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Automatic Speed Reduction to Avoid Accidents

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Abstract: ***We analyse the automatic braking system to reduce the speed automatically to avoid the panic action of automobiles. Stop the vehicle when it is in the accidental zone, we applied the velocity calculation according to the weight of the body which can reach to required velocity state to avoid the accident. We are using the electromagnetic braking system to reduce the speed of vehicle it is about meet the accident. In this we achieve a better braking system and also it is relevant to future automobiles.***
The prototype has been prepared depicting the technology and tested as per the simulated conditions. In future the actual model may be developed depending on its feasibility

I. INTRODUCTION OF BRAKING SYSTEM

A. *Braking System*

In an automobile vehicle, a braking system is an arrangement of various linkages and components (brake lines or mechanical linkages, brake drum or brake disc, master cylinder or fulcrums etc.) that are arranged in such a fashion that it converts the vehicle's kinetic energy into the heat energy which in turn stops or decelerate the vehicle.

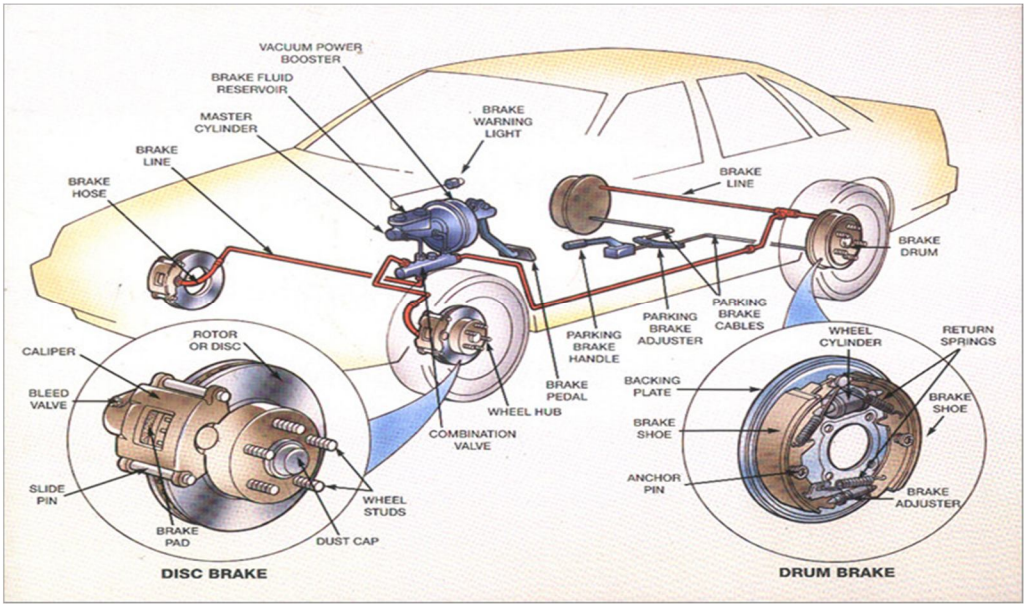

Fig.1.1 Braking System

1) *Need of a Braking System*

a) In an automobile vehicle braking system is needed.
b) To stop the moving vehicle.
c) To de accelerate the moving vehicle.
d) For stable parking of a vehicle either on a flat surface or on an slope.
e) As a precaution for accidents.
f) To prevent the vehicle from any damage due to road conditions

2) *Classification of Braking System*

As we have already discussed the evolution of braking system from vintage carts to modern cars, from vintage carriages to modern trucks has given us various different purpose braking systems which are classified on the basis of various needs and purposes of an automobile vehicle. So let's just discuss them.

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a) *On the Basis of Power Source:* The power source which carries the pedal force applied by the driver on brake pedal to the final brake drum or brake disc in order to de accelerate or stop the vehicle the braking systems are of 6 types-

- Mechanical braking system
- Hydraulic braking system
- Air or pneumatic braking system
- Vacuum braking system
- Magnetic braking system
- Electric braking system

b) *On the Basis of Frictional Braking Contact:* On the basis of the final friction contact made between the rotating brake components i.e. brake drum or disc rotor and the brake shoe the braking systems are of 2 types-

- Internal expanding brakes (e.g.- drum brakes)
- External contracting brakes(e.g. disc brakes)

c) *The Basis of Application:* On the basis of method of applying brakes, braking systems are

- Foot or service brakes
- Hand or parking brakes

d) *On the Basis of Brake Force Distribution*

- Single acting brakes
- Dual acting brakes

B. *Different Types of Braking System on Power Source Basis*

1) *Mechanical Brakes:* It is the type of braking system in which the brake force applied by the driver on the brake pedal is transferred to the final brake drum or disc rotor through the various mechanical linkages like cylindrical rods, fulcrums, springs etc. In order to de accelerate or stop the vehicle. Mechanical brakes were used in various old automobile vehicles but they are obsolete now days due to their less effectiveness.

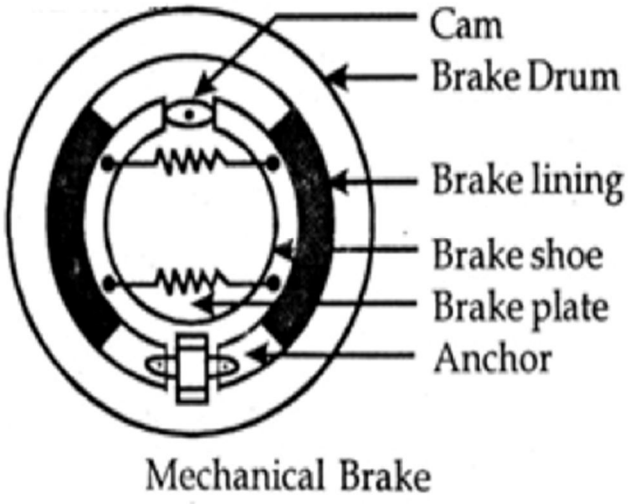

FIG.1.2.A. Mechanical Brakes

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2) *Hydraulic Brakes:* It is the type of braking system in which the brake force applied by the driver on brake pedal is first converted into hydraulic pressure by master cylinder (for reference read article on master cylinder) than this hydraulic pressure from master cylinder is transferred to the final brake drum or disc rotor through brake lines. Instead of mechanical linkages, brake fluid is used in hydraulic brakes for the transmission of brake pedal force in order to stop or de accelerates the vehicle. Almost all the bikes and cars on the road today are equipped with the hydraulic braking system due to it high effectiveness and high brake force generating capability.

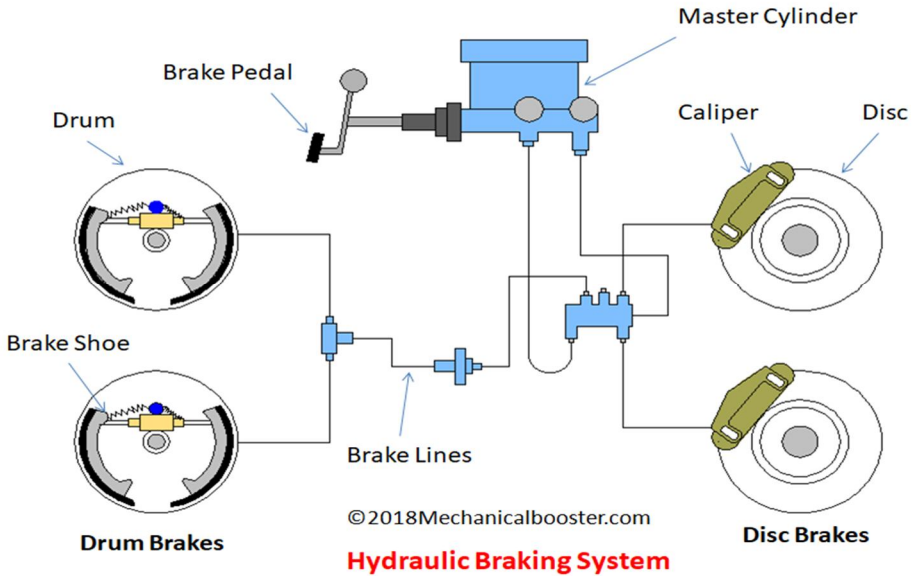


Fig.1.2.B. Hydraulic Brakes

3) *Air or Pneumatic Brakes:* It is the types of braking system in which atmospheric air through compressors and valves is used to transmit brake pedal force from brake pedal to the final drum or disc rotor. Air brakes are mainly used in heavy vehicles like busses and trucks because hydraulic brakes fails to transmit high brake force through greater distance and also pneumatic brakes generates higher brake force than hydraulic brake which is the need of the heavy vehicle. The chances of brake failure is less in case of pneumatic brakes as they are usually equipped with a reserve air tank which comes in action when there is a brake failure due to leakage in brake lines. High end cars these days are using air brakes system due to its effectiveness and fail proof ability.

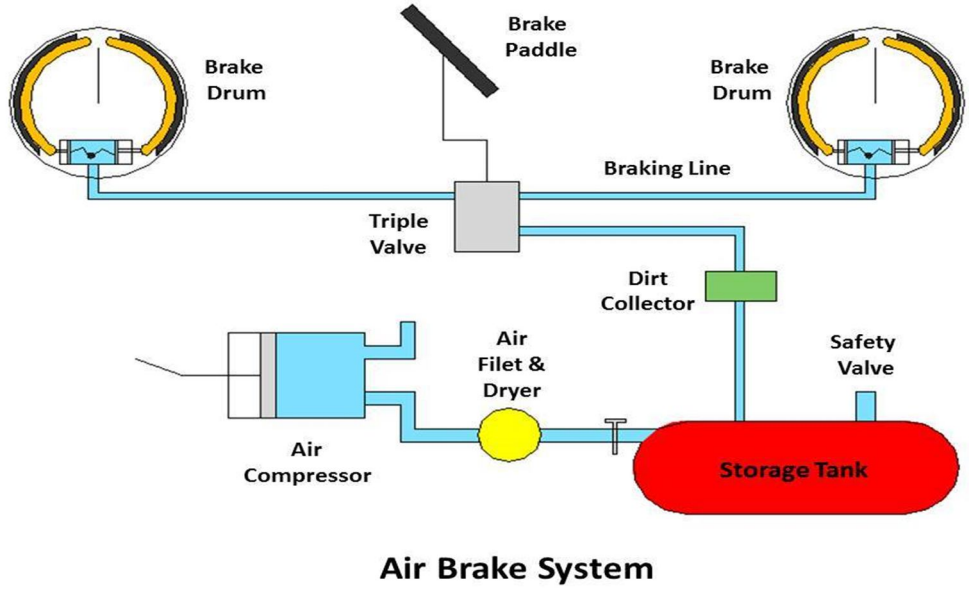


Fig.1.2.C. Air or Pneumatic Brakes

4) *Vacuum Brakes:* It is the conventional type of braking system in which vacuum inside the brake lines cause's brake pad to move which in turn finally stops or de accelerate the vehicle. Exhauster , main cylinder , brake lines , valves along with disc rotor or drum are the main components that combines together to make a vacuum braking system Vacuum brakes were used in old or conventional trains and are replaced with air brakes now days because of its less effectiveness and slow braking. Vacuum brakes are cheaper than air brakes but are less safe than air brakes.

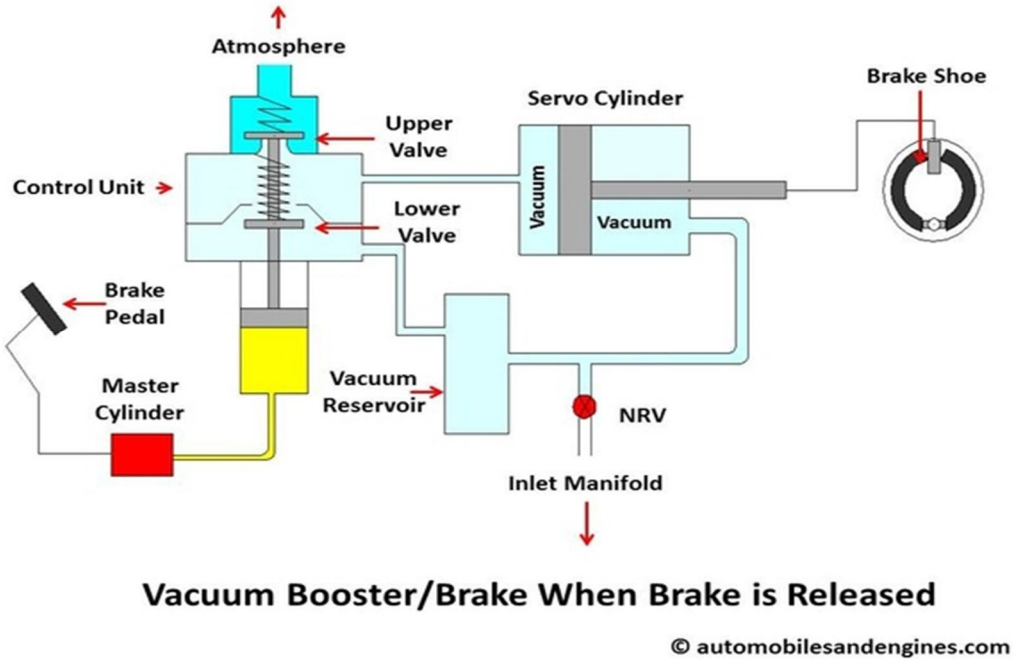


Fig.1.2.D. Vacuum Brakes

5) *Magnetic Brakes:* In these types of braking system, the magnetic field generated by permanent magnets is used to cause the braking of the vehicle. It works on the principle that when we pass a magnet through a cooper tube, eddy current is generated and the magnetic field generated by this eddy current provide magnetic braking. This is the advanced technology in which no pressure is needed to cause braking. The response to the braking in this is quite quick as compared to other braking systems.

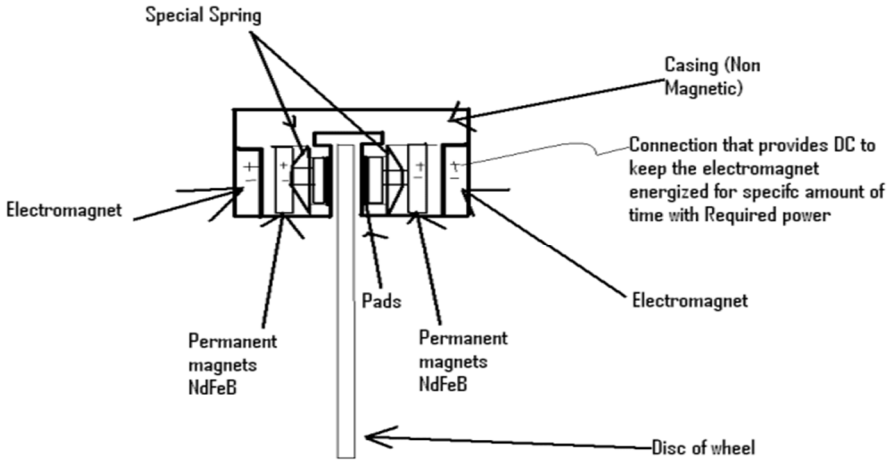


Fig.1.2.E.Magnetic Brakes

Unlike mechanical brakes, which are based on friction and kinetic energy, eddy current brakes rely on electromagnetism to stop objects from moving. Eddy currents are created when a conductor passes through a magnetic field, which creates opposing forces that spin inside the conductor.

6) Electrical Brakes

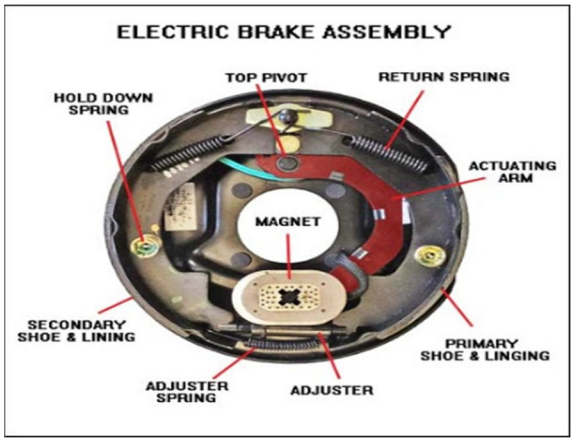


Fig.1.2.F. Electrical Brakes

It is type of braking used in electric vehicle in which braking is produced using the electrical motors which is the main source of power in electric vehicles, it is further divided into 3 types-

- *Plugging Brakes:* When the brake pedal is pressed in the electric vehicle equipped with plugging braking, the polarity of the motors changes which in turn reverses the direction of the motor and causes the braking.

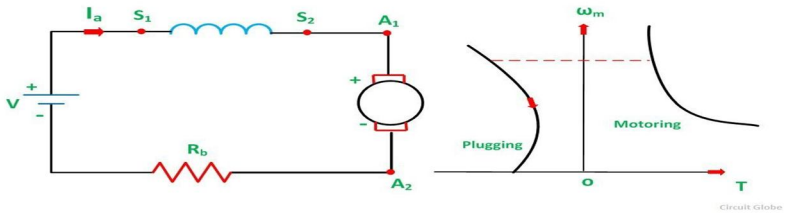


Fig.1.2.F.1 Plugging Brakes

- *Regenerative Braking:* It is the type of electrical braking in which at the time of braking the motor which is the main power source of the vehicle becomes the generator i.e. when brakes are applied, the power supply to the motor cuts off due to which the mechanical energy from the wheels becomes the rotating force for the motor which in turn converts this mechanical energy into the electric energy which is further stored in the battery. Regenerative braking saves the energy and is widely used in today's electric vehicles. Tesla Model-S provides the most effective regenerative braking.

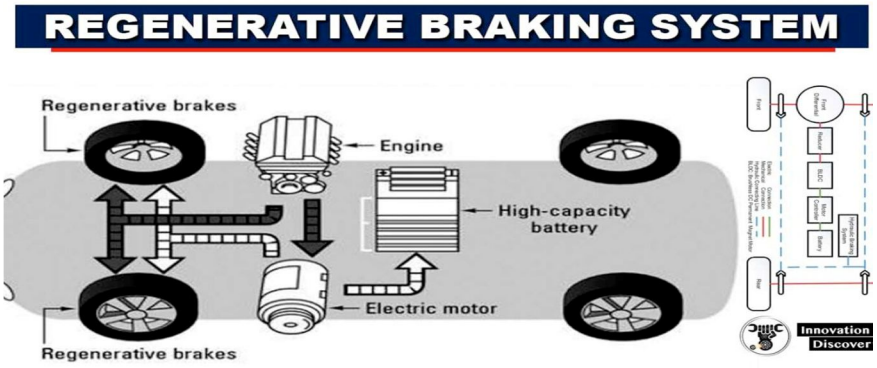
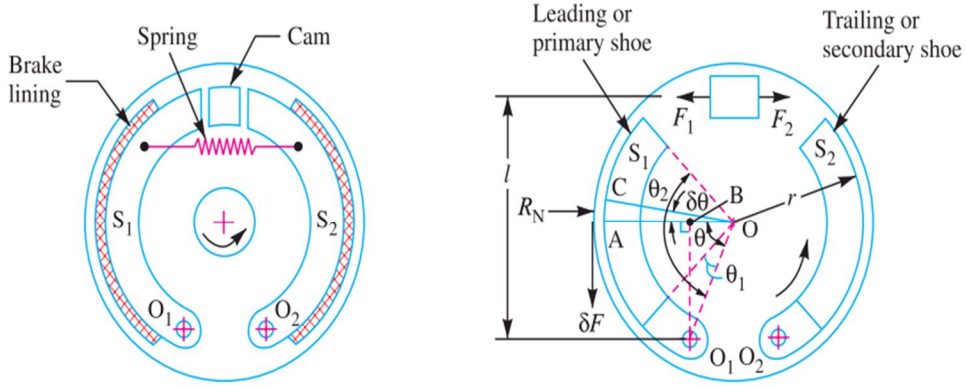


Fig.1.2.F.2 Regenerative Braking

- *Dynamic or Rheostat Braking:* It is the type of electrical braking in which resistance provided by the rheostat causes the actual braking, in this type a rheostat is attached to the circuit that provides the resistance to the motor which is responsible for de acceleration or stopping of the vehicle.

a) Frictional Contact Basis

- *Brakes or Internal Expanding Brakes*



(*a*) Internal expanding brake. (*b*) Forces on an internal expanding brake.

Fig.1.2.1.A Brakes or Internal Expanding Brakes

It is the type of brake system in which a drum which is the housing of the brake shoes along with actuation mechanism is attached with the wheel hub in such a fashion that the outer part of the drum rotates with the wheel.
When brakes are applied the actuating mechanism (wheel cylinder or mechanical linkage.) causes the brake shoes to expand due to which the outer frictional surface of the brake shoes makes frictional contact with the rotating drum part which in turn stops or de accelerate the vehicle.

- *Disc Brake or External Contracting Brakes:* It is the types of braking system in which instead of a drum assembly a disc rotor attached to the hub of the wheel in such a fashion that it rotates with the wheel, this disc rotor is clamped in between the calliper which is rigidly fixed with the knuckle or upright of the vehicle. This calliper used is the housing of the brake shoes along with the actuation mechanism (mechanical linkages or calliper cylinder).

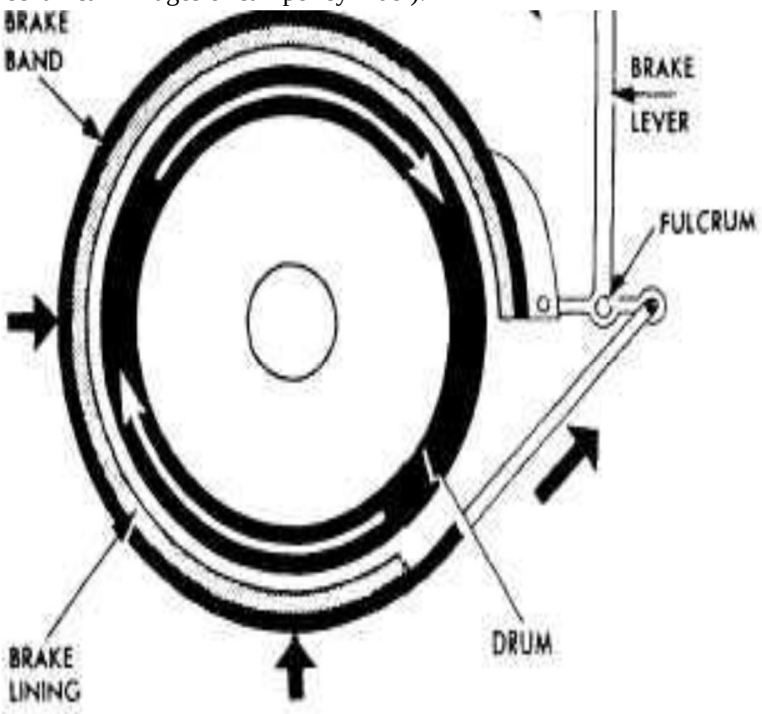


Fig.1.2.1.B Disc Brake or External Contracting Brakes

When the brakes are applied the actuation mechanism contracts the attached brake shoes which in turn makes the frictional contact with the rotating disc rotor and causes the braking of the vehicle.

b) Application Basis

- *Service Brake or Foot Brakes*

Fig.1.2.2.1.Service Brake or Foot Brakes

It is the type of brakes in which the brakes are applied when the driver presses the brake pedal mounted inside the cockpit or at the foot space of the vehicle with his foot, this pedal force applied by the driver is further multiplied and sent to the braking drum or disc either by mechanical linkages or by hydraulic pressure which in turn causes braking. In cars foot operated brakes are used and in bikes the combination of foot and hand operated brakes are used.

- *Hand Brake or Parking Brake:* This type of brakes are also known as emergency brake as they are independent of the main service brake, hand brakes consists of a hand operated brake lever which is connected to the brake drum or disc rotor through the metallic cable. When hand brake lever is pulled, tension is created in the metallic rod which in turn actuates the brake drum or disc rotor mechanism and final braking occurs.

Fig.1.2.2.2 Hand Brake or Parking Brake

Hand brakes are usually used for stable parking of the vehicle either on flat road or slope that is why it is also called parking brakes.

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c) Brake Force Distribution Basis

- *Acting Brakes:* It is the type of braking in which brake force is transferred to either a pair of wheels (in cars) or to the single wheel (in bikes) through single actuation mechanism (mechanical linkages or master cylinder).These types of braking system are commonly used in bikes or in light purpose vehicles.
- *Acting Brakes:* It is the type of braking in which the brake force is transferred to all the wheels of the vehicle through dual actuation mechanism (tandem master cylinder or mechanical linkages).This type of braking is used in cars as well as in heavy purpose vehicle.

d) Application of Different Types of Braking

- Mechanical brakes- Cars like Ford Model Y and bikes like Bajaj pulsar 180cc.
- Hydraulic brakes- Modern cars like Maruti Suzuki swift and bikes like KTM Duke 390.
- Air brakes – Volvo buses and various heavy vehicles
- Vacuum brakes- old trains
- Magnetic brakes- Bugatti Veyron and various hyper cars.
- Electric braking- Tesla Model S Use regenerative type electric braking.
- Drum brake- Old Maruti 800 and Tata 407
- Disc brake- All modern cars like Hyundai i20.
- Hand brake and foot brake– All automobile vehicles.
- Single acting – TVS Apache 180 front disc.

C. Electro Magnetic Brakes

Electromagnetic brakes (also called electro-mechanical brakes or EM brakes) slow or stop motion using electromagnetic force to apply mechanical resistance (friction). The original name was “electro-mechanical brakes” but over the years the name changed to “electromagnetic brakes”, referring to their actuation method. Since becoming popular in the mid-20th century especially in trains and trams, the variety of applications and brake designs has increased dramatically, but the basic operation remains the same. Electromagnetic brakes are the brakes working on the electric power & magnetic power. They work on the principle of electromagnetism.

These brakes are an excellent replacement on the convectional brakes due to their many advantages. The reason for implementing this brake in automobiles is to reduce wear in brakes as it frictionless. Electromagnetic brakes are of today’s automobiles. The working principle of this system is that when the magnetic flux passes through and perpendicular to the rotating wheel the eddy current flows opposite to the rotating wheel/rotor direction. This eddy current trying to stop the rotating wheel or rotor. This results in the rotating wheel or rotor comes to rest/ neutral.

D. History

It is found that electromagnetic brakes can develop a negative power which represents nearly twice the maximum power output of a typical engine, and at least three times the braking power of an exhaust brake. (Reverdin 1994). These performances of electromagnetic brakes make them much more competitive candidate for alternative retardation equipment’s compared with other retarders. By using by using the electromagnetic brakes are supplementary retardation equipment, the friction brakes can be used less frequently and therefore practically never reach high temperatures.

The brake linings would last considerably longer before requiring maintenance and the potentially “brake fade” problem could be avoided. In research conducted by a truck manufacturer, it was proved that the electromagnetic brake assumed 80% of the duty which would otherwise have been demanded of the regular service brake (Reverdin 1974). Further more the electromagnetic brakes prevent the danger that can arise from the prolonged use of brake beyond their capability to dissipate heat.

This is most likely to occur while a vehicle descending a long gradient at high speed. Ina study with a vehicle with 5 axles and weighting 40 tones powered by a powered by an engine of 310 Bhp travelling down a gradient of 6% at a steady speed between 35 and 40 Mhp, it can be calculated that the braking power necessary to maintain this speed to the order of 450 hp. The brakes, therefore, would have to absorb 300 hp, meaning that each brake in the 5 axels must absorb 30 hp that a friction brake can normally absorb with self-destruction.

The magnetic brake is wall suited to such conditions since it will 9 independently absorb more than 300 hp (Reverdin 1974). It therefore can exceed the requirements of continuous uninterrupted braking, leaving the friction brakes cool and ready for emergency braking in total safety. The installation of an electromagnetic brake is not very difficulty if there is enough space between the gearbox and the rear axle. If did not need a subsidiary cooling system. It relay on the efficiency of engine components for its use, so do exhaust and hydrokinetic brakes. The exhaust brake is an on/off device and hydrokinetic brakes have very complex control system. The electromagnetic brake control system is an electric switching system which gives it superior controllability.

E. Objectives

1) Primary Objective: The main objective of our project is to design and analysy on Electromagnetic Braking System model.

2) Secondary Objective

Besides the main objective, following are our secondary objectives:

a) To understand project planning and execution
b) To understand the fabrication techniques in a mechanical workshop
c) To understand the usage of various mechanical machine tools and also measuring tools.
d) To make day to day human life more easier by proper use of technology

F. Significances and Scope

The following are the significances:

1) Electromagnetic brakes satisfy all the energy requirements of braking without the use of friction. They have better heat dissipation capability to avoid problems that friction brakes faces times.
2) They can also be used as supplementary retardation equipment in addition to the regular friction brakes on heavy vehicles.
3) These brakes component cost is less so these brakes are cheap.
4) They can be used as an alternative method for the future crisis of the crude oils.

G. Limitations

The following are the limitations:

1) The installation of an electromagnetic brake is very difficult if there is not enough space between the gearbox and rear axle.
2) It cannot use grease or oil.
3) EM brakes are good at slowing things down, not completely stopping them.

II. INTRODUCTION OF SENSORS

A. Background

Driving is a common activity for most of the people. The number of vehicles Is increasing day by day. Now a days, the technology has got vast changes which Leads increase in speed. The speed plays a vital role to maintain time for longer Distances. But, this speed also getting a major problem for causes of road accidents.

The common braking is not sufficient for avoidance of accidents when driver is not active. Further improvement has to done in braking system in order to brake a vehicle When driver is not able to brake i.e., it may needs automatic braking system. This Automatic braking system allows the vehicle to brake without support of the driver.

The main target of the ultrasonic braking system is that, vehicles should automatically brake when the sensors sense the obstacle. This is a technology for Automobiles to sense an imminent forward collision with another vehicle or an Obstacle, and to break the vehicle accordingly, which is done by the braking circuit. This system includes two ultrasonic sensors viz. ultrasonic wave emitter and Ultrasonic wave receiver. The ultrasonic wave emitter provided in front portion of an Automatic braking system vehicle, producing and emitting ultrasonic waves in a predetermined distance in front of the vehicle.

Ultrasonic wave receiver is also provided in front portion of the vehicle, receiving the reflected ultrasonic wave signal from the obstacle. The reflected wave (detection pulse) is measured to get the distance between vehicle and the obstacle. The DC gear motor is connected to the wheels of Vehicle and power input is given to it from Arduino board. Then PIC microcontroller is used to control the servo motor based on detection pulse information and the servomotor in turn automatically controls the braking of the vehicle.

Thus, this new system Is designed to solve the problem where drivers may not be able to brake manually exactly at the required time, but the vehicle can stop automatically by sensing the obstacles to avoid an accident.

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In order to reduce the emission levels, more work is going on for the modification of engine work functions and all. There are several kinds of braking mechanism systems that would only can be applicable mechanically, to move the ideology more deep and brief the automatic braking system will be more sufficient and satisfactory in addition to mechanical braking system.
In present generation, number of vehicles is coming into existence with newer technologies for implementation of human comfort and other conditioning. To extend the ideology in briefer manner and to take the step in different way, May automatic braking system would fulfil the methods of extension of technical existences.

B. Objective

The objective of this project is to design the automatic braking system in Order to avoid the accident. To develop a safety vehicle braking system using Ultrasonic sensor and to design a vehicle with less human attention to the driving.
This project is necessary to be attached to every vehicle. Mainly it is used When drive the vehicles in night time. Mostly the accident occurred in the night Time due to long travel the driver may get tired. So the driver may hit the front side Vehicle or road side trees. By using this project the vehicle is stopped by automatic Braking system. So we can avoid the accident.

C. Scope Of Project

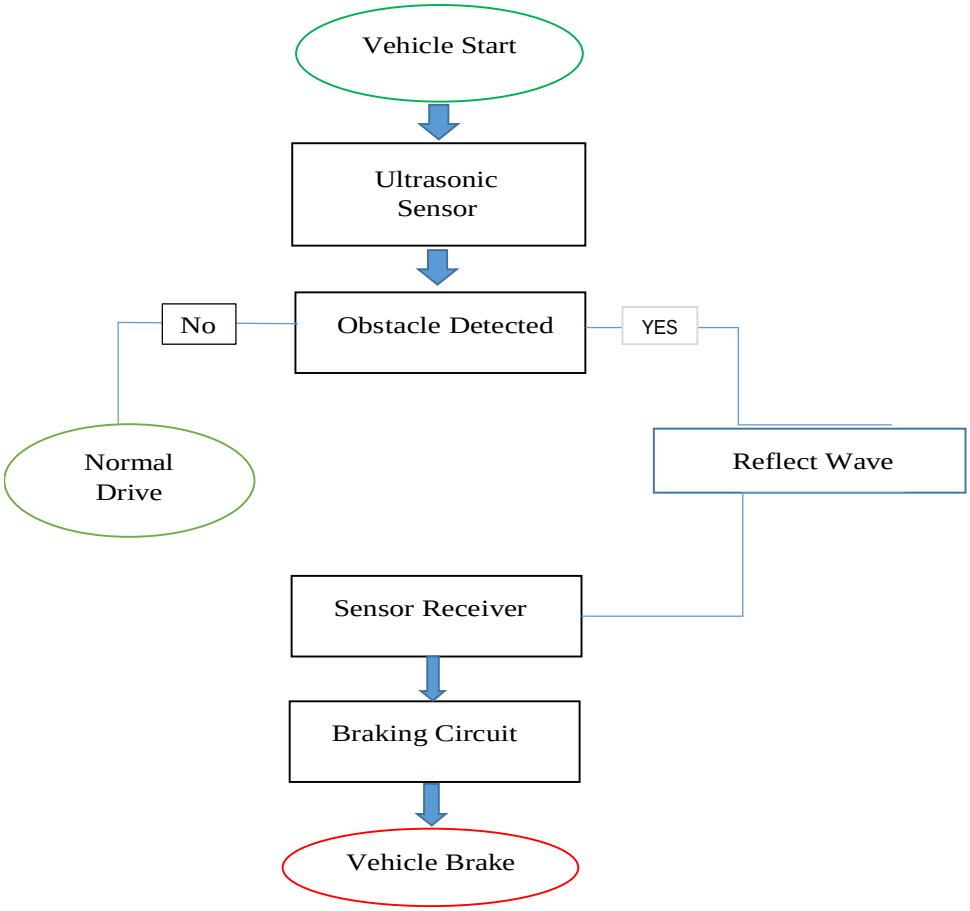


FIG.2.3Block Diagram of the Automatic Braking system

The scope of this project is to develop an ultrasonic sensor to detect the Obstacle and to process the output from the ultrasonic sensor to drive the servomotor as an actuator. Vehicles can automatically brake due to obstacles when the sensor senses the Obstacles. The focus of this project is designing an automatically braking system that can help us control the braking system of a vehicle. The automatically braking System also needs to work with an ultrasonic sensor, which produce sound pulse by a Buzzer. The ultrasonic wave is generated from a transmitter and sends to a receiver.

D. Methodology

Microcontroller	A Tmega 328P
Range	100-160 cm
Resolution	12 inches
Signal output	0-5V
Excitation voltage	12V

TAB.2.4.Maximum and minimum ranging of Ultrasonic Sensor.

E. Automatic Braking System

An automatic Braking system is an intelligent mechatronic system includes an Ultrasonic wave emitter provided on the front portion of a car producing and emitting Ultrasonic waves. An Ultrasonic receiver is also placed on the front portion of the car operatively receiving a reflective Ultrasonic wave signal.

F. Principal Components Of Automatic Braking System

1) *Sensor:* A sensor is an electrical device that maps an environmental attribute to quantitative measurement. Each sensor is based on transduction principle which is Conversion of energy from one form to another form. There are two important terms Related to any sensor

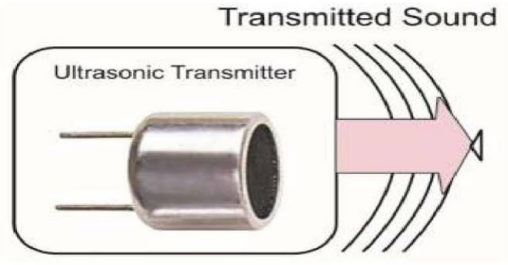
- *Target Angle:* This term refers to the 'tilt response' limitations of a given sensor. Since the ultrasonic waves reflect off the target object, target angles indicate Acceptable amounts of tilt for a given sensor.
- *Beam Spread:* This term refers to the maximum angular spread of the ultrasonic Waves as they leave the transducer.

2) *Transducer:* A transducer is an energy conversion device which converts one form of Energy into another. In the ultrasonic sensors they are used to convert electrical Energy into ultrasonic energy and vice-versa. In this system piezoelectric transducers Are used, which create ultrasonic vibration through use of piezoelectric materials Such as certain forms of crystals or ceramic polymers. Their working is based on the piezoelectric effect. This effect refers to the voltage produced between surfaces of a Solid, (non-conducting substance) when a mechanical stress is applied to it. Conversely, when a voltage is applied across surfaces of a solid that exhibits Piezoelectric effect, the solid undergoes mechanical distortion.

3) *Ultrasonic Sensor:* Ultrasonic ranging and detecting devices use high frequency sound waves Called ultrasonic waves to detect presence of an object and its range. Normal Frequency range of human ear is roughly 20Hz to 20,000Hz. Ultrasonic sound waves are sound waves that are above the range of human ear, and thus have frequency above 20,000Hz. An ultrasonic sensor necessarily consists of a transducer for Conversion of one form of energy to another, a housing enclosing the ultrasonic

Transducer and an electrical connection. These sensors are of two types:

a) *Ultrasonic Transmitter:* Before transmitting the ultrasonic wave, there is a part which is ultrasonic wave generator that functions to generate ultrasonic wave. In that Part, there is timing instruction means for generating an instruction signal for intermittently providing ultrasonic waves. This signal will send to an ultrasonic wave Generator for generating ultrasonic waves based on the instruction signal from said Timing instruction means (transform electrical energy into sound wave). After Ultrasonic wave was produced, ultrasonic transmitter transmits the ultrasonic waves toward a road surface to find out the obstacle. The range that obstacle detected is Depends on the range of ultrasonic sensors that used.



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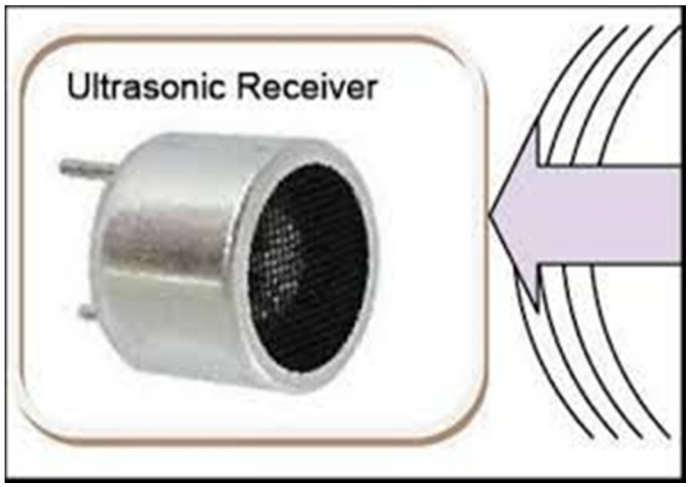
b) *Ultrasonic Receiver:* If the ultrasonic wave detects the obstacle, it will produce a Reflected wave. An ultrasonic receiver is used for receiving the ultrasonic waves Reflected from the road surface to generate a reception signal. There is ultrasonic Transducer that will transform back the sound wave to electrical energy. This signal Amplified by an amplifier. The amplified signal is compared with reference signal to detect components in the amplified signal due to obstacles on the road surface. The Magnitude of the reference signal or the amplification factor of the amplifier is controlled to maintain a constant ratio between the average of the reference signal and the average of the amplified signal.



4) *DC Gear Motor:* A DC gear motor is a fairly simple electric gear motor that uses electricity, Gear box and magnetic field to produce torque, which turns the motor. At its most Simple, DC gear motor requires two magnets of opposite polarity and an electric coil, which acts as an electric magnet. The repellent and attractive electromagnetic forces of the magnets provide the torque and causes the DC gear motor to turn. A gear box is Present just after the DC motor and a rotary shaft is connected to it, with the help of This DC gear motor setup the vehicle wheels can be rotated in this project.
5) *Servo Motor:* The output of the PIC is the input of the servo motor. The servo motor allows for precise control of angular position, velocity and acceleration. It consists of a motor Coupled to a sensor for position feedback. Thus, it is a closed loop mechanism that Uses position feedback to control its motion and final position. The input is a signal, either analog or digital, representing the position commanded for the output shaft. The measured position of the output shaft is compared to the command position (the external input to the motor). If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction as needed, to bring the output shaft to the appropriate position. As the required position approaches, the error signal reduces to zero and the motor stops. The output shaft of servo motor is capable of travelling somewhere around 180 degrees. A normal servo motor is used to control an angular motion between 0 and 180 degrees, and it is mechanically not capable of turning any farther due to a mechanical stop built on to the main output gear. The angle through which the output shaft of the servo motor need to travel is determined according to the nature of the signal given to the motor as input from the PIC. The servo motor controls the braking through mechanical arrangements. This is done by using a pair of crossed helical gears and a grooved cylindrical component. The larger gear is mounted on the output shaft of the servo motor and the smaller is mounted on the master cylinder piston rod. Thus, when the output shaft of the servomotor gets signals and hence the larger gear rotates in say anticlockwise direction, the smaller gear and hence the master cylinder piston rod rotates in clockwise direction. Due to the groove on the cylindrical component translatory motion is also produced. This is due to a pin, one end of which is inserted in the groove and the other end is fixed rigidly to a support. Thus, a combination of translatory as well as rotary motion is produced. Hence, the fluid pressure is applied due to stretching out of the master cylinder piston thus resulting in braking of the vehicle. The piston returns to the original position when the servo motor output shaft rotates in clockwise direction.Thus, the speed of the vehicle reduces for clockwise rotation of the smaller gear (i.e. Anticlockwise rotation of larger gear and hence the servo motor output shaft). Thus, the servo motor is used to control the brakes, when the PIC gives the signal to the servo motor, based upon the distance measured by means of sensors. This constitutes the braking circuit.

G. Advantages of Automatic Braking System

1) Discrete distances to moving objects can be detected and measured.
2) Resistance to external disturbances such as vibration, infrared Radiation, ambient noise, and EMI (Electro Magnetic Interference) Radiation.
3) Measures and detects distances to moving objects.
4) Impervious to target materials, surface and colour.
5) Solid-state units have virtually unlimited, maintenance free lifespan.
6) Detects small objects over long operating distance.
7) Ultrasonic sensors are not affected by dust, dirt or high moisture Environments.

III. REVIEW OF LITERATURE

A. Fundamentals of Sensors

In the broadest definition, a sensor is an object whose purpose is to detect Events or changes in its environment, and then provide a corresponding output. A Sensor is a type of transducer; sensors may provide various types of output, but typically use electrical or optical signals. For example, a thermocouple generates a Known voltage (the output) in response to its temperature (the environment). A Mercury-in-glass thermometer, similarly, converts measured temperature into Expansion and contraction of a liquid, which can be read on a calibrated glass tube. Sensors are used in everyday objects such as touch-sensitive elevator buttons (tactile sensor) and lamps which dim or brighten by touching the base, besides Innumerable applications of which most people are never aware. With advances in Micro-machinery and easy-to-use micro controller platforms, the uses of sensors have expanded beyond the most traditional fields of temperature, pressure or flow Measurement, for example into MARG (Magnetic, Angular Rate, and Gravity) Sensors. Moreover, Analog sensors such as potentiometers and force-sensing resistors are still widely used. Applications include manufacturing and machinery, airplanes and aerospace, cars, medicine, and robotics. It is also included in our day-to-day life.

1) *Ultrasonic Sensor:* Ultrasonic ranging and detecting devices use high-frequency sound waves to detect the presence of an object and its range. The systems either measure the echo Reflection of the sound from objects or detect the interruption of the sound beam as the objects pass between the transmitter and receiver. An ultrasonic sensor typically utilizes a transducer that produces an electrical Output in response to received ultrasonic energy. The normal frequency range for Human hearing is roughly 20 to 20,000 hertz. Ultrasonic sound waves are sound waves that are above the range of human hearing and thus, have a frequency above About 20,000 hertz. Any frequency above 20,000 hertz may be considered ultrasonic. Most industrial processes, including almost all source of friction, create some Ultrasonic noise. The ultrasonic transducer produces ultrasonic signals. These signals are Propagated through a sensing medium and the same transducer can be used to detect Returning signals. Ultrasonic sensors typically have a piezoelectric ceramic transducer that converts an excitation electrical signal into ultrasonic energy bursts. The energy Bursts travel from the ultrasonic sensor, bounce off objects, and are returned toward the sensor as echoes. Transducers are devices that convert electrical energy to Mechanical energy, or vice versa. The transducer converts received echoes into Analog electrical signals that are output from the transducer. The piezoelectric effect refers to the voltage produced between surfaces of a Solid dielectric (non-conducting substance) when a mechanical stress is applied to it. Conversely when a voltage is applied across certain surfaces of a solid that exhibits the piezoelectric effect, the solid undergoes a mechanical distortion. Such solids typically resonate within narrow frequency ranges. Piezoelectric materials are used in Transducers e.g., phonograph cartridges, microphones, and strain gauges that produce an electrical output from a mechanical input. They are also used in earphones and Ultrasonic transmitters that produce a mechanical output from an electrical input. Ultrasonic transducers operate to radiate ultrasonic waves through a medium such as Air. Transducers generally create ultrasonic vibrations through the use of piezo electric materials certain forms of crystal or ceramic polymers.

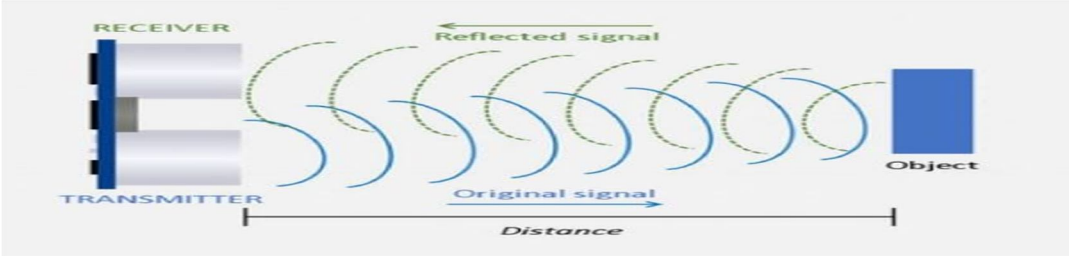


FIG.3.1.1 Ultrasonic Sensor

2) *Ultrasonic sensing and control:* Ultrasonic signals are like audible sound waves, except the frequencies are much higher. Our ultrasonic transducers have piezoelectric crystals which resonate to a desired frequency and convert electric energy into acoustic energy and vice versa. The illustration shows how sound waves, transmitted in the shape of a cone, are Reflected from a target back to the transducer. An output signal is produced to perform some kind of indicating or control function. A minimum distance from the sensor is required to provide a time delay so that the "echoes" can be interpreted. Variables which can affect the operation of ultrasonic sensing include, target surface angle, Reflective surface roughness or changes in temperature or humidity

B. Measurement Principle and Effective use of Ultra Sonic Sensor

Ultrasonic sensor transmits ultrasonic waves from its sensor head and again Receives the ultrasonic waves reflected from an object. Basically, in our project Ultrasonic sensor ranges of about 2 centimetres to 1 metre. By measuring the length of Time from the transmission to reception of the sonic wave, it detects the position of the Object. The ultrasonic transducer produces ultrasonic signal.

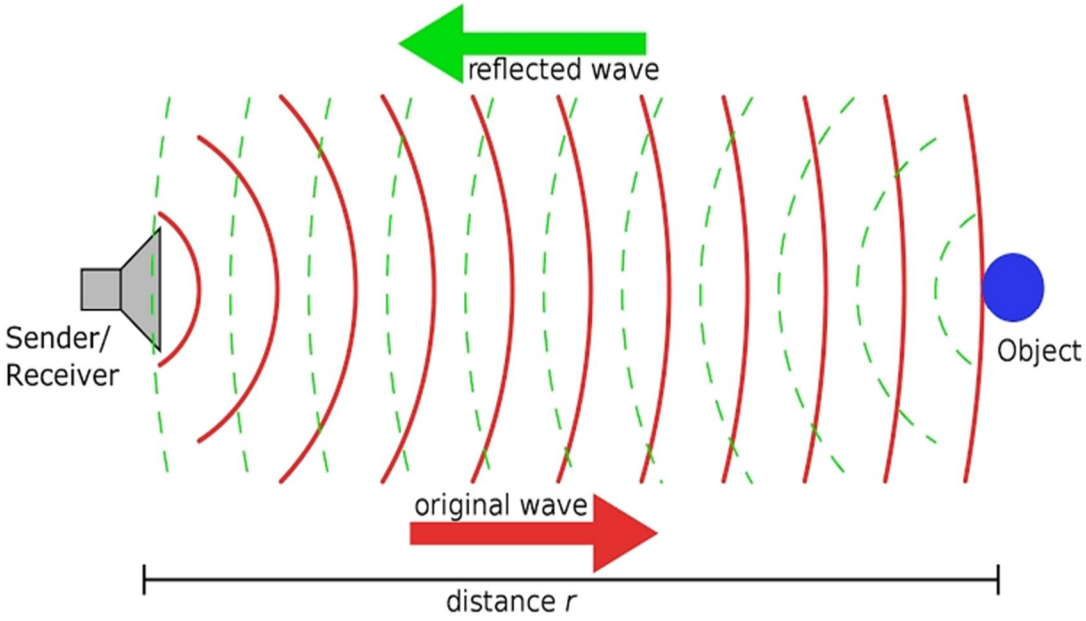


FIG.3.1.2 Ultrasonic sensing and control

These signals are propagated through a sensing medium and the same transducer can be used to detect returning signals. In most applications, the sensing medium is simply air. An ultrasonic sensor typically comprises at least one ultrasonic transducer which transforms electrical energy into sound and in reverse sound into electrical energy, a housing enclosing the ultrasonic transducer, an electrical connection and optionally.

C. Advantages of Ultrasonic Sensors

Ultrasonic have a lot of advantages for using in real application. The Advantages of ultrasonic sensor are:

1) Discrete distances to moving objects can be detected and measured.
2) Less affected by target materials and surfaces, and not affected by Colour. Solid-state units have virtually unlimited, maintenance free Life. Ultrasonic can detect small objects over long operating Distances.
3) Resistance to external disturbances such as vibration, infrared Radiation, ambient noise, and EMI (Electro Magnetic Interference) Radiation.
4) Measures and detects distances to moving objects.
5) Impervious to target materials, surface and colour.
6) Solid-state units have virtually unlimited, maintenance free Lifespan.
7) Detects small objects over long operating distance.

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D. Disadvantages of Ultrasonic Sensors

Some disadvantages of ultrasonic sensor are:

1) Overheating of a wave emitter precludes the energy of ultrasonic waves Emitted there from being enhanced to a practical level.

2) Interference between the projected waves and the reflected waves takes place, and development of standing waves provides adverse effects.

IV. WORKING OF VECHILE

A. Forward Collision warning/brake Assist

Bosch has developed a suite of Predictive Safety Systems (PSS), the aim of which is to warn drivers of an impending emergency situation support them and intervene to reduce the consequences of an accident (www.bosch.com.cn). The description provided in the manufacturer's literature states that the radar sensor used for Adaptive Cruise Control (ACC) monitors a distance of up to 200m ahead of the vehicle to detect vehicles in the same lane and calculate their distance and speed. When a dangerous situation is recognized in the area in front of the vehicle safety measures are introduced in three stages as soon as an accident is likely. If an accident risk is detected an emergency stop is considered by the system to be probable and the manufacturer then describes the following actions that can be taken:

1) The first stage, the Predictive Brake Assistant (PBA), prepares the braking system for an emergency stop by pre-filling the circuit with fluid such that the linings are just in contact with the discs. The tripping threshold of the Hydraulic Brake Assist (HBA) system is also lowered. In this way Bosch claim that as soon as the driver initiates braking, full braking performance is available, around 30ms earlier than without the system, significantly shortening braking distances.

2) Predictive Collision Warning (PCW) is the second module warning the driver of critical situations by applying a short burst of braking, a brief tug on the seatbelt and visual and acoustic signals to warn of imminent danger. Bosch claimed that a study by the Association of German Insurers shows that almost half of all drivers involved in accidents did not brake at all, prior to the crash. The Nissan Brake Assist system with Preview Function (BAP) utilizes information provided by Adaptive Cruise Control (ACC) sensors to judge when emergency braking application may be required based on the distance to the followed vehicle and the relative velocity (Tamura et al, 20016g).

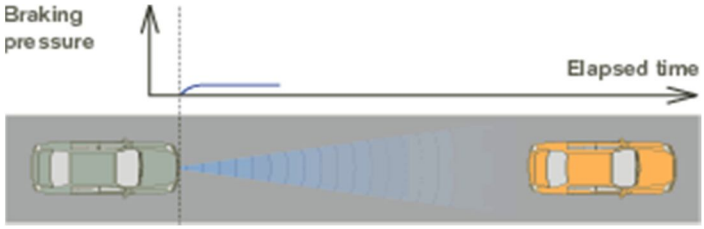


FIG.4.1Brake Assist with a Preview Function (BAP)

The results of experiments conducted by Tamura et al (2001) with the prototype vehicle. It shows that the delay time from the operation of the brake pedal to the rise of the brake pressure was shortened by 100ms with BAP.

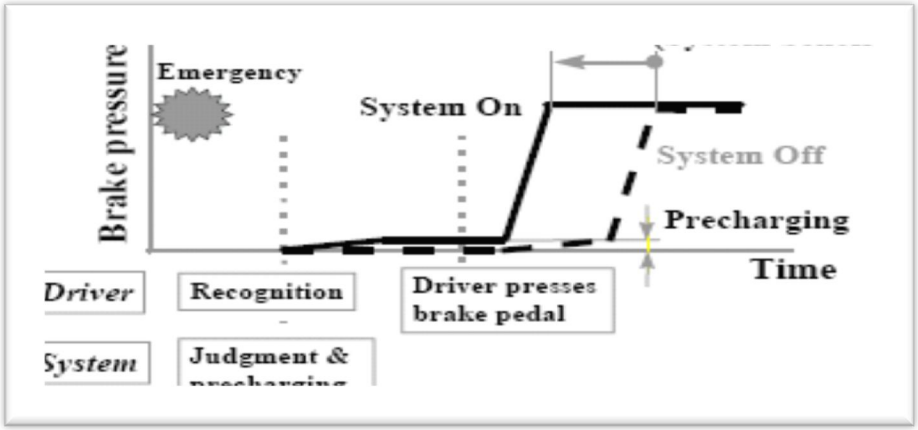


Fig.4.1.A Brake system reaction

B. Collision Mitigation

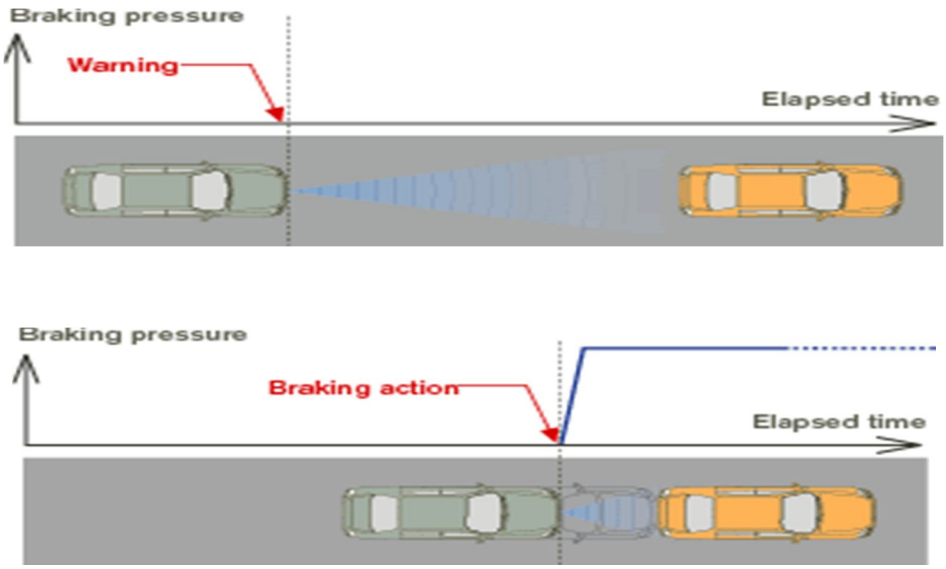
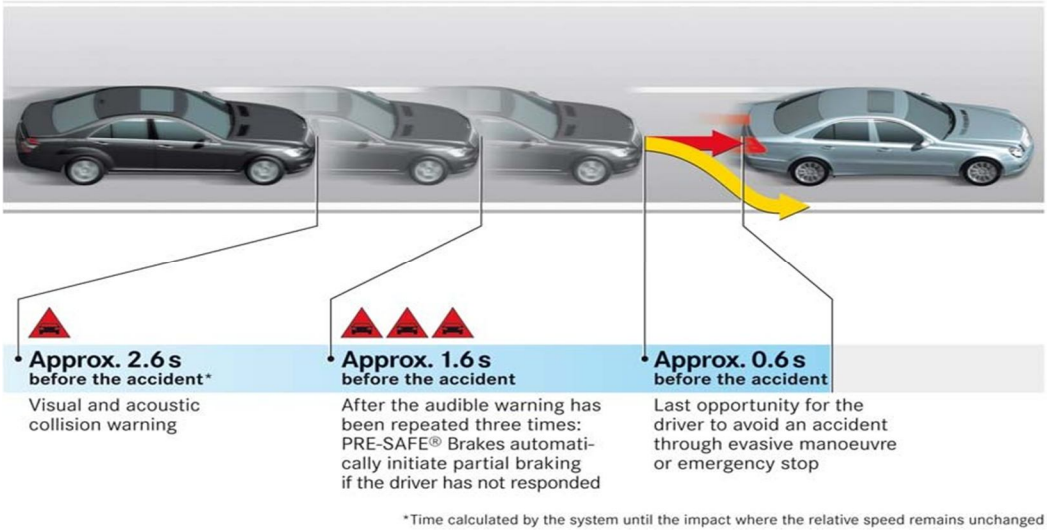


FIG.4.2 Intelligent Brake Assist

The 2006 Mercedes-Benz S-Class is equipped with Brake Assist PLUS (BAS PLUS) and PRE-SAFE Brake The available information suggests that both systems utilize a single 77GHz radar sensor capable of monitoring a typical three lane motorway environment in front of the vehicle with a narrow field of view angle of nine degrees up to a distance of 150m. Two additional 24GHz radar sensors with an 80° field of view monitor the area immediately in front of the vehicle up to a distance of 30m. DISTRONIC PLUS is claimed to be an additional driver assistance system which also relies upon the radar sensors to provide adaptive cruise control at speeds between 0 and 200km/h, maintaining headway to the vehicle in front by automatically braking the vehicle to a standstill if required and then accelerating the vehicle as soon as the traffic situation allows. Depending on the speed, automatic deceleration of up to 4m/s2is possible. Should heavier braking be required an audible warning is given telling the driver to watch the traffic situation and apply the brakes if necessary, and a warning light illuminates on the instrument cluster.

The system is active in the speed range between 10 and 180km/h where traffic is registered in front of the vehicle, and it also reacts when approaching a stationary queue of traffic providing the vehicle is not travelling at a speed in excess of 70km/h. According to the manufacturer's literature, PRE-SAFE Brake is a supplement to BAS PLUS. Should the driver fail to react to the warning proved by BAS PLUS, PRE-SAFE Brake intervenes by autonomously breaking the vehicle with a deceleration of up to 4m/s2if there is acute danger of an accident. A timeline representing a typical rear-end collision situation and the warnings provided.



Warnings provided by PRE-SAFE Brake in typical rear-end collision situation

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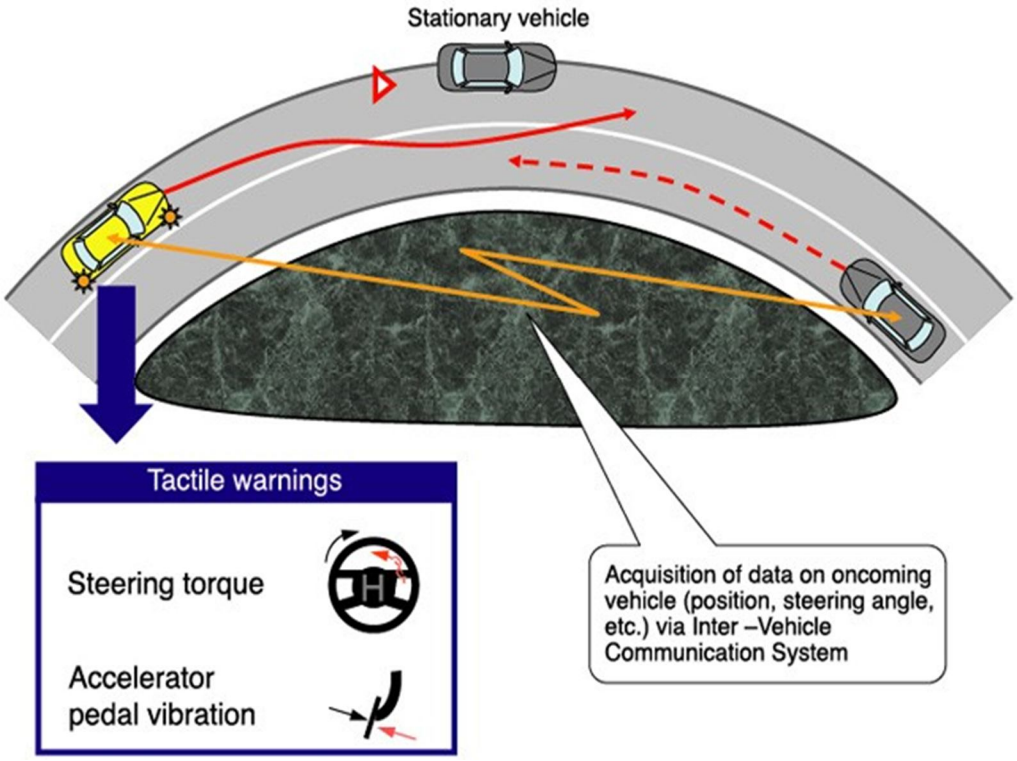
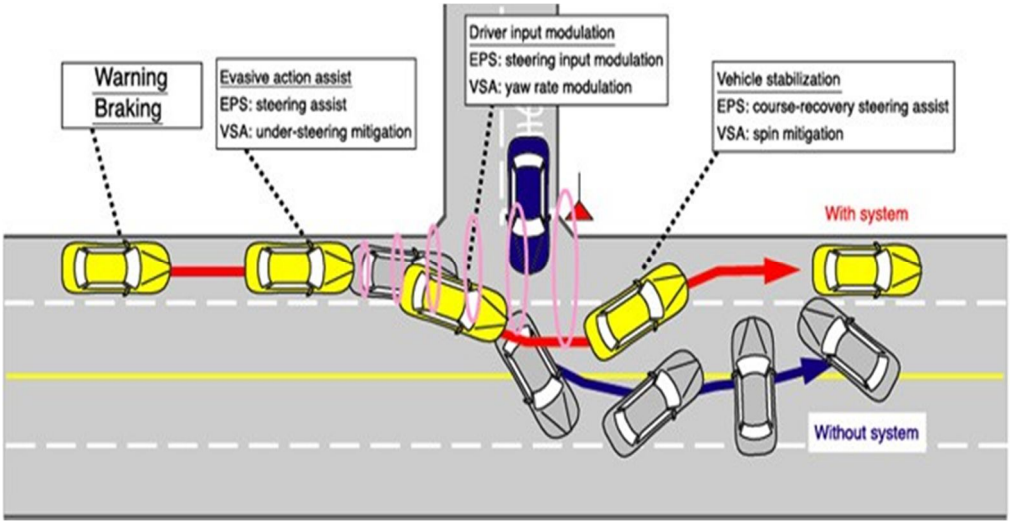
The head-on collision avoidance assistance system communicates with an oncoming vehicle to ascertain information such as its position, speed and steering wheel angle. If the system detects the driver of the ASV 3 changing lanes into the path of the oncoming vehicle the accelerator pedal vibrates and torque is applied to the steering wheel (in the opposite direction to the driver) prompting the driver to return to their own lane.



Head-on collision avoidance assistance system

The forward obstacle avoidance assistance system provides compensatory steering and braking assistance when a driver is slow to take evasive action when unexpectedly confronted with another vehicle or object in the vehicle's path.

At the start of an evasive action, the system helps the driver steer to avoid the accident, it then reduces the steering input to help prevent the driver turning too sharply then, if the driver is slow to return the car to its original course, it provides more steering assistance whilst using the ESP system to help stabilize the vehicle.



Forward obstacle avoidance assistance system

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V. CALCULATIONS

A. Braking Distance Calculations

As per the sensor range and weight of the moving body the Distance will be varied.

Braking Distance = V / 2μg (meter)
Where,
V= Velocity of the vehicle (m/s)
μ = Coefficient of friction of road = 0.8
g = Acceleration due to gravity = 9.81(m/s2)
Now,

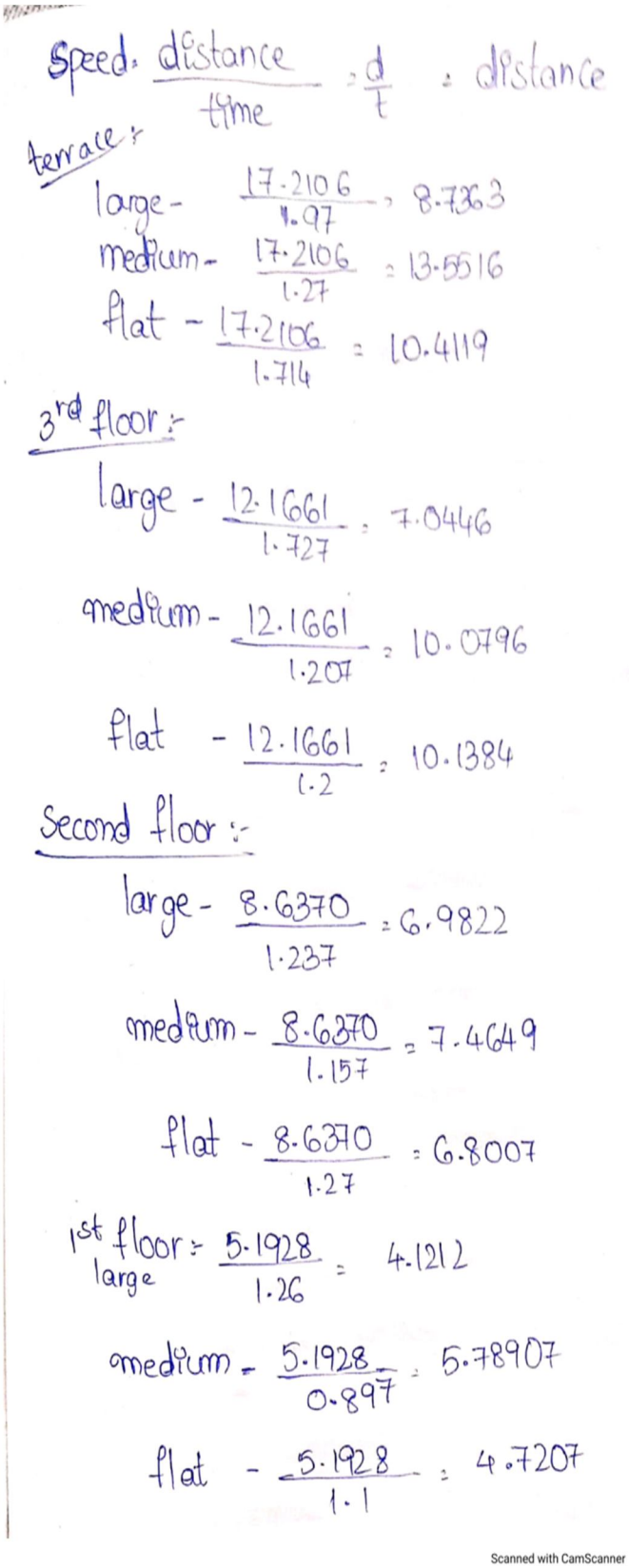
For velocity 10 km/hr.
Braking Distance = (10*1000/3600)/ (2*0.8*9.81)
= 0.18 m

For velocity 20 km/hr.
Braking Distance = (20*1000/3600)/ (2*0.8*9.81)
= 0.35 m

For velocity 30 km/hr.
Braking Distance = (30*1000/3600)/ (2*0.8*9.81)
= 0.53 m
For velocity 40 km/hr.
Braking Distance = (40*1000/3600)/ (2*0.8*9.81)
= 0.71 m
For velocity 50 km/hr.
Braking Distance = (50*1000/3600)/ (2*0.8*9.81)
= 0.88 m

B. Study Project Calculation

1) Experimental Objects



TAB.5.2.2 Speed and its calculations

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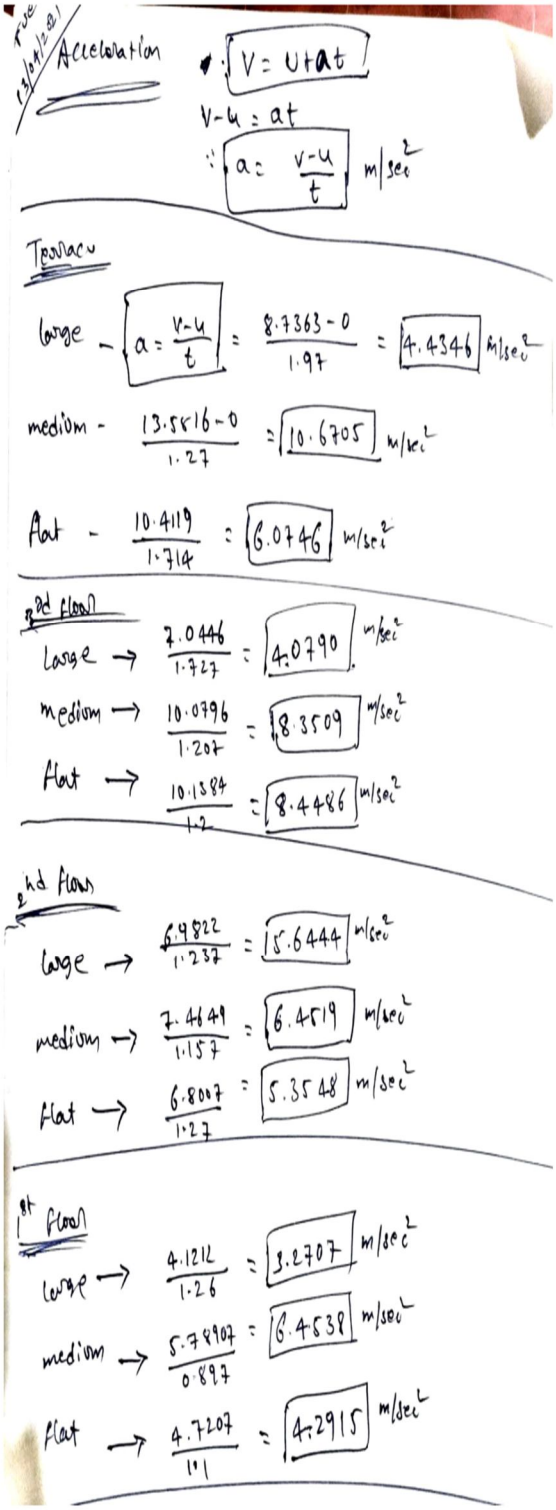
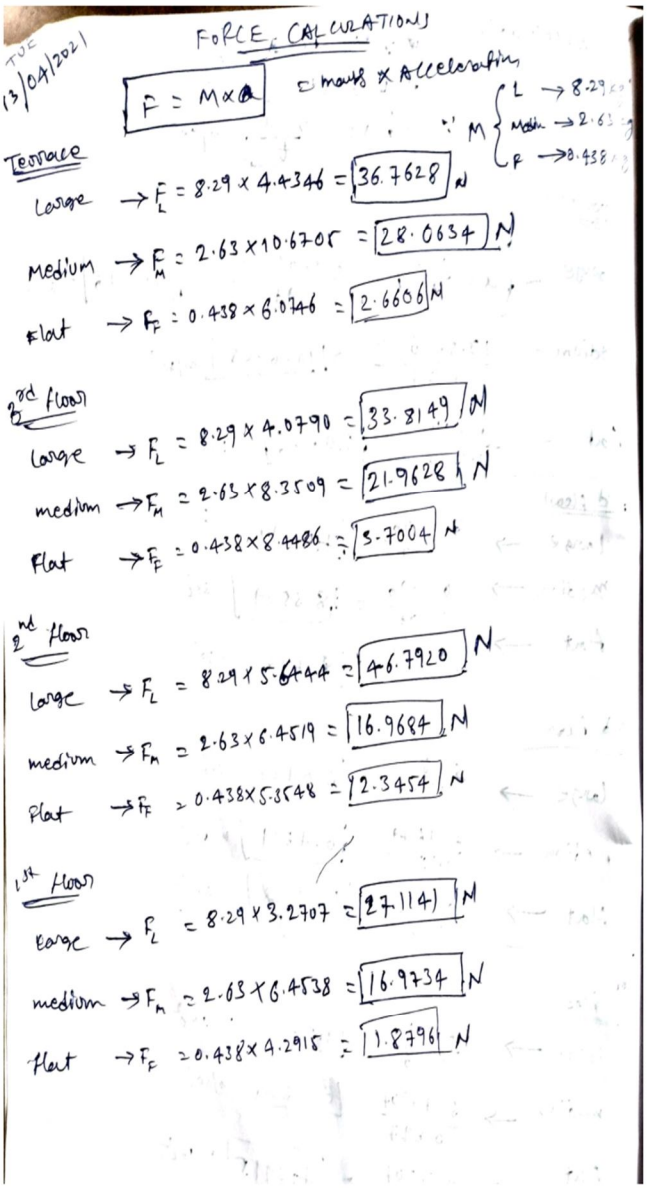


TAB. 5.2.3 Acceleration and its calculations



TAB.5.2.4 Force and its calculations

VI. RESULT

As a result of this automatic braking system, The safety distance is determined then the vehicle system is braked when the obstacle is detected. The ranging accuracy of ultrasonic sensor in this prototype is about 2cm to 1m and works effectively within the prescribed limit

A. Final Overview of Project

In this project, we connected it with a batteries and whose braking system is controlled by a DC gear motor and servomotor. This technique is eco-friendly and this work is an attempt to reduce accidents while in critical driving conditions. We have tested the working of the system by placing various objects ahead as obstacles. The system responded by reducing the speed of the vehicle when the obstacle is placed at various distances from it. Also the system stopped automatically in restricted areas. It gave very accurate measurement according to limit of values interpreted.

VII. CONCLUSION

We have successfully completed the Analysis of automatic braking system model prototype and this project presents the implementation of an Automatic Braking System for Forward Collision Avoidance, intended to use in vehicles where the drivers may not brake manually, but the speed of the vehicle can be reduced automatically due to the sensing of the obstacles. It reduces the accident levels and tends to save the lives of so many people. By doing this project practically we gained the knowledge about working of automatic braking system and with this future study and research, we hope to develop the system into an even more advanced speed control system for automobile safety, while realizing that this certainly requires tons of work and learning, like the programming and operation of microcontrollers and the automobile structure. Hence we believe that the incorporation of all components in Automatic Braking System will maximize safety and also give such system a bigger market space and a competitive edge in the market.

VIII. FUTURE SCOPE

The future scope is to design and develop a control system based on an automotive braking system is called "Automatic Braking System". The Automatic Braking System with ultrasonic sensor would alert the driver when the distance between vehicle and obstacle is in within the sensing range zone then the brakes are applied. This is the new function in this prototype design that could be possibly used for all the vehicles. By making it safer, this system will provide better guarantee for vehicle's safety and avoid losses. Therefore, the safety system of vehicles will be developed and may have more market demands. It can be further used for large type of heavy vehicles like buses, trucks, cranes, tractors, etc. We can surely get the information about the obstacle detection sense zone according to vehicle condition. It is verily useful to public sector and users. It is also avoids the accidents in large or metropolitan cities. So we feel it is a better idea for automatically braking of vehicle with moderate cost.

REFERENCES

[1] Ultrasonic Testing of Materials Book /Herbert Krautkrämer and Josef Krautkramer
[2] SAE International Journal / D Savitski, K Hoepping, V Ivanovic, 2015 - sae.org
[3] R Dhoot, S Gaikar, N Kulkarni, O Jain - IOSR Journal of Mechanical …, 2016 - academia.edu
[4] Large eddy simulations of electromagnetic braking effects on argon bubble transport and capture in a steel continuous casting mold / K Jin, SP Vanka, BG Thomas - Metallurgical and Materials Transactions B, 2018 – Springer
[5] K. Balaveera Reddy. "Design data hand-book for mechanical engineering.
[6] Flemming, Frank; Shapiro, Jessica (July 7, 2009). "Basics of Electromagnetic Brakes" .machine design.
[7] Electromagnetic braking of natural convection during Ohno continuous casting of an industrial aluminum alloy / S Fashu - International Journal of Nonferrous Metallurgy, 2015 - scirp.org
[8] Ultrasonic Testing of Materials / Book by Herbert Krautkrämer and Josef Krautkramer
[9] Sensors: Advancements in Modeling , Design Issues, Fabrication and Practical Applications Book by Subhas C. Mukhopadhyay
[10] Ultrasonic transducers for nondestructive testing / Maurice G Silk / Adam Hilger Ltd., Accord, MA, 1984
[11] Autoresonant control of nonlinear mode in ultrasonic transducer for machining applications / VI Babitsky, VK Astashev, AN KalashnikovUltrasonics 42 (1-9), 29-35, 2004
[12] Impedance matching network for high frequency ultrasonic transducer for cellular applications /Min Gon Kim, Sangpil Yoon, Hyung Ham Kim, K Kirk Shung / Ultrasonics 65, 258-267, 2016
[13] Ultrasonic transducers: Materials and design for sensors, actuators and medical applications / Kentaro NakamuraElsevier, 2012
[14] High-precision OFDM-based multiple ultrasonic transducer positioning using a robust optimization approach / Md Omar Khyam, Md Jahangir Alam, Andrew J Lambert, Matthew A Garratt, Mark R Pickering / IEEE Sensors Journal 16 (13), 5325-5336, 2016
[15] Ultrasonic transducer materials / Oskar E MattiatSpringer Science & Business Media, 2013
[16] High-frequency ultrasonic transducer operating in airMasayuki Tone, Tsutomu Yano, Akira Fukumoto / Japanese journal of applied physics 23 (6A), L436, 1984
[17] Pseudo-orthogonal chirp-based multiple ultrasonic transducer positioning / Mohammad Omar Khyam, Shuzhi Sam Ge, Xinde Li, Mark R Pickering / IEEE Sensors Journal 17 (12), 3832-3843, 2017
[18] A piezoelectric micromachined ultrasonic transducer using piston-like membrane motion / Tao Wang, Renshi Sawada, Chengkuo LeeIEEE Electron Device Letters 36 (9), 957-959, 2015
[19] Fabrication, modelling and use of porous ceramics for ultrasonic transducer applications / F Levassort, J Holc, E Ringgaard, T Bove, M Kosec, M Lethiecq /Journal of Electroceramics 19 (1), 127-139, 2007
[20] Film thickness measurement with an ultrasonic transducer / Qing Lu, NV Suryanarayana, Christodoulous ChristodouluExperimental thermal and fluid science 7 (4), 354-361, 1993
[21] Zero-bending piezoelectric micromachined ultrasonic transducer (pMUT) with enhanced transmitting performanceTao Wang, Chengkuo Lee /Journal of Microelectromechanical Systems 24 (6), 2083-2091, 2015
[22] Vehicle collision avoidance system using wireless sensor networks / S Ramesh, Ravi Ranjan, Ranjeet Mukherjee, Swarnali Chaudhuri /International Journal of Soft Computing and Engineering (IJSCE) 2 (5), 300-303, 2012
[23] Collision Avoidance Theory: With application to automotive collision mitigation / Jonas JanssonLinköping University Electronic Press, 2005
[24] A multilevel collision mitigation approach—Its situation assessment, decision making, and performance tradeoffs / Jrg Hillenbrand, Andreas M Spieker, Kristian KroschelIEEE Transactions on intelligent transportation systems 7 (4), 528-540, 2006

[25] Multi-Body Integrated Vehicle-Occupant Models for Collision Mitigation and Vehicle Safety using Dynamics Control Systems / Mustafa Elkady, Ahmed Elmarakbi, John MacIntyre, Mohamed AlhaririInternational Journal of System Dynamics Applications (IJSDA) 5 (2), 80-122, 2016
[26] Study on vehicle safety distance warning system /Yuan-Lin Chen, Shun-Chung Wang, Chong-An Wang2008 IEEE International Conference on Industrial Technology, 1-6, 2008
[27] Analysis and application of relationship between post-braking-distance and throw distance in vehicle–pedestrian accident reconstructionTiefang Zou, Zhi Yu, Ming Cai, Jike LiuForensic science international 207 (1-3), 135-144, 2011
[28] Analysis of emergency braking of a vehicle / Nerijus KudarauskasTransport 22 (3), 154-159, 2007
[29] Evaluation of veracity of car braking parameters used for the analysis of road accidentsSaulius Nagurnas, Valentinas Mitunevičius, Jan Unarski, Wojciech WachTransport 22 (4), 307-311, 2007
[30] Safety distance warning system with a novel algorithm for vehicle safety braking distance calculatingYuan-Lin Chen, Wei-Jen LeeInternational journal of vehicle safety 5 (3), 213-231, 2011.
[31] Adhesion considerations in Safe Braking distance calculationsDavid F ThurstonASME/IEEE JointRail Conference 56451, V001T03A003, 2015.
[32] Utilisation of optimisation solutions to control active suspension for decreased braking distanceJohannes Edrén, Mats Jonasson, Jenny Jerrelind, Annika Stensson Trigell, Lars DruggeVehicle System Dynamics 53 (2), 256-273, 2015
[33] Magnetorheological suspension electromagnetic brakeIoan BicaJournal of Magnetism and Magnetic Materials 270 (3), 321-326, 2004.
[34] Braking distance, friction and behaviourPoul GreibeTrafitec, Scion-DTU, 2007
[35] Research on an integrated electromagnetic auxiliary disc brake device for motor vehicleLi Luo, Qingzhi Zhai, Wen Li, Chen Qian, Hong LiuIEEJ Transactions on Electrical and Electronic Engineering 12 (3), 434-439, 2017
[36] The Analysis of the Key Problems about Traffic Accident Speed Identification Based on Braking TracesZhi Wei Guan, Shao Hua Wang, Wei Qiang Liang, Ming Feng Zheng, Lin Wu, Yang Liu, Zhen Xing Li
[37] Study of influence of operating parameters on braking distanceTianchi Tang, Kumar Anupam, Cor Kasbergen, Athanasios ScarpasTransportation research record 2641 (1), 139-148, 2017
[38] Friction condition characterization for rail vehicle advanced braking systemSundar Shrestha, Maksym Spiryagin, Qing WuMechanical Systems and Signal Processing 134, 106324, 2019
[39] Research of safe speed at snow on freeway based on braking model of stopping sight distance / Jian Jun Wang, Fa Yao Xu, A Jin MaApplied Mechanics and Materials 209, 837-840, 2012
[40] Determination of braking distance and driver behaviour based on braking trialsPoul Greibe87th Transportation Research Board Annual Meeting, Washington DC, USA, 2008
[41] Influence Relationship between Mathematical Model-Based Elevator braking Distance and Equilibrium Coefficient / Niu Kuangye, Chang Xiaoqing /Journal of Physics: Conference Series 1798 (1), 012008, 2021
[42] Deceleration rates for safe braking distance calculationsDavid F ThurstonASME/IEEE Joint Rail Conference 50718, V001T03A002, 2017
[43] Design of roadway test system for motor vehicle brake performance and its evaluation methods / Zhang Xiaolong, Peng Jiankun, Xia Ping2010 International Conference on Computer, Mechatronics, Control and Electronic Engineering 3, 392-395, 2010
[44] Research the Length of the Braking Distance for Speed and High-Speed Trains on Railway SectionsRavshan Aliev, Marat Aliev, Ezozbek Tokhirov, Kamoliddin TashmetovInternational Journal 9 (5), 2020
[45] Electromagnetic braking of natural convection during Ohno continuous casting of an industrial aluminum alloy / S Fashu - International Journal of Nonferrous Metallurgy, 2015 - scirp.org
[46] Modeling analysis of the electromagnetic braking action on rotating solid cylindersO Bottauscio, M Chiampi, A Manzin - Applied Mathematical Modelling, 2008 – Elsevier
[47] Electromagnetic braking revisited with a magnetic point dipole model / S Land, P McGuire, N Bumb, BP Mann… - American Journal of …, 2016 - aapt.scitation.org
[48] Suppression of flux avalanches in superconducting films by electromagnetic brakingelectromagnetic braking / F Colauto, E Choi, JY Lee, SI Lee, EJ Patino… - Applied Physics
[49] Performances Analysis of a Novel Electromagnetic-frictional Integrated Brake Based on Multi-physical Fields Coupling / K Wang, R He, J Tang, R Liu - World Electric Vehicle Journal
[50] Design and implementation of all FPGA-based motor control IC for permanent magnet AC servo motors / Ying-Yu Tzou, Tien-Sung KuoProceedings of the IECON'97 23rd International Conference on Industrial Electronics, Control, and Instrumentation (Cat. No. 97CH36066) 2, 943-947, 1997
[51] Practical modeling and system identification of R/C servo motorsTakashi Wada, Masato Ishikawa, Ryohei Kitayoshi, Ichiro Maruta, Toshiharu Sugie2009 IEEE Control Applications,(CCA) & Intelligent Control,(ISIC), 1378-1383, 2009
[52] DC motors and servo-motors controlled by Raspberry Pi 2BMichal Šustek, Miroslav Marcaník, Pavel Tomášek, Zdeněk Úředníček / MATEC Web of Conferences, 2017
[53] Position control of induction and DC servomotors: a novel adaptive fuzzy PI sliding mode controlReza Shahnazi, H Shanechi, Naser Pariz2006 IEEE Power Engineering Society General Meeting, 9 pp., 2006
[54] Analysis on PM Synchronous Servo Motors [J]Zhu Zhenglian Jiang Zhongwei Wei / Journal of Nanjing University of Aeronautics & Astronautics 4, 1991
[55] Analysis on PM Synchronous Servo Motors [J]Zhu Zhenglian Jiang Zhongwei Wei / Journal of Nanjing University of Aeronautics & Astronautics 4, 1991
[56] Position control of servomotors using neural dynamic sliding modeAli Karami-Mollaee, Naser Pariz, HM Shanechi
[57] Iterative identification of state-dependent disturbance torque for high-precision velocity control of servo motors / Seok-Hee Han, Young-Hoon Kim, In-Joong Ha /IEEE transactions on automatic control 43 (5), 724-729, 1998
[58] High-performance current regulation and efficient PWM implementation for low-inductance servo motors / J-O Krah, Joachim Holtz /IEEE Transactions on Industry Applications 35 (5), 1039-1049, 1999
[59] Steel/slag interface behavior under multifunction electromagnetic driving in a continuous casting slab mold / X Sun, B Li, H Lu, Y Zhong, Z Ren, Z Lei – Metals
[60] Electromagnetic Compatibility: Principles and Applications, Revised and Expanded

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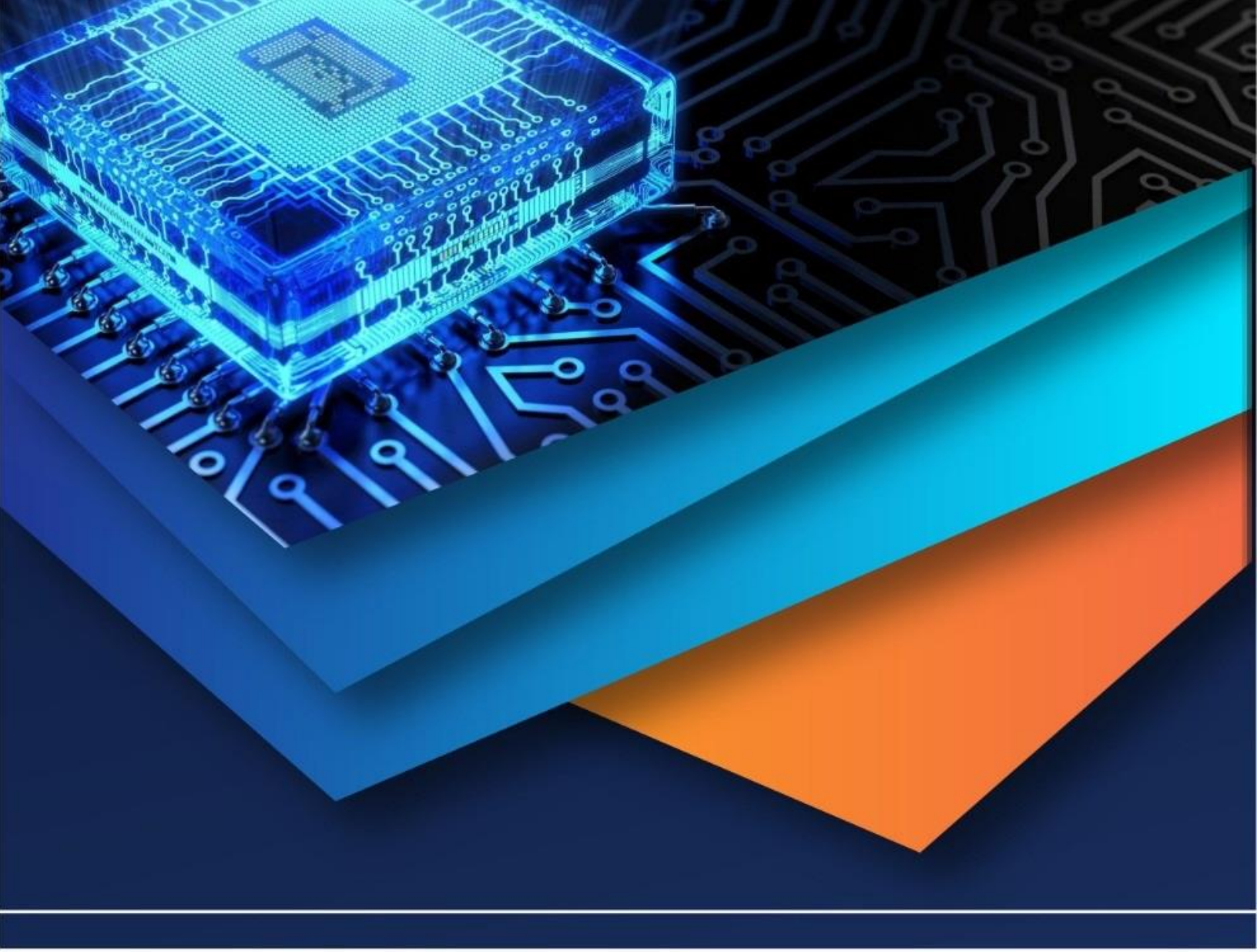

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