NARESH RAO S S - DESIGN AND FABRICATION OF HUB MOTOR POWERED PETRO-ELECTRIC HYBRID MOTORCYCLE

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DESIGN AND FABRICATION OF HUB MOTOR POWERED PETRO-ELECTRIC HYBRID MOTORCYCLE

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Abstract:

Transportation area are held record for enormous developing portion of worldwide nursery gas outflows. Around the world, the emanation of engine vehicle is around 900 million metric huge loads of carbon dioxide (CO2) consistently, over 15 percent of global fossil fuel gather CO2 emission. Automobile industry, replacement of old fuels to modern Electric Technology due to depletion and to control emission. It's still in a learning face and will take some time to commercialization these technologies. The product of Hybrid Vehicles is well known in the market and utilized internationally. The complete protentional will eventually take time to enter the automobile industry sector and need some time to solve users need and satisfaction. Looking, at current scenario of rapidly climate change and increasing of global warming has not changed but rather increasing daily the emission of fossil fuel in abundance with respect to combustion engine vehicle. Demand of Hybrid vehicle will increase and stand strong in the market for better utilization to all Users. In this, we aim to design the Hybrid Electric Vehicle using brushless DC Hub Motor and Lithium-ION Battery which can superior in Comparing IC Engine with better performance, economical and cost effective.

Introduction:

In recent development of world, automobiles have a vital role to Human Beings as the need of it is increasing day by day. Though it may be very much essential and useful to users but has flaw in our developing world. The main idea is to develop a vehicle which runs both on electric and fossil fuel, powered two-wheeler motorcycle design. Together it can make the vehicle dynamic in nature and powerful. The owner of this vehicle will be more benefited in terms of fuel costing and well aware of the impact towards environment. Hybrid Electric Vehicle uses a power framework with an inward burning motor to further develop fuel costing and decrease outflow. In electric vehicle battery gives ability to slow driving conditions while the burning motor is very much useful for faster driving and very much effective in nature. For saving fossil fuel for future and rapidly moving to next generation of technology E-vehicle will be major breakthrough. A hybrid vehicle has a solution for all of these bringing together the pros of both frameworks together and make use of both the frameworks depending on the condition. Pair of electric and fuel brings out the best preferred design to automobile industry. The mileage of the vehicle increases double the times of current one by reducing the emission to half. The usage of fuel and cost of it will have serious effects on electric vehicle. Nowadays, the price of fuels is almost the cost of production and few nations have import control fees. The cost of the fuel will increment as there will be depletion of stores like oil and gaseous petrol and need to restrict is

1. Environmental pollution.
2. CO2 generation.

Moreover, there is evidence of dangers purposed to environmental changes and to take immediate action to reduce (GHG) emission from any source. GHG emission are majorly from transportation industry which is widely increasing than any other emission sectors and India alone is held to produce 11.7 percent of total GHG emission in which survey took place in 2017. We would love to know in-depth knowledge of hybrid technology of two-wheeler vehicle and flexibility on roads. In this, we aim to design the Hybrid Electric Vehicle using brushless DC Hub Motor and Lithium-ION Battery which can superior in Comparing IC Engine with better performance, economical and cost effective.

Literature Survey:

- In 2007 Brian and his group observed a model which can clarify the costs of fuel when contrasted with IC vehicles utilizing MATLAB and ADAMS.2The vehicle which Brain utilized was HONDA IMA, in which e-engine was an extra to the force in motor. Mind showed that motor unit goes about as generator during the regenerative dialing back. He utilized a basic power the board calculation to control power the executives and intended for the relating vehicle.
- In 2008 Emadi et al focused in extra on power equipment as a development empowered for development to module hybrid vehicle and handling electrical design to fulfill needs for expanding electric burdens. Short rundown on the present for headway to module hybrid vehicle and the electronic to these vehicles enjoy many benefits and fruitful improvement which is expected of force electronic.

Objective:

- Building a hybrid vehicle using brushless DC hub motor and Lithium-ION battery pack.
- Find out mileage range of Petro-hybrid two-wheeler.

Methodology \ Plan Of Work:

Objectives:

- Calculations of parameters like Hub motors and Battery.
- Placing of motor and battery on the vehicle chassis.
- Connection testing of motor and battery to check the vehicle is in working/running condition.
- Designing the throttle for accelerator placed near to controller fit throttle and placing the charger below the seat.
- After checking the mileage of the bike, acquiring of Petro-electric vehicle, motor and engine in working condition.

Selection Of Components And Description:

Hub Motor

Components of motor used in this is 60v, 1.2kW, Brushless DC Motor. The changes made in this vehicle is ordinary back tire is supplanted by wheel center engine with power running of 1200w and 60v. Electromagnetic fields of Hub Motor are provided to the stationary windings of the motor. Turning wheels are moved by the outer part which are followed by those fields attached. The energy in brushed engine is moved by brushes in touch with engines turning shaft. The energy is carried by brushless motor electronically, wiping out physical contact between moving parts and stationery. In spite of the brushless technology which is expensive but are very much worth and last long than brushed motors mechanism. Hub motors are well developed which could offer better benefits in terms of conservativeness, silent condition and give elegant effectiveness to e-vehicle. They have non removal axle, with fixed magnet rotor attached in wheel. The conventional exterior rotor has hallowed cylindrical design spinning beside the stator pivot. There is air hole among stator and rotator. We designed our own swinger arm for the motor.

Fig 1: *Hub Motor*

Features:

- Real Wheel Drive.
- Nominal output up to 1200W.
- 17.8 Nm nominal and 76 Nm peak torque.
- Weight 9.5Kg.
- No gear, no brush, no wear, no noise.
- Smooth, controllable with speed variation.
- Highly efficient.

Motor Specifications

- Motor Diameter: 276.5mm , Shaft Length: 276mm
- Brake Size: 100mm
- Break Type: Regular break
- Tyre: Tubeless, Size: 90/100-10

Lithium-ION Battery

Power ranging of 60v and 30Ah is used. The main idea of using this is for getting more energy density and self-charging with less maintenance. The battery is placed under the seat so that there is no additional space taken up which is very much free. Because lithium-ion battery is king of all batteries / cell and have greater density. Similarly,

to mobile phones which operate longer between charges to completely drain the battery after long lasting hours but yet still consuming power which always needs a larger battery capacity. There are many ways of extracting power from the tools to power electric vehicles. The battery of Lithium powered has distinct advantage of having higher power capacity.

Throttle And Digital Speedometer

Throttle usage, it is completely based on the variations of speed the users provide while raising it. The speed may vary with respect to resistance. The throttle is placed just beside the engine throttle in the same handle bar in the hybrid vehicle. This will significantly reduce having another handle bar by making use of dual throttle. Digital speedometer will give out the access of the speed based on variation.

Controller

It is placed where the free space is available in normal bike battery. It is tied-up with the power source of motor. It can control speed and energy conversion takes place. Used 48v/60v 38A 1.2 kW wired type DC-DC converter.

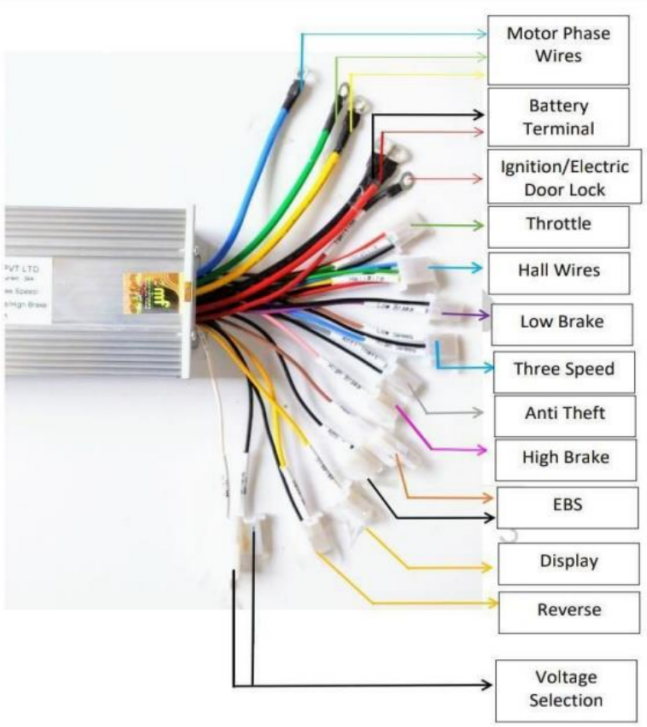

Fig 2: *Wiring Diagram*

Table 1: *Details Of Converter Connections*

SL.NO	FUCTION	CONNECTORS	DESCRIPTION
1	Supply Terminal (48v DC / 60v DC)	Single Wire Ring Connector	Red = Battery Positive Black = Battery Negative
2	Motor Phase Wire (Connected with YGB wire)	Single Wire Ring Connector	Yellow = Motor Y Green = Motor G Blue = Motor B

3	Hall Wire (Connected with hall wire)	6 pin connectors	Red = Hall Positive Black = Hall Negative Yellow = Hall Y Green = Hall G Blue = Hall B
4	Throttle (Accelerate vehicle)	3 pin connectors	Red = Throttle Positive Black = Throttle Negative Green = Throttle signal
5	3 speeds (High speed = Blue & Black Low speed = Brown & Black)	3 pin connectors	Blue = High speed Positive Black = Ground Brown = Low speed Positive
6	Electric Door Lock / Ignition (Connected to main battery positive)	Single Wire Ring Connector	Red = Electric Door Lock Positive
7	High Voltage Break (Externally Connected to 12v DC to supply voltage DC)	1 pin connector	Pink = High Voltage Brake Positive
8	Low Voltage Break (Apply break short yellow and black)	2 pin connectors	Violet = Low Voltage Break Positive Black = Ground
9	Reverse (Connect yellow and black to run motor in opposite direction)	2 pin connectors	Yellow = Reverse Positive Black = Negative
10	Speed Display (Read motor speed)	2 pin connectors with 1 wire	Yellow = Positive
11	Anti-Theft (Short this Gray and Black for wheel locking function)	2 pin connectors	Gray = Positive Black = Negative

Motor Cycle

The vehicle used for this is IC engine motorcycle, second hand Honda CD 100 (1993) model. To take up this decision and using this motor cycle was important in terms of choosing motor, battery, controller and many other things used.

Fig 2: *Motor Cycle*

Specification

- Rated Power (Watts) – 1200
- Rated Torque (Nm) – 17.8
- Peak Torque (Nm) – 76
- Operating Voltage (Volts) – 60
- Rated Current (A) – 22.7
- Peak Current (A) – 30
- Rated RPM – 640

Table 2: *Technical Readings Of HUBMOTOR*

SL NO	VOLTAGE (V)	CURRENT (A)	INPUT POWER (W)	TORQUE (Nm)	SPEED (rpm)	OUTPUT POWER (W)	EFFIENCY	TIME (S)
1	60.459	3.1392	189.79	0.2	652.2	13.96	7.4	0
2	60.455	3.2796	198.27	0.3	651.6	21.44	10.8	3
3	60.452	3.422	206.87	0.8	651.9	52.25	25.3	6
4	60.449	4.6643	281.95	1.8	652.2	124.82	44.3	8.98
5	60.458	6.8857	416.3	3.9	652.4	265.21	63.7	12
6	60.465	10.588	640.2	7	654.8	481.24	75.2	14.98
7	60.467	13.628	824.03	10	655	684.2	82.5	17.98
8	60.468	14.54	879.18	10.9	655.1	745.09	84.7	20.98
9	60.466	19.894	1202.9	15.6	648	1058.4	88	22.21
10	60.465	22.27	1346.6	17.8	643.3	1200	89	23.4
11	60.464	24.561	1485.1	20	638.8	1336.5	89.9	24
12	60.464	25.706	1554.3	21.1	636.6	1404.7	90.4	26.98
13	60.463	30.191	1825.5	26.8	581.5	1630.5	89.3	28.67
14	60.464	30.678	1854.9	30	522.6	1626.7	87.7	30
15	60.464	31.058	1877.9	32.5	476.5	1623.7	86.5	32.98
16	60.463	30.616	1851.2	38.8	401.9	1631.4	88.1	33.53
17	60.463	30.608	1850.7	40	388.4	1618.4	87.4	35.98
18	60.465	30.573	1848.6	45.3	328.8	1561	84.4	38.51

19	60.464	30.544	1846.8	50	284.6	1486.4	80.5	39
20	60.464	30.538	1846.4	50.9	276.1	1472.1	79.7	42
21	60.464	30.526	1845.7	56.4	233.7	1379.9	74.8	43.67
22	60.465	30.48	1842.9	60	209	1304.7	70.8	44.98
23	60.465	30.445	1840.8	62.8	189.7	1246.2	67.7	48
24	60.464	30.41	1838.7	69.6	148.4	1081.2	58.8	48.17
25	60.464	30.405	1838.4	70	146.1	1069.2	58.2	51
26	60.464	30.323	1833.4	76.4	109.7	877.9	47.9	54
27	60.463	30.26	1829.6	74.7	43.1	336.62	18.4	56.98
28	60.526	0	0	0.4	0	0	0	56.985

Design And Fabrication Of Models

Battery Calculation

Running an electric bike with 60v 1.3kw BLDC Hub Motor

How much ampere hour of lithium-ion battery is required?

Step 1: Finding current consumed by the motor to run

Power = voltage * current

1200 = 60 * current

Current = 1200/60 =20 amps (theoretically)

Step 2: Find out watt hour of battery

1200 * 1 hour = 1200 - watt hour

Taking efficacy of 80% for battery

i.e., 1200/.8 = 1500 – watt hour

Step 3: Converting watt hour of battery into ampere hour of battery

Watt hour = voltage * ampere hour

1500 = 60 * ampere hour

Ampere hour = 1500/60 = 25 ampere hour

Motor Calculations

Speed (max) = 45km/hr

Weight of cd 100s = 166kg

Weight of rider = 70kg

Electric of equipment weight = 30kg

Total gross weight = 266kg

Diameter of wheel (rim + tire) = 508mm

Radius of wheel (rim + tire) = 254mm

Tire circumference (wheel travel per rotation) =2πR

2 * 3.14 * 254mm = 1595.12mm ≈ 1.6 m

Velocity (v) = speed (km) / 60 * 60 = 45 * 1000 / 3600 = 12.5 m/s

RPM required = velocity * 60 minutes / wheel travel = 12.5 * 60 / 1.6 = 468.75 ≈ 470 RPM

Total Force Acting Against The Vehicle

Total Force = Frictional Force + Air Drag Force + Gradient Force – Accelerating Force

(i) Frictional Force = mass * acceleration due to gravity * Cr

= 266 * 9.81 *.02

= 52.18 kg m/s^2

(ii) Air Drag Force = .5 * [air density(ρ) * Cd * bike frontage area * v^2]

= .5[1.23 * .8 * .84 * $[(12.5)]^2$]

= 64.575 kg m/s^2

Neglecting gradient force and acceleration force as the vehicle is designed for the city use not for hilly areas (hub motor).

Total Force = Frictional Force + Air Drag Force.

= 52.18 + 64.87

= 116.74 ≈ 117 kg m/s^2

Calculating Power:

Power = Total Force * velocity

= 107 * 12.5

= 1.3 kw

Calculating Torque:

P = 2πNt / 60

T = P * 60 / 2πN

= 1300 * 60 / 2 * 3.14 * 470

= 26.4 Nm

Working Principle

In this Hybrid Vehicle we have 3 processes,

- First process, includes when the vehicle is running with an IC engine.
- Second process, includes when the vehicle is running with electric motor
- Third process, includes when the vehicle is running is dual mode based on user's requirement.

If the vehicle is driven far away from city it actually needs more power to drive the vehicle, this actually uses IC engine. Power is taken from pulley and wheel starts rotating.

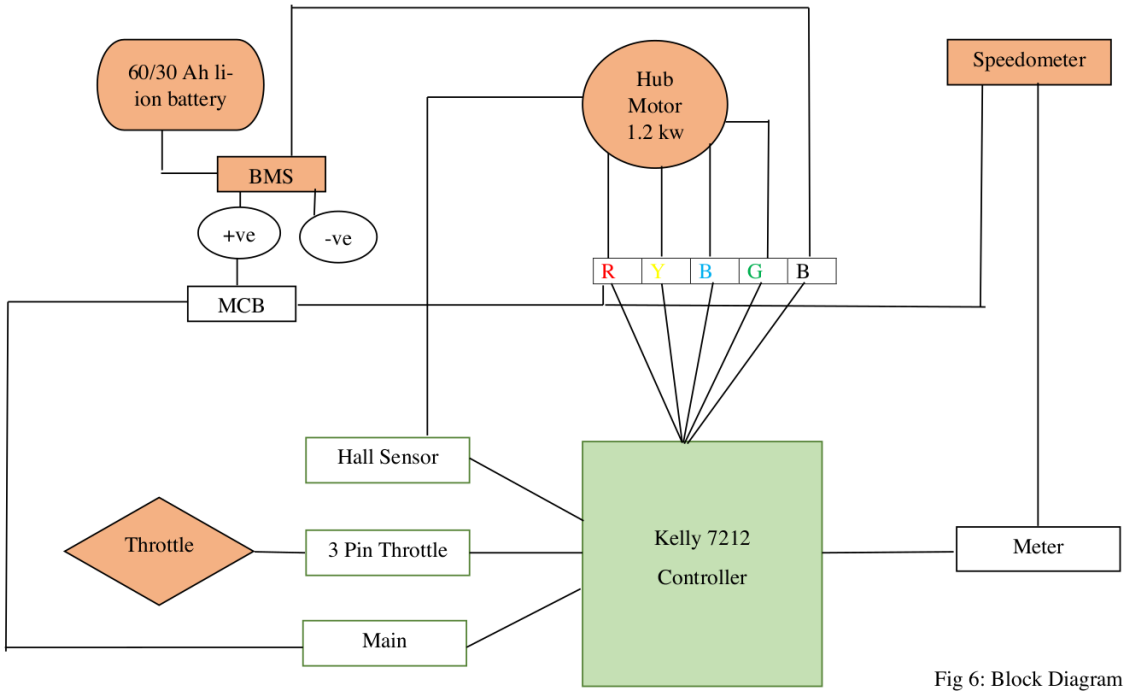

Fig 6: Block Diagram

Petrol Mode

In this mode the engine will supply energy to rear wheel. When the switch is turned on to S1 microcontroller will understand the position of switch and make use of the signal to relay, which will ignite the IC coil and start motor. The rider can control the speed by throttle which is famously known as accelerator handle. BLDC will be stationary position at front wheel, in this the battery connection are dropped by another relay which is also controlled by micro controller.

In this mode the vehicle is driven in high power at outskirts of the city. It will run on high-power operation own speed rpm, so that the consumption of fuel is very low, also pollution is reduced which is emitted by vehicle.

Electric Mode

BLDC Hub Motor which makes use of battery power. Battery is placed under the seat of the vehicle. Motor is fixed nearby front wheel of the vehicle and controlled by control unit. Just like E-bikes, scooters, solar vehicles and many other light electric vehicles are steadily emerging by using Hub motor and standard of level is increasing. Using hub motor there is no need of external mounting of vehicle and drives to support a motor and transmission.

It is simple as direct Hub Motor. Motor is fixed at center axis wheel. Vehicle rim starts to spin over the axis body for moving the wheel. There is separate charger for the battery unit to supply electric power. We also have the fuel driven in back of the wheel of the vehicle.

The vehicle is powered by means of power when we are driving in the city, running in plain and low power. Power is supplied by the battery to run the motor. There will be less speed of the vehicle having no smog and less pollutants are emitted during the vehicle is moving. Depending on the electric charge the distance can be measured based on the capacity of the battery. Mileage is increased steadily.

Hybrid Mode

The user doesn't need to care of the current mode of operation and just drives randomly. This is controlled by microcontroller. In this mode of driving, it will be in S3 mode position. Micro-controller manages based on program when the vehicle is moving in 30 km/hr or less than that the mode of electricity mode is activated, incase the speed of the vehicle is more than 30 km/hr it is switched to IC engine petrol mode. To know the speed of the vehicle we use speedometer to know the readings. While driving in city limits it make uses of electric mode and other way it makes uses of petrol mode. We can reduce the petrol rate per kilometer and emitting less pollutant in the environment.

Result

Expexted Speed v/s Achieved Speed

Expected was 45 km/hr

3 Modes of speed based on testing the vehicle.

- Economy: 30 km/hr
- Standard: 40 km/hr
- Sports: 55 km/hr

Observations:

- In economy mode the pick up had very low acceleration but range was more.
- In standard mode the acceleration was moderate and had sufficient km range.
- In sports mode the acceleration was high but the range was less.
- When the battery is about to get drained and the user is riding in sports mode, he can still drive the vehicle for 2-4 km in economy mode depends on the acceleration.
- The speed of the vehicle in petrol mode didn't change at all.

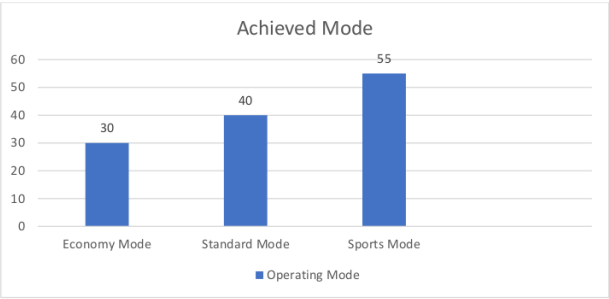

Fig 6: Expected Speed

Expected range was for 75 minutes, roughly it was close to 40 km per charge.

3 modes of testing

- Economy: 47 km
- Standard: 40 km
- Sports: 32 km

Observations:

- In economy mode had low acceleration power but the range was more.
- In standard mode had moderate acceleration and sufficient range.
- In sports mode had good acceleration power but the range was less.
- When the battery is about to get drained and the user is riding in sports mode, he can still drive the vehicle for 2-4 km in economy mode depends on the acceleration.
- The range of the vehicle in petrol mode didn't change at all.
- When we drive the vehicle faster the faster the battery drains.

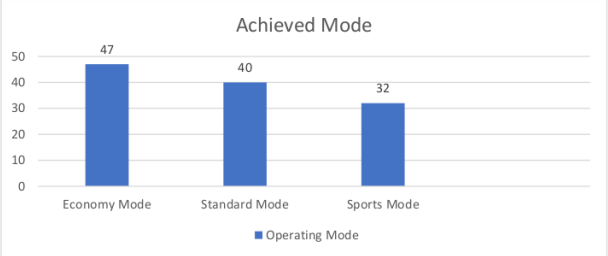

Fig 7 Achieved Speed

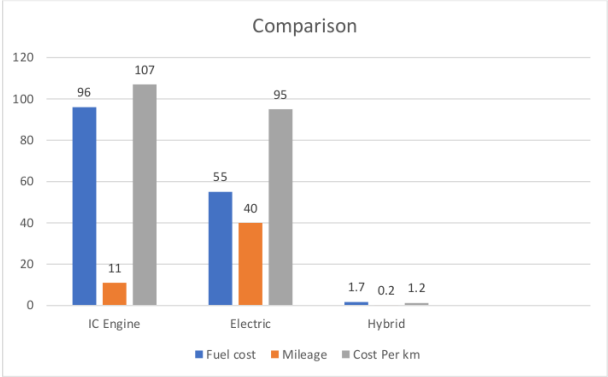

Fig 8: Comparison Between 3 Modes

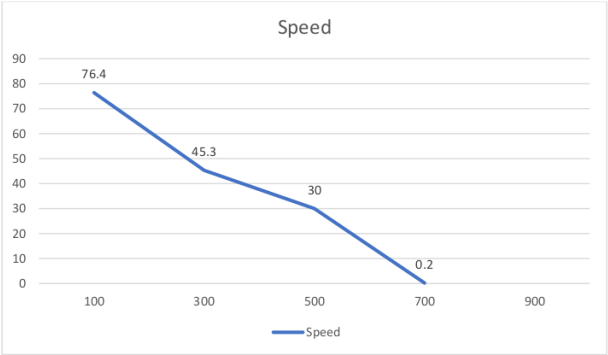

Fig 9: Speed(rpm) vs Torque(Nm)

Conclusion

HEV is such a vehcile which uses both sources which is gas and battery. For inner city low power is used which is battery and for high power outer city gas is used. Gas is very much efficient for driving high speed. In this HEV both gas and battery operates at their max efficiency. Low speed is not handy in petrol mode, rather only in high speed. Having this it can provide double the mileage of normal vehicle. As this is HEV only emits 50 % of pollution from

vehicle thus reducing when compared to other vehicle without given up on efficiency. This can be very much useful in city traffic as it is emitting pollution to the environment. Majority of the people depend on fuel for vehicle impetus. Electric vehicle isn't valuable for high power condition. In this by making use of both the mode to increase the efficiency which is known as hybrid mode. This is used preferably for 2 wheeler vehicle. It is known that IC engine is used for getting drive of vehicle, when the ideal speed is accomplished the BDLC engine together IC engine propulsion the vehcile is moved. The total torque is generated by using IC engine and electric motor and is varied by the controller. When the torque is divided appropriately the life of the battery can also be increased by driving in electric mode to reduce fuel requriment for IC engine. Throttle involves both while driving that is IC engine and electric. Both of this throttle helps the vehicle to be in moving condition. The current e-vehicles issue are relating to battery life it can be solved using this technology.

Future Work

Relates to charge the battery automatically without consuming electricity. By making use of the energy lost in exhaust and cooling process of engine. According to sankey diagram in gasoline uses 25% of fuel energy is converted to quality work and rest into the environment. Almost 40% is wasted in exhaust respectively to 30% in coolant. To convert the wasted energy into useful energy is by having striling engine and array of thermocouple from heat energy to mechanical energy. In order to implement this concept use exhaust pipe attached to hot cylinder of the striling engine and cold cylinder is exposed to the environment. The difference between heat gives a hint to striling engine and it is attached with dynamo as it rotates through dynamo electric power which can be a great help to charge the battery. Thermocouple based electric generators can be done by attaching thermocouples parallely. They are connected to cylinder head thermally. The output of electric is connected to charging unit to recharge the battery. Mechanical energy will further be converted to electric energy by the generator. This kind of concept has never been used anywhere in the world. By therotically we can get double the mileage of the vehicle and reduce the emission by 50% with same fuel consumption.

If the weights of the battery and hub motor is reduced then the efficiency and capacity of the vehicle will increase. Moreover, the complete performance of the vehicle will increase drasticaly.

On all HEV designs, regerative breaking will supply power to storage unit. Overall, the cost and the mass of powertrain with regenerative breaking will be more when compared to fuel economy. So, there needs to be a trade-off between the efficiency over energy recovery, storage and subsequent reuse, for more power a higher vehicle is needed to propel.

References

1. *Fabrication of Hybrid Petro Electric vehicle G.Adinarayana et al. Int. Journal of Engineering Research and Applications ISSN: 2248-9622, VOL. 4, Issue. 10(Part-6), October 2014, pp.142-144.*

2. *S.Deb, K.Tammni and P.Mahanta, "Charging Station Placement For Electric Vehicles: A case study of Guhawahati," in IEEE access, VOL. 7, pp.100270-100282, 2019, doi:10.1109/ACCESS.2019.2931055.*

3. *Petro Electric Bike 1st International Conference on New Scientific Creations in Engineering and Technology(ICNSCET-19) International Journal of Recent Trends in Engineering and Research (IJRTER) Special issue; March – 2019[ISSN: 2455 – 1457].*

4. *Potential Need of Electric Vehicle, charging station infrastructure and its challenges for the indian national market advance in Electric and Electronic engineering. ISSN: 2231-1297, VOL. 3, Number 4(2013), pp.471-476 Research India Publications.International Research Journal Of Engineering And Technology (IRJET) e-ISSN:2395-0056 VOL.5, Issue Feb 2, 2018.*

5. *B. S.M Fan, "Modeling and simulation of HEV using matlab/simulink and adams, "master's thesis, Universiy of Waterloo, 2007.*

6. *T.Bauml and D.Simic,"Simulation and comparsion of different energy management strategies of a series Hybrid vehicle." In vehicle power and propulsion conference, 2008, VPPC'08, IEEE, pp. 1-5, IEEE, 2008*

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