DESIGN AND FABRICATION OF SAP CAR

L.Sunil kumar[1],Dhruva kumar reddy2[2], Manik Reddy[3], Bhagvan[4], Jeevan[5], Rakesh[6]

[1]Asst-professor, Mechanical, NNRG, Telangana, India
[2] B-tech student, Mechanical, NNRG, Telangana, India
3 B-tech student, Mechanical, NNRG, Telangana, India
4 B-tech student, Mechanical, NNRG, Telangana, India
5 B-tech student, Mechanical, NNRG, Telangana, India
6 B-tech student, Mechanical, NNRG, Telangana, India

ABSTRACT

Since last 2-3 decades the average temperature of earth increased by 3-4^{0}C because of the green house effect. Due to increase in the fuel prices and continuously depletion of natural recourses for the fuels causes fuel crises in the modern society. Due to which demand of development of newly energy efficient vehicles increases. The hybrid technology fulfils this requirement by incorporating various combinations of bio-fuels and also by combinations of highly efficient electric drive systems. Along with the same it reduces the emission and cut the fuel cost. This project illustrates an implementation of hybrid technology on a small scale. Project aims at improving the mileage of the car using simple mild parallel hybrid technology with combination of electric motor drive and the petrol engine drive. We have used the straight open chassis design. The results show that alone a petrol engine gives best 35Km/lit, alone a electric motor gives 5 kms on full battery charge. The combination of above two gives 40Kms. The battery charging in our sap car is done in three different ways which provides easy fast and less wall socket usage to charge the battery we are using solar panel, wind turbine, and the battery even charges when the engine is in the motion

KEY WORDS: hybrid technology, electric motor drive, petrol engine drive, wind turbine, solar panel

1. INTRODUCTION

A hybrid Technology is defined as a technology 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-Electric Vehicle (HEV) combines the power of a gas engine with an electric motor. These dual engine systems can be configured for different purposes such as increasing the car's power, improving fuel economy, mileage, efficiency etc. A HEV may include a battery, an electric motor, a generator, an internal combustion engine and a power split device. All these components make the vehicle able to run on both gas and electric power. Any vehicle that combines two or more sources of power that can directly or indirectly provide propulsion power can be called a hybrid. In fact Hybrid vehicles are all around us. For example, a mo-ped (a motorized pedal bike) is a most common type of hybrid because it combines the power of a gasoline engine with the pedal power of its rider. Most of the locomotives we see pulling trains are diesel-electric hybrids. Cities like Seattle have diesel-electric .buses these can draw electric power from overhead wires or run on diesel when they are away from the wires. Submarines are also example of hybrid vehicles using nuclear-electric or diesel-electric system.

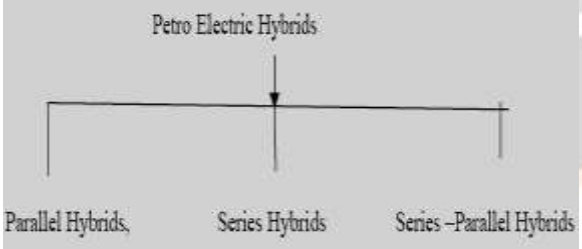
Electric motors use no energy during idle or during turn off and use less energy than IC-engines at low speeds. IC-engines do better at high speeds and can deliver more power for a given motor weight. That means during rush hour to stop and to go, the electric motor works great and, as an added benefit, does not produce any exhaust thus reducing smog levels. At higher speeds, the IC-engines kicks in and gives that power feeling that many

car owners look for when driving on the highway. Another benefit is to charge the batteries while it's running.

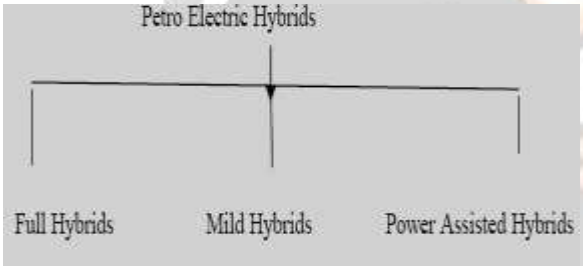
Much of the fuel efficiency comes from improvements in aero dynamics behaviors of vehicles, weight reduction and, the biggest change: a smaller, less powerful gas engine. In fact, any vehicle will get substantially better mileage just by reducing the engine size. Even a small increase in fuel economy makes a large difference in emissions over the life of the vehicle. Also, in large cities were pollution is at its worst, they make an even larger difference since they produce very little emissions during low speed city driving and the inevitable traffic jams. Because hybrids use regenerative braking, brake pads may even last longer than those in normal vehicles. A hybrid vehicle cuts emissions by 25% to 35% over even the most fuel efficient gas powered models.

1.1 Classification of Hybrid Electrical Vehicles

Hybrid electric vehicles can be classified according to the way in which power is supplied to the drive train as follows:



- Classification based on degree of Hybridization:



1.2. Parallel Hybrid Technology

In parallel hybrids, the engine and the electric motor are both connected to the mechanical transmission in parallel and can simultaneously transmit power to drive the wheels. Engine can also act a generator for recharging of the battery with help of a generator. Parallel hybrids are more efficient for highway driving than in urban stop-and-go conditions.

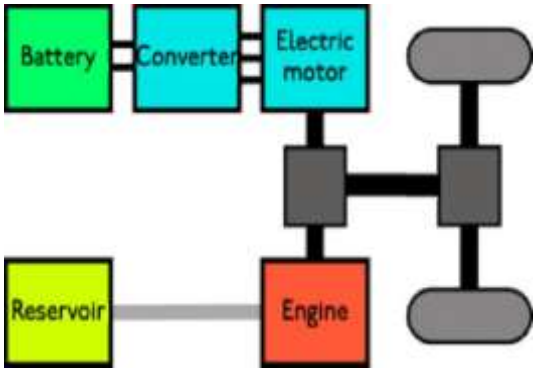


Figure 1 parallel hybrid technology

Generally in parallel hybrid vehicles both the power sources IC-engine & the electric motor are connected to same transmission via torque convertor so that at any time only one of them is in action. Regenerative braking is also used to convert the vehicles kinetic energy into electrical energy which is stored in batteries.

1.2.1 Working of Parallel Hybrids

1.2.1.1 Vehicle start up and low speeds: As the internal combustion engine is inefficient in this range due to low torque at lower RPMs, acceleration with electrical motor with higher starting torque is suitable.

1.2.1.2 Normal working: To avoid the battery flat-outs and excessive performance losses in this range, vehicle is driven by both internal combustion engine and electrical motor.

1.2.1.3 Sudden acceleration: In this mode, full throttle acceleration of the vehicle is considered. With the help of the extra energy from the generator, electrical motor runs in its full performance. So, internal combustion engine and electric motor together produce the maximum available power.

1.2.1.4 Battery recharge at rest: When the state of charge is below certain levels, it is possible to run the internal combustion engine in its efficient ranges and recharge the batteries with the help of the generator

2. Introduction to SAP-CAR

SAP-car is a type of small, suspension vehicle.. The three main components of the sap car are chassis, steering & transmission.

2.1 Chassis

sap car chassis are classified in as 'Open', 'Caged', 'Straight' or 'Offset'..

- In Straight chassis the driver sits in the center. Straight chassis are used for sprint racing.
- In Offset chassis the driver sits on the left side. Offset chassis are used for left-turn-only speedway racing.

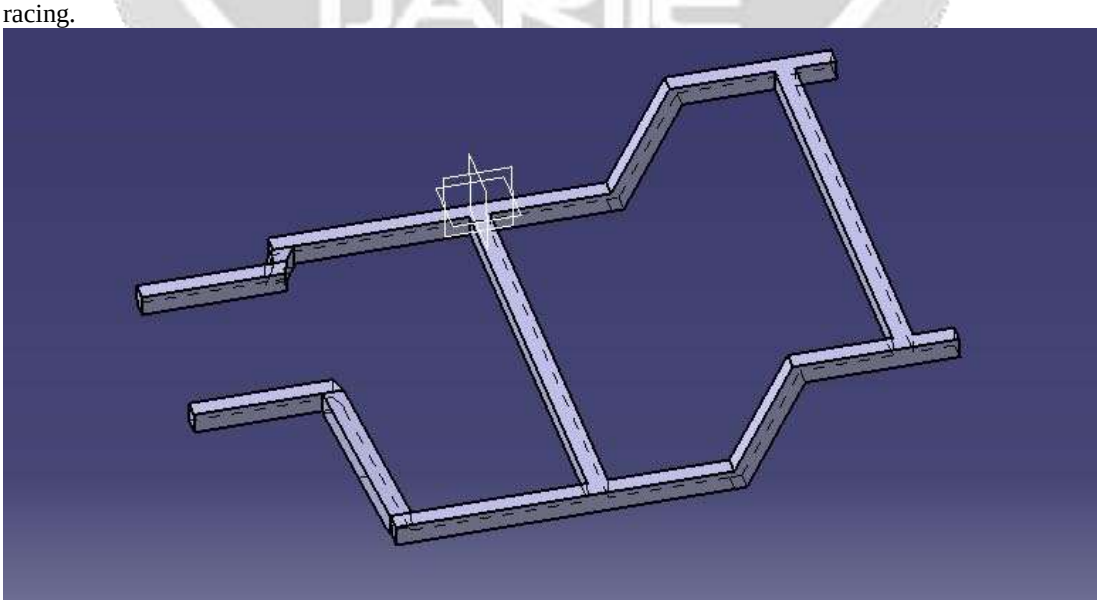


Figure2 3D Model of chassis

We have used the straight open car chassis design .In order to reduce the weight and cost, & due to lack of space availability differentials are also not used in the car. Most of the problem is faced during turning due to lack of differential. During turning the rear outer wheel must rotate at higher speed than the rear inner wheel. The differential allows each of the driving road wheels to rotate at different speeds; hence it allows ease of turning. In sap car no differential is used which means power is transmitted to the rear axle through chain drive, and both wheels rotate with same speed and equal torque is transmitted to both of them. So while taking a turn the outer wheel of the car must be able to loose traction and skid over the road surface. This is done by slightly twisting the body of the car during turning by providing castor angle to the front steering wheels. This castor angle brings the height changes in the front wheels and the outer rear wheel looses its traction allowing it to slip.

The design of sap car chassis is very complicated. The chassis are generally made of square or round steel tubing's, or angle iron. We have built the chassis according to a standard tested design

We have used 40*6 angle iron for making the frame. All the pieces are cut to required and the being welded by MMAW (Manual Metal Arc Welding)

2.1.2 Chassis dimension

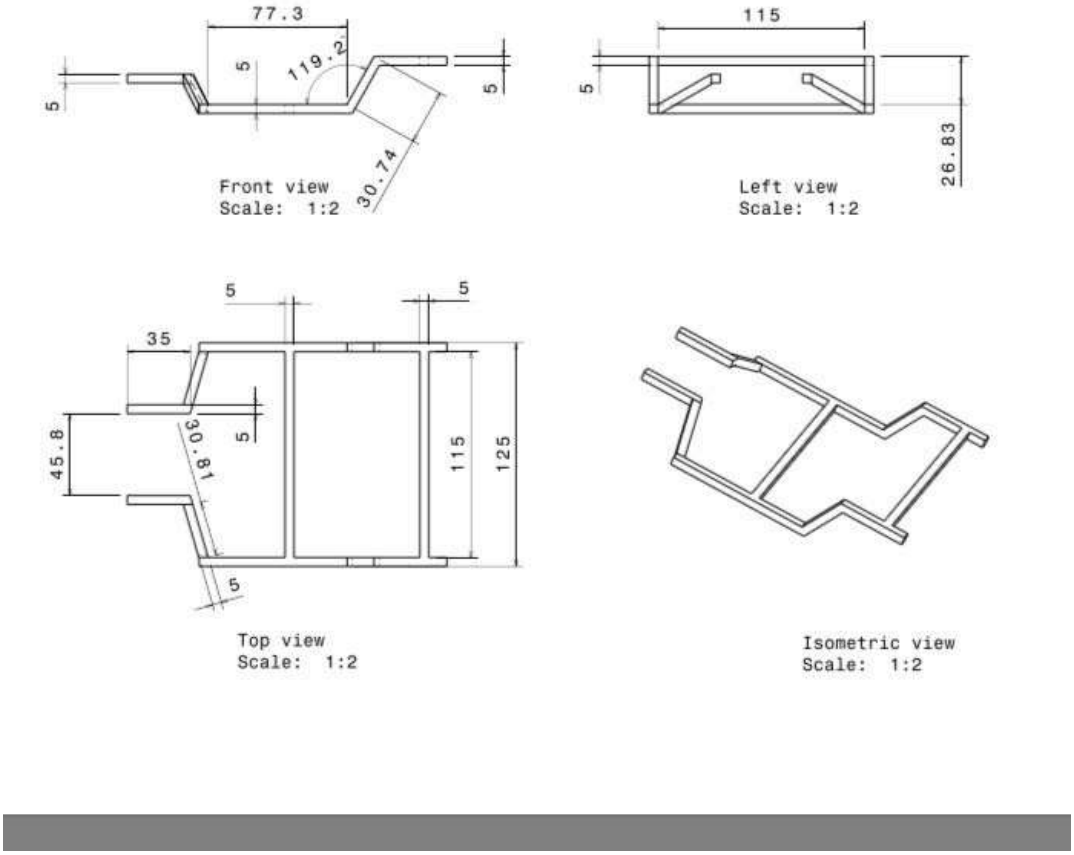


Figure3 Chassis dimensions

2.2 Steering

Steering is the term applied to the collection of components, linkages, etc. which will allow a vehicle to follow the desired course. Generally Steering used sap car is a simple linkage type Ackerman steering.

Ackerman Steering Principle describes the relationship between the front wheels of a vehicle as they relate to each other when in a turn. The inner wheel will be traveling in a smaller diameter circle than the outer wheel. All the wheels should move around a common point.

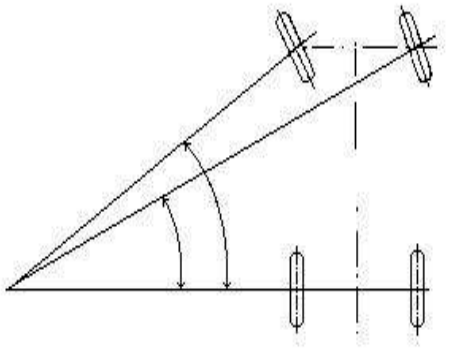


Figure 5 Steering Mechanism

Figure6 steering

2.2.1 Stub Axles

Stub axles are small rods attached to the front steering mechanism to support the wheels. It has been made from 35 mm MS bar.

2.3 Battery

battery charges in the following 3 ways
1.Solar panel
2.wind turbines
3.Engine

Solar panel: the solar panel is mounted above the car which charges the battery during the day time

Figure7 solar panel

wind turbines: wind turbines are placed in front of the car which rotate and produce electricity while the car is in motion

Figure8 wind turbine

Engine : engine and battery are connected to the differential shaft while the engine is in motion it charges the battery

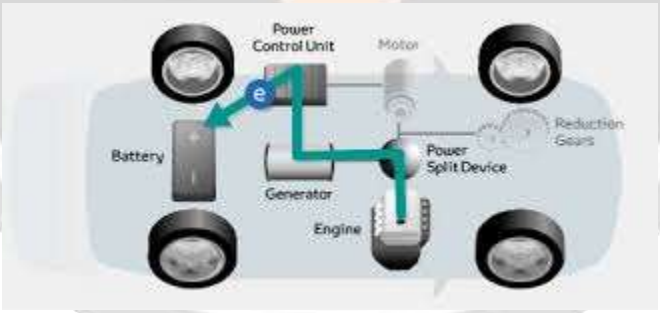


Figure9 battery charging mechanism

2.5 Engine specifications

ENGINE SPECIFICATIONS:	
Car type	Concept car
Start type	Self start
Stroke(mm)	56.4
Engine displacement(cc)	149
Ignition	Self
No. of cylinders	1
Maximum torque	14.2nm6500rpm
Fuel type	Petrol
No.of gears	5
Gearbox type	Manual
Clutch	Wet multiple clutch
Brake type	Internal expanding brake and disc brake
Front suspension	Wish bone
Rear suspension	Dual helical
Wheel base	10cm
Front tyre	-
Rear trye	-
Dimensions(WxLxH)mm	15r
Weight	200kg
Wheel type	rubber
Fuel economy	40
Colour	silver
Type	4 stroke,dtsi
Type of cooling	Air cooled
Max,power	15.06@9000(ps@rpm)

2.6 Rear Axle

Generally two types of axles are used in go-karts:

1. Live axle
2. Differential axle

2.6.1 Live Axle

A live axle on a go kart means that the engine will power both rear wheels at the same speed and power. This is accomplished with a single sprocket mounted to the live axle. Since both wheels are locked in to the power all the time we'll have twice the traction. This is great for sand, loose dirt, etc, where a single wheel would often spin out. It is very cheap and simple as no gears are used and also light in weight. Unfortunately for the on-road for a live axle turning is difficult. This is because both rear wheels turn at the exact same speed. When making a turn, the outside wheel must be able to spin faster than the inside wheel. If they are forced to turn at the same rate by a live axle, then the outside wheel must slip on the driving surface in order to turn as fast as needed. Wear of tires is more.

2.6.2 Differential Axle

Differential on the rear axle is just like normal car has. This allows both wheels to be powered, and allows for easy cornering. But when traction is lost on one wheel, it will spin and the other won't turn at all, effectively giving you a single-wheel drive. It has advantage of reducing tire wear during cornering by turning both wheels at different speeds. It has disadvantage that when one of the wheels struck or locked all the power is transmitted to the other wheel providing the least resistance to transmission. Its cost is higher due to various gears used and the weight of transmission also increases.

We have used a live axle to reduce the cost reduce the weight and due to its simplicity. Rear axle has been made from 25 mm bright MS bar. Pedestal bearings are used to support the axle.

2.7 suspensions

2.7.1 Front suspension

In automobiles, a **double wishbone suspension** is an independent suspension design using two (occasionally parallel) wishbone -shaped arms to locate the wheel. Each wishbone or arm has two mounting points to the chassis and one joint at the knuckle. The shock absorber and coil spring mount to the wishbones to control vertical movement. Double wishbone designs allow the engineer to carefully control the motion of the wheel throughout suspension travel, controlling such parameters as camber angle, caster angle, toe pattern, roll height, scrub radius, scuff and more.

Figure10 Front suspension

2.7.2 Rear suspension

Dual helical suspension

..

Figure11 rear suspension

2.8 Working Modes

Engine drive: A centrifugal clutch and a 6 speed manual transmission is used with the engine so as to facilitate idling of the engine. The driving sprocket is mounted on the clutch and the freewheeling hub on the axle giving a reduction ratio of 5:1. DC Motor drive: A same chain sprocket reduction is used between the motor and axle again to keep traction, but the sprocket on the axle uses a freewheeling hub to mechanically disconnect the electric motor from the drive when the engine is driving the axle, so as to protect the motor from any undesirable load. Electric vehicle mode: During this mode the engine is off, and the battery provides electrical energy to power the motor during starting and at lower speeds because at lower RPMs torque of IC engine is lower but starting torque of a DC motor is high. If the starting torque of the motor is less then IC engine also starts to drive the kart and after starting the electric motor takes the charge. Cruise mode: When the vehicle is cruising or accelerating and the motor cannot meet the load demand then the engine takes

over and the motor switches off. The power from the engine is transmitted through the chain sprocket drive to the rear axle. The electric motor gets disconnected due to freewheeling hub. Limit switches are provided to start the motor again when the speed of kart decreases. The selection of the power source is preset and is a function of the pedal feed provided by the driver. Initially when the pedal is pressed the DC motor brings the vehicle into motion and accelerates up to a preset pedal position after which the engine is accelerated which leads to the centrifugal clutch connecting the engine to the axle and powering the vehicle for further acceleration. This is done by leaving the engine throttle wire with slack, for it to have sufficient tension only at the desired pedal position. A foot pedal dependant system was used as it makes the driver a kind of a feedback system, as, when more power is needed such as on hill climb the driver would press the pedal further until sufficient torque is transmitted to the engine.

Figure12 Working model

Source	Fuel	Efficiency
I.C .engine	Petrol	35 k.m./liter
Electric motor	Battery	5 km on full battery charge
Hybrid	Petrol and battery both	40

3. RESULT ANALYSIS AND DISCUSSION

We have tested the car for its fuel economy under three conditions running fully on IC-engine, running fully on electric motor, & running on combination of both electric and ic-engine (hybrid). In our project we have used an old DC starter motor of a car which has very high current consumption of the rate of 25 amperes at start-up because of high torque requirements during start up, but it gradually decreases to 10-12 amperes as it gains speed. So the battery drains out quickly reducing the overall efficiency. Instead of this to improve the performance high efficiency DC brushless motor can be used which have low current consumption. The IC-engine used is also an old 150CC, 15 h.p. having very less efficiency reducing the overall efficiency.

4. FUTURE SCOPE & CONCLUSION

By using a good battery and powerful motor we can make a typical hybrid car which drives with motor in city and on highway it uses internal combustion engine. In cities cars have speed around 40-45 k.m./ hour. And powerful motor is capable to drive car at this speed and due to this exhaust gases emissions can be reduced in cities and this is helpful for health and also for global warming.
Currently, hybrid vehicles utilize Ni-MH battery technology, which needs replacements after some period, but instead of these Lithium-ion batteries which are very reliable can be used. However the initial cost increases as this is a new technology.
Nowadays new bio fuels are also made to reduce the exhaust emissions and cut down the fuel prices. Also use of CVTs in hybrids has proven that they are having better transmission efficiency than normal ones. Combining CVTs with the smart computer integrated circuits and smart sensors, the efficiency can be greatly improved.
New inventions of lighter but stronger materials like carbon fibers,

5.References

1. A Text book on Automobile engineering by kirpal singh, vol 1&2

2. A Text book on Internal Combustion engines by V.Ganesan

3. A Text book on production and technology by p.c sharma

4. A Text book on Automobile engineering by Er.S.K.Gupta

5. A Text book on Automobile engineering by R.b.gGupta

6. gokartguru.com

7.wikipedia