

“Solar Grass Cutter”

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Abstract -

The Solar Grass Cutter is a mechanical device used for cutting

The Solar Grass Cutter is an eco-friendly and energy-efficient machine designed to cut grass using renewable solar energy. The increasing demand for sustainable and pollution-free equipment has led to the development of this system as an alternative to conventional electric and fuel-powered grass cutters. This project consists of a solar panel, rechargeable battery, DC motor, cutting blade, and a supporting frame structure. The solar panel captures sunlight and converts it into electrical energy, which is stored in the battery. This stored energy is then used to drive a DC motor that rotates the cutting blade to trim the grass effectively. The machine is mounted on a lightweight frame supported by wheels, allowing easy movement and operation. The use of solar energy reduces dependency on fossil fuels and electricity, making the system cost-effective and environmentally friendly. It also minimizes noise and air pollution compared to traditional grass cutters.

This project demonstrates the practical application of renewable energy in agricultural and domestic use, providing a low-cost and sustainable solution for grass cutting.

Keywords: - Solar Energy, Grass Cutter, Renewable Energy, DC Motor, Solar Panel, Battery, Eco-Friendly, Sustainable Technology

1.INTRODUCTION

In the present era, rapid industrialization and urbanization have led to an increased demand for energy. Conventional energy sources such as coal, petroleum, and electricity are not only limited in quantity but also contribute significantly to environmental pollution. The excessive use of petrol-

driven grass cutters releases harmful gases like carbon monoxide and hydrocarbons, which adversely affect both human health and the environment. Therefore, there is a growing need to develop alternative solutions that are eco-friendly, energy-efficient, and sustainable.

Solar energy is one of the most abundant and renewable sources of energy available on Earth. It is clean, free of cost, and does not produce any pollution during usage. By utilizing solar energy for mechanical applications, we can reduce dependency on non-renewable energy sources. The Solar Grass Cutter is an innovative step in this direction, designed to operate using solar power instead of conventional fuels or electricity. The proposed system consists of key components such as a solar panel, charge controller (optional), rechargeable battery, DC motor, cutting blade, wheels, and a supporting frame. The solar panel absorbs sunlight and converts it into electrical energy through the photovoltaic effect. This electrical energy is stored in a battery, which supplies power to the DC motor. The motor converts electrical energy into mechanical energy, which rotates the cutting blade at high speed to cut grass efficiently. The structure of the machine is designed using a lightweight yet strong frame, typically made from hollow square bars. Caster wheels are attached at the base to allow smooth movement of the machine over the ground. An inclined platform is provided to mount the solar panel at an optimal angle for maximum sunlight absorption. The design ensures ease of operation, portability, and stability during use.

This project focuses on developing a low-cost and user-friendly grass cutting machine suitable for small lawns, gardens, and agricultural applications. It eliminates fuel costs, reduces maintenance requirements, and operates with minimal noise compared to conventional machines.

Moreover, it supports the concept of green energy and sustainable development.

In conclusion, the Solar Grass Cutter is an effective solution that integrates renewable energy with mechanical systems. It not only reduces environmental impact but also provides an economical and efficient alternative for grass cutting operations, making it highly suitable for future applications.

2. PROBLEM STATEMENT

Grass cutting is an essential activity in maintaining lawns, gardens, playgrounds, and agricultural fields. At present, most of the grass cutting operations are carried out using petrol engine-based grass cutters or electric grass cutting machines. Although these machines are widely used, they suffer from several major limitations that affect their efficiency, cost, and environmental impact. Petrol-operated grass cutters consume fossil fuels, which are non-renewable and becoming increasingly expensive. The combustion of petrol releases harmful gases such as carbon monoxide (CO), carbon dioxide (CO₂), and hydrocarbons, contributing to air pollution and global warming. In addition, these machines generate high noise levels, which can cause discomfort to users and disturb the surrounding environment.

Electric grass cutters, on the other hand, depend on a continuous supply of electricity. In many rural or remote areas, reliable electricity is not available, making these machines unsuitable for such locations. Moreover, the use of long electric cables may lead to safety hazards such as electric shocks and operational inconvenience. Manual grass cutting methods using hand tools require significant human effort and time, making them inefficient for covering large areas. They also lead to operator fatigue and are not suitable for modern fast-paced requirements.

Another important issue with conventional machines is their high maintenance cost, frequent fuel refilling, and complex operation, which makes them less user-friendly, especially for small-scale users like homeowners and farmers.

Considering these challenges, there is a strong need to develop an alternative solution that is:

- Environmentally friendly
- Cost-effective in operation

- Independent of fossil fuels and grid electricity
- Easy to operate and maintain
- Suitable for both urban and rural applications

Therefore, this project focuses on the design and development of a Solar Grass Cutter, which utilizes solar energy as its primary power source. The aim is to create a sustainable and efficient grass cutting machine that reduces pollution, minimizes operating cost, and provides a reliable solution using renewable energy

3. OBJECTIVES

➤ To design and fabricate a solar-powered grass cutting machine

The primary objective of this project is to design and build a working model of a grass cutter that operates using solar energy. The machine should be structurally strong, stable, and capable of performing efficient grass cutting.

➤ To utilize renewable solar energy effectively

The project aims to harness solar energy using a photovoltaic (solar) panel and convert it into electrical energy, which is then used to operate the system. This reduces reliance on non-renewable energy sources.

➤ To convert solar energy into mechanical energy for cutting operation

The system is designed to convert solar energy into electrical energy and then into mechanical energy through a DC motor. This mechanical energy is used to rotate the cutting blade at high speed for efficient grass cutting.

➤ To reduce dependency on fossil fuels and electricity

One of the key objectives is to eliminate the need for petrol or continuous electric power supply, making the system more sustainable and suitable for areas with limited resources.

➤ To minimize environmental pollution

The project focuses on reducing air pollution (caused by fuel emissions) and noise pollution (caused by engine-based machines), thereby contributing to a cleaner and greener environment.

➤ To develop a cost-effective and economical solution

The machine should have low operating and maintenance costs since it uses free solar energy. This makes it affordable for common users such as homeowners and small-scale farmers.

➤ To design a portable and user-friendly system

The grass cutter should be lightweight, easy to

move with wheels, and simple to operate, ensuring convenience for users without requiring technical expertise.

➤ **To reduce human effort and increase efficiency**

Compared to manual grass cutting, the proposed system should reduce physical effort and save time, thereby improving overall efficiency.

➤ **To ensure safety and reliability in operation**

The design should include safe operation features, reducing risks such as electric shock, blade hazards, and mechanical failure.

➤ **To promote sustainable and green technology**

This project aims to create awareness and encourage the use of renewable energy-based machines in daily life, supporting sustainable development.

4. WORKING PRINCIPLE

The Solar Grass Cutter operates on the fundamental principle of **energy conversion**, where solar energy is converted into electrical energy and then into mechanical energy to perform the cutting operation. The system integrates solar power technology with mechanical components to achieve efficient and eco-friendly grass cutting.

Step 1: Solar Energy Collection

- The solar panel (photovoltaic panel) is mounted on the machine at an inclined angle to receive maximum sunlight.
- It absorbs solar radiation and converts it into electrical energy using the photovoltaic effect.
- The output from the panel is direct current (DC).

Step 2: Voltage Regulation (Optional but Recommended)

- A charge controller may be used between the solar panel and battery.
 - It regulates the voltage and current to prevent:
 - Overcharging of battery
 - Deep discharge
- This improves battery life and system safety.

Step 3: Energy Storage in Battery

- The electrical energy generated is stored in a rechargeable battery (Lead-acid or Lithium-ion).

- The battery acts as a backup source, allowing operation:

- During low sunlight
- In cloudy weather
- In evening hours

Step 4: Power Distribution System

- The stored energy is supplied to the DC motor through:

- Wires
- Switch (for ON/OFF control)

- Proper insulation is maintained to ensure safety.

Step 5: Conversion into Mechanical Energy

- The DC motor converts electrical energy into rotational mechanical energy.
- The motor rotates at a specific speed (RPM), depending on its rating.

Step 6: Transmission of Motion

- The motor shaft is directly connected to the cutting blade.
- When the motor rotates, the rotational motion is transmitted to the blade without significant loss.

Step 7: Blade Operation

- The cutting blade, made of high-speed steel or similar material, rotates at high speed.
- The blade has sharp cutting edges designed to:
 - Cut grass efficiently
 - Provide smooth and uniform trimming

Step 8: Grass Cutting Mechanism

- When the machine is moved over the grass:
 - The rotating blade comes in contact with grass
 - The grass is cut due to high-speed rotational motion
- Cutting height can be adjusted depending on blade position (if adjustable design is used).

Step 9: Machine Movement

- The entire system is mounted on a frame with wheels (caster wheels).
- The operator pushes the machine manually:
 - Ensures easy movement
 - Covers large area with less effort

Step 10: Continuous Charging and Operation

- While the machine is in operation, the solar panel continues to:
 - Generate electricity
 - Charge the battery simultaneously
- This improves efficiency and increases working time.

Step 11: Safety and Control Features

- A switch is used to control motor operation.
- Proper shielding may be provided around the blade for safety.
- Electrical connections are insulated to avoid short circuits.

Overall Energy Flow

Solar Energy → Electrical Energy → Stored in Battery → DC Motor → Mechanical Energy → Blade Rotation → Grass Cutting

5.METHODS AND MATERIAL

Solar Energy

Solar energy is very large, inexhaustible source of energy. The power from the sun intercepted by earth is approximately 1.8/10MW, which are many thousands of times larger than the present consumption rate on the earth of all energy sources. The quantum of energy India’s land area receive from sun is equivalent to 15,000 times its consumption requirement (500 billion kWh) as projected for 2004. In addition to its size, solar energy has two other factors in its favor. Firstly, unlike fossil fuels and nuclear power, it is an environmentally clean source of energy. Secondly, it is free and available in adequate quantities in almost all parts of the world people live. But there are some problems associated with its. The real challenge in utilizing solar energy is of and

economic concern. One has to strive for the development of cheaper methods of collection and storage so that large initial investments required at preset in most applications are reduced, solar energy in India:

A large amount of solar radiation fall on India and for most of the country very few days are without sunshine. India lies within the latitude of 7 N to and 37 N with annual average intensity of solar radiation as 500 to 600 cal/cm/day with more such insulations available in arid and semi-arid regions. Average solar radiation falling on India in arid and semiarid regions is 7.5 K w h/m/day. Solar energy 5× 10 K w h/year potential to meet basic energy needs of teeming millions who live in rural India. Solar energy is an important, clean, cheap and abundantly available renewable energy. The sun radiates heat and light. The heat, light received from the sun supports the environment on the earth through the following well known natural effects.

- Temperature balance on the earth
- Photo-synthesis by biological plants production of oxygen and organic materials, production of organic chemicals and bio-mass.
- Wind due to unequal heating of water, land surfaces.
- Heating of ocean water: ocean thermal energy (OTEC)
- Waves in ocean: ocean wave energy
- Tides in ocean: ocean tidal energy (due to gravitational forces)

The sun produces enormous amount of energy of heat and light through sustained nuclear fusion reactions. The solar energy received on the earth in the form of radiation is used for heating and producing an electrical energy.

Among the non-conventional sources of energy solar energy is the most promising. Hence our project is based on the solar energy conversion to mechanical energy to run a normal grass cutter

Table 1: Comparison

Sl. No	Solar System	Fuel System
1	Totally free from pollution	Pollution is a great factor
2	No fuel consumption	Fuel is the important need
3	No. of reciprocating parts are less	No. of reciprocating parts are more
4	Friction is greatly	Frictions between

	reduced	the parts are high.
5	Low cost and maintenance	Maintenance is difficult & costly
6	Load carrying capacity is low	Load carrying capacity is high
7	Continuous ride for hours together is not possible	Continuous ride is possible
8	Ratio of speed reduction more when weight increases very much	Speed reduction ratio is less and it does not vary

Components Used

The main components of the solar powered grass cutter are,

1. Solar panels
2. Battery
3. DC motor
4. Blades
5. Solar charger

1. Solar Panel

1.1 Photovoltaic Principles

The photo-voltaic effect can be observed in nature in a variety of materials that have shown that the best performance in sunlight is the semiconductors as stated above. When photons from the sun are absorbed in a semiconductor, that create free electrons with higher energies than the created there must be an electric field to induce these higher energy electrons to flow out of the semi-conductor to do useful work. A junction of materials, which have different electrical properties, provides the electric field in most solar cells for the photon interaction in a semiconductor. A solar cell consists of

1. Semi-conductor in which electron hole pairs are created by the absorption of incident solar radiation.
2. Region containing a drift field for charge separation.
3. Charge collecting front and back electrodes.

1.2 Photovoltaic Effect

The photo-voltaic effect can be described easily for p-n junction in a semi-conductor. In an intrinsic semi-conductor such as silicon, each one of the four valence electrons of the material atom is tied in a chemical bond, and there are no free electrons at absolute zero. If a piece of such a material is doped on one side by a five valence electron material, such as arsenic or phosphorus, there will be an excess of electrons in that side, becoming an n-type semi-conductor.

The excess electrons will be practically free to move in the semi-conductor lattice. When a three valence electron material, such as boron dopes the other side of the same piece, there will be deficiency of electrons leading to a p-type semi-conductor. This deficiency is expressed in terms of excess of holes free to move in the lattice. Such a piece of semi-conductor with one side of the p-type and the other, of the n-type is called p-n junction. In this junction after the protons are absorbed, the free electrons of the n-side will tends to flow to the p-side, and the holes of the p-side will tend to flow to the n-region to compensate for their respective deficiencies. This diffusion will create an electric field from the n-region to the p-region. This field will increase until it reaches equilibrium for voltage, the sum of the diffusion potentials for holes and electrons. If electrical contacts the connected through an external electrical conductor, the free electrons will flow from the n-type material through the conductor to the p-type material as shown in the figure. Here the free electrons will enter the holes and become bound electrons thus both free electrons and holes will be removed. The flow of electrons through the external conductor constitutes an electric current, which will continue as long as move free electrons and holes are being formed by the solar radiation. This is the basis of photo-voltaic conversion that is the conversion of solar energy into electrical energy. The combination of n-type and p-type semiconductors thus constitutes a photo-voltaic cell or solar cell. All such cells some rate direct current that can be converted into alternating current it desired. The photo-voltaic effect can be observed in almost any junction of material that have different electrical characteristics, but the best performance to date has been from cells using semiconductor material especially all of the solar cells used for both space and terrestrial applications have been made of the semiconductor silicon. Future cells may use such materials as the semiconductors like Gallium arsenate, copper sulphate

cad sulphide etc. The device used to utilize the photovoltaic effect is solar cell.

1.1 Specifications

Array size : 35 × 30 cm Maximum Power : 10W
Maximum Voltage : 16.5V Maximum Current : 2.9A No
of modules : 1 Type : Poly crystalline



2. Battery



The batteries are used as a storage device for solar energy which can be further converted into electrical energy. The only exceptions are isolated sunshine load such as irrigation pumps or drinking water supplies for storage, for small units with output less than one kilowatt. Batteries seem to be the only technically and economically available storage means. Since both the photo-voltaic system and batteries are high in capital costs, it is necessary that the overall system be optimized with respect to available energy and local demand pattern. To be economically attractive the storage of solar electricity requires a battery with following particular combination of properties:

- (1) Low cost
- (2) Long life
- (3) High reliability
- (4) High overall efficiency

3. DC Motor

In the presented idea for grass cutter model we used DC motor interfaced with blades for cutting grass when

operated. A dc motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The input of a DC motor is current/voltage and its output is torque (speed).

DC motor has many novel linear and rotary motors and at least one self-powering magnetic rotary device in motor uses a bidirectional “two particle” theory of magnetic flux showing the internal bidirectional energy flows in all potentials and fields. The motor utilizes controlled spin-waves and self-initiated precise exchange forces, which are known to momentarily produce bursts of very strong force fields. In short, the motor used to produce precisely located and directed sudden magnetic forces, using self-initiated nonlinear magnetic phenomena.

4. Blade



5. Solar Charger

The power charge regulator is also known as charge controller, voltage regulator, charge-discharge controller or charge-discharge and load controller. The regulator sits between the array of panels, the batteries, and the equipment or loads. By monitoring the voltage of battery, the regulator prevents overcharging or over discharging. Regulators used in solar applications should be connected in series: they disconnect the array of panels from the battery to avoid overcharging, and they disconnect the battery from the load to avoid over discharging. The connection and disconnection is done by means of switches which can be of two types: electromechanical (relays) or solid state (bipolar transistor).

Solar chargers should never be connected in parallel. In order to protect the battery from gasification, the switch opens the charging circuit when the voltage in the battery reaches its high voltage disconnects (HVD) or cut-off set point. The low voltage disconnects (LVD) prevents the battery from over discharging by disconnecting the load. The most modern regulators are

also able to automatically disconnect the panels during the night to avoid discharging of the battery. They can also periodically overcharge the battery to improve their life, and they may use a mechanism known as pulse width modulation (PWM). Solar charger has three light indicators. The first light blinks when the batteries are charging by using solar energy. The second light glows when the charging in the batteries is very low. The third light glows when the batteries are fully charged and an extra load (charging) is applied on the batteries.

6.RESULTS AND DISCUSSION

Design Analysis

The shearing force of most annual and perennial grasses found on most lawns is usually between 9.2N ~ 11.51N

Force required by cutting blade to shear the grass is given by; Assume $F = 11 \text{ N}$

$$F = T/R$$

Where $T =$ Shaft torque;

$R =$ Radius of cutting blade = 12cm

$$T = F \times R \quad T = 11 \times 0.12 \quad T = 1.32 \text{ Nm}$$

But shaft power is given by;

$$P = \frac{2\pi NT}{60}$$

Where $P =$ Power developed by shaft;

$T =$ Torque required; and

$N =$ Shaft speed in Rev/min = 8000 rpm

$$P = \frac{2\pi NT}{60}$$

$$P = 1105.84 \text{ watt}$$

1 Selection of electric motor:

1.1 8000 RPM DC motor

SPEED = 8000 RPM VOLTAGE = 12 VOLT

WATTS = 1105.84 WATT

1.2 Electrical (electric) power equation:

$$\text{Power } P = I \times V$$

Where $V = 12$

$$W = 18 \quad I = 18/12 = 1.5 \text{ A}$$

$$\text{H.P} = .02414$$

1.3 Solar panel calculation:

$$\text{VOLT} = 16 \text{ V} \quad \text{WATT} = 10 \text{ W} \quad W = V \times I \quad 10$$

$$= 16 \times I$$

$$I = 0.625 \quad I = 625 \text{ ma}$$

1.4 Battery calculation:

$\text{BAH} / \text{CI} = 7.2 \text{ ah} / 625 \text{ ma} = 11.5 \text{ hrs}$ To find the Current

$$\text{Watt} = 18 \text{ w} \quad \text{Volt} = 12 \text{ v} \quad \text{Current} = ? \quad P = V \times I$$

$$18 = 12 \times I$$

$$I = 18/12 = 1.5 \text{ AMPS}$$

BATTERY USAGE WITH 1.5 AMPS

$$= \text{BAH} / I$$

$$8/1.5 = 5.3 \text{ hrs}$$

7.CONCLUSION

Our project entitled Fabrication of solar powered grass 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. In the presented paper provides the fabricated information about the "Fabrication of Solar grass Cutter" which was designed such that the solar plate generates solar energy and utilizing this energy for running the grass cutter motor. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Thus the project has been successfully designed and tested.

REFERENCES

- [1] SAN JOSE STATE UNIVERSITY Electrical Engineering Solar Powered Automatic Lawn Mower "Lawn Buddy" Darwin Ramos Jessie Lucero Advisor: Dr. Kwok December 9, 2009
- [2] Thiruchelvam T; Nimal D A D; Upali S (2007). Com-parison of quality and yield of copra processed in CRI improved kiln drying and sun drying. Journal of Food Engineering, 78,1446– 1451
- [3] International Journal & Magazine of Engineering, Technology, Management and Research A Peer Reviewed Open Access International Journal ISSN No: 2348-4845

- [4] Shanmugam V; Natarajan E (2006). Experimental investigation of forced convection and desiccant integrated solar dryer. *Renewable energy*, 31, 1239–1251
- [5] P.Amrutesh et al. *Int. Journal of Engineering Research and Applications* www.ijera.com ISSN : 2248-9622, Vol. 4, Issue 9(Version 3), September 2014, pp.10-21
- [6] Chr.Lamnatou, E. Papanicolaou, V. Belessiotis and N. Kyriakis, “Experimental investigation and thermodynamic performance analysis of a solar dryer using an evacuated-tube air collector,” *Applied Energy*, vol. 94, pp.232-243, 2012.
- [7] Ahmed Abed Gatea, “Performance evaluation of a mixedmode solar dryer for evaporating moisture in beans,” *Journal of Agricultural Biotechnology and Sustainable Development*, vol. 3(4),pp.65-71, April 2011.
- [8] Wikipedia <http://www.wikipedia.com>
- [9] M. Mohanraj P. Chandrasekar (2009), “Performance of a forced convection solar drier integrated with grav-el as heat storage material for chili drying”, *Journal of Engineering Science and Technology* ,Vol. 4, No. 3.
- [10] Jan Banout, Petr Ehl (2010), “Using a Double-pass solar drier for drying of bamboo shoots”, *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, Vol. 111 No. 2 (2010) 119-127, ISSN: 1612-9830
- [11] M. I. Fadhel, Ramez Abdulwasea Abdo, B. F. Yousif, Azami Zaharim , K. Sopian(2011), “Thin-Layer Drying”, *Recent Researches in Energy & Environment* ,ISBN: 978-960-474-274-5.
- [12] Songchai Wiriyampaiwong, Jindaporn Jamradloedluk (2007), “Forced Convection Solar Drying: Experimental Investigation and Mathematical Modeling of Pork Strips”, *KKU Engineering Journal* Vol. 34 No .2 (243 - 250).
- [13] *Non Conventional Energy sources* by G.D.RAI, Khanna Publishers
- [14] A project report on solar powered bicycle (MeRITS)
- [15] WWW.solar powered grass cutter.com [on line]