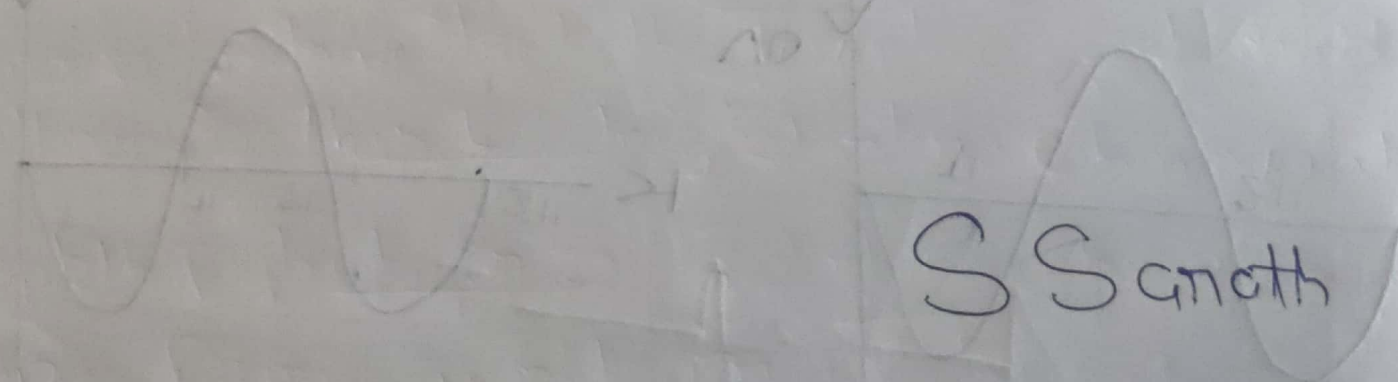




Assignment No: 1



SS Smith

1. Automobile is a vehicle which transport from one location to another. The basic requirements of an automobile is an energy source, Energy Conversion Device and a mechanical Device for transferring the energy from the energy Conversion Device. ~~Let's go~~

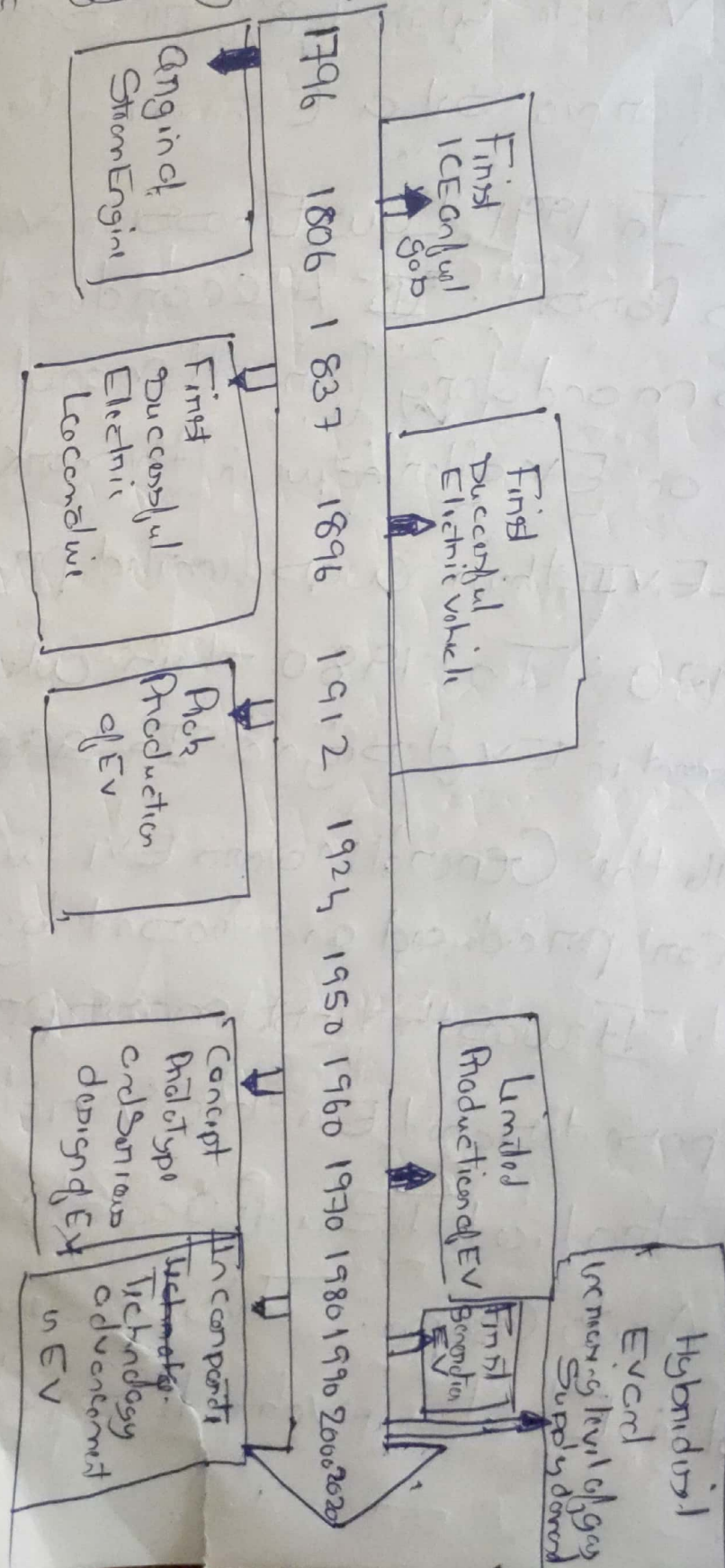
The very First vehicle in the world was built by Nicolas Cugnot. It was a Steam Engine. Maximum speed of the vehicle was 4 km/hr and Maximum load it can carry was about 4 tons. It was built in 1768. In the year 1806 Isaac de Ravez built the very first IC Engine. It uses Hydrogen gas as a fuel. In 1828 Hungarian Invention Angus Jedlik invented an world's first Electric Motor, and Crooked a first small model car powered by this Motor. In 1886 Thomas Pank developed Electric vehicle to undergo production. In 1884 Carl Benz developed IC Engine to undergo production. The first known electric locomotive was built in 1837, in Scotland by chemist Robert Davidson of Aberdeen.

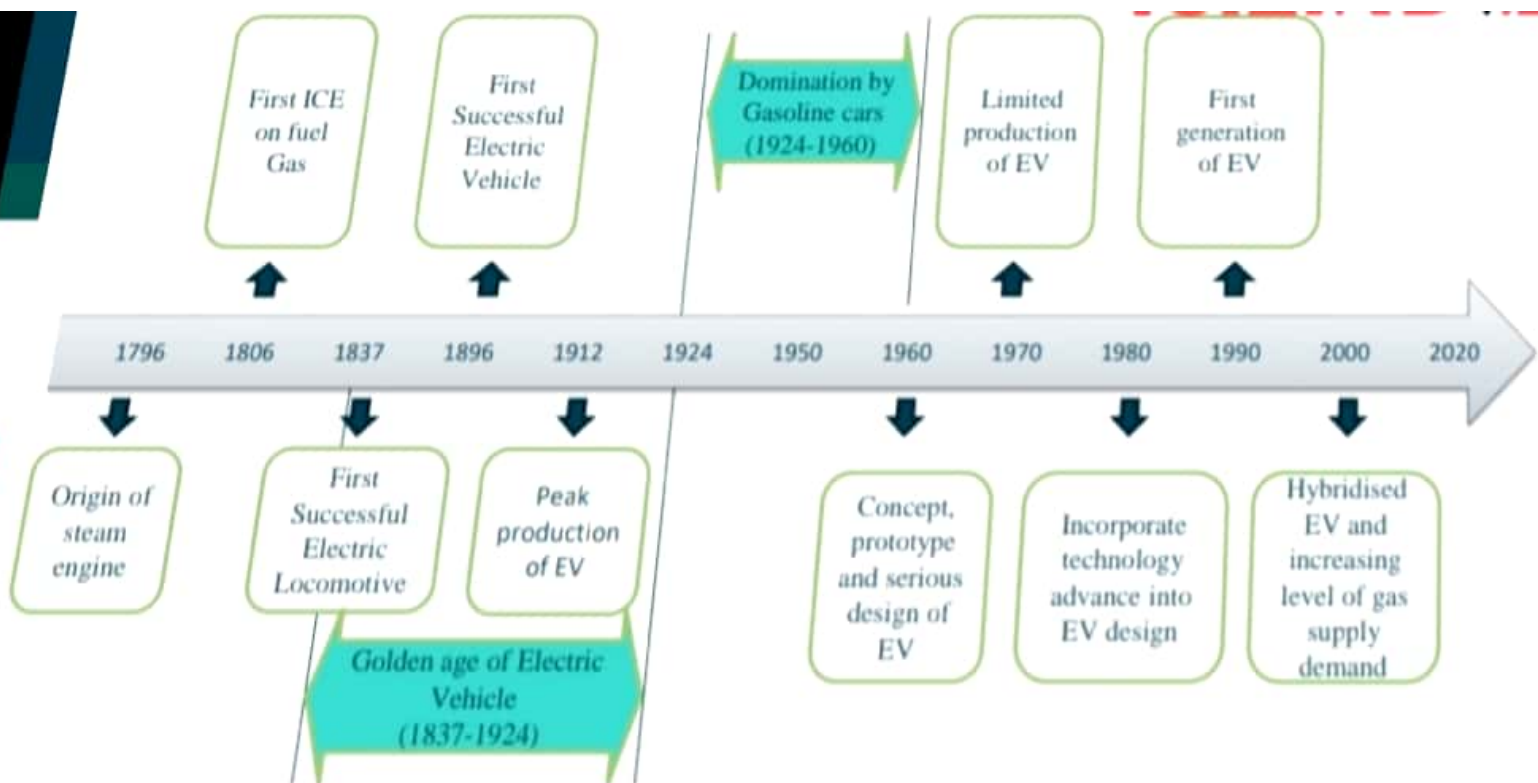
In 1896 William Morrison built a William Carriage that is having a capacity to carry 8 people. It has a speed of 20 kmph. Power of motor used is 4 hp and battery specification of 58V, 112Ah. It has a 4 speed control. In 1906 Electric vehicle has a Range of 100 miles with a single charge having a top speed of 45-50 kmph. In beginning of 1906 Electric Car were labelled as 'Woman's Car'. During 1906 EV gained popularity due to No Emission, Easy start, Low cost, Efficiency etc. In the year 1912 Petrol power Cars became easier to drive due to the Invention of Charles Kettering and his Electric Starter. Chonvalot took the patent for Self Start mechanism in 1912. During world war electric vehicle had disadvantage of Range and charging time. This ~~all~~ all factors led to the declining on the Interest on EV (1924).

And in the duration of 1924-1960 there was a domination of Gasoline vehicle over Electric vehicle due to following Reasons. In 1960 the Great Smog occurred ~~and~~ in California and Gasoline vehicle was 48% reason for the pollution. And California set a Emission Regulation in 1970. In 1991 Low Emission Vehicle I (1993-2003) was Passed. According to LEVI it was mandatory for all manufacturers to provide an EV alternative in the market. Due to ~~the~~ LEVI there was limited production of EV in 1970. In 1980 there were technological advancement in EV design. In ~~1990's~~ the

In 1996 the General Motors EV1 was the Electric Car produced and loaded by General Motors. It was the first mass produced and purpose designed Electric vehicle. In 2006 Tesla Introduced Tesla Roadster in the Santa Monica Auto Expo. This made a high Interest in Electric vehicle Sector.

On 2010 Nissan Leaf was Introduced.
It was a Sedan hatch Back EV. Hybrid
Vehicle where given more importance due to
increase in ~~gas~~ gas prices.

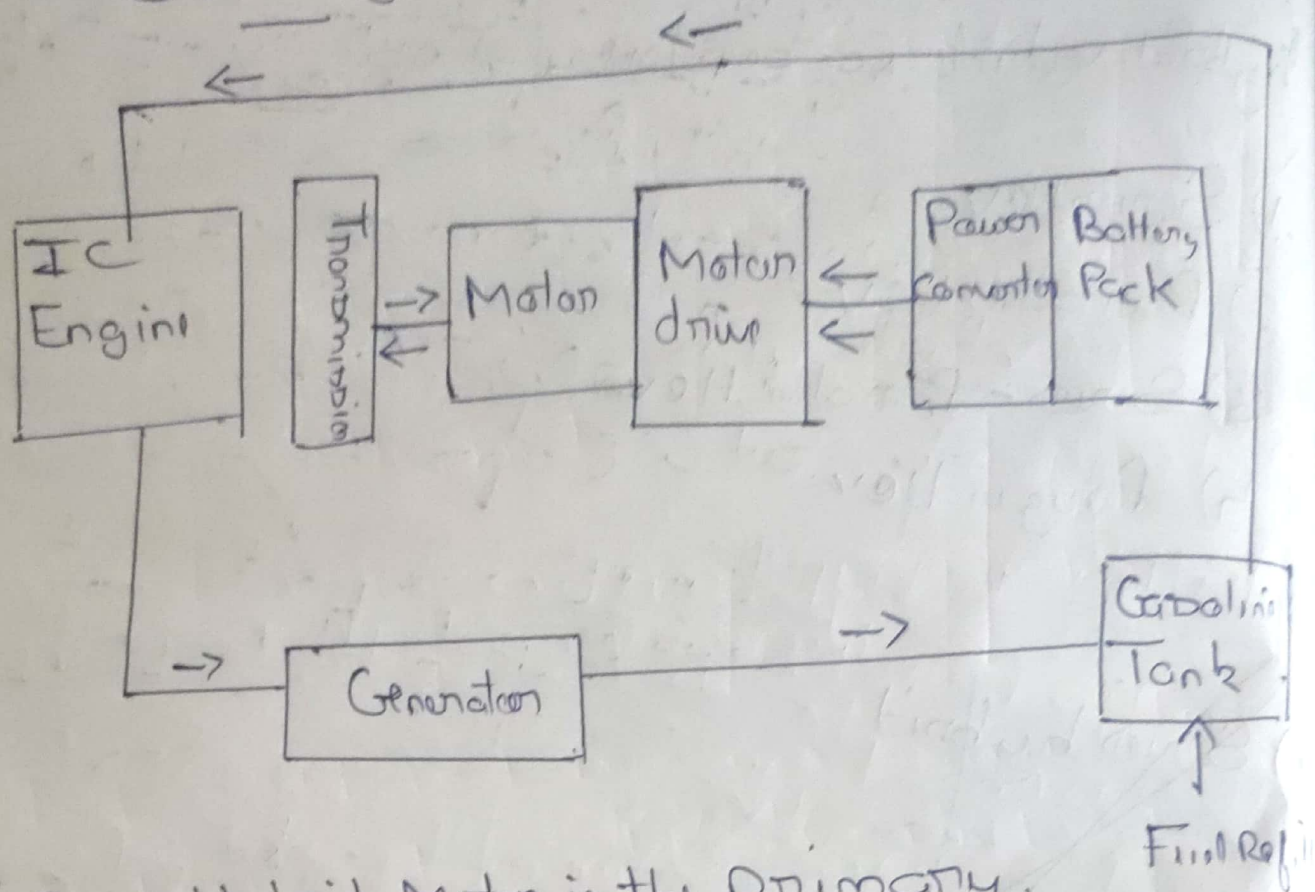




2. Based on the ~~different~~ Hybrid Architecture hybrid vehicle can be classified as

- 1) Series HEV
- 2) Parallel HEV
- 3) Series - Parallel HEV
- 4) Plug-in HEV.

Series Hybrid



In Series Hybrid Motor is the primary source and IC Engine is the secondary source. Power is transferred to the Transmission only through Motor drive system. IC Engine act as a Backup. Series hybrid works on LCAD

1) Case 1: Non motoring

Both IC Engine and battery supplies power to power converter which then drive motor.

2) Case 2: Light load

ICE output is greater than required to drive the wheels, fraction of electric energy is used to charge battery

3) Case 3: During braking

Electric motor acts as generator

4) Case 4: Vehicle stop

Battery recharged by ICE via generator even when vehicle comes to complete stop

Advantages

1) Mechanical Decoupling between ICE and driven wheels allows ICE engine operating at very narrow optimal Region

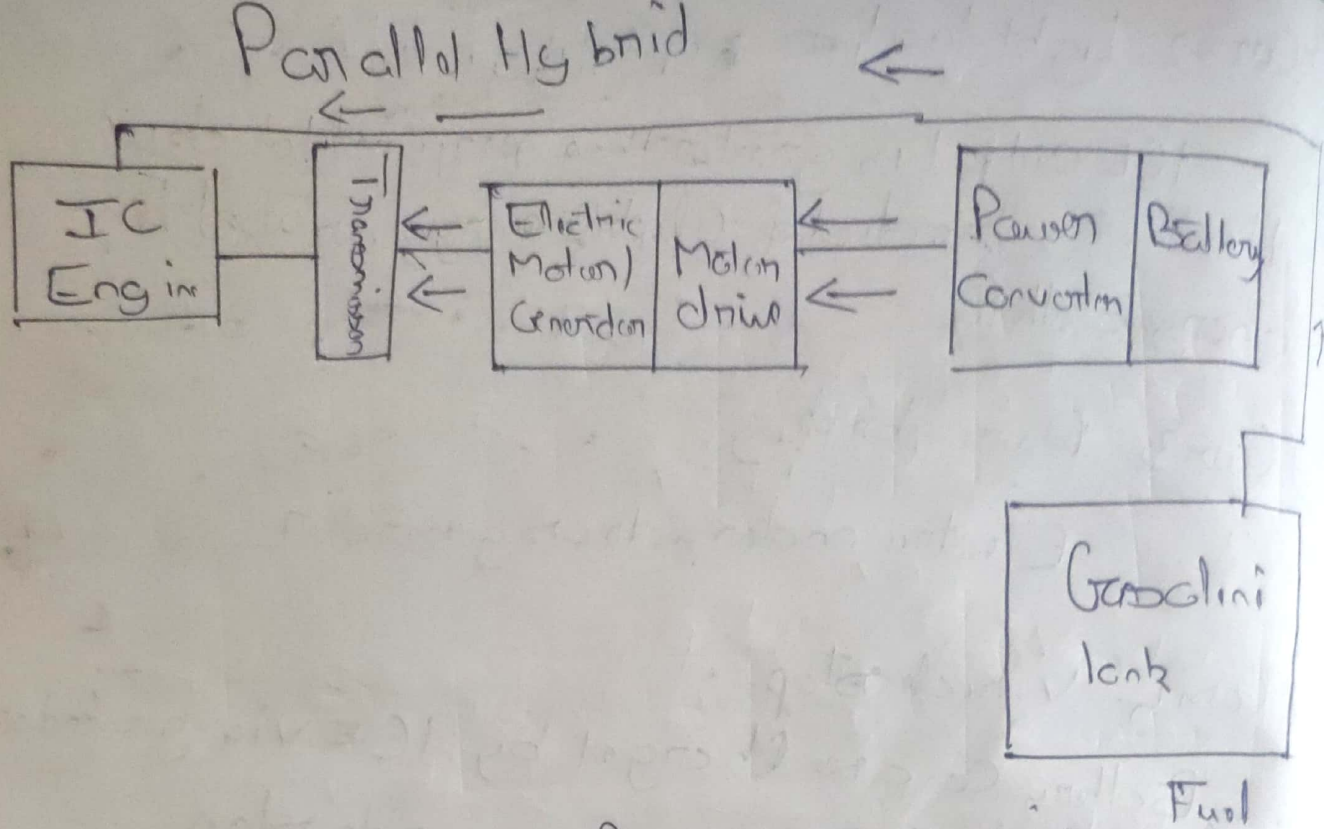
2) Nearly ideal Torque speed characteristics of electric motor make Multi gear transmission unnecessary

Disadvantages

→ The energy is converted twice and ~~thus~~ this reduces overall efficiency

→ Two Electric machines are needed and a big

Traction motor is required because it is the only torque source of the Driven wheels
Es: BMW i13



In Parallel hybrid Primary source is IC Engine and Secondary source is Electric motor. Here both IC Engine and electric motor supplies power to transmission.

Case 1:

Motor charging. IC Engine Performing drive

Case 2:

Motor performing drive IC Engine Rest Condition

Case 3:

Both Engine and Motor operating

Case 4:

Engine charging and drive mode

Case 5

: Regenerative braking, Motor acts as Generator.

Advantages

→ Both Engine and Electric motor supply torque to driven wheels and no energy form conversion occurs

→ Compactness due to no need of the generator and smaller in action motor

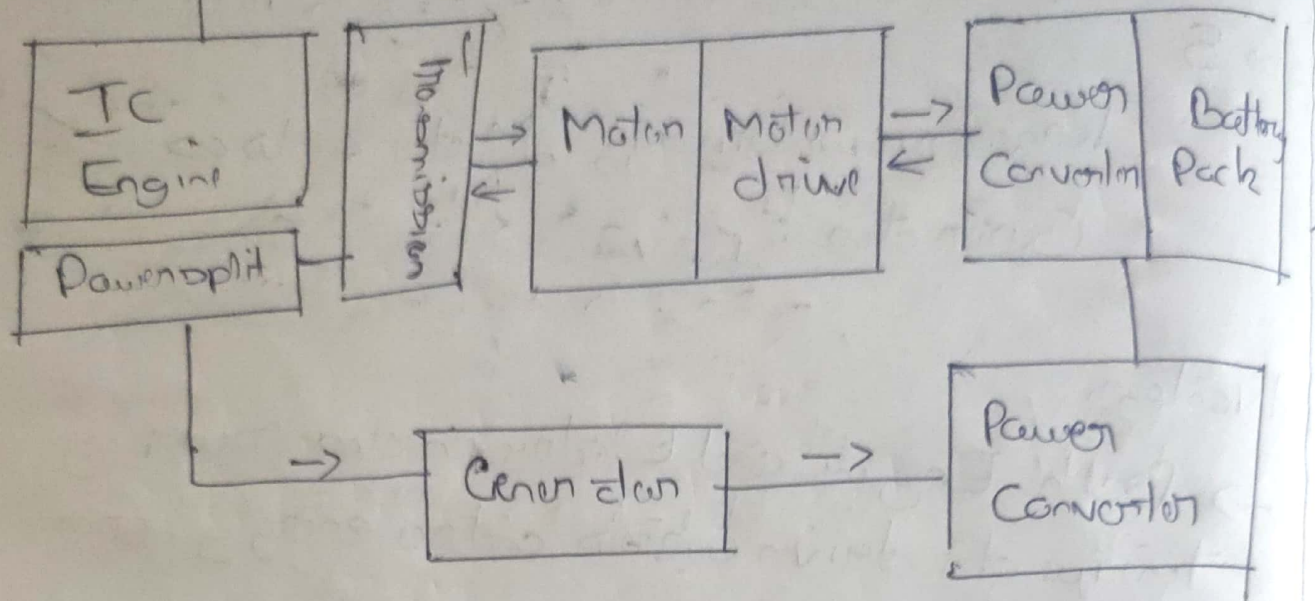
Disadvantages

→ Mechanical coupling between engine and the driven wheels, thus the Engine operating points cannot be fixed in a narrow speed region

→ Mechanical configuration and the control strategy are complex compared to Series hybrid drivetrain.

eg: Honda Civic Hybrid

Series Parallel Hybrid



It has both features of Series and Parallel Hybrids. Power split is a device which splits power. Many different modes of driving are possible under Motor dominant drive mode.

~~Advantages~~

Advantages

→ Enable engine and electric motor to provide power independently or in conjunction with one another

→ Zero emission operation is possible

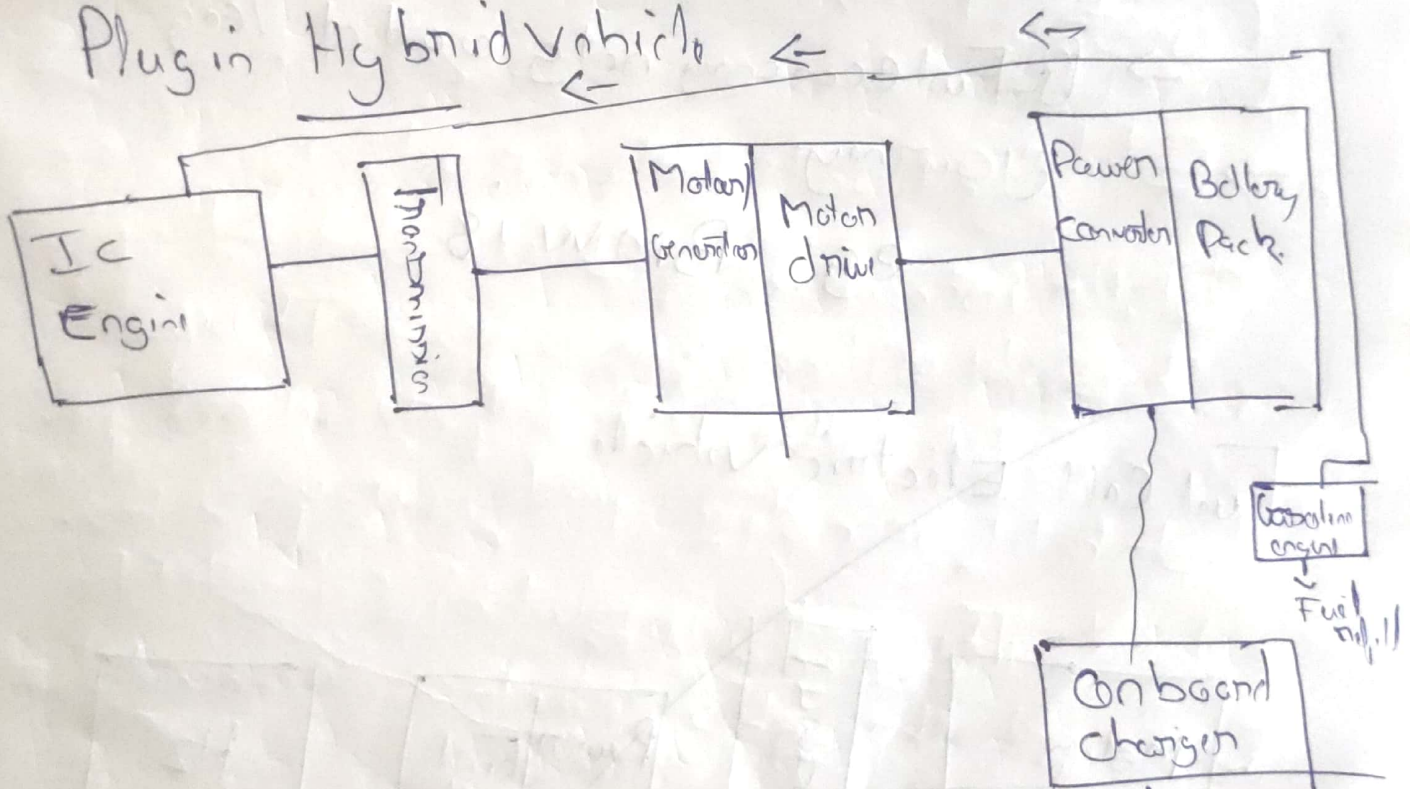
Disadvantages

→ Very expensive

→ Complex space packing

Eg: Toyota Prius

Plug in Hybrid vehicle



Plug in hybrid is nothing but it have a charging ~~port~~ to plug for charging. It can be series, parallel or series parallel hybrid. These hybrids may have longer range.

c) ~~Fuel Cell Electric vehicle~~

Advantages

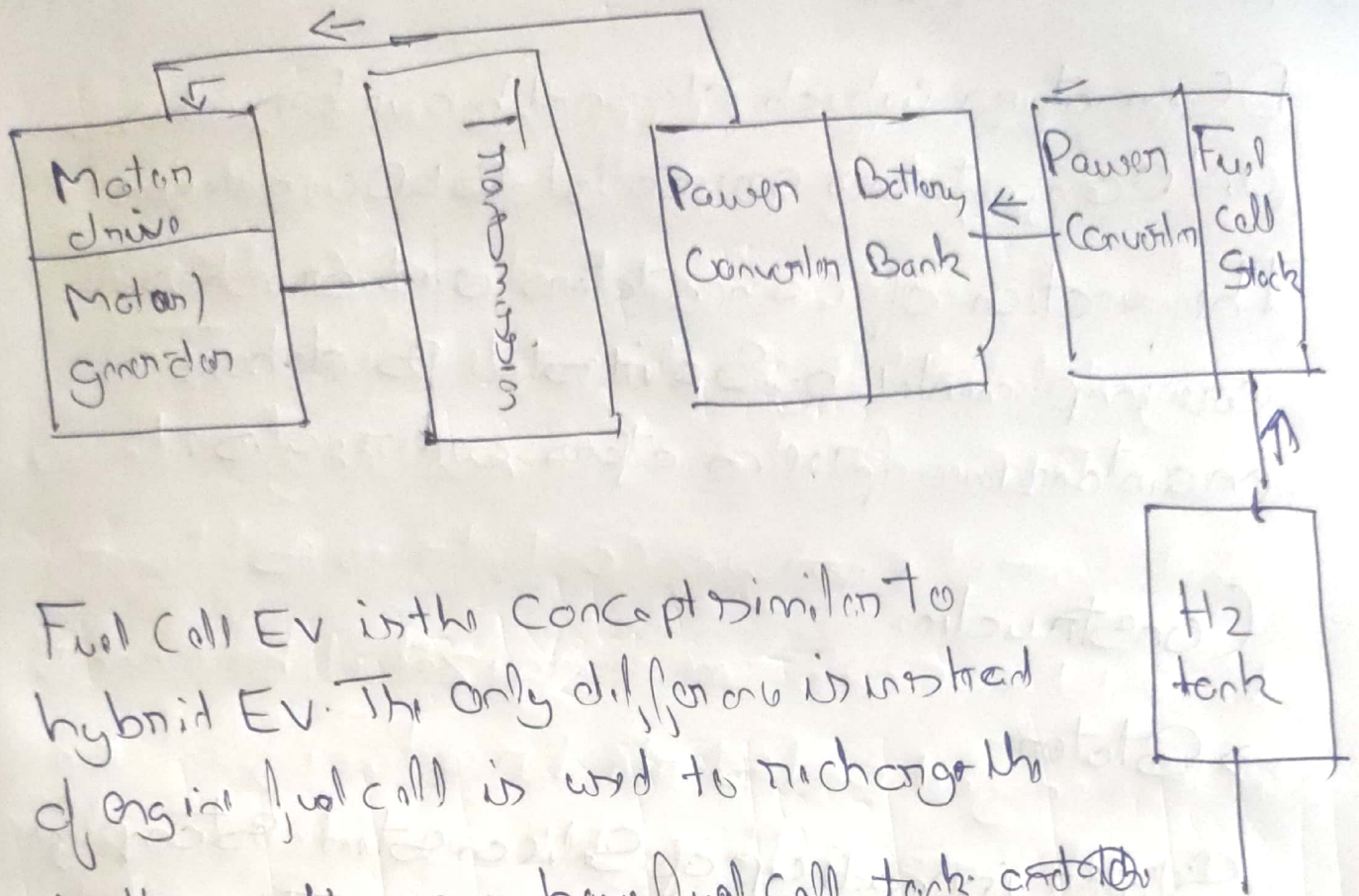
- Easy to drive
- Fuel efficient in traffic

Disadvantages

- Relatively expensive
- Fuel economy not good at long journey

eg: BMW i8

Fuel Cell EV



Fuel Cell EV is the concept similar to hybrid EV. The only difference is instead of engine fuel cell is used to recharge the battery. Here we have fuel cell tank and H₂ will come to fuel cell will generate electricity, Fuel cell charge the battery, battery bank.

Advantages

- Produce no harmful emission
- Highly efficient compared to other

Disadvantages

- 1) Difficult to handle H₂ fuel
- 2) Cost

eg: ~~Hyundai~~ Hyundai Nexo.

3. ~~DC motors~~ are

DC motors which do not have brushes and commutators are called BLDC motors.

The function of commutators and brushes are implemented by solid state switches, maintenance free motors are realised.

Construction

→ Stator

Stator is made up of Silicon steel stampings with slots in its interior surface. These slots accommodate either a closed or a general distributed armature winding. Usually, it is closed. The winding is electrically connected to DC supply through a electronic commutator.

→ Rotor

Rotor is made up of forged steel. Rotor accommodates permanent magnet. Permanent magnet can be fixed in the rotor in two different ways.

1) Interior PM

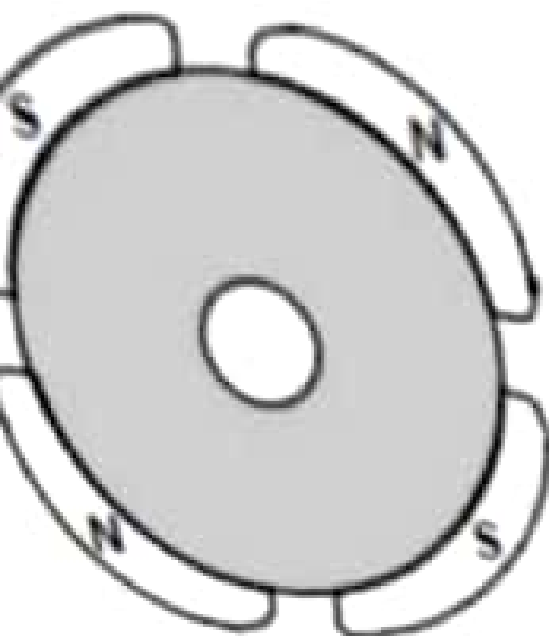
2) Surface Mounted PM.

① The no. of poles on the Rotor is same as that of Stator. The Rotor position sensor is on the Rotor shaft. Position sensor gives information about position of the shaft to the ECU Controller which sends suitable signals to Electronic Commutator.

②



Constructional details of a BLDC motor



Surface mounted PM rotor



interior PM rotor

Working Principle

Working Principle of BLDC motor is same as that of Conventional DC motor. Whenever a current carrying conductor is kept in a magnetic field it experiences a force. In case of BLDC motor, Permanent magnet moves while current carrying conductor is stationary.

When Stator coils are energized it becomes electro magnet and starts producing uniform field in the air gap. Though the power supply is DC, switching makes to generate an AC voltage waveform with trapezoidal shape. Due to the force of interaction between Electro magnet Stator and permanent magnet rotor, the rotor continues to rotate.

→ The Stator has three concentrated winding which are displaced by 120° .

