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Review Article

Design & Development of a Hybrid System for Non Hybrid Vehicles

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ABSTRACT

Vehicles' environmental impact is growing by the day, and it is quickly becoming one of the world's most serious social issues. Alternative technologies, such as electric vehicles, hybrid vehicles, and other alternative fuel vehicles, must be monitored and implemented in the future to avoid deteriorating Air Quality Index. Hybrid electric vehicles (HEV) are seen as a ready-to-use alternative option in terms of infrastructural limitations due to their ease of use. The aim of this project is to develop a hybrid system for non-hybrid vehicles with increasing fuel efficiency and lowering greenhouse gas emissions. Develop a hybrid system with Idle Start-Stop and Driving Assist using microcontrollers, and validate the developed hybrid system with non- hybrid vehicle and an Electronic Fuel Injection System.

Keywords: Hybrid vehicle; Hybrid electric vehicles

INTRODUCTION

Since The last few years have seen the introduction of Hybrid systems by many manufacturers across various vehicle models to improve fuel consumption and reduce exhaust emissions. Nowadays city traffic jams are increasingly devastating. Vehicles' continuous short stops can cause the frequent occurrence of engine idle condition and excessive consumption of fuel. The hybrid vehicle typically achieves greater fuel economy and lower emissions than conventional internal combustion engine vehicles, resulting in fewer emissions being generated.

Urban road congestion which involves constant encounter of a short waiting and frequent start-stop the fuel economy decreases needlessly. In modern day Colombo metropolitan area, traffic congestion is becoming a serious issue which leads to number of negative consequences including higher transit times, loss of money and environmental pollution. Although a number of initiatives have been carried out by the government/s, long-term solutions are yet being achieved irradiating the adverse results of traffic congestion. Alternatively Hybrid vehicles Electric vehicles can be a better as well an accepted solution in reducing the number of Non hybrid vehicles circulating in urban city roads. More than 60 percent of the energy that goes into an automotive combustion cycle is lost, primarily to waste heat through the exhaust or radiator system.

In the city, vehicles are stationary for almost 35% of the time, with their engine's idling. In which emits higher exhaust emissions at idling. Vehicles' continuous short stops can cause the frequent occurrence of engine idle condition and excessive consumption of fuel. As the fuel prices increases day by day, people uses fuel every day in their life to fulfill their needs and in return they reduce their lifetime by polluting the environment. Environment pollution increases due to the vehicles exhaust gasses. Carbon monoxide (CO) and Hydrocarbon (HC) emissions are gaining importance because they contribute to the greenhouse effect of the planet and impact the air quality.

RELATED WORKS

A review of micro and mild hybrid systems (2019) Overview of the status of micro and mild hybrid technologies [1].

A Review on the Trends and Developments in Hybrid Electric Vehicles (2019)

The history, the development, and the current scenario of hybrid electric vehicle (HEV) [2].

Development of Hybrid Electric Vehicles (2015)

Review on Development of Hybrid Electric Vehicles [3].

Electric Vehicle Technologies Progress and Development Prospect (2012)

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Developing electric vehicles (EVs) has been chosen as national strategy as solution to energy security and urban air pollution by China [4].

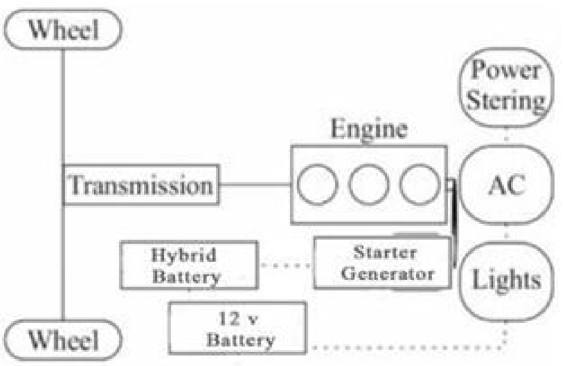
Design and Development of a Parallel Hybrid Powertrain for a High Performance Sport Utility Vehicle (2005) Parallel & Series hybrid powertrain has been developed for a high performance sport utility vehicle [5].

METHADOLOGY

The research project is to design a hybrid system for non- hybrid vehicles which includes Idle Start-Stop; driving assist for vehicles which can be can be fixed to any type of vehicle such as passenger cars.

Figure.1. is shown the block diagram with the details about the major parts of the system and connecting with each other.

Figure1: Block Diagram

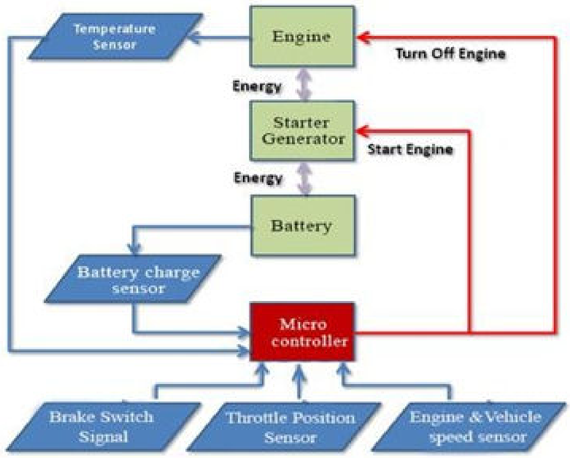


In this system the 12v battery powers all the equipment except the starter generator. Hybrid battery powers the starter generator.

The starter generator is a combination of two different engine components. The starter component generates the initial ignition, starting the vehicle, and the generator maintains the voltage while the vehicle is being operated.

Figure.2. is shown the process flow of the developed hybrid system.

Figure2: Process flow diagram



The mild hybrid system has particular advantages in city traffic, with the BLDC motor supporting the combustion

Engine when re-starting after traffic stops. This action supports a faster and smoother engine start with supplemental torque, drawing on energy from the 48V battery.

As a result of the earlier and faster delivery of torque, the engine start can be anticipated by 0.2 seconds. The conventional 12V starter is only used for the initial starting operation if the engine oil is still cold and a higher starting torque is required.

Under acceleration, the BLDC motor supports the combustion engine with compensatory 4 to 12 kW of power, depending on the battery system's state of charge and the degree of accelerator input from the driver. Once the required speed is reached, the BLDC shifts to neutral mode, delivering no power.

The Idle start-stop system used automatically shuts down and restarts the internal combustion engine to reduce the amount of time the engine spends idling, thereby improving fuel economy and reducing emissions. In a typical situation the driver releases the accelerator pedal, activates the brake paddle and the vehicle comes to a halt. The driver takes the leg out of the brake pedal. The microcontroller checks the following.

- Engine is in idling condition.
- The vehicle speed sensor is showing a zero speed.
- Electronic battery sensor is showing adequate battery charge for next start operation.

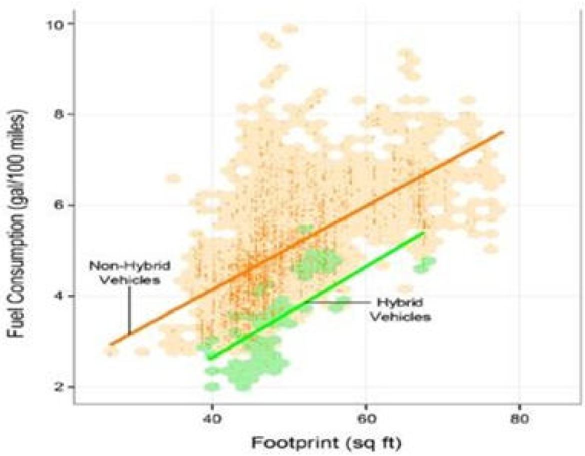
When all these conditions are satisfied the engine will wait for 3 seconds time and then switches off automatically. This can causes the engine to be started quickly. As soon as the brake pedal is released is actuated the Motor receives the signal to restart the engine. The engine is started quickly and quietly and is immediately ready for operation again.

RESULTS

Fuel consumption Comparison with Non hybrid Systems, Hybrid systems can reduce fuel consumption and co2 emissions by up to 35%, equivalent to more than a 50% increase in fuel economy. The precise reduction varies with the sophistication of the hybrid system. The reduction can also be difficult to quantify if there is not a directly comparable non-hybrid vehicle.

In Figure.3. shows the fuel graph of the non-hybrid vehicles and hybrid vehicles

Figure 3: Fuel Graph of the Hybrid vs. Non Hybrid Vehicles



The emission report of the car without the hybrid system. The emission levels for a patrol car is measured from the Engine speed , HC(Hydrocarbon), CO(Carbon Monoxide) , and the Lambda is shown in the figure.4.

Also it gives a detail report of the O2 & CO2 emission of the car

Figure 4: Emission report of the car without the hybrid system

GASOLINE	SPEED rpm	HC (ppm v/v)	CO (% v/v)	LAMBDA	O2 (% v/v)	CO2 (% v/v)	OVERALL RESULT	ESTIMATED FUEL WASTAGE (For your Guidance only)	
								%	Rs/Ltr
STANDARD		1000	3.00				FAIL		
IDLE	819	988	3.831	1.143	6.170	8.130		18.41	25.22
2500 RPM	2365	1118	4.129	1.091	5.600	8.300		19.26	26.39
STATUS		F	F						

Compared with traditional cars, this hybrid system can ensure the same performance and advantages, while being superior in energy saving and emission.

Figure.5. shows the Pass report of the car with the system is running. It lowers the emission values and reduce the greenhouse gasses.

Figure 5: Emission report of the car with the hybrid system

GASOLINE	SPEED rpm	HC (ppm v/v)	CO (% v/v)	LAMBDA	O2 (% v/v)	CO2 (% v/v)	OVERALL RESULT	ESTIMATED FUEL WASTAGE (For your Guidance only)	
								%	Rs/Ltr
STANDARD		1000	3.00				PASS		
IDLE	970	212	0.286	1.543	8.410	9.550		2.58	3.53
2500 RPM	2483	186	1.037	2.036	11.780	5.950		8.11	11.11
STATUS		P	P						

When analyzing the fuel wastage of the car with and without the system, there is a significant change when comparing the both reports.

The wastage of the fuel in the car without the hybrid system is = 19.0% wastage per 1 liter.

The wastage of the fuel in the car with the hybrid system is = 8% wastage per 1 liter. So there is a 11% saving fuel in using this hybrid system.

CONCLUSION

More than 50% of the newly registered vehicles will have Hybrid systems as standard technology. Even though the technology is widely utilized for small / mid segment cars in Europe it also has high potential for compact and luxury car segments. It can be expected, that especially Micro-Hybrid technology will gain increasing relevance in the coming years as technological challenges are solved. The hybrid system is a key technology to be used in conjunction with other fuel saving technologies to attain the stringent carbon norms of 2020.

It is so important to build a design and simulation for a hybrid electric vehicle with a fully functional driving model. For example, it is necessary to compare actual speeds with ideal speeds in the Urban Dynamometer Driving Schedule and the Highway Fuel Economy Driving Schedule to obtain optimum vehicle values. In addition, this implementation is achieved by multiplying Km/l to achieve lower fuel consumption. So, since it consists of two power modes, the higher efficiency of output power for a hybrid vehicle is achieved. Gasoline engine energy is one of them, and electrical energy is the other. The electrical energy represented by the battery will enable the gasoline engine to drive the vehicle, and the battery would be charged by the engine to avoid depletion. Therefore, for the reasons given above, a hybrid vehicle is better than a conventional vehicle in terms of performance, lower emissions, and fuel efficiency.

Hybrid systems are intended for urban road congestion, which requires a quick wait and a regular start-stop. Vehicles are idle in the city for about 35% of the time, with the engine idling unnecessarily. Which, when compared to the vehicle running, emits higher exhaust emissions at idling. Some companies have equipped some vehicles with this hybrid system. Fuel consumption is decreased by about 12 percent compared to cars without the hybrid system.

HEV's main problem is how the multiple energy sources can be optimized to obtain the best fuel economy or low emissions at lower costs. This paper provided an overview of HEVs with a focus on configurations and key concerns, in particular the design of a hybrid system for non-hybrid vehicles with a view to increasing fuel efficiency and reducing the potential for greenhouse gas emissions.

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