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Treadmill to Generate Electricity by Human Power: A Review

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Abstract: The increasing cost of electricity is largely due to insufficient power production and the growing demand for energy. Conventional power generation methods, especially those dependent on non-renewable resources, contribute significantly to environmental degradation. As a result, there is a critical need to develop alternative, environmentally friendly methods of generating electricity. This study investigates an innovative technique that involves generating power using manual treadmills. By connecting a generator to the rotating shaft of the treadmill, human motion can be transformed into electrical energy. This method produces no pollution and is capable of generating around 50–60 watts of power per hour. As a person walks on the manual treadmill, the force they apply causes the shaft to spin. This rotational motion is then mechanically transferred to a DC generator, which creates electricity. Due to the uneven application of force, the power output can be inconsistent, so a charge controller is used to regulate the electricity, ensuring a steady output. The energy produced is stored in a battery for future use. This technique presents a sustainable and creative solution for generating electricity on a small scale.
Keywords: Treadmill, Power generation, Free energy generator, Sustainable energy, DC generator, Smart generation.

I. INTRODUCTION

As environmental concerns continue to rise and the demand for clean, sustainable energy sources grows, finding innovative alternatives to traditional power generation has become more crucial than ever. Given the limited availability of fossil fuels and their harmful impact on the environment, there is an urgent need to explore renewable and efficient energy solutions. One such approach is to harness mechanical energy—specifically the kinetic energy generated by human movement—and convert it into electrical energy. This project, titled “Electricity Generation Using a Treadmill,” presents a novel concept that utilizes the energy produced during treadmill workouts as a viable source of green electricity.

Treadmills are common fitness machines used in homes, gyms, and rehabilitation centers. Although their primary function is to facilitate exercise, the repetitive motion involved in walking or running makes them an ideal platform for energy conversion. This project taps into that mechanical movement to drive a generator that produces electricity. The energy generated can be collected, stored in batteries, or used directly to operate small electrical appliances. In doing so, the project promotes the idea of converting routine physical activity into a practical and sustainable energy source—highlighting the dual benefits of exercise and eco-friendly energy production.

II. DESIGN

Design Load analysis of the selected material: -
Maximum applied load = 150kg = 1471.5 N.
Design of Shaft: - Maximum allowable load = 150 kg = 1471.5 N
Length of Shaft= 600 mm.
Uniform distributed load= 2.45 N/mm.
Consider simply supported load.
Material: -
Designation - C45.
Condition - Tubes, cold drawn and tempered.
Yield strength (syt) - 600 N/mm2.
Ultimate tensile strength (Sut) - 700 N/mm2.
Tp = 0.3 Syt = 0.3600 = 180 N/mm2.

Tp = 0.18 Sut = 0.18700 = 126 N/mm2.
Select whichever is smaller value – Tp = 126 N/mm2.
Assume kb =1.5 and kt =1.
P(KW) = 2□NT 60□1061.5=2□T□1500 60□106.
T = 9549.29 N-mm.
Mmax = (2.45600) 300 = 441450 N-mm.
As per ASME code,
π□3Tp16= √ (□□ □ □)2 + (□□ □ □)2.
π□3 □ 126 16= √ (1.5 □ 441450)2 + (1 □ 9549.29)2.
π□3 □ 126 16= 662243.852. d3= 26768.097.
d = 29.91. d □ 30 mm.
Step 6: - Bearing selection and design P = XVFr + YFa
Where,
P = equivalent dynamic load (N),
Fr = Radial load (N),
Fa = Axial or thrust load (N),
V = Race rotation factor
F□ =200 □ 9.81 4 = 490.5 N
Hence, the bearing is subjected to Pure bearing load.
The value of V is 1.2 when the outer race rotates w.r.t.
Load while the inner race remains stationary.
P = VFr = 1.2* 490.5 = 588.6 N.
Bearing life (L10)
We take L10h = 16000 L10 =60n□10*h* 106
Where,
n = Speed of rotation (rpm)
□10*h* = rated bearing life (hours)
□10= bearing life (mill. revln) =60□1500□16000 106 = 1440 milli revln
Then, we find Dynamic load capacity (C)
C = P (L10h)1/3= 588.6 (1440)1/3
C = 6645.725 N.
We select bearing 16006.
Belt selection and design
P=1.5 KW
Load correction factor= 1.2
Maximum power= 1.21.5= 1.8 KW
α□ = 180 −2sin−1(□ − □) 2□
α□ = 180 −2sin−1(67 − 50) 2 □ 1520 α□ = 179.359 α□ □ 180.
Hence, arc of contact factor Fd =1
Power corrected= (KW)max * Fd =1.81= 1.8 KW
Power corrected= 1.8 KW.
Assume n = 120 rpm not 1500 rpm as human being run on the belt to measure velocity.
Belt velocity is given by,
v =□ □ □ □ □ 60 □ 103
v =□ □ 67 □ 120 60 □ 103
v = 0.4209 m/s.
Corrected KW rating =0.118 □ □ 5.08
Corrected KW rating =0.118 □ 0.4209 5.08
Corrected KW rating = 9.778 □ 10−4 KW.

width □ plies =□□□□□□□□□□ □□□□□ □□□□□□□□□□ □□□□ □□□□□□
width □ plies =1.8 9.778 □ 10−4
width □ plies = 1840
for 4 plies,
width =18404
width = 460 mm
width = 46 cm.
For standardization we assume width = 50 cm.
Length of Belt is given by,
L = 2□ +□(□ + □) 2+(□ − □)2 4□
L = 2 □ 1520 +□(67 + 50) 2+(67 − 50)2 4 □ 1520
L = 3223.83 □□ L □ 325 □□.

III. PROBLEM IDENTIFICATION

As the global demand for energy continues to rise, environmental pollution is becoming an increasingly severe concern. The overconsumption of non-renewable resources contributes to significant ecological damage, prompting the need for cleaner, more sustainable energy solutions. A potential solution lies in harnessing the kinetic energy produced through human activity, specifically walking and running.

This study introduces an innovative treadmill system that converts human-generated kinetic energy into electrical power. The treadmill incorporates gears that multiply the rotational speed, which is then used to drive a generator for electricity production. The experiment compares energy generation from both a conventional treadmill and the proposed energy-harvesting treadmill system.

By installing this new treadmill system with gears in fitness centers, it is estimated that a facility with ten machines could produce up to 500 kW annually. This approach not only boosts energy production but also contributes to reducing pollution, presenting a promising path toward sustainable energy generation.

IV. LITERATURE REVIEW

Vikas Pansare et al. [1] proposed a project aimed at meeting the basic daily household power requirements, such as inverter battery charging for auxiliary power supply and charging mobile phones and other electronic devices. Their system focused on harnessing renewable energy for everyday applications.

Gopinath et al. [2] introduced a technique for generating electricity using components that capture the energy of human footsteps. Their system employs a converter to store the energy for future use. The study emphasized the importance of increasing power generation capacity by implementing such systems in high-traffic areas, addressing the energy crisis while simultaneously promoting a healthier environment.

Ravindra Burkul et al. [3] developed a branch-and-bound approach to optimize the "Treadmill Electric Bicycle," which serves both as an exercise tool and a means to reduce reliance on non-renewable energy sources. Their platform converts mechanical energy into linear motion, offering a potential solution for harnessing the energy wasted on treadmills in fitness centers. This concept introduces a novel way of energy distribution, providing a sustainable approach for the future.

Kunal Titare et al. [4] observed the current generation during test runs of their project, finding that current output was achieved at specific speeds. They calculated the current drawn from the motor to the battery and confirmed that the treadmill assembly remained free from failure or deformation, providing a reliable energy generation system.

Harsha et al. [5] developed a treadmill-based human power generator, using an electromagnetic dynamo generator coupled with the manual treadmill's flywheel. Their study demonstrated that a human-powered treadmill could significantly reduce energy consumption in gym environments. They highlighted the treadmill generator as a low-cost, quick-to-implement, simple-to-operate solution, especially beneficial for isolated areas such as rural regions or developing countries.

Gandhewar et al. [6] proposed a platform that converts mechanical energy into linear motion. Their fuel-saving technology was designed to harness the energy wasted on treadmills in fitness centers. They explored the application of this system in large indoor environments with significant foot traffic, such as malls, warehouses, open markets, and large office spaces, to optimize energy use.

Masuma Akter et al. [7] explored the idea of capturing wasted energy from human locomotion.

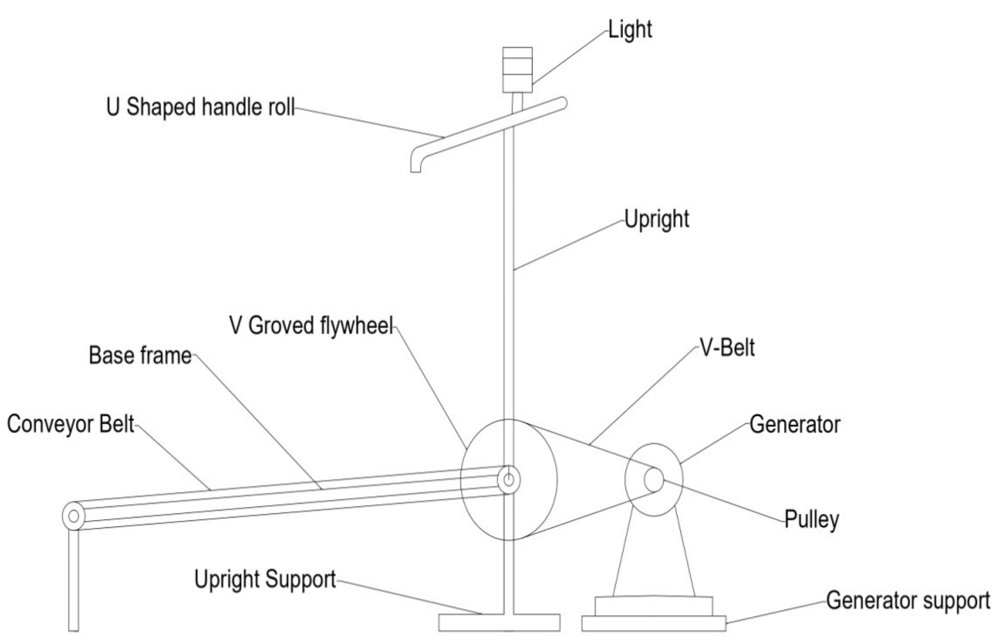
By installing feasible energy-harvesting devices at high-traffic locations such as railway stations, shopping malls, and roadways, they demonstrated that significant amounts of electricity could be generated. Their piezoelectric system, designed to capture footstep energy, was identified as a practical solution for harnessing kinetic energy in urban spaces.

Abhiram et al. [8] proposed a novel model combining a treadmill with a tricycle. This "treadmill tricycle" could serve as an eco-friendly alternative to regular bicycles, offering reduced initial and running costs. Their model is a step forward in promoting sustainable, pollutant-free transportation.

Manish Debnath et al. [9] explored an eco-friendly electricity generation method using manual treadmills equipped with small DC generators. Their system, which requires minimal torque to operate, is particularly feasible for remote areas where access to electricity is limited. This method provides a significant opportunity to reduce fossil fuel consumption and promote sustainable energy production.

Shamshad Ali et al. [10] designed a simple, sustainable manual treadmill integrated with an electricity generator. Their system not only addresses various health benefits, such as muscle strengthening, but also contributes to environmental sustainability by reducing greenhouse gas emissions. They emphasized the potential of this innovation to play a role in mitigating climate change.

V. PROPOSED CONCEPT



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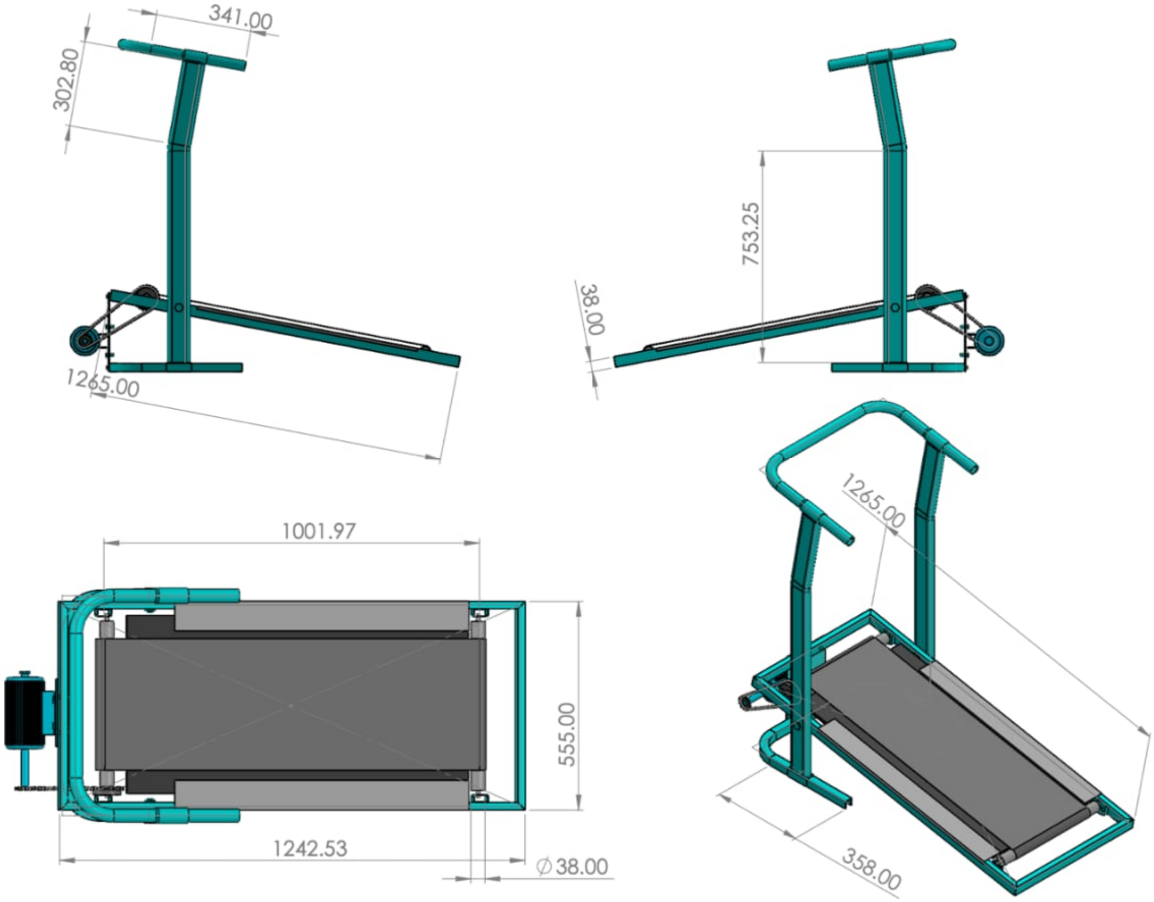
VI. CAD MODELING



VII. OBJECTIVES

1) Design and develop a treadmill integrated with an energy-generating system to facilitate the conservation of electrical energy.
2) Create a treadmill with an electricity generator that can function as a practical solution for charging batteries in regions with limited or no access to power.
3) Develop a treadmill with an electricity generator featuring a straightforward and efficient design.
4) Offer a cost-effective treadmill with an electricity generator to ensure its affordability and promote widespread adoption.
5) Design a treadmill with an electricity generator that is easy to manufacture, allowing for scalability and efficient implementation.
6) Contribute to environmental sustainability by using the treadmill's electricity generator to lower energy consumption and reduce pollution.
7) Ensure the treadmill with an electricity generator maintains a simple design while effectively generating energy.

VIII. METHODOLOGY

The methodology outlines a systematic approach to acquiring, validating, and applying knowledge throughout this research, ensuring the study is conducted in a rigorous and reliable manner.

1) Design Phase: The first step involves conceptualizing the shape and size of the model, taking into account the functional and structural requirements for the project.
2) Material and Component Selection: Materials and components for the project are carefully chosen based on their suitability, durability, and efficiency in fulfilling the project's objectives.

3) Equipment Identification: The required equipment for measuring various performance parameters of the system is identified and procured.
4) Component Fabrication: The individual parts of the experimental setup are fabricated according to the finalized design specifications, ensuring proper assembly and operational functionality.
5) Performance Evaluation: The experimental setup undergoes testing to assess its performance, gathering data on essential parameters to evaluate the system's effectiveness and efficiency.

IX. ADVANTAGES

The proposed treadmill with an electricity generator provides multiple benefits, enhancing its functionality and impact:
1) Health and Fitness Benefits: The exercise treadmill promotes physical fitness, which is crucial for maintaining good health. Unlike traditional gym workouts that can become repetitive, this portable treadmill allows users to enjoy outdoor exercise, offering fresh air and a more dynamic workout experience.
2) Energy Conservation: The treadmill generates electricity during use, contributing to energy savings. By converting the user's kinetic energy into electricity, it can power household devices or be stored for future use. Thissystem helps minimize energy waste while providing a sustainable power source.
3) Environmentally Friendly: The treadmill operates without fuel, making it an eco-friendly solution. It produces no harmful emissions, helping to reduce pollution and encourage sustainable practices.

X. CONCLUSION

The treadmill-based electricity generation system explored in this study offers a promising and sustainable approach to meeting the increasing demand for energy while simultaneously reducing environmental pollution. By capturing kinetic energy from human movement, such as walking or running, the system effectively converts mechanical motion into electrical power through a simple, eco-friendly process. The inclusion of a small DC generator, combined with a charge controller, enables the generation of 50-60 watts per hour, providing a reliable source of clean energy, especially in areas with limited access to traditional power sources.

This research highlights the practicality of utilizing manual treadmills for small-scale power generation, making it a feasible solution for both personal and community-level energy needs. The system is particularly beneficial in regions with inadequate electricity infrastructure or where environmental sustainability is a priority. With its straightforward design, low production cost, and ease of implementation, this technology has significant scalability, making it ideal for widespread adoption.

Additionally, the combination of fitness and energy generation offers dual advantages—promoting public health while fostering energy conservation. This project opens the door for further advancements in clean, human-powered energy solutions, providing a novel approach to reducing the negative environmental impacts of non-renewable energy production. In conclusion, the research demonstrates the potential of this innovative treadmill system to support sustainable energy practices, reduce dependence on fossil fuels, and contribute to a greener, healthier future.