Design and Fabrication of Mechanical Footstep Power Generator

A Projectand Thesis
By

Ashikur Rahman Sarder	**BME 1802015140**
Omar Faruque	**BME 1902018340**
Suman Ali	**BME 1903019253**
Rakesh Roy	**BME 1903019300**
Md. ShahariarImon	**BME1903019156**

Supervised by

Md. SharfulInsan
Lecturer,

Department of Mechanical Engineering

Sonargaon University
Dhaka-1215, Bangladesh

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Md. Shahariar Imon	**BME 1903019156**

Md. SharfulInsan

Lecturer

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STUDENT'S DECLARATION

We do hereby solemnly declare that, the work presented here in this project report has been carried out by us and has not been previously submitted to any University/ Organization for the award of any degree or certificate.

We hereby ensure that the works that have been prevented here do not breach any existing copyright.

We further undertake to indemnify the university against any loss or damage arising from a breach of the foregoing obligation.

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Ashikur Rahman Sarder **BME 1802015140**

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Omar Faruque **BME 1902018340**

_____

Suman Ali **BME 1903019253**

_____

Rakesh Roy **BME 1903019300**

_____

Md. ShahariarImon **BME 1903019156**

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project. In my opinion, this project is seen satisfactory in terms of scope and quality for the award of the degree of Bachelor of Science in Mechanical Engineering.

Md. SharfulInsan
Lecturer
Department of Mechanical Engineering
Sonargaon University

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ABSTRACT

Today, one of the primary demands in this contemporary environment is energy and power. Demand for energy is rising daily. On the other side, there are numerous energy resources that are being wasted and depleted. In densely populated nations like Bangladesh, where millions of people travel about daily and roadways, train stations, bus stops, temples, etc. are overcrowded, the proposal for using human locomotion's wasted foot force is highly pertinent. All of this energy is useless. It would be a fantastic invention if using this energy were made possible. In this project, we are turning unconventional energy—just your bare feet moving—into electrical energy. In this project, a straightforward drive mechanism like a rack and pinion assembly is used. D.C generator, the rack and pinion, and the control mechanism

In this project, we are using an unconventional approach to generate electricity by just running or walking on the footsteps. Currently, our country's non-conventional energy system is crucial. Non-conventional energy sources such as foot power can produce electricity without the use of fuel. This project uses a simple drive mechanism, such as a rack and pinion assembly and chain drive mechanism, to generate power by utilizing the force that is obtained while walking up and down stairs is converted into electrical energy with the use of mechanical systems. This is one of the small, effective electricity-generating systems that may be quickly deployed in numerous

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CHAPTER 1
INTRODUCTION

1.1 Introduction

Non-conventional energy is in high demand in the age of globalization because conventional energy sources like fossil fuels are spectacularly running out.

Because of today's rising energy use. Concerns about future energy security have increased as a result of the prospective lack and growing price of oil and gases, which could have a negative influence on the growth of the national economy [1].

A number of easy setups are installed under the walking platform as part of this operation. On this platform, people can walk as their body weight rotates a pinion through a rack. The dynamo, which is connected to the pinion, generates electricity in the end. Additionally, energy is produced at higher levels despite the power plant's overcrowding from people moving around on it. More individuals moving around will produce more energy. If walking energy is appropriately used, this work will be a remarkable invention. The availability of such renewable energy is typically greatest in areas with high population densities [2].

Rack and pinion assembly is used to transform mechanical energy into electrical energy. The step that has been positioned at a specific angle of inclination has been subjected to force when someone claims the stairway. A rack attached to a step descends and turns the pinion when force is applied.

This technology, which is the ultimate source of all currently known types of energy, is among the many alternative energy sources. In the future, it will be a very competitive option because it is clean, free, and safe. It also doesn't harm the environment. As there is a significant growth in the population, the stress placed on people's feet causes it to continuously produce energy, which may be stored and used to power the street lights. The idea is to transform mechanical energy into electric energy in this case [3].

1.2 Problem Statement

Proposal for utilizing waste energy of foot power with human movement is very relevantand vital for highly populated countries like Bangladesh, especially in our Dhaka city. where the train station, bus stand, mosque, temples, etc., are overcrowded all the time. The model of foot step power generating was designed and built. Also, create a model of the same that can demonstrate the properties of the systems and how they work.

1.3 Objectives

The objective of a mechanical footstep power generator is to convert the mechanical energy generated by the weight and motion of a person's footstep into electrical energy. The energy produced can then be used to power various mechanical devices.

The idea behind a footstep power generator is to harness the energy that is otherwise wasted when a person walks or runs. By placing a device in a high foot traffic area such as a busy street, shopping mall, train station and bus terminal, the mechanical energy produced by people walking can be captured and converted into a usable form of sourced.

The use of mechanical footstep power generation can be particularly useful in areas where there is a shortage electricity or in remote locations where traditional power sources are not available. They can also be used in Publicspaces to promote sustainable energy practices and raise awareness about renewable energy sources.

1.4 Methodology

The power is generated using the footstep arrangement. Because power demand has increased recently, the footstep arrangement is being employed to create electrical power in order to compensate for the increased demand. Mechanical energy is turned into electrical energy in this configuration.

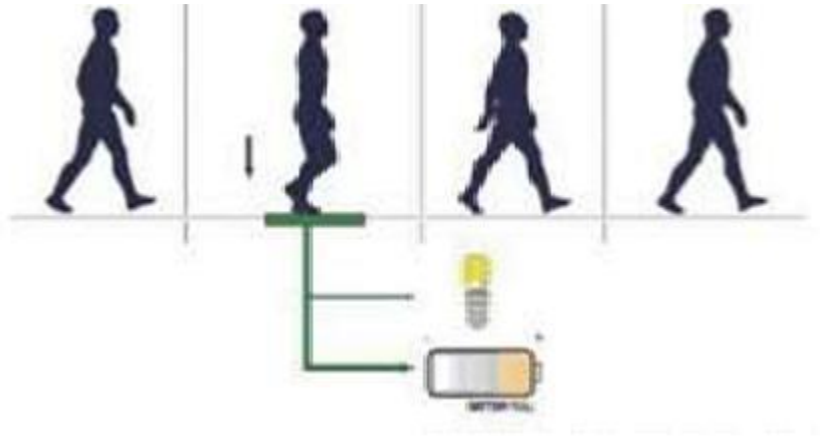

Figure1: Methodology

The methodology of this project:

1. Creating an idea for the design and construction of an "**Mechanical Foot Step Power Generator".** And designing a block diagram & circuit diagram to know which components we need to construct it.

2. Collecting all the components and planning for work

3. Then start work step by step.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A literature review is a critical and complete examination of existing research and publications on a certain topic. It entails locating, evaluating, and synthesizing public material and data related to the topic of interest. A literature review's objective is to provide an overview of the current level of knowledge and understanding on a certain issue, highlight gaps in knowledge, recommend areas for future research, and inform decision-making.

2.2 Literature Review

[3] "Mechanical footstep power generation" by B.Munaswamy, Ch.Prudhvi and at all.

In this paper the author discuss "power generation by foot step" designed and developed, for the demonstration purpose a proto type module is constructed with lower ratings of devices, & results are found to be satisfactory, and 12v DC is connected to the inverter to convert it into 230AC.

[4] ''Foot step power generation‟ by Ajinkya V. Gothane, Akshay R. Gosavi2, and Prof. P.V.Raut.

In this research journal the author discusses'' Foot step power generation'' A rack and pinion type power generation be concluded that is mode of power generation system is eco-friendly No pollution is caused during the generation of power using this type of model. Here they mainly focus on environment friendly the no has no pollution.

A 12volt lead acid battery is used to store the generated electrical power.

[5] "Modeling and Design of a Prototype Footstep Power Generating Machine" by Israel Enema Ohiemi,Nnorum Choice Obundah and at all.

In this paper author described ''Modeling and Design of a Prototype Footstep Power Generating Machine'' The system consists mainly of a connecting rod, gears, u-shaped shaft, and an alternator

The results show an output power of 0.912W, voltage of 1.52*V*, and an efficiency of 21% when an average mass of 62*kg* acted on it.

Here no rack and pinion are used.

[6]"Footstep PowerGeneration" by Mr. Vishwanil V. Saranik, Mr.AkshayP.Karnewar and at all.

This is the paper where author discuss ''Footstep Power Generation'' this system works as basic rule rack and pinion type power generation but also here author added Piezo-Electric system.

12 Piezo-electric transducers connected in series and 2 such series in parallel an installed on the top of the MS plate. rack and pinion and piezo-electric material are integrated to produce desired output

[7] "Power Generation Footstep" by Shiraz Afzal and Farrukh hafeez.

This paper is about generating electricity while people walk on the floor. If we can develop a power generating floor that can make 100W in just 12 steps, we can produce 1000 Watt in 120 steps, and if we put such a system on 100 floors, we can produce 1MegaWatt.In fact, renewable energy accounts for only 11% of our primary energy. If this idea is implemented, we will not only be able to solve the energy crisis, but we will also be.

[8] "Power Generation Through Step" by Vipin Kumar Yadav, Vivek Kumar Yadav andat all.

Authors of these research papers used the following equipment: 10 volt motor D.C. Generator, 1000 rpm, Gear 1 is made of mild steel and has 59 teeth (large gear) and 36 teeth (small gear).Spur Gear, 2 gears Spring 1-Load bearing capacity: 60-90 kg, Mild Steel, Total displacement: 5 inch Bearing 1-Type: Ball bearing, Bearing No.N35, Shaft 1-Diameter: 15

mm- Material: Mild steel The author concluded that these methods of energy conversion are simple, efficient, and pollution-free.

[9] "Design and Fabrication of Load Applied Power Generator" by NWE NI TUN.

In this study, by using the kinematics relationship between linear velocities oflarge gear and velocities of a large gear small gear (20 teeth), the rotational speed of output shaft is found to be570rpm. Theoretically the large gear and the small gear mesh at the pressure angle of 17.59°

[10] "DESIGN AND FABRICATION OF POWER GENERATING CARPET" by Ujjal Kalita

The paper proposes a novel technique for the creation of power utilizing the rack and Pinion is kept along the footpaths which can ready to charge the battery and ready to supply the force at whatever time of our prerequisite.

In this paper a substitute strategy for generation of power is finished by utilizingpiezoeplateinthis framework when a power is connected on the piezo plate the state of the piezo plate changes which prompts the generation of voltage.

2.3 Proposed System

A mechanical footstep power generator is a device that harness is kinetic generated by human footstep and converts it into electrical energy. This type of generator is typically uses in application where there is a flow of foot traffic, such as public areas, malls, stadiums, or even sidewalks. Here is a proposed system for a "Footstep power generator.

1. Footstep Mechanism: The generator consists of a series of mechanical components embedded in a platform or flooring system. These components are designed to capture and convert the downward force and movement of a person's footsteps into rotational motion.

2. Gear System: The rotational motion generated by the footstep mechanism is transmitted to A gear system. The gear system helps to increase rotational speed and torque to optimize the power generation efficiency.

3. Energy Storage: The generated electrical power can be stored in batteries or supercapacitors to provide a steady supply of electricity, especially during periods of low foot traffic. These energy storage devices help to balance the supply and demand of the electrical power generated

4. Power Distribution: The stored electrical energy can be distributed to power various devices or system within the vicinity. This can include lighting systems, electronic displays, charging stations for mobile devices or even feeding back into the main power grid.

It is vital to note that the design and efficiency of a mechanical footstep power generator might vary depending on the application's specific requirements and limits. During the design and implementation phase, factors such as foot traffic patterns, footstep force, and system durability should be considered.

2.4Cost Analysis

SL	Name of the components	Unit Price	Quantity	Price(BDT)
1.	12volt DC motor	500	1	500
2.	Spring	300	1	300
3.	Rack	1000	1	1000
4.	Pinion	200	1	200
5.	LED Light	20	1	20
6.	Shaft	150	2	300
7.	Square Bar	2000		2000
8.	Sheet Metal	700		700
9.	Others cost	3000		3000

Total = 8020/-

2.5 Summary

We try to do this project by reading the above literature, and collect idea from you tube video and we have been able to make our project successful. We did try our best to completed the project.

CHAPTER 3

DESCRIPTION OF COMPONENTS

3.1 Introduction

This project works on different types of mechanical instrument or components. Here we discuss about our project components.

COMPONENTS

Shaft
Spring
Rack & Pinion
DC Motor
Square Bar
Sheet Metal (3mm)
Angle
LED Light

3.2 Shaft

A shaft is a revolving machine element that is used to transfer power from one location to another. The shaft that is clamped between the iron frame works and the freewheeling type

A shaft-mounted bearing. The freewheeling bearing only rotates in one direction.

Figure 2: Shaft

3.3 Spring

It is defined as an elastic body that distorts when loaded and returns to its original shape when the load is removed. It absorbs or controls energy as a result ofdue to vibrations or shocks.

Figure3: Spring

3.4 Rack & pinion

A pinion is a circular gear that engages teeth on a linear gear bar called a rack. This component is joined to the bottom plate. When a force is applied to the floor rack, it moves. Downhill, converting linear motion to circular motion.

Figure 4: Rack & pinion

3.5 DC Motor

A direct current (DC) motor is a type electric machine that convert electrical energy into mechanical energy. DC motor takes electrical power through direct current, and convert this energy into mechanical rotation.

Figure 5: DC Motor

3.6 Square Bar

Square bars, also known as square steel, squares and square metal bar are a multipurpose steel section mainly used for manufacturing and repairs. General purpose square bars are part of our light and re-rolled section, making it suitable for everyday commercial projects. The thickness of square bar is 12 mm.

Figure 6: Square Bar

3.7 Sheet metal

The process of converting flat sheets of steel or aluminum into metal structures or goods by cutting, punching, folding, and assembling is known as sheet metal fabrication. Sheet metal may be cut, twisted, or stretched into almost any shape, which is usually accomplished by cutting and burning the metal.Here in our project,the dimension of sheet metal is Length: 1.5 feet, Width: 1.0 feet, Thickness: 2 mm

Figure 7: Sheet metal

3.8 Angle

Metal angles, also known as angle iron, are a sort of L-shaped steel product that can be used for a variety of purposes. They are adaptable and can be used in a variety of industries such as

building, manufacturing, and engineering. Here in our project the length of angle is 0.2032 meter.

Figure 8: Angle

3.9LED Light

The term LED refers to a light-emitting diode. LED lighting devices are up to 90% more efficient than incandescent light bulbs at producing light. An electrical current flow through a microchip, illuminating the small light sources known as LEDs and producing visible light as a result.

Figure 9: LED Light

CHAPTER 4
METHODOLOGY

4.1 Block Diagram

Here we describe the block diagram of "Mechanical Footstep Powe Generator"

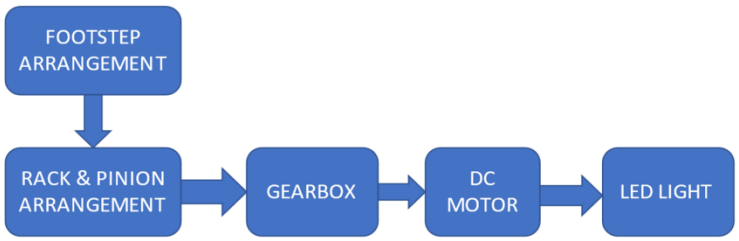

Figure: Block Diagram of Mechanical Footstep Power Generator

4.2 Working Principle

The upper plate is supported by two springs, and the weight impact is turned into electrical power by a suitable control unit.

The spring and rack & pinion arrangement is fixed below the foot step which is mounted on base. Spring system is used for return mechanism of upper plate after release of load. The shaft from pinion is connectedwith the DC motor. The DC generator is rotated with the help of this shaft pinion arrangement. The terminal of DC generator is connected to lightning LEDs

Only one step is inclined at a short angle to create power. Proper driving arrangement converts pushing power into electrical energy.

The complete diagram of footstep power generator is given below.

The upper plate is supported by two springs, and the weight impact is turned into electrical power through the use of an appropriate control unit. The spring and rack-and-pinion assembly is installed beneath the foot step, which is positioned on the base. After the weight is released, a spring system is employed to return the upper plate.There is other equipment available. The shaft from pinion connected with a DC motor. The dynamo capacity employed in this case is 12V. The cables are taken from the DC motor. These lines are linked to LEDs, which display the output power. The generator employed in this case is a 12V permanent magnet DC generator. The airport's terminal.

The steps are directly connected to the Rack & pinion arrangement in the first step. A dynamo is connected to the pinion shaft, and LEDs are connected to it. As a result, mechanical energy is turned into electrical energy.

Step 1: When force is applied to the plate by stamping on it, the force spring is compressed

Step 2: As a result, the rack moves vertically down.

Step 3: Because the pinion gear is meshing with the rack gear, it moves in a circular motion.

Step 4: The pinion is compressed fully for one full compression. When the tension on the plate is released, the pinion reverses and moves another semi-circle.

Step 5: Shaft of the pinion connected to the gearbox.

Step 6: A DC motor also connected to the gearbox in other side.

Step 7: Wires from DC motor connected to the LED, as a result the light given the desired output

4.3 Final Project View

The final view of our project is rectangular in shape where, Height: 31cm, Length: 45.8 cm, Width: 30 cm.

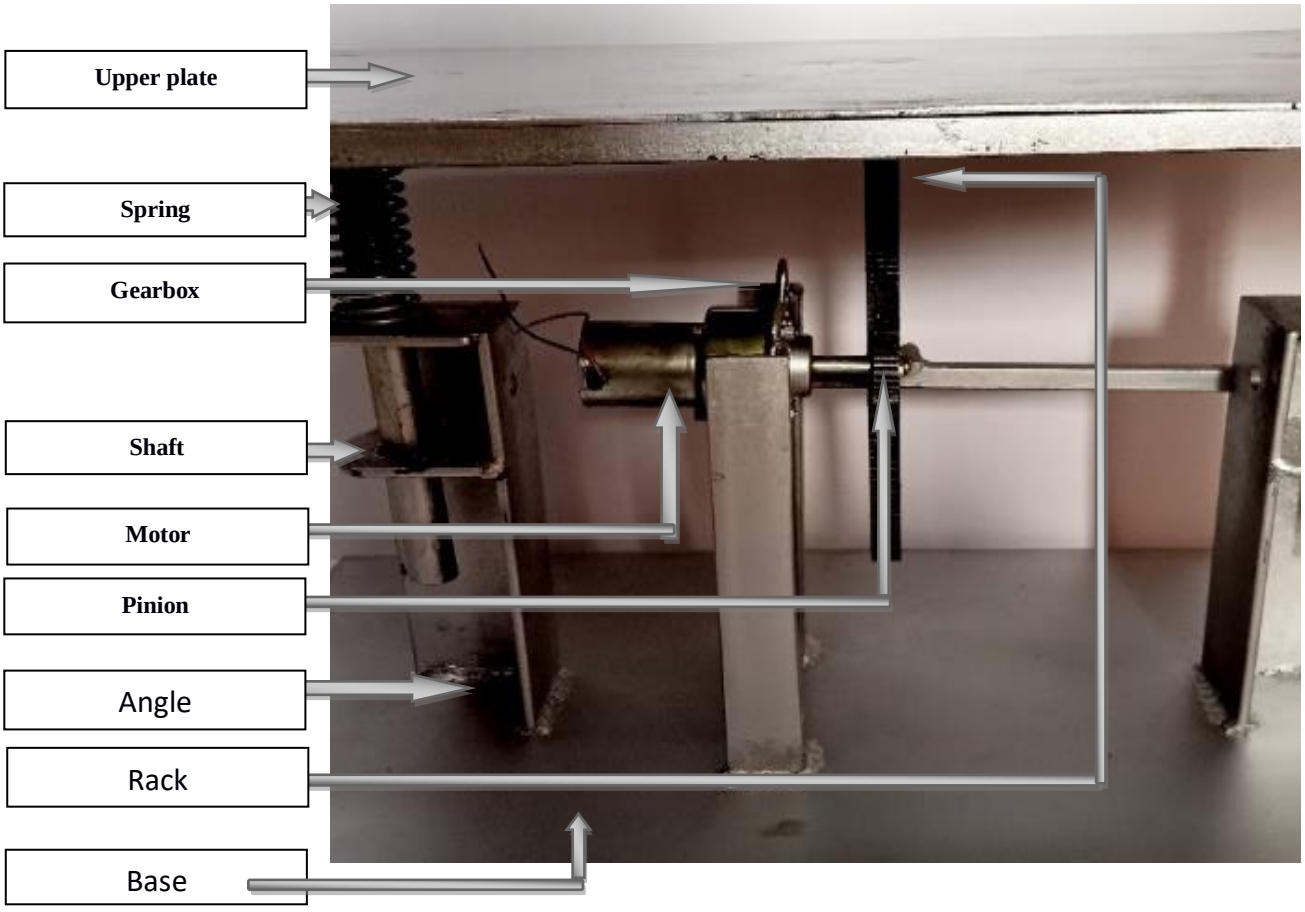

Figure 10: Final Project Overview

4.4Structure of Project View

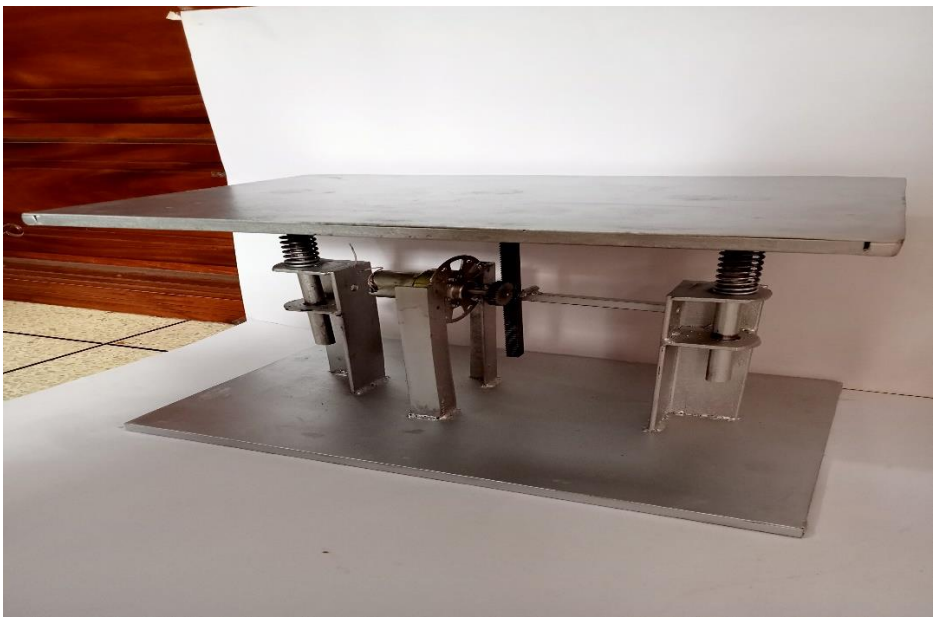

Figure 11: Outer Structure

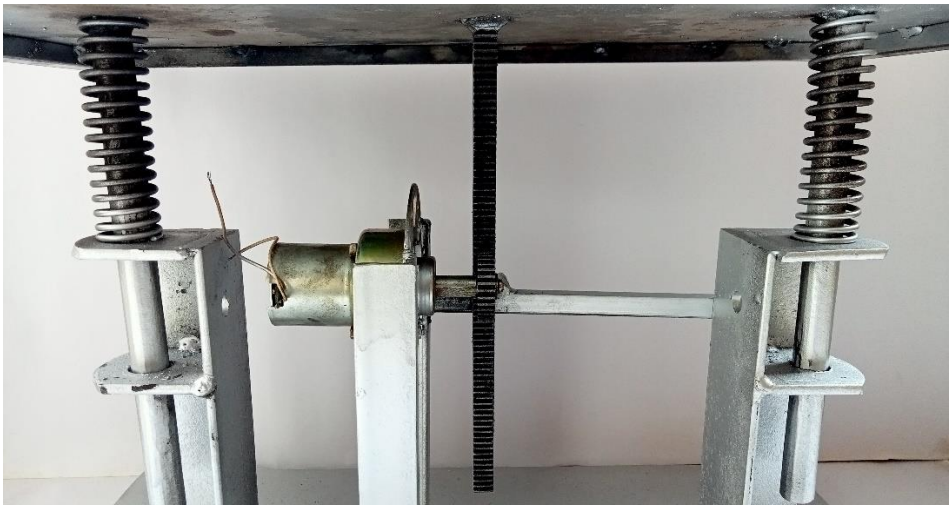

Figure 11: Inner Structure

CHAPTER 5
RESULT AND CALCULATION

5.1 Discussion

We observed some challenges when working on our project because it is a very complex system, but the end results were extremely satisfying. We took the entire system through many tasks to check our work and made the required notes for future improvement. Some future recommendations include better system design and wiring, as well as introducing features for greater efficiency.

In working time, when we tested the machine DC Motor was damaged for 2 times. In 3rd time achievement our goals.

5.2 Result and Calculation

THEORITICAL POWER OUTPUT

To determine the output power, it is essential to determine the force applied on the model. Let the force applied be calculated as,

Force=Weight of the Body

Work done =Force x Displacement

Power= Work done/Sec

Let the weight applied by the body is 60 kg (Approximately), then the maximum displacement of the spring can be noted as 0.033 m

Force =60 x 9.81=588.6 N

Work done = (588.6 x 0.033) = 19.42

Power = 19.42\60

Power = 0.32 watt

Power Generated = 0.32 watt

5.3 Specification:

Table 1: Materials Details

No	Components	Details
1	Motor	Capacity:12 volt
2	Rack	Material: Mild steel, Length :23.5 cm, Width: 1cm
3	Spring	Material: Mild steel, Diameter: 2.54 cm, Length: 20.8 cm
4	Shaft	Material: Mild steel, Diameter: 1.6 cm, Length: 22.86 cm
5	Sheet Metal	Material: Mild steel, Thickness: 2 mm, Length: 3.81 cm, Width: 2.54 cm
6	Angle	Length: 20.32 cm
7	Square Bar	Thickness: 1.1 cm

5.4 Advantages & Disadvantages

Advantages:

1) No need for the fuel.

2) Creating electricity is as simple as taking a step.

3) Power is also produced when walking or exercising on the step.

4) A battery is utilized to store the power created.

5) There is no pollution produced.

6) It is completely eco-friendly.

7) Simple construction

8) It can be used whenever it is required**.**

9) Low maintenance due to fewer moving parts.

10) Low price point.

11) It lowers transmission losses.

12) Broad range of applications.

Disadvantages

1. Low power output: The power output from mechanical footstep power generation is relatively low, which means that it is generally only suitable for low-power applications. This limits its usefulness for applications that require high power output

2. Limited efficiency: The efficiency of mechanical footstep power generation is limited, which means that a significant amount of energy is lost during the conversion process. This limits its effectiveness as a primary power source.

3. Maintenance requirements: Mechanical footstep power generation requires regular maintenance to ensure that the system is functioning correctly and to prevent any damage to the materials. This can be time-consuming and costly.

5.5 Applications

1.This can be used in train stations, bus stops, and airports to generate electricity through

human physical activity.

2. It can also be used in parking lots and electric escalators.

3. This mechanism may be used on gym equipment such as cardio machines to generate electricity, and the power generation rate is high.

4. This mechanism can be used in automotive suspension systems.

5. In rural places, for example. High Initial Investment.

6. This technique can be used in all school, college and university main gate.

CHAPTER 6
CONCLUSION

6.1 Conclusion

The project work "Power generation by foot step" is successfully conceived and produced; for demonstration purposes, a proto type module is constructed with lower ratings of devices, and the results are satisfactory. It cannot be used for real-world applications because it is a demo module, but the principle is similar to a real-world working system. To make it more realistic, a higher rating power generator with an appropriate gear mechanism is required to create more energy.

This concept falls under the category of non-conventional energy resources; one dependable source of alternative energy is solar energy, although it is an expensive affair. As a result, the cheapest choice is to generate electricityby walking. This technology demonstrated here is the ultimate low-cost source.

6.2 Future Scope

1. In future we make it more effective and collect more desired output.

2. We also want to attached battery for store the electricity with help of dynamo. And will also try too more reliable.

3. We will try to reduce the reliability of use fossil fuel for our environment safety.

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