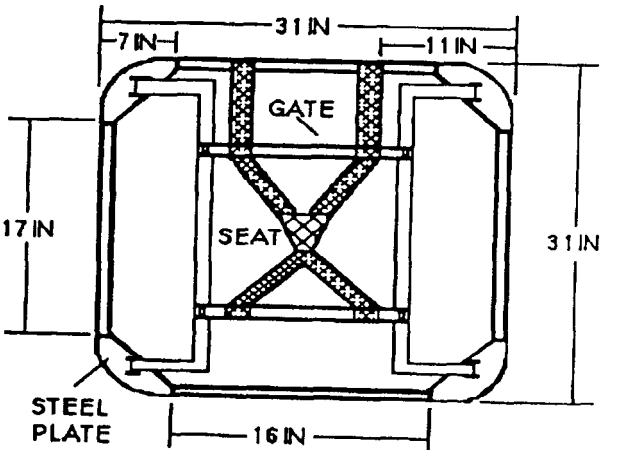
One of the design parameters was that the device must fold up into a compact shape to facilitate the transportation of the device. To accommodate this parameter and allow for ease of entry, it became necessary to have the front and rear (top) frame rails detach from the side rails. With the front and rear rails removed, the sides of the device can be folded down reducing the height of the device to less than ten inches, significantly increasing the device's portability. Pieces of velcro were provided around the bottom frame to secure all the parts after folding the device. To restore most of the torsional rigidity lost by making the front and rear frame rails removable, ball lock pins were used to hold the frame rails in place when the device is in use. The seat was connected to the front and rear rails by using two (2 inches) straps. Seat belts are provided for the user and a strap is connecting the seat to the bottom frame in order to keep the occupant from obtaining a full upright position, reducing the possibility of tipping over due to a high center of gravity. This is due to the fact that his weight can increase the stability of the device. The length of the straps is adjustable to change the height of the seat.

To reduce maintenance and increase the aesthetic appeal of the device, the entire frame was chrome plated. Padding was added to the top and bottom frames for comfort.

The "Mobility Device" cost $94.27 to build and with proper maintenance should serve the client for years to come.



FRONT VIEW OF THE MOBILITY DEVICE



TOP VIEW OF THE MOBILITY DEVICE

Textured Keyboard

Design Group: M. Gurr, D. Oliver, S. Markham
Disabled Coordinator: Dee Phillips, Arlington House
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INTRODUCTION

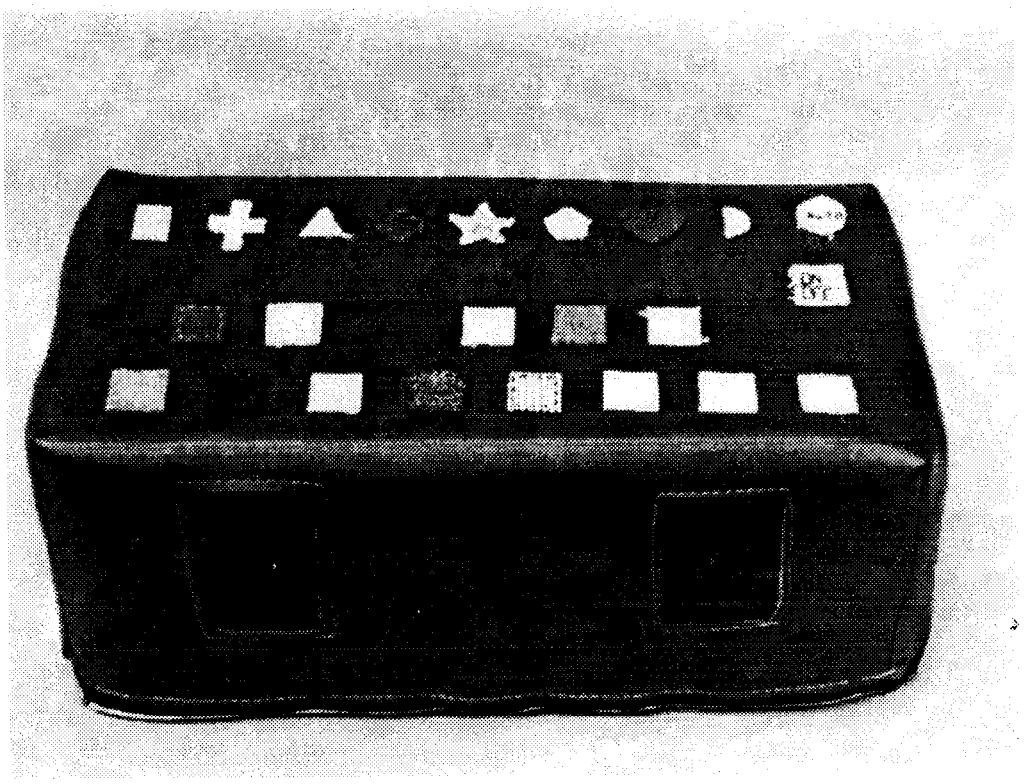
Two keyboards, similar to the musical Casio keyboard, are placed inside a toolbox that is enclosed by a removeable vinyl cover. Switches are attached to the top of the box in three rows. There is a on/off switch to the right on the top of the box. Each switch on the top row plays a different tune. The middle row of switches relates to the black keys on the keyboard while the bottom row of switches relates to the white keys. Different textures are sewn to the vinyl above each switch and two speakers have been drilled through the front of the box. The batteries are placed in the bottom and are easily replaced.

SUMMARY OF IMPACT

The Textured Keyboard is a musical keyboard specifically designed for a blind person. This person does not communicate with others and tends to get frustrated easily. He does, however, enjoy music. The different textures will allow the user to associate a certain sound to the switch being pushed. The user can hear and play the sounds. The soft case allows him to rest his head against the keyboard.

TECHNICAL DESCRIPTION

The "Textured Keyboard" components are housed in a box measuring 173/4 inches long, 7 inches wide, and 7 5/8 inches tall. An off the shelf high impact plastic tool box was used for the casing to house the switches and the electronic keyboards. The top of the tool box has three-eighths of an inch holes drilled in it so that twenty-four switches could be mounted. Wires were then soldered to the switches and the appropriate places on the pc-boards inside the electronic keyboards. The keyboards are then fastened inside the tool box with threaded rod and fasteners.



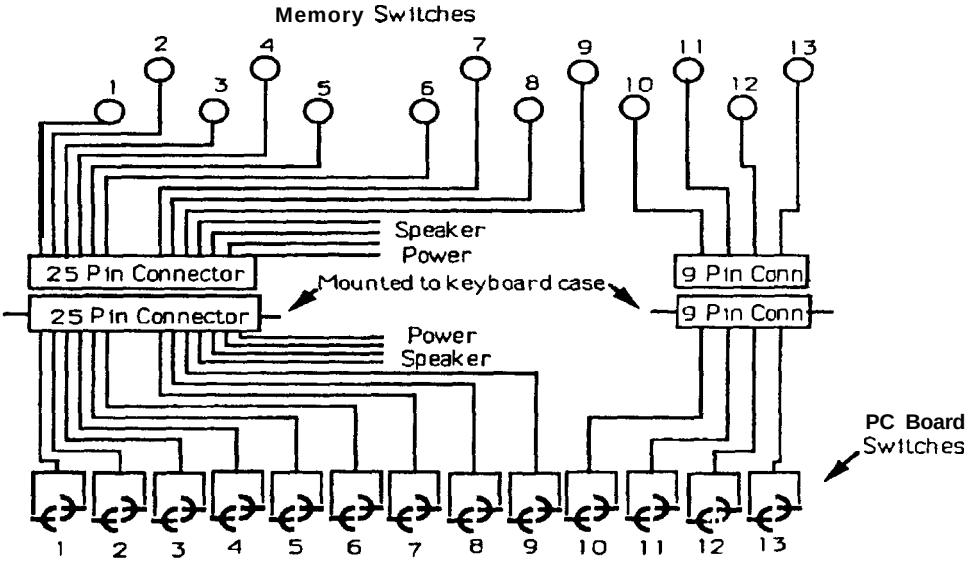
Each of these keyboards has a separate function. One keyboard is used to play back eight pre-programmed songs: Happy Birthday, Twinkle Twinkle Little Star, London Bridge is Falling Down, Mary Had a Little Lamb, Jingle Bells, Frere Jacque, and Oh Susanna. The other electronic keyboard is used to play notes. One octave of the electronic keyboard is connected to thirteen switches of the textured keyboard.

The component box is covered with protective vinyl cover. The vinyl used to make this case is similar to the grade used to make school bus seats because of its durability. There are two holes in the front of the case to allow sound to escape from the speakers that are mounted in the front of the tool box. The textures and shapes were sewn on to the top of the case directly above the switches. As an example, a star was sewn directly above the switch that when pressed would play Twinkle Twinkle Little Star. The case has a heavy duty zipper that will allow access to the tool box to change batteries or perform other maintenance actions. The padded vinyl case provides safety, provides a durable surface to mount the textures and shapes.

The connection of the keyboards to the switches located on the top of the device was accomplished by decoding the circuit board of each keyboard and then hard wiring the device switches to the corresponding grid switch in each unit. The wiring of the circuit boards to the external switches was done in two parts by implementing the use of pin connectors mounted in the casing of each of the keyboards. This provides strain relief for the internal connections and minimizes the chance of damaging the keyboards whilst the wiring is being soldered to the external switches by creating a natural division between the keyboards and the momentary switches. The wiring diagram for the pin connectors is shown below.

The operation of the keys is as follows: The first row of keys numbered 1-8 are function keys. When the unit is turned on and the auto key is pressed followed by pressing a function key, a preprogrammed tune will play. The bottom two rows of keys operate similar to an electric piano. The middle 5 keys correspond to the black keys on the piano while the bottom row of keys correspond to the white keys.

The cost of the "Textured Keyboard is $164.02 to build. With proper maintenance the device should provide hours of enjoyment to the client.



Twist On Puzzle

Design Group: Bassem Rustom, I. Sbinati
Disabled Coordinator: Dee Phillips, Arlington House
Supervising Professor: Dr. Ed McMahon
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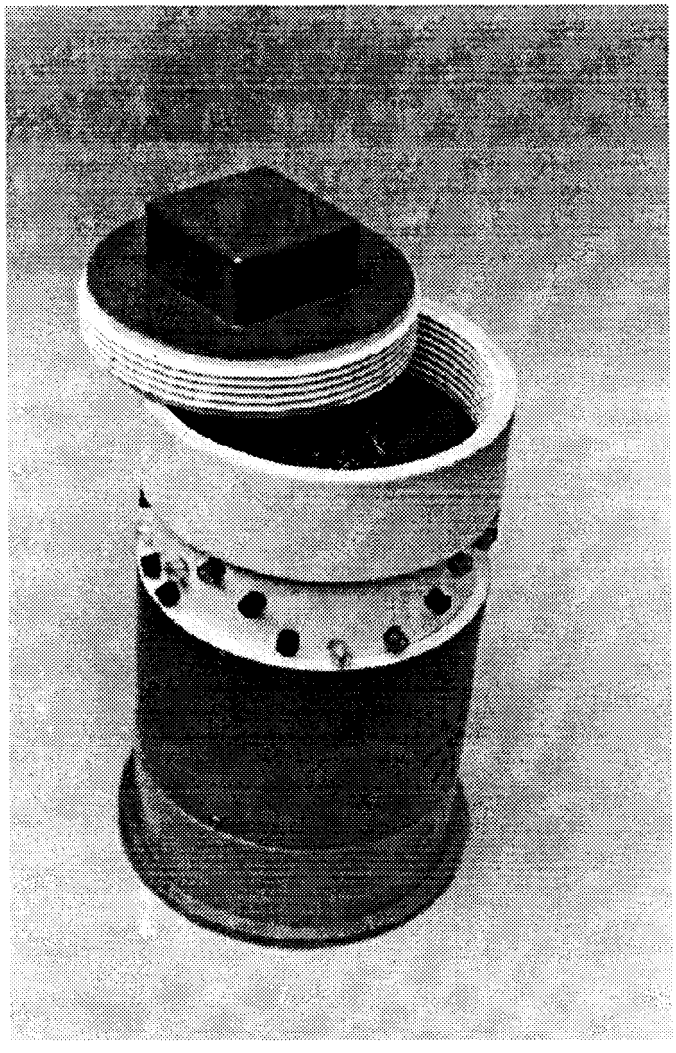
INTRODUCTION

This device consists of a piece of PVC pipe 4" wide by 9.3" high. The electronic circuit and batteries are placed in the bottom of the cylinder. More than halfway up the outside of the cylinder is a section that has been cut away. In this section thirty-two lights are placed all the way around the cylinder. The top is a screw on lid that is attached to the cylinder by a rubber chain. As the top is screwed on music begins to play and the lights illuminate in sequence, sixteen traveling in one direction and sixteen traveling in the other direction. After 20 seconds the music stops but the lights continue to light up. When the top is unscrewed the lights stop.



SUMMARY OF IMPACT

The "Twist On Puzzle" was designed for an individual who enjoys puzzles , however, has a hard time building even what some would consider simple puzzles. There was also a desire to improve the individuals motor skills in performing simple tasks. Preliminary tests were conducted to determine if the individual could screw the plug onto the pipe before the final design was selected.
The user needs to do only two things to complete the puzzle. He must screw the lid on to activate the music and lights and unscrew the lid to stop the music and lights.

The individual can complete the puzzle and gets much satisfaction out of the lights and the music.

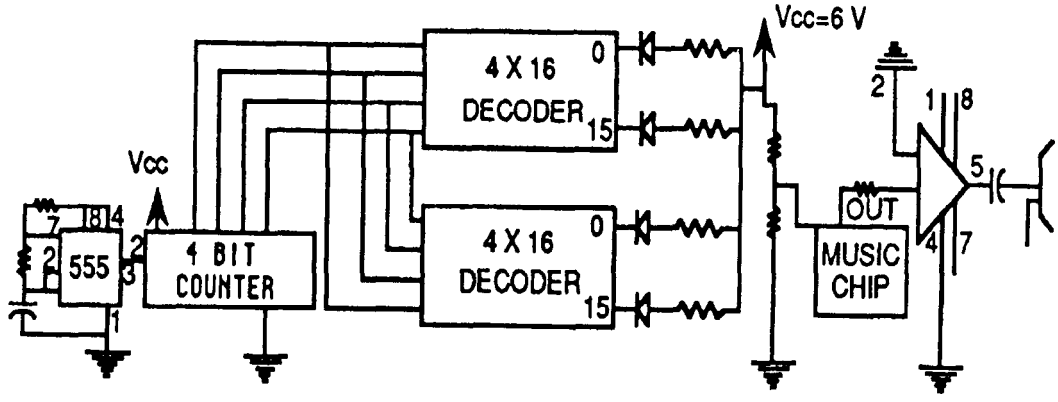
TECHNICAL DESCRIPTION

The components of the "screw-on puzzle" are contained within a PVC housing measuring four inches by nine and a half inches overall. The circuitry consists of 4 IC chips, 7 resistors, and a capacitor. The IC555 timer is designed to work in the synchronous mode as a pulse generator. The value of R1, R2, and C were chosen to develop the desired frequency of 10 Hz.

The clock is driven into a 4-bit synchronous counter. The input to the counter along with the "enable" line were connected to ground in order for the count to go from 0000 to 1111. The "clear pin" set was connected to the power supply (high). The four outputs of this counter drive two 4-16 line decoders. Each decoder provides one output that is "low" and 15 outputs that are "high", corresponding to the count of the counter. The "enable" lines are tied to low.

The LED's are connected to the output of the decoder in a manner that would turn the LED's "on" when the output was "low" (i.e. output less that 0.5 volts). TTL logic allows this connection to be made because the TTL can supply approximately 30mA of current at logic "low". All outputs are connected to the LED's via one resistor because the LED's will be an open circuit when not conducting, "off". 32 LEDs of different colors (red, green, orange, and yellow) were soldered to two different ribbon cables. Each cable was connected to 16 lights and goes in a 34 pin header on the board. All the anodes of the LEDs were tied together by wire wrapping and soldering, and connected to one line in the cable that corresponded to a pin tied to Vcc.

The "screw-on puzzle" costs $91.01 to build and with simple maintenance should provide the clients at the residence with years of recreational and educational stimuli.



Basketball Powered Cart

Design Group: C. Fife, J. Holloway, G Mann, T. Wall
Disabled Coordinator: Rhoda Ruffner
Siskin Rehabilitation Center
Supervising Professor: Dr. Ed McMahon
School of Engineering
University of Tennessee at Chattanooga
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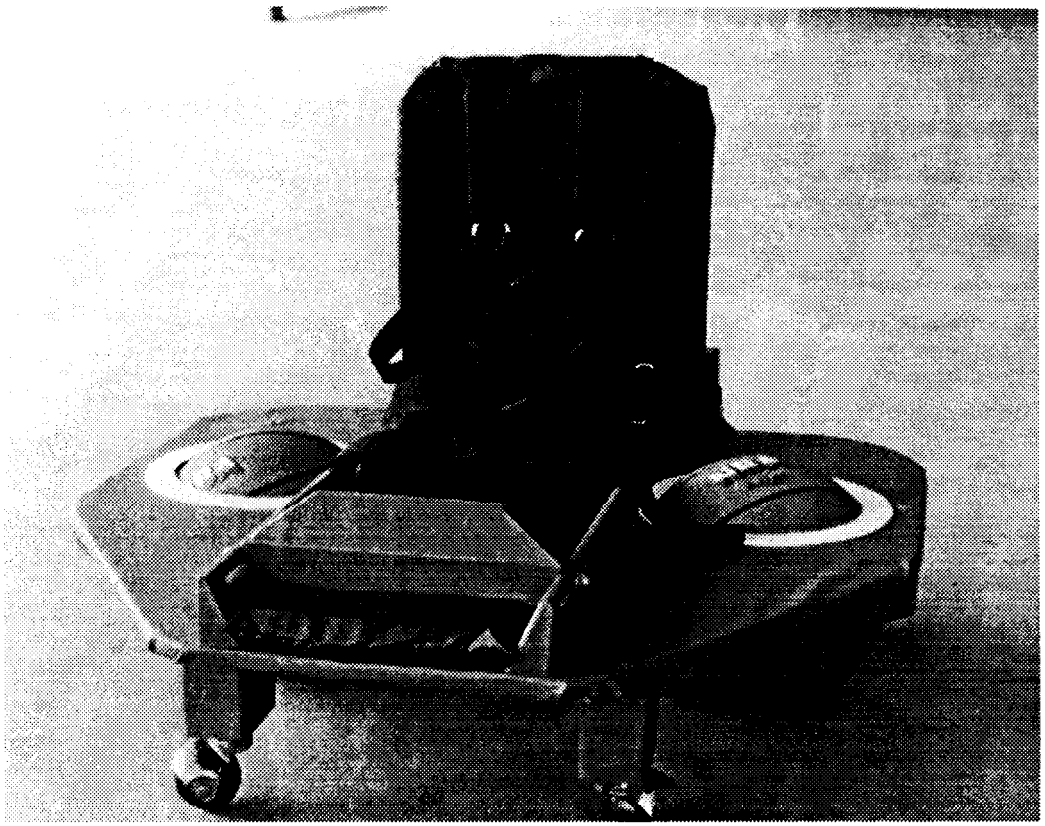
INTRODUCTION

The device is a cart that is low to the floor and "powered" by two basketballs. By pushing in any direction on the basketballs the client can maneuver in a confined space and be near his classmates as they play. He is seated at 90 degrees with his legs extended. An adjustable foot and leg support is provided, including blocks to keep his feet from turning out. The seat is padded with "Pudgee" to provide padding and allow for good blood circulation. The "pudgee" is covered with nylon material. A harness is provided to support his upper body and a strap is provided for his legs. The seat back is adjustable.

SUMMARY OF IMPACT

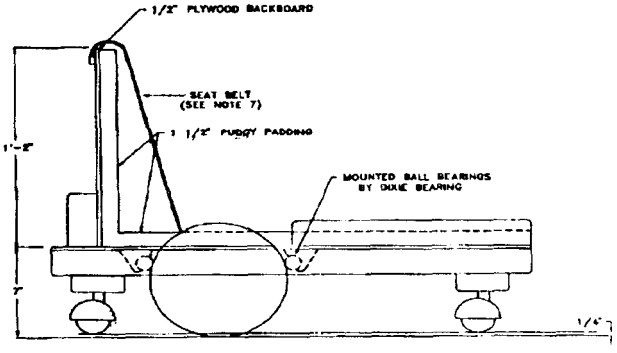
The client is a three year old male with spina bifida. He has some control of his left arm and hand but good strength in his right arm. He has little interaction with his classmates because of the lack of self mobility. His muscle development is very slow and needs to be improved. The therapist wanted a way for the client to exercise his arms (including the left arm) and allow the client to play on the floor with his classmates while maintaining his safety.
He can move around in the device without training. He can be with his peers in the classroom and to use small tables in the classroom that he couldn't access from his wheelchair. He uses both hands to propel himself and therefore benefits from the exercise to his left hand.



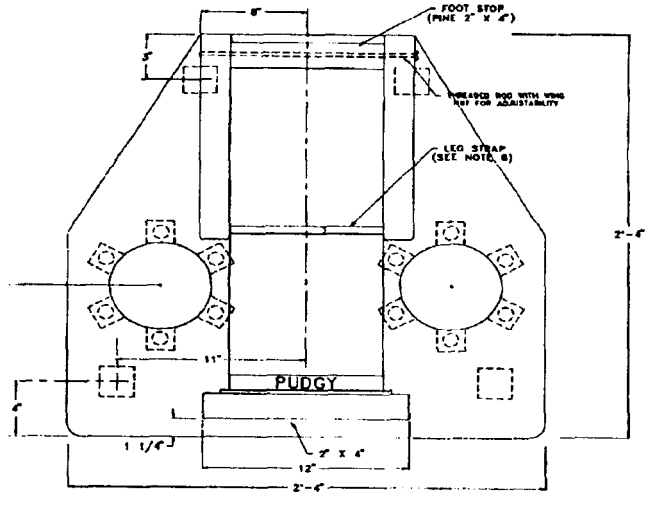
TECHNICAL DESCRIPTION

The major design problem was to design the bearings that would support the weight, and allow the basketballs to be rotated to maneuver the cart. Various bearing designs were considered. Most would require expensive machining. The design selected was to use a combination of single encased bearings and casters to support most of the weight. The details of the design of the bearings and the casters are shown below. The casters were placed slightly higher then the basketballs (about 1/4"). When the client sits on the cart some force is applied to the basketball to ensure enough normal force for the friction drive; after the weight has depressed the basketball slightly the balance of the weight will be borne by the casters.

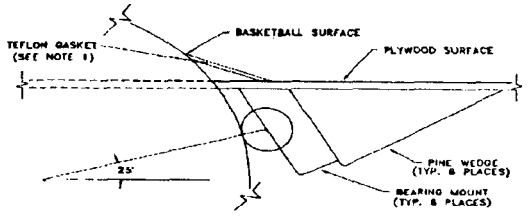
Tests were run to determine the force required to propel the cart and the force that could be applied by the client. The force to propel the cart was 3 pounds while the client was able to supply a force of 8 pounds. The cost of the materials for the device was $318.50.



SIDE VIEW



TOP VIEW



DETAIL: BEARING ASSEMBLY

Handpowered Swing

Design Group: S. Purcell, R. Beutel, D. Brewer, R. Hickey
Disabled Coordinator: Rhoda Ruffner
Siskin Rehabilitation Center
Supervising Professor: Dr. Ed McMahon
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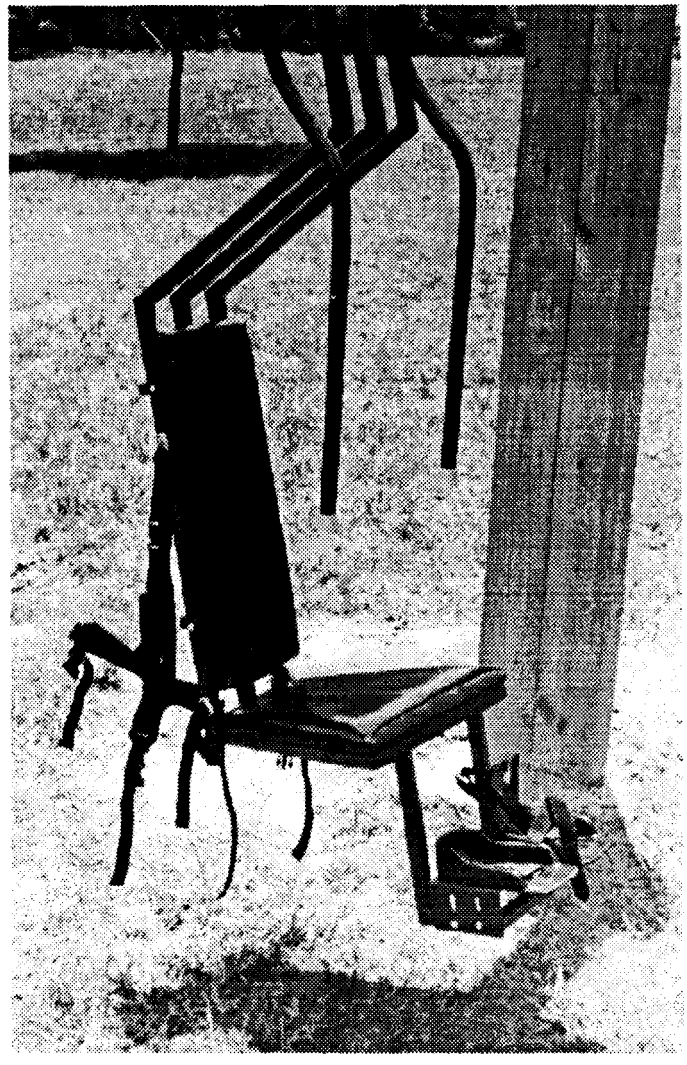
Chattanooga, TN 37403

INTRODUCTION

The client is seven years old His weight is estimated at seventy pounds. He can sit up on his own and can move about some with a wheel chair. However his strength is limited. The project objective was to provide a play activity that also would develop arm strength to improve his ability to operate a wheelchair.

The result was a hand-powered swing similar to the "Exerglide" swing. By pulling and pushing on the hand bars the swing is started and kept in motion; similar to the way a normal swing is kept in motion by use of leg motion. It is difficult to initiate the swing motion without a push as it is on a regular swing by just pumping your feet. Motion is maintained by pulling on the forward motion and pushing on the backward motion.



SUMMARY OF IMPACT

The swing was originally designed to be installed at the school the student attends. Since he was moving to a new school, which did not have a playground yet, the swing was installed at his home.

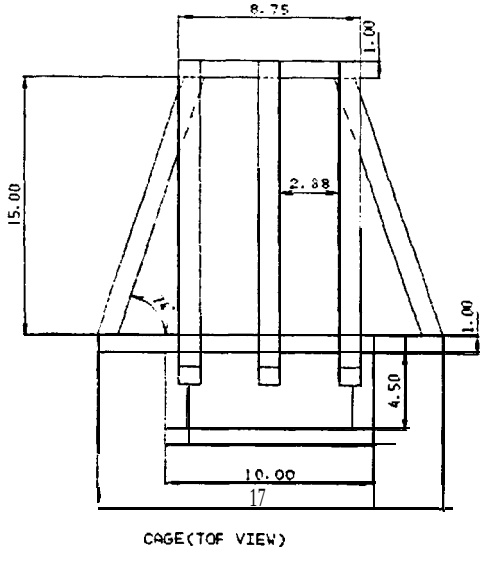
The student is very excited about the swing. At first he had difficulty maintaining and increasing movement of the swing. He would rather be pushed than swing on his own. Through use of the swing and instruction by the designers he has become more adapt at maintaining the motion. He will become stronger through use of the swing and use the strength for other activities such as maneuvering his wheelchair.

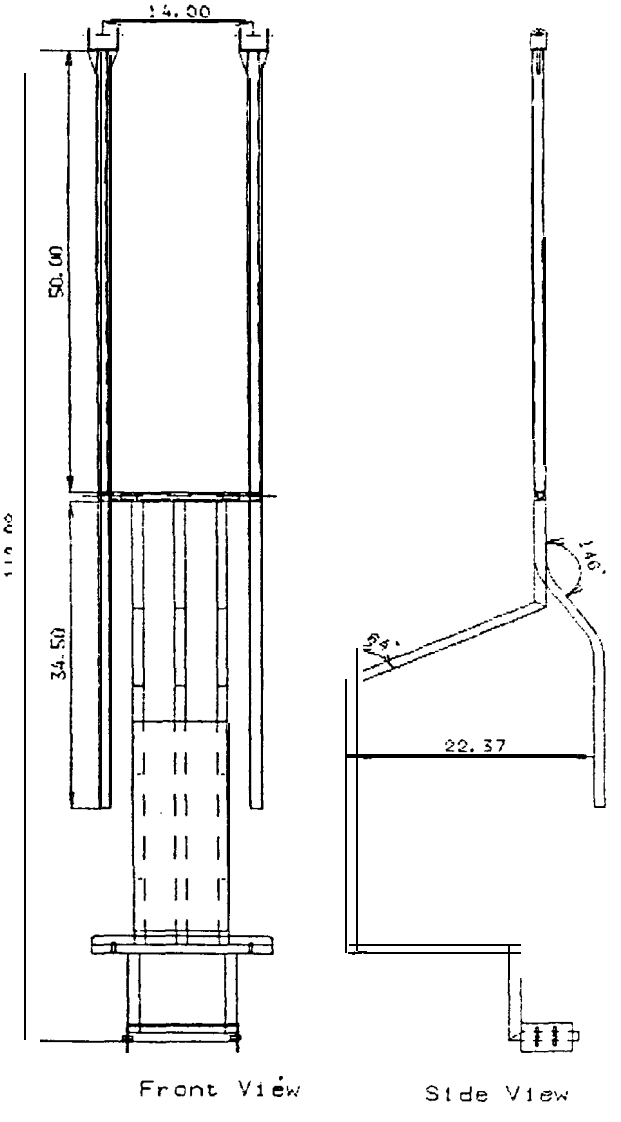
TECHNICAL DESCRIPTION

The three main components of the swing are the swing "cage", the seating, and the swing support. The swing "cage" is shown below. The cage is made of 1x1" 11 gauge (.120" wall) square carbon steel tubing. The swing pivots at two points. The upper pivots are at the points of attachment and provide for the overail swing motion. A second pivot is about half way up the swing and it allows for the client to use his hands to push and pull on the bars, changing his center of gravity and provide the swinging motion. Nylon bushings were provided at the pivot points and grease fittings were provided to ensure smooth motion. The frame was primed and painted to prevent rusting.

It was most important that the design fit the client. Pressure treated plywood was used to construct the seat. The seat was covered with vinyl boat seat material to withstand the elements. To allow for the client to grow adjustments were provided on the seat back. Adjustable foot supports were also provided. Plastic foot supports, similar to those used on his wheelchair, with velcro straps were used to keep his feet in the proper position. A four point harness device was used to provide upper body support.

The swing support structure was made form 4x6" timbers. Two timbers were used for each vertical support and one for the horizontal cross piece. Special brackets were designed and constructed to attach the swing to the cross member. The cost of the swing, including installation was $440.





Wheelchair Switching Device

Design Group: D. Kirkendoll, R. Baker, M. Patrick, J Morgan
Disabled Coordinator: June Phillips, Orange Grove Center
Supervising Professor: Dr. Ed McMahon
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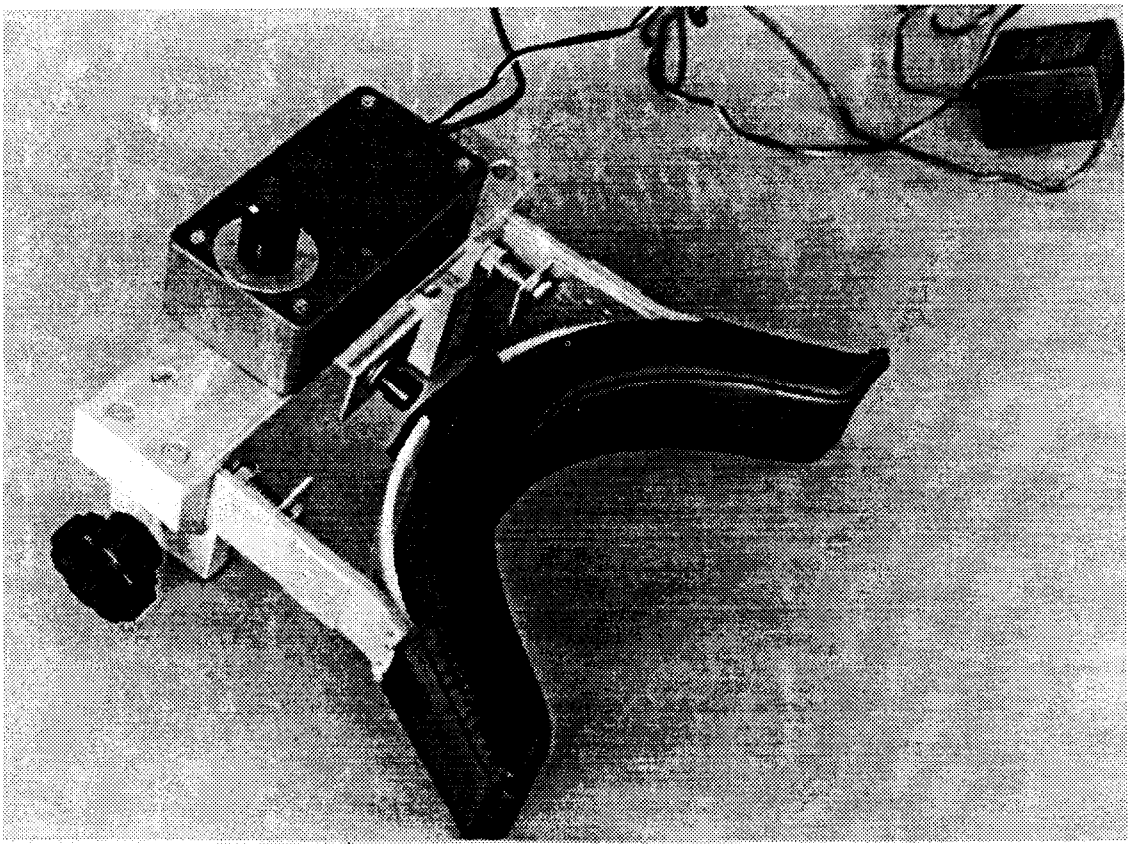
INTRODUCTION

The switching device was designed to utilize a padded head support that was mounted to the back of the wheelchair. The head support spring loaded so that when the head support is pushed a contact switch activates a timing circuit that turns on a radio or tape player for a prescribed time (1- 5 minutes). At the end of the timed period the radio/ tape player will turn off and remain off until the circuit is activated again.

SUMMARY OF IMPACT

The client is a fifteen year old male who suffers from cerebral palsy and is confined to a wheelchair. He is slightly retarded and has poor motor control. The client is responsive verbally and physically and has some control over his head movement. He can raise his head at will but has difficulty keeping his head in an upright position for long periods of time. The client likes to listen to a radio or tape player for both education and recreation. His therapist indicated the need for some type of switching device that he could control with his head that would allow him to turn a radio or tape player on. The secondary function of the switch would be to exercise his neck muscles.

The design performed the desired functions and enabled the client to control the music and provide the exercise for his neck muscles.

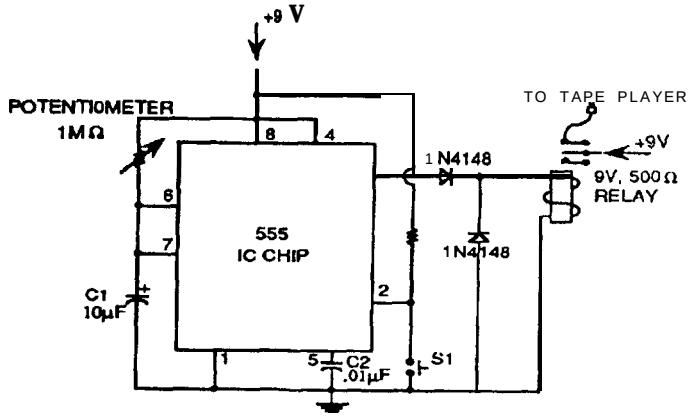


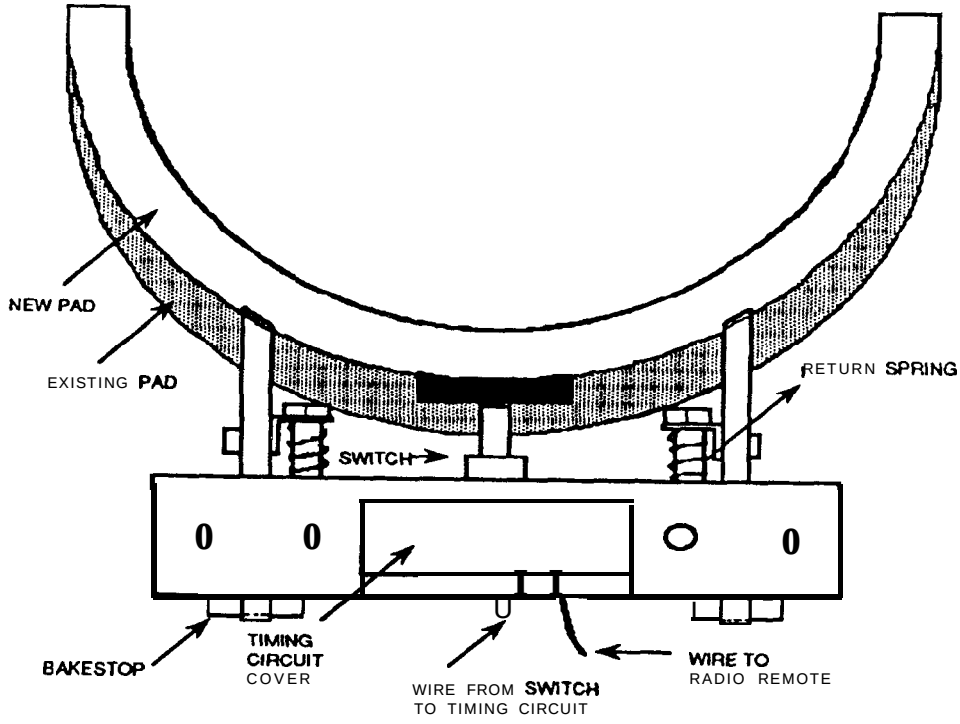
TECHNICAL DESCRIPTION

The head switch is made up of three major parts. The mounting blocks are fastened to the existing headpiece. The mounting blocks are connected by a bar that supports the momentary contact switch and the circuit. The head support to activate the switch is attached to the blocks and is spring loaded to return head support when the head is lowered.

The time delay circuit is shown below. The circuit is controlled by a 555 timer chip. A 1 **mega** ohm variable resistor was used to allow a variable time delay. The 222 **mF** capacitor was selected to achieve a **1-5** minute time delay. The power is supplied with a 9 V AC/DC adaptor and supplied to the radio/ tape player via the **9V** 500 W relay.

The cost of the device was $146.00 not including the head rest, which was donated and cost about $75.00.





Eyeswitch Communication Device

Design Group: S. Hamlin, B. Glaspell, G. Wilson, B. Standifer
Disabled Coordinator: June Phillips
Orange Grove Center
Supervising Professor: Dr. Ed McMahon
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INTRODUCTION

The main function of the eye enhancement device is to display pictures of various activities one at a time to the client. This will allow him to choose his daily activities and learn the important skill of decision making. Another benefit of this function is the improvement of client's eye gaze skills. The performance of this index wheel was based upon the following criteria:

1) The device must be portable and adaptable to the various seating arrangements.
2) The device must allow the therapist and the client to communicate interactively with each other without confusion.
3) The device must be expandable to allow a number of activities to be displayed as the activities of the client will change as he grows and progresses.
4) The device itself must interact with client constructively to improve not only his decision making skills and vocabulary, but also his eye gaze skills.

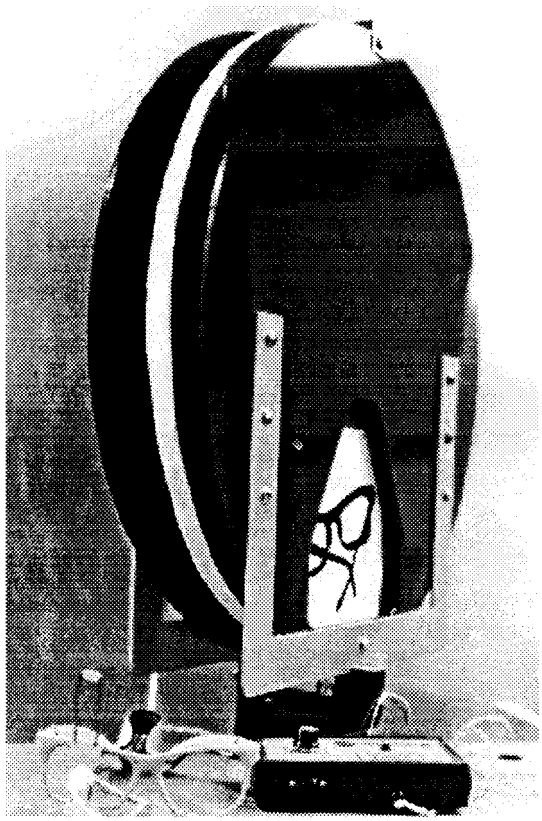
SUMMARY OF IMPACT

The eye enhancement device is made to allow the client to have an active roll in the choosing of his therapeutic activities. This will stimulate and encourage his mental growth. The therapist indicated that for the student to be able to see the pictures that are going to be used clearly, without losing concentration, they must be within a foot of his eyes. She also explained to us that whenever this device would be used, the student would be in his wheelchair.

The student can activate the wheel with an eye blink. The sensitivity needs to be adjusted to distinguish a purposeful blink from a normal blink. The equipment is capable of this and with practice the device should be effective in enabling the student to select activities.

TECHNICAL DESCRIPTION

The mounting stand for the eye enhancement device consists of a C-clamp, 1 inch PVC pipe, and two mounting brackets. The C-clamp is approximately three inches long and will attach directly to clients activity tray. The PVC stand is affixed to the C-clamp and is constructed out of 1 inch PVC pipe. A coupling secured with a locking pin is attached to the viewing side of the stand. This coupling is situated so that the viewing shield and mounting bracket can simply be detached by the therapist, by removing the locking pin, thus accessing the picture wheel. The mounting brackets simply provide a



method of attachment between the PVC and the outer covers of the enhancement device. These brackets are constructed of 1/8 inch thick aluminum and are designed to extend into the PVC pipe approximately two inches. The brackets are then mounted to the PVC and the outer covers by sixteen 1/4 inch machine bolts. The mounting stand is primarily designed to provide a method of attachment and stability for the eye enhancement device. Secondly, the mounting stand functions to provide quick and easy access to the picture wheel.

Motor Actuation

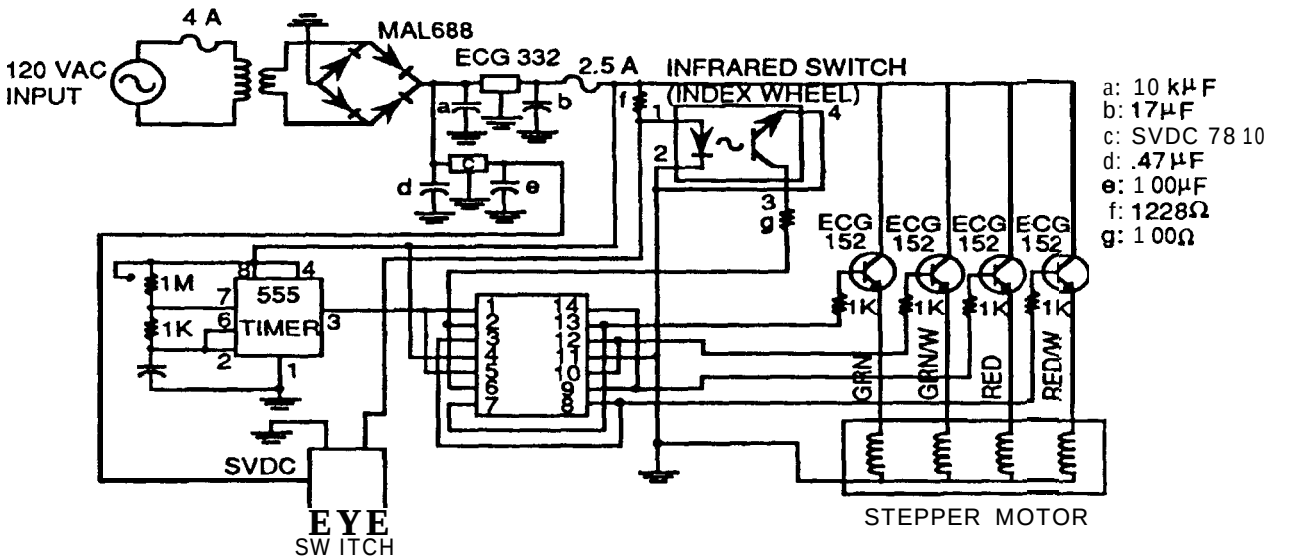
The design contains two rotating synchronous wheels attached to a shaft that is connected to a stepper motor. The motor is attached to the inner cover of the enhancement device and is activated by an infrared switch mounted on the client's eyeglasses. This switch will be set to monitor the client's eyelid movement. When he blinks his eye, it will start the motor. The wheel will then turn until the next picture comes into view. This will allow the client to select activities and to learn to recognize certain objects. We used another infrared switch similar to the first to stop the rotation of the wheel. This switch is mounted next to an additional wheel called an index wheel.

The way the circuit works is that when the client blinks his eye, the wheel begins to turn. Once it has begun to move he has no control over its movement until it stops again. In this way, it is not sensitive to the client's movement while turning. Once the client has started rotation of the motor, the control goes to the other switch. This switch, mounted next to the index wheel, turns off the motor when the index wheel reaches an opening. The wheel has six notches cut in it, one for each picture on the picture wheel. The edge of the wheel will fit in the switch, and rotate until a hole is reached; at this point the wheel will stop. Once it stops, the client has control of it again. By constructing the wheels in this way, the circuit could be kept simple, and breakdown was determined to be much easier. To attach the wheels to the motor shaft, we decided to use a coupling with a set screw. The index wheel was designed to be connected directly to the coupling. The picture wheel was designed to be removable, with a cotter pin holding it in place.

Picture Attachment

The picture wheel was constructed of Styrofoam and was located between the two outer covers. The pictures where attached to the picture wheel with a material that allows paper to be attached by just pressing it to the surface. The center wheel is accessed by removing the front cover. Due to the large 20 inch diameter of the picture wheel, the viewing window was located at the lower section on the front cover. The front cover allows viewing of one of the six activities on the picture wheel.

The cost for the materials to build the device was $442.00, which includes $295 for the eye switch device.



Joystick Controlled Vehicle

Design Group: G. Shanmugasundaram, D. Curry, A. Coleman
Disabled Coordinator: Rhoda Ruffner
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Supervising Professor: Dr. Ed McMahon
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University of Tennessee at Chattanooga
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INTRODUCTION

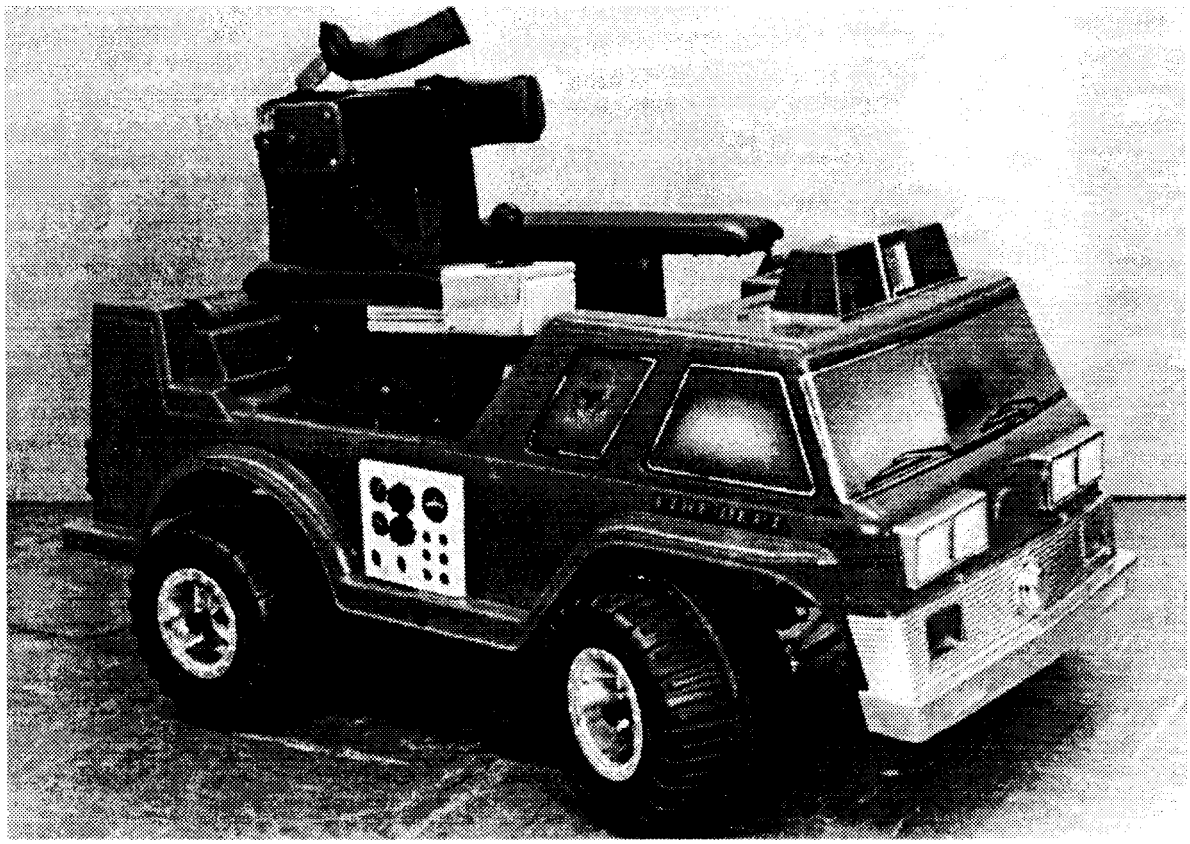
The project objective was to design a device that would enable a youngster to play on the playground and that would serve as an educational source so that he could learn to use a joystick mechanism.

A commercially available battery powered toy fire engine was purchased. The seat, steering wheel, and footpedals were removed. A joystick control and servo motor were added to provide motion and control the steering. A custom seat, with armrests and a harness, provides the necessary support.

SUMMARY OF IMPACT

The client is a seven year old handicapped boy. He has a form of cerebral palsy referred to as hypotonia. This disease decreases motor coordination. The client has limited mobility and needs support for his back and neck. The client had some experience with a motorized wheelchair but is unable to control it indoors.

He responded immediately to the joystick controlled fire engine. The therapist remarked that this was just what he needed so that he could play and learn to better utilize the joystick control so that he will be able to operate a wheelchair.



TECHNICAL DESCRIPTION

The seat was designed to duplicate the dimensions of his wheelchair. The seat was constructed of plywood and covered with 1 1/2" padding and vinyl. An abductor is provided that is fastened with velcro for adjustability. Arm rests are provided to support his arms and lateral support is provided for his shoulders. A neck support is provided and he is secured in the wheel chair with a harness.

The fire engine receives its power form two H batteries, connected in series, to provide a 12 volt power source. The fire engine has two motors in the back above the rear wheels. They allow the fire engine to go forward and when the polarity is reversed to go backward. The fire engine was initially capable of going 2.5 mph or 5 mph. For safety the high speed hook-up was eliminated.

The steering is provided by a servo motor attached to the original steering mechanism. Polarity is reversed to turn left and right. Limit switches were installed to cut off the motor when the wheel has turned to a maximum turning radius for either side. The joystick control has eight switching positions. Forward provides power to the motor to move the fire engine in the forward direction, while pulling back on the joystick reverses the direction. Pushing the joystick to the right turns the wheels to the right until the limit switch interrupts the power to the servo motor. Pushing the joystick to the left turns the wheels to the left. When the joystick is moved to an intermediate position, for example forward and to the right, the vehicle will move in a forward direction and turn right.

The cost of purchased parts for the joystick controlled fire engine, including the vehicle, was $420.