

Design and Analysis of Nut Separator from Cashew Fruit

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ABSTRACT: Cashew is one of the main potential fruit. Cashew fruit and nut separation process in a large quantity is a tedious job. Today, there is an obvious scarcity for labors and the higher labor cost, making farmers to go for machine to carry out the task. Presently there are no machines that could separate the nuts from fruit. The present project is an attempt made to accomplish the automated cashew nut separating facility in a device concentrating at the difficulties of farmer who grow cashew nut in large scale. Apart from the new product development, the invention is targeted to reduce the time during the manual operation. The fatigue during the manual operation and labor cost is reduced considerably.

INDEX TERMS: Agricultural equipment, manual labour, Cashew fruit, Separating machine

I. INTRODUCTION

Cashew, the dollar-earning crop is of considerable importance to the Indian economy as a source of foreign exchange, employment and farmers income. In India, mainly 8 states are popular for the commercial cultivation of cashew. These are Andhra Pradesh, Goa, Kerala, Karnataka, Orissa, Maharashtra, Gujarat and Tamil Nadu.

Cashew, the dollar-earning crop is of considerable importance to the Indian economy as a source of foreign exchange, employment and farmers income. In India, mainly 8 states are popular for the commercial cultivation of cashew. These are Andhra Pradesh, Goa, Kerala, Karnataka, Orissa, Maharashtra, Gujarat and Tamil Nadu. Over 1300 cashew nut processing factories in eight different states constitute cashew processing sector in our country. India is the most immensely colossal cashew processor in the world (25lt of raw cashew nut per annum) Export of cashew nut shell liquid/cardinal from India stood at 11,677 million tonnes (MT), valued at US\$ 9 million in FY 2015-16, while exports of cashew kernels stood at 96,346 MT, valued at US\$ 765 million.

India exports cashew nuts to above 60 different countries. Cashew fruits major markets are Japan, France, Netherlands, UK as well as east countries, India is one of the largest producer in the world, Karnataka is the important state in cashew production. Karnataka plays important role in Indian economy. Because in India it has 6th rank in cashew production in Karnataka. Dakshina Kannada district producing more cashew fruit also it has more area under cashew cultivation.

Cashew is one of the costliest crop and also called as dollar crop, also India has more area under cashew cultivation, So it gives the economy, employment, and also India produce and export nearly 4 lakh tons of cashew every year. Till now there is no particular machine for separating nut from fruit. So this paper gives an idea about separation of nut from fruit. In cashew fruit cultivation so many problems are there, like labour cost, labour scarcity etc, So to overcome all these problems, this paper gives a technical solution. This paper is also concentrated on safety and health issue.

Cashew is a tree. Its nut in addition to and referred to as cashew, is often consumed as food. People as well as use the nut to put together medication cashew is used for abdomen and intestinal ailments, Some of us practice cashew straight to the pores and stimulant and to shut (cauterize) ulcers, warts and corns The nationwide centre for Biotechnology info (NCBI) in its case find out about elements out that nuts tend to be really helpful for health, ensuring a look on various ailments. Comparable to coronary disease. There are mainly two methods of separating cashew fruits from nut. One method is by using hand and other one is by using nylon thread. Sometimes there will be huge amount of fruit, for separating that fruit minimum five to ten persons are required. One person alone will not be able to complete the process. When quantity to be collected is more, more workers are required. This project will be an alternate solution for all these challenges.

II. MATERIALS

The machine is manufactured from locally available materials and assembled and maintained at a relatively low cost. This mechanism is connected to the motor is fixed and guiding plate is rotatable controlled by controller unit depends on flow of cashew apple. The rotating plate guides the cashew apple to fall one and the other which falls through the guide made by sheet metal to the stopper. At that 2nd motor activate the tool edge separates the cashew nut from cashew apple.

Table I: Material list

S no.	Sub-Assemblies	Components
1	Hopper	Mild Steel Sheets Fasteners
2	Shafts	Mild Steel Support shafts Mild Steel Crank shaft
3	Motor Assembly	DC Motor Power source Battery
4	Frame Assembly	Mild Steel flats Mild Steel Shafts Support structure Mounts
5	Control Unit	Arduino Uno controller Relay Module Electronic Control Timing Unit



Fig 1: 5V Relay



Fig 2: 8 bit AT mega 328P Arduino controller



Fig 3: 12V DC Actuators

III. MODEL

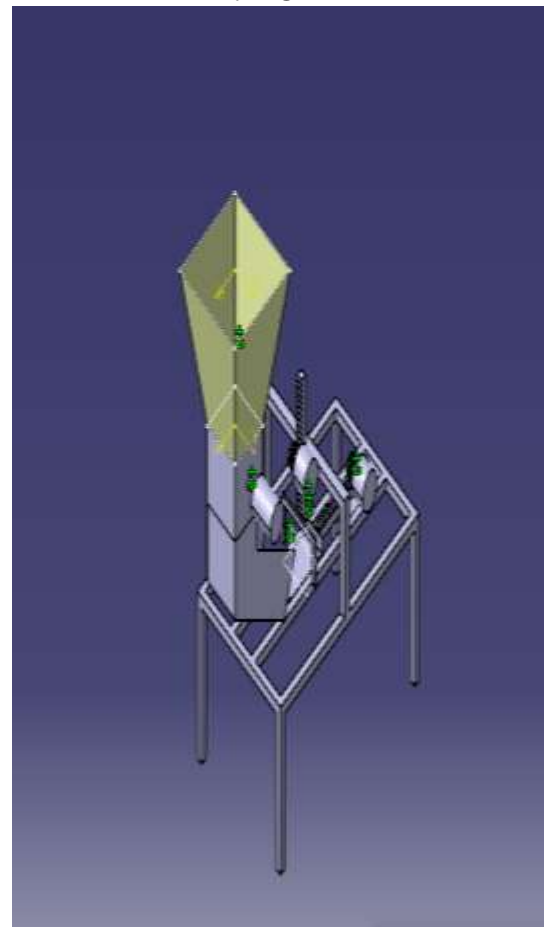


Fig 1: 3D Model of the machine

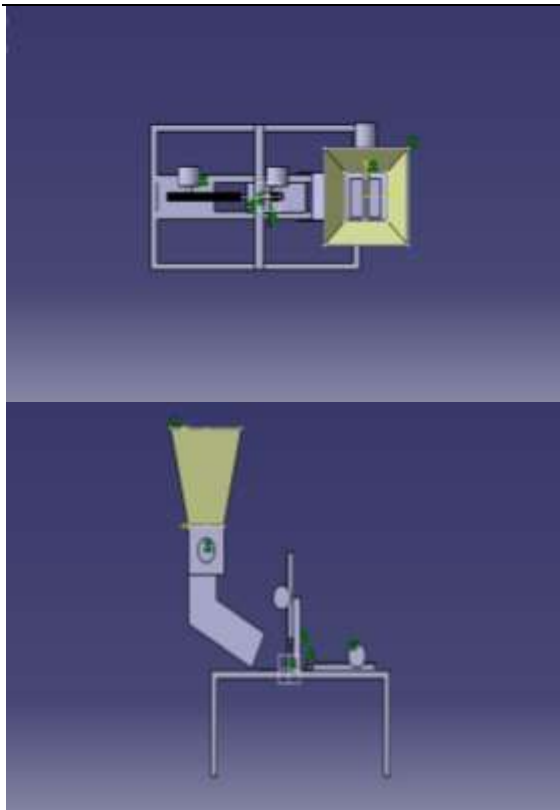


Fig 2: Top view of the model
Fig 3: Side view of the model

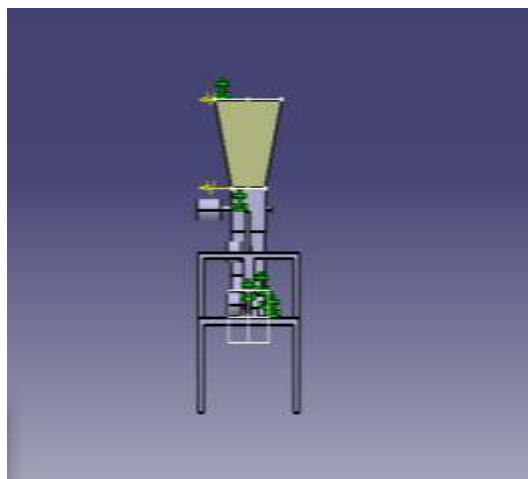


Fig 4: Front view of the model

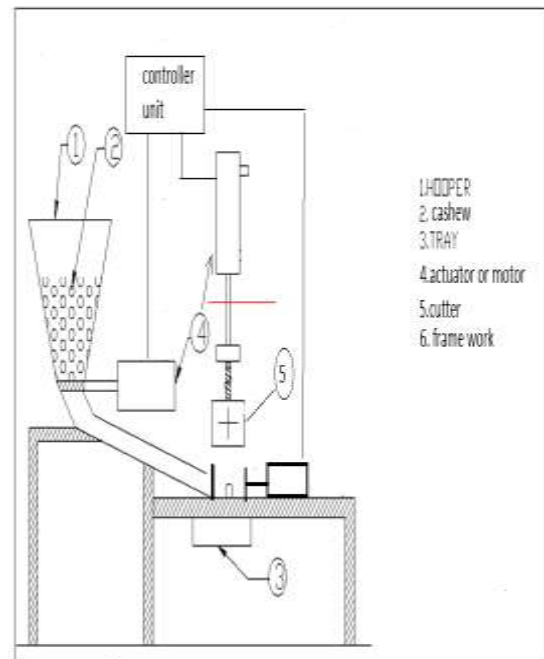


Fig 5: 2D Model of the Machine

IV. WORKING PRINCIPLE

The automation is achieved by motors and controller unit, motor which works on lead acid battery, the hopper is made of mild steel were storage of cashew apple at the bottom opening of the hopper motor is fixed with rotating guiding plate which control the flow of cashew apple one by one. The rotating plate guides the cashew apple to fall one and the other, which falls through the guide made by sheet metal to the stopper. At that time dc motor 2 activate the rack and pinion which is connected to the tool edge, which separates the cashew nut from cashew apple. At the bottom collects the cashew nuts and other 3 motor connected by rack and pinion which pushes the cashew apple to the other side.

The whole system is automated stage by stage process using controller unit.

V. DESIGN AND SPECIFICATION

A. Pinion

Material	: cast-iron
Outside diameter	: 75mm
Circular pitch	: 4.7mm
Tooth depth	: 3.375mm
Module	: 1.5mm
Pressure angle	: 21°
Pitch circle diameter	: 72mm
Addendum	: 1.5mm
Dedendum	: 1.875mm
Circular tooth Thickness	: 2.355mm
Fillet radius	: 0.45mm

Clearance : 0.375mm

B. Design and Specification of Rack

Pitch circle diameter of the gear is = 72mm

Circumference of the gear is = $\pi \times$ pitch circle diameter

$$= \pi \times 72 = 226\text{mm}$$

The dimension is for 360° rotation. For 180° rotation the rack length is 113 mm.

Material : cast iron
 Module : 1.5mm
 Cross-section : 75×25mm
 Teeth on the rack is adjusted for 113mm.

C. Design of Shaft

The design of the shaft will be based on the maximum bending stress and will be driven by the following formula:

$$\text{Maximum bending stress } T_b = (M * r) / I \dots$$

Eqn 1.1

Where,

M is maximum bending moment on the shaft.

r is the radius of the shaft.

I is area moment of inertia of the shaft.

From the bending moment diagram, the maximum bending moment (**M**) is calculated as 66666.67 N/mm².

Area moment of inertia (**I**) of the circular shaft is:

$$I = \pi * r^4 * 0.25 = 0.785 * r^4 \dots \text{Eqn. 1.2}$$

From **Eqn1.1** we can write:

$$40 = (66666.67 * r) / (0.785 * r^4)$$

$$r = 7.05 \text{ mm}$$

So, the minimum diameter of the shaft should be **14.10**

D. Ball Bearing

Bearing No. 6202

Outer Diameter of Bearing (D) = 35 mm

Thickness of Bearing (B) = 12 mm

Inner Diameter of the Bearing (d) = 15 mm

r_1 = Corner radii on shaft and housing

r_1 = 1 (From design data book)

Maximum Speed = 14,000 rpm (From design data book) Mean Diameter (d_m) = $(D + d) / 2$

$$= (35 + 15) / 2$$

$$d_m = 25 \text{ mm}$$

OBJECTIVE

- To separate the fruit from nut
- To separate nut in faster rate
- To minimize wastage of time
- To overcome the labour problem
- To reduce the strain to operator
- To reduce labour charge
- A person can handle the equipment

ADVANTAGES

- Quick response is achieved
- Simple in construction
- Easy to maintain and repair
- Cost of the unit is less when compared to other machine
- No fire hazard problem due to over loading
- Comparatively the operation cost is less
- Great accuracy is achieved
- Continuous operation is possible without stopping

VI. CONCLUSION

This paper deals with the solution for time consuming and effort taking process of Cashew nut separator. Now a day's process of Cashew collection and separation from fruit is manual process. And we know this large amount of Cashews collection and separation from fruit by human hands is not better option. Also it takes lot of time and effort. So that this paper work inform that there is a best technical solution for this. Machine that is mentioned in this paper will be operate by single person and it will easy to handle. Power require for this machine will be less than human efforts. So we can conclude that this machine is the technical solution to solve this cashew farming problem.

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