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Solar Powered Lawn Mower Machine

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ABSTRACT—The rising interest in sustainable and energy-efficient options for everyday tasks has inspired the creation of a solar-powered lawn mower. This initiative offers an eco-friendly substitute to conventional gasoline or electric mowers by relying primarily on solar energy. The design features solar panels mounted on the mower that capture sunlight and store it in a rechargeable battery. This stored energy powers a DC motor connected to the cutting blade, enabling efficient grass cutting without relying on fossil fuels.

The mower is crafted to be lightweight, user-friendly, and appropriate for small to medium-sized lawns. By eliminating gasoline use, it significantly reduces both air and noise pollution, operating quietly and producing no emissions. Furthermore, utilising solar power lowers operational expenses and decreases reliance on traditional electricity sources. This project exemplifies a practical use of renewable energy in lawn care and showcases the potential for solar-powered devices in both residential and commercial landscaping applications.

1. INTRODUCTION

In recent years, the demand for environmentally friendly alternatives to traditional fuel-powered devices has grown significantly due to rising ecological concerns and the depletion of fossil fuels. One area of focus is the development of solar-powered machines for routine tasks, such as mowing lawns in residential gardens, parks, and agricultural fields. Conventional lawnmowers are typically fueled by gasoline or energy from non-renewable sources, leading to air pollution, noise disturbances, and higher operating costs.

To address these challenges, this project aims to create a solar-powered grass cutter that operates

efficiently using renewable energy. The device utilizes photovoltaic (PV) panels to capture solar energy, converting sunlight into electricity to power a DC motor connected to the cutting blade. By relying on solar energy, this innovation reduces dependence on fossil fuels, lowers harmful emissions, and provides a cleaner, quieter, and more cost-effective solution for lawn maintenance.

This initiative not only promotes environmental sustainability but also encourages the adoption of green technology in mechanical applications.[1] The machine is designed to be lightweight, portable, and user-friendly, making it suitable for residential, agricultural, and public maintenance tasks, especially in sunny regions with limited access to electricity.

The solar-powered mower operates via a switch on the control board, which completes the circuit and enables the flow of electricity to the motor, activating the blade for cutting grass.[3] The battery is recharged with the help of a solar charging controller, and performance tests have been conducted with various grass types.

Solar energy offers a consistent and sustainable power source for numerous functions on Earth. [1] The key difference lies in the application of this energy. A solar-powered lawnmower is expected to resolve many of the shortcomings associated with traditional internal combustion engine and electric mower models.

Using a solar-energy lawnmower streamlines the mowing process, eliminating the need for continuous trips to the gas station for refueling

and the hazards tied to gasoline spills. By removing the harmful emissions from both gasoline spillage and internal combustion engines, the solar-powered lawnmower contributes to reducing air pollution. Therefore, a solar grass cutter is proposed:

- To design and build a lightweight solar-powered grass cutter.
- To ensure it is compact in size.
- To make it affordable.
- To allow for efficient operation in rural areas.

2. METHODOLOGY

The methodology provides a structured approach for designing and building a solar-powered grass cutting machine, broken down into several crucial stages:

1. Problem Identification and Objective Definition

- Recognized the necessity for an environmentally friendly and cost-effective method of cutting grass.
- Established the goal: to design and create a solar-powered device that efficiently cuts grass without relying on fossil fuels.

2. Conceptual Design and Component Selection

- Investigated current grass cutting machines and applications of renewable energy.
- Developed initial sketches and CAD models to outline the system's layout.
- Choose essential components, including:
 - Solar panel (for harnessing solar energy)
 - Rechargeable battery (for energy storage)
 - DC motor (to power the cutting blade)
 - Cutting blade (made of stainless steel or alloy)
 - Lightweight chassis and frame (using metal or composite materials)
- Solar charge controller (to manage energy from the solar panel)

3. Electrical System Design

- Assessed power needs based on the motor's load and anticipated operational duration.[4]
- Sized the solar panel and battery accordingly, such as a 12v, 20w panel and a 12v, 7Ah battery.[7]
- Incorporated a solar charge controller to guarantee stable power delivery and prevent overcharging.

4. Mechanical Design and Fabrication

- Created the frame design using CAD software like SolidWorks or AutoCAD.
- Cut and assembled the chassis following the designed specifications.
- Positioned the motor, blade, and battery for optimal balance and efficiency.
- Installed protective housing and insulation around electrical parts.

5. Assembly and Integration

- Assembled all components into the constructed frame.
- Connected the output of the solar panel to the charge controller and battery.
- Wired the battery to the motor, incorporating a manual or automatic switch.
- Ensured all moving components were correctly aligned and adequately lubricated.

6. Testing and Evaluation

- Performed performance tests on various types of grass.
- Analyses cutting efficiency, operational duration, and battery charging times.
- Evaluated safety features, user-friendliness, and maintenance requirements.
- Made necessary modifications based on testing outcomes, such as adjusting blade height and motor RPM.

7. Final Optimization and Documentation

- Refined the design to improve portability, reduce weight, and enhance safety.
- Recorded design specifications, circuit diagrams, and the materials utilized.
- Compiled the final report and presentation for assessment.

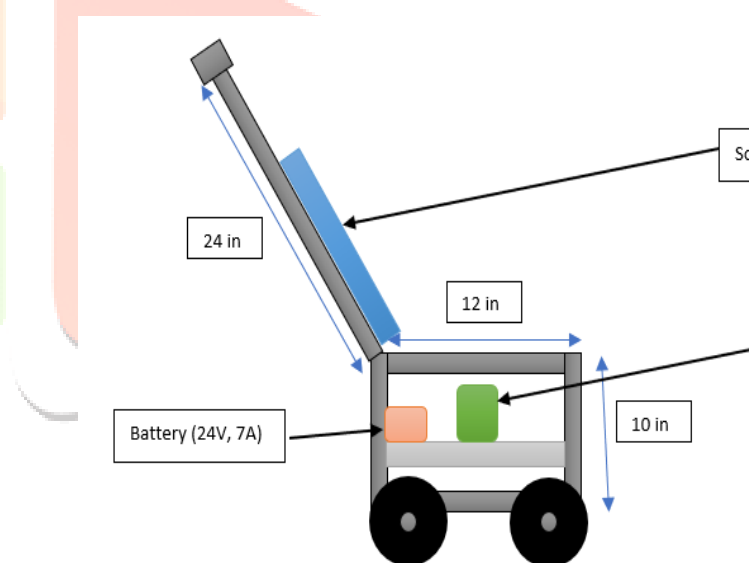


Figure 1: Drawing of a Solar grass cutting machine

WORKING COMPONENTS

The main components of the solar-powered grass cutter are

S.No.	Components	Quantity	Specification
1	Frame (structure)	20 ft (Approx)	Mild steel (1in X 1in)
2	Wheels	4	5 in Dia
3	Metal disc	4	4 in
4	Motor	1	24V
5	Solar panel	1	12v
6	Charge Controller	1	
7	Switch	2	5A
8	Wire	10 mts	1 mm
9	Battery	2	12V, 7A
10	Cutter blade	1	Steel

A lawn mower, or grass cutter, is made up of various components, including an induction motor, battery, alternator, three retractable blades, and a linkage system. The power and charging setup feature an alternator that recharges the battery while the mower is in use. The primary component driving the blades is a D.C. motor that creates the necessary force for operation. The machine's functionality relies on the synchronized movement of the cutting blades and the mower itself. An electrical switch connects the induction motor to the battery, completing the circuit and allowing operation. To enhance safety and prevent damage, an infrared sensor is incorporated to monitor the mower's path. Users can also adjust cutting height through a shaft mechanism.

Solar-powered grass cutters operate with a compact yet potent engine that produces enough torque to spin a sharp horizontal blade, effectively trimming grass on contact. The blade is encased within a deck to contain the clippings, preventing them from scattering. Generally, the motor is located above the deck and is supported by four wheels for easy maneuvering. This type of mower utilizes energy from a photovoltaic panel, making solar power its main energy source. By relying on solar energy, these mowers address several issues faced by traditional gas or electric models. Users of solar-powered mowers can enjoy convenience without the hassles of frequent refueling, the risks associated with gasoline spills, and the environmental impact of combustion engines. Furthermore, solar mowers contribute to reducing air and noise pollution commonly caused by other lawnmower types, while also lowering operational and maintenance costs.

Material selection for the frame and stand

In this study, various materials were evaluated for manufacturing the frame and stand of the solar-powered grass cutter. Ultimately, mild steel was chosen for both components due to its cost-effectiveness, welding ease, and accessibility in the market.

Solar panel

1. Sunlight strikes the solar panel, which is made up of numerous photovoltaic (PV) cells, usually crafted from silicon.
2. The photons from the sunlight dislodge electrons within the PV cells.[1]
3. This electron movement generates an electric current, producing direct current (DC) electricity.[1]
4. An inverter then transforms the DC electricity into alternating current (AC) electricity, which is commonly utilized by households and businesses. [1]

Solar charge controller

A solar charge controller is an essential part of a solar power system, particularly in off-grid or battery-operated setups. Its main function is to regulate the power flow from the solar panels to the batteries, ensuring that they are charged properly and safely.[2]

Types of Solar Charge Controllers:

1. PWM (Pulse Width Modulation)

- Simpler and cheaper.[3]
- Best for small systems.[3]
- Less efficient, especially if the panel voltage is much higher than the battery voltage.[3]

2. MPPT (Maximum Power Point Tracking)

- More efficient (up to 30% more).
- Best for larger systems and cold/cloudy environments.
- Can use higher-voltage solar arrays with lower-voltage batteries.

Battery

Apex 12V-8Ah Heavy Duty VRLA Battery, which is a type of sealed lead-acid battery. Key features and information about this battery include:[1]

Type: Valve Regulated Lead Acid (VRLA) battery, also known as a sealed lead-acid (SLA) or maintenance-free (MF) battery.[5]

Voltage: 12V.

Capacity: 8Ah.

Max Charging Current: 2.25A.

Standby Use: 13.5-13.8V.

Cycle Use: 14.4-15.0V.

Maintenance: Requires less maintenance compared to flooded lead-acid batteries but still needs regular monitoring and testing.

Safety: Avoid short circuits, do not charge in a sealed container, and keep away from sparks and flames. Recycle or dispose of properly.

Lifespan: Typically lasts 3-5 years.

Temperature: Best kept in a temperature-controlled environment around 20°C, as high temperatures can reduce lifespan.

Durability: Ruggedly built to withstand vibration, heat, and shock.

Origin: Made in India.

Motor

The motor is used MY6812 24v 100w brushed DC motor. Key details include:

Model: MY6812

Voltage: 24v DC

Power: 100w

Speed: Around 2500-3500 RPM

Material: Typically made of aluminium

Applications: Suitable for electric scooters, e-bikes, and small electric vehicles

Features: It has a metal belt pulley for power transmission and is designed for durability

Type: Brushed motor, meaning it uses brushes to deliver current to the rotor

Size: Compact, allowing for use in smaller applications

Block diagram

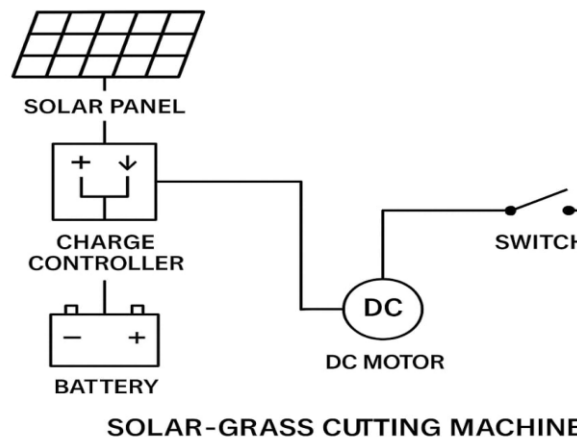


Figure 2: Block diagram of a solar grass cutting machine.

CONCLUSION

The solar-powered grass cutting machine offers a sustainable and environmentally friendly alternative to traditional lawn mowers. By utilizing solar energy, this machine functions efficiently without dependence on fossil fuels, leading to a reduction in environmental pollution and lower operating costs. The successful execution of this system highlights the practical application of renewable energy in daily life, fostering green technology and energy self-sufficiency.

This project not only presents an innovative solution for lawn care but also promotes the use of clean energy options in both residential and commercial settings. With further advancements, such machines can be improved for enhanced efficiency, automation, and scalability, playing a vital role in building a cleaner and more sustainable future.

FUTURE SCOPE

1. Improved Energy Storage

Advancements in battery technologies, such as lithium-ion or graphene-based batteries, can enhance energy storage capabilities, allowing for extended operational periods and more efficient energy utilization.

2. Hybrid Power Systems

Implementing a hybrid approach that combines solar power with manual or grid-charging options can ensure reliable performance, even in cloudy or rainy conditions, thereby enhancing overall dependability.

3. Automation and Robotics

The incorporation of sensors, microcontrollers (such as Arduino or Raspberry Pi), and GPS technology can facilitate greater automation and precision in

operations. modules can enable the machine to operate autonomously, detecting obstacles, mapping lawn areas, and optimising cutting paths without human intervention.

4. Sustainable Material Utilization

Incorporating biodegradable or recycled materials in the construction process can help minimize the environmental impact of the machine.

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