VERSATILE PAINTING SYSTEM: AN ARM SUPPORT AND WRIST ATTACHMENT FOR PAINTERS WITH LIMITED MOBILITY

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INTRODUCTION
Lack of adequate muscle control caused by cerebral palsy (CP) interferes with some artists’ ability to draw and paint. The first part of the Versatile Painting Solution consists of a support system that mimics the movement of an arm. This helps to prevent difficulty with painting and drawing due to limited mobility. The support system is made to easily attach to the side of a wheelchair. It is adjustable in terms of height, arm length, and positioning angle. The arm rests in a comfortable support to allow for an extended painting session.

The second component of the Versatile Painting Solution Support System is a wrist attachment. This element is designed to provide a mechanism for optimizing marker control. The wrist attachment is a modified wrist guard that has a comfortable fit. The art of painting requires fine motor skills and precise movements; however, some patients with CP lack this motor control, and therefore, require assistance from outside sources. The support system, coupled with the wrist attachment, make up the Versatile Painting Solution. These devices operate collectively to enhance the artistic experience.

SUMMARY OF IMPACT
The task of painting with limited hand and arm mobility requires the attention of an aid. This support was designed for a client that needs an aid to hold his arm extended towards the canvas while brush strokes are made with small movements of his wrist. This device allows more independence for the artist and requires less physical attention from the aid. The aid can make adjustments to the joint position and the support will remain static while the artist works on one part of a canvas. The wrist attachment allows a marker to be held at the wrist with maximum comfort.

TECHNICAL DESCRIPTION
The Articulating Arm Positioning Support (Fig. 14.1 and 14.3) is a device designed for a user to rest his arm on during painting. The cushion will provide support for the user’s arm and allow for a longer, easier, and more satisfying painting experience. The device features an ergonomic design with a molded composite arm support. The fiberglass composite support is a lightweight and durable material that can endure the stress of everyday use. The aluminum stock and joints provide a lightweight structure to support several ranges of motion that include movements from side to side, up and down, adjustable arm angle, and even rotation.

The Articulating Arm Positioning Support features a variety of mechanisms to maximize the amount of positions available for a user in a wheelchair. Two ultra-high molecular weight polyethylene linear slides offer a durable low-friction method to adjust the height and side position of the support. These
slides are durable and long-lasting because they are constructed with such a quality plastic. The five locks allow the device to be positioned in the exact necessary support position and also offer a method to adjust the device quickly and easily. The three joints in the support provide many supporting positions and also allow for easy no-lock positioning adjustments. Each joint uses a special bolt that rests on a bushing to prevent loosening of the bolt caused by vibrations and operation. The bolts sit in straight brackets that reinforce the structure and contain the brass bearings.

The device features an ergonomic molded composite arm rest. The fiberglass arm rest was made with nine layers of fiberglass mat and polyester resin. The composite rest is covered with foam cushioning and a durable cloth cover that provides a comfortable resting surface. The device can be optionally attached to the arm by Velcro and elastic straps. The cushioned arm rest has a 360 degree swivel mechanism which allows the support to be adjusted to the ideal position. The swivel is designed with three durable 1 1/8" nylon washers. It has integrated Velcro straps for additional support.

A heavy-duty clamp was added to the design to interface with a variety of wheelchairs. The clamp is a compact design that can be easily adjusted by the user with a comfortable knob. The clamp has a duty rating of 30 pounds. This is sufficient to accommodate the weight of the support infrastructure as well as the arm of a 300 pound person. The clamp requires a small amount of force for any adjustment allowing a quick and easy connection to the wheelchair.

The wrist support, with small spring action dial attached, provides comfortable structure. The wrist attachment is shown in Fig. 14.2 and 14.4. The dial allows for angle adjustment of the marker by pulling out the tube and twisting it into the notches. The PVC tube tightens down on the marker and fits into the dial with a spring. Hollow PVC tube with a small inner diameter was used for the dial. The inside was machined out to provide a shelf for the spring compression. Holes were machined onto the flat surface of the PVC in order to provide adjustment slots. Notches were added to a smaller piece of PVC that holds a marker. Wing nuts are the clamping mechanism that keeps the marker stable in the tube. The spring is on a bolt that is inside the dial and connects to the marker tube. This whole subunit is fastened securely to the wrist guard. A marker is clamped into the tube then the tube can be pulled out and rotated to a proper drawing angle. The spring holds the marker securely in place allowing the artist to comfortably draw from the wrist level.

The approximate cost is $600.
EASELECTRIC: AN ELECTRICALLY CONTROLLED EASEL FOR PATIENTS WITH LIMITED DEXTERITY AND MENTAL DISABILITIES.

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INTRODUCTION
The Easelectric is a unique electrically-powered easel capable of assisting an artist with the placement and positioning of a canvas. Using a single joystick, the artist is able to move the canvas horizontally and vertically as well as tilt the easel toward and away from himself. In addition, a linear tracking system allows the entire easel to slide along its base and be moved closer to the user. The easel (shown in Fig. 14.7) was designed to be simple and compact, yet sturdy. It was created for a client with cerebral palsy and limited dexterity who had difficulty reaching all areas of a large canvas. Using the easel, an artist is able to remain stationary and bring the inaccessible regions of the canvas within his range of motion.

SUMMARY OF IMPACT
The project specifications required that the easel be able to safely operate within a community of individuals with mental retardation and developmental disabilities (MRDD), and every aspect of the easel was designed to meet those specific needs. Due to the limitations that individuals in this community experience on a daily basis, art has become a very influential part of their lives and allows them to express themselves in beautifully imaginative ways.

The program’s vision is as follows: “To create and live out a best practice model for collaborative art making between artists with and without development disabilities. This new mindset demonstrates that creativity is innately a part of all people and recognized that art enhances the quality of life and strengthens communities.” The Easelectric project is significantly influenced by this vision and is meant to help these talented artists achieve the program goals.

TECHNICAL DESCRIPTION
The design for the easel involves a square base that is attached to a series of aluminum frames, which are attached to the table on which the easel is mounted. The base of the easel is clamped to the table with an adjustable screw clamp assembly (Fig. 14.8). This provides added stability to the device, keeping it sturdily attached to the table while the client is painting. The adjustability of the clamp allows for the accommodation of different sizes and shapes of tables. Besides providing stability, the base of the easel also allows for the canvas to be manually adjusted closer to the user by means of aluminum extrusion and ultra high molecular weight polyethylene linear bearings (UHMWPE). Additionally, using a joystick, an artist can control the tilt and vertical placement of the canvas, which
is controlled by two 165-lb force, 12-volt DC linear actuators, each which has a stroke length of six inches. The horizontal placement is controlled by a small 12-volt DC gear motor connected to a 24-inch screw drive.

Aluminum was chosen as the ideal building material due to its low weight, high strength, relative inexpensiveness, and resistance to corrosion. As a result, the easel is extremely strong and weighs only about 50 lbs. To further reduce corrosion and also enhance the aesthetics of the easel, portions were painted blue using a corrosion-resistant paint.

The joystick used for the easel was custom-made for the project and included four micro-switches activated by the joystick’s position as well as a large thumb rocker switch mounted in the top of the handle. The large joystick and rocker switch make moving the easel simple for a person lacking fine motor skills. The joystick connects to the easel via a standard 9-pin serial cable (see Fig. 14.9) and the switches activate a number of relays on the easel. The actuators and screw drive control the movement of the easel and operate at around one per second, allowing the artist to move the canvas to its desired position.

Exposed wiring was kept to a minimum in order to ensure safety. The relays, circuit breakers, and power supply are safely housed in an enclosure designed to isolate any potential electrical dangers. The device plugs into any grounded 120-volt AC wall outlet.

The approximate cost of parts and materials was $815.
INTRODUCTION
The Human Integrated Gripping Device is a universal device that allows users with limited hand strength and dexterity the ability to perform everyday tasks. This project is specifically aimed at helping those who are living with disabilities as a result of stroke. The device facilitates the user’s ability to grasp objects. Products currently on the market do not integrate the user’s hand into the device. Instead, they replace the hand. The Human Integrated Gripping Device is user friendly, light, and functional. These objectives are accomplished through a mechanical ratchet mechanism design that enables the user to adjust his or her degree of gripping with a lightweight and user-friendly system.

SUMMARY OF IMPACT
The Human Integrated Gripped Device was designed for a client who had a stroke. Because of the stroke, the client lost hand strength and, consequently, the ability to maintain a grip with sufficient strength for a prolonged period. A glove system allows the user to grip objects. The user hopes to have sufficient grip to swing a golf club, sweep the floor, and rake the lawn.

TECHNICAL DESCRIPTION
The Human Integrated Gripping Device is comprised of three components: 1) the ratchet mechanism; 2) the release mechanism; and 3) the glove interface. The following paragraphs describe these sections in more detail.

THE RATCHET MECHANISM
The ratchets are the basic core of this device. They function by allowing motion to proceed in one direction (indicated in Fig. 14.10). The user is able to close his hand, and once closed, the hand is locked into position. This is possible because the teeth on the ratchet, combined with the pawl, restrict any movement in the opposite direction.

THE RELEASE MECHANISM
Once the user wishes to release his or her grip he or she simply pulls on the strings of the release mechanism (seen in Fig. 14.11). The release mechanism is comprised of tubing inside of which Kevlar strings run, connected to each pawl. The tubing of the release mechanism is attached to the inner glove to prevent shifting of the tubes, which could result in decreased effectiveness. One way the tubes are attached is by sewn supports similar to that of the ring supports. Multiple locations along the length of the tubing are stitched to the inner glove, encompassing all three tubes per release mechanism. This helps keep all the tubes not only bundled but also in the correct position for optimal functionality. As the user pulls on a string, the corresponding pawl is pulled backwards, releasing the contact between the pawl and the ratchet surface. This enables the user to freely move the joint in question, allowing the segment to straighten. This process is repeated for each joint until the hand is released.
THE GLOVE INTERFACE
The inner workings of the device are unseen to the user in the final product. The user simply sees the glove interface as seen in Fig. 14.12. The user pulls these strings to release the device. There are two release holes located on either side of the outer glove that allow the Kevlar strings from the inner release mechanism to come through to the outer glove. For the release strings to be secured to the outer glove, two rubber rings are attached approximately two inches away from the release holes, towards the wrist. These rings are attached by sewing supports. The release strings are tied to these rings, forming a closed loop and preventing any dangling strings.

The cost of parts and materials was about $180.

Fig. 14.11. Release Mechanism.

Fig. 14.12. Glove Interface.