# Generation of Electricity From Gyming Equipments

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***Abstract-*** *Every Equipment in Gym releases Energy when they are used but a lot of it is wasted, The Main Motive is to Use this Energy at most efficiently.*

*Some of the Gym Equipmentsare :*

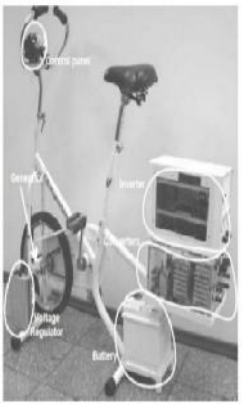
1. *Weight- Pulley based Equipments*
2. *Treadmill Machine*
3. *Cycling Machine*

*Etc.*

***Keywords***- Electricity generation, Piezoelectric effect, Pulley, Electromagnetic induction, Green Energy

## I. INTRODUCTION

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. Also, the government aims at developing action plans in the sectors of industry, agriculture, transportation, construction.



## II. DISCUSSION

**1. Weight- Pulley based Equipments:**

**Power Generation through Gym Equipment:**

There are basically two types of equipment in the fitness centre. They are free weights and machines. Free weights are the most basic form of body building equipment. The reason they are called “free weights”. We are not dealing with them as we are trying to generate electricity through machines.

**Machines:** The wide variety of exercises are performed in the machines. Some machines are designed to work individual muscles, while other machines consist of a multi-station that works the whole body

**Methodology of project:**Using stationary puller machines to generate electricity and charge a 12 volt battery and power of output 60 Watts.

It will consist of several subsystem:

1. The first subsystem is the mechanical connection which will transfer the kinetic energy from pulling to the generator.

2. This subsystem transfers the rotational movement created when the pulley machine is in use to the rotor of a generator which will in turn output an AC voltage.
3. The third subsystem is the rectifier, which converts AC power to DC.
4. The fourth subsystem the battery and the battery charger
5. The fifth subsystem is the inverter which converts the 12V DC to 12 V AC.
6. A sixth subsystem is the step up transformer which steps up the 12V AC to 230V AC supply.

**Elements of Proposed Design:**

1. Prime Mover-source of mechanical power to turn Generator's rotors
2. Generator (Alternator)-An alternator is an electrical generator that converts mechanical energy to electrical energy in the form of alternating current
3. Rectifier-Rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction
4. Inverter-convert input voltage to match battery.
5. Load-Load is the generic term for something in the circuit that will draw power
6. Battery-To store energy
7. Battery Charger-To charge battery.

**Analysis of machine structure:**It is the rigid body which is used to support all the parts of the machine and to stabilize the overall weight of the machine. The structure is fixed at one end. The material chosen as A36 mild steel for the stability of the structure. Thus the analysis of the machine structure for the applied load is done and the maximum deflection due to load is found as 0.450893mm.

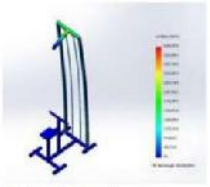


Fig. 4 Machine structure – Vonmises stress

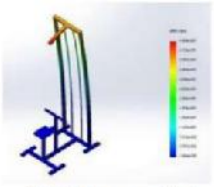


Fig. 5 Machine structure – Displacement

**Analysis of hand rod:** It is the solid bar which is made up of alloy steel.Thus the analysis of the hand rod for the applied load is done and the maximum deflection due to load is found as 0.02355mm.

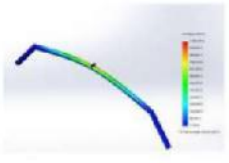


Fig. 6 Hand rod – Vonmises stress

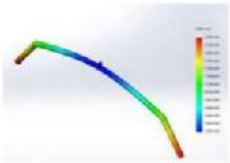


Fig.7 Hand rod – Displacement

**Results**

The relation between Speed and voltage and speed and current is shown in the following Figure

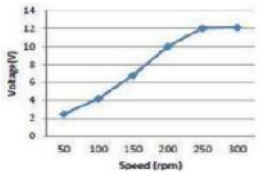



**Fig. 10** Speed Vs Voltage

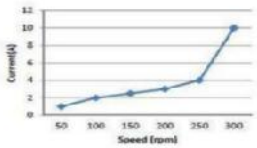



**Fig. 11** Speed Vs Current

**2. Treadmill Machine:**

**Energy harvesting through smart gym**

Running on a treadmill is a very effective way of working out, but there is a huge flaw in the system. A lot of energy in the form of vibrations is being wasted while one does his workout on the machine. This energy can be tapped and converted to electrical form with the help of a special type of crystals known as Piezoelectric crystals.

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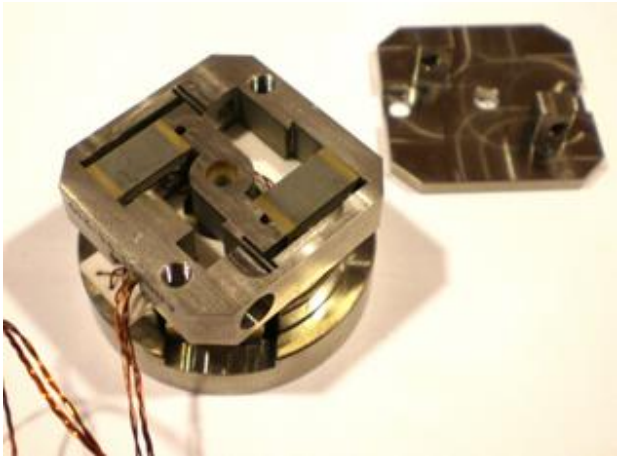
Piezoelectric crystals convert mechanical vibrations into electrical energy. When piezoelectric crystals are subjected to vibrations, they generate a very small voltage, commonly known as piezoelectricity. It has a crystalline structure that converts an applied vibration into an electrical energy



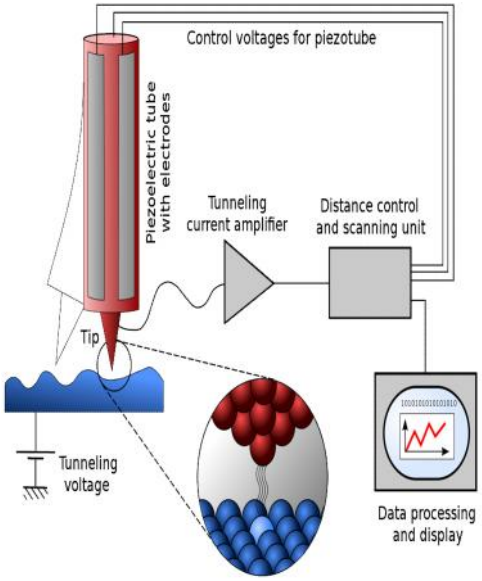
The piezoelectric effect exists in two properties: The first is the direct piezoelectric effect that describes the material's ability to transform mechanical strain into electrical charge. The second form is the converse effect, which is the ability to convert an applied electrical potential into mechanical strain energy. These properties allow the material to function as a power harvesting medium. The produced output voltage is in the form of AC. Then it can be converted to DC by passing it through the Rectifier circuit.

For harvesting kinetic energy, we will use electric generators that will convert kinetic energy into electrical energy. A generator does not actually create electrical energy. It uses the mechanical energy supplied to it to force the movement of electric charges present in the wire of its windings through an external electric circuit. This flow of electric charges constitutes the output electric current supplied by the generator.

There are two types of generators, one is AC generator and other is dc generator. Whatever may be the types of generators, it always converts mechanical power to electrical power. An ac generator produces alternating power. A dc generator produces direct power. Both of these generators produce electrical power, based on the same fundamental principle of Faraday's law of electromagnetic induction.

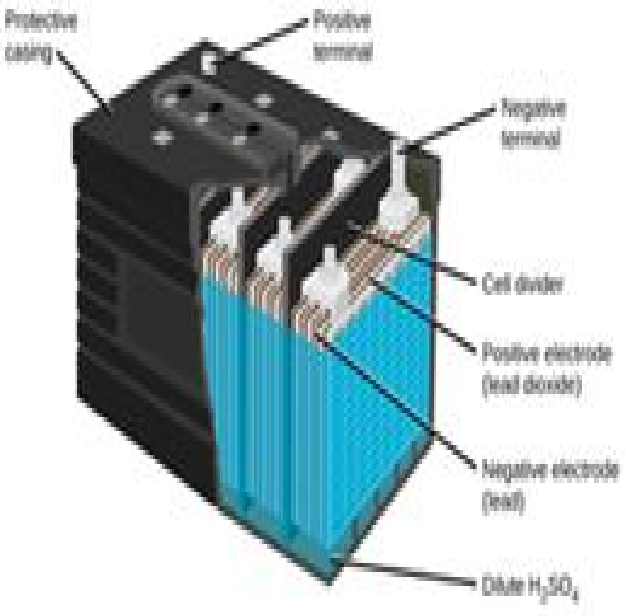
After converting all the available energies into electrical energy, a battery is required to store the generated electrical energy. We prefer to use a nickel cadmium battery for the following reasons: -

- Its efficiency is far greater than any of its alternatives.
- It is relatively inexpensive compared to its alternatives.
- It has more charge discharge cycles than other rechargeable batteries for longer battery life.




**Result:**

The produced output is relatively low and is in ac form. We can convert it into dc by passing it through a rectifiercircuit.




To increase the output, we can use a boost converter. A boost converter can convert the received output of 2-3V and enhances it to 12V which is further stored in a 12V battery.
According to a survey, an average human can generate approximately 75 Watts for eight hours of exercise period.

The number goes up to 298 Watts for a first-class athlete. Furthermore, a research paper even states that we can generate up to 2400 watts of power a day which make power generation by this method efficient and practical for further use of general purposes.

**3. Cycling Machine:**

**Gym Power Station: Turning Workout into Electricity**

**Introduction:**

The Cycling Machine is basically the machine where one just has to paddle to make leg muscles stretch. In this course , Lot of energy is released in the form of heat energy, So we can use this energy for every basic purpose.

**Generation of Electrical Power Using Gymnasium Bicycle:**

On a Cycling Machine ,a lot of circular work is being done ,So we can make a continuous change in flux, As a result Changing Flux Induces Current.

The proposed system is broken down into different operations. First, kinetic energy is produced from the pedaling motion. Then, it is converted into rotational energy via a gearing system that rotates a flywheel attached to it. The flywheel is connected to an alternator through a coupling belt. This rotational energy is converted into electrical energy by an AC generator, which is then used to charge the battery and store power that was generated without maintaining constant pedaling speed.

An inversion from DC into AC voltage is done by an inverting circuit, and then it is stepped up using a step up transformer. The gearing system of the bike is set up in a way to get suitable rpm. That is, a low rpm alternator produces less power at low frequency, while a high rpm alternator produces more power at high frequency. As a result, the change in speed affects power generation but does not impact the overall efficiency, because it is converted into DC voltage and then stored in batteries. The following illustration simplifies the mechanism as well as the gearing system:

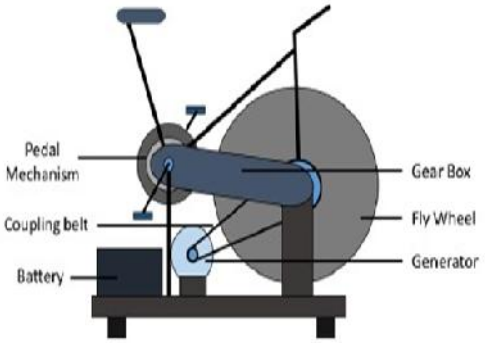



Figure 1: Exercise cycle mechanism

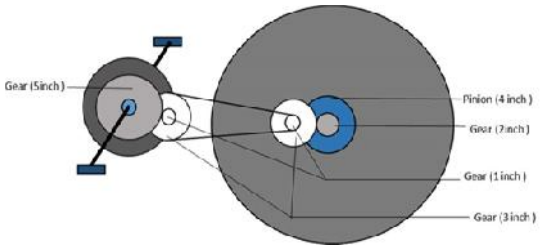



Figure 2: Gearing system

In this device, the generator uses a three phase permanent magnet alternator of 750W, 220V, and 50Hz. The output current reaches its maximum potential between 2500 and 3000 rpms. The battery consists of a 12 volt 80 AH (Ampere-Hour) lead acid battery. A conversion is made from 12VDC to 15VAC by the inverter circuit, and the voltage goes from 250VAC to 15VAC by step up transformer.
The total efficiency of the whole system is calculated as:

$$\eta = \frac{output\ power}{input\ power} \times 100\% = \frac{39.56}{67.5} \times 100\% = 58.6\%$$

the total energy consumption in 295 days is 4800kWh, with every exercise bike working at least 6 hours a day at an average speed of 20 kph. The system assumes a flywheel of 40 cm diameter and 10 kg. Thus, the kinetic energy is:

$$K = \frac{1}{2} \cdot m \cdot r^2 \cdot \omega^2 = \frac{1}{2} \cdot 10 \cdot 0.2^2 \cdot 264^2 = 13939J$$

With: ω = 264 rpm

Therefore, the energy produced by a single bike in one hour is:

$$W = 13939 \cdot 2.7778 \cdot 10^{-7} \cdot 60 = 0.232\,kWh$$

Consequently, the energy of one cycle or 6 hours is 1.38kWh. With 5 bikes, the total energy produced in one year can go beyond 2000kWh, which makes up 42% of the entire energy consumption. The setup of the system comprises: a control panel, a generator, an inverter, converters, a voltage regulator, and a battery.

This energy production is not so Effective But we can produce the energy sufficient to drive basic appliances like Fan, Laptop, Charging Phones etc.

**Future View:**

Our country India is planning to develop Smart cities, so lots of Gyms are required to be built, Hence we can use these Gym for effective purpose.

Many Mountain regions are unable to get Electric supply, so this would be a better option for getting a clean source of Energy

Today's Youth and Indian People are showing high Interest in maintaining their Fitting, So they started joining Gyms. This would be beneficial .

## III. CONCLUSION

The various methods of generating electricity discussed in this paper are eco-friendly and cause no pollution. They are easy to install and utilize human bio-energy in the most efficient way. These energy conversion methods convert a traditional gym into a ‘Smart Gym’. Despite the limitation that its installation cost is higher, the concept of ‘Smart Gym’ has great scope in developing countries where youths are becoming more fitness conscious. Government can also ensure maximum energy harvesting by encouraging investors and providing the gym facility to a large number of people at a reasonable price.

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