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Eco-Hybrid Electric Vehicle (HEV)

Y.R.Naik[1], V.S.Kandale[2], S.R.Kubal[3], A.D.Patil[4], Y.Y.Yadav[5]

[1]Asst.Prof.Dept of Electrical Engg, [2,3,4,5]UG Students/EE

Sanjeevan Engineering & Technology Institute, Panhala, Kolhapur Maharashtra (INDIA)

ABSTRACT

In a country like India, the usage of two wheelers for daily activities is high. To bring the advancements in these two wheelers, hybrid electric vehicle prototype is being developed. From the vehicles, mostly two wheeler are used than the other vehicle. As the ICE (Internal Combustion Engine) is least efficient at low speed (traffic condition).The electric drive is not only silently but also low heat dissipation compared to petrol powered two-wheeler. The objective is developing of hybrid two wheeler with geared system powered by ICE and electric motor with the help of fuel and battery supply. The rear wheel of two wheeler is propelling with ICE as well as electric hub motor.

***Keyword**: BLDC Hub Motor, Motor Controller, Lower Pollution, Two Wheeler Hybrid Vehicle, Payback Period*

I. INTRODUCTION

Millions of people living in large cities in the developing world, two- wheeled motorcycles offer convenient, affordable access to motorized transportation [2]. Nowhere is this trend more evident than in Asian countries, where motorcycles comprise up to 95 percent of motor vehicles on the road. Two-wheelers generally offer flexible personal mobility while three-wheelers fill the gap for larger families and commercial transport. Once dominated by bicycles, pedestrians, and buses, urban areas around the globe are transforming to accommodate growing ranks of motorcycles [1].

The development of hybrid and EVs become mostly popular. That can be seen due to highly increased awareness of global warming and also rise in cost of petrol prices. Thus also due to increased in air pollution which is concern in environment and increase in oil prices, the HEVs is one of the choice for the transportation.

In this paper, the concept of hybrid vehicle incorporates to reduce running cost of vehicle, To reduce the emissions, To overcome the draw backs of electric vehicle, To increase life period and efficiency of existing gasoline vehicle.

II. BLOCK DIAGRAM

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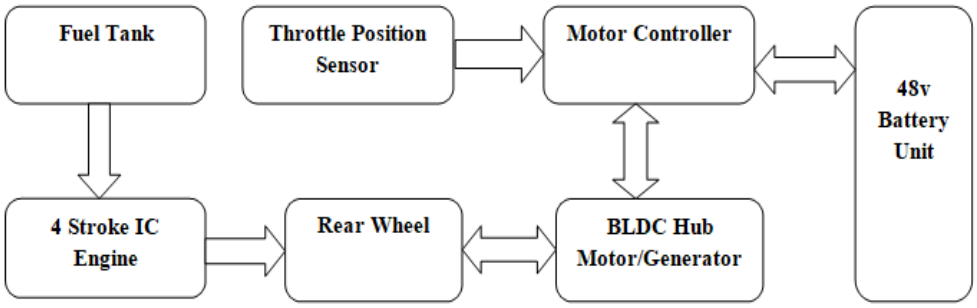

Fig. 1, Block Diagram of Hybrid Vehicle

Components:

A. BLDC-Hub Motor:

BLDC motor is a closed loop synchronous motor [6]. It has all the characteristics of DC Motor with some added features. Stator is made of laminated steel stacked up to carry copper windings. Stator winding connected in star for high torque at low RPM and in delta to obtain low torque at low RPM [9].

Fig. 2,BLDC Hub Motor And Winding Of Motor

Specifications of motor:

- **Voltage:** 36V- 48V – 60V – 72V
- **Power**: 500W -800W -1000W
- **Motor Type:** BLDC hub motor
- **Gross Weight:** 13.2 kg
- **The Tire Diameter:** R17*3.00/R17*2.75
- **Tire Width:** 70mm
- **No Load Speed:** 36 V 150-200 Rpm
  (0. 48 A) 48 V 200 - 400 Rpm (0. 57 A) 60 V 250 - 600 Rpm (0.68 A)
- **Rated Speed**: 150 – 800 Rpm

- **Rated Torque**: 8 – 45 Nm
- **Brakes**: Disc break
- **Load Carrying Capacity**: 60kg – 300kg
- **Noise**: > 50Db
- **Efficiency** : 85%
- **Maximum Speed Can Be Achieved**: 25 – 65km/Hr
- **Constant Current At Ideal Load**: 15 – 40ampere

The rotor of the Hub motor is made up of permanent magnets. The number of permanent magnets used in rotor impact the torque. Increasing the number of poles gives better torque.

B. Motor Controller:

An electronic controlled unit is used in a BLDC motor to determine the position of the rotor and to energize the coils accordingly [7]. The Hall Effect sensor is used to sense the position of the rotor. This sensor gives information to the controller, which energizes the stator coils [8].

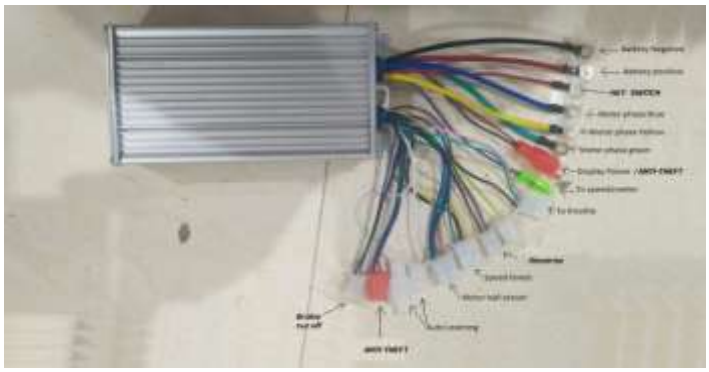

Fig. 3, Motor Controller

Specifications:

- Rated voltage: DC 36/48V
- Rated power: 1000W
- 40 AMP Current
- Anti Theft
- Reverse
- 3 Speed Mode
- Cruise

C. Battery

Lead acid battery is the oldest type of rechargeable battery. It has a very low energy-to-weight ratio and a low energy-to-volume ratio. Its ability to supply high surge currents means that the cells have relatively large power-to-weight ratio and due to low cost it is used in motor vehicle to provide high current.

For more convenient we use SMF batteries.

Selection of batteries:

Power rating of motor- 1000W, 48V, $20.83A$ at full load rated load

70% loaded motor taking current

$$I = \frac{P}{V} = \frac{700}{48} = 14.58A \cong 14\text{A}$$

Four batteries are connecting in series for 48V of 12v.

Requirement of current rating & back up time of batteries:

We need max 2hrs back up to cover 60km distance with help of motor at 30-35kmph speed.

Current rating of battery

$$\text{Ah} = 14 * 2 = 28A\square$$

So we choose 35AH, 12V battery then back up time is:

$$\text{T} = \frac{AH}{A} = \frac{35}{14} = 2.5\square r$$

Four units of 12V 35Ah lead acid batteries are connecting for power supply to motor.

TABLE NO I: Comparison of Batteries

Factors	**Lead Acid**	**Lithium Ion**
Weight	Maximum	1/3rd of lead acid
Efficiency	Inefficient over the lithium ion batteries	Nearly 100% efficient in both charge & discharge
Discharge	Low self-discharge	Batteries are discharged 100% versus less than 80% for lead acid
Cycle Life	400-500 cycles	>5000 cycles
Voltage	Voltage drop consistently throughout the discharge cycle	Maintain their voltage throughout entire discharge cycle
Environmental	The electrolyte and the lead	Much cleaner technology & are safer for the

impact	content can cause environmental damage.	environment
Cost	Inexpensive	Expensive

To get more efficiency & reduce the bike weight we can use SMF batteries.

Before Modification

Fig. 4, Bike

After Modification

Fig. 5, Bike after Modification

III. ANALYSIS OF TEST DRIVE

The test drive of bike on the route assists by Google map from Nipani-Radhanagari (98km) has been covered. Further test drive for analysis of data to calculate their economy.

Fig. 6, Route chosen for test drive of vehicle through Google Map

This route of 98km including incline & decline road with plane road. All calculation based on through that route for analysis.

IV. PAYBACK CALCULATION

TABLE NO II. Hybrid electric vehicle covered distance

TRAVELLING	IC ENGINE	ELECTRIC	HEV
Daily	40km	60km	100km
Monthly (30day)	1200km	1800km	3000km
Yearly (293working Day)	11720km	17580km	29300km

The calculation on the basis of daily covered distance by user about 100km per day. So neglecting vacation periods remaining days calculation followed by this table.

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TABLE NO III. Calculation on the basis of working days

PARAMETER	PETROL ENGINE	HEV	DIFFERENCE
Requirement Of Petrol	418.40 Ltr	167.30 Ltr	251.10 Ltr
Cost of petrol	33903.03 □	13560.54 □	20342.49 □
Maintenance	9500 □	3500 □	6000 □

TABLE NO IV. Payback calculations for actual case

PARAMETER	IC ENGINE	HEV
Cost of travelling 100km per day	115.71 □	50 □
Cost of travelling per month	3471.3 □	1500 □
Cost of travelling per year(293days)	33903.03 □	14650 □
Cost of travelling per 4 year	135612.12 □	58600 □
Maintenance cost after 4 year servicing	40000 □	25000 □
Total Expenses	175612.12 □	83600 □
Saving over IC Engine after 4 year	0 □	92012.12 □
Cost of travelling per 8 year	271224.24 □	117200 □

Maintenance cost after 8 year servicing	80000 □	75000 □
Total Expenses	351224.24 □	192200 □
Saving over IC Engine after 8 year	0 □	159024.24 □

In above table the calculation of cost of petrol by refers through the local petrol agencies. Also maintenance of bike included the oil changing, service maintenance & routine maintenance charge included in maintenance

When the project prototype is used in combined cycle the payback period for the project is slightly more than 4 years.

V. FUTURE SCOPE

When the entire world is facing the scarcity of petrol and the gasoline prices are touching the sky, hybrid electric vehicle have come up as a promising and a feasible option to cope with the situation
The use of hybrid is being encouraged by many governments in the world.

VI.CONCLUSION

The eco hybrid vehicle is more advantages for future life to maintain or reduces the emission of gases due to burning of fossil fuel. The cost of fuel increasing day by day, the HEV reduces the running cost and excessively maintenance cost of the vehicle.

In urban areas high traffic condition HEV is more efficient. Due to that less fuel usage emission of oxide gases minimizes so pollution is controlled.

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