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Young Tender Coconut Punching and Splitting Machine

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Abstract : Demand for coconut in today's market is increasing due to its high nutrient level and refreshing character. Therefore, coconut production and coconut selling among vendors also expanded in Malaysia. However, based on the studies and observation, we realize that coconut drink vendors still use machetes to get coconut water and also to cut them. Using traditional methods to cut the young tender coconut leads to injuries, it requires skills, more force and manpower. The purpose of this initiative is to develop a design for a machine which can decrease the likelihood of hazards while chopping coconuts with manual-based operation. This machine operates in manual, user-friendly, capable of punching and splitting the tender coconut. The machine's development process involves design of the machine using SolidWorks, material selection, fabrication includes adhesive bonding, welding, and testing to evaluate the efficiency of the machine. The performance analysis demonstrated that the Young Tender Coconut Punching and Splitting machine provides safe, hygienic and less force or less movement cutting operation compared to traditional methods. In the future, it is suggested that the machine be fitted swivel caster wheels to make moving it around less difficult. A rotating clamp can be installed as an extra safety feature to prevent users from accidentally cutting their own fingers. Using the handle on the instrument, the user may clamp both sides of the coconut and spin them while cutting.

Keywords: Coconut Vendors, Manual-Based, Punch and Split, Traditional Method Young Tender Coconut

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1. Introduction

According to the Malaysian Agricultural Research and Development Institute (MARDI), plantation of coconut trees has increased from 84,609 hectares (2016) to 85,630 hectares (2020). The demand for coconut is increasing as health consciousness among people is increasing. Malaysia is ranked as the number 10 coconut producer in the world [1]. Moreover, studies show that 63% of coconut production is for domestic demand in the form of tender coconut drinks, coconut oil, and coconut oil-based cream powders, whereas 37% is for export purposes. Tender coconut is a popular pleasant drink that has long been used as an excellent isotonic in tropical areas. Tender coconut drink is high in minerals, antioxidants, L-arginine, a free form amino acid, and vitamin C, all of which promote healthy growth [2]. Tender coconut water is a beverage that is frequently served fresh by street vendors while still in its green shell and sipped through a straw in tropical nations like Malaysia. In particular during the summer, it is at its peak. Despite all of those benefits, punching and splitting the tender coconut is a regular difficulty that many people, especially coconut drink sellers, face in our country. Chopping the young tender coconut needs skills and patience. Mostly, the coconut is cut using the machete or hand sickle to obtain the coconut water and the flesh. The Young Tender Coconut Punching and Splitting Machine is the best solution for coconut drink street vendors to cut the tender coconut.

There are several problems with the currently existing methods that are being used to cut the young, tender coconut. This will reflect the need for a new efficient machine. The traditional way of cutting the coconut leads to high risk and injuries [3]. Traditional methods of cutting coconut include using a machete or a hand sickle, which are dangerous, messy, and pose a high risk of injury. Furthermore, it requires special skills and more force [4]. Not all elderly people can cut the coconut properly. Weak, elderly, or female street vendors may have difficulty chopping coconuts while doing business. According to the studies, using the traditional method to punch and split the young tender coconut requires high force from vendors, perhaps harming inside hand nerves, blood vessels, and tissues [5]. Besides that, the traditional method of cutting coconut has a high risk of injuries and requires an effort of 300 N and 150 N, respectively. High force must be applied by the vendor, which could harm the hands and cause pain and various sorts of discomfort for those who frequently use heavy machinery [4]. Sharpened knives to create a hold on coconut are dangerous, time-consuming, physically strenuous, unclean, and unhygienic. Additionally, it has an impact on the health and excessive energy consumption of coconut vendors [6]. Jig Concept, which is rarely used to cut coconut using a sharp hollow cylinder. This type of manual machine is only to extract coconut water, and the vendors need to use a hand sickle to split them. This is an unsafe method and less hygienic. Based on studies, there was a coconut breaker and an extractor grater machine design, which were fabricated with sharp blades and graters. However, this design consumes more power as it works on a motor concept [7]. So, coconut drink sellers do not have access to safe, hygienic, and easily accessible equipment to increase their income. Therefore, the objectives of the study were to identify the safe way to cut tender coconuts and to design and fabricate a young tender coconut punching and splitting machine.

2. Materials and Methods

The completion process of the project led to several discussions to make the project work. The most important in the project is bound to be the material selection. Some rejected materials were removed from he list as they did not possess the properties in various aspects required by the project. In conclusion, five materials suit the best to use in the project. In addition, several methods are listed as an aid in carrying out the project efficiently.

2.1 Materials

Strength, mass, and material properties are considered in the material selection purposely to increase the efficiency of the project. The project consists of several types of materials and components to operate successfully.

i. Hollow square bar

Firstly, the chosen material to be the pillar for the project is the hollow square bar. This material provides enough strength to withstand the high impact of the force while chopping coconut. Secondly, the square hollow bar is lighter than the solid bar regardless of the higher strength properties in comparison.

ii. Paint

The paint's purpose is to coat the project to prevent rusting.

iii. Plat bar

Firstly, the project consists of two different dimensions of plat bars. The higher dimension number of the plat bar, is the coconut placement for the chopping process. The material was chosen because the coconut placement should be stable. Thus, a strong joint such as welding is needed, in which steel is a suitable substance. Secondly, the other plat bars are welded together with the main body at the upper part of the project. The plat bars joined perpendicularly with the bolt and nut to hold the spring and the knife. The chosen material provides a firm hold to keep both items functioning efficiently.

iv. Green Fiber Sheet

The chosen material is picked as it consists of the mass properties. In comparison, fiber sheets are far lighter than steel, hence moveable as desired by the user.

v. Bolt and nut

The bolt and nut function to join together the plat bars along with the main body. These components allow the parts to be removable as desired. Nevertheless, the bolt and nut provide a strong joint as the welding.

vi. Stainless steel

The pointy part purpose of penetrating coconut is made of stainless steel. Stainless steel possesses the advantage of corrosion resistance [8]. Thus, it is safe to pierce the coconut to extract the coconut water.

vii. Cleaver

The cleaver-type knife is selected as it can take on any vegetable and fruit. The high strength of the knife comes in handy in chopping the hard coconut cover.

viii. Spring

The project involves a spring to bring the cleaver to the initial position [9]. The spring is chosen by its constant to ease the user during the chopping process. The user effortlessly chopped the coconut with the aid of the spring.

ix. Thinner

The thinner is used to dilute the paint to coat the finished project.

Procedures can be described using flowcharts and algorithms, in which case the chart will be considered as a figure (see section 3.4). Include the appropriate references to standards. Authors can also explain the scope and limitations of the methods.

2.2 Methodology

The project involves the SOLIDWORKS software to produce the final design of the prototype. The overall process of this project, which includes a few steps involved to make the project a success. Starting from brainstorming ideas, the group members identified the problem, objectives, and scope project. Next, the draft designs, the group members decide to draw several sketches by hand-drawing as an initial design. This stage leads to the selection of the best draft for the project. After picking the best drawing, comes the detail design stage. The selected design filters the material selection, each type and size of the component, and the usage for the project. The function of Solidworks makes it easy to

get a clear picture of the project's outcome. Next, the project consists of variable types of material, so this stage is crucial to make it efficient. The evaluation of each component is based on its strength, mass, and size to fabricate the project. The fabrication process allows for making the prototype of the project. Following the measurement done by SolidWorks, the project construction can be accomplished. Before clarifying a project is successful, the project goes through the test run stage, whereas the project performs the task proposed for it to determine the efficiency of the project. The project has to be able to chop the coconuts smoothly to obtain positive feedback. Next, the evaluation is made based on the test result and discussed by group members before concluding.

2.3 Prototype Specification

After going through four design revisions, the author managed to churn out the final version of the prototype. The prototype initially made in the form of sketch and after the design related analysis is completed. The design of the prototype is constructed in the Solidworks software. Figure 2 shows the detailed illustration of the fabricated prototype. This stage is crucial before proceeding with the fabrication processes.

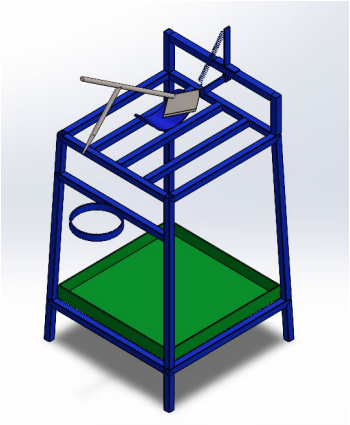

Figure 1: The fabricated prototype drawing using SOLIDWORKS software

3. Results and Discussion

The result and discussion section are crucial because it offers a thorough analysis of the information gained throughout the study, enabling the reader to grasp the importance and relevance of the results attained as well as the ramifications of the findings.

3.1 Machine Specifications

The machine design will need to be tested after the fabrication process. Also discussed in this section is the machine performance analysis. The specification for the machine is shown in Table 1.

Table 1: Machine specifications

No	Product Name	Young Tender Coconut Punching and Splitting Machine
1	Masses	10kg
2	Height (From the spring)	1115mm
3	Width	550mm
4	Length (At the top)	475mm
5	Length (At the bottom)	525mm

3.2 Performance Analysis

Performance analysis was done to evaluate how well a safe way of harvesting the tender coconut used in our machine compared to a machete or hand sickle. The tool performs excellently when cutting and punching. **Figures 3(a)** and **Figure 3(b)** depict the cutting and punching of the young coconut.

(a) (b)

Figure 2: The operation of the machine (a) The punching operation and (b) The cutting operation of the young coconut

Table 2: The difference in punching and cutting forces between the research and the experiment

	Experimental	Research
Punching Force (N)	124.60	132.80
Cutting Force (N)	9504.13	9605.4

The variation in punching and cutting forces between the research and the experiment is displayed in Table 2 [10]. The young coconuts are punched by a machine that needs 124.60N to create a hole to extract the coconut water. This machine needs 9504.13N to cut the young coconut.

4. Conclusion

In conclusion, a well-functioning Young Tender Coconut Punching and Splitting Machine was constructed. The manufactured project achieved the main objective, to keep the user away from any form of danger while chopping coconut. The project uses a simple mechanism that users can operate with no worries running in their minds. In addition, the spring benefits the user to bring the chopping knife back to its initial position. From the previous setup, the current design is the best among them, hence being the outcome of this project. To accomplish this project, approximately RM 650 worth of materials and labor are needed. The project improvement in the future is worthy as it provides safety to the user while chopping coconut regardless of the significant cost and construction time taken into account to carry out the project.

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