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Design And Fabrication of Solar Operated Multifunction Grass Cutter

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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. Proposed System

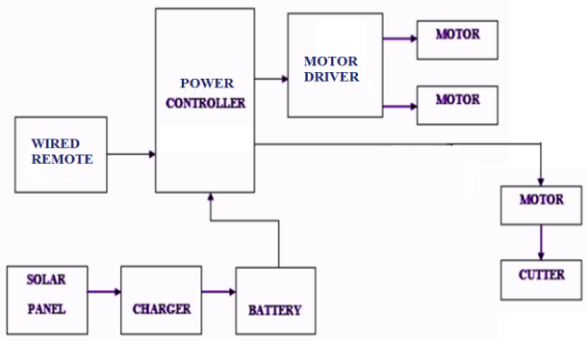

Fig. 1. Block Diagram of system

4. Working Principle

Coming to the working of solar powered cropcutter, 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 cropSolar 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.

5. Working Flow Chart

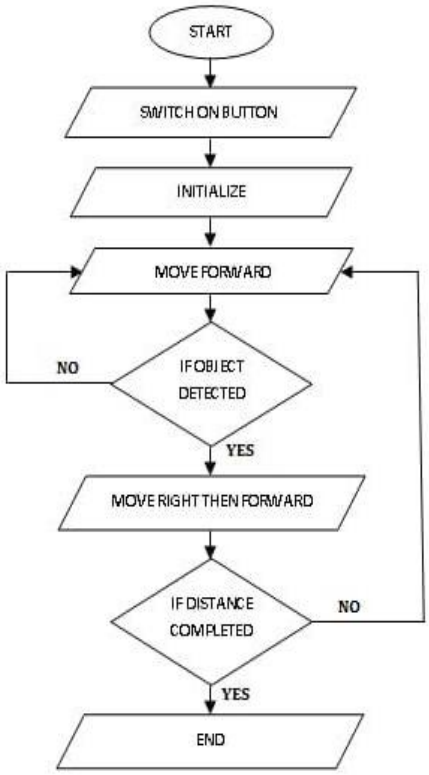

Fig. 2. Working flow chart

6. 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.

7. Calculation

Torque Calculation For Wheel Motor
Rating of the Battery: 12 Volt, 12 Ah
Power produced: 12 X 12 = 144 Wh
Speed of the motor: 45 rpm
Torque of motor:
P = [2πNT]/60
144 = [(2π) x 45 x T]/60
T = 30.557 Nm
For 2 wheels, T = 15.2788 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 = [2πNT]/60
144 = [(2π) x 7000 x T]/60
T = 0.19644 Nm
T = T1 = T2
Hence the efficient torque is produced than the rated torque of the motor.

Force Produced In Cutter Blades
As we all know that,
Torque = Force x Radius
0.19644 = Force x 0.01
Force = [0.19644]/0.01 = 19.644 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
Power = Volt x Current
20 = 12 x Current
Current (I) = 1.6667 A
Charging Time = 12 Ah / 1.6667 = 7.2
Charging Time = 7 Hours 12 Minutes

Battery Life

$$\text{Battery Life} = \frac{Battery\ Capacity\ x\ 60\ x\ Power}{Current\ x\ Voltage}$$

$$\text{Battery Life} = \frac{12\ x\ 60\ x\ 144}{1.667\ x\ 12}$$

Battery Life = 5182.9634 sec
Battery Life = 1 Hour 26 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,

Project Image

Fig. 3. Project Model

8. 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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