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Development of Mini Corn Shelling Machine

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ABSTRACT - The design and fabrication of a mini corn shelling machine aimed to address the challenges faced by small-scale farmers in the process of shelling corn. The machine was developed with the primary objectives of simplicity, cost-effectiveness, and efficiency. The design incorporates a hopper for corn input, a shelling unit consisting of rollers or blades, and a separation mechanism to extract the kernels from the cob. To ensure ease of operation and maintenance, the machine was designed to be portable and user-friendly. Fabrication utilized commonly available materials and standard manufacturing processes, resulting in a compact and durable Sheller. Performance testing demonstrated satisfactory efficiency in shelling corn, meeting the target for small-scale farming needs. The mini corn shelling machine presents a promising solution to enhance the productivity and reduce manual labor for small-scale corn farmers.

***Key Words*:** Design, automation, efficiency, corn shelling, agricultural machinery, prototype, scalability, sustainability.

1.INTRODUCTION

The creation of a Mini Corn Shelling Machine responds to the increased demand for effective, affordable, and accessible crop processing technologies, particularly for small-scale and rural farmers. Manually shelling kernels out of corn cobs is traditionally time-consuming and requires much labor, involving major human effort and leading to wasted or damaged kernels. This is especially problematic for small-scale farmers who cannot access large industrial equipment. The mini corn shelling machine attempts to address this issue by mechanizing the process of shelling, providing an efficient solution that saves time and labor. It is designed for small and medium-sized farms, the mini corn shelling machine is small in size, simple to use, and inexpensive. It is designed specifically to handle moderate amounts of corn, enabling farmers to improve productivity without incurring the costs of large and costly machinery. The design of the machine integrates effective mechanical systems that extract the corn kernels from the cobs with little damage, enhancing the final product quality. This automation minimizes the chances of human error, hence making the shelling process more uniform. Some of the most important features of the mini corn shelling machine are that it has low maintenance needs, is durable, and is simple, making it appropriate for farmers who have little technical expertise. It is also energy-efficient, which is important for rural communities that might not have much access to electricity. The machine is also scalable, so it can be used for varying levels of production, making it appropriate for small family farms as well as larger-scale agricultural production. Finally, the mini corn shelling machine is at the forefront in the process of modernizing the practice of farming by enhancing efficiency, minimizing costs, and conserving labor through sustainable agriculture practices. Through an affordable and workable means to shelling the corn, the machine enhances farmers' livelihood and enhances agricultural output in rural settlements.

2. PROBLEM STATEMENT

The Problem statement for “MINI CORN SHELLING MACHINE” might be: “Design and develop a compact, efficient and cost-effective corn shelling machine capable of swiftly removing kernels from cobs, suitable for small scale agricultural operations or home use, with a focus on ease of operation, safety and minimal waste”.

To design and develop a compact, efficient, and cost-effective mini corn shelling machine that addresses the challenges of manual corn shelling by providing a mechanized solution suitable for small-scale farmers or home users. This machine should aim to improve productivity, reduce labor intensive processes, ensure safety, and enhance overall efficiency in corn shelling operations for small batches of corn kernels.

3. METHADOLOGY

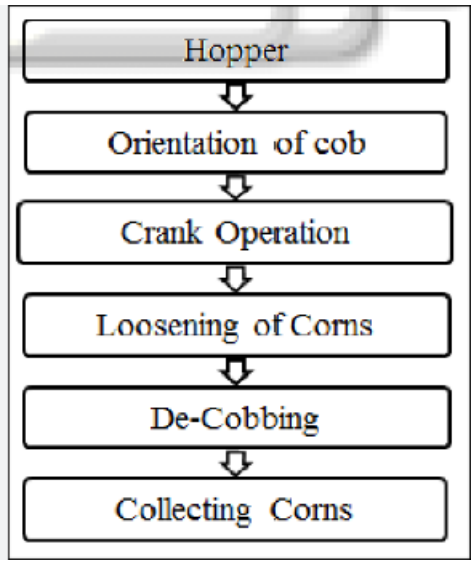

Figure (1) Architecture Diagram of shelling machine

The design methodology for the mini corn shelling machine is based on the belt drive mechanism. The belt was transferring the power from the motor to the blade. To ensure it efficiently separates corn kernels from the cob without causing excessive damage. the process of designing and building an efficient, durable, and user-friendly mini corn shelling machine.

4. OBJECTIVES

To automate and streamline the process of removing corn kernels from the cob, providing increased efficiency and convenience for farmers or small-scale agricultural operations.

This machine aims to save time and labor while maintaining the integrity of the corn kernels, ultimately contributing to higher productivity in corn harvesting and processing.

5. PROPOSED DESIGN

The 3D design listed below is made with SOLIDWORKS Software:

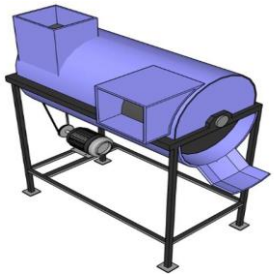

FIGURE (2) 3D MODEL OF SHELLING MACHINE

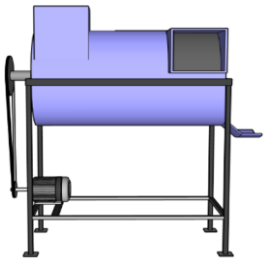

FIGURE (3) MOTOR AND PULLEY

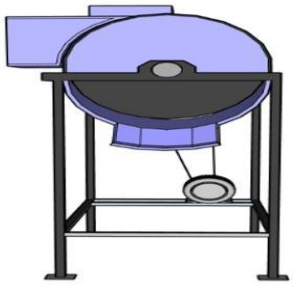

FIGURE (4) BACK VIEW OF THE DESIGN

6. CALCULATIONS

Number of spikes (Sn)

$Sn = Ls/St$

Ls=935 mm; St=55 mm

Sn = 17

Shelling speed (N2)

$N2 = (D1 \times N1/D2)$

D1 = 0.1 m; D2 = 0.14 m; N1 = 1725

N2 = 1232.14 rpm

Length of belt (L)

$L=2C+(\pi/2)(D1 + D2) + (D1 - D2/4C)2$

C = 580 mm; D1 = 100 mm; D2 = 140 mm

L = 1537.04 mm

Power (P)

$P = (T1 + T2)\ V$

V = 9.03 m/s ;T1 = 29.01 N; T2 = 9.03 N

P = 399.2 W

7. DESIGN AND FEA

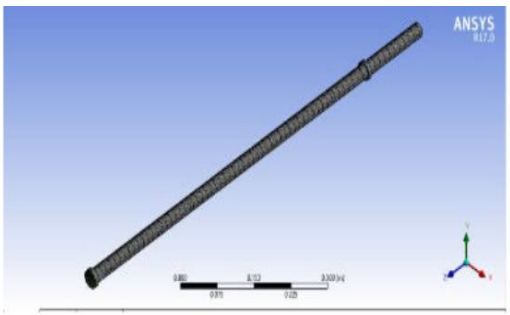

Figure 5 shows meshing of shaft by using ANSYS software. The generated mesh is done by fine position to obtain the good quality of mesh. Number of nodes are 27997 and Elements are 5964.

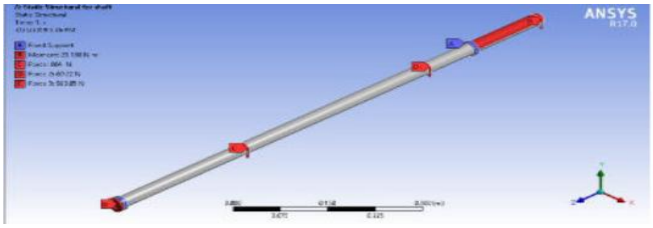

Figure 6 shows the boundary condition of shelling shaft. Fixed supports are provided at the bearings on the t shaft. The simulation is carried out by choosing the static condition. The weight of shelling cylinder, pulley, fan blade and torsional moment are acting on the shaft.

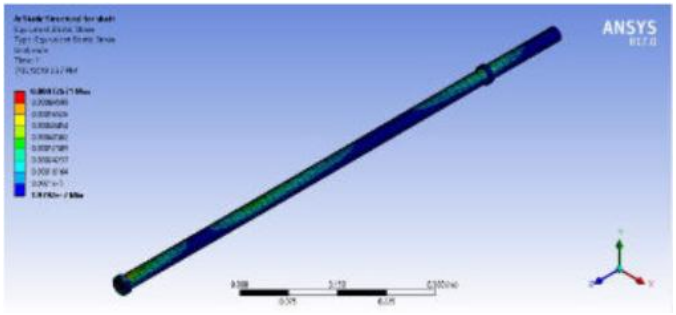

Figure 7 shows the effective strain distribution of shelling shaft. The maximum and minimum effective strains are 7.2671×10 -4 and 1.9792×10 -7 which occur due to Von-Mises stresses on the shelling shaft.

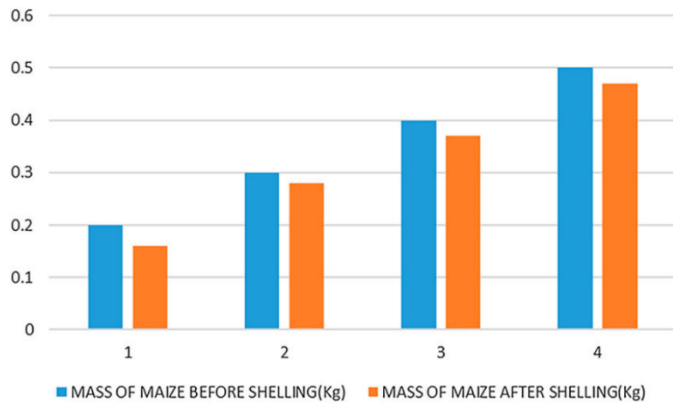

Figure 8: Graph of time against the mass of maize before shelling.

Sample no.	Time (s)	Efficiency (%)
1	30	80
2	34	92
3	40	93.3
4	49	94

7. LITERATURE REVIEW

1. Rushekesh Nehete et. al discussed about the fabrication of the automated drain cleaner which removes the floating objects such as plastic bottles, covers, food packages from the drainage water in order to free the flow of drainage water without any clogging with the help of gutters hand and mentioned the future upgradation of this cleaner machine can be made fully automated system by the use and application of automatic sensors and by the implementation of control algorithms. This system can be run fully automated by eliminating the idle time running by starting and stopping mechanism by use of proper sensors. Controlling and managing the wastes efficiently by use of appropriate device.

2. Akash R. Fakke et. al fabricated an automated drain cleaner with chain drive of sprocket and 12V DC motor. The gears used were also customized and their calculations are included in paper. For driving motor, a 9V battery which operates between -20 deg Celsius and 60 deg Celsius was used. Finalizing of bolts and nuts plays an important role in calculation. Arduino Uno is a software used to simulate the running of machine in software itself. Proximity sensor 8 is used to improve the physical between the sensor and sensed object.

3. N. Ashwinkumar, K. Adithya said that manual cleaning of drainage which is already blocked may lead to loss of their life. To avoid these things, the machine is designed to move on place to another with a ground clearance considering the water level of drainage. Battery performance and lifetime calculation was introduced. Calculation for the sprockets used was included with simple chain drive mechanism. Usage of RF transmitter for operation increased the operating range.

4. Gaurav Mullick et. al mentioned about the fabrication of the automated cleaner machine which works that the motor runs in the regular interval which is controlled by the arudino circuit which consists of Arduino UNO board, PN2222 Transistor, 1N4001 diode and the 12V dc motor of rating 17W which runs on the 30 rpm and with collecting bin of dimensions 75X30X38. The equipment required for the fabrication of the cleaning machine is studied with the help of this journal.

5. Shubhangi Gondane mentioned the parameters required for the fabrication of the automated cleaning machine that is the saft diameter of 6mm and torque developed on the motor is 30N, gears of teeth 54 and 35 teeth the solar panel for the battery management us powered with 84W. By considering those parameters and the calculations values the fabrication of the cleaning machine was done.

6. D. N. Dubey et. al said that for the sake of reducing the worker's health risk automation of drain cleaner project was planned. Bearing calculations and base frame calculations were noted down. Shaft calculation was very clearly explained. A

detailed component specification table was given. A fully developed CAD model figure was attached with the final real time product which helped to visualize the project. A result of collecting 5 – 6 Kg of wastes in half a day with constant speed of motor and channel, which is a good one.

7. Ajay Khadse et. al describes the process involved in the fabrication of automated drain cleaner machine with the help of 12V DC motor with 10 rpm speed. The design of the chain drive mechanism with gutters is designed based on calculations which provides the gap between each lifter is 700mm, chain length of 2057. 2mm and the shaft length of 905mm which can bear the load of 25 kg approx.

8. Steven Chodnekar et. al fabricated the semi-automatic drain cleaner machine which works with the help of solar panel and found a drawback that the machine is not properly functioning

in the closed drainages, the drains go under the machine so that the machine could not be able to collect the drains and also mentioned that the cleaning machine is can operated only in the morning due to the presence of solar panel and only in the open drainages.

9. S Navaneethakrishnan et. al fabricated the device to place across drain in order that solely water flow through lower grids, waste like bottle, Etc. Floating in drain are upraised by teeth that is connected to chain. This chain is connected by gear driven by motor. Once motor runs the chain starts to flow into creating teeth to raise up. The waste materials are upraised by teeth and are keep in waste vessel. The lower shaft and wheel arrangement is placed for transporting the machine from one place to a different place likewise united gutter to a different gutter.

10. Kavin Bharathi E et. al discussed about the fabrication of automated drain cleaner with DPDT switch that drives the 3-pole coreless DC motor to drive the shaft which contains sprocket so that through chain link the other shaft with sprocket is rotated. So, the solid wastes from the drainage are collected through the gutters/lifters fitted with the chain and shaft which are stored in collecting bin and then they are removed and replaced with empty baggage.

8. CONCLUSION

The mini corn shelling machine, based on its design and fabrication, has demonstrated strong potential in terms of shelling efficiency, separation quality, and cost-effectiveness. While the initial testing phase shows promising results, further improvements are necessary to optimize performance, especially for various corn sizes and moisture levels. Additionally, the market for such a machine is substantial, especially in regions with significant smallholder farming populations, making it a promising product for both local manufacturers and global distributors.

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