Design & Development of Cashew Nut Scooping Machine

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Abstract *- The Main Purpose of* ***Design & Development of Cashew Scooping Machine*** *is to reduce the manual work and eliminate health hazards, help the cashew industries gain more profit out by cashew processing. The impact force is use to scoop the cashew nut automatically from shell. This machine reduces the time, makes the process easier and safer. It helps in eliminating the health hazards in manual scooping done mostly by woman in cashew industries & rural areas.*

Objective

Use in small scale industries.

Reduce the manual works.

Increase the production rate.

Reduce the processing time & cost.

Safer system.

Eliminate health hazards.

Easy to operate.

INTRODUCTION

Cashew is one of the most popular nuts among dry fruits obtained from an exotic tree class. The commercial cultivation of cashew is taken up mainly in eight states in India namely Andhra Pradesh, Goa, Kerala, Karnataka, Orissa, Maharashtra, Gujarat and Tamil Nadu. The current production in India accounts for 20 per cent of global production. Cashew nut is formed outside the fleshy fruit known as cashews. At the time of maturity, the cashew apple along with seed falls down on the ground. These are collected and processed to get cashew nut. The cashew apple being fleshy and sweet in taste is used to prepare a fermented fruit drink known as Feni. Kerala is the leading state in processing of cashew. More than two third of cashew processing units are in Kerala, whereas remaining are scattered in the other states. These units together have processing capacity of more than 8 lakh tons per annum. The seeds are separated from cashew apple and dried in the sun for 4-5 days. The dried raw cashew seeds are processed to get cashew nut for marketing.

In India, processing of cashew is manual and highly labor-intensive process. The cashew industry is highly unorganized and scattered. Women constitute almost 90 per cent of labor force in cashew industry. Mechanization in cashew processing is picking up slowly. The challenge of designing and actualizing the successful fabrication of a motorized cashew nut scooping machine should be accepted by engineers and investors as a result of the discovery of a dearth of mechanized system of cashew nut scooping in most cashew nut processing industries in many countries, especially in Nigeria. Therefore, this project is important because it will proffer solution to the drudgery associated with manual cashew nut scooping. The main objective of this work is to design and develop a motorized automatic cashew nut scooping machine and evaluate it for optimum performance.

Scooping is the removal of kernel from shell and has an objective of producing clean, whole kernels free of cracks, as whole kernels have a better market value than broken kernels. The manual scooping process involves placing the unscoop nuts in hand and removing with a needle type screw driver or needle. An average scooper can open ten nuts per minute which amounts to 6 nuts or about 1.8 kg of kernels per hour. Experienced shellers can produce only with a quality of 55 per cent whole kernels. The manual traditional method of scooping cashew nut using needle is a labour intensive, slow and tedious process. It also has some health implications due to the corrosive action of CNSL on human skin. Recently, scooping is done by manually, each shaped in the contour of half a nut had a daily production of about 15 kg of kernels and a scooping of 80 per cent and whole kernel yield of 55 per cent.

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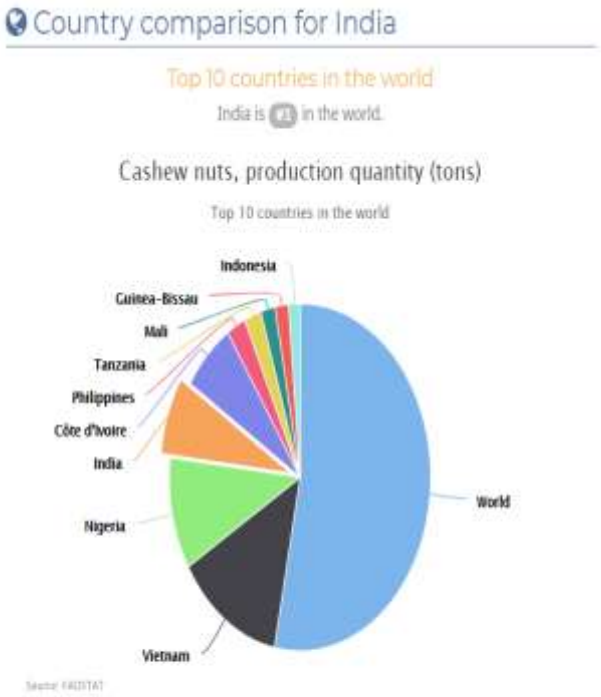
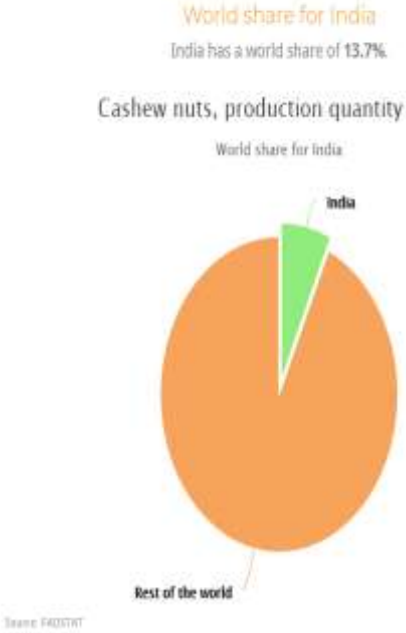
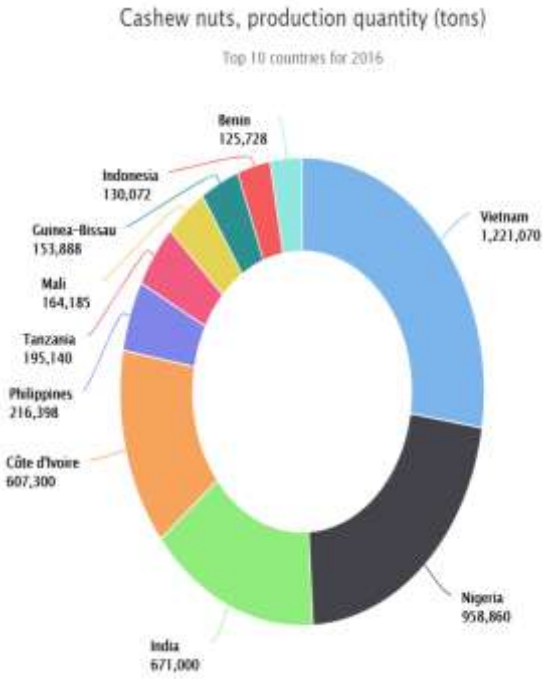
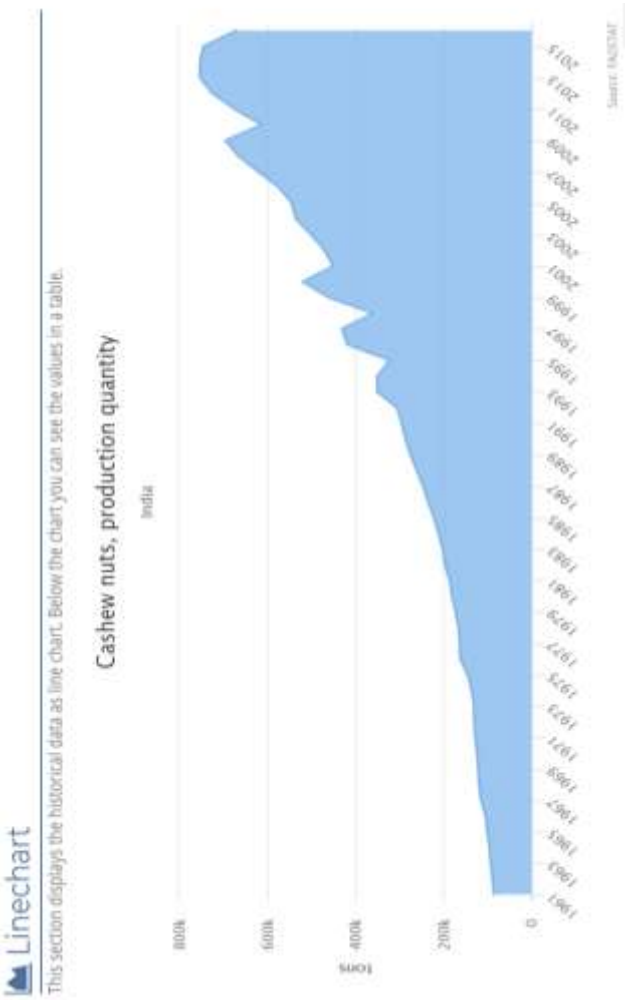




Country	Rank	Cashew nuts, production quantity (tons)		Year
		Value as Number	Value as Bar	
World		4,896,210		2016
Vietnam	1	1,221,070		2016
Nigeria	2	958,860		2016
India	3	671,000		2016
Côte d'Ivoire	4	607,300		2016
Philippines	5	216,398		2016
Tanzania	6	195,140		2016
Mali	7	164,185		2016
Guinea-Bissau	8	153,888		2016
Indonesia	9	130,072		2016
Benin	10	125,728		2016
Mozambique	11	104,176		2016
Burkina Faso	12	78,525		2016
Ghana	13	78,268		2016
Brazil	14	76,548		2016
Kenya	15	24,964		2016
Thailand	16	21,865		2016
Malaysia	17	10,689		2016
Guinea	18	9,405		2016
Togo	19	8,984		2016
Madagascar	20	7,181		2016
Senegal	21	6,999		2016
Sri Lanka	22	6,078		2016
Mexico	23	3,865		2016
Gambia	24	3,094		2016
Peru	25	2,965		2016
Angola	26	2,076		2016
Honduras	27	2,011		2016
Burma	28	1,846		2016
El Salvador	29	940		2016
Dominican Republic	30	765		2016
China	31	132		2016
Belize	32	24		2016





DESIGN, DEVELOPMENT, DATA ACQUISTION AND ANALYSIS

B. Problem Statement

The process of cashew nut scooping is done manually. The manual traditional method of scooping cashew nut using needle is a labour intensive, slow and tedious process. It also has some health implications due to the corrosive action of CNSL on human skin. The heat radiated and the sap which flows from the shell when it is broken causes many health problems to women.

Mostly scooping is done by manually, each shaped in the contour of half a nut had a daily production of about 15 kg of kernels and a scooping of 70 per cent and whole kernel yield of 50 per cent.

So tackle these problems the automatic cashew nut scooping machine is designed and fabricated.

Fig. 1: Automatic Scooping Machine (CAD Model)

APPROACH AND METHODOLOGY

Fieldwork for the study was conducted in four cashew processing companies namely, A One Kaju India (Ajmer), Shri Shyam food Products (Surat), Sanskriti Agrotech Services Pvt Ltd (Sirsa). Fieldwork entailed collecting data from different categories of respondents using a variety of methods

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To obtain a holistic understanding of the cashew processing industry, indepth interviews using semi-structured guidelines were also conducted with owners of cashew processing units, cashew traders, exporters, trade union representatives and officials in the Labour Department and Cashew Workers' Welfare Fund Board. The interviews covered questions on major problems faced by the cashew industry in processing, marketing, industrial relations, export and procuring of raw nuts. Their views and suggestions on issues related to the welfare of the workers were also elicited.

A. Mechanism

Materials and methods

The machine designed is motorized. During operation, it removes cashew nuts from shell by impact when the nuts are hurled toward a fixed wall by an impeller which is driven by the electric motor.

Working Principle. The orientation of the cashew nuts in relation to the impeller prior to impact could not be fixed due to the tumbling action of the nuts through the feed hopper. Cashew nut fall on impeller freely from hopper. Impact force is applied on the cashew nut impeller fingers and then it strikes on the wall of the housing due to impact action cashew is cooped from shell. Through lower hopper is out from the machine.

Feed hopper design. The major parameter governing the size and configuration of the feed hopper is the throughput capacity of the machine. The hopper must be able to accommodate enough nuts to achieve the required throughput capacity and efficiency of operation. The feed angle of the hopper is configured to enable free flow of the nuts and ensure the system is self-cleaning. The stability of the sheller in operation has also been taken into consideration in sizing the hopper such that the weight of fed nuts in the hopper does not affect the balance of the impeller in operation. The feed hopper was made of steel and was designed to be detachable to enable utilization of different hopper size and also for convenience in moving and storing the sheller.

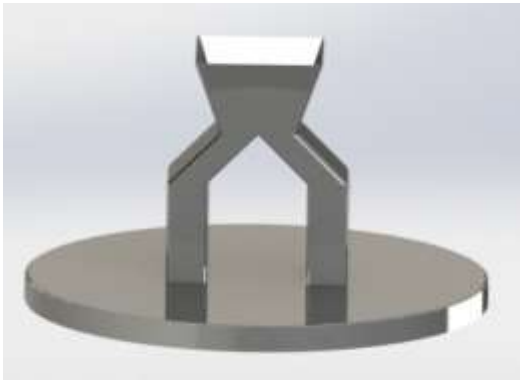


Fig. 2: Feed Hoper

Casing design. The functional requirements of the casing are primarily to house the internal components of the scooper, the scooping impeller, the drive motor, and to ensure easy passage for the nuts to be scooped and exit of the scooped kernels.

Impeller Plate design. Impeller are design in 3 different way. 1 impeller consist of 8 fingers, 2. Impeller consist of 4 figures and 3. Impeller consist of 2 fingers as show in figure. Impeller is mount on top of motor and unscooped cashew are free fall on the rotating impeller. Due to the impact by impeller fingers on cashew it strike on the wall of housing.

Fig3. Impeller with 8 fingers

Fig4. Impeller with 4 fingers

Fig5. Impeller with 2 fingers

TESTING AND PERFORMANCE EVALUATION

The scooper was tested and its performance was evaluated by the scooping efficiency,

whole kernel recovery and throughput. The results of the test are presented in Table 1, 2 & 3. The feeding efficiency was found to be dependent on the feeding rate (nuts/minute) which in turn determined the throughput of the scooper. When the hopper was filled, with the nuts falling through under gravity gave impressive results. Some nuts, however, got stuck at the throat of the hopper.

Manual feeding at a rate of 2 kg to 2.5 kg nuts per minute produced

an overall throughput capacity upto 150 kg of nuts per hour.

The scooping efficiency was evaluated by:

$$\text{scooping effeciency} = \frac{\text{completely scooped nuts (average)}}{\text{total feed}} X\ 100\%$$

The whole kernel recovery was evaluated by:

$$\text{Whole kernel recovery} = \frac{\text{whole kernels recovered (average)}}{\text{total feed}} X\ 100\%$$

The throughput was evaluated by:

$$\text{Throughput } \left(\frac{\text{kg}}{\text{h}}\right) = \text{mass X scooping rate X1 h}$$

ON PERFORMING EXPERIMENT FOLLOWING RESULT OBTAINED

1. Table show the output at 2800 rpm

Serial No.	Scooped %	Broken %
2	97	98
4	97	96
8	96	95

2. Table show the output at 1400 rpm

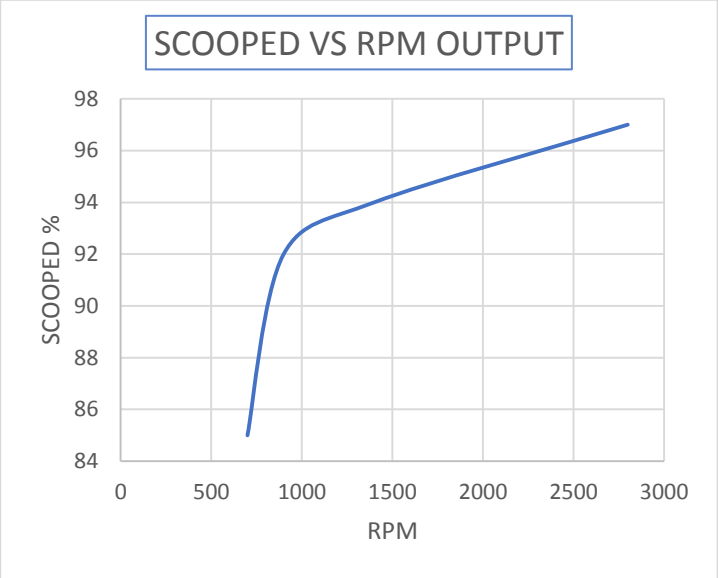
Serial No.	Scooped %	Broken %
2	95	70
4	95	85
8	96	90

3. Table show the output at 900 rpm

Serial No.	Scooped %	Broken %
2	92	20
4	94	24
8	95	30

From above result we conclude that with 2 finger disc we get more optimum result in almost every case

When we perform the experiment using A.C. drive, we get following result.



Advantages

Less man power

Low cost

Maintenance is easy

More profit

Reduce the health hazards

CONCLUSION

The scooping efficiency was evaluated on the basis of the number of completely scooped nuts per batch of 50 nuts. Results indicated that out of every 50 nuts an average of 48 nuts were completely scooped, thus giving a scooping efficiency of 95 per cent; this is higher than 60 per cent obtained by manual scooping. The whole kernel recovery, evaluated on the basis of the number of kernels recovered unbroken out of every batch of 50 nuts scooped, indicated that a mean number of 38 nuts out of every 50 nuts were recovered whole. The whole kernel recovery was 70 -75 per cent. The scooping efficiency of

the cashew nut scooping machine has a higher scooping efficiency than that obtained from the manual scooping which was 15 kg/h. The whole kernel recovery was higher than 60 per cent obtained by manual scooping. The throughput (150 kg/h) is much higher than 15 kg of nuts/day (that is, 1.875 kg/h) achievable by manual scooping of nuts using a needle or needle type screw driver

COMPARISION

S No.	Parameters	Automatic cashew nut scooping machine	Manual hand operated cutting machine
1	Production rate	150 Kg/hr	15 Kg/hr
2	Labour cost	-	Rs.120
3	Charges apply in current supply cost	Rs.10/day	-

Table : Cost Estimation

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