



ELECTRICITY GENERATION USING RACK AND PINION MECHANISM

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Abstract--- A nation can become more prosperous economically by increasing its power generation efficiency. The suggested concept is to implement energy during the passing of vehicles over a speed breaker using the Rack and Pinion mechanism, which converts rotational energy into electrical energy. This method is useful in regions where producing electricity is a challenging task. The kinetic energy of moving automobiles on roads, highways, etc. can be used to create power using this method.

Index Terms – Speed Breaker, Rack-Pinion Gears, Spur Gear, Springs, Generator or Dynamo, Battery, Inverter Circuit, Arduino UNO, LDR Light Sensor, LCD display, Voltage sensor module.

I. INTRODUCTION

Every part of daily life requires electricity, yet due to population expansion, conventional energy sources are becoming less. Many individuals in India struggle with the problem of having no electricity. Everyone who tried finds the electricity supply to be unpredictable and irregular. Electricity is one example of a reliable, sustainable energy source that India lacks. In the modern world, the availability and consumption of electricity is one indicator of a nation's standard of living. Innovative technologies have been created to improve and make more sustainable the processes used in power generation. India is the country that is most affected by insufficient electricity production. Interestingly, India still has a serious electricity shortage despite possessing the fifth-largest coal reserves in the world. In the modern world, there are many automobiles on the roads, and when they move, they produce some kinetic energy. These vehicles waste a lot of energy on the road because of the speed limiters. There are more speed bumps than ever before, thus it's more critical than ever to develop a novel device that can convert the energy that moving vehicles expend on them into a valuable resource. Electricity-producing speed limits are a novel and practical idea. In general, a moving vehicle produces a number of energies, such as "Heat Energy," which is produced when a vehicle's tires scuff against a rough surface, like a road, or when a fast-moving vehicle encounters the wind. As a result, power can be generated using the weight and speed of a vehicle as inputs. For this project, the generation of power via vehicle pressure has been proposed.

II. RACK PINION MECHANISM

A speed breaker that uses a rack and pinion mechanism to generate electricity is an inventive approach to using the kinetic energy of moving objects to create power. This device, which is attached to a generator or dynamo, is situated beneath a speed breaker. The rack and pinion system rotates the generator or dynamo, which produces electrical energy when vehicles pass over the speed breaker. A voltage sensor module is next used to process the electrical energy that was generated. This module delivers data to an Arduino board after measuring the voltage level of the energy produced. The voltage level data is sent to the Arduino board, which analyses it to decide whether the generated energy is adequate for use or storage. Near the speed limiter is a Light Dependent Resistor (LDR) sensor. This sensor picks up the presence of a car crossing the speed limit. The relay module receives a signal from the LDR sensor when a car crosses the speed limiter. The relay module then turns on a charging circuit, which uses the electrical energy produced by the generator or dynamo to charge a battery.

The charging circuit is built to prevent either an overcharge or an undercharge of the battery. By doing this, the battery's lifespan is increased and harm to the charging circuit is avoided. Many devices and appliances can be powered by the battery's electrical energy. The voltage sensor module and the LDR sensor output data to an Arduino board, which is used to monitor and manage the system. The circuit board is configured to manage the charging circuit when the generated energy is adequate for usage or storage. The information about the voltage level is displayed using an i2c LCD display module. A bulb can be added to the battery charging circuit to show how the system works. The charging circuit will cause the bulb to illuminate, and the frequency of illumination will depend on how frequently passing vehicles push the speed breaker down.

III. BLOCK DIAGRAM OF PROPOSED SYSTEM

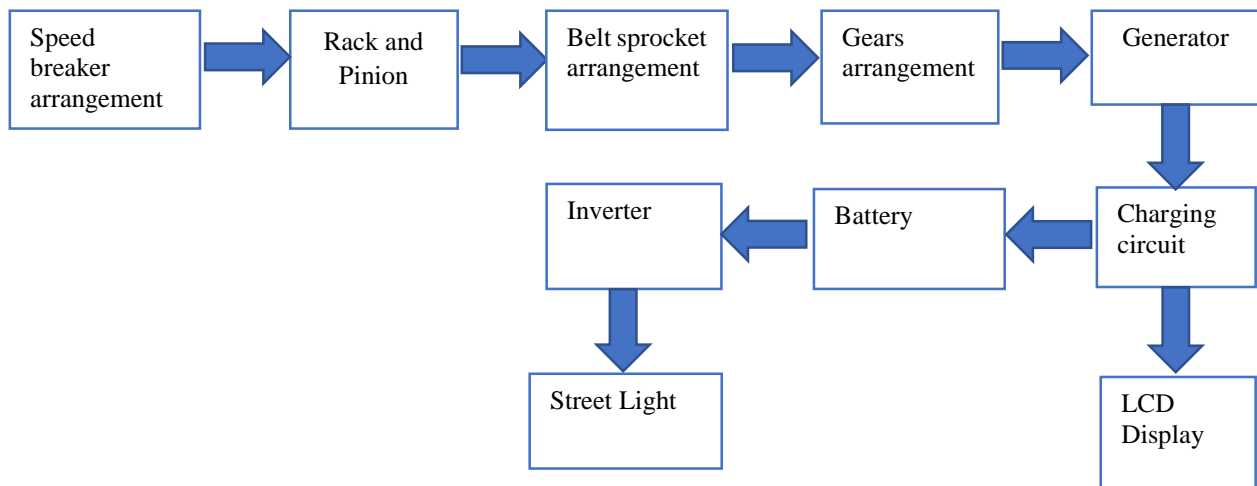


Fig 1. Block diagram of Proposed system

Figure 1 displays the connection between the various blocks of the proposed system. These blocks together define the functionality Rack pinion mechanism. This consists of a speed breaker arrangement which is designed to capture waste and kinetic energy from all moving objects. The speed-reciprocating breaker's motion is converted into rotational motion using a rack and pinion configuration. The axis of the pinion is connected to the sprocket system. A rack and pinion is used to convert rotational motion into linear motion. The rack is flat, and the gear has teeth that are known as the pinion. A rack and pinion may convert both rotary and linear motion. In a belt sprocket system, a gear is used to attach to the chain to increase the number of revolutions per minute (rpm). The sprocket arrangement consists of two sprockets. The one is bigger than the smaller one. Power is moved from the larger to the smaller sprocket by means of a chain that connects the two.

IV. RESULTS AND DISCUSSION



Fig 2. Rack pinion mechanism prototype

Figure 2 displays when a vehicle passes over the speed breaker it compresses downwards in vertical motion enabling the start of the rack and pinion mechanism, which we demonstrated that by pushing the speed breaker with our hands. During this when the pressure is applied the springs that are attached to the speed breaker compress enabling the pinion to move down which further rotates the rack, which produces rotational energy. This produced rotational energy is passed to a chain sprocket whose functioning is explained in the working thus enabling the gears to rotate that is further connected to the generator which converts the rotational energy into electrical energy and it is passed to the battery to get charged through a charging circuit. The Arduino microcontroller used can be effectively controlled the system, detecting the motion of the speed breaker using sensors, controlling the generator, rectifier, and charge controller, and calculating the battery capacity and is displayed in LCD for getting to know when the battery capacity is low and can be used as an indication for us.

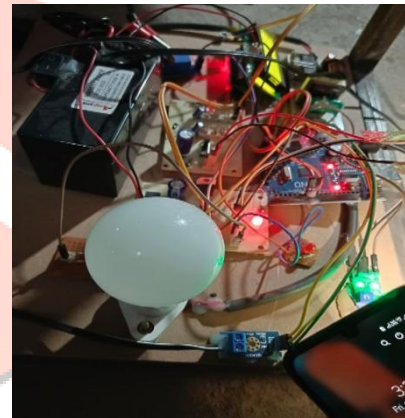


Fig 3. When the LDR sensor senses the daylight, the bulb turns off

Figure 3 displays the observations such that when the LDR sensor senses the light in the environment it allows the bulb to turnoff by using the stored energy in the battery.

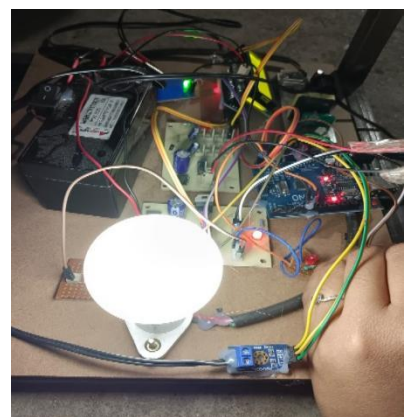


Fig 4. When the LDR sensor senses the darkness the bulb glows

Figure 4 displays the observations such that the generated electricity is stored in the battery which is used for lighting the bulb. Thus, the generated electricity can be used for the roadside street lights or nearby villages. When the LDR sensor senses the darkness in the environment it allows the bulb to glow by using the stored energy in the battery.

Table 1: Increase in voltage for the number of pushes

S.NO	Number of pushes	Increase in Voltage(v)
1	150	0.19
2	200	0.23
3	200	0.21
4	250	0.24
5	100	0.12
6	250	0.22

VI. CONCLUSION

For everyone, India's electricity supply is now inadequate. Every action we take involves electricity. Despite the fact that we get less electrical output, this is an easy way to use the kinetic energy of moving cars to generate electricity. If this concept is further developed and is created with high potential, a tremendous amount of power might be developed. These rack and pinion mechanisms may be adapted for bigger cars by using the multiple transmission system, which is a more efficient method, boosting input torque and ultimately generator output. The technique covered in our project will help to generate electricity on a national scale while also preserving our natural resources. Additionally, this technology has very cheap operating expenses because it produces power without the usage of fuel. The prototype of an electricity generation system using a rack and pinion mechanism for speed breakers presents a promising approach to harnessing kinetic energy from moving vehicles and converting it into electrical energy. Through the conversion of the vertical motion of the speed breaker into rotational motion using a rack and pinion mechanism, this system has the potential to generate clean and renewable electricity at the point of generation, contributing to local power generation and reducing carbon emissions. Further research and development can focus on improving system efficiency, durability, and scalability, as well as exploring potential applications in various settings, such as urban areas, highways, parking lots, and other locations with heavy vehicular traffic. Cost-effectiveness and feasibility should also be considered to determine the practical viability of implementing this system on a larger scale. In conclusion, the prototype of an electricity generation system using a rack and pinion mechanism for speed breakers has the potential to contribute to sustainable energy generation, reduce dependence on fossil fuels, and promote renewable energy sources. Continued efforts in research, development, and testing can pave the way for practical implementation and wider adoption of this innovative technology in the future.

7	200	0.18
8	200	0.15
9	150	0.09
10	150	0.08
11	150	0.08
12	100	0.05
13	100	0.06
14	200	0.18
15	300	0.26

Table 1 displays the calculations of the observations gained from the prototype evaluation of the project. For an average human when pushed on the speed hump, due to the pressure applied on the hump, it goes down thus generating the vertical motion which makes the gears rotate thus providing the rotation energy to voltage generation.

VII. FUTURE SCOPE

India is regarded as a developing nation and hence due to the growing population, the needs will increase which will indirectly increase the consumption of electrical energy. Electricity can be produced from a wide range of resources but however, but their cost is commercially high and hence the concept proposed in this paper would be useful in the future for electricity production as the cost of electricity production is comparatively less. Suitable at the parking of malls as well as multiplexes. Also, can be used for toll booths, signals, etc. Such speed breakers can also be designed for heavy-duty vehicles, thus increasing input torque and ultimately output of the generator.

VIII. ACKNOWLEDGMENT

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IX. REFERENCES

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