

Design and Fabrication of Semi-Automated Tender Coconut Drilling Device

P.Raja Raghu Vamsi Krishna¹, K. Raghava Rao² And Seeram Srinivasa Rao³

¹Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation, Deemed to be University, Vaddeswaram, Guntur-522502, India,

²Department of ECM, Koneru Lakshmaiah Education Foundation, Deemed to be University, Vaddeswaram, Guntur-522502, India,

³Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation, Deemed to be University, Vaddeswaram, Guntur-522502, India

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Abstract:

Automation plays a very vital role in present technology aspects and as there is a heavy demand for young coconut in today's market as it contains nutrients, it helps in dissolving kidney stones, reduces blood pressure, energy drink, etc., and it's a natural gift. But making a punching and slicing a young coconut have some difficulties it cause injuries, as the demand for young coconuts are high due to various medicinal values there are a lot of coconut sellers and there are various conventional ways to cut, chop, slice out the exocarp of the coconut which are hazardous to health and sometimes threat full, by this automated device these all factors have majorly reduced. In existing techniques and methods it requires a lot of manpower and time and other factors, aged people, handicapped people feel difficulties to do this. But as compared to them this device requires very less manpower and in very less time numerous tender coconuts can be drilled. Automation plays a vital role in present engineering services where sensors are widely used for various purposes in automation which is not only applicable for industries but also majorly used where ever human effort is reduced and save time. In this paper the design and fabrication of tender coconut drilling machine with which uses sensors to detects the presence of tender coconut and sends signals to the DC motors and starts drilling hole into the coconut as the demand for young coconuts are high due to various medicinal values there are a lot of coconut sellers and there are various conventional ways to cut, chop, slice out the exocarp of the coconut which are hazardous to health and sometimes threat full, by this automated device these all factors have majorly reduced. In existing techniques and methods it requires a lot of manpower and time and other factors, aged people, handicapped people feel difficulties to do this. But as compared to them this device requires very less manpower and in very less time numerous tender coconuts can be drilled.

Keywords: DC motors, sensors, drill bit, rack and pinion, battery

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INTRODUCTION

As there are many people of different ages mostly have the livelihood on the small coconut selling shops and their lives depends on them to reach their daily needs. Sometimes people lose their lives using

hazardous methods of coconut cutting in place of that these can be replaced. People who have very busy lives and don't care on their health for them this device helps them in having good healthy coconuts. People who wants a nice and clean surroundings can use this device because of less

wastage. People are attracted for new technology and innovation not only for fulfilling purpose but also having fun. There are sellers who are physically disabled can also use this easily. It doesn't need more knowledge about the device because it totally works on automation so that people who have less knowledge can also afford. It can be used in a disciplined aces as there is less clumsy.

As of survey there a lot of developed machines and techniques which are so heavy and risky. Problem of using different hazardous and time taking processes of coconut cutting/opening is being reduced. Weight of the machinery is reduced so it can be portable from place to place. Time taken to make a hole in a coconut is less compared to other machines and techniques. Less usage of sharp knives results in avoiding accidents and hazards compared to other techniques. A lot of man power is required for cutting the coconut with a bear hand, and in some other machines fluids are used in this machine we do not use such sharp tools. Here in this machine less power required due to usage of batteries and solar panels. Although there are a lot of mechanisms, methods and machines for opening the coconut, for chopping, slicing, crushing. Which uses hydraulic fluids and other mechanical concepts. But in this machine we directly drill a hole through the exocarp of the tender coconut with automated sensors, which is very new and unique innovation regarding coconut cutters existing now. Compared to other machines it is less weight. Due to full automation it takes less time to complete the operation. Less knowledge of the machine is required to operate. No buttons, switches, pedals, levers, etc. are used as there are in other developed products. Lot of coconuts are made hole at very less time compared to other methods. Solar panels are used for power source so that as long as solar power is present this device works, if not a battery can be used as a power source. Very less maintenance is required. Availability of tools are abundant and less cost. The size of the hole in the coconut can be changed as of requirement. Compared to other methods it has less wastage and less junk.

LITERATURE REVIEW

H. Rajanikanth, Prof. Reddy Naik. J [1] has designed a tender coconut punching and splitting machine which has less effort of cutting a tender coconut compared to other machines at that time and have calculated various amounts of forces required to cut the tender coconut and concluded that the mean value is of 712N to punch and split the tender coconut.

Jerry james et al [2]. designed and fabricated a coconut breaker and extractor grater machine which has a sharp blade to cut the coconut and shaves the exocarp of the coconut and grater helps the movement of the cutter/slicer with a motor and consumes more power to cut

K.Balachandar et al [3]. This project is mainly taken from the concept of punch cum splitter coconut device this contains a sharp pointed needle to punch a hole through the coconut and a splitter which makes the coconut to two halves and the spring attached to it is pushed down and after cutting the coconut the blade and needle goes back to the rest position.

Mr. Anil Sharma et al [4]. This design has a hydraulic system which helps in applying force over the cutter and splitter instead of manual power as shown in regular punch cum splitter coconut machines.

Prof. R. D. Pistulkar, Prof. K. S. Zakiuddin [5] has proposed and a new design for the further development of the punch cum splitter coconut machine by adding a fly wheel mechanism where a human sits on it and pedals the fly wheel as the energy stored in the flywheel continues the punching repeatedly along with splitting.

Prof. S. M. Fulmali , Prof. A. A. Bhojar [6] developed a multipurpose coconut cutting tool which works on the screw jack mechanism when the screw

is rotated the coconut moves up towards the knife and then split-ups the coconut.

Roshni T., Jippu J., Ratheesh C.S., Sachin J., Sreevisakh K.L [7] the initial design and concept of coconut punch cum splitter has been proposed and developed which uses a sharp knife to split the coconut and a sharp punch to make a hole to the coconut.

Based on the survey there a lot of developed coconut cutting of different kinds of machines and techniques which are so heavy and risky existing now but no one is found the same as we are proposing the innovative idea that simple is an automated hole making to a green coconut to drink its water. The existing coconut water drinking outlets are using a heavy sharpened knife to make a hole to drink the coconut water. This is risky, time taking, physical strain, not clean and hygienic. Besides, it is effecting coconut seller health and high energy consumption. A lot of manpower is required for cutting the coconut with a bare hand, and in some other machines, fluids are used.

Our idea is to make automated this whole process and reducing human involvement in making a hole at a faster rate to the server the customers at green coconut sale outlets. The green coconut retail sales outlets are mobile having power problem which will be solved with this device by the usage of batteries or solar panels. The design of this device will be taken care of lightweight, no harm and easy carry and it is estimated that human cutting takes 10 coconuts the whole making takes 15-20 minutes but this device will take 5 minutes.

India's *coconut water market* stood at \$ 9.2 million in 2017 and is projected to grow at a CAGR of 18.4% during 2018-2023 to reach \$ 25.4 million by 2023, on the rear of growing health concerns among consumers as a consequence of hectic and stressful lifestyle. As this is a fully automated device it will have more CAGR in the future. The demand for coconut water can also be recognized to escalate consciousness about prospective health benefits of drinking coconut water, rising consumer preferences

towards natural and healthy drinks over high calorie carbonated drinks, and availability of innovative flavored variants of beverages. In addition, increasing personal income on disposable items, rising young working-class population base, and growing organized retail and e-commerce industry are a number of the opposed factors expected to propel the demand for coconut water in India over the subsequent five years.

There are various machines and methods based on working they are as follows

CONVENTIONAL BREAKING METHODS:

- By using a sharp knife
- Hitting on a hard surface

CONVENTIONAL GRATING METHODS:

- Traditional methods
- Kitchen tool methods
- Electric machines methods

MAIN OBJECTIVE OF THE DEVICE

- To automate hole making to green coconut
- To provide non-conventional(Battery, solar) power to retail green coconut mobile outlets
- To increase speed, time-saving and less wastage through this machine
- To reduce the risk of damage to the health manual strain by using this machine
- To reduce maintenance and speedy serving of customer with the quality process of drinking water
- To help anybody can operate with little knowledge this machine

1. DESIGN AND METHODOLOGY

This design is done in solid works 2020 according to the patented design in 2018 by K. Raghava Rao, in this design comprises of a motor, drill bit, rack and pinion, assembly and chuck.

1.1 3D Model Of The Entire Assembly:

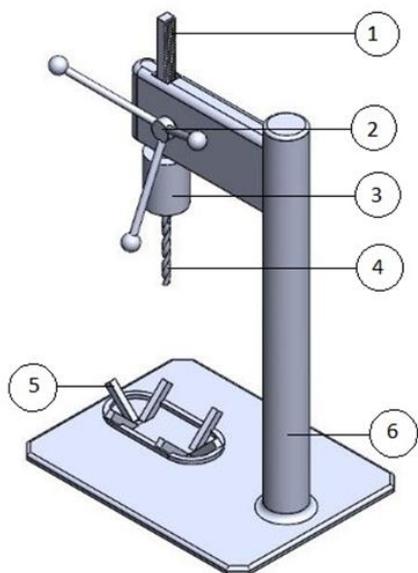


Figure: 1. Isometric view of the device

The figure.1 shows the isometric view of the device which is modeled and assembled in solid works 2020.

The details of the parts contained in the model are explained below:

1. Rack and pinion: it is a mechanism is widely used in mechanical machines which is used for converting rotary motion to the translating motion. Here the pinion gear wheel which overlaps on the rack, as the pinion is rotated the rack begins to move in translating motion.

2. Lever: This lever is connected to the pinion gear which helps in rotating the pinion gear. When the lever is forced to rotate the pinion gear starts rotating and helps in rack to move in translator motion

3. Motor: the motor is used to rotate the drill bit, when it is given power the motor shaft rotates the drill bit and with the rack and pinion mechanism it translates up and down and hence the hole is drilled through the exocarp of the coconut, the motor is taken according to the availability in the market and the motor specifications of the motor is given in table below:

Table.1. motor specifications

Motor model	MY6812B
Voltage	12 Volts DC
Output	100 Watts
Sprocket	Removable Bolt Sprocket
No load current	< 0.55A
Rate torque	4.58 KgCm (0.45N.m)
Rate current	< 7.0A
Shaft diameter	8 mm (milled groove one-sided 1 mm)
Speed	3350RPM

4. Tool bit: Tool bit is connected to the motor by means of a chuck. The required tool bit is selected according to the size of chuck available in the market. The tool bit here we have taken is shank spade which have different diameters generally available from 10mm to 28mm diameter and these are customized according to the chuck size.

Here the chuck specifications and tool specifications are given in tables below

Table.2. tool and chuck specifications

Tool specifications	
Material	heat treated, tool Steel HRC48-56
Length	150MM
Hole diameter	10mm-28mm
Chuck specifications	
Tool bit holding size	0.3-5mm

5. Holder: coconuts of various sizes are held in here to stop the movement of the coconut while drilling hole through it.

6. Frame: and all the parts are assembled to this frame. And this helps in weight distribution all over the device, so that the device can with stand vibrations, and helps in balancing.

7. Sensors: To sense the presence of the coconut on the coconut holder a proximity sensor is used, and after sensing this sends the signals to the micro controller and this sends signal to the power supply and starts the motor.

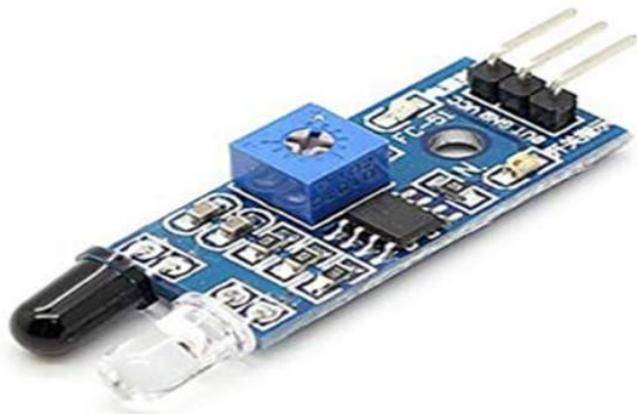


Figure: 2. IR proximity sensor

1.2 Working of the Semi-Automated Tender Coconut Drilling Device

a stepper motor configured to facilitate a rotation of the device by attaching to a drill bit, whereby an electrical impulse of minute intensity is sent through the drill bit, whereby the set-up of the drill bit and the stepper motor is shifted by a worm gear which is moved downwards towards the coconut during drilling, as there is an increase in charge flow upon the contact of the drill bit with the contents inside a coconut. Wherein the drill bit is supported by a drill chuck. The drill bit is configured to rotate in a clockwise direction. The drill bit is configured to rotate in a counter-clockwise direction wherein stepper motor is fixed with the suspension

enabling the reduction in the pressure on the motor while drilling. Wherein the size of the drill bit is customized as per the circumference of the coconut to be drilled.

1.3 Benefits of the Device over Other Machines

- It has less weight compared to other machines
- It is portable
- Less wastage is acquired
- Less knowledge of using is required so that everyone can use it
- As there is no sharp blades or knives are used there is less hazardous
- Less manpower and strain is required
- Since it has DC motors a battery, solar panels can also be used.

1.4 Analysis Of The Tool In Solid Works Simulation

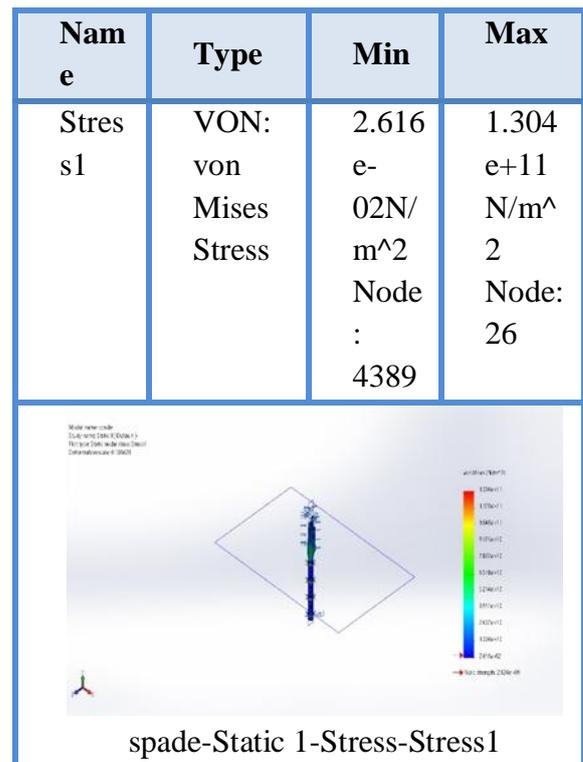


Figure: 3. Stress distribution on the tool

Name	Type	Min	Max
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Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+ 00mm Node: 49	8.36 0e+ 01m m Node: 548

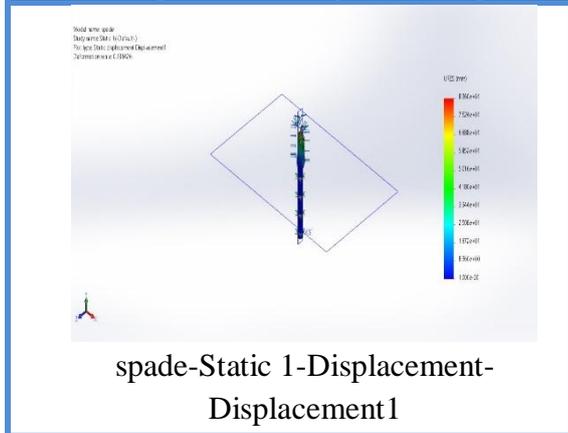


Figure: 4. Static Displacement of the tool

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	1.529e- 13 Element : 4635	3.111 e-01 Element: 2501

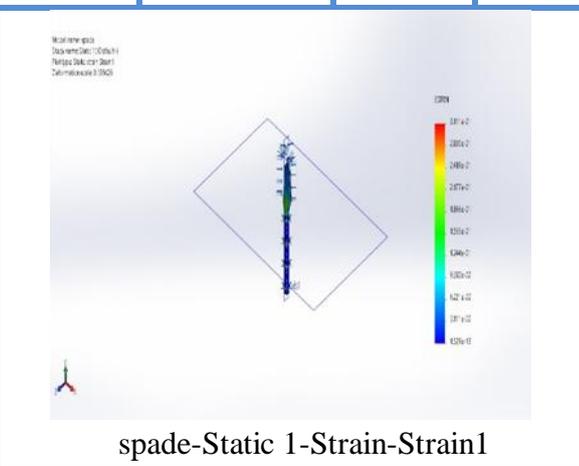


Figure: 5. Equivalent strain distribution

FABRICATION OF THE MODEL



Figure: 6. Fabricated proto-type of the semi-automated tender coconut drilling device

TESTING OF THE MODEL:



Figure: 7. Drilling hole into coconut

The time taken to put a hole to a tender coconut is very less (10sec) compared to other techniques and methods. The graphical comparison is given below:

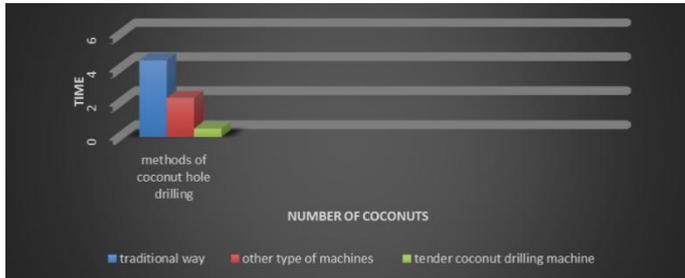


Figure: 8. Graphical comparison of time required to tender coconut drilling with other traditional and machinery methods

Revenue comparison of tender coconut drilling device over other machines and techniques

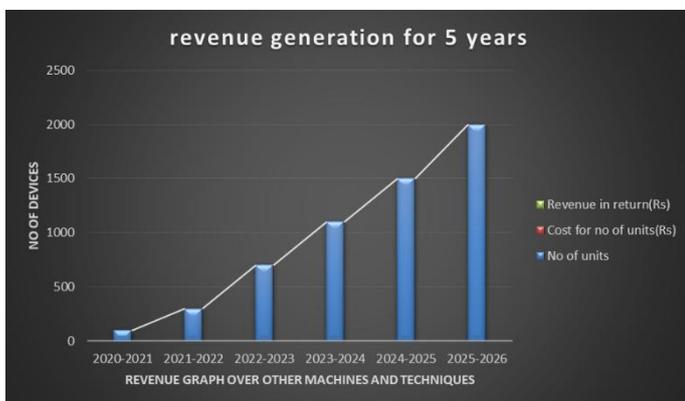


Figure: 9. Revenue graph over other machines and techniques

FUTURE SCOPE

- This will be further developed into a fully automated device.

In future the machine is efficient because the components used for the machine is less hence its maintenance is less or negligible.

Findings and Conclusion

As there are many people of different ages mostly have the livelihood on the small coconut retails and their lives depend on them to reach their daily needs.

Sometimes people lose their lives using hazardous methods of coconut cutting in place of them these can be replaced. People who have very busy lives and don't care about their health for them this device helps them in having good healthy coconuts. People who want a nice and clean surrounding can use this device because of less wastage. People are attracted to new technology and innovation not only for fulfilling purposes but also for having fun. Some sellers are physically disabled can also use this easily. It doesn't need more knowledge about the device because it works on automation so that people who have less knowledge can also afford it. It can be used in disciplined aces as there are less clumsy parts.

References

1. H. Rajanikanth, Prof. Reddy Naik. J "Product Design and Development of Tender Coconut Punching and Splitting Machine" international journal of research in aeronautical and mechanical engineering, Vol.3 Issue 11, November 2015 Pgs: 119-129
2. Jerry James, Jacqwin Joy, Abin Shaji, Basil Chandy, Vinay Mathew John, "Design & Fabrication of Coconut Breaker Extractor Grater Machine" IJRST –International Journal for Innovative Research in Science & Technology, Volume 2, Issue 11, April 2016
3. K.Balachandar, K.Chaithanya, S.Balamurugan, Ch.Vijay kumar, "design and fabrication of tender coconut cutting machine" international journal of research culture society, Volume - 2, Issue - 3, Mar – 2018
4. Mr. Anil Sharma, Mr. Promod udan, Mr. Rahul Keche, Mr. Manohar Hedau, "design & fabrication of green coconut cutting machine" International Journal on Research & Modern Trends in Engineering & Management (IJRMTEM) Vol. 1, Issue1, June 2016
5. Prof. R. D. Pistulkar, Prof. K. S. Zakiuddin, "Design and Fabrication of Coconut Punch-Cum-Splitter for Young Coconut" international journal for research & development in technology, Volume-7, Issue-1 (Jan-17)

6. Prof. S. M. Fulmali , Prof. A. A. Bhojar, “Development of Multipurpose Coconut Cutting Machine” International Research Journal of Engineering and Technology (IRJET), Volume: 02 Issue: 08 Nov-2015
7. Roshni T., Jippu J., Ratheesh C.S., Sachin J., Sreevisakh K.L. “Development of a Household Coconut Punch-cum-Splitter”. Agricultural Engineering International: the CIGR Ejournal. Manuscript 1188. Vol. XI. May, 2009
8. s. b. patil & a. d. chendake, “development of multipurpose punching and cutting machines” International Journal of Agricultural Science and Research (IJASR), Vol. 7, Issue 2, Apr 2017, 177-188
9. Satip Rattanapaskorn, Kiattisak Roonprasang, “Design and development of semi-automatic cutting machine for young coconuts” Maejo International Journal of Science and Technology, Mj. Int. J. Sci. Tech. 2008, 1(Special Issue), 1-6
10. Vaibhav Y. Potraje, Aman S. Attarde, Prof. G. D. Gosavi, Swapnil D. Nimkar, Sagar M. Kubde, “Coconut Water Extracting Machine”, IJSRD - International Journal for Scientific Research & Development Vol. 3, Issue 02, 2015