



ENERGY HARVESTING FROM REVOLVING DOORS

Prasheel Rathod¹, Ganesh Mandal², Avinash Dhangada³,
Chitralekha Vangala⁴

¹(ELECTRICAL DEPARTMENT, VIVA Institute of Technology, India)

²(ELECTRICAL DEPARTMENT, VIVA Institute of Technology, India)

³(ELECTRICAL DEPARTMENT, VIVA Institute of Technology, India)

⁴(ELECTRICAL DEPARTMENT, VIVA Institute of Technology, India)

Abstract: As today's world is completely dependent on different types of energies and these energies are going to disappear or exhaust one or the other day so we need to use free energy to run our basic appliances which require electricity for its working. So there is a dire need to find new sources of energy. Most people do not realize that there is a lot of energy that is formed around them all the time. The purpose of this project is to show that the ambient energy in the surroundings can be utilized to generate electricity. In this project, the energy used to open a revolving door is being converted into electrical energy with the help of gears and generator. Further, this electrical energy can be regulated according to the load requirement. Accordingly, a revolving door prototype is designed, fabricated and tested. This prototype can be further optimized in terms of size to generate more electrical energy.

Keywords - Energy harvesting, free energy, prototype, revolving door

I. INTRODUCTION

Currently, the whole technology is progressing towards renewable energy. Renewable energy is growing immensely as a possible alternative to non-renewable power generation. One of the most prominent purposes of renewable energy is to produce a small amount of energy through methods of Energy Harvesting. The idea of Energy harvesting is to avail the energy that is usually freely available in the surroundings and convert it into useful electrical energy. Most people do not realize that there is a lot of energy is formed around them all the time. Energy can be harvested from sources such as vibrations, thermal and mechanical sources. Currently, energy harvesting makes little impact on the overall electricity consumption in a built environment. Nevertheless, It does improve the overall consumption by a tiny margin and in the future, this margin will be magnified by the production and implementation of more and more energy harvesting products in the market. The concept of using revolving doors to harness Energy is new in the market. A revolving door can be used as a new form of renewable energy by capturing wasted energy used to open the door and converting it into a power source. Currently, research is being done to enhance the efficiency of the revolving door to get maximum output power. Although it is agreed that this method is not a major source of power production, it is a measure forward in the direction of renewable energy. It also limits the emission of harmful gases into the atmosphere. This green energy solution makes use of an everyday occurrence to produce some electrical energy can be used for a large range of low powered electronics.[1] Energy harvesting (also known as energy scavenging) is the process in which energy is obtained from the environment and converted into useful electric power. Energy harvesting is best explained as a process in which energy is obtained from external sources and later stored for smaller electronic devices. This area of research is expanding quickly due to its capability to provide reasons for replacing the conventional methods of producing electrical energy. It is also known as "Energy Scavenging" from the name itself, it can be assumed that the power provided in this process has a very small amount. This small amount of power is usually used for low energy electronics. If the fuel input of Energy Harvesters is compared to some large-scale generations, the difference in cost is much huge. While large-scale Electricity

Generators feed on a huge amount of fuels, the energy source for energy harvesters is obtained mostly from the surroundings and the operating cost is close to nothing. Fabricate a model of a revolving door and finding a cheap and convenient solution by creating a model of the revolving door and generating electrical power. To find out how much energy can be generated at the lowest possible cost through the research of revolving doors and converting them into useful electrical energy. This is a scaled-down model of the revolving door so that it generates a voltage of 12 volts or more to measure and examine the output parameters to estimate the power generation of a real-size model, the setup created the small size of the actual model so that an average-sized person can't pass through it..

II. METHODOLOGY

2.1 WORKING

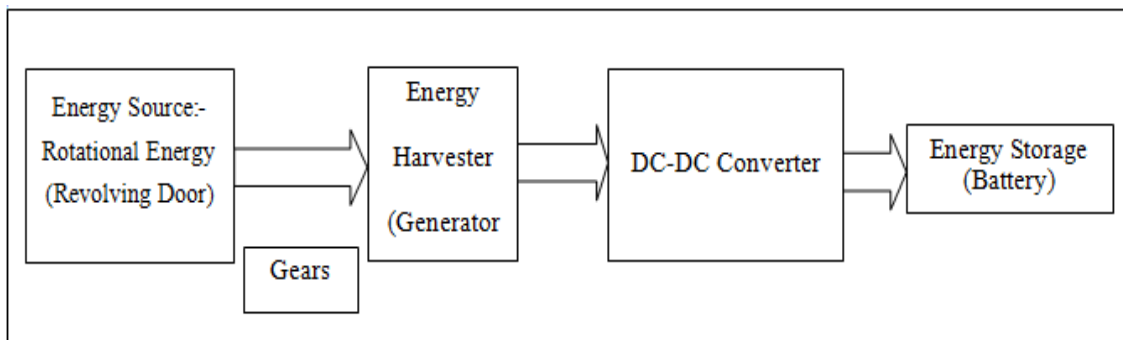


Figure 1: Block Diagram

. The revolving door generates power by harnessing energy that is dispersed by a human during walked through the door. As people use the door, the combined gears attached to the central axis of the door revolve. Due to the gear ratio, the rotation given to the door can be increased multiple times, which is applied to the motor shaft. A DC motor coupled with the integrated gears produces electricity. A bridge circuit is used to rectify and filter current and in one direction. A rechargeable lithium-ion battery is used to store the generated energy. The figure below illustrates the flow diagram of the system. The direction of rotation is often enforced by the door governor mechanism. The kinetic energy of the rotating door is calculated intern is used as a torque input to the generator. Speed of rotation of door is increased by gear assembly which is connected to the bottom of the shaft. This increased speed is applied to generator shaft which converts the rotational (mechanical) energy into electrical output. The electrical output generated is further regulated using a dc-dc converter and then stored into a rechargeable lithium-ion battery.[2]

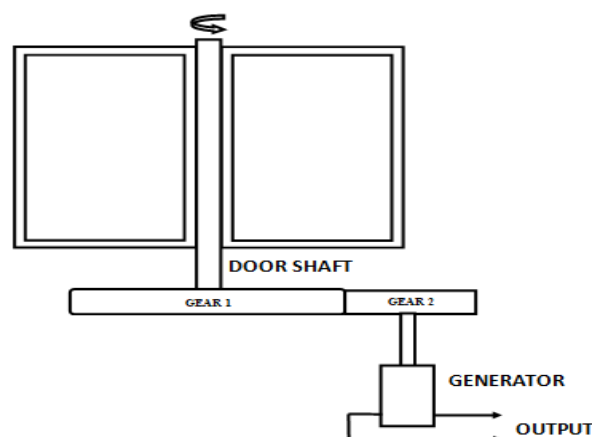


Figure 2: Basic Arrangement

2.2 MATHEMATICAL CALCULATION FOR DESIGNING

(The calculations below are for understanding the real-time values and calculations may vary according to the requirements of the prototype)

Assume the output we want is +12v DC to charge a 12v lithium-ion 1500mAh battery,

Charging voltage= $12 \times 1.15 = 13.8v$

Charging current= 10% of amp hour= 0.15A

Taking the charging voltage and current as a reference generator is selected,

Generator specification- 24v 0.25A 120 rpm

Now considering the rated speed of generator gear teeth and the gear ratio is selected.

Assuming a person takes 2 sec to go through a 4-panel door we get 15 rpm at door shaft.

Gear mounted on the shaft is 160 teeth and gear mounted on generator shaft is 20 teeth

$G1 = 160$ T $G2 = 20$ T

Gear ratio 8:1

Input speed= 15 rpm

Output speed we will get is 120 rpm which is the rated rpm of generator

The torque will also be reduced corresponding to gear ratio.

According to the required torque of the generator, the dimensions of the door frame is designed.

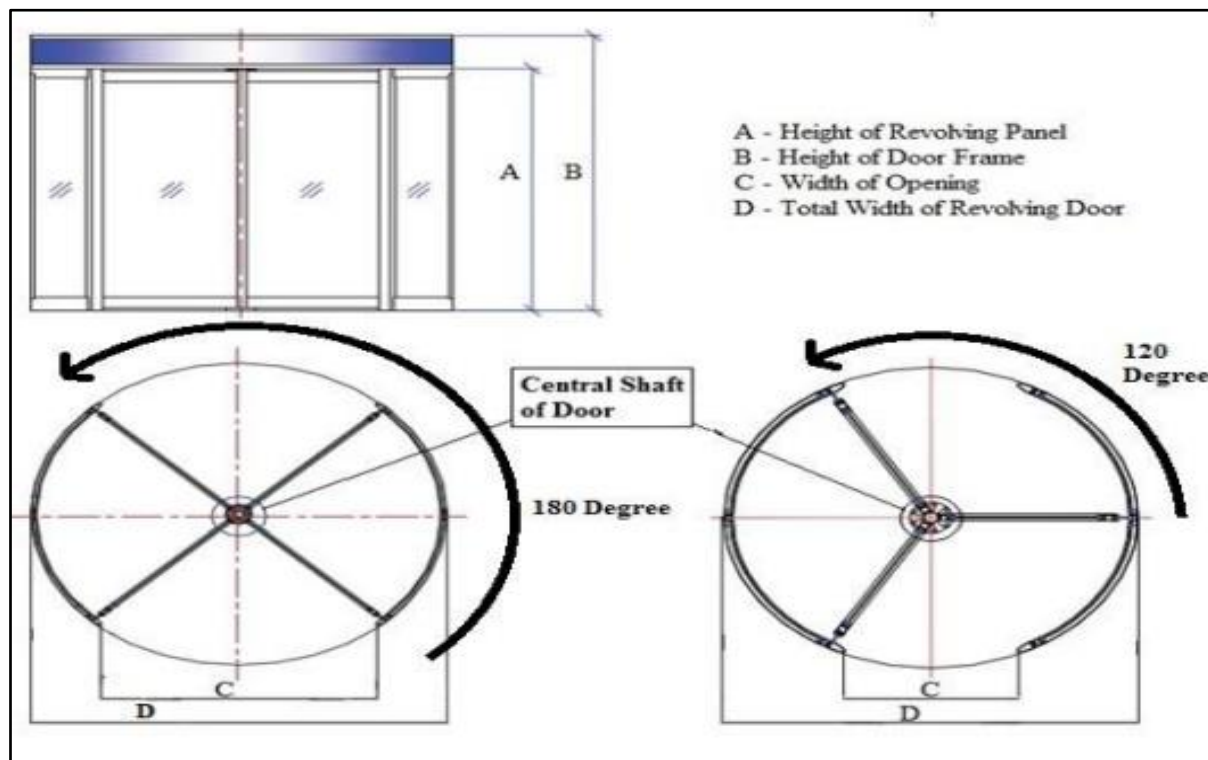


Figure 3: Comparison of Three And Four Panel Door [1]

DESIGN AND CALCULATION OF FOUR PANEL DOOR

Door Opening angle = 180 Degree

Time assumed to open the door = 2 seconds

$$\therefore \text{RPM of Door} = \left(\frac{180}{360}\right) \left(\frac{60s}{2s}\right) = 15 \text{ rpm}$$

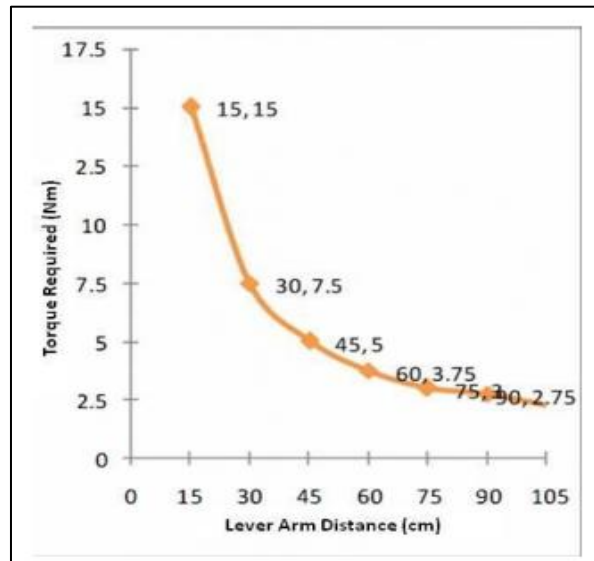


Figure 4: Torque Required Against Lever Arm Distance [1]

From the above figure, it can be seen that the Lever Arm Distance has a great effect on the Torque required to open the door. As the Lever Arm Distance increases, the required torque decreases. From these studies, it can be noted that the width of the door plays an important role in the overall power produced by the Revolving Door and in designing the dimensions of door frame.[1]

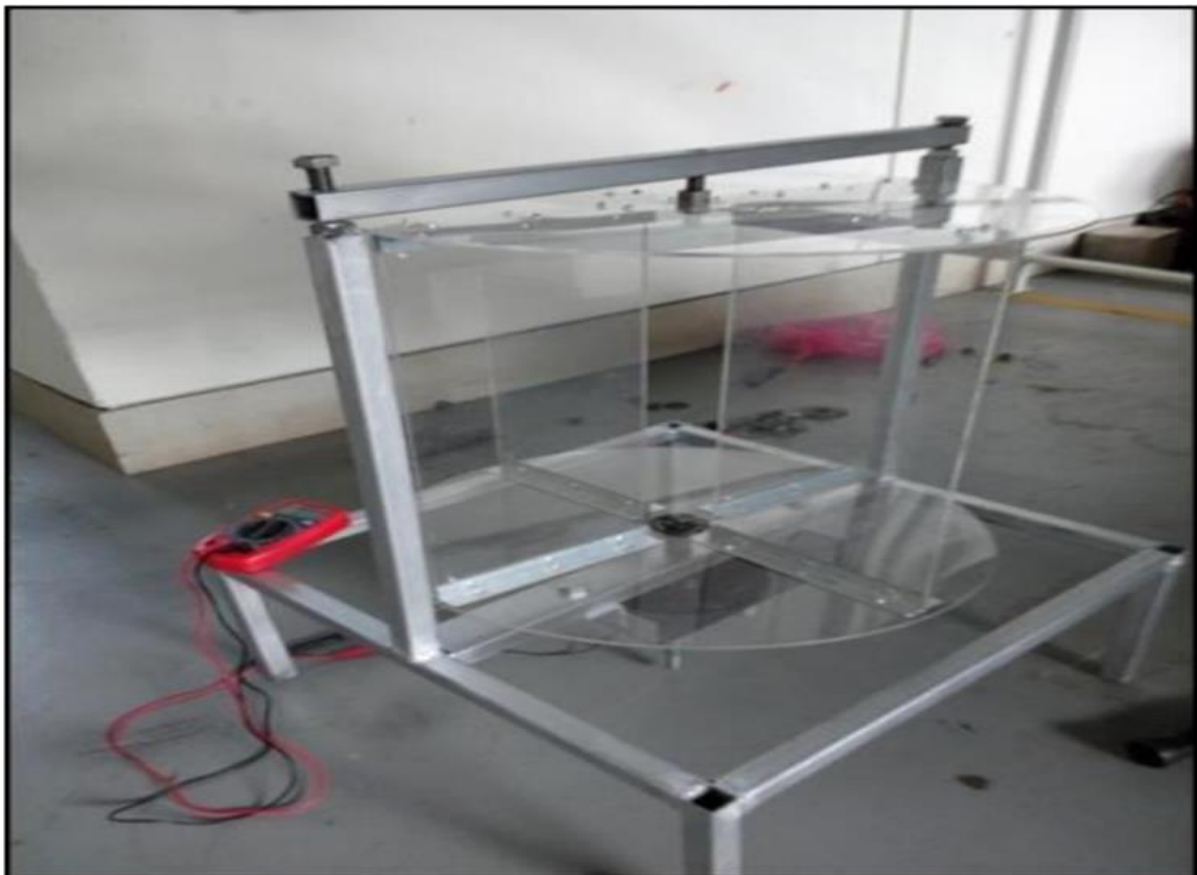


Figure 5: Prototype Assembly [1]

III. CONCLUSION

The energy which is going waste one or the other way can be utilized to generate power using a simple mechanism. The power generated from this mechanism depends on shaft rpm of the door and frequency of people passing through the door.[2] If it is employed in places where there is a heavy moment of people with proper designing it is possible to generate sufficient power from it. It can be further optimized by using a higher gear reduction ratio and a generator with higher efficiency. It should also be noted that this energy is produced using a small scale model. Therefore, a full-scale model of a revolving door will generate higher power output.

Advantage of energy harvesting from the revolving door is it is simple in design and can be easily installed but it generates less power in comparison to other renewable sources like solar, wind, hydro, etc.

REFERENCES

- [1] "ENERGY HARVESTING SYSTEM USING ROTATION MECHANISM OF A REVOLVING DOOR", Syed Faizan-ul-Haq Gilani¹, Syed Ihtsham-ul-Haq Gilani², Zuhairi Baharudin¹ and Rosdiazli Ibrahim¹, *ARPN Journal of Engineering and Applied Sciences*, ISSN 1819-6608, VOL. 10, NO 21, NOVEMBER, 2015.
- [2] "Generation of Energy using Revolving Door" Aniket M. Dighade¹, Dipeeka A. Gondane², Priyanka V. Raut³, *International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 06 Issue: 01 | Jan 2019*
- [3] M. S. Murthy; Y. S. Patil, s. V. K. Sharma, b. Poley, s. S. Kolte, n. Doji "Revolving doors producing green energy" clean energy and technology (CET), *2011 IEEE first conference, pages160.: 157 –*
- [4] Dymarski, P., Grabham, N., Beeby, S. and Tudor, M. (2011): "Survey of Potential Energy Harvesting Solutions for use in the built environment", *ICT for sustainable homes Conference 2011, Nice, 24-25 October 2011*
- [5] Ahamed R., Rashid M.M., Islam J., Javed A., Yusof H.M., Energy Generation from Revolving Door, *Indian Journal of Science and Technology* 9(19) (2016).
- [6] Edam B., Boon Edam introduces the world's first energy-generating revolving door (2008).
- [7]https://kupdf.com/download/electrical-power-generation-from-revolving-door-in-park-place_598b536edc0d60a05b300d1c_pdf
- [8] Pradesh Meshram, Akshay Kasurkar, Pullawar P.V., Development in Energy Harvesting System Using Escalator & Four Way Door Mechanism, *International Journal of Advanced Research in Science, Engineering and Technology* 4(4) (2017).
- [9]"People Powered Fluxlab Revolution Door". Retrieved, 2013 Available: <http://www.igreenpot.com/people-powered-fluxlab-revolution-door/>
- [10]<https://www.printedelectronicworld.com/articles/1686/revolving-doors-harvest-human-energy>
- [11] Ahmad, S. A., Mazli, M. N. I., & Ariffin, M. K. A. M. (2016, November 14–16). A mechanical design of power generator using door openings for household use. In *2016 International Conference on Advances in Electrical, Electronic and System Engineering*. Putrajaya.
- [12] Gilani, S. F., Gilani, S. I., Baharudin, Z., & Ibrahim, R. (2015). *Development of energy harvesting system using a rotation mechanism of a revolving door*, 10 (21), 10159–10163.