CHAPTER 13
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MANUAL OR POWER-ASSIST COMPUTER KEY STRIKER FOR PERSONS WITH QUADRIPLEGIA

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INTRODUCTION

A chin-stick key striker was designed for persons with quadriplegia who are also non-vocal. It may also be useful as a backup to voice recognition computer interfaces for individuals with quadriplegia who do have the use of their voice. This assistive device was designed to be lightweight, unobtrusive and comfortably worn.

SUMMARY OF IMPACT

For some persons with quadriplegia who are do not have the use of their voice, communication via computer is essential. This device allows the user to strike computer keys using only the muscles of the head and neck. Many commercially available devices use a padded helmet with a bent aluminum rod attached to the top for striking the keys. This previous design has adverse characteristics:

- It tends to dominate the user's appearance,
- The rod obstructs the client's view of the keyboard and the view around the user,
- It tends to be heavy and may be uncomfortable, and
- The user may stress his or her neck muscles when providing the bobbing motion required to strike the keys.

The chin-stick key striker, however, fits like a pair of eyeglasses. The rod is attached to the chin so it does not obstruct the view of the keyboard. The device is lightweight, so the user is less likely to fatigue. The users and special education teachers who requested the project have responded favorably to the manual chin-stick key striker and power assisted chin-stick key striker.

TECHNICAL DESCRIPTION

During use, the keyboard is placed at a comfortable 18" from the user's face. The chin-stick key striker is adjustable, for use at a distance that allows the user to see the whole keyboard comfortably. The user looks directly at the key being struck, then provides motion to strike the key either by 1) a manual key striker using a forward motion of his or her head or 2) a power-assisted striker using a puffer switch to activate a solenoid that moves a pin to strike the key. In either case, the user finds and strikes the computer key primarily applying a vertical and horizontal motion of his or her head within a plane.

Two computer key strikers, a manual striker and a power-assisted striker, were fabricated using the same chin-ring, eyeglass frame to support the key striker. A piece of straight, brass tubing is rigidly attached to a padded chin-ring. Temple straps curl around each ear, like eyeglasses, and hold the chin-ring in place. The assistive device is secured to the user's head with fitted temple straps, which are further secured by a thin, elastic eyeglass strap connection at the rear of the user's head. The brass tubing is rubber tipped.

In manual operation, the user provides forward motion of his or her head to strike the key. During power assist operation, the user locates the key, points the brass tube within ¼" of its surface and activates a puffer switch. Two solenoids force the tip of a photographer's cable release to strike the key. In either mode of operation, the user finds and strikes the computer key with minimum motion of his or her head, and the user always has a clear view of the keys.

The chin-ring and temple straps are made with 12-gauge galvanized steel bale wire; the wire is joined together by brazing. Every piece is shaped directly on the client, and then is brazed. Bale wire is used for its combination of rigidity and malleability. Temple straps are brazed to the oval chin loop. Two wires, bent to 45° at one end, are brazed on each side of the oval ring. These wires are attached with

epoxy, 2.5" below the chin-ring, to 10" long, 5/32" OD, brass tubing. This bond is then shrink wrapped for appearance and added strength. The end of the striker is a 10" long, 3/32" OD, brass tubing, which slides inside the 5/32" OD brass tubing; this allows the length of the striker to be adjusted. Hot glue applied to the overlap of the two brass tubes firmly holds the correct length of the striker; reheating the glue permits readjustment of the striker length. The tip of the brass tubing key striker is covered with a rubber cap to minimize slip on the keys. Upon finishing the fit to the client, the chin-ring is wrapped with moleskin strips and the temple straps are shrink-wrapped for comfort. An elastic strap, one commonly used for eyeglasses, keeps the fit snug to the user's head.

For the power-assisted striker, two solenoids are used to apply force to a photographer's camera cable release. The solenoids are placed in a box and bolted to an adjustable desk lamp arm. The 12-volt battery provided by the client's wheelchair powers the solenoids. A puffer switch completes the circuit of the solenoids and battery. At one end, the cable release is fixed to the solenoids in a box and at the other end, the cable is fixed to the tip of the brass tubing. The client points the brass tubing to within ¼" of the desired key and provides a puff; the solenoids drive the striker and depress the computer key.

Figure 13.1. Rear View of Power Assisted Chin-Stick Key Striker.

Figure 13.2. Front View of Power Assisted Chin-Stick Key Striker.

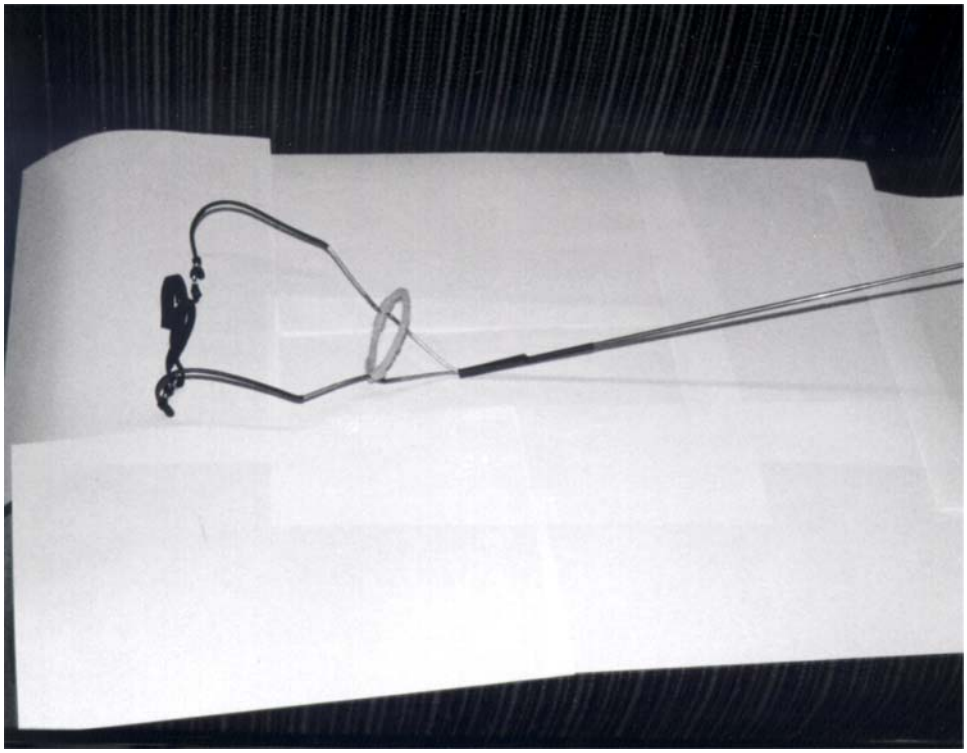

Figure 13.3. Full View of Manual Chin-Stick Key Striker.

Figure 13.4. Side View of Manual Chin-Stick Key Striker.

ASSISTIVE DEVICE FOR MAINTAINING ATTENTION OF COGNTIVELY AND HEARING IMPAIRED CHILDREN

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INTRODUCTION

A device was constructed for a child with cognitive and hearing impairments. The child has a short attention span. An assistive device is needed to help her to focus on the hands of the Occupational Therapist (OT), who is teaching her sign language. The assistive device provides both visual and loud auditory stimulation.

The device was designed and fabricated as a small unit that fits on the palm and wrist of the OT's hand. On the palm are bright green and red lights and an activation switch. On the wrist is a box containing batteries and a circuit board; a recorder and microphone are mounted on the cover of the box. The device is activated with motion from a single finger on the hand on which the device is placed. When activated, the red and green lights shine brightly and prerecorded music is played for a period of between 0 and 20 seconds. Using the microphone on the device, the music can be changed an infinite number of times by recording a new tune over the old one. The light and music stop automatically after a period settable by the OT, but not longer than 20 seconds. The user depresses a single button to activate both the light and sound circuit. There are switches on the control box that allow the OT to either switch the music off and use the light only, or switch the light off and use only music.

SUMMARY OF IMPACT

While teaching sign language to a child who is both hearing impaired and cognitively challenged, the child's attention span is often too short for her to attend sufficiently. This device helps the child regain attention to the lesson at hand. When the child loses attention to the lesson, the OT activates the device; the music and red and green lights help attract attention back to the lesson. This device could be adapted to other learning tasks.

TECHNICAL DESCRIPTION

A plastic box (2 ¾" x 3 ¾" x 1 ¼") contains the circuit board, battery pack and single pole, single throw button switches (both momentary and permanent). A small microphone and a 2-inch-diameter speaker are mounted on the box cover. The box is held closed, and also held to the OT's wrist, by Velcro straps. The child seems to like the color red, so red LEDs and a green LED for contrast were positioned around the activation switch, which rests in the palm of the OT's hand. A schematic of the circuitry is shown in Figure 13.6. When the activation switch in the OT's palm is pressed, both the sound and light are turned on for a predetermined amount of time. The play/record circuit then outputs a signal to a speaker and also an operational amplifier, which stabilizes the signal to suit the LEDs. The device produces music at approximately the same intensity as that of the music recorded; this feature allows the OT to change the music to suit the needs of the child. A 20-second tune or instruction can be recorded by activating the record switch on the box and recording the sound at the desired level. The activation switch is attached to the OT's hands by an adjustable Velcro strap. Four AA batteries power the device. The device is covered with bright colored paper.

One unit cost approximately $60.

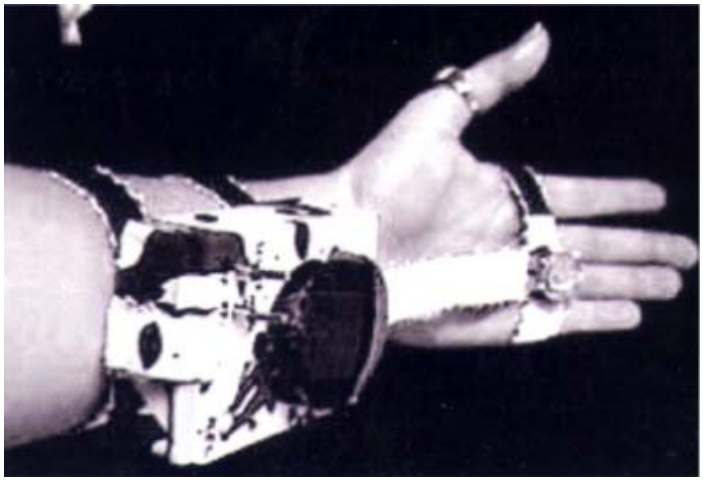

Figure 13.5. Fully Assembled Device on OT's Hand.

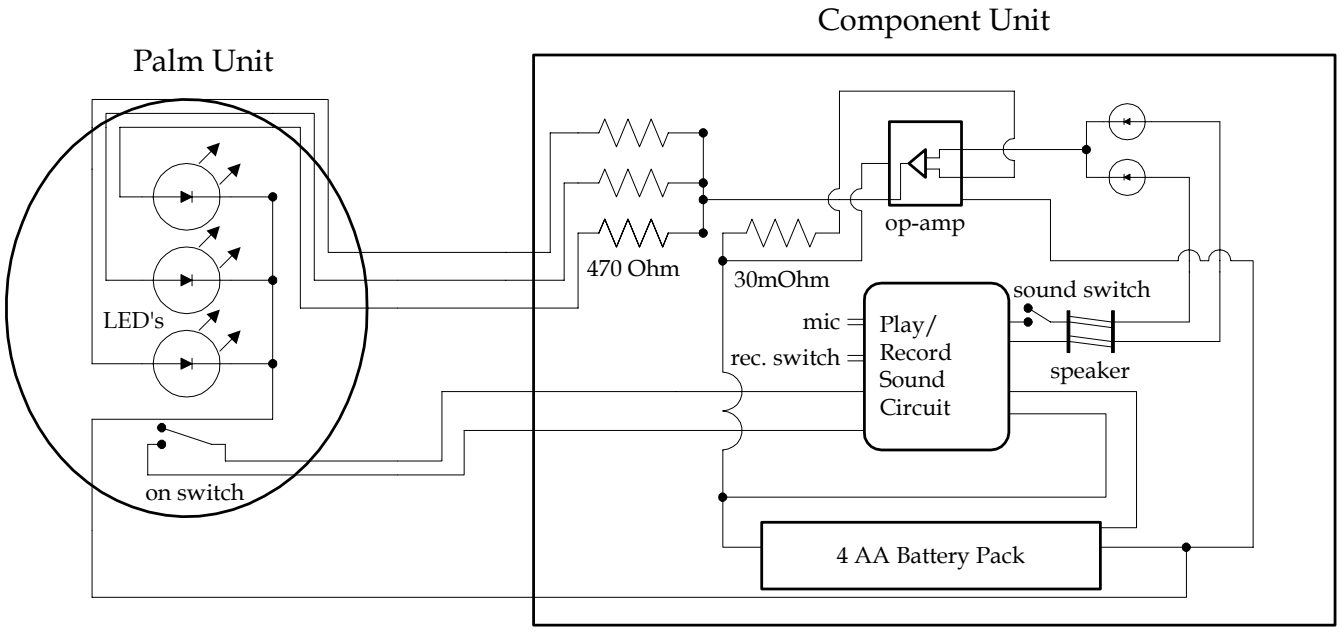

Figure 13.6. Circuitry of Unit.

RACETRACK WITH RAILS, MULTIPLE PATHS AND REMOTE CONTROLLED CARS FOR CHILDREN IN WHEELCHAIRS

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INTRODUCTION

This racetrack was designed to assist children who use wheelchairs in playing with a remote controlled electric car. Multiple electric cars can be used simultaneously on the racetrack. Thus, use of this racetrack could encourage children of different physical and mental aptitudes to play together. The racetrack has guardrails to prevent cars from leaving the racetrack. Cars are always in view of the user. The cars can be operated at their normal speed without fear of the car injuring someone by collision or tripping a walking person. Since the car cannot leave the racetrack, it cannot become stuck under a piece of furniture, which would require assistance in placing the car back on the racetrack. Thus, this racetrack offers enhanced independence for children in wheelchairs. The racetrack was tested with several cars operating simultaneously on the racetrack. Collisions between cars did not damage them. The child has a choice of different paths through which to guide the car including an oval and figure eight. The racetrack is designed to be lightweight and modular, quick and easy for assembly-disassembly, and convenient to store. The racetrack is designed with a wooden road to permit use on any surface: carpet, grass, linoleum etc.

SUMMARY OF IMPACT

Children who use wheelchairs need toys that will help improve their coordination skills and attention spans, as well as provide entertainment. A group of ten children in wheelchairs were seated around the racetrack, which lay on the floor. By using the remote control to operate the car, children were able to steer cars around the racetrack. The racetrack is designed with a sufficiently large radius so that actual steering is not essential for directing the car; contact with the wall of the racetrack forces the cars around the racetrack in the forward or reverse direction. The direction of the cars can be changed, much to the delight of the children. Three cars may be used on the racetrack at one time. Even children waiting to steer the cars seemed entertained.

TECHNICAL DESCRIPTION

The racetrack is made out of one 4′ by 8′ sheet of ¼" Luaun, a synthetic wood. The racetrack was drawn on the Luaun and cut with a band saw. The components are as follows:

Arc: The outer radius of this piece is 20″ and the inner radius is 13″. There are four of these pieces (two pairs). Each pair makes up the round portion of the oval shaped racetrack.

Rectangle: Each of the two rectangular pieces is 20″ by 7″. In the racetrack layout, these are the straight areas on the sides of the oval shaped racetrack.

Transition: These pieces have a portion that is 7″ wide and 18″ long, with a curve continuing 11″ into the piece before becoming straight for 9″. There are four of these pieces. They serve as transitions from the curve of the oval to the figure eight portion of the racetrack.

Cross: There is one piece in the center of the racetrack that is shaped like an "X". This piece is actually two halves of the "X" permanently combined. Each straight portion has a length of 30″ and a width of 7″. The angle of the X is such that the inside corners of the X are 9″ and 12″ respectively. The purpose of this piece is to provide a crossing for the branches of the figure eight.

Railing: The railing goes around the inside and outside of the entire racetrack. The railing is made

out of plastic corner molding that is 4" high. Corner braces, 51 mm, are bolted to the Luaun to support

Figure 13.7. Close-Up View of Racetrack.

the corner molding. Half-inch-wide, adhesive-backed Velcro is attached to the corner braces and the plastic corner molding to hold them together. To increase the modularity and stability of the racetrack, corner braces are placed at the end of each piece and directly next to the next piece of racetrack.

The racetrack is held together with pieces of Velcro attached to the corner molding on both ends of each

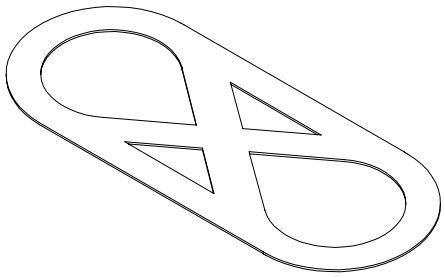

Figure 13.8. Schematic of Track Paths.

piece of racetrack.

Setup: With the racetrack fully assembled, the junction between each two-piece connection of racetrack is marked with a unique identifying letter. For setup, a piece of racetrack is placed on the floor, and then the next piece is attached to it by using the matching letters at each end of the racetrack. The pieces are joined using the Velcro at each junction of the racetrack.

Figure 13.9. Racetrack on 4'X 8' Plywood.

A PORTABLE SCALE FOR AMBULATORY, OBESE PATIENTS WHO MUST REMAIN AT HOME

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INTRODUCTION

A potable scale was designed to facilitate weighing of obese patients by healthcare professionals who provide in-home care. Generally scales that accommodate obese persons are too large or heavy for the home healthcare professional to carry on his or her rounds from house to house. This portable scale is designed to be a light weight and low cost scale to be transported by car and utilized for monitoring the weight of persons confined to their homes, especially very heavy persons.

The portable scale is designed to weigh persons up to 700 lb. to within $\pm$0.5%. To increase portability, the platform of the portable scale is made to be carried separately from the weighing mechanism. The weighing mechanisms are three ordinary, 9-volt, battery operated bathroom scales aligned in parallel to distribute the weight evenly among them. The scale zero and weight LED display are removed from each scale, attached to a six foot cable and mounted in a single plastic, electrical control box. A calculator is fixed to the top of the control box, providing the means for simply and accurately totaling the weight of the three LED displays.

To operate the scale, one places the three bathroom scales on a hard surface and plugs them into the control box. The platform is placed on top of the bathroom scales. The health care professional pushes the zeroing button of the control box and the patient steps on the platform. When the three LED displays indicate weight, the numbers for each LED display are summed using the calculator.

SUMMARY OF IMPACT

This portable scale appears to fit the requirements of the health care professional who must visit patients confined at home. Its 750 lb. weight limit is adequate; the platform could be easily expanded to include a fourth scale and a 1000 lb. weight limit. Because the scale and components weigh less than 30 lb., they can be easily transported on a suitcase dolly or carried by hand. The portable scale has the additional benefits of incorporating easily replaced or repaired bathroom scales and an indestructible platform. The 9-volt alkaline battery should last one year. The platform surface provides safety for the patient with its step height of only two inches and its non-slip, large surface. In the future, the three LED displays could be combined into a single display for added simplicity and accuracy.

TECHNICAL DESCRIPTION

The platform is constructed from aluminum, ¼" plate, cut 40" X 15". The aluminum plate is diamond faced on one side and smooth on the other. A 2" square is removed from each corner. Then all four sides of the plate are bent to 90°, with the diamond face out; these bent edges form 2" sides perpendicular to the platform. The bottom (smooth) side of the platform is divided into thirds, then an 11" long, aluminum 2" angle bar is arc welded to form three compartments, each 11" X 12". Together the four 2" edges and two 2" angle bars give the platform rigidity. The diamond plate surface is non-slip, but not uncomfortable to stand on with bare feet.

The bathroom scales operate by means of a picket fence disc and a spring. When weight is placed on the bathroom scale, the spring compresses. The compression causes the disc to rotate a number of degrees relative to the amount of weight on the bathroom scale. A photogate (photodiode) is connected to a counter chip that counts the amount of rotation of the disc; the degree of rotation denotes the weight upon the bathroom scale. A signal indicating weight lights the LED display.

The zero switch, nine-volt battery, LED display, photogate and circuit board of each bathroom scale is removed. The photogate is mounted on a new

circuit board and reinstalled in the bathroom scale. The original circuit board is wired to a male, nine-pin serial port plug. The zero switch, nine-volt battery, LED display and original circuit board are mounted in a plastic electrical box. A male nine-pin serial port plug is wired in where the photogate output used to be. A 6', five-lead cable is connected at both ends to female, nine pin serial port plugs. This cable connects the bathroom scale to the plastic electrical box. This arrangement allows the plastic electrical box to be easily placed on a table or for the bathroom scales to be reassembled should this ever become desirable. Three bathroom scales are placed under the platform; three bathroom scales have a maximum load of 750 lb.

To operate the weighing system, the user first assembles the bathroom scales by plugging the smaller scales into the plastic electrical box. Then the LED display is turned on by pushing the button mounted on the plastic electrical box. Each bathroom scale tares itself to zero. The patient then steps on the scale and is weighed. The patient's weight is evenly distributed among three separate LED displays (one from each scale), which must be added together to get the total weight of the patient. The scales automatically turn themselves off when not in use. The patient must distribute his/her weight evenly across all three scales for greatest accuracy.

The cost of the final prototype is about $200.00.

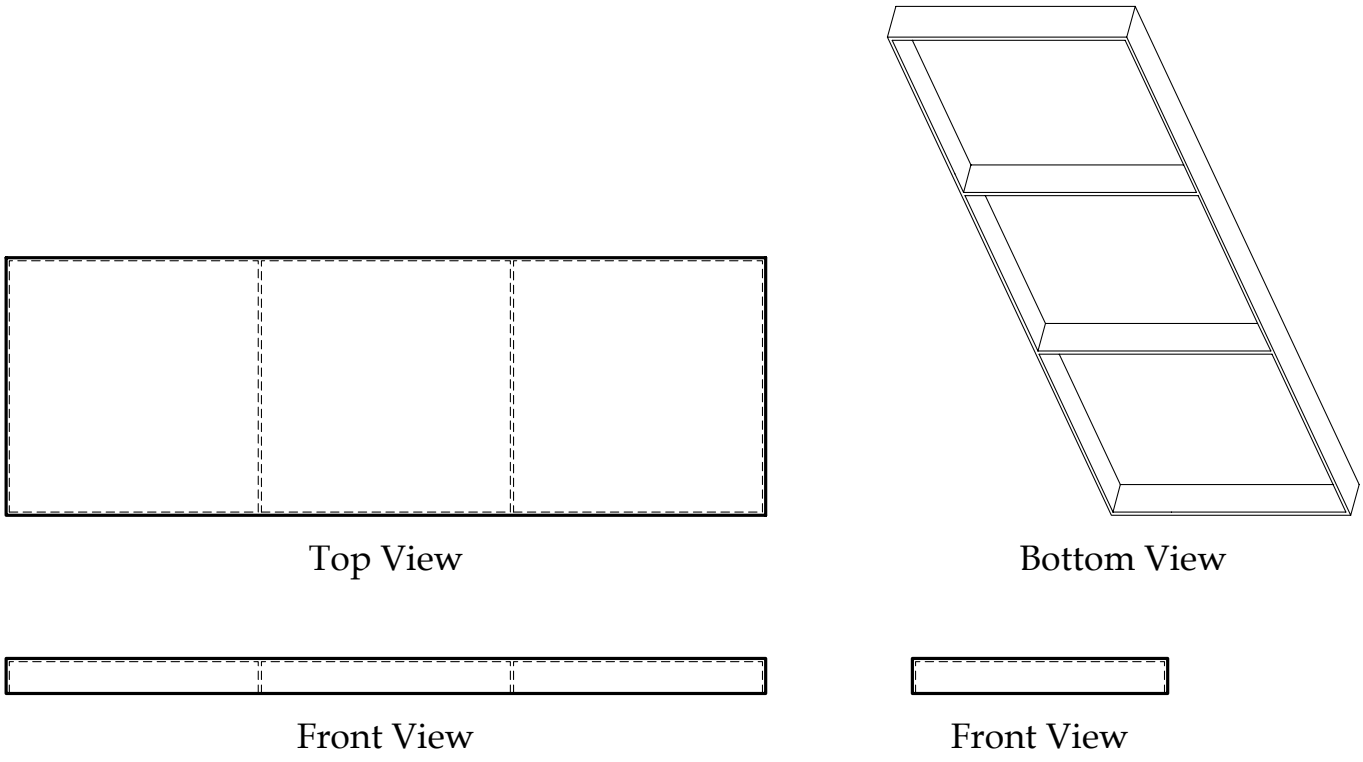

Figure 13.10. Four Views of the Aluminum Platform.

ARM SUPPORT AND GUIDE TO FACILITATE USE OF AN ELECTRIC MIXER

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INTRODUCTION

This assistive device was designed and constructed so that a person with cognitive and physical disabilities. Could participate in food preparation with an electric mixer. The mixer bowl-arm support system is designed to prevent spilling while mixing, prevent the mixing bowl ingredients from splashing out of the bowl during mixing, and prevent the system from falling over. The OT places the materials for the cake in the mixing bowl, which is easy to secure to the base of the mixing system with Velcro tape. An electric mixer is attached to an arm support. The user places his or her arm through the armrest and grasps the mixer. The mixer bowl-arm support system supports the arm of the user and the mixer as his or her hand contacts the mixer handle in a comfortable position. The client can only move the mixer in a curricular motion around the bowl; vertical motion of the arm or hand, either willfully or as a result of a spasm, is prevented by aluminum rods attached between the mixer bowl-arm support and the support structure of the device. Because the rods are long and the angle of motion small, the swinging rods confine all motion to a near plane.

SUMMARY OF IMPACT

The device is designed to assist persons with poor motor skills in developing participatory social skills. The electric mixer supplies the necessary strength to carry out the operation of mixing. The client receives an additional benefit from the vibratory motion, namely, that it calms and relaxes the client's musculature. Since the assistive device also confines the arm to a comfortable position there is an additional safety factor during use. The contents of the bowl remain in the bowl.

TECHNICAL DESCRIPTION

The base of the device is made from an 11" X 31.25" X 0.5" Lexan. All corners and edges are rounded. The frame is constructed from PVC piping. Part of a

Figure 13.11. Top Left Side View of Support and Guide for Use of an electric mixer.

PVC drain for tile shower bases (Oatley #42213) is used as the base of the frame and is attached to the base of the device with PVC cement (Oatley #31013) and ¼" Stainless steel, flat head bolts. A 17.5", 4" OD pipe extends vertically from the drain part and connects with a 45° branched pipe (PVC-1 NIBCO 2X2X2 4180). A 4" OD pipe extends vertically and joins a 90° corner pipe (PVC-1 NIBCO 4807). A 4", 4" OD pipe extends horizontally from this corner pipe and joins with another braced pipe. The two braced pipes are joined by a 7", 4" OD pipe. A 19", 4" OD pipe extends horizontally from the second branched

pipe and is capped on the end. Two 6" long, 3/8" diameter, zinc coated eyebolts are attached vertically to the 19" pipe. The eyebolts link to 2" long, 1/4" diameter eyebolts that are connected to aluminum rods. The rod closest to the vertical pipe is 12.25" long and is connected to the hand mixer (West Blend 8-10 speed electric mixer Model # 41000-41100) using a hose clamp. The other aluminum rod is 8 3/8" long and is connected to a sewer drain filter (4" STY NDS 401) via a smaller eyebolt and a 1/4" bolt horseshoe. The sewer drain filter serves as the armrest and is lined by a 6" x 8" piece of 1/2" foam. The armrest and mixer are connected to each other with a 2" corner bracket. A 12" diameter Sterilite mixing bowl is attached to the base with Velcro tape (#90083) and is located directly below the mixer. The lid of the mixing bowl has a 9" diameter hole cut out of it to allow the beaters of the mixer to fit in the bowl, yet prevent splashing during use. The entire unit is easily disassembled and washed using bleach as a disinfectant.

Figure 13.12. Front View of Support and Guide for Use of an electric mixer.

A SCALE FOR WEIGHING A CLIENT WHILE IN THE WHEELCHAIR

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INTRODUCTION

Some individuals who use wheelchairs require frequent monitoring of their weight as an indicator of health. Many do not have the strength to stand on a floor scale to be weighed. And some are sufficiently fragile that removal from the support and safety of the wheelchair may place them in peril. A prototype scale was designed for monitoring the weight of a client who should remain in the wheelchair.

The wheelchair scale is meant to be a stationary weighing station located in a school or healthcare facility. It was designed to weigh the wheelchair with the client remaining in it, for a maximum total weight of 500 LB. All weights are accurate within $\pm 0.5\%$. The wheelchair scale consists of four parts: a ramp, a platform, a wheel stop and a weighing mechanism. Access to the platform is via a ramp. The ramp has a small angular slope to prevent disturbing the client in the wheelchair during access to the platform, and sides to prevent sliding off the ramp accidentally. The small angular slope of the ramp eases the effort of the assistant who is to push the client onto the platform and minimizes the drain on the electric battery of a motorized wheelchair. The platform has a wheel stop to prevent the wheelchair from rolling off the platform and to position the wheelchair correctly on the platform. The weighing mechanism consists of two ordinary 9-volt battery-operated bathroom scales aligned in parallel to distribute the weight evenly between them. The scale zero and weight LED display are removed from each scale, attached to a six-foot cable and mounted in a single plastic, electrical control box. A calculator is fixed to the top of the box; this provides the means for simply and accurately totaling the weight of the two LED displays.

To operate the scale, the two bathroom scales are placed on a hard surface and the electrical cable is plugged into the control box. The platform is placed on top of the bathroom scales. At the first weighing, only the wheelchair is weighed. The health care professional pushes the zeroing button of the control box and the wheelchair is rolled onto the platform. When the two LED displays indicate weight, the numbers for each display are summed using the calculator. The weight of the wheelchair is recorded and placed on a yellow tag, which is attached to the wheelchair. The same routine is then performed with the client in the wheelchair. The weight of the "wheelchair" is subtracted from the weight of the "wheelchair plus client"; this indicates the client's weight. By affixing tags to each individual wheelchair, the weight of each client can be monitored often without disturbing the client.

SUMMARY OF IMPACT

This portable scale appears to fit the requirements of the health care professional who must monitor the weight of wheelchair bound clients. The risk of injury during frequent lifting of clients, both to client and to healthcare professional, has been avoided. A clinically useful weight is obtained for medical records or patient trends.

The wheelchair scale has the additional benefits of incorporating easily replaced or repaired bathroom scales and an indestructible platform and ramp. The 9-volt alkaline battery of each bathroom scale should last a year. In the future, the two LED displays could be combined into a single LED display for added simplicity.

TECHNICAL DESCRIPTION

The wheelchair scale is composed of four main components: 1) a ramp, 2) a platform, 3) a wheel stop, and 4) a weighing mechanism.

Ramp: The ramp consists of ¼" thick, diamond faced, aluminum plate, 26" long by 40" wide. A 2" square is removed from two corners along a 40" side to form a "rear" side, i.e., side next to the platform. The two short sides are bent to 90° forming two 2" edges "up"; the shape is a "U" with diamond face on the inside and the large diamond face surface is designated "up". The edge between the two cut out squares form the rear edge of the ramp and it is bent downwards at a 90° angle. The ramp's rigidity is increased by arc welding a 21.5" long, 1" aluminum angle bar along the center and parallel to the bent sides of the ramp; the 1" angle is arc welded with both edges touching the ramp. The incline of the ramp is 4.40° and the height at the rear is 1.99".

Platform: The platform is constructed from ¼" thick, aluminum plate with diamond face on one side and smooth on the other; the diamond face is the topside or "up" side. The aluminum plate is cut 38" X 40". A 2" square is removed from two corners along a 40" side to form a "rear" side. The two long sides are bent to 90° forming two 2" X 36" edges "down"; the shape is an upside down "U" with diamond face on the outside of the "U". The platform is then bent downwards at 90° along the 38" side to form a 2" X 36" edge of the platform in the rear. The final size of the platform is 36" X 36". Four pairs of 5/8" holes are drilled in the platform for placement of the wheel stop pegs. Each pair of holes is located 3" behind the previous set starting at 25" from the front of the platform and ending 2" from the rear.

The platform's rigidity is increased by arc welding a 2" aluminum angle bar at the front and along center parallel to the edges; with these welded angle bars and the bent sides, the platform is sufficiently rigid. In addition, the four edges, one along each side, nearly touch the floor and, thus, are designed to prevent the platform from tipping as the wheelchair is rolled on in addition to providing rigidity.

Wheel Stop: An adjustable wheel stop prevents the wheelchair from rolling off the platform at the rear. Permanent 2" high sides on the ramp prevent the wheelchair from rolling off to the side. The stop is formed from an aluminum 2" angle bar cut 35" long. At the place where each hole is to be drilled, an aluminum plug, 1" high and 5/8" diameter, is arc welded to the platform. The plug and angle bar are drilled through producing a ¼" hole. Holes are spaced to align with the corresponding holes in the platform. A ¼" X 1-1/2" SS rod is tapped into the hole and extending ½". The angle bar can be moved to different distances from the rear edge by simply lifting and setting the bar in new holes.

All edges of the aluminum plate are smoothed and rounded by milling and sanding.

Electrical Weighing System: The bathroom scales operate by means of a picket fence disc and a spring. When weight is placed on the bathroom scale, the spring compresses. The compression causes the disc to rotate a number of degrees relative to the amount of weight on the bathroom scale. A photogate (photodiode) is connected to a counter chip that counts the amount of rotation of the disc; the degree of rotation denotes the weight upon the bathroom scale. A signal indicating weight lights the LED display.

The zero switch, nine-volt battery, LED display, photogate and circuit board of each bathroom scale is removed. The photogate is mounted on a new circuit board and reinstalled in the bathroom scale. The original circuit board is wired to a male nine-pin serial port plug. The zero switch, nine-volt battery, LED display and original circuit board are mounted in a plastic electrical box. A male, nine-pin serial port plug is wired in where the photogate output used to be. A 6', five-lead cable is connected at both ends to female, nine-pin serial port plugs. This cable connects the bathroom scale to the plastic electrical box. This arrangement allows the plastic electrical box to be easily placed on a table or for the bathroom scales to be reassembled should this ever become desirable. Two bathroom scales are initially placed under the platform; two bathroom scales have a maximum load of 500 lb. There is room for two additional bathroom scales under the platform for weighing a maximum load of 1000 lb.

Two scales were made. The cost for each final prototype is about $300.00.

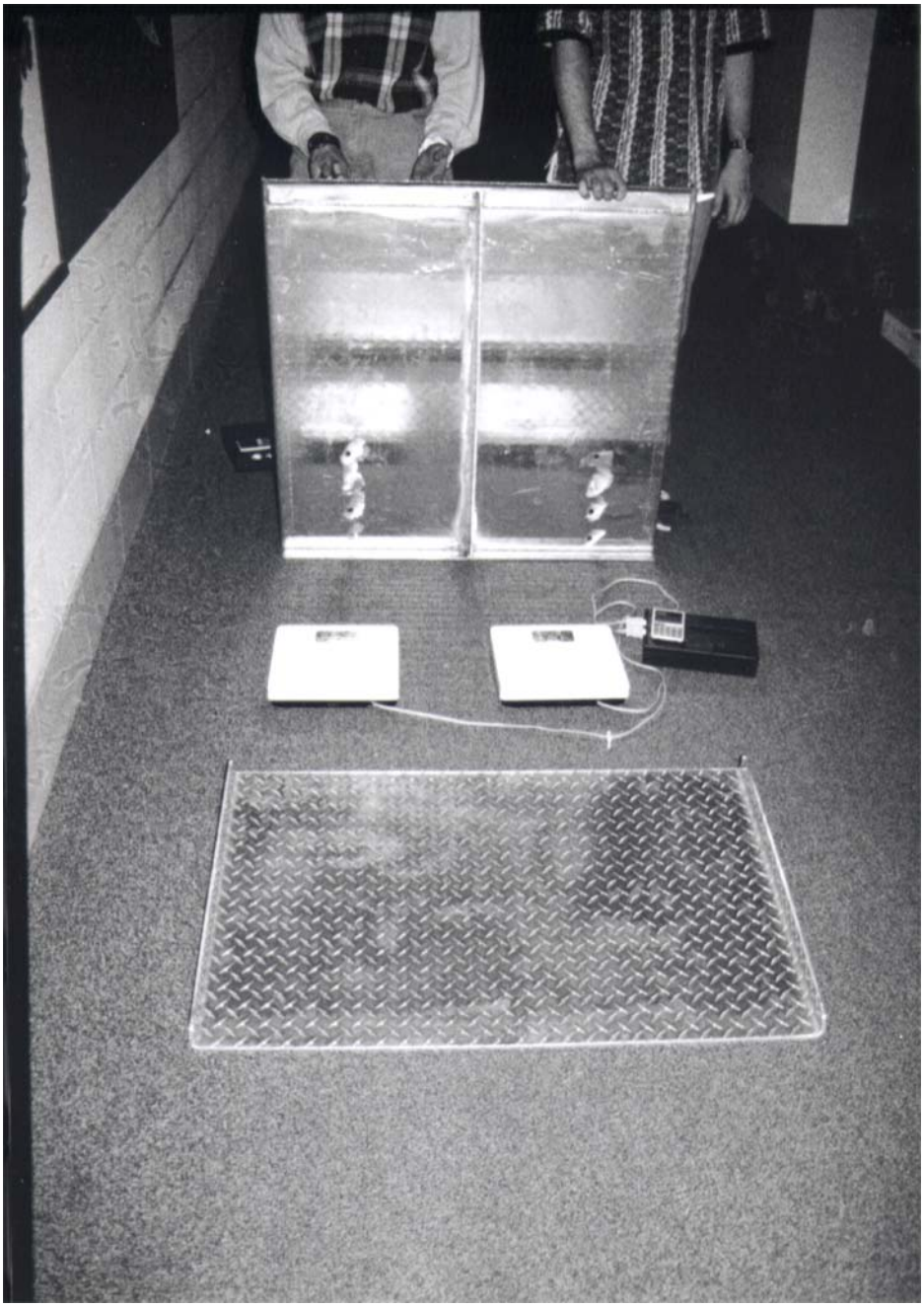

Figure 13.13. Bottom View of Platform.

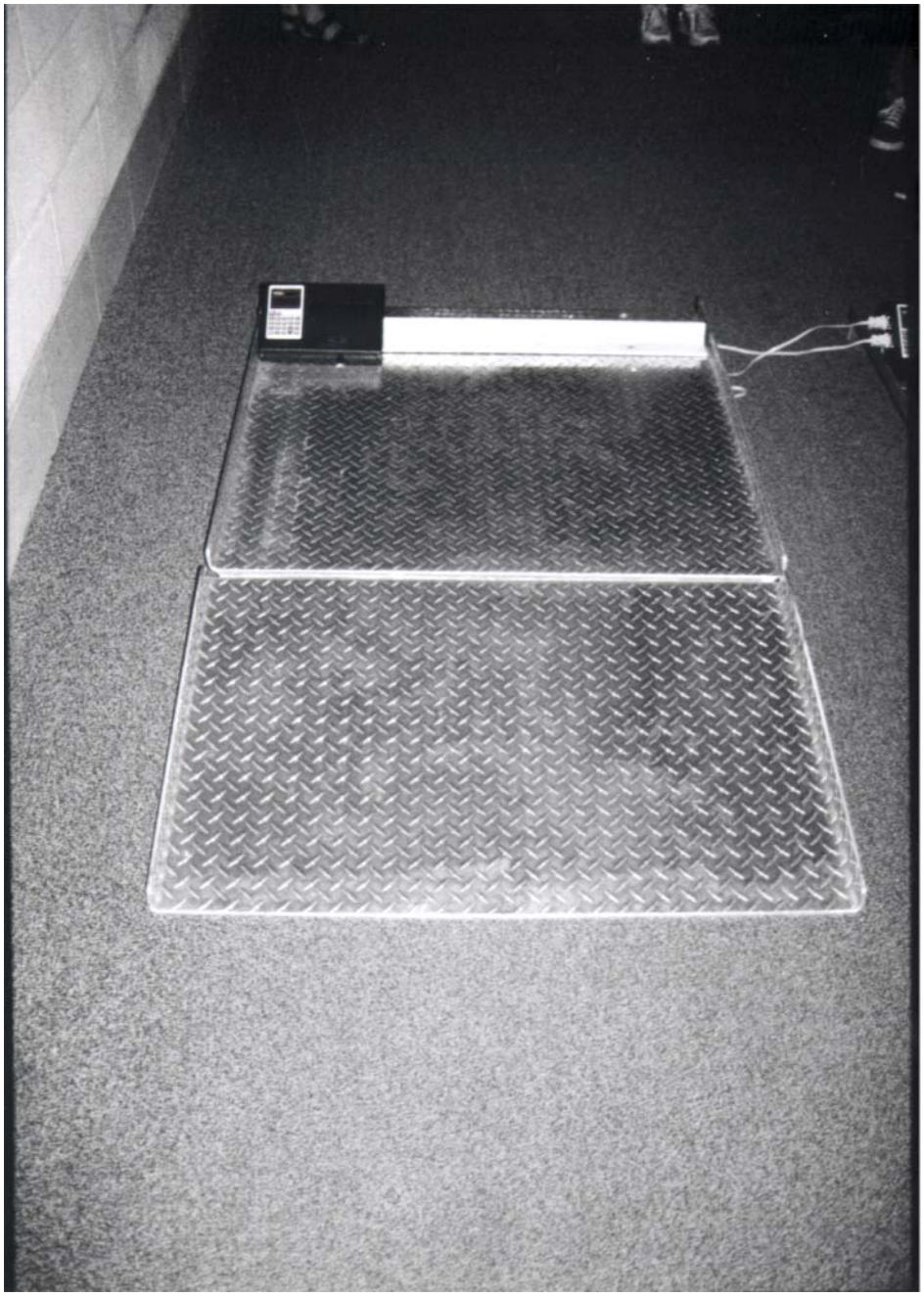

Figure 13.14. Top View of Platform and Ramp.

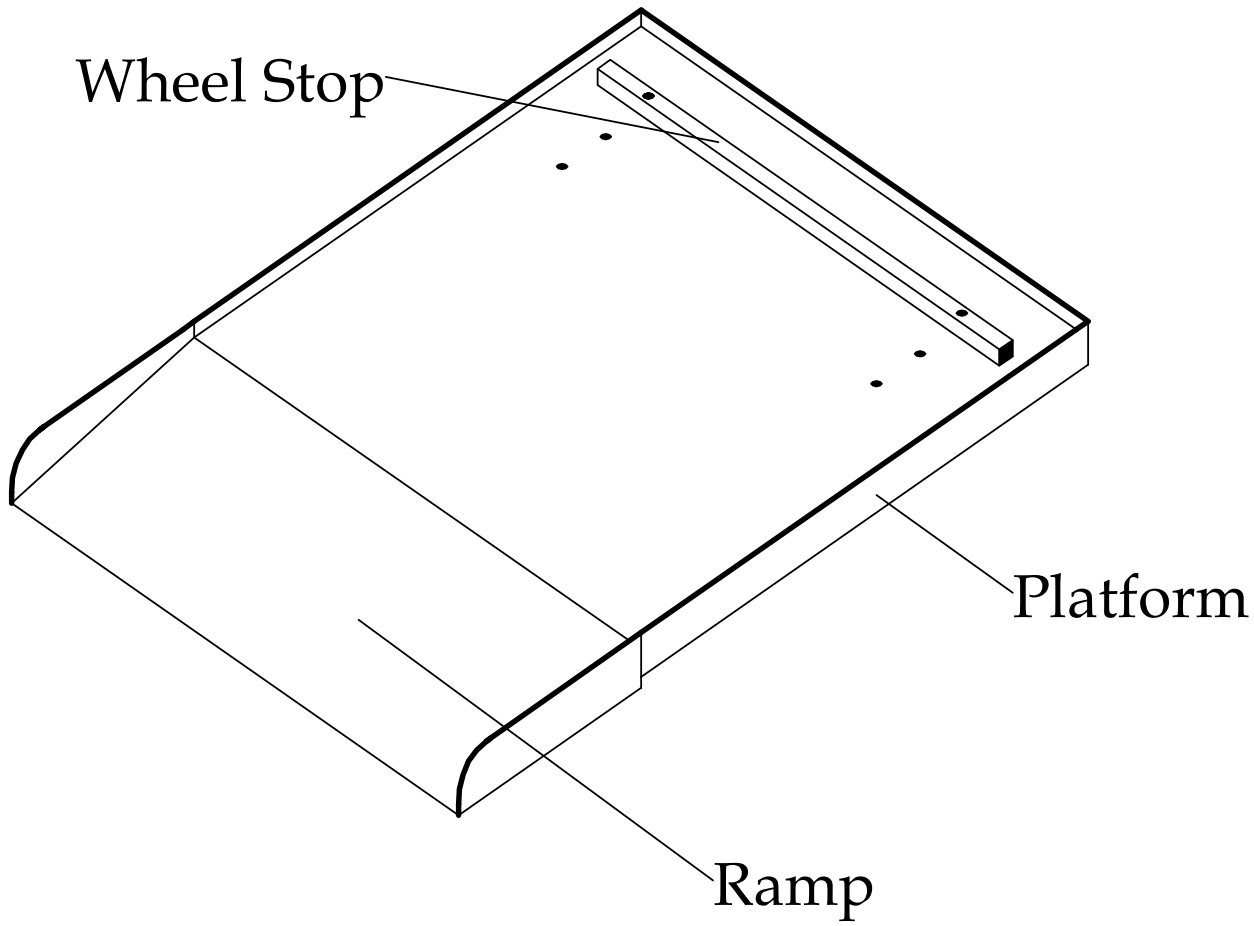

Figure 13.15. Schematic of Top View of Weighing Scale.