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Design and Analysis of Efficient Electromechanical Braking System (EBS)

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Abstract

Using electromagnetic induction, the electromagnetic brake slowly keeps slow the moving vehicle under which it will produce resistance. The Friction brakes create a pressure on the two separate objects to reduce the vehicle speed in a Controlled mode. The magnet current turns in the form of plate heat which definitely lowers the kinetic energy. In this magnetic type of braking device, as the driver applies force on the brake pedal, a pulsating D.C. current is sent to the power pack. As per the driver's requirement a proportionate torque is produced to decelerate the vehicle. In oil braking or air braking systems even a small leakage can result in complete brake failure and cause accidents In previous braking system we use oil which is a natural element and it has many other usages so if we exchange our hydraulic braking system with electromagnetic braking system so it may help us in economic growth and it is a clean and affordable energy.

Keywords: Friction brakes, Electromagnetic induction, V-belt, Electromagnetic brake,

I. INTRODUCTION

In this project we targeting SDG's goal is Decent Work and Economic Growth & clean and affordable energy in previous braking system we use oil which is a natural element and it has many other usages [1], [2]. Oil is extracted with giant drilling machines. Which is very costly and time consuming process and on the other hand disk is use to stop the car wheel which produce heat and sound and they are much expensive so instead of using hydraulic brake we use electromagnetic brakes which

work on the principle electromagnetism if we provide electricity to them its work efficiently hence we know electricity is a human creation and we generate it in bulk quantity as well and in a cheaper and easier way [3]. We can also generated and charge our battery while our car is running by just a simple way we connect generator in parallel with crank shaft in this way our electricity is also produces By making this project we can easily achieve our SDG's goal. The core concept of the braking method used in all the vehicles is the transfer of kinetic energy to thermal energy. While applying pressure on the brake, a force which stops is observed that is many times stronger than the momentum of the vehicle and emits heat by absorbing the kinetic energy associated. When the vehicle is running at very high speed the braking system should be sufficiently capable to hold the vehicle's speed in a very short time. As a result, the brakes have the big potential to produce more torque and consume energy within a limited amount of a time at exceptionally high speeds. Brakes in larger vehicles are often deployed at high speed for a lengthy period going down a long gradient. Brakes also have the capability to retain the ability to absorb the heat for the entire duration of as an auxiliary brakes device in effect a decelerator to ensure vehicle safety. Applying the brakes. In this work we introduced an electromagnetic braking mechanism that could be mounted in any car. It can be used similar to its simplicity in construction. Hence it can't produce any heat any noise and its very cheaper in the comparison of other braking system if we mounted it in any car it can help our country's economy and make it strong as well because in our country oil is extracted from earth in very little amount mostly we import it from different countries and there are many other usages of oil in our country if we reduce braking need of oil in our country so automatically oil consumption reduce in the country and our economy is increase [4]. It also helps other countries as well who extract oil from the earth because they save their giant drilling cost. This braking system has less friction and noise compared to the previous braking systems. It requires low maintenance and high degree of safety. This project increases employment in our country which also helps to increase the growth of any country. We can also use this system in crane controlling system [5], in lift controlling system, we can easily use this system in electric car as well and it also operate automatically through controlling of voltages this system has a vast field if we work on it its beneficial for us in the development and growth of our industry. This system is also mounted in the car externally as well this system can make the climate good as well there is no noise of breaking.

II. PROPOSED MODEL/DESIGN

The mechanical parts in our design are mainly power transmission belt, bearing, motor, motor gear and electromagnetic solenoids. The standard parts we have used are bearing, nuts and bolts and solenoid, all other things are custom made. We have

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done some calculations for the speed ratio between motor and the disc, motor torque and RPM.

Mechanical Parts Description:

- A solenoid is a series of coiled wire that behaves as an electromagnet when passing current through it. It directly transforms electric energy into linear mechanical motion.
- A bearing is a device used to help rotational or linear movement, while reducing friction and stress handling.
- A belt is a cycle of flexible material used to mechanically and most often parallel connect two or more rotating shafts.

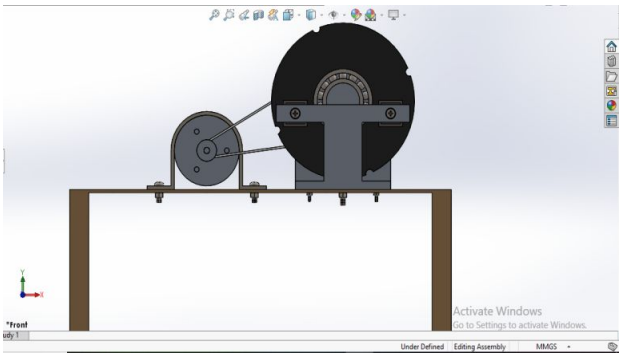

Fig 1. Front view of system

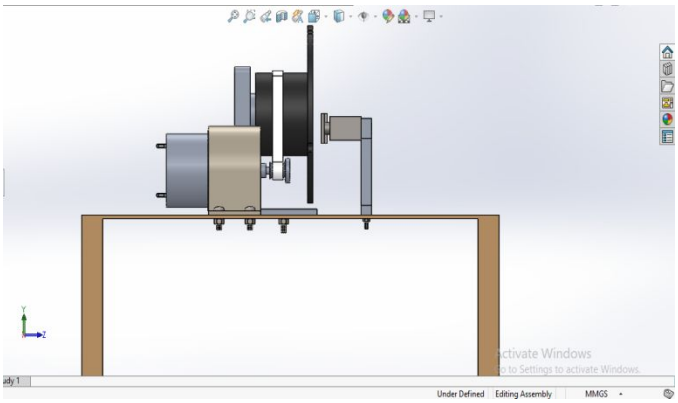

Fig 2. Side view of system

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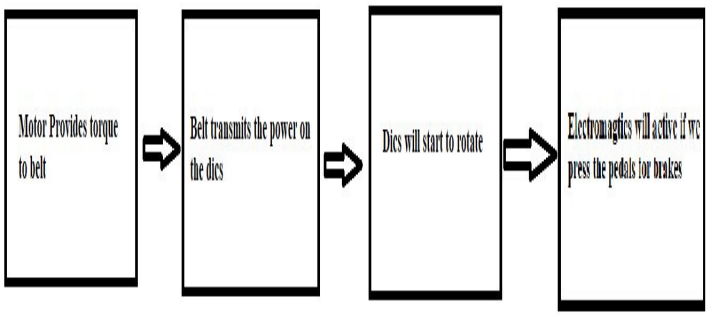

Fig 3. System process flow

Electronic components and modules to control the speed of the motor and also use sensors to measure heat and rpm of the motor. The electronics will be a tachometer to measure the speed of the disc and a thermistor to measure the heat releasing from the friction between brakes and disc. We will also use electromagnet solenoid controllers and speed controlling modules. We will be using the following circuit to control the speed of our motor and control the ON and OFF state of the brakes:

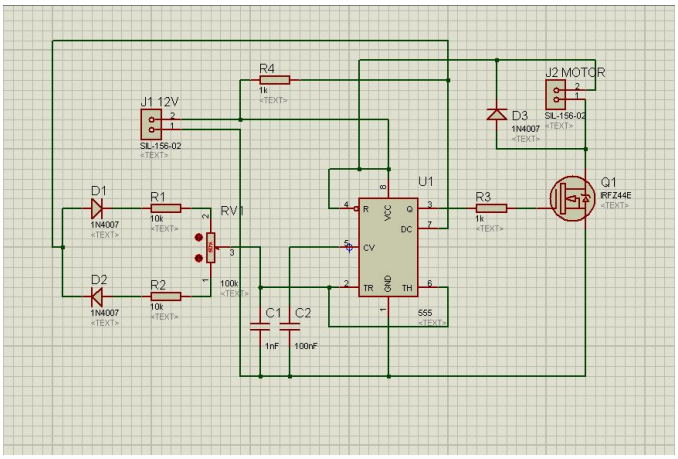

Fig 4. Proposed circuitry

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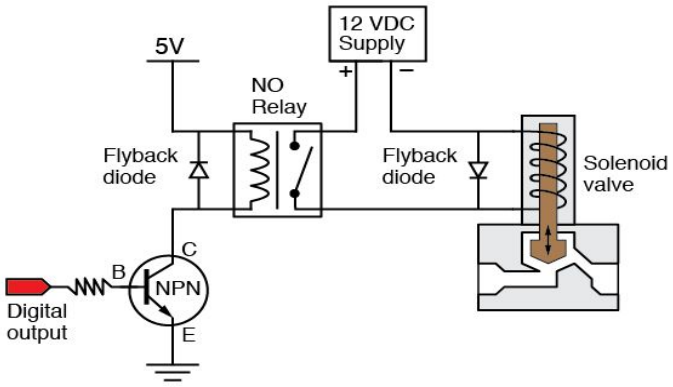

Fig 5. Electromagnetic switching circuit

III. SIMULATIONS

1) Identify critical parts and perform stress analysis, place their graphs/pictures obtained from Solidworks and discuss them in detail.

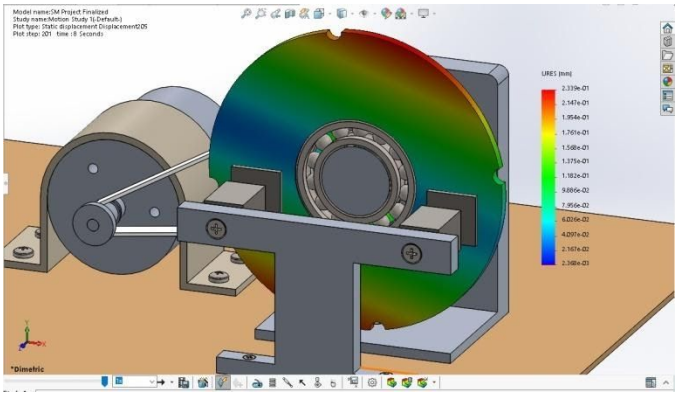

Fig 6. Deflection Analysis

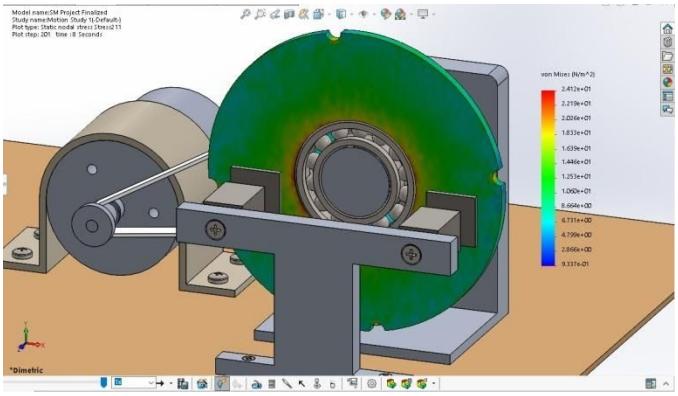

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Fig 7. Stress Analysis

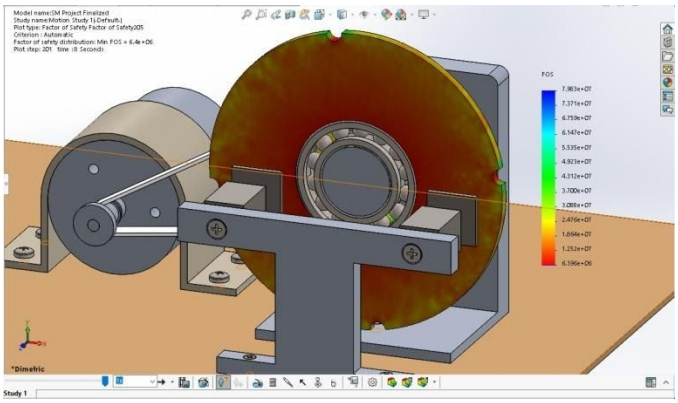

Fig 8. Factor of Safety

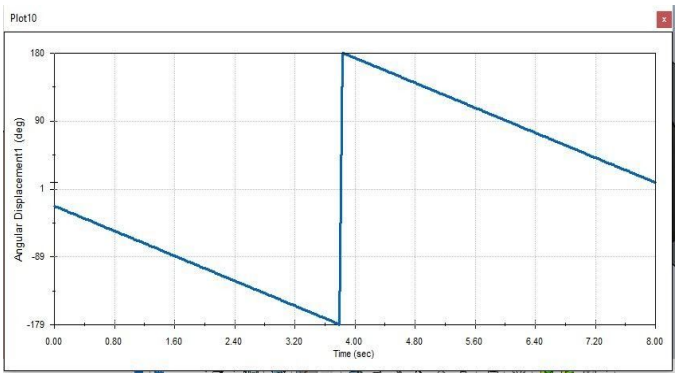

Fig 9. Angular Displacement of disc

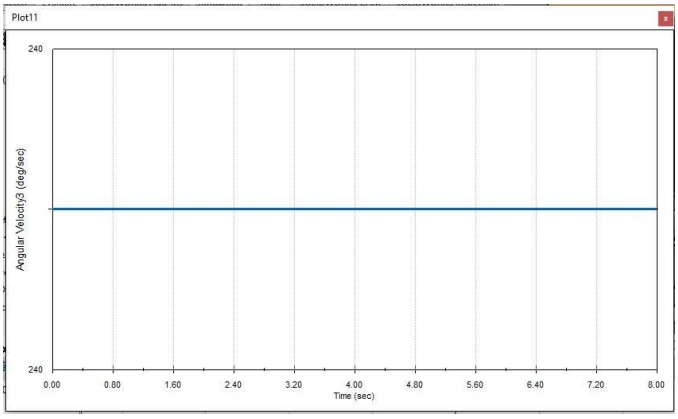

Fig: 10. Angular Speed of disc

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IV. LITERATURE REVIEW

An electromagnetic brake is groundbreaking and a fresh concept. These are less of an obvious friction. Electromagnetic brakes are brakes which perform on the electrical and magnetic powers. An electromagnetic braking device uses magnetic force to attach the brake but transmits the power required for braking manually but how manually we control the brake? In which amount force is required to stop or slow down the vehicle? Magnetic brake (also known as Eddy Current Brakes) does not operate at low speed as well. These brakes are good for slowing vehicles down but they don't stop vehicles so what can happen if we want to stop the car? In any vehicle it's really complicated to mount an electromagnetic brake because there's not enough storage between the gearbox and the rear axle to mount it then where can we mount it? [6] From many researches we get to know that how can we apply the brake manually in electromagnetic braking system first of all connect the pressure sensor with the pedal of the brake the driver of vehicle press the pedal as same as in past he do for the other braking system then they design controller and triggering circuit to control the electromagnet accordingly when the person apply the brake the pressure sensor give some value to the controller and the controller accordingly pass current in electromagnet and the brakes apply. For example when someone want to slow down the vehicle not to stop the vehicle so he press the pedal of the brake with the same pressure which he applies in previous braking systems so the pressure sensor attached with the brake pedal give some value to the controller and the controller accordingly pass current in electromagnet and the brakes apply and it slow down the vehicle. example when someone want to stop down the vehicle not to slow down the vehicle so he press the pedal of the brake with the same pressure which he applies in previous braking systems so the pressure sensor attached with the brake pedal give some value to the controller and the controller accordingly pass current in electromagnet and the brakes apply and it stop the vehicle. In this way we get to know the relation manually and electrically this experiment therefore says that the manual force applied is directly proportional to the amount of current passed by the electromagnet [7].

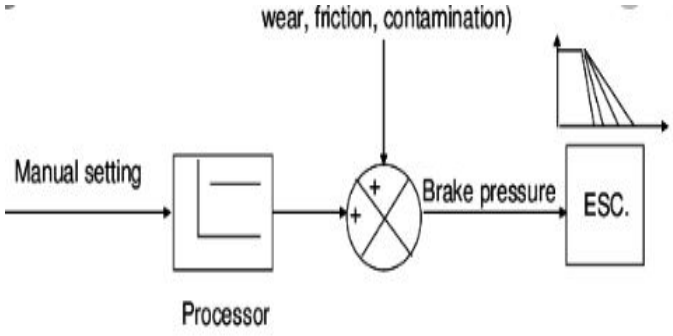

Fig 11. Braking Principle

In this fig show the brake controlling the electromagnetic braking system manually. Electromagnetic brakes slow an object by force generated by an electromagnetic induction that serves as a barrier to the vehicle's motion. This kind of brake exerts pressure on two distinct objects to slowly stop the vehicle in a uniform way. The study of current involves the developments of electromagnetic braking but the question is how we can stop the car immediately. From many researches we get to know that if we increase the induction power of electromagnet so we can achieve this task but how can we increase this we can increase it by increasing the number of turn off the coil of the electromagnet more number of turn more magnetic field produce more magnetic field produce so it can stop down the vehicle and secondly we provide them high amount of eddy current but how can we provide it from back we use some types of circuit which increase the current in electromagnet in this way we can achieve the immediate braking. Now the next target is that in any vehicle it is very complicated to mount an electromagnetic brake because there is not enough capacity between the gearbox and the rear axle to mount them. We know from other studies that mounting an electromagnetic brake is not quite complicated if there is enough capacity between the brakes. Rear axle and gearbox. We make and adjust the design of the vehicle like that have some amount of space for installing the electromagnetic braking system It does not require a subsidiary cooling system like exhaust and hydrokinetic braking it does not rely on engine component efficiency for its use. For the electromagnetic brake too there is greater controllability. The exhaust brake is a very complex on \ off unit control system for hydrokinetic brakes. The electromagnetic brake control system is a system of electrical switching that gives it superior controllability. It is obvious from the foregoing that the electromagnetic brake is also an attractive complement to the safe braking of heavy vehicles. According to me there are some shortcomings of their research which is we can spent many money and time to rebuilt the model of car and increasing the space between the rear axle and the gearboxes to mount electromagnetic braking system this is money consuming and time consuming both so this is the shortcoming of this research' hence if we apply the brakes manually so we cannot control the front steering and it may cause accident and the car is become uncontrolled so at that time what can we do? When we are attached as 4 disk plates in the electromagnetic braking system, coils and firing circuits are individually attached to each wheel of the vehicle, even if any coil fails the brake does not fail to work completely. The shorter the distance between the armature and the Magnetic Brake Housing, the more abrasive the brake linings wear off. If the brake magnet box is in touch with the armature, brake braking capacity full empty brake linings. This system requires maintenance but

in very little amount. Furthermore, it is found that electromagnetic brakes make up around 80 to82 percent of all the brake applications. The brake linings would last considerably longer before maintenance is required, thus avoiding the potential "brake fade" problem. This improved braking mechanism not only helps to stop effectively but also helps avoid a crash and to reduce accidents. Furthermore, the electromagnetic brakes eliminate the risk that can occur from prolonged brake usage outside their heat dissipation capacity. Costs of manufacturing, time needed for product creation, time necessary for process improvement are all drastically minimized with the proper use of resources. Not only the above listed benefits but also the modeling technologies used in braking systems give the final component a boost to quality control. In addition, cost estimates are easier to make for business Relationships with consumers defined parameters as specifications for technical purposes as all of these are needed in structures prevalent in world consumer relationships, defining parameters as specifications for technical purposes as all of these are necessary in the frameworks existing in company world businesses.

V. CONCLUSION

This system could significantly increase braking efficiency whilst reducing wear of the friction brake. Marketing this technology would generate extra revenue for automotive companies, and could increase customer base. It reaffirms the dedication to health and efficiency of the enterprise. By manufacturing this brake, it can be marketed for considerably less than outsourced systems, while still making a profit. This alternative will be preferred by most prospective truck owners because it decreases the maintenance and expense of conventional brakes, and improves truck protection. Electromagnetic braking systems stand for the future of the braking mechanism in future we use it in

- In trains
- Buses
- lifts use in Industries
- Heavy duty vehicles
- Cars
- It use in the application of aeronautic
- Use to slow an airplane speeds on the carrier ship

The focus of the research was on developing a systematic method of shielding. And raising the electromagnetic interference effect pressure sensor in Automotive braking systems. For automobiles the brakes are very critical, the successful braking plays a crucial role in accidents. Most heavy-duty vehicles are air or vacuum braking

systems. The air pressure has to be maintained to its threshold level, else there is a bright chance of meeting an accident but in electromagnetic brakes its chance of accident is very less. Compared to other braking Systems the electromagnetic method of braking is regarded as more effective. Just a minor leakage will lead to full brake failure in the oil braking system or the air braking system. Electromagnetic braking coils and firing circuits are individually mounted on each wheel, even if any coil fails the brake, the remaining three coils work correctly. Additionally, electromagnetic brakes are reported to make up around 80 percent of all brake applications deployed in the power field. It is completely electrically operated resulting in less malfunctions. The stopping force in that brake is not as good as the block brakes. It can then be used as an extra or disaster-slowing device in the vehicles.

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