iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** IX **Month of publication:** September 2020

DOI: https://doi.org/10.22214/ijraset.2020.31335

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue IX Sep 2020- Available at www.ijraset.com

Performance Analysis of Hybrid System

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Abstract: ***With the increase in the lifestyle and technological advancements in automotive sector, the demand for the transport vehicular has increased rapidly. The dependency of personal automobile had encroached the traffic problems and also environmental problems. The hybrid system could not only increase the efficiency of the running engine but also reduce the exhaust waste to the environment. We only need to do a small configuration to our existing models and replace with our system for maximum efficiency. The hybrid system would enhance our engine and lower our dependency on the natural fuel. This would be our best option to develop our automobiles sector. Not only it improves performance but would also lower air and noise pollution. Meanwhile this system would be running free of cost as the batteries can also be charged either by electric supply or running vehicle would provide free energy via hub motor which that can be stored for future work. This paper provides more detail study regarding the hybrid structure and how they can be utilized in different ways to improve the efficiency and performance of the vehicle.***

Keywords: Hybrid System, HUB Motor, Battery system, Controller, Fabrication, Efficiency.

I. INTRODUCTION

In the modern developing world, everything is becoming more and more advance and economical with efficient utilisation methods. The technological advancements are leading to the enhancements, automation and redesign of the existing system especially in the automobile sector. Automobiles plays important role in the human need as they are increasing needs in day today life. They help in smooth working of nation economy. But they too possess such issues like pollution, fuel economy, and efficiency. Researches are going, to solve these issues and make our lives smoother. In spite of recent efforts to improve the effectiveness and reduce poisonous exhaust gases, it has tremendously increased in the past two decades. Motor vehicle nearly contributes 14% of CO_2 from all sources besides other pollutants. Thus regulations on exhausts emission are progressively made. But more over we are more in need to develop our design for efficient and clean energy source and even by retrofitting the existing models to achieve the goals.

A. Problem Identification

1) Increase in motorcycles in India
2) Demerits of petrol bikes
a) Rising Prices and foreign affairs.
b) NOx emission
c) Unburnt HC emission

3) Demerits of electric vehicles
a) Lack of Charging Stations
b) Expensive cost
c) Lack of Power and Reduced range.

4) Limited space for battery.
5) Power Assisting for the vehicle.
6) Charging of the battery.
7) Proper disposal of battery.

In Hybrid system the front wheel is being propelled by the energy from stored battery system and rear wheel is run by the IC engine. So both electrical and petrol based engines are used to drive the vehicle. Generally at lower speed we can switch to electric system and at high speed or highways we can prefer IC engine drives. But for optimum utilisation we can easily run on free energy source. There is no need of gear reduction in switching as the torque produced is sufficient enough for driving the vehicle easily on the road.

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The controller is designed to implement the switching between IC engine and Electric motor and is attached to the stator and battery system. A lot of research have been carried out to make batteries more compact and powerful to run on electric system along, but there efficiency and reliability is still far ahead. Till then we can surely depend upon Hybrid system for better efficiency and clean energy source.

II. METHODOLOGY

The working principle of HYBRID TWO-WHEELER involves three processes, the first process involves when the vehicle operates by the means of internal combustion engine, secondly when the vehicle is running by means of an electric motor and the third process when the vehicle is running in both the modes according to the requirements of the driver. When the vehicle is driven at the outside of the city we may need more power to drive, so it can be powered by means of internal combustion engine and when the high speed is not required we can easily run in electric system. The power from petrol engine runs the rear wheel and the front wheel runs from battery source when we switch to electric mode.

III. MATERIALS AND METHODS

Following are the materials included:

A. BLDC Hub Motor

Hub motors are beneficially important equipment needed in the development of Hybrid System as they offer several benefits such as compactness, noiseless operation and high efficiency for electric vehicles. These motors have stators fixed at the axle, with a permanent magnet rotor embedded in the wheel. BLDC motor is a closed loop synchronous motor. They have an array of permanent magnets on inside surface. They provide high torque at low Rpm.



Fig 1: BLDC Hub Motor attached at front wheel

1) Specifications of Motor

a) Voltage: 36V- 48V – 60V – 72V
b) Power: 500W -800W -1000W
c) Rated Speed: 150 – 800 Rpm
d) Load Carrying Capacity: 60kg – 300kg
e) Noise: below 50Db
f) Efficiency: 85%
g) Maximum Speed Achieved: 40-65km/Hr

B. Battery

The battery is like a fuel tank for an electric system and requires refilling by means of charging. The lead-acid battery is the power source of the electric drive. While most of the electric vehicles choose lead acid battery other variety of power source can also be used. Sealed lead acid batteries have good energy density and power density ratio. It has a very low energy-to-weight ratio and a low Energy-to-volume ratio.

Selection of batteries:

Four units of 12V 35Ah lead acid batteries are connected for power supply to motor.
No. of battery: 4
Voltage: 12V each (12*4= 48 V)
Current: 35Ah
We need maximum of 2hrs back up to cover 60km distance with help of motor at 30-35kmph speed.

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Fig 2: Lead Acid batteries arrangements

C. Controller

The controller controls the speed and torque of the motor. The controller connects the power source –fuel cell or battery to the actual motor. It controls speed and direction and optimizes energy conversion. While batteries produce a fairly constant voltage which decreases as they are used up, we need electronic controlled unit attached to the BLDC motor to determine the position of the rotor and to energize the coils accordingly



Fig 3: Controller

D. Resistor

It works as a throttle substance for the motor from it we can control the speed of the vehicle.



Fig 4: Resistor

E. Methods Of Modification

Methods of our project are:

1) The front wheel of the vehicle is redesigned by adding BLDC hub motor.
2) Batteries are connected in series and are then they attached to the hub motor through the controller.
3) The connections from IC engine to hybrid system is made by the controller.
4) A circuit is designed with the connecting wires to switch the vehicle from the electric source to petrol fuel at a particular speed automatically.
5) A manual switch is also been provided to derive the vehicle either on battery source or fuel supply.

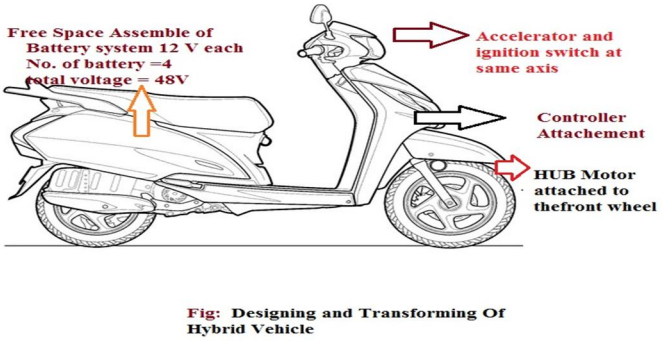


Fig 5: Layout of the Proposed Vehicle.

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IV. RESULTS

The above fabrication model for the vehicle is analysed under different parameters and detail observations are done. It has been noted that the above proposed model of Hybrid System shows more promising results than those of IC engine vehicle or power produced through the electrical system only. The detail study regarding torque produced power on engine, average speed of engine, backup time, delay durations, mileage of vehicle, etc. The obtained results are compared with both electric system and fuel engine and table is made as below.

A. Analysis Of Vehicle

On full charge battery bike goes 40km with economy speed of 40-50kmph.Since IC engine gives us mileage of 60 kmpl and Battery on full charge can have average of 40-50 km.
So the calculation is based on 100km daily running of vehicle for (295 working days.)

Parameters	IC Engine	HYBRID	Differences
Petrol consumption	491.67 liters	295 liters	196.67 liters
Cost of petrol (78/ litre)	38350.26	23010	15340.26

Table 1: Cost of travelling in various modes.
Battery and components cost: 20,000
Average life of battery: 4 years

Actual Analysis: Payback Calculations

Parametrs	IC Engine	HYBRID
Cost of travelling per day	130	78
Cost of travelling per month	3900	2340
Cost of travelling per annum (working days)	38350.26	23010
Cost of travelling for 4 years	1,53,401.04	92,040
Maintenance for 4 years	40,000	20,000
Total Expenses	1,93,401.04	1,12,040
Saving in 4 years	0	81,361.04
Cost of travelling for 8 years	3,06,802.08	1,84,080
Maintenance for 8 years	80,000	40,000
Total Expenses	3,86,802.08	2,24,080
Saving in 8 years	0	1,62,722.08

Table 2: Actual Case Running Cost

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B. Calculation

In the calculation the market price is used also oil changing, service maintenance & routine maintenance charge are included .
The project prototype is used for the payback period of 4 years.
Amount saved in 4 years: 81,361.04
Profit percentage: 42.06%
Ride Economy per Km:
IC ENGINE: 1.3/Km
HYBRID : 0.78/Km

C. Comparison

Type of vehicle	IC ENGINE	ELECTRIC	HYBRID
Vehicle cost	55000	38000	60000
Fuel cost 1 liter (Rupees)	78	0	78
Charging cost	0	50	0
Mileage in km per lit	60	45	100
Running cost per kilometer	1.3	1.1	0.78
Speed of vehicle	60	35	50

Table 3: Comparison between different design models of vehicle.

V. CONCLUSION

The Hybrid System so proposed is designed successfully which is both economical and environment friendly as nearly half of the distance is covered by the help of electric system. More so the amount of fuel used in hybrid system is almost half used than those running on commercial vehicle. More over most economical part is that the electric system runs free of cost as the batteries are charged via running motor and energy is provide through controller attached to it. The stator point is separately provided for user friendly as to switch automatically between the petrol system to electric system and vice-versa. The throttle valve is mounted on same accelerator axis. The complete system is attached perfectly with minimum losses and maximum output. The power consumption is reduced while driving through electric system. When we required high torque we can switch to petrol engine. Thus by this we can increase fuel economy and improve the mileage. The initial cost may be slightly high for hybrid system but the overall efficiency in mileage capacity and fuel economy is greater than petrol engine and also exhaust emissions are less with less noisy and smooth. .

VI. FUTURE SCOPE

Since we all know that entire world is facing scarcity of petrol and gasoline price is rising up daily. More over the tussle between OPEC over petrol production and pricing have left no option on importing countries to reduce dependency on it and develop technological advancement for using more effective and clean source of energy. The use of Hybrid system can be feasible and profitable option for this situation**.** We can improve the battery life either by fast mode of charging or by recycling it for economic purpose. Research in other areas like fuel cells and renewable fuels can e more advantageous in future.

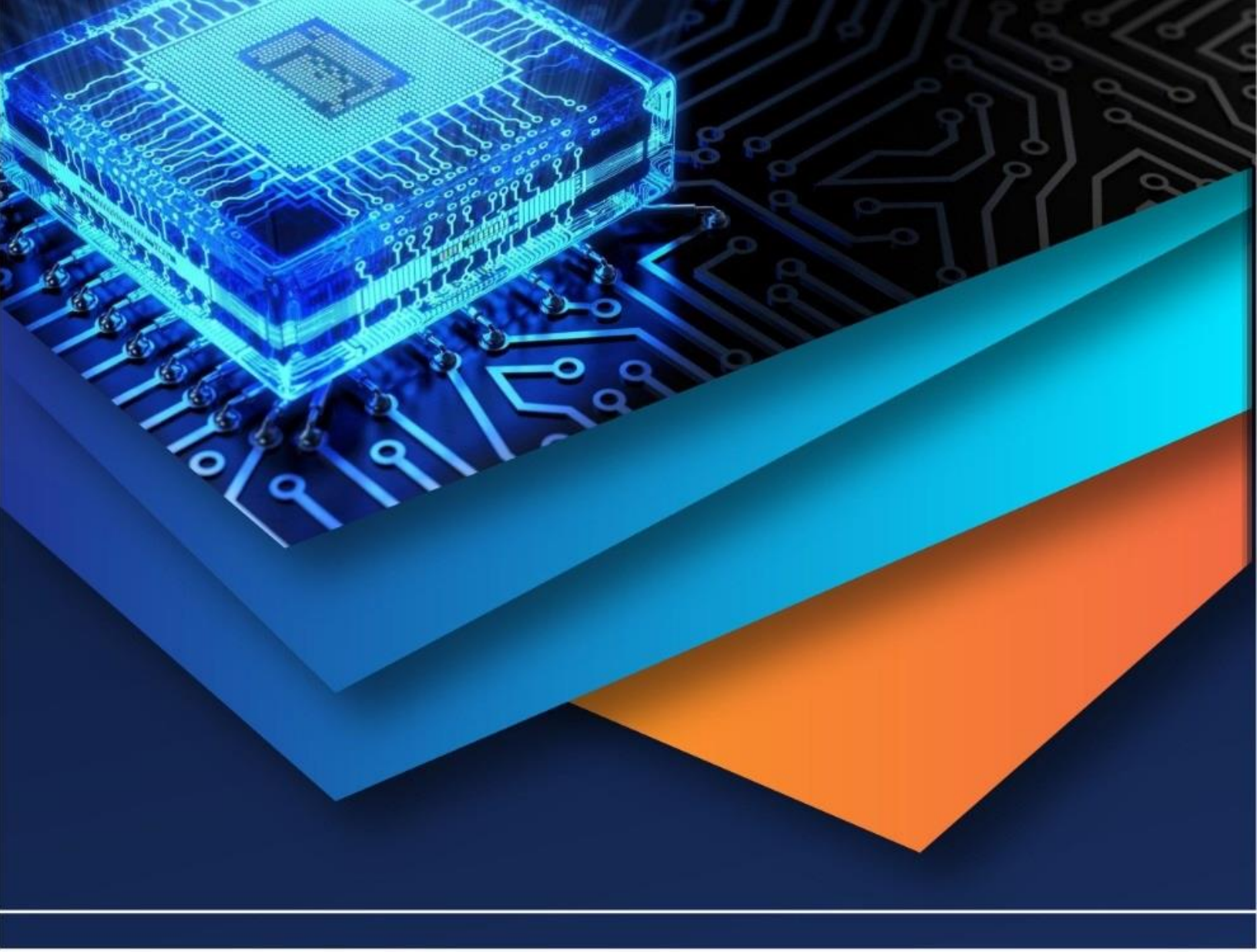
A. Charging using solar power.
B. Automatic selection of driving mode for ease.
C. Battery cut off circuit for avoiding charging overload.
D. Reliable and affordable power switching / assisting devices for higher efficiency.
E. Using gas fuel as source of energy.
F. Used for heavy vehicle like-Diesel Hybrid-Electric buses, or hybrid Citi vans for urban fleets.

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[10] Karen et al., 1999, presented a simulation and modelling package developed at Texas AM University. An Electric Vehicle, a series HEV, a parallel HEV and a conventional internal combustion engine have been designed using the simulation package. Simulation results such as fuel consumption, vehicle emissions, and complexity are compared and discussed for each vehicle.
[11] Emadi et al. (2008), focused more on power electronics as promising technology for the development of plug-in hybrid electric vehicles and implementing those advanced electrical architectures to meet the demands for increased electric loads.

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