

**CHAPTER 17**  
**UNIVERSITY OF NORTH CAROLINA AT**  
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# SIGHT 'N' SOUND SHOWER TIMER

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## INTRODUCTION

The Sight 'N' Sound Shower Timer (SSS Timer) was created for a client with cerebral palsy who has difficulty following sequences of steps. The client requested a timer with: 1) accessible controls; 2) a large display; 3) loud sounds; and 4) highly visible indicator lights.

The SSS Timer is a multi-step programmable timer that is interactive (see Fig. 17.1). The device has two modes: "Shower" and "Non-Shower". The timer is also versatile and allows for saved settings. Icons light up on the timer to tell the client what task he should complete. The timer has bright lights and a customizable alarm to notify the client when time is up. It also uses: 1) large LEDs; 2) a low-frequency buzzer that is easier for the client to hear; 3) an LCD screen that displays the step and countdown time; and 4) illuminating icons corresponding to each step.

## SUMMARY OF IMPACT

The SSS Timer allows the client to have greater independence while showering and reading and during mealtimes. The client uses the timer about three times per week. His mother stated, "The device is great. It is easy to use. The flashing lights and buzzer really engage him. The 'GO' button is perfect for him. He seems to really like the count down lights." The device corresponds to the client's color and style preferences and appears to be enjoyable for him to use (see Fig. 17.2).

## TECHNICAL DESCRIPTION

The SSS Timer is housed in a 7 3/4" x 4" x 2" case with a white acrylic face and plastic sides and bottom. The acrylic face has milled sections of 0.05" thickness so that each of the 13 LED lights can shine through. The lights are inside to ensure water resistance. Screening spline was used to seal the gap between the face and sides of the enclosure.

The SSS Timer is controlled by a PIC microcontroller (PIC16F876), programmed in C. A regulator (LP2957) controls the voltage output to the circuitry from 4 AA batteries. The PIC chip outputs to an LCD screen and 13 lights (SSP-LX6144D3SC). The LCD screen displays the programming instructions on the front plate and also counts down the time once the timer has been initialized. Five of the lights count down the last five minutes of each stage. The lights are situated vertically in the center of the front face. Two of the lights are green, two are yellow, and one is red. The other eight lights are used to indicate which step the user is on. Transparencies are attached to the face of the timer with icons and words that represent each task. The images light up from behind when the timer is on the corresponding step.

A low frequency buzzer sounds when the time reaches zero for each stage. The PIC outputs a square wave to a speaker to produce this sound. When the timer reaches zero time, two blinking LEDs flash on the front of the SSS Timer.

The only button that the client has access to is the "GO" button. The button is used when time is up and is used for the client to turn off the buzzer and blinking lights and advance to the next step. It is a piezo pushbutton located on the front face of the SSS Timer. Four SPST Switch Pushbuttons (RP3502MA) are located on the sides of the shower timer for programming use. These are used by the parent or caregiver. The programming buttons include: 1) two black pushbuttons for UP and DOWN; 2) a red ENTER button; and 3) a red INTERRUPT button that adds time during the timer countdown.

The cost of the parts and materials was about \$289.



Fig. 17.1. SSS Timer Showing Time Remaining.



Fig. 17.2. Client Learning How to Use SSS Timer.

# ADAPTED BUBBLE BLOWER AND CONNECT FOUR GAME

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## INTRODUCTION

Two different toys were modified for a girl with spastic cerebral palsy so that she could access them to play independently or with her peers. A commercial bubble-blowing toy was adapted so that the client could blow bubbles independently. The bubble gun holder stabilizes the toy to her wheelchair lap-tray or to a desk (Fig. 17.3). It is equipped with a handle to ease triggering and dampen spastic pulls. The bubble gun also strengthens the client's shoulders and back.

A Connect Four® game was also modified to meet the client's needs. Funnels were placed at the top of the slots to improve accessibility. The funnels help the client to improve her motor control as she drops checkers into the desired slot. Further modifications were made to tilt the entire unit forward to decrease the amount of reach needed to access the top of the funnels (see Fig. 17.4).

## SUMMARY OF IMPACT

These two devices allow the client to interact with other children during leisure time and also help to improve strength and motor control. The devices can be used independently if desired.

## TECHNICAL DESCRIPTION

The bubble gun holder is made of 1 1/4" PVC joints resting on a 7" x 7" white 1/4" acrylic base. The gun handle fits in one opening of the PVC design and a bubble solution well sits on the other end. A rubber-lined clamp is located between the trigger and handle of the gun to dampen the force of spastic pulls. Colored straps tie the gun to the holder. Colored 1/8" inch rope was fed through the ring-shaped trigger and wrapped around a 1/4" dial to create a handle. The bubble gun can be easily removed from the holder for cleaning.

The Connect Four® adapter is made out of 1/16" clear acrylic. A 3 1/4" tall inverted pyramid-shaped funnel with a rectangular base runs the length of the game unit. The opening is 3 1/4" wide at the top and 0.37" wide at the bottom where it meets the slots. Colored triangular dividers separate the slots to improve visibility. The adapter and game unit are bonded together by an acrylic adhesive. The unit is attached to a base, which clamps to the client's lap tray for stability. The entire unit is hinged so that it can be tilted toward the client. Custom acrylic pieces are attached to the base to limit the tilting to an appropriate angle.

The total cost of the materials was \$99.



Fig. 17.3. Bubble Gun.

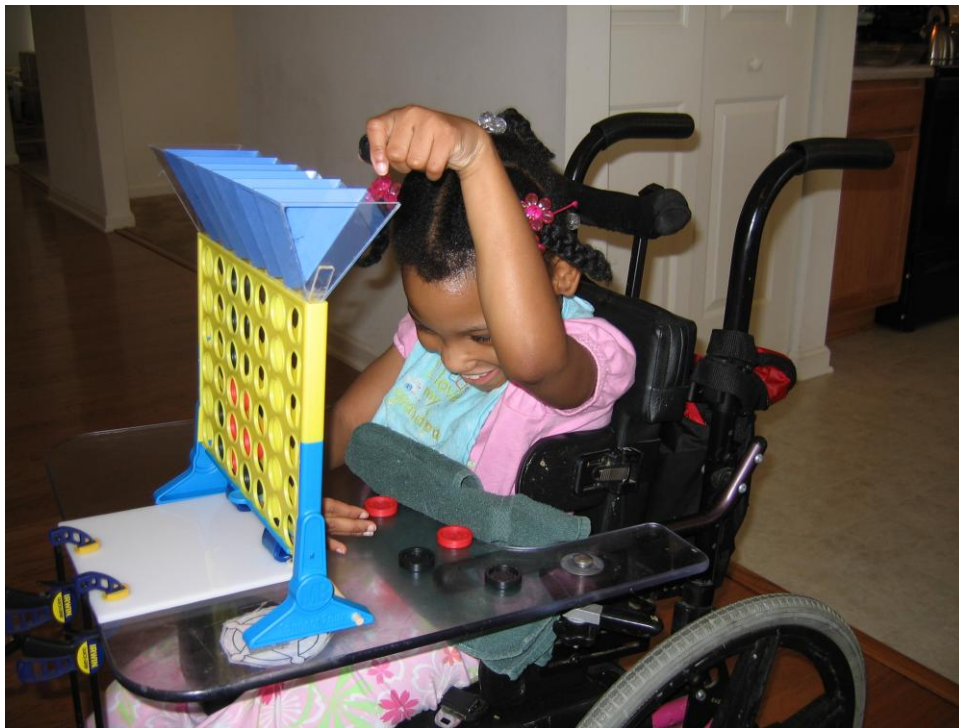


Fig. 17.4. Connect Four® Adaptations.

## WALKER MONITOR

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### INTRODUCTION

The Walker Monitor (Fig. 17.5) was designed for a woman with Parkinson's disease. She requested a walker that would minimize "freezing of gait" episodes, falls, and loss of balance. The Walker Monitor constantly monitors the patient's position behind the walker and automatically activates visual and vibratory stimuli to help the client break a freeze. The device also promotes correct posture and position.

### SUMMARY OF IMPACT

The device serves as a preventive measure to remind the client to step forward and regain proper position behind her walker, helping prevent injury. The vibratory cue allows the client to focus her gaze ahead. The client coordinator said that the device will be of great benefit to people with Parkinson's disease who experience freezing of gait.

### TECHNICAL DESCRIPTION

A Sharp GP2D12 infrared distance sensor, with the ability to measure from 10 cm to 80 cm at an accuracy of  $\pm 1$  cm, continuously measures the distance between the torso and front of the walker. The sensor outputs the distance to a Basic Stamp 2 (BS2) microcontroller chip (Parallax, Inc., Rocklin CA). The distance is compared every 50 ms to a threshold distance, which is set by the clinician and represents the upper limit of the "safe-zone." When the measured distance exceeds the threshold, the BS2 activates external cues to remind the user to take a step closer.

One of the external cues is a horizontal laser light beamed on the ground in front of the client's feet to remind her to take a step. Vibrating (pager) motors that are sheathed in pads are attached to the handles of the walker. They provide a tactile prompt and indicate when the client should be taking a step.



Fig. 17.5. Client with Walker Monitor.

The clinician or client may set the threshold distance on the device by turning a knob attached to a potentiometer. The threshold distance (in cm) is on the LCD display of the device. The LCD also displays the distance that is read from the distance sensor. It instructs the client to "move away" when she is too close and to "step closer" when she gets too far. Switches allow the client to choose between the laser cue and vibratory cue. Diagnostic switches are used for testing and calibration of the laser and the motors. They allow the therapist to adjust the laser light position for the client, and they also allow the client to feel the vibratory motors. All

components except the laser were enclosed in a low-profile custom built box (Fig. 17.6). The box mounts quickly and securely to the walker using bicycle light mounts.

The device can remain on at all times. When the user steps away from the device, the walker monitor enters a low-power sleep mode. When in sleep mode, the device briefly wakes up and reads the sensor every four seconds to see if there is an individual in front of the device. When a client is detected in front of the walker, the device returns to

operational mode and scans every 50-ms. The energy efficient function enables a battery life of more than three days when fully charged. A rechargeable 7.4-volt Lithium-ion battery powers the device. It can be recharged by plugging in a detachable battery charger, which also disconnects the main circuit from the battery during charging. A 'low battery' LED prevents over-discharge of the battery and reminds the user to plug in the charger.

The cost of the parts and materials was about \$377.

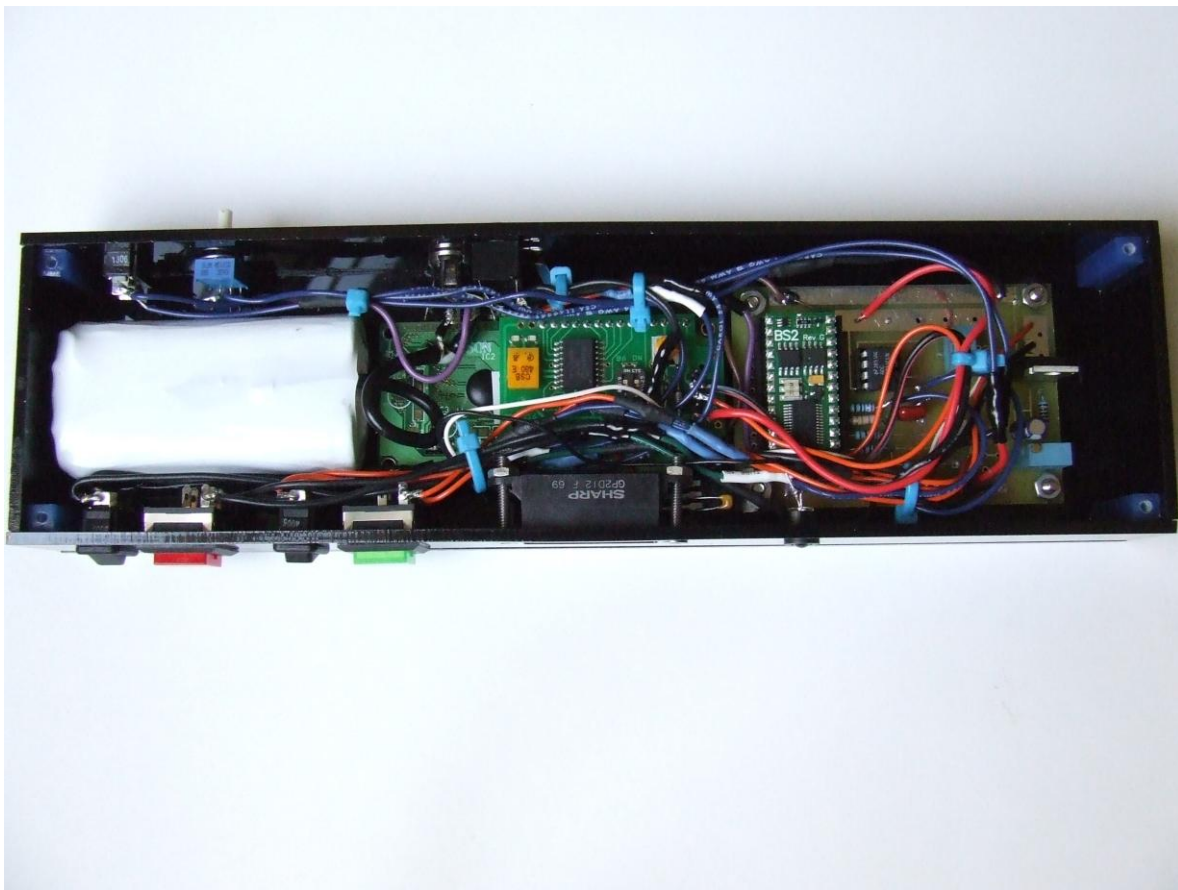


Fig. 17.6. Interior of Device.

# MOVEABLE ARM SUPPORT

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## INTRODUCTION

The Moveable Arm Support was created for a man with peripheral neuromuscular disease. The device helps him to lift his arms with minimal strength, and it takes advantage of his relatively good leg strength. His ankles are connected to his wrists via a pulley system such that kicking his legs out causes his arms to lift (Fig. 17.7). Each ankle is connected to the corresponding wrist. The device is mounted to a chair, and it can be easily transferred between his wheelchair and most conventional chairs.

## SUMMARY OF IMPACT

This device increases the client's ability to perform tasks that entail lifting his arms. The client stated that to pick up food, "before I had this device, I had to use both hands and bend over, but now I only need one hand. I like being able to sit back and still lift my arm. Also, I can reach more keyboard keys at the computer." Use of the device improves the client's activities of daily living, such as his ability to eat.

## TECHNICAL DESCRIPTION

The device is a pulley system that straps to a wheelchair or conventional chair. The system was made from black PVC pipes. It is left-right symmetrical so that it can be used with both arms and legs simultaneously. Each side is in the shape of a "C". The upper end is just above the client's shoulders for the arm connection, and the lower end is just below the seat of the chair for the ankle connection. A cross-piece connects the left and right halves, which allows for easy adjustment to change the distance between the two halves. The "C" shaped pieces also adjust to different heights relative to the chair, which allows for easy adjustment for different chairs.

A pulley system connects the client's leg motion to the lifting of his arms, and it allows for easy movement. Clear picture hanging wire passes through the sets of pulleys. It provides enough strength to lift the client's arms and is relatively discreet. It connects to straps on each end that wrap around the client's ankles and wrists. The straps are adjustable and comfortable for the client.

The total cost of the device was about \$100.



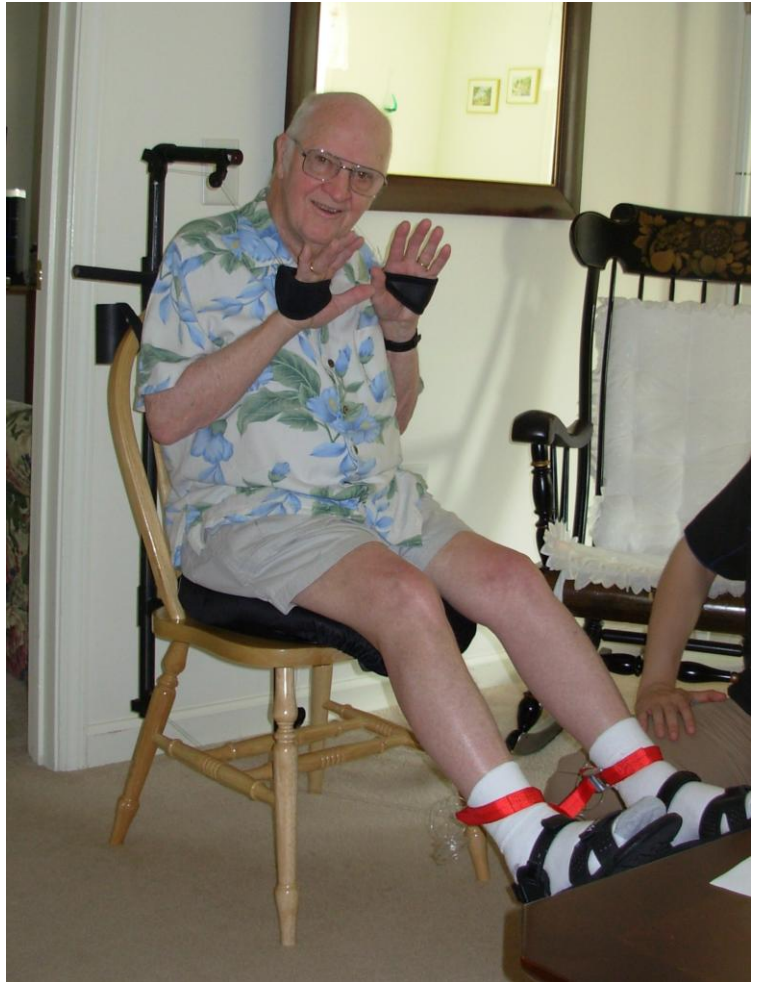


Fig. 17.7. Movable Arm Support.

## ASSISTIVE PLAY STATION

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### INTRODUCTION

The Assistive Play Station was created for a four-year-old client with cerebral palsy (see Fig. 17.8). The station allows him to play by himself and explore different textures. The station can be used in the classroom and when he stays with his mother at work. The station also provides the client with auditory stimuli. It complements physical therapy by strengthening movement in his arms.

### SUMMARY OF IMPACT

The Assistive Play Station incorporates the client's senses of touch and hearing. His teacher said, "The toys and textures [of the Assistive Play Station] are very age-appropriate for him. Usually, he has to play with toys for infants."

The device motivates the client to develop and strengthen the use of his left arm and hand. The device is adaptable, and the client can use it while in a group setting as well. It allows for interaction with his classmates who also enjoy activating the music. The client's teacher said that the device impacts his life through "independent exploration [and] social interaction... He can use it at home and school, [to] work on developing cause/effect skills, reach and grasp."

### TECHNICAL DESCRIPTION

The Assistive Play Station incorporates cause and effect stimuli. Only auditory and tactile stimuli are used. The device has two push switches (commercial) and two pull switches (custom-made) for motor tasks. All of the switches are interchangeable with any commercial switch that uses a standard 1/8" plug.

The device is adaptable to three different positions: 1) on the floor over the client; 2) attached to the arms of his wheelchair; or 3) on a table in front of him. The device has telescoping sides and a rotating

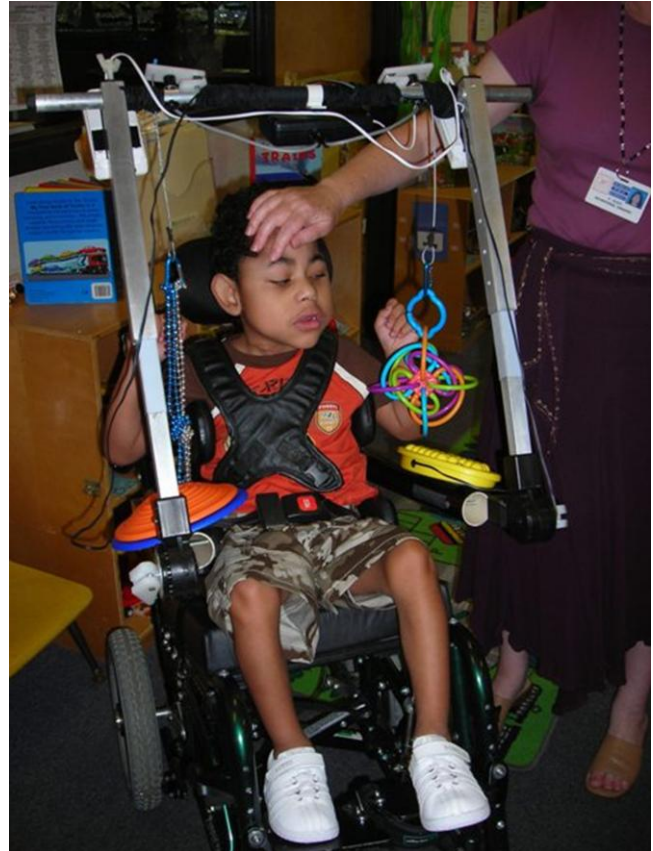


Fig. 17.8. Client Using Play Station.

frame so the configuration can be changed based on how he is using the device and adapted as he grows.

The Assistive Play Station is built out of an aluminum frame. The top crossbar is made out of 3/4" diameter aluminum of 1/16" thickness. The telescoping sides are made from two pieces of aluminum: 3/4" square tubing inside one inch square tubing. The telescoping tubing is held in place by a quick-release button. Teflon and thin acrylic are attached inside the outer tube so that the inner tube can slide easily within the outer one. The telescoping tubes are attached to incremental-angle

position hinges. The hinges lock the frame at any angle based on how the client is positioned. Quick-release cams were included to allow the client to release the locks (Fig. 17.9). They work similarly to quick-release levers on bicycle wheels.

The base is made of  $\frac{3}{4}$ " square tubing, stabilizing the frame. Attached to the square tubing are 1  $\frac{1}{4}$ " diameter black PVC tubes. The base can be pulled out of the hinge, turned inward, and reinserted so that the PVC tubes face inward. They then slide over the armrests of the client's wheelchair for attachment.

When the client activates one of the four switches, it directly triggers the  $\mu$ MP3 player (Rogue Robotics)

to play the corresponding song. The four songs are stored on a Secure Digital (SD) flash card, and different songs can be downloaded to it using an SD card reader interfaced to a computer. The player is set up for uninterrupted play mode; the song will not restart if the client pulls the switch while a song is playing. The MP3 player connects to battery-powered speakers, which have a volume control for listening to the music. A regulator converts the 9-volt DC from the battery into the 5-volt needed for circuitry operation.

The total cost of the device was \$466.

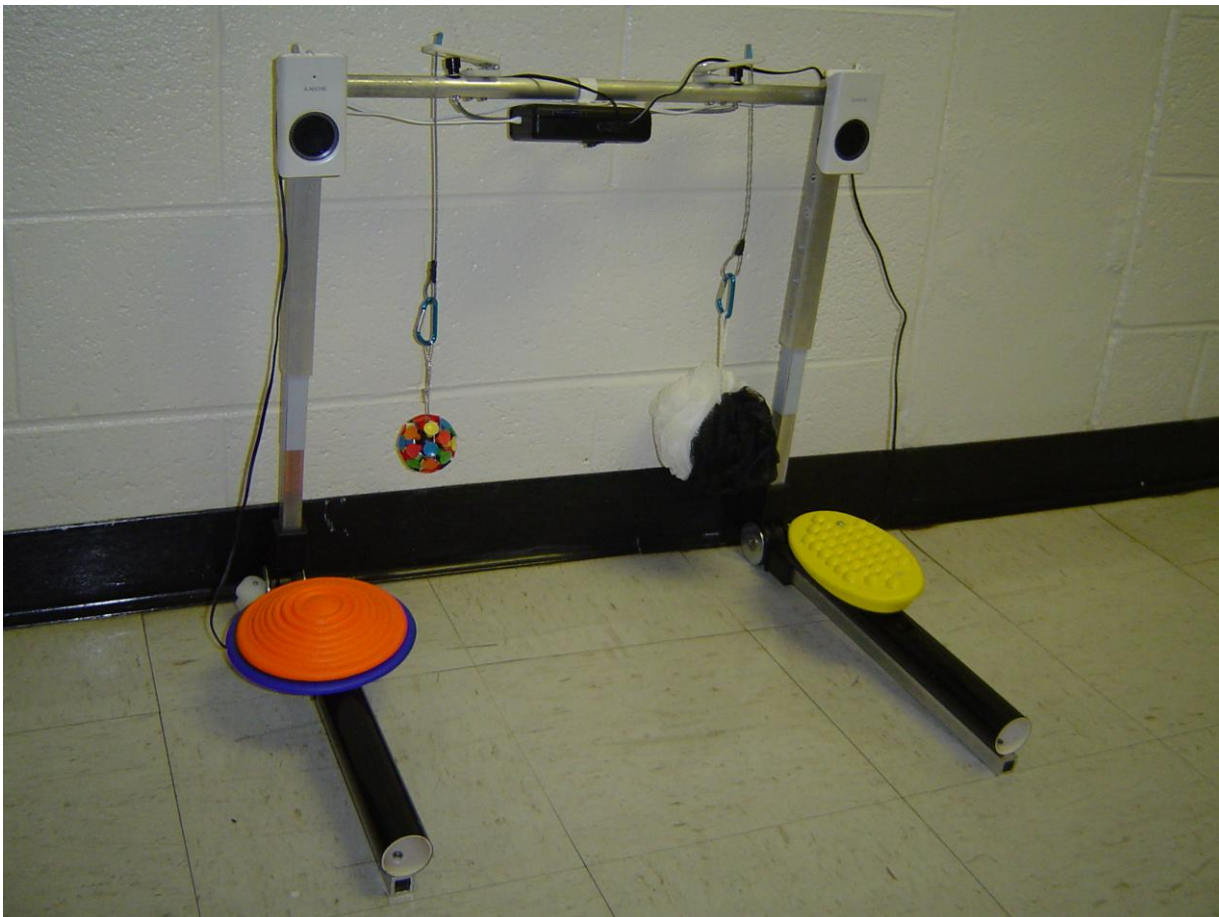


Fig. 17.9. Play Station Device.

## C-PAD AUDIBLE ITEM COUNTER

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### INTRODUCTION

The C-Pad counting device (Fig. 17.10) is a learning tool that helps high school students with disabilities learn how to count and package a particular quantity of items. The counter introduces the students to the process of template counting and also increases their understanding of numbers. The counter is used to count any “widgets,” which contain a magnet, that trigger the magnetic sensors of the device. In turn, the device provides audio feedback and praise to teach the students how to accurately perform the task. The magnets are in tea candles and a variety of plastic objects.

### SUMMARY OF IMPACT

The C-Pad facilitates student progression from a classroom setting to a vocational environment by providing auditory feedback and encouragement. The C-Pad runs smoothly with minimal troubleshooting required from the client. Through the counter’s variability and adaptability, the device allows students to progress to a state of counting independence. The client coordinator commented, “Given the multi-dimensional presence of this counting device, a student will have many opportunities to increase the ability to count, recognize numbers and transition the learning to home and pre-vocational... Students... were able to use this device with varying levels of assistance.”

### TECHNICAL DESCRIPTION

The device has a three-board design. Board one is a storing area for the widgets. Board two is the template where counting takes place. Board three is a containment bin that holds widgets after the student is done counting and clears the template. The smooth surface allows the students to easily transfer the widgets across the board. Board two is designed with a high back lip that prevents widgets from falling off. The teacher or therapist places different templates on top of this area. There are one



Fig. 17.10. Client Using C-Pad

to eight holes in it to provide a target area for placing the widgets while counting. A switch is set on the device so that it knows which template is being used.

A PIC 16F877 microcontroller (Microchip) controls the device. Due to limitations of the PIC, a maximum of eight magnetic sensors were possible. Hall effect sensors were mounted to the underside

of the template to detect when widgets (with magnets incorporated into them) were placed above them in the appropriate locations on the template. The  $\mu$ MP3 device (Rogue Robotics) provides voice feedback.

The code cycles through the Hall effect sensors and checks for sensor changes. If nothing happens for a prolonged period of time the PIC triggers the  $\mu$ MP3 player to play a reminder cue. If a sensor change is detected the program waits until the sensor stabilizes. The program: 1) counts how many active sensors are detecting widgets above them; 2) updates the seven segment display with the current

count; and 3) checks which types of feedback are selected. If the count feedback is on, an audio feedback of the current count is played. If encouragement feedback is on, then audio encouragement is given.

The  $\mu$ MP3 player voices a command to clear the template of the widgets when all the sensors are covered. When all the sensors are uncovered, encouragement is given and then a voice cues the user to begin counting again.

The total cost of the parts and materials was \$492.



Fig. 17.11. Client Using C-pad.

