Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 1580 - 1586
Received 15 April 2021; Accepted 05 May 2021.

Wearable Energy Generator

Sundar Ganesh C S[1], Akash B [2], Chandru Gowtham S [3], Nithin Prakash G [4], Sutharssan S U [5]

[1]Assistant Professor, Department of EEE, Karpagam College of Engineering, Coimbatore.

[2,3,4,5] UG Final year students, Department of EEE, Karpagam College of Engineering, Coimbatore.

ABSTRACT

Energy Harvester is one of the essential technology and found use in many applications. Recently advances have been made in miniaturizing energy harvesting devices to supply wearable devices by exploiting ambient energy in the form of motion, etc. Harvesting energy from the body for powering wearable devices is more challenging due to constraints in terms of size, weight, and cost. As muscle is ultimately the origin of energy available for wearable energy harvesting, the main purpose of this paper is to explain the physiological principles that guided our design process and to present a brief description of our device design and its performance. We implemented the Wearable Energy Harvesting technique which works on the principle of human locomotive movements. We designed a device to generate power effectively without any cost. The power is produced, when we wear the device during locomotion or daily activities, the movements happening in the joints [elbow & knee] of our body.

Key words: Energy Harvester, Wearable devices, locomotion, Power generation, DC-DC converter.

1. INTRODUCTION

The wearable energy generator is developed for the generation of electrical energy from the movements of joints in the human body during locomotion. The concept of wearable energy generators is a variety of generation systems intended to supply small amounts of power to keep portable electronics in a good state of charge through natural motions of the body. Electronic devices are becoming smaller, lighter, and consume less power. Mechanical energy harvesters are regarded as the most perspective and universal energy source for wearable electronic devices according to various scientists. Wearable Energy Generator–generating electricity from people during daily activities is a promising alternative to batteries for powering increasingly sophisticated portable devices. We recently developed a wearable energy harvesting device that generated electricity during human locomotion. In this paper, we explain the physiological principles that guided our design process and present a detailed description of our device design with an emphasis on new analyses.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 1580 - 1586
Received 15 April 2021; Accepted 05 May 2021.

2. RELATED WORK

Penguin Niu addresses energy harvesting from biomechanical motions. This technique is useful for powering small portable devices, like wireless phones, music players, and digital assistants. They also discussed the practical issues associate with power electronics required to connect the bio-mechanical source to the required loads.

Lawrence C Rome developed the suspended-load backpack which converts mechanical energy from vertical movement of carrier loads to electricity during walking, where little extra metabolic energy is required during the power generation. This kind of power generation gives space for scientists, explorers from the heavyweight of replacement of batteries.

J Maxwell Donelan developed a biomechanical energy harvester that generates electricity during walking with some effort. He says that producing substantial electricity with little extra effort makes this method well-suited for charging powered prosthetic limbs and other portable medical devices.

B Yang, KS Yun proposed and demonstrate that harvesting scheme of efficient energy for general human motion by using the shell structures of piezoelectric. This proposed harvester effectively coverts the random and the slow movements of human motion, i.e., mechanical into electrical energy.

R Kerley, X Huang, DS Ha their activities on the energy harvesting from wearable devices from the human body for the usage of biomedical and portable devices and powering up with implant devices. Further they classify two sources, Voluntary and Involuntary. The voluntary activities by human can be able to produce several watts, the device should be in active. Involuntary source are constantly available which provides a small amount of energy, produced up to several milli watts.

G Terlecka, J Blums, A Vilumsone, describes the prototype of smart garment and offer several alternate places for the parts of generator, based on the principle of electromagnetic generator. Their research on Homecare, Healthcare application by wireless, mobile networks and wireless sensors for the elderly, children, athlete and especially for the patients.

M L Saez, analysed the state-of-art knowledge of the use of energy harvesters to power the wearable of clothing. He also discussed with some of the examples of energy harvesting from body movement from temperature difference and from solar radiation. Clothing with integrated piezo elements was subjected to test where the output voltage resulting from the body movements like extension of body in various joints, walking, push-up and squat exercises.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 1580 - 1586
Received 15 April 2021; Accepted 05 May 2021.

3. COMPONENTS USED

WEARABLE ENERGY HARVESTER

It is the base part of the energy harvester. It connects the two shaft connectors at one end of the chassis. It is the main component of a harvester, when the device is worn by the user, these bearings rotate according to their locomotion. The main function of this device is to convert mechanical energy into electrical energy, the input has taken from the rotation of the bearings, i.e., the generator is coupled to the bearings. Due to the rotation, it takes the mechanical energy as input and converts it into an electrical energy.

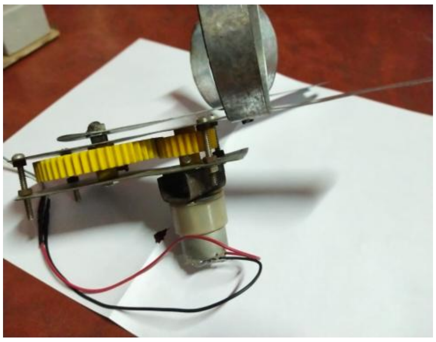


Fig.1 Design of Wearable Energy Harvester

DC-GENERATOR

The motor generates energy from the magnet fields inside the magnets. These fields can be used to initiate force which in turn creates movement. This motion may then be used to create energy. This is what makes a magnetic powered generator into a perpetual generator. The basic working principle of a DC motor is based on the fact that whenever a current carrying conductor is placed inside a magnetic field, there will be mechanical force experienced by that conductor.

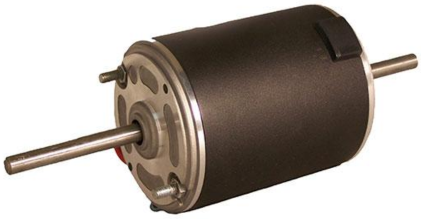


Fig.2 D.C Generator

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 1580 - 1586
Received 15 April 2021; Accepted 05 May 2021.

ATMEGA 8 MICROCONTROLLER

It is an 8-bit AVR microcontroller that is based on RISC CMOS technology and comes with a 28-pin interface for the PDIP package. The Program memory is 8K Flash while RAM and EEPROM are 1K and 512 bytes respectively. Microchip has been the main source for producing PIC and AVR microcontrollers that are mainly used in embedded and industrial automation systems. These modules can perform several functions on a tiny chip, preventing you from spending too much and purchasing external components for laying out automation in the relevant project.

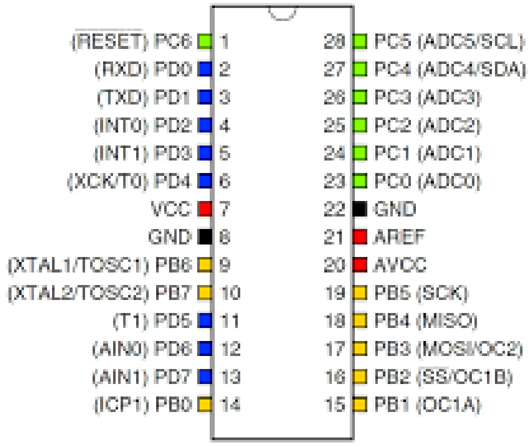


Fig.3 Pin Out Diagram of Atmega8 controller

4. PROPOSED METHOD

The Fig.4 shows the diagram of the Wearable Energy Generator System. Hence the hardware aspect consists of Wearable Energy device, DC generator, Atmega8 controller and Converters.

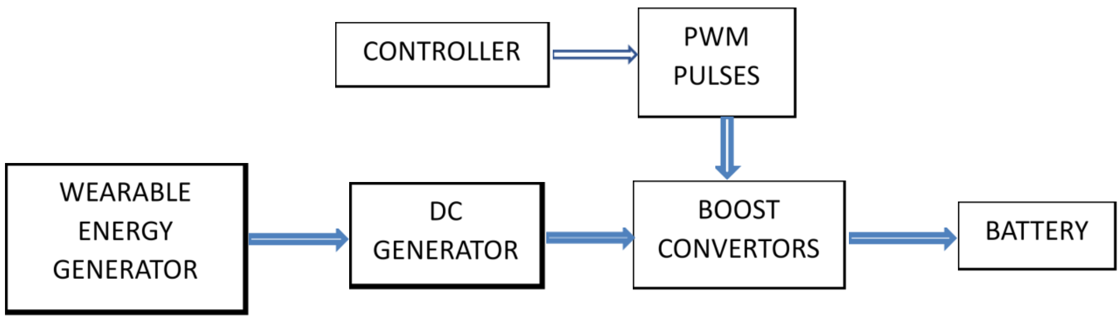


Fig.4 Block Diagram of Wearable Energy Generator

We implemented the Wearable Energy Harvesting technique which works on the principle of human locomotive movements. We designed a device to generate power

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 5, 2021, Pages. 1580 - 1586
Received 15 April 2021; Accepted 05 May 2021.

effectively without any cost. The power is produced, when we wear the device during locomotion or daily activities, the movements happening in the joints [elbow & knee] of our body. Here we implemented a multiport boost converter so they connected in multiport DC-DC converter generator it converts and boost variable voltage to constant voltage. Here we implemented a multiport boost converter so they connected in multiport DC-DC converter generators it converts and boosts variable voltage to constant voltage. Here microcontroller (ATmega8) is used to get feedback voltage from the generator according to input voltage generations microcontroller will give PWM pulses to DC-DC converter to give constant DC voltage.

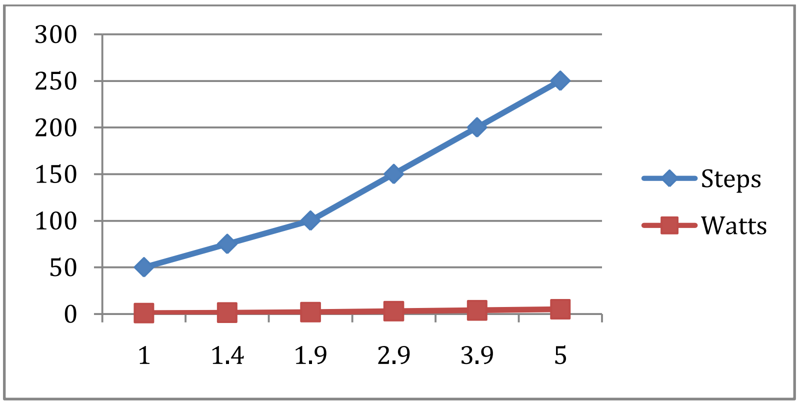
5. RESULT

The Fig.5 shows that the energy has produced by using the Wearable Energy Generator; it is fully based on the mechanical aspects of human locomotion in their day-to-day life activities. It is mainly focused and designed for the people in remote areas, there will be low possibility for current for charging their electronic devices or gadgets. This device will be a better solution for them, because when they wear this device during their travelling period, they need not put any much more effort for this energy generation. We can able to generate above 25 Watts per day.

Fig.5 Wearable Energy Harvester

S.No.	Steps	Watts
1	50	2
2	75	3.1

3	100	4.2
4	150	6.2
5	200	8.3
6	250	10.4



6. CONCLUSION

While future versions of this technology may prove useful to the general public for powering their portable devices, people whose lives depend on portable power will embrace it more quickly. Energy harvesting to trickle charge batteries in current computerized and motorized prosthetic limbs, for example, would allow amputees to walk further and faster. It would also enable future prosthetic and orthotic technologies to become more sophisticated by alleviating some of the limitations that batteries currently place on their design. The key principles are considerably more general than the current embodiment they extend to joints other than the knee and to movements other than walking. Energy harvesters that operate about body joints and selectively engage power generation have the potential to improve the quality of life for the user without increasing their effort.

7. REFERENCES

[1] Yuan, Y., Liu, M., Tai, W. C., & Zuo, L. (2017, April). Design and experimental studies of an energy harvesting backpack with mechanical motion rectification. In Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems 2017 (Vol. 10168, p. 1016825). International Society for Optics and Photonics.
[2] Sue, C. Y., & Tsai, N. C. (2012). Human powered MEMS-based energy harvest devices. Applied Energy, 93, 390-403.
[3] Niu, P., Chapman, P., Riemer, R., & Zhang, X. (2004, June). Evaluation of motions and actuation methods for biomechanical energy harvesting. In 2004 IEEE 35th Annual Power Electronics Specialists Conference (IEEE Cat. No. 04CH37551) (Vol. 3, pp. 2100-2106). IEEE.

[4] Riemer, R., & Shapiro, A. (2011). Biomechanical energy harvesting from human motion: theory, state of the art, design guidelines, and future directions. Journal of neuro engineering and rehabilitation, 8(1), 22.

[5] Zhao, J., & You, Z. (2014). A shoe-embedded piezoelectric energy harvester for wearable sensors. Sensors, 14(7), 12497-12510.

[6] Kuang, Y., & Zhu, M. (2016). Characterization of a knee-joint energy harvester powering a wireless communication sensing node. Smart Materials and Structures, 25(5), 055013.

[7] Dagdeviren, C., Li, Z., & Wang, Z. L. (2017). Energy harvesting from the animal/human body for self-powered electronics. Annual review of biomedical engineering, 19, 85-108.

[8] Rome, L. C., Flynn, L., Goldman, E. M., & Yoo, T. D. (2005). Generating electricity while walking with loads. Science, 309(5741), 1725-1728.

[9] Chen, C., Chau, L. Y., & Liao, W. H. (2017). A knee-mounted biomechanical energy harvester with enhanced efficiency and safety. Smart Materials and Structures, 26(6), 065027.

[10] Niu, P., Chapman, P., Riemer, R., & Zhang, X. (2004, June). Evaluation of motions and actuation methods for biomechanical energy harvesting. In 2004 IEEE 35th annual power electronics specialists conference (IEEE Cat. No. 04CH37551) (Vol. 3, pp. 2100-2106). IEEE.

[11] Rome, L. C., Flynn, L., Goldman, E. M., & Yoo, T. D. (2005). Generating electricity while walking with loads. Science, 309(5741), 1725-1728.

[12] Donelan, J. M., Li, Q., Naing, V., Hoffer, J. A., Weber, D. J., & Kuo, A. D. (2008). Biomechanical energy harvesting: generating electricity during walking with minimal user effort. Science, 319(5864), 807-810.