POLLUTION FREE ENERGY GENERATION FROM SPEED BREAKER

S. Praveen Kumar[1], B. Priyadharhiny[2], Ramachandran Manoharan[3], Mr. Senthil Murugan[4]

[1,2,3]Student, Department of ECE, Valliammai Engineering College, Tamilnadu, India.
[4]Asst. Professor, Department of ECE, Valliammai Engineering College, Tamilnadu, India.

Abstract-*Power is everything in this recent world, from the beginning of science still people try to discover the sources, modify and develop many concepts and methods for a better future .The efficiency of power generation is the key to making a country economically enriched. This project includes how to utilize the energy which is wasted when the vehicles passes over a speed breaker. Lots of energy is generated when vehicle passes over it. We can tap the energy generated and produce power by using the speed breaker as power generating unit. The kinetic energy of the moving vehicles can be converted into mechanical energy of the shaft through rack and pinion mechanism which is an electromechanical principle. Then, this mechanical energy will be converted to electrical energy using generator which will be saved with the use of a battery. AC voltage acquired for street lights and traffic system is obtained using inverter. The energy we save during the day light can be used in the night time for lighting street lights. Therefore, by using this arrangement sufficient energy can be generated to meet various daily needs. The practical results show that proposed project is highly promising for future renewable technology, which can be used as the ecofriendly power generation technology.*

Key Words: *Rack pinion arrangement, speed breaker, Chain sprocket and shaft, renewable energy.*

1. INTRODUCTION

The world without power without electricity cannot be imagined. Everything in this era depends on power without this it is impossible to fulfill the needs of the generation. Everything that happens in the world is the expression of the flow of power or can be said energy in one of its forms. Renewable energy sources are getting popular day by day. Different renewable sources like solar, biogas, wind etc. all the sources of energy are not capable of reaching the demand of generation of electricity. In the recent years, some other mechanisms except renewable energy sources speed breaker technology like crankshaft, roller and rack and pinion are using to produce electricity from speed breaker on the road and highways. Basically, mechanical energy is converted to electrical energy. Thus, electricity can be generated using vehicle weight and speed as input. In this project, the generation of electricity from the vehicle pressure has been proposed.

2. LITERATURE REVIEW

[1] observes customers pull in and out all day, and at least 100,000 cars visit the drive-thru each year. And a newly installed, mechanized speed bump (video) will both help them slow down and harvest some of that coasting energy. The weight of a car is used to throw a lever, explains Gerard Lynch, the engineer behind the Motion Power system developed for New Energy Technologies, a Maryland-based company. "The instantaneous power is 2,000 watts at five miles-per-hour, but it's instantaneous which means some form of storage will be required.

[2] This paper attempts to show how energy can be tapped and used at a commonly used system- the road speed breakers. The number of vehicles passing over the speed breaker in roads is increasing day by day. A large amount of energy is wasted at the speed breakers through the dissipation of heat and also through friction, every time a vehicle passes over it. There is great possibility of tapping this energy and generating power by making the speed-breaker as a power generation unit. The generated power can be used for the lamps, near the speed breakers. The utilization of energy is an indication of the growth of a nation. For example, the per capita energy consumption in USA is 9000 KWh (Kilo Watt hour) per year, whereas the consumption in India is 1200 KWh (Kilo Watt hour). One might conclude that to be materially rich and prosperous, a human being needs to consume more and more energy. A recent survey on the energy consumption in India had published a pathetic report that 85,000 villages in India do not still have electricity. Supply of power in most part of the country is poor. Hence more research and development and commercialization of technologies are needed in this field. 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. This energy can be used for the lights on the either sides of the roads and thus much power that is consumed by these lights can be utilized to send power to these villages.

[3] The rotor (rotating shaft) is directly connected to the prime mover and rotates as the prime mover turns. The rotor contains a magnet that, when turned, produces a moving or rotating magnetic field. The rotor is surrounded by a stationary casing called the stator, which contains the wound copper coils or windings. When the moving magnetic field

passes by these windings, electricity is produced in them. By controlling the speed at which the rotor is turned, a steady flow of electricity is produced in the windings. These windings are connected to the electricity network via transmission lines. IIT Guwahati has evaluated the machine and recommended it to the Assam ministry of power for large scale funding. IIT design department says it is a „very viable proposition" to harness thousands of megawatts of electricity untapped across the country every day. A vehicle weighing 1,000 kg going up a height of 10 cm on such a rumble strip produces approximately 0.98 kilowatt power. So one such speed-breaker on a busy highway, where about 100vehicles pass every minute, about one kilo watt of electricity can be produced every single minute. The figure will be huge at the end of the day. A storage module like an inverter will have to be fitted to each such rumble strip to store this electricity. The cost of electricity generation and storage per megawatt from speed-breakers will be nearly Rs 1 crore as opposed to about Rs 8 crores in thermal or hydro power station institute of technology, kanpur.

3. ANALYTICAL COMPARISON

A. Crankshaft mechanism

In the Crankshafts mechanism to generate electricity, vertically movement is converted to rotational movement. Due to heavy weight, vibrations and balancing problem of the Crankshafts mechanism caused to damage the bearings used in the mechanism

B. Roller mechanism

In the process of Roller Mechanism, the mechanical energy converted to electrical energy. A Roller is installed by using some grip in a speed breaker. When a vehicle passes over the speed breaker it rotates the roller and the movement of the roller is used to rotates the shaft of the DC generator, it produces electricity.

C. Rack and Pinion Mechanism

In this mechanism, the kinetic energy converted into electrical energy. When a vehicle moves on the speed breaker, the rack will be pushed down. This rack is connected with pinion, so it will be rotated. This rotated pinion will rotate the generator and it will produce electricity. Hence, we have used this mechanism due to their better efficiency and effectiveness of designing.

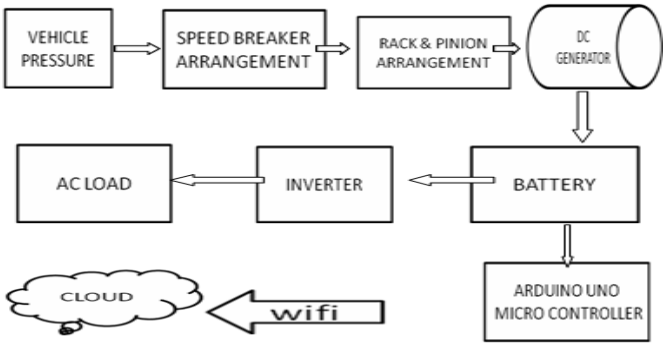
4. Proposed Methodology

Generation of energy using speed breaker involves step by step procedure of energy conversion and involves electromechanical process.

1. Selecting Suitable Components
2. Assembling and Organizing Components
3. Testing and Monitoring

Initially the pressure of vehicles on speed breaker assembly is used to drive the mechanical arrangement of rack pinion and chain sprocket. The linear output is converted into rotary motion using the mechanical assembly which is fed to dc generator. The generator uses this input to generate dc electrical output which is given to LED light. The output voltage is monitored on Wi-Fi based ESP module which senses the voltage and sends it to local server from where it can be monitored using real time monitoring.

4.1 Block Diagram



5. Working Principle:

The pushing power is converted into electrical energy by proper driving arrangement. The rack & pinion, spring arrangement is fixed at the speed brake. The spring is used to return the inclined L-angle window in same position by releasing the load. The pinion shaft is connected to the supporter by end bearings. The larger sprocket also coupled with the pinion shaft, so that it is running the same speed of pinion. The larger sprocket is coupled to the small cycle sprocket with the help of chain (cycle). This larger sprocket is used to transfer the rotation force to the smaller sprocket. The smaller sprocket is running same direction for the forward and reverse direction of rotational movement of the larger sprocket. This action locks like a cycle pedaling action. The fly wheel and gear wheel is also coupled to the smaller sprocket shaft. The flywheel is used to increase the rpm of the smaller sprocket shaft. The gear wheel is coupled to the generator shaft with the help of another gear wheel. The DC generator is used. The generated voltage is stored to the Lead-acid battery. The battery is connected to the inverter. This inverter is used to convert the D.C source to the A.C source. The inverter gate signal is generated by arduino and it also monitoring the power generation using wifi This A.C voltage is used to activate the light, fan and etc. By increasing the capacity of battery and inverter circuit, the power rating is increased. This arrangement is fitted in highways; the complete arrangement is kept inside the floor level except the speed brake arrangement. For real time monitoring purpose of the produced output voltage ESP8266 is used that will sense the voltage and will send it to server using Wi-Fi created by its own.

5.1 Rack-Pinion Mechanism

A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. The circular pinion engages teeth on a linear "gear" bar – the rack. Rotational motion applied to the pinion will cause the rack to move to the side, up to the limit of its travel. For example, in a rack railway, the rotation of a pinion mounted on a locomotive or a railcar engages a rack between the rails and pulls a train along a steep slope The rack and pinion arrangement is commonly found in the steering mechanism of cars or other wheeled, steered vehicles. This arrangement provides a lesser mechanical advantage than other mechanisms such as recirculating ball, but much less backlash and greater feedback, or steering "feel". The use of a variable rack (still using a normal pinion) was invented by Arthur E Bishop, so as to improve vehicle response and steering "feel" especially at high speeds, and that has been fitted to many new vehicle after he created a special version of a net-shape warm press forging process to manufacture the racks to their final form, thus eliminating any subsequent need to machine the gear teeth. This converts the pressure applied by vehicle into rotary motion.

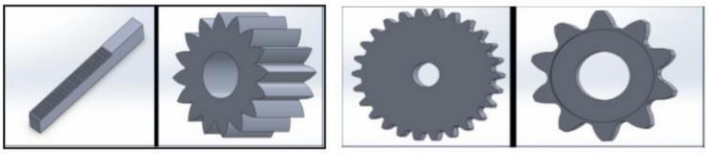


Fig. 1. Rack and Pinion.

5.2 Chain Sprocket

The chain sprocket used mainly converts the input linear motion into rotational motion to the shaft. The rotation of shaft will act as an input for dc generator which will produce the desired electrical output. Chain and sprocket is useful for when the distance between shafts is relatively large compared to the desired size of the gearing. The sacrifice is typically strength as solid gear teeth are usually stronger than chains. The reason a bike uses a chain and sprocket is that the desired distance between shafts would be inconvenient for gear to gear meshing. Now one could consider a driveshaft like a car but it would be heavier, more awkward to package, and not gain anything relevant in terms of durability. And remember lighter is better for bicycles. So in short, chain and sprocket is the lightest transmission possible that would deliver durability that consumers demand. And that's to say nothing of Derailleur mass vs gearbox for multiple speeds. Bicycles that use shaft drives, a type of rack-and- pinion gear mechanism, have too many disadvantages for mainstream adoption, but they have persisted in niche markets for over a hundred years, mostly through novelty appeal. For instance, the Sonoma D- drive pictured below is sold at Walmart as a commuter bike. Shaft drives never caught on like chain-and-sprocket designs for several reasons. The main problems are weight, higher cost, added complexity, more difficult maintenance, and lower mechanical efficiency. The deal-breaker is that every problem solved by a shaft drive can be solved with a chain case, except for the utter impossibility of looking cool while riding a bike with a chain case. In that regard, the shaft drive wins. Shaft driven bicycles must either be single-speed or use gear hubs, the latter being heavier and costlier than a chain, cassette and derail. The shaft and gears must be relatively small and very strong due to the

extreme rotational force, so they are heavier and cost more to make than chain drives. The frame has to be stronger too and that means still more weight and higher cost.

5.3 DC Generator

The dc generator of 500 rpm is used in this system which convert the mechanical input provided by mechanical arrangements into electrical output. The input to dc generator is fed by the rotation of shaft obtained from chain sprocket system. A coil of wire rotating in a magnetic field produces a current which changes direction with each 180° rotation alternating current (AC), however many early uses of electricity required direct current (DC). In the first practical electric generators, called dynamos, the AC was converted into DC with a commutator, a set of rotating switch contacts on the armature shaft. The commutator reversed the connection of the armature winding to the circuit every 180° rotation of the shaft, creating a pulsing DC current. One of the first dynamos was built by Hippolyte piixi in 1832. The dynamo was the first electrical generator capable of delivering power for industry. The Woolrich Electrical Generator of 1844, now in Thinktank, Birmingham Science Museum, is the earliest electrical generator used in an industrial process. It was used by the firm of Elkingtons for commercial electroplating. The modern dynamo, fit for use in industrial applications, was invented independently by Sir Charles Wheatstone, Werner von Siemens and Samuel Alfred Varley. Varley took out a patent on 24 December 1866, while Siemens and Wheatstone both announced their discoveries on 17 January 1867, the latter delivering a paper on his discovery to the Royal Society. The "dynamo-electric machine" employed self-powering electromagnetic field coils rather than permanent magnets to create the stator field. Wheatstone's design was similar to Siemens', with the difference that in the Siemens design the stator electromagnets were in series with the rotor, but in Wheatstone's design they were in parallel. The use of electromagnets rather than permanent magnets greatly increased the power output of a dynamo and enabled high power generation for the first time. This invention led directly to the first major industrial uses of electricity. For example, in the 1870s Siemens used electromagnetic dynamos to power electric arc furnaces for the production of metals and other materials. The dynamo machine that was developed consisted of a stationary structure, which provides the magnetic field, and a set of rotating windings which turn within that field. On larger machines the constant magnetic field is provided by one or more electromagnets, which are usually called field coils.

Fig -3: 500RPM DC generator

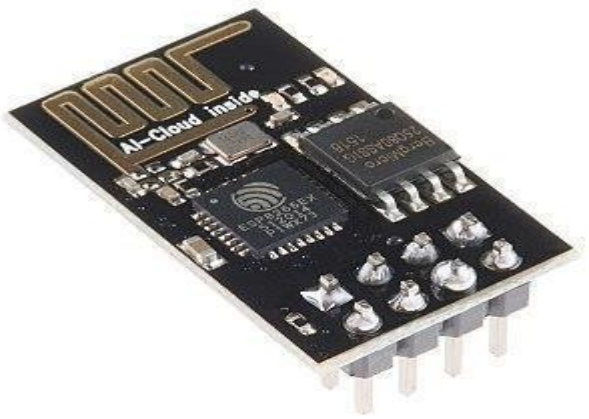
5.4 Battery

The output produced by dc generator is used to charge the battery and is used for various purposes. A rechargeable battery, storage battery, secondary cell, or accumulator is a type of electrical battery which can be charged, discharged into a load, and recharged many times, as opposed to a disposable or primary battery, which is supplied fully charged and discarded after use. It is composed of one or more electrochemical cells. The term "accumulator" is used as it accumulates and stores energy through a reversible electrochemical reaction. Rechargeable batteries are produced in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network. Several different combinations of electrode materials and electrolytes are used, including lead– acid, nickel–cadmium (Ni-Cd), nickel– metal hydride (NiMH), lithium-ion (Li-ion), and lithium-ion polymer (Li-ion polymer).

5.5 ESP8266 Module

The output of dc generator and piezoelectric crystal can be monitored on real time basis using a Wi-Fi based ESP chip. The ESP sends the sensed output voltage on server using Wi-Fi network created by itself. The data send on server can be observed on laptops or mobiles by connecting to that Wi-Fi server and accessing the IP address. The ESP8266 is a low-cost Wi-Fi chip with full TCP/IP stack and MCU (microcontroller unit) capability produced by Shanghai-based Chinese manufacturer, Espressif Systems. The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer, Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted The very low price and the fact that there were

very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation. The ESP8266 Wi-Fi Module is a self co SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with a AT command set firmware, meaning, you can simply hook this up to your Arduino and get about as much Wi-Fi- ability as a Wi-Fi Shield offers. The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community. This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth interfaces, it contains a self-calibrated following it to work under all operating conditions, and requires no external RF parts. There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support. In the Documents section below you will find many resources to aid you in using the ESP8266, even instructions on how to transforming this module into an IOT (Internet of Things).



6. MODEL CALCULATION

Let, the mass of a vehicle = 200 kg Height of speed breaker = 25.4 cm

=.254 m

Work done= Force* Distance

Therefore, Force, F=Weight of the body=ma = (200 kg*9.81 ms^{-1}) =1962 N

The output power for one pushing force= (1962*0.254)/60 =8.31 Watts

The calculation for per car (passing over the speed breaker) Power developed =498.6 Watts

The calculation for one hour Power developed = (498.6 *60) = 29.92 KW

The calculation for one day Power developed = (29.92*24) =718 KW

Power developed for one month = (718*30) = 21540 KW Power developed for one year = (21540*12) =258480 KW

CONCLUSION:

This proposed project can be placed where so many vehicles are passed everyday like at the starting of the flyover and also at the end of its or on busy roads, then the produced energy will be much more compared to the experimental result. In metropolitan cities can be implemented this. Though comparing to the other technique, less current or energy can be produced by these types of system, but the advantage is to gain this energy there not would be required any kinds of fuel as an input and also the maintaining cost for this project is so negligible as well as the cost of the component of this project. After using this project a hole day the energy can be stored in a battery and this stored energy can be used for the various

purpose, for example, it can use for a street light or can use for traffic signals etc. For doing this project three things must be perfect that is: The settings of the pinion teeth must be accurate, the gap of the lock system by which, when the rack work as downward then there will be no effect on the pinion and when the rack work as upward that time the rack teeth and the pinion teeth must be attached and the last and most important thing is to set up the dc generator perfectly. If the gap of the lock system is not perfect then the pinion either will rotate wrong or that will not rotate at all. These types of power generating system can be implemented in metropolitan cities where the rate of population is high. By doing this and placing the project in much more suitable place it is possible to get more energy for these kinds of project. In future, this mechanism can be used for heavy vehicles. To enhance the efficiency and more acceptance, this mechanism can be used vastly.

REFERENCES

1. R.D.Sharma, S.Jain, K.Singh, "Growth rate of motor vehicals in India", Journal of economics and social studies, Vol.I, 2011

2. A.Padam Rao,"Power generation from speed breaker by rack and ratchet method", International Journal of Current Engineering and Technology Issue-2, Februry,2014

3. S. Srivastava, A. Asthana,"Produce electricity by the help of speed breakers", Journal of engineering research and studies, Journal of Engineering Research and Studies, Vol.II, April- June,2011

4. Mishra, P. Kale, International Journal of Engineering and Science, Vol. II, March 2013.

5. 5.G.R.Prabu, G.Ethiraj, International Journal of Advanced Research in Electrical, Electronics and Instrumental engineering, Innovation in Engineering and Technology (IJIET) Vol.2 Issue 2, March 2013.

6. R.Gupta, S.Sharma, "A Revolutionary Technique of Power Generation from speed breaker, International Journal of Engineering Research and technology, 2013.

7. Amol Sheshrao Fawad, Air Compression and Electricity Generation by Using Speed Breaker with Rack And Pinion Mechanism, International of Modern Engineering Research (IJMER) Vol.5 Issue 1, January 2015.

8. Ankita, Meenu Bala, Power Generation from Speed Breakers, "International Journal of Advance Research in Science and Engineering, 2013.

9. Ashwathamah V Priyadharshini M., "International Journal of Recent Research and Review," Vol. I, ISSN22778322, March 2012.

10. "Every speed breaker is now a source of power", IPCBEE Vol.1, 2011.