Design of Solar Tricycle For Handicapped People

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Abstract - *Mobility of the physically disabled or crippled people is a great concern of the society. It is really difficult to realize the problems and sorrows of a physically disabled or crippled person who is partially or fully dependent on others or confining himself in a wheel chair with limited mobility. The goal of the solar operated Tricycle is to bring increased mobility to disable persons. This three-wheeler is operated by solar power and suitable for outdoor use. Solar power option enables the disabled people to use it at any place, even in remote areas where there is no electricity.*

The renewable energy is vital for today's world as in near future the non renewable sources that we are using are going to get exhausted. The solar vehicle is a step in saving these non renewable sources of energy. The main content of the solar tricycle is solar PV panel, brushless DC motor and battery. This idea, in future, may help to protect our fuels from getting extinguished.

Key Words: Shafts, Bearing, Motor steps, Solar panel, Chain sprocket, Battery

1. INTRODUCTION

A lot of difficulties involved with the mobility of the physically disabled people in the society. It has been observed that physically disabled people are basically using some assistive devices like, crutches, artificial limbs or legs etc. and manual wheel chairs or three-wheelers for their day-to-day movements. But, these wheel chairs or three-wheelers are crude or of inefficient in design; not very much suitable for outdoor use or common terrain in the country

Hand-powered tricycles are presently being used to provide mobility for disabled persons in a rural community in and other places. With this project we designed and manufactured a system to convert the hand powered tricycle to an solar operated electric motor powered version. Tricycle will be self-operated and independent in nature, using unending solar energy from the sun. The transport idea concerned here is a solar power operated three-wheeler with light structure of moderate height-width and weight. Use of available resources (for components such as pipes for chassis/body, wheels, bearing etc. from the local market) and simplicity in designing result cost economy. The battery used, motor and solar panels are also very much available in the markets. All these features make the solar three-wheeler a very cost effective and environment friendly transport for the daily use of the disabled people.

1.1 Problem Definition

PROBLEMS FACED BY HANDICAPPED PEOPLES-

Fig -1: Hand Operated

Fig – 2: Manually Operated

1.2 Problem Statement

- Need Physical Force To Drive It.
- Repetitive Strain Injuries.
- Vibration Exposure Injuries.
- Accedintal Injuries.
- Use Of Convential Energy Source.
- Environmental Pollution.
- High Cost

1.3 Objective

To overcome the problems and weakness, this project need to do some research and studying to develop better technology. There are list of the objectives to be conduct before continue to proceed on this project.

1) To develop a vehicle that uses renewable energy.
2) Environmentally friendly and cheap.
3) Better mobility and comfort over the available manual tricycle.
4) To overcome the problems and weaknesses of the handicapped people.
5) Light structure and weight.

1.4 Methodology (Solar System)

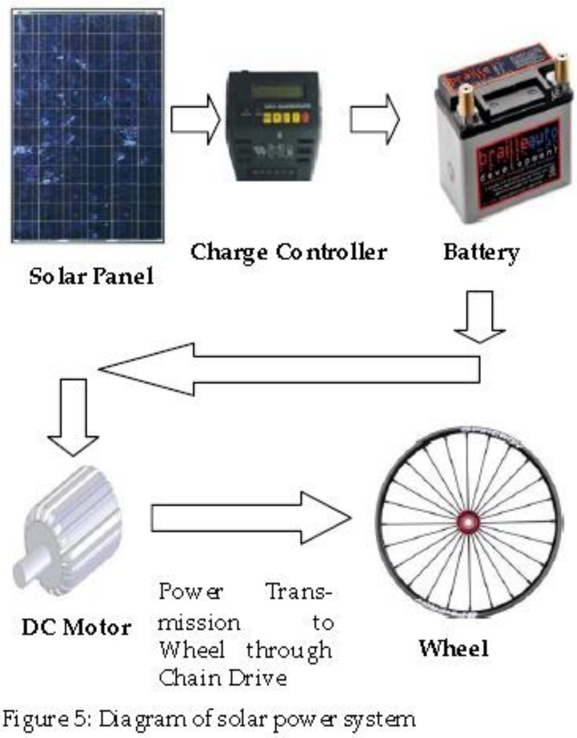

Fig -3: Methodology (Solar System)

2.KEY DESIGN CONSIDERATION

2.1 Solar Panel

Fig -4: Solar Panel

CALCULATION-

- The Weight Of Tricycle = 50 kg
- The Weight Of Person = 70 kg
- Total weight = 120 kg = 1200 N
- Coefficient Of Friction (μ) = 0.23 to 0.3
- Hence Force Required To Drive The Tricycle = 1200 * 0.3 = 360 N
- Assume The Distance Travel By Tricycle Per Day = 5 km
- Hence Workdone = Force * Displacement = 5 * 1000 * 360 = 1800000 Joules-----(1)
- Assume Solar Radiation For 8 Hours
- Intensity Of Solar Radiation = 900 Watt
- Available Solar Radiation = 900 Joules/Second * 8 Hours

  = 900 * 8 * 3600-----(2)

Now Equating Equation (1) and (2)
Hence By Solving , We Get

- Wattage Of Collector = 100 Watt
- Hence By Above Calculations We select 100 Watt Solar Panel

2.2 Dc Electric Motor

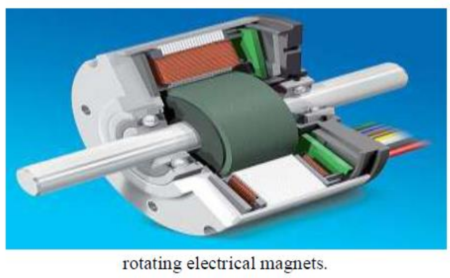

Fig -5: Electric Motor

The brushed DC electric motor generates torque directly from DC power supplied to the motor by using internal commutation, stationary permanent or electromagnets

2.3 Shaft

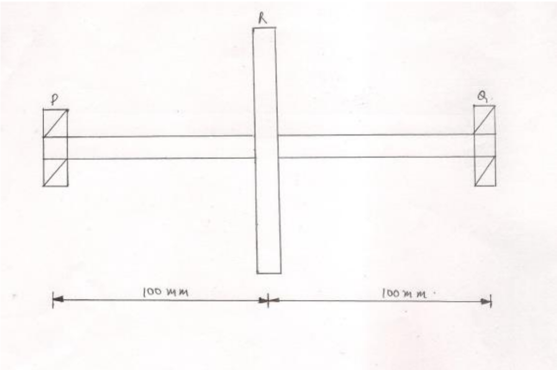

Fig –6: Shaft

The shaft is subjected fluctuating load, combined bending & torsion.
Material used is C-50. Sut = 750 N/mm^2, Syt = 460 N/mm^2.
Wt. of the sprocket = 10 N.
Diam. of the sprocket = 50 mm.
Speed of the sprocket = n = 1440 rpm.

1. Equivalent torque and bending moment of shaft

$P = 2\prod NT/60*1000$

$T = 2.47*10^3$ N-mm

2. Max bending moment on shaft is

$M = F*L/4 = 250$ Nmm

3. Equivalent torque on shaft is

$Te = \sqrt{(Kb*M)^2 + (Kt*T)^2} = 2498.3$ Nmm

4. Equivalent bending moment of shaft

$Me = \frac{1}{2}(Kb * M + \sqrt{(Kb*M)^2 + (Kt*T)^2})$

$= 1436.65$ Nmm

5. maximum shear stress theory

$\tau_{max} = 16*Te/\prod d^2$

$d = 5.71$ mm

6. Diameter of shaft by maximum principal shear stress theory

By maximum principal shear stress theory

$\sigma_{max} = 32*Me/\prod d^3$

$d = 5.39$ mm

Hence diameter of shaft is d = 6 mm

2.3.1 IDLER SHAFT

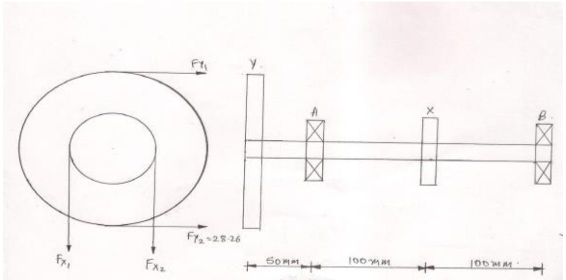

Fig –7: Idler Shaft

Material used for shaft is C-50. Sut = 750 N/mm^2, Syt = 460 N/mm^2.
Diameter of X = 100 mm
Diameter of Y = 150 mm
Ratio of chain tension for sprocket X: fx1/fx2 = 3.5
Ratio of chain tension for sprocket Y: fy1/fy2 = 2.5
1. According to A.S.M.E code the allowable shear stress for shaft is

$\tau s = 0.75*(0.18*Sut) = 101.25$ N/mm^2

$\tau s = 0.75*(0.3*Syt) = 103.57$ N/mm^2

2. Torque on shaft

$P = 2\prod NT/60*1000$

$T = 3.18$ Nm $= 3.18*10^3$ Nmm

$Tx = (Fx1-Fx2)*dx/2$

$Fx2 = 25.44$ N and $Fx1 = 890.4$ N

$Fy1 = 28.26$ N and $Fy2 = 70.67$ N

3. Bending moment on shaft

At chain X, Vertical force is

$Fxv = (Fx1 + Fx2) = 114.48$ N

$Fyv = (Fx1 + Fx2)*\cos 45 = 70$ N

$Fyh = (Fy1 + Fy2)*\sin 45 = 70$ N

At A & X Vertical B.M. are,

Mxv=3974Nmm, Mav=3500Nmm

At A & X Horizontal B.M. are,

Mxh=1750Nmm, Mah=3500Nmm

4.At A & X Resultant B.M. are,

Mxh=4342.25Nmm, Mah=3500Nmm

- BEARING

- DESIGN OF WHEEL BEARING

Power = P = 0.5 HP = 373 watt.
Speed of shaft N = 373 rpm.
Diameter of shaft D = 35 mm.
Step : 1
Each bearing load = 150/4 = 37.5 Kg
Resultant radial load A

$Ra = \sqrt{Rav^2 + Rah^2} = 367.87$ N

Resultant radial load B = Ra = 367.87 N
Step : 2
Assume load applying further = 1.4
Step : 3
Equivalent dynamic load on bearing Pe

PeA = (X*V*FrA + Y*FaA)*Ka = 515 N
PeB = (X*V*FrB + Y*FaB)*Ka = 515 N

Step : 4

Rating life of bearing (L10)

L10 = L10h*60*n/10^6 = 1119 million

Step : 4

Required dynamic load capacity Cr
At bearing A, L10 = (CrA/PeA)^a
CrA = 5346.67 N
At bearing B, CrA = 5346.67 N

The basic dynamics capacity required 5.346 KN & the 6207 bearing has inner dia = 35 mm and the dynamics capacity is 25.50 KN. Hence bearing is safe.

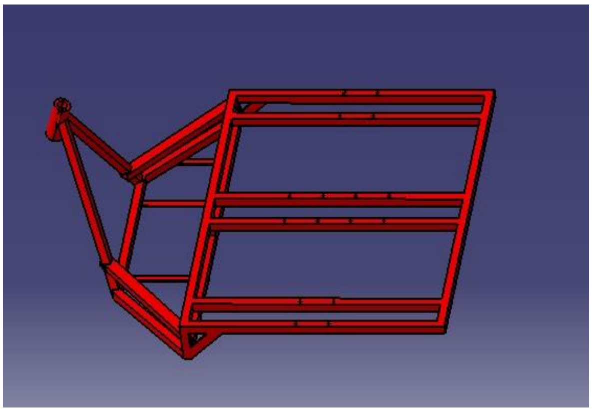

Fig -8: Chasis Structure

Fig –9: View Of Tricycle

The results of solar tricycle from trial

- The speed of solar tricycle = 6 km/hr.
- Time required for battery charging = 8 hours.
- Distance travelled by tricycle in single charging = 35 km.

3. FUTURE SCOPE

- SOLAR PANEL : Use the Ultra Efficient Solar Cell.
- BATTERY : Use Nickel-cadmium battery

1) Nickel cadmium batteries are less affected by overloads.
2) Nickel cadmium battery can be discharge completely unharmed.
3) Nickel cadmium batteries have lower maintenance and longer life.

- ANGLE OF SOLAR PANEL

4. CONCLUSIONS

While concluding this part, We Feel quite contented in having completing the project assignment the project assignment well on time. We had enormous practical experience on the manufacturing schedules of the working project model We are therefore happy to state that the inculcation of the mechanical aptitude proved to be very useful purpose. Undoubtedly the joint venture had all the merits of interest and zeal shown by all of us the credit goes to the healthy co-ordination of our batch colleagues in bringing out a resourceful fulfillment of our assignment of our assignment described by the university although the design criterion imposed challenging problem which however welcome by us to availability of good reference books The selection of choice of row materials helped us in machining of the various components to very close tolerances and there by minimizing the level of wear and tear We believe that we have system that will be effective in providing mobility for persons who have disabilities one of the major lesson we have learned is that designing an appropriate technology is a huge challenge appropriate is more than just availability for replication it considers reliability and efficiency

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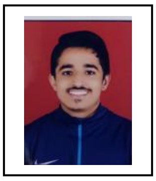

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