CHAPTER 14
UNIVERSITY OF ALABAMA AT BIRMINGHAM

Department of Biomedical Engineering
1075 13th St. S.
Birmingham, Alabama, 35294-4461

Principal Investigator

Alan W. Eberhardt, PhD (205) 934-8464

aeberhar@eng.uab.edu

OVER-THE-BED COMPUTER STAND

Designers: Hilary Hornbuckle, Nat Lavoy and Tony Seale
Client Coordinators: Laura Vogtle, Dept. of Occupational Therapy
Supervising Professors: Alan Eberhardt, PhD, B.J. Stephens, PhD1
Department of Biomedical Engineering
1Department of Mechanical Engineering
University of Alabama at Birmingham
Birmingham, AL 35294-4461

INTRODUCTION

An over-the-bed laptop computer holder was needed for patients at rehabilitation in a hospital. The clients who will use this apparatus have various impediments that require them to lay with minimal elevation or completely supine. Several requirements for the design were set prior to the design-phase of the project by members of the advisory team. The requirements to be met were that the apparatus: 1) be a stand-alone, portable unit, 2) accommodate the adjustability of bed heights, 3) be aesthetically pleasing, 4) be stationary while not in use, but quickly removable in case of medical emergency and 5) be compatible with most models of laptop computers. In addition, the monitor must tilt to at least 90 degrees. Safety is very important since the apparatus will support a monitor above the patient's head and upper body. Additional requirements were that the surfaces must be easy to clean, with the fewest possible seams in the integral construction and exposed edges rounded.

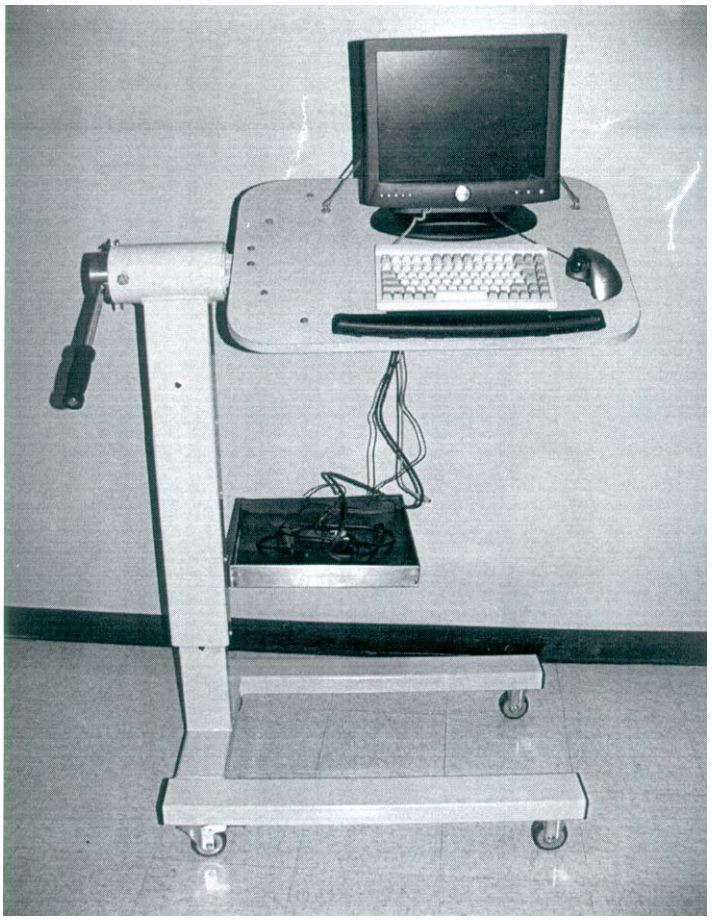

Figure 14.1. Over-the-Bed Computer Stand.

SUMMARY OF IMPACT

Most of the patients for whom this device was designed have been injured in car accidents or other situations that result in severe injuries to the spine, pelvis or lower extremities, immobilizing them for weeks or months. Many of the users are professionals who must complete work while in the hospital, and some wish to use their laptop computers. The computer holder successfully provides the opportunity to work on a computer while bedridden, and also enables additional leisure opportunities other than television. The patient's laptop sits on the lower tray and links with the monitor, which is permanently attached to the tray, along with the keyboard and roller mouse. The assisting nurse positions the device over the client's bed and establishes the angle position of the monitor using the handle at left and locking pin.

TECHNICAL DESCRIPTION

The overall structure of the device is modeled after a hospital food serving apparatus. The working surface cantilevers over the bed, supported on a base with casters, as shown in Fig. 14.1. While in use, the table is kept stationary using total-lock casters at the rear, which prevent both swivel and rotary motion. Height adjustment is achieved through telescoping tubing. The outer tube is three by five inch, 11 gage steel and the inner tube is two by four inch 11 gage steel. An ultra-high molecular weight polyethylene bushing is cut to fit between the two tubes. A power screw lifts the tabletop and attached monitor, keyboard and mouse.

Tilt of the apparatus occurs in the tabletop portion of the device and is achieved through use of two concentric pipes. The outer pipe is welded to a vertical column and remains stationary. The tabletop is bolted to one inch by one inch tubing with ¼ inch galvanized steel carriage bolts. The one by one inch tubing is welded onto a plate and then welded into the inner tube. On the back end of this inner pipe a lever is attached for use as a handle for turning. Aluminum-bronze bushings are press-fit into each end of the outer pipe. A ¼ inch 18-8 stainless steel pin that is inserted at the back end of both pipes provides the stop for the tilting mechanism. Pinholes are drilled at 0°, 30°, 60°, and 90° along the inner pipe and one hole is drilled at 90° in the outer pipe for positioning the tabletop at these angles. A safety stop allows the device to rotate through only 90° of motion, and is engaged if the tabletop is dropped while in use.

To meet the compatibility requirement and to decrease safety hazards, a flat screen monitor is attached to the tabletop. To ensure safety, cables are attached from the monitor to the tabletop. These straps prevent the monitor from falling onto the patient if the monitor support bracket fails. The patient's laptop sits in a stainless-steel shelf provided along the vertical column of the table. A power strip is attached to the vertical column for the laptop and monitor.

All metal components are painted light gray. The tabletop is cut from countertop laminate material and is a light gray to match the stand. The tabletop is edged in matching laminate material and is rounded at the corners. End-caps are used on all tubing.

Total cost was $1306.18.

CHILD BATH LIFT

Designers: Kristen Bridges, Cahalan Mackin, and Marty Sims
Client Coordinators: Marlese Delgado, UCP Hand-in-Hand
Supervising Professors: Alan Eberhardt, PhD, Raymond Thompson, PhD1
Department of Biomedical Engineering
1Department of Materials Science and Engineering
University of Alabama at Birmingham
Birmingham, AL 35294-4461

INTRODUCTION

A bath lift was requested for children with cerebral palsy (CP) to be used in the home. The design team was given the task of designing a device that would lift a child having little or no muscular control into and out of a bathtub, without causing harm to the child. Design constraints included: 1) child weights ranging from thirty to fifty pounds, 2) child heights ranging from two and a half to four feet tall. Requirements were that materials, components, and systems: 1) be compatible with a bathing environment, 2) not present a safety hazard for the child or the caregiver, 3) be able to fit and operate inside a home bathtub (16 to 17 inches inside width and 38 to 44.5 inches inside length). Because the children who will be using this device have little to no muscular control, there were to be head and body supports that fit the individual child. Lastly, the device was to be portable.

SUMMARY OF IMPACT

The primary impact of this device was to enable children to take baths who, due to their disabilities, may have been prevented from doing so in the past. This is important in terms of maintaining proper hygiene. Taking a warm bath provides pleasurable sensory input for the child and may even be considered play activity. A secondary benefit of the device relates to the caregivers. Many caregivers of children with disabilities suffer from back pain as a result of regularly lifting a heavy child in and out of the bathtub. The present device, which lifts the child to a height level with the top of the bathtub, reduces the amount of back strain experienced by the caregiver.

TECHNICAL DESCRIPTION

The Child Bath Lift is a mixture of commercially available equipment and custom fabricated parts. The commercial products include a water-powered bath lift mechanism (Sunrise Medical) and a shower chair (Rifton Medical Supplies). The water-powered lifting device fits into a custom-made base, constructed from 6061-T6 rectangular aluminum tubing and lifts the frame and chair (Fig. 14.2). The base consists of a rectangular aluminum tube with two arms welded on either end. Four suction cups support the arms-one on each end. A nylon bushing is located near the end of the rectangular tube into which the hydraulic tube is placed. Stainless steel bolts attach the chair to the frame, constructed from 6063-T52 square aluminum tubing, and attach to the tube by means of aluminum brackets and stainless steel bolts. The brackets are welded to the tubing and the seat is subsequently attached.

The lift mechanism has a hose that attaches to the water faucet in the bathtub. Turning on the water causes the chair to rise in the tub to the height of the bathtub edge. At this point, the child is easily placed on the chair and various restraints are used to secure the child to the chair. A water release valve allows the chair to slowly descend into the tub. The caregiver is responsible for ensuring that the water is the proper temperature and depth; however, the seat was designed so that the child's head could never be below water level, even if the tub were completely full.

Total cost was approximately $1200.00.

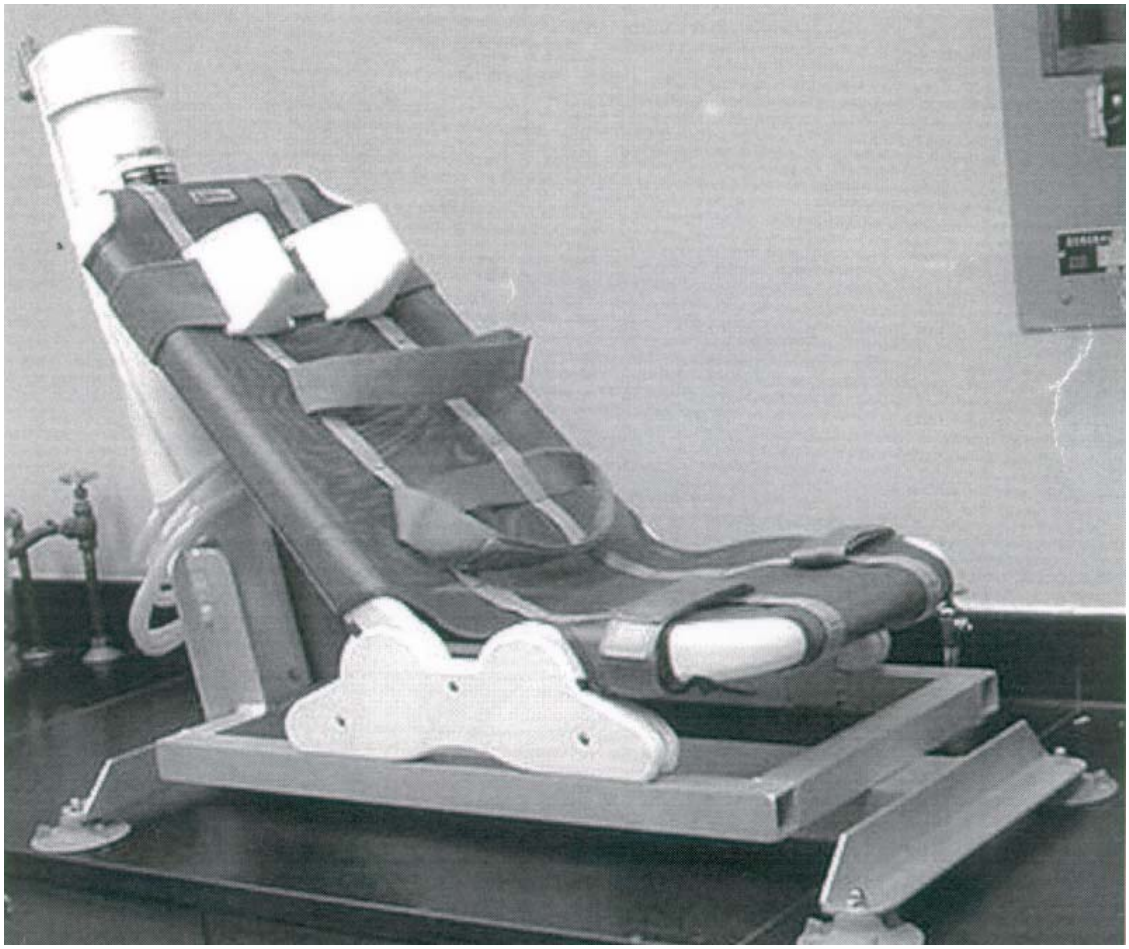

Figure 14.2. Child Bath Lift Including Base, Tube, Frame and Chair.

COFFEE BREWING SYSTEM FOR CLIENT WITH CEREBRAL PALSY

Designers: Bradley Bingert, Nadia Wright, and Kip Carlisle
Client Coordinators: Laura Vogtle, UAB Occupational Therapy
Supervising Professors: Alan Eberhardt, PhD, Raymond Thompson, PhD1
Department of Biomedical Engineering
1Department of Materials Science and Engineering
University of Alabama at Birmingham
Birmingham, AL 35294-4461

INTRODUCTION

The present design was developed specifically to benefit a young woman who has cerebral palsy. She enjoys coffee and wished to have a device to help her pour her own cups of coffee throughout the day. The client has a non-spastic form of the condition and could potentially carry out many of the tasks associated with brewing coffee, provided suitable automated mechanisms were designed for her use.

The primary objective of this design was to produce a device capable of providing the client with a means of dispensing coffee at a temperature between 105 and 125 degrees Fahrenheit. The coffee was to be delivered into a drinking container that is spill resistant and compatible with a straw. In so doing, the coffee maker was to satisfy the following conditions: 1) difficult to overturn (should withstand a force of 50 lbf to any surface that requires contact for operation), 2) actuation mechanisms easily cycled by the client, 3) fits into current residence with a minimum of disturbance to the current arrangement, 4) has a positive placement device such that the drinking container is stable while coffee is being dispensed, 5) requires at least one lbf be applied to the container to remove, and 6) conforms to all applicable codes and standards.

SUMMARY OF IMPACT

The present device allows the client autonomy to perform a task for which she previously had to depend on the assistance of others. This allows her to receive the pleasures of coffee at any time and cut down on the use of personal care assistants.

TECHNICAL DESCRIPTION

The control system is divided into three major subsystems: 1) brew, 2) heat and 3) dispense. The brew subsystem is perhaps the most complex, since the brew cycle consists of filling a tank with water, heating that water to the temp necessary to produce coffee, and then returning to the off state to save power and increase safety. The heat subsystem is placed on a timer so the client would not be required to actively return the device to an off state. Beyond the timing circuit, this subsystem consists of an electrical resistance heater and a thermostat to regulate the output of the heater. The dispense system consists of a solenoid actuated ball valve. A relay has been placed in between the user-actuated switch and the valve to handle the relatively high current loads required by the solenoid. Throughout the electrical design of the device, safety and ease of use were the utmost priorities. The device is designed to be actuated using only three switches. These switches are large push-button style and are easily managed by the client. The circuit design assures that the device would return to an off state after a set period of time without user intervention.

The cup is a 14 ounce model and the cup holder is constructed from 6061 T6 flatstock, which is easy to form and heat treat in the desired shape. An electrically controlled ball valve is the dispense valve. The exterior casing is fabricated from stainless steel, for looks and durability, as well as ease of bending.

Total Cost $1262.79.

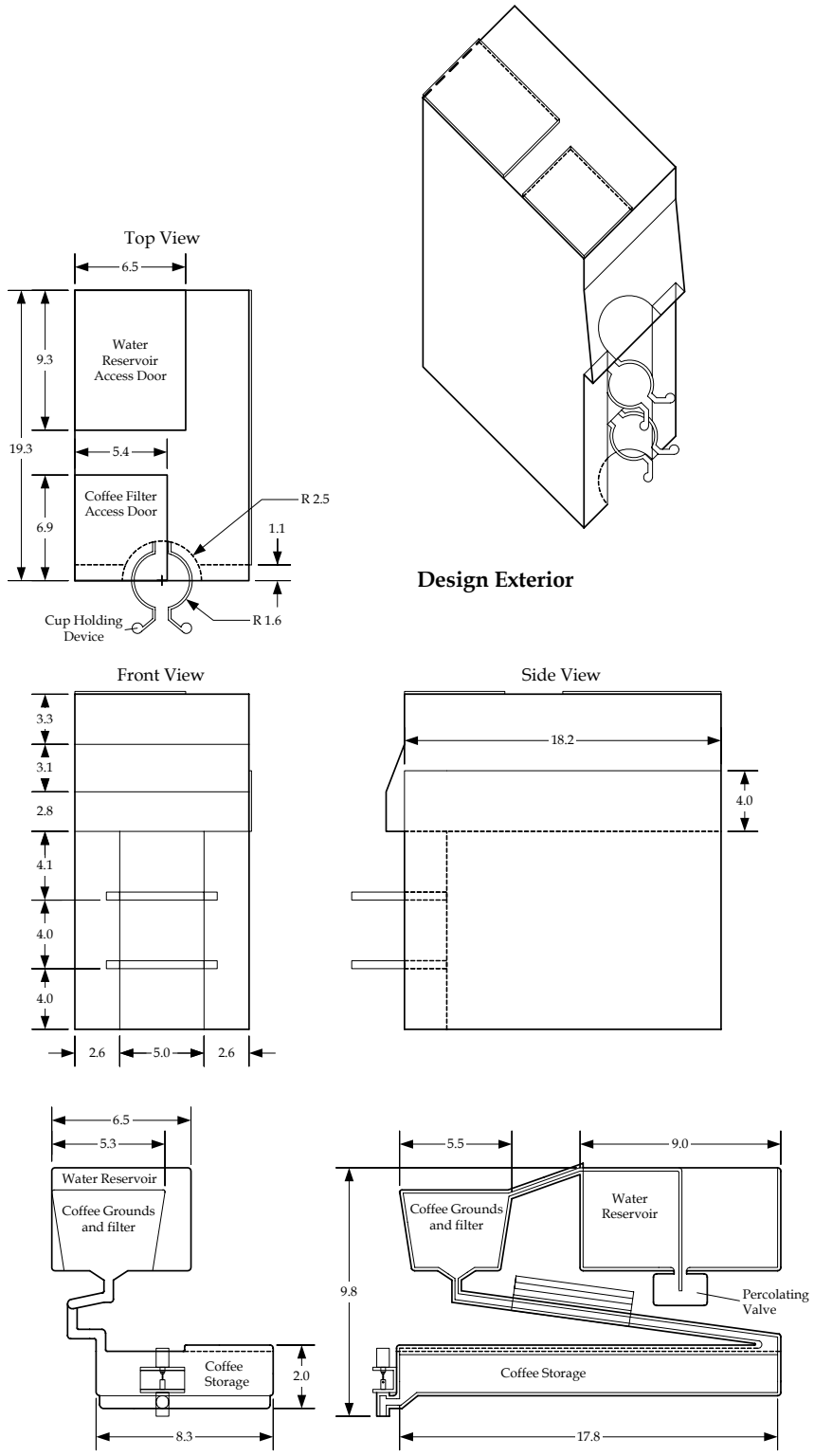

Figure 14.3. Coffee Brewing System Schematics for Exterior Casing (top) and Internal Brewing/Dispensing System (bottom). All Units Shown in Inches.