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Design and Fabrication of Mechanical Footstep Power Generator

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ABSTRACT.

Demand on energy has been adopted throughout the worlds, and traditional method of generating power have adirect impact on environment. So, here are a non-converting method of power generation that utilizes wasted energy and cope with the increasing demand energy. The basic concept of this system capturing unused energy when a person walks on certain arrangement converting it into electrical energy. The power generated with the non-conventional methods depending on the human daily activity (walking). This energy also change AC-DC electrical and display the number of the voltage output. This product would be installed in crowded cities and other place like mall and jogging track. This product can obtain and efficient and reliable system using embedded technologies. The Arduino uno whish the heart circuit, allow dynamic and fast control of all of the functions, the LCD make the system user friendly. At the end of implementation, it will be able to develop a compactible system that serves us in many ways after installing it at home, schools and other place where the people move around. The system successfully generates power.

1. Introduction

Now a days, energy and power are the one of the basic need in this modern world. Energy demand is increasing day by day. On the other hand, the many energy resources are getting exhausted and wasted [1]. On the other side, human must to decide how to make the energy resources from exist.

In general, proposal for the utilization of waste energy of mechanical footstep power generator with human locomotion is very much relevant and important for other countries especially in high populated countries like India, China where mobility of its masses will turn into boon in generating electricity from its footsteps[2,3]. For the information, this product includes number of simple setup and component that is installed under the walking or standing platform. When the person walk or stand on this platform their body weight compress the setup of system which tends to rotates a dynamo and current produced is stored in dry battery, while the power producing platform is over crowded with moving population, energy is produced is high. More movement of humans will generate more energy[4,5].

In this product I will generating electrical power as non-conventional method by simply walking running on the footsteps. Non-conventional energy system is very essential at this time to our nation to produce a lot of backup energy resources. Non-conventional energy using footsteps need no fuel input power to generate the electrical power. A lot of benefit will be given by this product[5,6].

This product use simple spring and piezoelectric is used for generating power by utilization of force which is obtained during the walking on steps is converted in to electrical energy with the help of mechanical system.

2. Hardware Requirement

1. Arduino Uno R3 (microcontroller)

Figure 1. Arduino Uno R3.

Arduino Uno R3 is a microcontroller board based on on ATmega328 show in figure 1. It has 14 digital Input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonators 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-DC adapter or battery to get started.

2. Piezoelectric Sensor.

As we mentioned before, the Piezo electrical sensors are placed under insulating material (platform) and pressure is created by footstep. The property of piezoelectric material is to generate electricity when we apply pressure [7] Piezoelectric material has a crystalline structure It is ability to convert mechanical strain to electrical energy. Piezoelectric material is the main component of the project. It is belongs to the group of ferroelectric material. It is important to choice the proper piezoelectric material. The most available piezoelectric material is PVDF and PZT [8].

A piezoelectric sensor is a device that uses the piezoelectric effect to measure pressure, acceleration, strain or force by converting them to an electrical signal. Piezoelectric sensors have proven to be versatile tools for the measurement of various processes. They are used for quality assurance, process control and for research and development in many different industries it was only in the 1950s that the piezoelectric effect started to be used for industrial sensing applications. Since then, this measuring principle has been increasingly used and can be regarded as a mature technology with an outstanding inherent reliability. It has been successfully used in various applications, such as in medical, aerospace, nuclear instrumentation, and as a pressure sensor in the touch pads of mobile phones. In the automotive industry, piezoelectric elements are used to monitor combustion when developing internal combustion engines. The sensors are either directly mounted into additional holes into the cylinder head or the spark/glow plug is equipped with a built in miniature piezoelectric sensor [9].

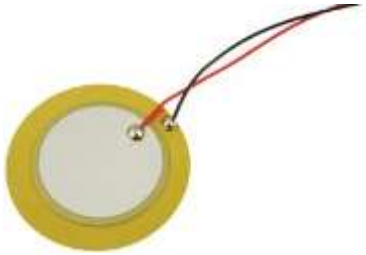

Figure 2. Piezoelectric Sensor

3. LCD Display.

Figure 3. LCD Display.

There are many choices for LCD like: 2x40 without backlighting, 1x16 which has only one row to show and finally 2x16 which is the most common type that can cover the system needs in very simple way. The LCD is interfaced with the microcontroller to display the battery voltages and the number of steps.[8,9].

3. Methodology

The main concept applied is the safety, save connection and wiring, low cost of the equipment, can accommodate when heavy load or force and other part. For the safety part will be applied by using spring to absorb the maximum pressure. It also can control motion and balance the project. Secondly, piezoelectric will connect and wiring in the series-parallel. The maximum output voltage and current will be balance at the same time. The Arduino UNO will convert the output and declare the number of step at the LCD Display (16x2). So, we will get the much better output automatically. After that, we will applied the EVA foam and the flat rubber at the upper and lower piezoelectric sensor. The function this equipment are to absorb the vibration to the ceramic plate clearly. Then, the size of the plate expected 300mm x 300mm and can assembly more piezoelectric sensor to generate electricity. It also easy to maintenance because using the basic and most usually equipment electronic. Figure 4 shown flow chart mechanical footstep power generator process for Arduino programming.

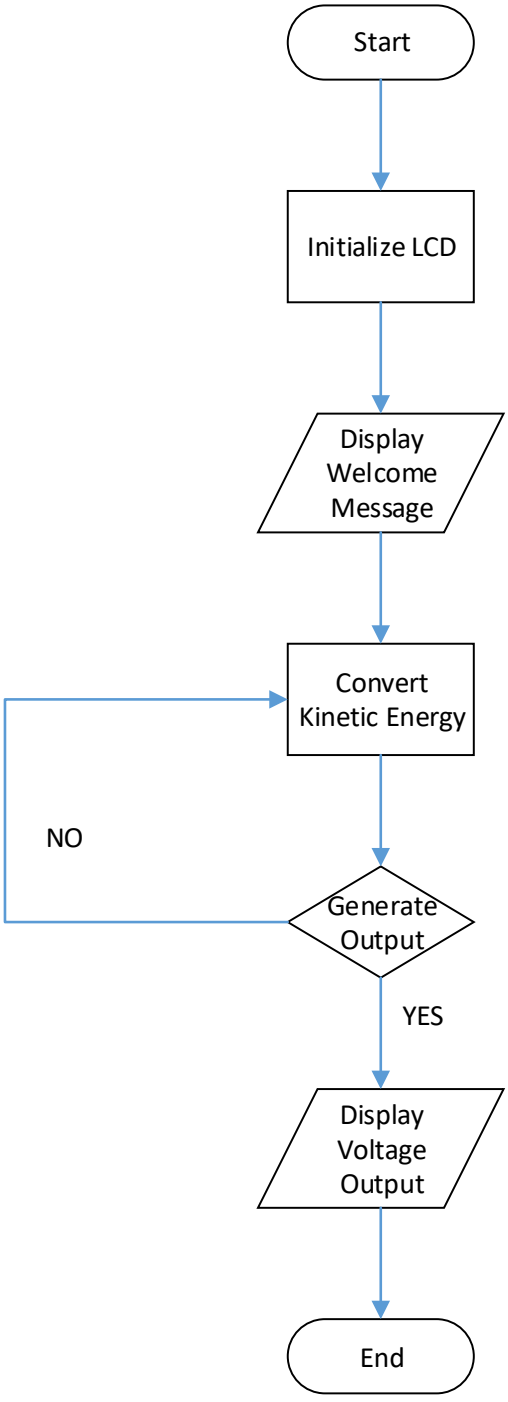

Figure 4. Flow chart mechanical footstep power generator.

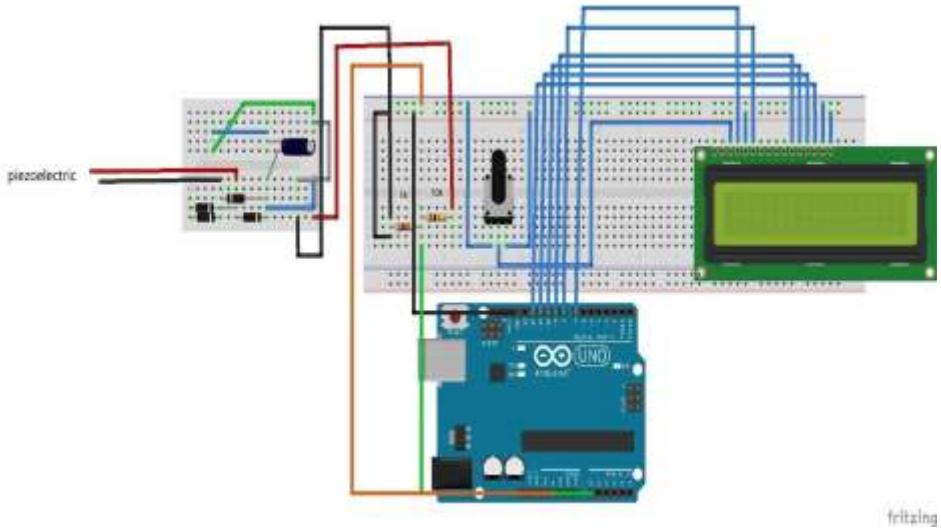

Figure 5. Electric circuit diagram of mechanical footstep power generator.

Figure 5 shown the electric circuit diagram of mechanical. 18 Piezoelectric sensor as a input. have connected to full bridge rectifier. Piezoelectric generate alternating current pulse. Output from rectifier distribute to load and Arduino for appear data collection as voltage indicator shown in LCD Display. Arduino process data in analog input.

4. Result and Discussion

The product of footstep power generator is shown in Figure 6. This prototype ha seen tested by a the Piezoelectric Sensor in different conditions with variable parameter to valuate its performance and properties.

Figure 6. Protoype Footstep Power Generator

Piezoelectric Sensor.

The piezo plate should be pressed in the right manner for the generation of AC pulse. The aximum output pulse is achieved only when it is pressed in the center, we have tested the pressure on crystal at different points of the circle. Touch the centre point of the piezoelectric sensor to make the maximum output. Mostly use the soft rubber between the upper and lower piezo to absorb pressure clearly. Figure 7 shown parallel connection for 18 number of piezoelectric and table 1 shown the result of voltage and current are collected.

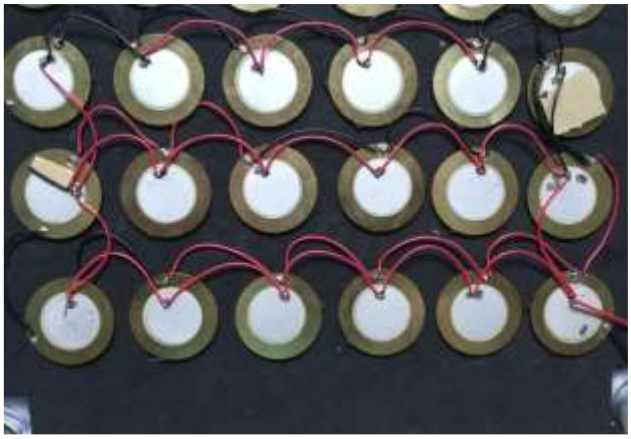

Figure 7. Paralle1 connection 18 numbers of Piezoelectric

Table 1. Parallel Output 18 numbers of Piezoelectric

Number of Piezoelectric	Number of Step	Output Voltage (V)	Output Current (mA)
18	1	5.7	3.5
	2	10	5.8
	3	10.5	6.7

The gap between piezoelectric almost 0.1mm. Need to increase the gap to avoid the voltage measured before compress the piezo. Range 0.3-0.5mm gap between piezoelectric and upper Eva foam. The height must be balance at the all plate to make all piezoelectric touch at eve foam plate. Decide the maximum output during compress the piezoelectric.

Diameter of the spring compress used are 20mm at the each of corner. The thickness spring is 2mm and the height 21mm. The size of the spring almost unsuitable when apply heavy load above 100kg. Use the 3mm thickness and large diameter spring range 25-30mm when apply the heavy load. Its also can return back to the initial position fastly range 1-3s.

5. Conclusion

In conclusion, A non-conventional, non-polluting energy is achieved when applying a force on piezoelectric sensors. These sensors are placed in such an arrangement so we can obtain the maximum output voltage; it converts a pressure into an electrical signal. As a result, installing this model in crowded places like malls and entries, where large numbers of people can step on, would generate more power.

Generating electricity by piezoelectricity principle is inexpensive and easy to install. This method helps in generating eco-friendly electricity. This method can be used in some common places like home entrance gates, parking area, bus stands etc. This method helps in exploiting different areas of electricity generation. Experimentally its efficiency is low, as complete amount of energy cannot be utilized.

A Foot step power generation using piezo electric sensor is proposed. Many scholars have proposed different methods for generating power. Many different sensors, intelligent generating techniques and various equipment were applied to generate power so that power cannot be wasted. So far the majority of power generation worldwide in rural areas generated by piezoelectric sensor and foot step with minimum manual operation. Thus, it is clear that the method of Foot step power generation system for rural energy applications is a technique worthy being developed.

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