Design And Development Of An Efficient Grass Cutter For Urban Green Spaces

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Abstract:
This paper presents the design and development of a solar-powered grass cutter aimed at providing an eco-friendly solution for grass maintenance tasks. The project focuses on harnessing solar energy to power a grass cutting mechanism, thus reducing reliance on fossil fuels and minimizing environmental impact. The paper outlines the design process, including component selection, system integration, and testing procedures. Furthermore, it discusses the potential benefits and challenges associated with the implementation of solar-powered grass cutting technology.

Keywords: Solar energy, Grass cutter, Eco-friendly, Sustainable design, Renewable energy.

Introduction:

This project focuses on minimizing the harmful effects of using manual grass cutters.

Urban green spaces play a crucial role in providing recreational areas, enhancing biodiversity, and mitigating the urban heat island effect. Maintaining these spaces requires specialized equipment that can efficiently cut grass while minimizing environmental impact. This paper focuses on the design and development of such a grass cutter, addressing the specific needs of urban environments.

The newly developed grass cutter operates on power and consists of different parts such as a plate, 12 Volt D.C.Battery, motor, cutting blades, and wheels. In the modified grass cutter, the rotary fixed between the bearings is attachedto the frame of the grass cutter, and the motor is connected tothe rotor, which is fixed to the grass cutter frame.

The plate is affixed to the upper part of the grass cutter to shield it from direct sunlight and is directly linked to the motor. The motor rotates either clockwise or anticlockwise depending on the connection or requirement. The project primarily focuses on designing a suitable operating system using locally fabricated units to maintain simplicity and economy in the design. Our project achieves higher safety,reduces human effort, increases the efficiency of the grass cutter, lessens the workload and fatigue of workers, and reducesmaintenance costs.

Literature Review

Research by [1] Li et al. (2018) discusses the design considerations for solar-powered grass cutters, emphasizing the integration of solar panels, battery storage, and efficient electric motors. Various studies (Chen et al., 2019; Singh & Kaur, 2020) highlight the importance of lightweight materials, aerodynamic design, and ergonomic features for enhancing the performance and usability of solar-powered grass cutters.
[2] Jiang et al. (2017) and Gupta et al. (2021) evaluate the performance and efficiency
of solar-powered grass cutters under different environmental conditions and grass type. [3] Wang et al. (2019) and Zhang

et al. (2020) investigates the environmental impact of solar-powered grass cutters compared to traditional gas-powered and electric models.

Objectives:

Design and Develop an Efficient Solar-Powered Grass Cutter: The primary objective is to design and develop a solar-powered grass cutter that effectively harnesses solar energy to efficiently cut grass while minimizing environmental impact. Optimize Energy Harvesting and Storage: Implement advanced solar panel technology and battery storage systems to optimize energy harvesting and storage, ensuring continuous operation even in low-light conditions. Enhance Cutting Performance and Efficiency: Improve cutting performance and efficiency through the integration of high-performance electric motors, lightweight materials, and ergonomic design features.

Reduce Environmental Impact: Minimize greenhouse gas emissions, noise pollution, and resource consumption compared to traditional gas-powered and electric grass cutters, contributing to environmental sustainability.

Methodology

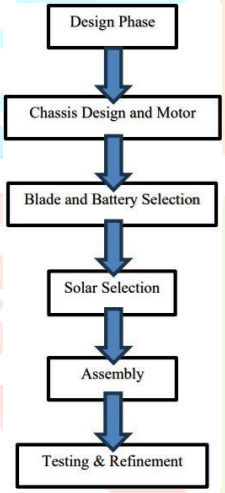

Fig. Methodology Flow Chart

Methodology Components

• Research existing solar-powered grass cutter designs and technologies.

• Define project requirements and objectives.

• Design conceptual sketches and models of the solar-powered grass cutter.

• Select suitable components including solar panels, batteries, and electric motors.

• Develop detailed CAD drawings and specifications for the grass cutter assembly.

Prototype construction and integration of solar panels, batteries, and motor.

Conduct performance testing under various environmentalconditions.

Evaluate cutting efficiency, energy autonomy, and overallperformance.

Refine design based on testing feedback and performanceresults.

Design Calculation:

Electrical System Calculation:

Total Power Consumption: The main power-consuming components are the motor and the control system.

Let's assume the motor's power consumption is around 50watts.

Total Power Consumption = Motor Power + Control SystemPower = 50 watts

Battery Capacity:

Considering the grass cutter operates for 1 hour, we need tocalculate the battery capacity required.

Using the formula:

Battery Capacity = Total Power Consumption * OperatingTime

Battery Capacity = 50 watts * 1 hour = 50 watt-hours (Wh)

Battery Selection:

The selected battery has a capacity of 12V 2.5Ah (30 Wh),which meets the calculated requirement.

Solar Panel Calculation:

Solar Panel Power Output: The solar panel needs to provideenough power to charge the battery during daylight hours. Let's assume 6 hours of effective sunlight per day.

Solar Panel Power Output = Battery Capacity / (ChargingTime * Efficiency)

Solar Panel Power Output = 30 Wh / (6 hours * 0.85efficiency) ≈ 5.88 watts

Therefore, a 10W 12V solar panel provides sufficient power.

Working Principle:

The solar-powered grass cutter operates on the principle ofharnessing solar energy to power its cutting mechanism, ensuring efficient and eco-friendly grass cutting. Solar panels mounted on the grass cutter's frame absorb sunlight and convert it into electrical energy, which is stored in a rechargeable battery. When the operator initiates the grass cutting operation, electrical power from the battery is supplied to the motor, driving the rotation of the cutting blade attached to the motor shaft. As the grass cutter moves forward, guided by the operator, the spinning blade efficiently cuts through grass and vegetation, aided by the mobility provided by the wheels

Conclusion:

The design and development of a solar-powered grass cutter offer a sustainable alternative to traditional gasoline-powered machinery for grass maintenance tasks. By harnessing solar energy, the grass cutter reduces carbon emissions and promotes eco-friendly practices in landscaping and agriculture. Further research and development are needed to enhance the efficiency and reliability of solar-powered grass cutting technology for widespread adoption.

The design and development of an efficient grass cutter for urban green spaces represent a significant step towards sustainable and effective maintenance practices. By prioritizing efficiency, sustainability, and user experience, the cutter offers a practical solution to the challenges of maintaining green spaces in urban environments. Future research could focus on further optimizing the design and exploring innovative technologies to enhance performance and environmental impact.

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