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Handheld Portable Potato Cutting Machine

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Abstract: A potato cutting machine was once very prevalent, particularly in the food industry. The machine will be described as a large device that is not suitable for domestic use based on these statements. This project was born out of a need to address the issue while also easing the strain on the home and possibly assisting the small vendor community. The project focuses on tiny and medium-sized potatoes, as well as a portable and low-cost fabrication machine that may be employed in households and small businesses. The machine's functionality was tested, and the results were compared to manual methods. For comparison, the machine is estimated can cut potatoes in up to 62 percent less time. This compact item will not take up any space in the kitchen during the renovation. Finally, this product greatly aids the community in producing their homemade potato chips using their recipes and patterns.

Keywords: Potato, Cutting, Household

1. Introduction

Potato chips, or crisps in the United Kingdom and Ireland, are thin slices of potato that have been deep-fried or baked till crisp. Snacks, side dishes, and appetizers are all typical uses for them. Potato chips were a very addictive snack due to their high salt and fat content. According to studies, eating salt causes the release of dopamine, a chemical messenger that controls your brain's pleasure region [1],[2],[3]. When your brain receives its first reward, it begins to need more. As we all know, several types and brands of potato chips are available in our country. This demonstrates that our society enjoys snacking since it is an addictive food that can benefit people in various ways.

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Potato chips are today one of the most popular snack foods on the planet [4]. Since its inadvertent inception in 1853, the potato chip market has grown to become a multi-billion-dollar industry. Potato chips are popular among people of all ages due to their low cost and low price, even for luxury brands [5],[6],[7]. All potatoes were peeled and sliced by hand in the early nineteenth century, which did not fulfill the high demand for potatoes. Potato chips rose from a modest specialty item to a top-selling snack food thanks to the advent of the motorized potato peeler in the 1920s.

The cutting machine became increasingly sophisticated due to the invention, as it would only be utilized in industrial settings [8],[9],[10]. However, because the machine runs automatically once it is started, the procedure of making a potato chip was relatively simple. After discovering a machine that runs as smoothly as an industrial machine, the concept arose, but it is smaller and more convenient for home usage. Before being fried or baked, this machine will focus on producing a thin slice of potato. One of the most intriguing elements of our product was that it allowed us to customize the size of each slice, making it easier to fit different people's preferred sizes.

Figure 1 shows various designs of potato chip cutting machines available in the market. Electrical motor mechanism design as shown in Figure 1(a) was the most prevalent machine in the industry. The size was so large that it could only be used in a factory that generated a lot of potato cuts. The unique feature of this product is that it can cut the potato into three various kinds of cutting: standard chips, wave chips, and strips. Figure 1(b) shows the pneumatic potato cutting machine. This type of machine was unique in that a pneumatic system powered it. Because it relied on restricted power sources, production was kept to a minimum to ensure the machine's continued operation. It also relies on how much air is delivered to the machine. The manual potato cutter is shown in Figure 1(c). This device provided an option for cutting potato chips with less capital investment and energy cost. However, it will become a burden especially for a woman as it required high human strength to operate the device.

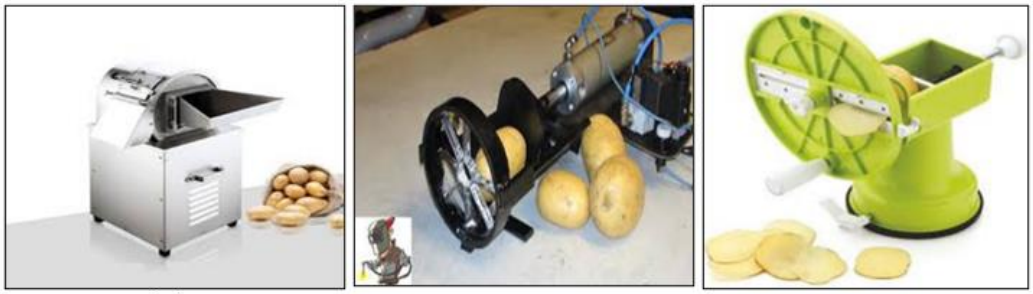

Figure 1: Potato cutting machine design mechanism (a) electric motor (b) pneumatic (c) manual

This research work was performed to design a motorized household potato chip cutting machine. The machine will be designed based on the requirement of the household user. Instead of potatoes, it will also be usable for other applications such as cutting of cumbers, carrots, bananas, and others. This project entails the process of developing a cutting machine for humans to operate, taking into account forces and ergonomic aspects. Once it was entirely developed, it was turned into its genuine product, with the design serving as guidance. These initiatives also include maintaining the publication's security. Joining, utilizing bending, welding, drilling, and cutting operations are some of the methods and techniques used in this project. This project is primarily focused on developing a new cutting machine idea that is easier to transport and cut chips with. After all of the procedures have been completed, these machines may be able to assist us in comprehending the fabrication and design processes involved in this project. Although there are many different types of cutting machines on the market, completing this new model gives more practical usage that would be extremely useful in the home.

2. Materials and Methods

The machine's development may be broken down into various design stages, ranging from concept creation through preliminary design to detailed design, including material selections. Brainstorming, idea drawing, and assessment were all part of the early stages of design. The best concept was picked and improved before moving on to the next level of design. The machine's functioning, machine component size, and material for each machine part and component were carefully considered throughout the detail design stage. SolidWorks 2020 is the CAD programmer that was used to create this comprehensive design drawing. **Figure 2** depicts an isometric perspective of the mechanism. Following the development of the comprehensive design, the material selection for each machine part and component is the next step in manufacturing this machine before going on to the fabrication phases. The machine's cutter is intended to be connected to the shaft through a bearing. The shaft is connected directly to the motor, which is a cordless screwdriver. A cordless screwdriver rotates a blade situated on the bottom of the machine body. The container will also serve as a divider to optimize the amount of potato that can be sliced in a given amount of time.

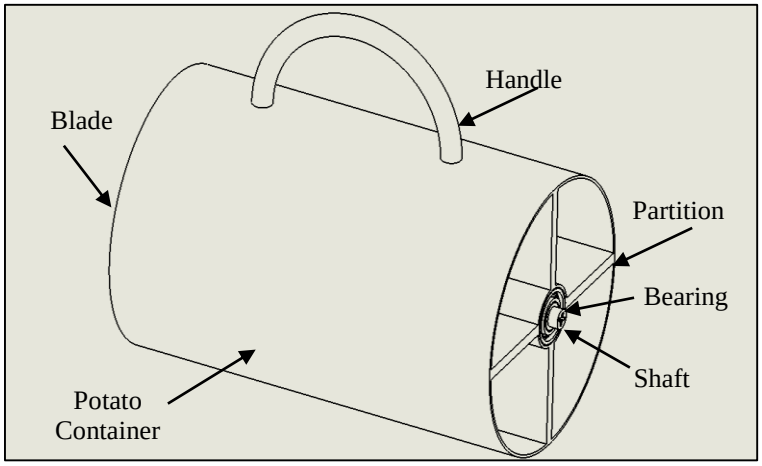

Figure 2: The design of the cutting machine

The machine is designed to operate using a 12V Cordless Screwdriver. To determine the torque required for a cordless screwdriver to rotate the shaft mechanism, the force required to cut an average size potato is then first determined experimentally. The value of force is determined experimentally by cutting a potato manually on a weighing scale. The test was repeated with varying sizes of potatoes. From the experiment, the amount of average force required to cut an average size potato through a manual cutter is 176.58 N. While, the value of torque required by the 12V Cordless screwdriver to rotate the shaft mechanism may be estimated using equation one by referring to the shaft mechanism and calculating the load that the machine can bear.

2.1 Equations

By referring to the shaft mechanism and calculating the load that can be accommodated by the machine, the value of torque required by the 12V Cordless screwdriver to rotate the shaft mechanism can be calculated using **Eq 1**.

$$\tau = F \cdot r \qquad \textbf{Eq.1}$$

According to the calculations, the screwdriver motor requires 9.6 N.m of torque, assuming that all frictional forces are ignored. After that, an appropriate 12 V cordless screwdriver is chosen based on the predicted value, with an additional 30% more torque to compensate for variations in potato size, hardness, and weight.

3. Results and Discussion

Each machine component's material is chosen based on technical characteristics, cost, market availability, and manufacturing simplicity. **Table 1** lists the parts together with their specifications and quantities for the machine prototype. In the following development step, the material chosen at this stage may be replaced by another material of a specified grade

Table 1: Part list of the machine

Item	Parameter Name	Variable Value	Quantity
1	Cordless Screwdriver	12 V dc motor	1
2	Container with Partition	130 mm diameter	1
3	Blade	127 mm diameter	1
4	Bearing	25mm x 52mm x 15mm	2
5	Shaft	52mm x 350 mm	1

3.1 Potato Cutting Test Estimation

The number of potatoes that may be placed between the cutter pusher and cutting blade in the cutting test is also determined by the size of the potatoes. Once the operator activates the operating switch, the cutter continues to operate indefinitely. This cutting test compares the performance of the machine cutting process to that of the hand cutting procedure. A manual top pressing cutting mechanism was utilized to cut the potato for the manual cutting procedure. **Figure 3** shows the comparison between the expected number of slices performed by the machine and manual slicing.

From studies and findings from prior research, the machine is capable for slice cut potatoes. The designed machine is estimated can cut the potato in average 0.5 seconds per slice. For medium-size potato, average 5 pieces per kg, the number of slices for 1 kg potato is about 125 times. In contrast with manual slicing, the slicing process took 0.6 seconds per slice. The slicing time is varies depending on the number of slicing. The higher the number of performing the slicing, the longer the slicing time the worker will take. This phenomenon could be due to the worker experiencing human fatigue. Slicing potatoes using a machine could reduce slicing time by about 20 % at the early stage. The reduction of the slicing time increases as the number of weight increase. On the other hand, an enormous potato needs more force from the pusher to press the potato against the cutting blade.

According to the estimated machine test that has been completed, the machine successfully runs according to design criteria. A pusher is used to chop potatoes, which are attached to a connecting rod and revolving shaft. However, at this stage, the potato is being pushed through the cutting blade using a pusher intended to slide with friction on a metal surface, which reduces the pushing effort. In this stage, the torque produced by the motor is more than the minimum torque necessary. This friction may be ignored for average-sized potatoes. The pusher and rotating shaft can be modified to minimize friction and offer more significant acceleration and inertia force to push potatoes through the cutting blade [3]. The machine is still in the early stages of development. Therefore, several enhancements may be done to improve the machine's flexibility, durability, efficiency, and safety features. In the following stage of machine development, the material selection and part design can be enhanced even more. The suitable materials and design are essential for developing a fully functional machine with minimal manufacturing and running costs.

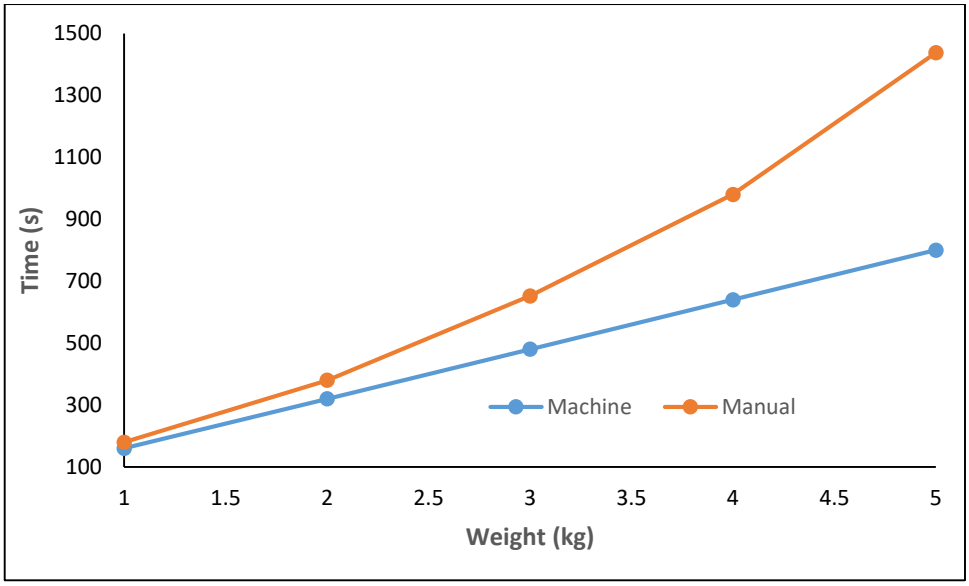

Figure 3: Time vs potato weight sliced using machine and manual

4. Conclusion

The creation of the portable potato cutting machine is detailed in this study, and its performance is evaluated. Chips made from potatoes are a popular snack among locals and in foreign markets. To achieve a uniform and consistent output, raw product preparation necessitates using a specialized apparatus or machine. The equipment is capable of peeling and cutting potatoes of standard size. According to estimates and research from the sources, the average size of potato cutting time improved by up to 62 percent. Although the machine has demonstrated a substantial improvement over human techniques, some enhancements may be made to the machine to improve its efficiency, flexibility, stiffness, and cleanliness. A more suitable material with a specified grade can be substituted for the material in direct touch with the product.

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References

[1] M. A. Hoque and K. K. Saha, “Design and development of a manual potato cum sweet potato slicer”, Journal of Science, Technology & Environment Informatics, J. Sci. Technol. Environ. Inform., vol. 5, no. 2), pp. 395-401, Nov. 2017

[2] S.B. Kartika., Arahanth, “Design and Development of A Potato Slicer”, IOSR Journal of Mechanical and Civil Engineering, pp. 21-26, 2013

[3] G. S. Ganyani and T. Mushiri, “Design of an Automated Vegetable Cutter and Slicer,” Proceedings of the International Conference on Industrial Engineering and Operations Management, Pilsen, Czech Republic, July 23-26, 2019

[4] V. Wadagavi et al, “Automatic Potato Chips Making Machine”, International Journal of Science and Research (IJSR), pp. 2319-7064, 2017

[5] K. R. Pawar et. al., "Development of Fruit and Vegetable Slicing Machine", International Research Journal of Engineering and Technology, vol. 7, no. 3, pp. 1399-1404, 2020

[6] K. K. Singh and B.D Sukhla, "Abrasive Peeling of Potatoes", Journal of Food Engineering, vol. 26, pp. 431- 442, 1995

[7] Y.Ambikar, S. S. Kore, and V. K. Dhumansure, "Design of Balancer Shaft in Single Cylinder Diesel Engine", International Engineering Research Journal, Special Edition PGCON-MECH (2017). Available: https://www.ierjournal.org/pgcon2017.php/. [Accessed Sept. 2, 2021]

[8] R.Wankhede et. al., "Design and Fabrication of Automatic Fruit Slicing Machine-Testing and Performance", - International Journal for Scientific Research & Development, vol. 7, no. 3, pp. 297-299, 2019

[9] A.Yadollahinia and M. Jahangiri, "Shrinkage of potato slice during drying", Journal of Food Engineering, vol. 94, no. 1, pp. 52-58, 2009

[10]. O. S. Kamaldeen and E. F. Awagu, "Design and Development of a Tomato Manual Slicing Machine," International Journal of Engineering and Technology, Nigerian Stored Products Research Institute, pp. 57-60, 2013