Development of Electrical Power Generation System Through the Use of Speed Breaker

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Abstract - *Due to the shortage of energy rocking the Nigerian power sector, the need for harnessing other sources of power generation cannot be over-emphasized. Therefore, this paper presents a non-conventional means of producing electrical power that is economical and environmentally friendly. The generating system involves the conversion of kinetic energy of cars at speed breakers into electrical energy. A model was designed using a Permanent Magnet Direct Current (PMDC) generator, through springs, ball bearings, rack, and pinion gear. The results obtained from the system shows that the system generates a higher voltage at lower speed limit and a lower voltage at a higher speed limit. Further results show that 4.9MWh of electric energy could be generated if the present vehicular traffic situation in Nigeria is seeing as an advantage.*

Index Terms - Speed Breaker, Nigeria, Electrical Power, Generation, Kinetic Energy, Potential Energy

I.   INTRODUCTION

Power generation has been a serious challenge in our society today hence, the need for an improvement has become very necessary. The epileptic power supply characterizing the Nigerian Power Sector is begging for remedial actions to be taken with a view to improving the system. An increase in population is supposed to be followed by an increase power supply by the authorities in charge of the sector but in Nigeria, there is a wide gap between the energy generated and the demand from the customers [1]. Municipal lighting has also created a challenge with respect to who is to pay the bill and in cases where the bills are not paid as at when due then the life of the citizen is at risk because the resultant effect taken by the Distribution Companies is to de-energize the lines supplying the street light. The overall effect of this anomaly is a blackout on the highway thereby creating more room for the men of the underworld to attack poor and innocent travelers on the highway by taking advantage of the dark environment. According to [2], there are three different methods of electrical power generation using speed breakers and these include (i) crankshaft type [3], (ii) roller type method [4-5] and (iii) the rack-pinion method [6]. Furthermore, [7] carried out research on the energy potential of a speed breaker to produce electrical energy, where they discovered a car weighing one ton has the capability of producing 0.98kW of electrical power when ascending a 0.1m ramp. Lagos, Nigeria is a city which is densely populated with various activities as well as traffic gridlock due to an increase in the number of vehicles on the highway. According to [8], Lagosians spent three years out of every 10years in traffic gridlock although this may result in man-hour loss but there is an advantage that this can induce in the economy by converting the available potential energy at that instance to kinetic energy thereby generating energy that can be used to light up small communities and as well as for municipal lighting. This paper, therefore, discusses how to use the speed breaker on the highway to generate electric power.

Figure 1: Traffic Gridlock in Lagos Nigeria

II.   METHODOLOGY

The system uses a Speed Breaker SB which is a medium used to reduce the speed of a vehicle at any point in time. As the vehicle moves over the inclined plane now known as the SB, it gains height resulting in increase in Potential Energy PE, the pressure from it is transferred to the spring which presses the system that has the shaft gear which is connected to the rack and pinion gears that is connected to the shaft of the PMDC generator which produces the electric current and then to the battery which stores the charge that is eventually used to power streetlights or neighboring communities.
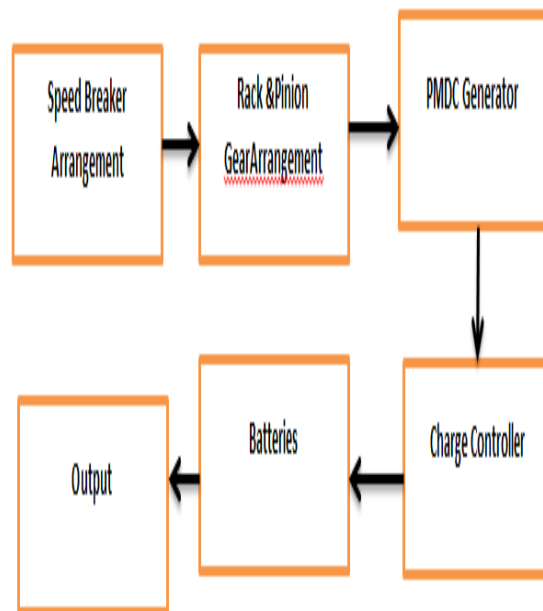

Figure 2: Block Diagram of Power Generation System

The work done on the vehicle is calculated firstly using

$$Workdone = Force \times Distane \qquad [1]$$

Then calculating the output power generated by the system, we have:

$$Mass\ of\ vehicle = xKg\ (approximately)$$

$$Height\ of\ speed\ break = Ymetres \qquad\qquad Force = mg \qquad [2]$$

$$Output\ power\ generated\ by\ the\ system\ for\ a\ minute\ = \frac{fd}{t} \qquad [3]$$

Therefore, the power generated by the speed breaker arrangement by a vehicle weighing 450kg for one minute is 3.16W.

Energy generated for 60 minute

$$= 3.16 \times 60 = 189.68Wh$$

Energy generated for 24 hours

$$= 189.68 \times 24 = 4.55kWh.$$

$$Energy\ Generated\ for\ 3years = 4.9MWh$$

III. DISCUSSION OF RESULTS

The results are shown in table 1 and table 2. From table 1, the lower the speed of the vehicle the greater the voltage generated by the system and from table 2, the greater the weight of the vehicle the higher the voltage produced.

Figure 3: Pictorial View of the System.

Table 1: Voltage Generated By Vehicles

S/N	SPEED(Km/Hr)	Voltage(V)
1	10	11.09
2	20	9.93
3	30	8.50
4	40	7.93
5	50	6.32

Table 2: Voltage Generated by Human

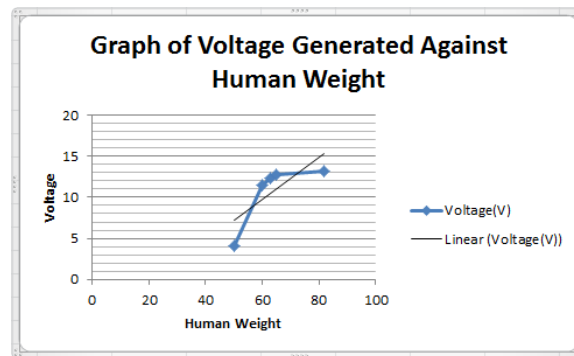| S/N	Weight(Kg)	Voltage(V)
1	50	4.07
2	60	11.49
3	63	12.26
4	65	12.68
5	82	13.22

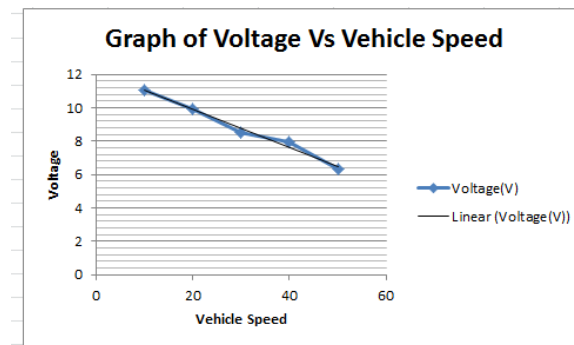**Figure 4: Graph of Voltage against Weight**

Figure 5: Graph of Voltage Vs Speed of Vehicle

IV.   CONCLUSION

The existing sources of energy such as coal, oil etc. are obviously inadequate to match the ever increasing energy demands and these conventional sources of energy are also depleting and may get exhausted very soon. With the reasons above, there is an urgent need for harnessing non-conventional methods of generating energy. This is a step to a path of exploring the possibilities of energy from several non-conventional energy sources. The energy wasted

on speed breakers in our roads has been effectively and efficiently tapped, conserved and utilized to breach the gap between power generation and power demand in Nigeria. The power generated from the system can be used to power streetlights and community.

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