**International Journal of Mechanical and Industrial Technology** **ISSN 2348-7593 (Online)**
Vol. 7, Issue 1, pp: (54-59), Month: April 2019 - September 2019, Available at: www.researchpublish.com

# A study on the energy output humans in customized home gym equipment

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***Abstract:*** **The purpose of this research is to identify the correlation between the amount of voltage generated to the body mass index (BMI) number by performing the lateral pull down using the home gym equipment. The home gym equipment was customized by connecting a simple generator set-up, where the car alternator is used as the generator and the equipment as the prime mover of the assembly. The experimental method was used in the study and used the Pearson correlation coefficient to test the correlation of the voltage generated and to the body mass index number of the thirteen participants, which are all males and with age between 16 to 22 years old, assuming that there is a linear correlation between the two parameters. The thirteen participants performed the lateral pull down routine up to their limit of endurance or until they decided to stop. The duration of the individual's exercise was recorded to compute for the total voltage generated. The result shows that the value of Pearson correlation coefficient, which is equal to 0.558, is greater than the critical value which is 0.553. Thus, it can be concluded that there is a moderated positive correlation between the amount of voltage generated to the body mass index number of male participants. It is recommended to improve the assembly by using permanent magnet for the generator and to test the correlation by performing other forms of routine applicable using the home gym equipment.**

***Keywords:*** **Alternative Energy, Body Mass Index, Correlation, Home Gym Equipment, and Voltage Generated.**

## I. INTRODUCTION

According to an article, fossil fuels became the optimal source of energy since the Industrial Revolution began in the 18th century. Huge amount of these fuels were used to power the economy and bring exceptional wealth to various people. And at that time, they thought that the fossil fuels are unlimited. Upon discovery that fossil fuels are non-renewable and can cause harm to our planet, the innovation of using renewable and cleaner energy sources has taken place. Since working out uses energy to perform certain exercises or routines, utilizing the energy exerted from body workout into useful energy may help our society to provide an alternative source of energy. The existing question now will be the amount of energy that can be converted from exerted energy by a human from body workout into useful energy depending on his body mass index. The idea of using human energy to generate alternative source of energy using equipment like stationary bike and elliptical inspired this study to apply the conversion of energy using other gym equipment. The home gym equipment will be used to be the new gym equipment on generating electricity upon conditioning the study, which will be used to identify if the human's capability of generating electricity using the said equipment is related to the BMI of the performer. Using gym equipment requires energy in order to perform certain exercises and routines and instead of just letting the energy exerted by human from exercise to become a waste. A machine can be used to transform exerted human energy to electrical energy. The general objective of the study is to design an assembly that will convert human energy from body workouts into electrical energy of which the home gym equipment will be used as the driver of the generator assembly. This study is focused on the amount of electricity generated depending on the body mass index of the performer.

## II. LITERATURE REVIEW

There are various types of exercise machine, and these have different effectiveness for electricity production. One of the most efficient and simplest way of producing electricity is by continuously turning a wheel at a constant speed. By having a weighted wheel turned when a force is applied, for example, much of the useful work fitness-wise is done when

lowering a weight as well as lifting it. A person in decent shape can burn about 400 calories an hour and consistently generate about 100 watts of electricity. An efficient bike generator pedaled by a reasonably fit person can produce about 100 watts of continuous output. The body mass index (BMI), is a measure for human body shape based on an individual's mass and height. It is defined as the individual's body mass divided by the square of their height. The body mass index, is a commonly used indicator of weight status. BMI measurements are between 18.5 and 24.9 show normal weight, while a BMI over 25 indicates overweight. BMI is a great factor that affects the endurance of an individual. And for our study, we will then determine if the BMI number of men, with ages between 16 to 22 years old, does affect the amount of voltage that can be generated using the Home Gym Equipment.

## III. METHODOLOGY

The correlational research was used upon the study. The correlational research determined the BMI number and the voltage generated if positively correlated, negatively correlated or no correlation at all. We used convenience sample to gather our data. Volunteers and member of a class are examples of often used convenience samples.

The materials needed are Home gym equipment, chain, sprocket (24 teeth), big sprocket (36 teeth), metal pulley, car alternator, fly wheel, pillow block (bearings), digital multimeter, ignition switch, indicator lamp and car battery. To conduct this study a design was created that will transmit human energy into electrical energy using home gym equipment. The design assembly must harness the mechanical energy from the machine and convert to electrical energy using generator base system.

To build the needed assembly

1. The home gym equipment, which served as the prime mover, was attached to the generator based system in order to generate electricity
2. The generated electricity then was read by multimeter

- Check if the small sprocket on the gym equipment is connected on the big sprocket on the table.
- Check if the battery has a twelve (12) volt charge
- Check if the wiring on the circuit is loose or unwired.
- Connect the post terminal to the positive pole of the battery.
- Connect the body ground of the alternator to the negative pole of the battery
- There are two terminals that are located to the upper part of the alternator: Positive (red wire) and Negative (green wire)
- Connect the positive (red wire) to the positive wire of your multimeter
- Connect the negative (green wire) to the negative wire of your multimeter.

3. After the assembly is proven to work out, the data gathering now can be conducted.
4. Only people who are male between 16 to 22 years old without health problems are involve upon conducting the study
5. The height and weight of the participant was measured and recorded for the analysis of his BMI value.
6. Each participant used the equipment with the same amount of loaded weight up to their endurance limit or in other words, they can no longer perform the routine and decided to stop. The routine was performed using the home gym equipment will only be lateral pull down.
7. The time elapse recorded for an individual and the average amount of voltage generated were computed by taking the amount of voltage that the performer produced in every 5 seconds
8. We took a video of the multimeter while it is reading the amount of voltage generated, together with a timer for us to record the 5 seconds interval of the voltage generated.

The data obtained from the experiment was tested to determine if there is a correlation between the BMI of the performer and to the amount of voltage he generated.

The study was conducted from September 2013 to February 2014 at the Department of Engineering and Architecture, College of Engineering, Computer studies and Architecture, Lyceum of the Philippines University Cavite Campus. Moreover, the experiment was conducted from January 2014 to February 2014 at the Mechanical Engineering Laboratory, Lyceum of the Philippines University Cavite Campus.

## IV. RESULTS AND DISCUSSION

The initial objective of the study is to create a design that utilized exerted human energy into electrical energy using the home gym equipment. We used the equipment and observe its mechanism for us to determine the strategic place of connection to transmit the energy from the equipment into the generator.

**Table 1: Performers' Data and BMI**

| Name | Age | Height (m) | Weight (kg) | BMI (kg/m2) |
|---|---|---|---|---|
| Marasigan, John Arnelius | 21 | 1.65 | 75.5 | 27.698 |
| Gobaton, Jonald | 20 | 1.71 | 85 | 29.07 |
| Estores, Brennick Avery | 20 | 1.63 | 83 | 31.24 |
| Sierra, Kiervin Karl | 20 | 1.70 | 61 | 21.11 |
| Vegas, Rodolfo Jr. | 20 | 1.68 | 62 | 21.97 |
| Are, Henry John | 20 | 1.79 | 81 | 25.28 |
| Ayala, Mel Victor | 20 | 1.75 | 68 | 22.2 |
| Barlas, Ivan Cris | 22 | 1.69 | 53 | 18.56 |
| Rolle, Earl Justin | 17 | 1.76 | 63 | 20.338 |
| Ocampo, Dave | 16 | 1.68 | 49 | 17.36 |
| Mendoza, Ewin | 19 | 1.66 | 72 | 26.13 |
| De Guzman, Carl Brian | 17 | 1.69 | 80 | 28.01 |
| Fadriquela, Nixon | 19 | 1.70 | 54 | 18.685 |

The formula of obtaining an individual BMI is,

$$\text{BMI} = \frac{\text{weight in kilogram}}{(\text{height in meters})^2}$$

**Table 2: Voltage Generated by the Performers**

| Name | Average rate of voltage produced (Voltage/second) | Duration of exercise (seconds) | Total voltage generated (Volts) |
|---|---|---|---|
| Marasigan, John Arnelius | 0.019 | 140 | 2.66 |
| Gobaton, Jonald | 0.019 | 75 | 1.425 |
| Estores, Brennick Avery | 0.023 | 160 | 3.68 |
| Sierra, Kiervin Karl | 0.01 | 156 | 1.56 |
| Vegas, Rodolfo Jr. | 0.007 | 237 | 1.659 |
| Are, Henry John | 0.011 | 253 | 2.783 |
| Ayala, Mel Victor | 0.014 | 220 | 3.08 |
| Barlas, Ivan Cris | 0.018 | 136 | 2.448 |
| Rolle, Earl Justin | 0.006 | 164 | 0.984 |
| Ocampo, Dave | 0.004 | 160 | 0.64 |
| Mendoza, Ewin | 0.008 | 173 | 1.384 |
| De Guzman, Carl Brian | 0.005 | 417 | 2.085 |
| Fadriquela, Nixon | 0.005 | 147 | 0.735 |

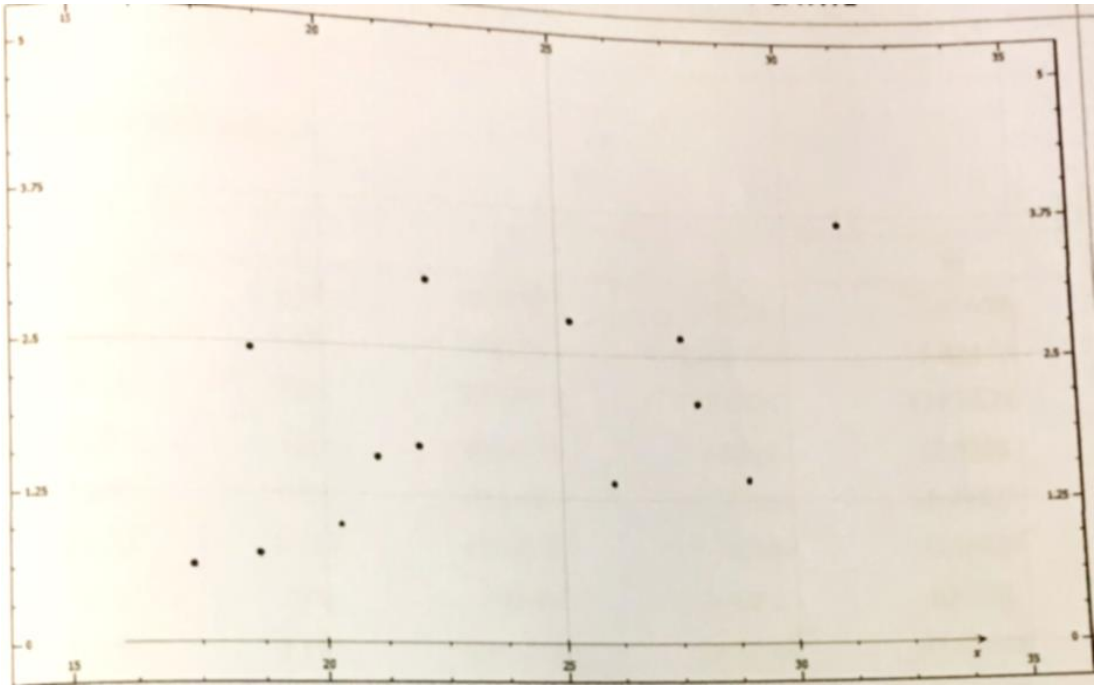

**Figure 6: Graphical Presentation of BMI and Generated Voltage**

To determine the correlation of the variables, we used the Pearson's correlation coefficient that is defined as,

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

Where *r* is the Pearson correlation coefficient, and *n* is the number of sample.

**Table 3: Data Table for Variables**

| X | y | $x^2$ | $y^2$ | xy |
|---|---|---|---|---|
| 27.698 | 2.66 | 767.1792 | 7.0756 | 73.67668 |
| 29.07 | 1.425 | 845.0649 | 2.030625 | 41.42475 |
| 31.24 | 3.68 | 975.9376 | 13.5424 | 114.9632 |
| 21.11 | 1.56 | 445.6321 | 2.4336 | 32.9316 |
| 21.97 | 1.659 | 482.6809 | 2.752281 | 36.44823 |
| 25.28 | 2.783 | 639.0784 | 7.745089 | 70.35424 |
| 22.2 | 3.08 | 492.84 | 9.4863 | 68.376 |
| 18.56 | 2.448 | 344.4736 | 5.992704 | 45.43488 |
| 20.338 | 0.984 | 413.6342 | 0.968256 | 20.01259 |
| 17.36 | 0.64 | 301.3696 | 0.4096 | 11.1104 |
| 26.13 | 1.384 | 682.7769 | 1.915456 | 36.16392 |
| 28.01 | 2.085 | 784.5601 | 4.347225 | 58.40085 |
| 18.685 | 0.735 | 349.1292 | 0.540225 | 13.73348 |
| $\Sigma x = 307.651$ | $\Sigma y = 25.123$ | $\Sigma x^2 = 7524.357$ | $\Sigma y^2 = 59.23946$ | $\Sigma xy = 623.0308$ |

Substituting the values from Table 3 to the equation, with value of $n = 13$, $r$ now will then be equal to,

$$r = \frac{13(623.0308) - (307.651)(25.123)}{\sqrt{[13(7524.357) - (307.651)^2][13(59.23946) - (25.123)^2}}$$

$$r = 0.558$$

## V. CONCLUSION

According to the findings from the chapter 4, there is a moderate positive correlation between the BMI number and the amount of voltage generated. Based on the previous studies mentioned from the chapter 2, the relationship of the endurance level and the BMI number was negative. It is assumed in the chapter 3 that the voltage generated has a relationship has a relationship to the level of endurance. Thus, this study opposes the previous studies that concluded that BMI number and the level of endurance has a negative relationship. Based on our observation, the amount of voltage generated in the alternator is related on the speed of repetition and of course, to the duration of the routine. Also, the intensity level of an individual that he usually performs can affect the amount of voltage he could generate of which we did not consider on our experiment. Thus even though the person has a high level of endurance, but perform the routine in slow rate, the amount of voltage that will be generated will not be that high.

## VI. RECOMMENDATION

Use permanent magnet than electromagnet in the generator assembly in order to conduct the experiment more easily. The use of permanent magnet will be more practical upon storing the voltage generated to a battery which has a capacity level. We also recommend for the improvement of the design of the generator assembly, to improve the efficiency and its physical appearance. We also recommend to try the other forms of routine/exercises available using the home gym equipment to identify the level of voltage that can be generated upon doing those routine/exercise.

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