

# Design and Fabrication of Groundnut Plucking Machine

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**Abstract**—In India, land is widely used for agricultural purpose hence Groundnut production and processing is one of its aspects. Groundnut is grown in small scales by farmers. Due to lack of processing machines, there is a necessity of such machine which will pluck the Groundnut from its plant with greater efficiency and less efforts. Overall this paper describes design, fabrication and assembling of Groundnut Plucking Machine. Farmers and businessman can start their business with less investment.

**Index Terms**— Groundnut, Efficiency, Design, Fabrication, Assembling, etc.

## I. INTRODUCTION (HEADING 1)

Main purpose of this paper is to understand the design and fabrication of Groundnut Plucking Machine. Design is eco-friendly and the mechanism is as kept simple as possible. The concept of the project is such that the knowledge of designing, mechanism and plucking forces are increased.

Some plucking forces are needed to pluck the Groundnut from its plant. This project consists of designing and development of a machine to pluck Groundnut so that the farmer can sell it directly in the market and can achieve more profit. This project can be directly applied for commercial purposes to produce number of identical machines as a agricultural equipment.

This project includes the process of designing and fabrication of different parts of this plucking machine considering plucking forces, economical and ergonomic factor for people to use. Main purpose of this project is to generate new technology of Groundnut plucking that would reduce human efforts and to make things easier than before. After the design and fabrication, it was transformed to its real product which made the objectives accomplished.

## II. PROBLEM FORMULATION

We are going to design and fabricate such machine that will eliminate most of the problems which were faced by farmers to pluck the Groundnut from its plant. Productivity increased, efforts are reduced and hence farmers earns more profit.

Concept and Objective of the machine is explained below

### a. Concept

By introducing a low cost machine was to overcome various limitations with the current manual traditional method. The concept of the work is,

- (1) Observe the manual method and to identify the drawbacks.
- (2) To identify various process variables.
- (3) Investigate all areas of automating the technology.
- (4) Produce a specification for a low cost automatic system.

### b. Objective

The main objective of this project is to overcome the traditional method

- (1) To increase the efficiency.
- (2) To reduce fatigue to hands of farmer or worker.
- (3) To satisfy the economic needs of village peoples.

## III. WORKING PRINCIPLE

A three phase 1 HP Induction motor drives ring carriage through belt pulley drive. The ring carriage mounted on bearing will get rotated due to this arrangement. The whole assembly of shaft, ring carriage and bearing is mounted on rigid support. L- Angles are welded around periphery of ring carriage. Hence, one side of L – angle is projected out from ring carriage.

The L-angles are so welded that they will not contribute to dynamic unbalancing. Hence, all L-angles are welded by means of considering dynamic balancing criteria. When groundnuts with the plant are held against side of L- angles, which is projected outside the rotating ring carriage, striking action takes place. This produces stroke on the groundnuts. This stroke is sufficient enough to separate groundnuts from its plant. Plant remains in the hand clamp and separated peanuts are thrown away by striking action. The minimum three operators can work simultaneously on this machine. Hence, in this way machine is designed and fabricated to reduce human efforts.

Groundnut Plucking Machine is operated on the hitting and hammering action. Firstly the inputs i.e. the groundnut are fed to the machine. Then groundnuts come in contact with L-angles. After plucking the groundnut and shells of the groundnut gets dropped from the semicircular net, in downward direction then a centrifugal force is applied on the peanut and shell of the groundnut. Due to more weight, the peanuts gets moved downward and collected in the separator. But due to lighter weight the shell of the groundnuts are thrown outside the machine and which are collected from the backside of the machine. From the plucking chamber the unplucked groundnuts also gets dropped in the tray. This groundnut gets dropped from the clearance made among the grill. The three kinds of the nets can be used with different size of capsule slots, size wise small, medium and large for various size of groundnuts. In this way the "GROUNDNUT PLUCKING MACHINE" works.

#### IV. DESIGN OF THE MACHINE

##### (1) Design of Shaft

- (1) Selected motor 1 hp = 0.746 kW
- (2) Speed of main shaft = 1440 rpm
- (3) Motor pulley diameter = 70 mm
- (4) Shaft pulley diameter = 250 mm
- (5) Central distance = 114 cm = 0.114 m
- (6) Design torque = 9.89 N-m
- (7) Diameter of shaft = 40 mm
- (8) Belt tensions,  $T_1 = 85.1$  N,  $T_2 = 5.98$  N
- (9) Selecting shaft material = SAE EN8
- (10)  $T_{max} = 2.40$  MPa
- (12) Resultant moment,  $M_c = 61.418$  N-m

##### (2) Design of bearing

As per the shaft diameters  $D$  and  $d$  derived above,

$d = 17$  mm

$D = 40$  mm

$B = 16$  mm

$\alpha = 40^\circ$

Static capacity ( $C_o$ ) = 280 N

Dynamic capacity ( $C$ ) = 765 N

Maximum permissible speed = 16000 rpm

Select the Recommended life values

AS, our type of operation is infrequently operated

$L_{h10} = 500$  hrs.

For self-aligning bearing with double row bearing.

$X_o$  = static radial load factor = 1

$Y_o$  = static axial load factor = 1

$F_a$  = Actual dynamic axial load = 0 N

Race Rotating Factor = 1

$K_a = 2.0$

$F_r$  = Radial load on the bearing = 45.54 N

Equivalent Dynamic Load ( $P_a$ ) = 91.08 N

Rating Life of Bearing ( $L_{10}$ ) = 11.76 million Revolutions

Required Dynamic Load Capacity ( $C$ ) = 208 N

As, our selected bearing has  $C = 765$  N

##### (3) Design of Belt

According to Kick's relation Power required to pluck groundnut

(1) Selected motor 1 hp, 1440 rpm

(2) Speed of main shaft = 720 rpm

(3) Motor pulley diameter = 75 mm

(4) Shaft pulley diameter = 450 mm

(5) Design power,  $P_d = 0.746$  kW

(6) No. of belts,  $n = 1$

(7) Length of belt,  $L = 2$  m

(8) Bending load,  $F_b = 39.11$  N

## V. MODELLING, FABRICATION AND ASSEMBLY

After completion of design 3D model is created of a semi atomize machine, then regarding development done on plucking machine. Parameters are selected according to objectives. Main mottoes of this project were to develop the first prototype of any easy use, low priced and test its performance. Design must be easy to maintain and should not require highly skilled worker or operator, which is hard to be found in rural and urban areas. Fabrication process should be simple and based on locally available techniques in rural areas. Important components of the Groundnut plucking machine:-

- (1) Rectangular Frame.
- (2) Ring carriage with L-Angles.
- (3) 3 phase induction motor.
- (4) V-Belt.
- (5) Shaft.
- (6) Pedestal Bearing.
- (7) Wooden cover

The assembly of various component of “Groundnut Plucking Machine” is done as follows:

- (1) The Bearings are mounted on the Rectangular frame.
- (2) Shaft is supported between two bearings.
- (3) Ring Carriage is mounted over shaft so that it will also get rotated with shaft.
- (4) Larger pulley is mounted on at either end of the shaft.
- (5) Over motor pulley and larger pulley V-belt is mounted.
- (6) The above arrangement ensures that all element of the project are balanced.
- (7) Center of gravity of the assembly lies on the axis of rotation of ring carriage and solid shaft.

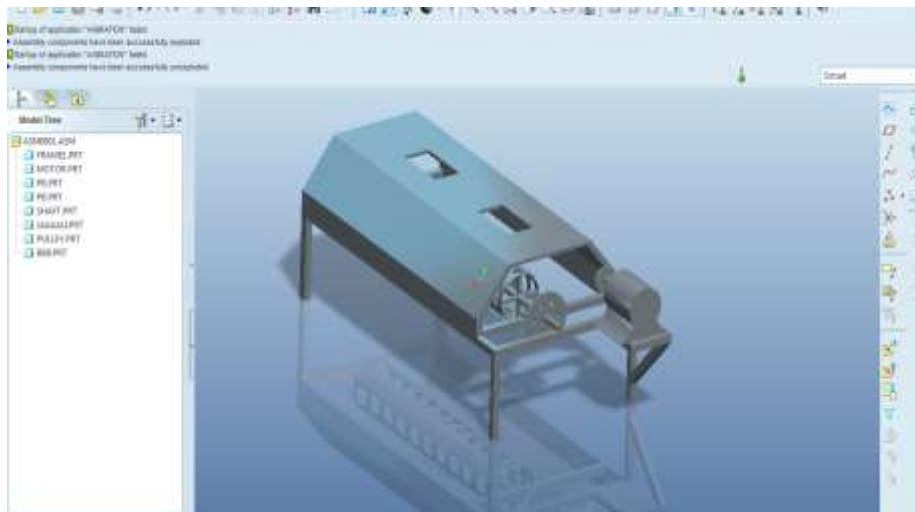


Fig. 1 Final model of Peanut Plucking Machine



Fig. 2 Final Assembly of Peanut Plucking Machine

## VI. TESTING AND ANALYSIS

The Groundnut plant as sample is brought from local farmers in market. Sample is nothing but an unplucked groundnut and some soil adhered to plant. As per the working principle and experimental set up of plucking Machine we decide one sample & testing is done three times. After taking readings, we have found out results of Groundnut Plucking Machine.

## VII. RESULTS

Generally, production of Groundnut per acre is 1900-2000 Kg.

To pluck 1900-2000 Kg from the plant, it requires 12 hours per worker.

Hence, separating capacity per worker in Kg per hour = 166 Kg/hr.

Now,

For same amount of Groundnut to be plucked by this Groundnut Plucking machine,

To separate these 1900-2000 Kg = 4 hours per worker is required.

Hence, separating capacity of Groundnut separating machine is = 500 Kg/hr.

Table 1 Testing table

| Test no. | No of crops | Plucked | Un-plucked | % Plucked |
|----------|-------------|---------|------------|-----------|
| 1        | 10          | 8       | 1          | 80.00     |
| 2        | 11          | 9       | 2          | 81.81     |
| 3        | 12          | 10      | 2          | 83.33     |
| 4        | 13          | 11      | 2          | 84.61     |
| 5        | 14          | 11      | 3          | 78.57     |
| 6        | 15          | 11      | 4          | 73.33     |

Average of % peanut plucked =  $\frac{80.00+81.81+83.33+84.61+78.57+73.33}{6}$

Average of % peanut plucked = 81.55 %

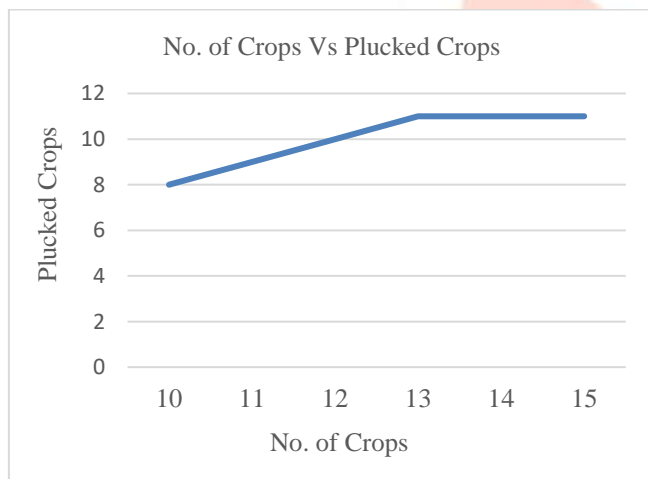


Fig. 3 Plot of no. of crops vs. plucked crops

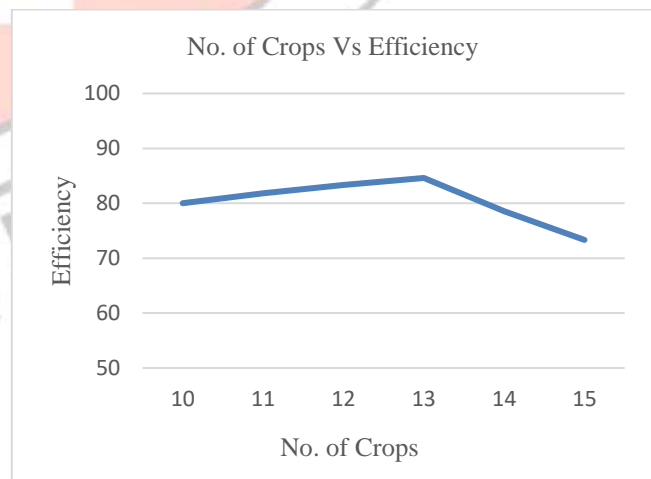


Fig. 4 Plot of no. of crops vs. efficiency

## VIII. CONCLUSION

This work presents the design of an electrically powered peanut plucking machine. The machine was fabricated using materials that were sourced locally. It can be used for both domestic and industrial purposes. The advantage to be derived from the use of this machine far out weights its shortcomings.

The test result showed that the machine can separate a total of 400kg of groundnut in an hour. It was also observed that groundnut with one seed per pod and those with two small seeds in their pods were the ones that came out unplucked or partially plucked.

## IX. ACKNOWLEDGMENT

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