



Power Generation Using Piezoelectric Effect

E. Suneetha, K. Revathi, M. Akhila, A. Supraja, G. Hema latha, J. Gayathri

ABSTRACT:- In present situations the shortage of electricity is the major problem for industrial growth as well as rural development. To solve such type of problems, we need to develop strong electricity generating techniques with the available resources, during all conditions. In this work, electrical power is generated as non-conventional method by the human work or run mechanism using the piezoelectric sensor; there by non-conventional energy using foot step, converts mechanical energy into electrical energy. Piezoelectric materials are used to produce the non-conventional energy, when a piezoelectric sensor is strained, and it produces the electric field. A circuit comprising of Arduino (UNO R3), LED, Buzzer(5V), DC cooling fan(12V), Connecting wires, bread board are used to construct circuit to generate piezoelectric current. Therefore, piezoelectric materials convert ambient variations into electric power and hence utilization of waste energy with foot power following human locomotion is most important in highly populated and crowdie areas, which will be helpful to generate adequate amount of energy.

Index terms: piezoelectric sensor, electrical energy, mechanical energy

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I. INTRODUCTION

The creation of electric power from different types of energy sources is called generation of electricity. Generally, electrical energy produced by converting the sources of energy like atomic, gasoline, coal and some other natural sources. Atomic power plants require vigilant treatment of both raw and unwanted materials. From the beginning, man has needed a lot of energy and used at an increasing rate prior to his existence. Now-a-days, electricity is the one of the most important things that a man needs to survive on the earth, which is now being generated using water. The quantity of water is drastically reducing on the earth which leads to the shortage of electricity in future generations. After recognizing that the electrical energy is being generated from the renewable resources like wind, sun and water, people are using number of ways to use and save the energy. There can be insufficiency of the renewable sources on earth any time which can be compensated by the method of piezoelectric effect using piezoelectric materials.

Walking is one of the most essential things every man will do on his daily life. While walking a man losses some of his energy levels. Also there will be some pressure applied on the earth surface. So here we are planning to convert the pressure which is becoming a waste, into the electrical energy we use in our daily life. The phenomenon we are using to convert the mechanical energy (pressure) to electrical energy is called the piezoelectric effect which was introduced by the physicist Pierre Curie in the year 1880.

Piezoelectricity is the electric charge that is present in certain solid materials such as crystals, certain ceramics, and biological matter such as bone, DNA, and various proteins in response to applied mechanical stress. The word piezoelectricity means electricity generating from pressure and latent heat. The implanted piezoelectric material can give the captivation of the changing overweight applied by moving individuals into the electric current, which can be stored in a battery. To develop this renewable energy with low-cost here we are using the Arduino UNO as the microcontroller. In this process there is no need of external power required, the electricity is generated simply by walking on the sensor. The piezoelectric effect is achieved by the quartz crystal which is being introduced in the form of a sensor. The sensors can withstand a lot of weight even the vehicles can travel on the sensor. These sensors can be placed on the roads or a walkway where people will be in massive amount. By having the people walking on the sensors the electricity can be generated and it can be used directly or it can be stored for further purposes.

II. PROPOSED METHODOLOGY

The primary objective of the proposed work is to produce the electric power from the foot step of the people and the pressure exerted during walking. The transformation of mechanical energy to electrical energy

due to the pressure induced by footstep and it is converted by using sensors hence it is called power generation using piezoelectric effect. We can store the power generated by the sensor in a battery and it can be used directly. Here we are using the power directly to the LED, buzzer and the DC cooling fan. The arduino UNO controls the rest of the components based on the power generated from the sensor. We can charge a mobile phone by improving the circuit to some extent. When pressure is applied on the sensor the changes in the voltages in the arduino can be observed on the serial plotter. When pressure is applied there will be changes in the curve as a maximum or a minimum peak.

III. METHODOLOGY

The circuit given below shows the process of generation of electrical energy by foot step. This process is useful in public places like bus stands, theaters, and railway stations, shopping malls, mostly crowded areas. Whenever the force is applied on the sensor either in the form of a human foot pressure or the weight of a vehicle the sensor converts that mechanical energy to the electrical form. This leads to the working of the arduino UNO in which the code is written so that when there is a form of energy releasing from the sensor then the arduino will supply power to the rest of the components to make them ON. The power generated from the sensor can also be stored in a battery. Here we are tried to store the charge in a 9V rechargeable battery but it is taking a long time to save the power. So we are unable to use the battery. And we are using the advantage of the serial plotter option in the Arduino UNO which helps to show the variations in the voltage values on the circuit. When the pressure is applied on the sensor the plotter shows the variation in the form of a minimum or a maximum peak value.

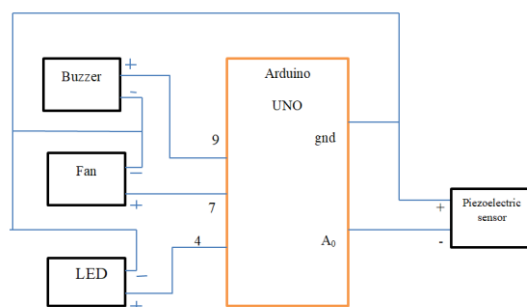


Fig 2.1: Block diagram

A.Arduino UNO:

Arduino is a popular programmable board which is used to create projects. It is an open source electronic prototyping platform enabling users to create interactive electronic objects. Arduino is designed in a way that any user can use by a “one click compile or upload” and without being an expert. The board is equipped with sets of digital and analog pins. It has 14 digital I/O pins, 6 analog I/O pins and is programmable with the Arduino IDE using a type B USB cable. Arduino can be powered by USB cable or a 9V battery.

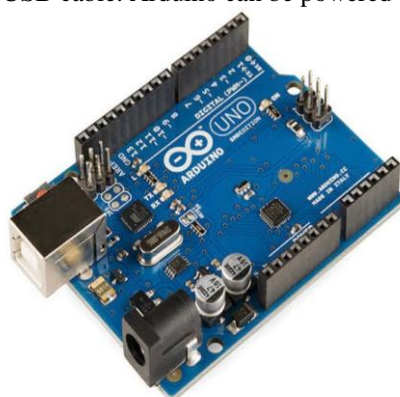


Fig 2.2 Arduino UNO

B. Piezoelectric Sensor:

The structure of a piezoelectric sensor is as depicted in figure 2.4. The sensor we used here is a pressure sensor which loads the elements in one direction. The other type is the accelerators in which a seismic mass is attached to the crystal elements. The main difference between the two sensors is that the way of applying forces on the sensor. Pressure sensor contains a thin membrane and a massive base, ensuring that an applied pressure. The figure 2.3 represents the actual piezoelectric sensor which contains two terminals for

positive and negative terminals. The inner white membrane is for positive and the outer gold membrane is considered as negative terminals that are used for the voltage outlet.



Fig 2.3: Piezoelectric sensor

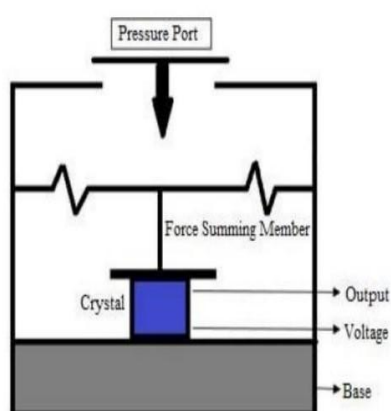


Fig 2.4: Structure of Piezoelectric sensor

IV. IMPLEMENTATION

The power generation system using piezoelectric effect works as follows. The first step is to apply pressure on the sensor. The applied pressure is converted into the electrical energy and it is send to the arduino. The arduino works based on the amount of voltage generated. If the voltage generated from the sensor is greater that the threshold value given the code which is already dumped on the microcontroller then the arduino will let the output components to ON condition. The components we used here are the buzzer and DC cooling fan.

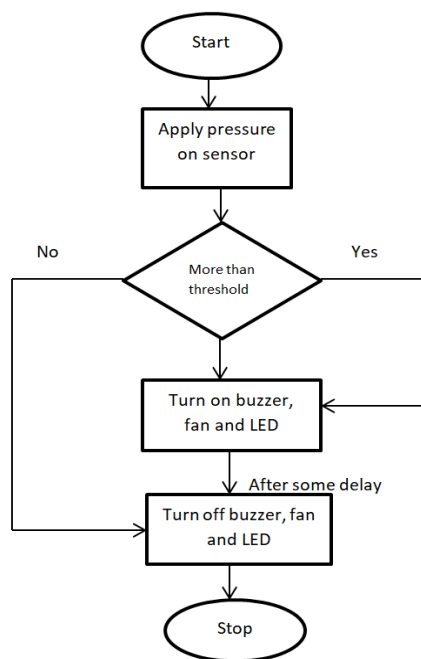


Fig 3.1: Flow chart for power generation

The serial plotter is used to check the change in voltages in arduino. It represented by a plot as shown in figure 4.2, when pressure is applied there will be a change in peak either by a negative peak or a positive peak.

V. RESULT

Power generation by using piezoelectric effect” is designed and developed successfully, for presentation. The results of the constructed proto type model are satisfying. The energy which is being wasted while humans are walking is used in the prototype. This system can be mainly used in the crowded places for generation of electrical energy. The figure 4.1 represents the immediate usage of the electrical energy generated from the sensor with the help of arduino. And figure 4.2 represents the serial plotter when the pressure is applied on the sensor.

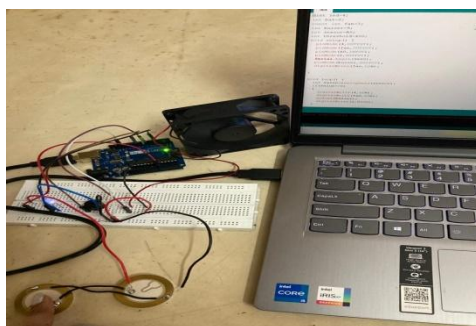


Fig 4.1: Circuit for power generation system

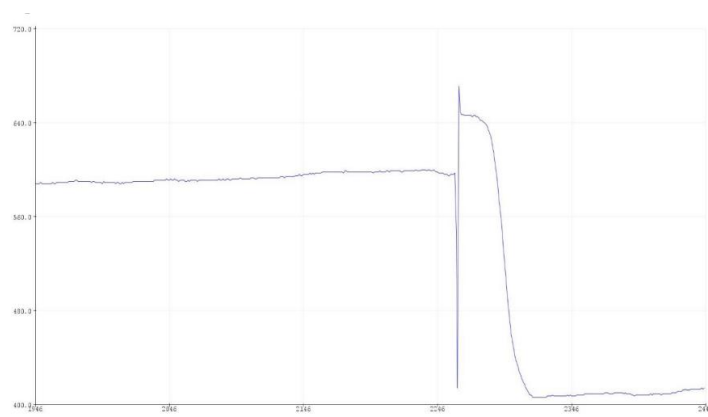


Fig 4.2: Serial plotter showing the changes in voltages

VI. CONCLUSION

The project undertaken is effectively tried and objectified which is the best conservative, responsible vitality answer for average citizens of our country. Electrical energy can be generated and used with the electronic components. Super capacitors can be used in place of the conventional ones in order to improve the capacity of system then a lot of charge can be saved than the standard ones. This energy can be used in larger cities where the requirement of electricity is high as well as population. And also in small areas where usage of electricity has less requirement.

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