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Solar Powered Tricycle for Handicapped Person

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***Abstract* - The basic tricycle is a three-wheeled, which is pedaled by disabled person who is sitting in the middle of seating arrangement provided. The ride in these tricycle's is mostly affected by rough, uneven conditions and potholes in India. In this paper, we have discussed how to utilize Solar power and drive the brushless DC motor, controller, battery, throttle, and other components to reduce human effort.**

***Index Terms* - Tricycle; Solar power; Handicapped person; Battery**

I. INTRODUCTION

The fast depletion of fossil fuels due to exponential increase in demand and global warming due to the emission of CO2 made engineers and scientists to look for an alternative source of energy which is renewable, eco-friendly, affordable and available. Among the renewable sources like wind, tidal, geothermal and solar energy, solar power is promising in nations like India which is in the tropical region. Also, India spends a lot of foreign resource on crude oil. With the use of solar power assisted vehicles, the dependency on the import of crude oil can be reduced and reasonable amount of foreign exchange can be saved

II. PROBLEM DEFINATION

A. Problems Faced by Handicapped Peoples

Fig 1-Hand Operated Tricycle

In present scenario, a physically handicapped person needs to put lot of effort to travel from one place to another. Additionally, the person cannot travel a long distance with the help of a normal person. Therefore, it is need of the hour to provide them a seamless transportation service.

So, it is time to overcome this problem by fabricating a solar wheelchair which will be available at an optimal cost so that it can be reached to persons with physical disabilities to make their life easy and productive.

III. OBJECTIVES

To overcome the problems faced by handicapped person, this project needs to do some research and studying to develop reliable mode of transport. There is list of the objectives to be conduct before continuing to proceed on this project.

1. To build a green vehicle that runs for free purely off of the sun's energy.
2. To eliminate the need to drive handicapped person everywhere, especially short trips.
3. Promote the usage of green alternative energies.
4. To develop a vehicle that use renewable energy, environmentally friendly and cheap.
5. To develop low speed tricycle, but for a longer distance close.
6. To design a tricycle with attachable and detachable arrangement of solar panel as well as front wheel.
7. To design a tricycle that works on throttle to reduce manual effort.
8. To advance the tricycle that can charge even when travelling by addition of foldable solar panel.

IV. METHODOLOGY

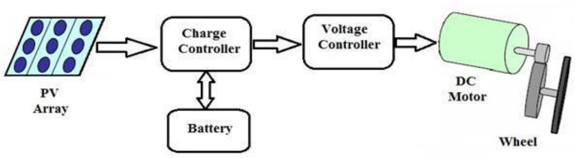

Fig. 2: Flow Diagram of the solar power system

V.DESIGN CONSIDERATIONS

1.SOLAR PANEL

Fig 3. Solar panel

2.Shaft

Shaft is a rotating machine element, usually circular in cross section, which is used to transmit power from one part to another, or from a machine which produces power to a machine which absorbs power. The various members such as pulleys and gears are mounted on it.

Specification of shaft:
• Material- mild steel
• Shaft diameter-15m

Calculations:
Weight calculation of Mild Steel
35x25x3 hollow rectangle bracket Weight calculation of mild steel angle
Weight = volume *density
We need to calculate volume
Volume = A - B
= (0.035x 0.025x 1) - (0.029 x 0.019x 1)
= 0.000324 m^3
Density of MS = 7850 kg/m^3
0.000324 x 7850
=2.54 kg
Its value for 1-meter mild steel rod

3.Frame Design

Frame design for safety for 35*25*3 square hallow mild steel channel
b = 35 mm, d= 25 mm, t = 3 mm.
Consider the maximum load on the frame to be 50 kg.
Max. Bending moment=force*per. distance
= 50*9.81*460
M =225630 Nmm
We know,
M / I = σb / y
M = Bending moment
I = Moment of Inertia about axis of bending that is; Ixx
y = Distance of the layer at which the bending stress is consider
(We always take the maximum value of y, that is, distance of extreme fiber from N.A.)
E = Modulus of elasticity of beam material.
I = BD^3/12-bd3 /12
=35 *25^3 / 12 -29*19^3/12
I = 28997mm^4
σb = My / I
=225630 *12.5 /28997
σb = 97.2643N /mm^2
The allowable shear stress for material is
σallow = Syt / fos
Where Syt = yield stress = 210 MPa = 210 N/mm^2.
And fos is factor of safety = 2
So σallow= 210/2 = 105 MPa = 105 N/mm^2
Comparing above we get,
σb<σallowi.e 97.2643< 105 N/mm 2
So design is safe.

SHAFT STRENGTH UNDER TORSIONAL LOAD

The shafts are always subjected to fatigue load hence they must be calculated for fatigue strength under combined bending and torsion loading. However, the initial estimate of diameter is obtained from the torque that is transmitted by the shaft. The bending moment variation along the length of the shaft is established after fixing some structural features like distance between supporting bearings and distance between points of application of forces and bearings.
Following notations will be used for shaft.
d = diameter of shaft,
Mt = torque transmitted by the shaft, = 25 Kgcm= 2.5 Nm.
W = power transmitted by the shaft (W)
N = rpm of the motor shaft = 30 rpm
τs = permissible shearing stress,
σb = permissible bending stress, and
Mb = bending moment.

Considering only transmission of torque by a solid shaft.
The power transmitted by shaft and the torque in the shaft are related as
W= Mt* ω
If *W* is in Watts and *Mt* in Nm. *ω* is angular velocity in rad/s and equals 2πN/60 W=2πNMt/60
Mt=30W/πN
The shearing stress and the torque are related as
$\tau = 16\ Mt*103 / \pi*d^3$
If Mt is in Nm and d in mm.
$Mt = \pi/16\ (10\text{-}3 / \tau\ d^3$
$d^3 = Mt*16 / \pi 10^{-3}$
Taking allowable shear stress for shafts under small loads in coupling as τ= 8 GPa = 13*109 Pa
d3 = Mt*16 /π τ 10-3
d3 = 2.5 *16 /π*13*106
d3= 9.79 *10-7 m
d= 0.00996 m = 9.96 mm
considering factor of safety 1.25
D= 12.45 mm.
So selected shaft diameter closest to D= 12.45 mm is = D=15 mm. This is taken as 15 mm to add better safety and availability in market. So we take diameter of second shaft will also be 15 mm.

4. DC MOTOR SELECTION
Specifications
Voltage =24v
Current=15 am
Voltage=current*resistance
24=15*R
R = 24/15
R = 1.6 ohms
The major constraint on motor operation is thermal.
Pdis = I2 *R
Heat Heat dissipated = current through the motor squared, multiplied by the terminal resistance
Pdis= (15)2*1.6
Power dissipated = 360J
force required to move weight on motors assume 70 kg
F = w*μ
F=70*9.81*0.05
F = 24.525 N
Torque required for motor
T=f*r
wheel radius 260 mm
T=24.525*0.26
T = 6.37 Nm.
Power requirement for entire tricycle:
P = V^2/R
P = 24^2/1.6
P = 360W
Power required for Motor:
Pm = Total weight*g*speed * gradient
=120*9.81*25*5/18*0.03
=245.25W
Therefore Power requirement is approximately 250W.
Hence 250W, 24V motor is selected.
To find maximum RPM of motor:
360 = 2*3.14*N*6.37/60
N = 515.40 rpm.

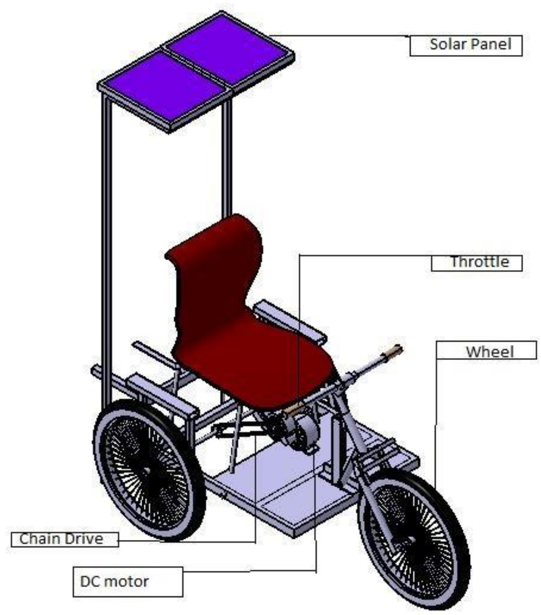

Fig 4- 3-dimentional design of tricycle

VI. PERFORMANCE ANALYSIS

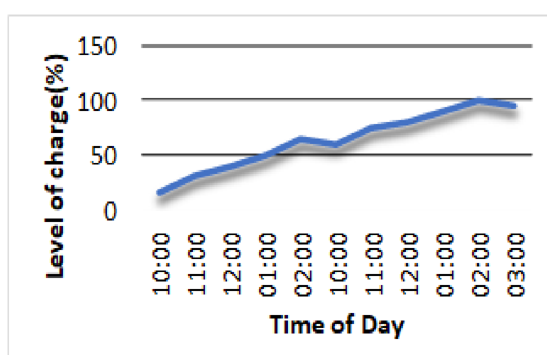

Fig 4. Level of charge vs time of the day

1.Battery Discharging with solar panel

The battery was connected to the motor that runs the solar tricycle. While running the tricycle discharging was started. Discharging the battery while running the vehicle is a linear phenomenon. Fig.4 shows the relation between the levels of charges (%) with a time of the tricycle. It clearly displays the decreasing of the storing energy due to consumption with the increasing of time. Discharging of the profile of the battery with solar panel is shown in Fig.no 4. On Fig.no.4, the level of charge is reduced from 100% to 15%. Theoretically, the discharge curve should be linear, but on Fig.no4 it slightly deviates from the linear phenomena. It took approximately 3 hours for discharging the battery. It was found from the discharge curve that in the first half hour battery lost its 8.5% storage energy. But for the next every half hour discharge percentage was 16%, 17%, 10%, 14% and 21% respectively.

2.Charging and discharging simultaneously

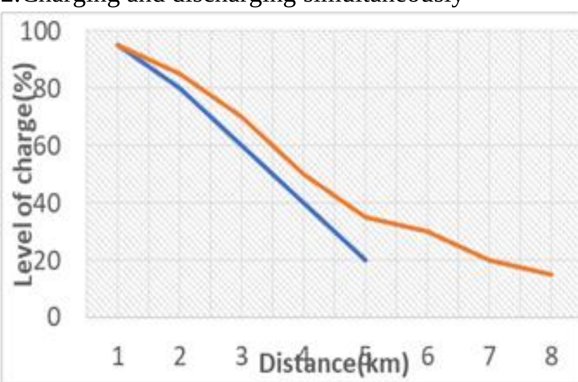

Fig 5. Level of charge vs distance.

In this portion two curves were derived, one of which represents discharging the battery without connecting to the solar panel and the second one shows the discharging of the battery when it is connected to the solar panel. The variation of the level of charges with discharging without solar and discharge with solar is the main outcome of Fig.no 5.

Fig.no 5 shows the two curves of discharging the battery. The blue line on the curve indicates discharging the battery without solar panel and the orange line indicates discharging the battery when the solar is acting. As a result, the red line ends at 8 km which is 3 km far from the green line end point. It shows the performance of solar assisted tricycle. So, by activating the solar panel during discharge of the battery, solar tricycle runs more than the earlier scenario.

VII. CONCLUSION

The recharging capacity of the panels is satisfactory. We can achieve our aims, and we believe that we have a system that will be helpful in providing medium of transport for persons who have disabilities. Appropriate is more than just availability for replication, it considers longevity, reliability, and efficiency.

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