NOVATEUR PUBLICATIONS
JournalNX- A Multidisciplinary Peer Reviewed Journal
ISSN No: 2581 - 4230
VOLUME 10, ISSUE 6, June - 2024

SOLAR OPERATED GROUNDNUT SHELLING MACHINE

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Abstract
Groundnut is one of the most on demand and on increase legume and the application depends on the cleanness of the nuts. As the groundnut seed is surrounded by a pod, which is developed underground, the pod is harvested by pulling and lifting the plant manually or by using the machine. Usually groundnuts are shelled simply by hand using manual method. To separate the nuts from its shell, a shelling machine was designed and developed. This mechanical project aims at designing and fabricating a groundnut shelling machine. The shelling machine is operated using electric DC motors which is connected to the external power supply. When power is supplied to the motors, it rotates the roller which have shell crushing horns. Groundnuts are fed into the crushing chamber through hopper and gets crushed between the semi-circular net and the roller.

Keywords: Groundnut shelling, solar power-renewable energy.

I. INTRODUCTION

The purpose of this papers to understand the knowledge of design and fabrication mechanism of solar groundnut Sheller machine. The design is an environment friendly and uses simple mechanism properties such as shelling system, and automation separating system etc. Agricultural innovation plays a crucial role in enhancing productivity and sustainability, especially in developing regions where access to modern technology and reliable energy sources is limited. One such innovation is the design and fabrication of a solar-operated groundnut shelling machine, a technology aimed at improving the efficiency and sustainability of groundnut processing.

Groundnuts, or peanuts, are a vital crop in many agricultural economies, providing significant nutritional and economic value. Traditional methods of shelling groundnuts are labor-intensive, time-consuming, and often inefficient. While mechanized shelling machines exist, they typically rely on electricity or fossil fuels, which can be costly and inaccessible in remote or off-grid areas.

The solar-operated groundnut shelling machine addresses these challenges by utilizing solar energy to power the shelling process. This innovative approach leverages the abundant and renewable energy of the sun, ensuring that the shelling machine can operate independently of traditional power sources. This is particularly beneficial for farmers in rural areas who may face frequent power outages or lack access to the electrical grid.

In this project, designing & development of a machine to crush or shell groundnut so the farmers can

gain high profit by selling groundnut direct in market. As well as the study of manufacturing was very important in order to carry out this project to ensure that what are needs to do. This project involves the process of designing and fabrication of different parts of this shelling machine considering forces and ergonomic factor for people to use. This project is mainly about generating a new concept of groundnut shell (crush) that would make easier to bring anywhere and easier to crush groundnut. After the design has completed, it was transformed to its real product where the design is used for guideline.

II. PROBLEM IDENTIFICATION

In the context of agricultural productivity and sustainability, several key issues have been identified that necessitate the design and fabrication of a solar-operated groundnut shelling machine. These problems highlight the challenges faced by farmers, especially in rural and off-grid areas, and underscore the need for innovative solutions.

1. Labor-Intensive Shelling Process

Manual Shelling: Traditionally, groundnut shelling is performed manually, which is labor-intensive and time-consuming. This method is inefficient, leading to low productivity and fatigue among farmers.
Inconsistent Quality: Manual shelling often results in inconsistent quality, with a higher likelihood of damaging the kernels.

2. Limited Access to Reliable Energy Sources

Electricity Dependence: Existing mechanized shelling machines rely on electricity, which is often unavailable or unreliable in rural areas. Frequent power outages disrupt operations, affecting productivity.
Fossil Fuel Dependence: Some machines use fossil fuels, which are costly and environmentally harmful. This increases operational expenses and contributes to pollution.

3. High Operational Costs

Energy Costs: The cost of electricity or fuel to operate traditional shelling machines can be prohibitive for small-scale farmers, reducing their profit margins.
Maintenance Costs: Mechanical breakdowns and regular maintenance add to the operational costs, making it difficult for farmers to sustain their operations.

4. Low Efficiency and Productivity

Slow Processing Rates: Manual shelling and some mechanized methods have low throughput, limiting the amount of groundnuts that can be processed within a given timeframe.
Kernel Damage: Inefficient shelling mechanisms can damage the kernels, reducing the quality and market value of the produce.

III. PROBLEM FORMULATION

The aim is to design & develop a low cost ground nut shelling machine which will help farmer to sell finished (shelled groundnut) instead of unshelled groundnut. Considering the above problems we are going to design and fabricate such a machine that will eliminate most of the problems from previous available manually shelling machine, so human effort is reduced and getting more productivity, earn

more profit to former. The machine shown in figure below is the modeling of groundnut Sheller machine.

A. Concept

Introducing Low cost automation was to overcome problems with the current manual traditional method. The concept of the work is,

(1) Observe the manual methods to identify the important process variables.
(2) Quantify the important method.
(3) Develop a prototype automation system which could control over all of the process.
(4) Investigate all areas of automated forming.
(5) Produce a specification for a low cost automated system.
(6) Refined design of the machine & fabricate the machine, as this plays a major role in rural area.

The above considering point we design the semi-automated machine which replace manual process.

B. Objective

The main aim of this project is to overcome the traditional method.

(1) To reduce wastage due to crack or crushed groundnut.
(2) To increase the efficiency.
(3) To reduce the hard work and To reduced time to shell the groundnut.
(4) To develop a low cost machine which can be used by farmer to convert their semi-finished (shell groundnut) into finished product (groundnut).
(5) It satisfies the need of village people to earn more money.

IV . WORKING PRINCIPAL

Groundnut sheller is operated on the shearing action blowering action and separating action. Firstly the inputs i.e. the groundnut are fed to the machine through the hopper. Then groundnuts come in contact with the two members, one is semicircular net and another is roll shaft. Semicircular net is a stationary member while the roll shaft is rotating member. When the groundnut comes in contact with these two members then the shearing action takes place here. Due to shearing action (crushing) the groundnuts gets shelled and divided into two parts. i.e. in the peanut and outer shell of the groundnuts. There clearance is provided between the net and roll shaft. The clearance provided is depends upon the size of the groundnuts which is to be decocted. After shelleing the groundnut the peanut and shells of the groundnut gets dropped from the semicircular net, vibrating motor on the end of semicircular net to vibrate the net to separate peanut and shell of the groundnut. The peanuts gets moved downward and collected in the separator. But on semicircular net we are drilled 12 mm size of hole's and to vibrate the semicircular net the peanuts gets moved downward and collect the separator and shell's are throughout the machine by using the vibrating motor.. From the shelling chamber the unshelled groundnuts also gets dropped in the tray (7% to 10%). This groundnut gets dropped from the clearance made among the grill. The two or three kinds of the net angle's can be used with different size of groundnuts, size vise small, medium and large for various size of groundnuts. In this way the "Groundnut Sheller" works.

V . HARDWARE DISCRIPTION

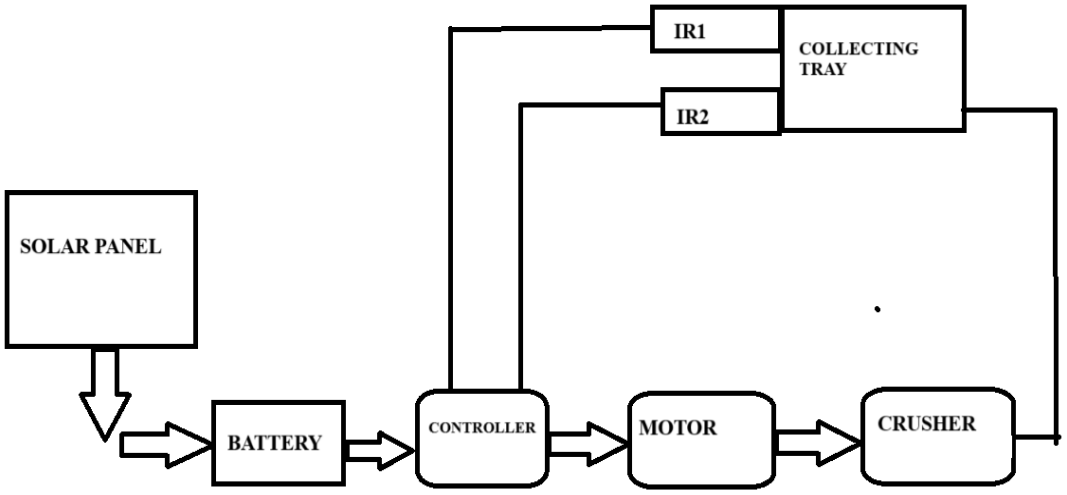

Figure 1 :- Block Diagram of the solar powered Groundnut Seprator

The block diagram (Figure 1) consist of solar panel, which turn sunlight into direct current electricity (DC). Then, an inverter converts the DC electricity into alternating current electricity (AC), and once this process has taken place, the electricity is used, fed into the grid or stored in a battery. And the rotor,which are cylindrical in shape having parallel slots on it to place rotor windings. It is made up of solid steel. They are smaller in diameter but having longer axial length. These Block diagram is about to tell the process of working.

A. Solar Panel :-

The solar panel (Figure 2) which converts solar energy into electrical energy is stored in the battery for future use. Solar panels contains of number of solar cells.

Figure 2 :- Solar Panel

Technical Specification: -

- maximum power (Pmax) – 10WP
- Voltage at max power (Vmp) - 18.50V
- Current at max power – 0.54A
- Open circuit Voltage (Voc) – 21.50v
- Short circuit current – 0.56A
- Tolerance - 3%

B. 12V Square Box DC Motor (10 RPM) :-

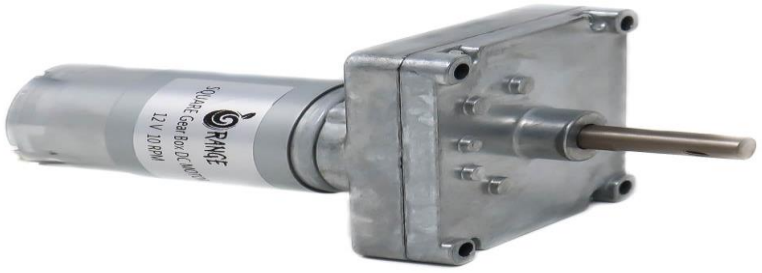

Figure 3 :- 12V Square Box DC Motor (10 RPM)

This 12V 10RPM Square Gearbox DC motor is high torque motor i.e. 781.2 N-cm with a gear ratio of 478K. The main feature of this motor is it has a 27mm long shaft with M4 tapping and a diameter of 8mm.

Normally the motor available in the market is having a shaft length of 20 ~ 22 mm long; but we have customized the shaft of this motor to meet customers' requirements. So it's too easy to mount a wheel or any type of coupling on the shaft.

The applications of this motor are Central air conditioning valve, Amusement equipment, Coin refund devices, Grill, Oven; Peristaltic pump, ATM bank automatic system, Medical equipment, Office equipment, Household appliance, Automatic actuator and many more.

Features:

i) Lightweight and compact-sized motor with high performance.
ii) 27mm long customized shaft for ease of mounting.
iii) The Shaft is D type hence wheel/ coupling arrangement is simple.
iv) The motor is useful for hobbyists and for DIY projects.

C. Roller / Crusher :-

Figure 4 :- Roller / Crusher

Roller/Crusher is a rotating shaft by motor which is having hard extruded surface to crush the peanut/groundnut shell.

D. SOLAR PANEL :-

Using solar power to operate the machine.

Technical Specification: -

- maximum power (Pmax) – 10WP

- Voltage at max power (Vmp) - 18.50V
- Current at max power – 0.54A
- Open circuit Voltage (Voc) – 21.50v
- Short circuit current – 0.56A
- Tolerance - 3%

Figure 5 :- Solar Panel

E. DC 12v Vibrating Motor :-

Figure 6 :- DC 12v Vibrating Motor

It is a combination of DC motor and Cam mechanism which helps in rotating cam and cam mechanism thus vibrate the funnel.

F. Circuit :-

The circuit using for the machine to runs automatically. The circuit work as controller of the machine. The circuit control the motion of both motors.

Figure 7 :- Circuit

The circuit includes: -

- IC- ATMEGA328P
- Resistors
- Capacitor
- Transistor
- Buzzer

- Led
- Push button
- Slide switch

i) Specifications of Circuit

Category	Quantity	References	Value
Capacitors	2	C3-C4	22p
Capacitors	1	C5	10uf
Capacitors	2	C8-C9	1000uf
Resistors	1	R1	330
Resistors	3	R2-R3, R5	10k
Resistors	1	R4	2k2
Integrated circuit	1	U1	AT MEGA 328P
Transistors	1	Q1	IRF9530
Transistors	1	Q2	BC547BP
Diodes	1	D1	1n5822
Diodes	1	D7	1N5822
Diodes	1	D10	R-LED
Miscellaneous	1	1	LM2576
Miscellaneous	1	BUZ1	Buzzer
Miscellaneous	2	IR, IR1	Ir1
Miscellaneous	3	J1-J3	SIL-100-02
Miscellaneous	1	L2	100mH
Miscellaneous	1	SW	Push button
Miscellaneous	1	SW1	Slide switch
Miscellaneous	1	X1	16mhz

H. Wooden Frame :-

An engineered composite wood product made from residues of hardwood and softwood gluing together with wax and resin under extreme pressure and pressure is called Medium Density Fibreboard or MDF wood.

Figure 8 :- Wooden Frame

I. Handle :-

The handle used to operate machine manually, If the rainy season or shortage of electricity. Handel is made up of mild steel, having "L" shape to proper handling. Using lock nut handel tit on the crusher shaft, so we can operate / rotate handle and operate machine manually.

Figure 9 :- Handle

VI .IMPLEMENTATION

The Solar-Operated Groundnut Shelling Machine is simple in design and easy to carry. A DC square box motor is used for running the crusher. The square box motor is attached to the main shaft of the crusher with the help of a coupling. The main shaft is directly connected to get high torque. In the crushing chamber, there is a fixed plate with a number of spines to crush the groundnuts efficiently. To automate this system, a controller is provided. The controller's main function is to control the entire system to get a proper response. Two IR sensors are mounted on the collector tray to avoid the overflow of peanuts. IR sensors are very helpful. When the peanut level reaches the IR sensors, they will detect the presence of peanuts and give feedback to the microcontroller. The microcontroller switches off the motor, and hence the machine will be stopped. The use of a control system reduces wastage of peanuts and reduces energy wastage. The power supply used in this machine is solar energy. Using a 12V solar panel, we can store the electric energy into a DC battery. From the DC battery, power is supplied to the machine. This is the first mode to give a power supply to the machine. We can use another two modes to give a power supply to the machine.

i) Using direct supply of electricity with the help of an adapter. The output of the adapter is 12V, which is suitable for running the machine.

ii) Manually operating the machine using a handle in case of a shortage of electricity or rainy season. The handle is designed such that the operator can rotate the handle with less effort.

The Solar-Operated Groundnut Shelling Machine is simple in design and easy to carry. A DC square box motor is used for running the crusher. The square box motor is attached to the main shaft of the crusher

with the help of a coupling. The main shaft is directly connected to get high torque.

VII. CONCLUSION

Proper evaluation of the design will be performed and created something even better instead of simply manually operated operations. Finally, we conclude that atomize machine is better option to use farmer instead of manually operated. The demands atomize shelling machine of farmer & other customers will be also considered while designing machine. Purpose of fabrication of the Sheller was to determine the suitability of machine for farmer's use. Five experiments were performed with peanuts. Since this machine is made for small businessman or for farmers, therefore the work carried out by this machine is less. The capital required for purchasing the bigger size groundnut decorticator is very high or the cost required for decorticating the groundnut on the job work is also more. In comparison these "Groundnut Sheller" is very cheap. We have selected the "SOLAR OPERATED GROUNDNUT SHELLING MACHINE" as our project work. The "SOLAR OPERATED GROUNDNUT SHELLING MACHINE" is the ideal equipment for decocting process. In the process of completion of the project work our ideas and thought are development towards the mechanisms and technologies of the equipment. We also visualized that this "SOLAR OPERATED GROUNDNUT SHELLING MACHINE" is the most critical equipment for the future growth and development of cottage sector projects. Similarly, we can say that for the purpose of decocting the groundnut this is economical and ideal in case of cottage sector projects. The "SOLAR OPERATED GROUNDNUT SHELLING MACHINE" can be used in cottage industry or even a former can also take benefit from this machine. The decocting process of groundnut by this machine is more economical and faster than manual process or any other processes. Therefore, on the completion of this project, we conclude that the "SOLAR OPERATED GROUNDNUT SHELLING MACHINE" will save the tremendous time, energy manpower and save financial input of the project, reducing the cost and time considerably which is the backbone of the present world economy.

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