Design and Fabrication of Duel Modepower in Two Stroke Engine

N. Balakrishnnan
N. Prithivi Raj
Department of Mechanical Engineering
Gnanamani College of Technology
Namakkal Tamil Nadu, India.

G. Niirmal, R. Manikandan,
V. Muruganantham, J. Naveen
Department of Mechanical Engineering
Gnanamani college of Technology
Namakkal, Tamil Nadu, India.

Abstract: **A Duel fuel mode is a vehicle which relies not only on batteries but also on an internal combustion engine which drives a generator to provide the electricity and may also drive a wheel. It has great advantages over the previously used gasoline engine that drives the power from gasoline only. It also is a major source of air pollution. The objective is to design and fabricate a two wheeler electric vehicle powered by both battery and gasoline. The combination of both the power makes the vehicle dynamic in nature. It provides its owner with advantages in fuel economy and environmental impact over conventional automobiles. Hybrid electric vehicles combine an electric motor, battery and power system with an internal combustion engine to achieve better fuel economy and reduce toxic emissions. In HEV, the battery alone provides power for low-speed driving conditions where internal combustion engines are least efficient. In accelerating, long highways, or hill climbing the electric motor provides additional power to assist the engine. This allows a smaller, more efficient engine to be used. Besides it also utilizes the concept of regenerative braking for optimized utilization of energy. Energy dissipated during braking in HEV is used in charging battery. Thus the vehicle is best suited for the growing urban areas with high traffic.**

Keywords:ICEngine,Gasoline,Electricmotor, Convert

I. INTRODUCTION

Around 93% of today's automobiles run on petroleum based product, which are estimated to be depleted by 2050 [1]. Moreover, current automobiles utilize only 25% of the energy released from petroleum and rest is wasted into the atmosphere [2]. Despite recent efforts to improve fuel efficiency and reduce toxic emissions in cars, emissions have continued to increase steadily in the past two decades.

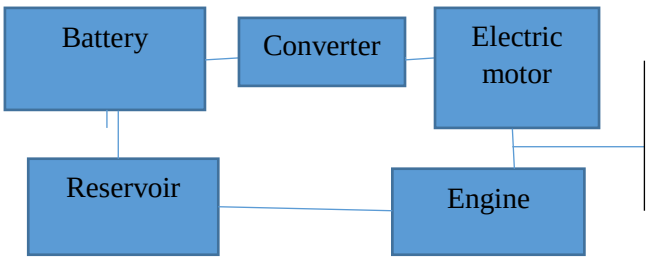
For preservation of gasoline for future and increasing the efficiency of vehicle an electric vehicle can be a major breakthrough. An electric vehicle is pollution free and is efficient at low speed conditions mainly in high traffic areas. But battery charging is time consuming. Moreover, it cannot provide high power required by drives during high speed conditions or in slopes of hilly areas. Gasoline engine proves its efficiency at higher speeds in high ways and waste a lot of energy in urban areas. A hybrid vehicle solves these problems by combining the advantages of both the systems and uses both the power sources at their efficient conditions. The objective of this project aims at better utilization of fuel energy and reduces dependence on non-renewable resources using latest technology.

1.Concept Of Duel Fuel Mode:

A 'gasoline-electric hybrid vehicle' is an automobile which relies not only on gasoline but also on electric power source. In DFM, the battery alone provides power for low-speed driving conditions. During long highways or hill climbing, the gasoline engine drives the vehicle solely. Hybrid electric vehicles comprise of an electric motor, inverter, battery as electric drive and an internal combustion engine with transmission connected as gasoline based drive. It is to achieve better fuel economy and reduce toxic emissions.
It has great advantages over the previously used gasoline engine that is driven solely from gasoline. This hybrid combination makes the vehicle dynamic in nature and provides its owner a better fuel economy and lesser environmental impact over conventional automobiles.

2. .Basic Design Of Fuel Duel Mode:

The basic design consists of a dc power source battery The battery is connected to inverter that is fed to a BLDC motor that works on AC. The motor is attached to the front wheel of the two wheeler vehicle. As the motor rotates the attached wheel rotates too, thus, leading to vehicle motion. At low speeds this mode of propulsion is used. The next phase consists of an IC engine that moves the piston continuously. This is connected to the transmission and thus, the vehicle moves.



a.Basic Diagram of Duel Fuel Mode

HEVs have been vehicles of numerous advantages. Hybrids do indeed get superior gas mileage. They use less gasoline, and therefore emit less greenhouse gas. Thus the problem of environmental pollution can be avoided to certain extent. Apart from that they use less gasoline in comparison to the other vehicles of same power that run only on gasoline. Thus this reduces the extreme dependence on gasoline which is a non-renewable source of energy. This encourages the method of sustainable development that has been the topic of concern in the modern society. Moreover, HEVs mode of operation are maximum efficient to the conditions, i.e, at low speed and high traffic areas where gasoline engine is least efficient with a lot of energy wasted, HEV moves with power from battery. At up slopes where high power is required and battery is inefficient, gasoline power is used for vehicle motion. Thus the advantages of HEV make it superior than any other vehicle of today.

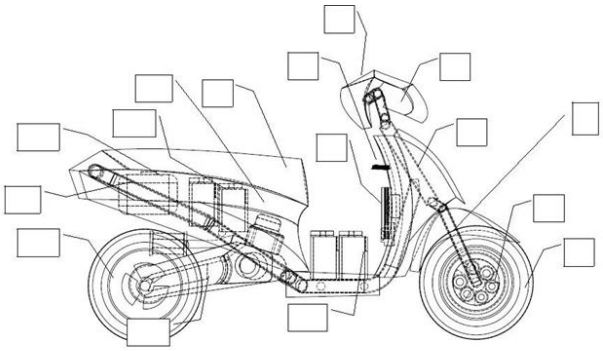
3. Overview of proposed work done

Many a literature are used to carry out the project which includes notes on Hs, electric drives, energy management, batteries, internal combustion engine, etc. Reference [1]-[2] gives us the data of the global scenario regarding the vehicle dependence on non-renewable resource gasoline and the expected year of depletion of the product. It gave a detailed discussion on importance of development of other types of vehicles such that too much dependence on gasoline based can be reduced. Reference [3]-[4] gives an overview about the electric drive technology. Reference [5] describes about battery technology available in the market. Reference [5] tells about the various batteries and their advantages. Reference [6] gives theories about motors, their efficiency as per the application and about the controller. References [7]-[8] describe the internal combustion engine, ways to increase their efficiency etc. Reference [9]-[11] gives an overview of HEV and its associated advantages.
The following objectives are to be achieved at the end of the project.

a)Design and virtual analysis of the vehicle.
b)Designing& Assembling of IC Engine.
c)Designing& Assembling of the Electric Power Drive.
d)Designing a two wheeler vehicle with front wheel powered by electric motor and rear wheel drive powered by an Internal Combustion Engine.
e)A switching circuit used to switch from IC Engine to the electric power and vice versa.
f)Implementation of control algorithm by microcontroller
g)Efficiency calculation of vehicle.

II. INTRODUCTION OF CAD MODEL

The project discloses a hybrid system consisting of an Electric and Internal Combustion(IC) based power drives. The front wheel is being propelled by battery and the rear wheel is powered by gasoline, i.e, it includes a single cylinder, air cooled internal combustion engine and a BLDC motor based electric power drive used for hybrid powering of the vehicle. The controller is designed to implement the switching between IC Engine and Electric motor depending on the power requirement and load conditions.



1. *Cad model view*

a..Rendered view

III. WORKING OF DUEL FUEL MODES;

In Duel Fuel Mode, the battery alone provides power for low-speed driving conditions where internal combustion engines are least efficient. In accelerating, passing, or hill climbing where high power is required battery provides power to electric motor as an additional power to assist the engine. This allows a smaller, more efficient engine to be used.

A throttle position sensor (TPS) is a sensor used to monitor the position of the throttle in an internal combustion engine. It consists of a hall sensor. When the accelerator throttle angle
changes magnetic field is created and it creates voltage across position sensor terminal. Thus for various angles, various voltages are obtained.

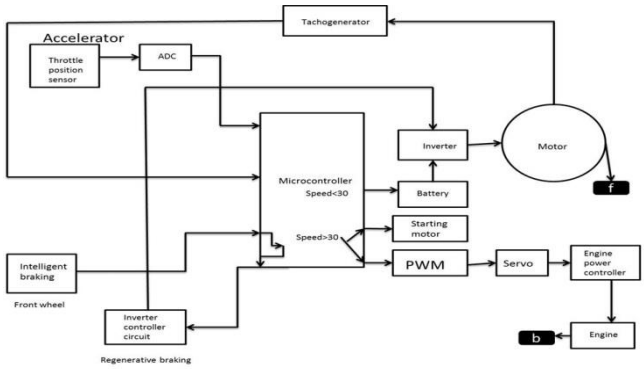
3.1Components:

1)Tyre 2) Hub Motor 3) Suspension 4) Headlamp 5) Body Cover 6) Display
7)Microcontroller 8) Hub Motor Controller 9) Seat 10) Engine 11) Front Battery
12) Fuel Tank 13) Chassis 14) Rear Tyre15)Transmission 16) Rear Battery

3.2D*iscription of diagram*

The vehicle at lower speed act as front wheel drive and at high speed gets switched to rear wheel drive automatically. Component 1 in Fig 7 shows the attachment of tyre with the hub motor. There is no need for any gear reduction since the torque produced is sufficient enough to drive the vehicle. The axel of the motor is connected to the suspension Suspension is connected to the handle which is connected to the main chassis. Accessories such as headlamp display are included as user aid. A microcontroller powered up from battery, performs the switching from electric to internal combustion or vice versa as per the requirement. It senses throttle position and controls the hub motor speed via controller circuit and the IC Engine via servo motor to control speed of rear wheel. Due to space constraints, two batteries are placed in front and two are placed near the fuel tank. Engine is connected to the main chassis and seat is situated above the engine. CVT is connected to the crank shaft of the engine to avoid any shocks while switching and it makes the controlling simpler and easier.

3.3Circuit Diagram of Duel Fuel Mode



IV. BATTERY

1.CHARGING A BATTERY
2.3-STAGE CHARGING
3.TYPES OF CHARGER
4.PROTECTION
5.REMOTE SENSING
6.POWER FACTOR CORRECTION
7. CE MARKING
8. VOLTS,AMPS and WATTS
9. CHARGER SELECTION
10.DC-DC CONVERTERS
11. INSTALLATION

4.1 *Charging a Battery*

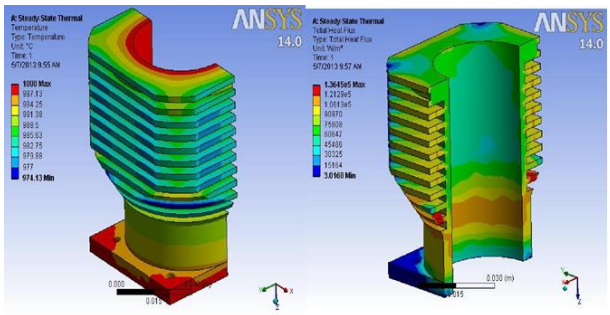
There are many types of battery but batteries on boats are nearly always LEAD-ACID types - similar to car batteries but heavier duty.
A BATTERY is made up of a number of CELLS.
A LEAD-ACID CELL generates around 2 volts. Small batteries contain 6 cells in a container which add together to give 12 volts at the terminals. Larger cells are quite heavy and individual CELLS are connected together 'in series' to make batteries of either 12 volt (6 cells) or 24 volt (12 cells).
Although a battery is called a '12 volt' battery, its voltage varies from about 12.6 volts down to 10 volts when it is discharging and can rise to 15 or 16 volts during charging. It is very important, however, to limit the maximum battery voltage during charging otherwise the battery will be damaged. The battery voltage should not exceed 13.8 volts for long periods and 14.4 volts for short periods (8 hours maximum).

V. CAD MODEL OF IC ENGINE

A single cylinder, gasoline based air cooled engine is designed in computer aided software, comprising of part modelling with part assembly. An engine consist of various parts such as piston, cylinder head, cam shaft, chains, timing controlling, fuel supply system, spark ignition system.

.5.1 Indicated thermal efficiency

It is the ratio of energy in the indicated power ip, to the input fuel energy in appropriate units.



Efficiency = ip[kJ/s]/energy in fuel per sec [kJ/s]
= ip[kJ/s]/(mass of fuel/s x calorific value of fuel)

5.2Thermal efficiency

Brake thermal efficiency is the ratio of energy in the brake power, bp, to the input energy in appropriate units.

Efficiency = bp/(mass of fuel/s x calorific value of fuel)

5.*3Mechanical efficiency*

Mechanical efficiency is defined as the ratio of brake power (delivered power) to the indicated power (power provided to the piston).

Fp = ip-bp

5.*3Specific fuel consumption*

The fuel consumption characteristic of an engine are generally expressed in terms of specific fuel consumption in kilograms of fuel per kilowatt-hour. It reflects how good is the engine running or performing. It is inversely proportional to the thermal efficiency of engine.

Sfc = Fuel consumption per unit time/ Power

5.4EFFICIENCY OF ELECTRIC DRIVE

Efficiency = (Output power/Input power)
= (T*w/Vdc Idc)

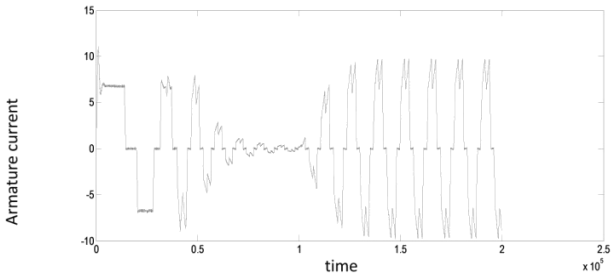
Thus through the expressions efficiency of the vehicle is calculated. The efficiency of IC engine at low speed is very less,i.e, it is less than even 25%. Whereas at this speed the efficiency of battery based drive is almost hundred percent. At high speeds both of them have the same efficiency as both of them are propelled by gasoline energy. Thus from the above discussions it can be concluded that hybrid electric vehicle is more efficient than normal vehicle based on gasoline power source.

5.5 Analysis

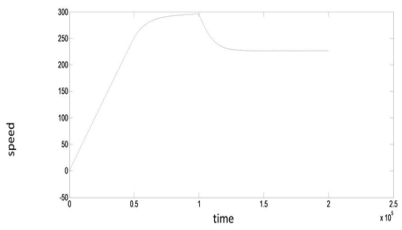
During combustion of gasoline, high temperature gases are generated which increase the temperature of the cylinder head. A long, conductive radiating fins are casted with the cylinder head to remove the heat from the interior to the environment. High temperature affects the performance of the engine, combustion of the lubricating oil is a serious problem which needs to be taken care of. Fig. 6.1 shows the temperature distribution of the cylinder head when the vehicle is running at higher speeds and heat transfer is mainly through convection. The simulation is colour coded which depicts that red colour shows higher temperature and blue colour shows the region of lower temperature. Fig. 6.2 shows the heat flux distribution in a cylinder head. Fig 6.3 shows the stress analysis of the the chassis. The bluish portions experience less stress and the reddish portions have more stress. The chassis portion with red in colour is to be made with proper care. Fig 6.4 shows the inverter output of the electric vehicle. The square wave produced is fed to the BLDC motor for maximum efficiency. Fig 6.5 shows the variation of torque, speed, output voltage and armature current with time of the electric drive.

(a) (b)

a Temperature Distribution of Cylinder Head
b Heat Flux Distribution in a Cylinder



5.6 Output of inverter circuit



5.7Armature current of electric drive circuit

VI. HUB MOTOR

Hub motor electromagnetic fields are supplied to the stationary windings of a motor. The outer part of the motor follows those fields that turn the wheel that is attached. In a brushed motor, energy is transferred by brushes which are in direct contact with the rotating shaft of the motor. In a brushless motor, the Energy is transferred electronically, with no physical contact between stationary and moving parts. Although the brushless motor technology is more expensive, most of them are more efficient and longer lasting than brushed motor systems. Electric motors have greater torques at startup, making them more suitable for vehicles as they need the most torque at startup too. Their greatest torques occurs as the rotor first starts turning and this is why electric motors do not require a mode. A gear down arrangement might be needed, but unlike in a transmission type combustion engine, shifting is not needed for electric motors.

6.1 Alternator

An alternator is an electromechanical device that converts mechanical energy to electrical energy in the form of alternating current. The brushes in an alternator carry only excitation current, a small fraction of the current carried by the brushes of a DC generator, which carry the generator's entire output. A set of rectifiers (diode bridge) is required to convert AC to DC. To provide direct current with low ripple, a three-phase winding is used and the pole-pieces of the rotor are shaped (claw-pole) to produce a waveform similar to a square wave instead of a sinusoid. Wehave used alternator of Yamaha bike which works athigh RPM since our e-bicycle is limited to low RPMso we altered the windings of alternator and increases the drive ratio. So, that it can function at low RPM

VII. 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 hybrid vehicle 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.

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