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POWER PRODUCING FLOORING USING PIEZOELECTRICITY

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Abstract - Energy harvesting is very fascinating area of research, now when the whole world is looking for green energy as the alternative source. This paper describes the design of energy harvester as a prototype and the power conditioning circuit. The optimization of the extracted power out of the piezoelectric tile has been presented. The generation of electric energy, when some load is applied on the sensor either in the form of direct strains or ambient vibrations depends upon various factors such as numbers of piezoelectric transducers, electromechanical coupling coefficient of the piezoelectric sensors, amount of the load applied, and also on the scheme of arrangement. Energy harvester floor tile has been designed with inferior quality piezoelectric diaphragms which are used in the buzzers. An efficient way has been presented to capture the generated energy by the dedicated IC and boost it by a converter to get regulated output for charging the batteries of smart phones. The complete charge cycle has been studied for the developed of the system. The simulation and experimental studies have been successfully carried out and the model design and testing was purely for studying the energy generation and capturing phenomenon in the efficient manner. It can be implemented to generate large power by suitably considering the several factors as mentioned above and implementing it on the large scale.

Index Terms— Storage device,Energy harvesting, power conditioning, piezoelectric sensors, Boost converter.

Key Words: optics, photonics, light, lasers, templates, journals

1. INTRODUCTION

The sun is the most important source of energy for the life on the planet earth either in the direct or derivative form. Dependency on non renewable source decreasing these sources per day and in near future it will get exhausted completely. Hence it is required to explore for the alternative sources and shift our dependency on the renewable sources. This will conserve non renewable sources and will produce clean energy. These renewable sources include wind mills (Wind energy), solar cells (Solar energy), tidal turbine (Tidal energy), geothermal power plants (Geothermal energy) etc. Solar power provides a considerable amount of energy per area and volume, but unfortunately is limited to applications that are actually sunlit.

We utilize a large part of our muscular energy for moving from one place to other and also the infrastructure like roads, railways, runway bears a large amount of mechanical strain energy. This energy i.e. muscular or mechanical strain on various infrastructures gets wasted. But it is possible to convert this mechanical energy in to electrical pulse form with the help of piezoelectric transducers. These electrical pulses, which are alternating in nature, can be directly utilized or may be captured by a storage device for further utilization. Efforts have been put in this work to harvest energy from mechanical stress using the principle of piezoelectric energy conversion.

For a harvesting system of constant thickness, the generated power increases with increase in applied force. The output power of harvester depends on increase in the thickness. We have various models of piezoelectric generators. The output power obtained from piezoelectric generators depends on various factors like which piezoelectric sensor has been used, it's packing density, type of strain applied to it, electronic circuitry to process the pulse generated, storage device, and load connected to it. When a simple rectifier is used the output power generated greatly depends upon the load connected. The important criteria for maximizing the output power are to match the optimal load of the harvester to that of converter circuit.

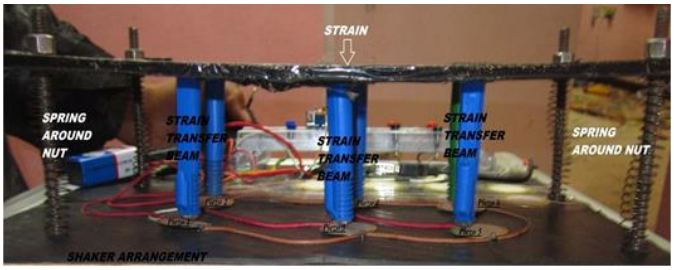
Several techniques are available for converting mechanical vibration energy to electrical energy. The most prevalent methods among them are electrostatic, electromagnetic and piezoelectric conversion. A majority of current research has been done on piezoelectric conversion due to low complexity of its analysis and fabrication. Most of research however has targeted a specific device scale.

The latest advancement in the micro-electromechanical system systems (MEMS) and wireless technology, the portable electronics and wireless sensors are in great demand. These portable devices must have their own power supply. If this supply is a conventional battery, then using this type of power supply will be problematic as their life span is finite. In portable electronics, replacing the battery may destroy the electronics any time. For sensors which are planted in the remote locations or in the host body, if battery has been discharged the sensor must be retrieved and the battery should be replaced. Because of remote location of the mobile host body, it is quite difficult to retrieve the sensor and replacing the battery.

If a sensor is embedded inside a civil infrastructure then it is not possible to replace the battery. If the adequate energy in the surrounding medium could be obtained, then it can prove as the substitute of the battery. One method is to use the piezoelectric material to obtain the energy lost due to vibration of the host structure. This captured energy can be processed and could be used to prolong the life of the power supply or to provide the endless energy to a device. The host structure may be a mobile floor, roadway, pedestals, rail, runway etc where a continuous strain is experienced and this strain or vibration energy which was wasted earlier may be transformed in to usable electrical energy to power up the low power electronic and electrical devices

Piezo electric effect

Piezoelectricity is defined as a change in electric polarization with a change in applied stress (direct piezoelectric effect) shown in Fig. 1(a). The converse piezoelectric effect is the change of strain or stress in a material due to an applied electric field shown in Fig. 1(b). Another interesting property of piezoelectric material is that they change their dimensions (contract or expand) when an electric field is applied to them. The converse piezoelectric effect describes the strain that is developed in a piezoelectric material due to the applied electric field. Piezoelectricity is the ability of some materials such as crystals and certain ceramics, to generate an electric potential in response to applied mechanical stress or heat. If the piezo crystals are not short circuited, the applied charge induces a voltage across the material.



Objective

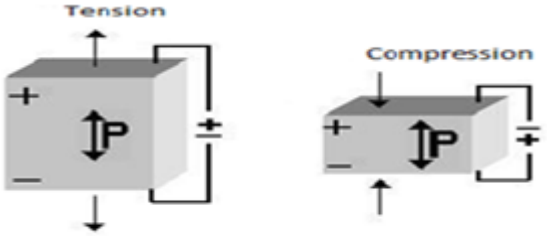
The core objective of this project is to transform the energy you use while walking in to useable electric power. We will use piezoelectric transducer to generate electricity, which will be fitted inside the shoe. A piezoelectric sensor is a device that uses the piezoelectric effect, to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge. They are used for quality assurance, process control, and for research and development in many industries

Literature Review

In [4], the author used the series parallel combination of piezoelectric transducers to yield voltage and controlled the equipment using micro controller. In [5], the author placed the transducer inside the floor of busy passage whose circuit include Unidirectional Current Controller, Voltage Sampler, AC ripple neutralizer and Inverter Pierre Curie discovered the piezoelectric effect in 1880, but only in the 1950s did manufacturers begin to use the piezoelectric effect in industrial sensing applications. Since then , this measuring principle has been increasingly used, and has become a mature technology With excellent inherent reliability. Piezoelectric sensors are electromechanical systems that react to compression, the sensing elements show almost zero deflection. This gives piezoelectric sensors ruggedness, an extremely high natural frequency and an excellent linearity over a wide amplitude range. One disadvantage of piezoelectric sensors is that they cannot be used for truly static measurements. A static force results in a fixed amount of charge on piezoelectric material. In conventional readout electronics, imperfect insulating materials and reduction in internal sensor resistance causes a constant loss of electrons and yields a decreasing signal.

2. Planning of work

The microscopic origin of the piezoelectric effect is the displacement of ionic charges within a Transducer structure. In the absence of external strain, the charge distribution is symmetric and the net electric dipole moment is zero. However, when an external stress is applied the charges will be displaced and the charge distribution will be no longer symmetric and net polarization will be created. In some cases a Transducer possesses a unique polar axis even in the unstrained condition. This can result in a change of the electric charge due to a uniform change of temperature. This is called the pyroelectric effect. The direct piezoelectric effect is the basis for force, pressure, vibration and acceleration sensors and the converse effect for actuator and displacement devices.



Electromechanical Conversion

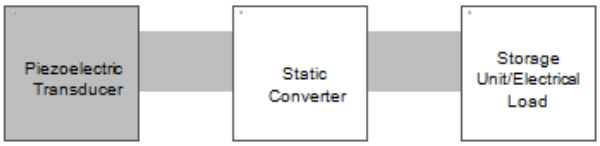


Fig -1: Block Diagram

The Block Diagram Consist Of

1. Piezoelectric Transducer: This transducer is our voltage source for our project

2. Bridge Rectifier: The voltage produce from the transducer is in AC So we need to

Convert it to DC with the help of bridge rectifier.

3. Switch: Our device has a switch which will shift the supply to the indicator path and Regulator path

4. Voltage Regulator: Our device which is to be charged need constant output, which is to be controlled by voltage regulator circuit

5. LED Indicator: Our device also consist an indicator to show there is an output from the source.

6. Output: The Device which is to be charged is connected to the circuit in the Output electrically erasable programmable read-only memory (EEPROM) to store the voice message data in digitized form. If timing circuit is not interrupted by switch and is timed out, it will activate the automatic telephone dialer system. All of the above circuitry may be implemented with printed circuit boards located on the backside of cabinet, and the associated manual adjustment controls of the circuits may also be located at the back of the cabinet.

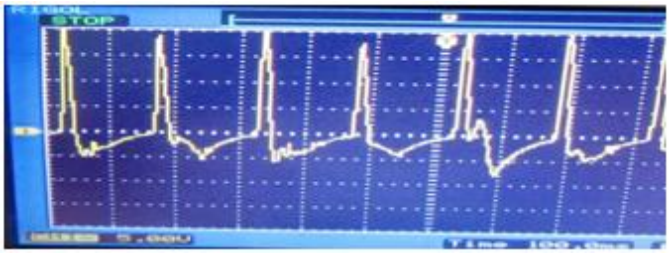


Fig -1: AC output voltage observed on DSO

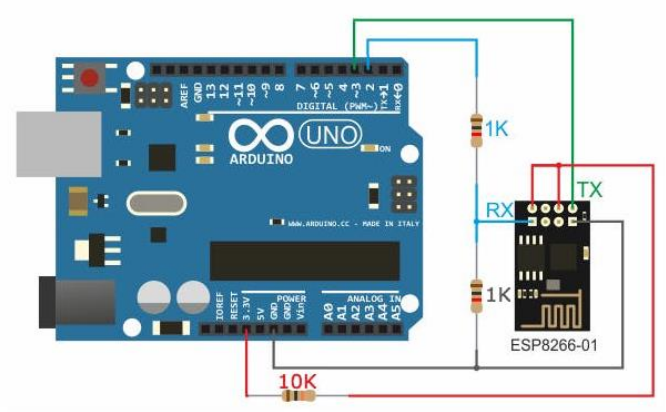
Table -1: Components Used in the Project

Parts/Materials	Specification	Quantity
Cheap/Generic USB Power Bank		1x
Piezoelectric Transducers	Voltage output- 0-1 0VDC Maximum Pressure- 2000 Torr	6x
Rectifier Diodes	1N4007	4x
Hook-up Wire	Very thin	At least 12
Old Pair Of Shoes	Hard glue	1 pair
Contact Adhesive		1 Bottle

Tools & Equipment:	Specification	Quantity
Digital Multimeter		1x
Rotary Tool		1x
Zener diode	5v,1A	1x
Led		1x
Resistor	47 ohm	2x
Switch	Two way supply	1x

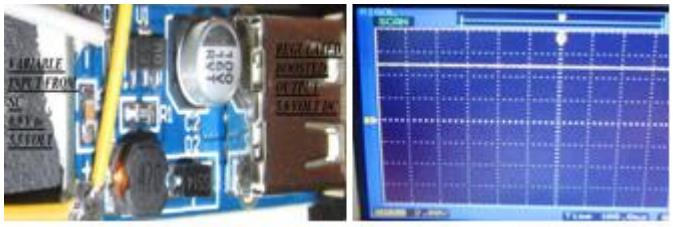
3. Advancements over the previous basic module

1. Addition of IOT circuit to monitor the amount of power generated.

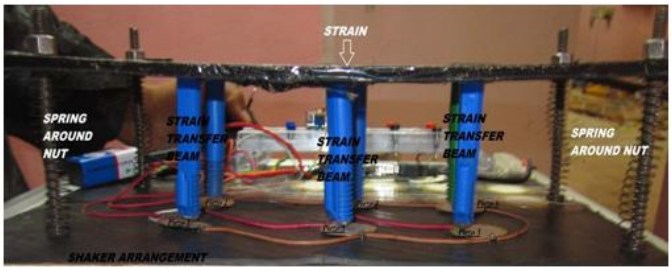


2. Adding a charging circuit comprising of capacitors to harvest all the energy formed.

3. Test the piezoelectric transducers with various dimensions so as to gain the maximum output.



4. Designing Power Producing Pavements.



4. CONCLUSIONS

The project represents an energy saving system using a Passive Infrared Radio sensor to switch 'off' fan and light circuits in the classroom in the absence of students. The design system comprises a motion detector and temperature sensing component. The motion detector is meant to detect any human being displaced through the infrared (IR) heat generated by human body. The temperature detector operates when the room temperature is above a given threshold. For this project the room temperature is summed to be in the range of 25C to 30C. The future should include a shorter recovery

time for the device to switch off the lamp and fan in a span time of 60 seconds when there is no occupancy.

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