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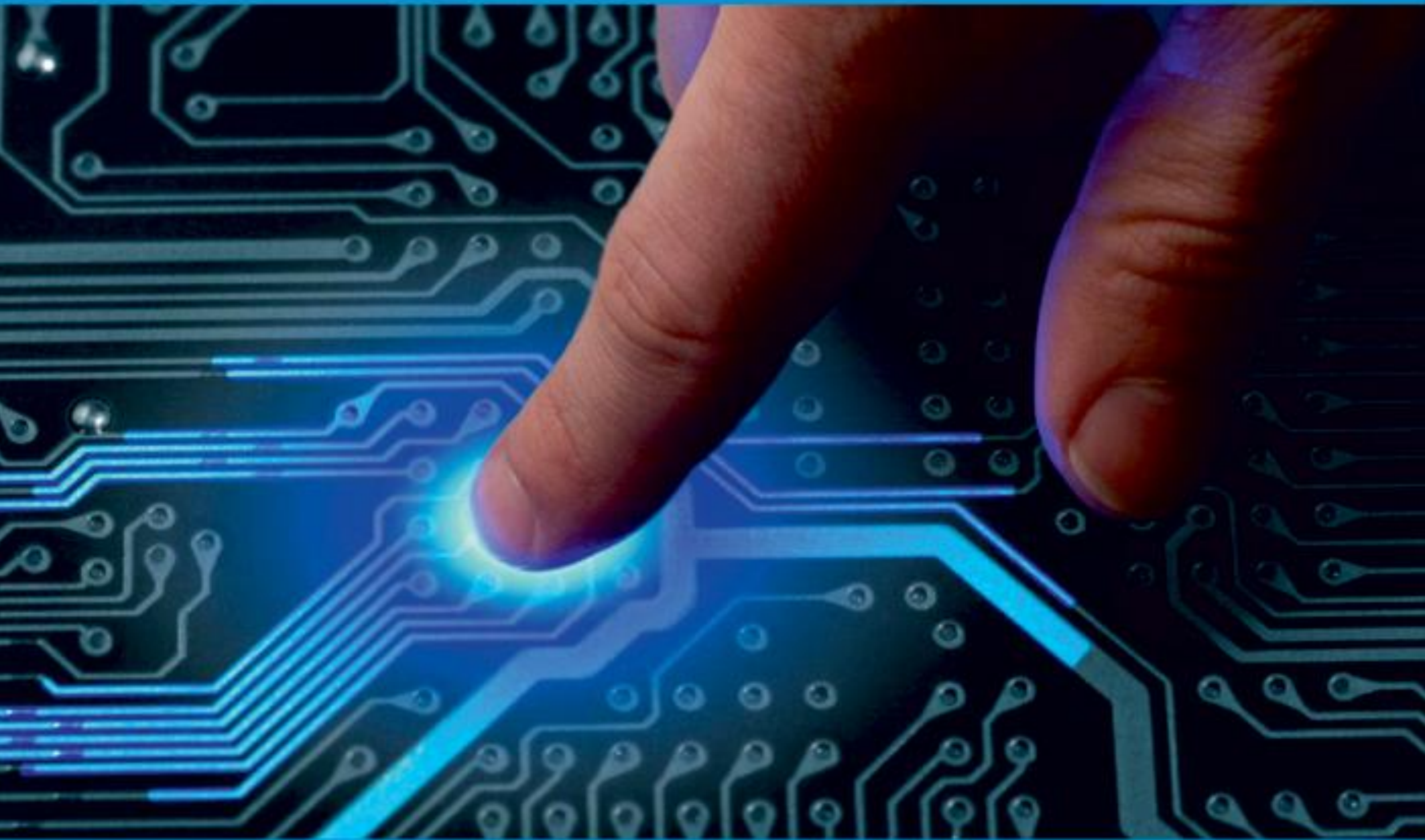

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Design and Fabrication of Regenerative Braking System

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ABSTRACT: The abstract for a regenerative braking system would encapsulate the essence of the technology, its purpose, principles, and potential benefits.

Regenerative braking systems represent a pioneering approach to enhancing vehicle efficiency and sustainability. This abstract delves into the fundamental principles and functionalities of regenerative braking, highlighting its ability to recover kinetic energy during deceleration and store it for later use, thereby reducing energy wastage and enhancing overall vehicle performance. By seamlessly integrating with conventional braking mechanisms, regenerative braking systems offer a promising solution to mitigate environmental impact and optimize energy utilization in transportation. This abstract explores the theoretical framework, technological advancements, and practical implications of regenerative braking systems, emphasizing their significance in fostering a greener, more sustainable future for the automotive industry.

I. INTRODUCTION

The introduction serves as a gateway to understanding the significance and context of regenerative braking systems in the realm of transportation and energy conservation.

In recent years, the quest for sustainable transportation solutions has intensified in response to growing concerns over environmental degradation and finite energy resources. Among the myriad innovations aimed at addressing these challenges, regenerative braking systems have emerged as a promising avenue for enhancing vehicle efficiency and reducing carbon emissions. This introduction provides a comprehensive overview of regenerative braking technology, elucidating its underlying principles, historical development, and contemporary applications. By harnessing kinetic energy typically dissipated as heat during braking maneuvers, regenerative braking systems enable vehicles to recuperate and store this energy for subsequent use, thereby augmenting fuel efficiency and extending driving range. As the automotive industry continues to embrace renewable energy and eco-conscious practices, the adoption of regenerative braking systems represents a pivotal step towards realizing a more sustainable and environmentally responsible transportation landscape.

1.1 MOTIVATION

The motivation section outlines the driving forces behind the development and adoption of regenerative braking systems, highlighting the challenges and opportunities they address.

The adoption of regenerative braking systems is motivated by a pressing need to revolutionize conventional braking mechanisms and optimize energy utilization in transportation. Traditional friction-based braking systems dissipate kinetic energy as heat, leading to energy wastage and increased fuel consumption. This inefficiency not only imposes economic burdens but also contributes to environmental degradation through heightened emissions and resource depletion. Moreover, the burgeoning demand for electric and hybrid vehicles necessitates innovative solutions to enhance energy efficiency and extend driving range. Regenerative braking systems offer a compelling response to these challenges by harnessing the kinetic energy dissipated during braking maneuvers and converting it into usable electrical energy. By seamlessly integrating with vehicle propulsion systems, regenerative braking not only improves fuel economy but also reduces greenhouse gas emissions and alleviates dependence on fossil fuels. The motivation to embrace regenerative braking systems stems from their potential to mitigate environmental impact, enhance vehicle

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performance, and propel the automotive industry towards a more sustainable future.

II. PROBLEM STATEMENT

The widespread adoption of conventional friction-based braking systems in vehicles has long been associated with inefficiencies and environmental repercussions. These systems dissipate kinetic energy as heat during braking maneuvers, leading to energy wastage and increased fuel consumption. This inefficiency not only contributes to escalating operating costs but also exacerbates carbon emissions and resource depletion, exacerbating the environmental impact of transportation. Furthermore, the transition towards electric and hybrid vehicles presents additional challenges in optimizing energy utilization and extending driving range. Regenerative braking systems emerge as a promising solution to these pressing concerns by addressing the fundamental inefficiencies inherent in traditional braking mechanisms. However, several barriers hinder the widespread implementation of regenerative braking systems, including technological complexities, cost considerations, and compatibility issues with existing infrastructure. Consequently, there is a critical need to overcome these challenges and unlock the full potential of regenerative braking technology to realize its envisioned benefits in enhancing vehicle efficiency, reducing emissions, and advancing sustainable transportation.

1. **WORKING**
   The working of a regenerative braking system involves several key components and processes that enable the capture and conversion of kinetic energy into electrical energy. Here's an overview:

2. **Detection of Braking:**
   When the driver applies the brakes, sensors detect the deceleration or brake pedal pressure, signalling the need for braking action.

3. **Activation of Regenerative System:**
   Upon detection of braking, the regenerative braking system engages, initiating the process of energy recovery.

4. **Electric Motor Operation in Reverse:**
   In electric and hybrid vehicles, the electric motor(s) typically act as generators during braking. Instead of drawing power from the battery to propel the vehicle, the motor(s) operate in reverse, generating electrical energy through electromagnetic induction as they slow down the vehicle.

5. **Conversion and Storage of Electrical Energy:**
   The electrical energy generated by the motor(s) during braking is converted from AC to DC by an on-board power electronics system. This converted energy is then stored in the vehicle's battery pack or capacitor bank for later use.

6. **Integration with Mechanical Braking System:**
   Regenerative braking systems are often integrated with traditional mechanical braking systems to provide seamless and efficient braking performance. The mechanical brakes are still utilized for additional braking force when needed, especially during emergency stops or when the regenerative braking system reaches its limit.

7. **Monitoring and Control:**
   Sophisticated control algorithms manage the transition between regenerative braking and mechanical braking to ensure smooth and responsive braking performance while maximizing energy recovery. These algorithms may also optimize the distribution of braking force between the regenerative and mechanical systems based on driving conditions, battery state-of-charge, and other factors.

8. **Feedback and Efficiency Optimization:**
   Real-time feedback mechanisms and vehicle telemetry systems monitor the performance of the regenerative braking system, allowing for continuous optimization and refinement to maximize energy recovery efficiency and overall vehicle efficiency.

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III. DIAGRAM

IV. RESULT

After the successful testing, the model is operated and the results obtained in various loading condition are noted and tabulated below.

RESULT TABLE

It can be seen from 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 increase in the motor speed. The losses are higher at lower speed because the motors are inefficient at lower speeds, whereas the losses at higher speeds are mainly mechanical losses like friction losses and air drag.

S.N	RPM before brake pedal pressed	RPM after brake pedal pressed	Voltage output
1	500	480	9.34
2	900	870	10.88
3	1300	1260	11.81
4	1700	1650	12.91
5	2100	2040	13.49
6	2300	2270	13.89
7	2500	2460	14.49

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V. CONCLUSION

In conclusion, regenerative braking systems represent a transformative innovation in the realm of transportation, offering a sustainable solution to the inherent inefficiencies of traditional braking mechanisms. Through the harnessing of kinetic energy during deceleration, these systems facilitate the conversion of wasted energy into usable electrical power, thereby enhancing vehicle efficiency, reducing fuel consumption, and mitigating environmental impact.

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