Footstep Power Generation Using Piezoelectric Sensors

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ABSTRACT:

Background and Objectives: Demand on energy has been adopted throughout the world, and traditional methods of generating power have a direct impact on environment. So, here we are proposing a non- conventional method of power generation that utilizes wasted energy in un-interrupted way and cope with the increasing demand of energy. The basic concept of this system is capturing unused energy when a person walks on a certain arrangement and converting it into electrical energy.

Methodology and Implementation: The power generated with this non-conventional method depending on the human daily activity (walking) .This energy is then stored in a Lead Acid battery so we can charge any device such as mobile phones. Also this system enables us of viewing the amount of output voltage using an LCD. This project would be installed in crowded cities like Hebron and Gaza strip in places where people exists the most, for example: stations, entries, stairs, restaurants, and streets. We made such an arrangement so we can obtain an efficient and reliable system using embedded technologies. The ATMega328 microcontroller which is the heart of the circuit, allows dynamic and fast control of all of the functions, the LCD makes the system user friendly. At the end of implementation, we were able to develop a compatible system that serves us in many ways after installing it at homes, schools, and other places where the people move around. The system successfully generates power and the results were approved.

Keywords: Piezo Electric Sensor, LED, Arduino Uno

1. INTRODUCTION

1.1. Overview

Energy crisis is a major concern in today's world. As the demand of energy is increasing day by day, energy is wasted in many ways. So we think that implementing a renewable source of energy is the optimum solution to deal with this problem. Footstep

power generation would be an effective method to generate electricity. In this project, we could use a technique that generates power through footsteps, which enables the use of energy that is wasted when a person walks on certain arrangements like footpaths and stairs. We could install this project, in highly crowded areas such as stations, entries, etc. So, we can obtain the maximum amount of wastedenergy.

1.2.Motivation

Man has been looking for energy from the starting of human beings. This demand is always increasing; at the same time the wastage of energy is also increasing. So, thinking of ways to reform this wasted energy back to usable form is so helpful. Generating power using conservative methods is becoming deficient. So, our project is a new way to overcome the increasing demand of energy easily by utilizing human force.

1.3.Importance

The Fuel deposit will soon extinct, in addition of many petrol resource, so our project is non- conventional and non-polluting form of power system to be applied in crowded cities same as Hebron and Gaza strip that would have also a low chance of using petroleum products in future.In our system we try to utilize the wasted energy of foot that is produced by human motion and converting mechanical energy into electrical energy; thus reduce the dependency on conventional electricity. This system is reliable, economical and eco- friendly system , which means it has no harm upon the environment.

1.4.Aim

Our aim is to design and develop almost free noise power generator that depends on human footsteps, also to create a model that would show the feature of the system and works depending on our need.

In order to reach this valuable aim, these objectives should be achieved:

- Collect and arrange the electrical system in proper order that will transfer mechanical energy into electrical energy.
- Attach the Piezo sensors to the platform in suitable arrangement.
- After that, voltage is produced through the steps and stored in the lead acid battery.
- Finally, this voltage could be used in many applications like charging the mobile battery.

1.5.System Description

The system design is based on the foot force applied on the" biezoelectrical" sensors which are placed bellow the platform. The force is converted to electrical energy and

that process is known as the piezoelectric effect. Then the energy provided to the circuit allows user to monitor the voltage on drive DC loads. The voltage is stored in the Lead Acid battery. Finally, the circuit is connected to USB cable for charging as shown in figure 1.5. All of these components convert voltage to power that enables the charging of devices like: Mobile, Tablets, MP3 devices, and charger light.. Fig 1.1 shows a simple overview of our project.

2. LITERATURE SURVEY

2.1 LITERATURE STUDY:

According to T.R. Deshmukh paper deals with design and modeling of parts of the model of the foot step power generation system using 3d modeling software creo. This process consist number of simple setup that is installed under the walking or standing platform.

Project system works on the principle of converting the linear motion because to pressure of foot steps into rotating motion by rack and pinion arrangement. This mechanism fails if there is any occurrence of variable load leads to balancing type problems Power is not generated during return movement of rack. Sasank shekhar Panda's paper is based on crank shaft; fly wheel, and gear arrangement .This type of footsteps power generation system are eligible to be installed in crowded places and rural areas. Thus this is a very good technology to provide effective solution to power related problems to affordable extent. This will be the most acceptable means of providing power to the places that involves difficulties of transmission. Maintenance and lubrication is required time to time. Miss. Mathane state that Piezoelectric materials having crystalline structure. They can convert mechanical energy in the electrical energy and vice versa. The produced electrical energy from piezoelectric crystal is very low in the order of 2-3 volts and is stored in battery to charge controller, since it is not possible to charge 12v battery through crystal output.

To increase the voltage, the boost converter circuit is used. Comparison between various piezo electric material shows that PZT is superior in characteristics. Also, by comparison it was found that series- parallel combination connection is more suitable. The weight applied on the tile and corresponding voltage generated is studied and they are found to have linear relation. It is especially suited for implementation in crowded areas. Jose Ananth Vino state that project using simple drive mechanism which include rack and pinion assembly and chain drive mechanism. The conversion of the pressure or force energy in to electrical energy. The power generation is very high but The initial cost of this system is high. There is

no need of power from the mains and these system is eco friendly. It is very useful at the crowded places and on all roads and as well as all kind of foot step which is used to generate the electricity. Maintenance and lubrication is required time to time. Power is not generated during return movement of rack.

2.2 Literature Survey:

Earlier developments in the piezo electric circuitry involved concentration on small vibrations and hence small strains. Also, few of them required external voltage supply and there were number of losses in the system which amounts to low voltage output.

In December 1929, scientists in U.S Navy performed various researches on piezoelectric crystals. Their focus was primary on the dimensions of crystals. This research proved that by changing the dimension and orientation of crystal the output is considerably changed. They designed the crystal named 'Curie cut' or 'Zero Cut' based on the changes made in the angles of the crystal. Thus, this proves that the crystals designed with such dimensions are effective in controlling oscillations of a 50watt vacuum tube. So, they act as a voltage controlling device too.

In 1985, the concept of using handwriting dynamics for electronic identification was performed in Sandia Laboratories. A piezoelectric sensor pen for obtaining the pen point dynamics during writing was studied. Design equations were derived and details of an operating device were studied. Typical output waveforms obtained from the operation of the pen and showed the dissimilarities between dynamics of a genuine signature and an attempted forgery. So, this also shows high sensitivity of Piezo material towards marginal pressure change.

In 2000, various applications of piezoelectric in wireless sensing was studied and experimented. Numerous industrial and military applications require remote sensing of various machine and equipment operating parameters in locations where traditional power sources may not be available and long periods of unattended operation are required. Quite often, however, some source of Vibrating energy may be present in operation of the machine in question. Hence a piezoelectric source is efficiently utilized to generate power for the operation of a microcontroller and radio transmitter to acquire sampled machine data. Various techniques for the efficient conversion, use and storage of piezoelectric power are discovered and

3.HARDWARE DESCRIPTION

3.1Power supply:

Her e we are using an adapter of 12Vand 1A as a power supply to turn on the system.

This adapter contains a transformer to convert the mains electricity voltage (220V) to a lower voltage (12V), a rectifier to convert it to pulsating DC, and a filter to smooth the pulsating waveform to DC, with residual ripple variations small enough to leave the powered device unaffected.

3.2Piezoelectric 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.

3.3AC Ripple Neutralizer:

It is used to remove the ripples from the output of the rectifier and smoothens the o/p of the D.C which is received from the filter, and it is constant until the load and mains voltage is kept constant. Though, if either of the two is varied, then the received D.C. voltage at this point changes. So a regulator is applied at the output stage. For the positive half cycle of the input ac voltage, diodes D1 and D3 connect, whereas diodes D2 and D4 remain in the OFF state. The conducting diodes will be in series with the load resistance RL and hence the load current flows through RL. For the negative half cycle of the input ac voltage, diodes D2 and D4 conduct whereas, D1 and D3 remain OFF. The conducting diodes D2 and D4 will be in series with the load resistance RL and hence the current flows through RL in the same direction as in the previous half cycle.

3.4Lead acid battery:

Battery (electricity), an array of electrochemical cells for electricity storage, either individually linked or individually linked and housed in a single unit. An electrical battery is a combination of one or more electrochemical cells, used to covert stored chemical energy into electrical energy. Lead battery is most commonly used in PV systems due to low cost and easily available everywhere in the world. These batteries are available in both sealed and wet cell batteries. Lead acid batteries have high reliability due to their capability to withstand overcharge, over discharge & shock. The batteries have excellent charge acceptance, low self-discharge and large electrolyte volume. Lead acid batteries Are tested using Computer Aided Design. These applications of these batteries are used in UPS Systems and inverters and have the skill to perform under dangerous conditions.

3.5Battery Connections :

Lead-acid batteries are normally available in blocks of 2V, 6V or 12V.In most cases, to generate the necessary operating voltage and capacity of the batteries for the solar Inverter, many batteries have to be connected together in parallel and/or in

series. Following the two connections are shown below.

3.6 VoltageSampler:

Voltage Sampler or sample and hold circuit is an essential analog building block and the applications of voltage sampler includes switched capacitor filters and analog-to-digital converters. The main function of the sample and hold circuit is to sample an analog i/p signal and hold this value over a particular length of time for subsequent processing. Sample and hold circuit is designed using only one capacitor and one MOS transistor. The working of this circuit is straight forward. When CK is high, then the MOS switch will be ON, which in turn permits output voltage to track input voltage. When CK low, then the MOS switch will be OFF.

3.7 Analog to Digital Converter:

ADC (analog-to-digital converter) is a device that converts analog to digital symbols. An analog to digital converter may also offer an isolated measurement. The reverse operation is achieved by a DAC (digital-to-analog converter). Typically, this is an electronic device that alters an analog input like voltage or current to a digital output, which is related to the magnitude of the voltage or current. Nevertheless, some partially electronic devices like rotary encoders, can also be considered as ADCs.

3.8Arduino

The Arduino can be a small board with a brain (called microcontroller) that could be customised .An Arduino is an open source microcontroller advancement board . Basically ,this stage passes on an approach to manufacture and program electrical modules.It interfaces with led's , sensors ,engines ,LCD's ,ringers ,and so on for this real world.

3.9 Inverter:

An inverter is an electrical device that converts direct current to alternating current; the converted alternating current can be at any required voltage & frequency with the use of applicable control circuits, transformers and switching.

4.RESULTS AND DISCUSSIONS

4.1 TESTING AND RESULTS:

This work here presents number of experiments for testing the Piezo sensors in different conditions with variable parameters to evaluate its performance and properties.

4.1.1.EXP1 output voltage of variable number of Piezo cell

Steps:

1. We have taken one Piezo plate and soldered 2 wires on its negative and positive sides.

2. Also we have connected a single diode on the positive end for the purpose of rectification (because the Piezo plate generates AC voltage and we need to convert it into DC).

3. We have connected the wires into a multimeter to measure the voltage.

4. We have applied some pressure on the plate and noticed the output voltage on the multimeter and filled up the result on a table (the output voltage varies with the pressure we applied on the plate).

For the other part of the experiment, we increased the number of Piezo plates starting from 2 plates to 4, and followed the same steps (connected the Piezo plates, wires, a bridge rectifier and the multimeter) to see how the amount of generated voltage would varies, and filled up the results.

5. 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. These signals are then provided to the microcontroller based circuit.

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, thus using this power to charge a connected battery by it. This model displays the charge generated on an LCD display, Also it consists of a USB mobile phone charging point to charge other devices.Implementing this project can be considered as a solution of power crisis that faces our country.

As a future work, this principal can be applied in the speed breakers at high ways, where the vehicles rushes too much so ultimate power generated is obtained.

6. REFERENCES

1."Footstep Power Generation" by Vishwanil V. Sarnaik; Akshay P. Karnewar; Akshay S. Jidge; Tejas P. Pawar; GRD Journals- Global Research and Development Journal for Engineering | Volume 2 | Issue 7 | June 2017.

2.Footstep Power Generation system by Muhammad SherazKundi, Kamran Hayat, Muhammad Zeshan Haider.

3."Footstep Power Generation system", YogeshMotey, PoojaDekate, MadhushriKewate, JayashreeAswale. International Journal of Innovations in Engineering and Science, Vol. 2, No.6,2017.

4." Foot Step Power Generation System" Ali Muhammad,aAsifAlib, SumeraBibic, Nadeem

Ahmed Tuniod, 4th InternationalConference on Energy Environment and Sustainable Development 2016 (EESD 2016).

5."Power Generation Footste" Sir Syed, Karachi, Pakistan, International Journal of Advancements in Research & Technology, Volume 3, Issue 4, April-2014.

6.Footstep Energy Generation By Piezoelectric Effect: A Case Study On New Delhi RailWay Station, International Journal of electronics & data communication.

7.Foot Step Power Generation Using Piezoelectric Material, MathaneNitashree V., SalunkheArati L, GaikwadSayali S, International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) Volume 4, Issue 10, October 2015.

8. Footstep Power Generation Using Piezo Electric Transducers, KiranBoby, Aleena Paul K, Anumol.C.V, Josnie Ann Thomas, Nimisha K.K., International Journal of Engineering and Innovative Technology (IJEIT) Volume 3, Issue 10, April 2014.

9. Proposed Method of Foot Step Power Generation Using Piezo Electric Sensor, Mr.A.Adhithan1, K.Vignesh, M.Manikandan, International Advanced Research Journal in Science, Engineering and TechnologyVol. 2, Issue 4, April 2015.

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