iJRASET
International Journal For Research in Applied Science and Engineering Technology



# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 11 **Issue:** V **Month of publication:** May 2023

**DOI:** https://doi.org/10.22214/ijraset.2023.52391

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
*ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538*
*Volume 11 Issue V May 2023- Available at www.ijraset.com*

# Power Generation by Speed Breaker

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***Abstract:*** ***In the present scenario, power becomes a major need for human life. Due to the day-to-day increase in population and lessening of conventional sources, it becomes necessary that we must depend on non-conventional sources for power generation. While moving, the vehicles possess some kinetic energy and it is being wasted. This kinetic energy can be utilized to produce power by using a special arrangement called "POWER HUMP". The Kinetic energy of moving vehicles can be converted into mechanical energy of the shaft through the rack and pinion mechanism. This shaft is connected to the electric dynamo and it produces electrical energy proportional to traffic density. All these mechanisms can be housed under the dome-like speed breaker, which is called a hump. The generated power can be used for general purposes like streetlights, and traffic signals. The electrical output can be improved by arranging these power humps in series this generated power can be amplified and stored by using different electric devices. The maintenance cost of the hump is almost nullified. By adopting this arrangement, we can satisfy future demands to some extent.***

***Keywords: Conventional source, Power hump, Electrical energy, rack & Pinion.***

## I. INTRODUCTION

### A. *Problem Statement*

1) *Energy crisis:* There is a growing demand for electricity, and traditional sources of energy, such as coal and oil, are finite and depleting. Power generation by speed breakers can offer a sustainable and renewable solution to meet the increasing energy demand.
2) *Climate change:* Fossil fuel-based power generation is a significant contributor to greenhouse gas emissions, leading to climate change. Power generation by speed breakers can reduce carbon emissions and promote a cleaner environment.
3) *Power outages:* Power outages are a common occurrence, especially in developing countries. Power generation by speed breakers can provide a reliable source of power during such outages.
4) *Safety concerns:* There is a risk of accidents and damage to vehicles if speed breakers are not designed or installed correctly. The power generation system should be integrated with the speed breakers without compromising their safety.
5) *Cost-effectiveness:* The power generation system must be cost-effective to make it a viable option for implementation.
6) *Maintenance and durability:* The power generation system should be durable and require minimal maintenance to ensure its longevity and efficiency.
7) *Integration with the existing power grid:* The power generated by speed breakers should be integrated with the existing power grid to ensure efficient distribution and utilization of energy.
8) *Public acceptance and awareness:* The public must be aware of the benefits of power generation by speed breakers and its potential for reducing carbon emissions and providing a reliable source of power. Public acceptance and cooperation are crucial for the success of the project.

### B. *Objectives*

1) To generate electricity using the kinetic energy of vehicles passing over speed breakers.
2) To develop a cost-effective and efficient system that can be easily installed on existing speed breakers.
3) To reduce the carbon footprint of the transportation sector by generating electricity from renewable sources.
4) To provide a sustainable solution for powering streetlights, traffic signals, and other public utilities in areas with high traffic volume.
5) To promote awareness and encourage the use of renewable energy sources among the general public.
6) To reduce the load on the conventional power grid and provide a reliable source of power during power outages.
7) To explore the potential of power generation by speed breakers and identify opportunities for scaling up the technology.

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8) To collaborate with stakeholders, including government agencies, private companies, and academic institutions, to promote research and development in the field of renewable energy.
9) To create new job opportunities and contribute to the local economy through the production and installation of power generation systems.
10) To ensure the safety of the system and minimize any potential negative impact on the environment and public health.

### C. *Solution*

1) Development of an efficient and cost-effective power generation system that can be integrated with existing speed breakers.
2) Use of piezoelectric materials or electromagnetic generators that can convert the kinetic energy of vehicles passing over speed breakers into electrical energy.

### D. *Scope*

1) Research and development of efficient and cost-effective power generation systems that can be integrated with existing speed breakers.
2) Testing and validation of the power generation system to ensure its safety, efficiency, and durability.
3) Installation of the power generation system on selected speed breakers in high traffic areas to generate electricity.
4) Integration of the power generated by speed breakers with the existing power grid to ensure efficient distribution and utilization of energy.
5) Use of the power generated by speed breakers for powering streetlights, traffic signals, and other public utilities in areas with high traffic volume.
6) Collaboration with government agencies, private companies, and academic institutions to promote research and development in the field of renewable energy.
7) Awareness campaigns and education programs to promote the benefits of power generation by speed breakers and encourage public cooperation.

### E. *Methodology*

Electricity is a basic part of nature and it is one of our most widely used forms of energy. 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. In this research, a roller is fitted in between a speed breaker, and some kind of a grip is provided on the speed breaker so that when a vehicle passes over the speed breaker it gets displaced in a vertically downward direction distance 7 cm. The rack which is connected to the speed breaker also moves down simultaneously with the same distance of 7 cm. The rack is in mesh with the pinion which is coupled with the shaft of gear which have 72 teeth then meshed with the pinion with 32 teeth which is coupled with the generator motor. This whole mechanism converts linear displacement into rotary motion. Hence shaft of the generator rotates which generates a current proportional to the number of revolutions of the pinion. This produced current is stored in the battery for future use. Later the rack gets displaced to the original position due to the springmechanism.

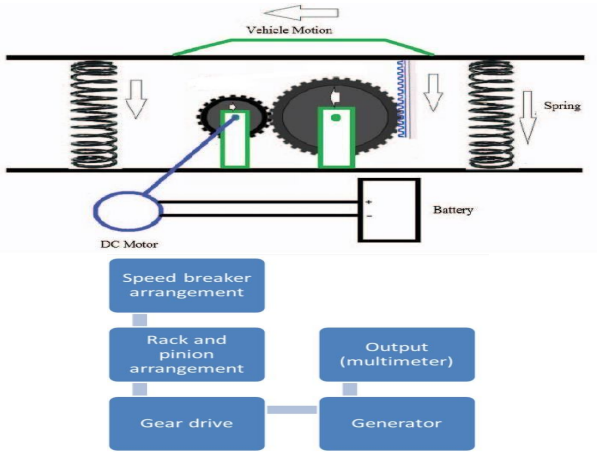



Fig 01 Methodology

*ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538*
*Volume 11 Issue V May 2023- Available at www.ijraset.com*

## II. DESIGN

Calculations

*1) Spring design for 200 kg weight:-*

Weight of vehicle = 200Kg * 9.81 = 1962.00 NThere fore
P=1.962 KN=2KN
Permissible shear stress is taken as 0.5 of sut
Ƭ=0.5*sut(ultimate tensile strength) Ƭ=0.5*1050=525
N/mm^2
The spring stiffness k,
K=(4c-1/4c-4)+(0.615/c)…….std formulaK=(4*8-
1/4*8-4)+(0.615/8)
K=1.184
Calculation of wire diameter d,
Ƭ=k*(8pc/πd^2) 525=1.184(8*2000*8/
π*d^2)
D=4mm
Free length of spring =150mm

Model Calculations

Theoretical Calculation (Approximate)Let us
consider,
The mass of a vehicle moving over the speed breaker = 200Kg (Approx.)Height of speed
brake =10 cm
Work done=Force x Distance where,Force =
Weight of the Body
= 200 Kg x 9.81m/s2 = 1962 N
Distance travelled by the body = Height of the speed brake =10 cm Output power=
(1962 x 0.1)/60 = 3.27 Watts (For One pushing force)
Power developed for 1 vehicle passing over the speed breaker arrangement for one minute
= 3.27 watts

*2) Design of Square PipeFrame*

The Yield Strength

The yield strength or yield point of a material is defined in engineering and materials science as the stress at which a material begins to deform plastically (bends and not return). Prior to the yield point the material will deform elastically and will return to its original shape when the applied stress is removed. It should be provided as a specification by the supplier of the material.

The value depends on the quality of the material. In this instance the value of the yield strength was rated at 280Mpa (mega Pascal) that of a construction quality steel.

Moment of Inertia

Also known as the second moment area, the area moment of inertia, moment of inertia of plane area, or second area moment, is a property of a cross section that can be used to predict the resistance of beams to bending and deflection, around an axis that lies in the cross-sectional plane. It should be provided as a specification by the supplier of the material (see below).

Standard Table of Dimension and Properties

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**Table 1 Dimensions and Properties of Square Hollow Sections**
(*Clause* 8.1 and *Note in Annex A*)

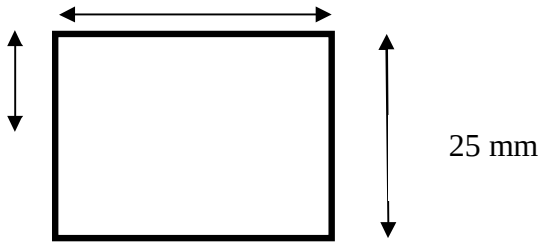
| Designation | Depth or Width *D* | Thick-ness | Weight | Area of Section | Moment of Inertia | Radius of Gyration | Elastic Modulus | Plastic Modulus |
|---|---|---|---|---|---|---|---|---|
| mm | mm | mm | kg/m | $cm^2$ | $cm^4$ | cm | $cm^3$ | $cm^3$ |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| 25.0 × 25.0 × 2.6 | 25.0 | 2.6 | 1.69 | 2.16 | 1.72 | 0.89 | 1.38 | 1.76 |
| 25.0 × 25.0 × 3.2 | 25.0 | 3.2 | 1.98 | 2.53 | 1.89 | 0.86 | 1.51 | 1.98 |
| 30.0 × 30.0 × 2.6 | 30.0 | 2.6 | 2.10 | 2.68 | 3.23 | 1.10 | 2.15 | 2.68 |
| 30.0 × 30.0 × 3.2 | 30.0 | 3.2 | 2.49 | 3.17 | 3.62 | 1.07 | 2.41 | 3.08 |
| 30.0 × 30.0 × 4.0 | 30.0 | 4.0 | 2.94 | 3.75 | 3.97 | 1.03 | 2.64 | 3.50 |
| 32.0 × 32.0 × 2.6 | 32.0 | 2.6 | 2.26 | 2.88 | 4.02 | 1.18 | 2.51 | 3.11 |
| 32.0 × 32.0 × 3.2 | 32.0 | 3.2 | 2.69 | 3.42 | 4.54 | 1.15 | 2.84 | 3.59 |
| 32.0 × 32.0 × 4.0 | 32.0 | 4.0 | 3.19 | 4.07 | 5.02 | 1.11 | 3.14 | 4.11 |
| 35.0 × 35.0 × 2.6 | 35.0 | 2.6 | 2.51 | 3.20 | 5.43 | 1.30 | 3.10 | 3.81 |

Table 01 Dimensions & Properties of Square Hollow Section

We need to know the distance from the center of the tube (x-x) to the outside edge in this case 12.5mm

25 mm

12.5m




*Solving the equation*

Yield strength of steel = (moment of turning force) * (half the material thickness /second moment of inertia)
We don't know the amount (or 'moment') of turning force required to meet that of the yield strength (bend and not return) of the steel as this is what we are trying to find out.
However, we do know that to find a 'moment' we multiply the force applied to a lever (extended tube) by the distance of the lever (here it is unknown or x). So we keep these two things apart in the equation as shown below here:
(294.3N/m2 * x) ... (Consider 30 Kg of force for one side of frame)The remaining known values are as follows:
Yield strength of this steel = 280MpaForce = 294.3N/m2
Distance = x (This is what we are trying to find out)Half the material thickness =12.5mm
Moment of inertia = 1.72$cm^4$
So the equation in numerical terms reads:
280Mpa = (294.3N/m2 * x) * (12.5mm / 1.72$cm^4$)
In the equation above you will notice (12.5mm ÷ 1.72$cm^4$ ) we can't divide millimetres bycentimetres so we will have to convert 1.72 $cm^4$to mm which is 17200mm
280 Mpa = (294.3N/m2 *x) * (12.5mm ÷17200mm) or in numbers alone:280 = (294.3*x) * (12.5/17200)
What we are trying to do is isolate x so we can determine what it280*17200 = (294.3*x) 12.5
280*17200=294.3*12.5* x

280*17200 = (294.3*12.5)* x
4816000 = (3678.75)* x
4816000/3678.75 = x
*1309.4 = x*
Or x (the yield point at which the metal will bend and not recover) = 1309.4 mm
Hence, there is chance of bending the pipe at 1309.4 mm when 30 kg (294.3N/m2) of force isapplied.
In our demo, there is maximum of 900 mm of length of pipe for Frame in no support between. So,our design is safe as 600 is value less than 1309.4.

*3) Design Of Welded Joint*
Checking the strength of the welded joints for safety
The transverse fillet weld welds the side plate and the edge stiffness plates,The maximum load which the plate can carry for transverse fillet weld is

P = 0.707 x S x L x ft

Where, S = factor of safety, L = contact length = 25mm The load of shear along with the friction is 50 kg = 500NHence, 500 = 0.707 x 3 x 35 x ft
Hence let us find the safe value of 'ft'

$$\text{Therefore ft} = \frac{500}{0.707 \times 3 \times 35}$$

ft = 6.73536 N/mm$^2$

Since the calculated value of the tensile load is very smaller than The permissible value as ft=56 N/mm$^2$. Hence welded joint is safe.

## III. WORKING

Our main aim of the project is to generate a electricity from speed breaker and provide the generated power for smart lightning. Whenever the vehicle passes over the speed breaker, the mechanical assembly provided under the speed breaker generates electricity. The generated electricity is stored in the battery.

**CONCEPTUAL DIAGRAM**

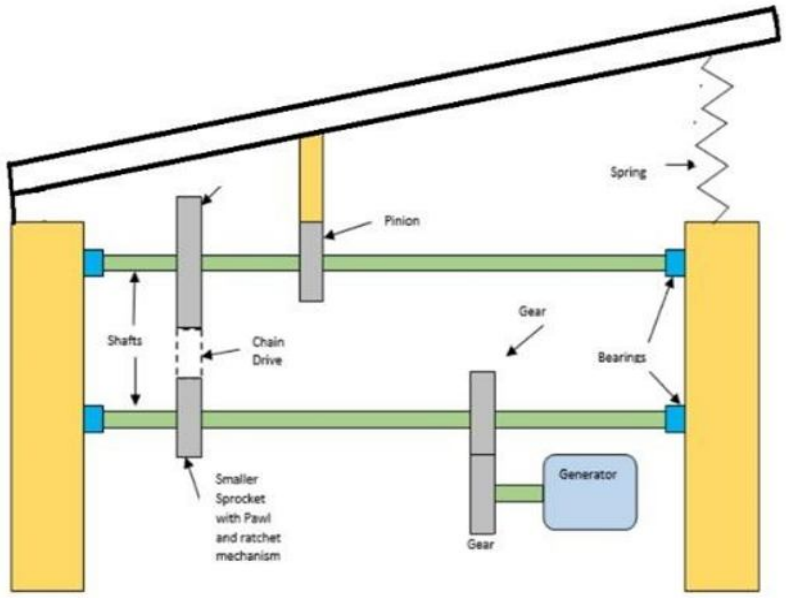
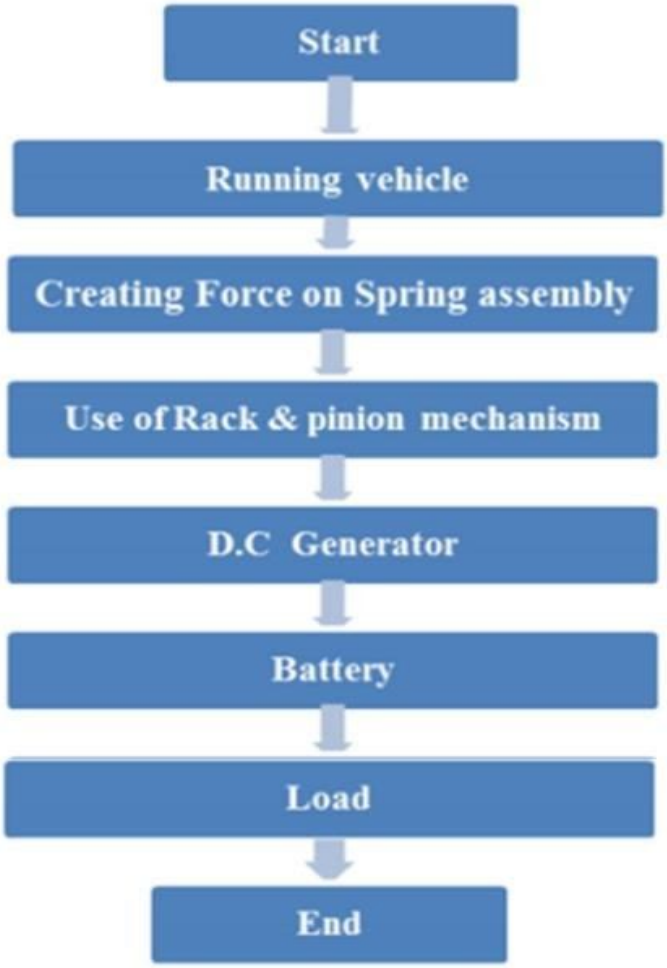



Fig 02 Conceptual Diagram

*ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538*
*Volume 11 Issue V May 2023- Available at www.ijraset.com*

FLOW CHART

By using the algorithm user can easily understand the flow of power generation using speedbreaker. The working is start




## IV. ADVANTAGES & APPLICATION

### A. *Advantages*

1) *Renewable Energy Source:* The power generation system using speed breakers is a renewable energy source that does not emit any harmful pollutants or greenhouse gases, making it an eco-friendly solution.
2) *Cost-Effective:* The installation and maintenance cost of the power generation system using speed breakers is relatively low compared to other renewable energy sources like solar or wind power.
3) *Energy Savings:* The generated electricity can be used to power street lights or other electrical appliances, reducing the overall energy consumption and cost.
4) *Reduces Traffic Speed:* The installation of speed breakers can help reduce traffic speed, which can lead to a safer driving environment and fewer accidents.
5) *Easy to Install:* The power generation system using speed breakers can be installed quickly and easily without the need for any specialized skills or equipment.

### B. *Applications*

1) *Urban Areas:* The power generation system using speed breakers can be installed in urban areas where there is a high traffic flow, such as roads and highways, to generate electricity.
2) *Rural Areas:* The power generation system can also be installed in rural areas where there may not be access to traditional power sources.

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3) *Public Spaces:* The system can be installed in public spaces such as parks, shopping centers, and universities to generate electricity and reduce energy consumption.
4) *Military Installations:* The system can be used to provide power to military installations, especially in remote locations where traditional power sources may not be available.
5) *Airports:* The power generation system using speed breakers can be installed in airports to provide electricity for lighting and other applications.

## V. CONCLUDING REMARKS AND SCOPE FOR THE FUTURE WORK

In conclusion, the project on power generation by speed breakers is a promising solution for generating renewable energy in urban and rural areas. The system is cost-effective, easy to install, and has various applications in public spaces, military installations, and airports. The project involves the design and fabrication of a speed breaker that can generate electricity by harnessing the kinetic energy of moving vehicles. The generated electricity can be used to power streetlights, traffic signals, and other electrical appliances, reducing energy consumption and cost.

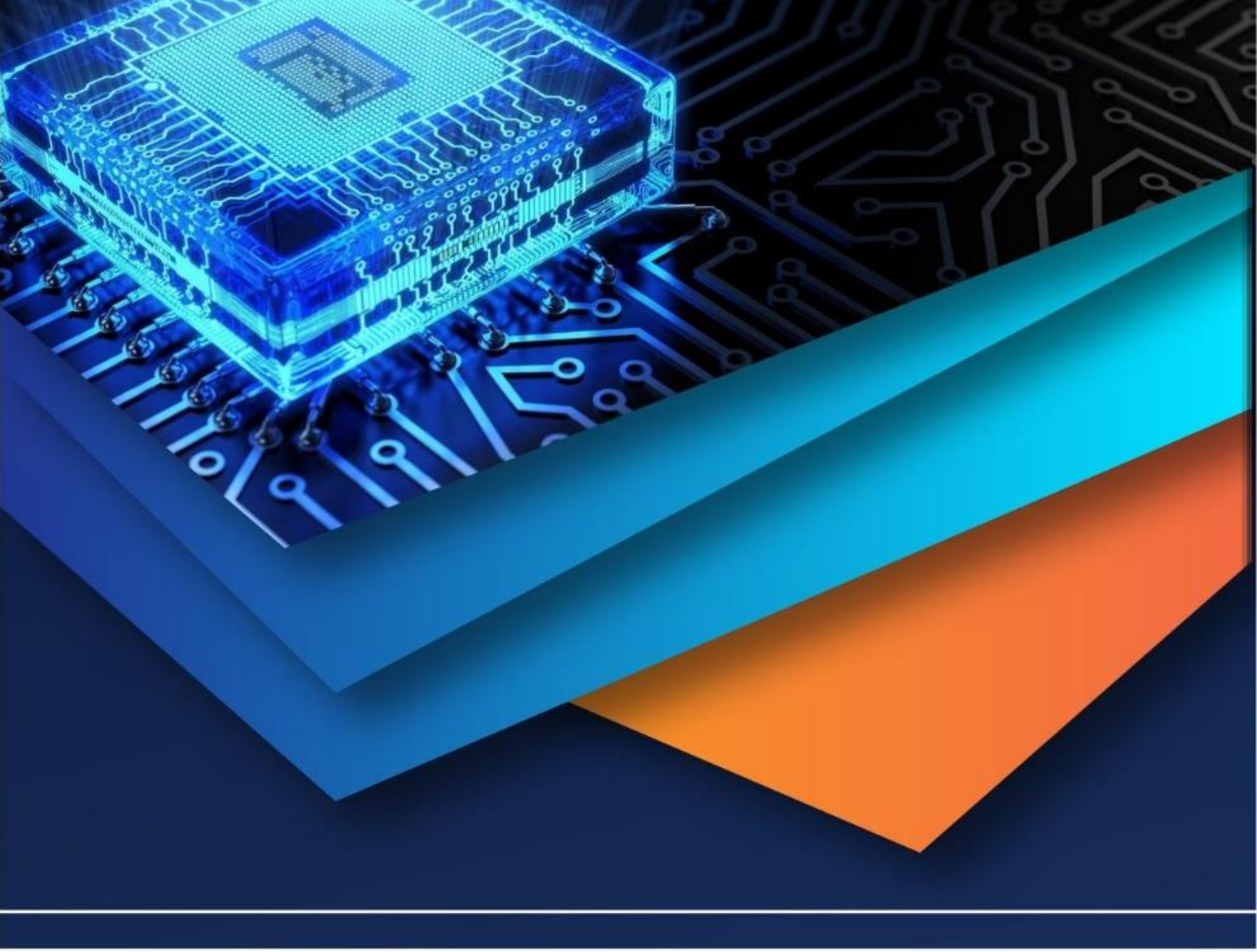
1) *Increasing Efficiency:* There is a need to increase the efficiency of the power generation system to generate more electricity from speed breakers. Researchers can explore the use of different materials and designs that can improve the conversion of kinetic energy into electrical energy.
2) *Integration with Smart Grid:* The power generation system can be integrated with the smart grid to optimize the energy flow and distribution. This will ensure that the generated electricity is stored and distributed efficiently.
3) *Expansion of Applications:* The power generation system using speed breakers can be applied in various fields, including transportation, construction, and mining. Researchers can explore these areas to identify new applications and develop solutions that are tailoredto meet the specific needs of each field.
4) *Scalability:* The power generation system can be scaled up to meet the energy demands of a larger population. Researchers can explore the use of multiple speed breakers and other renewable energy sources to generate enough electricity to power entire cities.
5) *Commercialization:* The power generation system can be commercialized to generate revenue and create job opportunities. Researchers can explore the market potential and develop business models that can help bring the technology to the market.

In conclusion, the project on power generation by speed breakers is a promising solution for generating renewable energy. The future work outlined above can help improve the efficiency, expand the applications, and scale up the power generation system to meet the energy demands ofa growing population.

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