Design And Development of Vibration Sensor Using Moving Car

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ABSTRACT

Today, the man has needed a lot of energy in day to day life. Many application is related to or operated on electrical energy. Energy crises is a major problem in the world. So the focus of this paper is generation of electrical energy, and this energy is generated by using the sensor known as Piezoelectric Sensor. It converts the pressure or weight into electrical energy. Piezoelectric material can be used to convert mechanical energy to electrical energy, when mechanical stress is applied. Conversely, a mechanical deformation is produced when an electric field is applied. In this research paper we can used this mechanism and generate electrical energy that can be stored and used to power device. The goal of this research work is to make power generation more economical.

Keyword : *-Piezoelectric effect, Piezoelectric material, Electrical Energy, Energy Crises etc…*

1.INTRODUCTION

In last few years low power electronic devices have been increased rapidly. The devices are used in a large number to comfort our daily lives. With the increase in energy consumption of these portable electronic devices, the concept of harvesting alternative renewable energy in human surroundings arise a new interest among us.[1] In this project we are trying to develop a piezoelectric generator. That can produce energy from vibration and pressure available on some other term (like people walking, Train vibrations, Moving cars vibrations etc). This project describes the use of piezoelectric materials in order to harvest energy from people walking vibration for generating and accumulating the energy. This concept is also applicable to some large vibration sources which can find from nature. This project also represents a footstep of piezoelectric energy harvesting model which is cost effective and easy to implement. The piezoelectric material we used is Lead Zirconate Titanate.

2.PIEZOELECTRIC MATERIAL

*2.*1 Study of Piezoelectric Material

Piezoelectric ceramics is a made up of group of ferroelectric materials. Without an electric field applied Ferroelectric materials are crystals. The piezoelectric effect is common in piezo ceramics like PbTiO3, PbZrO3, PVDF and PZT. The main focus in this project is the piezoelectric material. The proper choice of the piezo material is very important. For this, the analysis of the two materials is important which is used like PZT and PVDF. The criterion for selection was better output voltage when pressure is applied. For this the Piezo transducer material under test is placed on a Piezo force sensor. Voltmeters are connected across both of them for measuring voltages and an ammeter is connected to measure the current.By changing applied pressure on piezo material it gives

different voltage. For each such voltage reading across the force sensor, various voltage and current readings of the Piezo test material are noted.

PZT

PZT, or Lead Zirconate titanate (Pb[Zr(x)Ti(1-x)]O3),is one of the world's most widely used piezoelectric ceramic material. When fired ,PZT has a perovskite crystal structure, each unit of which consist of a small tetravalent metal ion lattice of large divalent metal ion.[2] In case of PZT, the small tetravalent metal ion is usually titanium or zirconium. The large divalent metal ion is usally lead.Under condition that confer a tetragonal or ehombohedral symmetry on the PZT crystals, each crystal has a dipole moment.

Basic Principle

The main principle of piezoelectric material is to produce a electric charges on the crystal surface like quartz, Lead Zirconate Titanate when they subjected to compressive force. The charge thus produced can be called as piezoelectricity. Piezoelectricity can be defined as the electrical polarization produced by mechanical strain on certain class of crystals. The rate of charge produced will be proportional to the rate of change of force applied as input. As the charge produced is very small, a charge amplifier is needed so as to produce an output voltage big enough to be measured. The device is also known to be mechanically stiff.

3.MAXIMUM VOLTAGE GENERATION

When a force is applied on piezo material, a charge is generated across it. Thus, it can be assumed to be an ideal capacitor. Thus, all equations governing capacitors can be applied to it. In this project, on one tile, we connect 3 piezo in series.10 such series connections are connected in parallel. Thus when 3 piezoelectric discs are connected in series, its equivalent capacitance becomes

$$1/Ceq = 1/c1+1/c2+1/c3 \quad (1)$$

We Know $Q = C*V \quad (2)$

So, $C = Q/V \quad (3)$

Hence , $Veq = v1/Q+v2/Q+v3 \quad (4)$

Thus, $Veq = v1+v2+v3 \quad (5)$

Hence, the net voltage generated in series connection is the sum of individual voltages generated across each piezoelectric disc. Consider Output voltage from 1 piezo disc is 13V.

Thus, $Veq = v1+v2+v3$

$= 13+13+13$

$= 39V$

Thus the maximum voltage that can be generated across the piezo tile is might be around39V.

3.1 ANALYSIS DONE ON THE PIEZO TILE

When people travel on the piezo tile then it generate the electricity. People whose weight varied from 40kg to 75kg were made to walk on the piezo tile to test the voltage generating capacity of the piezo tile. [3] We have plotted the graph of the weight of the person and power generate. From the graph it can be seen that, maximum voltage is generated when maximum force is applied. Thus, maximum voltage of 40v is generated across the tile when a weight of 75 kg is applied on the tile. Analysis can be done by applying pressure on sensor and how energy is generated.

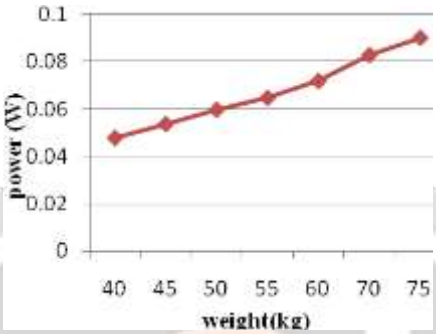

Chart-1: Weight V/s power graph of piezo tile

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4. System Description

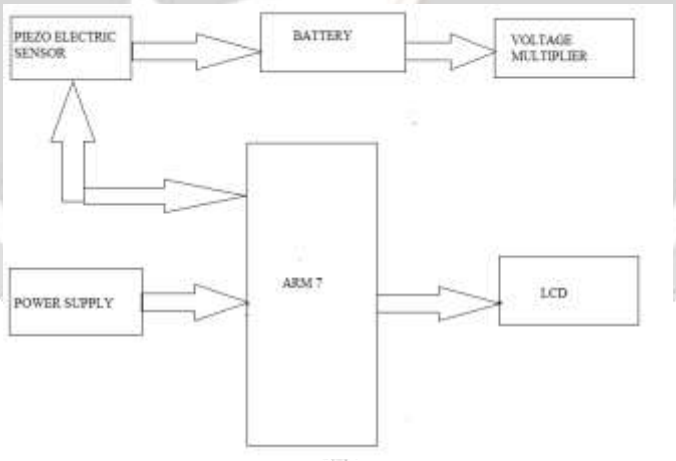

Fig-1: Block Diagram

4.1 Piezoelectric Sensor

A piezoelectric sensor is a device that uses the piezoelectric effect, to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge. In this paper these piezoelectric sensors are placed on two sides of the road to get the optimum amount of pressure.

4.2 Battery

The electricity which is generated by piezos are stored in the battery and can be utilize for various purposes in and around the platform.

4.3 Voltage Multiplier

The voltage generated from piezo sensor is very less so to make that voltage high we use Voltage Multiplier. It used for voltage boosting, so that we get the maximum voltage at the output. A voltage multiplier is an electrical circuit that converts AC electrical power from a lower voltage to a higher DC voltage, typically using a network of capacitors and diodes. Voltage multipliers can be used to generate a few volts for electronic appliances, to millions of volts for purposes such as high-energy physics experiments and lightning safety testing. The most common type of voltage multiplier is the half-wave series multiplier, also called the Villard cascade (but actually invented by Heinrich Greinacher).

4.4 Power Supply

Power supply is used for operating the Arm 7. 7805 is 5v fixed three terminal positive voltage regulator IC. The IC has features such as safe operating area protection, thermal shutdown, internal current limiting which makes the IC very rugged. Output current upto 1A can be drawn from the IC provided that there is a proper heat sink.

4.5 ARM 7

The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed.

4.6 LCD

In this paper 5v power supply is given to LPC2148 Primer Board; the LCD is connected with Arm7 LPC2148 Primer Board. When the program is downloading into LPC2148 in Primer Board, the screen should show the text messages on LCD.

5.FUTURE WORK

In future definitely their will be more number of electric cars than petrol, diesel cars because of its efficiency. So the electricity generated from the road can be used for roadside lamps and also to charge the vehicles itselfs from electric charging station. Industrial and manufacturing units are the largest application market, for piezoelectric devices, followed by the automotive industry. There is also high demand from medical instruments as well as information in telecommunication. The global demand for piezoelectric devices was valued at the approximately US$14.8 billion in 2010. The largest material group for piezoelectric device is piezo crystal and piezo polymer due to its low weight and small size. Piezoelectric crystals are now used in buzzer, solar system also. This technique can solve the problem of electricity to road lighting system, and without the need of kilometers of electrical wire which runs along the side of the road. It is more efficient operation techniques with cost effective device.

6.CONCLUSION

First we connected Piezo sensor with only two stage voltage multiplier circuit but the generated voltage was very low hence we connected 3 piezo sensors with 2stage multiplier circuit for each piezo element and we connected this piezo elements in series hence we generated approximately voltage of 7 to 8 volt. When piezo sensor were activated then we connected the output of the generated voltage to the battery which is 6V dc. when piezo sensors were activated the battery start charging the battery voltage was 6.2V which is given to voltage regulated IC7805 input, the voltage regulated IC generated 7V at is input 5V at is output this 5V was given to LM117 voltage regulated which generated 3.3V which is necessary for LPC2148 then we connected the LCD and piezo sensor output to the

LPC2148 module. When power was given to ARM processor welcome message was displaced then analog channel 1 was read, which is connected to battery output voltage then it show approximately 6.2 V continuously. when 1 LED was connected across the output of the battery, then it is glow .while LED normally used in domestic or outdoor application. From that we conclude energy which is generated from piezo sensor is used in various applications.

7. APPLICATIONS

- This can be implemented on railway station to generate electric power.
- In bus station.
- In car parking system.
- In Airports.
- In Lift system.
- In car lifting system.
- In street lights
- Electric escalators

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