# UNIT - IV

# INTELLIGENT TRANSPORTATION SYSTEM

## CONTROL ARCHITECTURE :

* The term 'architecture' is widely used but often loosely so, and with different specific meanings.

* The term therefore encompasses a range of relationships, or 'topologies', connecting various sub-systems or modules.

* In increasing order of abstraction, there appear to be five potentially levels of topology that compromise overall control architecture :-

1) the physical layout of microcontrollers, routers, communication links, sensors and actuators.
2) the casual connection and relative authority of control actions - incorporating the connectivity of demands, reference signals and any co-ordination and protection mechanisms.

3) the connection and flow information - from sensors state estimators, control output, condition monitoring and diagnostics.

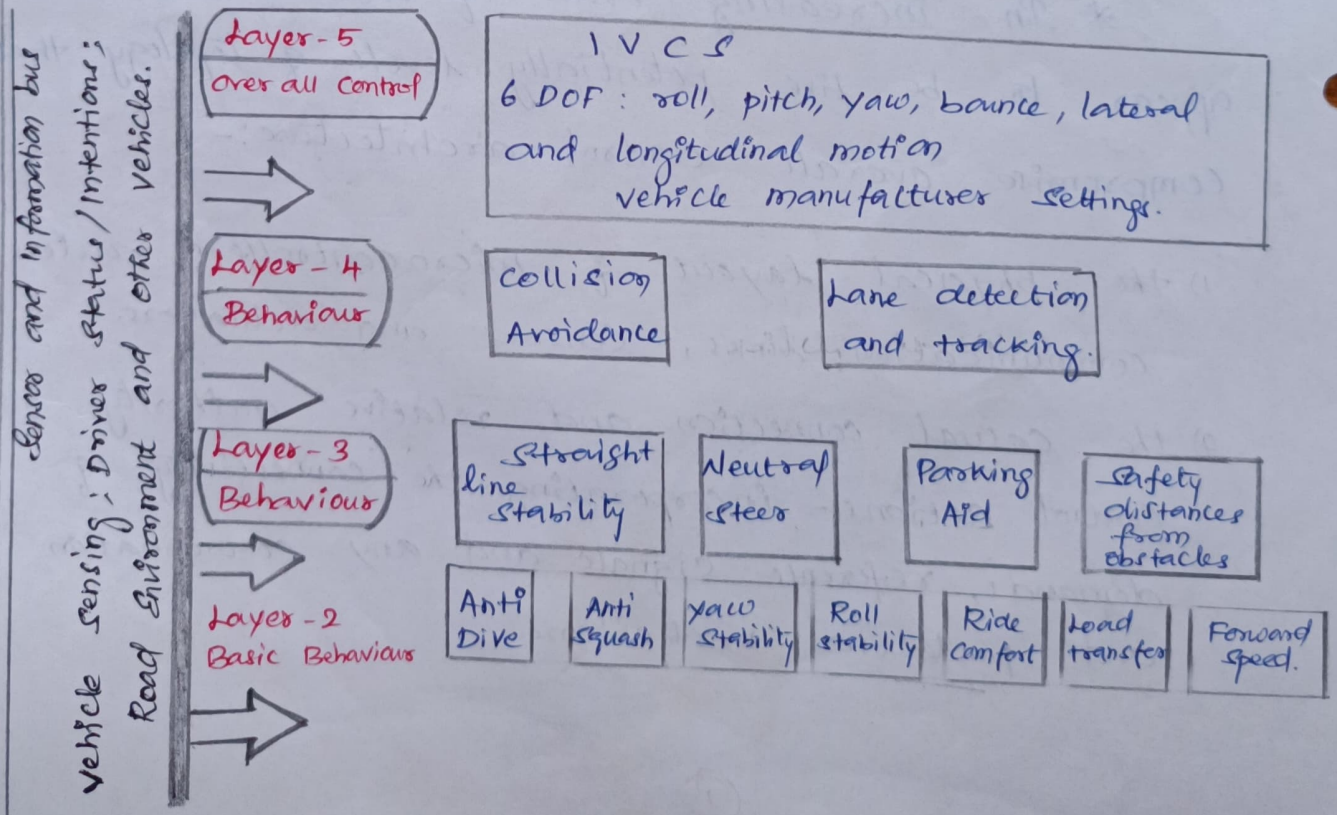
4) the structure of the control algorithms and methodologies that underpin the above, for example that help guarantee stable and fault-tolerant operation of the overall IVCS.

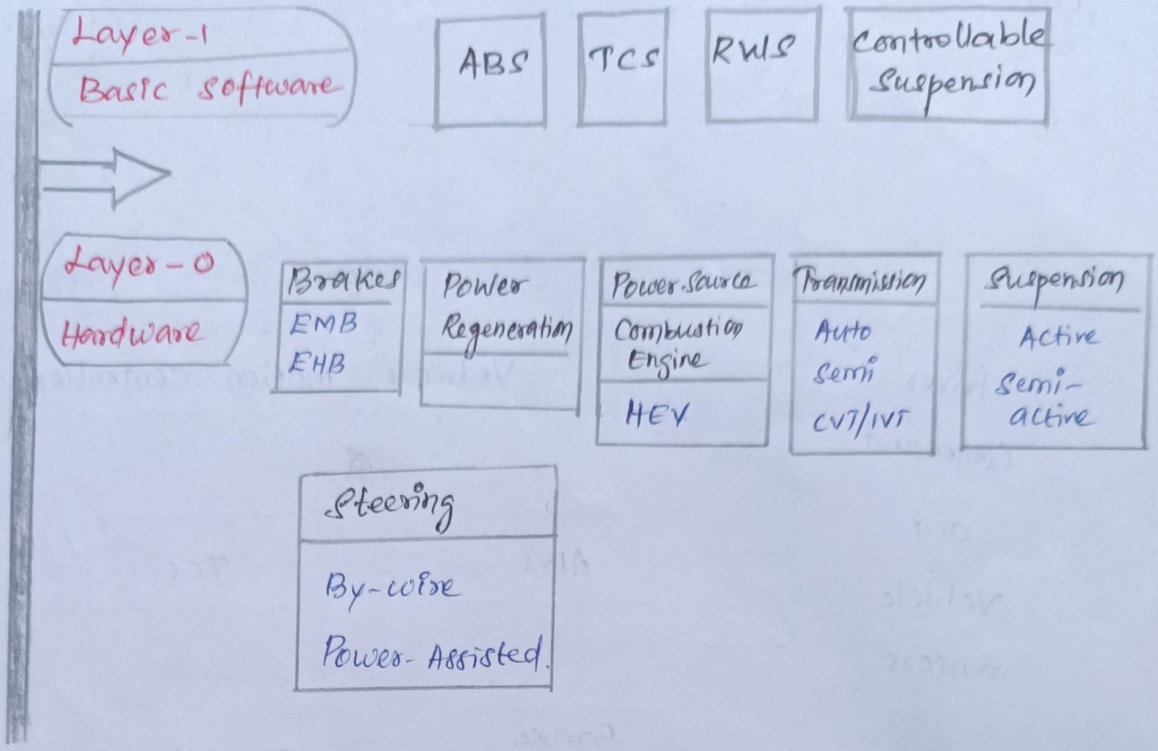
5) the underlying structure of the control functional design -

Types of Control Architecture

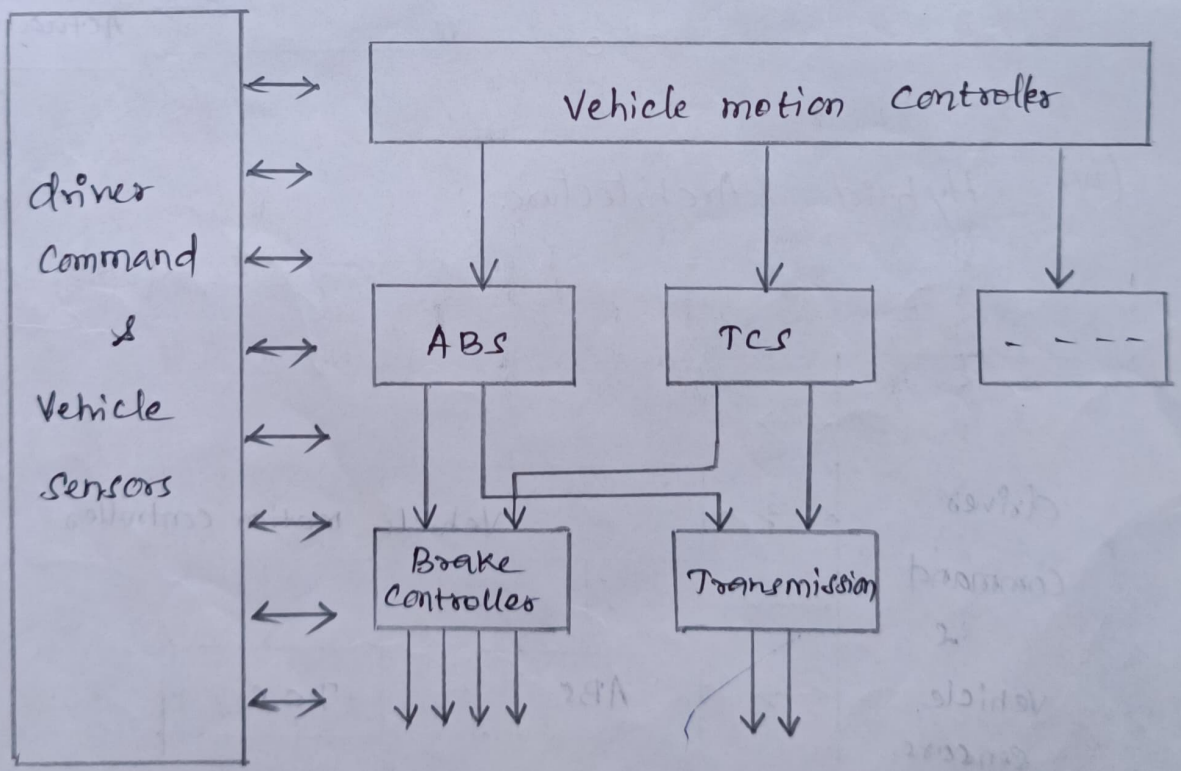
(i) Hybrid (ii) Multilayered (iii) Subsumption
(iv) Hierarchical control.

(i) Multilayered vehicle Control Design Architecture!

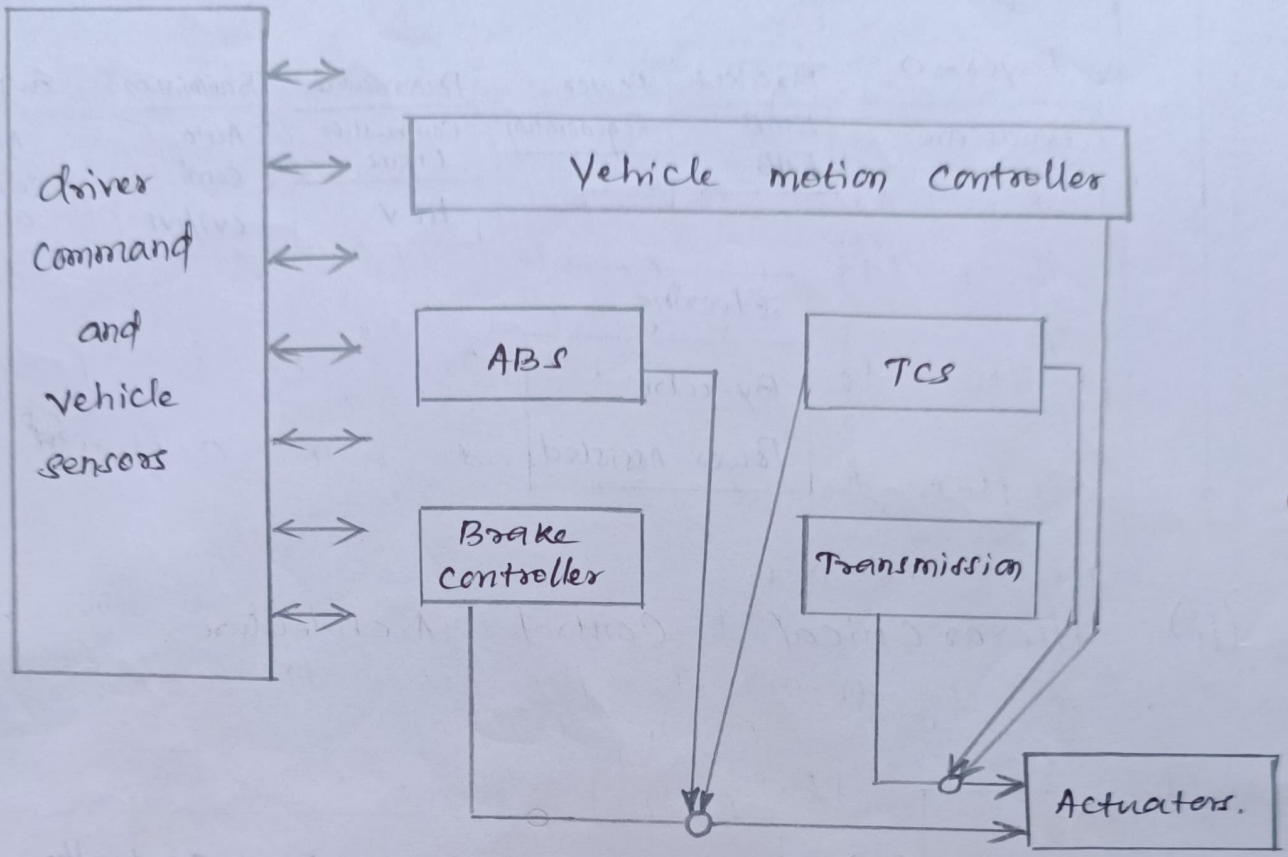




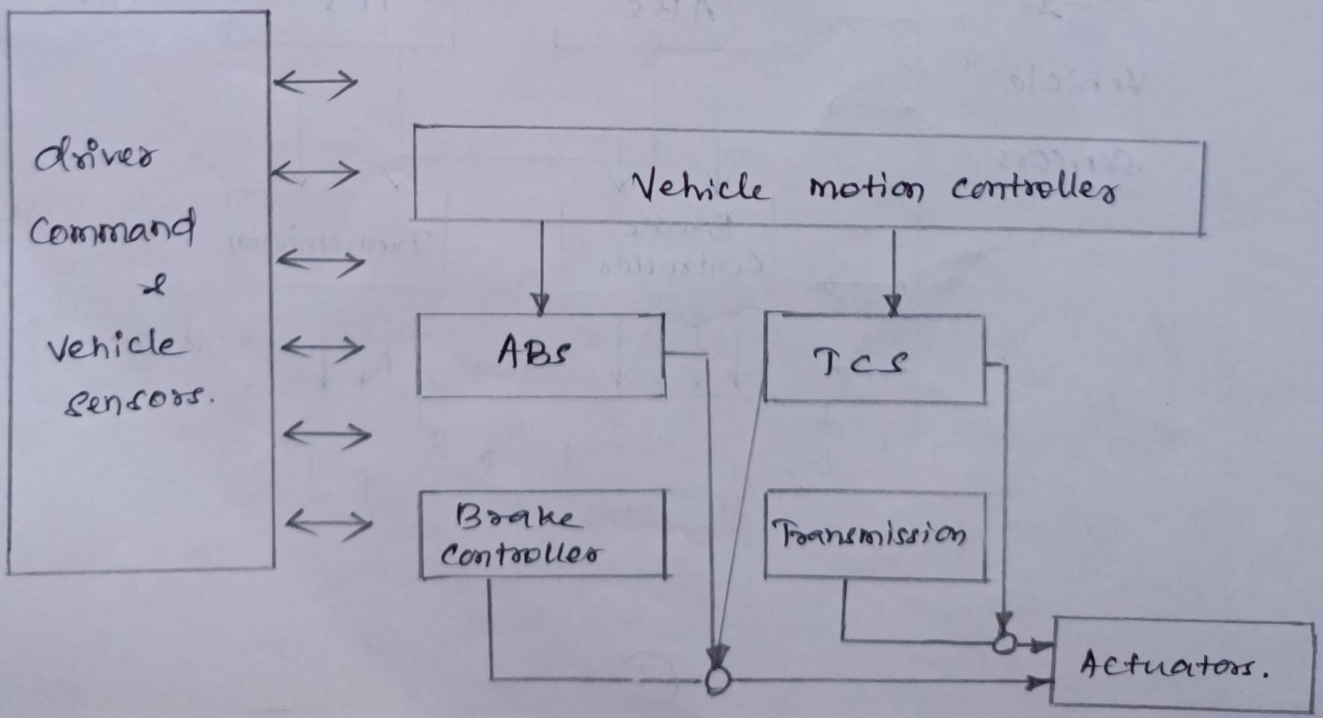

(ii) Hierarchical Control Architecture :



(iii) Subsumption Architecture:




(iv) Hybrid Architecture:



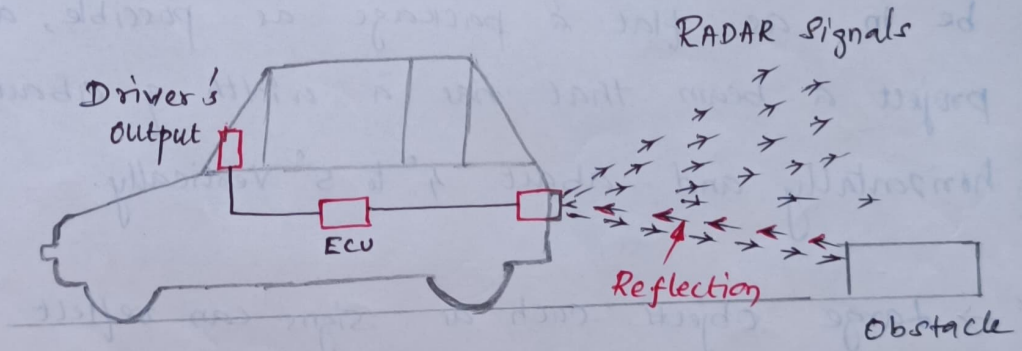
# Collision Avoidance :

→ This system can be looked at into two ways.

→ First, as an aid to reversing which gives the driver some indications as to how much space is behind the car.

→ Second, collision avoidance RADAR can be used as a vision enhancement system.

→ The principle of RADAR as a reversing aid is shown below.

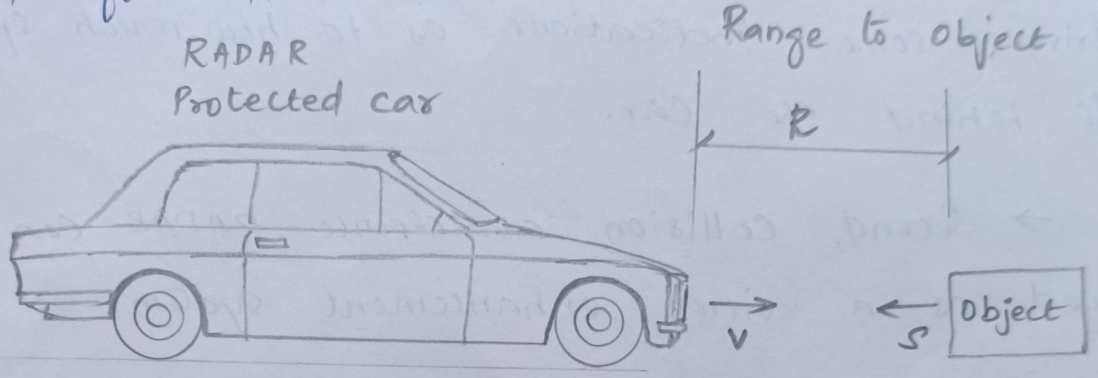



→ This technique is, in effect, as the driver is likely to be looking backwards.

→ The audible signal repetition frequency of which increases as the car comes nearer to the obstruction, and becomes almost continuous as impact is imminent.

→ Collision avoidance radar, when used as a vision enhancement system, is somewhat difficult.

→ For an anti-collision warning application, the RADAR antenna should be mounted on the front of the car and should project a relatively narrow beam forward.




Vision Enhancement System.

→ Ideally, the antenna for such a system should be in as flat a package as possible, and should project a beam that has a width of about 2° to 3° horizontally and about 4° to 5° vertically.

→ Large objects such as signs can reflect the RADAR beam, particularly on curves, and trigger a false alarm.

→ If the beam is scanned horizontally for a few degrees, say 2.5° either side of centre, false alarms from roadside objects can be reduced.

→ For the collision warning system, better results can be obtained if the RADAR transmitter is operated in a pulse mode rather than in a continuous wave mode.

→ In this mode, the transmitter is switched 'on' for a very short time and then it is switched 'off'.

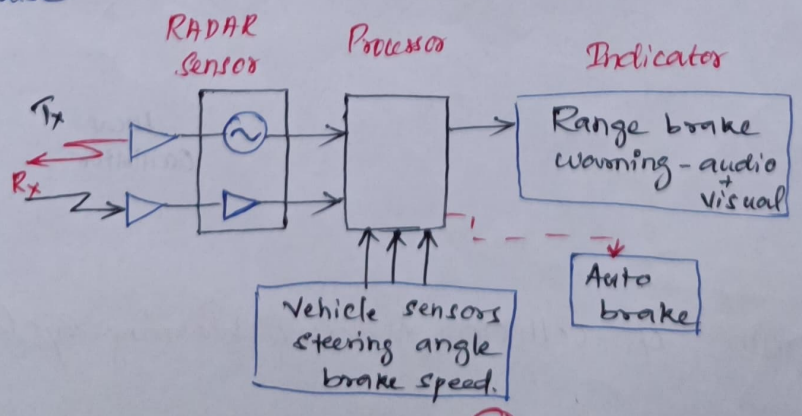
→ During the off time, the receiver is set to receive a reflected signal.

→ If a reflecting object is in the path of the transmitted microwave pulse, a corresponding pulse will be reflected to the receiver.

→ The round trip time, 't', from transmitter to object and back to receiver is proportional to the range, 'R' to the object & can be expressed as

$$t = \frac{2R}{c}, \text{ where } c \text{ is the speed of light}$$

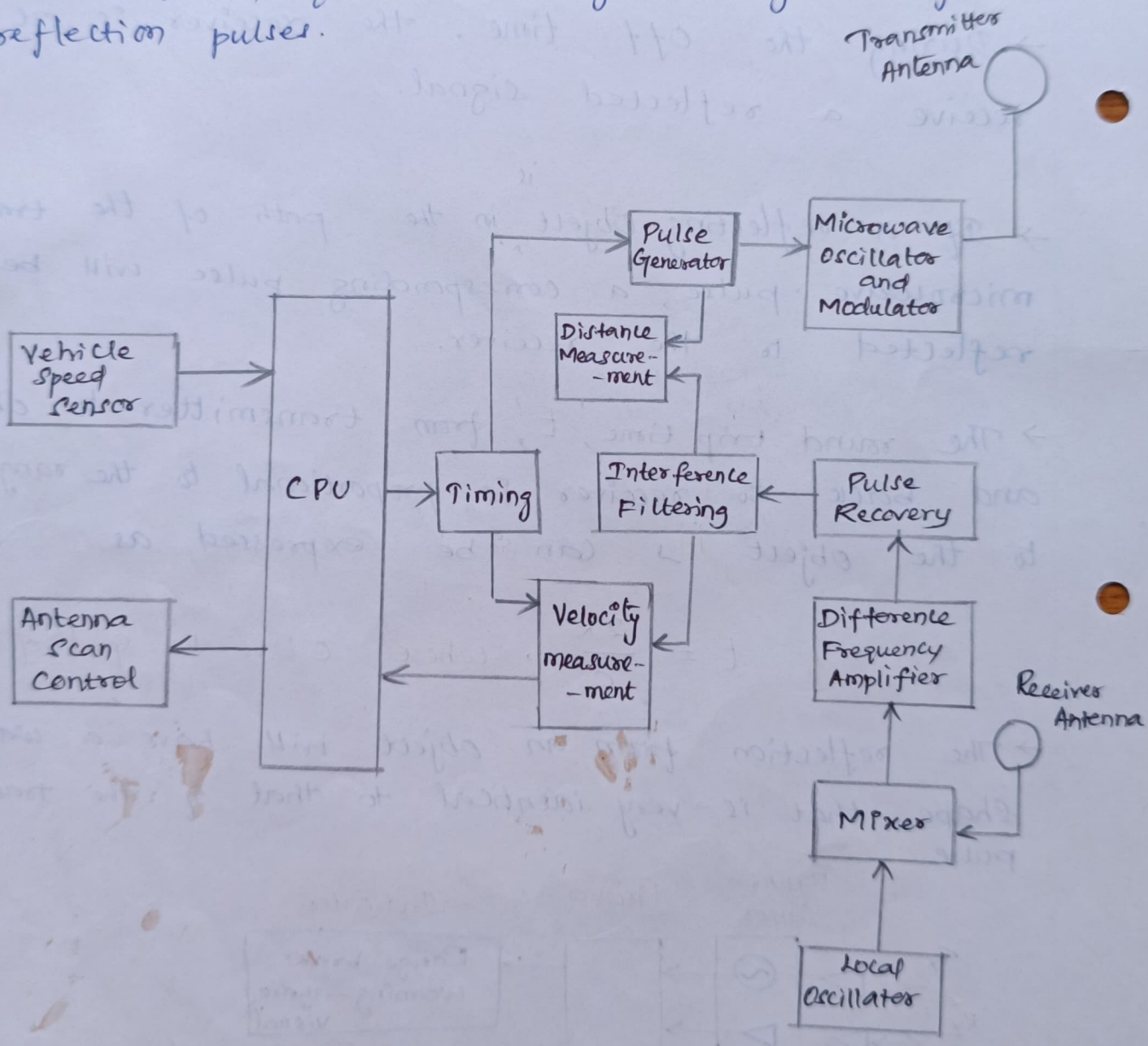
→ The reflection from an object will have a wave pulse shape that is very identical to that of the transmitted pulse.




Range R, to the object & the closing speed, v+s is measured.

→ As noted, the RADAR system can detect this object reflection and find R to determine the distance from the vehicle to the object.

→ In addition, the relative speed of closure b/w the car and the object can be calculated by adding the vehicle speed, V, from the ground reflected pulses and the speed of the object, S, which can be determined from the change in range of object's reflection pulses.




Block Diagram of Collision Avoidance Warning System.

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→ The computer can perform a number of calculations on these data, for example the computer can calculate time to collision, T.

→ Whenever this time is less than a preset value, a visual and audible warning is generated.

→ The system could also be programmed to release the throttle and apply the brakes, if automatic control were desired.

Pitch:

– Motion about the lateral axis is called pitch and it's a measure of how far an airplane's nose is tilted up or down.

– Cars also experience pitch, yaw, roll, but the amounts are relatively small and are usually the result of the suspension reacting to turns, acceleration, & road conditions

## YAW :

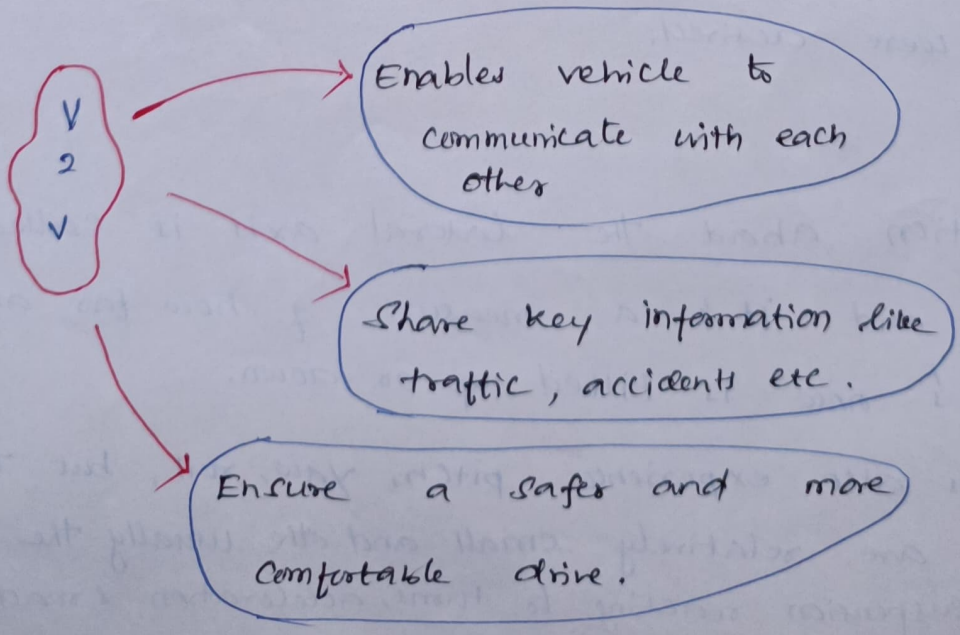
The yaw rate or yaw velocity of a car, aircraft, projectile or other rigid body is the angular velocity of this rotation, or rate of change of the heading angle when the aircraft is horizontal. It is commonly measured in degrees per second or radians per second.

## BOUNCE!

Sudden expansion / contraction of suspension springs in a vehicle is simply termed as bounce.

## Traffic Routing!

Vehicle to vehicle communication system



VANET – Vehicular Ad-Hoc NETWORK.

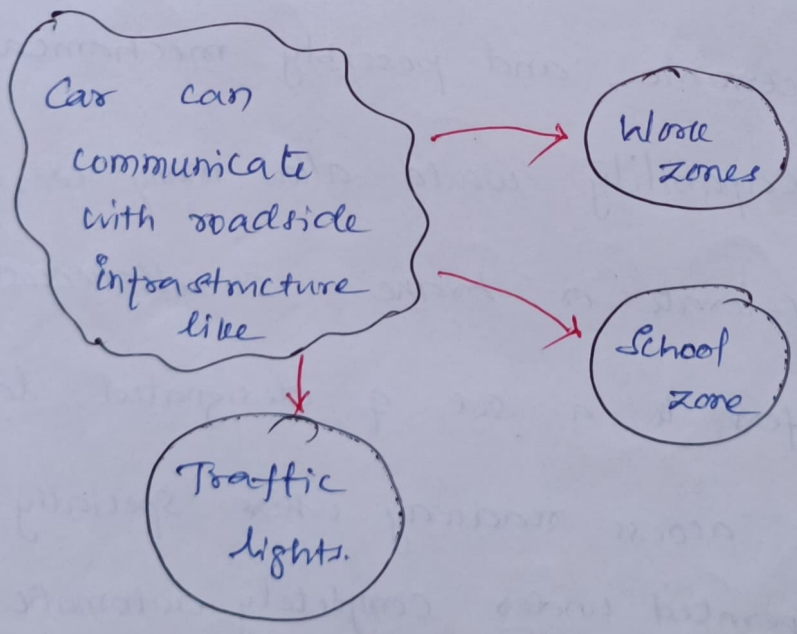
GPS system → Important components → Dedicated wireless network

Cars with a specified radius can automatically link with each other and transfer information.

Informations about parameter:

* Direction
* Speed
* Respective position of vehicle

Vehicle to Infrastructure



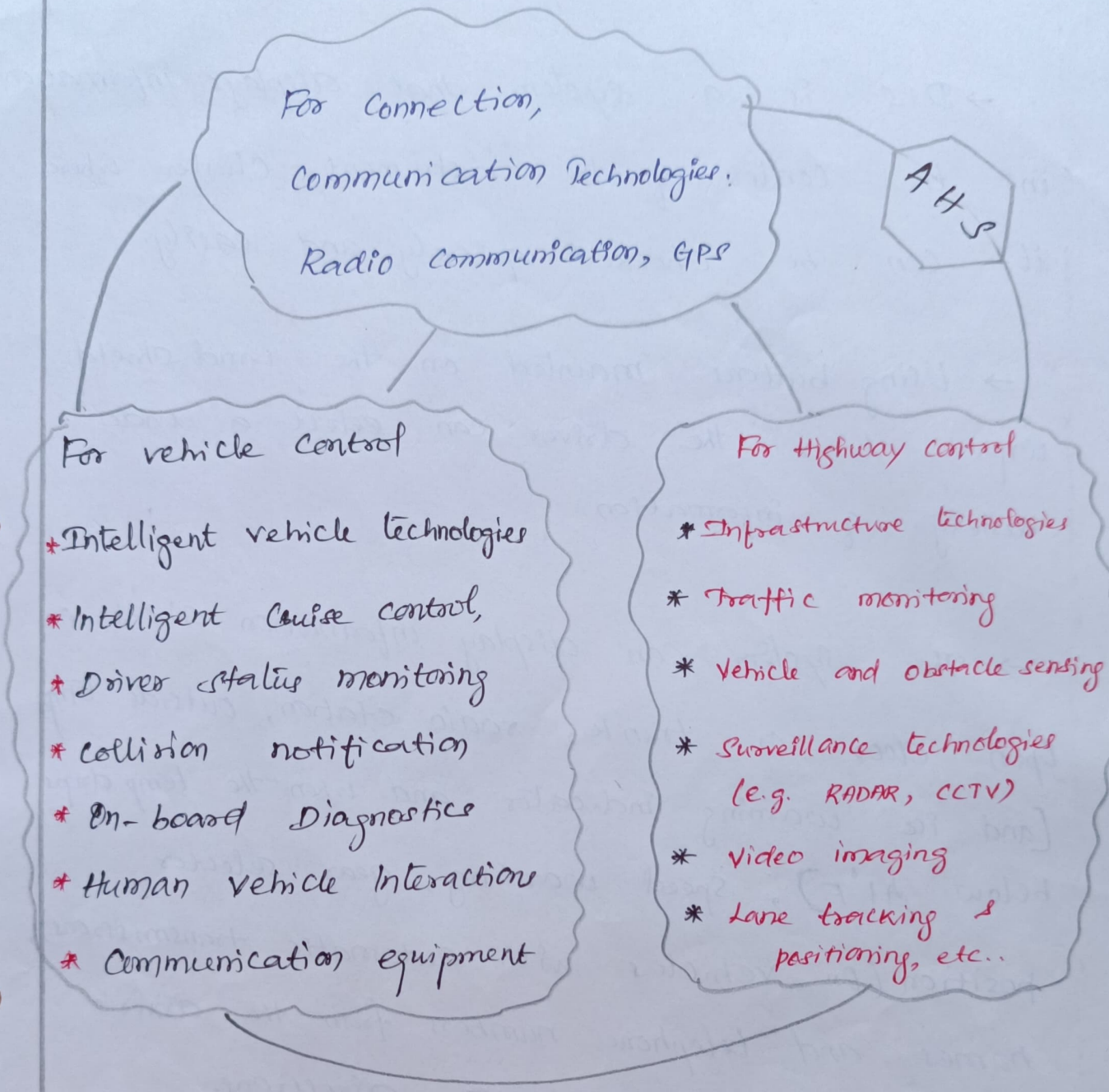
Benefits of V2V

* Traffic light optimum speed advisory
* Information about traffic lights.
* Optimum speed to maintain
* Un-necessary braking avoidance.
* Emergency vehicle (i.e., ambulance, fire service) warning.

## Automated Highway System (AHS)

* An AHS is a proposed technology for doing this. Platoons decrease the distances b/w cars or trucks using electronic, and possibly mechanical, coupling. This capability would allow many cars or trucks to accelerate or brake simultaneously.

* AHS refers to a set of designated lanes on a limited access roadway where specially equipped vehicles are operated under completely automatic control.




## Lane Warning System

Roadway with lane markings. In road transport terminology, a Lane departure Warning System is a mechanism designed to warn the driver when the vehicle begins to move out of its lane (unless a turn signal is on that direction) on free ways and arterial roads.

# Driver Information System:

→ DIS is a system that displays information in the center of the instrument cluster where it can be checked quickly and easily.

→ Using buttons mounted on the wind-shield wiper lever the driver can select a wide variety of information

→ The system can display information about an open door or trunk, radio station, outside temp [and ice warning indicator and when the temp drops below 41°F], speed warning, gear selector position (On vehicles with automatic transmissions), names and telephone numbers from the driver's phone book, and navigation directions.

→ The system can also check/show info from the on-board computer including instant and avg fuel economy, range, travel time & avg speed.

→ The auto check control notifies the driver if there is a problem with the brake or light systems, coolant level, engine temp, oil pressure, fuel level wind shield washer fluid, battery voltage and tire pressure.

## Data communication within the car:

→ A vehicle bus is a specialized internal communications network that interconnects components inside a vehicle.

→ Special requirements for vehicle control such as assurance of message delivery, of non-conflicting messages, of minimum time of delivery, of low cost and of EMF noise resilience, as well as redundant routing and other characteristics mandate the use of less common networking protocols.

→ Protocols include controller area network (CAN), Local Interconnect Network (LIN) and others.

→ Conventional computer technologies (such as Ethernet and TCP/IP) are rarely used, except in

aircraft, where Local Interconnect Network (LIN) & aircraft, where Implementations of the ARINC 664 such as the Avionics full-Duplex Switched Ethernet are used.

Commonly used protocols in cars

* AFDX
* ARINC 429
* Byte flight
* CAN
* D2B - (Domestic Digital Bus) a high speed multimedia Interface
* FlexRay - a general purpose high-speed protocol with safety critical features
* VAN - vehicle Area Network
* DC-Bus - Automotive power line communication with multiplexed network.
* IDB-1394
* IEBUS
* J1708 and J1587
* J1850
* J1939 & ISO 11783 - an adaption of CAN for commercial & agri vehicles
* LIN - Local Interconnet network
* MOST - Media Oriented System Transport
* SPI

Physical transmission Media

⇒ Single wire ⇒ Twisted pair ⇒ Fibre optic