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Solar Powered Farming Harvester

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Abstract: ***Agriculture is the important part of world to live human life and we need to focus on some important point that how to increase the productivity-profit, to reduce the cost and solve the problem of workers. As the harvesting is done the harvester vehicle consume lots of fuel and emits the lot of smoke which is very harmful for nature, human beings and environment. Moving step to step with racing world, becoming smart and responsible person we have to adapt renewable resources like solar, wind etc. as much as possible. For overcoming the problem of commercial harvester, we are going to introduce solar powered harvester.***

Keywords: Solar energy, Solar harvester, crop cutting.

I. INTRODUCTION

Solar energy is a renewable energy from the sun, which is available in infinite amount . With fossil fuels disappearing rapidly and likely to be exhausted sooner or later and their piece is also increasing day to day. Fossil fuels releases lots of smoke and harmful gases which is dangerous for our nature, for such large problem we have to move for adapting renewable resources as much as possible, mostly solar energy. Today the farmers have become aware of the modern technologies that can fetch them better yields and also help them manage it with multiple machineries. We are aware about petrol and diesel prices. According to google In 2021, about 134.83 billion gallons (or about 3.21 billion barrels)1 of finished motor gasoline were consumed in the United States, an average of about 369 million gallons per day, and 88.2 billion liters of diesel per year. Which also releases tremendous amount of smoke which is very harmful to our nature, our earth. Solar energy is the most abundant energy resource on earth -- 173,000 terawatts of solar energy strikes the Earth continuously. That's more than 10,000 times the world's total energy use. Which is very helpful to our nature. So, we are designing a solar powered harvester which is very useful to them and to our nature also.

As we all are aware that during harvesting, crop cutting by hands is a very complex and laborious task for the Farmers. And now a days there is a shortage of workers for this task. Crop cutting by hands also takes very much time. So, it is not a very efficient process. We also know that there are various types of crops harvesting machines available in the market, which takes very less time for crop cutting but they are very costly and there hiring charges is also more which is not economical for the farmers. And also, such harvesting machines utilize fossil fuels for their working, which is also a cause of pollution to the environment. They also produce very much noise. So, finally we find its solution to design and fabricate Solar Powered Farming Harvester which is economical, cheap and also safeguards our environment.

II. OBJECTIVES

1) To utilize renewable source of energy (Solar energy) to run Farming harvesters.
2) To provide economical and less costly crop cutting machines to the Farmers so that small farmers can also buy or hire such crop harvesting machines.
3) Finally, to reduce pollution by minimizing the use of fossil fuels in crop harvesting machines.
4) To reduce the cost of maintenance of harvesting machines

III. LITERATURE REVIEW

1) Lohit & Hasson (2019) evaluated Solar operated Paddy Harvester. The steady showed that they designed multipurpose cutting blade which is operated by solar energy . In this steady the only part is operated by solar energy is cutting blade and the operation takes place by holding on hands.
2) Jain et al. (2013) designed and fabricated small scale harvesting machine, consisted of motor and different mechanisms. The cost of the machine was Rs 30,000. The machine had a capacity to cut 3.75 ton of sugarcane per hour. Compared with manual harvesting 50% of harvesting time and 60% of labors are reduced (in manual crop (sugarcane) harvesting 15-16 labors are required). The cost of harvesting is reduced by 34% compared to manual harvesting.

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3) Hossain and faraque (2008-9) evaluated performance of self-propelled cereal reaper. The study showed that the effective field capacity, field efficiency and fuel consumption were 0.21 ha/h 80.76% and 0.45 L/h, respectively at forward speed of 2.15 km/h. The cutting width of the reaper was 1.2 m and total loss of crop was 3%. The labor requirement of mechanical harvesting was 15 manh/ha against for manual harvesting was 240 manh/ha. Mechanical harvesting saved 94% labour requirement of manual harvesting. The reaping cost by reaper was Tk. 626/ha

4) After that various solar operated farming harvesters are made but they are operated by holding it in hands by pulling it towards the crop to be cut. Which saves the labor but takes very much time and also are not suitable for cutting a large field of crops. And holding it with hands is also a tough task.

IV. PROPOSED METHODOLOGY-

In this project the idea is to make the mechanization of small-scale solar power farming harvesting machine.

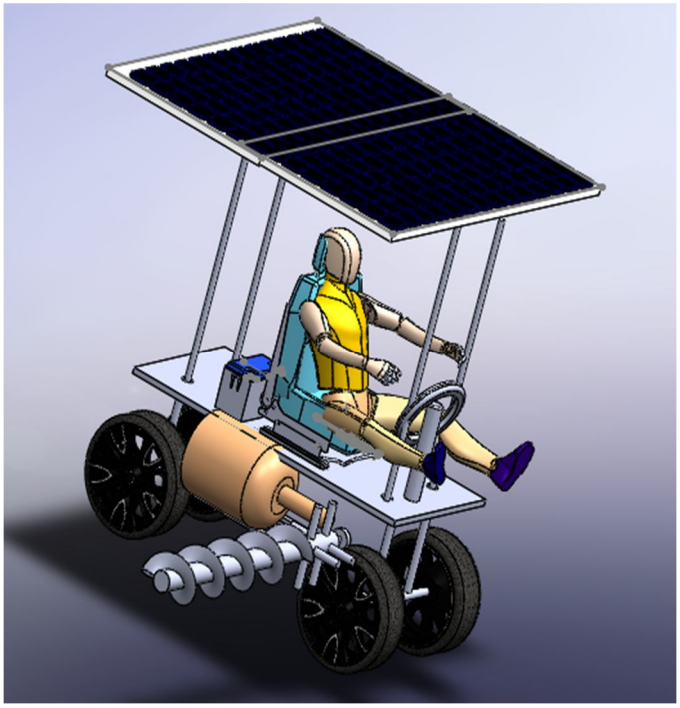


Fig-1 Solar Power Farming Harvester

Different parts of a machine will be mounted on strong chassis. The wheels will be attached to this chassis so that it can be moved in the farm. The solar panel is mounted on upper side of chassis and it connected on the battery and it connected to the electric motor. The induction motor is mounted on the chassis which provides the power to the wheels to move by means of a gear and chain mechanism and it also provides the power to the cutter. The shaft of the gear box and the shaft which is connected to the wheels are inter connected by means gear and chain mechanism to provide variable speed. The pulley is connected to the output shaft of the engine which intern connected to the front pulley which is mounted on the shaft by using belt then by using bevel gear the power is transmitted to the cutter shaft.

V. CALCULATIONS

A. Cutting Unit

To design the reel and cutter bar, the following mechanical properties, obtained from the tensile and bending tests carried out on wheat stalks of 15% moisture content by Chandio A. in the comparison of the mechanical properties of wheat and rice straws (Chandio, et al., 2013) are utilized. According to Persson (1987), the critical speed of a blade, that is the minimum speed required to cut a crop stalk is given by;

$$V_K = \sqrt{\left[d_{ws}\frac{F_c - F_b}{m}\left(1 + \frac{z_{cg}}{r_g^2}\right)\right]}$$

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B. Power Transmission Unit

Assuming that the shafts are loaded with suddenly applied loads and minor shocks (K_b=2 and K_t=1.5), the following method is used to design the shaft diameter.

For shear

$$d^3 = \frac{16}{\pi\tau_{max}}\sqrt{[(K_bM)^2 + (K_tT)^2]}$$

For bending

$$d^3 = \frac{16}{\pi\tau_{max}}0.5K_b\,M\sqrt{[(K_bM)^2 + (K_tT)^2]}$$

The minimum number of teeth on the bevel gear pinion is

$$T_p = \frac{2A_w}{G\left[\sqrt{\left[1+\frac{1}{G}\left(\frac{1}{G}+2\right)\sin\varphi^2\right]}\right]}$$

C. Stress Analysis

The Simple Elastic Bending and Simple Torsion theories were used in the calculations of the principal stresses, which were then used to obtain the von Mises Stresses.

Simpal Elastic bending theory:

$$\frac{M}{I} = \frac{E}{R} = \frac{\sigma}{y}$$

Therefore , $\sigma = \frac{4M}{\pi R^3}$

Simple Torsion Theory : $\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$

Therefore , $\tau = \frac{2T}{\pi R^3}$

D. Calculations of Solar Power and Efficiency

Efficiency of solar system :-

$$\{\eta_{\text{pannel}}\} = \frac{output}{input}$$

$$\eta_{pannel} = \frac{power\ produced\ by\ solar\ pannel\ per\ unit\ area(m^2)}{Standerd\ sun\ power\ (full\ sun\ hour)}$$

$$\eta_{pannel} = \frac{power\ produced\ by\ solar\ pannel\ per\ unit\ area(m^2)}{1000\ watt/_{m^2}}$$

Photovoltic system (PV) size :-

$$\text{PV system size} = \frac{Energy\ Demand}{\left(annual\ sun\ hour/_{efficiency(\eta_{panel})}\right)}$$

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VI. MAIN COMPONENTS REQUIRED

A. *Solar Panel*

solar panel of 20 watts 12volts,1.4amps.Photovoltaic solar panels absorb sunlight as a source of energy to generate electricity.



Fig-2 Solar Panel

B. *DC Battery*

Sealed lead acid battery with voltage 12v and nominal capacity of 7Amp is used for the energy storing purpose. _. The battery is charged during the day in the presence of sun i.e., solar energy and use when necessary. The batter after charging can be used up to 5-6 hrs Continuously.



Fig-3 DC battery

C. *DC Motor*

The motor used for the controlling the cuter, the permanent dc motor with 12V is used having the speed 1800rpm. This single phase motor work on the Fleming hand rule and generate electric current and this electric current converted to mechanical work like to rotate the blade and cut the brush.



Fig-4 DC Motor

D. *Cutting Blade or Reel*

Different types of blades are used for operation to be done and these blades are made by cast iron, Stainless Steel, carbide steel. We are using steel blade for cutting purposes.

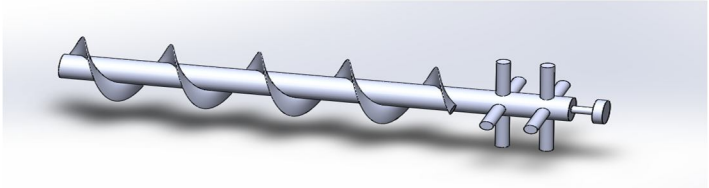


Fig-5 Cutting Blade

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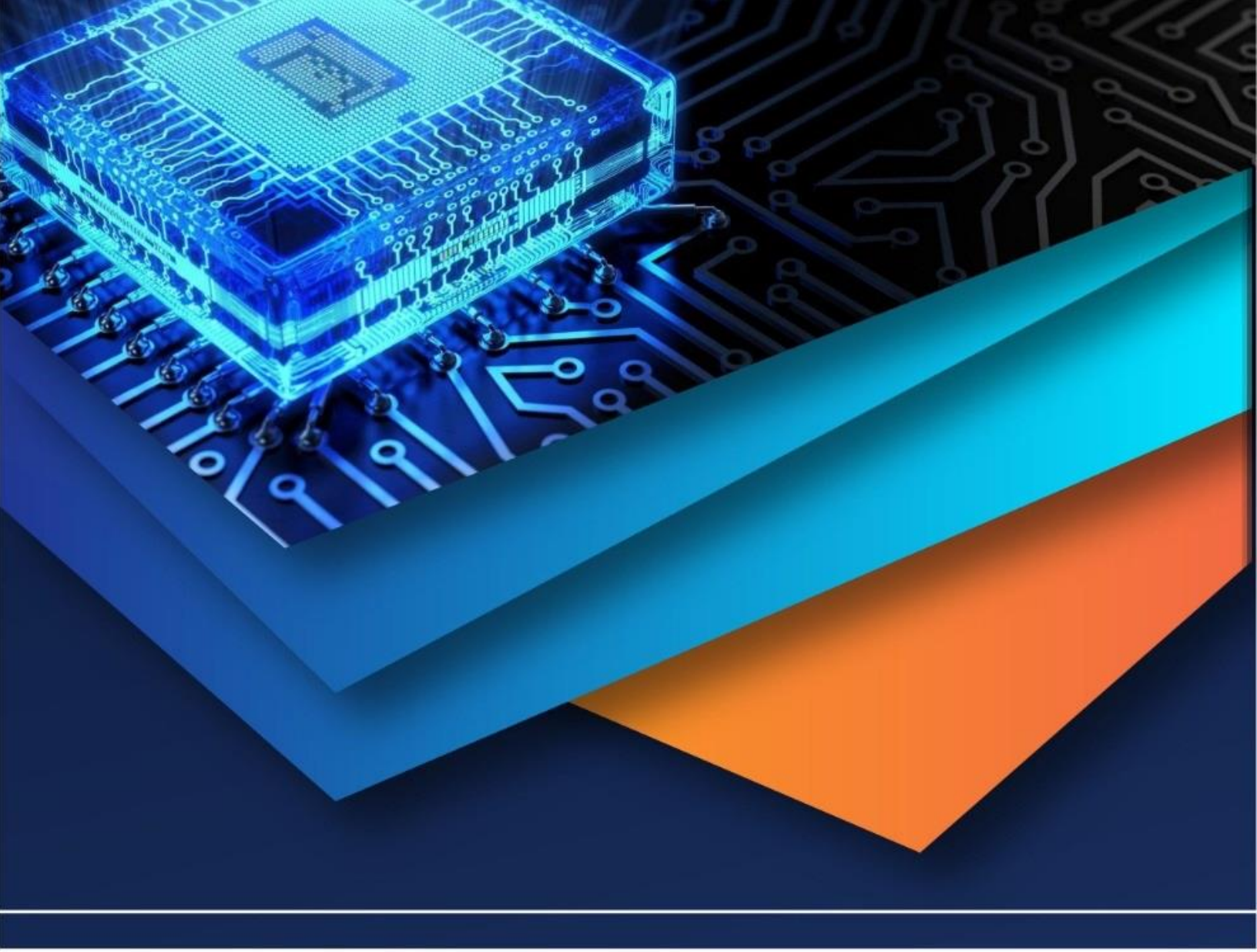
VII. CONCLUSION

The solar farming harvester will result in a fast-harvesting method for small scale farmers; reduce labour and the fuel costs associated with hiring labour; and give the small-scale farmers enough time to focus on other operations at the farm. The harvester will be more convenient for the operator, and most importantly, reduce postharvest losses due to traditional methods' use. This will increase the productivity and quality of the crops produced, allowing small scale farmers to contribute more to the nation's development to a greater extent. It can also provide an alternative way for cereal crop harvesting to all farmers, preventing the loss of cereal crops due to early rains or animals, birds in the case of cereal crops, destroying the crops. Therefore, an increase in harvest mechanization was seen to be very important in order to harvest crops in a fast way with minimum losses. For most small-scale farmers (A1 and A2), there is therefore a need for the design of harvest machinery that is economical for them, as most of them do not afford the machinery already present, or acquire the machinery way past the harvesting period.

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