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Review Paper on Solar power operated Sugarcane Harvesting Machine

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Abstract - *In today's world there is a heavy demand of sugar and it's byproducts. Sugarcane is the world's largest crop and it is estimated that it was cultivated on about 23.8 million hectares in more than 80 countries with a worldwide harvest of 170.9 million metric tons.* ***India*** *is the leading producer of sugarcane in the world at about 17.9% in 2016-17 . The major states growing sugarcane are Maharashtra, Uttar Pradesh, Karnataka. In India there is a scarcity of labors in agriculture. Day by day labor wages are increasing. The project aims to design and fabricate small scale sugarcane harvesting machine with solar power operated for sugarcane harvesting to reduce farmer's effort and to increase the output of agricultural products. It is easy to operate, less maintenance, eco-friendly and no skilled labors is required.*

Key Words**: Sugarcane harvesting1, agricultural products2 eco-friendly3, low cost4**

1.INTRODUCTION

India is the largest producer of sugarcane in the world. Harvesting is the process of cutting and gathering of mature crop from the field. In India agriculture is facing serious challenges like scarcity of agricultural labor, not only in peak working seasons but also in normal time. Due to these different types of harvesting machines are introduced and available such as wheat harvester, tea harvester etc in small scale except sugarcane harvesting machine.

In many small scale sugarcane agricultural fields harvesting is done manually that is with hand knives, cutting blade or hand axes also known as manual harvesting. It requires skilled labors as improper harvest of cane leads to loss of cane and sugar yield, poor juice quality and problems in milling due to extraneous matter. Our aim behind this project is to cut sugarcane at ground level.

In our project we have designed and fabricated sugarcane harvesting machine which works with the help battery. Battery is charged with the help of solar panel. Two cutters are provided at the ground level which can cut two sugarcane continuously from two rows. The other main components are brushless square dc motor, bevel gear and belt drive mechanism.

1. LITREATURE REVIEW

In agricultural harvesting, we require maximum man power, ample money and also it is more time consuming process. In cutting process we face various problems and this are not easily solved. So we have studied the following research paper and decided to find the best solutions of this problems by designing and fabricating the sugarcane harvesting machine which will be economical and efficient for small scale farmers.

[1]Dr. Sharad S. CHAUDHARY : There project aims at designing and fabricating small scale harvesting machine for sugarcane harvesting to reduce farmer efforts to increase production of agricultural products. Machine consists of petrol engine and different mechanisms. When compare to manual harvesting by using this machine has a capacity to cut canes at faster rate and it economical. The machine is helpful for both whom having small or big farms.

[2]Joby Bastian: The mechanical properties of the plant material significantly influence the performance of the different unit operation in combine harvester. Hence studies of this properties were done prior to the design of sugarcane harvesting system. The mechanical properties of sugarcane stalk viz., bending resistance, cutting resistance, penetration resistance and crushing resistance were studied in laboratories. It is found that the young's modulus of the sugarcane stalks as 86mpa, the specific cutting resistance varies between 1764.56 and 957.48 KN/m^2 to 53.33 KN/m^2 and crushing force varied from 0.75 KN to 1.53 KN. This study help us very much while deciding the force require to cut the cane in one knocking stroke.

[3] T. Moontree, S. Rittidech* and B. Bubphachot "Development of the sugarcane harvester using a small engine in Northeast Thailand" International Journal of Physical Sciences Vol. 7(44), pp. 5910-5917, 23 November, 2012 This research presents the developing sugarcane harvester using small engine in order to focus on its appropriateness in sugarcane farming for farmers who are encountering problems of labor shortage and sugar factories lacking sugar cane for producing sugar. It is operated by 180 hp (134.28 kW) at 2500 rpm. Sugarcane was harvested at 12 months after planting with an average-stalk length of 1.8 m, and average-stalk diameter of 0.0254 m; each clump consisted of 8 to 12 stalks, the distance of each sugarcane row was 1.20 m. The sugarcane harvester using small engine can perform at an average speed of 1109.73 m2/h with fuel consumption of 20.03 l/h and at a mobile speed of 0.25 km/h. The percentage of sugarcane-cut stalks is 100% since this engine is installed with double blades with a speed of 1,090.5 rpm; a speed of leaf-cutting blades is at 669 rpm with the break even point of 122,572.8 kg/year and the payback period of 2 years.

[4] Adarsh J Jain designed and fabricated small scale Sugarcane harvesting machine which on testing in the field it is found that the front wheels are struck in mud, due to that the machine was not moving. The machine has a capacity to cut 3.75 ton of sugarcane per hour. Comparing with manual harvesting 50% of harvesting time and 60% of labors are reduced (in manual sugarcane harvesting 15-16 labors are required).The cost of harvesting is reduced by 34% when compare to manual harvesting. When comparing with the large scale, though the harvesting time and fuel consumption is less in large scale, but the cost machine is very high (1.85 crore) and the cost of the small scale machine is Rs. 30000. So it will be helpful to our farmer. By comparing with manual harvesting, Rs. 10,000 for an acre can be saved by small scale harvesting machine.

[5] H. Taghijarah, H. Ahmadi, M. Ghahderijani, M. Tavakoli "Shearing characteristics of sugar cane (Saccharum officinarum L.) stalks as a function of the rate of the applied force" AJCS 5(6):630-634(2011) ISSN:1835-2707
This research was carried out to determine the effect of loading rate and internode position on shearing characteristics of sugar cane stalk. The experiments were conducted at three loading rates of 5, 10, and 15 mm min-1 and at ten internode positions down from the flower. Based on the result obtained, loading rate had significant effect on the shear strength and specific shearing energy of the stalk. With increasing loading rate, the shear strength and specific shearing energy increased. Therefore, lower rates of blades are recommended for reducing energy requirement during harvesting and processing sugar cane stalks. In addition, the intemode position had a significant effect on the specific shearing energy, while it did not have significant effect on the shear strength. The specific shearing energy increased towards the lower internodes. The average shear strength was obtained as 3.64 MPa varying from 3.03 to 4.43 MPa. The average specific shearing energy was calculated as 51.41 m J mm-2 ranging from 37.42 to 64.25 m J mm-2. The results of this study are useful for designing and optimizing equipment associated with harvesting, threshing, and processing.

SICKLE is a hand-held agricultural tool designed with variously curved blade and typically used for manual harvesting, or reaping, grains crops or cutting succulent forage chiefly for feeding livestock, either freshly cut or dried as hay. Falx was a synonym but was later used to mean any of a number of tools that had a curved blade that was the sharp on the inside edge such as scythe.

Generally manual sugar cane cutting involve slicing and tearing action that results in plant structure failure due to compression, tension or shear. This manual sugarcane cutting practice is followed by majority of farmers because of socio-economical and agro-technological reasons. Different types of sickle are used in different part of country.

3. MAJOR COMPONENTS OF SUGARCANE HARVESTING MACHINE.

3.1 BRUSHLESS SQUARE D.C MOTOR

Brushless dc electric motor (BLDC) also known as electronically commutated motors (ECMs) are synchronous motors powered by dc electrically via an inverter/switching power supply which produces an ac/bi-directional electric current to each phase of the motor via a closed loop controller. The structural elements of a brushless motor system is typically permanent magnet synchronous motor, but can also be a switched reluctance motor, or inductance motor. In our project BLDC motor(24v) is used to drive cutters at high speed with help of shaft and bevel gear. BLDC motor runs with the help of battery.

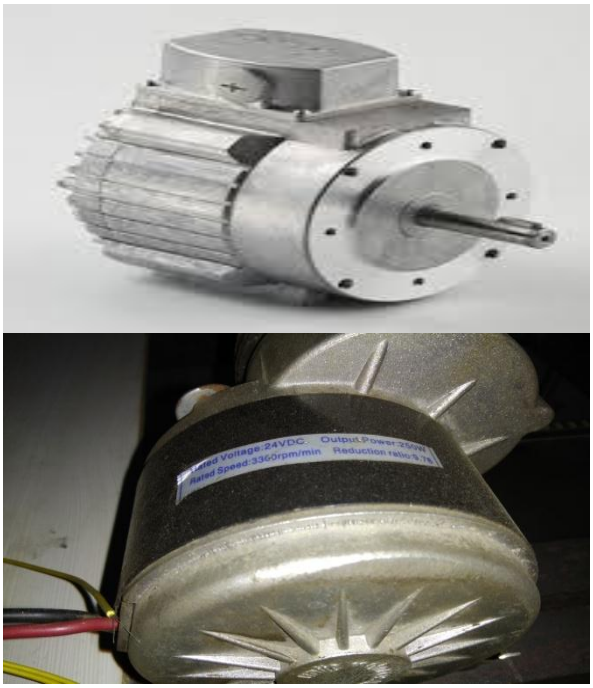

Fig. BLDC MOTOR

3.2 SOLAR PANEL

Solar panel refers to a panel designed to absorb the sun rays as a source of energy for generating electricity or heating.

A photovoltaic (PV) module is a packaged, connect assembly of typically 6*10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. In our project it is used to charge the BLDC motor.

Fig. SOLAR PANEL.

3.3 BATTERY

A rechargeable battery, storage battery or secondary cell is a type of electrical battery which can be charged discharged into a load, and recharged many times, while a non-rechargeable or primary battery is supplied fully charged, and discarded once discharged. It is a composed of one or more electrochemical cell. Rechargeable batteries typically initial cost more than disposable batteries , but have a much lower total cost of ownership and environmental impact , as they can be recharged inexpensively many times before they need replacing

In our project we used two 12 volt, 50Amp, dry battery. The machine is operated with the help of electric motor which is connected with battery. The machine is taken out in sunrays to generate electric current and to charge the battery.

3.4 BEVEL GEAR

Bevel gears are gears where the axes of the two shaft intersect and the tooth-bearing faces of the gear themselves are conically shaped. bevel gears are most often mounted on shaft that are 90 degree apart, but can be designed to work at the other angle as well.

In our project we used the bevel gear arrangement to transmitted the power to the cutting shaft from the motor. The is power transmitted from the motor to the horizontal shaft on which bevel gear is mounted, the rotating bevel gear are in turn connected to the vertical rod which rotate the cutters.

Fig. BEVEL GEAR

3.5 BELT DRIVE MSM WITH PULLEY

A belt is a loop of flexible material used to link two or more rotating shafts mechanically, most often parallel. Belt may be used as a source of motion, to transmit power efficiently, or to track relative movement. Belts are loop over pulleys and may have a twist between the pulleys, and the shaft need not be parallel. In a two pulley system, the belt can either drive the pulley normally in one direction, or the belt may be crossed, so that the direction of the driven shaft is reversed. As a source of motion, a v belt is one application where the belt is adapted to transmit the power from motor to shaft.

Fig BELT DRIVE MSM WITH PULLEY.

3.6 STEEL SAW CUTTER

In this project the cutter is the main component. Limited less parameter in cutting process. It was observed that sharpness is affected power requirement. A blade having leading edge thickness less than 0.127 mm required 35% less energy. Blade velocity is another important parameter in cutting process. This velocity depends upon diameter of blade and number of rpm are less the time and force required for cutting will be more and vice versa and hence optimum value of diameter and rpm must be taken into consideration. Cutting force are changed according to the diameter of stem. According to category of sugarcane. The strength and diameter of stem varies and thus the cutting force also changes.

4. ADVANTAGES

- Harvesting time will be less.
- Efficient work is done by using machine harvester.
- Limited number of labors required.
- Cost of harvesting is less as compared to manual harvesting.
- Running cost is negligible.

5. CONCLUSIONS

The cost of the machine is less and if the farmer buys this machine farmer can recover the invested money back. By using this machine problems of the labor crises can be release. Comparing to the manual harvesting only 18% of labors are required. It makes the process faster hence reduces most of the harvesting time and labors required to operate the machine is also less. The machine is helpful for both small and big farms.

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