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Design and Analysis of Wireless Remote Controlled Lawn Mower

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Abstract—*A lawn mower is a device which is used to mow i.e. cut the grass in a lawn to an even height. It can be operated manually or by some energy conversion. Generally these are powered by electric motor or internal combustion engine. In this paper, effort has been made to modify the old mower to improve its usability. An all new design is made and analyzed using ANSYS. The overall geometry is made smaller and lighter. Adjustable cutting motor height is introduced for better mowing of grass at intricate locations.*

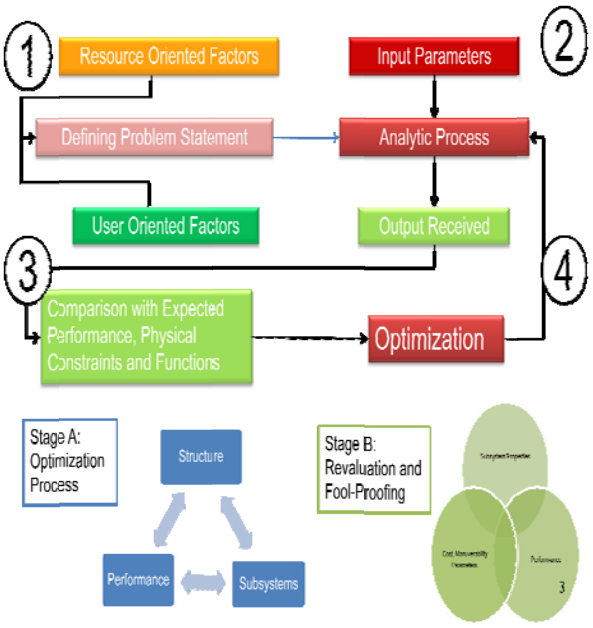
1. INTRODUCTION

A lawn mower is a machine that is used to cut grass in a lawn. The blades of the lawn mower are generally powered by pushing the mower forward. The blades may also be rotated by an electric motor or an IC engine. Several types of mowers exist, each suited for to a particular purpose. From 2012 onwards, there is shifting trend, about 15 times form traditional hand-guided or ride on mowers to automatic electric mowers. Since 1830, there have been various lawn mower designs that have been created. These designs include push lawn mowers, which are suitable for smaller lawns, and the ride-on mowers, which are capable to cut grass in larger lawns [1]. Other more recent models of the lawn mower contain corded and cordless electric power. Cordless electric powered lawn mowers are powered by 12 volt rechargeable batteries. Cordless mowers have the maneuverability of a gasoline powered mower and the environmental friendliness of a corded electric lawn mower [2].

The lawn mower considered for study in this paper was quite large, heavy, is AC powered and is hand propelled. There is a need felt to make it smaller, lighter and DC powered for better handling and endurance. An effort has been made in this paper to implement the same.

2. METHODOLOGY /FLOWCHART

The steps followed for the analysis of lawn mower is represented in the form of a flowchart as depicted in the figure below.



3. ANALYSIS

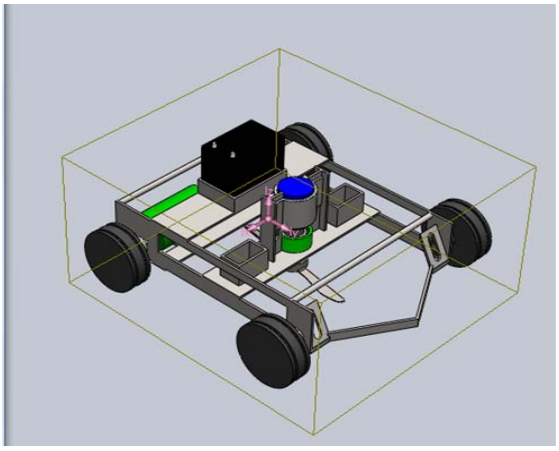
The analysis of the lawn mower is now presented using ANSYS. The data taken as input are voltage, rpm of the motor and current.

4. CALULATIONS

Battery power, P = V x I = 12 x 3.4 = 40.8 W

Angular velocity, N = 180 RPM = 18.85 rad/s

So, driving torque, T = 3.514 Nm



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Mass properties of Lawn Mower
   Configuration: Default
   Coordinate system: -- default --

Mass = 20150.64 grams

Volume = 8387976.60  cubic millimeters

Surface area = 1249716.80  square millimeters

Center of mass: ( millimeters )
    X = 157.75
    Y = 313.43
    Z = 476.92

Principal axes of inertia and principal moments of inertia: ( grams * square millimeter
Taken at the center of mass.
     Ix = (0.01, -0.00, 1.00)     Px = 536026644.95
     Iy = (1.00, -0.02, -0.01)    Py = 568853795.82
     Iz = (0.02, 1.00, -0.00)     Pz = 977861807.33

Moments of inertia: ( grams * square millimeters )
Taken at the center of mass and aligned with the output coordinate system.
     Lxx = 569044728.05      Lxy = -9001006.42      Lxz = 487781.99
     Lyx = -9001006.42       Lyy = 977663630.01     Lyz = 2116.93
     Lzx = 487781.99         Lzy = 2116.93          Lzz = 536033890.03

Moments of inertia: ( grams * square millimeters )
Taken at the output coordinate system.
     Ixx = 7131811291.95     Ixy = 987314765.45     Ixz = 1516508906.37
     Iyx = 987314765.45      Iyy = 6062380314.01    Iyz = 3012078142.80
     Izx = 1516508906.37     Izy = 3012078142.80    Izz = 3017003844.82
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Fig. 1: Estimated Mass and Inertia Properties

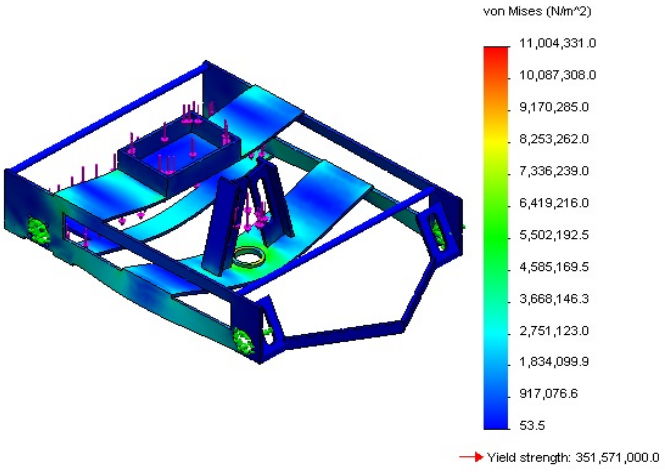

Fig. 2: Von-Mises Stress developed

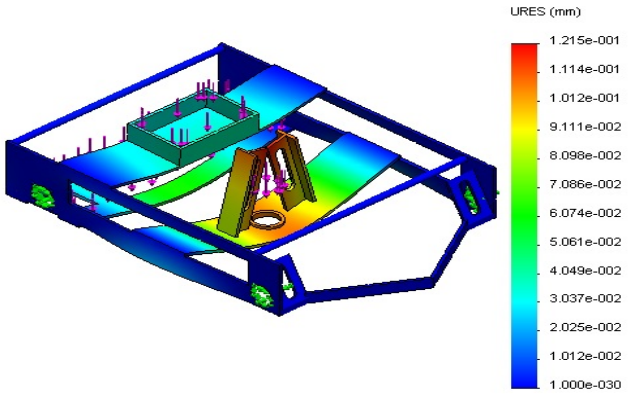

Fig. 3: Deflection of Base

5. THEORETICAL AND PRACTICAL CORRELATION

Table 1: Correlation of Theoretical and Practical Aspects

Properties	Theoretical	Practical
Mass/Weight(Kg/N)	20.15/197.67	22.3/218.76
Dimensions	18” x 18” x 12”	19" x 18" x 10.5"
Driving Motor RPM, N2	180	155
Cutting Motor RPM, N1	800	750
Estd. Driving Torque, T2 (Nm)	2.08	3.514
Blade Material	HSS	HSS
Base Material	AISI 1020	MS

The actual diagrams of the lawn mower after modifications have been shown in Fig. 4 and Fig. 5.

Fig. 4: Plan of lawn mower

Fig. 5: Elevation of lawn mower

Finally, a much efficient and environmental friendly lawn mowing machine has been designed which can be easily implemented in any application with little training to the operator.

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