

Design and development of coconut scrapping machine for small scale and household working

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Abstract: The study presented here based on considerations taken into account of small-scale coconut scrapping requirement. There is need of smart solution for scrapping the coconut into required scrapping with minimal effort. The presented solution helps to solve the problem of scrapping of coconut with minimal effort with cleanliness. The present study was taken up to improve a profile-raising strategy for innovation and generate public awareness regarding the availability of a coconut fiber extraction machine in the market at a lower cost. The collection of needed information and data on user routine and current process by which they perform their job is done with various literature and machine available. The present complications were analyzed. Interviews were held with users. A comparative bench marking study was done on similar processes developed in other similar extraction processes. Concepts were generated keeping benchmarked product in view. Five concepts were generated with different functions and operating processes for coconut fiber extraction machine. Final concept was selected by considering the users' operating environment and ease of operation, which could be used in small scale and in the household purpose. Considering the users' requirements and purchasing capacity, a prototype was contrived. This machine works with simple mechanism, consisting of pressure plate, grater plate, and sliding locker mechanism. Pressure plate attached to a rotating shaft with rope. When rope is pulled outward shaft is rotating and applies pressure on coconut which is held between pressure plate and grater plate. The pressure and rotation help for scrapping of the coconut in fine pieces with minimal effort. Validation was carried out with the user group and the feedback was positive. It was noticed that there is potential market for this product. Further work could be carried in terms of aesthetics, material and weight reduction by adopting advanced manufacturing techniques.

Keywords — Coconut scrapping, Pressure plate, Grater plate, Self-adjusting scrapper

I. INTRODUCTION

Coconuts are a popular fruit all around the world. Traditionally, it is simple to crack the coconut that we buy in the market and use on a regular basis. There is every day need of grated coconut for cooking purpose in household as well as for restaurants and hotels. This need is increasing day by day. The process of coconut scrapping now days is done with hand having a risk of cutting also the time required for scrapping with conventional machines are considerably high. For small-scale production, however, the process begins with de-husking or stripping the fiber off the coconut. After you've finished peeling, you'll need to cut and grate coconut. However, each procedure has its own equipment on the market. As a result, a machine that meets both needs is attractive, and our project gains traction. They offer a wide range of applications, including health and nutritional advantages.

Coconuts are cracked with a hammer or knife in small-scale coconut processing. Hand tools or mounted-type coconut scrapers are used to extract the kernel. Even in small-scale

coconut processing, using hand tools is time-consuming and requires effort (Practical Action, 2008). Coconutscraper machines that are operated manually are portable and may be used efficiently in the home, with the clamping screw securely fastening the entire mechanism on a table. The rotation of the manual handle is communicated to the scraping bit (Figure 1). While rotating, the dehusked coconut half-shell is forced against the sharp bit (Figure 2). To grate a coconut using this device, you'll need to exert some effort



Figure 1: Manual Coconut Scrapping Machine

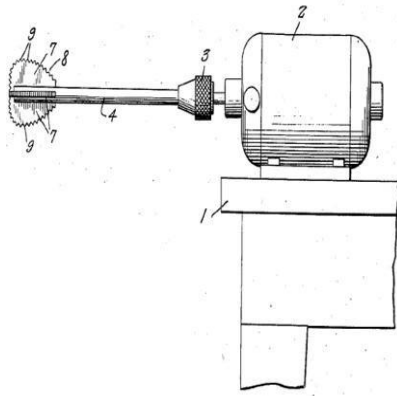


Figure 2: Motor operated Coconut Scrapping machine

The scraping component of a manually driven scraper is often linked to an electric motor in semi-automated industrial scrapers. The scraping bit may have a varied design, but they all scrape in the same way and with the same amount of effort. Figure 2 depicts a typical semi-automated coconut scraper.

The purpose of this study is to describe the creation of a cutting-edge coconut scraping machine. Coconuts come in a variety of sizes and forms. To be automated, the design would have to drastically eliminate all operator input during operation. In addition, the new design must support a variety of coconut sizes and shapes. The new scraping machine must be self-

II. LITERATURE SURVEY

Sajil Raj, Anshadh, Raj, and Ahsana (2016) offered a compact design for coconut scrapers that included a clamp (locking adjustable, dependent on the size and shape of the coconut). The sharp bit in traditional coconut scrapers rotates at a high velocity. The operator presses the inside of the dehusked coconut shell, which contains the meat, against the rotating sharp bit. This procedure is time-consuming and might be dangerous. It is consequently vital to create a mechanism that can imitate the operator when scraping coconuts. There are no studies that the authors are aware of that detail the construction of a fully automated scraping machine. Commercial coconut scraping machines are not totally automated and still require physical interaction from the operator. mechanism), movers (for lateral and forward feed), a coconut holder, a motor (to rotate the coconut), a plate holder, and blades (for scraping of the coconut). James, Joy, Shaji, Chandy, and John (2016) described another design of a coconut breaker extractor grater machine that had a motor, breaking tool, scraping tool, body, an angle plate, a hanging weight, two pulleys (motor and shaft), bearings, and a spring. Bapat, Ballewar, Sarode, and Hande conducted a review of a multipurpose scraping machine (2018). The cylindrical drum, blade, v-belts, motor, and steel frame are the key components of this machine. Senthil Kumar, Kamaraj, Kaviraju, and Mano Bharathi (2018) suggested a single-drive multi-blade coconut scraping machine. A frame,

worm shafts, worm gears, blades, a motor, and chain drives make up the system. The term "coconut scraper (grater)" is covered by a number of patents (Thompson & Thompson Noel, 1984; Kannukkaden, 1993; Kumar, 2004; Zaldivar, 2016). All of these options are either manual or semi-automatic, and each has its own set of features. Mattathil designed a more flexible mechanism for scraping and harvesting coconut flesh from a half coconut with less human interaction and increased convenience (2019). Variable-width, variable-movement-control, and variable-opening mechanisms are all included in this gadget.

1.1.1 PATENTS

A patent survey is carried out in the application area of scraping coconut. The variety of machines are developed till now having manually operated and automatically operated. The figures are showing the actual models of patents available till now. Figure a shows the patent US2190105A which is operated by motor as a power source, and feeding is done manually. Figure b shows patent US4441410 there is no any power source available also feeding is done on manual basis. The improved version patent shows in figure c USD335615 here adjustable screws are provided for accommodation coconut of any shape. The unit designed with motor as power source. Figure d shows the patent USD10251416B2 based on gear and chain drive for continuous operation which is motor operated.

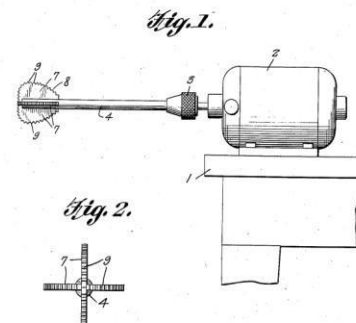


Figure 3: Patent US2190105A

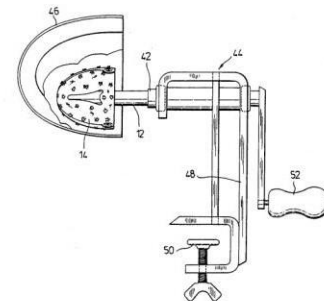


Figure 4: patent US4441410

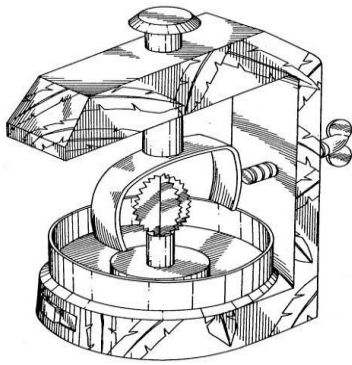


Figure 5: Patent USD335615

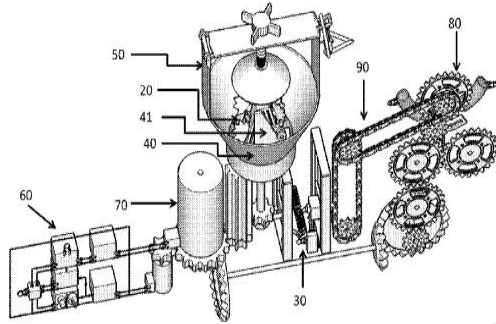


Figure 6: Patent USD10251416B2

1.1.2 Summary of Literature review on Coconut Scrapper machine

Based on current research papers and patents on coconut scrapper machines, the gaps are found out like it should be ease of operation. There is no any storage available so contamination issues are may to happen. Some machines are not considered the cleanliness aspect this need to improved. There is scope available in that area. A extensive literature study is conducted to build a small coconut scrapping system that could be deployed in household working as well as restaurants for easily scrapping of coconut.

1.2 PUGH MATRIX

The Pugh matrix allows the consultant to organize various criteria (or features) of a solution in a structured way for easy comparison. Using this matrix, a consultant can develop an optimal solution, which is a hybrid of other strong solutions. Furthermore, this matrix facilitates a team-based process for disciplined concept generation and selection.








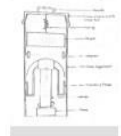
Patents/Products	Existing Machine	Coconut Grater Patent :US2190105A Patent No.: US4441410	Patent : COCONUT GRATER Patent No.: USD335615	Patent : APPARATUS TO SCRAPE COCONUT Patent No.: USD10251416B2	Product Heavy Duty Coconut Scrapper Machine	Product : KRN Commercial Coconut Scrapper	Concept 1:	Concept 2:
Engineering Characteristics								
Capacity	0	-1	0	0	3	0	2	1
Tool Type	0	-2	-2	-2	1	-2	1	0
Operating Cost	0	2	1	1	-2	1	1	1
Storage unit	0	0	0	0	0	0	2	2
Feeding System	0	0	0	0	0	0	0	0
Cleaning Mechanism	0	1	1	1	-1	1	0	0
Safety	0	-1	-1	-2	0	0	1	1
Rating	0	-1	-1	-2	1	0	7	5
Ranking					3		1	2

Figure 7: PUGH matrix for Conceptual design

III. METHODOLOGY

The five-step process described in this paper led to the concept of the coconut scraping machine: problem definition and research objective; literature review; development of the scraper mechanism; development of the clamp mechanism; description of the electrical and control systems; detailed design. As a first stage in the design process, the problem and objective were defined in the first two sections of the paper. To further understand how the coconut is constructed, researchers undertook a literature study. Existing coconut machine concepts were examined in order to discover elements that could be included in the proposed model. The scraper mechanism was designed with at least two axes of movement in mind. The material was chosen based on

current designs and the demand for coconut kernels. The clamp mechanism was created to keep the coconut firmly in place while reducing the amount of time it takes to mount it. The operation of the key sub-systems of the model provided in this paper was used to provide a brief overview of the electrical and control circuits.

IV. DEVELOPMENT OF SCRAPER MECHANISM

A coconut scrapper which is having eased of operation, dedicated storage unit and easy for cleaning is developed. The following parts are used for development of scrapper. The scrapper machine consists of a bowl which is easily available in the market. So, retrofitting of our machine is done in that bowl and successfully that machine is used for

scrapping. The upper part of bowl comes with a rotating shaft and one small diameter rope having a length of 40 cm is attached to it. When we pull out that rope so shaft start rotating in the bowl. So that rotation of shaft is used for rotation of pressure plate. This applies pressure as well as rotating motion to the coconut which is placed in between pressure plate and grater plate. This rotating motion against stationary grater plate helps for scrapping of coconut in smallest pieces. The following parts are used for developed explained below.

A. Pressure plate

The pressure plate is developed as shown in figure 8. This plate is attached to rotating shaft with the help of pressure plate upper part. When shaft is rotating upper part will transmit the rotating motion to the pressure plate. The dimples created on the bottom part of surface are used for holding the coconut.

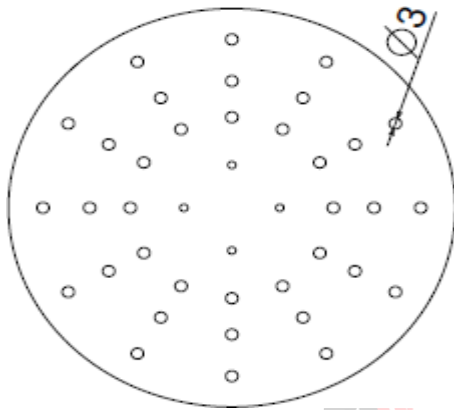


Figure 8: Pressure Plate

Grater Plate: The food grade steel is used for making the grater plate. The grater plate is shown in figure 9. The circular types of cutting holes are drilled and cutting edges are prepared. The circular array of holes is helped to rotating coconut to cut easily. The grater plate held stationary with the help of locker which allow grater plate only upward and downward motion and rotating motion is restricted.



Figure 9: Grater Plate

B. Locker

The locker is part of mechanism which help to hold the grater plate. This locker is shown in figure 10. This locker

consists of three slots which will place on base. Upper part of locker is hold to grater plate this allows to hold plate stationary. Plate only moves upward and downward in the slots. The locker restricts the rotation of grater plate which help for scrapping. This part is manufactured with the help 3D printing machine.

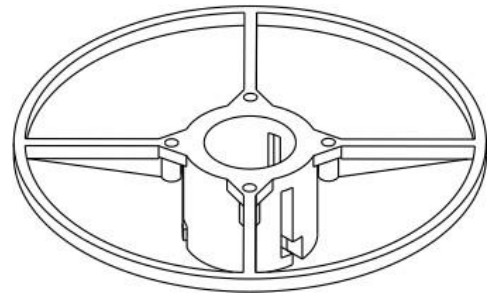


Figure 11: Pressure Plate Holder

E. Base

The locker and grater plate are placed over the base. Base allows the locker slide vertically into its edges. Base hold the locker and grater plate firmly. Base attached at the bottom of bowl. It will hold stationary. This base allows grater plate to held stationary so cutting will take efficiently. This part is manufactured with the help 3D printing machine.

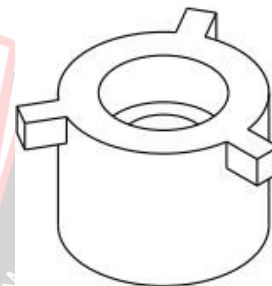


Figure 12: Base

F. Spring

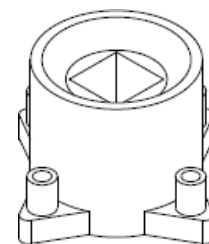


Figure 10: Locker

D. Pressure Plate Holder:

The bowl used to hold the mechanism has a rotating shaft. This rotating shaft rotates when attached rope pulled out. This shaft attached to pressure plate holder and this is attached to pressure plate. This holder holds the pressure plate and it transmit the rotating motion to pressure plate. This part is manufactured with the help 3D printing machine. The spring is placed between locker and base. This spring will help to apply pressure from bottom side to coconut. Also, this spring allows locker to slide vertically on the base. As the cutting take place, the distance between pressure plate

and grater plate is get reduced to the firm holding is taken with the help of spring. This allows total scrapping of coconut. At the end minimal distance is remaining in between pressure plate and grater plate which allows user to takeout the grated coconut and put the new fresh coconut pieces for scrapping.

V. ASSEMBLY OF DEVELOPED MECHANISM

All the parts are manufactured and assembled as shown in the figure. The figure shows all the components of mechanism except the upper part of bowl. Assembly is done successfully and the mechanism is ready to grate the coconut at desired speed and shape.

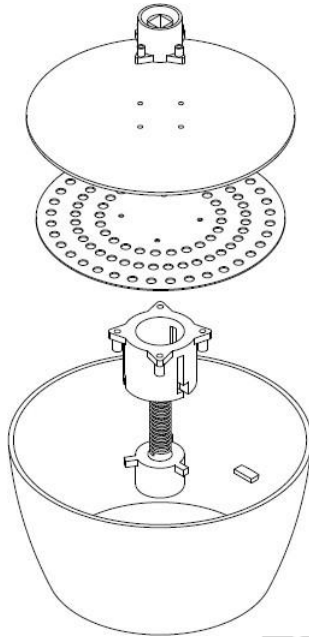


Figure 13: Parts to be assembled

VI. CONCLUSION

Coconuts are a type of fruit with a wide range of applications. Despite the fact that the edible fleshy section of the coconut is one of its softest, removing it from the coconut shell needs considerable effort. Several methods for securely and easily removing the coconut meat have been proposed. The literature survey gives the idea about existing coconut scraping machines. This helps for innovate the idea of scraping and proposed scraping machine developed. The goal of this study was to build a semi-automated scrapper that would save time and effort while also being safer and more efficient than manual and conventional scrapers. The developed machine is successfully working on variety of coconuts. The presented scrapper machine successfully shows a significant reduction in time for scraping of the coconut. Also, storage at the bottom will ease to taken into bowls. Cleaning of parts is easy task. The design and developed machine presented in this study includes a self-adjusting scraping or scraping mechanism that adjusts to the size of the coconut as it rotates.

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