Desgin and Fabrication of Solar E Tricycle

[1].Mr. V V N Bhaskar K [2]..Mr. Naveen Ch [3]..Mr.Nazeer Ahamad Md [4].Mr.V Jagannadh G [5].Mr.Mohana Krishna J [6].Mr.Harish K A

[1] Assistant Professor,[2,3,4,5,6] UG Students

Electrical & Electronics Engineering

Sri Vasavi Institute of Engineering and Technology (JNTUK)Machilipatnam,India

Abstract—Technology in transportation is being improved in our day to day life but in case of handicapped the journey to one place to other is becoming difficult. We see lot of people who are struggling in journey to go from one place to another. So we came forward with an idea of implementing a better way for handicapped people to travel with ease and without struggle.

Solar energy is being a renewable and non-conventional source of energy which is also a environmental friendly and free of cost. We came to implement an idea to make journey easier to handicapped people by using solar energy to move tri-cycle.

This project is about building a tricycle that is motorized and is powered by solar energy, the overall layout of this tri-cycle is economical to fabricate and this type of tri-cycle may prove mile stone in development of technology for physically challenged people. The main content of the tri-cycle is Solar PV panel, DC motor, Controller, Throttle, battery. In this project it is discussed that how solar tri-cycle will help to reduce the effort of handicapped person

Keywords—Solar PV Cell, Battery, Controller, DC Motor, Throttle.

I. INTRODUCTION

The depleting reserves of fossil fuels made the engineers and scientists to look for renewable energy sources. In addition, the environmental decay due to the combustion of fuel is alarming and justifies the design of eco-friendly system. India is spending large amount of foreign exchange to import crude oil even though we have abundant resource of solar energy. If we utilize solar power for local conveyance, a large amount of currency can be saved and we can also ensure pollution free environment and contribute to nation's economy.

Why should we go for SOLAR E-TRICYCLE?

Today there is a large problem of energy resources so we need to develop the emerging technologies in using renewable resources of energy and to show people that those technologies are ready for use. The goal of this report is to highlight Solar E-Tricycle, their technology, use and cost/ benefit. The first part of the report presents the technical features of the Solar E-Tricycle. It then deals with the economic aspects, the cost of the Solar E-Tricycle, the energy created and a comparison between the electric E-Tricycle and the solar electric E-Tricycle.

MAIN COMPONENTS

- Solar Panels
- DC Motor
- Controller
- Throttle
- Charge Controller

II. SOLAR PANEL

Solar panel refers to a panel designed to absorb the sun's rays as source of energy for generating electricity or heating.

Photovoltaic solar panels contain a set of solar cells that convert light into electricity. It is called solar because this one of the strongest energy sources for this type of use. Solar cells are sometimes called Photovoltaic cells, and Photovoltaic literally means "light-electricity".

TYPES OF SOLAR PANELS:-

The solar panels can be divided into 3 major categories:

• Monocrystalline solar panel

• Polycrystalline solar panels

• Thin-film solar panels

MONOCRYSTALLINE:-

The monocrystalline solar panels are also known as the single crystal panels. They are made from pure silicon crystal which is sliced into several wafers forming cells. These wafers are cut to an octagonal shaped wafer because of which they get their unique look and uniform colour. They can be easily identified by their black or dark blue colour, as they are made from pure silicon.

Fig :1 monocrystalline solar panel

POLYCRYSTALLINE:-

The polycrystalline solar panels are composed of multiple silicon crystals. They are made from silicon fragments that are melted and poured into square molds. Once these crystals are cooled, they are sliced into thin wafers and assembled together to form a polycrystalline solar panel. They are also known as “multi-crystalline”panels.

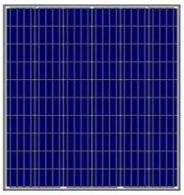


Fig: 2 polycrystalline solar panel

THIN-FILM SOLAR PANELS:-

Unlike monocrystalline and polycrystalline solar panels, thin-film solar panels are manufactured using photovoltaic substances which include Amorphous silicon (a-Si), copper indium gallium selenide (CIGS) and cadmium telluride (CdTe). These substances are deposited onto a solid surface such as glass, metal or plastic making it lighter and easy to install.

Fig : 3 Thin film solar panel

III.BATTERIES:

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smartphones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit.

TYPES OF BATTERIES :-

- Lead Acid. Lead acid batteries are the oldest battery type used
- Lithium-ion. Lithium-ion batteries are widely used in your smartphones and laptops
- Flow. Flow batteries are a relatively new type of battery emerging in the market.
- Sodium Nickel Chloride.
- Lithium Iron.

LEAD ACID BATTERY:-

The lead–acid battery consists of two electrodes submerged in an electrolyte of sulfuric acid. The positive electrode is made of grains of metallic lead oxide, while the negative electrode is attached to a grid of metallic lead. Lead–acid batteries are classified into two types: flooded and valve-regulated.

Fig: 4 Lead Acid battery

LITHIUM-ION:-

Lithium ion batteries are rechargeable batteries that are characterized by very high power densities. Such batteries have become very commonplace: from everyday electronic

Fig: 5 Lithium-ion battery

products such as cell phones to electric vehicles. What is not commonly appreciated is that voids play a very important role in such batteries. As this example will illustrate the void structure in a material, it does not always need to be spherical. Let us first briefly describe the main features of a lithium ion battery and then point out the important role of voids in it.

IV. SOLAR CHARGE CONTROLLER:

A solar charge controller is fundamentally a voltage or current controller to charge the battery and keep electric cells from overcharging. It directs the voltage and current hailing from the solar panels setting off to the electric cell. Generally, 12V boards/panels put out in the ballpark of 16 to 20V, so if there is no regulation the electric cells will damaged from overcharging. Generally, electric storage devices require around 14 to 14.5V to get completely charged..

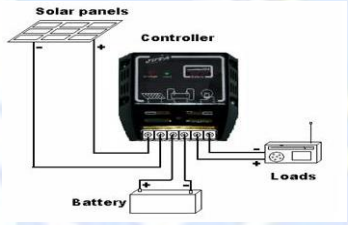


Fig: 6 Solar charge controller

V. BRUSHLESS DC MOTORS:

Some of the problems of the brushed DC motor are eliminated in the brushless design. In this motor, the mechanical "rotating switch" or commutate or brushgear assembly is replaced by an external electronic switch synchronized to the rotor's position. Brushless motors are typically 85-90% efficient, whereas DC motors with brushgear are typically 75-80% efficient.

Fig:7 Brushless Dc Motor

VI. ACCELERATOR (OR) THROTTLE:

The implementation is controlling a BLDC motor in open loop. The motor current is measured and speed is monitored, to be able to respond to stall and overload situations. Three PWM channels are connected to the low side of the driving Half-bridges to control the speed of the motor. A BLDC motor driver stage, consisting of three half-bridges.

Fig: 8 Throttle or Accelerator

VII.PWM CONTROLLER:

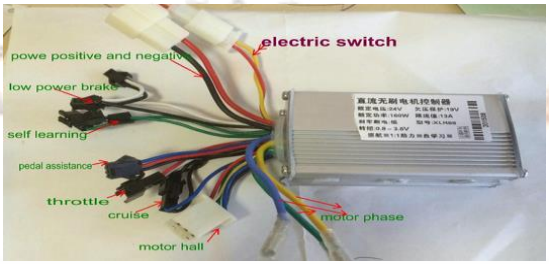


Fig: 9 PWM Controller

APPLICATIONS:

Brushless motors fulfill many functions originally performed by brushed DC motors, but cost and control complexity prevents brushless motors from replacing brushed motors completely in the lowest-cost areas. Nevertheless, brushless motors have come to dominate many applications, particularly devices such as computer hard drives and CD/DVD players.

BLOCK DIAGRAM:

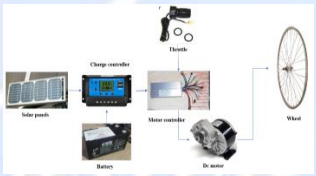


Fig: 10 Block Diagram for Solar E Tricycle

VIII. RAW MATERIAL & ITS SPECIFICATIONS

Table 1 : For Various Raw Materials.

S no.	Description	Specifications	Amount
1	Tricycle	Hero Tricycle	4000
2	E-Tricycle kit – BLDC Motor,Brakes,Accelerator , Speed controller.	BLDC Motor:- 24DCV,3200 RPM.350 w	10000
3	Batteries	2*12V DCV	2,400
4	Chain	2	200
5	Nut,Bolt & washers	Mild Steel	300
6	Solar Panel & Solar Charge controller	24V DCV,40W	3300
	Total Amount		20200

IX.DESGIN & CALCULATIONS:

Formulas:

Tricycle wheel rim radius r = d/2

Friction Force acting each tyre $F = \mu N_1$

Torque Developed on Shaft due to Friction Force $T = F \times r$

Angular Velocity w = v/r

Power required to ride the Tricycle $p = 2\pi NT/60$

DC Motor:

Power (Watts) = Total Weight ×g×Speed×gradient
Maximum Weight = 30kg
Speed =30 Km/h
Gradient = slope (assume 3%)
Gravity = 9.81 m/s^2

Design Calculation:

Change in voltage cause change in speed for solar powered tricycle.

24V ⟶ 30 km/h
12V ⟶ 15 km/h
6V ⟶ 7.5 km/h
3V ⟶ 3.25km/h

Motor Calculations for 100Kgs:

(1). Normal reaction on each tyre
$N_1 = w/2 = 100/3 = 33.33$ kg
$33.33 \times g = 33.33 \times 9.81 = 326.96$ N

(2). Friction Force
$F = \mu \times N_1$
$= 0.3 \times 326.9 = 98.088$ N

(3). Torque
$T = F \times r$
$= 98.088 \times 0.335 = 32.85$ Nm

(4). Speed
$W = v/r = 10000/0.335 \times 3600 = 8.29$ rad/sec
$N = (60 \times 8.29)/2 \times 3.142 = 79.153$ rpm

(5). Power
$P = 2 \times 3.142 \times NT/60$
$= 2 \times 3.142 \times 79.153 \times 32.85/60 = 272.32$ w

Motor Calculations for 150Kgs:

(1). Normal Reaction on each tyre
$N_1 = w/2 = 150/3 = 50$ kg
$50 \times g = 50 \times 9.81 = 490.5$ N

(2). Friction Force
$F = \mu \times N_1$
$= 0.3 \times 490.5 = 147.15$ N

(3). Torque
$T = F \times r$
$= 147.15 \times 0.335 = 49.29$ Nm

(4). Speed
$W = v/r = 10000/0.335 \times 3600 = 8.29$ rad/sec
$N = (60 \times 8.29)/2 \times 3.142 = 79.153$ rpm

(5). Power
$P = 2 \times 3.142 \times NT/60$
$= 2 \times 3.142 \times 79.153 \times 49.29/60 = 408.612$ w

Battery Calculation for 100 Kgs:
$P = V \times I$
$I = P/V$
$I = 272.32/24$
$I = 11.34$ Amp/h

Battery Calculation for 150Kgs:
$P = V \times I$
$I = P/V$
$I = 408.61/24$
$I = 17.025$

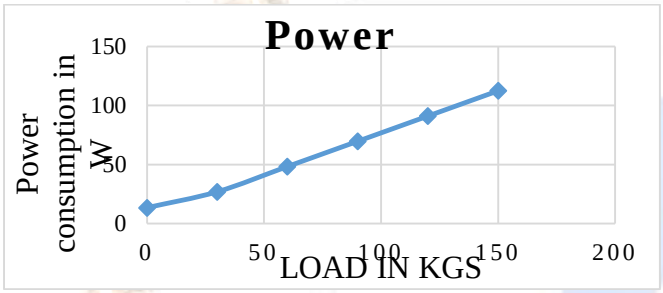
Various Loads Output Table:

Table 2 : Various Loads Outputs :

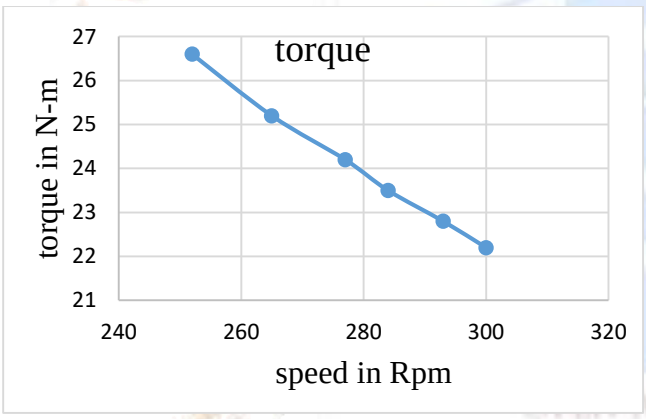
Weights	Battery	Motor	PV Module
100Kgs	11.34 Amp/hr	272.32 w	590mm*540mm*35mm
150Kgs	17.02 Amp/hr	408.61 w	780.5mm*670*34mm

X.GRAPHS :

1. speed (x-axis) & torque (y-axis)
2. load (x-axis) & power consumption (y-axis)



Graph1- Load Vs Power Consumption



Graph2- Speed Vs Torque

XI.CONCLUSION:

Solar assisted E-Tricycle is modification of existing Tricycle and driven by solar energy. It is suitable for both city and country roads, that are made of cement, asphalt, or mud. This E-Tricycle is cheaper, simpler in construction & can be widely used for short distance travelling especially by school children, college students, office goers, villagers, postmen etc. It is very much suitable for young, aged, handicap people and caters the need of economically poor class of society.

Moreover, it is noiseless and can be recharged with the AC adapter in case of emergency and cloudy weather. The operating cost per kilometer is minimal, around Rs.0.70/km. It can be driven by manual pedaling in case of any problem with the solar system. It has fewer components, can be easily mounted or dismounted, thus needs less maintenance.

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