



Fabrication of Solar Powered Multifunction Grass Cutter Robot

Ritesh A. Thakare, Ranjit V. Chimada, Jignesh N. Bij

DEPARTMENT OF MECHANICAL ENGINEERING
G.E.S'S KATGARA POLYTECHNIC INSTITUTE , BORDI

H.O.D :- M.M. Sirsikar & Project Guide:- Susmit Dongarkar

Abstract -

Now a days we are facing the problem like pollution power cut problem etc., in order to avoid or overcome this problem we have plane to make a device which does not face such problem so we have thought about the device which can be performing its function without causing any problem so we have decided to making the project on crop cutting this project uses the renewable energy sources because of power storage for its operation here using solar energy the aim of our project to develop portable fully automated solar based crop cutter. The design objective is to come up with a mower that is portable, durable, easy to operate and maintain. It also aims to design a self-powered mower of electrical source; a cordless electric lawn mower. The heart of the machine is a battery-powered dc electric motor. It comprises of a system of speed multiplication pulleys which drive the cutting blades and the charging unit comprising of a 12V alternator and a lift mechanism meant to alter the height of cut. The use of collapsible blades and incorporation of an alternator for recharging the battery make the design unique such that no engine is involved. Performance test gave a cutting efficiency of 89.55% with 0.24kN human effort. Thus, the machine is considered highly efficient and is readily adaptable to different cutting conditions.

Keywords— Remote operating features , Solar panel, Grass Cutter, water etc.

1. Introduction

Crop cutter machines have become very popular today. Most common machines are used for soft crop furnishing. The main parts of the Crop cutting machines are DC motor, relay switch for controlling motor, Battery for charging it through solar panel. It is placed in a suitable machine structure. The motors having 350rpm and 35rpm are connected to the electric supply by the use of a roll of wire. The linear blades are attached in this machine. Working principle of the crop cutter is providing a high speed rotation to the blade, which helps to cut the grass. The blade will get kinetic energy while increasing the rpm. The cutting edges are very smooth and accurate. Also electric crop cutting machines are much easier to be used in garden, lawn and crop fields. In order to enhance the beauty of home-lawns and gardens, Crop cutting machines are the best available option in the industry. With the help of a lawn mower which is a machine with revolving blades to help us cutting lawns at even length, people can easily maintain and beautify their lawns and gardens without any hassle.

Now a day, there are plenty of options starting from the simplest push along mower to the most advanced electric crop cutting machine. According to world energy report, we get around 80% of our energy from conventional fossil fuels like oil (36%), natural gas (21%) and coal (23%). It is well known that the time is not so far when all these sources will be completely exhausted. So, alternative sources should be used to avoid energy crisis in the nearby future. So introduce solar energy for the machine process to work. A solar panel is a large flat rectangle. The cells, each of which is about the size of an adults palm, are usually octagonal and colored bluish black. Just like the cells in a battery, the cells in a solar panel are designed to generate electricity; but where a battery cells make electricity from chemicals, a solar panel cells generate power by capturing sunlight instead. Solar crop cutter have no moving parts and hence require little maintenance and work quite satisfactorily without any focusing device. It does not cause any environmental pollution like the fossil fuels and nuclear power. Solar cells last a longer time and have low running costs.

2. Problem Identification

An electric Lawn mower There are so many complication with Electric Lawn mower Like Electricity, Wiring, Efficiency, Ecofriendly etc. And design is so complicated so behalf of Electric lawn mower we have made Solar power crop cutter which is efficient, less noisy, No need of any external wiring. The basic idea is that we have made crop cutter with electric motor that runs from a 12 volt battery. This battery will be charged using solar panel of 10W.

3. Objectives

- The objective of the proposed work is to the design and construct the solar crop/crop cutter is a fully controllable from wired communication. Crop/Crop cutting robotic vehicle powered by solar energy.
- The system uses 12V batteries to power the vehicle movement motors as well as the crop cutter motor. We also use a solar panel to charge the battery so that there is no need of charging it externally.
- The crop cutter and vehicle motors are interfaced to high speed dc motor that cuts the crops/crop as per command.

4. Literature Review

Sivarao, T.J.S.Anand, Hambali, Minhat, Faizul

Presented a review of researches done on the subject of automated tractor. An autonomous tractor is a vehicle that can operate without or with minimal human control, self propelled and guided automatically along a desired path. The benefits from such a system are useful for agriculture industry by reducing labour cost and time, as well as improving output efficiency by eliminating human errors. Many researches and inventions have been made, with the results ranging from successful, encouraging to some that are impractical for commercial implementation for certain reasons. These implements include sensor, global navigation satellite system, machine vision, laser triangulation, ultrasonic transmitter and geomagnetic controller, as well as actuator and servo motor.

Pratik Patil, Ashwini Bhosale, Prof. Sheetal Jagtap

Described about an automatic lawn cutter that will help the user to cut the crop in their lawn with less efforts. The different sensors are used it will detect and avoid objects and humans while mowing. The main objective of this automatic lawn cutter is that the user can specify the area that is to be mown and also the height of crops per there requirement by using the keypad. This design contains a microcontroller like ATmega 16,multiple sensors, LCD Display, Keypad.

Ernest L. Hall

Another example of an autonomous lawn cutting system is called the Weed Eater developed by the Weed Eater Corporation. The system is a solar powered emission free mower that harnesses enough power to

operate itself. The robot is equipped with 34 iridescent solar cells embedded on top of the systems platform and has the capability of handling properties up to 13,500 sq-ft. The system operates on the same principle as the Lawn Ranger except it uses a cable beneath the surface of a persons lawn. The mower uses this wire along with its sensors to allow the robot to maneuver around while keeping the system on track. The mower will continue to operate as long as then mower has energy, from the sun. The robot is equipped with a flexible bumper that when activated backs the mower up and continues the robot on a different path. It has the advantage of cutting crop in the form of a mulch so that the use of a crop catcher or raking is not required.

Vicky Jain, Sagar Patil, Prashant Bagane, Prof. Mrs. S. S. Patil

Solar Based Wireless Crop Cutter, International Journal of Science Technology and Engineering, Vol. 2, 2016, 576-580. They have prepared wireless crop cutter. They have used solar panel so it is not required to charge battery externally and battery is continuously charged at constant voltage when crop cutter is in working. The battery is getting charged by using day light and we can use it as per our convenience . Because of two DC motor both forward and backward motion of crop cutter can simultaneously possible.

Ashish Kumar Chaudhari, Yuvraj Sahu Prabhat Kumar Dwivedi, Harsh Jain Reference Book

Experimental Study of Solar Power CropCutter Robot, , International Journal of Advance Research and Innovative Ideas in Education, Vol. 2, 2016, 68-73. In this paper author explained that solar plate which is placed above the crop cutter generates solar energy and use this energy for working the crop cutter. Also, using driver circuit for controlling speed of motor as per the requirement. For preventing battery from overcharging and over discharging regulator is placed into the system and it should be placed in series. They have provided LCD display unit which displays voltage generated during solar rays trapping. Due to seasonal conditions if battery is not charged they can provide the power bank to charge the battery instantly.

Praful Ulhe, Manish D. Inwate, Fried D.Wankhede, Krushnkumar S. Dhakte

Modification of Solar Crop Cutting Machine, International Journal for Innovative Research in Science & Technology, Vol. 2, 2016, 711-714 In this paper they have prepared manually operated crop cutter with spiral roller blades due to spiral blades increases the efficiency of cutting. For adjusting the height reel cutter is component placed on crop cutter. The battery can be charged during working conditions and it also having AC charging. For collection of cut crop a box is placed over crop cutter so the cut crop put outside the lawn. It is having light in weight and compact in design.

T. Karthick, S. Lingadurai, K. Muthusvelan, M. Muthuvanesh, C. Pravin Tamilselvan

Crop Cutting Machine Using Solar Energy, International Journal of Research in Mechanical, Mechatronics and Automobile Engineering, Vol. 2, 2016, 1-5. In this paper author fabricated crop cutting machine with rotary blades by using solar energy. The solar energy is trapped in the photovoltaic cell to generate electricity. The cells may be grouped in the form of panels or arrays. Solar panel is placed such that to absorb high intensity from sun and it will incline at 45°. The main function of solar charger is increased current during batteries are charging and also disconnect when they are fully charged. By considering ground clearance they can adjust the height of grass.

5. Proposed System

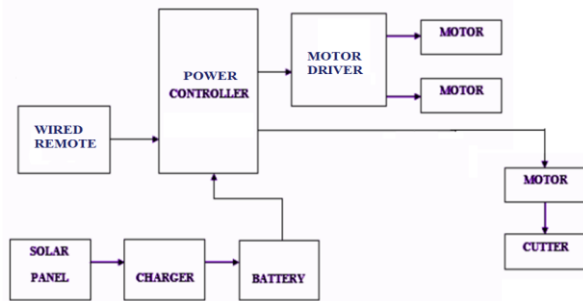


Fig. 1. Block Diagram of system

6. Working Principle

Coming to the working of solar powered cropputter, it has panels mounted in a particular arrangement at an angle in such a way that it can receive solar radiation with high intensity easily from the sun. These solar panels convert solar energy into electrical energy as studied earlier. Now this electrical energy is stored in batteries by using a solar charger. The main function of the solar charger is to increase the current from the panels while batteries are charging, it also disconnects the solar panels from the batteries when they are fully charged and also connects to the panels when the charging in batteries is low. The motor is connected to the batteries through connecting wires. Between these two motor driver is provided. It starts and stops the working of the motor.

The lawn mower is made up by DC motor, battery and blades. Speed of blade shaft is increased by an arrangement of a speed multiplication pulley system mounted on a steel platform. At once only one thing can work Charging battery or Motor. The DC motor forms the heart of machine and provide the Power to blade To cut the grass. This is achieved by the combined effect of mechanical action of cutting blade and forward thrust of mower. The system is powered by an electrical switch which completes the circuit comprising the DC motor and battery. we have made frame with three wheels, 2 In back and 1 front, front wheel will give direction to mower from handle.

From this motor, the power transmits to the mechanism and this makes the blade to rotate with high speed and this makes to cut the crop. Solar panel receives

solar energy from the sun and it converts solar energy into electrical energy by photovoltaic principle. Electrical energy is then stored in the battery. The battery used here is rechargeable battery; the vehicle can be powered on either by using solar energy or by using external power supply.

7. Working Flow Chart

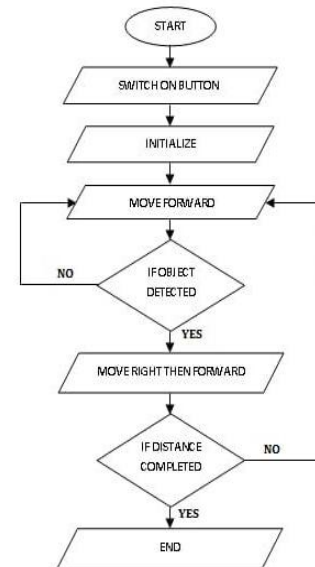


Fig. 2. Working flow chart

8. Selection of Materials

• Selection of Electric Motor

For smooth crop cutting, a motor power of not less than 628.3W (0.84hp) having a rotational speed of not less than 3,000 rev/min and producing a shear force of about 10.5 N is recommended. However, due to non availability of wide range of DC motors in the market, a 1¼ hp (932.5 W) having a rotational speed of 2,500 rev/min was used. Though this gives a sufficient torque with a high cutting force, using an average blade radius of 210 mm, the speed is still not sufficient enough for easy crop cutting.

• Mounting the motor

When mounting the motor to the mower deck the most important thing was to make sure it was centered and properly secured. I made sure it was centered by measuring an equal distance from the sides of the motor to the outside diameter of the mower. I secured the motor to the deck with welding joint on specific height from the surface. It is mounted below the frame so it is not seen from the top.

This method of battery mounting is working out well. I have had no issues.

• Mounting the blade

Mounting the blade is very difficult task for us but we tried so many ways after so many ways we choose one way to mount blade on motor shaft. we mount blade on motor with welding.

- **Mounting the battery**

Once the motor was mounted I needed to find a place for the battery to sit. As I mentioned in the mounting the motor section, the base of the motor was facing the rear of the mower and would provide a solid mounting surface for the battery mount. To get the proper weight distribution I wanted to mount the battery as close as I could to the back wheels. This would allow the handle bars to serve as a lever and allow the mower to easily pivot when on its back wheels.

Using a piece of stainless steel I purchased from a local scrap yard I fabricated the battery mount. I started by placing the battery in the center of the square piece of stainless steel. Then I marked the outline of the battery on to the steel. Next I cut the corners to allow the sides that extend beyond the battery to be folded up. After folding up all four sides I welded them together for support. The battery fits tightly into the mount so no excess strapping is needed.

- **Mechanical arrangement**

In the first phase we just considered only about the mechanical arrangements, which is responsible for rotating the dynamo. For this the team members divided the work into two divisions. The mechanical arrangement consisting of

- External framework
- Solar frame

- **External Framework**

The external frame work is having 20/15 inches .There are four pairs of cylindrical hollow pipes are welded as pillars, which will give the support for the surface of the platform.

- **Solar framework**

The solar frame having the iron cylindrical hollow pipes are welded in square shape which is used to carry the solar panel. The solar panel is 5watts which is connected to the battery.

9. Calculation

Torque Calculation For Wheel Motor

Rating of the Battery: 12 Volt, 12 Ah

Power produced: $12 \times 12 = 144$ Wh

Speed of the motor: 45 rpm

Torque of motor:

$$P = [2\pi NT]/60$$

$$144 = [(2\pi) \times 45 \times T]/60$$

$$T = 30.557 \text{ Nm}$$

For 2 wheels, $T = 15.2788 \text{ Nm}$

Hence the efficient torque is produced than the rated torque of the motor.

Torque Calculation For Cutter Blades

Rating of the battery: 12 Volt, 12 Ah

Power of the battery: 144 Wh

Speed of the Motor: 7000rpm

Torque produced:

$$P = [2\pi NT]/60$$

$$144 = [(2\pi) \times 7000 \times T]/60$$

$$T = 0.19644 \text{ Nm}$$

$$T = T_1 = T_2$$

Hence the efficient torque is produced than the rated torque of the motor.

Force Produced In Cutter Blades

As we all know that,

$$\text{Torque} = \text{Force} \times \text{Radius}$$

$$0.19644 = \text{Force} \times 0.01$$

$$\text{Force} = [0.19644]/0.01 = 19.644 \text{ N}$$

Hence a force of 19.644 N is produced in the cutter blade which is sufficient enough to cut the grass.

Charging Time For Battery

Solar Panel:

20 watts, 12 volts

$$\text{Power} = \text{Volt} \times \text{Current}$$

$$20 = 12 \times \text{Current}$$

$$\text{Current (I)} = 1.6667 \text{ A}$$

$$\text{Charging Time} = 12 \text{ Ah} / 1.6667 = 7.2$$

$$\text{Charging Time} = 7 \text{ Hours } 12 \text{ Minutes}$$

Battery Life

$$\frac{\text{Battery Capacity} \times 60 \times \text{Power}}$$

$$\text{Battery Life} = \frac{\text{Current} \times \text{Voltage}}$$

$$\frac{12 \times 60 \times 144}{1.667 \times 12}$$

$$\text{Battery Life} =$$

$$\text{Battery Life} = 5182.9634 \text{ sec}$$

$$\text{Battery Life} = 1 \text{ Hour } 26 \text{ Minutes}$$

8. Advantages

- a) Compact size and portable.
- b) Manmade pollution.
- c) Robotic operation.
- d) Automatic obstacle detection.
- e) Operating principle.
- f) Is simple.
- g) No wear and tear losses.
- h) No maintenance cost.
- i) No skilled persons are required.

9. Application

- i) For cricket ground.
- ii) For football ground.
- iii) Lawn mover.
- iv) Small farm.

10. Result & Description

Our project entitled "solar powered crop cutting robot" is successfully completed and the results obtained are satisfactory. It will be easier for the people who are going to take the project for the further modifications. This project is more suitable for a common man as it is having much more advantages i.e. no fuel cost, no pollution and no fuel residue, less wear and tear because of less number of moving components

and this can be operated by using solar energy. This will give much less physical exertion to the people and can be easily handled. This system has the facility of charging the batteries while the solar powered crop cutter is in motion. So, it is much more suitable for crop cutting also. The same thing can be operated in night time also, as there is a facility to charge these batteries in day light. By Switching the Motors Rotating In Forward direction and the Crop Cutting Motor Activates, The Blade Which Is Fine-tuned To The Crop Cutting Motor Cut The Grass,

10. Conclusion

Our project entitled Manufacturing of solar powered crop cutter is successfully completed and the results obtained are satisfactory. It will be easier for the people who are going to take the project for the further modifications. This project is more suitable for a common man as it is having much more advantages i.e., no fuel cost, no pollution and no fuel residue, less wear and tear because of less number of moving components and this can be operated by using solar energy. This will give much more physical exercise to the people and can be easily handled. This system is having facility of charging the batteries while the solar powered crop cutter is in motion. So it is much more suitable for crop cutting also. The same thing can be operated in night time also, as there is a facility to charge these batteries in day light.

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