

Energy Efficient Hybrid System For Comfortable and Ecofriendly Driving in Metropolitan Cities

Presenna Kumar Babu¹, Ajay.R², Suren.S³

U.G Scholar, Department of Electrical & Electronics Engineering, Sri Krishna College Of Engineering and Technology, Coimbatore, India¹

U.G Scholar, Department of Mechanical Engineering, Sri Krishna College Of Engineering and Technology, Coimbatore, India^{2 3}

ABSTRACT: Here in this paper we have proposed a design of a hybrid vehicle that runs on an electric motor when the vehicle is operated in the first two gears and is driven by engine in the latter gears, and when the power of the battery is insufficient to drive the vehicle in the first two gears the vehicle operation completely relies on the engine and the given motor with limited power in battery is used just as a starter motor in this case. Re-generation of power in the batteries can be done either by employing suitable drives that makes the motor act as generator, when the battery power is low or by EV charging stations.

KEYWORDS: IC engine, Electric motor, Battery, Power split up device, Gears, Regeneration.

I. INTRODUCTION

The metropolitan cities in India like Mumbai and Chennai are characterised by long rows of traffic in the roads, especially during peak hours. This leads to the production of unnecessary noise (due to standby mode operation of vehicles powered by IC engine), smoke (due to vehicle emission) and standby power losses (due to IC engines). So we have designed a vehicle that is driven by a DC motor for the first two gears and by an IC engine in the rest of the gears as motors are characterised by less noisy operation, lesser standby power losses, and zero emission. This design will reduce discomforts, emission and power losses in traffic. The purpose of driving the vehicle by IC engines in the latter gears is due to lower thrust provided by motors. So in highways where higher speeds are required the vehicle may be driven by IC engines. Since the vehicle shaft is already running when IC engine has to power vehicle this design eliminates the need for a starter motor in the vehicle. Thus on the whole the vehicle runs on a motor for lower speeds and an IC engine for higher speeds. Automobile hybridization is considered as an important step in reducing greenhouse gases and related automotive emissions. However, current hybrid electric vehicles are a temporary solution on the way to zero emission road vehicles. It differs from the conventional hybrid vehicles from the fact that when the power of the battery gets too low to power the motor the vehicle operation is made to rely completely on engine and the motor is just used as a starter motor to turn on the engine through a suitable flywheel and gear assembly, thus the mode of charging the batteries is either through EV charging stations for using the motor to power the vehicle or by using the same motor as generator using drives that contain anti-parallel IGBT switches thus bringing drastic reduction in the cost of the vehicle by eliminating the need of a generator. This paper discusses the use of hybrid electric vehicle power train. This vehicle allows a control strategy which includes both fuel-economy and performance modes.

II. WHY ELECTRIC MOTOR?

An alternative fuel vehicle is a vehicle that runs on a fuel other than "traditional" petroleum fuels (petrol or

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization,

Volume 5, Special Issue 7, April 2016

National Conference on Trends in Automotive Parts Systems and Applications (TAPSA-2016)

On 18th & 19th March

Organized by

Sri Krishna College of Engineering & Technology, Kuniamuthur, Coimbatore-641008, Tamilnadu, India

diesel) and also refers to any technology of powering an engine that does not involve solely petroleum (e.g. electric car, hybrid electric vehicles, solar powered). A hybrid vehicle is a vehicle that uses two or more distinct power sources to move the vehicle. The term most commonly refers to hybrid electric vehicles (HEVs), which combine an internal combustion engine and one or more electric motors. A hybrid vehicle uses multiple propulsion systems to provide motive power. The motors used are usually relatively small and would be considered "underpowered" by themselves, but they can provide a normal driving experience when used in combination during acceleration and other manoeuvres that require greater power. The presence of the electric power train is intended to achieve either better fuel economy than a conventional vehicle or better performance.

The modes of operation are summed up as

- **Battery is full**
First two gears are driven by motor and the rest by Engine
- **Battery is low**
All gears are driven by engine, Motor is used as a starter motor with the available power, and the motor is made to act as generator by suitable drive operation.
- **Slope**
Combined action of motor and engine on the drive train

III. ADVANTAGES OF HEV ENVIRONMENTALLY

Fuel Consumption and Emissions Reductions

The hybrid vehicle typically achieves greater fuel economy and lower emissions than conventional internal combustion engine vehicles (ICEVs), resulting in fewer emissions being generated. These savings are primarily achieved by three elements of a typical hybrid design: Relying on both the engine and the electric motors for peak power needs, resulting in a smaller engine sized more for average usage rather than peak power usage. A smaller engine can have less internal losses and lower weight. Having significant battery storage capacity to store and reuse recaptured energy, especially in stop-and-go traffic typical of the city driving cycle. The greater fuel economy of HEVs has implication for reduced petroleum consumption and vehicle air pollution emissions worldwide.

Noise

Reduced noise emissions resulting from substantial use of the electric motor at idling and low speeds, leading to roadway noise reduction with comparison to conventional gasoline or diesel powered engine vehicles.

Pollution

Hybrid vehicles are eco-friendly, as hybrids use NiMH batteries which can be recycled and that disposal will pose no toxic hazards and also does not release any harmful gases that help to give green earth.

IV. PARTS

The HV contain the following main parts that is

- 1) Battery
- 2) Internal combustion engine
- 3) Power split device
- 4) Electric motor

BATTERY

The batteries in a hybrid car are the energy storage device for the electric motor. Unlike the gasoline in the fuel tank, which can only power the gasoline engine, the electric motor on a hybrid car can put energy into the batteries as well as draw energy from them.

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization,

Volume 5, Special Issue 7, April 2016

National Conference on Trends in Automotive Parts Systems and Applications (TAPSA-2016)

On 18th & 19th March

Organized by

Sri Krishna College of Engineering & Technology, Kuniamuthur, Coimbatore-641008, Tamilnadu, India

INTERNAL COMBUSTION ENGINE (ICE)

The hybrid car has an ICE, also known as a gasoline engine, much like the ones found on most cars. However, the engine on a hybrid is smaller and uses advanced technologies to reduce emissions and increase efficiency. Receives its energy from the fuel tank where the gasoline is stored.

POWER SPLIT DEVICE

The power-split-device resides between the two motors and together with the two motors creates a type of continuously variable transmission.

ELECTRIC MOTOR/GENERATOR

The electric motor on a hybrid car acts as a motor as well as a generator. For example, when needed, it takes energy from the batteries to accelerate the car. But acting as a generator, it slows the car down and returns energy to the batteries. The same motor is used as a generator for recharging the battery.

Fig 1: Internal view of the hybrid vehicle system

Starting Off

Taking advantage of the electric motors' low-speed high torque at start-off When the car starts off, hybrid vehicles use only the electric motors, powered by the battery, while the gas/petrol engine remains shut off. A gas/petrol engine cannot produce high torque in the low rpm range, whereas electric motors can - delivering a very responsive and smooth start.

Low-speed Driving

*Energy-efficient motor-driven running. A gas/petrol engine is not energy efficient in running a car in the low-speed range. On the other hand, electric motors are energy efficient in running a car in the low-speed range. Therefore, our design uses the electric energy stored in its battery to run the car on the electric motors in low-speed range.

* If the battery charge level is low, then the mode of vehicle operation is shifted to normal engine vehicle type operation where the available motor is used as a starter motor .

* Once the vehicle sets running the given motor is made to act as a generator using suitable drives and battery might be recharged.

Cruising

*Energy-efficient driving, using the gas/petrol engine as the main power source Hybrid vehicles use the gas/petrol engine in the speed range in which it operates with good energy efficiency. The power produced by the gas/petrol engine is used to drive the wheels directly, and depending on the driving conditions, part of the power is distributed to the generator. By making use of the engine/motor dual powertrain, the energy produced by the gas/petrol engine is transferred to the road surface with minimal loss.

* If the battery charge level is low, the power output from the gas/petrol engine is increased to increase the amount of electricity generated to recharge the battery.

Cruising/Recharging

Recharging the battery with surplus energy. Vehicle operates the gas/petrol engine in its high efficiency range, the gas/petrol engine may produce more power than is necessary to drive the car. In this case, the surplus

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization,

Volume 5, Special Issue 7, April 2016

National Conference on Trends in Automotive Parts Systems and Applications (TAPSA-2016)

On 18th & 19th March

Organized by

Sri Krishna College of Engineering & Technology, Kuniamuthur, Coimbatore-641008, Tamilnadu, India

power is converted to electric energy by the generator to be stored in the battery, where as our design has provisions to make use of the motor as a generator for recharging the battery.

Full Acceleration

Dual power for acceleration one class higher. When strong acceleration is called for (e.g. for climbing a steep slope or overtaking) the power from the battery is supplied to the electric motors to supplement driving power. By combining the power from the gas/petrol engine and the electric motors, The vehicle delivers power comparable to cars having one class larger engine displacement of one class higher.

Deceleration/Regenerating Energy

Storing regenerated energy under deceleration in the battery. Under braking or when the accelerator is lifted, hybrid vehicles use the kinetic energy of the car to let the wheels turn the electric motors, which function as regenerators. Energy that is normally lost as friction heat under deceleration is converted into electrical energy, which is recovered in the battery to be reused later.

At Rest

*Shutting down entire power train when the car is at rest. The gas/petrol engine, the electric motors and the generator are automatically shut down when the car comes to rest. No energy is wasted by idling.

* If the battery charge level is low, the gas/petrol engine is kept running to recharge it. In some cases, the gas/petrol engine may be turned on in conjunction with the air-conditioner switch operation.

SERIES/PARALLEL HYBRID SYSTEM

With the Series Parallel Hybrid System, it is possible to drive the wheels using the dual sources of power (electric motors and/or gas/petrol engine), as well as to generate electricity while running on the electric motors.

The system runs the car on power from the electric motors only, or by using both the gas/petrol engine and the electric motors together, depending on the driving conditions. Since the generator is integrated into the system, the battery can be charged while the car is running. The basic components of the system are the electric motors, the gas/petrol engine, the generator, the power split device and the power control unit (inverter/converter). The power split device transfers part of the power produced by the gas/petrol engine to drive the wheels, and the rest to the generator to either provide electric power for the electric motors or to recharge the battery. This system takes advantage of the energy-efficient electric motors when the car runs in the low speed range, and calls on the gas/petrol engine when the car runs in the higher speed range. In other words, the system can control the dual sources of power for optimum energy-efficient operation under any driving conditions.

Fig 2: Functional block diagram

V. CONCLUSION

HEV is a vehicle that uses two sources of power- gasoline and battery. For low power application battery drive is used whereas for high power application where power requirement is very high gasoline engine is used. Gasoline drive is most efficient at high speed drive. Thus HEV's both mode of operation occurs at their maximum efficiency. But in gasoline engine low speed operation is not efficient. Its high speed mode is only efficient. Therefore, it gives twice the mileage given by a normal vehicle. As this HV emits 50% less emission than normal vehicle it plays an important role for reducing pollution to certain extent without compromising with efficiency. Thus it is most efficient in urban areas mainly in high traffic where gasoline engines are least efficient as the energy from gasoline is being wasted away and creates pollution.

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization,

Volume 5, Special Issue 7, April 2016

National Conference on Trends in Automotive Parts Systems and Applications (TAPSA-2016)

On 18th & 19th March

Organized by

Sri Krishna College of Engineering & Technology, Kuniamuthur, Coimbatore-641008, Tamilnadu, India

REFERENCES

- [1] Environmental Regulations Become Restriction or a Cause for Innovation – A Case Study of Toyota Prius and Nissan Leaf, International journal of engineering and technology, Vol 3, Issue 1 , 2015, ISSN: 2347-1573
- [2] Design and Fabrication of Hybride Two Wheeler, IJSRD - International Journal for Scientific Research & Development| Vol. 3, Issue 02, 2015 | ISSN (online): 2321-0613
- [3] Introduction to HV by Using Regenerative Braking System, IJISSET - International Journal of Innovative Science, Engineering & Technology, Vol. 1 Issue 9, November 2014., ISSN 2348 – 7968
- [4] A review on hybrid vehicles, International Journal of Research in Engineering & Technology, ISSN(E): 2321-8843; ISSN(P): 2347-4599 Vol. 2, Issue 5, May 2014, 59-64