SOLAR RICKSHAW FOR SUSTAINABLE ENERGY FUTURE

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ABSTRACT

In order to achieve the sustainable environment for all the living beings from the pollution caused by the combustion of petrol and diesel in automobiles solar power should be used for the running of these vehicles. An electric rickshaw fitted with a solar panel and which run up to 40km per charge has a potential to replace the petrol consuming public transport vehicles. At our staggering consumption levels the worlds petroleum reserves will be exhausted in the next 30 to 40 years. Also the petroleum powered transportation network is responsible for a large amount of the hazardous emissions causing global warming and air pollution problems worldwide. Hence an alternative fuel should be used and solar energy is the cheapest and freely available sustainable energy which is captured by silicon plates fitted at the top of auto rickshaw for the sustainable energy future.

Keywords: solar rickshaw, Sustainable energy, petroleum, global warming, air pollution, hazardous emission.

1. Introduction

Since the invention of petro 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 petro diesel is going to extinct by 2050. But the need for the energy resources increasing is 10^5 times faster than the nature can create. Most of the 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 there 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 annum. Besides being a major hazard to people's health, these machines are guzzling huge amounts of petrol and diesel for which the country has to pay dearly in foreign exchange outflow. 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 non-polluting and a very silent transport system for urban and rural areas of India. Besides it is a very 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. Data collection and sampling

In major cities of India there are petrol and diesel powered three-wheelers called auto rickshaws. They are some of the most polluting vehicles on Indian roads. They run on 2 stroke engine principle which is inherently more polluting than the regular 4 stroke engine. Besides, data collected by us show that in the traffic conditions prevalent in most inner city areas these auto

rickshaws run only at 15-20 km/hr speed thereby producing even more pollution since they are designed to run efficiently at 40-45 km/hr. The pollution is further compounded by the fact that they continuously have to run in stop/start mode. Our data also shows that on an average these auto rickshaws travel about 50-60 km. during a day. Based upon this data it was felt that an electric rickshaw designed to run 60-80 km/charge and with speeds of 25-30 km/hr. will be an excellent substitute for these auto rickshaws. In a fair weather country like India, a silent and nonpolluting electric rickshaw with the above attributes can be a boon. This can also help it to become a low cost personal vehicle for middle class families.

Table: Daily Trip Characteristics of Auto-rickshaws

Parameter	Value
Average hours of operation	10
Average daily kilometers traveled	105
Average share of empty kilometers traveled	10.2%
Average trip length (in kilometers)	5.25
Average daily trips	18

Table. 4 Average running cost of vehicle powered by petrol

Kilometers	Price(fuel cost) Rs.
30 km/day	150
30 × 30 = 900 km/month	4500
900 × 12 = 10800 km/year	54000
Maintenance /year	9000
Total savings/year	45000

Whereas if we go for an electric rickshaw owner can make a net profit of Rs. 25,400/month for 10 years continuously. This requires that the fare will be Rs. 12/km and that the rickshaw will go to 70 km/day. Other assumptions are:

a) Driver will be paid Rs. 840/day.

b) Electric rickshaw will run for 300 days/year.
c) Battery replacement cost is Rs. 15,000 and it will be replaced every alternate year.

d) Interest is 15% p.a. and loan has to be paid back in 5 years.
e) The electricity cost is Rs. 5/kWhr which can be reduced by using a solar panel.

I. Assumpstions Made For Designing A Rickshaw

In order to full fill the minimum requirements of a transportation vehicle following assumptions were made

1. Weight of the passengers in rickshaw was considered to be around 250 kgs (weight of three persons).
2. Average speed for the rickshaw is equal to 20kmph.
3. The rickshaw should run at least 35 kms per charge.

II. Selection of Vehicle

In this project cycle rickshaw has been selected, because hybrid vehicle normally use electric motor as an additional source. Since hub motor can produce high torque and low speed. Thus for this condition only suitable. Vehicle will be cycle rickshaw because it is running within the urban area where low speed is recommended.

III. Solar Energy Utilization

3.1 Specification of solar module used whenever the designing of any system is considered the main thing that needs to be noticed will be the specification. In this project, panel specification need to be given for that the knowledge of surface area of the auto, power need to be produced by the panel and cost etc... Plays a major role thus the following tabulation is referred in the Table. 1. Table. 1 Specifications of solar panel

Type	Mono-crystalline silicon
Surface area	2*12 sqft
Power produced	400 watts
Voltage	36 V
Amps	12 Ah

IV. Selection of Motor

After the view of advantages of both AC and DC motor, it is obvious that for our requirement high torque producing motor will be more suitable. Thus the BLDC hub motor is to be selected.

4.1 Calculation for Selecting dc Motor

Weight of the auto rickshaw, W = WA+WE = 700 Kg

Power of the auto rickshaw, P=5.24 KW

Revolution of the crankshaft, N=5000 rpm

Engine torque TE =**10.01 Nm**

Wheel torque TW = $0.9 \times 3 \times 4.125 \times 10.01$ =**111.48 Nm**

Transmission shaft torque TS =**27.08 Nm**

Thus after calculating the torque required, now the motor that should be adapted should have the torque more than the theoretical value for safety measure. So to produce such a torque with low cost a BLDC hub motor is most suited for this purpose.

4.2 Specification of dc motor

After the calculations and selecting the type, the specifications are the only means that conveys the full detail about the motor, that are tabulated, which is specified in the Table. 4.1.

Type	Heinzman hub motor
Motor Power	800 watts
Torque	29 Nm
Speed	3000rpm
Voltage	36 Volt

Table. 2 Specification of DC motor

VI. Result and Discussion

The results obtained were found to be challenging.This rickshaw is was able to work continuously with a good mechanical efficiency and also it needed no fuel for its working as it can directly charge its batteries using a solar panel fixed at its roof. The maximum speed of the rickshaw found to be around 15 to 25 kmps at a load of 250kgs (load of 3 persons in rickshaw) and weigh of the body is 150 kgs (including all items). Full charging time of the batteries is around 3.5 to 4 hrs. Rickshaw is running around 35 to 45 kms per charge.

VII. Conclusion

Public transport vehicles with renewable fuels like solar panels can rule the coming markets as these vehicles need very less maintenance and no need to spend any extra amount of fuel. Hence a vehicle which runs using solar energy and having an average speed of around 25kmps and running around 40 kms per charge can save our environment from the pollution caused due to exhaust gases which are formed due to un burnt fuel in engine and also due to use of adultered fuel can be reduced. High import duty on the fuels can be reduced. The average income of the people who earn money by running transport vehicles will increase to around 40%. The transportation cost for the public decrease.

Hence with these many benefits the use of solar panels in the public transport vehicles will be a boon to human kind.

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