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Introducing a Solar Powered Grass Cutter as Environment Friendly Machine

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Abstract- *Grass cutter is a device used to cut grass and to keep field and surrounding free from extra grass. Various office, rest house, playground of sports club, campus of various educational institute, camp of various armed forced battalion have to cut extra grass regularly to keep their surrounding clean. Grass cutter of various design have been used now a days powered by engines run on fuel. This emits carbon in the environment. So this grass cutting operation used to clean surrounding make environment polluted. Moreover it is expensive because of high price of fuel. In this study a grass cutter was made that run using solar power as well as electricity (in case of necessary).This cutter is able to work equal to the cutter available in market now a days. It has two wheels and handle with control panel which any person can operate the machine easily. Its physical design also helps the operator to work comfortably. This cutter can also useable to cut paddy or other crops. From this study it was found that using this cutter all over the country save huge amount of fuel with zero carbon emission. It also cost effective and friendly to use this cutter than the running available grass cutter.*

Keywords: Grass Cutter, Environment Friendly, Solar Powered, Cost Effective.

1. INTRODUCTION

From very early man like to keep his premises beautiful and clean. The surrounding and yard of where people live grow various forest tree and grass. People have to take regular care to keep their premises clean. Along with personal residence, premises of various offices, educational institute need to keep free of grass and other foreign tree to increase beauty and freshness. Grass cutter is a machine used to cut grass and foreign tree to keep the premises clean. The most of the grass cutter available in today's market is of IC engine type those run on fuel. This consume about 250 g fuel generally petrol. Use of IC engine cutter release huge amount of carbon in the environment. Cost of fuel is also considerable. Operator have carry the weight of this kind of cutter. For this working with this is difficult for operator. To keep environment clean and reduce use of fuel a solar powered grass cutter has been designed in this research work. This ensures the use of renewable energy. In case of long time cloudy environment this can be used by charging using electricity. in this cutter AC motor has been used to rotate cutter. So if one want he can use it with the AC power supply directly.

The study is to ensure the use of renewable energy and to reduce the load on national greed this work has been done.

2. PROPOSED DESIGN

Mechanical Design: The cutter is designed as a two-wheel vehicle. The body bed is 0.45 m long and 0.3 m wide horizontal bed. The two wheel is off 0.3 m bicycle wheel. The cutting blade is attached in front of the body. The battery is attached at the front half of the bed to balance the weight of the handle. The charger and solar current controller is attached along shaft of wheel for balancing its weight. The height of the handle is taken as 1m for the comfort of operator. The height of the bed is 0.15m that will help it to run over surface which is not plane. The cutter is at 0.05m above surface. That will permit to cut grass at a height of 0.05m. According requirement of the size of grass this can be adjust during fitting.

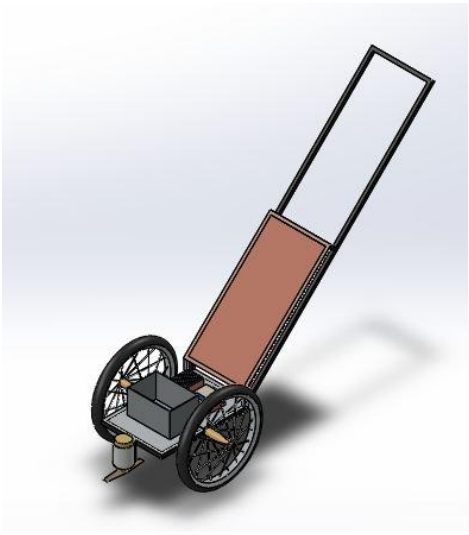

Fig1: Schematic view of proposed design.

The solar panel is attached with the handle to permit clear view of cutting point. The blade is of 0.225 m diameter. So the blade will cut 75% of the vehicle width.

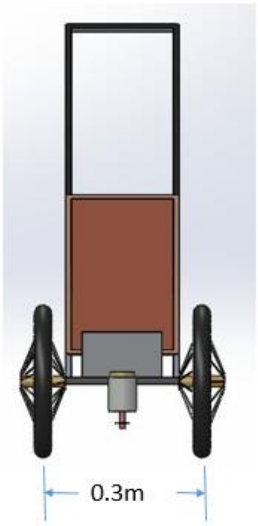

Fig 2: Front view of the cutter

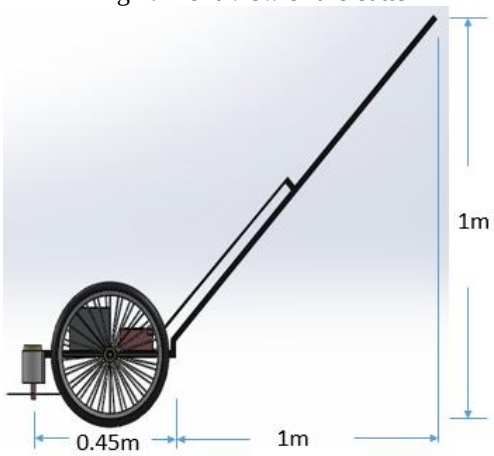

Fig 3: Right Side View of the cutter.

3.1 Mechanical Design and Components

Considered the design and dimensions of the components as given.

Length of cutting blade $L = 0.22m$

Width $W = 0.025m$

Area of blade $A = L \times W = 0.22 \times 0.025\ m^2$
$= 0.0058\ m^2$

Fig4: Cutting Blade

Volume $V = A \times t = .0058x0.00254$
$= 1.47 \times 10^{-5}\ m^3$

Density of steel $\rho = 7850\ m^3$

Mass of blade: $\rho \times V = 7850 \times 1.47 \times 10^{-5}\ kg$

Torque required to turn the blade:
$= Weight \times radius\ of\ blade$
$= 1.47 \times 10^{-5} \times 9.81 \times 0.112$
$= 1.613 \times 10^{-5}\ Nm$

A 150 watt electric motor is enough to rotate this blade and cutting grass.

3.2 Forward Velocity

Forward distance covered 30 meter

Time= 60 sec

Average forward Capacity 0.5 m/s.

3.3 Field Capacity

Theoretical Field Efficiency= Forward Distance Covered × Width of blade

$TFC = 0.5 \times 0.2254\ m^2/s = 0.1127\ m^2/s$

3.4 Electrical Design

Diagram of electric circuit is given below

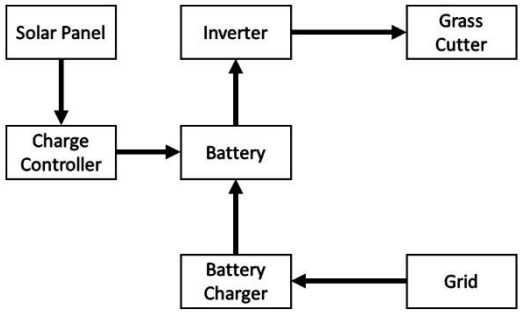

Fig 4: Block diagram of electric circuit

Electrical Load: AC motor 150W

Power factor = 0.8

Design Load = $150/0.8 = 187.5$ W

Considering 70% efficiency of inverter,

Size of inverter = $187.5 + (1/0.8) = 188.75$ W

So an inverter of 300W or 600W rating available in the market is perfect.

3.5 Battery Bank

Total Load of Battery Bank = (Total Load ×

Backup Capacity) / Battery Bank Voltage

Total Load of Battery Bank $= (150 \times 2)/12 \ = 25$ AH

Wire Loss Factor (LF) = 20%

Battery Aging Factor (Ag) =20%

Efficiency of battery $n = 90\%$

Depth of discharge DOD $= 50\%$

Size of Battery Bank $= [\,(Load) \times (1 + LF) \times (1 + Ag)] \,/\, [n \times DOD]$ AH

4. COMPONENT LIST

SL no.	Component Name	Rating
1.	Solar Panel	150W
2.	Solar Charge Controller	10A, 300W
3.	Inverter	600W
4.	Battery	80AH, 12V, C/rate: 8
5.	Battery Charger	12V, 8 A
6.	Wire	
7.	Blade	
8.	Chassis with handle	
9.	Wheel	
10.	Bearing	
11.	Battery Connector	

5. ADVANTAGES

i. Run on solar power. So no fuel is used and no carbon emission happen.

ii. Ensure the use of renewable energy.

iii. Can be charged with electricity too in case of emergency.

iv. For using AC motor in case of availability of source of electricity near the operating area, directly ac current can be used.

v. So the ability of using solar power, charging ability by electricity and ability of using AC current give it a flexibility of using power.

vi. Since wheel bear the load, easy to operate.

6. DISCUSSION

Conventional cutter in Bangladesh uses fuel to run. In this research work a cutter is designed to run with solar power. The design is economic according to our country. This will cost 12000-15000 taka to make a single unit. For batch production this cost will reduce some amount. But to make it more effective some change can be made. Here lad acid battery is used which is less effective. Lithium-ion can be used to reduce the size of the vehicle and increase the backup hour. Here one motor is used but using three motor on a triangular frame will increase the working area. The handle can be made adjustable to make comfortable for any height or any age of people.

7. REFERENCES

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Size of Battery Bank $= (25 \times (1 + 20\%) \times (1 + 20\%)) \,/\, (90\% \times 50\%)$ AH

Size of Battery Bank= 80 AH

3.6 Solar Panel

12V 80 AH battery stored energy $= 12 \times 80 = 960\ Whr$

So a single 150 W Solar panel can be used to charge the battery. It will take approximately 6.4 hours to charge.

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8. NOMENCLATURE

Symbol	Meaning	Unit
LF	Wire Loss factor	Dimension less
Ag	Battery Aging factor	Dimension less
n	Efficiency of battery	Dimension less
ρ	Density of blade material	Kg/m^3
A	Area of blade	m^2
V	Volume of blade	m^3
t	Thickness of blade	m