Proceedings of the
International Conference on Mechanical Engineering and Renewable Energy 2017
(ICMERE2017) 18 – 20 December, 2017, Chittagong, Bangladesh

ICMERE2017-PI-376

DESIGN AND FABRICATION OF A SOLAR POWERED LAWN MOWER

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Abstract- *This project is proposing an effective goal for developing a machine that will perform useful task independently with minimal supervision. The objective of this project is to discover the current issues in implementing the design of a solar powered lawn mower used to cut grass in house gardens, and fields with a specified area. It has achieved by doing research on current issues in designing the mechanism with electronic control circuitry. The simplicity of making this automated lawn mower has made it very versatile and flexible. The main objective of this solar powered lawn cutter is to cut grass using solar power or by using battery power which is stored by using solar panel. It is also very useful for low cost of fabrication and maintenance.*

Keywords: Solar power, Automation, Lawn mower

1. INTRODUCTION

In this modern age, pollution is great problem. And using fuel and gas is the main culprit of this pollution. To get rid from this pollution electric powered lawn mower has introduced. And here we want to introduce a new and friendly design of lawn cutter for environment. And this is solar powered lawn mower. [1]

It is easy to use solar power for charging and operating the mower. The main feature of this project is to cut grass by using solar power and the proper use of renewable energy. The design contains solar charging system, DC motor etc. it will help the consumer from mowing their own lawns and also reduce noise and environment pollution.

By the research and information we know that there are many kinds of lawn mower which are existing like: rotary type, riding type, self-propelled, hover, hydrogen powered etc. but here we propose an alternative solar powered lawn mower which will use solar energy during the availability of sun and uses battery power during the absence of sun at the time of cloudy environment or at night.

Here we design "Alternative Solar powered Lawn cutter' in which a solar charging battery is used, which is the main objective of our lawn cutter, also uses 2 DC motor of 12V each and for cutting we use 12V and high torque DC motor.The specific objective of this project is to develop a solar powered lawn mower which would be able to help users in cutting the grass in gardens. The mower will be able to cover a specific area of flat

land by avoiding any obstacle along the way. It was also considered that it should be moderately cheap and easy to implement with the help of the solar power and normal DC charging battery power.

We design the solar powered lawn mower by using solar power. A battery will be used for both rotating the blade cutter and 2 wheel within a shaft. It will be a 3 wheeler machine and the front wheel will be revolving. And the blade cutter will be protected by two additional protector.

2. DESIGN & FABRICATION

We will design the alternative solar powered lawn mower by using solar charging system and DC battery for alternative use in case of absence of sun. Solar power will be used for running wheel and rotating motor for the blade cutter and a motor shaft coupling. It will be a 3 wheeler machine and the front wheel will be revolving. And the blade cutter will be protected by two additional protector. The cutter will be lifted for better cutting by a certain desired limit. It will be an alternative solar powered machine for cutting grass and that is the reason for such name.

2.1 Components:

We used the following components to fabricate this solar powered lawn mower.

1. 3 DC motors (2 gear motor)
2. Solar Panel
3. Chassis
4. Charge Controller
5. Motor shaft gear mechanism
6. 2 rear wheels
7. 1 revolving wheel (front wheel)
8. Blades
9. Battery
10. Safety Protector, etc.

2.1.1 DC Motor

A DC motor shown in figure 1 converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motor have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. Generally it is a device which converts DC electrical energy to the mechanical force. The current carrying conductor experiences a mechanical force when it is placed in a magnetic field. Self-excited machines are further classified into series, shunt, and compound DC motors.

Fig. 1 DC Motor (12 V, 8.75 rpm)

2.1.2 Chassis

Chassis as shown in figure 2 is the main structure or frame where the total body will be situated. All the motors, shaft, charger controller, solar panel, gear mechanism, wheels, battery, blades and all other apparatus will be set up in this chassis. It is a wooden structure which will carry the total load and stress. Its length: 20 inches, width: 10 inches, height : 0.5 inch.

Fig. 2 Chassis of the lawn ower

2.1.3 Motor-Shaft Gear Mechanism

A motor converts electrical energy into mechanical movement. A given motor is capable of providing a certain maximum amount of torque. And we can use gears to change the amount of torque supplied by a motor. (Inevitably the speed at which the output shaft spins will change as well.). Finally the shaft transmit power from motor to gear and its main objective is power transmission as shown in figure 3 [3].

Fig. 3 Motor-shaft gear mechanism

2.1.4 Solar Panel

A solar panel is a set of solar photovoltaic module electrically connected as shown in figure 4. A photovoltaic module is packaged, connected assembly of solar cells. The solar panel can be used as component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Each module is rated by its dc output power under standard test conditions and typically ranges from 100 to 320 watts. A single solar module can produce only a limited amount of power, most installations contain multiple modules.

Fig. 4: Solar panel (Model: TBP 1210M, 17V, 0.6 A)

2.1.5 Blades

A blade is that portion of a tool, weapon or machine with an edge that is designed to cut materials. The blade is seldom sharp enough to give a neat cutting; the blade simply tears the grass resulting in brown tips. However the horizontal blades are easy to remove and sharpen or replacing existing trimmer suffers from high power consumption. Here we use rotating blade. It is at the centre of the chassis. The cutting blade is shown in figure 5.

Fig. 5 Cutting blade for lawn mower

2.1.6 Rear Wheel and Revolving Wheel

Rear wheels are places at the rear of the vehicle. In contrast to the RMR layout, the centre of mass of the engine is between the rear axle and the rear bumper. On the other hand revolving wheel is such kind of wheel that can rotate in 360 degree and it is both rotating and revolving. Rear wheel and revolving wheel arrangement is shown in figure 6.

Fig. 6 Rear wheel & revolving wheel

2.1.7 Solar Charge Controller

A solar charge controller (as shown in figure 7) manages the power going into the battery bank from the solar array. It ensures the deep cycle batteries are not overcharged during the day, and that the power doesn't run backwards to the solar panels overnight and drain the batteries. Some charge controllers are available with additional capabilities like lighting and load control but managing the power is its primary job. It is available in two different technologies: PWM and MPPT [4].

Fig. 7 Solar charge controller

2.1.8 Battery

To ensure flow of electricity when the sun is not shinning, it is necessary to store some of the energy produced. The most obvious solution is to use batteries, which chemically store electric energy. Batteries that are re-chargeable are called secondary or accumulator batteries. Each cell in a lead-acid battery has a voltage of about 2.0 volts; therefore a 12 volt battery has 6 cells connected in series. The lead-acid battery operates on the basis of chemical reactions[5].

←charging

$$Pb + PbO_2 + 2\,H_2SO_4 \leftrightarrow 2\,PbSO_4 + 2\,H_2O$$

discharging→

Fig. 8 Battery used in lawn mower.

2.2 Model of the lawn mower

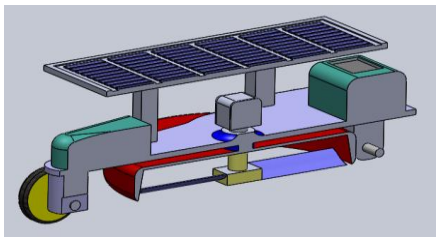

Fig. 9 Cross sectional view of the model

Here we illustrate the final design of the mower by Solid works CAD designing.

3. WORKING PRINCIPLE

This alternative solar lawn mower uses solar power or DC current from rechargeable battery to run and cut grass. The two rear wheels are connected to the power and wheels are rotated by two high torque gear motor. Blade is connected to another DC motor which has high rpm. When one wheel is stooped while another wheel is rotating, it turns the revolving wheel to make turn the whole chassis. Example: when left wheel becomes stopped right wheel started moving the total body turns into left side and vice versa. It can operates in two ways: when sun available it operates by direct solar power from solar panel and in the absence

of sun it will operated by battery volt which is stored by solar charging. And this machine will be controlled by a simple on off remote controlled system.

3.1 Load calculation

$$P=VI$$

Here,

P= load (Power)

V=Voltage

I= Current

1. for each motor: P= 12×1.5=18 W

So, total load= 18+18+18=54 W

3.2 Battery capacity

How long a battery will last at a given rate of discharge is as simple as amp-hours: for given capacity C and discharge current I, time will be:

$$t = C / I$$

However, battery capacity decreases as the rate of discharge increases[6].

3.3 Battery charging rate by solar power

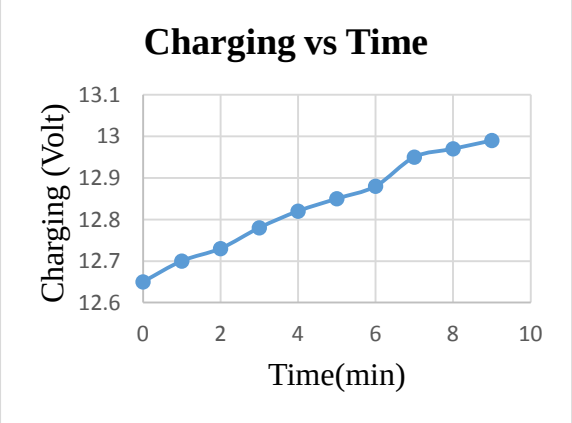

Fig. 10 Charging vs. Time graph

4. RESULT AND DISCUSSION

4.1 Result

 Total load = 54 W

 Battery charging rate by solar charging = 0.03 V/min

4.2 Discussion

From the received data during the tests it has been seen that the total machine consumes a little amount of power which is so effective and cost saving. The discharge rate is so adequate and small in value on the other hand charging capacity is remarkable and is too fast along the requirement. There is no noise during grass cutting and rotating the machine. A little problem arise there and that is the low rpm of rear wheel though it has a benefit also and for the low rpm the machine move slowly but cut the grass smoothly.

4.3 Further work

In future, further modification can be done so that the cutting height and speed can be developed with the necessity. It can be also developed as auto directional lawn mower by using microcontroller. Besides the rear wheel rpm, blade motor rpm, solar etc can be developed as required. For direct use it can be operated by using AC current also by further modification. By advance modification this lawn mower can detect obstacle and mow the total land by itself without human being.

5. CONCLUTION

This lawn mower will meet the challenge of environmental pollution and low cost of operation since there is no cost for fuelling. A lawn mower has been developed for the use of residences and establishments that have lawns where tractor driven mowers could not be used. The machine's capacity is adequate for its purpose. This system is having facility of

charging the batteries while the solar powered grass cutter is in motion. So it is much more suitable for grass cutting also. The same thing can be operated in night time also, as there is a facility to charge these batteries in day light. The frame which we use doesn't have height adjustment. This can be overcome by keeping wheels arrangement near the blades. Overall from this project it is demonstrated that an economic alternative solar powered lawn mower can be produced using a solar panel, charge controller, motors, blade cutter and battery.

6. REFERENCES

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