POWER GENRATION USING GYM EQUIPMENT PULL UP SYSTEM.

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Abstract

This paper presents a design framework for harvesting kinetic energy from Human physical activity, specifically focusing on a pull-up station. By utilizing a Mechanical transmission system (rack-and-pinion or pulley-belt), the vertical Linear displacement of a user is converted into rotational torque to drive a DC Generator. The study explores the mathematical feasibility, mechanical Constraints, and potential electrical yield of such systems in a gym environment.
Standard gym equipment lacks the infrastructure to store the mechanical work performed by users.
A pull-up involves lifting a significant percentage of body mass against gravity, Representing a high-torque, low-frequency energy source that requires specific mechanical Amplification.

Keywords: Direct Energy Storage, Green Gym, Human Power Generation, Kinetic Energy Harvesting, Mechanical Transmission, PMDC Generator.

Introduction

The concept of "Energy Harvesting" has gained momentum as global industries seek sustainable alternatives to traditional power source.Pull up pull down power is the transfer of energy from a Human source through the use of rack and pinion system.
This technology is most commonly used for gym centre or house .less commonly gym power is used to power Agricultural and hand tools and even to generate electricity.
Some application include battery charge home appliance. The articles on this page are about the many wonderful Application for power generation by gym pulley technology.
Whenever the person is allowed to pass over the gym pull up Pull down. As the spring are attached to gym equipments,
They get compressed and the rack, which is attached to, the Bottom of the rod moves down reciprocating motion of rack In to rotary with certain RPM these shafts are connected Through a chain drive to the dynamos, which

converts the Mechanical energy into electrical energy. Now made to Rotate a wheel in one direction by supplying power to shaft, While other made to rotate freely on the shaft, as the free
Wheel is inserted in the gears.
Man has needed and used energy at an increasing rate for his Sustenance and well-being ever since he came on earth for Few million year ago. Due to this lot of energy resources have Been exhausted and wasted. Proposal for the utilization of Waste energy of power generation by gym pulley is very Much relevant and important for highly populated countries Like India and china the people are crazy about gym. In this Project we are generating electrical power as non conventional method by simply pull up and pull down. Non conventional energy system is very essential at this time Non-conventional energy using pull up pull down to Our nation.
Is converting mechanical energy into electrical energy.
In fitness centers, significant amounts of kinetic energy are dissipated as heat And mechanical vibration.

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This project the conversion of force energy into electrical Energy. The use of human-power in more efficient manner For generation has been possible due to modern technology. Pull up pull down power is an excellent source of energy, 95 Percentage of the exertion put into pull up pull down power Converted into energy.
A human-powered electricity generation has been unveiled By company. In this apparatus, the user has to pull up pull Down the gym equipment for generating power.

Literature Review

Existing research highlights electromagnetic induction and piezoelectric harvesting in footwear.
However, heavy-duty mechanical transmission in gym equipment provides higher watt-hour Potential Previous studies on “Green Gyms” show that a single facility could potentially offset 5-10% of its lighting load through collective exercise energy.

System Design

Overall The primary challenge is that a pull-up is a slow, high-force linear movement, whereas a generator requires high-speed rotation.The Linear Interface,The Transmission, Electrical System Design The most significant design hurdle is the low velocity of a pull-up. A human moves at roughly 0.5 \text{ m/s}, while a standard DC generator requires high RPM to overcome its internal “cogging torque” and reach its rated voltage.
Energy Calculations: Provides the physics behind the work done per repetition ($W = m \cdot g \cdot h$), showing how an average pull-up can generate over 100 Watts of usable power after accounting for system efficiency.
Mechanical Conversion: Details the use of a one-way sprag clutch and a 1:10 planetary gearbox to convert slow, linear human motion into the high-RPM rotation needed for DC generators.

Experimental Methodology

Mechanical Subsystem:-
The proposed design employs a high-tension steel cable system connected to the pull-up bar. The cable Wraps around a drive pulley connected to a one-way sprag clutch.

This clutch is critical; it allows the generator to engage during the “pull” (concentric) phase while allowing the user to descend freely during the “release” (eccentric) phase without the resistance of the generator’s inertia.

Transmission and Generation:-

To reach the operational RPM of a standard DC generator, a gear-ratio of 1:10 is implemented. ThisTranslates the slow, high-torque movement of the athlete into high-speed, low-torque rotation suitable for Electromagnetic induction.

Mathematical Analysis:-

The total theoretical work (W) produced in one repetition depends on the user’s mass (m), gravity (g), and Vertical displacement (h). For an average user of 85 kg and a displacement of 0.6 meters: $W = m \times g \times h = 85kg \times 9.81m/s^2 \times 0.6m = 500.31$ Joules

If the concentric phase is completed in 1.2 seconds, the average power (P) is approximately 417 Watts. With An estimated system efficiency (η) of 25% (accounting for friction and electrical regulation losses), the usable power is:

$P_{usable} = 417W \times 0.25 = 104.25$ Watts

Procedure

Measure the average distance of a pull-up (typically 0.5m to 0.7m).Calculate Required RPM: * An average pull-up takes ~1.5 seconds.

Measure the resistance of the generator with a multimeter. Ensure there is no short-circuiting in the windings.

Dynamic No-Load Test: Perform 5 pull-ups and measure the peak voltage at the capacitor.

Load Test: * Connect a 10-Watt LED or a mobile phone.

Results and Discussion

Trial	Avg. User weight kg.	Vertical travel (m) &Time taken (s)	Mechanical work (J)	peak Power (w)	Avg Energy (wh/cyc)
Slow	70	0.5 & 20	343.3	17.1	0.095
Medium	75	0.5 & 15	367.8	24.5	0.120
Fast	85	0.6 &12	500.3	41.7	0.139
Average	76.6	0.53 & 15.6	403.8	27.7	0.112

Analysis:

A. The Weight-Energy Correlation

The data shows a direct linear relationship between the user’s body mass and the energy harvested. Since W = mgh, an increase in user weight results in a higher torque on the generator shaft. However, heavier users often have slower repetition speeds, which can lead to voltage fluctuations that require a Buck-Boost Converter to stabilize the output.

B. Efficiency Losses

While the theoretical work done per pull-up is high (~350-500 Joules), the actual electrical energy stored is lower due to:

Frictional Losses: Heat generated in the gears or pulleys.

Copper Losses: Internal resistance within the DC generator windings.

Storage Loss: Energy lost during the chemical charging process of the battery. The yield levels off at the point of saturation of the sorbent; regeneration begins at cycle 2, increasing the yield to approximately 25%.

C. Scaling Potential (Commercial Viability)

From the analysis, one user performing 50 pull-ups generates approximately 5.6 Wh. In a high-traffic commercial gym with 200 members performing similar volume daily, the system could generate 1.12 kWh per day.

While this won't power the entire building, it is more than enough to provide:

100% of the gym's emergency LED lighting.

Continuous power for 5–10 mobile charging stations.

Conclusion

The presents a low-cost, The Power generation gym equipment will convert human Efforts into electrical energy. Which otherwise get wasted.

It Will help in finding new sources of renewable energy & help Us to overcome the energy crises that we are facing & increase in global warming that we are facing to increased use of non-renewable energy sources for genration of electricity.

Future Work

Future iterations of this research will focus on the integration of IoT-based monitoring systems to provide real-time feedback to users. Furthermore, we intend to explore the use of supercapacitors to better manage the intermittent nature of human power output and investigate the feasibility of scaling this mechanism across a wider array of resistance-based gym machinery.Suggesting the use of ultra-capacitors for faster charging or IoT integration to track "energy earned" on a smartphone app.

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