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Grass Cutter with Solar and Petrol

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Abstract: *The proposed work presents a hybrid grass-cutting machine powered by both solar energy and petrol fuel. Conventional petrol-powered cutters produce noise, emissions, and dependency on fuel availability. To overcome these limitations, the hybrid system integrates a solar power unit consisting of a photovoltaic panel, charge controller, and rechargeable battery to assist the cutter's electrical requirements. The battery stores solar energy during daylight and supplies power to auxiliary loads and starting systems, thereby reducing petrol consumption. During heavy cutting operations, the petrol engine provides the required mechanical power to the cutting blades, ensuring continuous working even in low sunlight conditions. The system reduces operational cost, fuel usage, and environmental pollution while maintaining the reliability and mobility of petrol-based cutters.*

Keywords*:* Hybrid solar-petrol automated grass cutter with dual-power efficiency and sustainable engine performance

I. INTRODUCTION

The global imperative for environmental sustainability and the concurrent need for enhanced operational efficiency have spurred innovation across all mechanized industries, including grounds maintenance and small-scale agriculture. Grass cutting remains a ubiquitous and essential task, spanning routine residential lawn care, meticulous golf course management, and large-scale agricultural field clearing. Historically, this essential work has been reliant upon machines powered by Internal Combustion Engines (ICEs), owing to their high power density, robustness, and sustained autonomy in the field.

However, the continued dominance of purely petrol-powered grass cutters presents substantial, well-documented drawbacks. These conventional machines are significant contributors to localized air and noise pollution, emitting harmful greenhouse gases and smog-forming pollutants such as nitrogen oxides and unburnt hydrocarbons. For commercial operators, the dependency on volatile fossil fuel prices translates directly into high and unpredictable operational costs, making long-term financial planning challenging. Furthermore, the inherent mechanical noise generated by ICEs often restricts operating hours in noise-sensitive environments like residential areas and public parks.

II. PROBLEM STATEMENT

The maintenance of green spaces using conventional machinery faces a critical dilemma: Traditional Petrol Grass Cutters offer the necessary high power, durability, and unlimited runtime required for large, demanding areas and tough vegetation, but they are major contributors to air and noise pollution, incur rising operational costs due to fuel price volatility, and require high maintenance (oil, spark plugs, filters). Pure Solar/Electric Grass Cutters offer an environmentally friendly solution with zero emissions and low noise, but are inherently limited by low power/torque for heavy cutting loads, constrained runtime (typically 1–3 hours), and dependence on a long charging time from sunlight or the grid, which makes them unsuitable for professional landscaping, large properties, or use during cloudy conditions.

III. LITRATURE REVIEW

The literature regarding grass cutting technology reveals a significant shift from traditional internal combustion engines to more sustainable, hybrid power configurations. Historically, lawn maintenance relied exclusively on petrol-powered

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engines, which researchers such as Jain (2020) and Sinha & Mathur (2020) identify as major sources of both noise and atmospheric pollution. These studies emphasize that while petrol engines provide the high torque necessary for heavy-duty landscaping, their reliance on fluctuating fossil fuel prices and high maintenance requirements has prompted a search for cleaner alternatives.

In response to these environmental concerns, a vast body of research has explored the feasibility of solar-powered mowers. Scholars like Olajide et al. (2024) have demonstrated that photovoltaic panels integrated with DC motors can achieve high operational efficiency, effectively eliminating carbon emissions during use. However, the literature also consistently points out a critical limitation of purely solar systems: their dependence on consistent sunlight and limited battery storage, which often results in insufficient runtime for large-scale applications.

IV. METHODOLOGY

Hybrid grass cutter begins with the integration of a dual-power drive system where a DC motor powered by solar energy and a small internal combustion engine fueled by petrol are mounted onto a reinforced chassis to provide alternating or simultaneous torque. Solar panels are installed on the upper canopy to capture sunlight and convert it into electrical energy, which is then regulated by a charge controller before being stored in a high-capacity lead-acid or lithium-ion battery bank.

This stored electricity feeds the primary cutting blades or an electric propulsion motor, while the petrol engine serves as a high-torque backup or primary driver for thick vegetation, often connected via a belt-drive or a shared transmission shaft. A switching circuit or hybrid controller is implemented to allow the user to toggle between silent solar-electric mode for light trimming and petrol mode for heavy-duty tasks, ensuring continuous operation even when battery levels are low or weather conditions are overcast.

The system's efficiency is further enhanced by an automatic charging loop where the petrol engine can sometimes drive an alternator to recharge the batteries during use, creating a self-sustaining energy cycle that minimizes external plug-in requirements. Finally, the entire assembly is governed by a control handle equipped with throttle and power-source selectors, allowing for seamless transitions between the two energy sources to optimize fuel consumption and reduce overall carbon emissions.

V. WORKING

The process begins with the solar energy harvesting stage where photovoltaic panels mounted on the top of the machine absorb sunlight to generate direct current which is then regulated by a solar charge controller and stored within a high-capacity rechargeable battery. For the electrical operation, this stored battery power is transmitted to a high-speed DC motor that spins the cutting blades at high revolutions per minute to efficiently trim light to medium grass. In scenarios where the grass is exceptionally thick or the battery level is depleted, the secondary power source consisting of a petrol-powered internal combustion engine is engaged to provide mechanical torque directly to the transmission system. A central control unit manages the transition between these two power modes by utilizing a switching mechanism that allows the operator to select the most efficient energy source for the specific task at hand.

The system often features a regenerative aspect where the petrol engine can drive a small alternator during its operation to recharge the battery while the machine is moving. This ensures that the mechanical energy from the fuel helps maintain the electrical reserves for future use, creating a continuous loop of energy availability that maximizes the machine's uptime while minimizing the overall carbon footprint compared to standard gasoline mowers.

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VI. BLOCK DIAGRAM

HARDWARE REQUIREMENT
• SOLAR PANEL
• 12V BATTERY
• SOLAR CHARGE CONTROLLER
• PETROL DRIVE SYSTEM
• DRIVE & CUTTING MECHANISM
• CONTROL & CHASSIS

VII. COMPONENTS DESCRIPTION

Solar Panel: A 20W–50W photovoltaic module that converts sunlight into electrical energy for the battery.
Charge Controller: A protective device that regulates the incoming solar voltage to prevent battery overcharging or deep discharge.
Rechargeable Battery: Typically a 12V Lead-Acid or Lithium-ion battery that stores energy to power the electric motor.
DC Motor: A high-RPM motor (usually 12V or 24V) that drives the cutting blades during silent, eco-friendly operation.
Switching Circuit: A set of heavy-duty relays and switches that allow the user to toggle between solar-electric and petrol power.
Petrol Engine Components
IC Engine: A 25cc to 50cc small-stroke petrol engine used for heavy-duty cutting and high-torque requirements.
Fuel Tank: A small reservoir (0.5L–1L) that stores the petrol needed for the internal combustion process.
Centrifugal Clutch: A mechanical component that engages the drive shaft only when the petrol engine reaches a specific speed.
Throttle Lever: A manual control used to adjust the engine speed and cutting intensity during petrol mode.
Structural and Cutting Hardware
Chassis: A rigid frame made of mild steel or aluminum that provides the structural base for both the engine and motor.
Cutting Blades: Hardened steel rotary blades designed to withstand high-impact forces from thick vegetation.
Transmission Belt/Pulley: A mechanical link that connects both power sources to a single cutting shaft.

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VIII. ADVANTAGES

Dual Power Reliability: Operates on petrol when the battery is low or on solar when fuel runs out.
High Torque: The petrol engine provides the necessary power to cut through thick, wet, or overgrown grass.
Silent Operation: The solar-electric mode allows for noise-free mowing in residential areas or early mornings.
Continuous Run-time: Unlike purely electric mowers, there is no need to stop for long charging cycles if petrol is available.
Reduced Fuel Costs: Uses free solar energy for light maintenance, significantly lowering overall petrol consumption.
Lower Emissions: Reduces the carbon footprint by utilizing clean energy for a portion of the workload.
Self-Charging: The solar panels trickle-charge the battery even when the mower is idle or in storage.
Low Maintenance: The electric motor has fewer moving parts than a petrol engine, reducing wear and tear during light use.

IX. LIMITATIONS

• Increased Weight: Carrying both a petrol engine and a heavy battery makes the machine harder to maneuver manually.
• Complex Maintenance: Requires upkeep for two different systems, including engine oil changes and battery health monitoring.
• Limited Solar Speed: Solar charging is slow; it can take several hours of direct sunlight to provide just one hour of cutting time.
• Weather Dependency: The solar efficiency drops significantly on cloudy or rainy days, making the machine rely entirely on petrol.
• Higher Initial Cost: Purchasing both a solar-electric setup and a petrol engine increases the upfront investment compared to a standard mower.
• Space Constraints: Fitting two power sources on one small chassis can lead to overheating or difficult access for repairs.
• Power Mismatch: The electric motor may struggle with the same thick grass that the petrol engine handles easily, leading to inconsistent performance.
• Battery Lifespan: Continuous deep discharging and exposure to outdoor heat can shorten the life of the rechargeable batteries.

X. CONCLUSION

The hybrid grass cutter represents an efficient and versatile solution that successfully bridges the gap between eco-friendly solar technology and high-performance petrol power. By integrating these two systems, the machine offers a sustainable alternative for modern landscaping that reduces carbon emissions without sacrificing the raw strength needed for demanding tasks. Ultimately, this dual-power approach ensures consistent operational reliability and long-term cost savings for diverse gardening environments.

XI. FUTURE SCOPE

The future scope of this technology lies in the integration of artificial intelligence and GPS to transform the hybrid mower into a fully autonomous, self-navigating robot that optimizes its energy consumption based on real-time grass density and weather forecasts.

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