Elecrical Power Generation From Speed Breakers

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ABSTRACT

Electrical power generation from speed breakers is an emerging technique that converts the mechanical energy produced by vehicles into usable electrical energy. As vehicles move over specially designed speed breakers, the pressure and vibration generated are captured using mechanical systems such as springs, gears, and rollers. This mechanical motion is then converted into electrical energy using generators or dynamos. The system is particularly effective in high-traffic areas where continuous vehicle movement ensures steady energy production. The generated electricity can be stored and used for applications like street lighting, traffic signals, and public infrastructure. This method is environmentally friendly, reduces dependence on conventional energy sources, and provides an innovative solution to energy scarcity by utilizing otherwise wasted energy.

Keywords:
Electrical power generation, speed breaker energy harvesting, renewable energy, piezoelectric sensors, mechanical energy conversion, smart roads, energy harvesting systems, sustainable energy, road infrastructure, and micro power generation.

I. INTRODUCTION

The increasing demand for electricity, coupled with the depletion of fossil fuels, has driven the need for alternative and renewable energy sources. Traditional energy generation methods not only consume natural resources but also contribute significantly to environmental pollution. As a result, researchers are exploring unconventional methods of energy generation that are sustainable and efficient. One such innovative concept is generating electricity from speed breakers installed on roads.

Speed breakers are commonly used to control vehicle speed in urban areas, highways, and near institutions. Every time a vehicle passes over a speed breaker, it exerts force due to its weight and motion. This force, which is normally wasted, can be harnessed and converted into useful energy. By installing mechanical systems beneath the speed breaker, the kinetic energy of moving vehicles can be transformed into rotational motion, which in turn drives a generator to produce electricity. This system not only utilizes wasted energy but also contributes to the development of smart and energy-efficient infrastructure.

II. LITERATURE SURVEY

1. Title: Machine Learning for Predicting Online Shoppers' Purchase Intentions

Authors: David Torres, Luis Kevin Cepeda
Abstract:
This study focuses on predicting online shoppers' purchase intentions using machine learning algorithms applied to the UCI dataset. Models such as logistic regression, decision trees, and ensemble methods are used to analyze customer behavior and improve prediction accuracy. The research highlights the importance of feature engineering and preprocessing in handling large datasets. However, it identifies challenges such as imbalanced data and complex user behavior patterns affecting model performance.

2. Title: Using Random Forest and Support Vector Machine Algorithms to Predict Online Shopper Purchase Intention

Authors: Reza Alamsyah, Sri Wahyuni

Abstract:
This paper explores the use of Random Forest and Support Vector Machine (SVM) algorithms to predict purchase intention from e-commerce session data. The models are evaluated using metrics such as accuracy, precision, recall, and F1-score. The study demonstrates that machine learning models can effectively classify customer behavior and support business decision-making. However, the performance depends on proper feature selection and dataset quality.

3. Title: Purchase Prediction on Customer Behaviour Using Machine Learning

Authors: Neha J M, Sheethal P P
Abstract:
This research proposes a machine learning-based system for predicting customer purchasing behavior using browsing patterns, transaction history, and demographic data. It applies classification, regression, and clustering techniques to extract meaningful insights. The study shows improvements in marketing efficiency and customer targeting. However, it faces limitations in handling dynamic customer behavior and real-time prediction challenges.

4. Title: Research on E-Commerce Purchase Prediction Model Based on Machine Learning

Authors: Zaixin Lin, Zihui Huang, Huiyan He, Jiazi Liang, Xinbei Zheng, Jingde Huang
Abstract:
This paper presents a machine learning-based purchase prediction model using the Random Forest algorithm. It analyzes historical user data to identify patterns influencing buying decisions. The model achieves high accuracy and demonstrates practical applicability in e-commerce platforms. However, it mainly focuses on structured data and may not fully capture complex behavioral patterns.

5. Title: Predicting Customer Purchase Behavior Using Machine Learning Models

Authors: Emre Deniz, Semanur Çökekoğlu Bülbül
Abstract:
This study compares multiple machine learning models including SVM, KNN, Random Forest, and Gradient Boosting for predicting customer purchase behavior. It uses demographic and behavioral features such as age, income, and browsing time. The results show that ensemble models provide better accuracy. However, the study highlights increased computational complexity and difficulty in selecting the best model.

III. EXISTING SYSTEM.

Currently, most of the electricity generation relies on conventional sources such as thermal power plants, hydroelectric plants, and nuclear energy. These methods require significant investment, large infrastructure, and continuous supply of natural resources. Moreover, they have adverse effects on the environment, including air pollution, water usage, and greenhouse gas emissions. Although renewable energy sources like solar and wind power have gained popularity, they are dependent on weather conditions and are not always consistent.

In the context of road infrastructure, the mechanical energy generated by vehicles is completely ignored and wasted. While there have been some experimental models to generate electricity from speed breakers, they often suffer from limitations such as low efficiency, high installation cost, mechanical wear and tear, and lack of durability under heavy traffic conditions. These drawbacks prevent widespread implementation and highlight the need for a more efficient and reliable system.

IV. PROPOSED SYSTEM

The proposed system aims to efficiently generate electricity by capturing the mechanical energy produced when vehicles pass over speed breakers. The system consists of a specially designed speed breaker mechanism integrated with components such as springs, racks and pinions, gears, and shafts. When a vehicle moves over the speed breaker, it causes a vertical displacement, which is converted into rotational motion through these mechanical components. This rotational motion is then used to drive a generator that produces electrical energy.

The generated electricity is stored in batteries and can be used for various applications such as street lights, traffic signals, toll booths, and nearby public

facilities. The system is designed to be robust, cost-effective, and capable of withstanding heavy traffic loads. It provides a continuous and reliable source of energy in areas with high vehicle density. Additionally, this method promotes energy conservation, reduces dependency on conventional power sources, and supports sustainable development by utilizing renewable energy in an innovative way.

V. SYSTEM ARCHITECTURE

The system architecture for **Electrical Power Generation from Speed Breakers** is designed to convert the mechanical energy produced by moving vehicles into usable electrical energy through a structured process. It begins with vehicles passing over a specially designed speed breaker, where the applied force causes a vertical displacement in the mechanism installed beneath it. This movement is transferred to mechanical components such as springs, rack and pinion systems, shafts, and flywheels. These components work together to convert the up-and-down motion into continuous rotational motion, which is essential for driving the generator efficiently.

Once the rotational motion is generated, it is used to operate a generator that converts mechanical energy into electrical energy. The produced electricity is then directed to a power storage system, typically consisting of batteries, along with components like charge controllers and inverters to regulate and store the energy safely. Finally, the stored energy is utilized for practical applications such as street lighting, traffic signals, toll booths, and other public utilities. This architecture ensures efficient energy conversion, continuous power generation in high-traffic areas, and effective utilization of otherwise wasted mechanical energy, making it a sustainable and cost-effective solution.

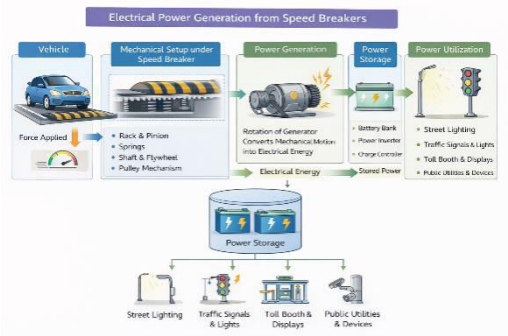

Fig 5.1: System Architecture

VI. IMPLEMENTATION

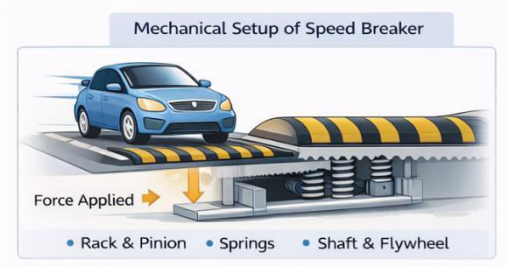

Fig 6.1: Mechanical Setup Of Speed Breaker

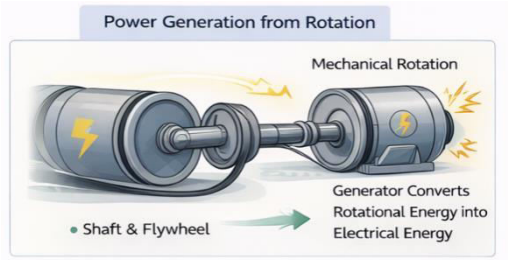

Fig 6.2: Power Generation From Rotation

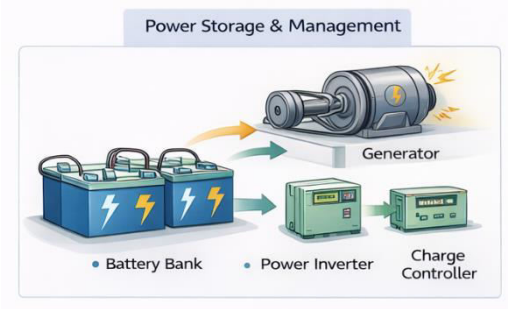

Fig 6.3: Power Storage &Management

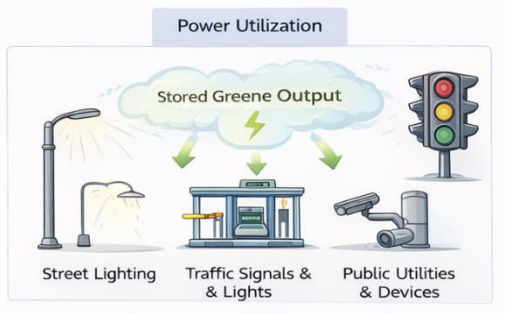

Fig 6.4: Power Utilization

VII. CONCLUSION

The concept of electrical power generation from speed breakers presents an innovative and sustainable approach to energy production by utilizing the otherwise wasted mechanical energy of moving vehicles. By converting the pressure exerted by vehicles into electrical energy through mechanical and electromechanical components, the system offers a practical solution for power generation in high-traffic areas. It reduces dependency on conventional energy sources and contributes to environmental conservation by promoting clean and renewable energy.

Moreover, the system is cost-effective, easy to install in suitable locations, and capable of generating continuous energy where vehicle movement is frequent. Although there are challenges such as mechanical wear and efficiency optimization, the overall benefits make it a promising solution for smart cities and infrastructure development. With proper design and maintenance, this system can significantly contribute to meeting small-scale energy demands.

VIII. FUTURE SCOPE

In the future, the efficiency of the system can be improved by integrating advanced materials and optimized mechanical designs that reduce energy loss and increase durability. The use of smart sensors and IoT technology can help in monitoring performance, detecting faults, and improving energy management in real time. Additionally, combining this system with other renewable energy sources such as solar panels can create hybrid systems that provide more reliable and consistent power generation.

The implementation of this technology can be expanded to highways, parking areas, toll plazas, and smart city projects where traffic density is high. Further research can also focus on increasing energy output and reducing maintenance costs, making the system more viable for large-scale deployment. With advancements in technology, electrical power generation from speed breakers has the potential to become an important component of future sustainable energy solutions.

IX. REFERENCES

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