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POWER GENERATION USING PIEZOELECTRIC MATERIAL

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Abstract - *In Present Condition The Shortage Of Electricity Is The Big Problem For Industrial Growth As Well As Rural Developing. Shortage of Electricity has its effects on India's Developing Growth. To Solve Such Types Of Problem We Need To Develop Strong Electricity Generating Techniques With The Help Of Wasting Human Energy For Our Better Future. In This Project We Are Generating Electrical Power As Non-Conventional Method By Simply Walking Or Running On The Foot Step. Non-Conventional Energy System Is Very Essential At This Time To Our Nation. Non-Conventional Energy Using Foot Step Is Converting Mechanical Energy Into The Electrical Energy. Due To This A Lot Of Energy Resources Have Been Exhausted And Wasted. Proposal For The Utilization Of Waste Energy Foot Power With Human Locomotion Is Very Much Relevant And Important For Highly Populated Countries Like India And China Where The Roads, Railway Stations, Bus Stands, Temple, Etc. Are All Over Crowded and Millions of People Move Around The Clock.*

***Key Words*: Walking, foot step, energy harvesting, quartz, Electrical Energy, Non-Conventional Energy, Shortage of Electricity.**

1. INTRODUCTION

Man has needed and used energy at an increasing rate for his purpose. Due to this a lot of energy resources have been exhausted and wasted. The utilization of waste energy of foot power with human locomotion is very much relevant for highly populated countries where the roads, railway stations, bus stands, temples, etc. The human bio-energy being wasted if it is made possible for utilization it will be very useful energy source. Walking is the most common activity in day to day life. While walking, the person looses energy to the surface in the form of vibration. This energy can be tapped and converted to electrical form. In this paper, piezoelectric crystals were used as a medium. These piezoelectric crystals will convert the mechanical vibrations into electrical energy.

1.1 Piezoelectricity

Piezoelectricity, Discovered By Curie Brothers in 1880, Originated From the Greek Word "Piezenin",[1] Meaning, To Press. The Original Meaning Of The Word "Piezoelectric" Implies "Pressure Electricity' –The Generation Of Electric Field From Applied Pressure. This Definition Ignores The Fact That The Process Is Reversible, Thus Allowing The Generation Of Mechanical Motion By Applying A Field. Piezoelectricity Is Observed If A Stress Is Applied To A Solid, For Example, By Bending Twisting Or Squeezing It. The Phenomenon Of Generation Of A Voltage Under Mechanical Stress Is Referred To As The Direct Piezoelectric Effect, And The Mechanical Strain Produced In The Crystal Under Electric Stress Is Called The Converse Piezoelectric Effect.

1.2 Piezoelectric Material

One of the most suitable methods for obtaining the energy from surrounding system is achieved by using piezoelectric crystals. Piezoelectric crystal is one small scale energy source. When piezoelectric crystals are subjected to vibrations, they generate a very small voltage, commonly known as piezoelectricity. It has crystalline structure that converts an applied vibration into an electrical energy .the piezoelectric effect exists in two properties. The first is the direct piezoelectric effect that describes the material's ability to transform mechanical strain into electrical charge. The second form is the converse effect, which is the ability to convert an applied electrical potential into mechanical strain energy. These properties allows the material to function as a power harvesting medium.[2]

1.3 Implementation of Piezoelectric Material

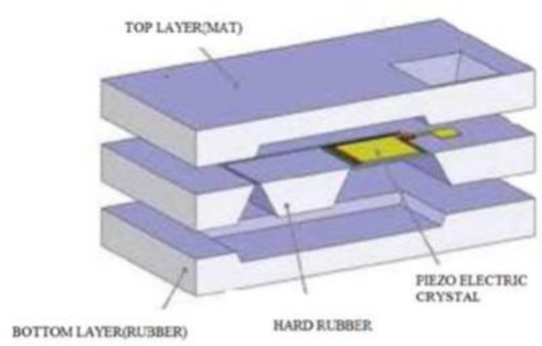


Fig. 1. Implementation of piezoelectric material

Due to the vibrations, a piezoelectric crystal generates the electrical power. The produced output voltage is in the form of ac. Then it can be converted to dc by passing it through rectifier circuit. The converted dc voltage can be fed into boost converter.

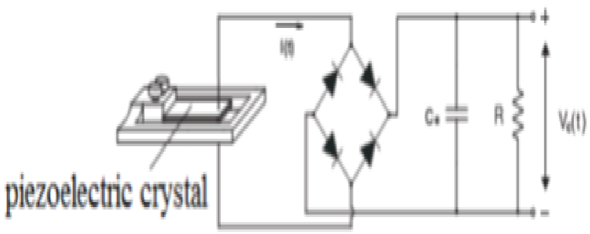


Fig.2 Typical AC-DC harvesting circuit

2. Piezoelectric Materials

1. Quartz
2. Berlinite
3. Sucrose
4. Rochelle salt
5. Topaz
6. Tourmaline-group minerals
7. Lead titanate


Fig.3 Quartz **Fig.4** Berlinite

3. ELEMENTS FOOT STEP POWER GENERATION UNIT

3.1 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 sensors have proven to be versatile tools for the measurement of various processes. They are used for quality assurance, process control and for research and development in many different industries. It was only in the 1950's that the piezoelectric effect started to be used for industrial sensing applications.[4] Since then, this measuring principle has been increasingly used and can be regarded as a mature technology with an outstanding inherent reliability. It has been successfully used in various applications, such as in medical, aerospace, nuclear instrumentation, and as a pressure sensor in the touch pads of mobile phones. In the automotive industry, piezoelectric elements are used to monitor combustion when developing internal combustion engines. The sensors are either directly mounted into additional holes into the cylinder head or the spark/glow plug is equipped with a built in miniature piezoelectric sensor.

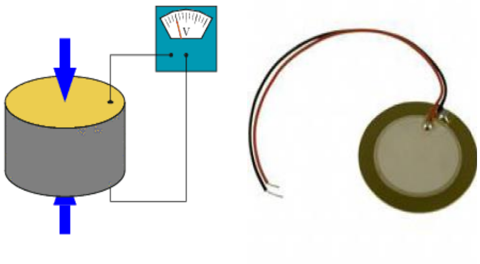


Fig.5 Piezoelectric Sensor

3.2 Unidirectional Current Controller

As name indicates this circuit allows only one direction current. following some devices which is used as unidirectional current controller.

1. Diode
2. Thyristors

3.3Lead 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 convert stored chemical energy into electrical energy. Batteries may be used once and discarded, or recharged for years as in standby power applications. Miniature cells are used to power devices such as hearing aids and wristwatches; larger batteries provide standby power for telephone exchanges or computer data centers.

Fig.6 Lead Acid Battery

3.4 Inverter

An inverter is an electrical device that converts direct current (dc) to alternating current (ac); the converted ac can be at any required voltage and frequency with the use of appropriate transformers, switching, and control circuits. Solid-state inverters have no moving parts and are used in a wide range of applications, from small switching power supplies in computers, to large electric utility high-voltage direct current applications that transport bulk power. Inverters are commonly used to supply ac power from dc sources such as solar panels or batteries.

There are two main types of inverter. The output of a modified sine wave inverter is similar to a square wave output except that the output goes to zero volts for a time before switching positive or negative. It is simple and low cost and is compatible with most electronic devices, except for sensitive or specialized equipment, for example certain laser printers. A pure sine wave inverter produces a nearly perfect sine wave output (<3% total- harmonic distortion) that is essentially the same as utility-supplied grid power. Thus it is compatible with all ac electronic devices. This is the type used in grid-tie inverters. Its design is more complex, and costs 5 or 10 times more per unit power. The electrical inverter is a high-power electronic oscillator. It is so named because early mechanical ac to dc converters was made to work in reverse, and thus were "inverted", to convert dc to ac. The inverter performs the opposite function Of A Rectifier.

3.5 Liquid Crystal Display (LCD)

A liquid crystal display (LCD) is a thin, flat panel used for electronically displaying information such as text, images, and moving pictures. Its uses include monitors for computers, television, instrument panels, and other devices ranging from aircraft cockpit displays, to every-day consumer devices such as gaming devices, clocks, watches, calculators, and telephones.

4. WORKING

Whenever force is applied on piezoelectric crystals that force is converted to electrical energy which can be used to drive dc loads and that minute voltage which is stored in the lead acid battery. The battery is connected to the inverter. This inverter is used to convert the 12 volt D.C to the 230 volt A.C. This 230 volt A.C voltage is used to activate the loads. We are using conventional battery charging unit also for giving supply to the circuitry. Here we are using AT89S52 display to show the amount of battery charged, whenever we place our foot on piezoelectric transducer.

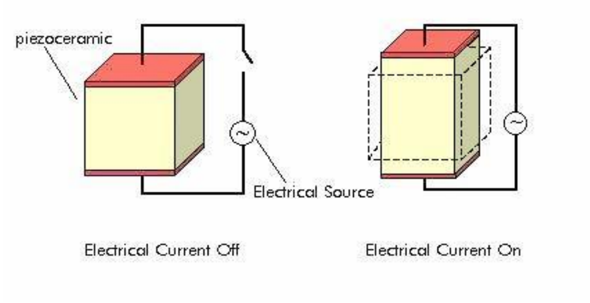


Fig.7 Working Principle

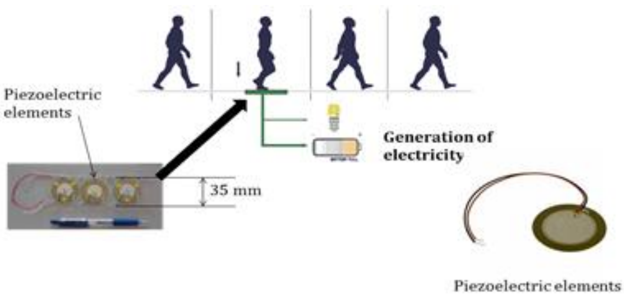
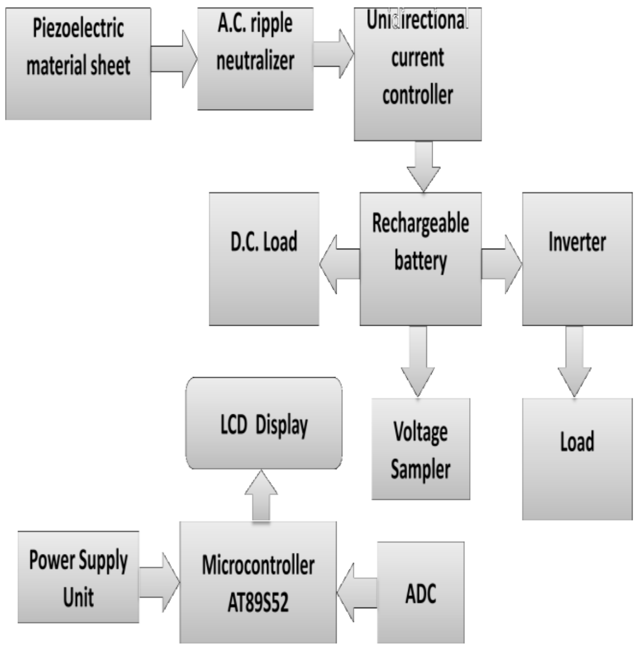


Fig.8 Working Diagram

5. BLOCK DIAGRAM AND IMPLEMENTATION



6. ADVANTAGES

1. Reliable, Economical, Eco-Friendly.
2. Less Consumption of Non-Renewable Energies.
3. Extremely Wide Dynamic Range, Almost Free Of Noise.
4. Suitable For Shock Measurement As Well As For Almost.
5. Imperceptible Vibration.
6. Excellent Linearity over Their Dynamic Range.

7. Compact Yet Highly Sensitive.
8. No Moving Parts-Long Service Life.
9. Self-Generating-No External Power Required.
10. Great Variety of Models Available For Nearly Any Purpose.

7. DISADVANTAGES

1. Capital cost is high.
2. Replace and maintenance is difficult.
3. Cost of replace and maintenance is more.

8. APPLICATIONS

1. Foot step generated power can be used for agricultural, home application, street-lighting.
2. Foot step power generation can be used in emergency power failure situation.
3. Metros, rural applications etc.

3. CONCLUSIONS

1. Power generation using foot step is successfully tested and implemented which is the best economical, affordable energy solution to common people.

2. This can be used for many applications in rural areas where power availability is less or totally absence. As India is a developing country where energy management is a big challenge for huge population.

3. By using this we can drive both A.C As well as D.C loads according to the force applied on the piezoelectric sensor.

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