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Design and Fabrication of Solar Transport Vehicle

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ABSTRACT:- In the current state of technological development, the future of vehicles seems to be with the hybridization of various energy sources. This sort of development in vehicles seeks to take the benefits from the best quality of each energy source and it is especially useful in urban driving vehicles. In cities of India one of the major medium of transportation is auto rickshaws, which is producing a huge amount of air pollution as well as green house gases like CO_2 . Fuel, which is used is a non-renewable source and also which costs high as a result of that transportation charges increases. It would also affect the economy as well as the users of the auto rickshaw. Thus they should go for an reliable source as know that current trend of using the reliable source like solar which is available in plenty in country like India. Adopted SOLAR ENERGY as the additional sources in addition to the conventional IC ENGINES. they using the solar panel, controller and DC motor setup to convert the light energy as an electrical energy which is fed to the DC motor to obtain mechanical motion. The mechanical motion was transferred to wheels through chain drive in the propeller shaft which leads to cheap and effective transmission. Finally, fabricated a concept auto rickshaw with the help of modified transmission system and energized with solar energy to ran it.

I. INTRODUCTION

A commercial vehicle is a type of motor vehicle which have Internal combustion engines powered by diesel, petrol or gas. Used for transportation of goods and passengers.

Commercial vehicles are classified into two types according to European standards,

- Light commercial vehicles
- Large goods vehicles

1.1 Comparison of current technologies with solar hybrid vehicle

In this paper cleaner vehicle options will be compared – SHEV for emission reductions, fuel efficiency and overall CO2 reductions, and life cycle costs. The cleaner vehicle options considered in this report can meet futurestricter regulations on emissions such as hydrocarbons, nitrogen oxides, sulphur oxides, and particulate matter using available, 'off the shelf' emission control technologies. The main difference between the technologies considered is in fuel consumption and the resulting emissions of CO2.

Although petrol is widely used for passenger vehicles, the diesel engine is inherently more efficient than a conventional petrol engine. For the average passenger car fuel savings are around 20%. Advanced cleaner diesel vehicles now include emission control technologies to lower tailpipe emissions, including harmful particulate matter .

Changing to Liquefied Petroleum Gas (LPG) or CNG are additional options that are still fossil-based. The advantages are that they are inherently low sulphur and the combustion process is cleaner, resulting in lower harmful particulate matter and hydrocarbon emissions. CNG vehicles also typically have lower emissions of NOx compared to standard petrol vehicles. CNG or LPG fuel petrol engines can also use a 3-way catalyst to reduce emissions even further.

II. VEHICLE USED

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

2.1 Selection of hybrid technology

After the view of all the following types parallel, series and series-parallel hybrid system.it infers that all the types of technology suits well for some particular purposes, for this project series-parallel hybrid technology is better and it is well suited. Because with this technology the fuel usage and the speed limit can be maintained well in the city limits as well as speed and heavy loads carryings can be attained outer of the city limits with less fuel consumption.

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	**12 sqft**
Power produced	**100 watts**
Voltage	**24 V**
Amps	**4.23 A**
Cost	**Rs.8000**

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 DC motor is to be selected.

4.1Calculation for selecting dc motor

Weight of the auto rickshaw , $W = W_A + W_E = 700$ Kg
Power of the auto rickshaw, P=5.24 Kw
Revolution of the crankshaft, N=5000 rpm

Engine torque $T_E = \frac{P60}{2\pi N} = \frac{5240\times60}{2\times\pi\times5000}$

$= \mathbf{10.01\ Nm}$

Wheel torque $T_W = \eta_m G T_E$ $= 0.9\times 3 \times 4.125\times 10.01$ $= \mathbf{111.48\ Nm}$

Transmission shaft torque

$T_S = \frac{WHEEL\ TORQUE}{DIFFERENTIAL\ GEAR\ RATIO} = \frac{111.48}{4.125} = \mathbf{27.08\ Nm}$

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 the permanent magnet DC 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.

Table. 2 Specification of DC motor

Type	**Permanent magnet DC motor**
Motor Power	**1 HP (750 watts)**
Torque	**29 Nm**
Speed	**3000rpm**
Voltage	**24 Volt**
Cost	**Rs. 12,500**

V. TRANSMISSION SYSTEM

5.1 Needs of transmission system

When a vehicle is running, various resistances oppose it. In order to keep the vehicle moving at a uniform speed, a driving force or tractive effort equal to the sum of all the opposing forces has to be applied to it. If the tractive effort increases the total resistance affecting the movement of the vehicle, the excess tractive effort will accelerate the vehicle .If the tractive effort is less than the total resistances, the excess of the resistances will lower down the speed of the vehicle.

Vehicle acceleration = Tractive effort – Total resistance affecting the movement of vehicle.

5.2 Series-parallel hybrid transmission system

Whenever a hybrid system is implemented in a vehicle that to in an existing vehicle, then the designing of the hybrid mechanism plays a major role in it. Thus the power transmission from the motor to propeller shaft should be via chain drive was decided and after the calculations duplex chains suited the situation well. The technology that is handled here is a series hybrid system and hence the vehicle should be running with help of only one power at a time. Since the chain drive is implemented when the vehicle is running under ic engines power some of its power may be utilized to drive the motor this will lead to power loss to the vehicle and hence the sliding gear mechanism is used so that the power will be used completely to run the vehicle and hence unnecessary losses will be avoided. One of our innovation in hybrid technology is depicted below. Hybrid series-parallel transmission system is as shown in Fig2.

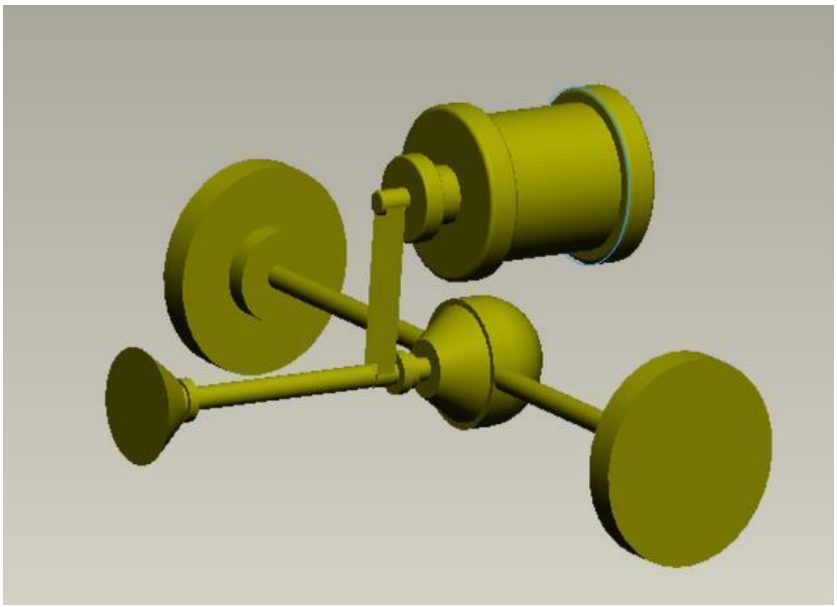

Fig 1 Hybrid transmission system

VI. RESULT AND DISCUSSION

Any project should have a cost analysis because it makes one to go through the budget and also it helps by guiding one in a right direction. In this project the main requirements that has to be considered will be auto rickshaw, solar panel, DC motor , battery and controller.

Table. 3 Cost analysis of project

Cost of old auto rickshaw	**Rs.**	**7,000**
Cost of solar panel	**Rs.**	**7,000**
Cost of DC motor	**Rs. 12,500**	
Battery & controller	**Rs. 10,000**	
Redesigning of transmission	**Rs.**	**3,000**
Repairing and repainting	**Rs.**	**4,000**
Total cost	**Rs.**	**43,500**

6.1 Running cost of vehicle with petrol

Normally, the auto rickshaw (lampe model) which has petrol engine so it has to be powered with petrol. hence the running cost of the vehicle will be enormously huge. It has been discussed in Table.4.

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**

From the above Table. 4 it is cleared that the average running cost of the auto rickshaw powered by the petrol will cost around Rs. 54000. But when the auto rickshaw is installed with solar panel and powered by DC motor then the running cost of the vehicle is almost negligible and also we can retrieve the amount that is spend to the project with in a year.

6.2 Hydro carbons (HC)

it is observed that HC decreases with increasing of load for all type of fuels. Exhaust gases leaving the combustion chamber of an SI engine contains up to 6000 ppm of hydrocarbon components due to the incomplete combustion of an IC engine. The incomplete combustion is happened due to the insufficient air availability for combustion process. With a fuel-rich mixture there is not enough oxygen to react with all carbon resulting in high level of hydro carbon emission in exhaust gas.

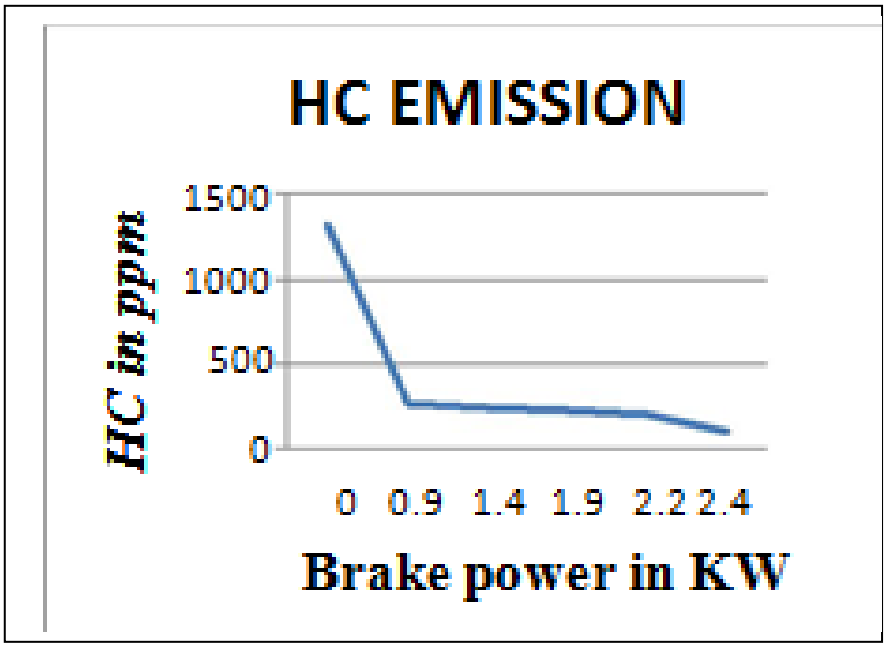

Fig 2 Hydro carbon emission in petrol engine

Initially at starting condition starting moment is high so we need higher power in engine. In order to achieve this we have supplied the rich air-fuel mixture. As a result of that above causes are happened in starting level after that torque distribution reduces and air-fuel ratio can be achieved as per the stoichiometric ratio. So that emission of hydro carbons (HC) can be reduced of increase of load or reduce the torque.

VII. CONCLUSIONS

After the discussions and lots of feedbacks, in this series-parallel hybrid system is selected and to run this technology successfully, the solar energy is utilized in the maximum way with the help of calculations and as that the panel had been selected. From the panel used and the motor has powered, the backup source for the motor power is calculated. Finally, battery and controller are used.

From all the above made selections the vehicle would be designed with a new successful hybrid transmission system. The vehicle would be running with help of solar-electric power one to two hours per day. As a result of that the air and noise pollution would be reduced up to 30% in urban areas. The fuel could be used very effectively and the city`s speed limit would be maintained to a great extent. The accidents could be avoided.

APPENDIX

Photos of experimental solar hybrid

Fig. 3 Modified transmission system

Fig. 4 solar hybrid auto rickshaw

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