CHAPTER 16
UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

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ELECTRONICALLY-ACTUATED LAZY SUSAN

Designers: Jacob McPherson, and Jeffrey Whittaker
Client Coordinator: Luanne Holland, Speech-Language Pathologist, Durham Public Schools.
Supervising Professor: Dr. Richard Goldberg
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INTRODUCTION

The goal of this project was to develop a device that elementary school children with severe and profound disabilities could use to select one of four different toys while remaining seated or standing. The device was also to provide audio and visual feedback. An electronically-actuated lazy susan (shown in Figure 16.1) was designed. It presents the user with a single toy at a time. A partition blocks the view of other toys on the device, so that the user is not distracted. When the student presses a button, the device starts to rotate, and it stops when the next toy is presented to the user.

SUMMARY OF IMPACT

According to the speech-language pathologist, the device succeeded in increasing the user's independence by providing direct access to desired items and decreasing the amount of teacher intervention necessary. It eliminates the need to navigate the classroom to obtain an object, and prevents confusion associated with choosing from among a group of items.

TECHNICAL DESCRIPTION

The device consists of a 36"-diameter top disc, a similarly-shaped base, and a thin sheet that is wrapped around its perimeter. All items are made of Plexiglas. A DC motor, located inside the device, rotates the top disc. The disc rests on a bed of ten casters that allow for smooth rotation while holding up the weight of the disc and toys (see Figure 16.2). The teacher can connect up to three external, commercial switches via standard audio jacks. When one of these switches is pressed, the device turns the motor on, initiates the first audio feedback message, "go," and turns on the LEDs that are around the perimeter of the device. The device continues to rotate, with the LEDs on, until the next toy is positioned in front of the user.

Figure 16.1. Client Using Lazy Susan

The partitions on the top of the device allow the lazy susan to be sectioned into halves or quadrants, and the device automatically senses which mode it is in and rotates either a half or quarter turn accordingly. There is a tab on the bottom of each partition; the device detects when the tab passes in front of a photo-interrupter, and stops the motor. Then, it plays the final audio feedback message, "stop," and the LEDs are turned off. The device then resets itself, and is ready for the next trigger.

All circuitry is housed within the device itself, and the microprocessor, speaker, other ICs, and the PCB are all contained within an internal project box (see Figure 16.2). User controls for power, volume, and LED on/off are contained in an external box, accessible to teachers but not to students.

The device is battery-powered and therefore does not need to be tethered to a wall, thus increasing its mobility. The low profile of the device allows it to be placed on the floor or on a table, depending on the child's needs, while the bottom of the device is covered with non-slip neoprene to prevent unwarranted movement. The neon colors of the partitions help to retain children's interest.

The cost of the project is approximately $370.

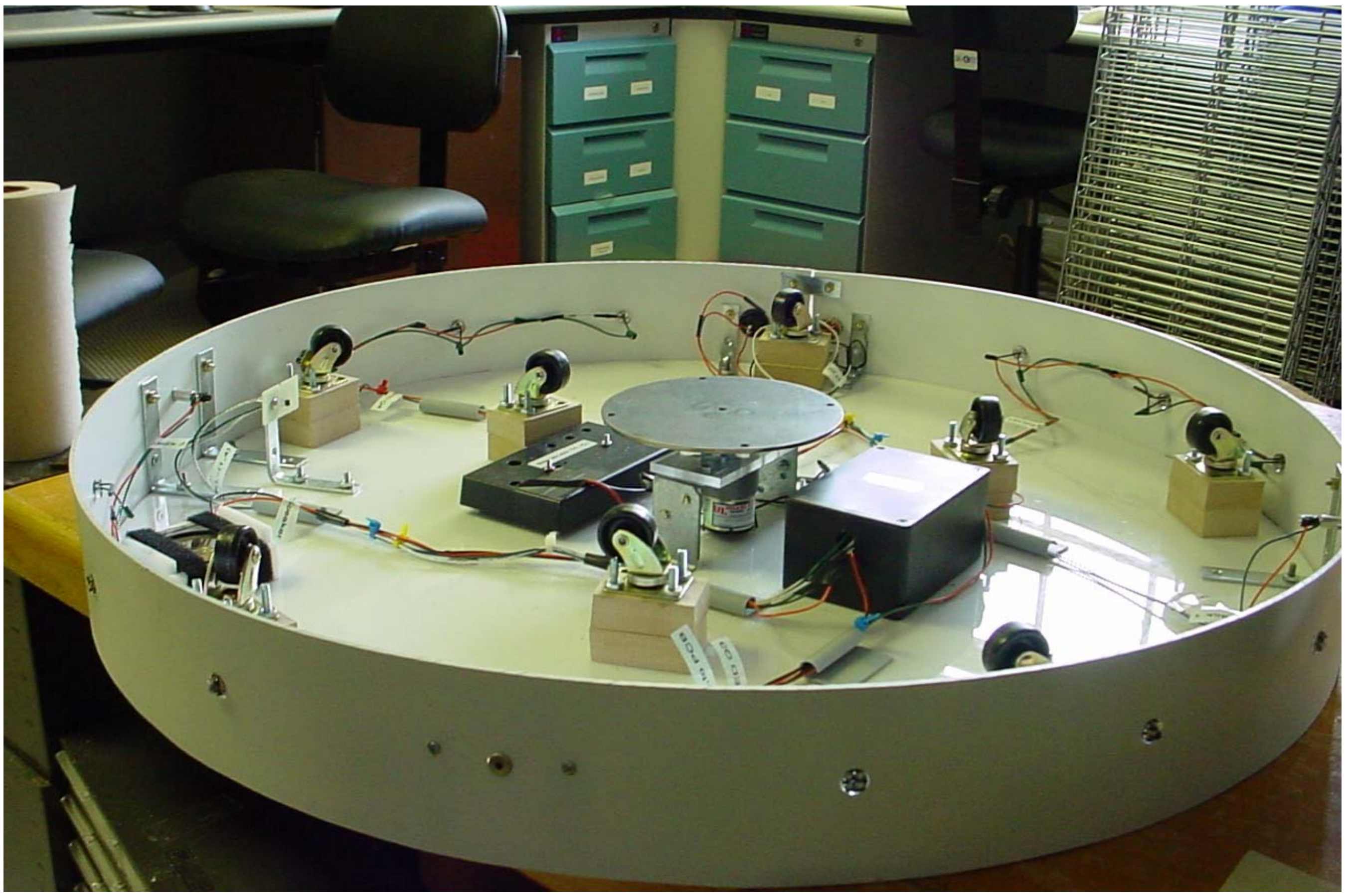

Figure 16.2. Lazy Susan with Top Disc Removed, Showing DC Motor, Electronic Circuitry Box, Casters, and LEDs

FLOW-CONTROLLED SPORTS BOTTLE

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INTRODUCTION

A client who had a traumatic brain injury at a young age occasionally develops high muscle tone. If this occurs while she is drinking, she cannot stop taking in fluid and she chokes. Currently, a caregiver needs to monitor her closely to prevent choking. The goal of this project was to build a flow-controlled sports bottle that limits the amount of fluid that the user can drink at one time. This will prevent choking and give the client more independence when drinking.

The design uses a two-cup system, in which one cup fits inside the other. A caregiver fills the inner cup with fluid, and the client can dispense a small amount of fluid into an outer cup. The client then

Figure 16.3. Client with Flow-Controlled Sports Bottle

drinks from the outer cup through a straw. After drinking, the user can then dispense more fluid from the inner cup into the outer cup. This limits the amount of fluid the user can drink at one time.

SUMMARY OF IMPACT

The flow-controlled sports bottle will have a large impact on the client's independence. While using a regular bottle and straw, the client would require assistance in pinching her straw to prevent excess fluid intake and choking. With this sports bottle, she will not require assistance. The flow-controlled sports bottle will help her to drink without fear of choking. The client's mother commented that the bottle "works great" and it was easy for the client to use.

TECHNICAL DESCRIPTION

The device uses a two-container design in which the client releases fluid from an inner storage bottle, through a valve, into an outer drinking container. The design uses the Nalgene GoCup, which consists of a Lexan polycarbonate sports bottle that snaps into a Lexan outer measuring cup. When the user presses down on the sports bottle, the fluid flows from the inner bottle through a valve into the outer cup. The user then drinks from a straw that is placed in the outer cup. The Lexan is durable and temperature-resistant from -135° C to 135° C. The bottom diameter of the outer cup is 6.0 cm, allowing it to fit easily into cup holders of 6.5 cm diameter.

The bottle design allows the client to easily refill the inner bottle. To activate flow release, the client simply places her hand above the bottle and presses the bottle downward. The flow rate from the inner bottle into the outer cup is 5.0 ml/sec when the bottle is half-full (240 ml or 8 oz). When the client stops pressing, the bottle springs back up and the valve closes. If the inner bottle is half-full, then up to 110 ml or 3.7 oz can be dispensed into the outer cup. However, the straw does not reach the bottom, so the maximum fluid that the client can drink is about 2.7 oz.

The valve consists of non-toxic commercial parts easily found in the faucet repair section of a hardware store. A nylon screw is placed through a

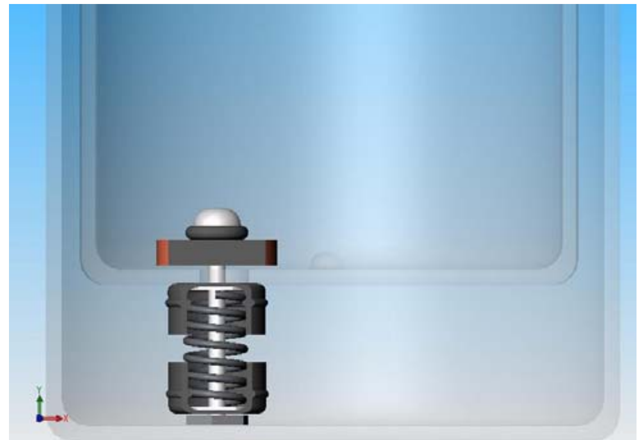

Figure 16.4a. CAD Drawing of Closed Valve

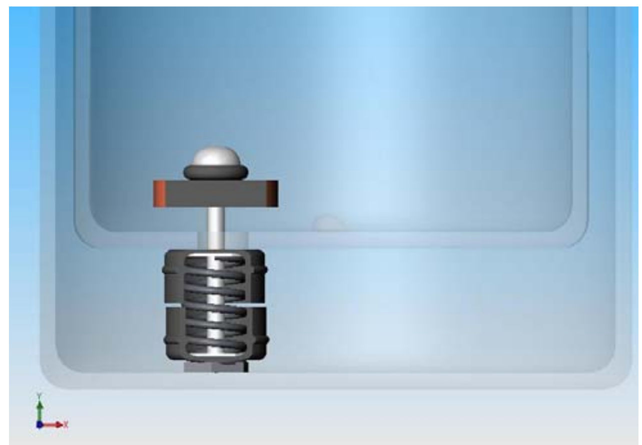

Figure 16.4b. CAD Drawing of Open Valve

hole in the bottom of the inner bottle. An o-ring and gasket are mounted below the head of the screw to seal the hole from above. Below the hole are gaskets, a spring, and a nut (see Figure 16.4a). The force of the spring causes the hole to be blocked under normal conditions. When the client presses down on the inner cup, the spring is compressed, opening up the hole and letting fluid flow into the outer cup (see Figure 16.4b).

There is a second hole in the bottom of the inner cup to provide an opening for the straw to reach the outer cup. A silicone gasket is used (taken from a child's spill-proof cup) around the straw to prevent fluid from leaking through that hole.

The total cost of the device is approximately $35.

ONE-HANDED NAILSET AND CHISEL

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INTRODUCTION

A carpenter who has functional use of just one arm due to a brain tumor is unable to perform finishing carpentry, such as nail setting and chiseling because both of these tasks require the use of two hands – one to hold the hammer, and the other to hold the nail set or chisel. When setting nails, the user strikes the nail set, which then punches the nail head below the wood surface. Chiseling requires similar actions.

The goal of this project was to create devices for nail setting and chiseling that can be operated with just one hand. The client needed devices that were easy to use, comfortable, practical, and portable. Commercial PowerShot staple guns were modified with custom tips to perform the desired functions (see Figures 16.5 and Figure 16.6). The nail set tip has a V shape so that the tip hits the nail only and not the surrounding material (i.e. wood). The chisel has a long beveled tip so that it can chisel into wood.

SUMMARY OF IMPACT

The device effectively drives the heads of nails below the surface of all types of woods tested. It requires minimal coordination and allows the client to work independently with just one hand. The client remarked that the device, "allows me to have the ability to set nails without having someone do it for me. This gives me more independence especially since I don't have to hire an extra carpenter needed for the job, saving $16 an hour."

These devices are safe, lightweight, portable and simple to use. It is easy to activate the staple gun lever that does the mechanical work of driving the nail into wood or chiseling wood. The device includes a safety latch to prevent undesired activation of the device.

TECHNICAL DESCRIPTION

Due to the requirements of functionality, size, weight, reach, and cost of the device, a commercial staple gun was used (see Figure 16.6). The chisel tip is approximately 2" long. The device is small, with dimensions of 16.50 inches x 1.50 inches x 9.25 inches; it is easily portable and weighs 3.17 pounds. Due to its small size and weight, the device can be used in a wide array of positions, enabling adjustment of torque and leverage. As long as the handle can be depressed, the device will do its job. The custom tips were the most expensive components.

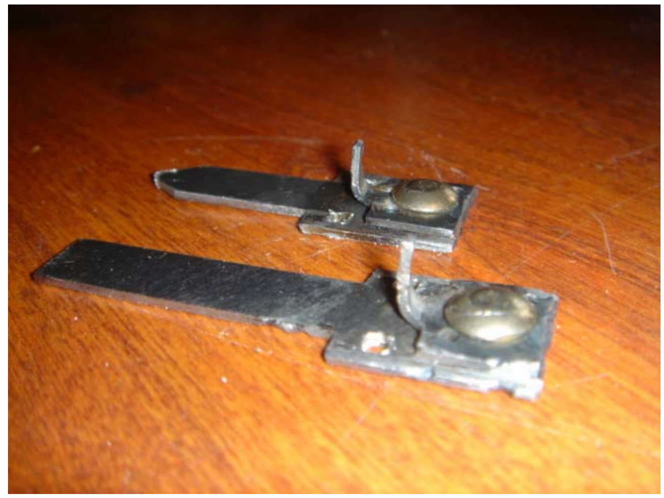

Figure 16.5. Custom Tips for Chisel (Foreground) and Nail Set (Background).

The device is easily made and fixed if broken because only one component of the commercial product is replaced (see Figure 16.7). The client was initially the only intended user of the device, but the universal design aspect of the device allows it to be used by anyone intending to increase productivity, efficiency, and ease of use.

The cost of the project is $40.

Figure 16.6. Completed Device (Custom Nailset Tip at Bottom Right)

Figure 16.7. Interior Mechanism

JAWS: ZIPLOC BAG MANAGEMENT SYSTEM

Designers: Uranie (Peppi) Browne, and Dorian Miller
Client Coordinators: Ashley Stone and Gena Brown, Goodwill Industries of Eastern North Carolina, Inc.
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INTRODUCTION

A vocational training regimen for high school students with disabilities includes performing repetitive tasks. The students are paid for each completed task. One task is to fill Ziploc bags with a user manual, a set of keys and three spare screws. This is difficult task because the bag is just barely large enough to hold the manual. It is particularly difficult for those students who have limited function in one or both hands. The goal of this project was to create a device that would assist the students in putting items into a Ziploc bag. JAWS, a modular universal device, was designed for two students with limited hand function.

SUMMARY OF IMPACT

The clients can successfully use JAWS to fill Ziploc bags with a four-page manual, three screws, and a pair of keys. JAWS made this task easier because it holds the bag in place, keeps it open, and provides a clear path for inserting the manual into the bag. A supervisor says, "I believe that JAWS will increase the productivity of our interns, level the playing field with their peers, and decrease the level of frustration that they feel as they work on this kind of job, while increasing their sense of accomplishment. Additionally, it will give them the opportunity to try jobs that they may not have been able to do before, while decreasing the possibility of damaging product materials."

TECHNICAL DESCRIPTION

The main component of the JAWS device is the metal and plastic pyramid, which is on its side (shown on the right side of Figure 16.8). The user places the Ziploc bag over the peak of the pyramid (see Figure 16.9), and inserts items through the opening on the opposite end. The sides of the pyramid are hinged to a metal frame that surrounds the opening, allowing the peak to open wide like a set of jaws, so that items can pass through the pyramid into the bag.

The metal frame is also hinged to the base of the JAWS device. This allows the peak of the pyramid to be raised and lowered relative to the base. The user raises the pyramid before placing the bag over the peak. Then, the user lowers the pyramid before loading items in the bag. The pyramid presses down

Figure 16.8. Side View of JAWS

firmly against the bag and prevents it from sliding. A magnetic touch latch, typically used for opening cabinet doors, was used to move the pyramid between the two positions. When the latch is pressed, it alternately extends and retracts by approximately ½”. It is located in the base of the JAWS device, below the pyramid (seen in black, directly below the center of the pyramid in Figure 16.8). To raise and lower the pyramid, the user simply presses down on the pyramid to engage the touch latch below it.

The perimeter of the pyramid consists of three plastic isosceles triangular surfaces (6” x 7”), and one 6” equilateral triangular opening through which items are inserted into the bag. Within the triangle is a transparent film that guides items as they are inserted. This curls the manual as it passes through the opening, and the manual flattens properly in the Ziploc when the bag is removed from JAWS.

The base of JAWS is made of wood, with a surface of stiff foam that includes an embedded metallic layer. This foam is an existing product that is commercially used to post messages with a magnet. A magnet is embedded in the acrylic, near the peak of the pyramid, to provide a strong force between the pyramid and the base. This helps to prevent slippage of the bag during filling.

Finally, there is a separate roller with a handle that is used to close the seal of the bag. The roller is made from a bed frame caster, with a customized ergonomic handle made of wood.

The cost of the project was approximately $160.

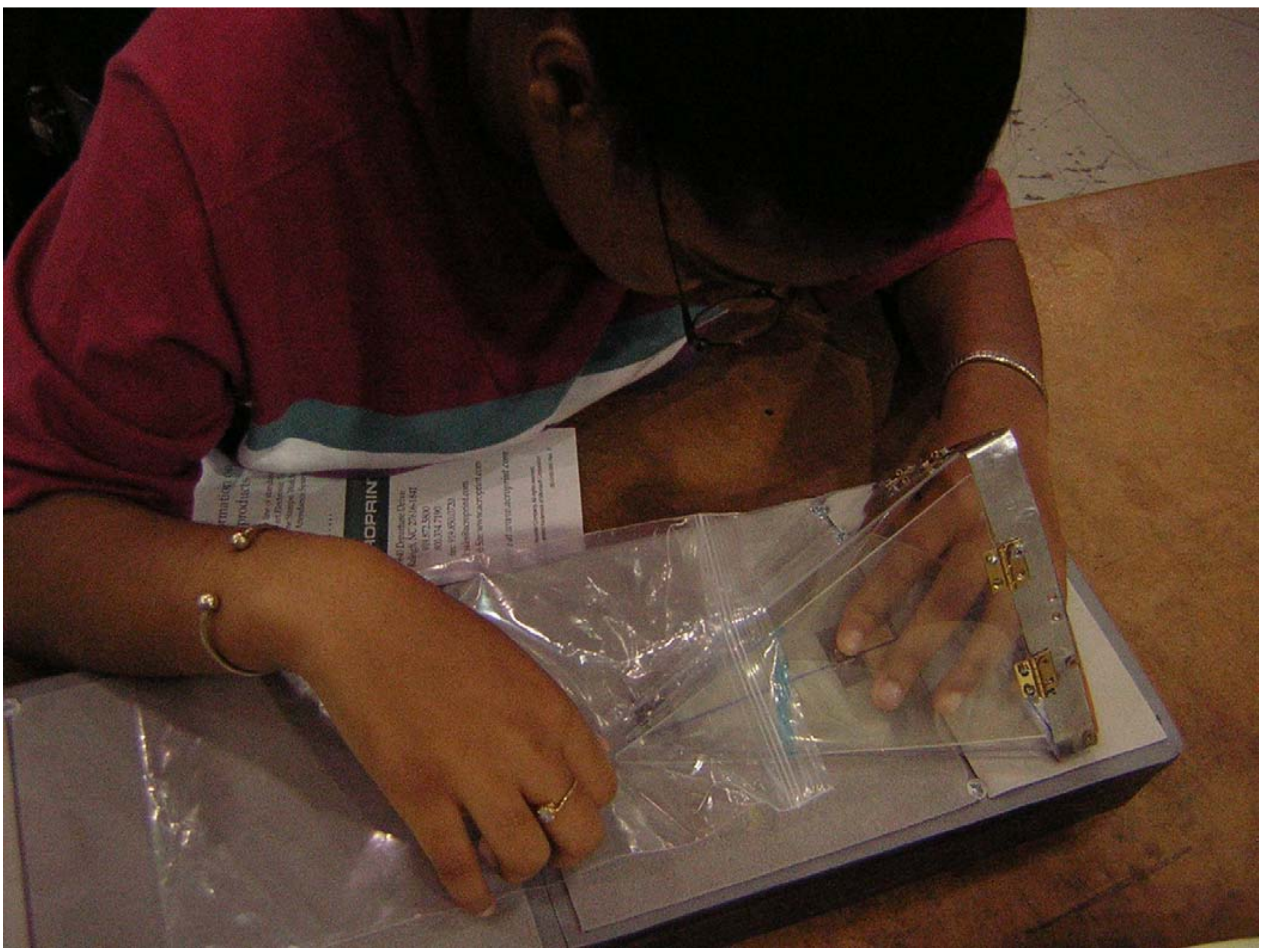

Figure 16.9. Loading Ziploc Bag onto the JAWS Pyramid