

Autotronics.

Sensors:-

Knock sensor, [Acceleration sensor].

- A piezoelectric accelerometer is a seismic mass accelerometer using a piezoelectric crystal to convert the force on the mass due to acceleration into an electrical output signal.
- The crystal not only acts as the transducer but as the suspension spring for the mass.
- The crystal is sandwiched between the body of the sensor and the seismic mass and is kept under compression by the bolt.
- Acceleration forces acting on the seismic mass cause variations in the amount of crystal compression and hence generate the piezoelectric voltage.
- The ~~acceleration~~ oscillations of the mass are not damped except by the stiffness of the crystal.
- This means that sensor will have a very

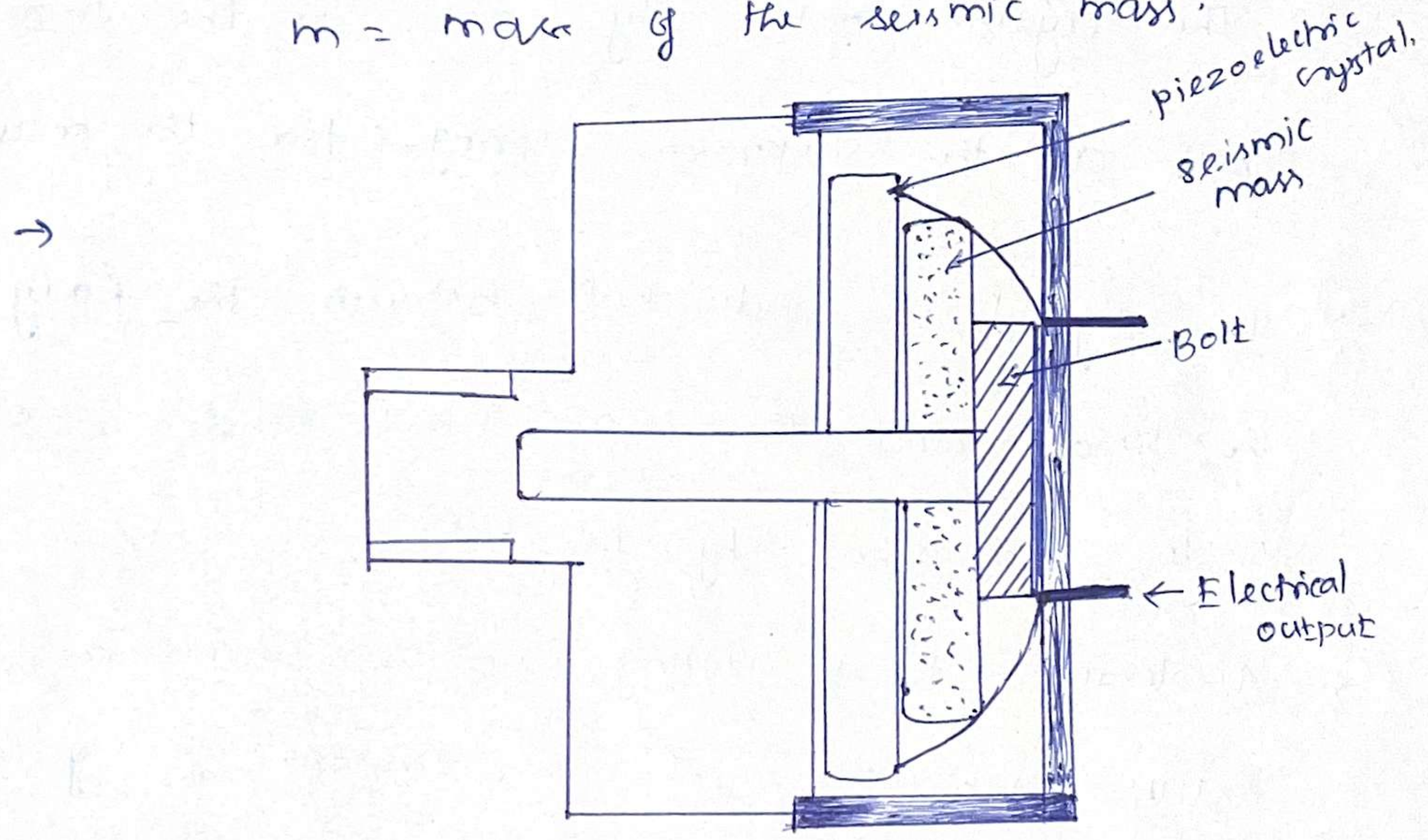


Strong resonant frequency but will also be at a very high frequency, giving a flat response curve in its working range up to about 15 kHz.

→ The natural (or) resonant frequency of a spring mass  $S/m$  is given by

$$f = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$$

where  $f$  = resonant frequency;  $k$  = Spring constant;  
 $m$  = mass of the seismic mass.



→ when used as a knock sensor, the sensor will also detect other engine vibrations.

→ These are kept to a minimum by only looking for 'knock' a few degrees before and after top dead centre.



→ unwanted signals are also filtered out electrically.

→ A charge amplifier is used to detect the signal from this type of sensor.

→ The sensitivity of a vehicle knock sensor is about 20 mV/g ( $g = 9.81 \text{ m/s}^2$ ).

Speed sensors.

\* Different types based on sensing.

\* Hall effect based

\* Eddy current based

\* RADAR Doppler based

\* LIDAR based

\* Accelerometer based

\* Pitot type based

\* Variable reluctance based

Variable reluctance based speed sensor.

\* It converts mechanical motion to electric energy without direct contact.

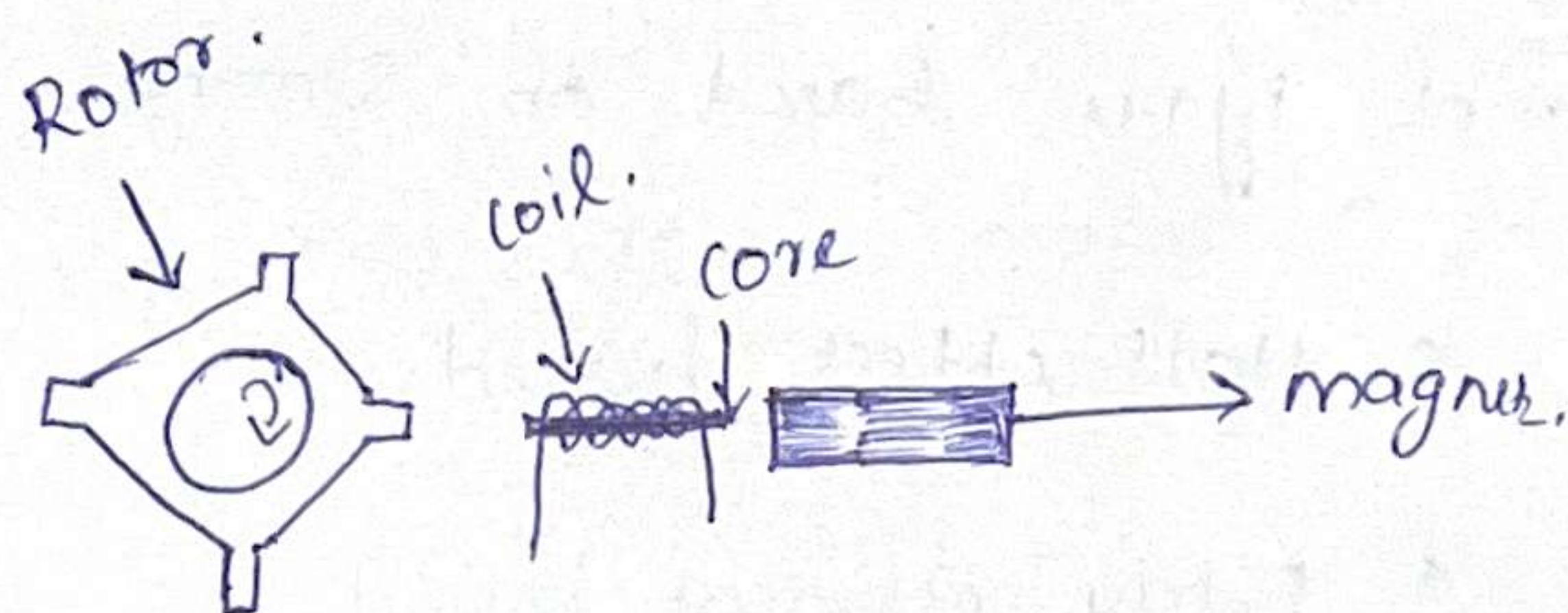
\* The o/p signal can be fed electronic device.



\* It consists of coil of wire wound around a cylindrical magnetic material, typically a ferrous material and is referred to as a pole piece.

\* A magnet is attached behind the pole piece, creating a magnetic field through the pole piece and winding.

\* This magnetic field projects out from the pole piece front, also known as the sensor tip.



\* As the ferromagnetic material, e.g. gear teeth, flywheel or other target features, pass by the sensor tip, the magnetic field is disrupted.

\* The amount of magnetic flux passing through the magnet, and consequently the coil, varies.

\* Due to time varying flux, a voltage is induced in the coil.



## x-by-wire systems.

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- Drive-by-wire, x-by-wire or simply by-wire technology is fly-by-wire technology applied to vehicles.
- In this case, the problems range from the need for more precision in electronic engine controls to eliminating continuously driven loads for improved fuel economy.
- XBW is required for advanced collision control avoidance sm that override the drivers input for brakes, throttles etc.
- In these sm, the actual control of the vehicle is initially supported by electronically assisted control prior to the elimination of mechanical linkage



# Electronic Ignition System.

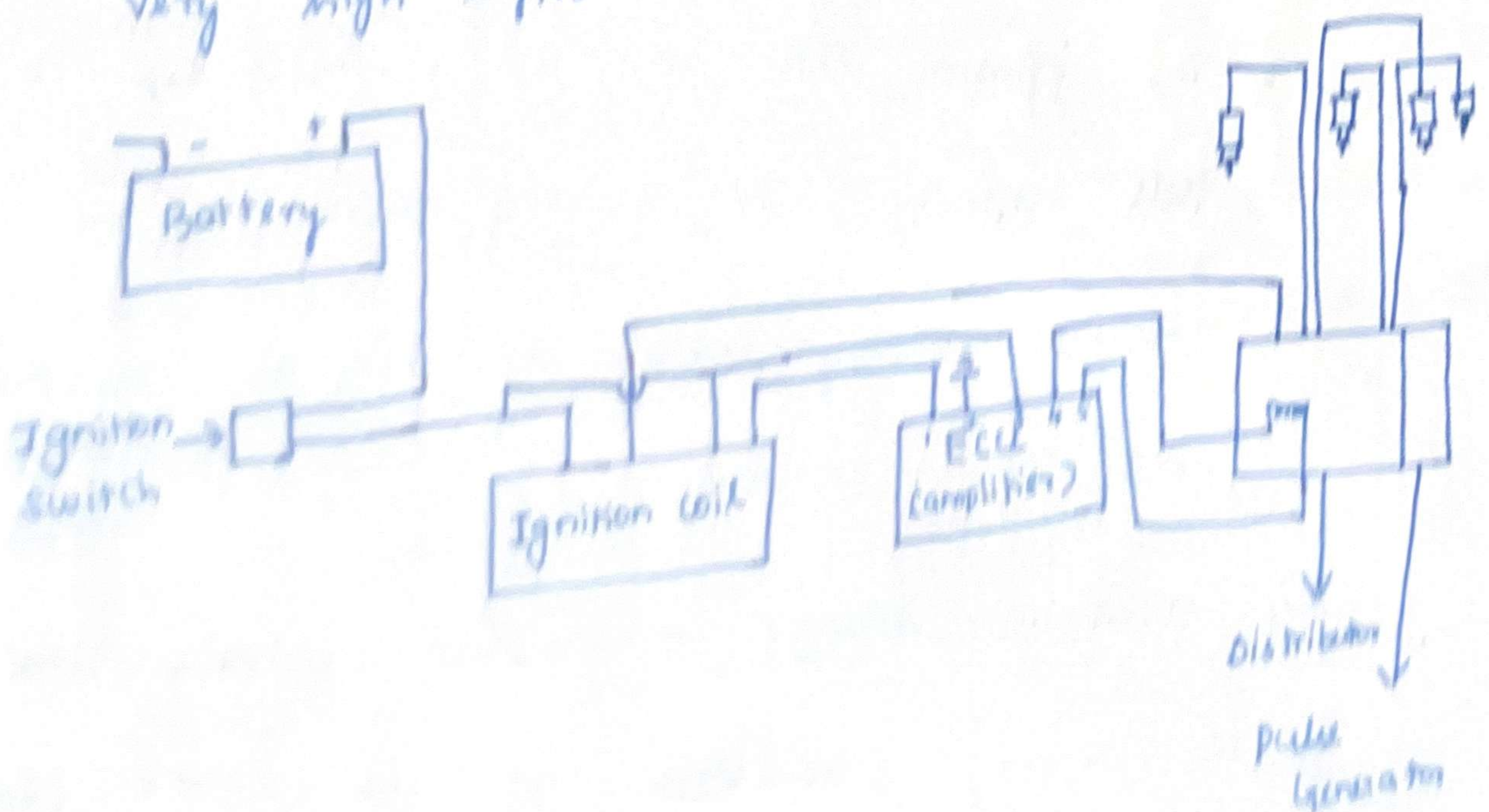
→ Electronic Ignition is now fitted to almost all spark ignition vehicles.

Disadvantages of conventional mechanical system:

→ Mechanical problems with the contact breakers, not the least of which is the limited lifetime.

→ Current flow in the primary circuit is limited to about 4A or damage will occur to the contacts.

→ weaker mixtures require more energy from the spark to ensure successful ignition, even at very high engine speed.



Electronic Ignition System



## Dwell Systems.

→ Dwell is measure of time during which the Ignition coil is charging, in other words when the primary current is flowing.

→ Constant dwell electronic ignition systems have now been replaced almost without exception by constant energy slm.

## Constant Energy Systems.

→ In order for a constant energy electronic Ignition system to operate, the dwell must increase with engine speed.

→ The ignition coil can be charged up to its full capacity, in a very short time

→ Constant energy coils are very low resistance and low inductance.

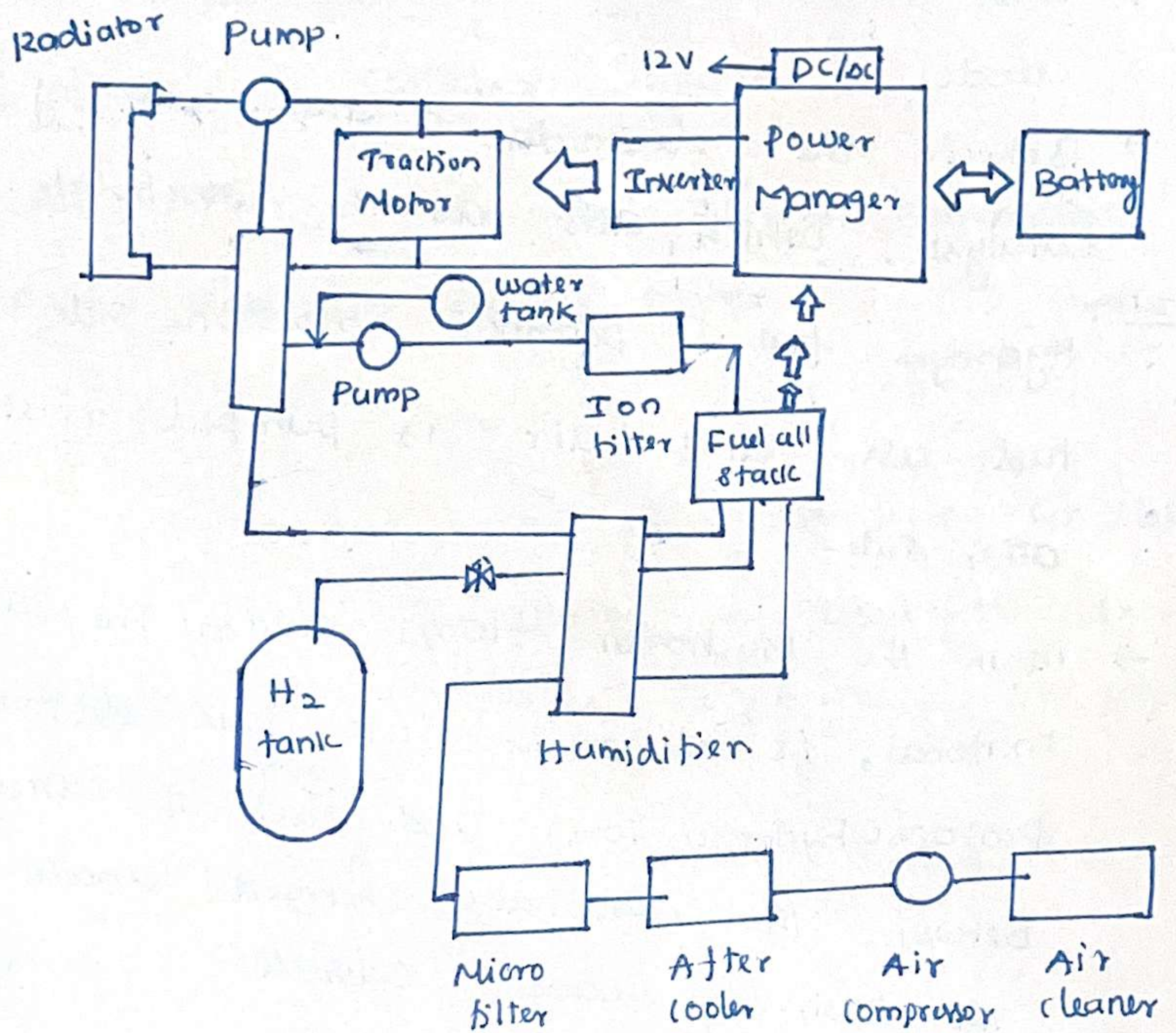
→ Constant energy means that, within limits, the energy available to the spark plug remains constant under all operating conditions.

→ An energy value of about 0.3 mJ is all that is required to ignite the stoichiometric mixture.



## Fuel cell Electric vehicles.

→ Fuel cell vehicles are electric vehicles that use fuel cells to convert chemical energy into electrical energy.



The basic layout for a fuel cell vehicle.

→ Fuel cell is a device that converts fuel directly into electricity.

→ Fuel cells release energy derived from the reaction between hydrogen and oxygen.

→ They have high efficiency and depending on the fuel used, produce little or no emissions.



→ Fuel cells operating on hydrogen emit nothing but pure water.

→ Fuel cell has no moving parts or chemicals and requires no maintenance.

CONSTR:

→ Fuel cell consists of two electrodes, cathode and anode.

→ Between the electrodes a thin coat of platinum catalyst, which acts as the electrolyte.

WORKING

→ Hydrogen fuel is pumped into one side of the fuel cell and air is pumped into the other side.

→ When the hydrogen flows across the catalyst material, it dissociates into free electrons and protons (hydrogen ions) and electrical current flows between the negatively charged anode and the positively charged cathode.

→ While, the free electrons become current, the protons move to the cathode and combine with the oxygen in the incoming air to produce water vapour and heat.

→ The electricity generated by the fuel cell is used to power the vehicle.

Reforming

→ Reformer changes the molecular structure of hydrocarbons into hydrogen-rich gas to power fuel cells.



→ Reformers extract hydrogen from normal fuels, such<sup>(1)</sup> as gasoline and methanol.

Hybrid

Com Electric Hybrid Vehicle. [HEV]

→ The vehicle that combines two or more sources of power is called a hybrid.

→ Current HEVs have an internal combustion engine and an electric motor.

Series Hybrids.

→ Some HEV designs are close to being an electric vehicle in that the engine is used to drive a generator that charges the battery or powers the electric motor.

→ The engine is there only to extend the vehicle's driving range.

→ A computer controls the operation of the engine depending on the power needs of the battery.

→ The generator also works as a starter motor.

→ When the computer senses that system voltage is low, the generator spins up and quickly starts the engine.



→ An electric motor can only operate at maximum power when it receives full voltage.

### Parallel Hybrids.

→ The most common design of hybrid vehicle relies on power from the electric motor or engine, and in some cases power from both.

→ When the vehicle moves from a stop and has a light load, the motor moves the vehicle.

→ Power for the electric motor comes from stored electricity in the battery pack.

→ During normal driving conditions, the engine is main power source. Engine also used to rotate a generator that recharges the storage batteries.

→ The motor is run to add power to the power train.

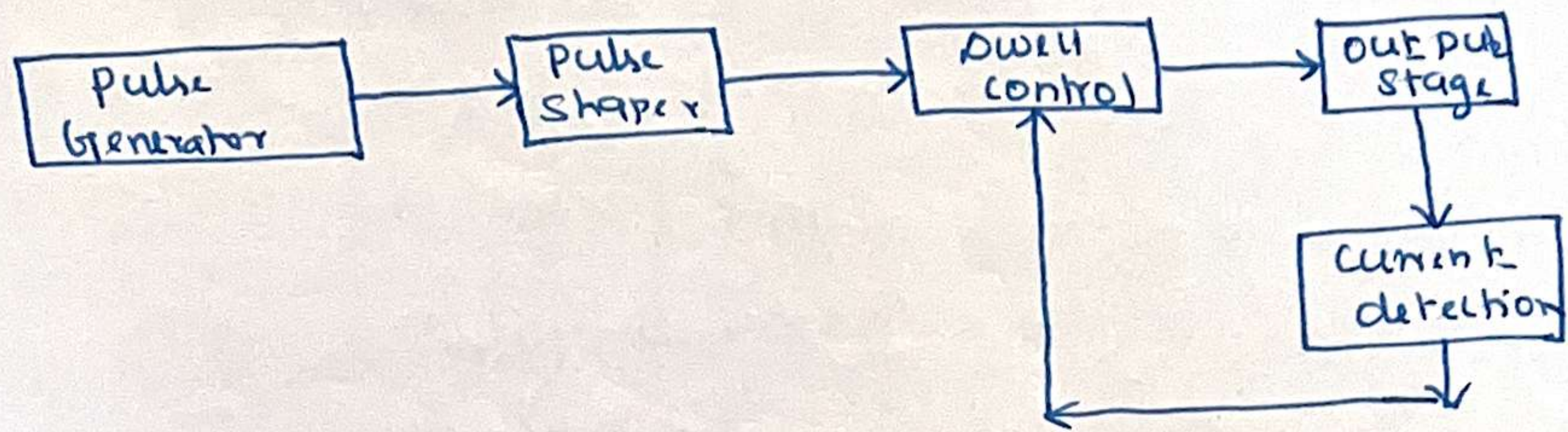
→ A computer controls the operation of the motor depending on the power needs of the vehicle.

→ During full throttle operation or heavy load operation the motor is turned on to increase the output of the power train.

→ During deceleration, the motor works as a generator to charge the batteries and to help to slow down the vehicle.



→ For rich and lean mixture, 3-4 mJ are necessary to ignite. (13)



Constant energy Ignition System

Hall effect Pulse Generator. [HEPG]

→ In HEPG central shaft of the distributor rotates, the vanes attached under the rotor arm alternately covers and uncovers the Hall chip.

→ The vanes cause the the Hall chip to be alternately in and out of a magnetic field.

→ The result of this is that the device will produce almost a square wave output, which can then easily be used to switch further electronic circuits.

Inductive Pulse Generator

→ This generator has the coil of wire wound on the pick-up and, as the reluctor



## Components of parallel hybrid vehicles.

19  
15

It consists of

\* Engine

\* Battery pack

\* Hybrid transaxle

\* Inverter

→ The hybrid transaxle has a power-splitting device that controls the amount of torque applied to the drive wheels by the engine and/or electric motor.

→ The power-split device uses a planetary gear to vary the amount of power supplied from the engine to either the wheels or the generator.

→ The ring gear of the gear set is connected to the electric motor and the differential.

→ The engine is connected to the planetary carrier and the generator is connected to the sun gear.

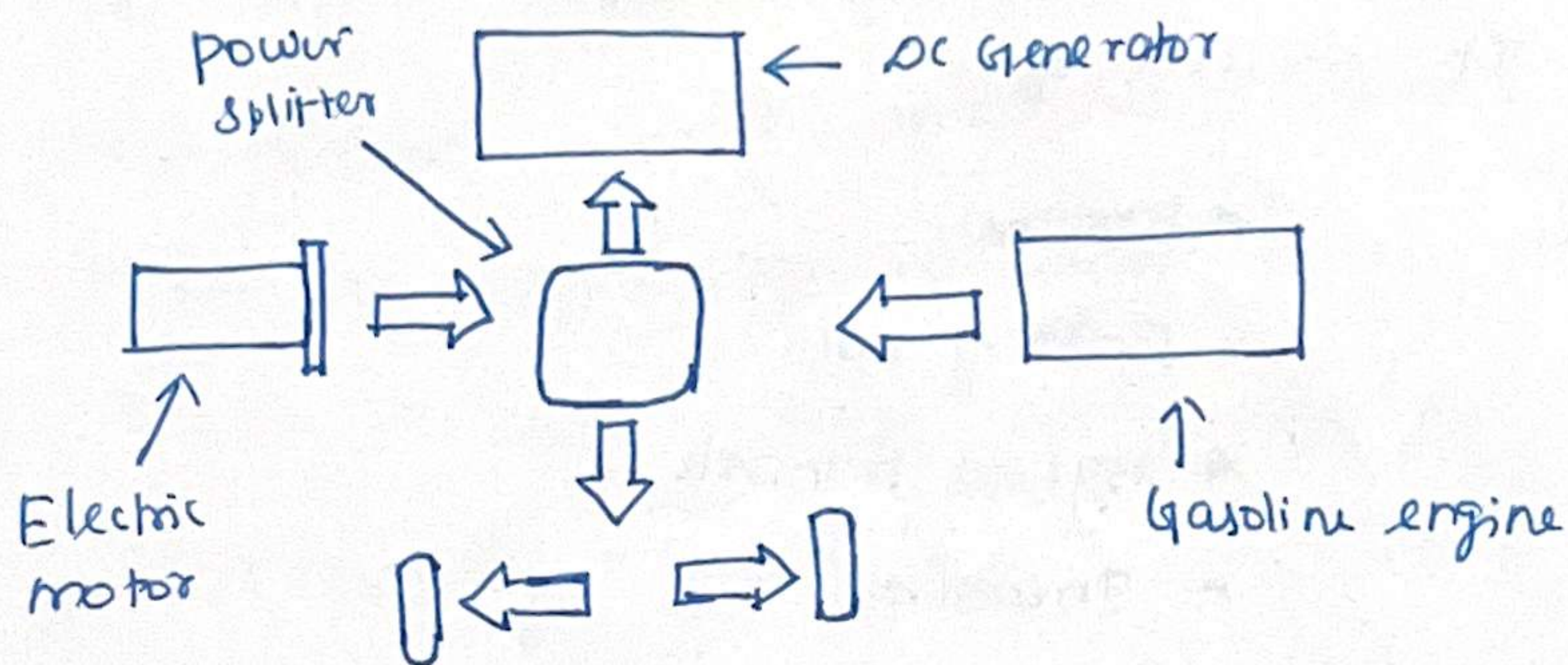
→ The entire transmission sim functions like an electronically controlled continuously variable transmission.

→ It adjusts the rates of revolution of the engine.

Inverter:-

→ It is an electric power converter that changes DC voltage of the battery to AC voltage for the electric motor.





Layout of the main components for hybrid vehicles.

### Vision based vehicle guidance.

- \* Growing number of Microprocessors on late-model automobiles now monitor and control engine operations to improve mileage and reduce emissions.
- \* Thus an eventual move to autonomous, self-guided vehicles might be viewed as a logical progression rather than a radical break with the tradition of entirely human controlled vehicle operation.
- \* The ability to perceive, or sense, the surroundings environment is essential to driving and thus to the development of autonomous self-guided vehicles.
- \* Though typically associated with living organisms perception can also be performed by radio, acoustic, magnetic and tactile sensors.



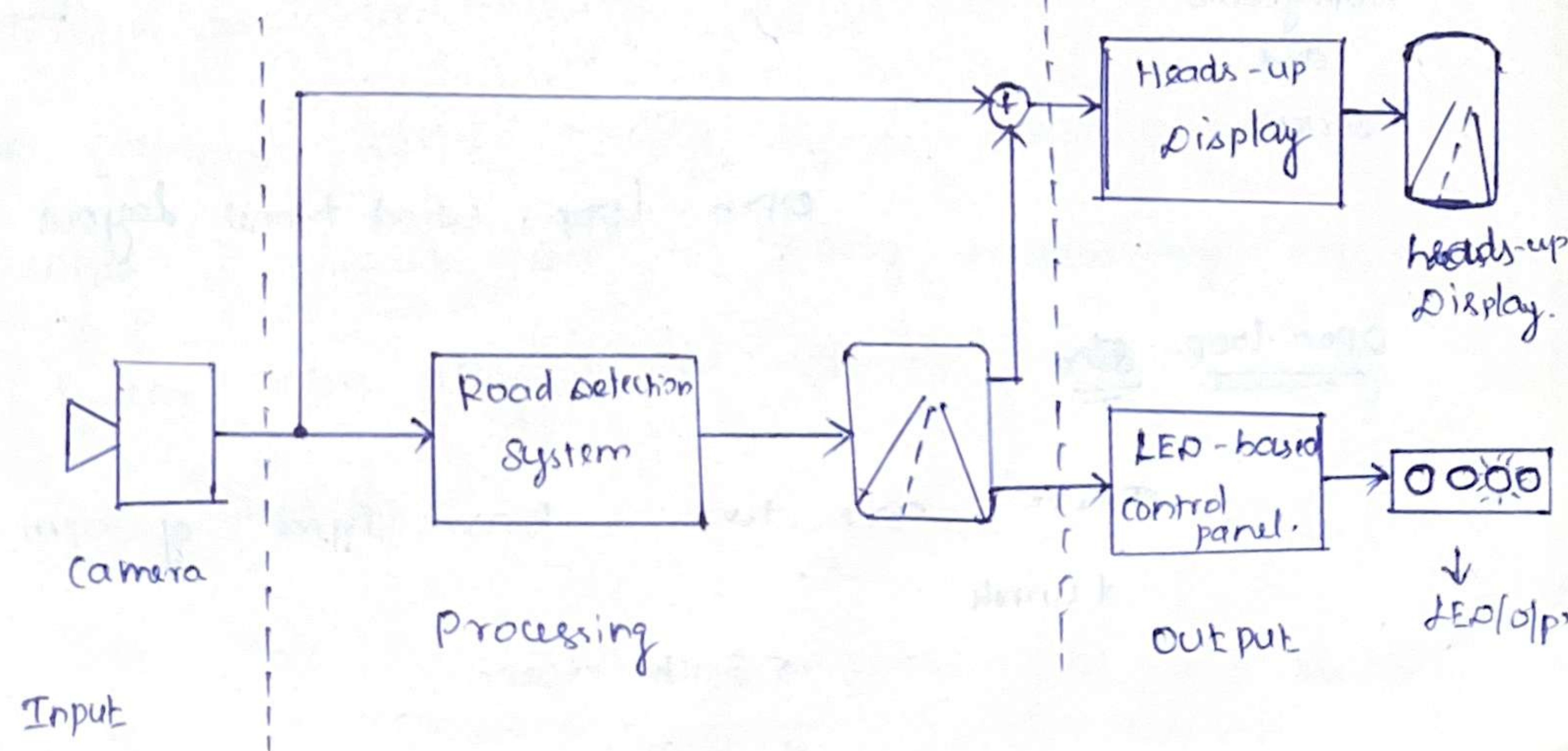
\* These active sensors can measure quantities directly and generate small amounts of data, however, there are applications in which only machine vision which acquires data non-invasively can be successfully employed.

\* But Automatic vehicle guidance in outdoor environments presents other problems intrinsic to the use of vision.

\* In addition, image processing for automatic vehicle guidance requires equipment that can compute a lot of data rapidly, and bounded by, the processing rate.

Process involves:-

- \* Lane detection
- \* Obstacle detection
- \* Stereo image analysis.



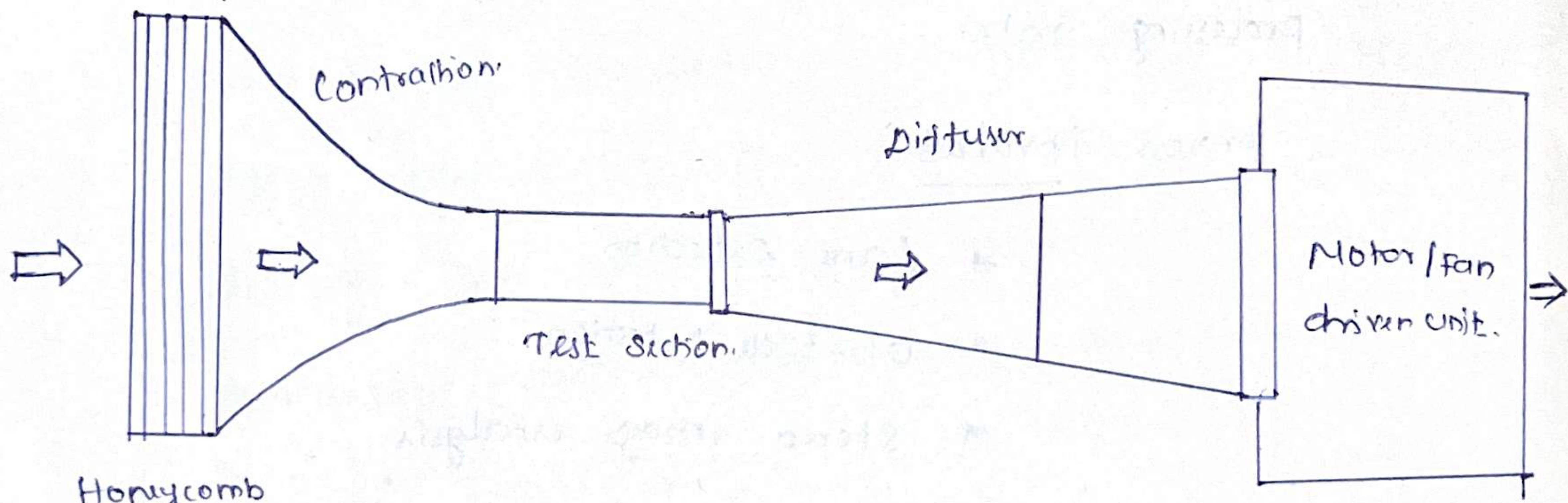


# Aerodynamic drag detection system.

\* Wind-tunnel type of Aerodynamic drag detection slm.

→ The earliest wind tunnels were invented towards the end of the 19<sup>th</sup> century, in the early days of aeronautic research, when many attempted to develop successful heavier-than-air flying machines.

→ Wind tunnel testing was applied to automobiles, not so much to determine aerodynamic forces, but more determine ways to reduce the power required to move the vehicle on roadways at a given speed.



Open loop wind tunnel layout.

Open loop slm

There are two basic types of open circuit tunnels.

\* Suck down.

\* Blower.



- \* The two are most easily differentiated by the location of the fan.
- \* Blower tunnels are the most flexible because the fan is at the inlet of the tunnel, so the test section can be easily interchanged or modified without seriously disrupting flow.
- \* These tunnels that exit diffusers can often be completely omitted to allow easier access to test samples and instruments, though the omission often results in a noticeable power loss.

### Objective Detection.

→ By detecting moving objects around the car and alerting the driver, this technology enhances safety when pulling out of a parking space, helping give drivers better awareness of their surroundings and increased peace of mind.

### Working or Functionality.

\* Cameras detect moving objects around the vehicle when it is in park or slowly maneuvering, the system then alerts the driver both visually and audibly.

\* There are two types of systems: one uses the around view monitor and, → four cameras to the front



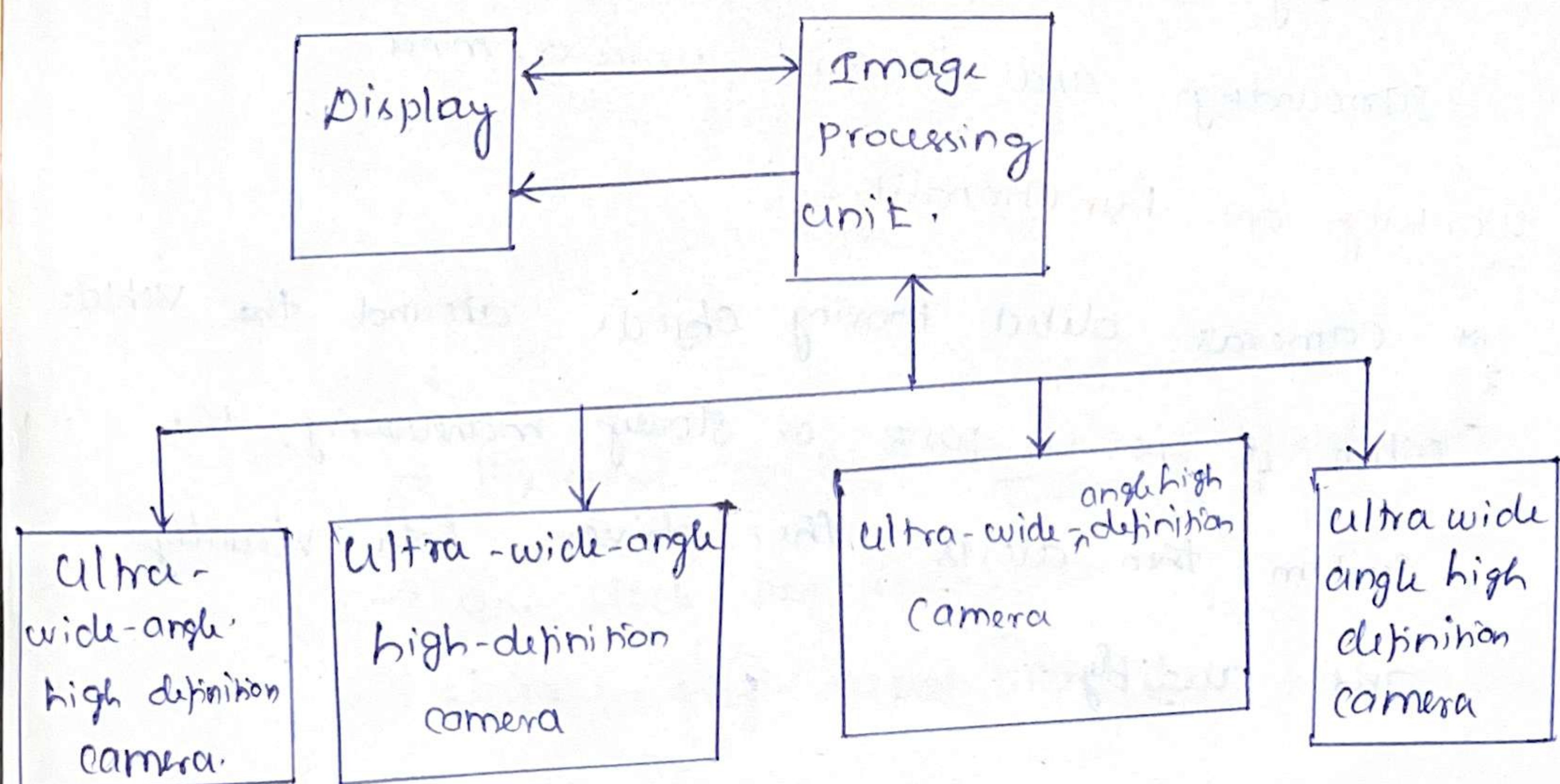
back and other sides of the car, while the second system uses only a single camera installed in the rear of the car.

\* The four-camera system can alert drivers in three scenarios:

- while parked or in neutral
- moving forward
- Backing up.

\* When moving forward or backing up, the cameras to the front or back respectively detect certain moving objects. When in park or neutral, the system detects certain moving objects around the car using a virtual bird's eye view image.

\* If a vehicle has the single rear view camera system it can only detect certain moving objects behind the vehicle.





## Collision avoidance system.

(21)

collision occurs due to:-

### Human Error.

- Human decision making flawed under pressure
- Distraction and other outside elements contribute to accidents.
- Human sense and reaction time are limited in capability.

### System working.

\* Sensors.

\* Microcontroller [ECU]

\* System Interface

### Sensors:-

- Infrared beam with  $2^\circ$  angle (or) ultrasonic for large range.
- Detection  $\Delta$  - 150 cm

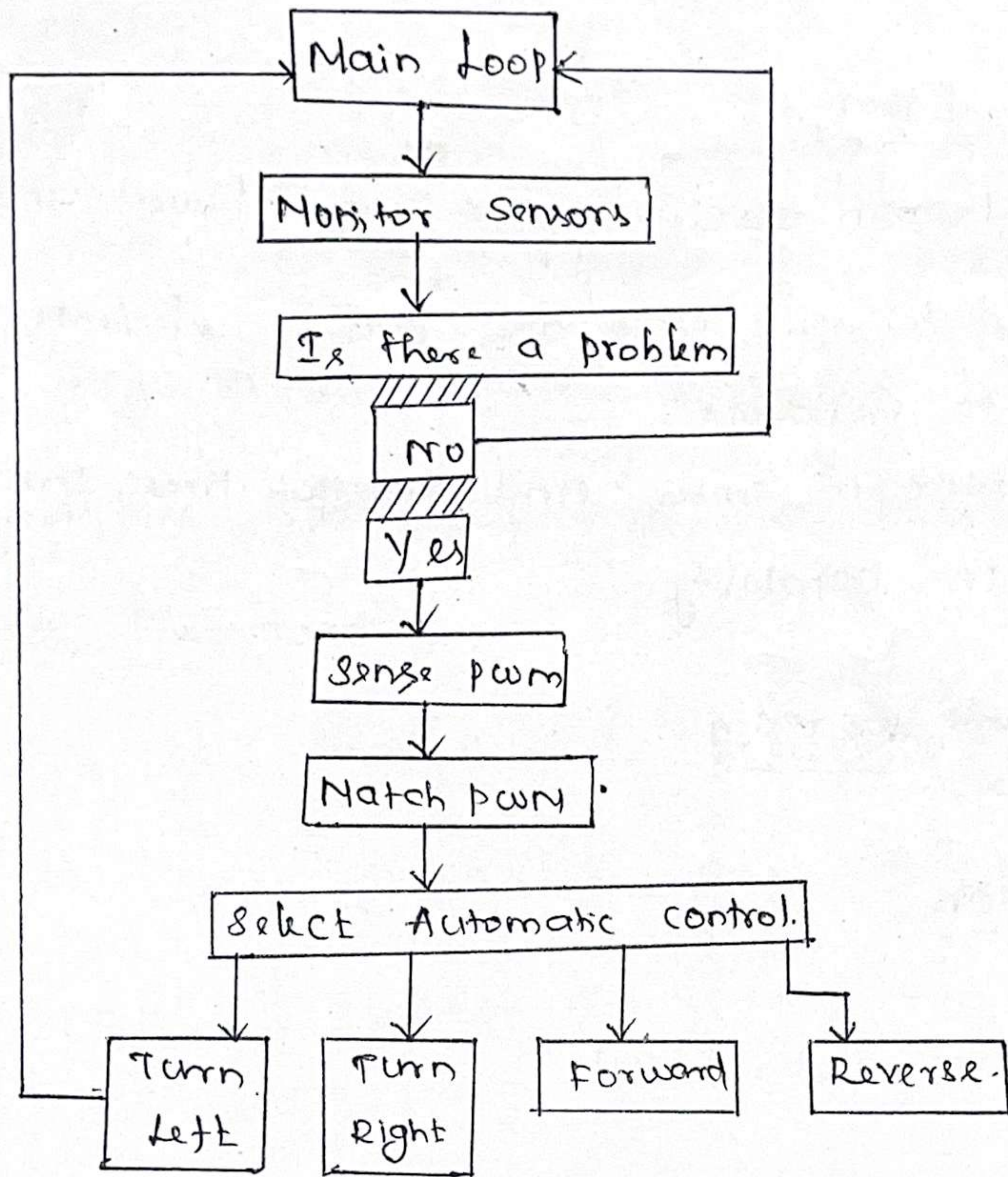
### Microcontroller.

#### Speed

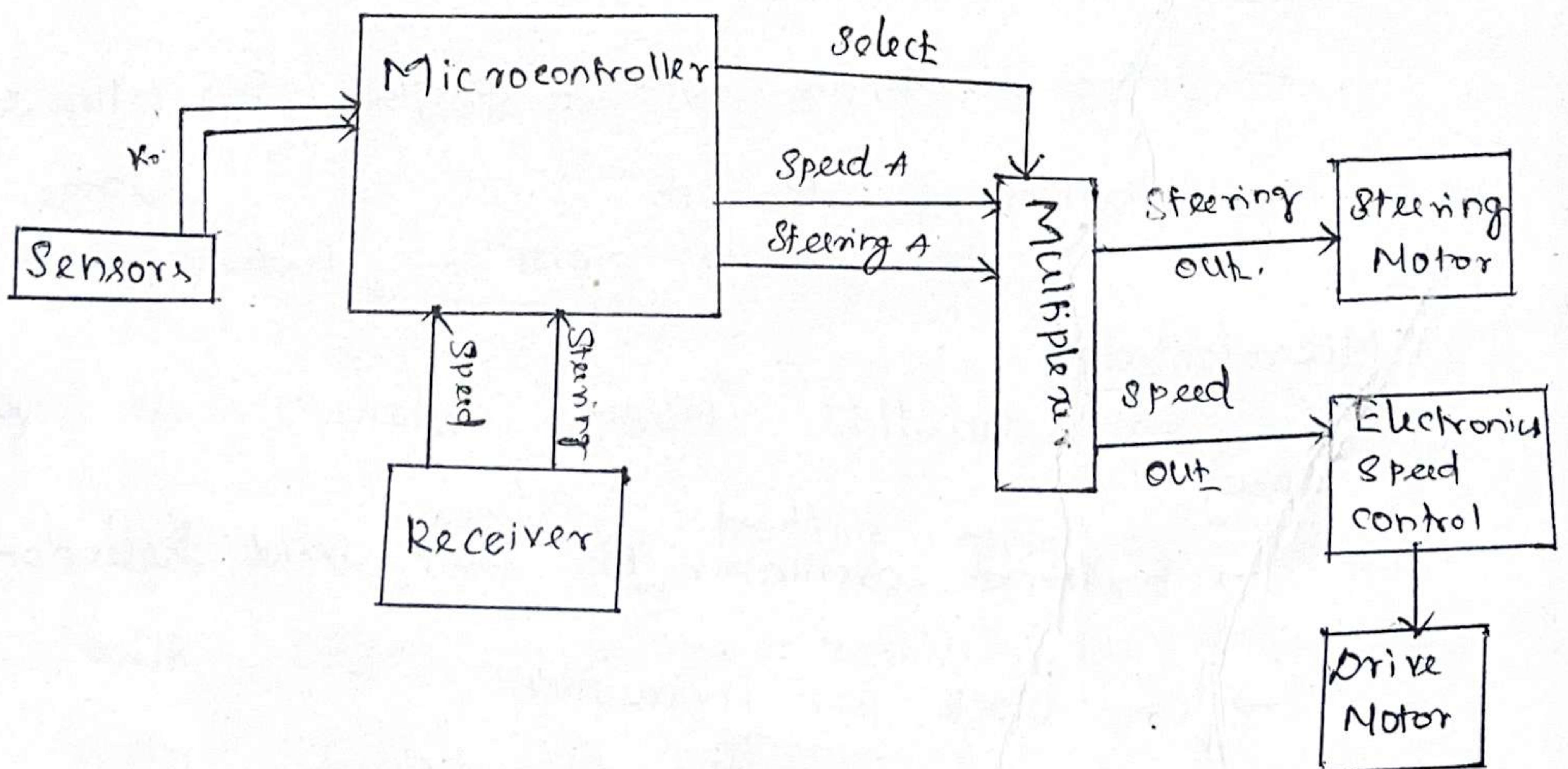
- External oscillator for user speed selection
- One clock per instruction
- Multitasking capabilities with fast response.



# Microcontroller program flow chart.



## System interface.





# Collision warning System.

(23)

## Introduction :-

- \* collision warning systems are based on camera or radar sensors monitoring the road ahead.
- \* They provide object recognition and detect relative speeds between a vehicle and objects in the road.
- \* If the closing speed represents a risk of an impending collision, drivers can be alerted through a number of warning methods.

## Two types :-

- \* Camera based collision warning
- \* RADAR based collision warning.

## Camera based collision warning sm.

→ The camera based collision warning sm uses a forward looking monocular camera with object recognition, mounted on the wind screen behind the the rearview mirror.



## RADAR based collision warning.

- The RADAR based collision warning system consists of a 24 GHz medium-range RADAR sensor.
- The RADAR sensor also mounted at the vehicle front and linked to a warning device.
- RADAR technology provides high performance with direct measurement of distance and relative speed, operating under all conditions.

## Child lock system.

- A child lock (or) child safety door lock is a switch on rear doors that disables the inside handle so children cannot open the door and be injured.
- With the switch engaged, only someone outside of the vehicle can open the door, presuming it's unlocked.
- The child safety lock prevents children from being able to open a rear door from the