

Suspension Based Power Production for Electric Vehicle Range Improvement

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Abstract

The suspension system is a system that converts vehicles kinetic energy like linear motion & vibration, this energy is transformed into electricity to be used in battery charging. General vehicle suspension systems are wont to simply absorb this energy without transforming it to electricity. So here we use this free energy and store it for further needs such as vehicle lights, cooling, and indicator lights etc. To achieve this we here use the principles of electromagnetism to generate electricity from this motion. Our suspension is made up of a metal shaft, spring, base with screws and joints. We use cylindrical supports to minimize friction and ensure smooth generation. The head of the suspension comprises a linear add-on to the outer core which is aligned with the inner core to guarantee smooth motion while ensuring effective generation. This arrangement is fitted in a precise manner to achieve the desired motion and linear motion convert into rotational which allows for the generation of electricity through the electromagnetism principle. Thus our method puts forward a smart power generation system using an electromagnetic suspension system. Free Sources of energy in a vehicle such as suspension, shock absorbers work a lot of power during the running process. This power production from suspension and shock absorbers using linear generators can be effectively utilized for vehicles efficiency improvement and range extension along with improving the vehicles fuel economy and reducing dependence on power generating sources thereby reducing pollution.

Keywords: Electromagnetism Principle, Motion, Vibration.

1. Introduction

The main objective of designing the controller for a vehicle suspension system is to decrease the discomfort sensed by

passengers which arise from road irregularity and to increase the ride handling associated with the pitching and rolling movements. This requires a very fast and accurate controller to meet as many control objectives, as possible. Thus, this paper deals with an artificial intelligence Neuro-Fuzzy (NF) technique to plan a robust controller to meet the control objectives. The assistance of this controller is that it can handle nonlinearities quicker than other conventional controllers. The methodology of the proposed controller is to shrink the vibrations on each corner of the vehicle by supplying control forces to the suspension system when travelling on the rough road. The extra purpose for using the NF controller for the vehicle model is to lessen the body inclinations that are made during intensive manoeuvres including braking and cornering. A full vehicle nonlinear dynamic suspension system is introduced plus tested. The results display that the intelligent NF controller has to improve the active response measured by reducing the cost function.

It was described to develop electricity using the real-time motion of parts in a form of a wheeler. After watchful analysis of many such parts, it was decided to generated electricity using relational motion existing in a suspension system of a two-wheeler. In the new age of electric bikes, almost everything has to be modified. In one hundred years, people will launch today's hybrid and pure electric vehicles rather in the way we launch at motor vehicles since 1880 that looked like something dragged beside by a horse since that was the starting point. Inside and out, today's electric vehicles look nearly similar to what went before. We have batteries and electrical and electronic controls in big lumps since that is what they had to look like in the past, organized with masses of wiring. We have a big piece of noisy, dirty, shaking internal combustion engine in a hybrid because that is what an engine has looked like in the past. Bring in smart electronic surfaces, wireless links, and laminar conformal batteries besides mini

turbine range extenders. Then we surely will have moved on in cost, performance and passenger safety, comfort and space available. Though, until we figure out how to make comfortable vehicle bodies we shall need shock absorbers, so they might too generate electricity.

2. Literature Review

There is a future need to make much more attacks to make Non-Conventional energy attain popular acclaim. This is also very essential to reserve the conventional sources of energy and explore possible replacements like sustainable energy, solar, wind and biomass that can enhance sustainable growth. What is more, such replacements are environmentally friendly and easily replenishable. Hence, they need to be systematically exploited with a functionally expedient, energy matrix mix. Growing economies, especially in Asia are gifted with enough resource base and non-conventional energy technologies are consistent both for grid linked energy generation and transmission in out of the way places that are islanded from the grid. We selected kinetic motors means the “Energy in motion when it is unexpectedly applied with a sort of difficulty, then according to Newton’s law for every action there is an equal and opposite reaction. The use of this response is the basic motive behind the selection of this project work. This chapter includes all-important studies which have been done before by other research work. It is essential to do the literature review before doing the project because we can implement it if there is information related to this project. The most essential thing before beginning the project we must clearly understand the topic that we want to do.

Methods to produce energy that is lost during road vehicle operation have been studied in recent years. Mechanical vibrations from vertical motion induced by road bumps waste a large amount of energy. A linear electric generation system is presented to produce this energy. The system uses mechanical resonance to maximize the effectiveness of harvesting. A shock absorber suspension plus an electric generator mathematical model were generated to analyse the vibration individualities induced by road bumps during the vehicle process. An electromagnetic simulation using the marketable software MAXWELL (Ver. 13, ANSOFT, USA) was implemented to predict electricity generation. Finally, the magnetic circuit design was optimized to recover the amount

of electricity generated. The results prove the possibility of using the proposed approach in practical applications. [1]

The suspension system in a vehicle provides the framework for the vehicle to reverse the vibrations arising from the road's irregularities by an interchange of coil mechanisms. Kinetic energy is stored in the springs when responding and the frequency of vibration is decreased by dampers only to dissipate all the energy in the form of heat. As the quest of green engineering is at its peak, the prototype Suspension System for Power Generation is in combination with it while being uncertain in design and basic in functioning. The well-known prototype suspension system usages the energy to produce electricity which is then dissipated. In this work, the process of arriving at the fabricated model of the suspension system for power generation is explained. The main and current techniques which help in regenerating energy dissipation in suspensions are argued and the way they led to fix the concept of the prototype suspension system is explained. With the thought, the derivation of specifications and the process of designing the Suspension System is defined. The Suspension System created a potential difference in the range of 125 mV to 350 mV. [2]

3. Block diagram

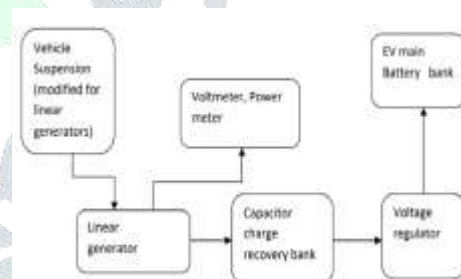


Fig. 3.1 Block Diagram



Fig. 3.2 Structure of Plan

Working:**1. Vehicle modified suspension unit**

Now, when the vehicle suspension works, the linear motion of the suspension constructs friction between the pulleys plus therefore the belt. Due to this, the pulley starts revolving. The pulleys remain attached to the shaft of the DC motors.

2. Linear Generator

As the pulleys get rotated the shaft of the motors get rotated which produce electricity. The figure shows the execution of the project and its working there. As the vehicle passes over an uneven paved surface, there's relative motion of the individual wheels. As shown, the linear motion of the wheels reasons the suspension to compress and this imparts indication to the belt which is attached to the wheel assembly. This successively gives rotational motion to the pulley as shown within the highlighted area. The belt then transfers the rotary motion through a pulley to the DC motors.

3. Capacitor Storage Bank

The motors generate electricity which is given to the capacitor storage bank and then stored or used by various auxiliaries of the vehicle. Through capacitor charge recovery we recover all the energy generated instantly.

4. Voltage Regulator

As the output from the linear generator is not fixed we need to regulate it for storage in the main battery unit. This protects the battery while charging and operating.

5. Voltmeter Display Unit

In this unit, we are displaying all the generations in live mode. This is done to show the capabilities of our project. For showing live power generation we used one voltmeter. Its dc voltmeter.

6. Auxiliary parts of the project

The project assembly thus includes one front wheel, suspension and therefore the designed units attached thereto.

1. DC Generator:-**Fig. 3.3 DC Generator**

By connecting the DC generator to the mainframe, we convert the kinetic energy generated in the mainframe into electrical energy which is a maximum of 500 RPM and can be varied for our demo according to the time of implementation and the force produced.

2. Battery Cell**Fig. 3.4 Battery Cell**

We will use the voltage generated in the DC generator to charge the battery cell by stabilizing it. Since the voltage generated in the DC generator is uneven, you cannot supply it directly to the battery unit, so you have used a regulator and you have used a lithium-ion cell for portability and size.

4. Specification of Hardware Development**i) Chassis dimensions**

- Length - 70 cm.
- Width - 22cm.
- Height - 7 cm.
- Material - MS Square channels.
- Channel specification - 15mm * 15mm Square channel.
- Thickness - 1.5mm.

ii) Welding Specifications

- Type of welding - Arc Welding.
- Temperature / Current - 400 degrees / 12 Amp.

iii) Mounting base - Wooden board.**iv) Generator specifications**

- Voltage - 12v.
- Power - 12Watt.

- Type - DC generator.
- v) **Output Power ratings**
- Pmax – 12 Watt. (500 Rpm rotation)
 - Pmin – 0 Watt. (0 RPM Rotation)
 - Power depends on the jerk/ torque applied to the linear gear which then transforms it into circular motion by circular gear.
 - Voltage at Pmax - 12Volt.
 - Voltage at Pmin - 0 Volt.
 - Current capacity - 1 Amp Max.

vi) **Storage unit**

- Battery type - Li-ion Battery pack.
- Ratings - 12V, 4Ah.
- Capacitor bank. (Used to acquire charges instantly)
- Voltage rating - 12V, 1 mill farad.

5. **Manufacturing Process:-**

- The main body is made up of mild steel (MS) with a measurement of chassis is 70cm*22cm*7cm use of channel arrangement 15mm² channel with a width of 1.5mm.

| SR.NO. | Chassis Making | Machine |
|--------|--|------------------------------|
| 1. | Cutting of MS Pipe | Grinder |
| 2. | Welding of Frame | Welding Machine (90-110 Amp) |
| 3. | Finishing of Frame | Grinder |
| 4. | Measurement and stability of the frame | Vernier Caliper |

6. **Result:-**

- Through the development of chassis-based modal, we analyzed that the technology can become practically implementable which can recover each fraction of the suspension movement into the electricity. Electrical vehicles will be benefited from range

extension through the same technology implementations.

- Here are some of the results plus analyses of our project.

a. **Movement (mm) vs Output Voltage Graph**

| Sr.No. | Movement in mm | Output Voltage(Approximated) |
|--------|----------------|------------------------------|
| 1 | 8mm | 2.5v DC |
| 2 | 12mm | 3.5v DC |
| 3 | 20mm | 5v DC |
| 4 | 30mm | 6v DC |
| 5 | 40mm | 7 v DC |
| 6 | 50mm | 8v DC |
| 7 | >50mm | 12v DC |

b. **Force (kg) vs Movement (For Our Design)**

| Sr.No. | Movement (Approximated) | Force in gram |
|--------|-------------------------|---------------|
| 1 | 3-4 mm | 200 |
| 2 | 6-7 mm | 400 |
| 3 | 8-9 mm | 600 |
| 4 | 10-15 mm | 800 |
| 5 | 15-20 mm | 1000 |
| 6 | 20-30 mm | 1200 |
| 7 | 30-40 mm | 1400 |

• **Additional significant results:-**

- To maximize the efficiency of power generation over suspension we need to use BLDC generators practically that has no brushes and longer life.
- The type of generator used magnets should be of high power. (Neodymium Magnets)
- The linear gear should be of metal material with self-lubrication assemblies this will lessen the wear.

7. Conclusion

- Successful development of the project suspension based power generation for EV system in our project activity will be useful for the upcoming electric vehicles. This system recovers the maximum amount of energy from the suspension and the storage system should be able to store it efficiently and use this energy for the range extension of the vehicles.

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