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# DESIGN AND FABRICATION OF GRASS CUTTER

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**Reference**

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**ABSTRACT:** This study presents a battery-operated handheld lawn cutter and fabricated using locally available materials. The machine's design considered various factors such as durability, strength, light weight, assembly, and disassembly, making it cost-effective and flexible. The grass cutter's performance was tested, and the results show that it accurately cuts grass in a shorter amount of time, while maintaining 76 percent process efficiency. The machine's construction was precise, and the design allowed for greater mobility. This handheld grass cutter offers an alternative method for grass cutting that is less cumbersome and more efficient, saving time and costs. Overall, this study contributes to the development of affordable and locally-sourced machines that can support agricultural activities in rural areas.

**Keywords: Design, DC Motor, Batteries, Hand-held grass cutter, portable.**

## I. INTRODUCTION

The use of fuel-powered lawn mowers poses health risks to both the user and the environment. These devices emit dangerous toxins, which can irritate the respiratory system and worsen air pollution. Furthermore, the noise pollution generated by these machines can cause hearing damage and disturb the peace of the environment [1]. To address these issues, the development of eco-friendly lawn mowers presents an ideal solution. Electric powered machines not only reduce carbon emissions but also minimize noise pollution, making them a safer and healthier option [2]. The use of rechargeable batteries in these machines also eliminates the need for fuel, making them a more cost-effective solution for consumers in the long run. Moreover, the use of eco-friendly lawn mowers can also promote environmental awareness and encourage people to adopt sustainable practices in their daily lives. By using these machines, people can reduce their carbon footprint and contribute to a greener future [1].

In conclusion, the use of eco-friendly lawn mowers is a crucial step towards promoting environmental sustainability and reducing carbon emissions [3]. With the increasing awareness of the environmental impact of our actions, it is essential to adopt eco-friendly practices in all aspects of our lives. By switching to eco-friendly lawn mowers, we can contribute to a greener future and protect our planet for generations to come.

Overall, the development and fabrication of an eco-friendly hand-held grass cutter that addresses important factors such as durability, lightweight design, and environmental friendliness are significant steps towards promoting sustainable and green technology [3]. Such initiatives contribute to a healthier environment and help create a more sustainable future. The development of such an eco-friendly lawn mower presents an alternative solution to the environmental pollution caused by fuel-powered machines, promoting sustainable practices and contributing to a greener future [4].

## II. LITERATURE REVIEW

Design and development of grass cutter with low cost, light weight, eco friendly and easy to use is one of main concern and it has been carried out by many authors. Some of those literature were discussed below. Kakahy A.N et al. [5] studied the effects of different mower speeds and grass moisture contents on certain parameters, specifically the percentage of leaf area and stem length. The experiments were conducted on various grasses with three replications for each treatment. The mower speeds tested were 2000 rpm, 2200 rpm, 2500 rpm, and 2700 rpm. The grass moisture contents considered were 20.37% and 57.07% during the grass chopping process. Based on the experimental results, the best outcomes were obtained when using a mower speed of 2500 rpm and a grass moisture content of 20.37%. In this particular condition, the average values obtained were 81.03% for the percentage of leaf area and 82.08% for the percentage of stem length. It's important to note that the interpretation of these results is limited to the specific parameters mentioned. Other factors or variables may have been measured or observed in the experiments, but the information provided only focuses on the percentage of leaf area and stem length.

Sahu et al. [2] come up with the idea of mechanizing grass removal through a grass cutter is indeed a practical approach to reduce time and effort. There are various types of grass cutters available based on the power source they utilize, such as solar-powered, battery-powered electrical, and manual grass cutters. In its simplest construction, a grass cutter typically consists of a high-speed motor connected to one end of a holding rod. The operator hangs the rod on their shoulder and holds it with their hand. At the free end of the rod, a battery pack can be attached to provide power to the motor. Additionally, a solar panel can be incorporated to charge the batteries, enabling the grass cutter to run on solar energy. The high-speed motor attached to the grass cutter's rod spins a cutting mechanism, such as a blade or a line, which effectively trims or cuts the grass. The operator can maneuver the grass cutter over the areas where grass needs to be removed, and the spinning cutting mechanism does the job quickly and efficiently. By utilizing a mechanized grass cutter, the process of removing unwanted grass becomes less labor-intensive and time-consuming. It allows for faster and more effective grass clearance, benefiting agricultural fields, nurseries, and even household lawns or gardens.

Pita, M. and Sob, P.B [3] Common grass-cutting equipment is powered by pricey fuel and electricity that requires a lot of maintenance. In this research, a solar-powered lawn trimmer has been developed to maintain environmental cleanliness and minimise fuel use. The goal of this research is to develop a cost-effective, user-friendly, and environmentally responsible solar-powered lawn trimmer. The lawn trimmer's 180W 12V DC motor is powered by a 12V, 100AH battery. The battery is charged with a system voltage of 1000V from solar panels. The power going into the battery is managed by a 20A solar charge controller. The mower cuts the grass using blades made of sheet metal.

Li B and Li S [6] conducted research on backpack brush cutters, which are widely used as portable forestry equipment both domestically and abroad. The forestry operations industry, namely the disciplines of landscaping, garden maintenance, forest cleaning, forest caring, and crop harvesting, saw the majority of its employment. Accidents and occupational diseases linked to cutting irrigation activities are on the rise in China. The main cause of occupational diseases and risks for employees is improper cutting irrigation position. According to ergonomics, changing the shape and structure of the brush cutter would enable users to adopt more consistent postures, which will reduce the risk of musculoskeletal conditions and workplace accidents.

From the above literature it is noted that design of grass cutter is very popular and it has been improved overtime in many aspect such as fuel efficient, battery powered and solar powdered. In this research work, design and development of grass cutter has been carried out in the aspect lost cost, light weight with more efficiency with the locally available materials.

## III. OBJECTIVE

- Study on DC Motor and Batteries to reduce cost of manufacturing.
- To Design a lawn mower operating on batteries.
- To reduce operating cost and weight of the machine.
- To make it environment friendly.
- It is workable for untrained labourers.

## IV. METHODOLOGY

Basically, it consists of a circular shape PVC Pipe, DC Motor, Battery, Switch, Cutter Blade. In Operation the Electrical energy converted to Mechanical energy. The operator just needs to switch on the hand grass cutter and the Motor starts rotating the Blade and cutting operation takes place.


**Fig 1:**Flowchart of Methodology

## V. PROBLEM DEFINATION

The history of grass cutting is manually operated by hand devices like knives and scissors which consumes much more human efforts and consumption of time. While using engine powered machine the pollution of air and noise increase and it require higher maintenance. It is much costly in market and it's consist of heavy weight and it is even difficult regarding transportation.

## VI. WORKING PRINCIPAL

- Blade: The cutting blades are part of the lawn mower and are connected to the motor. When the motor rotates, it transfers the motion to the blades, causing them to spin and cut the grass.
- Motor: The motor is mounted inside the PVC pipe, which likely serves as the housing or frame for the lawn mower. The motor is responsible for generating the rotational motion that powers the blades. It is connected to the battery and the switchboard via connecting wires.
- Battery: The battery serves as the power source for the lawn mower. It provides electrical energy to the motor, allowing it to operate. The battery is connected to the motor through connecting wires, enabling the transfer of power.
- Connecting Wires: These wires establish the electrical connections between the motor, battery, and switchboard. They ensure the flow of electric current from the power source to the motor, enabling the blades to rotate and cut the grass.
- The switchboard is the source of electric current. It supplies the power required to run the lawn mower. The motor wires are directly connected to the switchboard, allowing the flow of electricity and initiating the operation of the motor and blades.

Overall, this setup enables the lawn mower to function by tapping into the electric current from the switchboard, powering the motor, and ultimately causing the blades to rotate and cut the grass.

## VII. MODELLING DESIGN

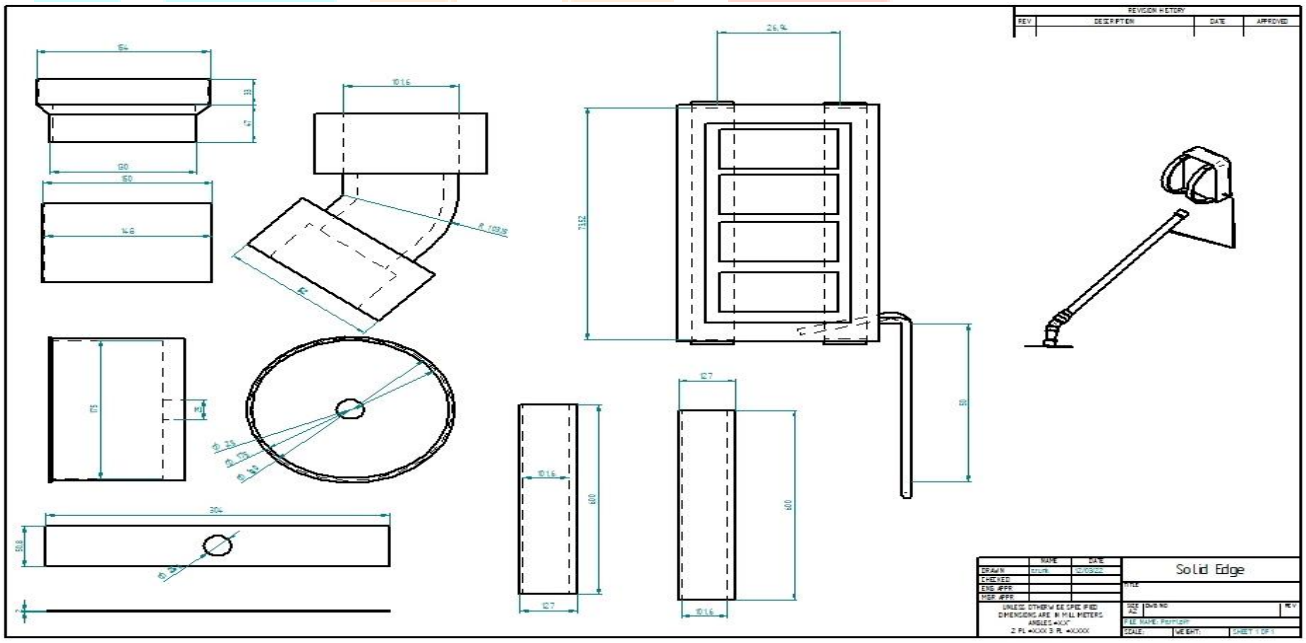


Fig 2:2D Diagram of Grass cutter


Fig 3:(a) 3D Model (b) Grass cutter used during

## VII. COMPONETS USED

| Item number | Part name | Specifications | Quantity | Material |
|---|---|---|---|---|
| 01. | PVC pipe | 124.46cm*12.4cm | 1 | Plastic |
| 02. | Dc motor | 12V | 1 | Magnetic steel |
| 03. | Battery | 12V*7Ah | 4 | |
| 04. | Elbow | 10cm*12dia | 1 | Plastic |
| 05. | End cap | 4cm | 2 | Plastic |
| 06. | Collar | 7cm*4cm | 2 | Plastic |
| 07. | Blade | 12in | 1 | Cast Iron |
| 08. | Wire | 1mm | 1m | Copper |
| 09. | Switch | 2-way switch | 1 | Plastic |
| 10. | Battery Charger | 12V*2A | 1 | Plastic |

## VIII. CALCULATION

Specifications

• Type: DC Gear Motor

• Voltage: 12 V

• Current: 1A

• Ohms: 12

• Weight of motor: 320g

•RPM: 6000

• Back Emf -By producing a back emf, the motor's armature generates a counteracting voltage that helps limit the current flowing through the motor windings. This is beneficial because it prevents excessive current that could lead to overheating and damage. The difference between the applied voltage and the back emf determines the net voltage across the motor, which in turn affects the motor's speed and torque characteristics.

Eb = 12V – 2.88V

= 9.12V

• Torque - Torque plays a fundamental role in various physical phenomena, such as the rotation of objects, the operation of engines and motors, and the behavior of systems involving rotational motion. It is commonly measured in units such as newton-meters (Nm) or foot-pounds (ft-lb) depending on the system of measurement used.

T = 60*Eb*Ia /2Pi* N

= 60*9.12*1 / 2Pi*6000

T = 14.514mNm

• Omega (w) , w = 2Pi N / 60

= 2pi*6000/60

w = 628.32 watts

• Input power of the motor

Pin = V*I

V = voltage

I = Current

Pin = 12*1

= 12

• Output power of the motor

Pout = Torque*Omega

Pout = T*w

= 0.014519*628.32

= 9.12

• Motor efficiency

= (Pout / Pin) *100

= (9.119 /12) *100

= 76

## IX. CONCLUSION

This study aimed to analyze the factors contributing to occupational injuries during brush cutter operation and propose design improvements to enhance safety. The researchers focused on incorporating ergonomic design factors while discarding elements that did not conform to ergonomic principles. As a result, an electrically operated brush cutter is developed and tested for performance. Here are the key features of the electric brush cutter:

1. Extended Operation Time: The electrical circuit of the brush cutter includes a charging device that allows for continuous operation of up to 4 hours when fully charged. This feature ensures a longer duration of use without the need for frequent recharging.
2. Noise Reduction: Unlike traditional lawn mowers and brush cutters, this electric brush cutter has been designed to eliminate the noise typically associated with such equipment. This reduction in noise levels helps create a quieter working environment.
3. Lightweight and Maneuverable: The brush cutter has the advantage of being lightweight, making it easier to handle and maneuver during operation. This feature enhances the user's ability to control the equipment effectively, resulting in improved overall performance.
4. Ergonomic Handle Design: The handle of the brush cutter has been redesigned to incorporate ergonomic principles. Through experimentation and analysis of relevant formulas, a series of product sizes with improved ergonomics has been developed. This design modification aims to enhance the fit between the human body and the equipment, reducing the likelihood of occupational diseases caused by poor working posture.
5. Blade Protective Cover: The brush cutter features a blade protective cover. The position of the blade in relation to the user's feet includes a blade guard, which ensures that the top of the blade remains at a plane higher than the user's feet. This design prevents hard objects from causing harm to the user's body during operation.

Overall, these improvements in the electric brush cutter contribute to a safer and more user-friendly experience, addressing factors that contribute to occupational injuries while prioritizing ergonomic design principles.

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