IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 2, January 2025

Development of Hybrid Vehicle

Swapnil S. Gurjar[1], Dushyant B. Pawar[2], Anant S. Bombatkar[3]
Lecturer, Department of Mechanical Engineering[1]
Assistant Professor, Department of Mechanical Engineering[2]
Assistant Professor, Department of Mechanical Engineering[3]
Takshashila Polytechnic, Amravati, India[1]
Takshashila Institute of Engineering and Technology, Darapur, Amravati, India[2,3]

Abstract*: Model-Based Design can be applied in the development of a hybrid electric vehicle system. The paper explains how Model-Based Design begins with defining the design requirements that can be traced throughout the development process. This leads to the development of component models of the physical system, such as the power distribution system and mechanical drive line. We also show the development of an energy management strategy for several modes of operation including the full electric, hybrid, and combustion engine modes.*

Keywords: Hybrid vehicle, IC Engine, BLDC, Power-split devices

I. INTRODUCTION

Hybrid vehicle is combining propulsion of a system of an internal combustion Engine and Electric Motor and battery power system. The IC engine mostly powers the vehicle additionally when accelerating or additional power is needed. Hybrid electric include a battery, an electric motor, an IC engine and a power split device. These entire components make the vehicle able to run on both powers. Electric motors use to energy during idle or turn off and use less energy than IC ENGINE at low speed. IC engine does better at high speed and can deliver more power for a given motor weight. Much of the fuel efficiency comes from improvement in aerodynamic behaviour of vehicle weight reduction and bigger change.

A hybrid car gets power from both a gasoline engine and an electric motor. The engine and motor can work together in different ways. In some hybrids there are times when only one of them operates. In hybrid cars, the engine can automatically shut off when it is not needed for example, at a red light or in stop-and-go traffic. This is one reason why hybrids usually use less gasoline than traditional cars. Another reason is that since the electric motor does some of the work of moving the car, the gasoline engine is usually smaller than in traditional cars.

The motor as in electric cars gets power from large batteries. Unlike ordinary electric cars, most of today’s hybrids don’t need to be plugged in to get recharged. Instead, their batteries can be recharged while the car is being used. The car may have a generator to make electricity. This generator is powered by the gasoline engine. In some hybrids the electric motor itself works as a generator at times.

II. CLASSIFICATION OF HYBRID SYSTEM

1. Parallel hybrid
2. Series hybrid
3. Series – parallel hybrid (Combined hybrid)

1. Parallel Hybrid

In parallel hybrid system, the engine and electric motor are both connected to the mechanical transmission in parallel and can simultaneously transmit the power to drive the wheel. So that at any time only one of them is an action. Regenerative braking is also used to convert the vehicle kinetic energy into electrical energy which is stored in battery.

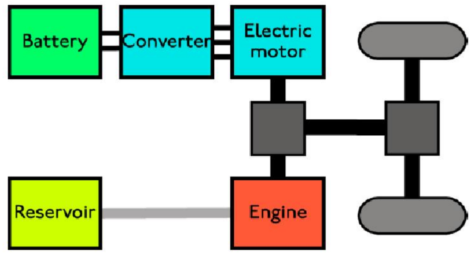


FIG.2.1 PARALLEL HYBRID

2. Series Hybrid

In a series hybrid system, the combustion engine drives an electric generator (usually a three-phase alternator plus rectifier) instead of directly driving the wheels. The electric motor is the only means of providing power to the wheels. The generator both charges a battery and powers an electric motor that moves the vehicle. When large amounts of power are required, the motor draws electricity from both the batteries and the generator.

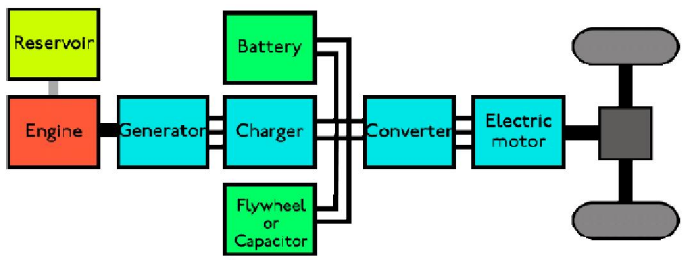


FIG.2.2 SERIES HYBRID

3. Combined Hybrid

Combined hybrid systems have features of both series and parallel hybrids. There is a double connection between the engine and the drive axle: mechanical and electrical. This split power path allows interconnecting mechanical and electrical power, at some cost in complexity. Power-split devices are incorporated in the powertrain. The power to the wheels can be either mechanical or electrical or both. This is also the case in parallel hybrids. But the main principle behind the combined system is the decoupling of the power supplied by the engine from the power demanded by the driver.

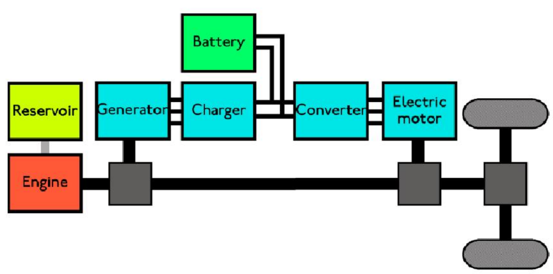


FIG.2.3 COMBINED HYBRID

III. METHODOLOGY

Design of Vehicle

1 Material Selection - Here selecting the AISI 1020 Seamless pipe by following stated reason.

2. Machinability

3. Weldability

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 2, January 2025

4. Availability
5. Cost

TABLE: CHEMICAL COMPOSITION OF THE MATERIAL

Material	Chemical Composition
Si	0.0117
Mo	< 0.0020
Ni	< 0.0030
Cu	0.00195
Al	0.0329
P	0.0262
S	0.00496
Fe	99.26

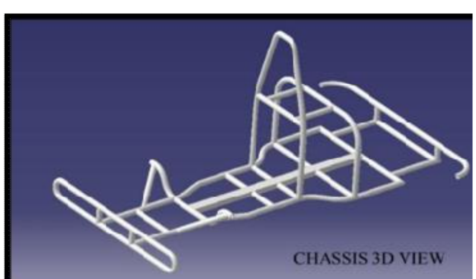
TABLE: MECHANICAL PROPERTIES

Stress Category	**Value**
Ultimate tensile stress	673 Mpa
Yield strength	630 Mpa
Elongation	18%
Density	7850 kg/m3
Poisson ratio	0.30
Modulus of elasticity	205 Gpa
Bulk modulus	105 Gpa

From above properties of material, we are selected the AISI 1020 SEEMLESS.
OUTER DIAMETER OF PIPE : 25.4 mm
INNER DIAMETER OF PIPE : 19.4 mm
THICKNESS : 3 mm
TOTAL REQUIRED PIPE : 17678.4 mm
SQUARE PIPE : 50.8×25.4 mm
LENGTH : 1117.6 mm
MATERIAL USED FOR FLOOR = 2 mm thickness Aluminium sheet.
MATERIAL USED FOR FIREWALL = 1.5 mm thickness of M.S. Sheet

IV. CHASSIS DESIGN

Wheelbase = 1117.6 mm
Front = 700 mm
Rear =700 mm
Ground Clearance =2 inch
No. Of joints = 33
No. Of bends = 18



IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 2, January 2025

Part Selection and Rating.

A. ENGINE POWER AND SELECTION IC ENGINE

Here selected the 110cc engine of Kinetic Honda ZX.

Specification-

MODEL	KINETIC HONDA ZX
Type	Two Stroke Petrol, Single Cylinder, Air Cooled Engine
Displacement	110 Cc
Max Speed	73 Kmph
Max Power	7.2 Bhp @ 5500 Rpm
Max Torque	9.4 N-M @4500 Rpm
Compression Ratio	7.1 : 1
Bore × Stroke	51.7 Mm × 52.4 Mm
Transmission	Cvt (Automatic)
Ignition	Electric
Fueling	Carburator
Weight	24.4 Kg
Clutch	Centrifugal
Area	510 Mm × 290 Mm × 320 Mm
Mounting Points	3
Air Cleaner	Oil Polyrythane Foam
Oil Sump Capacity	Lubricating Oil Tank

B. SELECTION OF MOTOR

Types of Motor

1. Hub Motor
2. PMDC Motor
3. BLDC Motor

Here selected BLDC motor for our design, which is suitable for our design.

BLDC Motor

Introduction

- BLDC brushless DC (BLDC) motor is a rotating electric machine with a classic three-phase stator like that of an induction motor and the rotor has surface-mounted permanent magnets.
- The generated stator flux interacts with the rotor flux defines the torque and thus speeds of the motor
- It also known as electronically commuted motor (ECMs, EC motor), having electronically commuted system.

Key characteristics Of A BLDC Motor

- Commutation done on windings
- High reliability (no brush wear)
- High efficiency
- Low EMI
- Medium construction complexity (multiple fields, delicate magnets)
- Driven by multi-phase inverter controllers

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 2, January 2025

Rating Of BLDC Motor

Power	1000 w
Speed	2600 rpm
Voltage	48 Vdc
Weight	4.5 kg
Motor size (in mm)	D= 161 mm, L = 94mm
Shaft (in mm)	D = 22.2 mm , L = 50 mm
Torque	3.67 N-m @2600 rpm

Working of BLDC Motor

- It operates by means of an electronic six step commutation system.
- The BLDC motor is synchronous, both the stator and magnetic field generates the same frequency.
- BLDC motor controller works on 48vdc with a current 2 ampere at no loading and current upto 20 amp. With loading.

Control of BLDC Motor

- With the help of a Hall Effect Sensor or Back Emf is used to identify the position of the rotor.
- Optical Encoder can also be added to the BLDC motor, allowing both the direction and the speed to be determined.

C. DESIGN OF HYBRID SYSTEM

Block Diagram Of Parallel Hybrid System

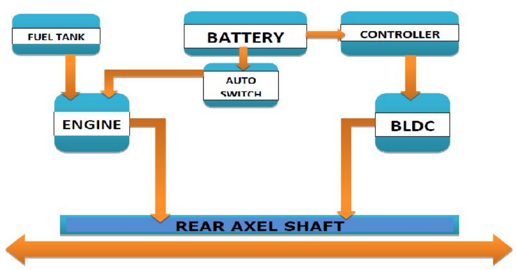


FIG. BLOCK DIAGRAM OF PARALLEL HYBRID SYSTEM

Arrangement of Hybrid System

As shown in the hybrid power train of the kart employs mainly the IC engine and electric motor connected to the rear axle via chain sprocket drive through free-wheeling hubs. The free wheel is a ratchet and pawl mechanism, which allows the outer wheel to rotate freely in one direction and locks the inner wheel with the outer in the other direction. This works on the relative motion between the two wheels hence when the inner wheel (axle) is rotating faster than the outer sprocket it rotates freely without any load on the motor, but when the motor rotates the outer sprocket, it locks the inner wheel to give the drive to the axle. This mechanism is similar to that used on a bicycle, when forward motion is given to the pedal it rotates the rear wheel in the same forward direction but when going downhill or moving due to inertia of motion there is no load on the pedal. As above data we are build our kart parallel hybrid vehicle system.

VI. ANALYSIS OF VEHICLE

Analysis Of Chassis Of Using Ansys Software, Force Estimation For Loading Condition Estimation Of Impact Force :-

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 2, January 2025

When M1and M2are the colliding masses with velocities u1 and u2. Then at that time force transferred by the first body on another body is 10G.

Weight Of The Vehicle = 250Kg

Weight Of The Driver = 70 Kg

By The Formula

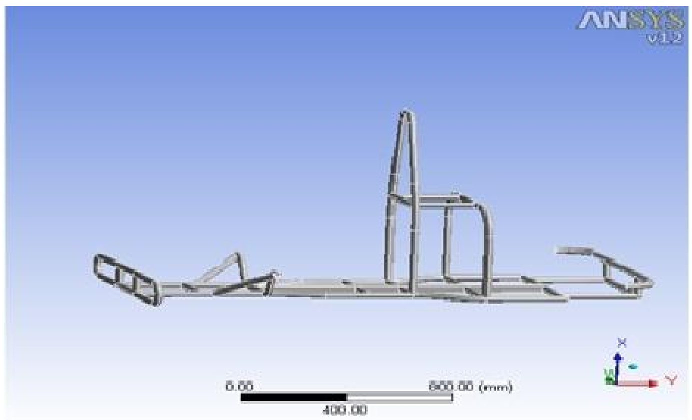
To apply load, 10 times of the vehicle.

Load application = M1 × g ×10

= 250 ×9.81 × 10

= 24525 N

Chassis Model In Ansys



TESTING OF VEHICLE

We have test hybrid vehicle on the playground of our institute. First, we run on I.C. Engine, continuously after that we get trial on BLDC motor by full external charging of batteries which is connected in series. The results we have get after continuous trial of 20 mins on hybrid, we have observed that in one litre petrol we run vehicle 35 km & saves 40% of fuel using hybrid system as compare to conventional system.

Performance of Vehicle

Mileage of Vehicle with Running on I.C Engine = 35 km/litre

Mileage of Vehicle with Running on Motor = 25 km/charge

Mileage of Vehicle with Running on Hybrid System = 65 km/litre/charge

VII. SAFETY POINTS IN VEHICLE

1. Driver Ergonomics
2. Seat belt
3. Kill switch on dash board
4. Kill switch on back of firewall
5. Fire extinguisher
6. Brake over travel switch
7. Front and Rear impact attenuator
8. MCB breaker for BLDC
9. Battery insulation
10. Mirrors
11. Brake light

VIII. COST ANALYSIS

Sr. No	Name of part	Quantity	Cost
1	chassis material	65 ft	03600=0
2	Engine	1	04300=00
3	BLDC Motor	1	15000=00
4	Battery	4	08500=00
5	Disc Brake, calliper, master cylinder	1	04200=00
6	Chain & sprocket	2	01200=00
7	Tyres & Rims	4	04500=00
8	Steering Arrangement	1	00800=00
9	Driver Seat	1	00400=00
10	Seat belt	1	00500=00
11	Potentiometer	1	00500=00
12	Fabrication		01000=00
13	Fibre work		01000=00
14	Wires		00600=00
15	Body colour		00900=00
16	Aluminium sheet	5ft	00350=00
17	Miscellaneous		01500=00
	Total		**48850=00**

IX. RESULT AND DISCUSSION

In presenting our results we have tried to be careful to present fair comparisons of conventional & hybrid electric vehicle in our experience, many reports describing the benefits & costs of new types of vehicle, e.g. Electric vehicles, have failed to account for important differences between the new vehicles& conventional ones or have failed to configure the new vehicles being analyse in such a way that they fulfil the same functions as the conventional vehicles.

X. CONCLUSION

By making a hybrid vehicle we have conclude that we can increase fuel efficiency with the help of another power source for motor drive. Also we conclude that by using Electric sources as another power source we can drive our hybrid vehicle.

In this project, we first described a typical HEV design and gave an overview of the key challenges. We discussed how the multi domain complications arise from the complex interaction between various mechanical and electrical components—engine, battery, electric machines, controllers, and vehicle mechanics. This complexity, combined with the large number of subsystem parameters, makes HEV design a formidable engineering problem.

We chose Model-Based Design as a viable approach for solving the problem because of its numerous advantages, including the use of a single environment for managing multi domain complexity, the facilitation of iterative modelling, and design elaboration. Continuous validation and verification of requirements throughout the design process reduced errors and development time

In the development process, the realization of a system-level model of the entire HEV. The subsystem components were averaged models, which underwent model elaboration with requirements refinement and modifications in parallel. We showed how state charts can be used to visualize the operating modes of the vehicle. After each component model was elaborated, we integrated it into the system-level model, compared simulation results of the averaged and detailed models, and noted the effect of model elaboration on the outputs. While times grew long as we moved towards a fully detailed model, we introduced techniques to alleviate this issue. Finally we concluded that the experience of driving a vehicle is great rather that driving a vehicle by using a single power mode.

IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.53

Volume 5, Issue 2, January 2025

REFERANCES

[1]. L. M. Gourd, Principles of welding technology (Viva Books, New Delhi, 1998).

[2]. L. L. Richard, Welding and welding technology (Tata McGraw-Hill, New Delhi, 1990).

[3]. L. Brooke, "Cost remains the boss", Automotive Engineering International, April 2007, SAE International.

[4]. Iqbal Husain, "Electric and Hybrid Vehicles—Design Fundamentals", 1st Edition, © 2003 CRC Press.

[5]. M.J. Schwarz and J.W. Shiller, Clean air act amendments of 1990, impact on motor vehicle and the environment, in Proceedings of Air & Waste Management Association 84th Meeting Exhibition, pp. 16–21, 1991.

[6]. N. Abbate, R. Attanasio, F. Gennaro, G. Guastella, G. Vitale,"High Efficiency Auxiliary Power Converter for HEV Applications", Elektrik/Elektronik in Hybridund Elektrofahrzeugen, Munich, 17-November- 2008