Design and fabrication of regenerative braking system for electric vehicles

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Abstract - What the world needs right now is a way or technology to save energy so as not to waste time. Energy saving is the most important thing. In cars, energy can be saved by using renewable energy systems (RBS). While driving, a lot of kinetic energy is wasted when stationary, making the starting power very high. The main aim of the project is to create a product that can store and reuse the energy lost when stopped. Their use also leads to a clean environment and renewable energy, one of the biggest problems of the global system. Obviously, more research needs to be done in this area. Their use also leads to a clean environment and renewable energy, one of the biggest problems of the global system. Obviously, more research needs to be done in this area.

Index Terms - Regenerative braking, kinetic energy, Fuel savings.

I. INTRODUCTION

II. In a moving car, the word "braking" usually means using the brakes to slow down its speed or stop its movement by pressing the pedals. The braking distance is the distance between when the brakes are used and when the vehicle comes to a complete stop. A conventional car's braking system uses friction to prevent the car from moving forward. Excessive torque is produced when the brakes pull on the wheels or axle-mounted discs. This heat energy is dissipated into the air and wastes 30% of the energy produced by the car. Over time, this friction loop and loss of power can reduce the vehicle's fuel efficiency. More power is required from the motor to compensate for the power loss from braking. Every time we press the brake, we waste energy. It is well known that energy cannot be created or destroyed. It can be changed from one form to another. So when our car slows down, the kinetic energy moving forward has to go somewhere. Most of them are released as heat as they are useless. Energy that could be used to do work is basically wasted. The solution to these problems is the regenerative braking system. This is a new type of braking system that recovers most of the car's kinetic energy and converts it into electricity or any energy [1].

III. Regenerative braking is one of the new technologies that can be very useful in the automotive industry. Regenerative braking is regenerative braking by converting the kinetic energy of the vehicle or equipment into another form that can be used immediately or stored for a short time. The energy normally distributed in the brakes is diverted from the drivetrain to the auxiliary battery during deceleration. The stored energy can be converted back into kinetic energy and used while the vehicle is accelerating. The size of the parts available for energy storage varies with the storage type, drivetrain efficiency, transmission cycle and inertia weight [2].

IV. Regenerative braking is less effective at high speeds than at full speed. Therefore, friction braking is necessary to stop the vehicle when friction braking fails.In a moving car, the word "braking" usually means using the brakes to slow down its speed or stop its movement by pressing the pedals. The braking distance is the distance between when the brakes are used and when the vehicle comes to a complete stop. A conventional car's braking system uses friction to prevent the car from moving forward. Excessive torque is produced when the brakes pull on the wheels or axle-mounted discs. This heat energy is dissipated into the air and wastes 30% of the energy produced by the car. Over time, this friction loop and loss of power can reduce the vehicle's fuel efficiency. More power is required from the motor to compensate for the power loss from braking. Every time we press the brake, we waste energy. It is well known that energy cannot be created or destroyed. It can be changed from one form to another[3].

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VII. LITERATURE SURVEY

VIII. Using renewable energy in cars not only restores energy, but also improves energy efficiency (in hybrid cars) and saves energy stored in fuel. Driving has many accidents, so more energy is lost with more savings. Buses, taxis, trucks, etc. The business has more potential. As we know, regenerative braking is effective because it allows the vehicle to increase the output power to the input power. The work done by the car's engine is reduced, which reduces the power required to move the car. Advances in the braking system control the speed of the vehicle by converting some of the vehicle's kinetic energy into other forms of energy. The energy produced in this way can be stored as electrical energy in the flywheel or as electricity in the car battery for reuse by the car. Many authors have highlighted key points for maximizing efficiency by reducing fuel consumption, from battery design to providing good and clean electricity, to the communication and control of cars and grids [6]. A series of articles also pointed to the potential needed to develop and manufacture a world-class competitive small electric concept car in India, and the fire concluded that electric vehicles are the best solution to reduce pollution in cities and the use of electric and hybrid vehicles will lead. The document also demonstrates that governments and communities around the world can play a role in supporting and accelerating electric vehicle projects [7,8].

III. OBJECTIVE OF THE SYSTEM

For this project we want to demonstrate our engineering knowledge. This will not only provide machine learning training, but also the necessary skills. This combination is suitable for many real-world applications, and we hope work in this area will be beneficial in the future. The main objectives of this mission are: · Control the speed of the vehicle and stop it quickly and efficiently without following it. · Reduces downtime by using brake energy and generates electricity by converting kinetic energy into electricity.

IV. Components Used In RBS :

In the Regenerative Braking System, various components have been used. They are-

a. Frame Body

First, create the body frame. To size the MS square pipe, remove it and cut it to the required size using a cutter. The pipe is then welded to a square pipe with size = 25mm, outer diameter = 2mm, the square pipe is light. Manufacturing is done by cutting, drilling and welding. Figure 1 shows the physical structure of the RBS.

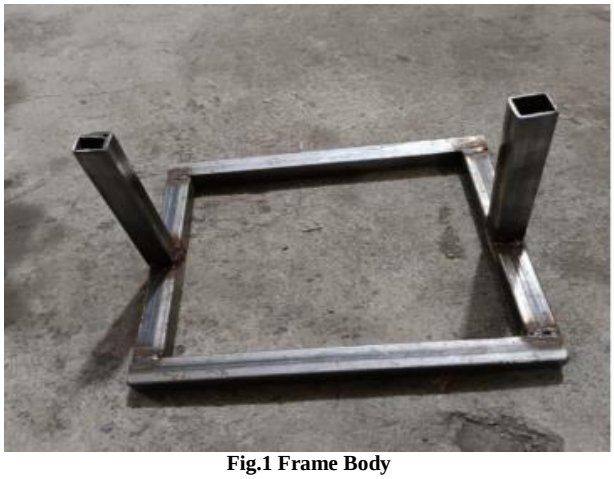


Fig.1 Frame Body

b. DC Motor

A DC motor is a class of electrical converter that converts DC power into electricity. The most common mode depends on the power produced by a magnetic field. Almost all types of DC motors have some internal functions such as electromechanical or electrical; diverting the current flowing through the motor parts. DC motors are the first type to be widely used because they can be used from existing DC power sources. The speed of the DC motor can be controlled in many ways by using a different supply voltage or by changing the amperage in the field winding.Small DC motors are used in tools, toys and appliances. Universal motors can run on DC, but it is the motor used in electrical equipment and appliances. Large DC motors are used to drive electric cars, elevators and cranes or drive rolling mills. The advent of electric motors has made it possible to replace DC motors with AC motors in many applications. Photograph. one. Figure 2 shows a DC motor.

Fig 2 DC Motor

c. Wheel

A wheel is a circle designed to rotate between bearings. The wheel is one of the main components of the axle, one of the six basic machines. Wheels are used with axles to easily move heavy objects for easy movement or transportation while supporting a load or working on a machine. Figure 3 shows the wheel.

Fig. 3 Wheel

d. Dynamo

The dynamo is just the reverse/reverse of the operation of the engine. When the conductor moves in the magnetic field, the electrical energy (voltage) is affected by the conductor because it opposes the change in the magnetic field (Lenz's law). The generator has a cylindrical permanent magnet (rotating in place) in the windings from which we get the output voltage. As the magnet rotates, its flux to the windings changes and the electric force is present through the windings as shown in Figure 4 the voltage of an dynamo.

Fig. 4 Dynamo

e. Battery

If you build a dam for a lake you can choose to have the water flow faster or slower. The faster you pump, the more power you can generate, but the faster the pool empties. On the other hand, the slower you let the water flow from the pool, the less energy will be generated, but the energy will last longer. The same goes for batteries. The need to release a lot of energy to allow the generator to start completing all models of the battery. For this reason, batteries are divided into two groups, those used with electric starters and those not used with electric starters. A battery that supplies a lot of power to an electric motor is physically different from a battery designed for long life. Figure 5 shows the battery.

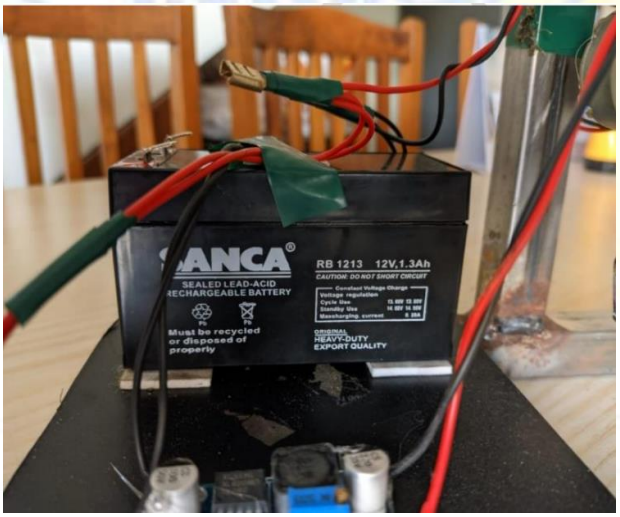


Fig 5 Shows Battery

f. Buck Booster Circuit

A buck-boost converter is a DC-DC converter whose output voltage amplitude is greater or less than the input voltage amplitude. It is equivalent to a flyback converter that uses an inductor instead of a transformer. The two different topologies are called buck-boost converters. Both can produce a wide range of output voltages, much larger (in terms of magnitude) than the input voltage, down to almost zero. Figure 6 shows the multiply-boost circuit.

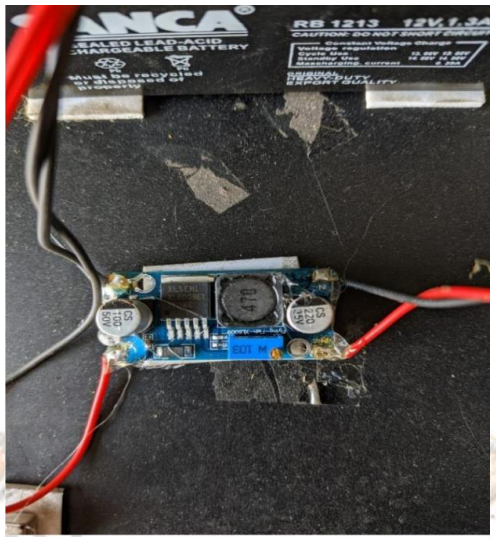


Fig 6 Buck Booster circuit.

g. Bush Bearing

A bearing is a machine that supports another machine. Allows movement of contact between surfaces during loading. Roller bearings are used in such automotive gearboxes. Ball or roller bearings have an inner ring mounted on a shaft or journal and an outer ring carried by the housing. There are balls or rollers in the inner and outer ring. Some balls or rollers are used, their handles are kept at a certain distance so that they do not touch each other. The cage is this strip, usually in two places, that is mounted behind ball bearings for light loads and roller bearings for heavy loads. Figure 7 shows the behavior. They must withstand radial and transverse loads. Use ball bearings. The hole is 38 because the load is medium. ball bearings = 307, , while 3 medium series gives 07 X 5 inner diameter Pillow block bearings numbered 6310 are used in our project, they were taken out of our will.

Fig 7 bush bearing

h. Connecting Shaft

The head is a circuit used to transmit energy from one point to another. Power is transmitted to the shaft by some tangential force, and the resulting torque or moment voltage generated in the shaft allows the power to be transmitted to the various machines connected to the shaft to ignite electricity from one pole where the rubies are installed to the other. . Various items such as glass.The material used in the shafts is generally mild steel, which requires high strength. Figure 8 shows the connection.

Fig 8 connecting shaft.

[V] Design of Regenerative Braking System

The main goal of our team is to create a product that can store and reuse the energy lost during downtime. The implementation of regenerative braking systems in cars gives us the means to compensate for the kinetic energy that the car loses when braking for something.

A. Experimental work

● We started our project with a 2D drawing of the regenerative braking system.

● For RBS, this process is iterative and depends on availability, cost, etc. It relies on various engineering and reverse engineering processes depending on the

● Goals to be achieved are four simple goals that apply to all aspects of the car: Durability, Low Cost, Ergonomics and Lightweight.

● Parameters such as cost, reliability, safety, performance, standard dimensions and information are considered simultaneously.

Various factors that determine product selection are discussed below.

The equipment selected should have features suitable for the application. Variety, weight, surface quality, hardness, chemical resistance, service life, reliability, etc. must meet the criteria. The following four important factors of the material decisively influence its choice. conductivity, magnetic density, etc. The different properties of materials include tensile strength, compressive shear, bending, torsional and buckling loads, fatigue resistance, impact resistance, elastic limit, endurance limit, modulus of elasticity, hardness, wear resistance and slip. From a manufacturing standpoint, many products include:

- Casting capability
- Welding capability
- Surface properties
- Shrinkage
- Deep drawing etc.

Sometimes it will be necessary to use special materials to keep production costs as low as possible or to make the most of the space using appropriate methods. Quality requirements This often affects production and ultimately equipment. For example, there is no need to cast a lower number than, which can be produced more economically by welding or hand forging the metal.

B. 2D Drawing of RBS

2D Drawing was developed using AutoCAD software. The figure 9 shows the various components that we have used in the RBS like frame body, dynamo, buck booster circuit, battery, dc motor etc.

The top view of the RBS is shown in the below figure 10 which was developed using the AutoCaD software. The dimensions are also mentioned. The figure 11 shows the behind view of the RBS with components

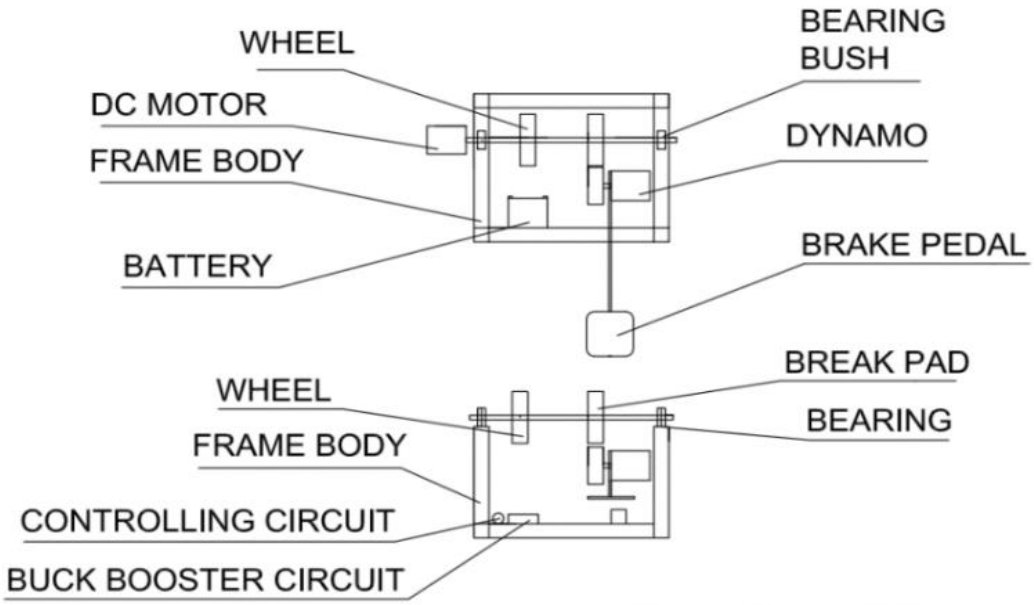


Fig. 9 RBS Components

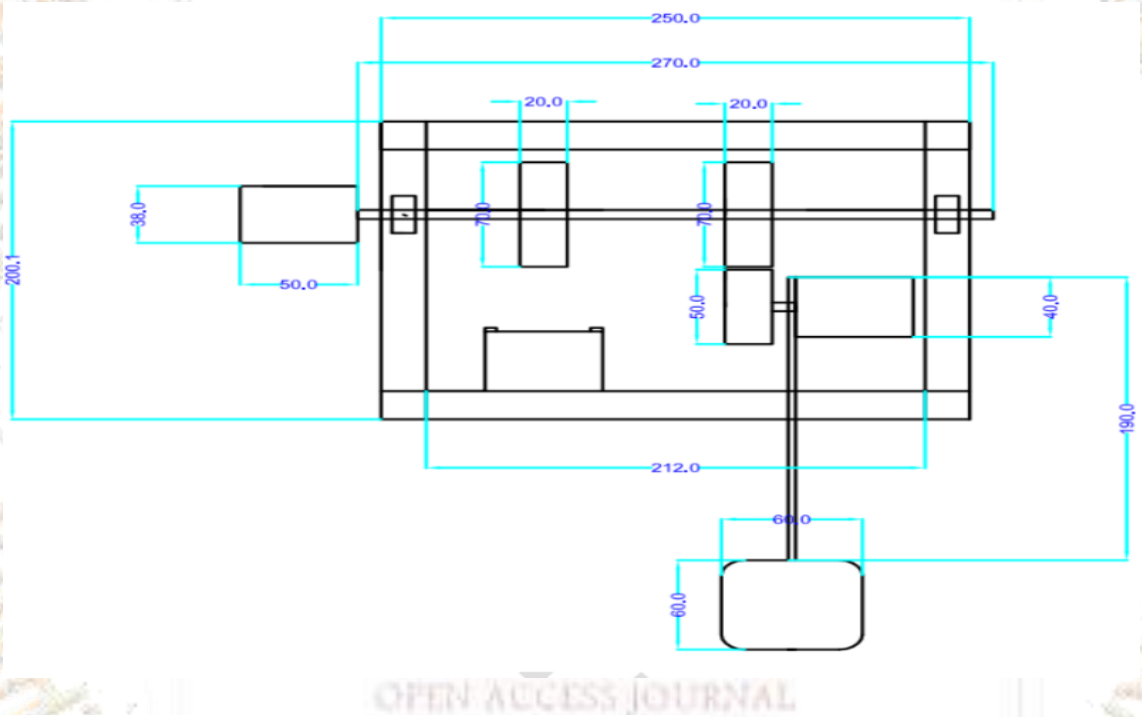
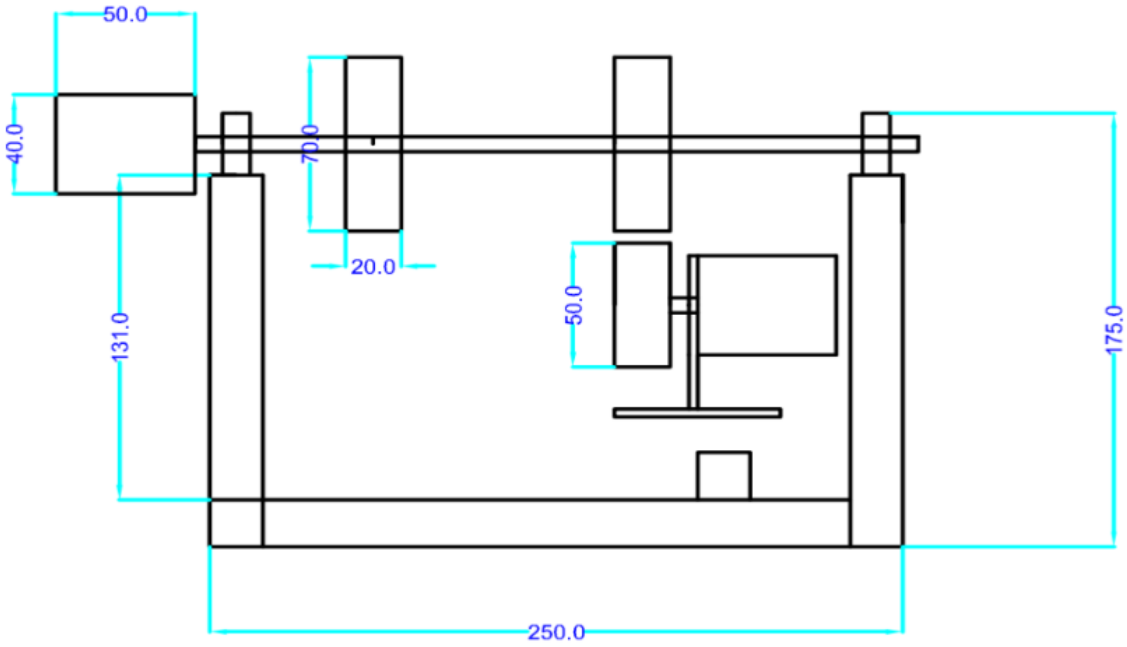


Fig. 10 Top View

Fig. 11 Behind view



[VI] Fabrication Process of Regenerative Braking System

Fig. 12

Fig. 13

Fig. 14 Fabrication Process of Regenerative Braking System

● The fabrication involved cutting the square rods to dimension to make the frame body. The figure 12 shows the completed frame body

● Components like wheels motor dynamo and brake pedal were attached to the frame body. The fig 13 shows the frame body with components attached to it.

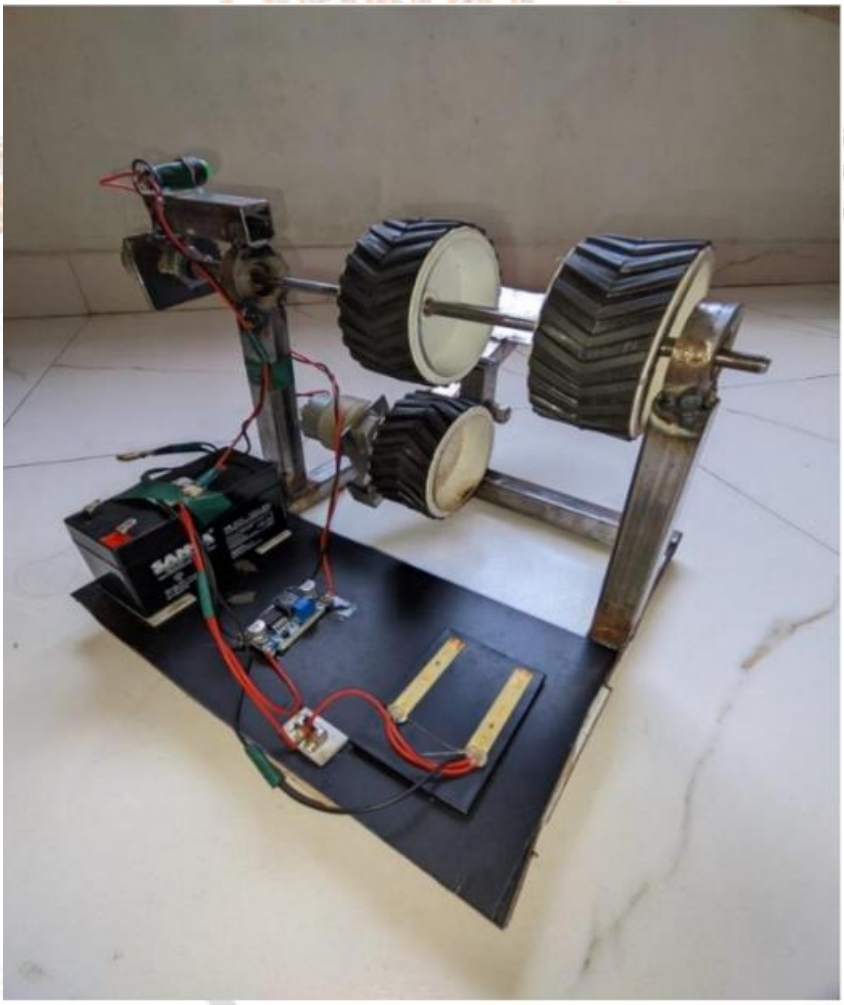
● Fig 14 represents the top view of the frame body with components attached.

● The fabrication of the RBS was completed. The figure shows the completed RBS prototype in top view.

● Components like wheels motor dynamo and brake pedal were attached to the frame body. The fig shows the more detailed view where the battery, buck booster circuit can be seen.

● This is the prototype of the Regenerative Braking System.

Fig. 15 Regenerative Braking System



[VII] Results and Discussion

Voltage output was measured for various speeds before and after pressing the brake pedal. The Table 1 shows the variation of the output voltage with respect to the change rpm before and after pressing the brake pedal.

Table 1. Output voltage

Sl. No.	RPM before pressing brake pedal	RPM after pressing brake pedal	Voltage
1	500	480	9.34
2	700	675	10.11
3	900	870	10.88

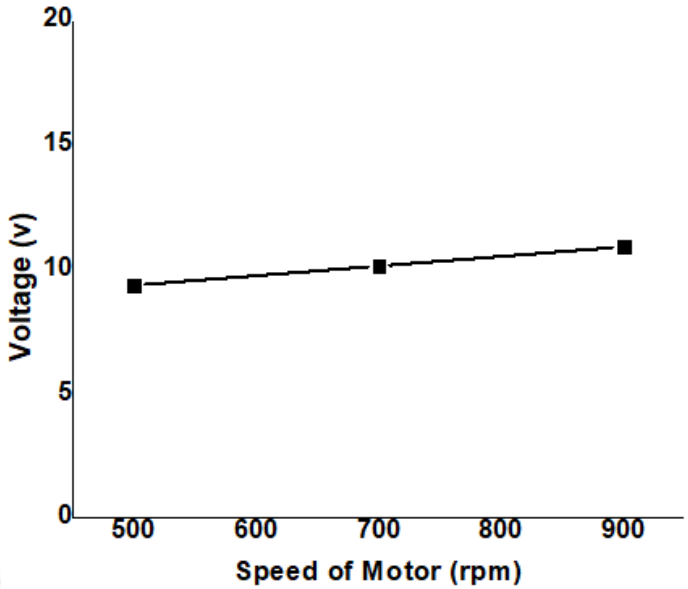


Fig 16 shows the graphical representation between rpm and the voltage generated.

[VIII] Conclusions and Future Scope

The following were the conclusions drawn after conducting the test wherein the voltage is measured upon varying the speeds:

- It is evident in the result tables that the efficiency of the regenerative braking systems using D.C Motors increases as the angular velocity of the motor increases and hence the regenerative braking systems are more efficient as higher angular velocities and the recoverable energy increases with an increase in the motor speed.
- Experimentally it is found that on increasing the speed of the wheel (rpm) the voltage generated will also be increasing and vice-versa. Like with others, researchers had used stepper or servo motors as regenerative motors, so in this project, it is replaced with a D.C motor. motor with gear.
- It has been found that the voltage generated by the D.C motor with gear is higher than that of voltage produced by those two motors.

A. Future scope

Regenerative braking systems need more research to develop better systems that capture more energy and stop faster. At the same time, designers and engineers will make the power work better, so these machines will become more common. Any vehicle in motion can benefit from these systems by regenerating the energy lost during braking. Of course, problems will arise as new technology evolves, but few future technologies have the potential to improve vehicle performance better than recycling. Future technologies for regenerative braking will include new types of electric motors that will be as efficient as generators, new drivetrain designs that will allow regenerative braking, and electrical systems with less energy loss.

The regenerative braking system used by the car meets the purpose of saving some of the energy lost in the braking process. It can also operate at high temperatures and is more efficient than conventional braking systems. The results of some tests show that the system can recover up to 30% of the energy. Regenerative braking systems have plenty of room for further improvement and energy savings. Effective automation can save a lot of money in any country's economy.

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