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SELF POWERED ROAD INFRASTRUCTURE

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Abstract : This paper examines the power production and structural integrity of a speed breaker power generator, which converts the kinetic energy of vehicles into electrical power. The device employs a rack and pinion system and the piezoelectric principle to convert the linear motion of a speed breaker into rotational motion to power a generator. The design was done in CATIA software and analyzed in ANSYS to check structural integrity. The results indicate an average power production of approximately 115.9 kW in 24 hours, depending on traffic flow. The structural analysis also verified the safety of the device under vehicular loading. The produced power can be utilized to power streetlights, traffic signals, and LED displays.

I. INTRODUCTION

The energy infrastructure of Bangladesh is relatively small, inadequate, and mismanaged. The per capita energy use in Bangladesh is one of the lowest (136 kWh) in the world. Noncommercial energy sources, like wood fuel, animal dung, and crop residues, are estimated to contribute over half of the country's energy use. Bangladesh has small oil and coal deposits, but enormous gas deposits. The use of commercial energy is dominated by natural gas (about 66%), followed by oil, hydropower, and coal. Electricity is the prime source of power for most of the economic activities of the country. Thus, we have to explore some approximate, alternative, new sources for the power generation, which is not exhausted in a very few years. It affects all the living things of all forms as present on the earth, in water, and in the air. Power plants and cars are the biggest sources of pollution. Thus, we have to explore other forms of renewable sources, which can produce electricity without using any commercial fossil fuels, which do not produce any harmful materials. Already, there are such systems present using renewable energy sources like solar, wind, etc. for power generation. The latest technology employed to produce the power from such a renewable energy source is “power generation using speed breaker” where crank-shaft and spring system is employed. In this system, a new system named roller system is proposed to produce electricity from speed breaker by utilizing the vehicle kinetic energy in the form of mechanical energy. As the vehicle moves over the speed breaker, the wasted kinetic energy can be tapped in the form of rotational energy of the roller to produce electricity, which is the basic concept of this research work. This new system offers greater efficiency and greater power output at a lower cost compared to the previous system. A roller with some gripping material is placed in between the speed breaker. When the vehicle moves over the speed breaker, it turns the roller. The rotation of the roller is then used to turn the shaft of the DC generator through chain drive with a speed ratio of 1:4. As the shaft of the DC generator turns, it produces electricity. The produced electricity is then stored in a battery and used to light up the street lamps on the road.

II. METHODOLOGY

Electricity is a natural component and it is one of the most used forms of energy by us. A lot of energy is wasted at the speed breakers due to the dissipation of heat and friction, every time a vehicle passes over the speed breaker. In this research, a roller is placed in between the speed breaker and some sort of grip is provided to the speed breaker so that when a vehicle passes over the speed breaker, it rotates the roller. This rotation of the roller converts the kinetic energy of the vehicle into the rotational energy of the roller shown in fig.

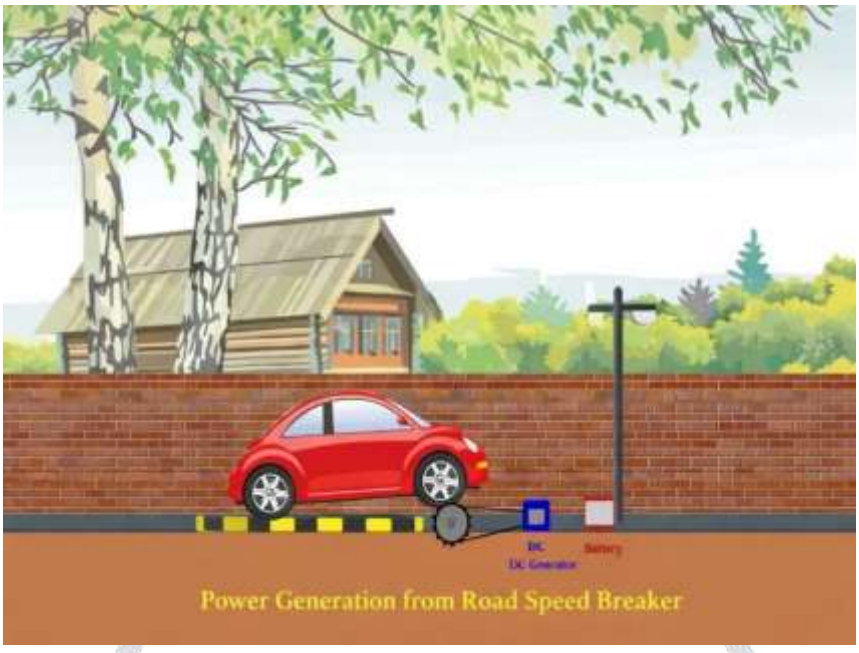

Fig. 1. Conversion of kinetic energy to rotational energy

The mass and this rotational energy are proportionate. For certain mechanical benefits, the shaft's mechanical energy is converted from the rotational energy of the r through a ratio of 1:1. turns mechanical energy into electrical energy as it rotates at a specific rpm. Traffic density will be the conversion. This process is demonstrated in a Fi speed vehicle, where the dynamo shaft energy is converted to be proportional to it through the gear ratio. Two.

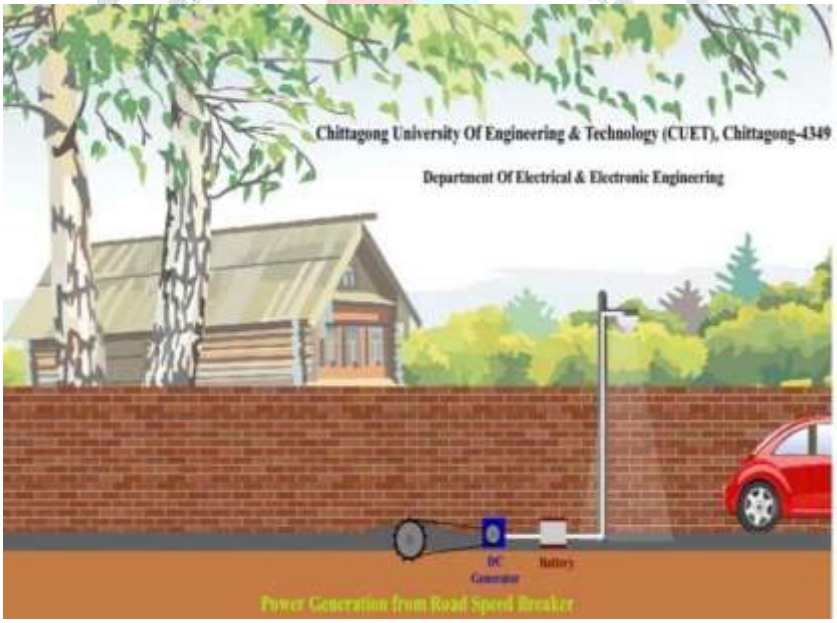

Fig. 2. Conversion of mechanical energy to electrical energy

III. SYSTEM DESIGN

The entire system can be depicted as shown in Fig. 3, where dissipated power captured by the roller as rotational energy is converted to mechanical energy through chain drive. This mechanical energy is then transformed into electricity using a dynamo, which is stored in the block diagram as r of the vehicle is, which is subsequently converted to Electrical energy is then provided by the battery.

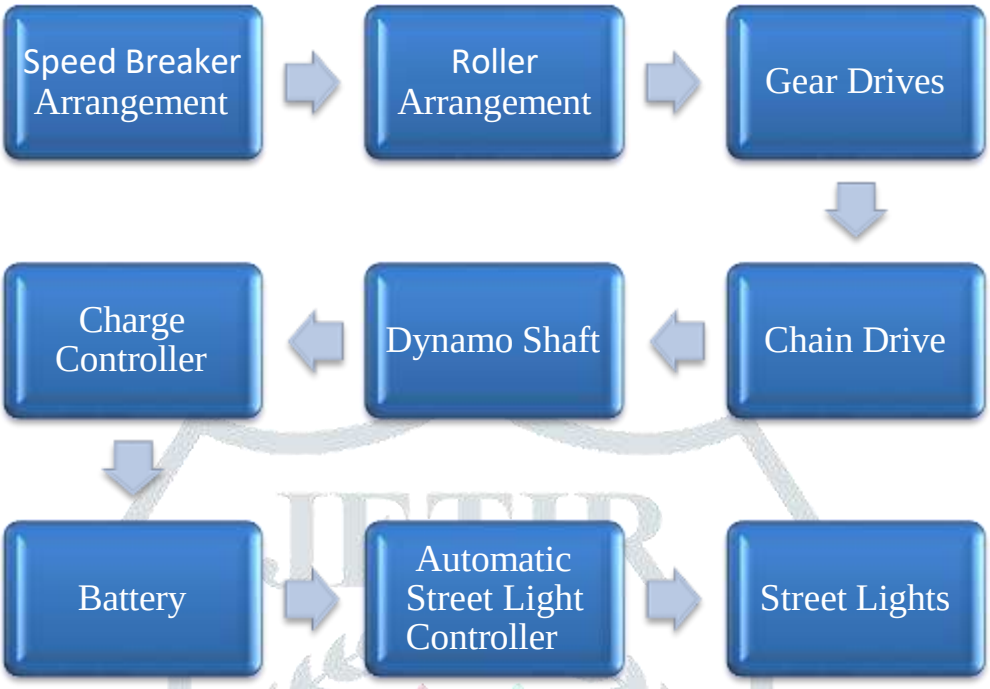

Fig. 3. Block diagram of the total s system

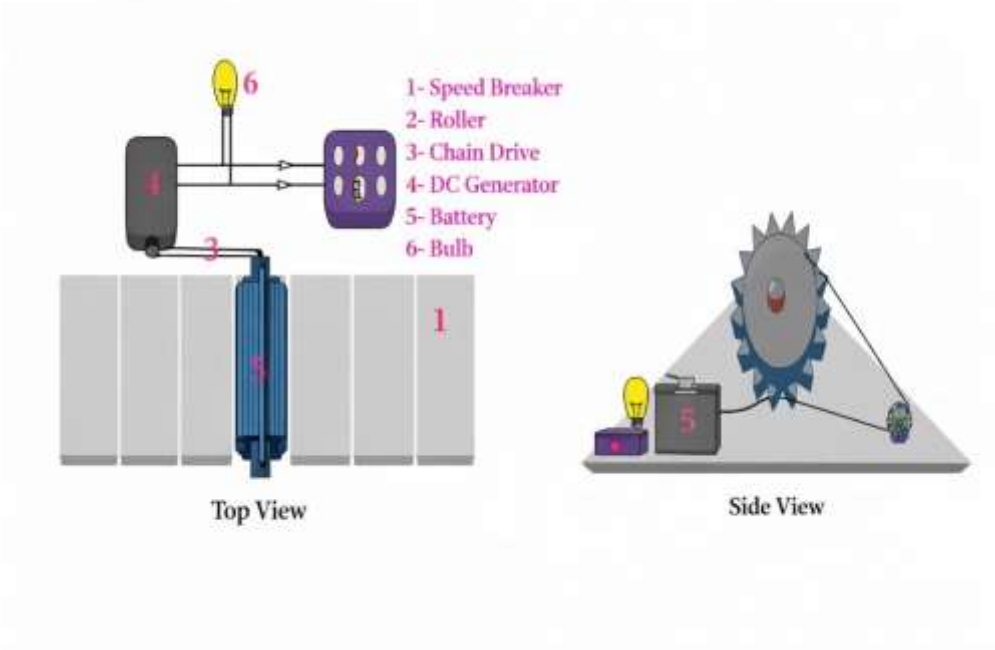

Fig. 4. Connection on diagram of the system

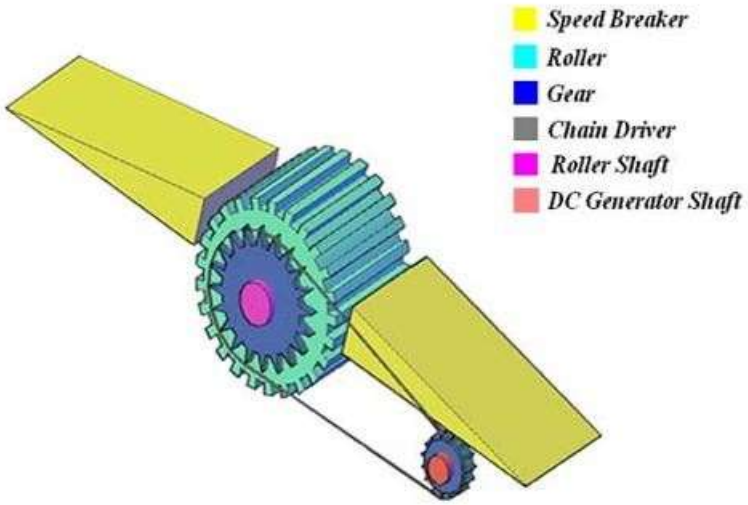

Fig. 5. Overall design layout

Fig. 4 illustrates how all of the equipment is connected between the roller and the dynamo sh drive from the side. Design is crucial in it. A roller-type roller is used for gripping in Fig. 5's notch to obtain more rotation and gs from the top and the shaft through chain.

IV. OBJECTIVES

- Utilize wasted kinetic energy: turn the substantial energy that cars lose when they go over speed bumps into electrical power that can be used.
- Encourage renewable energy: help reduce reliance on fossil fuels and the environmental problems they cause by increasing reliance on renewable energy sources for power generation.
- Decentralize power generation: Make it possible for decentralized power generation, especially in places where traditional grid infrastructure is scarce.
- Reduce energy consumption: Provide a different source of electricity for a range of uses to reduce overall energy consumption.
- Enhance traffic management by incorporating dynamic speed bump adjustment features and traffic monitoring to maximize safety and traffic flow.

V. PROBLEM STATEMENT

Every day, a significant amount of mechanical energy is wasted in quickly expanding urban areas when cars slow down while passing speed limiters. The need for electrical energy is also growing, particularly for small-scale uses like traffic signals, street lighting, and sensor systems. Traditional energy sources are expensive, scarce, and pollute the environment. Investigating sustainable, renewable, and alternative energy generation techniques is therefore necessary. By creating a system that can transform the wasted mechanical energy from moving cars into useful electrical energy without compromising traffic flow or vehicle safety, this project seeks to address the issue of wasted kinetic energy at speed breakers.

VI. APPLICATION

- Street lighting is important on highways, roads, and at intersections.
- Power supply for traffic signals and road signs.
- Charging stations for small electronic devices, like mobile phones and sensors.
- Powering CCTV cameras and surveillance systems at traffic lights.
- Energy source for automatic streetlight control systems.
- Supplying power to toll plazas and parking areas.
- Powering sensors for environmental monitoring, including air quality, noise level, and traffic density.
- Emergency power backup for roadside systems in case the grid fails.

VII. ADVANTAGES

- Energy available all year round.
- Simple construction, mature technology.
- No manual work necessary during generation.
- Pollution free power generation.
- No fuel transportation problem.
- No obstruction to traffic.

VIII. CONCLUSION

It is commonly acknowledged that one of the most important markers of a nation's economic development and growth is its energy consumption. The demand for electrical energy has increased dramatically due to the fast urbanization and population growth, particularly in developing nations. In order to minimize the impact on the surrounding engineering environment, this study suggests a novel power generation system that makes use of the mechanical energy generated by cars passing over speed limiters.

Because the amount of electricity produced is directly correlated with traffic density, a significant amount of energy can be extracted in densely populated urban areas. The potential energy output increases with the number of vehicles. Through the use of this system, energy that would otherwise be lost during vehicle movement is captured and transformed into electrical power.

The suggested approach is especially appropriate for developing countries with high traffic density and frequent energy shortages, like Bangladesh. In this method, the speed breaker serves as a small-scale power generator that can provide electricity for low-power uses like traffic signals, street lighting, and public display systems. Large-scale implementation of this system can promote sustainable and environmentally friendly energy production while reducing reliance on traditional power sources and future electricity demand.

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