SMALL PARTS COUNTING AND BAGGING DEVICE
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ABSTRACT

Team HandiCats of Ohio University worked with Tri-State Industries to facilitate the counting and bagging of small parts, such as nuts, bolts, and washers, by workers with limited mental and physical abilities. Higher functioning employees struggle to quickly, accurately, and easily count and bag the parts, while lower functioning employees cannot perform the task. In order to fulfill the need of an improved counting and bagging process, the team developed the Small Parts Counting and Bagging Device. This simple device increases productivity, is easy to use, maintains quality control, and affords the employees a greater independence in the workplace. The details of the final design and evaluation of this device are summarized in this report.

BACKGROUND

Tri-State Industries in Coal Grove, Ohio, is a non-profit organization that provides meaningful work to individuals with disabilities. Tri-State’s mission statement is to “assist our employees in the development and implementation of employment opportunities and related services as well as provide quality work services and products for our business customers.”

PROBLEM STATEMENT

One of the jobs Tri-State Industries provides its employees is to count and bag small bolts, nuts, and washers. These parts vary in material (plastic or metal), size, and quantity per bag. Each order also varies in the total number of bags required. However, the employees have difficulties counting to specified quantities. Simple wooden jigs were fashioned by Tri-State Industries to facilitate the process.

Unfortunately, the current process is tedious and difficult or impossible for the employees with limited range of motion or low mental functionality. Only a few of the employees are currently able to accomplish the larger orders because they have a greater range of motion and ability to count to larger numbers. Process errors and delays occur when the employees become distracted or have difficulty removing the parts from the current equipment. These failure modes call for a device that can keep the user’s attention, requires little input force or degree of motion from the user, and is simple to use for even the lower mental functioning workers.

RATIONALE

We researched existing solutions for counting and bagging small parts. There are some complex devices such as pill counters and large automated industrial machines that count, sort, and bag small parts.
parts. Our goal was to give them something simple, small, and inexpensive that would assist the workers in their job, but not take it away from them.

We decided to build on the concept that they already had: a jig with a number of locations to place a part. When all the locations are filled you have the correct number of parts.

We needed something that would keep them focused on their task and make it like a game. This would result in higher productivity and less error. We also needed something that would count a variety of parts. The bagging process was also very important as it was difficult to get the parts off the old jigs and into the bag.

Our solution was to make a board that had large holes to fit any type of parts. When one handle was pulled the parts would fall into a funnel then into a bag clipped to the end of the funnel. The device was also an aesthetic improvement and proved to keep the workers on task as they enjoyed using it which improved their performance.

**DESIGN**

![Small Parts Counting and Bagging Device](image)

It was decided that a maximum of 50 small parts would be counted by the employees, given information from the supervisors at Tri-State Industries. In order to reduce the overall size and weight of the device, the holes were set to a staggered array. The design of the stand allows its operators to stand or sit, further accommodating those with physical limitations. The bag clip located on the top of the funnel spout allows for any sized bag to be attached and then detached with little effort. Plastic was used for the board assembly to further reduce the weight, while the stand was made from steel to provide needed support and stability.
Small Parts Counting and Bagging Device

Function

1. Place bag on clip
2. Fill each hole with one part to be counted
3. Pull slider; parts drop into bag; return slider to middle
4. Remove bag

Figure 3: Device Operation

Material Selection
The board assembly is made from static dissipative ultra-high molecular weight polyethylene (UHMW). This plastic was chosen for several reasons: it has high scratch resistance, good strength, is lightweight, and adds little friction, all at an affordable price. UHMW also comes in a static dissipative form which will protect the users from static buildup that can result from sliding plastic on plastic. The stand is made from 14 gauge steel to make the device rigid and durable. In order to keep the weight to a minimum, all other metal parts are 16 gauge steel. These other parts include the shield, funnel, and board assembly supports. The lighter gauge steel still provides enough support or function, but do not add too much weight.
**Safety**

All of the edges have been ground down or rounded to reduce the chances that users might cut themselves. There is only one moving part and in normal operation the user’s fingers will not be near any pinch points. Even if the user or bystander were to place their finger(s) in a pinch point, the force required during normal operation is too small to cause injury. As further evidence of safety, after two weeks of real operations there were no injuries. Furthermore, the entire device was kept to just 17 pounds. In normal operation, this provides enough friction between it and the table to keep it from sliding around or even off the table. Nevertheless, the device’s weight is still light enough for the supervisors to transport it without much effort.

**DEVELOPMENT**

Once our team had the basic concept (discussed in the Rationale section) we created a 3D model in SolidEdge. The concept was then shown and described to Tri-State to receive some initial feedback. They were thrilled with even our preliminary design; however, we ran a Failure Modes and Effects Analysis (FMEA) on the device to ensure its safety and functionality. Through this analysis we reduced the weight by 23 pounds, reduced the size by half, and successfully confirmed the stability of the entire device.

We recognized that the original weight of the device (about 40 pounds) was far too heavy for the supervisors to transport. Therefore, we decided to use 14 gauge steel for the stand instead of 12 gauge, use 16 gauge steel in other non-critical features like the funnel, and make cutouts in the stand that reduced the weight while keeping the overall stability. We also originally had the parts holes spaced in straight rows and columns. By staggering the parts holes in the board assembly we effectively reduced the width from two feet to just one foot. These developments in the stand and board assembly reduced the size and weight of the device to a manageable 17 pounds.

**EVALUATION**

In order to verify that the device met our main design objectives, we performed two separate sets of tests. These tests evaluated both the ease of use of the device, as well as the productivity and quality control. In order to verify the ease of use of the device, we tested the average force required to move the sliding board between closed and open position. From this testing, we learned that the approximate force needed to operate the sliding board was 1.75 pounds. This force is approximately equivalent to holding three medium oranges or a third of a gallon of milk. This provided the initial verification of the device’s ease of use.

In order to verify the productivity and quality control, we asked Tri-State Industries to monitor and document the use of the device by the employees over a two week period. At the conclusion of the two week trial, we were given detailed notes of the results. Two employees, Corinna and Ben, were followed closely with time trials. Corinna, one of the higher functioning employees, could previously perform a full fifty count process without any assistance in about five minutes. When using our device, her fastest time counting and bagging fifty parts was around one minute and twenty seconds, while her slowest time was around two minutes and thirty seconds. Ben, a very low functioning employee, could previously not perform the job on his own. With the device, he was able to count and bag fifty parts in approximately four minutes. Neither Ben nor Corinna made any
errors in their counting while using the device. This verified that the device effectively increases the productivity, while maintaining a high level of quality control. The supervisors also noted that the game-like nature of the device allowed the employees to remain more focused while completing the task.

In addition to documenting the increase in productivity and the quality control, the supervisors verified that the system was easy to use by the employees. Prior to using the device, Ben was unable to perform the task due to his high dependence on the supervisors to help him. The device allows a much greater independence, such that Ben can now perform the task completely on his own. Along with the initial testing of the force required to move the sliding board between closed and open position, this satisfied the requirement that the device be easy to use.

**DISCUSSION AND CONCLUSIONS**

We have designed a small parts counting and bagging device that can not only improve the ease of work and productivity of higher functioning individuals, while maintaining a high level of quality control, but can also allow lower functioning individuals to begin performing the task. This is verified by both our testing, as well as the testing performed by the supervisors at Tri-State Industries. After using our device for the two week trial period, Tri-State Industries has already expressed an interest in obtaining additional quantities of the device.

While the device was specifically designed for use by the employees at Tri-State Industries, the device can be used universally. As previously stated, the device works with a variety of part materials, shapes, and sizes, provided that the part does not exceed the one-inch diameter of the device’s openings. We have also designed plugs to fit the device’s openings, so that the quantity of parts being counted can be altered. This allows a high transferability of the device.

Additionally, the device has minimal maintenance requirements, such as wiping it down with a towel, and the materials cost is only around $170. The device is low-maintenance, affordable, increases productivity, is easy to use, maintains quality control, is transferable to a variety of applications, and provides a greater independence for people with disabilities in the workplace.

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**REFERENCES**


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