DESIGN AND PERFORMANCE ANALYSIS OF FOOTSTEP POWER GENERATION SYSTEM

Group: 28
Section: ME220225_26H+26I

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Introduction

The Footstep Power Generation System is an eco-friendly solution that converts human kinetic energy into electricity using a rack and pinion mechanism connected to a generator. The produced energy can be stored in batteries and used for small applications like LED lighting or mobile charging. Ideal for crowded areas, the system promotes renewable energy and supports sustainable smart city development.

Objectives

- To design and develop of Footstep Power Generation System.
- To analyze the performance of Footstep Power Generation System.

Methodology

- Develop the concept and create a block diagram showing the mechanical components like rack and pinion, gear, springs, and generator to understand the working flow.
- Collect all mechanical parts and fabricate the footstep platform. Assemble the rack-pinion mechanism with the generator to convert mechanical motion into electrical energy.
- Connect the generator output to a rectifier and battery circuit. Test the system by applying foot pressure and analyze voltage/current output for performance evaluation.

Component List

- Generator Motor
- Battery
- Voltmeter
- Rack & Pinion Mechanism
- LED

System Design

The main processing brain of the system is the rack & pinion mechanism. This system created power will store in battery. After press the switch on then the system will be on and ready for operation. Here this system will able to generate power when a car cross over the speed breaker. Here we use voltmeter, generator motor, capacitor, led light, rack & pinion mechanism etc. All of this equipment are combined work together and full fill our required as we desire.

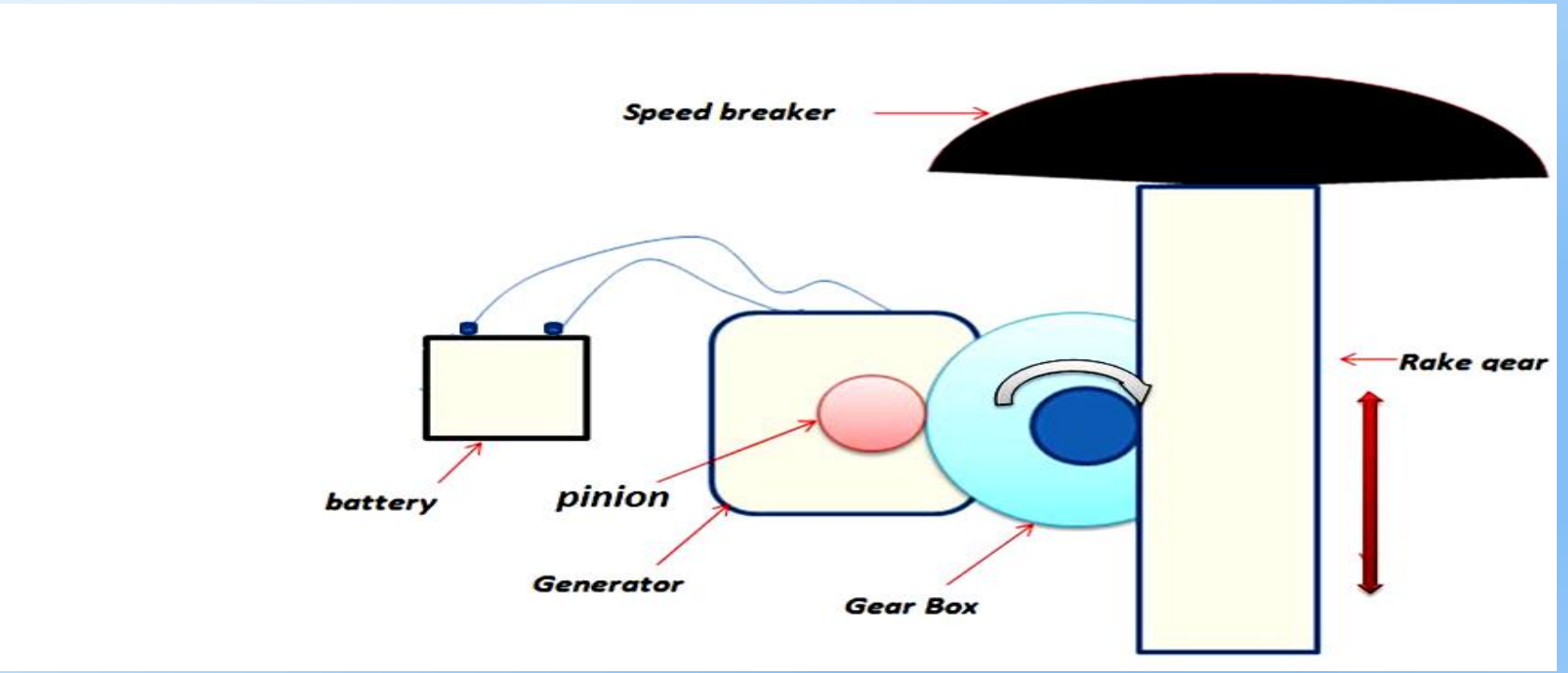


Figure 01: System Design

Block Diagram

In this diagram we will show by block the individual parts.

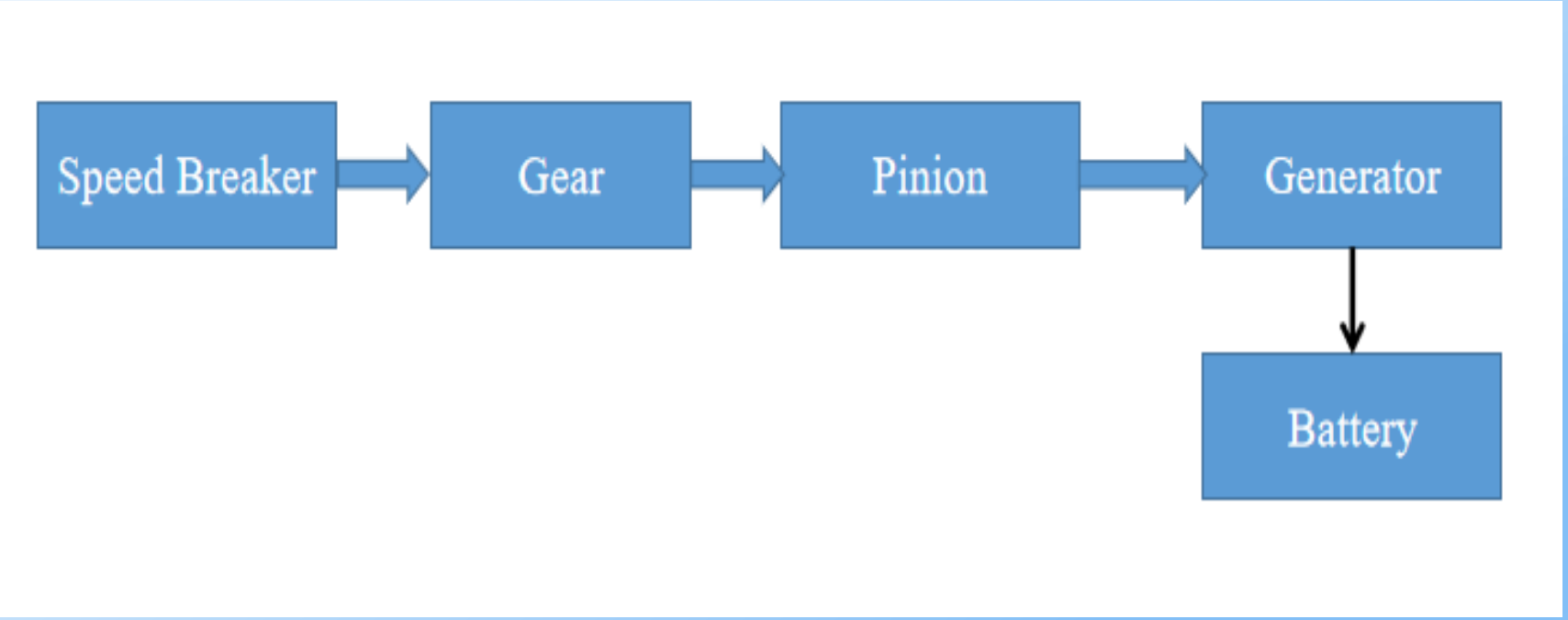


Figure 02: System Design

Circuit Diagram

The schematic diagram here is representing the electrical circuit and the components of our System. Here we connect equipment with smart wire connection.

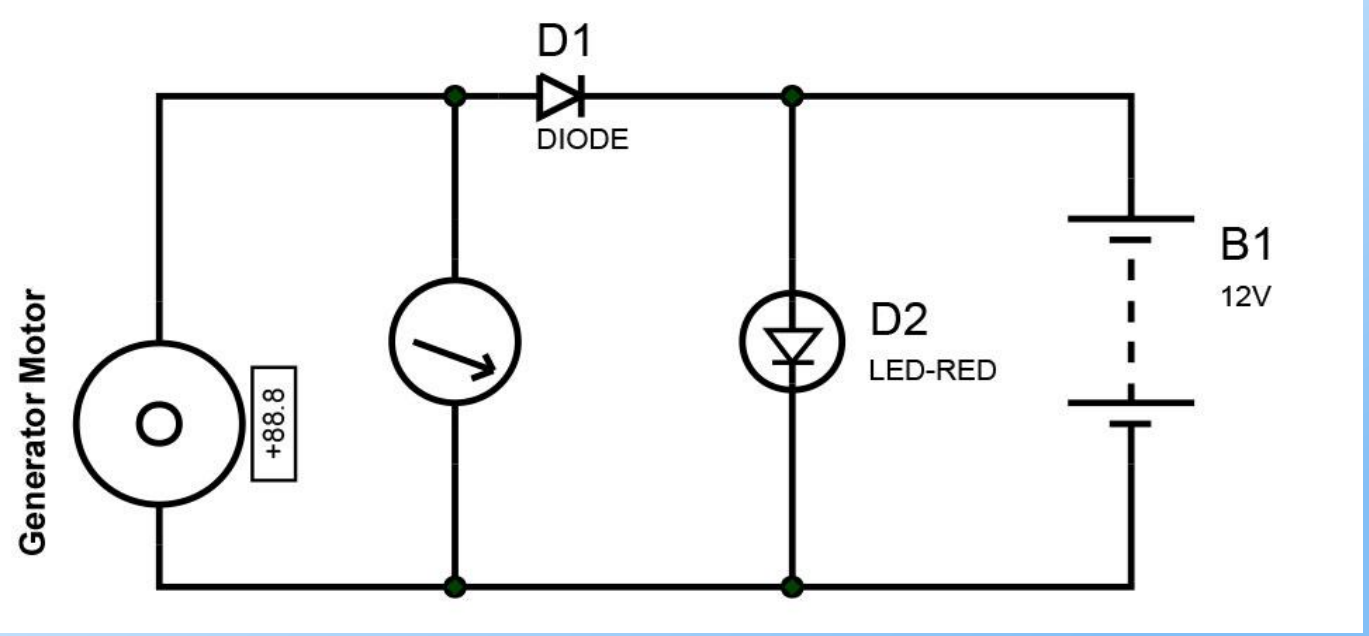


Figure 03: Circuit Diagram of our system

Complete Project Prototype



Figure 04: Project Front View



Figure 05 : Project Side View

Working Principle

When someone steps onto the platform, their foot pressure pushes the rack downward. This movement drives a pinion gear, which changes the straight motion into rotational motion. The rotating gear turns the generator shaft, producing electricity. The generated power is stored in a battery and checked with a voltmeter, making it useful for small-scale applications like lighting or charging.

Calculation

Total required footstep for full charge of 3.7V battery is 4000 and use 3W bulb.

Here Current drawn by the bulb

We know,

$P = VI$

or, $I = \frac{P}{V} = \frac{3\,W}{3.7\text{V}} \approx 0.81\text{ A}$

Battery capacity in amp-hours

2200 mAh = 2.2 Ah

Now, Ideal runtime

$Time = \frac{Battery\,Capacity}{\text{Current}} = \frac{2.2\,Ah}{0.81\text{ A}} \approx 2.7\text{ hours}$

So, the 3W bulb will run for about 2.5 to 2.7 hours on a fully charged 2200 mAh 3.7 V battery.

Project Outcome

- The system successfully generated electricity when pressure was applied through footsteps.
- The generated power was sufficient to light up LEDs and charge small batteries.
- The voltage output was displayed in real-time through a voltmeter.
- Power generation was consistent and repeatable during multiple footstep cycles.
- The system proved to be cost-effective and energy-efficient in crowded zones.
- Stored energy in the battery can be utilized for low-power applications, especially at night.

Advantage

- No consumption of any fossil fuel.
- No manual work necessary during generation.
- Eco-friendly.
- 24 hours applicable.
- Low installation cost.
- Low maintenance cost.
- Simple in construction.
- Less space is required.
- Pollution free power generation.
- Energy available all year round.
- Maximum utilization of energy.

Disadvantage

- Low power output per footstep.
- Depends on continuous human movement.
- Installation may be slightly complex.
- Less efficient without proper design.
- No extra power supply.

Application

- Street lights.
- Lighting of the check post on the highways.
- Lighting footpaths and corridors.
- Use in schools and malls.
- Smart city renewable energy.

Future Scope

- In future development this project can be develop by Microcontroller Unit .
- In future, I will try it to apply in real field.
- In Future we will add extra power system.
- In future develop Control on IoT System

Conclusion

The Footstep Power Generation System successfully demonstrates how human kinetic energy can be converted into useful electricity. Though the power output is limited, it provides a cost-effective and eco-friendly solution for small applications like lighting and charging. This project promotes renewable energy awareness and holds potential for integration into sustainable smart city infrastructure.


THANK YOU!