

Design of a Small-Scale Sugarcane Harvesting Machine

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Abstract: Now days, there is an increased demand of sugar in the world. In the current scenario, India, the largest producer of Sugarcane in the world and the states where it occurs are U.P., Maharashtra and Karnataka. The objective of this paper is to design a small-scale sugarcane harvesting machine that is farmer friendly that can make sugarcane harvesting an easy job for the farmers. This paper aims to present the design of a small-scale sugarcane harvester which can be used to cultivate as well as collect the sugarcane. The fabrication can be done using this design and this would be able to cut the cylindrical stalks of sugarcane.

Keywords: Sugarcane Harvester, Small Scale, Cutting Blades and Ergonomics

I. INTRODUCTION

Indian horticulture industry nowadays is facing a critical phase of labor scarcity, which is due to lesser wages or moving of the work force to the urban cities for higher wages. According to a report by food Agricultural organization, sugarcane was cultivated on nearly 24 million hectares in ninety countries. Of these countries, India tops the production. There are commercially available harvesters available in the market such as paddy harvester, potato harvesters and many others are available for small fields, but sugarcane harvester is not available in small scale. The machine comprises of four wheels, two cutting sharp edge, a cubical conveying box, Rack and pinion, Shafts, Motor, and Battery. Taking into view of the manual collection of harvested sugarcane, this machine chops off the lower part of the sugar stick containing leaves, all the while by setting the ideal development of the revolving cutting edges and moving instrument which would slide the sugarcane to the side of machine. Hence, this machine would be able to cut the sugarcane and simultaneously collect the harvested sugarcane.

II. LITERATURE REVIEW

Siddaling et al [1] work to plan and manufacture a small-scale sugarcane reaping machine for sugarcane collecting, to lessen rancher's exertion and expands the yield of agrarian items. At the point when contrasted with manual collecting, this machine cuts lower and upper parts of the sugar stick which contains leaves also, all the while sets the ideal development of the rotating sharp edges.

Jain et al [2] contemplate towards the outline and creation of small scale sugarcane collecting machine for sugarcane reaping which diminishes the rancher's exertion and expands generation of horticultural items. Machine comprises of petroleum motor and diverse components are utilized as a part of this machine. When compared with manual gathering by utilizing this machine to cut canes at quicker rate and it is spared. The machine is useful for all types of ranches.

Chaudhari et al [3] went for planning and manufacturing small scale sugarcane gatherer for sugarcane collecting to minimize rancher's exertion and to expand generation of rural items. Machine comprises of oil motor and distinctive instruments. At the point when contrast with manual gathering by utilizing this machine has an ability to chop off sticks at quick rate and it is very efficient. The machine is useful for all types of homesteads.

Pachkhande et al [4] prepared a machine that means to outline and create small scale sugarcane collecting machine to lessen rancher's exertion and to expand generation of horticultural items. The paper suggested that there is a requirement for speedier rate of creation of rural items. In India all agriculturists confronting issues are due to work lack. Step by step work compensation are expanding and similarly request of agribusiness items are likewise expanding and the present world need speedier rate of generation of horticulture items. As we compare it to manual collecting this machine cuts sticks at speedier rate.

Jamadar et al [5] presented a paper that plans and creates low scale sugarcane cutting machine for sugarcane collecting to decrease exertion and to build span for agricultural products. Compared with manual gathering, machine can cut canes at a faster rate. It is practically seen in this machine and outlines framework for any client to produce a machine for their homesteads applications.

Shekle et al [6] also prepared a low-cost sugarcane harvesting machine that can take perform shearing action with minimal efforts and in less time.

III. OBJECTIVES

After going through the literature, the gap that was found was that the sugarcane harvesters developed are not economical as they are able to cut the grains but there is a problem of collecting the grains. The commercial sugarcane harvesters are available in large sizes and that's too costly so to overcome these difficulties, the following objectives are listed down:

1. To create a low-cost sugarcane shearing machine, that can cut the grains with minimal cost.
2. To prepare a machine that is more productive and possess straight forward instrument for cutting the sugarcane at a very fast rate.
3. To create the cultivated sugarcane gathering attachment which is simple to work.
4. To produce an economical machine for small scale farmers.

IV. METHODOLOGY

To completely provide a design of the machine, the following stages of the design were incorporated to have a proper design methodology

- Design Conceptualization: Based on needs of the farmers and the market survey conducted. Different iterations of the design of machine were prepared.
- Calculation and outline validation: planning stage is imperative stage as quality, weariness, factor of safety, every single specialized point was taken while doing the computations and configuration.

- Prototype making and testing: After finishing the calculations, a three-dimensional assembly was made virtually on the software within the genuine conditions which gave a perspective of the real world and its quality that allows doing testing of any sort conceivable.
- Testing: After assembling the model, testing was done to check the feasibility of the model. This is also done using the virtual simulations.

V. DESIGN CALCULATIONS

Strength stresses and forces acting on major body parts Of the machine, cutter specifications were kept in mind while performing calculations and analysis was done on the SOLIDWORKS.

Design of shaft:

The process of its design is illustrated as under:

- $P = (2 \pi N T)/60.....(1)$

$P= 745.7 W$

$N= 1725 rpm$

$T= 11.58 N-m$

- Shear Stress

$S_{yt} = 150N/mm^2$

$FOS = 4 (assume)$

- $F_s = (0.5*S_{yt})/FOS.....(2)$

$F_s = 18.75 N/mm^2$

- Diameter Of cutter shaft

$T = (\pi F_s d^3)/16.....(3)$

$d = 31.45 mm$

- Diameter Of pulley

$T = (\pi F_s D_0^3) (1-k^4)/16.....(4)$

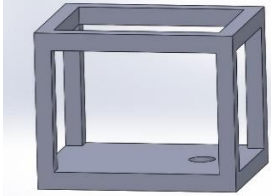
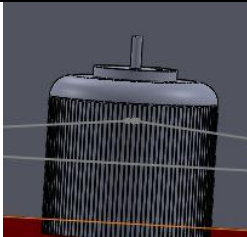
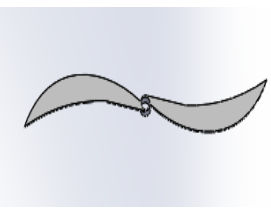


$D_0 = 43.47mm$




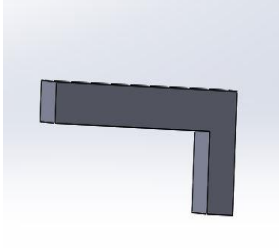
$K= 0.723$

The table-1 shows the parts designed for the sugarcane cutting machine. The detailed description of each component is described on the table.

Figure 1 shows the final assembly of the sugarcane harvesting machine that consists of two cutters which are used to harvest the sugarcane. Cutters are powered by a motor which tightens the pulleys with common belt which helps to rotate the cutters in anticlockwise direction. The two side arms can be seen for barricading the machine when there is a stack of sugarcanes in front of this machine.

Table 1: Parts of Machine

<i>Part Name</i>	<i>Dimension & Specification</i>	<i>Image</i>	<i>Description</i>
Cuboidal Safe Box	900x1200x900		This is the frame for the machine, all the fastenings will be done on this.
Motor	DC 12V, 15AMP		1HP motor will be used, its power is calculated and has completed the objective.
Cutting Blade	2 blade Of Mild Steel		Heavy blades for cutting the sugarcane.
Battery	12 V, 7.2 Amp		2-4 batteries of this configuration will be used for providing the electric current.
Wheel	2 Wheels		Wheels for the better traction and will not get stuck in sandy area.

Rod	Steel		This will be used as the sliding arm.
Shaft	4 Carbon steel shafts		Used for pulleys.
Rack and pinion			Used for sliding arm method.
Moving Arm			Used for the sliding arm method

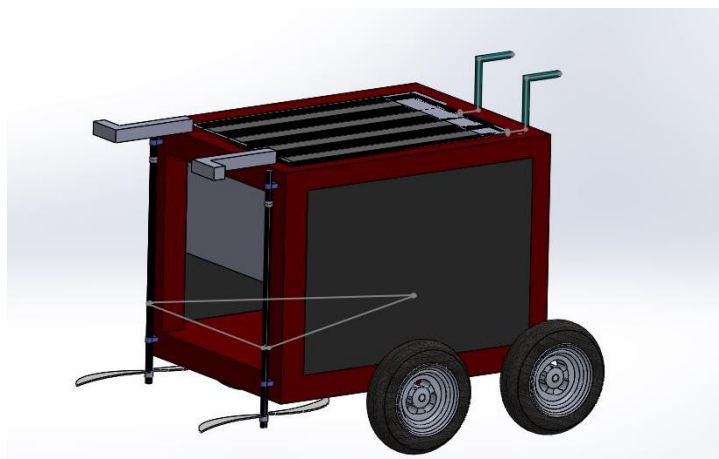


Figure 1: Final assembled Machine

VI. CONCLUSION

This paper presented a design for low cost sugarcane harvesting machine which can cultivate the sugarcane and the collection mechanism was incorporated so as to collect the grains, in the mean

time the machine will also prove to be light weight and cost effective. The testing of the model was done on the virtual environment. The fabrication of this model can be done easily to get the final output of the same.

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical statement: The authors declare that they have followed ethical responsibilities

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