Mini Sugarcane Harvester Machine

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ABSTRACT

This project is focused on development of sugarcane harvesting machines nowadays there is need of fast production of agricultural products. 75% Indian economy is based on agriculture. So development of agriculture field is considered as development of India. But nowadays because of industrialization shortage of labor found in agriculture field. Day by day labor demands about their salary are also increased. This project is a work towards development of sugarcane harvester machine aspects for economical harvesting which will help to minimize the working fatigue and to reduce labor cost. Today's world there is a heavy demand for sugar and its byproducts. The major states growing sugarcane are Maharashtra, Uttar Pradesh and Karnataka. Now India is the leading producer of sugarcane in the world. This project aims to reduce labor as well as farmer's effort and to increase the output of agricultural products. If compared to other harvesting machines, this machine can cut the sugarcane from the lower portion higher cost machine can not to purchase by common or middle class person, hence cost reduction is our main focused.

Keywords: Labor effort reduction, Cost cutting, Motorized, Solar power sugarcane, Harvesting word.

INTRODUCTION

Harvesting is a crucial activity of sugarcane production, which affects the overall productivity. Manual harvesting is a very labour-intensive and arduous activity and the intervention of mechanical systems for harvesting frees harvest labors from the drudgery and helps to improve productivity. Existing harvesting machinery are of huge size and are not suitable for Indian farming practices. There is scope and need for development of mini sugarcane harvester suitable for Indian farming conditions. The project dissertation work involved development of product specification of the proposed mini harvester through literature review and interaction with farmers through field visits. Interaction with the farmers helped deriving the requirement of the mini harvester, which were then converted to technical requirement and finally design specifications through Quality Function Deployment. Based on the derived specifications four different concepts were generated to suit the canopy requirements and finally the Dual disc base cutter sugarcane harvester concept which met overall necessary requirements was selected.

1.1. Objectives of present study:

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 sugarcane. 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 cutting machine, that can cut the sugarcane 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 design & develop the sugarcane cutting attachment which is simple to work.

4. To produce an economical machine for small scale farmers.

1.2. Methodology:

1) To completely provide a design of the machine, the following stages of the design were incorporated to have a proper design methodology.
2) Design Conceptualization: Based on needs of the farmers and the market survey conducted. Different iterations of the design of machine were prepared.
3) Calculation and outline validation: planning stage is imperative stage as quality, factor of safety; every single specialized point was taken while doing the computations and configuration.
4) Testing: After assembling the model, testing was done to check the feasibility of the model.

1.3. Scope:

The sugarcane harvesters available in market are too big in size and possess huge cutting capacity. Due to their size it is impossible to use these automatic harvesters in the small farm. The study of various harvesting process and various automatic and semiautomatic harvesting machine reveal that there is scope for modification in design of conventional harvester to motorized system.

2 – Literature review

2.1 Literature Survey 1:

Karengula Gopi, et al [1] done the work on, Performance Evaluation of Mechanical and Manual Harvesting of Sugarcane, according to his work, India is one of the most sugarcane producing countries in the world which covers 18.52% area and contributes 18.45% sugarcane production of the world.

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2.2 Literature Survey 2:

S. Shankar, C. Maheswari, R. Gowtham, P. Kiruba, K. Mohansrinivas, done the work on, Design and Fabrication of Portable Sugarcane Harvesting Machine, according to his work, In today's world, the human population is increasing a lot. Due to this there is a need for large scale production of agricultural products. There is a huge demand of sugar and its by product. For the cultivation of sugar, the human daily w ages are more than the total profit of the cultivation. The major sugarcane growing states are Maharashtra, Uttar Pradesh, Tamil Nadu and Karnataka. This work aims to design and fabricate a small scale portable sugarcane cutting machine for harvesting sugarcane's to reduce farmer's effort and to increase the production of agricultural goods. Compared to manual harvesting this machine has a capacity to cut canes in faster rate and in economical way. This work helps in laying design foundation for any aspiring user to fabricate a machine for application in their farmsy.

2.3 Literature Survey 3:

Kavana et al [3] done the work on, Fabrication of Sugarcane Harvester using Saw Chain, according to his work, In today's world there is a heavy demand of sugar and it's by products. The purpose of developing this paper is to develop machine to reduce cost and time required for sugarcane harvesting. By using this harvesting machine and advance techniques we can increase the production in minimum cost and time.

3. Constructions

3.1. Supporting Frame:

The frame lays the foundation upon which the whole set up rests. The main function of frame is to carry whole assembly on it so it has to be strong enough to hold it. The dimensions of the frame are the following: Length: 30 inches Width: 18 inches**.**

3.2 Rotary Cutter:

Fig -1: Rotary Cutter

The rotary cutter is the major part of the machine. The rated speed of the rotating cutter is 3000 rpm. But for efficient cutting of the canes, 1500-1000 rpm stands sufficient. The cutter is made of high speed steel material and the diameter of the cutter is 100mm.

3.3 Battery:

Fig -2: Battery

The battery used is of 12V and 8Ahr capacity. The main motive for the usage of electric drive is to reduce the weight and increase the efficiency. Fuel-run drives render high weight and are noisy. Each cell contains a positive terminal, or cathode, and a negative terminal, or anode. Electrolytes allow ions to move between the electrodes and terminals, which allows current to flow out of the battery to perform work.

3.4 DC Motor:

Fig -3: DC motor

A DC motor is a mechanically commutated electric motor powered from direct current (DC). The stator is stationary in space by definition and therefore so is its current. . 12V, 5A motor is used for the movement of cutter. The advantage of DC motor is that the speed of the motor is easily controllable. The rated speed of the motor is 3000rpm.

3.5 Solar panel:

Fig -4: Solar panel

A solar panel, or photo-voltaic (PV) module, is an assembly of photo-voltaic cells mounted in a framework for installation. Solar panels use sunlight as a source of energy to generate direct current electricity. A collection of PV modules is called a PV panel, and a system of PV panels is call an array. Arrays of a photovoltaic system supply solar electricity to electrical equipment.

3.6 Wheel:

Wheel is used to carry the whole assembly and move machine from one place to another by rotary motion of it.

3.7 **Ball bearings:**

The rotation of the bush inside the bearing housing is arrested by a snug at the bottom of the lower brass. The cap is tightened on the pedestal block by means of bolts and nuts.

3.8 Nut and Bolt:

As nuts and bolts are not perfectly rigid, but stretch slightly under load, the distribution of stress on the threads is not uniform. In fact, on a theoretically infinitely long bolt, the first thread takes a third of the load, the first three threads take three-quarters of the load, and the first six threads take essentially the whole load.

4. WORKING

This project consists of trolley operated sugarcane harvesting system which is mounted on movable trailer platform on M.S. frame stand. A motorized high speed cutter is attaching at front end for the application of sugarcane cutting operation. When we required operating the sugarcane harvesting machine, we can operate the switch of motor with the application of 12 Volt batteries. So that the sugarcane can be cut by cutter wheel. The solar panel is attached to sugarcane harvesting machine to charge batter.

5. **DESIGN CALCULATIONS**

5.1. Force required in cutting the sugarcane by shearing.

Shearing strength of sugarcane: 3.03 to 4.43 MPa
(AVG 3.64 MPa)
Area of sugarcane stalk cutting at a time = Diameter of stalk × length of serration
= 40mm × 1mm
= 40 mm^2
Shearing force required = Shear strength × Cutting area
= 4.43 × 40 (Taking maximum shear strength)
= 177.2 N

5.2. Power required cutting the Sugarcane:

The optimal combination of parameters was: blade cutting velocity of 13.8 m/s,
Diameter of Cutting Disc = 200mm

Optimal rpm for cutting sugarcane

$$= \frac{\text{Blade cutting velocity} \times 60}{\text{Radius} \times 2\pi}$$

$$= \frac{15.8 \times 60}{0.1 \times 2\pi}$$

= 1317.8 ~ 1318 rpm

Power Required for Cutting = $\tau \times \omega$

= Cutting Force×Radius × $\frac{2\pi N}{60}$

= 177.2×0.1 × $\frac{2\pi \times 1318}{60}$

P = 244.57Watt

Let we select the wheel having specification given below,

Diameter of wheel **D=30cm=0.3m.**

Radius of wheel **r =15cm=0.15m.**

Let to find Linear Velocity of wheel is,

V=r ω

V= Linear Velocity of wheel (m/s)

r = Radius of wheel (m)

ω= Angular Velocity of wheel.

N = Speed of wheel.(Assume 15 rpm)

V=r ω = r $\frac{2\pi N}{60}$

V= $0.15 \times \frac{2\pi \times 15}{60}$

V=0.235 m/s.

5.3. To find the shaft diameter of machine carrying wheels.

Let torque required to transmit the power is,

T = F x r

T = torque required to transmit the power.(N/m)

F= Load to pull the machine. Assume 30kg.

(30 x 9.81 = 294.3N)

Force on each wheel = 75N (Assume)

Radius of wheel r =15cm=0.15m.

T = F x r

= 75 x 0.15

T = 11.25 N-m

6. ADVANTAGES

1) The frame in chainsaw running is moved against sugarcane where chainsaw running at 4 inch above ground level cuts the sugarcane.
2) Harvester runs 50% more time capable of battery since continuous charging of batter is done, which increases its efficiency.
3) Power source from battery runs the main motor which drives the chain saw assembly which runs around 800RPM capable cutting even wood, being harder than sugarcane.

7. APPLICATION

1) It can be used in farms where there is less availability of labor.
2) It can be used to remove the unwanted crops or grass.
3) It can be used to harvest the agricultural field.
4) It can be used in small sugarcane farms.

8.CONCLUSION

As we know that due to increase in demand for sugarcane cutting labor, farmers have started using mechanical techniques for sugarcane cutting. Only difference is that instead of using conventional methods i.e. manual operation of the system farmers have started using automated mechanical machines to achieve the goal after using such small machine. Our project is now manually operated machine for sugarcane cutting, but in future we can make it semi/fully automatic with large scale machine. We can use tractor drive to fully automatically actuated sugarcane cutting machine with high speed blades for its future working.

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