ISSN (Online): 2456-5717

International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)
Vol.4 Issue.2 February 2018

Design and Fabrication of Hybrid Electric Vehicle

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Abstract – **Hybrid vehicle 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. The ECU is programmed to use the electric drive in starting phase and then combustion engine for higher speeds. Due to using electric drive we get higher starting torque at same period increase vehicle efficiency and reduce environmental pollution produced by gasoline vehicle. ECU uses the electric drive up to 30km/hr according to the pressure in the accelerating pedal and then for higher speeds inputs from accelerating pedal it switches to combustion engine and interchange between both power sources at calibrated speeds when required. Thus, our Hybrid Vehicle could be an alternative power source for effective fuel economy system and pollution free environment.**

Index Terms – **Hybrid Vehicle, Electronic Control Unit (ECU), Electric motor, Battery, Transmission, Fuel consumption, Battery indicator, Gasoline engine.**

I. INTRODUCTION

Hybrid vehicle is the concept of running the vehicle with the use of more than one source of energy. This is the concept of dual power vehicle i.e. vehicle runs with the help of petrol engine and electrical motor. In current affairs pollution makes the huge impact in the environment. Day today viruses and diseases are spreading because of pollution. In other hand fuel crisis is the danger that present and future going to face. To overcome those situations and dangers there is a need of alternate method. So, the reason electric motor is being introduced. In case of lighter vehicle high power motor is not able to use because of the power it requires in high level there is need to produce a large space for battery and it have to make more researches for the full electric vehicle. And moreover, motor don't make high speed and the pick-up level is too low. To overcome those faults petrol engine is being used as one more medium. Such a kind of vehicle is known to be the hybrid vehicle. With the power of petrol engine and non-pollutant and renewable energy used electric motor makes the vehicle in fulfilment.

II. NEED FOR THE STUDY

Hybrid cars operate on a dual mode where the electric motor, powered by batteries, takes over once the gasoline engine has gotten the vehicle up to speed. Braking and deceleration generates energy that is used to charge the electric motor's batteries. This system allows the hybrid car to provide better fuel efficiency. This also means that the engine of a hybrid vehicle is shut the moment the car is stopped. Considered the biggest advantage to the hybrid car is the reduction of environmental pollution due to fewer emissions of carbon dioxide and other harmful gases in to our atmosphere. Automobile manufacturers such as Honda, Toyota, and Ford have already introduced hybrid car models to the commercial market and several others are in development. Currently there are two types of hybrid vehicles on the market. The

first is the “Series” hybrid. A battery powered electric motor powers the Series hybrid car. It also has a gasoline powered engine but it does not singularly power the vehicle. The gasoline engine powers a generator which is used in turn to charge the batteries of the electric motor. The electric motor is left on during the vehicles entire operation however the gasoline engine can be switched on or off depending on the needs of the vehicle. This type of hybrid automobile provides better mileage in city traffic. The second type of hybrid vehicle on the market is called the "Parallel" hybrid. The Parallel hybrid car, like the Series type, has a gasoline engine and an electric motor. The electric motor and the electric motor can both be used to turn the transmission and power the vehicle. The major difference between the two types of hybrid cars is that the Parallel hybrid uses its electric motor to boost the vehicles power when required to increase the car's speed. The Parallel hybrid car is considered better suited for the open highway.

III. LIST OF COMPONENTS

BLDC Motor:

The 2 kW BLDC Motor is designed to maximize efficiency and increase battery life of your electric drive train. This unit is built to withstand heavy duty cycle is frequently run for a continuous 6 hours stretch. Based on a 48V configuration, the motor is most commonly run with a max rated 50-amp controller with a continuous operation around 33 to 35 amps.

Fig 1. BLDC Motor

Four Stroke Gasoline Engine:

Four stroke engines are an IC engine in which the piston completes the four separate strokes while turning a crankshaft. A stroke refers to the full travel of the piston along the cylinder, in either direction. The four separate strokes are intake, compression, combustion and exhaust. In here the combustion takes place with the help of spark plug.

Fig 2. Gasoline Engine

Chain Drive:

A chain that transfers power from the source to another place or mechanism, thus propelling it. A chain can be very energy efficient one study reported efficiencies as high as 98.6%. The study, performed in a clean laboratory environment, found that efficiency was not greatly affected by the state of lubrication. A larger sprocket will give a more efficient drive, reducing the movement angle of the links. Higher chain tension was found to be more efficient: "This is actually not in the direction you had expect, based simply on friction".

Fig 3. Chain and Sprocket

Battery:

The performance and life-cycle costs of Electric Vehicles (EV) and Hybrid Vehicle (HV) depend on the performance and life of their battery packs. Each battery chemistry operates over a particular operating range to achieve optimum life and performance. Temperature variations from module to module in battery packs result in unbalanced pack and thus reduced

performance. It is important to regulate battery pack operating temperature because it affects the performance (power and capacity), charge acceptance (during regenerative braking), and vehicle operating and maintenance expenses. Battery thermal management is critical for high power battery packs used in EV's and HV's to maintain their battery packs within the desired temperature range.

Fig 4. Lead Acid Battery

Specification of Vehicle:

TABLE 1: SPECIFICATION OF VEHICLE

Length of the vehicle	3810mm
Capacity of the engine	209cc
Capacity of the electric motor	2kW
Track width	1905mm
Wheel base	2900mm
Weight of the vehicle	250kg

IV. FABRICATION

Frame Modification:

Frame is the chassis of the vehicle it is being constructed using the MS pipes with the thickness of 3mm. Those frame is been welded using arc welding and CO_2 welding. Frame is been highly checked for the cracks, bends and welding joints for betterment purposes.

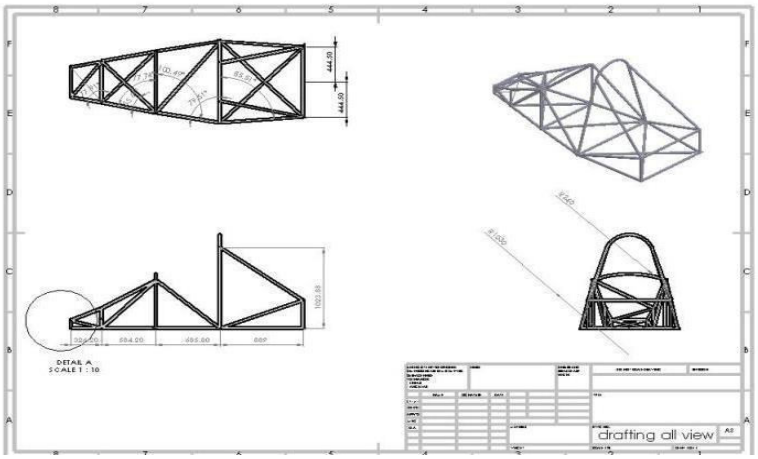

Fig 5. Drafting view

The frame has been designed as per the required parameters.

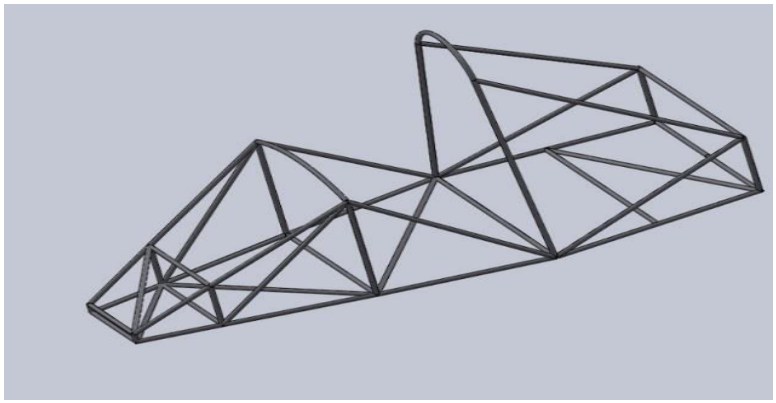

Fig 6. Structural view

Steering:

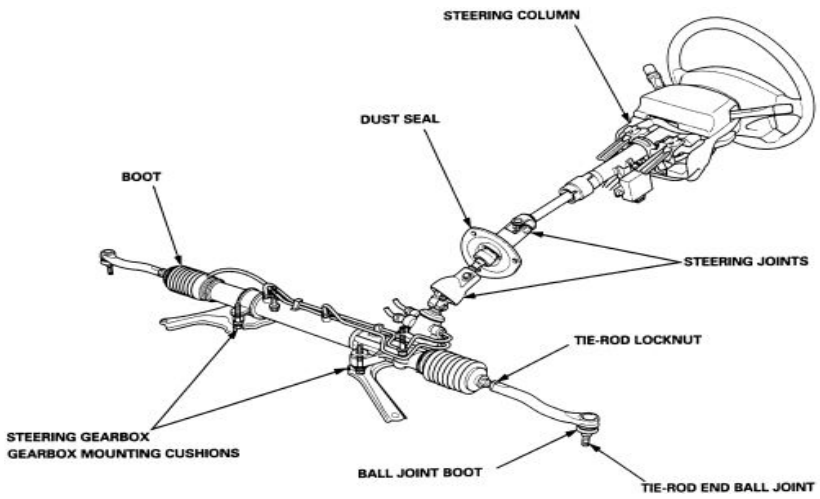

Fig 7. Rack and Pinion Steering

Brake:

In this project disc brakes are used for all the four wheels. Those brake system gives the assurance of safety in the curious time. Those disc brakes are been operated hydraulically. Such brakes are been in the form of making the assurance of sudden brakes. It withstand the large amount of pulling force. In here disc is been fitted to the hub of the wheels.

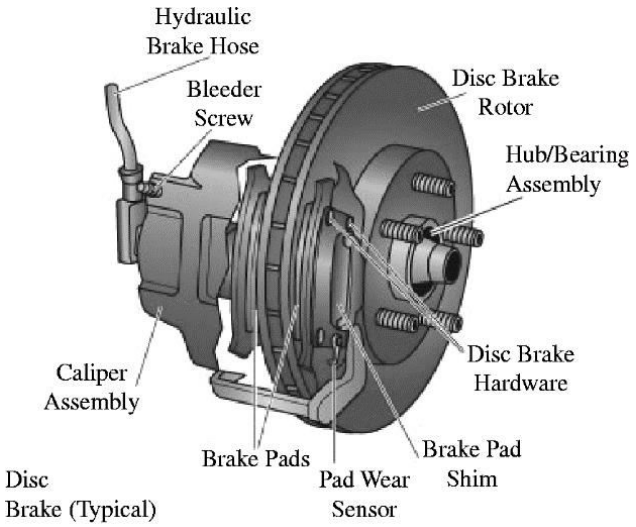

Fig 8. Disc Brake

Suspension:

In here the four-compressible spring is been used for the suspension. For each hub wishbone is constructed with the vision of up and down movement. Then the spring is being fixed in the wishbone to make the suspension system. Before constructing the design, analysis is being done.

Fig 9. Suspension

Electronic Control Unit:

Electronic control unit also known as ECU or Engine Control Unit is the controlling

of series of function of actuators on an internal combustion engine and ensuring the excellent engine performance. The Engine Control Unit is also called Power train control unit.

Fig 10. Electronic Control Unit

V. WORKING PROCEDURE

Initially, the vehicle starts with gasoline engine and continues to run for certain time until the battery is fully charged. Then, ECU changes the engine drive to electric drive for slower speeds and for higher speeds again, switches to engine drive. And the battery is charged by a generator that is driven by the gasoline engine when it is running. A hybrid vehicle never needs to be plugged in as it has the ability to create its own power. In most conditions, the gasoline engine will shut off automatically when the vehicle comes to a stop, it may also shut off when driving at slow speeds. This process continues to run alternatively for better fuel efficiency.

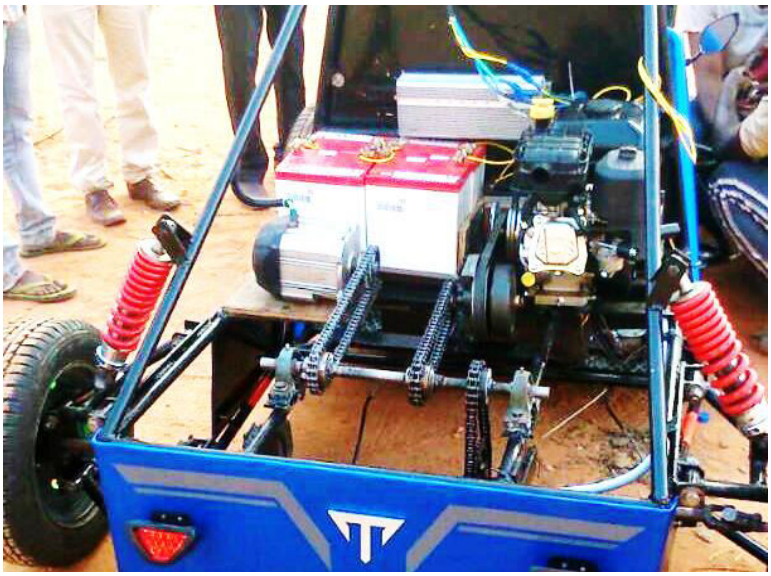

Fig 11. Erection

VI. RESULT AND ANALYSIS

Using the classification of design objectives, contributions, and attributes proposed above we can understand the vehicle design methods that have been proposed in literature on the basis of the conceptual level of their design objectives. Each method has a set of primary design objectives that are inputs to the design process. These objectives are the qualities that are to be met by the resulting vehicle design. For this study the design objectives are divided into subsystem-level, vehicle-level, and system-level categories. The primary groups that have documented a vehicle design process with subsystem-level design objectives are conversion and aftermarket modification companies. These companies have the design objective of using an existing vehicle and making subsystem-level component modifications or additions to achieve some improvement in a particular vehicle attribute. Systems engineering techniques allow us to logically categorize these components and deal with them in a structured manner to ensure that all aspects are accounted for properly as they have been defined.

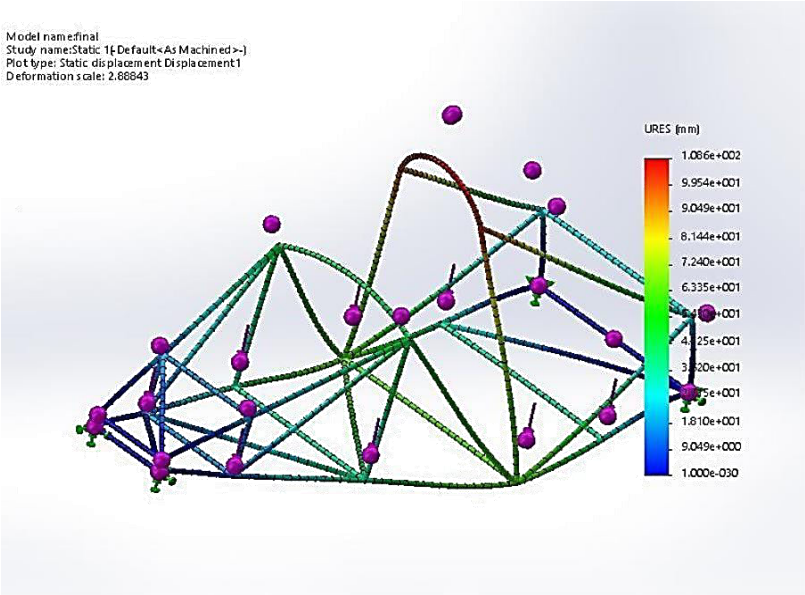

Fig 12. Analysis result of Frame

The solution procedure is based on stepping through the driving cycle at typically one second steps, calculating the equilibrium condition and then collecting all the data for plotting at the end of the cycle. The modelling assumptions are kept very simple in this initial work, so that no account is included for example of losses in the gear sets or differential. Thus, the focus of attention is on the overall efficiency of the engine and motor generator units and the major issue of whether it is possible to improve overall energy usage by operating the whole system at or near to the best efficiency points.

Fig 13. Hybrid Electric Vehicle

VII. CONCLUSION

HV technology for both light and heavy duty applications is commercially available today and demonstrates substantial reductions in tail-pipe emissions and fuel consumption, even when compared to other available low emission technologies. Continuing innovation in hybrid technology and a growing demand for cleaner vehicles will mean that costs are like to fall, particularly in second hand vehicle markets. All the measurement signals are optimized for the driveline for Chalmers ECO-marathon car Smarter so when a new driveline is fitted, some parameters need to be changed in the PLC system. A lot of work has been done to make Smarter run in the Shell ECO-marathon competition in Lausitz where a lot of the knowledge gained from the test bench was used. The evaluation on starting the ICE with the generators was a success taking away the need of a separate start engine which adds weight and is a complicated construction that may fail. By using the generators to start the engine some energy is lost from the super capacitor but the loss in traveling distance is even smaller than what is lost by adding a separate starter engine due to its weight.

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