SHOE EMBEDDED PIEZOELECTRIC ENERGY HARVESTER

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Abstract—There has been a rise in the usage of low powered portable electronic devices in the last decade. Use of these devices has eased our daily lives to a great extent. Due to increase in power consumption of these portable devices, the concept of generating alternative renewable energy arise a new interest.For an alternate method to generate electricity there are number of methods by which electricity can be produced, out if such methods piezoelectric generation can be an effective method to generate electricity. This project makes use of the piezoelectric concept which states that mechanical energy can be converted to electrical energy when the piezoelectric material is subjected to external pressure, for example walking. Walking is the most common activity in human life. When a person walks, he loses energy to the surface in the form of impact or vibration due to the transfer of his weight on to the surface, through foot falls on the ground during every step. This energy can be tapped and converted in the usable form such as in electrical form. This device, if embedded in the shoe, can convert foot impact energy into electrical form. This project represents a piezoelectric energy generating model.

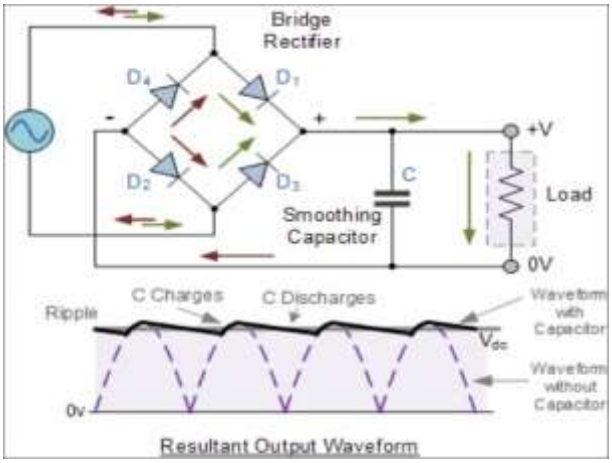
I. INTRODUCTION

With this project we try to promote use of non-conventional source of energy. As we know, the world is facing a major energy crisis. According to World Energy Outlook study by the International Energy Agency, the fossil fuels will be depleted in the next few decades. Hence for an emerging economy like India this issue is of a major focus. There is an urgent need to come with alternative sources of energy. With this project we try to take a step towards solving this problem. Due to rise in energy consumption of portable electronic devices, the concept of harvesting renewable energy in human surrounding arouses a renewed interest. Energy harvesting is defined as capturing minute amounts of energy from one or more of the surrounding energy sources. This project focuses on one such advanced method of energy harvesting using piezoelectric material. Piezoelectric materials can be used as mechanisms to transfer mechanical energy into electrical energy that can be stored and used to power other devices. A piezoelectric substance is one that produces an electric charge when a mechanical stress is applied. The functionality of this project is to generate electricity using these piezoelectric disks or chips which are placed beneath the sole of a shoe. The energy generated by the insole generator is stored in a battery which can be later used for charging portable electronic device and increasing their battery time.

II. PROPOSED SYSTEM

A. Current Generation

Generation of electricity is the most important step in this project. The piezoelectric plates are connected in a parallel manner and connected to the load with a specific circuitry. This generator is termed as insole generator and it is placed beneath the sole of the shoe. The output from a single piezo chip is extremely low, so combination of piezo chips are 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 chips there is increase in voltage. So we are using both parallel and series connection. Since the plates generate AC current , an additional bridge rectifier coupled with a capacitor is connected after the piezoelectric circuit to convert generated AC voltage into DC. A bridge rectifier allows current to pass in the forward direction during the positive part of the AC cycle and as shunt components to redirect current flowing in the reverse direction during the negative part of the AC cycle to the opposite rails. The capacitor is used to smooth out the power supply since the current generated by the piezo electric generator is unstable. This circuit is then connected to the load which in our case is a battery. This battery can be later used to charge portable devices.

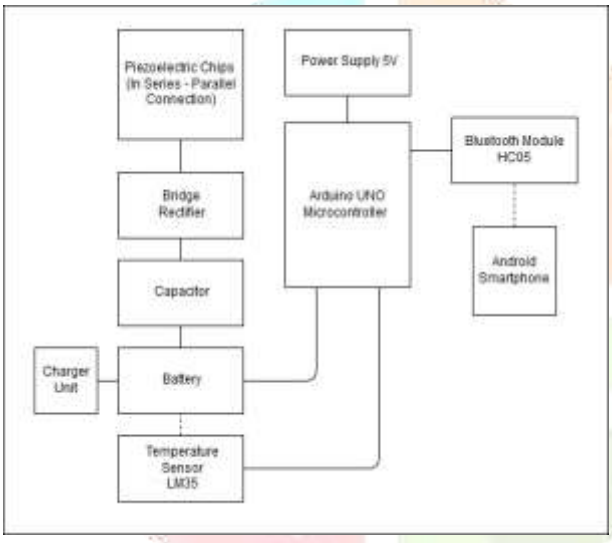


B. Android Application

This comes under the second part of the project where the focus is on software aspect of the project. Basically an Arduino (UNO) with a bluetooth module (HC05) is connected to the battery. It is programmed in such a manner that it collects and transmits live data to our Android smartphone. The information passed can be later processed to give us an idea about the voltage, temperature and steps needed to fully charge the device. A basic android application is developed in order to collect the transmitted data and represent in systematic manner, giving information about the tracked data. Battery temperature is measured using the LM35 Temperature Sensor and kept in vicinity of the battery.

III. System Architecture

The block diagram for the architecture of proposed system is as follows :



IV. Components used in Proposed System

Following components are used in the proposed system :

1] Piezoelectric Plates

The piezoelectric plates form the primary component of the generator. They are placed inside the sole of the shoe in series parallel combination.

2] Bridge Rectifier

A bridge rectifier diode is used to convert the generated AC current by the piezo electric generator into DC.

3] Arduino UNO

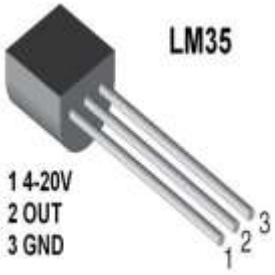
The Arduino UNO microcontroller interfaces the hardware part of the project with the software part. It is used to calculate the voltage as well as the temperature of the battery and send it to the android smartphone via its bluetooth module. The microcontroller is an integral part of the system.

4] Bluetooth Module HC05

The bluetooth module is used to connect the Arduino to your smartphone. It facilates the data transfer between the two.

5] Temperature Sensor LM35

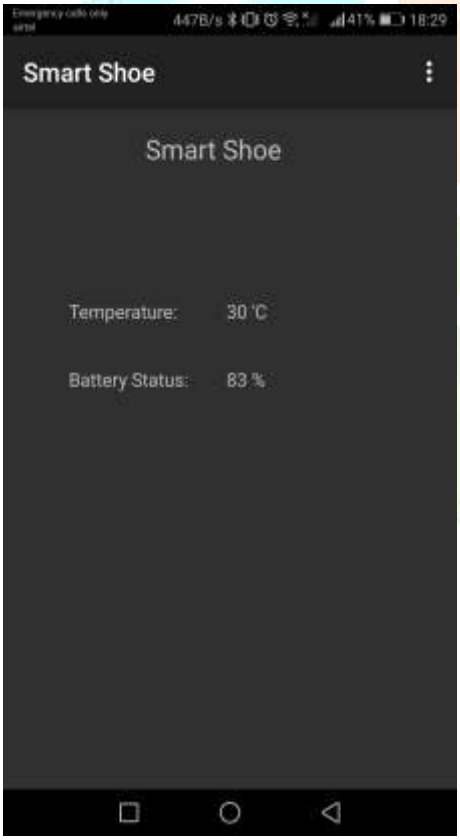
The LM35 temperature sensor for Arduino is used to sense the temperature of the battery which is being charged by the piezoelectric generator in order to monitor its condition.



6] Other Requirements
-Capacitor
-Wires
-Breadboard (For Testing)
-Android Device
-Rechargeable Batteries
-Shoe

V. Results

1] The Android App:



2] Specifications:

2.1] Current Generated: 3-4 Volts per foot step.
2.2] Capacitor discharge rate: 0.1 s.
2.3] Time taken to charge a 1.25V battery from 0 to full:15-20 min.

VI. Conclusion

The design presented here will be quite effective in providing an alternate means of power supply for the portable devices during an emergency. Furthermore, the approach presented in this project can be extended to many other applications where there is scope for similar kind of energy conservation.

VII. Future Scope

This system can be used to charge any device which supports rechargeable battery. It is not conned to only mobile phones. Future scope of this project is very high. It can be applied in any place wherever there is mechanical stress into play. Piezoelectric materials can be placed under the floor on various busy areas and can be used as a renewable energy source for lighting system present around. It can also be placed under the floor of discos as a large amount of pressure is applied on the floors there while jumping. This piezoelectric system can be employed under the railway tracks so as when the train passes over it, it will lead to the generation electric power. The power generated by this system will be very large as the force applied by the trains would be very high. This system can very efciently be used in wireless keyboards. Such keyboards then can be self-charging which will eliminate the frequent charging requirement of such keyboards.

References

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