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Design and Fabrication of Smart Electromagnetic Breaking System

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Abstract: ***According to a study 20-30% of the road accident cases are caused due to less attentiveness of vehicle driver or the failure of brakes and vehicles have mechanical brakes which requires a high mechanical force that cause a problem to handicap person so to overcome above described problem we came up with the idea of intelligent braking system with obstacles detection which has 3 parts first is electromagnets to provide automation to the brakes and second part is infrared sensor by sensing braking system can detect obstacles so that it can automatically send signal to relay and brakes can be applied third part is brake for which we electromagnet braking to provide smoothness and effective braking and the last and main part or brain of the system is infrared sensor and relay which gets the signal from sensor and activates the brakes So from this braking system we can provide the automation to a mechanical braking system which can be further modify and can be implement to vehicles the brakes in which we can fully rely on and can also be used in vehicles for handicaps that aren't able to apply conventional braking.***

BRAKE • A brake is a mechanical device which retards motion.

• Brakes use friction between two surfaces to convert the kinetic energy of the moving object into heat.

•Need for Alternative

These systems are prone to the wear and tear on usage

• Conventional braking systems produces continuous power dissipation as heat and may fail if the temperature rises too high

• Friction based braking methods are also not efficient under wet conditions



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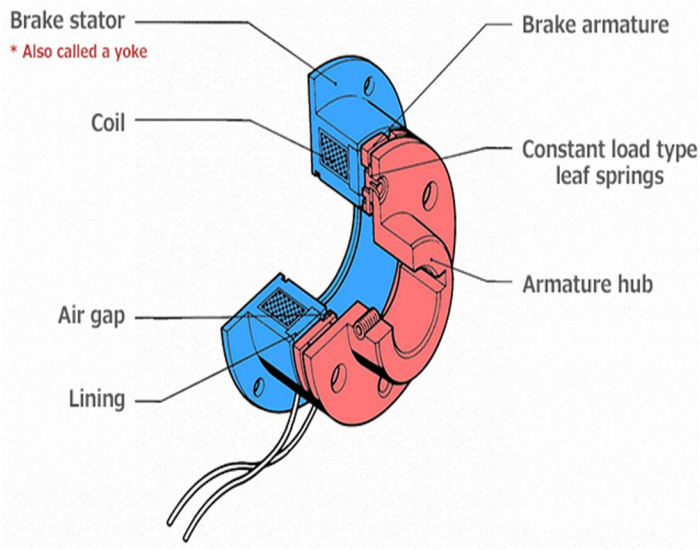
I. ELECTROMAGNETIC BREAKING SYSTEM

This is one of the simplest mechanical engineering projects. An Electromagnetic Braking system uses Magnetic force to engage the brake, but the torque required for braking is transmitted manually.

The main parts of an electromagnetic brake are:

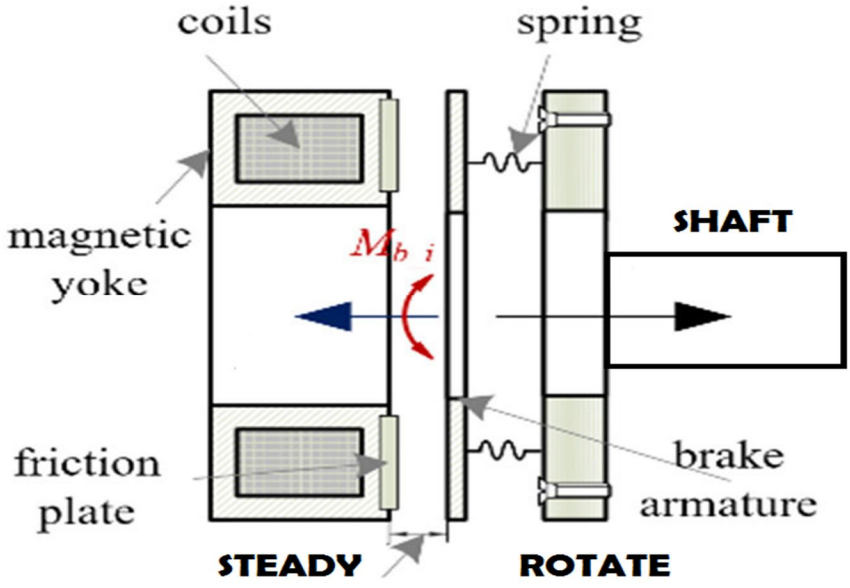
1) The coil
2) The armature.
3) The hub.

The hub is attached to the axle of the vehicle. The armature is mounted on the hub and rotates along with it. The coil is mounted on a stationary element attached to the machine frame of the vehicle. Two friction plates are mounted each on the face of the armature and the machine element holding the coil.



II. WORKING PRINCIIPLE

Electromagnetic brakes work in a relatively cool condition and satisfy all the energy requirements of braking at high speeds. It is generally based on electromagnetic induction principle. According to this principle when current passes through any electromagnetic coil, it produces a magneto motive force and the coil works as a permanent magnet. This magneto motive force is proportional to the current flowing in electromagnetic coil.



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III. COMPONENTS USED

The electromagnetic breaking system is one kind of a technological revolution where the prototype model of it shows a closer look to its design where the model consist of

1) Mild steel frame
2) Wheel
3) Infrared sensor
4) Relay
5) Power supply
6) Electromagnet
7) Motor
8) Pulley
9) Belt

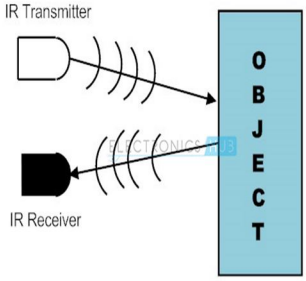
A. Main Mild Steel Frame

Frame Initially, it was proposed that a custom frame be built for the final product. Material considered for this is iron. As the rigidity does not matter in this project so, the material does not play a major role in the functioning of the prototype

B. Infrared Sensor

Infrared sensors can be passive or active. Passive infrared sensors are basically Infrared detectors. Passive infrared sensors do not use any infrared source and detects energy emitted by obstacles in the field of view. They are of two types: quantum and thermal. Thermal infrared sensors use infrared energy as the source of heat and are independent of wavelength. Thermocouples, pyroelectric detectors and bolometers are the common types of thermal infrared detectors.





C. Wheel

The Wheel is a circular component that rotate on an axle bearing where it is one of the key component of the breaking system with a radius of 90 cms.

D. Relay

A relay is an electromagnetic switch that opens and closes circuits electromechanically or electronically. A relatively small electric current that can turn on or off a much larger electric current operates a relay. Relays work like some electrical products since they receive an electrical signal and send the signal to other equipment by turning the switch on and off. Even if the relay contact is normally closed or normally open, they are not energized. Its state will change only if you apply an electrical current to the contacts



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E. Electromagnet

Since the name itself says "Electromagnetic braking system" and the main component required is the electromagnet, whereas the e.m.f. rule states that the metal is completely winded and it is been enclosed so that it can be ready to use anytime. When the current is passed the coils inside are excited and the magnetic field is produced from the electromagnet. The electromagnets works in the base of induction. Where the process induction causes electrical field to produce magnetic field thus the electromagnet uses the source of power from the electrical field into the magnetic field. The strength of the magnetic field from the magnet is a static property of the electromagnet. Hence the electromagnets works by a source of power which a magnet naturally produces.



STRONG ELECTROMAGNET DISC TYPE
SUPPLY VOLTAGE – 24 VOLT DC
TYPE – INDUCTIVE

F. Motor

An electric motor is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and electric current in a wire winding to generate force in the form of torque applied on the motor's shaft.



MOTOR HP – 1/2 HP
MOTOR RPM - 900
SUPPLY – 1 PHASE
TYPE – INDUCTION

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IV. DESIGN OF THE PROJECT

A. Given Data

- MOTOR RPM – 900 , VOLT – 230 VOLT A C SUPPLY
- MOTOR HP – 0.5 HP – 367 WATT
- MOTOR DRIVE PULLY – DIA 2''-50.8mm
- DRIVEN PULLY – DIA 8''-203.2mm
- Ratio of thr pully - 1:4

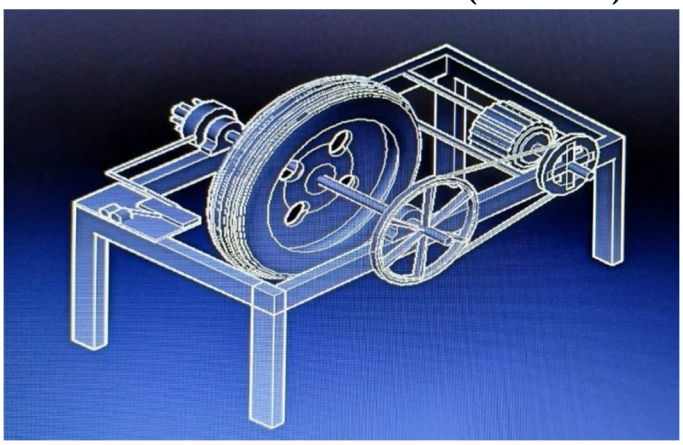
Assumed data

•12kg – M - Rotating mass
•2.5 sec - t -Braking time
•0.254m – d - Wheel diameter.
•μ -0.25- Coefficient of friction

B. Finding Design Parameters assuming certain Parameters

Braking force The total braking force required can simply be calculated using Newton's Second Law
Velocity of the wheel :V = Π *d*N/60
= (Π x 0.381 x 900)/60 = 17.954 m/sec
Acceleration of the wheel : A= (v-u)/t
= (17.954-0)/2.5 = 7.1816 m/sec2
Force = m*A
= 12 x 7.1816 = 86.1792 N
Torque = (Fx 0.5d)/R
= (86.1792 x 0.5 x 0.381)/1.725 = 9.5171Nm
Clamp force: The amount of force applied to a workpiece by closing and locking a clamp is called clamping force.
C = T/ (μ x Re)
= 9.5171/(0.25 x 0.06) = 634.47 N
•Calculation for diameter of shaft subjected to
Torque material = Mild steel
Force = 86.179 N = 8.787 kgf , Radius = 0.0125m
Torque = Force * Radius (kgfm)
= 8.787 * 0.0125
= 0.1098 Kgfm
Diameter of shaft = 25 mm(From PSG Design Data Book)

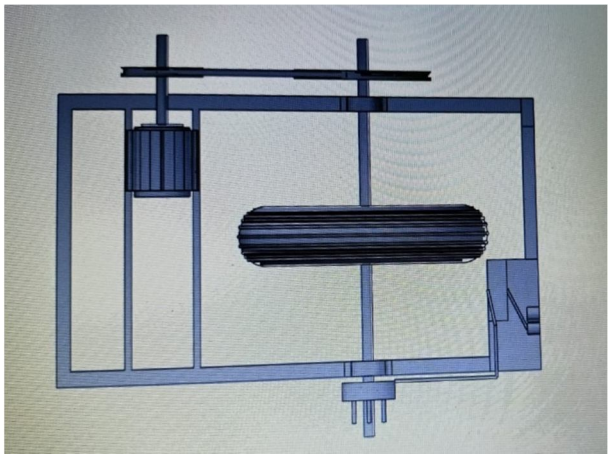
V. PROPOSED DESIGN (AUTOCAD)



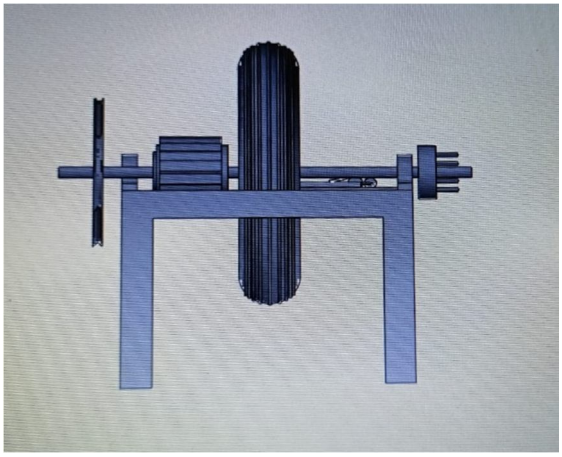
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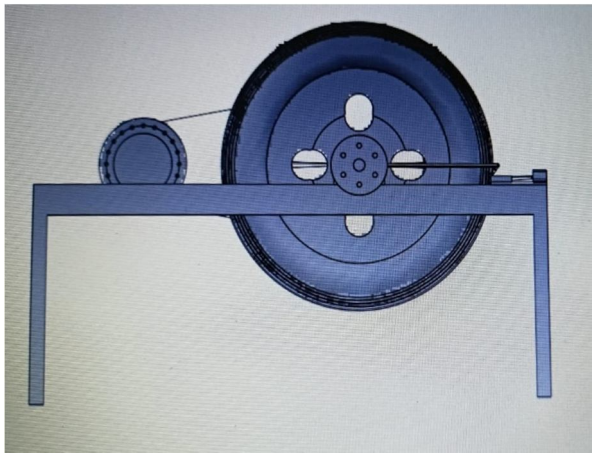
Top View Of The Model



Front View Of The Model



Side View Of The Model



A. Selection Of The Electromagnetic Brakes To Overcome The Problems

Selection of the electromagnetic braking system is to minimize the problems which normally occur in the conventional type of braking system where to overcome some problems like efficiency, maintaining parameters, safety. Hence to overcome these problems the electromagnetic braking system is been selected for the further process.

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B. Analysis Of The Electromagnetic Braking System

To study and analyze about the system where by focusing on to the working principle and the fabrication materials and design required for the model to be done and even a study towards the functioning of the braking system according to the design planned.

VI. FABRICATION

In this step the process consist of working on to the chosen design and approach into the reality. The model is then fabricated as per the specifications given and check if all the mechanisms work perfectly.

VII. TESTING:

The model is tested to check if it meets all the objectives and the model is again made to test weather there has to be done any improvement or any modifications to it. After the test is done completely the model is then made to implement.

A. Application

1) Already in use under some railway system
2) Can be used for any road vehicles
3) Equally applicable to heavy and light vehicles
4) Can be used as additional retarder for aircrafts
5) Used in crane control system.
6) Used in winch controlling.
7) Used in lift controlling.
8) Used in automatic purpose.

VIII. CONCLUSION

1) Electromagnetic Braking is superior to conventional frictional braking as there is no friction and heat in electromagnetic braking.
2) So the conventional disc and drum brakes can be replaced with electromagnetic brakes.
3) During the making of this project presentation “Fabrication of Electromagnetic brake”, we got a lot of information and knowledge about this brake, its construction, working and principle and how the brake action takes place. We are sure that while doing this project we will came across various manufacturing process which we learn in books and their actual meaning. Techniques of this braking system save the effort of the human being at the maximum level which provide the comfort to the rider of the vehicle. As this brake is require external power source of battery and it require to charge every time, to overcome this problem one can use dynamo for the charging of the power source is generated itself by the vehicle.

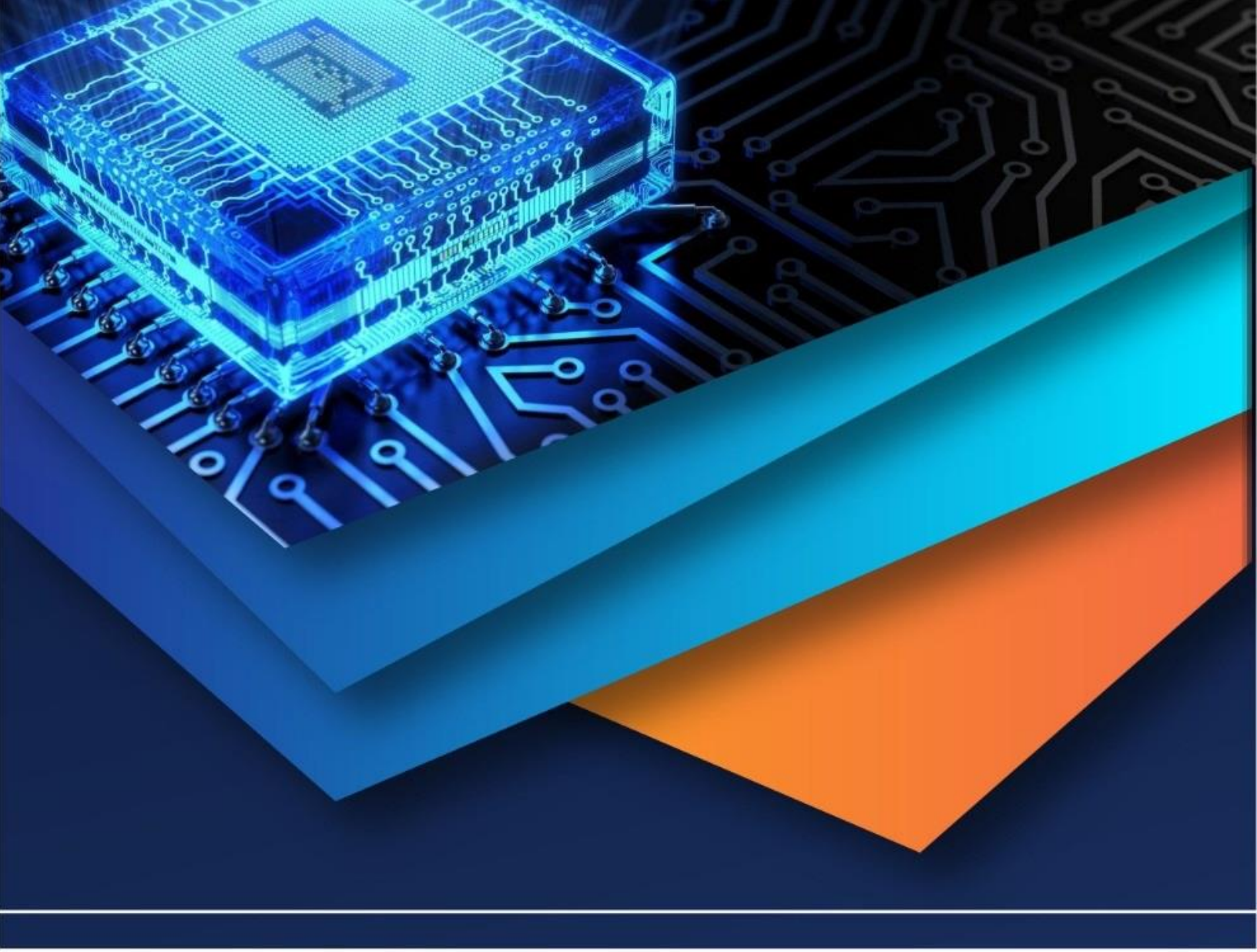
IX. ACKNOWLEDGEMENT

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