

ELECTRICITY GENERATION & ENERGY CAPTURING FROM THE VEHICLE LOADS IN HIGHWAY

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Abstract— In present time, day by day increasing number of vehicles are major causes of environmental degradation, Load on fossils (Petroleum) increasing regularly. CO₂, CO, SO_x, NO_x and ozone release by these vehicles. In this thesis we are trying to utilize the kinetic energy of vehicles to generate electricity with some simple mechanism on Roads. There are Rack and Pinion, Crank Shaft Mechanism and Roller Mechanism method to generate electricity. These methods are effective way to produce electricity as the numbers of vehicles on the roads are ever increasing. Also the cost of fabrication model is very low by using Roller Mechanism. It can be effectively placed near traffic light; gradient variation on Roads and fixed on the ramp. As vehicles are moving, Roller start moving and also rotating DC motor / generator for electricity generation. In India Thermal Power Plant consuming 545.9 million Ton of coal in 2015-16 and its regular increasing, Opreation and maintanace cost of 200MW to 600MW coal based power plant is 16lakh/MW, beside this 85000 villages in India have no electricity. Indian passenger car and commercial vehicle manufacturing industry is the seventh largest in the world, with annual production of 3.7 million units in 2010. In Thesis model vehicle weighing 5kg running on such a roller strip produces 4mA current and approximate 0.0032 watt power. One such roller mechanism on busy single lane highway, where about 100 vehicles of different weights passes every minute, then 0.32 watt of electricity produces in every single minute. The figure will be huge at the end of the day, higher weight vehicles producess more R.P.M on generator resulting more current and power. A rechargeble battery / inverter storing the electricity generated during day time, power will use during night. As the load of vehicle increase the current is also increasing. Large amount of energy can be tapped by these vehicles in future the fly wheel speed control device and rechargeble battery device can be added with large generators. Its control the coal consumption and environmental degradation.

Keywords— Roller, Traffic, Dynamo, Air Pollution.

Introduction:



Fig. 1: Traffic Flow

The automotive industry in India is one of the largest in the world and one of the fastest growing globally. India's passenger car and commercial vehicle manufacturing industry is the seventh largest in the world, with an annual production of more than 3.7 million units in 2010. We every day mesh up with these vehicles give us headache. But this mesh up could be answer of new type power generation. Road Power Generation (RGP) is one of the most recent power generation concepts. This device is engineered as a practical and useful alternative energy technology for generating clean electricity from the millions of vehicles on our roadways. The kinetic energy of the vehicles into electric energy. This is done by moving Rollers installed on the road, India, unlike the top developed countries has very poor roads. Talking about a particular road itself includes a number of speed breakers. By just placing a unit like the “Power Generation Unit from Speed Breakers”, so much of energy can be tapped.

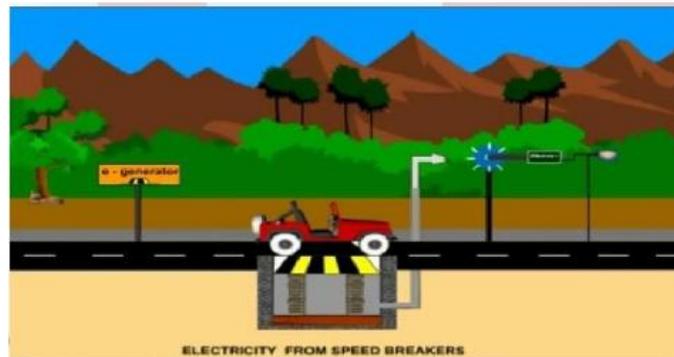


Fig. 2: Electricity production by Roller Mechanism

The day-to-day increasing population and decreasing conventional sources for power generation, provides a need to think on non-conventional energy resources. We are looking forward to conserve the kinetic energy that gone wasted, while vehicles move. The number of vehicles passing over speed breaker on road is increasing day by day. The unit used for power generation from speed breaker is small as compared to other power generation units like wind mill, power plants, and other such units. After Installation Only then after requires periodic maintenance which further adds ease of use of it. The amount of electricity consumed in one night by all the street lights around Chennai city (India) is equal to consumption of electricity in a remote village for one month and 14 days.



Fig. 3: Road Infra Structure through Villages

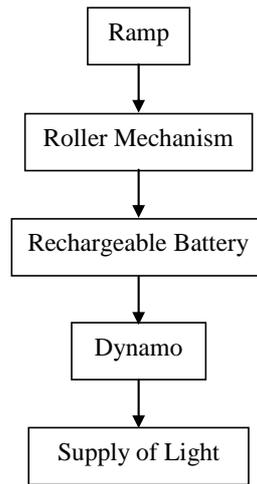


Fig. 4: Flow Chart of Roller Mechanism energy generation

A 1000 MW coal-fired power plant requires 2.6 million tonnes annually, whereas a 1000 MW nuclear power plant requires only 30 tonnes of fuel annually. These numbers are for nuclear fuel, which is enriched from natural uranium. For a comparison of raw materials, 1 kg of natural uranium will yield the same amount of energy as 20,000 kg coal. Uranium resources as lasting 400 to 500 years at the current rate of use. However, if breeder reactors are introduced that estimate is increased to 25,000 years. Breeder reactors are nuclear reactors that can produce energy using the daughter products of U235, without actually needing U235. Power plants can be a source for pollution, and can increase the process of global warming with CO₂ emissions. "During the past 20 years, half of all increases in energy related carbon dioxide emissions were from electricity generation". The operation of coal-fired power plants releases between 700 and 950 g CO₂/kWh. The operation of nuclear plants releases no carbon emissions. Coal ash contains "oxides of silicon, aluminum, iron, calcium, magnesium, titanium, sodium, potassium, arsenic, mercury, and sulfur plus small quantities of uranium and thorium". Coal fly ash contains mostly glass, which is derived from the non-combustible silicon in the coal. Particulate precipitators, which can capture up to 99.5% of the fly ash before it reaches the atmosphere. However, 85% of the coal volume is reduced through combustion, which raises the concentration of the impurities in the waste. According to the EPA, the key pollutants are CO₂, CO, CH₄, NO_x, and SO_x. The mass of life-cycle emissions released in kg from coal and nuclear technologies for an operating time of 100 years. Life-cycle emissions take into consideration the emissions from mining, building, operating, and shutting down the plant through the relative life-cycle emissions between coal-fired power plants and nuclear power plants for each pollutant.

Table 1: Mass of emissions in kg from Coal and Nuclear Technologies from 100 Years of Operation

Energy Technology	CO ₂ (kg)	CO (kg)	CH ₄ (kg)	NO _x (kg)	SO _x (kg)
Coal-Fired Power Plant	24,428,587	6090	97989	25020	26217
	98%	91%	99%	96%	91%
Nuclear Power Plant	380,836	582	1296	1052	2506
	2%	9%	2%	4%	9%

Methodology:

The Indian Road Congress latest Data consider a vehicular flow of 3150 pcu / h (Passenger carrying unit per hour) for peak hour (8 hour windows) 1500 pcu / h for peak and 400 pc / h night as a standard, resulting in a total flow of 40,400 pcu / day, the above data implies that large amounts of energy can be harnessed for 4 / 6 / 8 wheelers on highways employing similar steps.

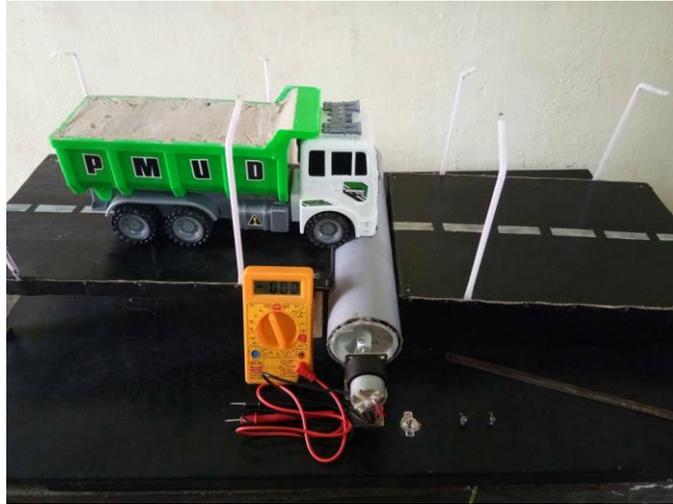


Fig. 5: Experimental Model

Working Principle

The working of power generation unit is based on actuation of roller mechanism arrangement by vehicle passing over the speed breaker. When the vehicle passes over the speed breaker roller moves downward which transmits the motion to axle. By using pulley assembly motion is transmitted from main shaft to another shaft on which flywheel is mounted. The flywheel is then connected to dynamo where the actual electrical power is generated. Thus, basic principle is to convert Mechanical power to Electrical Energy. kinetic energy of these vehicle into the rotational motion of generator then we can produce considerable amount of electricity, this is the main concept of this project.

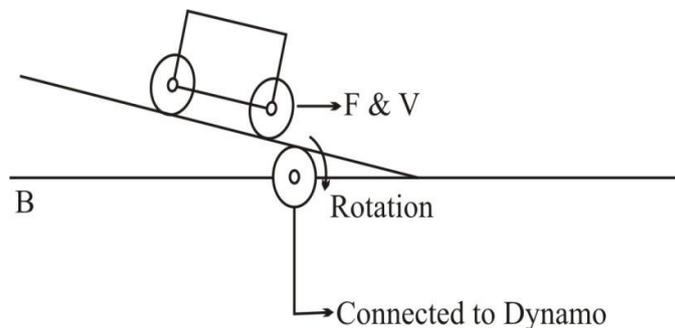


Fig. 6: Roller Mechanism of the Road

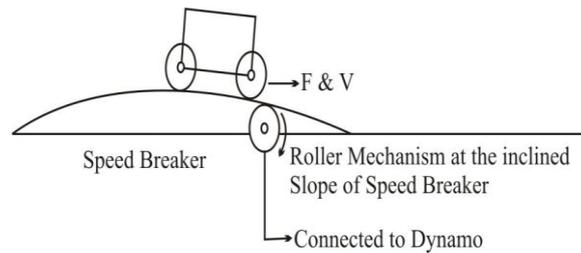


Fig. 7: Roller Mechanism at the inclined slope of Speed Breaker

Major Parts of the Systems:

- (a) Roller Mechanism
- (b) Generator
- (c) Microcontroller
- (d) LDR and Sensors

(a) Roller Mechanism

This project addresses both the issues of energy saving as well as energy generation using simple mechanism of a speed breaker on a busy road. Energy changes from one form to the other". When a vehicle moves over the speed breaker there are lots of energies involved in the process. Energy due to friction, potential energy, heat etc. are lost in the environment. The idea is to utilize and convert the potential energy due to the weight of the vehicle to electrical energy. A mechanical shaft with the dynamo is used and placed on the plane of the road. When a vehicle passes on this roller, due to friction, the roller rotates which in turn moves shaft of the dynamo. When the shaft rotates it generates the voltage based on Faraday's law. This voltage can in turn be stored in a battery which can be further used to light the street bulbs.

(b) **Generator:** In this project dynamo works as generator.

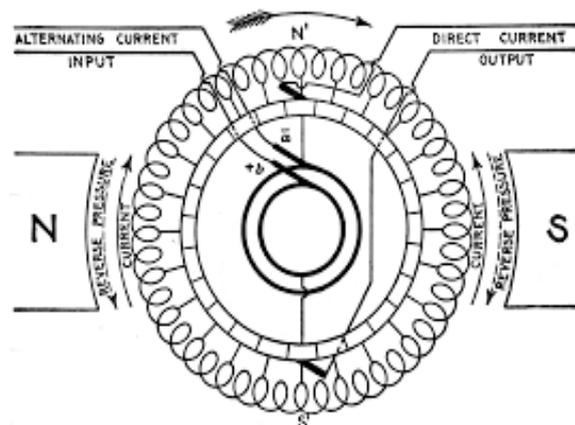


Fig. 8: Generator

Dynamo works on the principle of Faraday's law to convert mechanical energy into electrical energy. The shaft from the roller is connected to the generator to generate power. A dynamo consists of a stator, a fixed structure which generates magnetic field. The armature on the other hand consists of copper winding which rotates in the magnetic field created by the stator. For smaller machines permanent magnet can be used but for larger machines

electromagnets are used. In a direct current power is needed to flow in only one direction. The rotating armature in a dynamo reverses the current every half cycle.

(c) Microcontroller: In this project we use AT89C51 Microcontroller to control the light / bulbs with the help of sensors. The output of the sensor works as the input to the microcontroller. The LDR sensors are used to detect whether it's a day or night depending on which the lights are turned OFF or ON. The infra red sensor situated on the two ends of the road detects an activity on the road. If a vehicle is detected all the lights are turned ON otherwise only half of the lights are ON during night. AT89C51 has 4KB of Flash programmable and erasable read only memory (PEROM). It can be erased and program to a max 1000 times.

(d) LDR and Sensors: LDR is device whose resistance varies with the amount of light falling of the surface. LDR is very sensitive to visible light. We use a comparator circuit to compare this voltage with the set reference voltage. In this circuit, when LDR is in light then there is less positive output on the comparator circuit. When LDR is in dark then the output of comparator becomes more positive. Microcontroller senses this voltage change and switches ON the LEDs which is connected to the port 2 through the current limiting resistors in series.

Sensors: In this part we use Infra-Red sensors.

Infra-Red sensor:

- **Detecting Brightness:** The sensor works on the principle of detecting the amount of reflected light. It has an emitter and detector assembly that works in infra-red spectrum. This assembly is used to detect a vehicle on the road. When light in infra-red spectrum is incident on the photodiode there is a proportional change in the resistance with the magnitude of reflected light. When the vehicle enters a road it interrupts the first IR sensor, all LEDs on the street are turned ON. If there is no activity on the road, only half of the LEDs glow. Once the vehicle passes the other end it is detected by the other IR sensor thus turning OFF half of the LEDs if no other vehicle is present on the road. The comparator circuit compares the sensor output with the reference voltage.



Fig. 9: Roller mechanism

System Implementation:

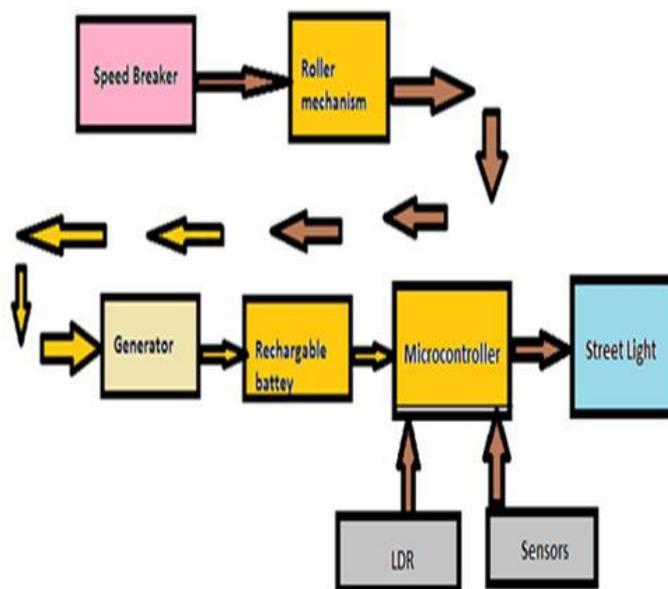


Fig. 10: Block Diagram of Energy Generation from Busy Road

Result and Discussion: For testing the above setup, a two-wheeler was run over the model at different speeds to get the reading of current and voltage generated under different conditions. Table shows the results of the experiments conducted on the prototype invention. It is observed that on moving a small vehicle over the roller, the load varies; the current produced is in the different range.

Table 2: Model Readings

S. No.	Load (kg)	Volt	Current (A) [1 mA = 0.001 A]	Power Generated (Volt x current = Watts)
1.	5	0.80	0.004	0.0032
2.	7.5	0.95	0.0051	0.0048
3.	10.00	1.00	0.0065	0.0065
4.	12.5	1.10	0.0074	0.0081

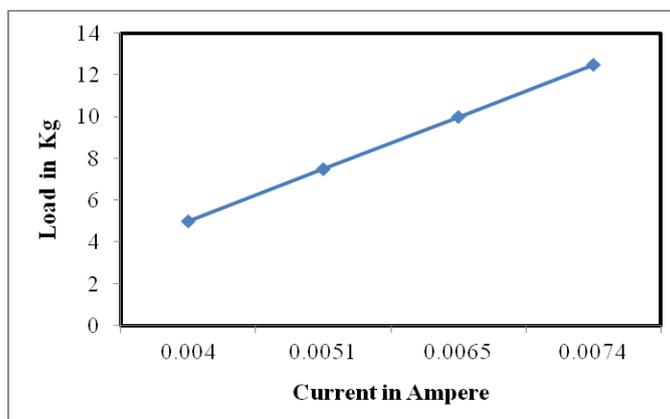


Fig. 11: Load vs Current

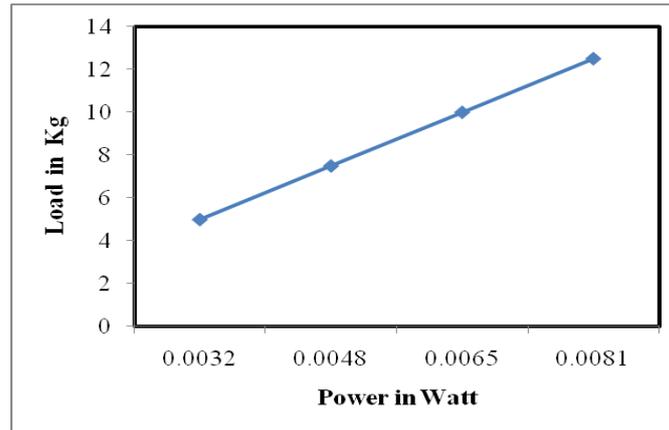


Fig. 12: Load vs Power Generated

For a vehicular flow of 40400 per day, which includes 2/3/4/6/8 wheelers, the energy produced will be much more significant compared to the experimental results obtained, thus making it a good energy producing setup as energy of vehicles on impact with the speed breakers is anyway lost. This is lost to heat and sound. This energy can be tapped, stored and used as back up or for small applications. Improvements have to be made in the setup to increase the efficiency which is discussed in following section. In this study a new technique has been proposed to gate electricity from speed breakers. This technique will help to conserve our natural resources.

Conclusion:

The existing source of energy such as coal, oil etc may not be adequate to meet the ever increasing energy demands. These conventional sources of energy are also depleting and may be exhausted at the end of the century or beginning of the next century. Efforts shall have to be made by engineers in exploring the possibilities of harnessing energy from several non-conventional energy sources. This project is a one step to path of that way. The overall goal was to design the speed breaker System while keeping the engineering, producer and customer models in check. The rollers used in this project can be intended/ upgraded for heavy vehicles large amount of potential energy generated on the busy road can be converted into electrical energy. This alternative source of energy can be used to provide an aid to the conventional energy sources thus improving the economy of the smart metro cities. Advantage of this system is it has not utilise any external source .Now the time has come to put forward this type of new ideas, and also researches should think to upgrade its proposal.

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