Solar Tricycle with Arduino Controlled Solar Tracking System

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Abstract— Solar plays a very vital role in our day to day life. In this paper it is discussed that how solar power is utilized for delivering power to the tricycle, which will reduce the effort of the humans. The discussion covers the design, assembly and performance calculation. This paper comprises all the calculation and information of the main components. This Tricycle is well designed and can be shown as good replacement for indigenous model used by disabled person.

Key words: Hub motor, Battery, charge controller, solar tracker, Arduino, Stepper Motor

I. Introduction

Electric Vehicles use 100% of Electric Power, which is supplied to Motors to provide Motive Force. It is carried out to benefit the user Conveniently, Physically and comfortably such that when little effort is applied, a Greater output is accomplished. Solar Powered Vehicle is use Photovoltaic cells to convert Sunlight into Electricity. The Electricity goes either directly to motor or to a special storage battery, without sunlight solar tricycle depends on electricity stored in batteries.

II. Objectives

To Overcome the Vulnerable Problem, this Project need to do some research and studying to develop better technology to make it success there are several thing that we need to know such as what will be prime mover, how to stored it and advantages of this tricycle. In that case there are list of objectives:

– To make a vehicle that utilises a renewable energy, environment friendly and cheap.
– To invent a tricycle that charges the battery at daytime while moving and when it is not in use.
– To develop a low speed tricycle for longer distance.

III. Construction

The Tricycle Consist of following components:

– Solar Panel
– Solar Tracker
– LDR Sensor
– Brushless HUB Motor
– Charge Controller
– Arduino
– Stepper Motor

A. *Solar Panel:*

Solar PV Panels are designed to collect desired energy required by solar tricycle. Power needed by solar tricycle is directly supplied by solar panel. When solar panel expose to sunlight produces DC current, is stored in a battery and used by motor as per requirement.

Fig. 1:

B. *Solar Tracker:*

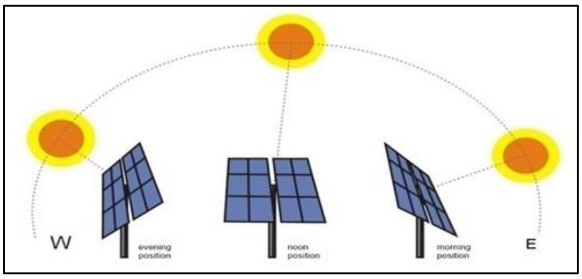

Fig. 2:

A solar tracker is a device that orients the solar panel towards sun. Trackers are used to minimize the angle of incidence between incoming sunlight and a photovoltaic panel. This increases the amount of energy produced from a fixed amount of installed power generating capacity. Solar tracker is used to increase the efficiency of tricycle.

C. *LDR Sensor:*

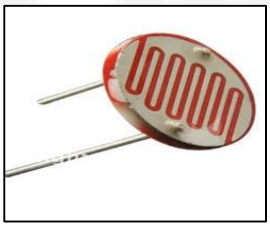

Fig. 3:

The Light Dependent Sensors are cheap and easily available. It is a sensor whose resisistance decreases when light impinges on it.This kind of sensors is commonly used in light sensors circuit in open areas like street lamp. LDR can detect only pulsed light. It will be more beneficial to detect solar light in daytime using LDR sensors.

D. Brushless Hub Motor:

Fig. 4:

The wheel hub motor is an electric motor that is incorporated into the hub of the wheel and drives it directly. As electric motor use mechanical inputs such commutator and two contacts carbon brushes so as to reverse electric current periodically and keeps the axle turning in same direction. Hub motors are brushless which does not consist of commutator and brushes instead of planetary gear and electronic circuit. The Hall effect sensors is to help keep an eye on permanent magnet which in turn helps to motor spinning.

E. Charge Controller:

Fig. 5:

A charge controller or battery regulator limits the rate at which electric current is added to or drawn from electric batteries. It prevents the overcharging and may protect against voltage, which can reduce battery performance or life span, and may pose to safety risk. It may also prevent complete draining, or perform controlled discharges, depending on battery technology to protect battery life.

F. Arduino:

Fig. 6:

Arduino acts a link between Solar Panel and Stepper Motor. The Program is feeded in the Arduino for tracking the sunlight when it is not to the reach of panels.

G. Stepper Motor:

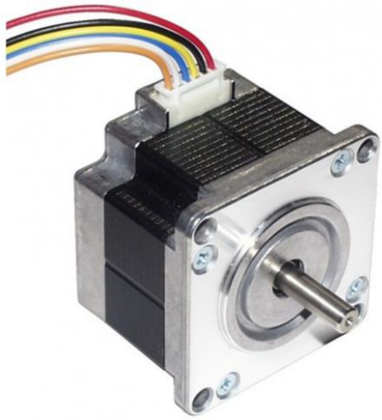

Fig. 7:

A Brushless Synchronous Electric Stepper Motor which converts the Digital Pulses into Mechanical Shaft Rotation. The motor moves in steps that divide full rotation into number of steps. The Position can be commanded to move and hold at the one of the steps without any feedback sensor as long as motor is carefully sized to the application in respect to Torque and Speed.

IV. CALCULATION

Power:

P=TotalWeight×g×Speed×Gradient

total weight = 120kg (tricycle + drivers), Speed = 25km/hr

gradient=slope=3%=0.03

$P=120\times 9.81\times 25\times \frac{5}{18}\times 0.03$

P=245.25 watt

therefore selecting 24V 250W Brushless Hub Motor.

Torque:

$P=\frac{2\pi\times N\times T}{60}$, N = 200 RPM

$250=\frac{2\pi\times 200\times T}{60}$

T = 11.9366 Nm

T = 121.67 Kgcm.

Battery:

System Voltage = 24V

Load Current $=\frac{250}{24}=10.41$ A

Considering 1 hour of Tricycle running per day

Load Current = 10.41×1.2 = 12.49 Ah/day.

Stepper Motor:

$\text{Power}=\frac{\text{Mass}\times\text{Gravity}\times\text{Height}}{\text{Time}}$

$\text{Power}=\frac{10\times 9.81\times 15}{25}$

Power = 58.86 watt

Speed-Velocity Relationship:

$\text{Velocity (km/hr)}=\frac{\pi\times D\times N}{60000}$

r = radius of wheel = 26 inch = 0.33m

N = Motor Speed = 200 rpm.

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$$V = \frac{2\pi \times 0.33 \times 200}{60000}$$

V = 24.88 km/hr

Charging Time of Battery:

$$\text{Charging time} = \frac{\text{Battery Ah}}{\text{Charging Current}}$$

$$T = \frac{Ah}{A}$$

We have two 12V 18Ah battery connected in series, therefore voltage get added and current remain same. Charging current should be 10% of the Ah rating of battery.

$$\text{Charging current} = \frac{18 \times 10}{100}$$

But due to losses we take 2-3 amperes for charging purpose.

$$\text{Charging time} = \frac{18Ah}{3A}$$

Practically, 40% of losses in case of battery charging

$$\text{Charging time} = \frac{18 \times 40}{100}$$

Therefore 18+7.2=25.2 Ah

$$\text{Charging time} = \frac{25.2}{3} = 8.4 \text{ hours}$$

V. Actual Model

Fig. 8:

Fig. 9:

VI. Conclusion

With an Unhealthy hike in prices of petrol and diesel, an automobile running on solar power can create a revolution. This kind of vehicle is user friendly. It is very simple to manage and use. It comes in affordable cost and per unit electricity consumption is very less. It can be used even during the times when there is no sunlight. Because, the sun's energy get trapped between the clouds so solar panel can efficiently convert electrical energy and get stored in battery. The importance of this kind of application is gradually increasing with diminishing non renewable energy sources like fossil fuels.

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