"FOOTSTEP POWER GENERATION USING PIEZOELECTRIC TRANSDUCER"

[1]KAJAL LADHE
Department Of Electronics And Telecommunication, Assistant Professor of Electronics And Telecommunication, Jagadambha College Of Engineering And Technology, Yavatmal.
kajalladhe02@gmail.com

[2]DIMPAL HATWARE
Department Of Electronics And Telecommunication, Assistant Professor of Electronics And Telecommunication, Jagadambha College Of Engineering And Technology, Yavatmal.
dimpalhatware@gmail.com

[3]RAKHI SONTAKKE
Department Of Electronics And Telecommunication, Assistant Professor of Electronics And Telecommunication, Jagadambha College Of Engineering And Technology, Yavatmal
sontakkerakhi58@gmail.com

[4]SHAMAL KAKAS
Department Of Electronics And Telecommunication, Assistant Professor of Electronics And Telecommunication, Jagadambha College Of Engineering And Technology, Yavatmal
shamalkakas1997@gmail.com

[5]PROF. V. R. THAKARE
Department Of Electronics And Telecommunication, Assistant Professor of Electronics And Telecommunication, Jagadambha College Of Engineering And Technology, Yavatmal
thakare.vinod@gmail.com

ABSTRACT: *We get electricity, (which is a secondary energy source) from the conversion of other sources of energy, like coal, natural gas, oil, nuclear power and other natural sources, which are called primary sources. Researches show that the world has already had its enough shares of its energy resources. we are proposing the prototype of a piezoelectric generator that harvests mechanical vibrations energy available on a staircase. Piezoelectric transducer, which is an electromechanical converter, undergoes mechanical vibrations therefore produce electricity. When the flooring is engineered with piezo electric technology, the electrical energy produced by the pressure is captured by floor sensors and converted to an electrical charge by piezo transducers, then stored and used as a power source and this power source has many applications as in agriculture, home application and street lighting and as energy source for sensors in remote locations. As our main purpose was to charge the battery through DC output and then by inverting it into AC for normal common usage. Thus as a result we have concluded that these types of designs and techniques of power generating systems are very useful and handy in order to match the supply and demand of energy globally as well.*

Keywords: mechanical vibration, electromechanical converter, piezoelectric generator.

1. INTRODUCTION

Electricity is a secondary source of energy i.e. converted from other sources. For this project the conversion of force energy is converted into electrical energy. In this project we have tried to generate electricity through the human powered mechanical energy. Energy generated by using wind, tides, solar, geothermal heat, and biomass including farm and animal waste is known as nonconventional energy. All these sources are natural, renewable or inexhaustible and do not cause environmental pollution and are eco-friendly. A person exerts lots of force when they walk down the stairs. The staircase power harvesting system intends to turn this energy into electrical power using a piezo-electric generator. Piezoelectricity refers to the ability of some materials to generate an electric potential in response to applied pressure. Linear increase of human population and energy demand led to the invention of a method to provide power from the increased population. Energy harvesting becomes a waste if not utilized properly. Pressure exerted by moving people can be converted to electric current with the help of embedded piezoelectric crystals. Electricity has become important resources for human being hence, it is needed that wasted energy must have to utilize, walking is the most common activity done by human being while walking energy is wasted in the form of vibration to the surface. A large amount of energy is wasted at the speed breakers through friction, every a vehicle passes over it. So electricity can be generated using the vehicle weight (potential energy) as input. So, this is a small step to try to improve this situation. In speed breaker arrangement it is better to use rubber road. A piezoelectric

sensor based costly product is available in some developed countries which can generate power from human locomotive force, but it is not suitable for countries like Bangladesh where power demand is very high but economy is not highly developed. The one of major source of external energy which can used to separate outer orbit electrons away from their parent atom is pressure. The phenomenon of generation of a voltage under mechanical stress is referred to as the direct piezoelectric effect, and the mechanical strain produced in the crystal under electric stress is called the converse piezoelectric effect. We can modify a normal stair tread to move a small distance and the vibrational energy will be converted to electrical energy using Piezo-electric Generator. From there, the energy will be stored in a battery for future use. Today we see more and more applications using piezoelectric transducers. Their use as a source of electrical energy presents increasing interest for embarked electronic devices, low power consumption (less than 1 Watt) such as lamps based LED (Light- Emitting Diode), displays or sensors.

2. LITERATURE REVIEW

1. According to V. Prasannabalaji in this system the force applied on the piezoelectric crystal is converted into electrical energy. The fluctuations in the generated voltage and the battery charging are controlled by the microcontroller. Voltage generated by series of sensors is stored by the battery[1]. This voltage can be used to drive AC or DC loads. The piezoelectric sensor interfaced with the microcontroller is used as a transducer, which converts the force into electrical energy. The voltage booster boots up the generated voltage.

2. Mr. G. Dhanalakshmi describe the pressure applied to the piezo electric material convert it into electrical energy. The pressure can be given by the people walking over it. The output of the piezo electric material is not stable. Bridge circuit converts the variable voltage into a linear voltage. AC ripple filter is used to filter any fluctuations in output. The output of the DC voltage is stored in a rechargeable battery. The output from a single piezo tile was extremely low, so combination of piezo tile is connected. Two possible connections are made parallel and series connection. For parallel connection there is no increase in voltage, where as in series connection by using additional piezo tile there is increase in voltage. So we are using both parallel and series connection for producing 40V voltage with high current density. The battery is connected to an inverter to provide AC load. The output voltage can be seen in a LCD. For this purpose ARDIUNO UNO is used [2].

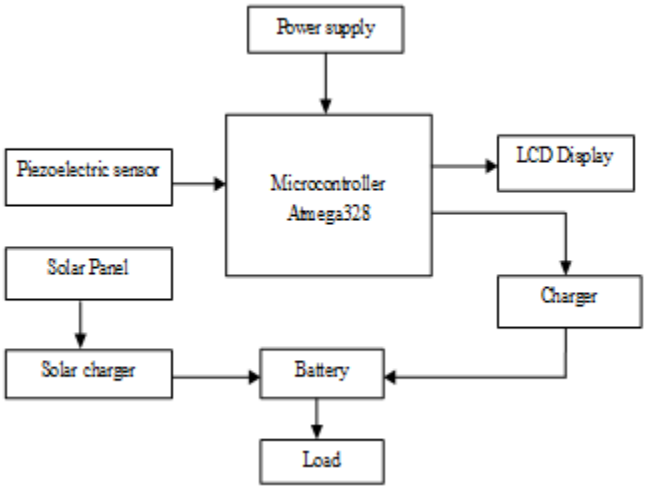
3. From the perspective of Yogesh Motey has describe that a tile made up of piezo material generates voltage across a piezo tile which is supplied to a bridge rectifier circuit to obtained DC voltage and given to a rechargeable battery and thus the battery gets charged and this can be used to drive DC loads. The battery used here is a Lead Acid Battery of 6V. A LCD is interfaced with microcontroller. The microcontroller used here is ATMEGA 328P which is 8-bit,32kb flash with 1k RAM and has 16MHz speed. The 16 x 2 LCD is used to display the voltage generated by the piezo-electric tile. The crystal oscillator is connected to microcontroller which is used to give clock signal. The power supply unit is used to supply power to microcontroller and LCD. This unit consist of an IC called IC7805 which will convert the 12V to 5V[3].

4. Mr. K. Ramakrishna describe that locating Piezo electric flooring in airports is dependent upon how much traffic, on average, certain parts of a terminal receive in a given day; the higher the averages the higher the potential for energy production. Based on this it is important to locate high traffic areas to gain the most benefit out of the power generating floor. One such high traffic area is the check-in station, these areas often have large lines of passengers waiting to check in baggage and obtain boarding passes. Piezo devices could also be installed under the baggage weighing scales in the check-in areas to harness the energy from placing luggage on these platforms. Another high traffic area is the security line; the Piezo devices could be located under the floors along these lines to capture the foot traffic in these lines. Concession areas and advertising signs would also benefit from having the power-generating floor. Billboards could be light up by people passing by and lighting in the concession areas could be partially powered by the flooring. Experimentation with different areas and by observing locations of high foot traffic in airport terminals are important in determining the optimal locations for capturing kinetic energy from walking[4].

3. PROPOSED WORK

In the proposed system we are going to design the system in which we add piezoelectric sensor and in addition solar panel. Due to mechanical pressure piezoelectric sensor will generate electrical energy and also by using solar panel we generate the electrical energy. The output voltage will display on LCD display.

4. BLOCK DIAGRAM



4.1 LCD DISPLAY

The display used here (shown in fig. 6) is 16x4 LCD (Liquid Crystal Display) that displays 16 characters per line by 4 lines. A very popular standard exists which allows us to communicate with the vast majority of LCDs regardless of their manufacturer. The standard is referred to as HD44780U, which refers to the controller chip which receives data from an external source (in this case, the Atmega328) and communicates directly with the LCD. The 44780 standard requires 3 control lines as well as either 4 or 8 I/O lines for the data bus. Here we are using 8-bit mode of LCD, i.e., using 8-bit data bus.

4.2 ATMEGA328

The ATmega328 is a low-power CMOS 8-bit microcontroller based on the enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega328 achieves throughputs close to 1MIPS per MHz. This empowers system designed to optimize the device for power consumption versus processing speed.

4.3 ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

4.4 PIEZOELECTRIC TRANSDUCER

To give better voltage and current three PZT are connected in series .A force sensor and voltmeter is connected to this series combination. As varying forces are applied on this connection and corresponding voltages are noted. Voltage and current generated across the series connection is measured. The voltage and current generated across the parallel connection is measured. From series connection obtained current is poor and from parallel connection obtained voltage is poor. To overcome this problem rectifier in series-parallel connection is used.

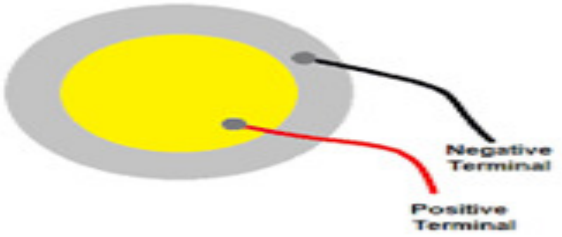


Figure 2: Piezoelectric Sensor

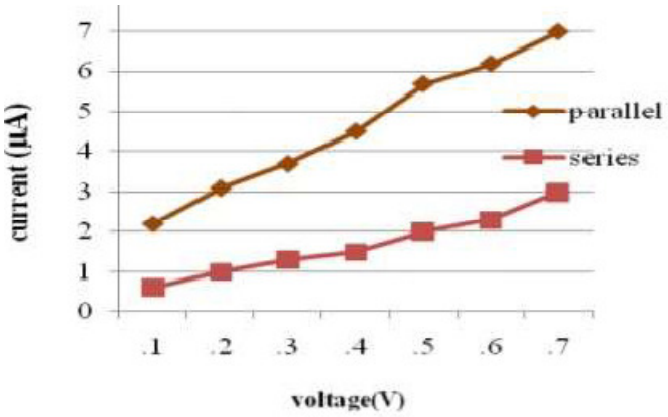


Figure 3: Graph of series and parallel connection of piezoelectric transducer

4.5 Calculation of piezoelectric transducer

20 piezoelectric sensor are used.

If an average of 50 Kg weight pressure from single person is taken, considering the steps of a 50 Kg weighted single person, the average calculation is:

It takes 800 steps to increase 1 V charge in battery. So, to increase 5V in battery Total steps needed = (5 × 800) = 4000 steps.

As this project is implemented in a populated area where foot step as source are available, if an average of 2 steps in 1 second are taken .

For 4000 steps time needed =4000/(60 × 2) =33.33 minutes. (Approximately)

4.6 SOLAR PANEL

Research by Imperial College, London has shown that the efficiency of a solar panel can be improved by studying the light-receiving semiconductor surface with aluminum nano cylinders similar to the ridges on lego blocks. The scattered light then travel along a longer path in the

semiconductors which means that more photons can be absorbed and converted into current. Although these nano cylinders have been used previously, the light scattering occurred in the near infrared region and visible light was absorbed strongly. Aluminum was found to have absorbed the ultraviolet part of the spectrum, while the visible and near infrared parts of the spectrum, were found to be scattered by the aluminum surface. This researched argued, could bring doen the cost significantly and improved the efficiency as the aluminum is more abundant and less costly than gold and silver. The research also noted that the increased in current makes thinner film solar panels technically feasible without "compromising power conversion efficiencies, thus reducing material consumption

5. WORKING

When we turn on the power supply the Arduino UNO and LCD display start conducting. The Arduino UNO has two analog input one is connected to piezoelectric sensor's output and another is connected to solar panel's output. When we applied pressure on piezoelectric sensor which is made up of PZT then it converts the pressure applied to it into electrical energy. Tthe source of pressure can be either from the weight of the moving vehicles or from the weight of the people walking over it. The output of piezoelectric material is not a steady one. So bridge circuit is use to convert this variable voltage into linear one. Again an AC ripple filter is use to filter out any further fluctuation in output. The output DC voltage is then stored in a capacitor. As the power output from single piezo was extremely low, combination of few piezo was investigate. Two possible connection were tested that is parallel and series connection. The parallel connection did not show significant increase in the voltage output. With series connection, additional piezo-film results in increased of voltage output but not in linear proportion. So here a combination of both parallel and series connection we use.

The way to charging the mobile phone through the solar panel. The second analog input to the Arduino is come from solar panel. The solar panel receives the sun rays with a proper altitude and then this output is given to Arduino then it converted into digital value. When some amount of energy will be stored on capacitor across solar panel then the mobile will charge through solar panel which is additional in this project

6. RESULT AND ANALYSIS

7. ADVANTAGES

- Power generation is simply walking on step.
- An innovative approach to a device that people use every day.
- No compromise to safety or reliability.
- Marketing and appearance could encourage people to take the stairs instead of energy intensive alternatives such as an elevator or escalator.
- No need fuel input.
- This is a non conventional system.
- An alternative way of power generation.

8. DISADVANTAGES

- Since the device operates with the small electric charge, they need high impedance cable for electrical impedance.
- More man power required.
- Only applicable for the particular place.
- Initial cost of this arrangement is high due to arduino.

9. APPLICATIONS

- Foot step power generation can be used in emergency power failure situations.
- Foot step generated power can be used for agricultural, home applications, street lighting and etc.
- Metros and rural applications.

10. CONCLUSION

Foot step power generation system is economical, affordable energy solution to common people. It can be used for many application in rural areas where power availability is less or totally absence.

11. FUTURE SCOPE

As the mobile evolution start from keypad mobile phones and evolution reach to android phones in today's era likewise we are start the charging of mobile phones by means of piezoelectric sensor and definitely we will make project which charge the android phone. In future we will generate the wind energy by using piezoelectric sensor. So that we can generate renewable energy.

12. REFERENCES

[1] V. Prasannabalaji, R. Rakesh, S. Sairam . "Staircase power generation using piezoelectric transducers", *Advance in Electronic and Electric Engineering*, 2013; 3: 747–754p.

[2] G.Dhanalakshmi ,T.Manjulai , "Footstep Power Generation System" **,**International Journal Of Engineering And Computer Science, ISSN:2319-7242, Volume 6 Issue 4 April 2017, Page No. 21011-21014,

[3] Yogesh Motey, Pooja Dekate, "Footstep Power Generation System", International Journal of Innovations in Engineering and Science, Vol. 2, No.6, 2017.

[4] K.Ramakrishna, Guruswamy Revana, "Generation of Electrical Power through Footsteps", International Journal of Multidisciplinary and Current Research, ISSN: 2321-3124.

[5] "Interfacing Piezo Film to Electronics", Measurement Specialties. March 2006, Retrieved December 2, 2007.

[6] Alfredo Vazquez Carazo (January 2000), "Novel Piezoelectric Transducers for High Voltage Measurements", Universitat Politecnica de Catalunya: 242.

[7] Orcutt, Mike, "Managing Light To Increases Solar Efficiency", MIT Technology Review, Retrieved 2018-03-14.