

Submission to the Undergraduate Design Competition

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BAGGING DEVICE FOR ONE HANDED USERS

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INTRODUCTION

Accommodations for disabilities in the workplace have improved significantly in recent years. Despite these improvements, an analysis [1] found that only “15.6% of workers with disabilities report needing accommodations, and 12.2% report receiving them.” Cottonwood Industries was founded in 1972 and is located in Lawrence, KS. A variety of jobs such as labeling, textiles, medical, and packaging are completed by employees. A large portion of the 140 person workforce at Cottonwood Industries is limited by physical and/or mental disabilities. Of these disabilities, 10 workers have full use of only one hand and struggle daily with simple tasks such as packaging. Manager, Steve Steinbach, identified a strong need for a device which would assist these workers by reducing frustration and speeding up the packaging process for them.

When the need for an assistive bagging device for one handed users was identified, management at Cottonwood first developed temporary jigs. These jigs were made out of recycled material, such as a cardboard box or cylinder, and large binder clips. While the clips were easy for a user to grasp, it was difficult for the worker to get the bag in position to be clamped with the use of only one hand. Workers currently package a variety of products in three predetermined bag sizes. The smallest bag measures approximately 7x4 inches, medium bag measures 11x6 inches, and the large bag measures 14.25x8 inches in size. The items in the small and medium sized bags are consistently light (.5 lb), where the large bag must hold a 5 lb military securing strap.

After the need for an assistive packaging device was identified by managers at Cottonwood Industries, a job analysis was performed on-site by the design team. Following standard guidelines provided in “Enhancing employment outcomes through job accommodation and assistive technology resources and services,” an article written by Langton and Ramseur [2], the team observed workers as part of a job task analysis as items were packaged and took special note of skills,

limitations, temperaments, work station layout and tools. The workers only had use of one hand or limited use of both. Managers noted that the workers would benefit most from a device that would reduce frustration and therefore allow workers to feel more productive in their jobs. This information was used to develop specific design criteria for a bagging jig that would accommodate workers with the use of one hand at Cottonwood.

When the preliminary design process was completed, the first step in the actual design process was to build a House of Quality using all of the engineering specifications and customer requirements. This was a tool used to help identify the specifications or requirements that had the most influence to the quality of the final design. The most important manufacturing aspects for the jig user was first to increase their productivity on the assembly line. Secondly, there was a need to keep the complexity of the jig to a minimum. Finally, a strong need for the use of platforms, clips, or other assistive techniques was identified. In regards to the management staff, device mobility was very important to work well with the facilities flexible floor plan. It must be noted that all of these design constraints support the main goal of decreasing user frustration so they may fully participate in society with low stress and in a productive workplace.

PRODUCT DESIGN

With needed basic functions of the device identified, the United States Patent and Trademark Office website was consulted and it was concluded that there were no current patents recognized in this application. The next step in the design process was to begin brainstorming as many viable solutions as possible. Cottonwood in the past had used various techniques to suspend the bags open, such as binder clips. While many of the original ideas stemmed directly from these vertical suspension clip solutions, the team continued to explore alternative methods for bag loading. The concept of loading the bags horizontally instead of vertically immediately eliminated any issues with weight capacity and was found to be especially beneficial for

packaging the 5 lb military strap. Also, the horizontal design would allow for an overall shorter and more compact jig to remain effective as a table top device. The team cycled through about 5 design ideas, with each building upon the previous design in order to better meet the customer requirements. Finally, the compact (7"x7"x2.5") "window" design was reached, as shown in Figure 1. The gray window block will be made entirely out of steel in order to provide a secure base weighing approximately 15 lbs. As clip possibilities developed, a magnetic based clip was chosen because it was more versatile and

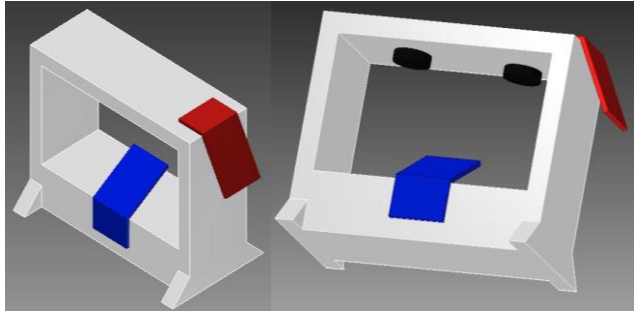


Figure 1: CAD model of device

simpler than the others. With the use of several magnetic clips, this device will allow the user to package the wide variety of products that Cottonwood sees every day.

For packaging with the small and medium sized bags, a toggle magnetic clip can be used on the corner of the device, as shown in Figure 1 in red. With a steel frame bent at a 120° angle and magnets glued to the inside of this frame, a simple 'see-saw' movement could be created. After some simple testing and prototyping it was concluded that the bag could be place in the proper position and the clip activated easily with one hand. The magnets could be used to hold the bags in almost any fashion desired. To explain the function of the magnetic clip process in more detail, the user will use their fingers to slightly open the bag, and pull the corner of the bag up under the open end of the clip. The clip may then be "bumped" to snap the clip down on the inside of the bag. After prototyping this design it was found that this magnetic clip could meet the weight requirements of both the small and medium sized bags, as shown in Figure 2 below. Unfortunately, the military strap was too large and heavy to be packaged in this similar vertical fashion.

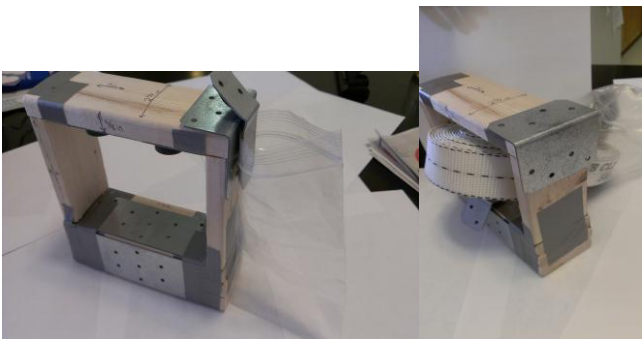


Figure 2: Early prototype holding small and large bags

For packaging the largest bag, the user will insert their hand into the bag in order to grab it, and push it away from their body through the window (5" wide and 4" tall opening). The bag will then be pulled

back, catching the lower edge of the opening on the magnetic toggle clip shown in blue in Figure 1. This clip can be easily bumped with their hand to lock down the lower surface of the bag opening. Free circular magnets (shown in Figure 1 in black) can then be positioned on the device to hold the bag open in the jig frame in whatever way the user finds the most accommodating for packaging the military strap or other large products. The items can then be pushed through the window, into the bag, and rest on the table. This idea can be seen in the prototype shown in Figure 2. When finished, the user can simply remove the magnets and pull the bag away from the device.

In conclusion, this device is simple enough to be used by the physically and mentally limited, and it is effective enough to increase the productivity and decrease the frustration of the users with all three bag sizes. In addition, the device is lightweight (estimated at 15lbs using CAD software) and extremely portable, thus suiting the needs of the management staff as well. All customer requirements were met.

BUDGET & MARKET ANALYSIS

The minimalistic and simplistic final design of the product allows for a very affordable product. The initial blocks of steel is estimated to cost \$30 total. To assemble the device an estimated 4 hours of welding and detailing will need to be done. An estimated cost to produce two clip frames is \$2.50. Finally, the cost of the magnets is estimated to be \$4. This would bring the total cost of materials and manufacturing to \$50.

The immediate market for the product is somewhat low. The amount of people with limited use of one hand in the workplace is low. The total sales-per-year has been estimated around 200 for a workplace setting. However, the device could also aid in the daily lives of anyone who requires assistance in bagging items, and the potential consumer market increases. [3] "Over 3 million people in the USA have a disability in their hands and/or forearms, including paralyzations, orthopedic impairments, either congenital or injury related." The retail products for home use will likely sell for 5x or 10x the base price and with a potential market of that size could be very profitable. When looking at the benefits and conveniences the device offers to the customer, as well as its low base cost, the jig would make a good investment.

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