

Solar-Operated Elephant Grass Cutting Machine

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Abstract: This paper presents the detailed design, fabrication, and field performance analysis of a solar-operated elephant grass cutting machine. Aimed at promoting sustainable agricultural mechanization, the machine is driven entirely by renewable solar energy, eliminating fuel dependency and reducing operational costs. The system integrates a 100W solar panel, a 12V, 20Ah battery, a 350W DC motor for the rotary cutter, and dual 12V DC motors for propulsion. The machine is constructed on a mild steel chassis

Keywords Solar Grass Cutter, Renewable Energy, Elephant Grass, Agricultural Mechanization, DC Motor, Self-Propelled System

1. INTRODUCTION

Elephant grass (*Pennisetum purpureum*), known for its high biomass yield, is extensively used as fodder in tropical regions. However, its robust stalk structure makes manual cutting labour-intensive and inefficient. Conventional grass cutters rely on fossil fuels, contributing to air pollution and recurring fuel costs. The proposed solar-operated elephant grass cutting machine addresses these challenges by combining environmental sustainability with rural usability. This research outlines the development.

2. Methodology

2.1 Problem Identification:

In semi-rural regions, laborers often manually cut elephant grass using sickles or outdated cutters. Surveys revealed challenges like physical fatigue, inconsistent cutting quality, and time inefficiency. A solar-based machine could mitigate these problems, enhancing productivity without increasing environmental impact.

2.2 Objectives and Requirements:

- Reduce human effort and increase cutting speed.
- Operate entirely on solar power without grid dependence.
- Use durable materials suitable for rugged outdoor environments.
- Maintain a simple design for ease of use and repair.
- Ensure affordability for small-scale farmers.

2.3 Conceptual Design:

The design process started with multiple CAD layouts and working simulations to verify feasibility. Design parameters like blade diameter, chassis clearance, battery size, and panel positioning were optimized through iteration.

2.4 Material Selection:

- Mild Steel: Used for frame due to strength and weldability.
- Rubber Wheels: 11-inch diameter for terrain adaptability.
- Polycarbonate Housing: Lightweight, corrosion-resistant cover for electronics.
- Monocrystalline Solar Panel: High efficiency and compact footprint.
- Lithium or Lead-Acid Battery: Balancing cost and performance.

2.5 Fabrication:

The frame was cut and welded to the specified dimensions. A tilted bracket was added for the solar panel. Motors and wheels were mounted using a keyed shaft system. Wiring was routed through protective sleeves to prevent dust.

2.6 Testing and Evaluation:

The machine was tested on actual elephant grass patches for runtime, torque delivery, grass cutting efficiency, and manoeuvrability. Data showed consistent performance with 30–35 minutes of uninterrupted operation under full load.

3. Design Specifications

- Frame Dimensions: 500 × 400 × 300 mm
- Battery: 12V, 20Ah
- Cutting Motor: 350W DC, 3000 RPM
- Drive Motors: 2 × 12V, 30 RPM geared motors
- Solar Panel: 100W, monocrystalline
- Wheels: 11" rubber tires
- Blade: 200 mm steel rotary blade

4. Diagrams

Fig. 1 Functional block diagram of the system.

Fig. 2: CAD Model

Fig. 3: Actual Model

Fig. 4: performance comparison chart

5. Performance Analysis

The machine successfully covered a 100 m² patch in 12 minutes with minimal operator fatigue. Runtime from a single charge was ~30 minutes, matching theoretical expectations. Power delivered by the blade motor was sufficient to cut grass up to 1 cm diameter. Energy loss due to mechanical resistance was within tolerable limits.

6. Conclusion

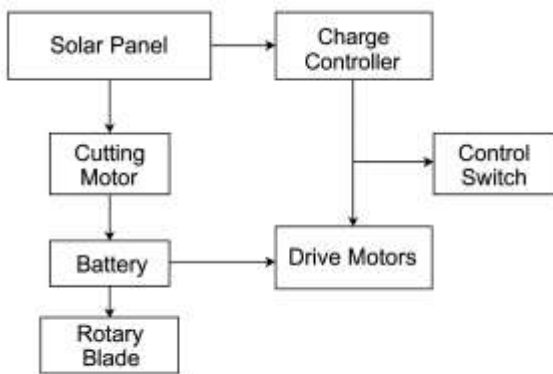
The developed system proved to be a viable alternative to traditional grass cutters, especially in energy-deficient rural regions. Its reliance on renewable power makes it both eco-friendly and economically sustainable. The design can be further improved with higher-capacity batteries or smart navigation modules.

Acknowledgement

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Block Diagram of Solar-Operated Elephant Grass Cutter

Fig. 1: Block Diagram of Solar-Operated Elephant Grass Cutter

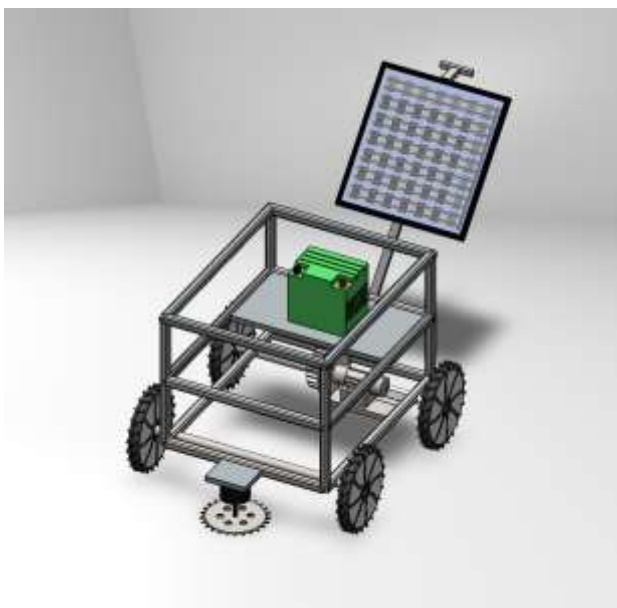


Fig. 2: CAD Model



Fig. 3: Actual Model

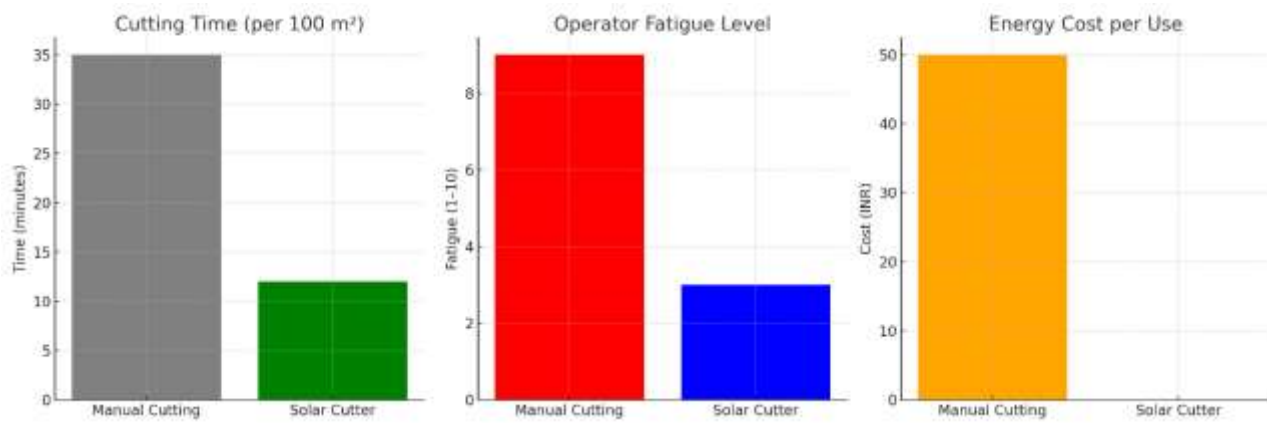


Fig. 4: performance comparison chart