# Piezoelectric Energy Harvester

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***Abstract*—Man has needed and used energy at a increasing rate since a long time with the energy consumption due to large growing number of electronic devices, the great effort has been taken to find echo-friendly and renewable source of energy, the most popular renewable energy sources has high initial investment(such as wind power, hydropower, solar power). This Concept can be used in highly populated countries such as India, china, where the temples and railway station are overcrowded all round clock. One of the most diverting techniques to obtaining energy for this system is to use piezoelectric material. The piezoelectric material has crystalline structure and that provide ability to convert mechanical pressure into electric energy or vice versa. This system can be used in agriculture, street lighting, and home applications.**

***Index Terms*—Piezoelectric sensor, Lead acid battery, LPC2148.**

## I. INTRODUCTION

In the current era, which is witnessing a skyrocketing of energy cost and an exponential decrease in the supplies of fossil fuels, there arises a need of to develop methods for protecting the environment. One of the new ways to finish this is through energy harvesting. Energy harvesting, or energy scavenging, is a process that capture small amount of energy that would otherwise be lost as heat, light, sound, vibration or movement.

It uses this capture energy to improve efficiency and to enable new technology, like wireless sensor networks. Energy harvesting also have capability to replace batteries for small low power electronic devices.

Piezoelectric materials can be used as means of transforming ambient vibration into electric energy that can be stored and used to power to other devices. With the recent surge of micro scale devices, piezoelectric power generation can provide a convenient alternative to traditional power sources used to operate certain types of sensors actuator, telemetry, and MEMS devices.

| Energy sources | Example | Energy level | Conversion mechanism |
|---|---|---|---|
| Ambient radiation | RF signal | <1 | Electromagnetic |
| Vibration | Machine vibration, human motion. | 4-800 | Piezoelectric, electromagnetic, Electrostatic. |
| Fluid flow | Wind ventilation, piping, current wave. | Air:-200-800 Water:-500mW/cm² | Turbine (electromagnetic) piezoelectric |

Table.1Available Energy Sources In The Environment

## II. WORKING PRINCIPLE

The piezoelectric material converts the pressure applied to it into electric energy. The sources of pressure can be either from the weight of the moving vehicles or from the weight of the people walking over it. The output of the piezoelectric material is not a steady one. So a bridge circuit is used to convert this variable voltage into a linear one. Again an AC ripple filter is used to filter out any further fluctuations in the output. The output DC voltage is then stored in a rechargeable battery. An inverter is connected to battery to provide provision to connect AC load. The voltage produce across the tile can be seen in a LED. For these purpose LPC2148 is used.

## II. BLOCK DIAGRAM

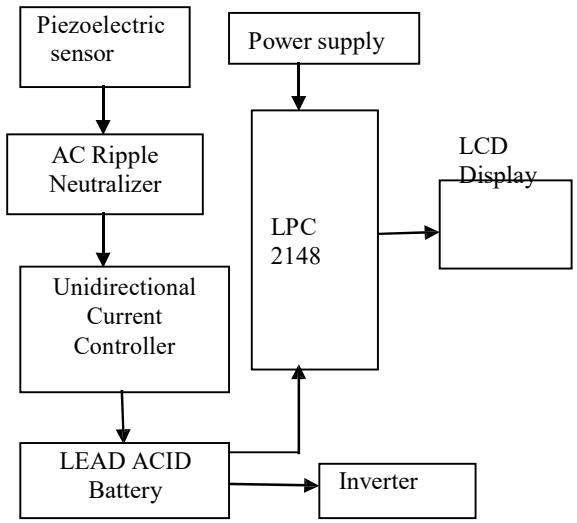


Fig.1 Block Diagram Of Piezoelectric Harvester

## IV. BLOCK DIAGRAM DESCRIPTION

### *A. Piezoelectric sensor*

Fig.2 Piezoelectric Sensor

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 materials exhibit the unique property known as the piezoelectric effect. When these materials are subjected to a compressive or tensile stress, an electric field is generated across the material, creating a voltage gradient and a subsequent current flow. This effect stems from the asymmetric nature of their unit cell when a stress is applied. As seen in figure, the unit cell contains a small positively charges particle in the center. When a stress is applied this particle becomes shifted in one direction which creates a charge distribution, and subsequent electric field. These materials come in several different forms. The most common is crystal, but they are also found as plastics and ceramics.

### *B. AC Ripple Neutralizer*

AC ripple neutralizer is a voltage stabilizer. It is required to protect a high rating component like AC from damage. The circuit essentially involves capacitors as they act as good filter.

### *C. Unidirectional Current Controller*

Diodes and triacs are used a unidirectional current controllers. Diode and triacs based charge controller can be used to charge lead acid battery. in this project, triac based battery charger is used. Triac firing angle control circuit is used to control flow of charge into battery. It will make the flow of current in one direction only by conducting in one direction only. It is used to protect back current to array of sensors. After that voltage is fed to lead acid battery and voltage divider which is connected with LPC 2148.

### *D. Lead acid battery*

Battery 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 convert stored chemical energy into electrical energy. Miniature cells are used to power to power devices such as hearing aids and wristwatches; larger batteries provide standby power for telephone exchanges or computer datacenters.

### *E. Inverter*

Inverter is an electronic device or circuitry that changes DC to AC. The input voltage, output voltage and frequency, and overall power handling depend on the design of specific design or circuitry. The inverter does not produce any power, the power is provided by DC source.

### *F. LCD Display*

16*2 LCD is interfaced with microcontroller. LCD interfacing with LPC2148 .It is used to display status of sensors and battery voltages. Output results are shown below:

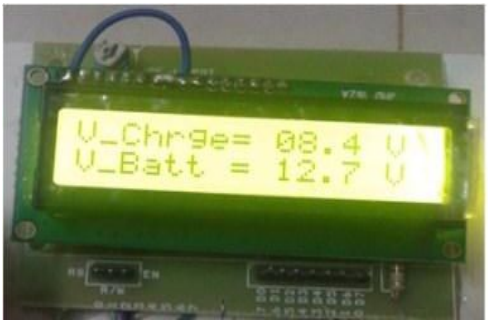


Fig.3 LCD Display

## V. RESULT

In 1square ft. we used 12 piezoelectric sensors. As piezoelectric sensors power generating varies with different steps, we get

Minimum voltage=1V per step

Maximum voltage=10.5V per step

We took an a average of 50kg weight pressure from single person considering the steps of a 50 kg weighted single person, the average calculation are:

It takes 800 steps to increase 1V charge in battery. So, to increase 12V in battery total steps needed

= (12*800)

= 9600 steps

As we will implement our project in a populated area where foot step as source will available, we took an average of 2steps

In 1 second.

Or 9600 steps time needed

= 9600/(60*2)

= 80 minutes. (Approximately)

## VI. CONCLUSION

This project provides the affordable energy solution. India is the developing country where energy management is big challenge for huge populations. By using this project we can derive both AC and DC drive according to force we applied.

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