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Improvement of Existing Onion Peeler Machines

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Abstract: Many entrepreneurs compete in today's marketplace to find strategies that benefit them. Entrepreneurs prefer to profit from machines nowadays. This project was an improvement of Politeknik Sultan Mizan Zainal Abidin students' previous design of a peeler (2016). A retrofit the old machine design when considered too big, heavy, and not efficient. The results of the study must fulfil the problem to be solved. The quantitative method is the right method in this study and the results of research in numbers and exactness are obtained through experimental methods and data collected and analysed. Design C has been increasing the level of onion peeling results from the overall study results. Overall, the goals of this project have been well and perfectly achieved. This machine peeled the onion skin successfully and reaches almost 90% of its success. This research can help all traders take wise decisions to raise productivity, reduce the consumption of electricity so that profitability is better and easier to use and thus does not cost much.

Keywords: Design, Improvement, Fabrication

1. Introduction

In today's marketplace, many entrepreneurs face multiple problems such as lack of efficiency in producing quality products, and costs for buying a new machine and high machine maintenance. Onion is the main ingredients of the cooking. The current method of peeling an onion is a traditional method. Many effects, such as a hand and a knife, occur with a traditional method. The probability of injuries to eye and hand using this traditional method is too high. Furthermore, it takes a long time if the user to peel in large quantities. The development of onion peeling machine needs to achieve the objective such as increasing the safety, save time and energy of human. The method apply in this project is to fabricate an onion peeling machine by analyzing the source of information data and apply its knowledge (Rosli, 2020). With this came the idea of designing a machine called "Onion Peeler Machines." This machine is ideal for entrepreneurs. This machine is designed with its advantages as it can peel off onion skin in large quantities and fast. Entrepreneurs can also save time and save on labour costs.

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This project was an improvement project from previous design of onion peeler machine by PSMZA students (2016). The first problem is that due to big size, un-use contact space between brushes and onion and such. The second is the result of the previous system being unsatisfactory due to the weakness of the friction force of onions due to the comparatively limited surface area, and this does not affect the friction of onions. Finally, each design is recorded 3 times and results in less precise results. Customers want a machine that able to produce massive and efficient output. Where this system will minimize employee numbers, save employee time, make it easier, and complete customer orders within a defined time (Rhazlin, 2016).

Research objective

The objectives of this study are to the objectives of this study are to come up with several improvement design of onion peeler machines. Besides, to investigate efficiencies of each design then propose the best design in term of efficiency.

Scope of this study

To achieve the objective of this research, some guidelines will be used as a research scope such as it focused on previous onion peeler design specifically design of internal core. It focused on red onion with diameter 4 to 15 cm and 3 kg of onion per usage.

2. Materials and Methods

2.1 Procedures

The procedure in designing this machine and the required PPE during the fabrication of this project are presented in the Table 1 and Table 2.

Table 1: PPE use in the project

No	Figure	Remark
1		Glove
2		Safety shoe

3		Respiratory mask
4		Safety goggle

Table 2: Fabrication of Onion Peeler Machines

Step	Figure	Remark
1		Prepare all the equipment such as drill, cutting machine, slotted angle bar, bolt & nut, measuring tape and stockpot.
2		Cut the slotted angle bar by part and size.

3		Assemble all the part to create main body of the machine and measure.
4	 	Mark the center of stockpot and mark water disposer. Measure the holes with pipe and pully to get a right size and start to drill the holes.

2.2 Project design

This design project is in accordance with the design of the previous machine, but its main frame is smaller, lighter and uses other materials. The method of design is generated with followed the engineering design guided. The final design selection of machine and internal core transforms into a 3D drawing using solidwork software as in Figure 1.

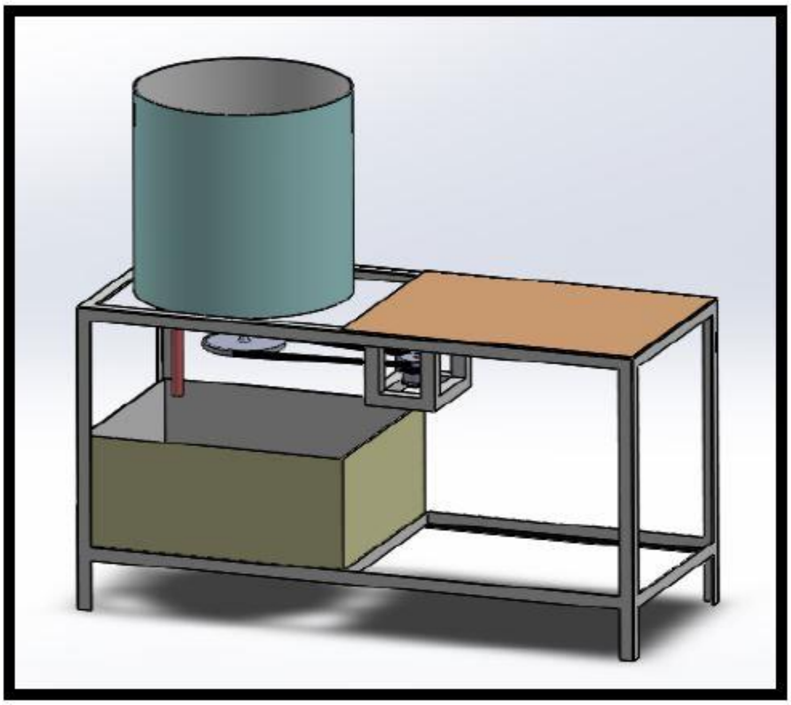

Figure 1: Isometric View of Machine Design

2.2.1 Comparison about machines design

Based on the preceding machine the difference with the latest machine does not appear to be so substantial but has always a big impact where the latest machine was constructed with the old design but has been modified by some additions, according to which the latest machine is lighter with slots and stronger. Moreover, the latest machine is smaller and easier to transport wherever it is loaded into the car. Moreover, there is no space between wasted machinery and as much space as possible is used. Compared to the machine, the modified machine is on the market as in the literature review, where it has its own weaknesses and advantages. An example of an advantage is that this machine is not as expensive as other machines. Furthermore, this machine is easy to use and costs little money and is easy to repair. The disadvantage of this machine is that it is not as complex as other machines which use an automatic system all over entire machine.

2.2.2 Internal core comparison design

Internal core design is the main component where it is needed to carry out the process of peeling onion skin. The design of the frame and layout of any material such as brush, rubber, etc. in the container will determine the effectiveness of a machine. Table 2.3 shows the three designs of internal core tested for this machine. Each internal core has their advantages and disadvantage, and it depends on how much of load. If too much will cause it to be less effective and become waste of time.

Design A illustrates the inner core used for the previous machine and this project is to find a replacement with a new and better design, such as design B and design C. The two new designs were tested with a weight of 3 kg onion. The average results of each design are tested three times and are selected to complete the onion peeling machine.

Table 3: Internal Core Comparison

Design	Figure	Discussion
A		The internal core of the previous machine is this Design A. This machine has a fairly good performance, but it is only 3kg per process and the peeling of the onion skin takes quite some time. This is because the space is too narrow, and it causes an uneven rotation of the onion in the container and the onion skin build up in the container and does not flow through the provided direction.
B		The internal design core B has been tested three times with 3kg onions. The result of this design is very unsatisfactory since the onion only rotates in the container without contacting the existing brush.

C		The inner core of design C is a combination of design A and design B. This design, however, has been very effective because it contains the best contact surface on the wall and below and flattens during the peeling process of onion skin.

2.2.3 Costing

The planning and cost of the products is very significant in the process of making an item. The budget resources as minimal as reasonable from the market but at the same time, the overall cost that was used in this project will be shown in the Table 4 to achieve best product quality.

Table 4: Cost Estimation

No	Equipment	Quantity	Price (RM)
1	Stainless Steel Stock Pot	1	159.00
2	Slotted Angle Bar	1 x 2/20ft	49.28
3	Slotted Angle Bar	1 x 1/5ft	10.91
4	Slotted Angle Plate	20 pcs	10.00
5	Bolt and Nut	10 pcs	10.00
6	Submersible Water Pump	1 unit	120.00
7	Wash Motor	1 unit	80.00
8	Wash Pulley Small	1 unit	16.00
9	Pulsator	1 unit	32.00
10	Timing Belt	1 unit	8.00
11	Nylon Brush	5 pcs	10.10
12	Mini Storage Box	7 L	12.90
13	Rubber Hose	2 m	8.00
		Total	474.19

3.0 Results and Discussion

3.1 Calculation

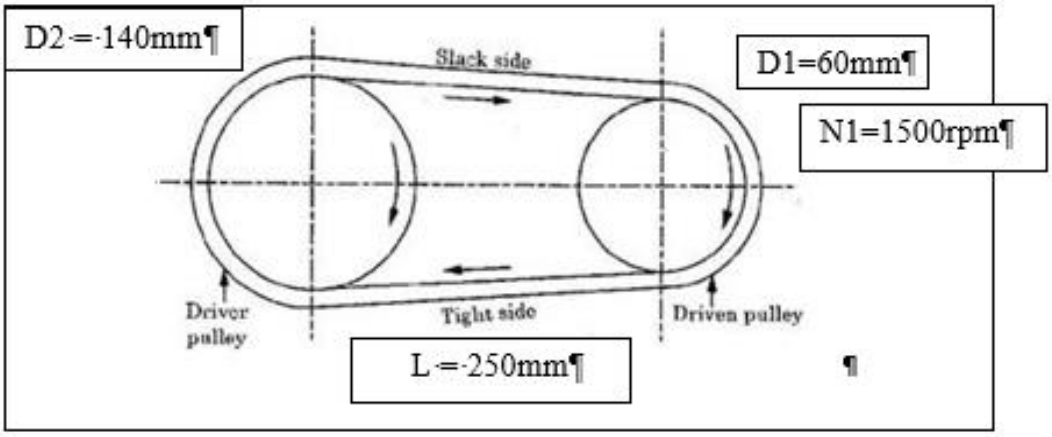

Figure 2: Belting system use in the project

Table 5: Calculation

No	Parameter	Value
1	Power, *P*	150 W
2	Ampere, *I*	1.5 A
3	Poles	4 P
4	Frequency, *F*	50 Hz
5	Rotation speed, *N*	$F = \frac{PN}{120}$ $50 = \frac{4N}{120}$ $N = \frac{(50)(120)}{4}$ $N = 1500\, rpm$
6	Torque, *T* (w/o weight)	$P = \frac{2\pi NT}{60}$ $150 = \frac{2\pi(1500)T}{60}$ $T = 0.95\, Nm$
7	Rotation speed for N2	$N1\, D1 = N2\, D2$ $\frac{1500(0.06)}{0.14} = N2$ $N2 = 642.86\, rpm$
8	Angular velocity, *ω*	$\omega = 642.86\ \frac{rev}{min}\frac{min}{60s}\frac{2\pi\, rad}{1\, rev}$ $\omega = \frac{642.86\ (2\pi) rad}{60s}$ $\omega = 67.63\, rad/s$
9	Work done, *W*	$W = \frac{1}{2}\, I\omega^2$ $I = \frac{1}{2}\, mr^2$ $I = \frac{1}{2}\ (3)(0.07)^2 = 0.007\, kg.m^2$ $W = \frac{1}{2}\ (0.007)(67.63)^2$ $W = 16.01\, Joule$
10	Contact surface, *A* Design A x 9 pcs Design B x 2 pcs Design C x 5 pcs	1 pc nylon brush = 0.013 m^2 Design A, 0.013 x 9 = 0.117 m^2 Design B, 0.013 x 2 = 0.026 m^2 Design C, 0.013 x 5 = 0.065 m^2
11	Power, *P*	$P = \frac{W(A)}{t}$

12	Torque, T	$(C)P = \frac{(16.01)(0.065)}{300} = 0.003\ W$ *(C) P*, 0.003 + 150 = 150.003W *(B) P* = 150.001W *(A) P* = 150.001 W $P = \frac{2\pi NT}{60}$ $(C)150.003 = \frac{2\pi(642.86)T}{60}$ *(C) T* = 2.228 N/m *(B) T* = 2.228 N/m *(A) T* = 2.228 N/m

This section shows the engine or driven pulley power and torque calculation to the driver pulley (Roth, D. C., 2019). Table 5 calculates the power used during the operation of the machine with load is 29.43 N. This calculation also shows the function of precise material selection in the machine design. This is because every tool selection is different and takes time and cost. The selection process of a machine tool has been a critical issue because the improper selection of a machine tool might cause many problems having a negative effect on productivity, precision, flexibility, and a company's responsive manufacturing capabilities. (Ayağ, 2002)

Onions can be categorized in 3 dimensions, small, medium, and large. Medium size of onion is chosen for this project. This is chosen based on multiple tests on the type of size where the medium size onions show good results. While onion large size is too big, and the result of the peeling is not satisfactory due to several factors like the lack of contact surface and the used container. Onions with small size are not suitable because during the running process they are too small and easy to crush and some of them get stuck in the pulsator gap the size of the onion and the contact surface play an important role, where the more contact between the onion and brush, the better the success. (Bourne, 2007)

3.2 Final result

Table 6: Calculation for design C

Test	Formula	Result
1	$\frac{Successful}{total}\ x\ 100\%$	$\frac{31}{36}\ x\ 100\% = 86.0\%$
2		$\frac{33}{38}\ x\ 100\% = 86.8\%$
3		$\frac{31}{35}\ x\ 100\% = 88.6\%$

The calculation method for the onion percentage successfully peeled in each test can be shown in Table 6. The load tested is 3 kg, but there are some errors in each test like the different number of onions and the size.

Table 7: Overall result for Onion Peeler Machine

Mass (kg)	Design	Time (m)	Result (%)			Average (%)
			1	2	3	
3	A	5	56.1	71.8	71.1	66.3
3	B	5	28.9	41.9	25.0	31.9
3	C	5	86.0	86.8	88.6	87.1

Table 7 shows a considerable difference in the percentage of onion yields successfully peeled with the new one according to the previous design. Each design is tested with the same load and time in 5 minutes with three attempts.

The results differ mainly on two factor which is nylon brush and suitable positions. The position of the brush in the container has a significant effect when used as the main tool to peel the skin of the onion. With the right brush position, the movement of the onions can therefore be predicted, and a good product. The number of brushes in the container also has an enormous impact. If the brush isn't in the container, the onion takes longer to peel, and if the brush is too much, it causes a narrow space in the container and can damage the onion. This shows that there are interrelations between the number of brushes in the container and the appropriate position to place the brushes. (Smoot, 1998)

Machines with design A or previous machines have shown relatively good results from this table in which they can make products and the average percentage achieved for design A is 66.30 %. Moreover, machines with design B do not have good results and the product success percentage is 31.90 %. Compared to design A, it is quite low and cannot be used. Machines with design C are, as expected, the best compared to design A and B. This was demonstrated by three tests, in which it can achieve the main goal of this project, where a percentage of over 80.00 % can be achieved for a successful product.

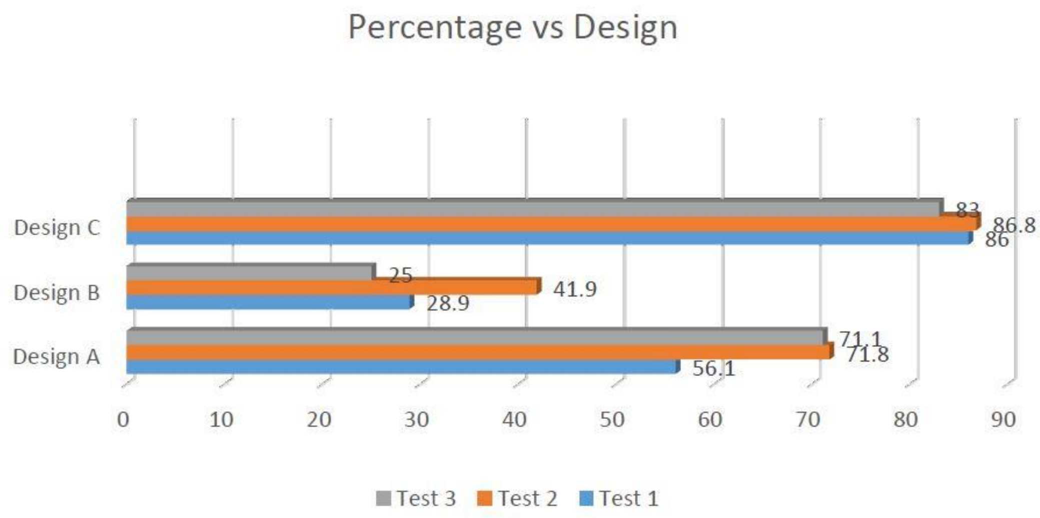

Figure 3: The percentage of result from design A, B and C

The difference in percentages between design A B and design C respectively was shown in Figure 3. Each design produces different movements to peel the skin of the onion. Design A is more concerned with the friction of onion on the container wall and anticipates a faster force for rotation, so that the onion always moves to the wall edge.

The motion of the onion with design B on the machine shows bad results because it is static and only at the end of the pulsator, it does not move or bounce over the brush which causes the smallest amount of peeled onions compared with others. Design C shows a turbulent movement when the onion always bounces in the container and around the pins.

The movement of onions in the container impacts the percentage of peeling onions enormously due to their respective designs on the different contact surfaces. As already mentioned, the contact surface between the brush and the onion will produce good results when it is in the correct position with the correct speed and load.

Table 8: The result of each design

Design	Core Design	Result
A		
B		
C		

4. Conclusion

Each project implemented has its own significance, benefits, and goals. Overall, this project has well and achieved its objectives. This machine successfully peels up to 85.00 percent or higher onion skin. Based on the analysis of the mechanisms used to build and complete this project, this project has found that it offers consumers a few advantages that can reduce the problem of excessive manpower consumption, especially for entrepreneurs of SMI. Moreover, this project has been developed or improved successfully in comparison with previous machines. Where there have been some problems with previous machines designed by Politeknik Sultan Mizan Zainal Abidin students.

All tests with the same load were done at 29.43 N and the performance of each design tested was tested for 5 minutes. In this project, the torque is 2,229 N/m. The energy consumed is 150.03 w. Here, it can be noted that the design A machine or the latest machine showed a relatively good average result of 66.30 percent in relation to the design B machines, which shows an average result of only 31.9 percent. Moreover, design C presses have preceded design A or B machines which have shown the highest percentage in all three tests and are classified as successful by achieving an average success rate of 87.13 percent.

Furthermore, this project achieved all the goals and was very satisfied with the performance demonstrated. It is not advisable to use this machine if you want to store peeled onions as the onions placed in this machine are exposed to water and damaged if not carefully stored or used immediately. In addition, it can further expand the public's views on the innovations made in this design through the benefits of this project. Finally, it is hoped that this project can be exploited fully and accepted by the public and used for modern technology development. It is expected that the results of this project will meet the needs of all restaurants and SMI dealers.

The improvement process in a project must be carried out occasionally to make the project better and more innovative. It also aims to ensure that the products manufactured are of better quality over time. Among the improvements on this machine is the pulsating system in the container, so that it is easy to pull the peeled onion skin down to the provided disposal hole and make it easier to pass through the water. Therefore, adding a brush to a strategic location can also help to peel better than existing ones. Finally, because space is still unused, it can still be reduced in size. All these suggestions will further increase the quality and efficiency of the product produced by the machine.

Acknowledgement

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