

Pedal Power Generation: An Implementation of Stationary Bike Generator

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Abstract

Despite not having the whole country, electrified, Power Generation companies still experience shortage in supplying enough power to the grid. This in turn results to rotational brownouts that we experience especially during summer. As we know, most of the daily activities today require a stable supply of power. Automated factories may lose millions of pesos when they are affected by rotational brownouts. That in turn affects the economy and leads to more problems. The proponents aim to develop a prototype that is used to convert mechanical energy into electrical energy. On the other hand, it is used to harness electrical energy by means of the human effort in doing cardio workout by using stationary bike. This study shows the design and development of an alternative source of electricity in supplying one household that is in rural areas. With the use stationary bike, the user can be productive in different ways beside of being active in cardio workout but also productive in such away the calorie burned upon using the pedal can produce a certain amount of voltage that is a part of power.

Keywords: Electrically Stable, Power Generation, Grid

I. INTRODUCTION

Generation of electrical energy are still a big problem to the Philippines. Especially on rural areas.

A stationary bicycle is usually a special-purpose exercise machine resembling a bicycle without wheels. It is also possible to adapt an ordinary bicycle for stationary exercise by placing it on bicycle rollers or a trainer. Rollers and trainers are often used by racing cyclists to warm up before racing, or to train on their own machines indoors. [1]

Benefits of stationary bicycle are also safer than to an ordinary bicycle, even though it provides a

low-impact exercise it strengthens legs and lower body muscles.

Objectives of the Study

The general objective of the project is to design and develop an equipment that can generate electricity through manual labor. This is to prove that manual mechanical input can produce stable power; design a system that can power small appliances; integrate a LED Display to show the battery capacity and other related statistics; introduce a personal system that can produce energy whenever there is a power outage.

Related Literature

What are the average calories used riding a Stationary Bike used for 30 minutes? [2]

The stationary cycle may not be the most popular in the gym floor, but it can be a good buddy if you goal to do cardio workout. The average calories you burned just by riding stationary bike in 30 minutes would be 396 calories it depends on the intensity how you engage your exercise. The stationary bike is a great help for burning calorie considering your body weight, length of the exercise and intensity level on how you work out.

The Pedal-A-Watt Stationary Bike Power Generator: create energy and get fit [3]

The product is forced to be made for those people who are interested in keeping fit and producing energy as well. It converts the pedal power of the bike to generate energy that can be stored in a power pack. The average rider can produce 200 watts for an hour that can light up 25 watt of fluorescent light bulb for eight hours.

How charge controller works [4]

A charge controller is a special part of a nearly all power systems that used to charge batteries in different power sources such as solar

panels, wind, hydro, fuel, or the utility grid. Its purpose is to keep your deep cycle batteries properly fed and safe for the long term. It also blocks reverse current and prevent battery to experienced overcharge. Some controllers also prevent over discharged, protection for electrical overload, and/or display battery status and the flow of power.

Controlling battery charging is so important that the most manufactures of batteries to specify the requirements for voltage regulation, low voltage disconnect and temperature compensation. When these limits are not followed, the battery will fail to reach its normal life expectancy

Difference between a normal lead-acid car battery and a deep cycle battery [5]

The normal Lead-Acid car Battery is designed to provide a very large amount of current on the engine for a very short period. Which this surge of current will turn over the engine during starting. As the engine starts, the alternator will produce power that the car needs, and this car battery may go through its entire life without ever being drained more than 20% of the total capacity.

On the other hand, Deep cycle batteries is designed to provide a steady amount of current over a long period of time. It is also designed to be deeply discharged repeatedly; in this situation it will damage a car battery very quickly. Also, to accomplish this, the deep cycle battery needs thicker plates.

Experimental Study on the effect of alternator speed to the car charging system [6]

This study does energy audit on alternator's current output and battery's voltage based on alternator speed. In the present day the demand of power automobile is always increasing. As the technology develops, more and more advance electrical devices installed in vehicles were produced. In this situation this study occurs to cope the demand, it will help to find out the effect of speed on charging the system.

The experiment used a Proton Preve 1.6 manual car. The alternator testing and labelling standards indicate the rated output an alternator is

the amount of current that can produce 6,000 RPM. They used three different constant speed of the engine 750 RPM the idle speed, 1500 and 3000 RPM are the cruise speed. The data gathering is provided by tachometer, a digital multi-meter use to measure battery's voltage, and AC/DC clamp is used to measure alternator current output. The study proves that the faster alternator spin, more power it produces proportion to the faster charging rate of the battery

Generation of electricity by running on a leg-powered treadmill [7]

This study deals about today's world global warming & other related environmental issues becomes an important matter of concern in the angle of environmental pollution. To tackle this problem, they must decrease our dependence on fossil fuel especially for generation of electricity and increase the use of green-energy or environment friendly method of electricity generation. This paper will discuss about a treadmill which can generate electricity when someone running on its track. Treadmill is generally used for walking or running while staying in the same place. If someone runs on the track of this machine for one hour, then it will generate certain amount of electric energy which will be enough to lighting a LED bulb up to 10 to 12 hours.

Improved performance alternator with fully integrated Switched-Mode Rectifier [8]

The technology of automotive alternators was advanced using Power Electronics Circuits. This device used Switched-Mode Rectifier (SMR) allows the alternator to run at a load-matches condition, optimizing power and efficiency overall operating speeds. But the use of SMR's has been focused on 42 Volts Alternators. This study aims to design, build and characterization of an SMR-based alternator that improves power and efficiency at the present automotive standard of fourteen volts. This SMR-based machines are built from commercial electronics devices so that it could be fully integrated into alternator physical presentation without impacting the physical structure or reliability. This alternator was characterized in

laboratory environment (250C ambient temperature) over the standard operating speed of 1500 rpm to 6000 rpm. Based on the data gathered the alternator load-matched condition, gathering a maximum power output up to 2400 rpm and achieved cruising speed output power of 2178W at full field current of 4.3A

Alternator Torque Model Based on Equivalent Circuit of Synchronous Generator of Electric Power Management [9]

This design presents an alternator model suitable for electric power management research. The proposed model estimates the alternator driving torque under various driving conditions, such as engine speed, output current, and generation voltage. Through field - wound - type synchronous generator, Base equation were derived by its equivalent circuit and phasor diagram. This project also tests by Short and Open circuit tests. Validation tests were also performed to evaluate model accuracy under several representative driving conditions. The proposed model was effective way to research power management, this was proven by case study.

Towards better alternator efficiency [10]

This thesis was proposed in Linkoping University, Sweden. The alternator model is used together with data recorded from different buses all over the world, this to be able to investigate how the alternator contributes to the fuel consumption depending on the way that the buses are driven. The model is supposed to consider all losses in the alternator and together with the output power give an efficiency model of alternator at different speeds and loads. The great part of this study has been dealing in magnetic losses. So, the design is based on the alternator used in vehicle as a salient pole alternator. The result of this thesis is a mathematical model that describes the losses in the alternator for different load cases and speeds.

II. METHODOLOGY

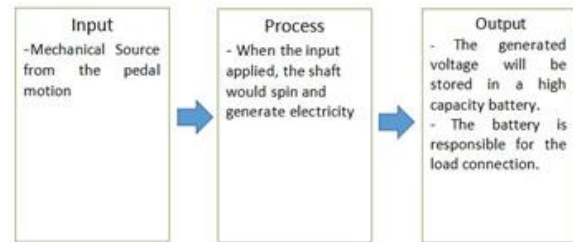


Figure 1. IPO Chart

Conceptual Framework

With a requirement of 1680-1960 rpm to produce an output of 12-14v, a belt ratio of 8:1 was used, three different tests were carried out, with results on the tables below. The following tests were done on 15 minutes of constant rpm.

200 rpm

With 200 rpm, due to the belt ratio, we achieved 1600rpm. For 15 minutes we try to make our rpm as close to 200 as possible producing an average voltage of 11-12v per minute with current of 10.4615A.

250 rpm

With 250 rpm, we achieved 2000 rpm. Producing an average voltage of 13.5-14.5v per minute which is in the optimal required output of 12-14v with current of 13.0769A.

300 rpm

With 300 rpm, we achieved 2400 rpm. Producing an average voltage of 16-17.5v with current of 15.6923A, which is above the required voltage, but using the charge controller, we can reduce it to 12-14v to not overcharge the battery used in storing the electricity.

Hardware Specifications

Stationary Bike

The stationary bike is commonly found in fitness establishments. It offers great work out opportunity as it tones the whole body.

Brushless Dc Motor

A variation of the motor with the distinction that it has no brushes. It provides smoother rotation and less maintenance since there are no contact points between the moving parts

Bridge Rectifier

It converts and regulates AC Voltage into DC Voltages. Its primary purpose is to control the voltage and current to enter the battery and the outlets of the prototype.

Charger Controller

Primarily used in Solar photovoltaic systems, it displays the state of charge of the battery and acts as a protective device to prevent overloading by automatically cutting of charging when the battery is full and diverting electricity straight to the load.

12V5Ah/20HR Lead Acid Battery

The lead- acid battery was invented I 1859 by French physicist Gaston plante and is the oldest type of rechargeable battery. Despite having a very low energy to weight ratio and a low energy to volume ratio, its ability to supply high surge currents means that the cells have a relatively large power to weight ratio.

12V DC 3 Watts Light Bulb

An incandescent light bulb, incandescent lamp or incandescent light globe is an electric light with a wire filament heated to such a high temperature that it glows with visible light (incandescence).

Flow Chart

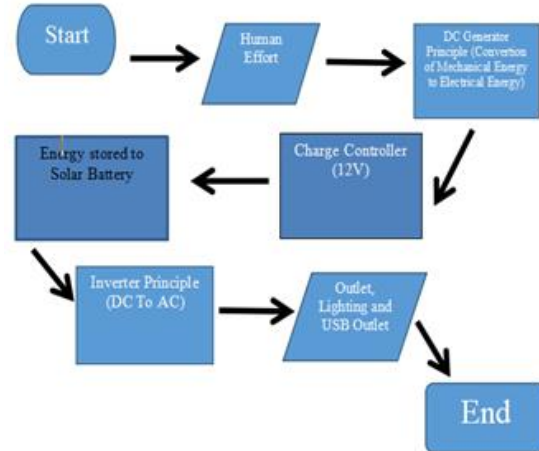


Figure 2. Flow Chart of the Concept

III. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

To produce the desired amount of power from the designed stationary bike generator the proponent put up a display where it shows the total amount of calories loss in desired time of usage.

Another parameter to consider is the best rating of a DC Brushless motor that function as a generator in this study. According to the proponents, the rating of Brushless motor in KV shows how many turns required to produce 1 volt. The ratio of producing voltage, the numerical number of ratings of the motor in KV to the number of turns is 1:1.

Recommendations

Best dynamic design to produce more rotation in the shaft of the motor for more production of power and shorten the involvement of losses. More supported needs that can sustain the comfortability of a person. If future research will be conducted to improve the operation of this device, it is suggested that there should be a deeper focus on the design and location of the components used to increase the visual presentation.

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