

15AD16 -Intelligent Transport System

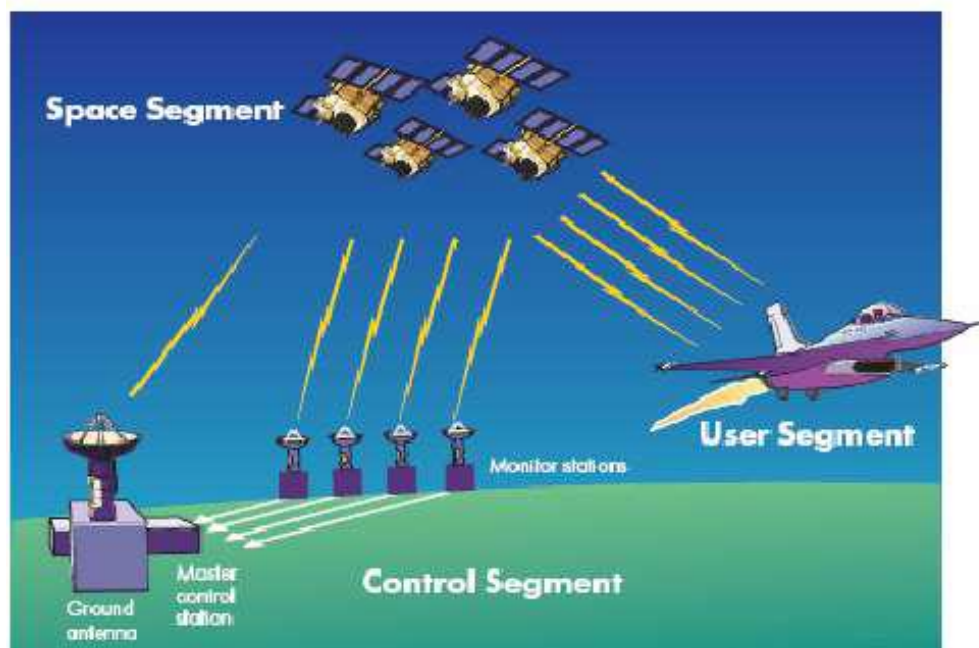
Global Positioning System (GPS)

It Space-based satellite navigation system Provides location and time information In all weather, anywhere on or near the Earth Used to refer locations and help if you are Lost. Secure cars; track your vehicles by sending SMS, making a missed call, preset interval or GPS tracking software for real time online tracking

Components of GPS

3 segments:

- Space segment
- Control segment
- User segment



Space segment-Information

The GPS uses a constellation of 24 satellites that orbit the earth at about 11,000 nautical miles, once every 12 hours. The orbital position is constantly monitored and updated by the ground stations. Each satellite is identified by number and broadcasts a unique signal. Each satellite has 6 orbits. 3 satellites work for GPS, 4th satellite work for accuracy.

3 satellites for 2d fix. Satellite orbital distance is 20,000km. Orbital speed is 14,000km/hr, 60 degrees apart and 55 degrees with respect to equatorial plane. Use measurement of 4 satellites

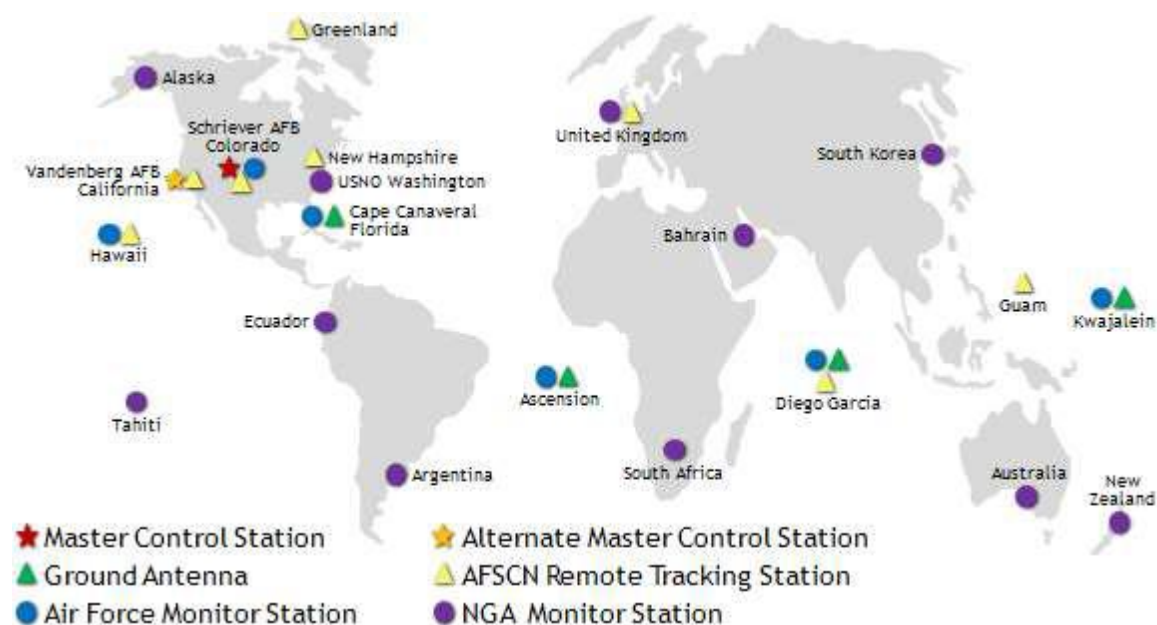
Space segment-Satellite signals

Uses two types of signals to calculate distance

- Code phase ranging
- Carrier phase ranging

Control Segment

The ground segment of GPS (US) has one master control, one alternative master control station, 12 command and control antennas and 16 monitoring sites.



User Segment

It Consists of GPS receiver. The receiver collects and processes signals from the GPS satellites. Use that information to determine and display the location, speed, time and so on. The accuracy and reliability is enhanced as the number of visible satellites increases.

Working of GPS Consist of two main components

- Receiver
- Location
- Receiver

The receiver collects satellite signals, decodes and processes them. The basic receiver does not include a transmitter. Different levels of precision are available. The receiver determines its location by trilateration.

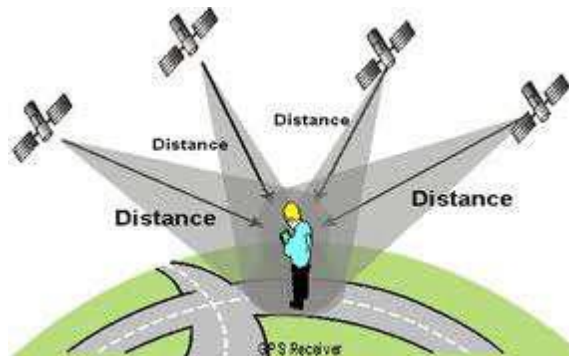
GPS Trilateration

Knowing its distance from three satellites, the receiver can determine its location because there is only two possible combinations and one of them is out in space. In this example, the receiver is located at b. The more satellite that are used, the greater the potential accuracy of the position location.

HOW GPS DETERMINES A LOCATION?

Things which need to be determined:

- Current Locations of GPS Satellites
- The Distance between Receivers's Position and the GPS Satellites



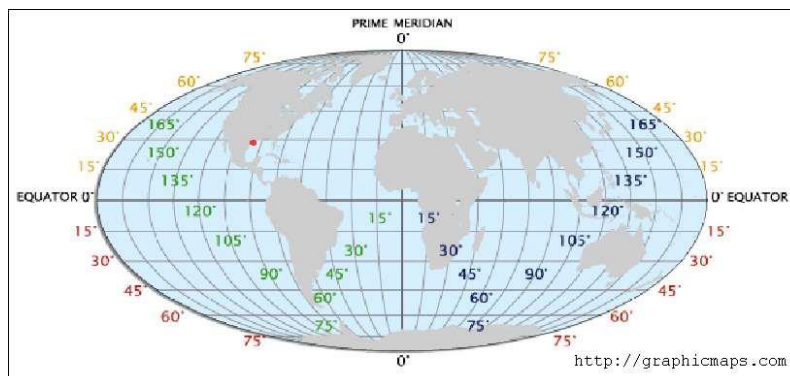
Location

Once the GPS receiver has located its position it is usually displayed in one of two common formats:

- Latitude and longitude
- Universal transverse Mercator (UTM).

Latitude and Longitude

Latitudes and longitudes are angles. Both use the center of the earth as the vertex, but they use a different zero reference.



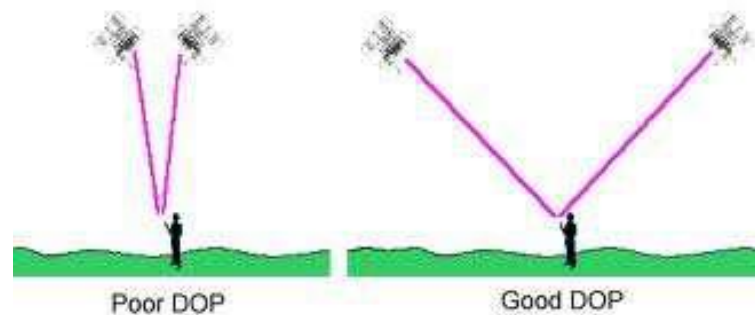
UTM Zones

The world is divided into 60 zones of longitude, each 6° wide at the equator, that extend from 84° N to 80° S. These zones begin at 180° longitude and are numbered consecutively eastward.



Dilution for Precision(DOP)

The more spread out the satellites are in the sky, the better the satellite geometry. PDOP (position dilution of precision) is a combination of VDOP and HDOP. The lower the PDOP value, the better the geometric strength.



General application

- Banking
- mobile phone operations
- Auto toll GPS service
- GPS watch
- Google Map
- Navigation

Advantages of GPS

- Easy to navigate
- Search nearby area
- Weather information
- Tracking
- Updated regularly
- Easy to Navigate
- Determine exactly where you are at any given moment. Give you the exact latitude and longitude
- Determine the atmosphere's water content to improving the accuracy of weather forecasts

Disadvantages and Limitations

- Need good care and handling
- Need external power
- Inaccuracy
- Potential failures
- Privacy concerns
- Geometry of satellite position
- Satellite clock errors
- SV position

Conclusion

GPS is very useful during adventures. GPS devices are perfect for water navigation. Though it has some limitation, it does not considered as a big error. Because these errors are only nano errors. GPS is the most advanced, accurate, commercially available and multi-use satellite navigation system that has ever been existed. In military application it is the only system relied upon in providing data to very expensive guided weapons.

Geographical Information System (GIS)

“GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data identified according to their locations.” “A GIS is an organized collection of computer hardware, software, geographic data, and personnel to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information.”

Principle

1) Data Capture

Data sources are mainly obtained from manual digitization and scanning of aerial photographs, paper maps, and existing digital data sets.

2) Database Management and Update

data security, data integrity, and data storage and retrieval, and data maintenance abilities

3) Geographic Analysis

The collected information is analyzed and interpreted qualitatively and quantitatively.

4) Preparing Result

One of the most exciting aspects of GIS technology is the variety of different ways in which the information can be presented.

Functions

1) Data Capture

The input of data into a GIS can be achieved through many different methods of gathering. For example, aerial photography, scanning, digitizing, GPS or global positioning system is just a few of the ways a GIS user could obtain data.

2) Data Storage

Some data is stored such as a map in a drawer, while others, such as digital data, can be as a hardcopy, stored on CD or on your hard drive.

3) Data Manipulation

The digital geographical data can be edited, this allows for many attribute to be added, edited, or deleted to the specification of the project.

4) Query and Analysis

GIS was used widely in decision making process for the new commission districts. We use population data to help establish an equal representation of population to area for each district.

5) Visualization

This represents the ability to display your data, your maps, and information.

Components

1) Hardware - Computer System, Scanner, Printer, Plotter, Flat Board

2) Software

GIS software in use are MapInfo, ARC/Info, AutoCAD Map, etc. The software available can be said to be application specific.

3) Data

A GIS will integrate spatial data with other data resources and can even use a DBMS, used by most organization to maintain their data, to manage spatial data. Geographic data and related tabular data can be collected in-house or purchased from a commercial data provider.

4) People - GIS users range from technical specialists who design and maintain.

5) Method

The map creation can either be automated raster to vector creator or it can be manually victories using the scanned images.

Data Types

- ☐ Vector
- ☐ Points
- ☐ Lines
- ☐ Polygons

Raster

- ☐ Cell
- ☐ Pixels
- ☐ Elements

Vector

- ☐ Points, lines, polygons
- ☐ More closely resembles real world

Raster

Areas broken into pixels' or cells

Each cell contains data

Good at representing dense data

- land cover
- elevation

RASTER DATA VS VECTOR DATA

Geographic Information Systems (GIS) Data Models: Raster vs. Vector Models

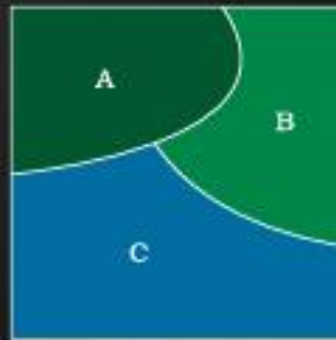
Raster Data Model

A	1	1	1	2	2
B	1	1	1	2	2
C	1	1	3	2	2
D	3	3	3	3	3
E	3	3	3	3	3
	A	B	C	D	E

Raster models....

- represent continuous variation well
- represent discrete objects poorly
- have simple data structure
- require large file sizes

Vector Data Model



Graphical Coverage

ID	Variable 1
A	1
B	2
C	3

Relational Database

Vector models....

- represent continuous variation poorly
- represent discrete objects well
- have more complex data structures
- typically require smaller files sizes than raster models

Advantages (Vector)

- ☐ Good Representation of data.
- ☐ Use small File Size.
- ☐ Accurate map output.

Disadvantages(Vector)

- ☐ Complex Data Structure.
- ☐ Expensive Technology.
- ☐ Analysis is Complex.

Advantages (Raster)

- ☐ Simple Data Structure.
- ☐ Cheap Technology.
- ☐ Analysis is Simple.
- ☐ Same grid cell for several attributes.

Disadvantages (Raster)

- ☐ Large Data Volume.
- ☐ Inefficient use of computer storage.
- ☐ Difficult network analysis.
- ☐ Less accurate or attractive maps.
- ☐ Loss of information when using large cells.

Advantages of GIS

- ☐ GIS allows us to view, understand, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts.
- ☐ A GIS helps you answer questions and solve problems by looking at your data in a way that is quickly understood and easily shared.
- ☐ GIS give the accurate Data.
- ☐ Better Predictions and Analysis.

Disadvantages of GIS

- ☐ Excessive damage in case of internal fault. Long outage periods as Repair of damaged part at site may be difficult.
- ☐ Expensive software.
- ☐ Integration with traditional map is difficult.

Navigation System

The word Navigation is a combination of two Latin words “navis” means boat and “agire” means guide. Traditionally meant the art or science of moving the ships and other watercraft safely from one place to another. Today word Navigation used in broad sense. Navigation system defines as a system providing useful information to determine the position of a boat, car or airplane etc.

GPS is used in automobiles for Navigation purposes.

What is GPS?

- GPS stands for Global Positioning System.

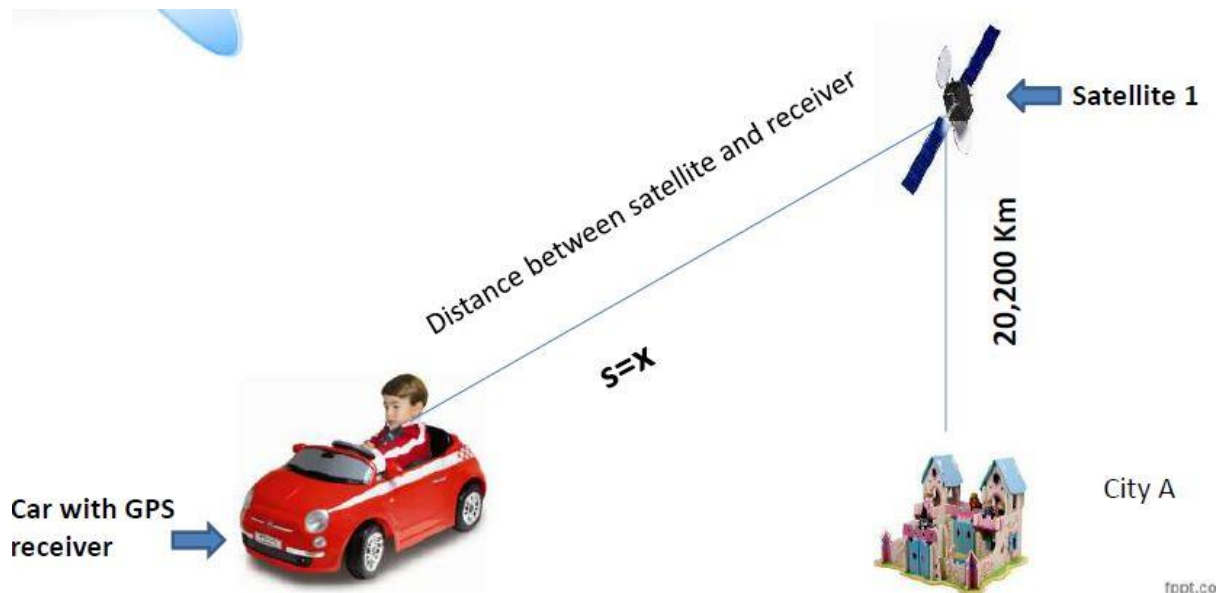
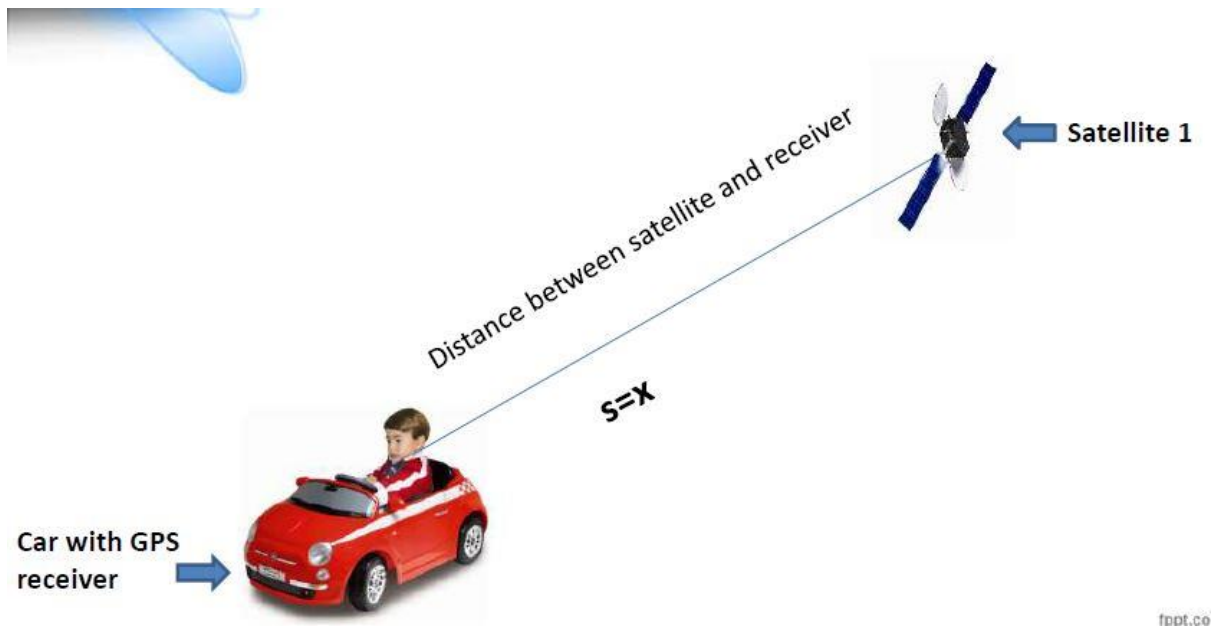
- GPS is the first man made Satellite Navigation System.

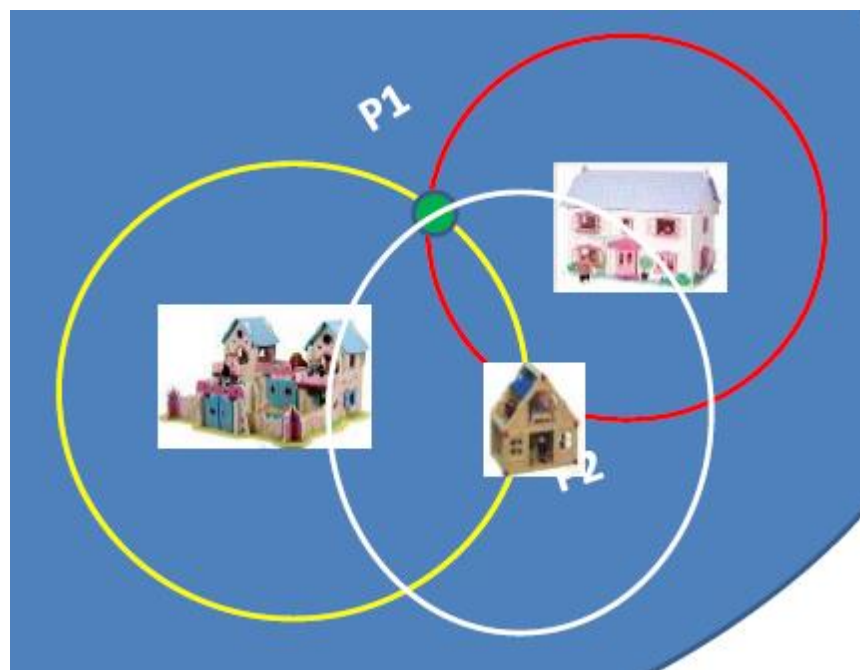
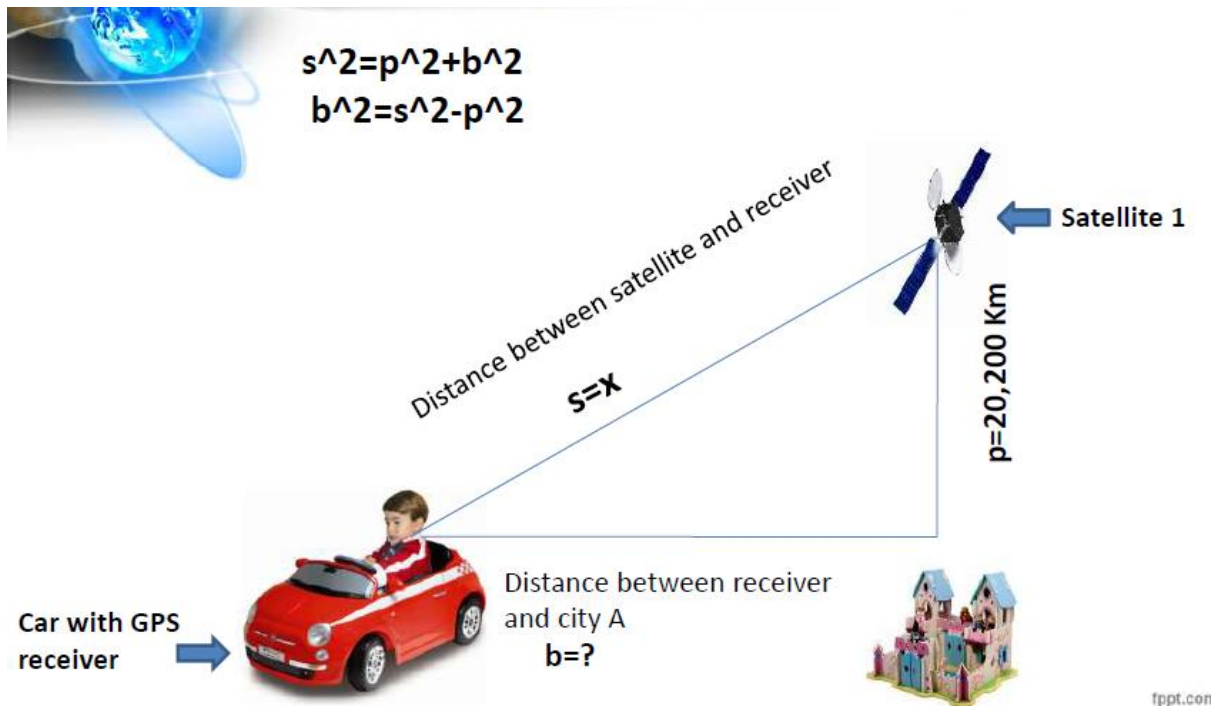
Working

- How the distance of receiver from satellite is determined?

- $s=vt$ (m)

$s=ct$ (m) where, c =speed of light= 3×10^8 (m/s)





■ So we are at position P1 on the map

Errors & Limitations

There are following errors in GPS.

- Multipath Errors

- Almanac Errors
- Errors In GPS Clock

Basic Question about the Errors:

What are multipath errors?

During their traveling from satellite to GPS receiver ,GPS signals can strike with trees, electromagnetic field, buildings etc. After striking these are reflected at a certain angle and thus increases the time to reach the receiver when the time .Producing error in distance.

How multipath errors are corrected?

They are corrected by introducing a stationary receiver at a high altitude. First the GPS signal sent to these stationary satellite and then sent to car GPS signal receiver. This method is called “differential method”.

What are Almanac Errors?

Due to the pull force of sun and moon on the satellites, the position of their orbits are slightly changed. Now ,although the position of their orbits are changed but almanac shows the original position .

How almanac error is corrected?

It is corrected by updating the almanac.

What are the GPS clock Errors?

A GPS uses an ordinary quartz clock for measuring time ,which can not measure too small time of a GPS signal from satellite to GPS receiver.

How this Error is corrected?

The error is corrected by using mathematical equations.

Automotive Night Vision System In Automobiles – Road recognition

Introduction:

- It is a system to increase a vehicle driver's visibility in darkness or poor weather beyond the reach of the vehicle's headlights. In this system Light waves [infrared (IR)] are emitted by source ; a special cameras collect small amounts reflected light and amplify it to generate display on cluster .

- These systems are currently offered as optional equipment on certain premium vehicles.

There are two types of Night vision system:

1) Active System

2) Passive System

We mostly use Active system in Automobiles

Active Systems:

- It use an infrared light (Invisible to human) source built into the car to illuminate the road ahead
- This type enables long ranges (250m) and high performance in rain and snow.

Advantages:

Higher resolution image, superior picture of inanimate objects, works better in warmer conditions.

Disadvantages:

Does not work as well in fog or rain, lower contrast for animals, Rocks / Fallen trees , shorter range of 150-200 meters

Passive systems:

Passive systems do not use an infrared light source, instead they capture thermal radiation already emitted by the objects, using a thermo-graphic camera .

Advantages: Greater range of about 300 meters, higher contrast for living objects

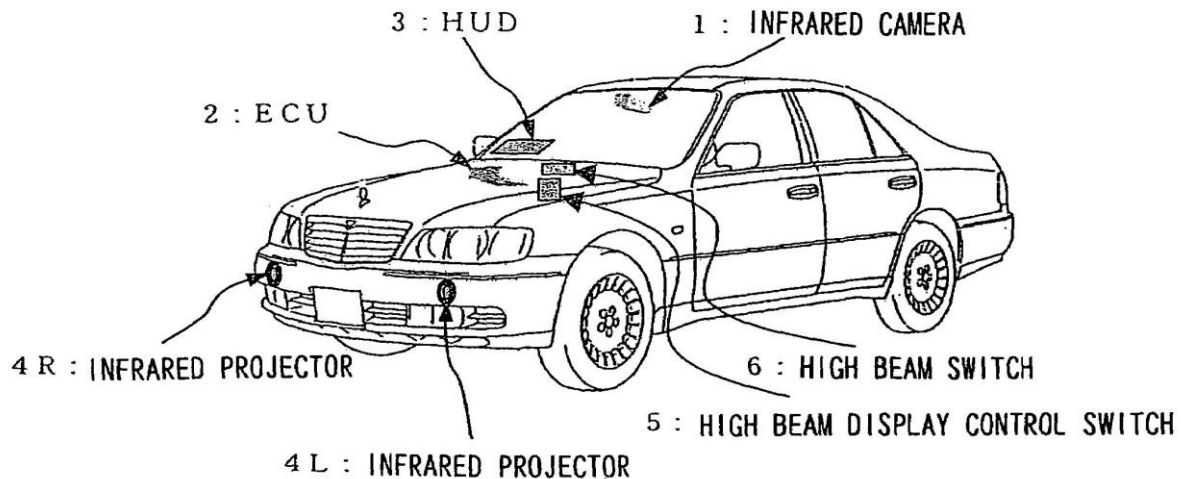
Disadvantages: Grainy, lower resolution image, works poorly in warmer weather conditions, require larger and costly sensor

System components:

- Dual camera
- Amplifier
- On board display
- Caution ICU
- Intelligent night vision system
- Motion detection sensor

SENSORS USED

- Vehicle Speed Sensor
- Daylight Sensors
- Night Vision Sensor
- Vehicular Output Sensors



Block Diagram of vision system

Active system is again further classified into:

- ☐ Near infrared (NIR)
- ☐ Far infrared (FIR)

Near infrared:

- This system uses near infrared (NIR) light waves for detection of objects
- NIR technology requires IR “flood lamps” to project invisible NIR light onto the surrounding area.
- The camera captures the reflected NIR light from the surrounding area and intensifies it to create an enhanced (brightened) image.
- Range of less than 183 meters.

The Advantage: Can see warmer living things just as clear as it can spot colder, dead animals or non-living objects.

Disadvantages: Doesn't handle fog and dense conditions well

Far infrared (FIR)

- ☐ Far infrared (FIR) light waves are used
- ☐ This type of technology may also be referred to as thermal imaging. Because FIR light waves are created from emitted heat rather than reflections of light
- ☐ It uses complementary metal oxide semiconductor (CMOS)-based sensors on the front of the car that pick up heat from objects and processes the thermal signature to display images on display mounted on the dash
- ☐ It has a range of around 299 meters

Google driving to be driverless

Google's modified Toyota Prius uses an array of sensors to navigate public roads without a human driver. Other components, not shown, include a GPS receiver and an inertial motion sensor.

Laser-guided mapping

A rotating sensor with lasers called a LIDAR on the roof scans more than 200 feet in all directions to generate a precise three-dimensional map of the car's surroundings.

Video camera



A camera mounted near the rear-view mirror detects traffic lights and helps the car's onboard computers recognize moving obstacles—such as pedestrians and bicyclists.



Position estimator

A sensor mounted on the left rear wheel measures small movements made by the car and helps to accurately locate its position on the map.



Radar

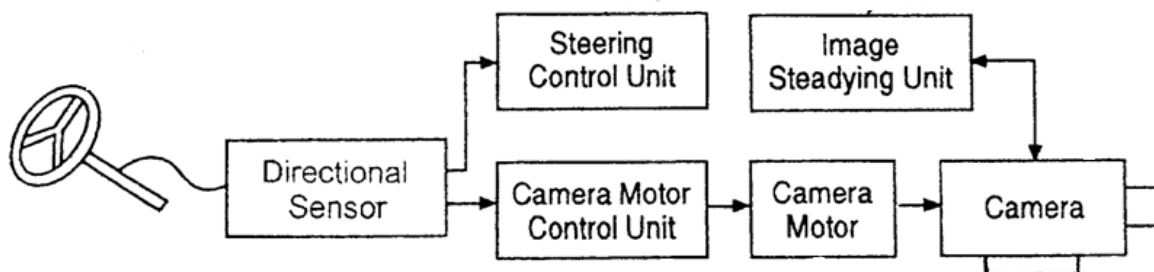


Four standard automotive radar sensors, three in front and one in the rear, help determine the positions of distant objects.

Source: Google

NEW YORK TIMES; PHOTOGRAPHS BY RAMIN RAHIMIAN FOR THE NEW YORK TIMES

Block Diagram for Automated Steering :



Limitations of nigh vision system:

While that works well for deciphering between animals and people, it doesn't do much for revealing a dead animal in the middle of the road or perhaps a large rock or a fallen tree.

- ☐ Performance is reduced in Dense, fog Conditions
- ☐ Initial cost of \$ 1500 to \$ 2000

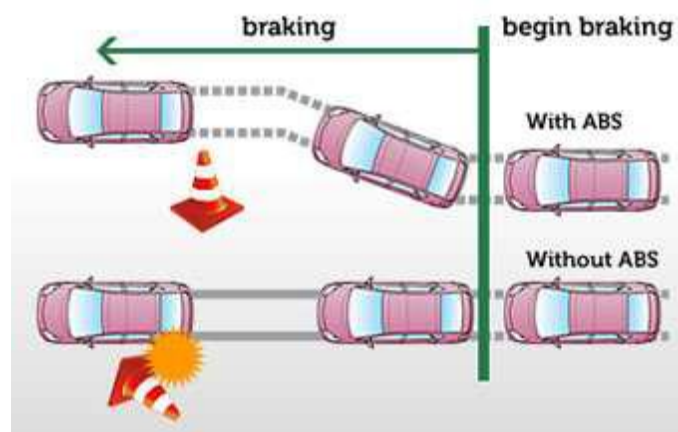
Driver Assistance system:

Basically Advanced driver assists (ADS) systems helps the driver in the driving process and enables safe, relaxed driving. It makes sense to get your new car with driver assist features if you find it at a reasonable price as it helps you drive easily and safely in everyday use.

1) Antilock Braking System (ABS)

Antilock braking system mainly known as ABS. Basically it allows the wheels to maintain traction control with the road surface while stop braking(emergency braking) and prevents the wheels from locking up and avoid uncontrolled skidding. ABS offers improved vehicle control and decreases stopping distances on dry and slippery roads.

Nowadays, most of the cars come with antilock braking system as standard if not please do check with your car manufacturer. We would strongly recommend to get your new car with ABS system for safe driving.



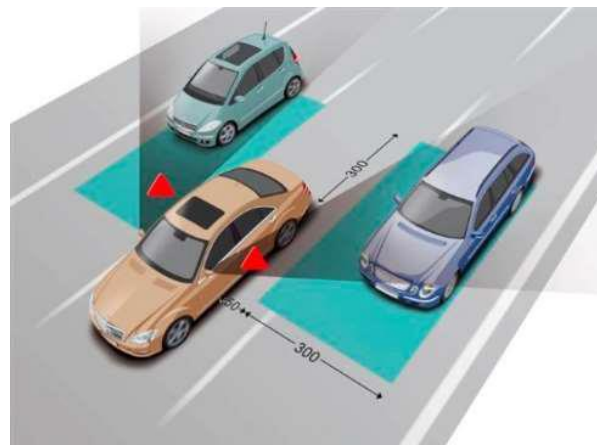
2) Adaptive Cruise Control

Adaptive Cruise Control (ACC) uses forward looking radar and maintains the safe distance from the car ahead. It is designed to avoid accidents by keeping your vehicle at a safe distance from the traffic ahead. It makes sense to get your new car with adaptive cruise control system as the price comes down and as you drive more highway miles(for longer trips).



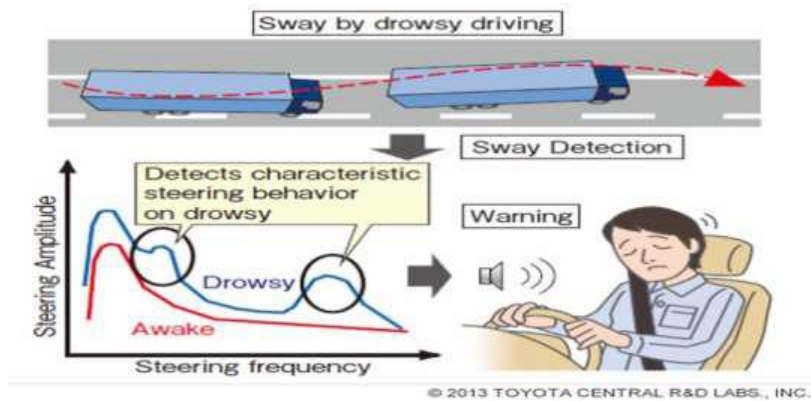
3) Blind Spot Detection

A blind spot monitor detects other vehicles located in the blind spot areas such as side and rear, however it detects other areas as well. Blind spot areas are hard to detect when you are specially driving in the night and any bicyclist stops in your blind spot area. It gets hard to move and detect the bicyclist. Also the system provides audible and visual sign to backing out of a parking space when traffic is approaching from other sides.



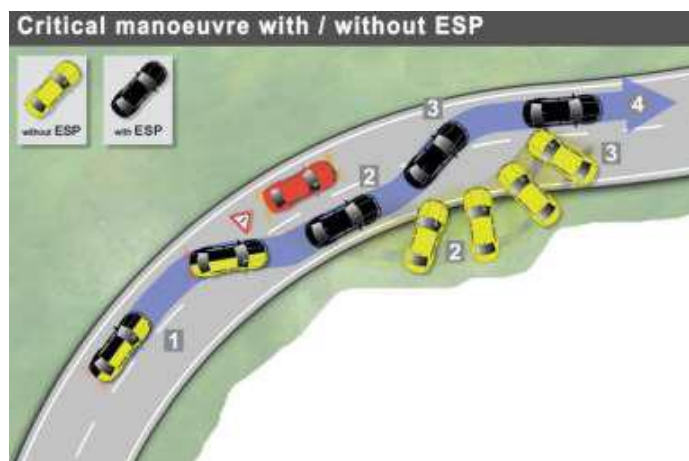
4) Driver Drowsiness Detection

Driver drowsiness detection is another car safety technology that designed to prevent accidents when the driver is getting drowsy and often fails to recognise early enough according to the experts. In this case, attention assist warns the driver for extending speed range and offers adjustable sensitivity of warning is emitted, also indicates nearby service areas in the navigation system.



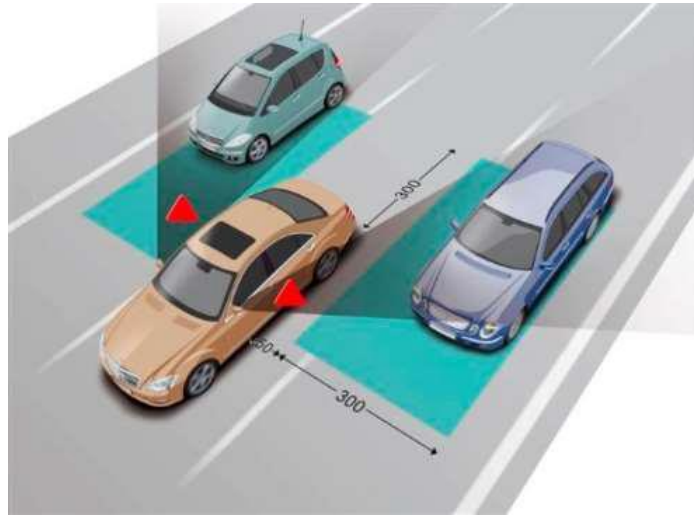
5) Electronic Stability Control

Electronic stability control (known as ESC) is a computer technology improves a vehicle stability control by reducing loss of traction or skidding. When ESC detects loss of steering control, automatically applies the brakes to help steer the vehicle. ESC is one of the most effective system now comes as standard on all the new cars from 2014. If not would recommend to ask your car manufacturer for it.



6) Emergency Braking System (EBS)

An advanced emergency braking system monitors the vehicles in front and detects situations where the relative speed and gap require and applies brakes to keep the proper gap between two cars to avoid collision. A recent study says, if all the cars come with EBS as standard then it will reduce accidents by up to 27 percent and save up to 8000 lives a year.



7) Hill Descent Control

Hill descent control mainly designed to work in rough terrain, allows a smooth and controlled hill descent without the driver needing to touch the brake pedal. It works with the ABS to control each wheel speed and automatically applies brakes to avoid skidding.



8) Intelligent Speed Assistance

The Intelligent speed assistance system constantly monitors vehicle speed and local speed limits on the road and control the speed if the vehicle is detected to exceeding the speed limit. This can be done first advising the driver with warning signs and if the driver fails to do it then the system activates automatically and brings the vehicle to normal speed.



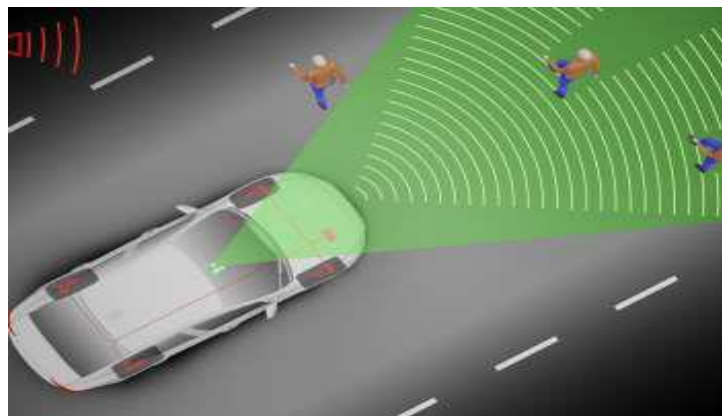
9) Lane Departure Warning/Lane Assist systems

Lane departure warning system is designed to warn a driver when the vehicle begins to move out of its lane especially on 70mph motorways. Some advanced system warns the driver and automatically brings the vehicle to safe position if no action taken by the driver.



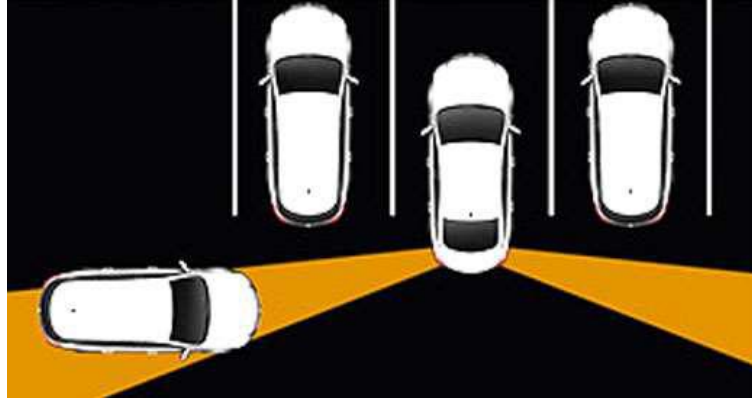
10) Pedestrian Detection

The predictive pedestrian protection system helps to prevent collisions and designed to minimise accident cruelty. If the pedestrian and car are in the same lane then the car warns driver or automatically start braking to avoid collision and minimise the accident.



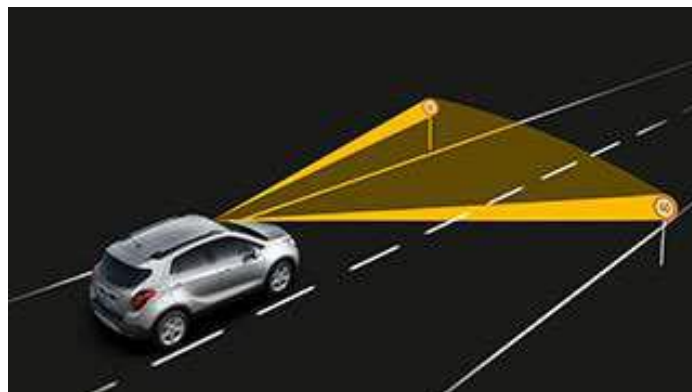
11) Rear Cross Traffic Alert

Rear Cross Traffic uses the same senses of blind spot detect system, designed to reduce the chance of accident and injury happened while the reversing out of a parking space. Basically the rear radar sensors continually monitor a wide area around 120 degrees and gives you visual and audible warnings when a potential collision detects.



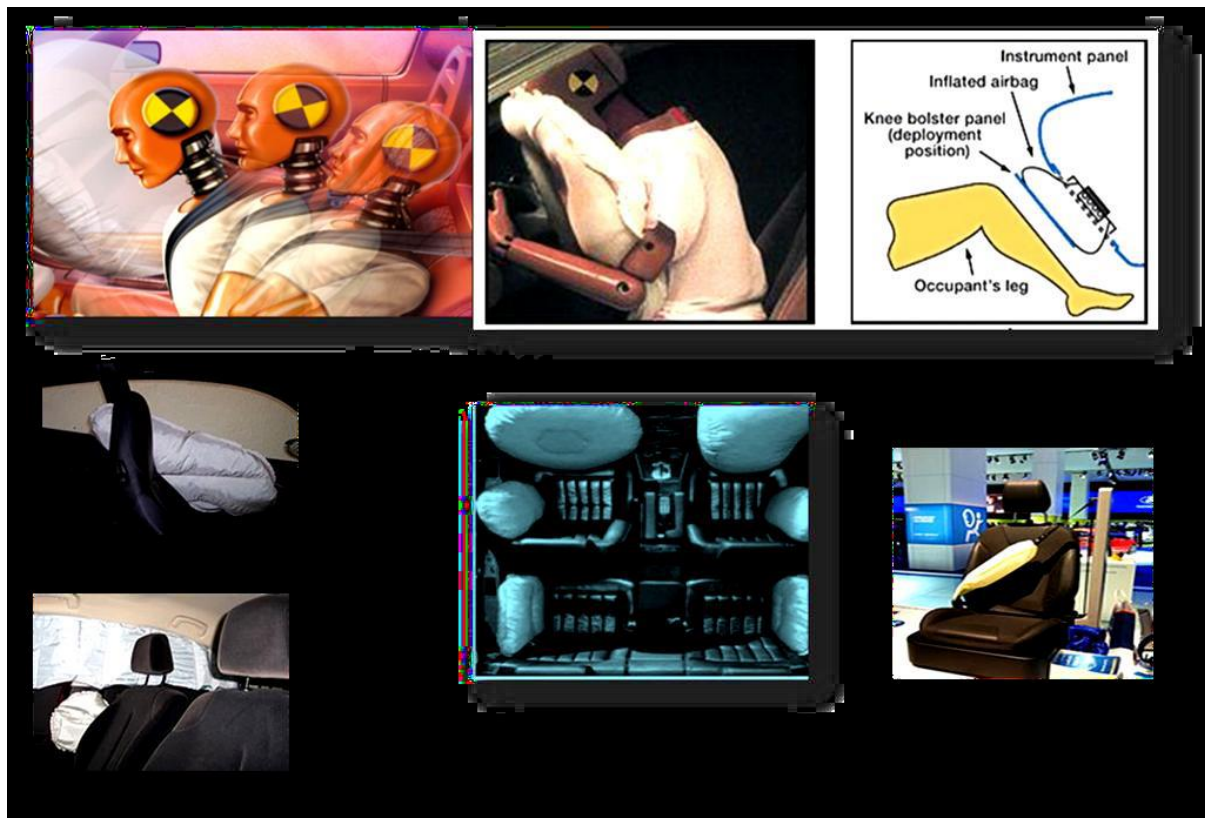
12) Traffic Sign Recognition

Traffic sign recognition (TSR) system detects the road signs such as school, turn ahead, speed limit etc.. and notify or warn the driver by displaying them on a colour screen. The first traffic sign recognition system first appeared on the BMW 7 Series in late 2008 and following other cars have introduced the TST system such as – Mercedes S Class, Audi A8, BMW 5 Series and Volvo's XC60, XC70, V60 etc..



Airbags

An Airbag is an automotive safety restraint system. It is an occupant restraint system consisting of a flexible fabric envelope or cushion designed to inflate rapidly during an automobile collision. Its purpose is to cushion occupants during a crash and provide protection to their bodies when they strike interior objects such as the steering wheel or a window. Thus it lowers the number of injuries by reducing the force exerted by steering wheel and the dashboard or any point on the body. This is accomplished in two ways, viz; i) by increasing the interval over the force being applied or ii) by spreading the force over a large area of the body



BASICS OF AIRBAGS

Newton's second law of motion.

If objects aren't restrained they will continue moving at the speed of the moving car even if the car is stopped by a collision. All airbags need to do is slow down the passengers speed to zero.

MAIN PARTS OF AN AIRBAG

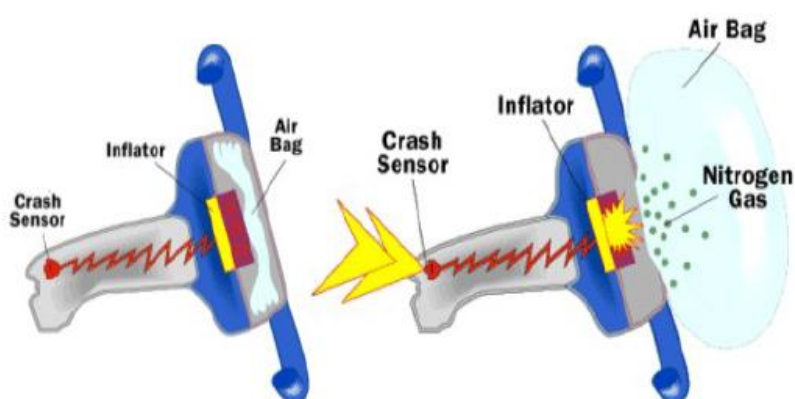
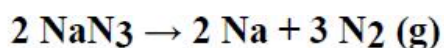
Bag - Made of thin nylon fabric, folded into a steering wheel or dashboard or more recently the door or seat.

Sensor - Tells the bag to inflate

Inflation system - The rapid pulse of hot nitrogen gas to inflate the bag.

WORKING

- During collision, a mechanical switch is flipped and an electrical contact takes place. Sensors send an electric current to the inflation system. Inflation system contains sodium azide and potassium nitrate.
- Electric current heats the filament which ignites the capsule containing Nitrogen gas.
- The gas expands quickly and inflation of air bags takes place, which literally bursts from its storage site in the steering wheel.



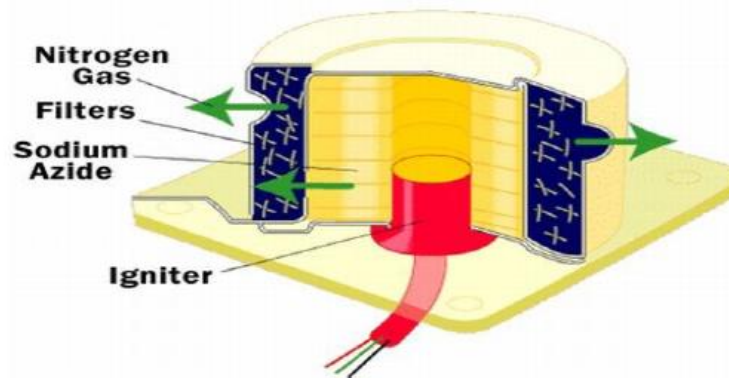
Future of airbags

- Smart Restraint Systems
- Adapts its geometry, performance or behaviour to suit various impacts and occupant position.
- Includes weight sensors.
- Determine type of occupant in the seat. i.e child or adult.
- Detect the distance of passenger from airbags.

This is how it takes place..

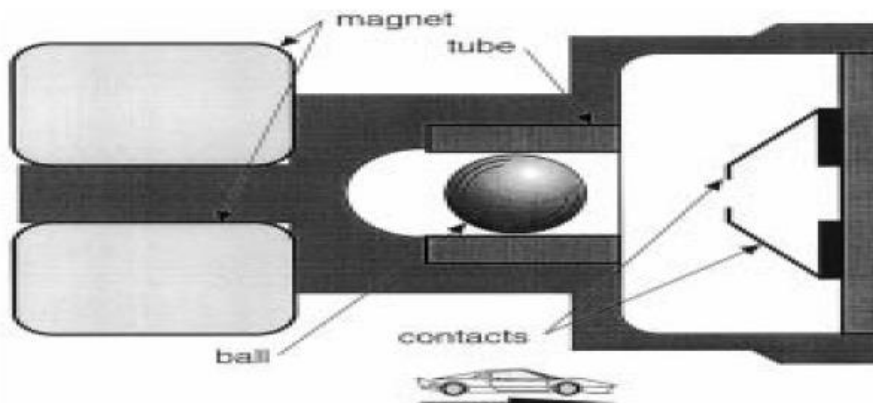


Air Bag Inflation Device



MECHANICAL CRASH SENSORS

- **CRASH SENSOR WITH DAMPING**
BALL IN-TUBE SENSOR



THE AIRFLOW GENERATES AN AERODYNAMIC DRAG FORCE THAT DAMPENS THE BALL MOTION.

- **SPRING MASS SENSOR**
ROLOMITE SENSOR

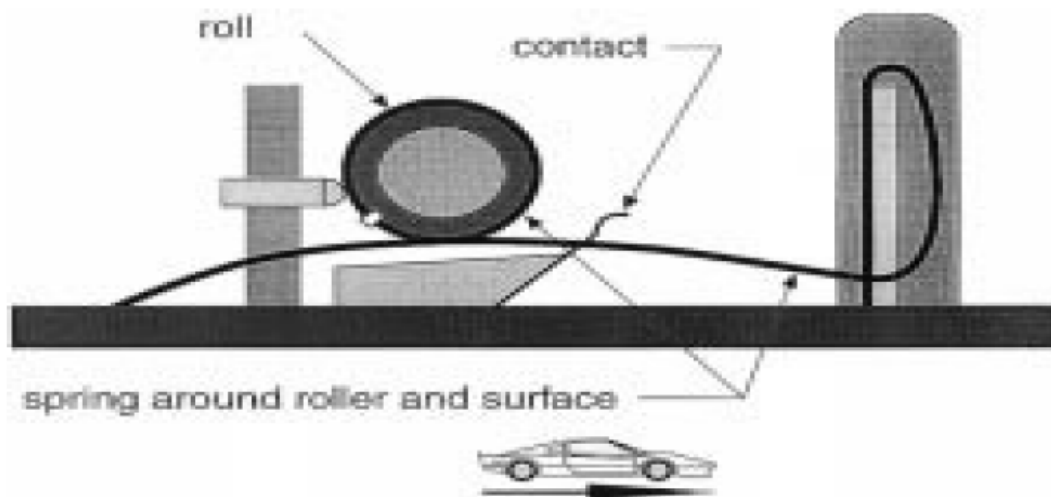
Roller- suspended with a tensioned band.

Substantial collision- roller overcomes a spring force and rotates forward.

Impact-moving contact of the metallic band touches a fixed contact and closes a circuit.

Parameters- distance of trigger

- magnitude of the spring.



MODERN TYPES OF AIRBAGS

Side air bag

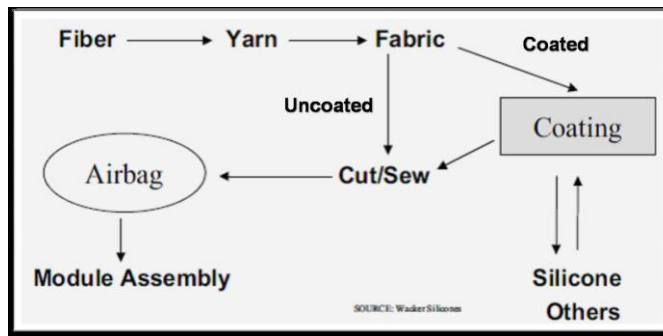
- Cars that currently offer side airbags represent the new wave of occupant protection.
- Provides protection during side collisions. This prevents the airbag on the undamaged side of the car from inflating.

Curtain airbags

It inflates in front of windows to provide passengers better head and neck protection.

- More efficient at tipping and side impacts.
- Door air bag

The door has more space, allowing for a bigger bag that provides more coverage developed by Ford and Renault. Door-mounted side air bags must begin deploying in mere 5 or 6 milliseconds!



Air bag fabric productions flow-chart

Air bag checks

Turn the key and look at the dashboard to find the airbag light on for 7-10 sec. & then it goes off.

Problems occur when

1. Light does not come on.
2. If light does not go off after the period.
3. If light comes while driving.

CONCLUSIONS:

Since safety of human life is of high priority, Air bags are of greater importance in the present vehicles. Safety bags must be implemented for safe riding and for saving precious lives. Let's hope every automobile manufacturer implements the same.

Seat belt tightening system (Seatbelt pretensioner)

The pretensioner mechanism uses an explosive charge to drive a concealed piston when sensors detect the signature abrupt deceleration of an accident. The piston, in turn, rapidly drives the spool around which the fabric strap of a seatbelt is wrapped. That incredibly fast retraction of the belt fabric removes the slack from the belt instantly. This extra seatbelt "pre-tension, moments prior to the full force of impact, pulls the bodies of the driver and front-seat passenger firmly into their seats. This positions them so as to receive the maximum protection benefit of the front airbags. It also helps prevent the unfortunate phenomenon car crash-ologists call "submarining." That's when the momentum caused by the crash jerks a victim's body under his or her lap belt and sends it careening forward below the dash.

Collision warning system

Automatic braking system

Automatic braking is a safety technology that automatically activates the vehicle's brake system, to some degree, when necessary. ... Active crash avoidance technologies use sensors, cameras, radar, and LIDAR to detect vehicles. Most systems issue a visual or audible warning when detecting an impending vehicle collision.



HOW AUTOMATIC BRAKING SYSTEM WORKS?

Each motor vehicle manufacturer has its own automatic braking system technology, but they all rely on some type of sensor input. Some of these systems use lasers, others use radar, and some even use video data. This sensor input is then used to determine if there are any objects present in the path of the vehicle. If an object is detected, the system can then determine if the speed of the vehicle is greater than the speed of the object in front of it.

A significant speed differential may indicate that a collision is likely to occur, in which case the system is capable of automatically activating the brakes.

In addition to the direct measurement of sensor data, some automatic braking systems can also make use of GPS data. If a vehicle has an accurate GPS system and access to a database of stop signs and other information, it can activate its auto brakes if the driver accidentally fails to stop in time.

Collision Mitigation Brake System (CMBS)

The collision mitigation brake system (CMBS) assists your braking operation by automatically applying an appropriate amount of braking force to help you avoid or minimize the chances of hitting a vehicle ahead of you in traffic. It consists of two parts

1) Monocular camera and

2) Radar sensor



When your speed is above 10 mph (15 km/h), the CMBS radar sensor in the front grille can sense a vehicle ahead of you. When your vehicle gets too close to the vehicle ahead of you, the system activates a warning beep, causes automatic application of the brakes. When CMBS activates its automatic brake, it also turns the brake lights on.

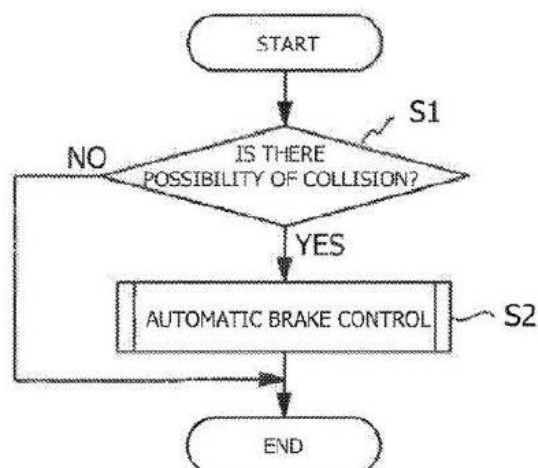
Two wheeler vehicle

For motorcycles, Honda faces the added challenge of adding automatic braking system certain limits to prevent disrupting the rider, which could pose its own risks. When a potential collision is sensed, the system checks to see whether the rider has already started applying the brakes.

If so, the automatic braking system provides supplemental braking pressure while keeping the same ratio of front and rear braking so it feels more natural to the rider.

Flow chart of auto braking system

FIG. 3

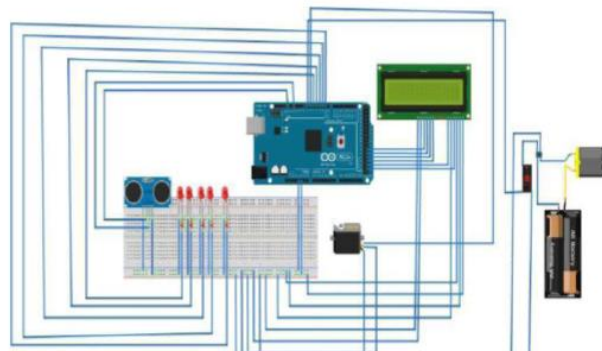


If the rider had not applied brakes, the system would first activate the rear brake to prevent nose dive. The system then calculates the friction coefficient of the road surface before determining the appropriate braking limits.

If the rear brake reaches its lock limit, the system then applies front brake pressure. The system continues to work until the motorcycle is stopped or the obstacle is no longer a threat.

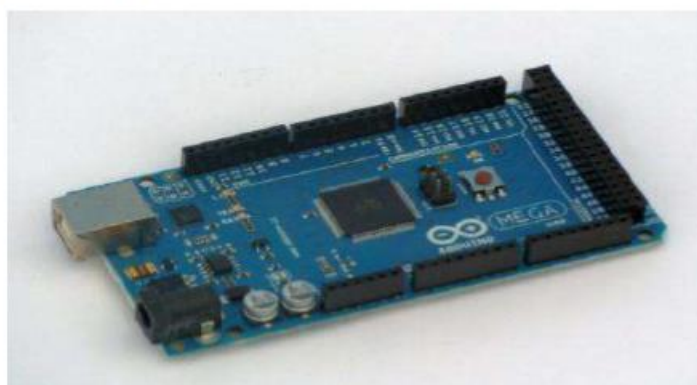
Construction

- The Collision warning with automatic braking system for electric vehicles comprises of the following



●Arduino Mega 2560:

- An Arduino board consists of an Atmel 8-, 16- or 32-bit AVR microcontroller with complementary components that facilitate programming and incorporation into other circuits. An important aspect of the Arduino is its standard connectors, which lets users connect the CPU board to a variety of interchangeable add-on modules known as shields.



●Fig: Arduino

Collision sensing mechanism:

The distance between the vehicle and obstacle is sensed using an Ultrasonic sensor. Like radar, lidar and active infrared systems, ultrasound can be used in detection and ranging applications using the time of flight principle to estimate the distance. Collision Warning With Automatic Braking System to an object.

Ultrasonic emissions are effectively sound waves with frequencies higher than that audible to the human ear, suitable for short to medium range applications at low speed. Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm.

The basic principle of work:

- (1) Using IO trigger for at least 10µs high level signal.
- (2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.
- (3) IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.
- Test distance = (high level time × velocity of sound (340M/S) / 2.

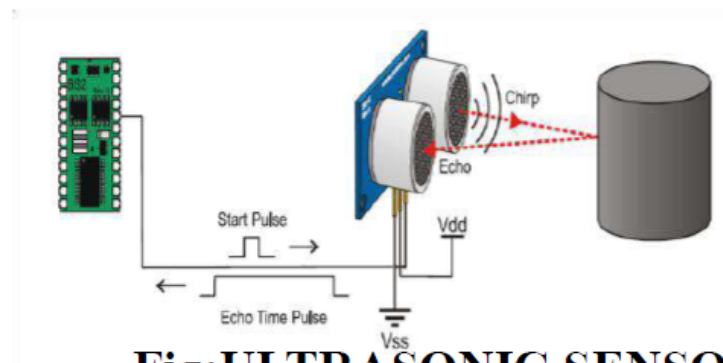
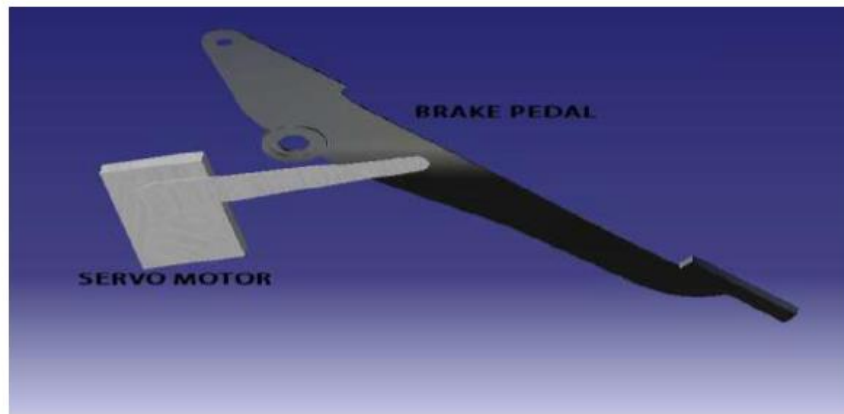


Fig:ULTRASONIC SENSOR

Braking Mechanism:



The brake is activated using a servo motor. An arm from the servo motor is connected to the brake pedal. When the arm of the servo motor rotates the brake pedal is actuated and the brake is applied.



WORKING MECHANISM:

When the distance between the vehicle and obstacle falls below the permissible limits which is sensed by the ultrasonic sensors, the Arduino send output signal to the servo motor and the relay switch and also to the LCD display and LED flashers. The output to the servo motor is the angle through which it has to rotate and to the relay switch is to turn off the signal to it by which the device i. e. prime mover connected to it is turned off. In the LCD display the distance between the vehicles and obstacle is shown along with Red color LED flashers turned on warning the driver about the collision.

Advantages

- The systems are able to sense other vehicles and road users, including pedestrians and cyclists, or objects near the vehicle. Audio and visual alerts help drivers to avoid potential crashes.
 - Forward crashes
 - Pedestrians and cyclists
 - Lane departure
- Headway monitoring (vehicles travelling in front of the driver)
- More warning of accidents when driving in adverse weather conditions
- Compensates for human error when driving

CONCLUSION:

- Automatic collision warning with braking system brings major transportation benefits in terms of safety, efficiency, affordability and usability, and environment in order to

achieve its development goals. It helps in decreasing the number of deaths that are occurring due to fatal accidents.

- Automatic collision warning with braking system is a complex large-scale control system, whose design required advances in sensor, actuator and communication technologies and in techniques of control system synthesis and analysis

CHILD LOCK

Child safety locks are built into the rear doors of most cars to prevent rear seat passengers from opening the doors both during transit and while the vehicle is stationary. With an update to the Code of Federal Regulations in 1985[3] vehicles sold in the US began installing rear door child safety locks on all models. While referred to as child safety locks, this device prevents operation of the interior door handle for any passenger using the engaged door's interior handle, preventing exit unless the rear window can be lowered and the exterior handle engaged, or the passenger relocates to the front driver's seat.

The lock is typically engaged via a small switch on the edge of the door that is only accessible when the door is open. Some cars[4] implement the child lock control as a rotary mechanism which can only be operated with a key. This design ensures the child lock remains in position, preventing passengers from changing the lock position when the door is open. Once the door is closed, control of these two mechanical type child locks is completely inaccessible to passengers. Starting in 1999,[5] manufacturers began using electronic child locks activated from the driver position via a Door control unit,[6] although Nissan offered manual, remote controlled child locks on their Pulsar/Cherry as early as 1982.[7]

when the safety lock is engaged, it "prevents operation of the interior door handle or other interior latch release control and requires separate actions to unlock the door and operate the interior door handle or other interior latch release control," effectively locking passengers inside the vehicle.

There are two types of child lock available in vehicle.

1Door lock: This lock prevent risk of opening door by children in running vehicle. By moving switch you can switch the lock on and off.

2. Window lock: If there is power window the opening it accidentally and Chance of loses will be there. So driver has a button that helps not to open any Window individually.

By using this simple technics you can easily avoid such accidents.

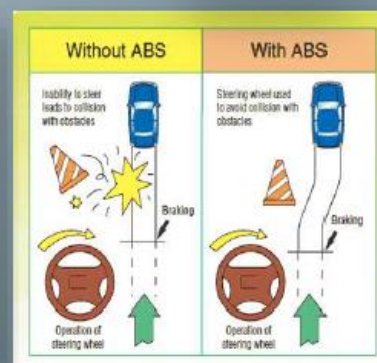
Anti-lock braking system (ABS)

ABS is an automobile safety system prevent the wheels of a vehicle locking as brake pedal pressure is applied - often suddenly in an emergency or short stopping distance. This enables the driver to have steering control, preventing skidding and loss of traction.

Motivation for ABS Development

- Under hard braking, an *ideal* braking system should:

- Provide the shortest stopping distances on all surfaces
- Maintain vehicle stability and steer ability.



Overview

Many different control methods for ABS systems have been developed. These methods differ in their theoretical basis and performance under the changes of road conditions.

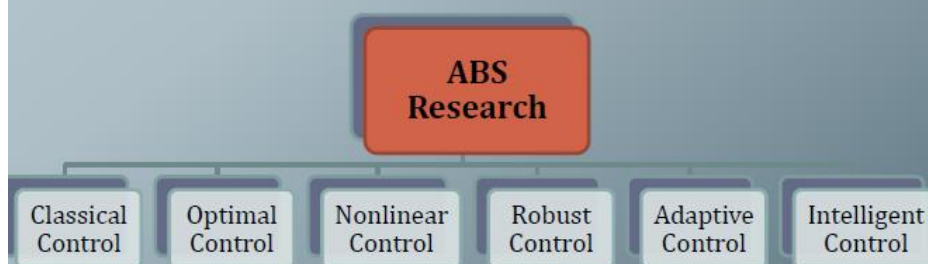


Figure 1. Sampling of ABS control

Principles for ABS Operation

When the brake pedal is depressed during driving, the wheel speed decreases and the vehicle speed does as well. The decrease in the vehicle speed, however, is not always proportional to the decrease in the wheel speed. The non-correspondence between the wheel speed and vehicle speed is called “slip” and the magnitude of the slip is expressed by the “slip ratio” which is defined as follows:

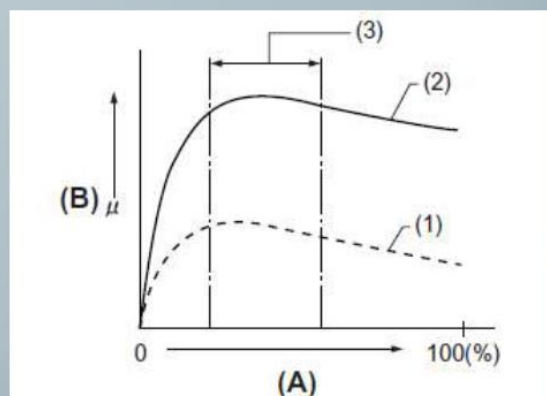
Slip ratio = $(\text{Vehicle speed} - \text{Wheel speed}) / \text{Vehicle speed} \times 100\%$

When the slip ratio is 0%, the vehicle speed corresponds exactly to the wheel speed. When it is 100%, the wheels are completely locking (rotating at a zero speed) while the vehicle is moving.

- The best braking action occurs at between 10-20%.

- If vehicle speed and wheel speed is the same wheel slippage is 0%

- A lock-up wheel will have a wheel slippage of 100%



(A) Slip ratio

(B) Coefficient of friction between tire and road surface

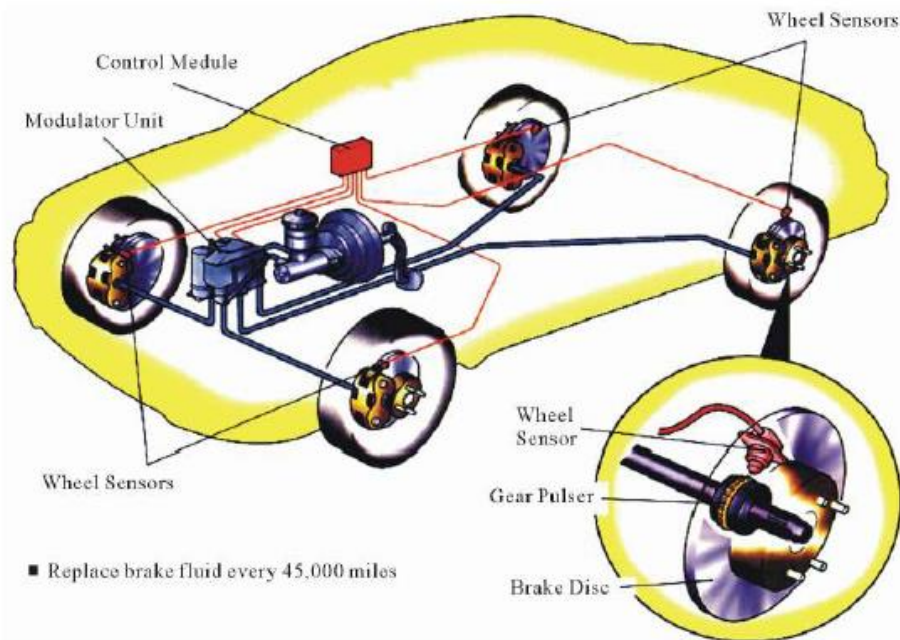
(1) Icy road

(2) Asphalt-paved road

(3) Control range by ABS

It shows the relationship between braking co-efficient and wheel slip. It is shown that the slide values for stopping/traction force are proportionately higher than the slide values for cornering/steering force. A locked-up wheel provides low road handling force and minimal steering force.

ABS Components Overview



- ☐ Hydraulic unit.
- ☐ Electronic brake control module (EBCM).
- ☐ Two system fuses.
- ☐ Four wheel speed sensors.
- ☐ Interconnecting wiring
- ☐ The ABS indicator
- ☐ The rear drum brake.

ABS brake system are,

Integrated - An integrated system has the master cylinder and control valve assembly made together.

Nonintegrated - A nonintegrated has the master cylinder and control valve assembly made separate.

How does ABS work? Simplicity

We will discuss how one of the simpler system works.

- ❑ Sensors at each of the four wheels → sense the rotation of the wheel.
- ❑ Too much brake application → wheel stop rotating
- ❑ Sensors → ECU → releases brake line pressure → wheel turns again.
- ❑ then ECU applies pressure again → stops the rotation of the wheel releases it again and so on

NB:

- ✓ This **releasing** and **re-application** or **pulsing** of brake pressure happens 20-30 times per second or more.
- ✓ This keeps the wheel just at the limit before locking up and skidding no matter
- ✓ ABS system can maintain extremely high static pressure and must be disabled before attempting repairs.

How does ABS work? Solenoid Valve

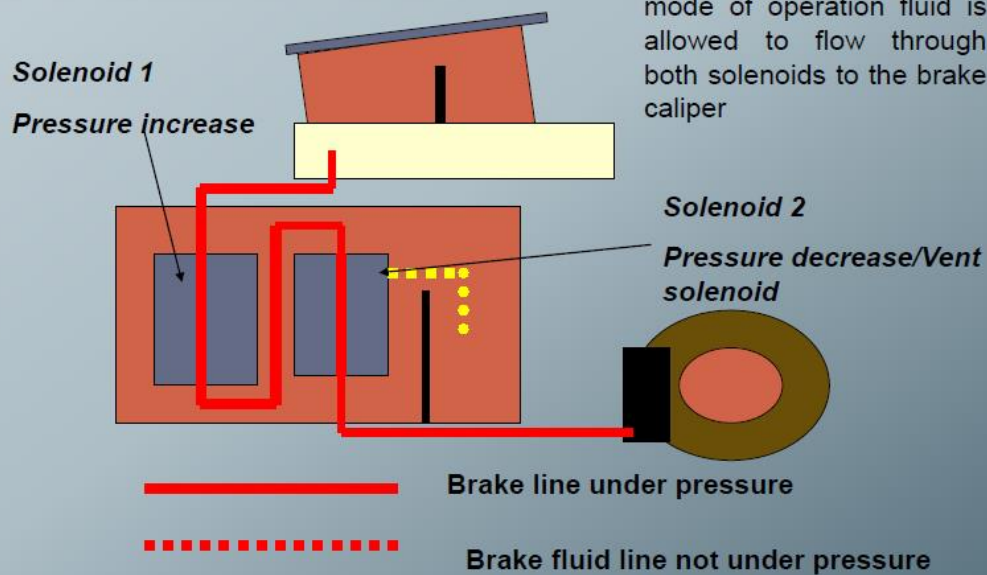
• Solenoid Valve Assembly:

Is a pair of valves that can:

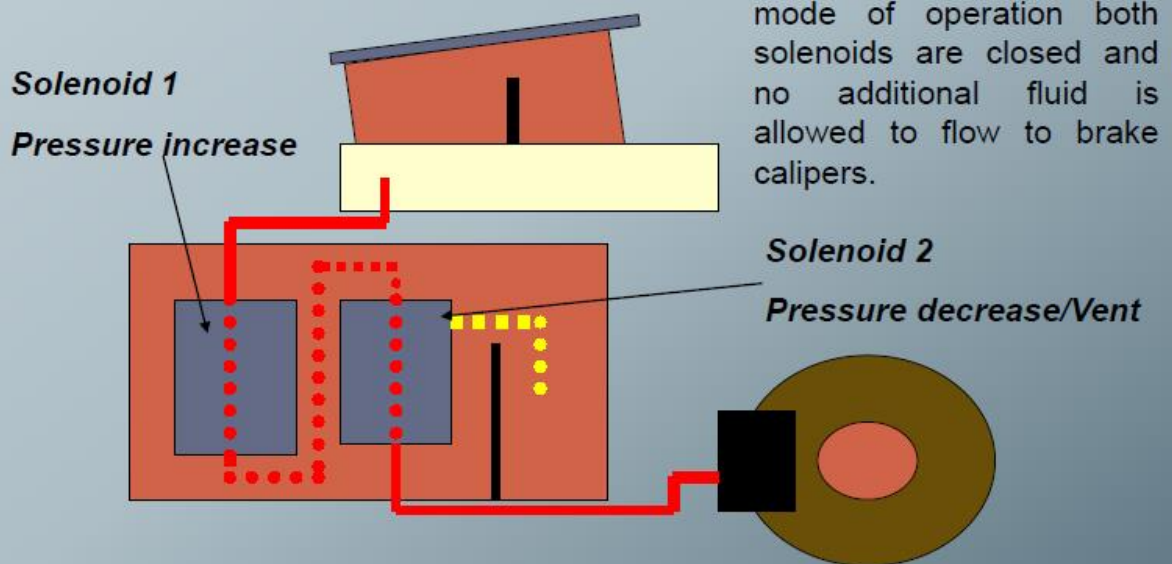
- A. Increase pressure
- B. Hold pressure steady
- C. Decrease pressure

How does ABS work? Solenoid Valve

A. Increase pressure

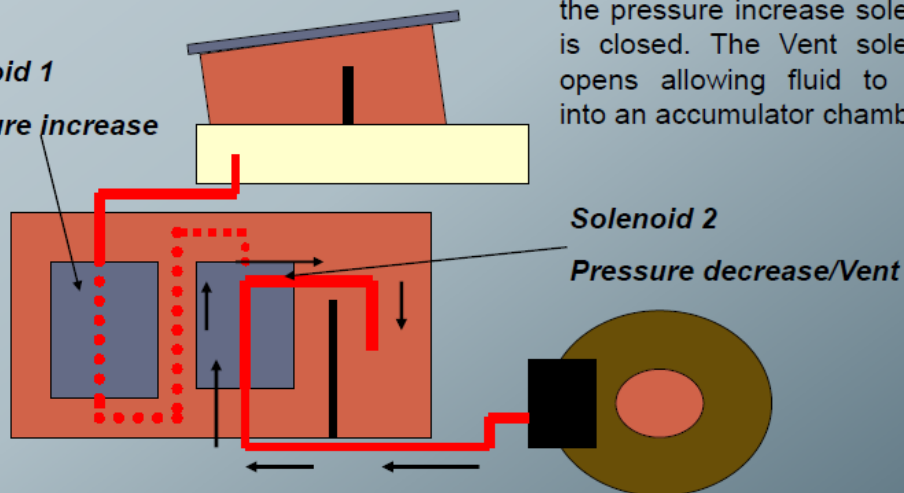


B. Hold pressure steady



C. Decrease pressure

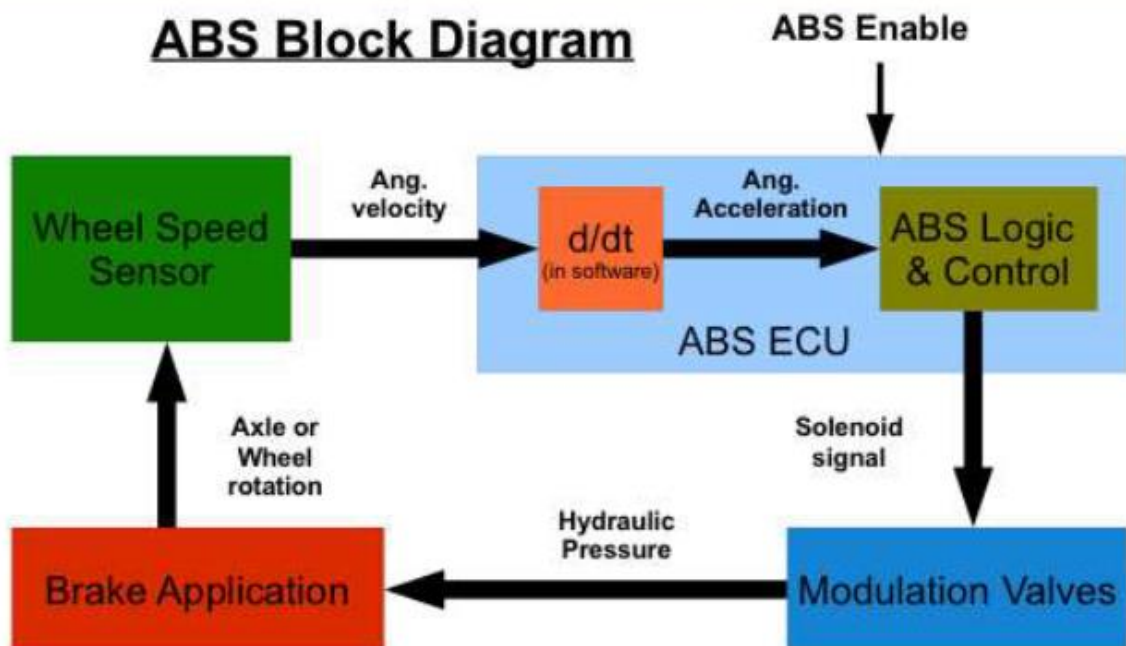
Solenoid 1
Pressure increase



During **Pressure Vent** mode the pressure increase solenoid is closed. The Vent solenoid opens allowing fluid to vent into an accumulator chamber

System Diagram

ABS Block Diagram

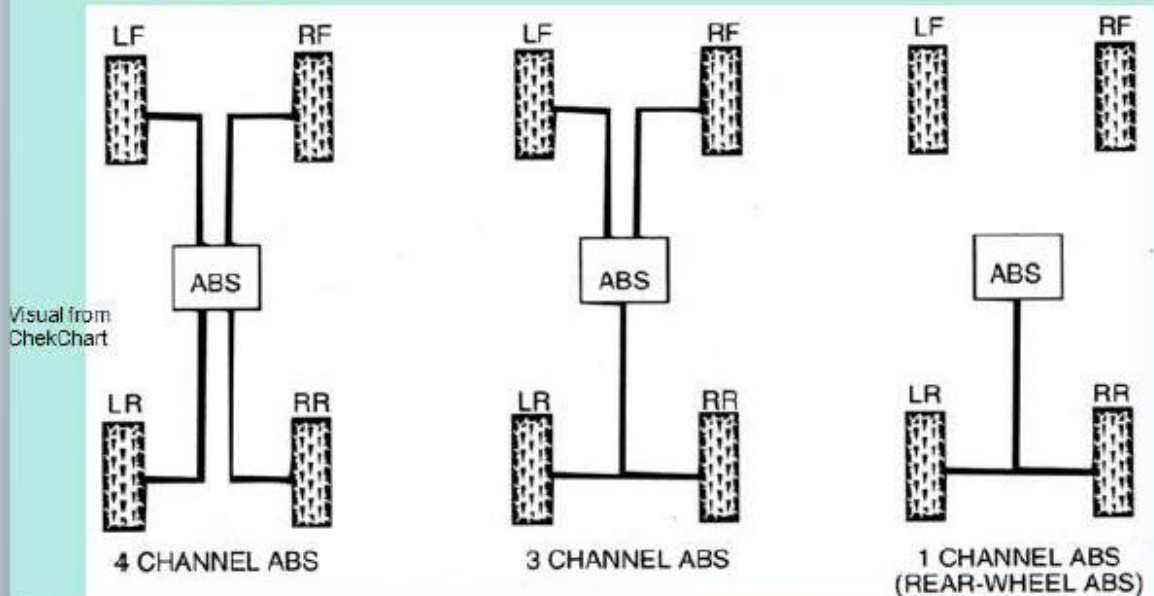


• Figure 4. ABS Block Diagram

Configuration Options:

- One Channel
- Three Channel
- Four Channel.

A Channel refers to how the control over the hydraulic brake pressure is organized.



Configurations of ABS Types

Advantages:

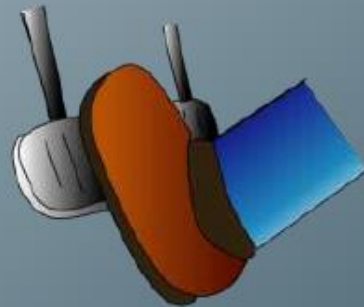
1. It allows the driver to maintain directional stability and control over steering during braking
2. Safe and effective
3. Automatically changes the brake fluid pressure at each wheel to maintain optimum brake performance.
4. ABS absorbs the unwanted turbulence shock waves and modulates the pulses thus permitting the wheel to continue turning under maximum braking pressure

• Disadvantages

1. **Stop Times** - Anti-lock brakes are made to provide for surer braking in slippery conditions. However, some drivers report that they find the stopping distances for regular conditions are lengthened by their ABS system, either because there may be errors in the system, or because noise of the ABS may contribute to the driver not braking at the same rate.



1. **Delicate Systems** - It's easy to cause a problem in an ABS system by messing around with the brakes. Problems include disorientation of the ABS system, where a compensating brake sensor causes the vehicle to shudder, make loud noise or generally brake worse.



3. **Cost** - An ABS can be expensive to maintain. Expensive sensors on each wheel can cost hundreds of dollars to fix if they get out of calibration or develop other problems. For some, this is a big reason to decline an ABS in a vehicle.



4. **System damage** - A variety of factors can cause the system to be less effective, and can present with everything from shuddering of the vehicle to loud noises while trying to stop



Limitations:

The sensors on the wheels might get contaminated by metallic dust. When this condition occurs the sensors become less efficient in picking up problems. In modern ABS systems, two more sensors are added to help:

- wheel angle sensor
- gyroscopic sensor

The idea behind this is that when the gyroscopic sensor detects that the car's direction is not the same as what the wheel sensor reports, the ABS software will cut in to brake the necessary wheel in order to help the car go the direction the driver intends.

Conclusion

The antilock braking system controls braking force by controlling the hydraulic pressure of the braking system, so that the wheels do not lock during braking.

The antilock braking system prevents wheels locking or skidding, no matter how hard brakes are applied, or how slippery the road surface. Steering stays under control and stopping distances are generally reduced.

Anti-theft technologies

3 Types of Anti-Theft Systems For Cars

1. GSM Technology Based Vehicle Theft Intimation to the Owner On Cell Phone



GSM Technology Based Vehicle Theft Intimation

The main goal of this project is to use **GSM technology** to intimate the owner of the vehicle about any unauthorized entry. This process is done by sending an SMS to the owner, and the advantage of this project is that the owner can send back the SMS with the necessary instructions to stop the vehicle instantly.

Hardware Requirements

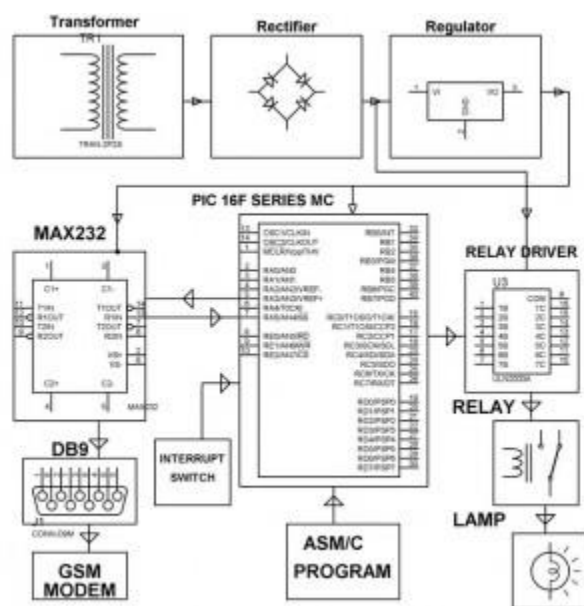
PIC16F8 Microcontroller, Level Shifter IC, GSM Modem, Crystal, Switch, LED, Resistors, Capacitors, Voltage Regulator, Relay Driver, DB9 Connector, Lamp, Relays.

Software Requirements

Embedded c or Assembly, MP Lab and CCS C Compiler

Project Description

Day by day crime rate is increasing, so, a better security system is very essential for vehicles. In this proposed system if someone tries to steal a car or any vehicle, the microcontroller gets an interrupt through a switch which is connected to the system; then, the system orders the GSM modem to send an SMS. The vehicle owner receives the SMS from the GSM modem informing the owner about the theft. Immediately, the owner of the vehicle can send back an SMS to the GSM modem to stop the engine.



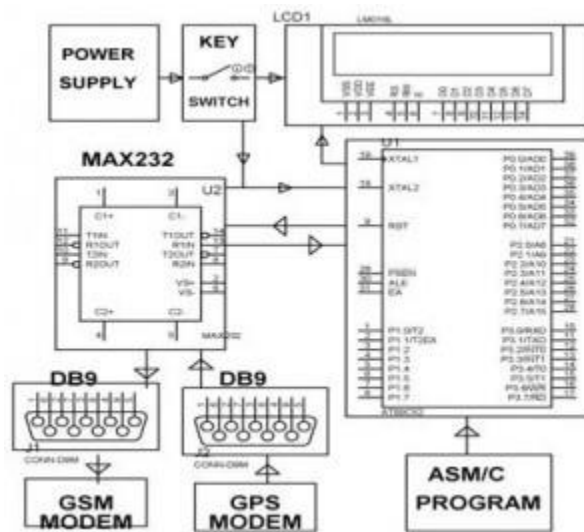
Block Diagram of Vehicle Theft Intimation System

The GSM modem interfaced to the microcontroller, receives the message that disables the ignition of the vehicle resulting in stopping the vehicle. This project uses a lamp (for indication purpose) to indicate the on/off condition of the engine.

Thus, the owner of the vehicle can protect his car from being stolen from anywhere. Furthermore, this project can be enhanced by integrating a GPS system, which gives the exact location of the vehicle in terms of its longitude and latitude. Apart from protecting the vehicle, the location information can also be sent to the owner through an SMS.

2. Vehicle tracking by GPS – GSM

The main intention of this project is to reduce vehicle thefts by finding the exact location by using a GPS modem.



Block Diagram of Vehicle tracking by GPS – GSM

Hardware Requirements

Microcontroller AT89C52, MAX 232, GSM Module, Resistors, Capacitors, Voltage Regulator, GPS Modem, DB9 Connector and LCD Display.

Software Requirements

Keil Compiler, Embedded C

Project Description

Nowadays, vehicles have been increasing day by day in our country, and along with them anti-theft- security systems for cars or vehicles have also been increasing. To overcome this problem, the following project: Vehicle tracking by GPS – GSM is useful.

This proposed system mainly includes a power-supply block, a microcontroller, a GPS, a GSM modem, Max232, and several other components. The GPS system navigates the location of the vehicle in terms of its longitude and latitude positions. The microcontroller gets the information from the GPS modem through MAX232. The MAX232 is a serial communication interface between the microcontroller and GSM modem; it converts from TTL level to RS232 level.

The GSM modem sends the SMS to a predefined mobile which stores the data in it. An LCD display displays the location information in terms of latitude and longitude values. The

microcontroller is pre programmed with the Keil software and therefore, continuously checks the GPS modem.

3. Microcontroller Based Anti-theft Security System Using GSM Networks with Text Message as Feedback

The main intention of this project is to protect a vehicle from being stolen by using GSM and GPS. In this project, we present an anti-theft-control system for automobiles. In present days, vehicle theft is increasing rapidly and people have started using anti-theft-control systems in different automobiles' systems. These anti-theft-control systems are very expensive, but this project is designed cost-effectively by using a microcontroller along with the GPS and GSM.



Microcontroller Based Anti-theft Security System

Hardware Requirements

Microcontroller, Power Supply, GSM Module, Keypad, LCD, Proximity Sensors, Engine and Ignition Key

Software Requirements

Embedded C, Keil IDE, ISP or U-Flash, Express PC

Project Description

In this project, we present an anti-theft-control system for automobiles that tries to stop a vehicle from being stolen. This proposed system makes use of an embedded chip with an inductive-proximity sensor. If a wrong key is entered into the keypad, the proximity sensor senses the key and sends the message to the owners mobile stating that the vehicle is being accessed. Subsequently the control system present in the car prompts the person entering the key to enter the correct password.

If the person accessing the vehicle fails to enter the correct password thrice, then a message will be sent to the nearest police station indicating the vehicle number, and subsequent to this, the fuel injector of the car gets deactivated. This makes the user helpless to start the car. This project is simple and robust.

Thus, by implementing these vehicle security system projects by using GPS and GSM technologies, a vehicle can be protected from thefts. In future, this security system will be improved to function as an integrated-data-security system for car communication systems. It would ensure that all the data exchanged within the vehicle and outside the vehicle is protected.

SMART CARD SYSTEM

A Registration Certificate copy or RC is a document that proves your **vehicle** is registered with the Regional Transport Office (RTO) authorities. Nowadays, you can avail your Registration Certificate copy in the form of a **Smart card**. The **smart card** will have the following information on it: Registration Number.

Smart cards can provide personal identification, authentication, data storage, and **application** processing. Applications include identification, financial, mobile phones (SIM), public transit, computer security, schools, and healthcare.

Types of Smart Cards

The term “**smart card**” is loosely used to describe any **card** that is capable of relating information to a particular application such as magnetic stripe **cards**, optical **cards**, memory **cards**, and microprocessor **cards**. It is correct, however, to refer to memory and microprocessor **cards** as **smart cards**

A **smart card** is a plastic **card** with a small, built-in microcomputer **chip** and integrated circuit that can store and process a lot of data. It is considered to be a secure, time-saving device that can access information without use of a PC or the Internet. However, **smart cards** have both **advantages** and disadvantages.

Smart-Card Features that Protect Privacy

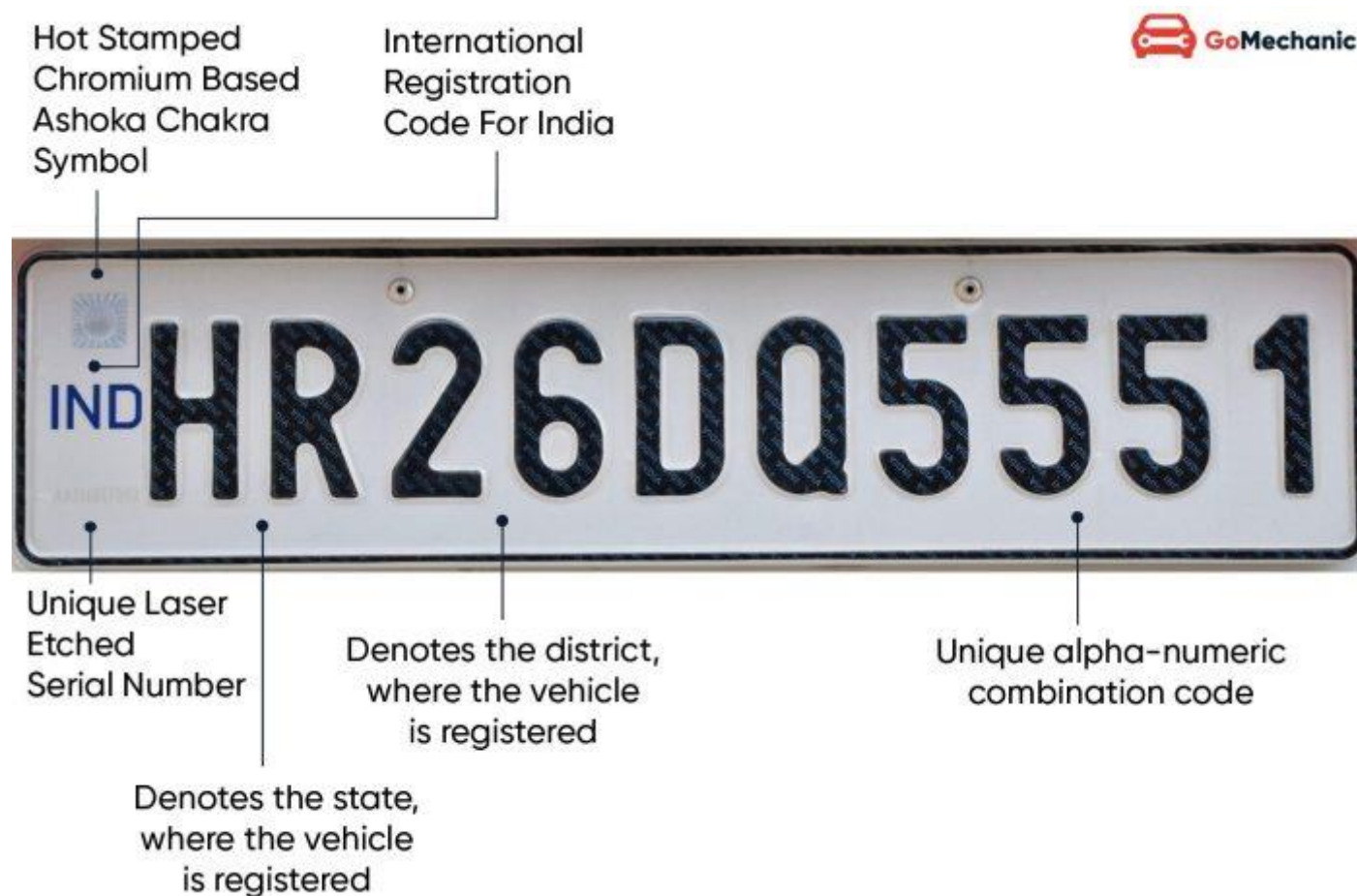
- Authentication. Smart cards provide ways to authenticate others who want to gain access to the card. ...
- Secure data storage. Smart cards provide a way to securely store data on the card. ...
- Encryption. ...
- Strong device security. ...
- Secure communications. ...
- Biometrics. ...
- Personal device.

NUMBER PLATE CODING

As per *The Motor Vehicles Act, 1988*, all motorised vehicles plying on Indian roads must be registered with the RTO and bear a *license plate* (number plate). There are various types of number plates in India. An unregistered vehicle falls in direct violation of the act which can attract a heavy penalty.

A license plate is a combination of alphabets and digits that form a registration number. The license plate is issued by the district RTO (Regional Transport Office) and should be placed in the front and the back of the vehicle with provision for illumination. The international registration code for India is **IND**.

Deciphering The Indian Number Plate



Car Number Plate In India

- The first two letters on a number plate (DL, KL, HR, MH etc) denote the region or the state the vehicle is registered with. For a vehicle registered with Chhattisgarh RTO will bear the letters CG.
- The following digits indicate the district in which the vehicle is registered.

- The third part of the license plate is a set of numbers (typically four) which is unique to the vehicle. Vanity numbers, like 0001, 0786, 1111 are regarded as VIP numbers and can be bought at RTO auctions for a premium price.
- The last part of the license plate displays the international registration code for India **IND**.

What Is HSRP (High Security Registration Plate)?



Types of Car Number Plates in India

The number plate regulations associated with the *Central Motor Vehicle Rules, 1989* state that all vehicles registered after April 1, 2019, should bear **HSRP** or **High Security Registration Plate**. This is also applicable to old vehicles registered with old number plates. High security number plates help prevent vehicle theft as these special plates are only issued by the government. HSRPs also help in creating a digitised national database of registered vehicles.

High security number plates are vehicle license plates standard across all states in India. Made of aluminium featuring a unique laser-etched code below the **IND** (international registration code for India) and the **Ashoka Chakra** hologram. The registration number is hot stamped with **IND** engraved at a 45-degree angle. The number plates are secured with snap locks which becomes non-reusable when tampered with

Types of Number Plates in India

- **White number plate with black lettering**



Personal Car Registration

The most common type of number plate, attributed to private or non-commercial cars. Vehicles bearing this number plate cannot be used for commercial purposes like goods transport, ferrying passengers etc.

- **Yellow number plate with black lettering**



Commercial Car Registration

These are commercial vehicles like taxi, cabs, trucks. Yellow number plates have a different tax structure compared to white number plates and commercial car drivers with yellow plates are also mandated to have a commercial driving permit.

- **Black number plate with yellow lettering**



Self Driven/Rental Car Registration

Black number plates are for a vehicle registered as rental or self-driven. These types of number plates are also popular with luxury hotel transport. These cars can ply as a commercial vehicle without the driver having to own a commercial driving permit.

- **Green number plate with white lettering**



Electric Vehicle Registration

This number plate is unique to electric cars only. This is applicable to road-legal electric busses and other electric commercial vehicles (like Mahindra e20, Tata Tigor Electric).

- **Red number plate with white lettering**



Temporary Car Registration

The red registration plate is issued as a temporary registration for a brand new vehicle until permanent registration is issued by the RTO. Temporary registration is valid for 1 month only. However, all Indian states do not allow temporarily registered vehicles to ply on road.

- **Blue number plate with white lettering**



Diplomat/Embassy Car Registration

A blue coloured number plate with white lettering is issued to a vehicle belonging to a foreign diplomat *United Nations (UN)*, *Diplomatic Corps (CD)* or *Consular Corps (CC)*.

- **Number plate with an upward-pointing arrow**



Military Vehicle Registration

A vehicle bearing these number plates are military vehicle registered Ministry of Defence in New Delhi. This registration plate has an upward pointing arrow at the first or after the second character, known as Broad Arrow. The digits succeeding the arrow denote the year in which the vehicle was procured. The next is the base code, followed by the serial number. The letter ending after the serial number indicates the class of the vehicle.