Chocolate Bar Wrapping Machine

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Abstract

The goal of this project was to create a 1:1 3D printed prototype chocolate bar wrapping machine for Birdwings of Alaska. Birdwings of Alaska is a small business that makes chocolate and other treats. They sell their chocolate in gift shops across Alaska. They need a wrapping machine that isn't overly expensive but increases their current productivity. This design was to be created from scratch. Inspiration was taken from state-of-the-art machines. This team brainstormed ideas so they could create a functional yet simple machine that wraps Birdwings' chocolate. Initially the plan was to design two machines - one that was fully automated and one that was manually powered. The fully automated machine proved to be difficult with limited time and resources, so the focus was shifted entirely on the manually powered machine. Over time the design developed into what is called the channel design. The chocolate was to be set on the wrapping paper and pressed into a channel (of the same dimensions as the chocolate). Arms controlled by levers then fold the paper around the chocolate. There were many design challenges with how the levers were supposed to move without interfering with each other, and how the design would be simplified so it would take the least amount of time to wrap the chocolate bar. The machine was designed in Solidworks, and the drawings and assembly were sent to the UAA 3D printing lab. In addition, an instruction manual for assembly and operation was created. There is work to be done on this project - future groups can work on fully-automating the design and making it even more efficient. This design offers a much cheaper option than the state-of-the-art machines and is perfect for the use of small businesses that don't want to spend the money on an expensive fully-automated machine.

Project Statement

The goal of this project was to brainstorm, draft, and create a manually operated chocolate bar wrapping machine. This machine was to increase the efficiency of wrapping, and to increase the total weekly amount of chocolate bars wrapped. For this project, a one-to-one scale 3D printed, manually operated prototype of the machine was made. The machine was designed in Solidworks, and this included detailed drawings for each component, assembly, and a motion study. Also, an instruction manual including assembly and maintenance was drafted for the machine. Finally, a cost analysis was completed for fabrication of the machine, if Birdwings wanted to fabricate our prototype using stainless steel 316.

Figs. 1 and 2. Birdwings Chocolate Bars

Methods

For the first iteration of the chocolate bar wrapping machine, sketches were drawn out for a horizontal, belt fed machine. However, as the design process continued, there were complications with the belt dimensions and how the arms for folding the chocolate bar were going to be organized and move fluidly, and the first iteration design was scrapped. In the second design, a vertical machine was drafted where the chocolate bar would move through a series of rollers to fold the middle and sides. This design was the design of choice for a couple weeks, and different changes were made to optimize it, but this design was also eventually scrapped due to complications of how to move the parts simply and efficiently. Finally, the channel design was sketched. This design includes a channel onto which the wrapping paper and chocolate bar are placed. The idea was to press the chocolate bar into the channel, and have different arms move around the channel to fold the paper around the chocolate. This design went through many iterations and different problems were encountered with the specific movement of the parts. The goal was to make the design as simple as possible. This meant that the number of motions to wrap the chocolate bar was to be as low as possible. Since this design was made from scratch, there weren't many other things involved in the project. This design isn't using any motors or sensors or other parts from different manufacturers, so the methods were straightforward. The difficulty was the actual design process and the changing ideas and the simplifying designs and the optimization of the moving parts.

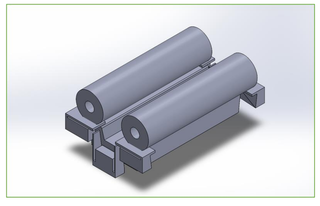

Fig. 3 Original Solid Model of Channel and Folding Mechanisms

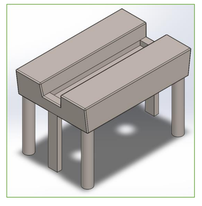

Fig. 4 Final Version of Channel

Since this design is only a prototype, the materials used are 3D printing materials. There are also a few springs and screws used in assembly. Solidworks was used to design the machine, and the Solidworks files were sent to the 3D printing lab for printing. A motion study in Solidworks was performed to show how the parts move.

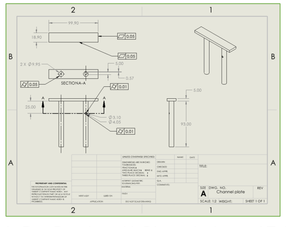

Fig. 5 Sample Part Drawing with Dimensioning and Tolerancing

Conclusions

Initially, the project scope included designing two machines - one manually operated and the other fully automated. Designing the fully automated machine was quickly scrapped because it took some significant time to brainstorm ideas from scratch, much less put those ideas on paper for the manually operated machine. The 1:1 scaled 3D printed prototype of the manual machine was fabricated. If the operator wraps one chocolate bar in 9 seconds, a 300% efficiency increase is obtained. To manufacture this machine using stainless steel 316, it would cost ~$300 for raw material and fabrication. This product provides a very affordable chocolate bar wrapping machine for those who don't want or need a state-of-the-art machine. For Birdwings, this product provides an efficient and easy way of wrapping their chocolate bars without having to pay for an expensive machine. There is no market for cheaper chocolate bar wrapping machines, and this product fills that market. This machine could be greatly improved by use of fully-automated hardware and software. This shouldn't add too much to the cost of the project (other than the labor to design the fully-automated parts), and it should prove to be an even more efficient way to wrap the chocolate bars. This improvement would include sensors, pneumatics, and motors to control the arms that fold the paper around the chocolate bar. This project impacts the small-market chocolate industry - our design (even though it is elementary) could be used by a future group or by an engineering firm to revolutionize the industry and make a cheaper way to fold chocolate bars.

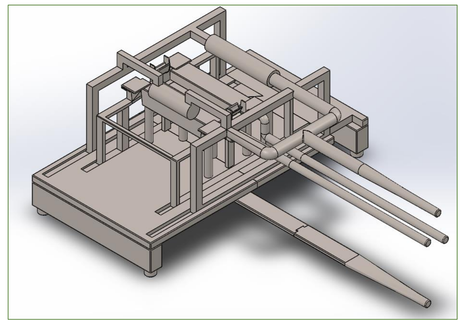

Fig. 6. Final Design of Wrapping Machine in Solidworks

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