

Power Scavenging from Moving Vehicles on Road

Syed Arslan Ahmad and Bilal Masood

Department of Electrical Engineering,
Superior University,
Lahore, Pakistan

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ABSTRACT: In the current scenario, population is increasing day by day therefore the demand of power is also increasing with it, The extensive usage of energy has resulted in reduction of conventional resources of power. Therefore, to overcome this problem we need to implement the technique which will not only overcome the energy crisis but also prevent the environment. Conventional resources like fossil fuels and nuclear energy requires careful handling and spoils the environment too. Hence the focus is now shifting towards the renewable resources of energy. This paper emphasizes on the idea that there is possibility of generating power by specially designed speed breaker. We can convert the energy which is being wasted everyday on the roads by the moving vehicles, into electricity and store it in the batteries. As we know, vehicles on road are increasing gradually with every passing day; this will help us to generate electricity as these vehicles pass through the speed breakers. This paper explains clearly, the working principle of the system, its practical implementation, output power calculation and its advantages. The energy we generate from speed breaker is enough for lighting street lights during night, by using this arrangement we can store a lot of power. The suggested model is an eco-friendly method for generating power i.e.; it does not consume any fuel.

KEYWORDS: Energy crisis, conventional resources, power generation, speed breaker, vehicles, practical implementation, output power calculation, street lights.

1 INTRODUCTION

During last few decades, Power has become the most important need for human life, works-in industry, agriculture, transportation and so on. But we know that the resources for power generation are limited, and this has cause the energy crisis. The increasing power demand results reduce in conventional resources for power generation and increase the carbon dioxide emission; it provides a need to think on non-conventional energy resources or renewable energy resources which are eco-friendly to environment [1] , [2]. In this paper we are looking forward to conserve the kinetic energy which is wasted on roads every day. The idea to generate electricity through speed breakers can bring revitalization in field of power generation. The number of vehicles passing over the speed breaker in roads is increasing gradually. According to statistics provided by the Provincial Excise & Taxation Departments, Government of Pakistan, from 2001 to 2010 there is tremendous vehicular growth as shown in Fig1; there are approximately 4.78 million vehicles on roads in 2001 and this figure reached to 7.86 million in 2010. The rate of growth of vehicle in Pakistan has been almost 64.5 percent during the last decade. So we can tap enough power from the vehicles moving over the power generating speed breaker (PGS).

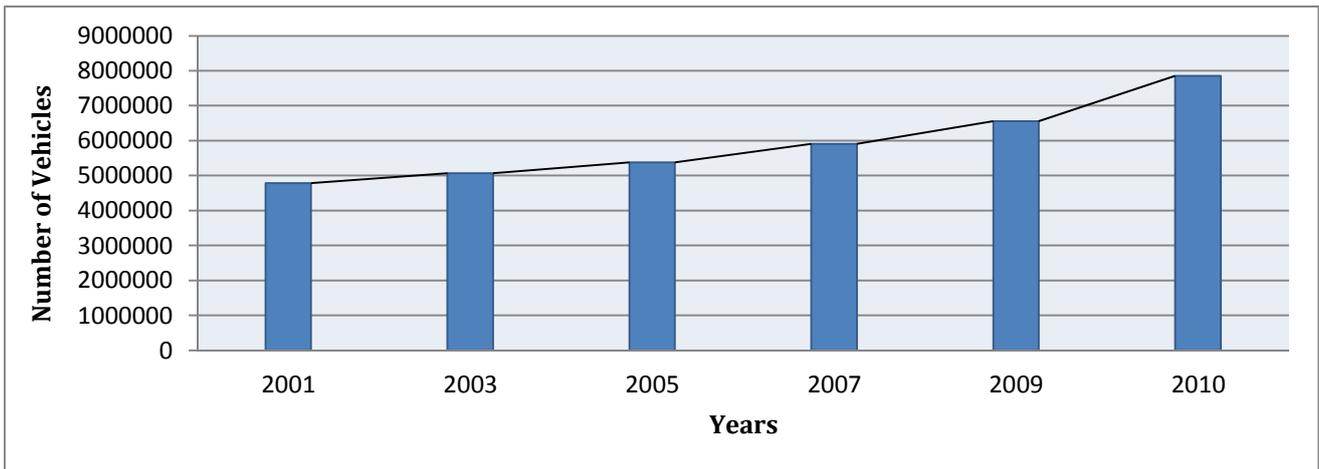


Fig. 1. Vehicular Growth in last 10 years

2 SCOPE OF THE PAPER

Power consumption is gradually increased with rapid urbanization. Some of the highlights of current power consumption in Pakistan is: House hold energy consumption is 43.2 percent, Industrial 30.1 percent, Agriculture 13.3 percent, Government sector 7.2 percent, Commercial 5.5 percent, and Street lights energy consumption is 0.7 percent as shown in Fig 2. The demand power of Pakistan is approximately 20,000MW in 2012 and generated power capacity is only 15,000MW. The power is mainly generated by thermal, hydro, oil, gas and nuclear power plants; the share of natural gas reached to 26 percent, oil 30.0 percent, hydro electricity 32 percent, nuclear electricity 3 Percent, and by other sources like solar wind, coal is 5 percent. Hydro electricity 32 percent, nuclear electricity 3 Percent, and by other sources like solar wind, coal is 5 percent. Contribution of each conventional source in power generation is shown in Fig 3. Pakistan; unlike the top developed countries has very poor roads. There are number of speed breakers, by just placing such mechanism on road, we can tap so much energy [3], [4].

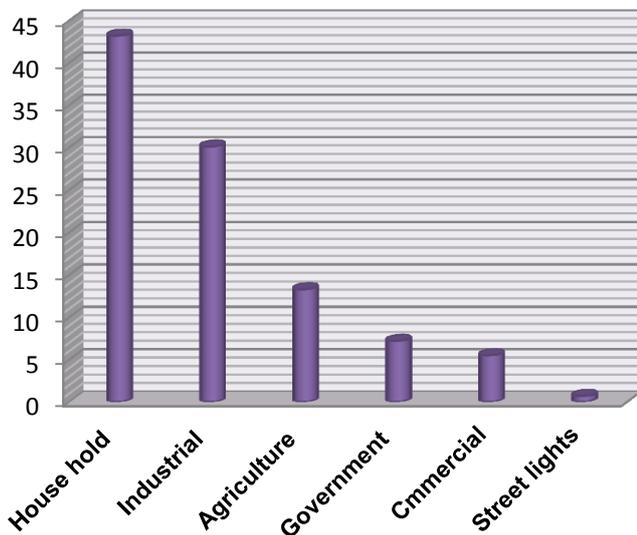


Fig. 2. Power Consumption Profile.

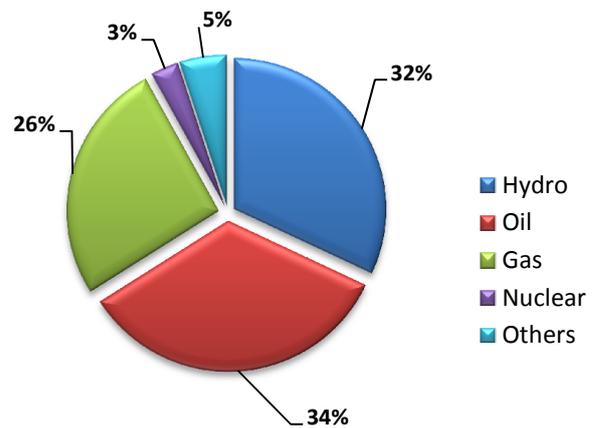


Fig. 3. Power Generation Contribution.

3 WORKING PRINCIPLE

When a vehicle moves over a speed breaker system it exerts a force on it as a result speed breaker moves down. This linear motion of system is converted to a rotary motion by using a rack and pinion mechanism which is placed in the bottom of speed breaker. The axis of the pinion is connected to a gear arrangement. This arrangement is made of two sprockets. One of them is larger in dimension and the other one is small in size. Both are connected by means of a chain, As the power is conveyed from the larger sprocket to the smaller sprocket, the larger sprocket rotates and relatively increases the speed of smaller sprocket. The speed that is available at the larger sprocket is relatively multiplied at the rotation of the smaller sprocket. A flywheel is mounted on the shaft, whose function is to regulate the fluctuation in the rotation and to make the speed uniform. So the shafts will rotate with certain rpm. As a result flywheel will rotate and this rotation is sufficient to rotate the rotor of a generator which causes the DC generator to convert mechanical energy into electrical energy [5]. Similar mechanism is performed on other side of speed breaker as shown in fig 4, and power is generated. Both generators are connected in parallel to increase the charging current. Therefore we can charge our batteries earlier.

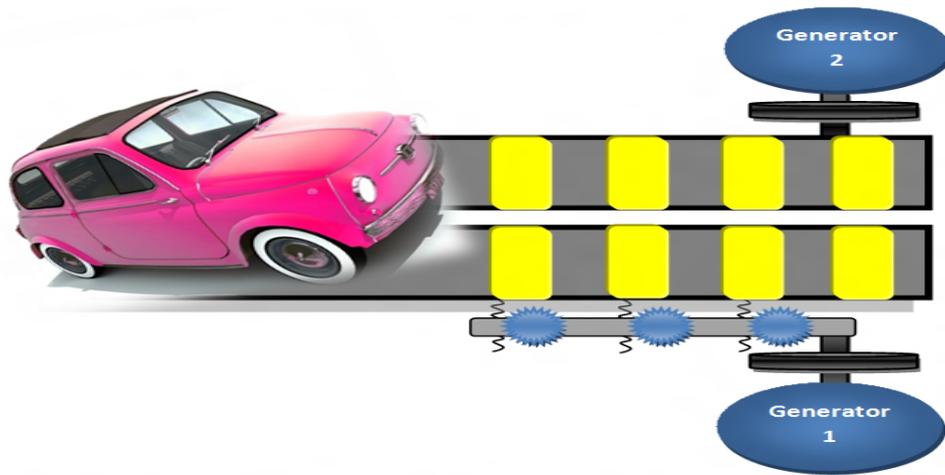


Fig. 4. Model of PGS

4 COMPONENTS DISCRIPTION

- Fly wheel: Store mechanical energy and then provide constant rpm.
- DC generator: Converts the mechanical energy to electrical energy, its output voltage is 12V.
- Rack and Pinion: Converts the linear motion into rotary motion
- Gears: It increases the shaft speed.
- Inverter: It converts 12V DC to 220V AC
- DC control charger: It controls the voltage of generator and regulates it.

5 BLOCK DIAGRAM

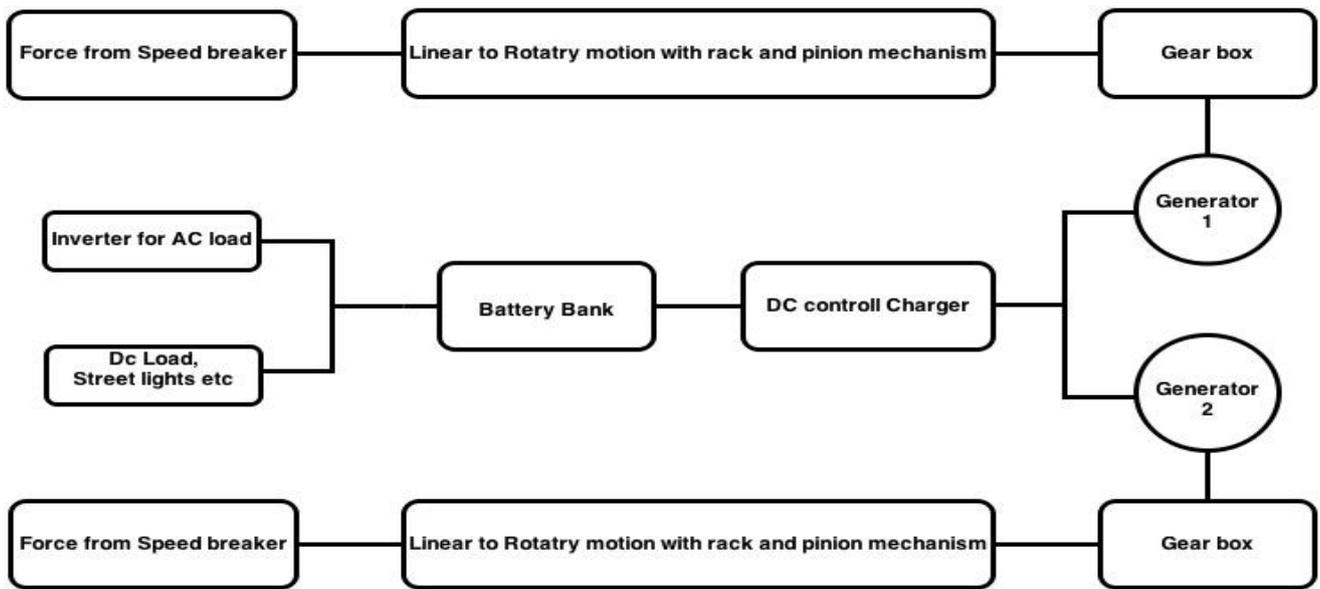


Fig. 5. Block diagram of PGS

6 OUTPUT POWER CALCULATION

Average Weight of a Vehicle = 700Kg

Height of speed brake =10 cm

- Work done=Force x Displacement (1)

$W = F \cdot d \cos(\theta)$, where $\theta = 0^\circ$, because force acted in the direction of displacement.

- Force= mass x gravitational force

Force=700 Kg x 9.81 =6867 N

Displacement covered by the speed breaker= 10cm /0.10 m

- Put the value of force and displacement in equation (1).

Output power=Work done/Sec

Output power= (6867 x 0.10)/60

Output power= 11.445 Watts

Power developed for 1 vehicle passing over the speed breaker is 11.445 watts; due to flywheel it delivers power for one minute continuously. So the Power developed for:

1 hr =686.7 watts

24 hours=16.480 KW

This power is sufficient to burn street lights in the roads in the night time [3] , [6] , [7].

7 EXPERIMENTAL RESULTS

The experimental results can be taken out by placing a power generating speed breaker on the road. When the vehicles move over the speed breaker voltage is generated and it depends on vehicle speed and vehicle weight [3] , [4] , [6]. Table 1 shows the relation between vehicle speed and the voltage generated. And similarly the relation between load and voltage at 10km/h speed of vehicle is shown in Table 2.

Table 1. Vehicle speed vs. Voltage generated

Speed of Vehicle (Km/h)	Voltage Generated (V)
5	11.5
10	8
15	7.14
20	6.28
25	5.65

Table 2. Vehicle load vs. Voltage generated

Vehicle Load (Kg)	Voltage Generated (V)
1000	13.8
900	12.8
800	12
700	11.81
600	11

8 ADVANTAGES

By using PGS (Power generating speed breaker) system on roads we can produce enough power [7] , [8], there are numerous advantages of this system such as;

- Eco friendly to environment.
- Simple Construction.
- Less area required for deployment.
- Easy and low cost maintains.
- No consumption of any fossil fuel. It is totally free power generation method.
- Power will be generated throughout the year.

9 APPLICATIONS

Power generation with speed breaker system can be used in most of the places such as; Highways, roadway speed breakers, tool plazas, parking lots, and traffic signals [9,10]. The power generated when the vehicles pass over the PGS, can be stored into the batteries and used to lighten the street lights, road signals, sign boards and bus stops during the night time [11] , [12] , [13].

10 CONCLUSION

As the population is exploding tremendously these days, the need for energy has also been increased. Countries like Pakistan cannot afford expenses on power generation through conventional sources like fossil fuels and coal because they are depleting fast. The presented model can serve as a best source to combat the daily energy needs as it is much economical, pollution free, efficient and easy to install without any use of conventional reservoirs. Increasing vehicles that are considered as a major problem of our country can be utilized in the capacity to generate sufficient amount of power and can help to boost the world’s economy. In future, it will establish a great boon to the world, since it will save a lot of power generated from power plants.

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