Accessible Cutting Board and Counter for Wheelchairs, Walkers & Scooters

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Introduction

Multiple sclerosis (MS) is a chronic disease that affects the central nervous system, consisting of the brain, spinal cord, and optic nerves 1 . The protective layers of myelin that surround the nerve fibers are attacked in individuals that have MS. This limits the nerve' s ability to communicate with the brain, creating the various symptoms of MS. The disease affects individuals differently and at different intervals. Common symptoms are fatigue, numbness, coordination problems, and pain. The MS Achievement Center at KU Medical Center is a program for supporting individuals that have multiple sclerosis. Members of the program attend once a week for sessions that include support groups, occupational therapy, physical therapy, and elective classes. In efforts to work with individuals at the MS Achievement Center, we interviewed members to investigate a device that could could be fabricated and tailored to aid an individual in their everyday life. After talking to multiple members, we discovered that a common problem was the height of standard countertops in the homes of the individuals with MS. Our team decided upon designing and fabricating a more accessible utility counter that individuals with MS could utilize due to the lower height. The utility counter design is to be integrated into an existing drawer space, but has dimensions that are dependent upon the cabinetry that already exists. The design objectives include designing and fabricating a utility counter with a height lower than standard countertops that are comfortable and able to be used in conjunction with a wheelchair or scooter. Along with this, the counter must support at least a 100-lb load and have a surface that is safe to use a kitchen knife on and can be removed for cleaning.

System Design

The utility counter design can be broken down into two subsystems: utility counter and drawer face. The utility counter subsystem and its respective parts are shown in Figure 1.

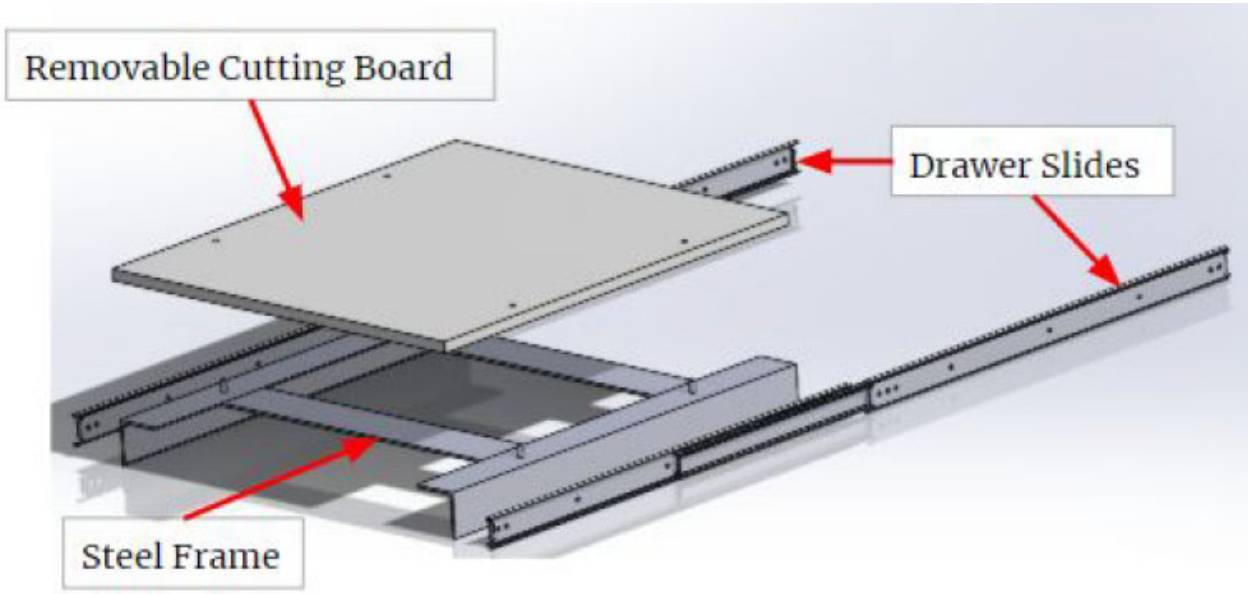

Figure 1: Utility counter subsystem

The utility counter subsystem consists of the steel frame, the removable cutting board, and the drawer slides. The drawer slides are Sugatsune ESR-6-22, rated for holding up to 106 lb. It is recommended that truss screws are used with these drawer slides. The removable cutting board used in this application was a

Thirteen Chefs brand plastic cutting board. The cutting board front end should have fillets on the corners for easy removal of the cutting board from the frame. Dependent upon the specific dimensions desired for the utility counter, it may be advantageous to buy a board larger than needed and cut it down to size. The steel frame is fabricated from flat steel and angle iron. The process for the correct welds and cuts are in the fabrication section of this report.

The second subsystem of the the drawer face is made from two components, as shown in Figure 2.

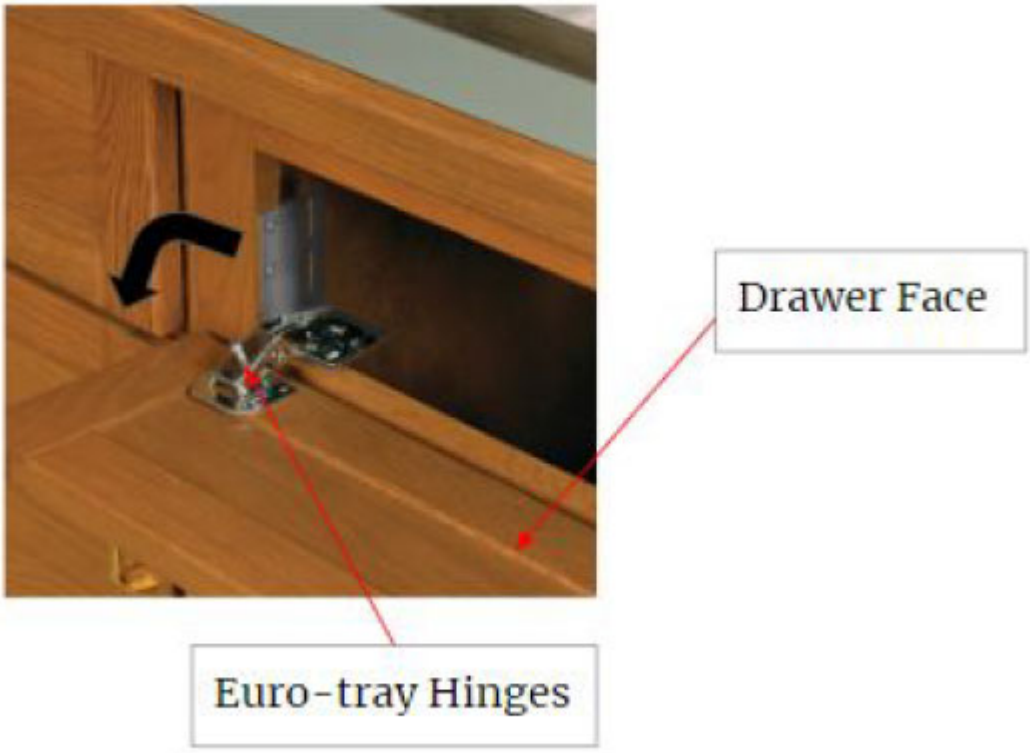

Figure 2: Drawer face subsystem

This subsystem includes a custom drawer face fabricated out of oak wood that is connected to the drawer cavity through the use of a Knape & Vogt 3.75-in W x 2.875-in Pull Out Metal Cabinet Door Mounting Kit. The design and fabrication of the drawer face will be further discussed in the next section.

Fabrication Overview

Fabrication will greatly depend on each individual situation as it is greatly based on the drawer selection chosen for the user and the specific user's needs. The dimensions shown and specified in the fabrication procedure below should be used as a template for how the utility counter is made, not the assumed dimensions for a replicated design. For safety reasons, unless the user is has knowledge of the machinery that can be used to cut, mill and weld the metal frame and the wooden faceplate, professionals should complete the fabrication.

Fabrication of Utility Counter Frame

The dimensions of the frame that was created can be found in the bottom of the report. To create the frame, 4 feet of 2" x2" x ⅛" thick angle iron, 4 feet of 2 ½" x ⅛" thick flat iron, and 1' of ¼"

diameter smooth rod, all of A-36 steel, should be purchased. The angle iron will be cut into two sections each 22” long. When the cut is being made, cut the iron longer than that of the actual 22” dimension, leaving room for the ends to be milled flat and square. The flat iron should be cut to 14”, again making the cut long to allow for the mill to square the cut sides. After the initial cut for the length of the angle iron, the length of one of the sides can be cut to 1.5” wide. This will allow for enough room to mount the slides to the angle iron, and provide more clearance to bottom of the frame. With the pieces cut and milled to the correct dimensions, the holes can be drilled into the top and the sides of the angle iron. The dimensions of the holes will be based on the drawer slides and the availability of access to these holes at installation. The recommended hole locations are 2”, 11”, and 19” all measured from the front of the frame. These will be drilled with a ¼” drill bit in the center of the angle iron. These holes should also be on the face that was cut and milled to 1.5” wide. For the holes that the pins will sit in, the holes are also ¼” holes, drilled on the top of the angle iron; this being the other side of the angle iron that has not be cut. These holes should be placed in the center of width of the angle iron, and 5” from the back and front. See the image below for reference on the approximate location.

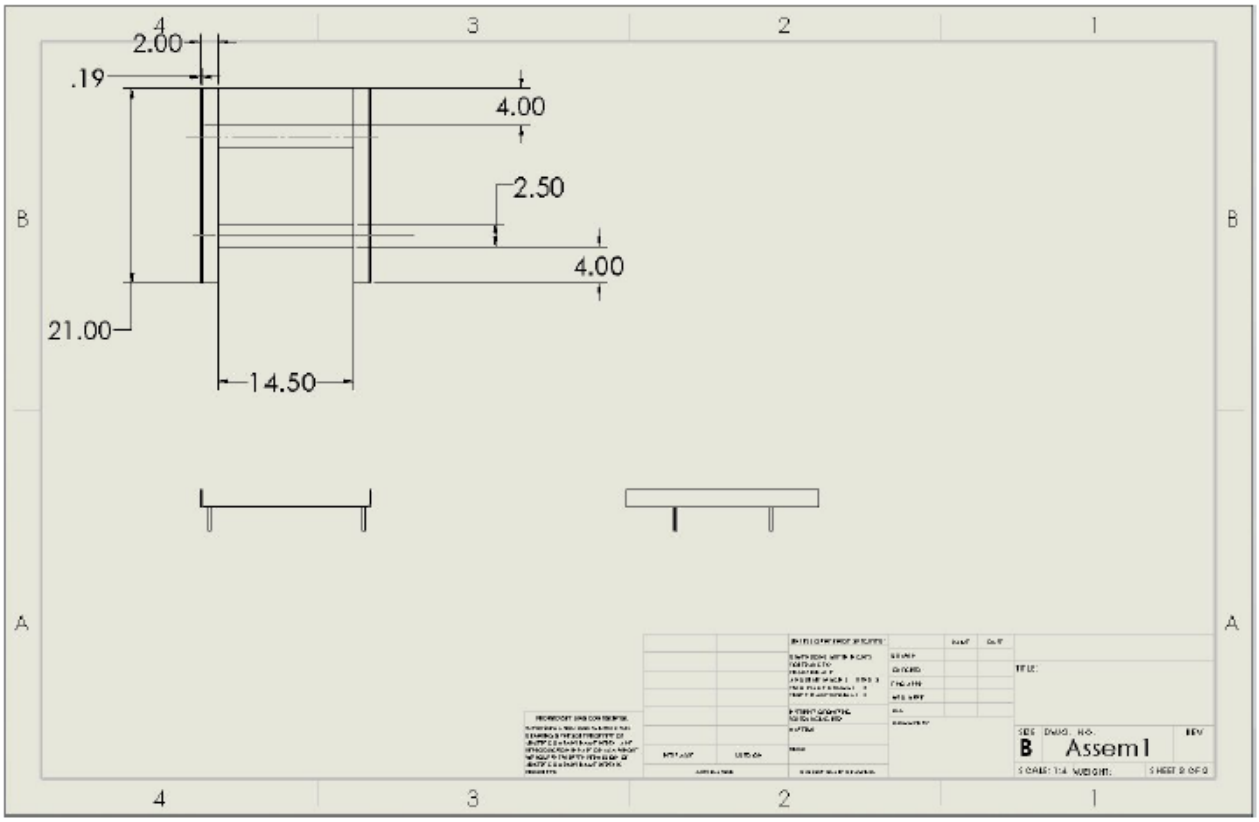

Figure 4: Utility counter frame CAD drawing

When all holes have been drilled, the frame can then be assembled by use of a welder. If you are not familiar with welding equipment, do not attempt to do it yourself; hire professionals to avoid personal injury. There should be 4 welds that are made at the joining of the flat iron to the angle iron, where a space of 4” from the top end of the angle iron, to the top face of the flat iron, can be seen in the drawing below. To begin fabrication of the pins that will ultimately hold the counter top to the frame, four 1.5”

rods should be cut from the stock. When these are cut, place the rods one at a time into a hole and weld them from the bottom. A palm grinder can be used to shorten the length of the rods after installation, but they will be easier to install the longer they are. Some alternative steps that may be taken, but will not increase the capabilities of the frame may be to use a grinder and grind the sharp corners to a rounded tip. This may decrease the chances of personal injury to the user. A coat of paint or "Rust-Oleum" may also be used to help protect the metal from rusting as the use of it increases. This may also increase the aesthetic appeal to the device.

Fabrication of Face Plate

It should be noted that all drawer face plates may not be able to be replicated due to may complications of tools used capabilities. For the creation of the faceplate, a table saw and the type of lumber to match will be the only tools required. If the user is unfamiliar with how to use a table saw, please do not try to attempt the replication of the drawer front. The table saw is one of the most dangerous tools in a shop area. To begin the design of the faceplate, first the measurements of the drawer front you are trying to replicate must be taken. All of the required measurements can be seen in the hand sketched image below. Not all drawer fronts will be the same as the one shown, so personalization should be done before creating this one. For the drawer face below, a 6" by 1" board was used. This allowed for the ripping of the board, which made it thinner and made it possible for us to replicate what is already there. First, one should take the board that you plan to use as the face and cut it to the appropriate length. It is recommended that you cut at least 2 boards this length as one board will be the replica, and the other will be a practice board to make sure the cuts are correct. Geometric calculations will need to be done to start cutting the angle. For a drawer that is similar design as the one shown, you will need to measure the thickness of the board on the edge, the thickness of the board in the center and the length of the edge of the board to the first edge of the chamfer. To see what the angle of the cut is, you would then calculate the tan^-1(length of the edge to edge/difference of the thicknesses). This will compute the angle that is going to need to be cut on the board. With the angle known, take the distance from the end of the board to the chamfer, with the blade still vertical, place the stop so the blade would make a cut at this length. Tilt the blade to the required angle. With your practice board, start a 1" cut into the board, then pull it out to inspect and measure to make sure the cut is correct. If it is, make the cut. If it is not, reposition the stop, and make another cut until the dimension is correct. When the first cut is made, the stop should not be moved. Turn the board 180-degrees and make the same cut but on the other side of the board with the same face pointing downward. Ensure that the cuts are correct, and then cut the board that will actually be the face. These will be the steps to also make the other sides cuts. To finalize the chamfer cuts, the blade can be rotated back to the vertical position. The stop should then be moved to make the thinner of the two thickness of the board. The cut that you are about to make is the ripping cut to thin your board. With the face that you have just cut facing the saw blade, move the saw vertically until the blade is the same length as the edge to edge length that was used earlier. One side and the adjacent side can be made without moving the stop. If the cuts goes to the edge of the angle cut, you can use the replica face wood to make the two cuts. If it does not, reposition the blade height or the sawstop based on what dimension is wrong. These are the same steps for the other two sides of the face. The face should then be stained to match the pre-existing cabinetry.

Fabrication of Counter

The cutting board surface can be purchased from Amazon as a standard 18” x 24” cutting board. To make the counter top, the board should be cut to 21” in length. This will leave one end with rounded corners; this will be the designated front of the board. The pins that are in the frame will need to be measured to see if any variation was made from the original placement specifications. If there is no change from the specifications, the holes to set the counter on the frame should be placed in the same locations as the pins sit on the frame. Mill these holes with a ¼” bit all the way through the board. Do not use a mill if you are not experienced in how to used it as this may cause personal injury.

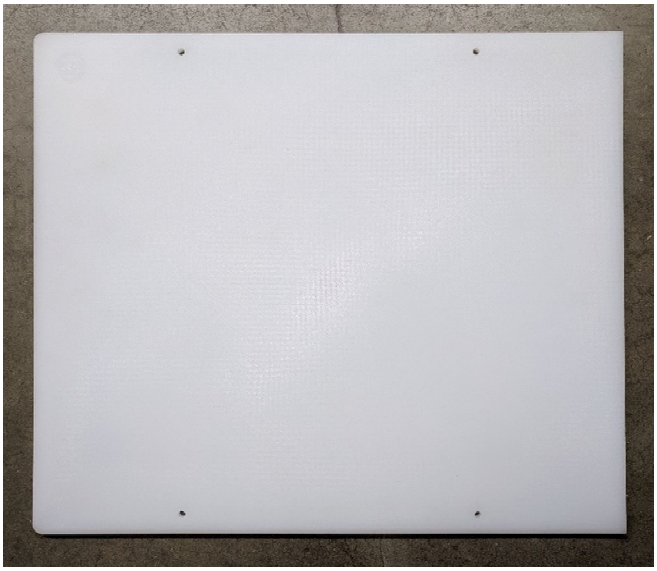

Figure 5. Cutting board cut to length with indexing holes.

Figure 6. Cutting board assembled with support frame.

Figure 7. The final product assembled, installed and deployed for kitchen use!