



# CHAPTER 14

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# ALY CONTROLLED ART EASEL

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## INTRODUCTION

The client is a 44 year-old man with cerebral palsy, dysarthria, moderate cognitive impairment, visual acuity trouble, limited dexterity, and limited upper body movement. He is an avid painter and continues to produce high quality work. Since his conditions limit the range of motion in his upper body, he is limited to smaller paintings. The client desires a devise that provides him with the ability to access larger works of art from a stationary position.

In order to satisfy this request, it determined that a movable easel provides him with a better platform from which to paint. The device is electromechanical in nature and provides the movement of the canvas through linear actuators. A joystick controls the movement. The entire easel is small and light enough to provide easy storage and not be overwhelming to the user. A photograph of the easel is shown in Fig. 14.1.

## SUMMARY OF IMPACT

This client relies on painting as a way of expressing himself and his talents. Painting has also provided him with a productive means of income, as his paintings have been selling for increasingly higher sums of money. The design provides the client with an easel that allows him to paint larger works of art.

## TECHNICAL DESCRIPTION

While many easels are produced, there are a limited number that adjust to or conform to a person using a wheelchair. Most easels have obstructions regarding the amount of legroom underneath the easel. The most common solution to this problem is a table-top version of the easel, which in this case did little to aid the user in the amount of area desired to be covered and was also insufficient in not having adjustable tilt capability.

The devise moves the canvas horizontally to enable the client to stay in a stationary position. It also tilts



Figure 14.1. Assembled Easel and Joystick Control

the canvas towards and away from him, giving him the ability to paint at any angle that best suits him. The angle of tilt also allows the client to see his canvas from different perspectives, which can be important when creating larger works of art. Sufficient legroom is also supplied

The easel consists of an electromechanically driven easel mounted onto four detachable legs. A linear actuator with a 12-inch stroke length powers the horizontal movement, while the degree of tilt is driven by a linear actuator with an eight-inch stroke length. All of the operations of the easel are internally controlled by a microcontroller which is

integrated into a design circuit. Tactile user control is provided via joystick mounted in an ergonomically desirable position on the final easel frame.

Certain safety features included are limiting switches that determine maximum tilt or movement. A microcontroller program has the ability to use the limit switch inputs and override the joystick control should it still be actuated.

The joystick controls the horizontal and tilting motions. The signal from the joystick is relayed to a microcontroller that processes a signal and produces output that controls the linear actuators. The joystick requires a minimum of two degrees actuation to produce a sufficient voltage change when in use. The microcontroller is programmed to recognize this voltage change and output the correct action for the linear actuators.

All movements of the easel frame are provided by two linear actuators. A 12 inch horizontal linear actuator provides horizontal movement across two linear rails. A second actuator (eight-inch) controls

the angle of tilt of the easel frame. Both linear actuators are able to power loads up to 100 pounds. Operating at 12 volt DC, speed is 0.5 inches per second, which is an acceptable speed for the client. These linear actuators also contain an internal limit switch that recognizes the limit of movement and shuts them down in case of overextension. There is a system of linear rails and bearing/pillow blocks that guide the actual movement of the device itself. These actuators are shown in front and elevation view respectively in Fig. 14.2 and 14.3.

Paintings ranging from eight by eight inches to 30 by 30 inches are accommodated. The frame material is aluminum. The base material is also aluminum, and provides the platform for the rail system as well as the electrical circuit and joystick. The base can be a tabletop element, or with its attachable legs it can be configured as a freestanding easel with 30 inches of ground clearance for the wheelchair. Power supply is standard 120 VAC. Since the actuators operate on 12 Volts DC, proper transformation of power is provided.

The cost of this project is \$980

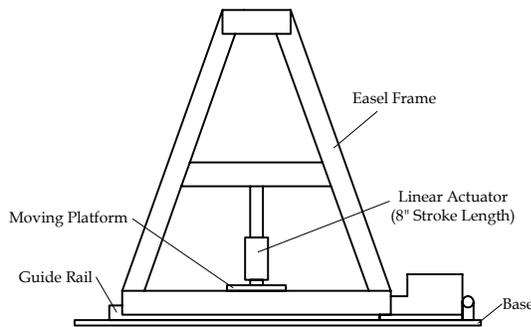


Figure 14.2. Front View Schematic of Easel.

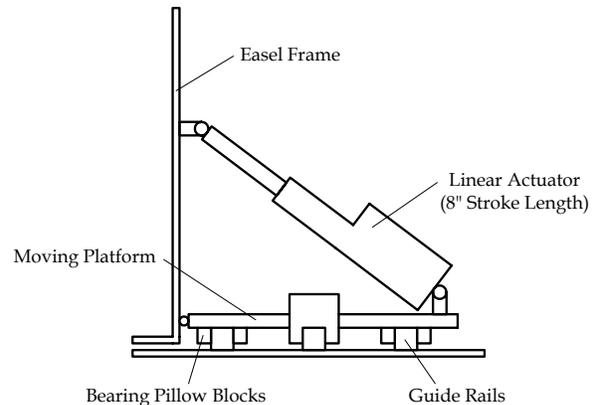


Figure 14.3. Side Elevation of Easel.

# CONTROLLED AND ADJUSTABLE ART TABLE

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## INTRODUCTION

Existing models of art tables are not ideal for artists with disabilities. There is not always sufficient space underneath the tables to allow room for a wheelchair and for the artist's feet. The table is being designed for any person who uses a wheelchair and has limited mobility. People with conditions such as cerebral palsy, multiple sclerosis, or paralysis are examples of those who would benefit from this product.

## SUMMARY OF IMPACT

For most people, arts and crafts such as drawing or painting seem like a relatively simple task. For certain artists however, sitting at a table to draw or use an easel to paint is not easy. These certain artists have limited motor skills in such areas as strength, dexterity, and range of motion. Limitations may place them in wheelchairs where a height adjustable art table would be useful. The Art Table is catered to fit various size wheelchairs and allow enough room for the clients' feet. The artist uses an electronically controlled device to adjust the table height.

## TECHNICAL DESCRIPTION

In order for the table to be easily adjusted by the artists, it is operated by a momentary rocker switch. Depending on the direction chosen by the artist, the table moves up or down. Several motors powered by a battery move the table vertically. A microprocessor is also used to give the correct commands to the motors. The table reaches a minimum height of 28 inches above the ground and a maximum height of 40 inches. A photograph of the completed table is shown in Fig. 14.4 below.

The adjustable table operates using a 12 Volt battery. A 5 V regulator is utilized to step down the voltage for the microprocessor system- in this case a PIC16F87. A switch operated by the user adjusts the height of the table. The microcontroller interprets



Figure 14.4. Adjustable Art Table

this information using an assembly program written in MPLab. Output is amplified and sent to two linear actuators. The actuator on each leg of the table moves the table vertically in the direction desired by the artist.

Most of the table is constructed of aluminum. It provides a sturdy, yet lightweight surface to do artwork. The tabletop is in the shape of a rectangle with a surface area of 180 square inches. Along the outside edge of the table is a strip of rubber to

provide a “softer” table edge. The legs of the table are also fabricated from aluminum. There are two table legs, each six by six inches and about 16 inches high. On top of the legs is a half-inch plate fixed to the linear actuators. Another plate is fixed to the underside of the table and attaches to the other end of the actuators.

Two electromechanical linear actuators that allow 12 inches of movement power the vertical movement of the table. These are Duff-Norton actuators, operate on 12 VDC and can support a load of 100 pounds.

They operate at a speed of 30 inches per minute (0.5 inches/second). Included with the actuators are fully adjustable limit switches. The limit switches are set to stop the motion of the actuators at any point providing a safety feature to prevent the table from moving too high or too low. A schematic of the actuator system is shown below in Fig. 14.5.

The total cost of the Adjustable Art Table is \$732.

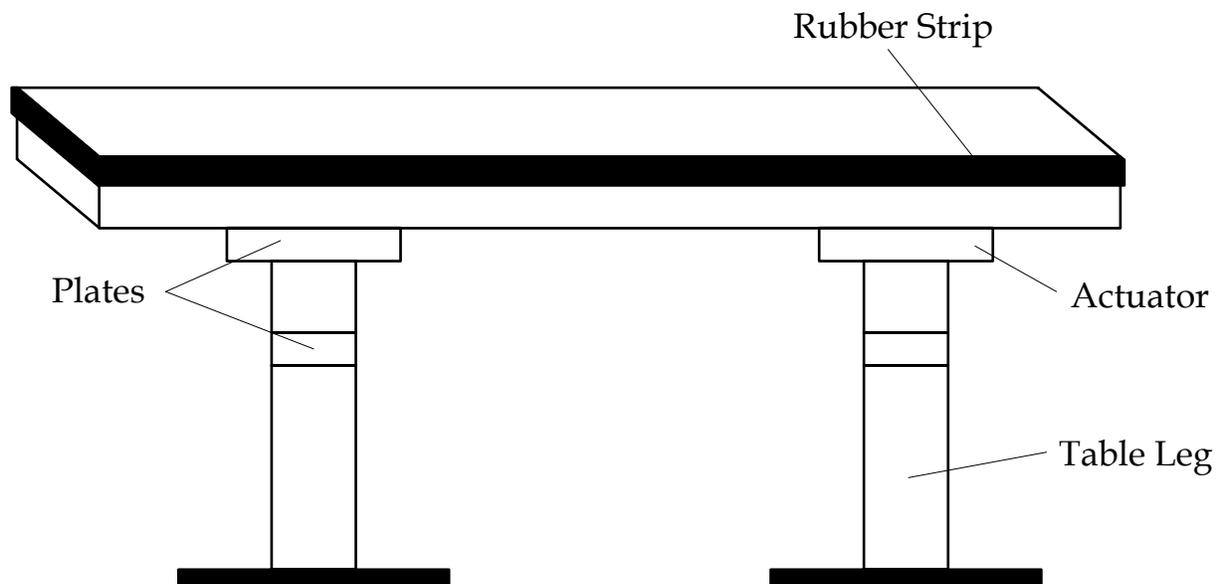


Figure 14.5. A Line Drawing Assembly of the Adjustable Art Table.

# CONTROLLED AND ADJUSTABLE EASEL

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## INTRODUCTION

Existing models of easels are not ideal for artists with disabilities. Many disabled artists find it difficult to bend over or reach the easels they are using, since most easels are designed to tilt away from the artist. This easel is designed to tilt towards the user. The easel is being designed for anyone who uses a wheelchair and has limited mobility. People who have cerebral palsy, multiple sclerosis, or paralysis are examples of those who would benefit from this product.

## SUMMARY OF IMPACT

For most of us, arts and crafts such as drawing or painting seem like a relatively simple task. For certain artists however, sitting at a table to draw or use an easel to paint is not easy. These certain artists have limited motor skills in such areas as strength, dexterity, and range of motion. These limitations make it difficult to do things such as reach out and touch an easel to paint. The easel can project forward and tilt at various angles. This prevents the artist from having to bend over or reach out to the paintings to work.



Figure 14.6. Easel Board.

## TECHNICAL DESCRIPTION

The easel projects forward (toward the artist) and vertically tilts from zero to forty-five degrees. It consists of a momentary contact rocker switch to allow the artist to position the easel in the most comfortable position. The switch causes an electromechanical linear actuator attached to the back of the easel to extend, while the bottom of the easel remains fixed to a hinge. This results in the easel tilting forward toward the user. The easel is able to attach to various size canvases and has restrictions based on the angle of tilt and rotation. Its main purpose is to tilt forward or back, so there will not be a need for a wide range of movement in other directions.

The easel consists mainly of an aluminum board on which the canvas rests. This is the part that tilts toward the user. The back of the board is attached to a stand in two places, one at the top edge of the board, and one at the bottom, both centered with respect to the width of the board. A hinge at the bottom acts as the point of rotation.

A linear actuator attached to the stand and the easel board provides the power to adjust tilt. The actuator is powered by 12VDC. The particular electromechanical linear actuator utilized is a Duff-Norton that can move 100 pounds a distance of 12 inches at .5 inches per second. This actuator is seen in Fig. 14.7.

The easel board is big enough to support canvases up to a size of 24 by 30 inches. A small tray will protrude two inches along the length of the board for the canvas to rest on. Rubber edging is applied to the exposed edges of the board for safety. A linear actuator is attached to the top of the easel that in turn is fixed to the stand. Both of the attachment points of the linear actuator are able to pivot. The stand for the easel has three legs in order to give it



Figure 14.7. Actuator Extending Between the Board Bottom and the Third Leg.

better balance. The configuration of the legs allow for optimum clearance for a wheelchair

The total cost of the Adjustable Art Easel is \$385.

# AN AUTOMATED TABLE TOP SLIDING EASEL

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## INTRODUCTION

Introduced is Slide-Art, an automated table-top sliding easel capable of attaching to a wheelchair and accommodating different sized canvases for painting. The intended client has limited use of his extremities due to Cerebral Palsy, so the device is fully automated. The completed device slides (bilaterally) left and right with the use of a large joystick. The joystick is operated by either the client or a third-party. The joystick requires minimal side movement pressure to actuate. The sliding action of the table is appropriately designed to support the weight of both the canvas and arms of the user. Fig. 14.8 shows the completed project.

## SUMMARY OF IMPACT

The client is a very prolific painter and this device allows him to contribute to the studio where he is employed. The table slides bilaterally to accommodate the limited movement of the client's arms.

## TECHNICAL DESCRIPTION

This device is separated into two main sub-systems, including the electrical system and the mechanical system. The main control system is microcontroller (PIC16F874) based. The use of a PIC microcontroller allows the device to interpret the user and system inputs and generate the appropriate output response. The responses allow it to move left, move right, or stop. Accordingly, the main function of the microcontroller is to transfer a signal from analog to digital via the manipulation of the joystick.

For the joystick to signal the microcontroller, it must be subjected to an offset in the direction that travel is desired. This offset can be as small as a few degrees to send the required signal to the controller (in this case a five-volt high). The microcontroller recognizes the five-volt signal and an internal program authored in MPLab sends the appropriate



Figure 14.8. Completed Slide-Art Project with Control Buttons.

command to the motor driver circuit. The motor reacts in accordance with the constructed circuit.

This device utilizes a stepper motor since it is light weight and the stator/rotor combination is easily programmed to move the device in opposite directions (left and right). The size and frequency of the square wave generated in the microcontroller program controls the speed of the table, which is no faster than about one inch per second. The particular stepper motor in this device has a toothed gear attached to its shaft that in turn moves a rack (thus the gear and rack combination) located on the underside of the tabletop. The range of motion for this table is about twelve inches in each direction. A 12-Volt Battery powers the device itself.

Mechanically speaking, the device contains a few basic sub-assemblies. These are the Motor Drive Assembly, the Table Top, and the enclosure for the electrical components. In general, the table can withstand a weight of 20 pounds and can be adjusted to fit a canvas ranging from eight inches by eleven inches to 24 by 30 inches.

The table-top is primarily constructed using 1/8 inch thick Aluminum Sheet stock. The dimensions

of this table-top are by larger than 24 by 30 inches. A stationary lip is added to one of the long sides of the aluminum table top representing the base from which all canvas sizes rest. Two rails are fastened along the sides of this table-top. A secondary lip that stretches between the two rails is allowed to move, accommodating the varying canvas sizes. Resistance is generated by a spring system. This entire sub-assembly rests on a pair of bearing rails mounted inside an enclosure fashioned to contain the stepper motor and rack assembly that drive the table back and forth. The motor shaft with its simple gear drives the rack, mounted on the

underside of the table top with the bearing bars and incorporates use of various pillow blocks acting to relieve binding as the table indexes. The method of fastening the canvas to the device itself is manual and not motor controlled.

Custom designed mounting brackets are fashioned to hold this device to a user's specific wheelchair. These brackets attach to the main enclosure of the device and areas on the user's wheelchair to offer the most convenience. Line drawing of the device is shown below in Fig. 14.9.

The cost of this project is \$775.

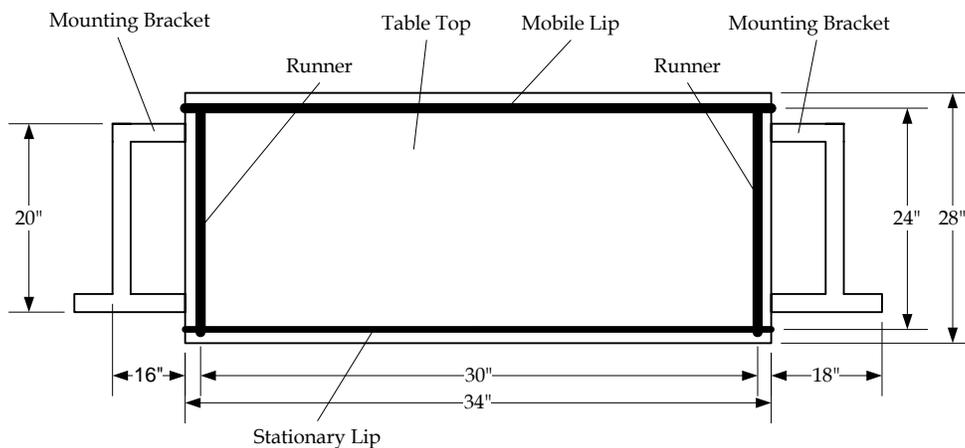


Figure 14.9. Mechanical Schematic of the Sliding Easel.

# THE ARCHITEUTHIS PROJECT (TAP)

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## INTRODUCTION

TAP controls a variety of household items extending the client's reach and control of daily tasks by the simple press of a single button. The following functions have been implemented in TAP: 1) Two Way Radio with Call and Talk functions, 2) Two X10 light or small appliance controllers utilizing RF signals to control hose current via plug-in control boxes, and 3) A Universal Remote Control capable of controlling a DVD, a VCR, a TV, or a satellite/cable box. A view of the completed TAP project is shown in Fig. 14.10.

## SUMMARY OF IMPACT

The client involved communicates to the world by typing on a computer using a head pointer device. His activities are limited to those that require no movement other than the motion of his head. He lives with his parents but spends much of his time in a little clubhouse next to his home. A device containing a two-way radio actuated in a manner conforming to his particular capabilities allows him to communicate between club and home with ease. When in his room, the same device operates his lights and TV as well as other things of interest. TAP, a single touch, large target switching system fulfills these requirements.

## TECHNICAL DESCRIPTION

The Control Box is mounted on a transportable table allowing for easy short distance transport. The box may be removed from the table utilizing two latches and carried anywhere using its side handles.

Internal components of TAP are easily accessible by turning the side lock and removing the top of the

unit. An internal fused power strip protects the internal modules in case of electric shorts or liquid spills.

Electromechanical solenoids control an Audiovox two-way radio, X10 RF remote control module, a Sanyo universal remote control, and give the signal the ability to go through walls. Two power adapters supply electricity to the unit. The universal remote control is the only module that runs on two AA batteries.

The two-way radio operates with any two-way radio located within a one-mile radius of the control box. Buttons marked Call and Talk are provided. A microphone is mounted at the front center of the control box and is activated when the "talk" button is depressed.

One Infrared to RF cone is included for use. The user must place the cone in front of a TV, DVD, VCR, or satellite box. A system within the control box produces RF signals to control the particular entertainment unit. The RF signal is capable of passing through walls so the device needs not be pointed towards the entertainment system. This control is centered on a Sanyo Starlight universal remote control.



Figure 14.10. Completed TAP Project.

