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EFFECTIVE POWER HARVESTING USING PIEZOELECTRIC EFFECT

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Abstract: In this paper,it explains about mechanical energy transformed to electrical energy using piezoelectric crystal. When a pressure is exerted on a piezoelectric crystal and this pressure can be converted into electrical energy and it can be used to power electronic devices. Micro to milliwatts of power can be generated from vibrating structures. In devices like mobile phones, remotes, laptops etc: there needed key depressions for operation, mechanical vibrations are produced during this key depressions. In this paper we are using this converted energy to charge a battery, along with this battery charging we are in cooperating a liquid crystal display so as to provide a display on the amount of charge that obtained while pressing the keys. The heart of the system is a piezoelectric crystal which is placed under the keys. The power that is generated by piezo electric generator circuit is then transferred to the device and stored.

Index Terms— *atmega32, piezoelectric crystals*

1 INTRODUCTION

In the recent years there has been an increasing interest in research and development of charging from renewable resources. Recent researches proven that this unused resources can be used for charging the gadgets. Nowadays the problems associated with the devices are the fast draining of battery. Almost every smartphone user wishes he had more battery life. Now, imagine your phone getting charged when you are pressing the keys. This is possible by Piezo electric mobile charging technique.

It is proven that vibrations due to the key depressions of any keypad integrated device such as mobile phones can be transformed to electrical energy.Mechanical low frequency stress is converted into electrical energy is obtained through the direct piezoelectric effect, using a rectifier and DC-DC converter circuit to store the generated electrical energy. There are three steps for power generation: (a) trapping mechanical AC stress from available source. (b) Converting the mechanical energy to electrical energy using piezoelectric transducer.(c) Processing and storing the generated electrical energy. This paper presents a model of piezoelectric transducer for a gadget like, mobile phone,prototype of the power scavenging circuit, and the overall circuit for charging the mobile

In this project we design a charging network. Depending on the frequency and amplitude of mechanical stress, one can design the required transducer, its dimensions, vibration mode and desired piezoelectric material.The energy generated is proportional to frequency and strain and higher energy can be obtained by operating at the resonance of the system.

2 LITERATURE SURVEY

2.1 Power Harvesting System In Mobile Phones And Laptops Using Piezoelectric Charge Generation:

This paper targets the transformation of mechanical energy to electrical energy using piezoelectric materials. With piezoelectric materials, it is possible to harvest power from vibrating structures. It has been proven that, micro to milli watts of power can be generated from vibrating materials. In gadgets like mobile phones, television remotes, laptops and other devices which employ key depressions for operation, mechanical vibrations are produced while pressing the keys. If these vibrations are successfully harvested, the resulting energy could serve as an ancillary source of energy for charging the batteries. This paper presents a model of piezoelectric

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circuit for charging the mobile battery using the generated energy.

2.2 Piezoelectric Energy Harvesting Via Shoe sole:

This paper present the experimental design of an energy harvesting system using active materials for power generation from the shoe sole. The active material as PZT has been employed and modified to be appropriately embedded in the shoe sole. When the mechanical pressure is applied to the embedded shoe sole while walking would extract mechanical vibration energy and convert extracted energy to electrical energy directly from the piezoelectric structure inserted in shoe sole via a rectifier to a power processing system. The power processing system regulates the harvested electrical energy and accumulates the generated electrical energy to sufficient voltage level for powering portable electronic devices for later use.

2.3 Full-Featured Pedometer Design Realized with 3-Axis Digital Accelerometer : Pedometers, now popular as an everyday exercise, Progress monitor and motivator, can encourage individuals to compete with themselves in getting fit and losing weight. Early designs used a weighted mechanical switch to detect steps, plus a simple counter. When these devices are shaken, one can hear a metal ball sliding back and forth, or a pendulum striking stops as it swings. Advanced pedometers rely on micro electromechanical systems (MEMS) inertial sensors and sophisticated software to detect true steps with high probability; MEMS inertial sensors permit more accurate detection of steps and fewer false positives. Taking advantage of the low cost and minimal space- and power requirements of MEMS inertial sensors, pedometers are being integrated into an increasing number of portable consumer electronic devices such as music players and mobile phones. The small, thin,low-power ADXL335, ADXL345, and ADXL346 3-axis accelerometers from Analog devices are very suitable for such applications.
This article, based on a study of the characteristics of each step a person takes, describes a reference design using the 3-axis ADXL345 accelerometer in a full-featured pedometer that can recognize and count steps, as well as measure distance, speed, and extent of calories burned. [3] discussed about principles of Semiconductors which forms the basis of Electronic Devices and Components.

increased a lot as compared to last year. As the use of electronic devices increases the demand for electricity also increases. By this project we can decrease the unwanted use of electricity. Unused power exists in various forms such as industrial machines, human activity, vehicles, structures and Environment sources. Among these, one of the promising sources of recovering energy is from the vibrations generated by the key depressions of any keypad integrated device such as a mobile phone.

4 SYSTEM DESIGN

It basically consists of piezo electric crystals, LCD display, atmega32. The primary source of the charge is the piezo electric crystal which produces the electric charge corresponding to the pressure applied due to the key depression. A bridge rectifier is used which converts the ac power generated by the crystal in to dc voltage. A filter is provided which removes the unwanted noise components in the signal. A charging circuit is provided which raise the signal power to the required level. The generated power is stored inside the battery.

The micro controller used here is the atmega32 which takes the supply from this battery to drive the lcd display. A transducer can be anything which converts one form of energy to another. Piezoelectric material is one kind of transducers. We squeeze this material or we apply force or pressure on this material it converts it into electric voltage and this voltage is function of the force or pressure applied to it. The material which behaves in such a way is also known as piezoelectric sensor. The electric voltage produced by piezoelectric transducer can be easily measured by voltage measuring instruments, which can be used to measure stresses or forces. The physical quantity like mechanical stress or force cannot be measured directly. Therefore, piezoelectric transducer can be used. The four diodes labelled D_1 to D_4 are arranged in "series pairs" with only two diodes conducting current during each half cycle. During the positive half cycle of the supply, diodes D1 and D2 conduct in series while diodes D3 and D4 are reverse biased and the current flows through the load.

During the negative half cycle of the supply, diodes D3 and D4 conduct in series, but diodes D1 and D2 switch "OFF" as they are now reverse biased. The current flowing through the load is the same direction as before.

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Capacitor filter: Filter capacitors work is based on the principle of capacitive reactance. Capacitive reactance is how the impedance (or resistance) of a capacitor changes in regard to the frequency of the signal passing through it. Resistors are nonreactive devices. This means that resistors offer the same resistance to a signal, regardless of the signal's frequency. This means, for example, that a signal of 1Hz and a signal of 100KHZ, will pass through a resistor with the same resistance. Frequency isn't a factor. However, a capacitor is not like this. A capacitor is a reactive device. Its resistance, or impedance, will vary according to the frequency of the signal passing through. Capacitors are reactive devices which offer higher resistance to lower frequency signals and, conversely, lower resistance to higher frequency signals, according to the formula **XC= 1/2πfc**.

Piezo electric crystals: They are substances which produces electricity when pressure is applied. This crystals convert mechanical energy into electrical energy. Piezo electric ceramics can be divided into single crystals and poly crystals. Single crystal ceramic usually referred to as piezo electric crystals. Piezoelectric crystals are substances that generate electricity when a pressure is exerted. This crystal converts the mechanical energy to electrical energy.

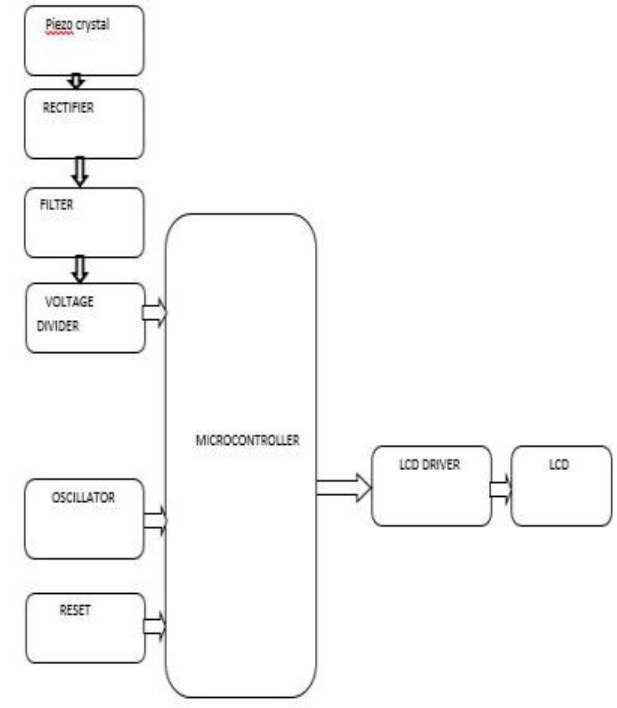
AVR microcontroller: AVR is the microcontroller used in this project. The major heart of this project is AVR microcontroller, it has more features like 16bit timer, 10-bit ADC, USART, SPI, I2C, 256 bytes of EEPROM memory, and 32kbytes of flash program memory, then at last its speed of program execution is about to 1 microsecond or 10 MIPS (10 Million Instructions per second),etc. However, compare to other microcontroller it is fast and very ease to program in C language because of huge support can gain from the manufacturer for programming.

Crystal oscillator: A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of vibrating crystal of piezoel ectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time, to provide a stable clock signal for microcontrollers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits incorporating them became known as crystal oscillators.

Power supply: A **power supply** is a device that supplies electric power to an electrical load. The term is most commonly applied to electric power converters that convert one form of electrical energy to another, though it may also refer to devices that convert another form of energy (mechanical, chemical, solar) to electrical energy. A regulated power supply is one that controls the output voltage or current to a specific value; the controlled value is held nearly constant despite variations in either load current or the voltage supplied by the power supply's energy source.

LCD display : It is an electronic display module and find a wide range of applications. Here we use of 16x2 LCD. It can display 16 characters per line. And there are two such lines. It has two registers command and data. The command register stores the instruction given to the lcd display. It is a defined task like clearing, positioning the cursor etc. The data register stores the data to be displayed in the screen.

Rectifier: A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification.



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5. IMPLEMENTATION

The hardware and software requirements and the work flow of the proposed system are described here. The rectifier maybe either a full wave rectification circuit or a half wave rectification circuit based on the combination of diodes or a voltage double rectifier. Since a diode is being used in the rectifier, a p-n junction diode or a Schottky diode can be used. The Schottky diode has a threshold voltage which is smaller than that of a p-n junction diode. For example, if the diode is formed on a silicon substrate, a p-n diode may have a threshold voltage of approximately 0.065 volts while the threshold voltage of a Schottky diode is approximately 0.30 volts. Accordingly, the uses of Schottky diode instead of p-ndiode will reduce the power consumption required for rectification and will effectively increase the electrical charge available for accumulation by the capacitor. When the electromotive force in the piezoelectricity generation section is small, a Schottky diode having a low rising voltage is more preferable. The bridge rectifier section provides rectification of the AC voltage generated by the piezoelectric section. By arranging the rectification section on a monolithic n- Si substrate, it is possible to form a very compact rectification section.

6. CONCLUSION

In this work we have illustrated the design of system which can use the power generation system by the human generation movement and use this for charging. This project helps the solution to the problem of charging the devices. Harvesting energy from mechanical stress is an attractive approach for obtaining clean and sustainable energy. The design presented here will be quite affective in providing an alternate means of power supply for the mobile phones and laptops during emergency using piezoelectric. Can be extended to many other applications where there is scope for similar kind of energy conservation. This project has its root in all the areas of consumer electronics.

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