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Design and Fabrication of Simple Solar Grass cutter

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ABSTRACT

In the recent years weed cutter machines are quite common in agriculture field and for lawn maintenance. The grass cutters were operating with IC Engine will use gasoline. The gasoline operated engines will generate harmful emissions which pollute the environment. Also the constant rise in fuel prices and the impact of gas emissions from burned fuel into the atmosphere make it necessary to use the sun's plentiful solar energy as a source of power to operate a grass cutter. Accordingly with the use of abundantly available solar energy it is attempted to make a "Simple Solar Grass Cutter". The fabricated grass cutter involves a solar panel, stainless steel blade, D.C motor, battery, and control switch. The control switch provided on the solar-powered lawnmower closes the circuit and permits current to pass to the motor, which drives the blade. The battery is chargeable and charged continuously by solar energy.

Keywords: Solar grass cutter, Solar Panel, Control switch

I. INTRODUCTION

Today's pollution is a serious problem for the entire world. Man-made pollution is present in our homes. Gas-powered lawn mowers are guilty of causing pollution because they emit gases. Additionally, it is inefficient due to rising fuel prices. Consequently, solar-powered lawn mowers are introduced. The use of solar energy to drive an electric motor, which in turn moves a blade, is what is referred to as a solar-powered lawn mower. However, those grass cutters which operate with engine are expensive. This design serves as an alternative to the harmful gas-powered lawnmower. Solar energy is a type of renewable energy source that can be either passive or active. Essentially, solar energy is a free energy source that is simple to use. Then, a solar-powered lawn mower will be manually controlled using this free solar energy. The blades are rotated by a motor for the purpose of cutting the grass. Since no fuel or wire extensions are required for the power supply, the project is pollution-free and environmentally safe. The conditions in India are taken into account in all of the assumptions and decisions made in the design of this project.

1.1 Problem Statement

The solar lawn mower is considered after the effectiveness of others felt insufficient due to the following factors:

1 Pollution is there due to the use of grass cutter working on IC engine.

2 Grass cutters working on electricity are efficient but it also increases electricity consumption.
3 More time is required to accomplish the work.
4 Human effort required is more.
5 There are many safety issues regarding grass cutters such as obstruction in the way of the cutter can cause damage to the blades of the cutter or it can cause the obstructions such as stones to fly and cause harm to the operator.
6 There is a probability that it could not be used during rain or in wet conditions.

1.2 Objectives

The objectives of this lawn mower are created to solve the problems which existing lawn mowers have, is as follows.

1 To design a lawn mower operating on solar energy.
2 To reduce operating cost.
3 To avoid any damage to operator and the lawn mower itself.
4 To keep the environment clean and healthy.
5 To cut various type of grasses with precision.

The current technology available in the market are too expensive, they can't be used in domestic applications, so the end product need to be economic in price for it to be used on a large scale.

In India the type of grass usually found are the "Ravenna Grass (Saccharum Ravennae)" our main objective is also to cut the grass properly, therefore proper blade design is also necessary for the lawn mower. Elephant grass is also one of the most found grasses in India, they are big in length but have a thin structure, so they must be taken in consideration while designing the lawn mower [4].

1.3 Methodology

Solar powered grass cutter has solar panels mounted on it in such a way that we can utilize the solar radiation coming from the sun with high intensity. This solar energy is then converted into electrical energy which is then stored in rechargeable battery. The battery supply power to D.C motor which drives the blades.

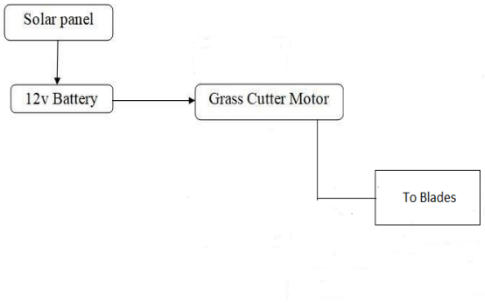

Figure 1: Block diagram of solar grass cutter.

II. DESIGN OF SLOAR GRASS CUTTER

Solar powered grass cutter has solar panels mounted on it in such a way that we can utilize the solar radiation coming from the sun with high intensity. This solar energy is then converted into electrical energy which is then stored in rechargeable battery. The battery runs the D.C motor so that the blades rotate in clockwise direction in a rated speed. In between the battery and motor a switch is provided to control the operation.

2.1 Battery

Normally there are non rechargeable and chargeable batteries. From button-sized cells to massive industrial systems, rechargeable batteries are available in a wide range of dimensions. Rechargeable batteries have a lower overall cost of use and far less environmental impact than their disposable counterparts, which are their key advantages. Although they are initially more expensive than disposable batteries of the same size, their multiple recharge ability reduces their overall cost over time.

Lead-Acid batteries are by far the most economical for larger power applications, as long as weight is of little concern. These batteries have been around since the mid-1800s because they are durable and provide dependable service. The only maintenance requirements are keeping them from discharging too far and there is no memory effect to deal with.

Figure 2: Lead acid battery.

By far the most common application of these batteries are with vehicles for starting engines, as they are heavy enough that the weight is not of much importance. They are also popular in larger energy applications that require constant current, such as golf carts and solar power storage. They are very cheap and available nearly everywhere.

2.2 Grass Cutting Blade

The cutting blade is made up of stainless steel to prevent the rusting and for durability. There are three blades fixed over a disc. And the disc is fitted directly to the motor shaft. The cutting blade arrangement is as shown in figure 3.

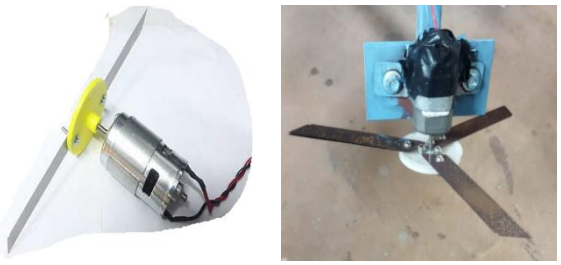

Figure 3: Stainless steel blade setup.

2.3 Motor operating the Cutting Blade

D C Motor is the heart of Simple Grass Cutter. When electric energy is actuated from the control switch the motor starts to rotate in clockwise rotation at a rated speed of 1500 to 2000rpm. In DC Motor electrical energy is being converted into mechanical energy. The principle of working of motor is whenever a current carrying conductor is placed in magnetic field it attains rotational effect. The schematic representation of construction and working principle is shown in figure 4.

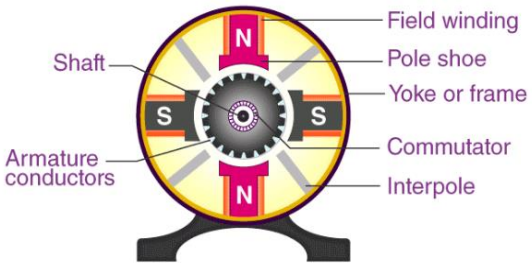

Figure 4: Construction of D C motor.

24V 775 DC Motor:

This motor runs at 5000-12000 rpm, this is more preferable compared to 24v DC motor whose rpm goes above 20000 rpm. Current required by the motor is 2.3 amps and weight is 150.00g. This motor has high torque and high power which is required for this project.

Figure 5: DC motor

Power developed by the motor:
P = V*I = 24*2.3
P = 55.2 watts
Torque developed by the Motor:
P = 2ΠNT/60
55.2 = 2*Π*10000*T/60
So, T = 18.97 N-M.

Torque developed by the Motor:

This application requires high torque low speed 12v DC motor. This motor has a rpm of 300.Current required is 0.3amp. Number of motor used are 4 and each motor is for separate wheel, a total of 1.2 amp current will be used.

Power developed by 4 motors:
P = V*I = 12*1.2
P = 14.4 watts
Torque developed by 4 motors:
P = 2ΠNT/60

14.4 = 2*Π*300*T/60
So, T = 0.45 N-M.

2.4 Solar Panel

Figure 6: Solar panel.

A solar panel of size 1 foot ×1.5 feet is used to generate the electric power required to drive the solar grass cutter blade motor. Solar panel capacity of 12 Volt and 10 Watt poly-crystalline panel is used in our project.

2.5 Wheels

The main frame is fitted with four wheels it carries the self wait of the entire assembly. Also it helps to move the grass cutter wherever required to trim the lawn.

Figure 7: Wheel of grass cutter frame.

2.6 Switch

The power which is received from the solar panel is stored in the battery. A DC motor is directly connected to the blade. The controlling of the grass cutter blade is achieved by the control switch placed between the battery and blade circuit.

Figure 8: Control switches to on or off the cutting blade operation.

III. MATERIAL SELECTION AND FABRICATION

Material selection is done on the basis of:

1. Availability of material.
2. Required properties of the material.
3. Weldable material.
4. Cost efficient material.

3.1 Material Selection of Blades

The blades of the Lawn Mower is to be made by using Stainless Steel, as the grass which blade will be cutting will not always be dry, so as we cut the wet grass there are chances for corrosion. Stainless Steel is the alloy of iron and carbon with 2% C which has non-corrosive properties. The stainless steel considered for this project is of grade X14CrMoS17, this steel is also known as “ASTM A276 / AISI 430F”.

3.2 Material Selection of Frame

The frame of the Lawn mower will be made of grey cast iron and will be welded at the joints. Grey cast iron is the alloy of iron and composes of 2-4% carbon with the presence of silicon and manganese. Grey cast iron used in the frame is of grade ASTM A48 CLASS 20. It is more effective because it can be easily machined and manufactured and it is easily available. MIG welding will be preferred for joining all the joints of the Lawn Mower.

Figure 9: Fabricated frame.

3.3 Fabrication

In this research fabrication work is the building of solar grass cutter from the scratch. Building each part individually and assembling or welding it together is the major goal of our project. Fabrication is the most significant step following the literature survey and designing. The simple solar grass cutter fabricated is shown below.

Fig. 10 Simple solar grass cutter.

IV.CONCLUSION

All machines in the modern world are made with the intention of lowering or eliminating the biggest contributors to climate change, greenhouse gas emissions. The problem of environmentally friendly production and low operating costs will be met by this solar-powered lawn mower since fuel is not required. For its intended use, the machine's capacity is sufficient. The device has shown promise as a potential substitute for the gasoline-powered grass cutter.

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