

Design and Fabrication of Power Generation System by using Gym Equipment

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Abstract

The intention of this project is to design a renewable energy source based around a piece of exercise equipment. The energy expended in a typical workout at the gym is usually wasted in the mechanics of the equipment. This project harnessed the mechanical energy of the machine and converted it to electrical energy using a generator-based system. The exercise equipment, attached to the shaft of the generator. Thus produced electrical energy is used in powering a piece of equipment such as lamp or a computer while exercising. This report will introduce the project and present all applicable information regarding the design, development, and the final product. This project will help one develop engineering skills while learning about a clean way of generating electricity. The modern challenge faced with the global energy situation is the growing energy demand and the strong dependence on unsustainable fossil fuels. Another concurrent issue is the adverse health and socio-economic implications of adult obesity. This Gym Power Generation Machine project, which uses metabolized human energy to generate electrical power, could potentially address both these challenges.

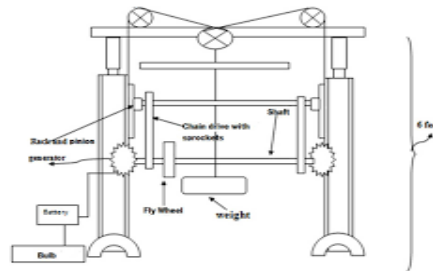
Keywords: Pulley, Dynamo

1.INTRODUCTION

Man has needed and used energy at an increasing rate for his sustenance and wellbeing ever since he came on earth for few million years 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 the modern age, there are more and more electrical devices which do the work that human beings once had to do physically. As more people spend more and more of their days in front of computers or any other equipment's without any movements, additional concerns, such as health and the exercise they need for healthful living are often overlooked. From the other side for people who want to be aerobically fit it's not common to spend

hours for example exercise in gym that produces nothing but heat, why not have your-my-our workout and generate usable electricity at the same time.

The field of energy conversation is becoming an increasingly notable subject of research among the scientific community today. The intention of this project is to build a straightforward human powered generator from Lat Pull-down machine. This project will help one develop engineering skills while learning about a clean way of generating electricity. Over the past decade, scientists and engineers around the world have been designing unprecedented energy-harvesting systems, drawing power from a variety of sources. One of the most creative and unlimited sources available is the kinetic energy produced from human exercise. This project includes an efficient yet controllable power storage and distribution system. The objective of this project is to design a renewable energy source based on a piece of exercise equipment. Also, people who are interested in minimizing environmental impacts and those who want to preserve the environment will use this type of electrical energy generation thereby reducing the emission of CO₂ to the atmosphere. The energy expanded in a typical workout at the gym is usually wasted in the mechanics of the equipment. This project harnessed the mechanical energy of the machine and converted it to electrical energy.



The current world faces different challenges that range from political and economical to environmental. And with the limited resources as well as the ecological concerns, most countries around the globe continue to rely on cleaner and more sustainable sources of energy such as wind and solar power. This policy has not only provided a solution for the ever-increasing demand on resources, but also helped raise awareness about the ecological issues linked to the nonrenewable sources of energy such as fossil fuel. With the diversified landscape and the incredible potential in terms of resources, the African continent is the perfect place to invest in renewable energies and guarantee a sustainable development that would meet the demands of its entire population. This would eventually move the continent towards economic prosperity. Morocco is a country with very limited natural resources. In fact, the main source of energy it relies on is fossil fuels in order to meet the domestic energy demand. The Ministry of Energy affirms that the country imports approximately 90% of its energy needs. The total primary consumption of energy has been increasing by 5% every year since 2004. According to ONEE, the production of electricity is derived from coal, fuel oil, hydroelectricity, natural gas, wind, and solar at 31%, 25%, 22%, 10%, 10%, and 2% respectively. The Kingdom adopted a national strategy aspired to improve security of supply by cutting down on energy import. One of the measures is the reliance on renewable sources for electricity production. As such, it is planning to increase the percentage of installed electrical generation capacity to 42% or 6000 MW by 2020, and to 52% of the total capacity by 2030. Morocco offers great opportunities to invest in sustainable sources of energy. In fact, it has an average solar potential of 5 kWh per square meter every day. MASEN (Moroccan Agency for Sustainable Energy)

intends on raising the installed capacity of CSP (Concentrated Solar Power) and PV (Photovoltaic) to reach 2000 MW by 2020. Another important opportunity is wind energy, with a technical wind potential of around 5000 TWh each year, and a potential useful capacity of about 25000 MW per AMEE (Moroccan Agency for Energy Efficiency).

1. LITERATURE REVIEW

- GYM POWER GENERATION CHM Naimeesh, S Kamatar - academia.edu
- As energy across the world continues to rise, there is a strong need to develop new methods for energy conversation and power generation
- Power generation through gym equipment V Tiwari - 2019 - ir.aiktclibrary.org
- Man has needed and used energy at an increasing rate for his sustenance and wellbeing ever since he came on earth for few million year ago
- AN INNOVATIVE GYM: ENERGY PRODUCTION USING GYM MACHINES R Amit - vqijstm.abes.ac.in
- Electric power is the basic requirement for everyone in all the fields. There is much energy conversation instead of energy conservation to fulfill the need of the time.
- ELECTRICITY GENERATION THOUGHT GYM EQUIPMENT (GYM CYCLE)K Omprakash, TBK Gottwald - irjmets.com
- Energy is essential for driving and enhancing the life cycle. The use of energy is proportional to humanity's progress

1.1 The energy problem:

The main sources of energy that we are using is from fossil fuels. But these are finite and environmental costly. More usage of fossil fuels will increase the carbon dioxide level in the atmosphere. This will cause an imbalance in the atmosphere. Reducing the usage of fossil fuel will result in less global warming. Totalworld energy consumption by source (2013). Just about 78.4% of the general vitality devoured is created by the petroleum derivatives. Yet, these non-renewable energy sources are the non-inexhaustible wellsprings of vitality. In the interim we realize that the non-renewable energy source repositories are running low as the utilization is excessively. Subsequently, as the power prerequisites on the planet is expanding it is obligatory to examine more about the sustainable wellspring of vitality.

Reasonable, condition inviting vitality can be created by catching energies from the common and human made sources that encompass us in the earth or by atomic splitting. The encompassing wellsprings of vitality are accessible in huge amount and the innovations are enhancing to extricate these energies proficiently. A few cases for these sort of vitality sources is wind vitality, sunlight-based vitality, hydroelectric vitality, wave vitality, human vitality, atomic vitality and so forth. Then again, little measure of vitality which is squandered amid any operation can be changed over into helpful type of vitality. Appending dynamo to a turning wheel to create power is one of the illustrations.

1.2 Concept of Green Gym:

In an exercise center individual, often perform controlled and redundant developments. Amid this period vitality created because of development is squandered. Making utilization of this vitality and re utilizing it utilizing gatherers is the idea of a green rec center. A couple wellness revolves far and wide have begun actualizing starting variants of energy producing frameworks concentrated on gathering human motor vitality. These outlines fluctuate in their utilization of the collecting ideas.

California Wellness, a rec center situated in Hong Kong, have been tried stationary bicycles and circular machines modified to work in this standard. A report by Motor wave Restricted, an organization arranged in Hong Kong, that creates financially savvy sustainable power sources computes that "if every one of the California Wellness rec center exercisers on the planet are being utilized, [their "Power by You" concept] will produce 21,900 MWh/year. To deliver a similar vitality, a power plant will discharge 11,000 tons of CO₂" (Motor wave). Another exercise center in Portland, Oregon the Green Micro Gym is firmly advancing natural sparing activities. Notwithstanding introducing sunlight-based boards to help diminish the power utilization of the building, Micro Gym additionally utilizes vitality effective treadmills, and "Human Dynamo" curved machines which are equipped for charging batteries to control an inverter to deliver up to 120 volts air conditioning.

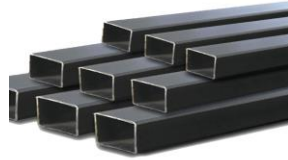
There is an exercise center in Britain where insane exercises accomplish something other than control muscles. They additionally control the building. The 42 cross-coaches, bicycles, and treadmills at the Cadbury House Club in Congresbury can change over human vitality produced amid an exercise to power which in the long run controls the machine.

2.3 Generation of Electrical Power Using Gymnasium Bicycle:

The Generation of Electrical Power Using Gymnasium Bicycle paper was proposed by a group of researchers from the University of Dhaka in Bangladesh. The paper discusses the need for power, and how it is one of the main challenges the world faces nowadays. Humanity has always relied on muscle power to perform daily tasks. And with time, the need for bigger and stronger tools rose. As such, humans began developing new methods, which lead to the first human powered products. This was all part of mechanical energy. After the discovery of other sources of energy such as electricity, humanity was able to come up with ways to convert energy from one form to the other. Then, new concerns surfaced such as limited resources and environmental threats, which lead to new and more sustainable energy sources. Thus, more countries invested in the field of renewable energies to maximize the benefits. Another important point the paper tackled is recycling. As a matter of fact, more and more people are concerned with their own fitness and have tried to make their lifestyle healthier by going to the gym and practicing different sports. For this reason, the researchers proposed a system that takes advantage of this physical effort and produces renewable energy instead of letting it going to waste. In fact, it uses pressure energy generated by human movement and converts it into electrical energy.

3. MATERIALS

3.1 SQUARE TUBE



Rectangular and square HSS are also commonly called tube steel or box section. Circular HSS are sometimes mistakenly called steel pipe, although true steel pipe is actually dimensioned and classed differently from HSS. Square tubes are generally used for maintenance and structural purposes.

3.2 PULLEY



A **pulley** is a wheel on an axle or shaft that is designed to support movement and change of direction of a taut cable or belt, or transfer of power between the shaft and cable or belt. In the case of a pulley supported by a frame or shell that does not transfer power to a shaft, but is used to guide the cable or exert a force, the supporting shell is called a block, and the pulley may be called a sheave.

3.3 MULTIMETER



A multimeter is a measuring instrument that can measure multiple electrical properties. A typical multimeter can measure voltage, resistance, and current, in which case it is also known as a volt-ohm-milliammeter (VOM), as the unit is equipped with voltmeter, ammeter, and ohmmeter functionality.

3.4 SPROCKET



A sprocket-wheel or chainwheel is a profiled wheel with teeth that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it.

Sprockets are used in bicycles, motorcycles, tracked vehicles, and other machinery either to transmit rotary motion between two shafts

3.5 DYANAMO



DC DYNAMO MOTOR

A dynamo is an electrical generator that creates direct current using a commutator. Dynamos were the first electrical generators capable of delivering power for industry, and the foundation upon which many other later electric-power conversion devices were based, including the electric motor, the alternating-current alternator, and the rotary converter.

3.6 BEARING



The 6202 15 mm Ball Bearing Inner Dimension 15mm X Outer Dimension 35mm X Width 11mm is an open style ball bearing designed for high rotational speeds and high dynamic loads. A bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts.

3.7 LED



A **light-emitting diode (LED)** is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light is determined by the energy required for electrons to cross the band gap of the semiconductor.^[5] White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.

3.8 12V BATTERY



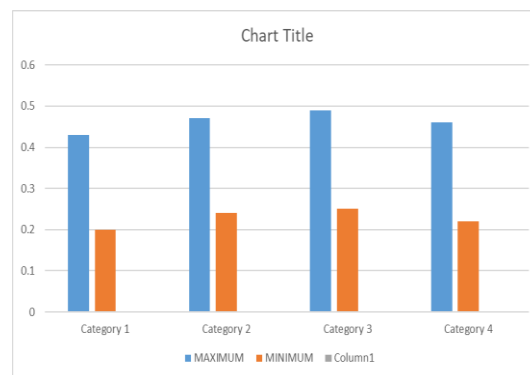
A twelve-volt battery has six single cells in series producing a fully charged output voltage of 12.6 volts. A battery cell consists of two lead plates a positive plate covered with a paste of lead dioxide and a negative made of sponge lead, with an insulating material (separator) in between. Your 12V battery system will power most of your basic systems like your lights and some appliances in your RV. You'll charge this battery system while plugged into shore power and draw from it while traveling or boondocking.

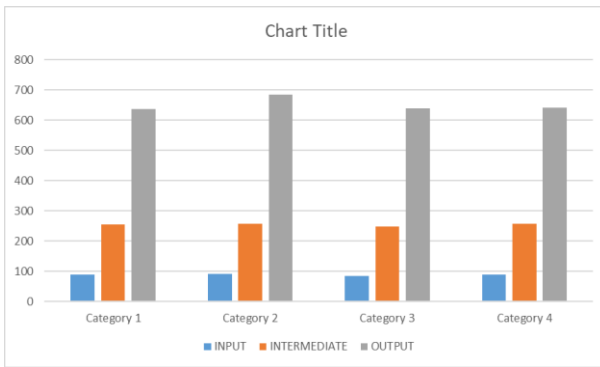
3.9 15MM ROD



Wrought iron is an iron alloy with a very low carbon content (less than 0.08%) in contrast to that of cast iron (2.1% to 4%). It is a semi-fused mass of iron with fibrous slag inclusions (up to 2% by weight), which gives it a "grain" resembling wood that is visible when it is etched, rusted, or bent to the point of failure. Wrought iron is tough, malleable, ductile, corrosion resistant and easily forge welded, but is more difficult to weld electrically.

4. FABRICATION IMAGES





5. CALCULATIONS

5.1 DESIGN CALCULATION

1 caloric = 4.2 joule

2500 kilo caloric = 1.05×10^7 J

1 day = 86400 s

$P = W/t$

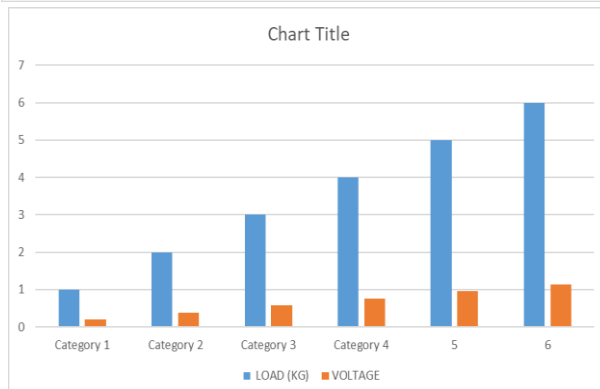
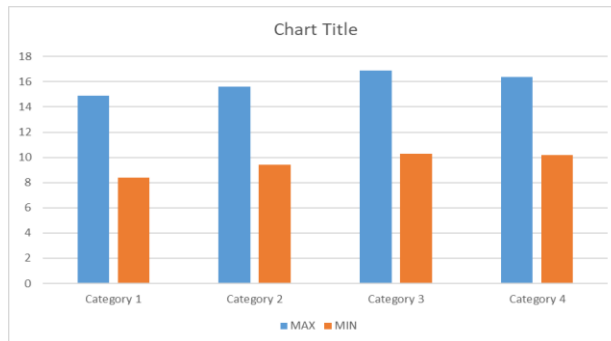
$= 1.05 \times 10^7 \text{ J} / 86400 \text{ s}$

$= 121.5 \text{ W}$

	Output current (amp)	
	Maximum	Minimum
1	0.43	0.20
2	0.47	0.24
3	0.49	0.25
4	0.46	0.22

Person operating the machine	Shaft speed in RPM		
	Input	intermediate	output
1	88	255	636.4
2	91.5	257	685.5
3	84	247	639.5
4	89	258	642.2
AVG	88.125	254.25	650.9

Person operating the machine	output voltage (in volt)	
	Max	Min
1	14.9	8.39
2	15.6	9.4
3	16.9	10.3
4	16.4	10.2



S.NO	LOAD	VOLTAGE
1	1 KG	0.19
2	2 KG	0.38
3	3 KG	0.57
4	4 KG	0.76
5	5 KG	0.95
6	6 KG	1.14

5.1 DESIGN CALCULATION

MASS = 1 KG

LOAD = $1 * 9.81$

= 9.81 N

VOLTAGE = 0.19 V

CURRENT = 1 Amps

1) $V = IR$

$$R = 0.19/1$$

$$R = 0.19$$

$$P = I^2R$$

$$= 1 * 0.19$$

$$= 0.19$$

2) $V = IR$

$$R = 0.38/1$$

$$R = 0.38$$

$$P = I^2R$$

$$= 1 * 0.38$$

$$A = 0.38$$

3) $V = IR$

$$R = 0.57/1$$

$$R = 0.57$$

$$P = I^2R$$

$$= 1 * 0.57$$

$$= 0.57$$

4) $V = IR$

$$R = 0.76/1$$

$$R = 0.76$$

$$P = I^2R$$

$$= 1 * 0.76$$

$$= 0.76$$

$$5) V = IR$$

$$R = 0.95/1$$

$$R = 0.95$$

$$P = I^2R$$

$$= 1*0.95$$

$$= 0.95$$

$$6) V = IR$$

$$R = 1.14/1$$

$$R = 1.14$$

$$P = I^2R$$

$$= 1*1.14$$

$$= 1.14$$

Pulley calculation

1:8 ratio

V belt using

Speed ratio : 8/1

I : 8

D = 300 mm

d = 50mm

$N_1/N_2 = D/d$

$N_1/N_2 = 300/50$

$N_1/N_2 = 6$

$N_1 = 6N_2$

Power = $I^2 * R$

$$= 1.14$$

Motor rpm = 775 rpm

$N_1 = 775$

$N_2 = 775/6$

= 129 RPM

$$\omega_1 = \frac{3.14 \times d \times N_1}{60 \times 1000}$$

$$= \frac{3.14 \times 50 \times 775}{60 \times 1000}$$

$$= 2.0279 \text{ rad/sec}$$

$$\omega_2 = \frac{3.14 \times D \times N_2}{60 \times 1000}$$

$$= \frac{3.14 \times 300 \times 129}{60 \times 1000}$$

$$= 2.0253 \text{ rad/sec}$$

BIG PULLEY

$$\text{Power} = \frac{2 \times 3.14 \times N_1 \times T}{60 \times 1000}$$

$$1.14 = \frac{2 \times 3.14 \times 300 \times 129 \times T}{60 \times 1000}$$
$$T = 0.2814 \text{ N-M}$$

SMALL PULLEY

$$\text{Power} = \frac{2 \times 3.14 \times N_2 \times T}{60 \times 1000}$$
$$1.14 = \frac{2 \times 3.14 \times 50 \times 775 \times T}{60 \times 1000}$$
$$T = 0.2810 \text{ N-M}$$

6. CONCLUSION

The purpose and a put into effect innovative exercise equipment to generate electrical power for the house appliances. These models vary in complexity and accuracy and therefore the model chosen must match the application for which it is needed. It will be very helpful for the rural areas. In this day where the world is challenged to be more responsible sourcing of electrical power. If additional design and study of this concept proves it effective in energy use reduction localized energy delivery and sustainability education, it could productive with effort. The Power generation gym equipment will convert human efforts into electrical energy which otherwise gets 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 generation of electricity. If all the equipment in the fitness center are fabricated with power generating unit, we can generate more power.

7. FUTURE SCOPE:

The fitness is important factor in modern life and people are interesting in gym exercise. This system is first implemented on gym bicycle. The other equipment's are available Leg Extension, Let Pull down, Adjustable Cable Crossover in the gym. This equipment's can be used to generate electricity. Hence gym can automate by using gym equipment's. It's our new approach to this future trend. India planned for smart cities; the number of gym may be increases in the smart cities. And the today's generation is attracting towards the gym exercise. So the energy generated from the gym bicycle will contribute the big role. As number of gym equipment increases the total power generation will increase. It will definitely helpful in reducing today's energy demand.

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