Scientific Journal Impact Factor (SJIF): 4.364
International Journal of Modern Trends in Engineering and Research
ISSN (ONLINE) : 2349 - 9745 ISSN (PRINT) : 2393 - 8161

WORKING MODEL OF ALTERNATE ENERGY SOURCED VEHICLE

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Abstract- The automobile industry is growing rapidly and all the major players i.e. major automobile companies look in to develop more and more efficient vehicles without compromising their power output. This led to development of many hybrid drive system and many other power sources for powering automobile. Basically hybrid drive system comprises of two or more than two power sources. The main motto behind development of hybrid technology is to provide the vehicle better fuel efficiency with no or bearable change in their power output. Various types of hybrid technology exists from which we have selected is hybrid electric system which makes the use of a DC electric motor to alternately power our vehicle along with the IC engine. We have selected DC electric motor as a source as it has numerous benefits such as lower operating noise which leads to silent operation of vehicle, better power output, no pollution, lower operating and maintenance cost, etc.

Keywords-Hub motor, controller, hybrid bike, hybrid vehicle, brushless motor, alternate energy sourced vehicle, hybrid electric vehicle(HEV).

I. INTRODUCTION

A. Overview of various alternate energy source systems:

AESV (Alternate Energy Sourced Vehicle) means a car, truck, or any other type of vehicle that is propelled by more than one power source coupled together to work in conjunction. This can also be referred as Hybrid Vehicle. Various hybrid systems exist such as CNG hybrid system, LPG hybrid system, hydrogen fuel cell hybrid system, electric hybrid system, etc.

B. CNG hybrid system:

In CNG hybrid system a vehicle running on IC engine is powered by gasoline and alternately by CNG (Compressed Natural Gas). The CNG system of any vehicle can be understood by referring below figure. It has a gas tank, a fuel filter, a high pressure fuel line to supply fuel to engine and shut off valve.

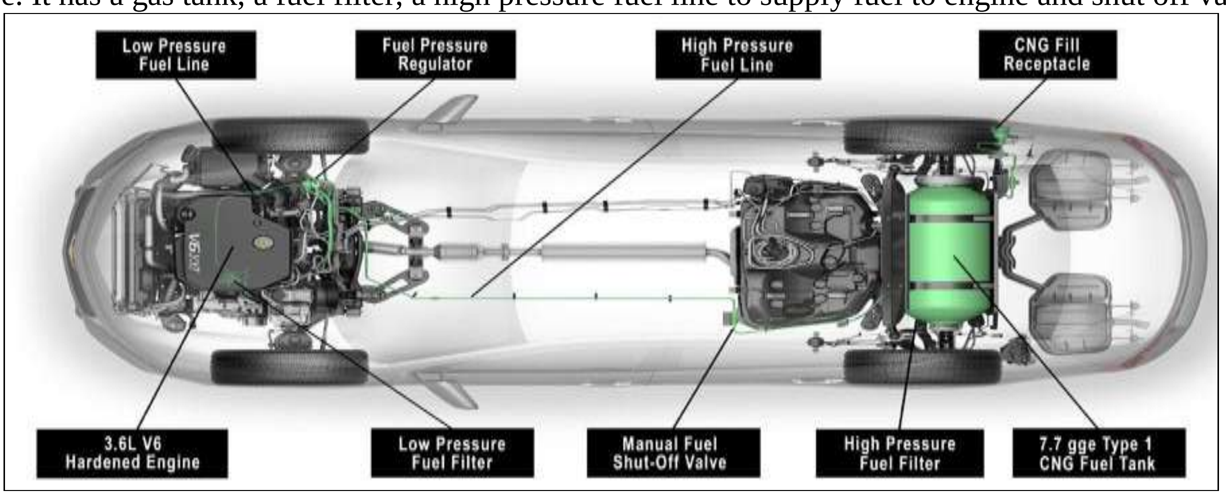

Fig 1.1 Components of CNG hybrid system

C. LPG hybrid system:

In LPG hybrid system a vehicle running on IC engine is powered by gasoline and alternately by LPG (Liquefied Petroleum Gas). The LPG is pumped in inlet manifold by LPG injector. The LPG readily vaporizes which cools surrounding air and its density increases. The cooled air improves the efficiency and performance of engine. The flow of LPG is governed by ECU which works in tandem with vehicles own control unit to optimize injection time.

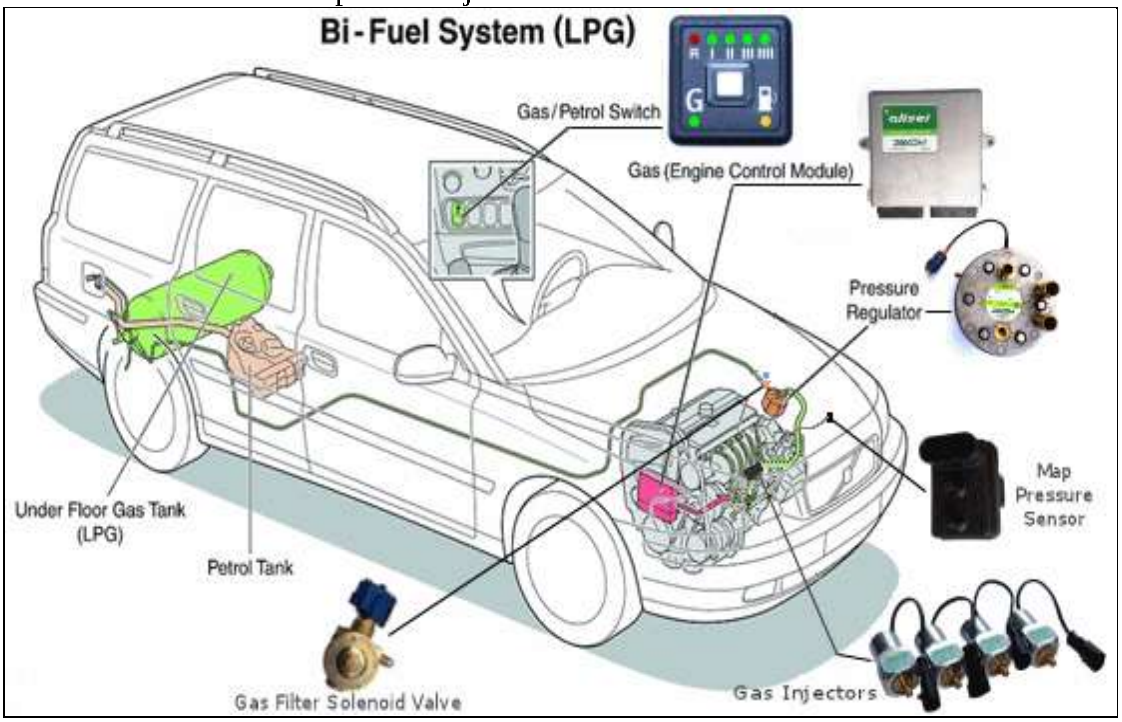

Fig 1.2 Components of LPG hybrid system

D. Hydrogen fuel cell hybrid system:

This type of hybrid vehicle has IC engine and its drive system and another source of power in the form of hydrogen fuel cell system. The hydrogen fuel system includes a hydrogen tank, a high output battery that stores power developed by regenerative braking system, stack of fuel cell which transforms oxygen and hydrogen into electricity to power electric hub motor, an electric motor and a control unit which controls flow of electricity.

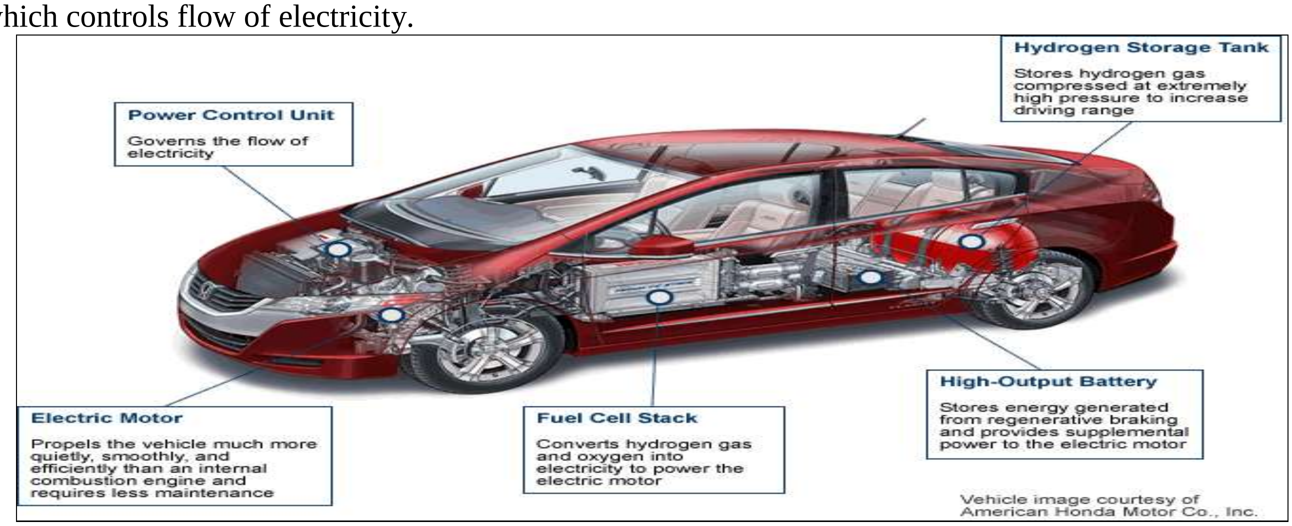

Fig 1.3 various parts of hydrogen fuel system

E. Electric hybrid system:

In this type of hybrid system, the required alternate power other than IC engine is provided by DC electric motor. It contains an electric motor, battery, generator and an electronic controller. It is the most efficient and has widespread application.

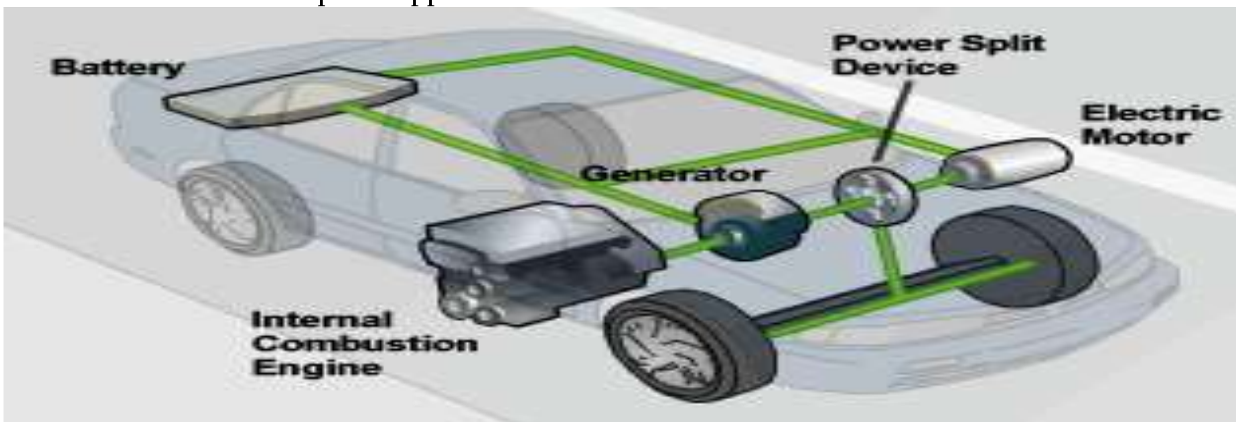

Fig 1.4 various parts of electrical hybrid system

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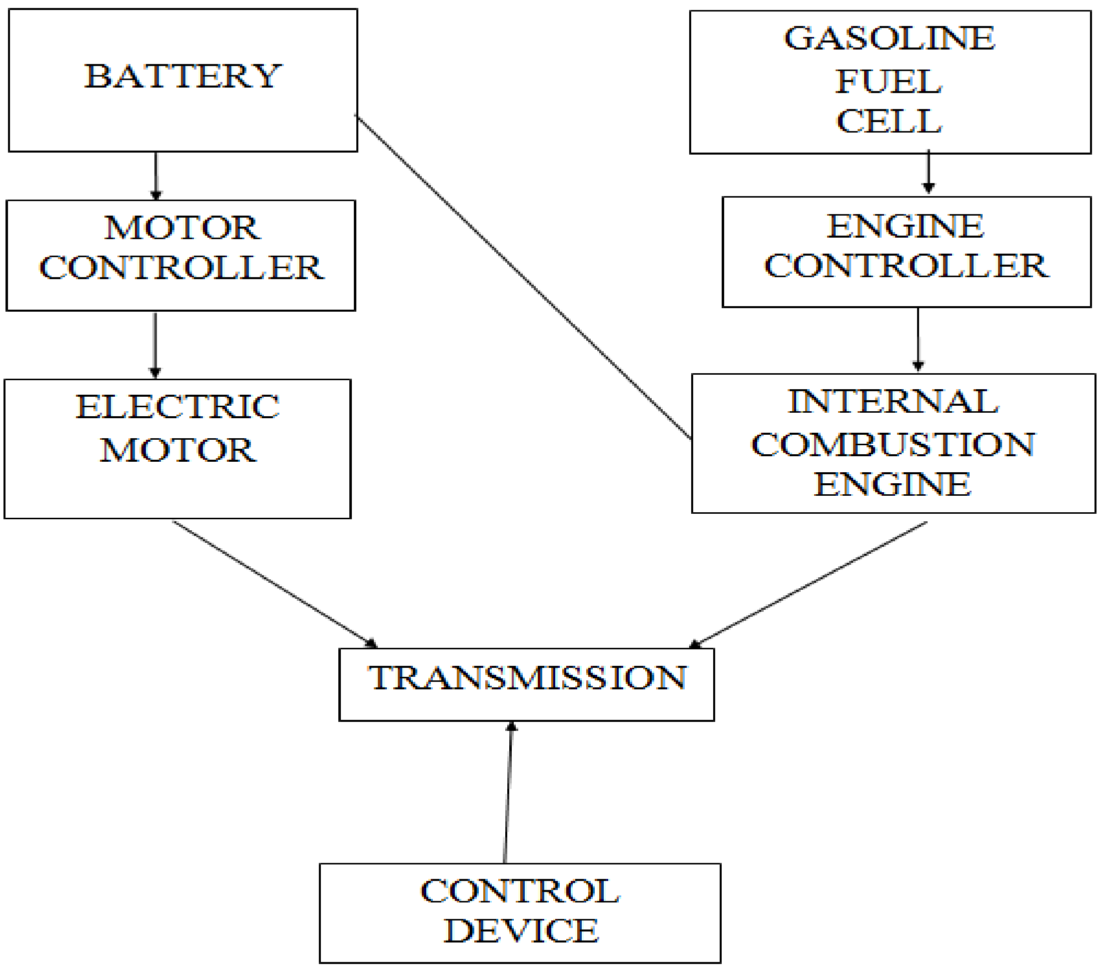

BLOCK DIAGRAM OF WORKING OF AESV

International Journal of Modern Trends in Engineering and Research (IJMTER)
Volume 04, Issue 5, [May– 2017] **ISSN (Online):2349–9745; ISSN (Print):2393-8161**

Fig 9.1 Controller

Fig 9.2 Hub Motor with independent brake

Fig 9.3 Independent hub motor display

1.2 Types of Hybrid Electric Vehicle:

The simplest definition for a hybrid electric vehicle is one that relies on two different power sources. Beyond that, a plethora of terms being bandied about today can make things appear unnecessarily complicated. Cutting through the sea of words, hybrids can basically be divided into three main types: These are: 1)full hybrids 2) mild hybrids, and 3) plug-in hybrids. Then again, you have variations, such as so-called "muscle hybrids" and "micro hybrids" – for which arguments could be made that these are sub-types.

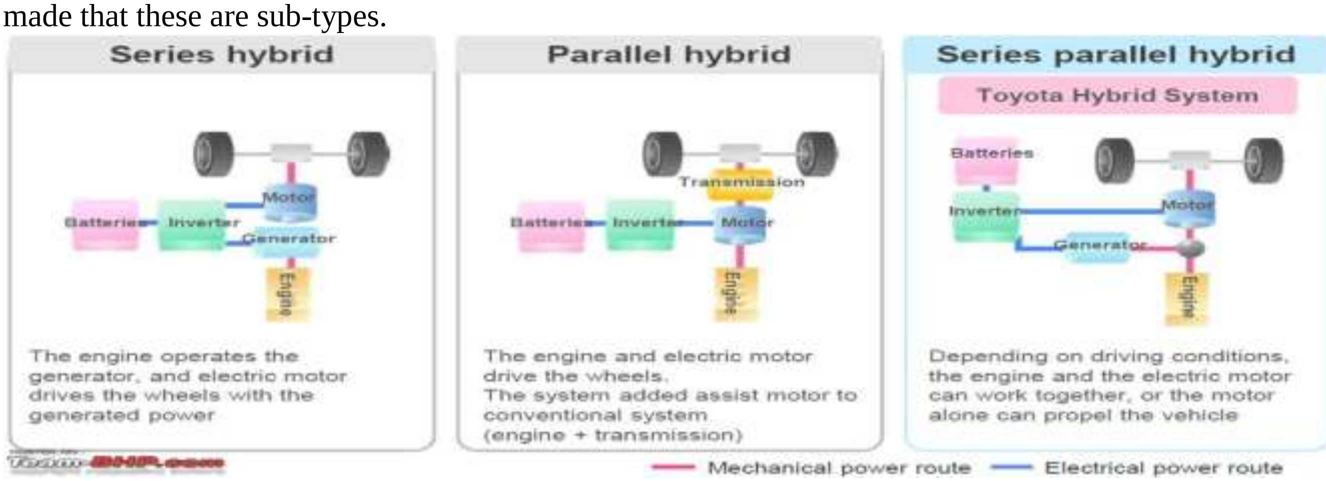

Fig 1.6 Types of hybrid vehicle

1.3 Purpose:

- The purpose of hybrid cars is to couple a gas engine and an electric motor that assists the engine when accelerating. The batteries that power the electric motor are recharged automatically while driving.
- Therefore the main purpose of hybrid cars is to cut down on fossil fuels while maintaining excellent performance and saving money in the process as the government offers tax incentives to those who purchase a hybrid car.
- For those who see the purpose of hybrid cars mainly from a reasonable point of view, there are a few factors to consider, including the cost of gas and the length of car ownership. The model of the car plays a significant role as well, especially its MPG rate.
- In their favor, hybrid cars have lower depreciation than standard gasoline cars. Besides, demand is likely to grow so if your purpose when purchasing a hybrid car is to make a financially wise investment, you probably are on the right track.

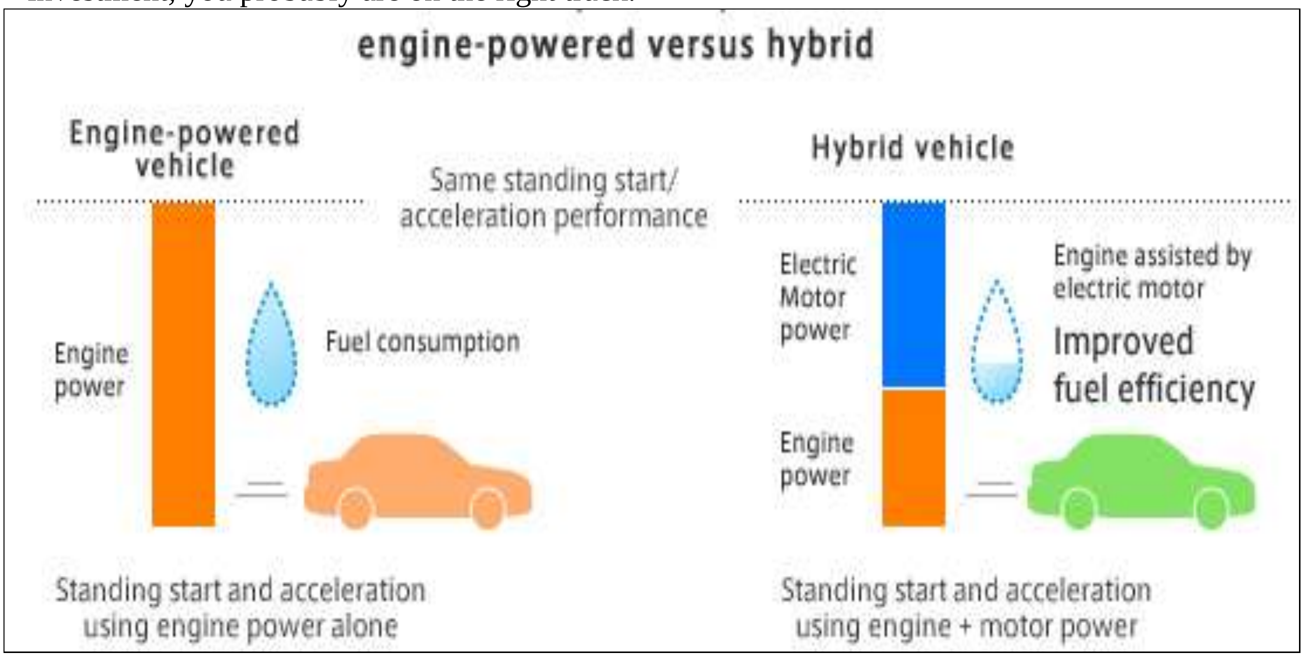

Fig 1.7 Fuel consumption comparison

Working of HEVs

Everyone loves cars, they're convenient, get you quickly from one place to another. Everyone hates pollution, it makes plants and animals and happy pristine environments unhappy. The H.E.V. is a compromise. Pure electric vehicles, while emission "free," can't go the distances or provide the power (for any extended length of time) of vehicles with internal combustion engines. Internal combustion engines pollute. H.E.V.'s combine both, so the vehicle can go as far and as long as most people would want and emit only a fraction of the harmful gases I.C.E.-powered vehicles do. The H.E.V. does this by balancing when and how each motor is used. On the highway, when internal combustion engines are at their most efficient, and where the battery would be depleted very quickly in an electric car, the I.C.E. is used. For shorter, city driving trips, the electric motor is either used exclusively, or in such a manner that the I.C.E. also runs, at its peak efficiency

1.4 Classification of HEV

According to technical Committee 69 (electric road vehicles) of the International Electro technical Commission, an HEV is a vehicle in which propulsion energy is available from two or more kinds or types of energy sources or converters, and at least one of them can deliver electrical energy.

Based on this definition, there are many kinds of HEVs, for example, battery and ICE, battery and capacitor, and battery and flywheel. However, the above definition is not accepted by ordinary people. Generally, they think that HEV is a vehicle having electric motor and ICE, thus this general definition is adopted in this paper. Traditionally, HEV can be classified into three types: series HEV, parallel HEV,and combination HEV.

Configuration of series HEV

We can see that the series HEV is composed of ICE, generator, power converter, motor, and battery. There is no mechanical connection between ICE and transmission, thus ICE can operate at maximum efficient point by regulating the output power of battery to satisfy the required power of vehicle.

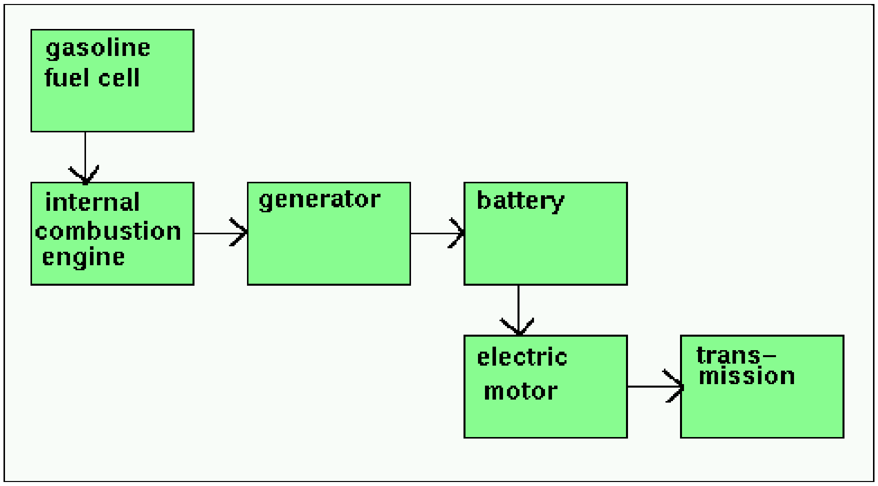

Fig 4.1 Configuration of series HEV

Configuration of parallel HEV

From Figure we can see that the parallel HEV allows both the electric motor and ICE to deliver power in parallel to drive the vehicle, that is, ICE and motor can drive, respectively, or together. Different from the series HEV, there is mechanical connection between ICE and transmission, and thus the ICE's rotational speed depends on the driving cycle, so the ICE can operate based on optimal operating line by regulating the output power of battery.

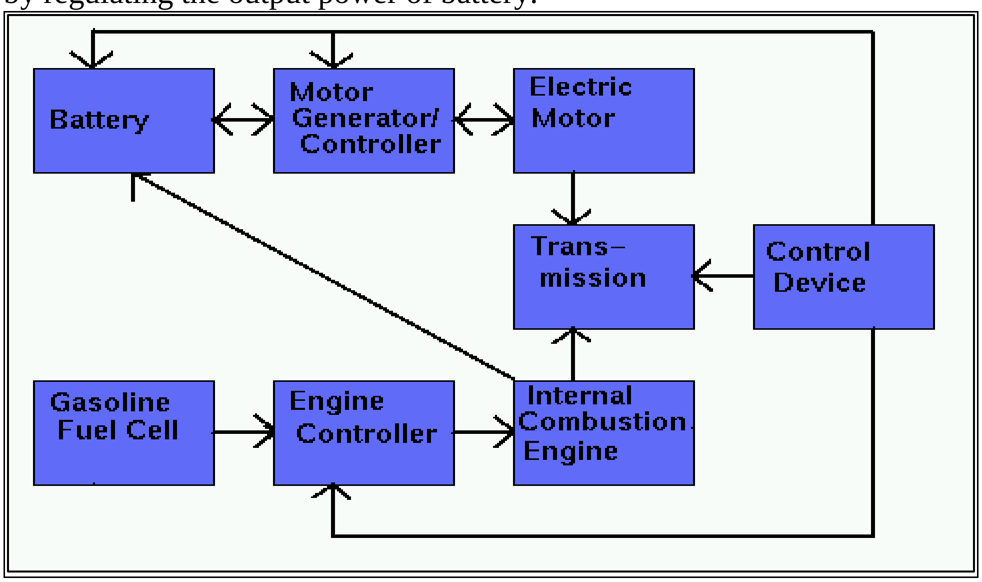

Fig 4.2 Configuration of parallel HEV

II. MODELING OF REGENERATIVE BRAKING SYSTEM

The regenerative braking system with two wheel drive series-parallel drivetrain configuration is modeled using PSAT. The RBS model from PSAT is then segregated into multiple ECUs and hardware components. The ensuing model consists of a driver model, a component (physical system) model and six ECUs, namely battery control unit, engine ECU, motor1control unit, motor2 control unit, mechanical brake control unit, and powertrain controller. These individual models in MATLAB/Simulink are converted into using MATLAB Real Time Workshop and then uploaded into the Vector environment. The simulation setup of ECUs and communication network of RBS is shown in Communication between the ECUs is carried out via signals on theaccelerator and brake pedal positions to achieve the desired vehicle speed. A simple proportional and integral (PI) controller is designed to control the vehicle speed, and a suit-able torque demandis requested that is proportionalto the error between the desired and actual vehicle speed subsequently, the torque demand is used to request the torque from different powertrain components via the supervisory.

III. WORKING OF HEV

The on-board batteries in hybrid cars are recharged by capturing the kinetic energy created when using the brakes (commonly referred to as "regenerative braking"), and some hybrids use the combustion engine to generate electricity by spinning an electrical generator to either recharge the battery or directly feed power to an electric motor that drives the vehicle.

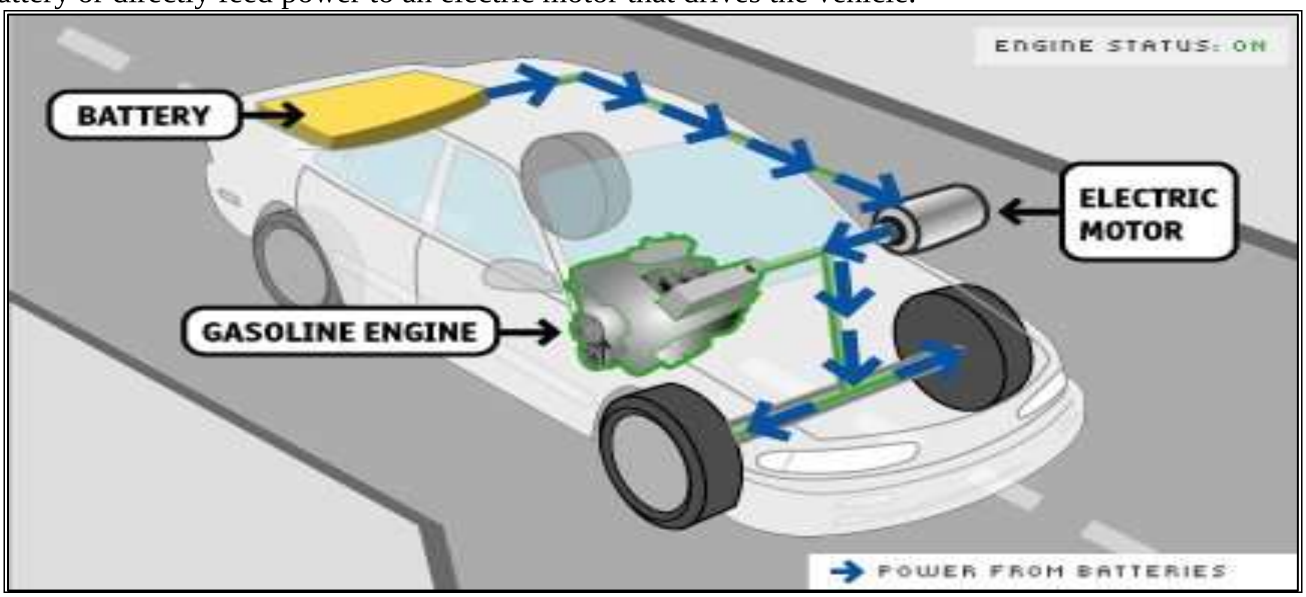

Fig 3.1 Working of HEV

IV. DOMINANT PHYSICS

The flow of power through the hybrid system and the efficiencies and mechanics of the components and connections therein comprise the most important physics in the H.E.V. For the components used, the object of the H.E.V. designer is to connect and control each part so that maximum efficiency is achieved.

An internal combustion engine runs most efficiently at highway speeds, and so it is used alone in highway driving. It is very inefficient in stop and go traffic, however. An electric motor would soon deplete its battery on a long highway drive, but can drive the vehicle efficiently through city traffic with no emissions to release into the city atmosphere. Of course, there are driving modes in between these, when both I.C.E. and electric motors work in tandem, as when the vehicle is accelerating.

Volume 04, Issue 5, [May– 2017] ISSN (Online):2349–9745; ISSN (Print):2393-8161

Power flow through the drive mechanism depends on the arrangement of the system and several clutches which engage and disengage components from the assembly. In the following diagrams (follow the links):

solenoid clutch #1	controls the connection between the I.C.E. and the generator.
solenoid clutch #2	controls the connection between the I.C.E. and the transmission.
overrunning clutch #3	controls the connection between the I.C.E. and the system.
overrunning clutches #4&5	control the connections between the electric motors and the system.

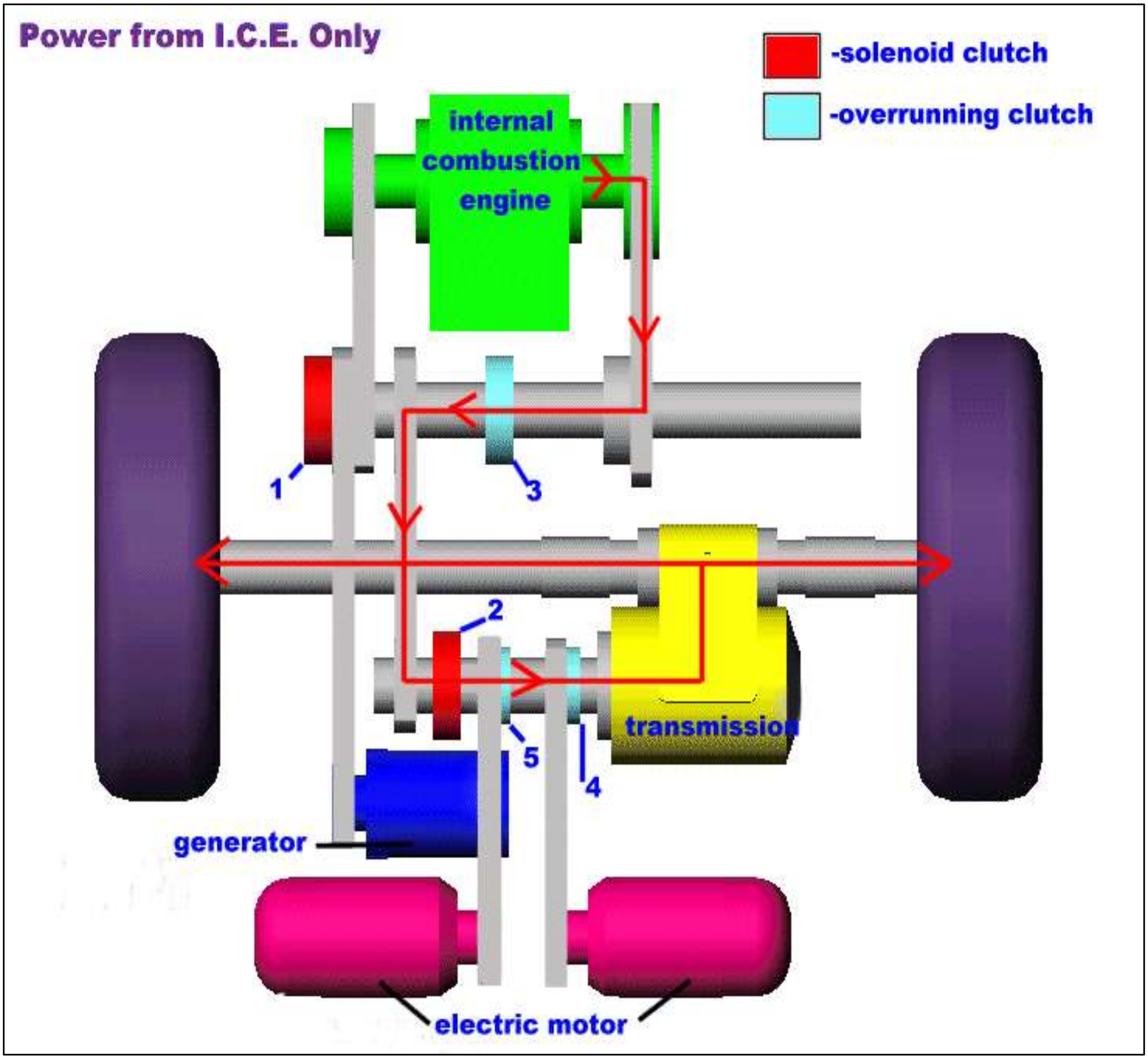

Fig 4.1 Power from I.C.E only

Power flows from the internal combustion engine, through the secondary drive shaft to the transmission. It then flows from the transmission to the primary drive shaft, and then to the wheels. Overrunning clutches 3 and 5 are engaged, all others are disengaged.

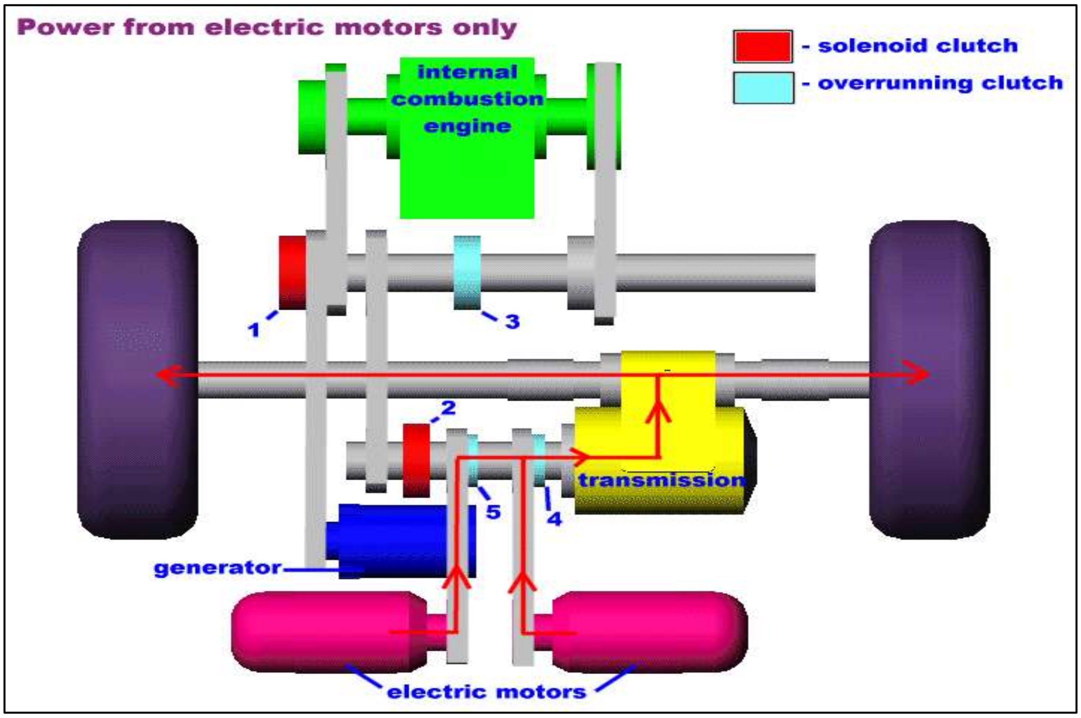

Fig 4.2 Power from Electric motors only

Power flows from both electric motors, through the transmission, and to the drive shaft and tires. Overrunning clutches 4 and 5 are engaged, all others are disengaged.

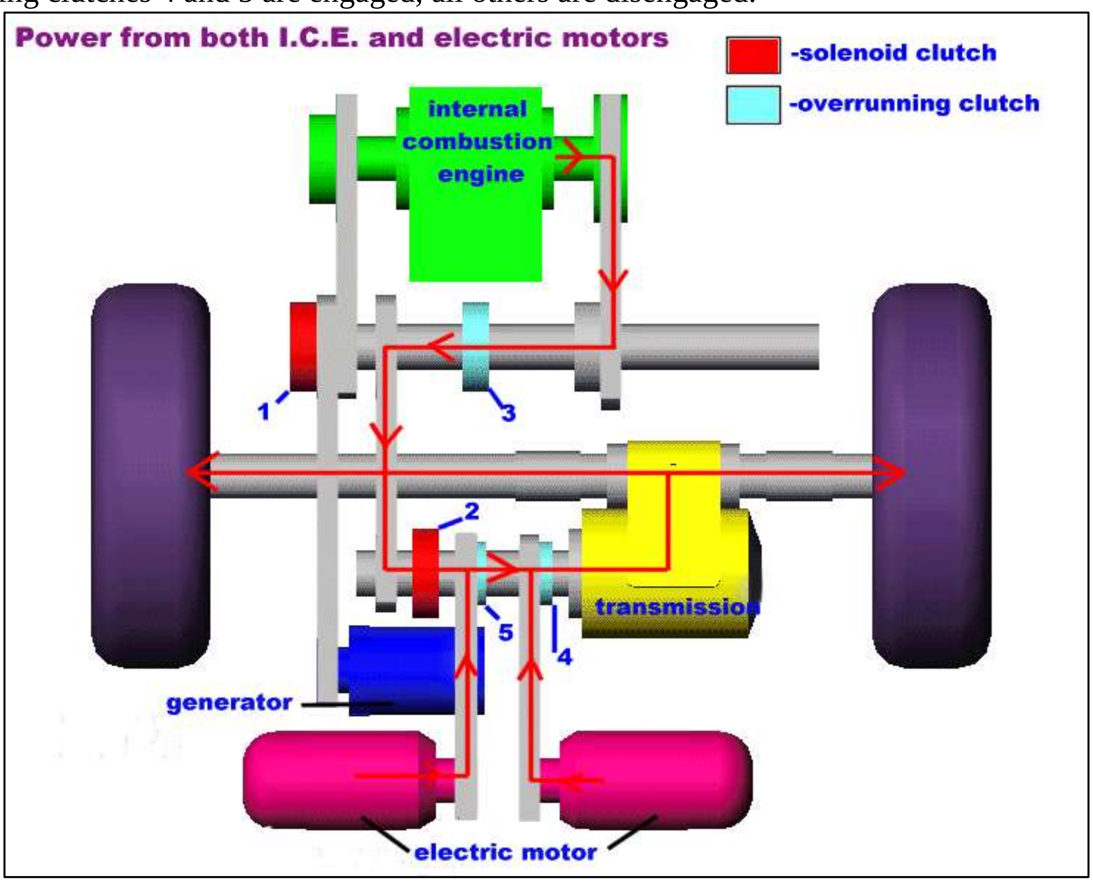

Fig 4.3 Power from both Motors and I.C.E

Power flows from the internal combustion engine, through the secondary drive shaft, through the transmission, and then to the primary drive shaft and then to the tires. Power also flows from both electric motors, to the transmission, and then to the primary drives shaft and the tires. Overrunning clutches 3, 4, and 5 are engaged and solenoid clutch 2 is engaged. All others are disengaged.

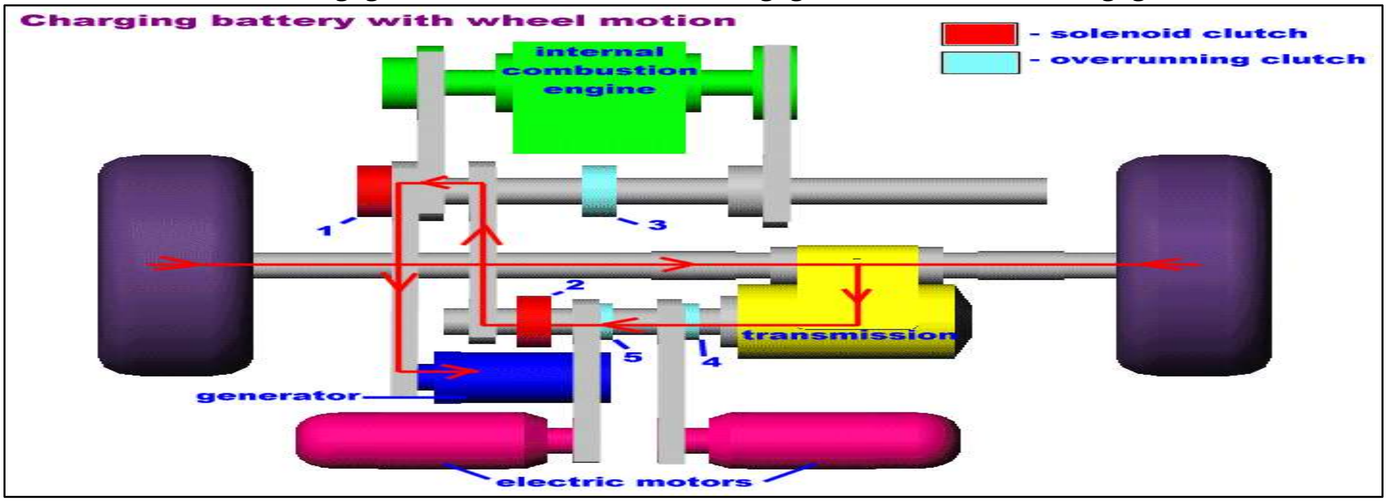

Fig 4.4 Charging batteries with wheel motion

Power flows from the wheels to the primary drive shaft, then through the transmission, through the secondary drive shaft, and to the generator, and finally to the batteries. This occurs during regenerative braking. Solenoid clutches 1 and 2 are engaged, all other clutches are disengaged.

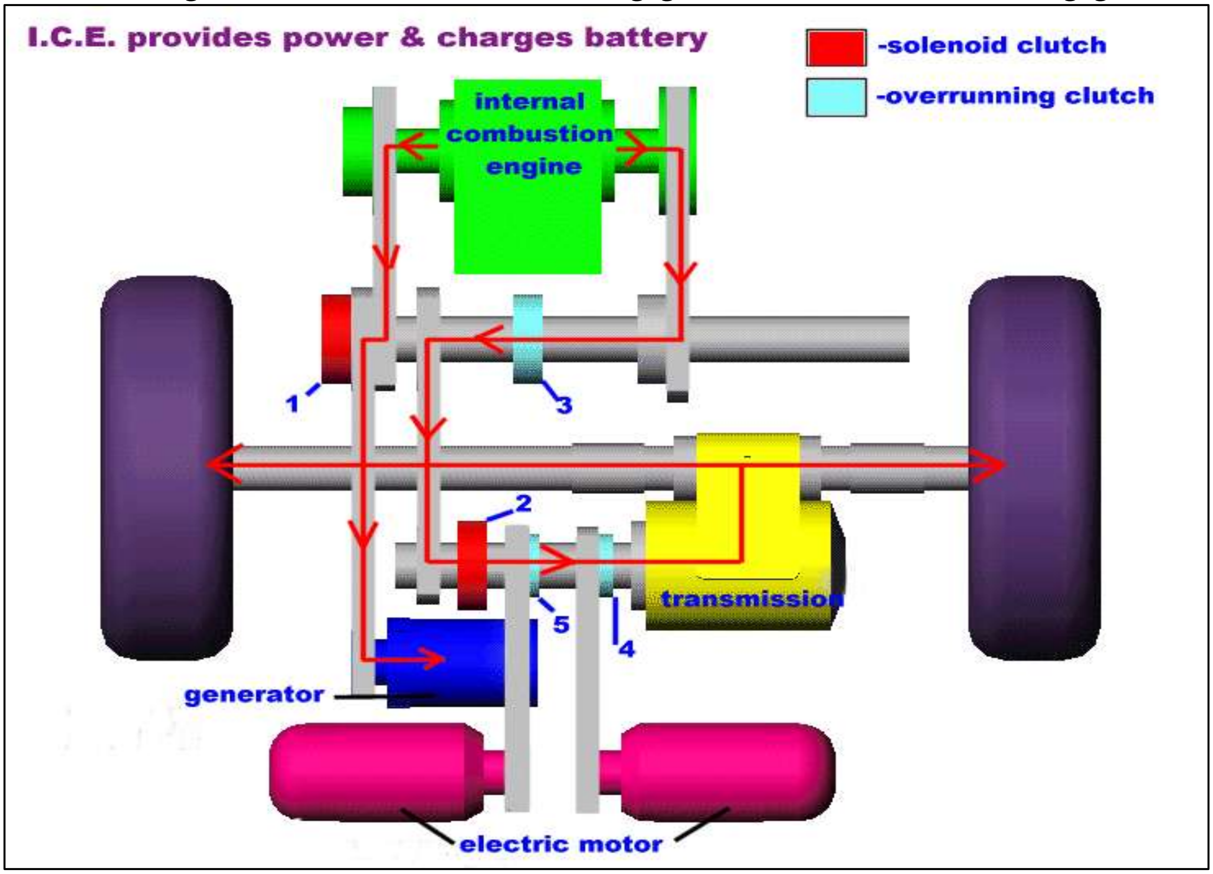

Fig 4.5 I.C.E provides power and charges battery

Power flows from the internal combustion engine, through drive shaft 2, to the transmission, and then to drive shaft 1 and the tires. Power also flows from the I.C.E., through drive shaft 2, and to the generator. Overrunning clutch 3 and solenoid clutch 1 are engaged, all others are disengaged.

V. ADVANTAGE AND DISADVANTAGE OF HEV

Advantage of HEV

Here are few of the top advantages of having a hybrid car :-

1. Environmentally Friendly: One of the biggest advantage of hybrid car over gasoline powered car is that it runs cleaner and has better gas mileage which makes it environmentally friendly. A hybrid vehicle runs on twin powered engine (gasoline engine and electric motor) that cuts fuel consumption and conserves energy.

2. Financial Benefits: Hybrid cars are supported by many credits and incentives that help to make them affordable. Lower annual tax bills and exemption from congestion charges comes in the form of less amount of money spent on the fuel.

3. Less Dependence on Fossil Fuels: A Hybrid car is much cleaner and requires less fuel to run which means less emissions and less dependence on fossil fuels. This in turn also helps to reduce the price of oil in domestic market.

4. Regenerative Braking System: Each time you apply brake while driving a hybrid vehicle helps you to recharge your battery a little. An internal mechanism kicks in that captures the energy released and uses it to charge the battery which in turn eliminates the amount of time and need for stopping to recharge the battery periodically.

5. Built from Light Materials: Hybrid vehicles are made up of lighter materials which means less energy is required to run. The engine is also smaller and lighter which also saves much energy.

6. Higher Resale Value: With continuous increase in price of gasoline, more and more people are turning towards hybrid cars. The result is that these green vehicles have started commanding higher than average resale values. So, in case you are not satisfied with your vehicle, you can always sell it at a premium price to buyers looking for it.

Disadvantage of HEV

There disadvantages to owning a hybrid car, but they are probably not what you think. Contrary to popular myth, hybrid cars have just as much power as regular cars and have no issue with mountain driving or towing. The disadvantages will depend on the type of hybrid fuel that your car uses.
Here are few of the disadvantages of a hybrid car:-

1. Less Power: Hybrid cars are twin powered engine. The gasoline engine which is primary source of power is much smaller as compared to what you get in single engine powered car and electric motor is low power. The combined power of both is often less than that of gas powered engine. It is therefore suited for city driving and not for speed and acceleration.

2. Can be Expensive: The biggest drawback of having a hybrid car is that it can burn a hole in your pocket. Hybrid cars are comparatively expensive than a regular petrol car and can cost $5000 to $10000 more than a standard version. However, that extra amount can be offset with lower running cost and tax exemptions.

3. Poorer Handling: A hybrid car houses an gasoline powered engine, a lighter electric engine and a pack of powerful batteries. This adds weight and eats up the extra space in the car. Extra weight results in fuel inefficiency and manufacturers cut down weight which has resulted in motor and battery downsizing and less support in the suspension and body.

4. Higher Maintenance Costs: The presence of dual engine, continuous improvement in technology, and higher maintenance cost can make it difficult for mechanics to repair the car. It is also difficult to find a mechanic with such an expertise.

5. Presence of High Voltage in Batteries: In case of an accident, the high voltage present inside the batteries can prove lethal for you. There is a high chance of you getting electrocuted in such cases which can also make the task difficult for rescuers to get other passengers and driver out of the car

VI. PROJECT DATA

The project data is mainly classified mainly in two parts :

6.1 Component Specifications

1) Vehicle -

The vehicle to be used is Honda Activa due to its compatibility of carrying the additional weight and space of the hub motor and its respective attachments .

2) Hub motor

The hub motor used is a kind of brush less motor generating high torque .
It is used due to high power capacity

Fig. 2 Hub Motor

Vehicle Specifications: Honda Activa

Table NO.1

Displacement	102 cc
Maximum Power	7 bhp@7000rpm
Maximum Torque	0.8kgm@550rpm
No .of Cylinders	1
No. Of Gears	Automatic
Ground Clearance	145 mm
Kerb Weight	110 Kg
Top Speed	80 Kmph

Hub Motor Specifications:

- 1000w Hub motor with controller
- Thumb Throttle and Hydraulic Disk Brake
- Regenerative brush less hub motor
- Speed/battery level Indicator

Battery Specifications:

- 4x Lead Acid Battery(Gel)
- 48 Volts(12*4)
- 24 Amps

Series Connection

6.2 Performance Calculative information

1) Average Velocity– The velocity of 45 Kmph can be achieved after the installation of hub motor. This does not include the power surge of engine.

2) Torque -The torque obtained is same that is 8.74 Nm as it is not affected by the hub motor.

3) Fuel Consumption – The average fuel consumption will increase as the hub motor will directly cut-off the petrol consumption. The fuel consumption if the vehicle is about 37-40 kmpl. The total average fuel consumption will increase due to the operation of the motor.

4) Battery Consumption – The full charged batteries would supply the motor for 6-7 hours. These distinct batteries are only connected to the hub motor and display.

VII. LITERATURE REVIEWS

Table NO.2.

Sr.no	Research papers	Author	Year Published
1	Energy efficient hybrid electric bike	1]-ArunEldho Elias 2]-Geo Mathew	March 2015
2	Design and development of hybrid electric bike	1]-Sharada Prasad N 2]-Dr.K R. Nataraj	May 2014
3	Super capacitor/Battery hybrid powered electric bicycle	1]-Manoj.E 2]-Dino Isa 3]-RoselinaArelhi	November 2010
4	Implementation Of Hybrid Bike	1]- Pier Francesco 2]Roberto Mura 3]Sergio M.Savaresi	June 2013

VII. CONCLUSION

- This paper describes the process of planning, designing, and testing a hybrid electric bicycle.
- The aim of this paper is to give details of modifying an existing mechanical system for individual that is based on both mechanical propulsion as well as a set of electro-mechanical interfaces that provide assists.

- After establishing criteria for speed, control, efficiency, and weight, we began a process of selecting parts and developing various models for how the overall system including the rider could be integrated in a way that is both safe, and easy to use.
- The project has a number of benefits to both the team members as well as external benefits through increasing awareness of alternative transportation modes.
- The goals of the project were to design and integrate an additional power transmission drive an existing mechanical bike.
- Some additional goals or constraints to the project included the following: (1) limiting the costs of the system, (2) limiting the additional weight of the added drive and related components, (3) developing ease of operation of the bike whenever the electrical system is disengaged, (4) and integrating some of the various mechanical features of the original system with those of the hybrid system.

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