

FABRICATION OF SOLAR GRASS CUTTER

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ABSTRACT

A Solar grass cutter is a machine that uses sliding blades to cut a lawn at an even length. Even more sophisticated devices are there in every field. Power consumption becomes essential for future. Solar grass cutter is a very useful device which is very simple in construction. It is used to maintain and upkeep lawns in gardens, schools, college's etc. We have made some changes in the existing machine to make its application easier at reduced cost. Our main aim in pollution control is attained through this. Unskilled operation can operate easily and maintain the lawn very fine and uniform surface look. Solar grass cutter is used to cut the different grasses for the different application.

In other grass cutter equipment's such as electric lawn there are so many complications like Electricity, Wiring, Efficiency, Eco-friendly etc. So on behalf of these types of equipment's we have made solar power grass cutter which is efficient, less noisy and portable. The basic idea is that we have made grass cutter with electric motor that runs from a 12 volt battery. This battery will be charged using solar panel of 10W. This grass cutter uses a solar based energy source, which is easier to use, more advantageous comparing to other energy

source especially for fuel based source of power .But our grass cutter is based on solar because this energy is a renewable energy source and it is easy to work. So we made solar powered grass cutter.

OBJECTIVES

Automated solar grass cutter is a fully automated grass cutting robotic vehicle powered by solar energy that also avoids obstacles and is capable of fully automated grass cutting without the need of any human interaction. The system uses 12V batteries to power the vehicle movement motors as well as the grass cutter motor. We also use a solar panel to charge the battery so that there is no need of charging it externally.

The main objectives are given as below,

- To reduce consumption of fossil fuels by using solar power.
- The devices will be controlled by android application.
- It helps to reduce human efforts for cutting grass.
- This project gives accuracy for grass cutting.
- This project has very less cost.

DESIGN IDENTIFICATION

To design a Smart Solar Grass Cutter, some parameters need to be considered such as the components to be used in the project, the position of the components, the structure of the main body, the advantages and disadvantages of the design and the safety factors. The Smart Solar Grass Cutter is able to operate autonomously or non-autonomously. Other than that, the important factor is the efficiency. The materials and components selections including the positions are crucial to achieve a better efficiency. This Smart Solar Grass Cutter is a simple design which is optimizing the usage of materials. The overall dimensions are depending on the size or the dimensions of the solar panel.

WORKING PRINCIPLE

The working principle of solar grass cutter is it has panels mounted in a particular arrangement at an 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. This electrical energy is stored in battery directly from the sun. The main function of the rechargeable battery is to increase the current from the panels while the battery is 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. 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 grass.

The designed solar powered lawn mower comprises of direct current (D.C motor), a rechargeable battery, solar panel, a stainless steel blade and control switch. Rotation is achieved by the electrical motor which provides the required torque needed to drive the stainless steel blade which is coupled to the shaft to the motor.

Intelligent information appliance is the main direction of development in the appliance control at irrigation fields. We designed a broad and commendable range of Solar Grass Cutter along with solar panel. As the energy conversation is very important in the current scenario and should be done to a maximum extent where ever it is possible. Still, these mowers grass cutting machineries all need the same things to work right -- a motor, a rotating blade, a means of getting around and a way to get rid of the grass clippings.

The controlling device of the whole system is provided using switch ON the DC motor interfaced with grass cutting blades. The entire model consists of two sections one controlling section and another designing section of the model. The controlling section consists of Rechargeable battery, relays switches and Solar panel. The system depending on the charging circuit the motor can be controlled using relay switch. The solar power stores the energy to a battery and then runs the motor through the relay switch.

WORKING OF SOLAR POWERED GRASS CUTTER:

Coming to the working of solar powered grass cutter, the panels are mounted on a play wood 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 directly.

The main function of the battery is to increase the current from the panels while battery is 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. 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 grass. Several design factors should be taken into account for the economical and efficient development of a solar lawn mower. These are considerations that should be put in place during the fabrication process so as to ensure optimal productivity of the machine. Listed below are the design considerations:

- The blade shape.
- Materials consideration of the blade.
- The r.p.m consideration.
- The area of the blade consideration

Considering the design for the proposed lawn mower, the blade to be used is a flat shaped blade. They are generally referred to as standard blades are used to easy to cut the grass. Other blade shapes like tapered blade and sickle bar blade can also be used for the mower, but flat blade is

preferred for this project because of its mass which is suitable considering the size and weight of the machine and speed of the motor. Tapered and sickle bar blades have higher cutting pressure but relatively low mass. The shaft rotating the blade has a high mass so the blade has to have a relative high mass to prevent the blade from wobbling. The material to be used for the desired flat blade is stainless steel. Stainless steel has strength and weight that can transmit the same speed as that of the motor which makes it suitable considering the size of the shaft rotating the blade. Stainless steel and angle bar iron can also be used for the blade construction due to their durability and long life span. But stainless steel is preferred mainly because of strength and its high resistance to corrosion.

Solar energy is a time dependent energy that occurs at irregular intervals. Therefore energy has to be stored so it can be readily available for use when there is no further supply of the sun energy. The solar panel (or photovoltaic cell) harnesses the solar energy when the sun is available during the day. The sun produces constant amount of energy with a solar radiation intensity of about $6.33 \times 10^7 \text{ W/m}^2$ at the surface of the sun. Photovoltaic modules and arrays produce direct-current (DC) electricity and current combination. Solar photovoltaic cells are essentially semi-conductors, which have electrical transmission properties like metal or salt water and insulators like rubber. Solar panels are constructed with sheets of doped silicon, primary element in beach sand with impurities added like phosphorus

that allows the flow of electron. To charge the battery, a solar panel is expected to tap the solar energy from the sun and convert it to electric energy that will be put away in the battery connected to it. At the point when the protons from the sunlight based energy hit a photovoltaic cell, a progression of electrons begins which can be drawn off by a connected wires, this generates direct current.

COMPONENTS

➤ Solar panel

SPECIFICATION OF SOLAR PANEL:

Operating Voltage: 4V,

Working Current: 100mA,

Dimensions: 70 x 70MM

The solar panel to be used for the solar lawn mower is a 12V, 100Watts panel which consists of 24 high efficiency solar cells resulting to high efficiency per spaces. There solar panels consist of three basic types; monocrystalline, polycrystalline and amorphous solar cells. For the development of this project monocrystalline is used because it is more space efficient as it consists of lesser silicon crystals. The maximum output voltage produced by a silicon cell is approximately 0.5Volts when there is bright sunlight. Solar panels need direct sunlight to produce greater solar output. Although in situations whereby the weather is cloudy, the solar panel can absorb solar energy but the rate will be

significantly reduced to about 25 to 40% when compared to sunny days.. Peak sun hours per day are approximately 4.86hours. Considering the power and voltage of the solar panel, the following calculations were made;

Power = 100W

Voltage = 4V

Current draw of the solar panel =
power/voltage (3.1)

= 100/4 =

25Ah

From this derivation, it shows that the solar panel will give 100 amps of current



➤ Batteries

Batteries are available in different voltages and ampere hour range. To



determine the battery selection, consideration was given to the rating of the voltage and current. Since the solar panel is 12V, then a 12V battery was selected. The ampere hour is used to measure the time the battery will take to discharge while it's not charging. A 40 ampere battery was selected and will give 40

amps of current of battery for one hour before it fully discharges.

➤ **Brushless DC motor**

A DC motor is a mechanically commutated electric motor powered from direct current (DC). The stator is stationary in space by definition and therefore so is its current. The Current in the rotor is switched by the commutator to also be stationary in space. This is how the relative angle between the stator and rotor magnetic flux is maintained near 90 degrees, which generates the maximum torque. DC motors have a rotating armature winding (winding in which a voltage is induced) but non-rotating armature magnetic field and a static field winding (winding that produce the main magnetic flux) or permanent magnet. Different connections of the field and armature winding provide different inherent speed/torque regulation characteristics. The speed of a DC motor can be controlled by changing the voltage applied to the armature or by changing the field current. The introduction of variable resistance in the armature circuit or field circuit allowed speed control. Modern DC motors are often controlled by the power electronic system systems called DC drives.

The speed controller works by varying the average voltage sent to the motor. It could do this

by simply adjusting the voltage sent to the motor, but this is an inefficient method. A better way is to switch the motor supply on and off very quickly. If the switching is fast enough, the motor functioning does not get affected, it only notices the average effect. This is a relatively new class of motors whose application have been increasing at a rapid rate

each year, due to both



declining costs as well as increasing functionality. A brushless DC motor is similar to that brush DC motor in that it has an internal shaft position feedback which tells which windings to switch on at which an exact moment. This internal feedback gives both the brush DC motor and brushless DC motor their unique characteristics. Linear speed-torque curves which are well suited for speed and position control and high starting torque. The internal feedback is accomplished in a brush type DC motor with the mechanical commutator (a series of copper bars which are insulated from each other) and the mechanical brushes through which the current is fed into the commutator bars and switched sequentially into the appropriate winding in the armature.

- Wheels
- Wires

➤ **Blades**

A blade is that portion of a tool, weapon, or machine with an edge that is designed to cut and/or puncture, stab, slash, chop, slice, thrust, or scrape surfaces or materials. A blade may be made from a flaking stone, such as flint, metal (usually steel), ceramic, or other material. Here we used one blade i.e fixed blade.

Fixed blade:-the blade which has no motion is called fixed blade. The fixed blade is placed with motor.

CALCULATIONS

DIMENSIONS FOR THE BLADE

Length= L = 6 inch = 152.4 mm

Breadth = B = 1 inch = 25.4 mm

Thickness = T = 0.01 inch = 0.254 mm

Speed of motor = N = 10000 rpm

Density = $\rho = 7857 \text{ kg/m}^3$

Acceleration due to gravity = $g = 9.81 \text{ m/s}^2$

1) To the determine the area of the blade

Area of the blade = length * breadth = 152.4 mm * 25.4 mm
= 3871 mm²

2) To determine the volume of the blade

Volume of the blade = area of the blade * thickness

Volume of the blade = 3871 mm² * 0.254 mm
= 983.2 mm³

3) To determine the mass of the blade

Mass = density * volume = 7857 kg/m³ × 1.0 × 10⁽⁻⁶⁾ m³
= 0.007857 kg

4) To determine the weight of the blade

Weight of the blade = mass of the blade * acc due to gravity

$$= 0.007857 \text{ kg} * 9.81 \text{ ms}^{-2}$$

$$= 0.08 \text{ N}$$

5) To determine the torque

Radius of the blade = diameter/2 = 152.4 mm/2 = 76.2 mm = 0.0762 m

Torque = weight of the blade * radius of the blade

Torque = 0.08 N * 0.0762m

Torque = 0.006 Nm

6) To determine the angular velocity

$$\omega = 2\pi N/60$$

where, N = 10000, $\pi = 3.142$

$$\omega = 2 * 3.142 * 10000/60 = 62840/60$$

$$= 1047.3 \text{ rad/s}$$

7) To determine the power generated at the blade

Power generated at the blade = Torque * angular velocity

$$= 0.006 \text{ Nm} * 1047.3 \text{ rad/s} = 6.2838 \text{ W}$$

$$= 0.0062838 \text{ KW}$$

8) To convert Kilowatt to Horsepower

Since 1KW is equivalent to 1.341 metric HP therefore, 0.0062838 KW is equivalent to 0.0084 Hp. For design purpose 1Hp will be used for this project, so that it provides the required torque in other to cut all types of grass effectively.

Hence, the centrifugal force $F_c = m\omega^2 r$

Hence, $F_c = 0.08 * 1047.3^2 * 0.0762 = 6686.3 \text{ N} = 6.6863 \text{ KN}$

RESULTS:

The solar powered lawnmower was fabricated and tested. During the machine

operation electrical energy of the battery was converted to mechanical energy through the blade to achieve cutting operation. The power was transferred from the battery to run the DC motor, while the solar panel continuously charged the battery during operation. The blade generated power from the DC motor at a speed of 10000rpm. When the switch is on, the electrical energy from the battery powers the motor which in turn actuates the blade. The solar panel generates current to recharge the battery, thereby compensating for battery discharge. The rotating blade continuously cuts the grass as the mower is being propelled.



CONCLUSION

In the world today, all machines are designed with the aim of reducing or eliminating greenhouse gas emissions which is the major causes of climate change. This solar powered grass cutter will meet the challenge of environmental production and low cost of operation since there is no cost for fuelling. A solar powered 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. In the presented paper provides the fabricated information about the "Fabrication of Solar grass Cutting Machine" which was designed such that the solar plate generates solar energy and utilizing this energy for running the grass cutter motor. Integrating features of all the hardware components used have been developed in it.

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