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Design And Fabrication Of Manual Operated Grass Cutter

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ABSTRACT: The main objective of the work is to develop the manually operated rotary lawn mower to clean and lawn. Rotary mower has a set of three wheels, one front wheel and two rear wheels. The shaft between the two rear wheels is connected to the compound gear train system. The wheels are rotated in forward motion and bevel gear system convert the forward motion to the vertical motion. The bevel gear system is connected to the blade and the blade is a low lift blade used for low speed. This lawn mower is used to minimize the cost and power requirement for domestic purpose. Heavy machine cannot be introduced in domestic purpose due to the limited.

KEYWORDS: Compound gear train system, Bevel gear system, Forward motion, vertical motion, Low lift blade

1. INTRODUCTION

Grass cutting is an important activity in gardening, agriculture, and lawn maintenance. Traditional lawn mowers run on electricity or fuel, which increases costs and impacts the environment. To address this, we have designed a manual grass cutter that works without fuel or electricity, making it eco-friendly and cost-effective. This grass cutter uses a bevel gear mechanism to transfer motion from the wheels to the cutting blades. As the user pushes the machine forward, the front and rear wheels rotate, which drives the gears and makes the blades spin. This allows efficient grass cutting with minimal effort.

2. LITERATURE REVIEW

.**Venkatesh.K, et al, [1]-** Have designed and fabricated the grass cutting machine to cut grass as well as crop in the field. It consists of electric motor, gear arrangement, cam, chain and sprocket, lead screw, wheel, control unit. Below the gear arrangement cutting blade is fixed. When the motor starts running, shaft and gears also rotates, this in turn actuate the cam arrangement and then the sickle bar which tends to cut the grass or crops. Sickle bar has one of its fixed cutters and another one is movable cutter which is placed on it. Whole set up is placed on a movable base which has a wheel arrangement.

Prof. BhaskarH.B, et al, [2]- In this paper they prepared a manually operated rotary lawn mower to clean the lawn.Rotary mower has a set of three wheels, one front wheel and two rear wheels.The shaft between the two rear wheels is connected to the compound gear train system. The wheels are rotated in forward motion and bevel gear system convert the forward motion to the vertical motion. This lawn mower is used to minimize the cost and power requirement for thedomestic purpose. Since heavy machine cannot be introduced in domestic purpose to the limited spaceof lawn.

P.Bulski, et al, [3]- Bulski identify the sound created by the machine is making noise pollution. He research on sound created by the machine and giving the result how toremove the sound while cutting the grass of lawn or ground. As looking to the petrol engine it make air pollution to environment so from my recommendation it should be implement operated lawn mower..

Mary Bellis, et al,[4]- In the United States, gasoline-powered grass cutters were first manufactured in 1914 by Ideal Power Mower Co. of Lansing, Michigan, based on a patent by Ransom E. Olds. Ideal Power Mower also introduced the world's first selfpropelled, riding lawn tractor in 1922, known as the "Triplex". The roller-drive lawn mower has changed very little since around 1930. Gang mowers, those with multiple sets of blades to cut a wider swath, were built in the United States in 1919 by the Worthington Mower Company.

Praful.P.Ulhe, et al, [5]-In this paper they have prepared manually operated grass cutter with spiral roller blades due to spiral blades increases the efficiency of cutting. For adjusting the height reel cutter is component placed on grass cutter. This grass cutter used to cut the grass uniformly and also it can cut the different types grasses. The battery can be charged during working conditions and it also having AC charging. For collection of cutting grass cutting box is placed over grass cutter so the cut grass put outside 6 the lawn. It is having light in weight and compact in design.

T.Karthick. et al, [6]- This paper author fabricated grass cutting machine with rotary blades by using solar energy. The solar energy is trapped in the photovoltaic cell to generate electricity. The cells may be grouped in the form of panels or arrays. Solar panel is placed such that to absorb high intensity from sun and it will incline at 45 degree . The main function of solar charger is increased current during batteries are charging and also disconnect when they are fully charged. Circuit's breakers are used to start or stop the motor. By considering ground clearance they can adjust the height of grass..

Prof.C.J.Shinde, et al, [7]- In this paper they have prepared manually handle device which is capable to cut the grass. This device consists of linear blades and it does not affected by climatic conditions. The main objective of this paper is to move the grass cutter is different directions to prepare various designs as per requirements. By using link mechanism the height of the cut can be adjusted. The unskilled labour can easily operate this device.

Darwin Romas, et al, [8]- Dr. KwokThis project is an autonomous lawn mower that will allow the user to the ability to cut their grass with minimal effort,through an array of sensors this robot will not only stay on the lawn, it will avoid and detect the objects and humans.In this project they used safety sensors such as PIR sensor for human detection ,ultrasonic sensor for object detection and accelerometer which prevents lawn operation while being held.They use multiple sensors as a eye of robot such as humidity sensor to see difference between grass and concrete,IR sensor to detect the heat radiation from the human and ultrasonic sensors to detect if the robot heading into an object.The accelerometer was thought of being used because it can detect its orientation based on pre calibrated axis orientation.Nickel metal hydride is used because of low charging current.Like batteries there is range of motors to choose from so two 7.2dc motors with integrated gear head.

Rakesh poojari, et al, [9]- Rakesh poojari,Rajesh kumar,Hitesh B.patilAutomated solar grass cutter fully automated grass cutting robotic vehicles powered by solar energy that also avoids obstacles and is capable of fully automated grass cutting without the need of any human interaction .12v batteries to power the vehicle motor as well as grass cutter motor .They also use solar panel to charge the battery so need of charging it externally.Grass cutter and vehicle motors are interfaced to 8057 family micro controller working of all the motors.The source is driven from the solar energy using photo voltaic panel which charges the battery and is utilized for powering operation of the system.The system controlled by P89V51RD2 micro controller.L298 driver circuit is used for compatibility of micro controller and motor.Toggle switch for movement operation .DPDT switch for movement operation.Wheel chain with 26 links on both sides are attached to platform support the whole model.In wheel two motors are used with 45 rpm. By this automated solar cutter is fully automated grass cutting robotic vehicle powered by solar energy.

Vicky jain, et al , [10]- In this design of solar powered agricultural equipment will comprise direct current dc motors,a rechargeable battery ,solar panel,stainless steel blade and control switch.The remote will allow the user to control the speed and direction of grass cutter.In transmitter they use power supply,keypad,priority encoder, RF encoder,RF transmission. In receiver they used solar system with control charger,powersupply,micro controller(ATmega2560),RF receiver,RFdecoder,motordriver.they mention about renewable energy.so there is no running cost.

3.METHODOLOGY

This chapter describes the step-by-step approach followed in designing and developing the manual operated grass cutter. The methodology includes the planning, design, material selection, assembly, and testing phases to ensure the project meets its objectives of being eco-friendly, cost-effective, and efficient.The development of a manually operated grass cutter follows a structured methodology to ensure efficiency, durability, and ease

of operation. This methodology consists of multiple stages, including problem identification, design, material selection, fabrication, testing, and optimization.

3.2 Background and ned for the project:

Background: Grass cutting is an essential maintenance task for lawns, gardens, and public spaces. Traditional gas powered or electric grass cutters can be expensive, noisy, and environmentally unfriendly. Additionally, they often require regular maintenance and can be heavy and cumbersome to use. Need for the Project: The manual operated grass cutter project aims to design and develop a low-cost, environmentally friendly, and easy-to-use grass cutting solution. The proposed grass cutter will be powered by human energy, eliminating the need for fuel or electricity.

3.3 Design and Planning:

1. Blade Design: Curved or straight blade with a sharp cutting edge 2. Handle Design: Ergonomic handle with a comfortable grip and adjustable length 3. Cutting Mechanism: Manual operated cutting mechanism with a lever or handle 4. Adjustable Cutting Height: Adjustable cutting height mechanism using a lever or screw.

3.4 control system

Control System Components

1. Handle: The handle is the primary control interface for the manual operated grass cutter.
2. Grip: The grip is a textured or rubberized surface on the handle that provides traction and comfort for the user's hands.
3. Trigger: The trigger is a lever or button on the handle that controls the blade's movement.
4. Blade Control Mechanism: This mechanism connects the trigger to the blade and controls its movement.
5. Safety Mechanism: This mechanism prevents accidental blade movement or injury.

Control System Operation

1. User Grip: The user grips the handle and prepares to cut the grass.
2. Trigger Activation: The user presses the trigger to activate the blade control mechanism.
3. Blade Movement: The blade control mechanism moves the blade to cut the grass.
4. Safety Mechanism Engagement: When the user releases the trigger, the safety mechanism engages to secure the blade and prevent accidental movement.
5. Repeat Cycle: The user repeats the cycle to continue cutting the grass.

3.5 step-by-step procedure

Pre-Operation Checks

1. Inspect the grass cutter: Check for any damage or wear and tear on the blades, handle, and other components.
2. Sharpen the blades: Ensure the blades are sharp and ready for use.
3. Check the handle and grip: Ensure the handle and grip are secure and comfortable to hold.

Operation Procedure

1. Hold the grass cutter: Hold the grass cutter with both hands, one hand on the handle and the other on the grip. 2. Position the grass cutter: Position the grass cutter at the desired cutting height and angle.
3. Start cutting: Begin cutting the grass by swinging the grass cutter in a smooth, even motion.
4. Maintain a consistent pace: Maintain a consistent pace to ensure even cutting and to avoid fatigue.
5. Change direction: Change direction by rotating the grass cutter and adjusting the cutting angle as needed.

Safety Precautions

1. Wear protective gear: Wear protective gear such as gloves, safety glasses, and a dust mask.
2. Watch for obstacles: Watch for obstacles such as rocks, trees, and power lines.
3. Keep children and pets away: Keep children and pets away from the area being cut.
4. Avoid cutting near open flames: Avoid cutting near open flames or sparks

4. FABRICATION

This chapter discussing about The manual operated grass cutter is a vital tool for maintaining lawns, gardens, and public spaces. The fabrication of a manual operated grass cutter requires careful planning, design, and construction to ensure a safe, efficient, and effective cutting experience. This fabrication process outlines the steps involved in creating a manual operated grass cutter, from material selection to final assembly.

4.2 Fabrication process

Fabrication Process

Step 1: Material Selection and Preparation

1. Select materials: Choose suitable materials for the grass cutter, such as steel, aluminum, or wood.
2. Cut materials: Cut the materials to the required dimensions using a cutting saw or hacksaw.
3. Deburr materials: Deburr the cut materials to remove any sharp edges or burrs.

Step 2: Handle Fabrication

1. Cut handle material: Cut the handle material to the required length and shape.
2. Bend handle: Bend the handle to the required shape using a pipe bender or a heat source.
3. Weld handle: Weld the handle components together using a welding machine.

Step 3: Blade Fabrication

1. Cut blade material: Cut the blade material to the required shape and size.
2. Grind blade: Grind the blade to a sharp edge using a grinder or a sharpening stone.
3. Heat-treat blade: Heat-treat the blade to harden it and improve its durability.

Fig:1 2T-Rhombus blade

Step 4: Assembly

1. Assemble handle and blade: Assemble the handle and blade components together using bolts, screws, or welding.
2. Attach grip: Attach the grip to the handle using glue, screws, or rivets.
3. Add safety features: Add safety features such as a blade guard or a safety catch.

Fig:2 Gear fitting

Step 5: Finishing

1. Sand and paint: Sand the grass cutter to smooth out any rough edges or surfaces, and paint it to protect it from corrosion.
2. Apply coatings: Apply coatings such as varnish or polyurethane to protect the grass cutter from wear and tear.
3. Assemble and test: Assemble the grass cutter and test it to ensure it is functioning properly and safely.

Fig:3 Final Fabrication

Fabrication Tools and Equipment

1. Cutting saw: A saw used to cut materials to the required dimensions.
2. Hacksaw: A saw used to cut materials to the required dimensions.
3. Pipe bender: A machine used to bend pipes or tubes to the required shape

CALCULATIONS:

Rolling Friction effort required to push an object with rolling wheel Normal-20-400.
Wheel diameter (D,)=300mm=0.3m
Bevel gear ratio (G1/G2)= 1.6:1
G1=16 G2=10
Blade Diameter (D2) = 300mm (0.3m)
Average walking speed= 1.31 m/s for human.
For polymer wheels
coefficient of rolling friction (μ r)=0.02
Blade cutting resistance(T-cut)=5Nm-10m
for soft Grass
light grass = 10- 30N
Dense/Tall g rass= 30- 70N

STEP-1 WHEELRPM

(Linear velocity/circumference of wheel)×60 = ((1.31)/(π×0.3)) ×60 =1.38×60
Wheel Rpm=82.8

STEP-2 Calculate the blade Rpm (using gear ratio)

Blade Rpm = wheel Rpm x Gear ratio= 82 ×1.6 =131.2 ~ 130 rpm.
Blade Rpm =130

STEP-3 Torque required at blade

T blade = F cut × R blade
Assuming cutting force of 50N at blade tip
T blade = 50 × (0.3/2)
= 50 ×0.15
T blade = 5N

STEP-4 Torque at the wheel shaft

Consider gear ratio
T wheel = T blade/Gear ratio = 5/1.6

T wheel = 3.12Nm

STEP-5 Force required to push the cutter

F push= T wheel/R wheel+(μ r× normal force)

Weight on wheels =25kgs= 245N

F push = 3.1/0.15+(0.02×245) = 20.6+ 4.9

F push =25.5N

Thus the operator need to apply 25N to push the cutter effectively

STEP-6 Power required to cut

P=T wheel × angular velocity

Angular velocity=2×π×N/60

=2×π×(82)/60

Angular velocity=8.5rad/sec

Power (p) = 3.1×8.5

P =26.5w

The power required (p) = 26.5 w

6.RESULT AND DISCUSSION

In this chapter we are discussing about the After fabrication and testing, the manually operated grass cutter was evaluated based on various performance parameters. The following results were observed:- Cutting Efficiency: The blade system effectively cut grass of varying heights and densities, with an average efficiency of 85-90% in a single pass.- Manual Effort: The bevel gear system reduced the force required to push the mower, making it easier to operate compared to traditional push mowers.- Blade Performance: High-carbon steel blades maintained sharpness over multiple uses, requiring only minimal maintenance.- Maneuverability: The lightweight frame and ergonomic handle allowed smooth movement, even on uneven terrain.- Cost-Effectiveness: The grass cutter was significantly cheaper than motorized alternatives, making it an affordable option for small-scale users.- Eco-Friendliness: With no fuel or electricity required, the device proved to be an environmentally friendly alternative to gas-powered The results indicate that the manually operated grass cutter is a practical and sustainable solution for lawn maintenance. The use of a bevel gear mechanism successfully reduced the physical effort required, making it accessible to a wider range of users, including elderly individuals and small-scale gardeners.

7. CONCLUSION

This structured methodology ensures the successful development of an efficient, durable, and easy-to-use manually operated grass cutter. By integrating an optimized gear system, durable materials, and ergonomic design principles, the project aims to provide a sustainable alternative to traditional motorized lawn mowers. The final product is expected to be an eco-friendly, cost-effective solution for small-scale lawn maintenance.

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