Design of Solar Powered Electric Auto-Rickshaw

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ABSTRACT: -_The aim of theses research paper is to cover all the design aspects of the designing and Rickshaw an important means of transportation contributing to the huge percentage in public transport. Tricycle rickshaw is very chip means of short distance transportation both in city and in rural areas. Tri-cycle rickshaw is generally propelled by human energy. Rickshaw is most common three-wheeler in India. Easy availability, less fare open ness in structure etc.-we have made this very popular vehicle. for short distance travel purposes. Two type of Rickshaws are seen playing on the road, one is manual peddling type another is an electric motorized type which needs to be charged using electricity from the national grid. Manual drive rickshaw is more affordable than hand driven. We have developed a solar Rickshaw especially for disable person or handicap person. So, we have discussed how to utilize solar power though the solar panel or photovoltaic cell and drive the brushless DC motor, battery controller throttle and all of the component._

KEYWORDS: - Brushless DC Motor, Solar panel, motor Controller, Electric Motors, Battery

1-INTRODUCTION

PROBLEM STATEMENT

Electric vehicle which uses 100% electric power, use electric motors instead of an internal Combustion engine to produce motive force. Solar powered vehicles (SPVs) use photovoltaic (PV) cells to convert sunlight into electricity. The electricity goes either directly to an electric motor powering the vehicle, or to a special battery. PV cells produce electricity only when the sun is shining. Without sunlight, a solar powered car depends on electricity stored in its batteries.

Since the invention of petrol diesel, it has been consumed recklessly for the source of energy without considering the harmful effects caused by it to the environment. At this level of consumption petrol diesel is going to extinct by 2050. But the need for energy resources increasing is 105 times faster than the nature can create. Most of cities in developing countries are highly polluted. The main reasons are the air and noise pollution caused by transport vehicles, especially petrol- powered two and three wheelers. For example, in India are close to 18 million petrol powered two wheelers and about 1.5 million petrol and diesel powered three wheelers and their population is growing at a healthy rate of about 15% per anablepids being a major hazard to people 'heath s, these machines are guzzling huge amount of petrol and diesel for which the country has to pay dearly in foreign exchange out flow. In fact, it is a common sight in developing countries that during traffic jams in congested areas of cities these vehicles produce tremendous pollution.

A solar powered electric cycle rickshaw can provide a none polluting and a very silent transport system for urban and rural areas of India. Besides it is Avery energy efficient and cost-effective vehicle. The survey has shown that the cycle rickshaws powered by electric motor solar panels and batteries have a potential to provide an attractive alternative to petrol and diesel. Powered three wheelers. Besides they also provide large scale employment and extra income to the rickshaw puller.

2-OBJECTIVE

- To overcome the problem and the weakness, this project needs to do some research and studying to develop better technology. To make it success there are several things that we need to know such as what will be the prime mover, how to stored it and the advantages of this new vehicle. In that case, these are the list of the objective to be conduct before continue to proceed on this project: To develop vehicle that use renewable energy, environmentally friendly and cheap. To develop an electrically cloth at can charge the battery when it is not in used.
- To develop low speed tricycle, but for a longer distance.
- Minimize the weight of rickshaw.
- Reduce use of fossil fuel.

3-METHODOLOGY

Step 1: - We started the work of this project with literature survey. We gathered many research papers which are relevant to this topic. After going through these papers, we learn about design and analysis about solar vehicle.

Step 2: -After that the components which are required for our project are decided.

Step 3: - After deciding the components, the 3D Model will be done with the help of CREO software.

Step 4: -calculations will be done and then the result will be concluded.

4-COMPONENTS

4.1-SOLARPANEL

As the title suggests, the tricycle is operated by solar energy. The batteries are charged with solar energy with the help of solar cell. Solar cells convert the energy of sunlight directly into electricity through the use of the photo voltaic effect. The Photovoltaic effect involves the creation of voltage into an electro-magnetic radiation. The photoelectric and photovoltaic effects are related to sunlight, but are different in that electrons are ejected from a material's surface upon exposure to radiation of sufficient energy in photoelectric, and generate electrons are transferred to different bands of valence to conduction within the material, resulting in the build-up of voltage between two electrodes in photovoltaic.

-There are three types of solar cells

- Mono–crystalline Silicon solar cell
- Poly–crystalline Silicon solar cell
- Amorphous Silicon solar cell

Specifications

- Power-540 Watt

- 72 Cell Format

- Weight-33 Kg (Approx.)

- Voltage-49.5 (Standard as Per Panel)

- Module Efficinecy-21%

- Panel Size-2256mm x 1133mm (Standard)

- Price-15000 Rs (Each panel)

Calculations

$P = V \times I$

$540 = 49.5 \times I = 10.9 \ A$

Current = 11 A (Approx.)

4.2 BRUSHLESS DC MOTOR

The prime mover to be used in this solar tricycle is a permanent magnet D.C. motor. The main reason for using this motor is that it is highly efficient and the flux density does not decrease with time. It's performance characteristics suite very well to the requirement of our solar tricycle.

Brushless DC motors use a rotating permanent magnet or soft magnetic core in the rotor, and stationary electrical magnets on the motor housing. A motor controller converts DC to AC. This design is simpler than that of brushed motors because it eliminates the complication of transferring power from outside the motor to the spinning rotor. Advantages of brushless motors include long life span, little or no maintenance, and high efficiency.

EV weight: 800kg

Acceleration time from 0 km to 100 km/h (= 27.78 m/s): t = 5sec

Acceleration:

$$a = v * t = 27.778 \ m/s \div 5 \ s = 5.55 \ m/s^2$$

- Force for acceleration:

$$F = m*a = 800 \ kg * 5.55 \ m/s^2 = 4440N$$

- Torque on the wheels (wheel diameter 0.64 m):

$$M_t = F*r = 4440 \ N * 0.32 \ m = 1420.8Nm$$

- Power: P[kW] = N[RPM] * Mt [Nm] / 9550

$$= 3600 * 1420.8/9550 = 535.58 \ KW \ (without \ load)$$

$$= 3450 * 1420.8/9550 = 513.27 \ KW \ (With \ load)$$

We used Brushless DC motor at 60 Hz, a motor with two poles operates at 3,600 RPM with no load and about

3,450 RPM with a load.

The power we get from solar around 540 and need for vehicle is around 513 to 535 so the motor is suitable for vehicle.

4.3 BATTERY

Specifications: -

- E-ShaktiLGC0ERTU 1800(For E-rikshaw)
- Capacity-120 Ah@C20
- Model-LGC0ERTU-1800
- Voltage-12v(Standard)
- BatterySize-410mmx175mmx229mm
- Price-6250 Rs (Each Battery)
- We Require-120x 4=480m Ah (For4 Batteries)
  Then -2X540=1080kw

Then,3 x 1080=3.2 kw

Considering80%Efficiency

3.2 x80 %=2.5 kw

5- MATERIAL SELECTION AND PROPERTIES

1. We used 4130 steel is a chromium-molybdenum alloy steel and it is considered a low carbon steel.

    it has density of 7.85 g/cm^3 which benefits from heat treatment hardening means high strength alloys.

2. Carbon percentage is between (0.28 to 0.33%). Increasing carbon content increases hardness and strength and improves hardenability. But carbon also increases brittleness and reduces weldability.

3. AISI 4130 steel is also good in weldability, and the 4130 alloy may be welded by any commercial method.

Steel 4130 Physical Properties

1.	Density (lb / cu. in.)	0.283
2.	Specific Gravity	7.8
3.	Specific Heat (Btu/lb/Deg F – [32-212 Deg F])	0.114
4.	Melting Point (Deg F)	2610
5.	Thermal Conductivity	22.3
6.	Mean Coeff Thermal Expansion	7
7.	Modulus of Elasticity Tension	29

6- WEIGHT DISTRIBUSTION

COMPONENT	QTY	WEIGHT
Persons	7 (60 kg per person)	420 kg
Battery	4 (35 kg per battery)	140 kg
Chassis	-	80 kg
Exterior Component	-	96 kg
Solar panel	2 (32 kg per panel)	64 kg
Total	-	**800 kg**

6.1-DESIGN SPECIFICATIONS

The EV Solar Vehicle is loaded by static forces from the Vehicle body and load. For this model, the maximum weight of vehicle 800Kg. The load is assumed as a uniform distributed obtained from the maximum loaded weight divided by the total length of chassis frame. Detail loading of model is shown in Figure. Earth gravity is also considered for the chassis frame as a part of loading. chassis are made from "C" Channels with = 210mm x 76 mm x 6 mm

The Following Condition will used for Design:

- Steel Front Overhang (a) = 935 mm

- Rear Overhang (c) = 1620 mm

- Wheel Base (b) = 3800 mm

- yield strength of = 7.1 x 10^8 Pa

- Steel Front Overhang (a) = 935 mm

- Modulus of Elasticity, E = 210 N / mm2

- Poisson Ratio = 0.30

- Capacity of vehicle = 800kg = 7845.32N

- Weight of the body and engine =420kg = 4118.793N
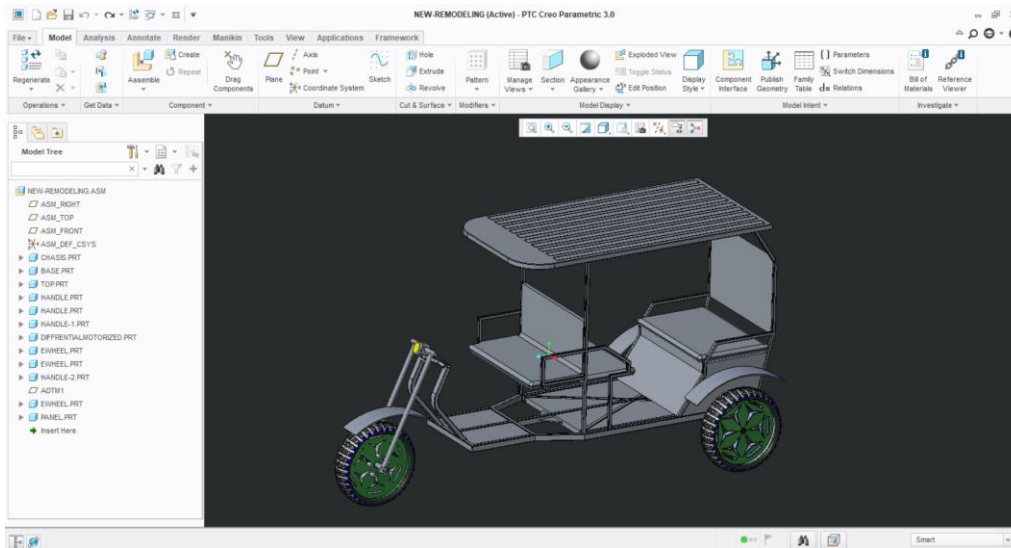
7-CAD MODELLING

Fig – Auto Rickshaw 3D VIEW

7.1-COST ESTIMATION

SYSTEM & COMPONENETS	AMOUNT (INR)
FRAME & CHASIS	5000
BRAKING & WHEEL UNIT	6000
SUSPENSION UNIT	5000
MOTOR UNIT	15000
BATTERY UNIT	22000
ELECTRICAL ELECTRONIC UNIT	10000
SOALR PANEL	15000
BODY WORK (FABRICATION & WELDING)	5000
MISCELLANEOUS	5000
Grand total	88,000(Approx.)

8-ADVANTAGES, DISADVANTAGES & APPLICATIONS

8.1-ADVANTAGES

- ➢ Save conventional energy.
- ➢ Low working cost.
- ➢ Low pollution as compare to fuel energy.
- ➢ Light in weight.
- ➢ Low maintenance.
- ➢ Solar energy utilization.
- ➢ It reduces the use of fossil fuels.
- ➢ Ecofriendly in nature.

➢ Reduces the Air and Noise pollution.
➢ High future scope in renewable energy field.

8.2-DISADVANTAGES
➢ Parts of solar car are very expensive,hence we can't produce large no. of vehicels.
➢ Since they need sun to get charged, if it darked out for some days then it becomes very difficult to run.

8.3-APPLICATINS
➢ Solar energy could be used for car propulsion in different ways: i) in indirect way, to produce bio-fuels (for conventional vehicles).
➢ Modules are high reliability, no expenditure on fuel, minimum cost of maintenance, long life, portability, modularity, pollution free working etc.

9-CONCLUSIONS

➢ The solar powered electric vehicle (SPEA) was designed, optimized and tested effectively for Indian conditions in this research article.
➢ The performance analysis of the vehicle demonstrated the charging and discharging characteristics of the battery at varied load conditions. The solar PV output followed the same trend as radiation intensity over a day and experienced a maximum charging rate of 250 W. A day-long charging of batteries on a typical sunny day yielded 2 units (2 kWh) of power.
➢ The battery discharging characteristics were studied at variable loading (number of passengers) conditions. The maximum discharge of 540 W was recorded at 390 kg load when the vehicle was moving at a speed of 12.11 km/hr.
➢ The maximum vehicle speed of 21.7 km/h was achieved at a discharge of 296 W when it was loaded with 90 kg. The environmental analysis of SPEA assessed the yearly CO_2 emissions that could be mitigated using SPEA. The results displayed CO_2 emissions of 1777 kg, 1987 kg and 1938 kg from using CNG, LPG and gasoline engines respectively, which can certainly be mitigated by using SPEA instead of conventional vehicles for the period of 25 years. The financial analysis of SPEA identified a payback duration 24.44% less compared to a gasoline-run vehicle. Socio-economic analysis of SPEA discussed its significant benefits and showed 15.74% and 0.85% rise in yearly income over gasoline driven and battery-driven electric vehicles.
➢ With these outcomes of the analyses discussed, the developed SPEA could be a suitable alternative for local and low-speed transit. SPEA not only mitigates carbon emissions but also progresses the livelihood of mankind in terms of economy and sustainability.

10-REFERENCES

1. International Energy Outlook 2016—Transportation Sector Energy Consumption Energy Information Administration. Available online: https://www.eia.gov/outlooks/ieo/transportation.cfm (accessed on 25 April 2017).

2. Lukic, S.M.; Mulhall, P.; Choi, G.; Naviwala, M.; Nimmagadda, S.; Emadi, A. Usage Pattern Development for Three-Wheel Auto Rickshaw Taxis in India. In Proceedings of the 2007 IEEE Vehicle Power and Propulsion Conference, Arlington, TX, USA, 9–12 September 2007; pp. 610–616.

3. Mulhall, P.; Emadi, A. Comprehensive simulations and comparative analysis of the electric propulsion motor for a solar/battery electric auto rickshaw three-wheeler. In Proceedings of the 2009 35th Annual Conference of IEEE Industrial Electronics, Porto, Portugal, 3–5 November 2009; pp. 3785–3790.

4. Mani, A.; Kreutzmann, P. Design and performance analysis of a hybrid solar tricycle for a sustainable local commute. Renew. Sustain. Energy Rev. **2015**, 41, 473–482.

5. Motor Specification of E Rickshaw. Available online: http://www.gemev.com/products/prince-e-rickshaw/ (accessed on 22 April 2017).

6. N. Lavanya et al. Int. Journal of Engineering Research and Applications www.ijera.com

7. WEBSITES-

https://www.loomsolar.com/blogs/corporate-brochure/product-catalogue

https://www.livguard.com/product-detail/E-Shakti-LG-C0-ERTU-1800.php

https://www.ijert.org/design-and-analysis-of-chassis-of-electric-solar-vehicle

https://www.alliedmarketresearch.com/solarvehicle.market