

Design and Fabrication of Solar Powered Lawn Mower

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Abstract--Due to rise in global warming and need for energy the world is looking forward for using the available inexhaustible sources of energy. Converting the available source of solar energy into useful form of energy can be a good start in this context. So therefore we are developing a solar powered lawn mower to convert solar energy into electric energy which can be converted into mechanical energy needed for cutting grass. We can easily perform this task by just using photovoltaic effect. This is a clean source of energy and free as well thus replacing the conventional fuel powered lawn mower.

Index Terms- - Solar Panel, Charge Controller, DC Motor, Battery.

1. INTRODUCTION

With the world moving towards development energy becomes a major factor. Thus giving utmost importance to its sources. Therefore the countries are looking forward for developing alternative sources of energy which are renewable thus making them comparatively cheaper. The decline of fuel has also lead the world to take major steps in this direction. The solar energy is one of the most important renewable source of energy available to man. Thus we should use it to its max capacity thereby ensuring progress and survival of human beings. Thus we are developing a solar powered lawn mower to make use of this available solar energy. The average amount of energy incident on earth is 164W per square meter over a 24 hour day. We can easily convert this available solar energy into electric energy by using the photovoltaic effect. The word "photo" comes from Greek word for light and "voltaic" is reference to Alessandro Volta.

The fuel powered lawn mowers today available in the market are very expensive and the constant need for refueling them does not make them any cheaper as well. The constant maintenance of this lawn mower is also a troubling factor. These lawn mowers are not environment friendly as we all know. All these are important factors considering the rise of global warming in the world. The electric lawn mowers are good replacement for fuel powered lawn mowers but they can be made better by using a renewable energy source. As electricity is made from an exhaustible source. The electric lawn mower also lack maneuverability due to the cords attached to it.

The frame of the lawn mower is made up of mild steel which makes it sturdy and robust. The solar energy is made incident on the solar panel which is made up of solar cells which traps the solar energy incident on it and converts it into electric energy using photovoltaic effect. This is connected to the charge controller. The charge controller is basically a device which ensures that there is no overcharging of the battery. It has 3 pairs of connectors each having a positive and negative. One of which is connected to the battery. The second one connected to the solar panel and the third one connected to the load that is the dc motor .

The solar lawn mower ensures a friendly way of cutting grass without polluting the environment thereby ensuring the decline of global warming and a saving the most important non-renewable sources of energy. The maintenance of this mower is also not a huge task only the blade needs to be replaced or sharpened if needed. Thus ensuring an overall efficiency.

2. METHODOLOGY & COMPONENTS

2.1. Rechargeable Battery

The battery is an important component of the circuit which powers the dc motor. There are two types of batteries considered for use namely lithium ion battery and lead acid battery. There are many considerations to be taken into account while selecting the battery. One of the important consideration is the weight of the battery and the space available in the frame. The lead acid battery is much bulkier and heavy as compared to lithium ion battery. The lead acid batteries have certain corrosion issues which have to be taken care of

and their maintenance is an issue as well. But they are very reliable and their overcharging tolerance is also as compared to other batteries. They are comparatively cheaper as well.

2.2. DC motor

A DC motor is class of electrical machines that converts the direct current electrical power into mechanical power. This mechanical energy is transferred to the cutter blade which produces the required torque needed for cutting grass. There are two types of dc motors namely brushed and brushless. In brushed motor torque is developed directly from the dc power supplied whereas in brushless dc motor the motor controller converts dc to ac.

2.3. SOLAR PANEL

Solar panel is basically an equipment which has solar cells attached to it. Its size varies a lot. It can be as small as palm of hand and can be as huge as a door. Its power rating is an important consideration while selecting the solar panel as it determines the time taken to charge the battery. Solar modules use the photons from the sun to generate electricity through photo voltaic effect. The majority of modules use water based crystalline silicon cells or thin film cells based on cadmium telluride or silicon.

3. Method

The solar panel is installed at an angle at the top of the frame. The inclined frame ensures more surface area for the incident photons from the sunlight. The solar cells convert the energy of the incident photons into electrical energy using photo voltaic effect. This electric energy is used to charge the rechargeable battery. The solar panel and the rechargeable battery are connected to each other through the charge controller. The charge controller is basically a device which is used to avoid overcharging of the battery thus, protecting it from damaging . The load i.e. the dc motor is also connected to the battery through the charge controller. This electrical energy is converted into mechanical energy by the dc motor. The dc motor imparts this mechanical energy to the blade to produce torque. This torque is needed to cut the grass. The frame required for the lawn mower is made up of mild steel. Mild steel is selected as it is hard but malleable. Thus it provides the flexibility required for machining the material.

3. CALCULATIONS

The shearing force for most of the perennial grasses is about 9N to 12N.(Chang and Yolo, 1991).

Considering shearing force= 12N
Speed of motor= 3000rpm
Radius of blade=0.1m

As we know, $T = F * r$

Using, Power of motor= $(2 * 3.14 * N * T) / 60$
Power of motor= $(2 * 3.14 * 3000 * 10 * 0.1) / 60$
Power of motor=314.15W

Therefore selecting 350W DC motor.

Calculation for current in battery:

Power of motor= 350W
Voltage= 12V

Using, $P = V * I$
 $350 = 12 * I$

Therefore, $I = 30$ ampere

4. PRINCIPLE

Photovoltaic effect: A solar cell is essential a PN junction with a large surface area. The N type material is kept thin to allow light to pass through to the PN junction. Light travels in packets of energy called photons. The generation of electric current happens inside the depletion zone of PN junction. The depletion region is the area around the PN junction where the electrons from the N-type silicon, have diffused into holes of P-type material. When a photon of light is absorbed by one of these atoms in N type silicon it will dislodge an electron, creating a free electron and a hole. The free electron and hole has sufficient energy to jump out of the depletion zone. If a wire is connected from the cathode (N-type silicon) to the anode (P-type silicon) electrons will flow through the wire. The electron is attracted to the positive charge of the P-type material and travels through the external load (meter) creating a flow of electric current. The hole created by the dislodged electron is attracted to the negative charge of N-type material and migrates to the back electrical contact. As the electron enters the P-type silicon from the back electrical contact it combines with the hole restoring the electrical neutrality.

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