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Experimental Validation of Electromechanical Product for Energy Harvesting System

Anju Vikraman.V.J[1], Dr.Bindu.S.S[2*], Sree Raj.M.P[3], Sree Mahesh.M.P[4], Joe Jeba Rajan.K[5], Krishnakumar.K[6], Arya.S.M[7], Sreehari Arun[8], Amjad Ali Khan R S[9]

[1]Assistant professor, Department of Computer science engineering,
Vidya Academy of Science and Technology,
[2*]Associate Professor, Department of Mechanical Engineering, Rajadhani Institute of Engineering and Technology
[3,4,5,6]Assistant Professor, Department of Mechanical Engineering, Rajadhani Institute of Engineering and Technology,
[7,8,9]UG Students, Department of Mechanical Engineering, Rajadhani Institute of Engineering and Technology
***Corresponding Author:** Dr. Bindu S.S
* Associate Professor, Department of Mechanical Engineering, Email:binduss@rietedu.in

ABSTRACT
Energy harvesting is the process of obtaining energy from the surroundings of a system and converting that into useful electrical energy. A novel product was developed, through which energy can generated from any vibrating body. The equipment comprises of piezo heap transducers implanted on a cantilever bar which goes about as a cantilever pillar, charge intensifier, Schottky diodes and capacitors. The model was associated with a vibrating body so to infer the out voltage accessible. The outcomes are obtained and examined. The equipment was additionally associated with a lab VIEW module and the framework was concentrated once more. The venture has its applications in the field of small scale electro mechanical framework (MEMS)

Keywords: Piezo electricity, energy harvesting, LabVIEW.

1. INTRODUCTION

With the progression in small scale electro mechanical frameworks (MEMS), the interest for convenient hardware and remote sensors is developing quickly. As these gadgets are compact, it becomes fundamental that they convey their own capacity sources. Just vitality collecting gadgets can meet this. The various sorts of vitality reaping gadgets are piezo electric gadgets, photograph voltaic gadgets, thermo electric generators and smaller scale wind turbines. Of these, piezo electric materials have a crystalline structure which gives them the capacity to change mechanical strain into electrical charge and the other way around. The mechanical strain can emerge out of various sources like human movement, low recurrence seismic vibrations and acoustic clamours. Aside from in uncommon cases, the piezoelectric impact works in AC requiring time fluctuating contributions at mechanical reverberation to be effective.
Collecting vitality from "squander" vibration present in nature has seen an expanding enthusiasm during the previous years as a component of the general increased mindfulness for elective vitality sources. Close to of commonplace electro mechanical techniques, ferroelectric gadgets have demonstrated to be exceptionally successful to reap vitality for low force gadgets as frequently found in versatile hardware, sensor controlled and condition checking frameworks because of the wide usable recurrence range and flexibility. Unused force exists in different structures, for example, machine vibration, streaming water, wind, human movement and stun waves. As of late, modern and scholastic research units have concentrated on gathering vitality from vibrations utilizing piezoelectric transducers.

2. PRINCIPLE OF OPERATION

In certain single crystal materials exhibit the following phenomenon: when the crystal is mechanically strained or the crystal is deformed by an external stress, the electric charges appear on the crystal surfaces. When the direction of strain reverses the polarity also reverses. This is called Piezo electric effect and the crystals which exhibit it are called Piezo electric crystals. PZT is the most commonly used Piezo electric crystal. Barium Titanate, Lead Titanate, Lithium Niobate, Lead Metaniobate are the other usual piezo materials used. It was selected because of the low cost and easiness in availability. As the voltage obtained from a single piezo electric crystal was about 250 mV, four of them were arranged on a stainless steel rod which was selected due to its elastic properties, as shown in the figure 1.

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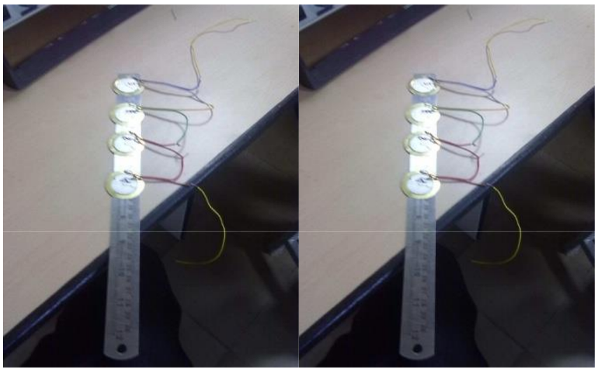

Fig.1 Piezo crystals embedded on a Stainless Steel beam.

3. PROPOSED ENERGY HARVESTING SYSTEM

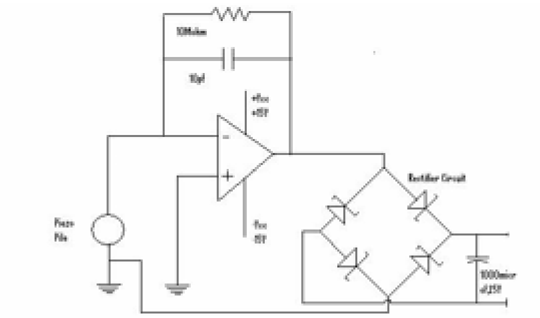

Fig. 2 Energy Harvesting Circuit for single piezo crystal.

A charge enhancer is a flow integrator driven by an electrical source with capacitive nature, for example, a piezoelectric sensor. The charge enhancer comprises of an opamp , criticism capacitor and a resistor. A rectifier circuit was utilized as shown in figure .2 in order to change over the AC voltage got from the yield of the piezo transducers into DC The 1000 F capacitor was utilized in order to store the yield voltage got.

4. EXPERIMENTAL RESULTS AND DISCUSSIONS

Experimental set up as shown in figure.3.

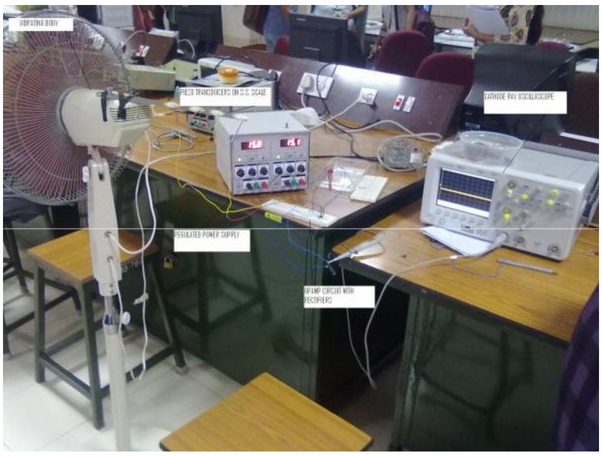

Fig. 3 The experimental set up

A. Single crystal arrangement

The trial was directed for a solitary piezo crystal utilizing the circuit appeared previously. The outcomes were appeared of the scope of 2V to 4V. It was this finding provoked us to coordinate various piezo transducers together in arrangement so to expand the yield.

B. Piles of crystals

The test was led for a progression of a piezo electric transducers. The rule utilized was that the voltage got from a solitary piezo will be added to the voltage acquired from the second and the equivalent for the remainder of the transducers to get a net yield voltage. A rectifier circuit was utilized to change over the AC voltage acquired from the yield of the piezo transducers into DC with the goal that the equivalent can be put away in to a battery.

TABLE 1: VOLTAGE VALUES FROM CRO

Max(V)	Amplitude(V)
3	>16.4
6.8	>12.7
4.1	>11.3
2.7	>16.3
12.9	>5.5
1.5	>17.7
600m v	>20v
2.1	>16.9
3.7	4.1
2.3	>17.2

C. Regulation of the output voltage using a capacitor

The capacitor was utilized for separating the AC part from the corrected sign acquired. This was done as such as to making the redressed sign to an unadulterated DC. The yield acquired was balanced out at 4V. Qualities were taken irregularly and are as given in the table 2.

TABLE 2: VOLTAGE VALUES FROM CRO, WITH CAPACITOR

Max(V)	Amplitude(V)
1.5	5.2
6.2	10
19.5	23.4
600m v	>15.6
11.5	27.7
2.4	2.8
10.4	14.1
16	19.7
18.5	>38
2.6	1.4
7.1	10.8
2.9	12.8
4.5	>15.5
900 mv	7.2
10.9	>30.3

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D. Data Acquisition using LabVIEW

So as to get the information originating from the piezo heap transducer, the National Instruments NIUSB9201, information procurement board was utilized, which has an example pace of 500 kS/s, a goals of 12 bits and a most extreme voltage go from 10V to 18V. The information gathered from the circuit through the DAQ board was put away and investigated utilizing LabVIEW.

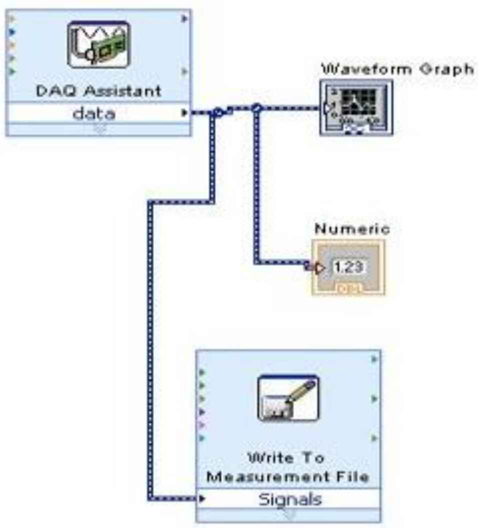

Fig. 4 Block diagram in LabVIEW

After making the connections, the energy harvesting circuit was connected to the DAQ .The DAQ assistant block in the labVIEW helped us to study the output obtained in various manners. A circuit of above type was made in labVIEW. The wave form graph was provided so as to obtain the output graphs, as obtained from a Cathode ray Oscilloscope. A separate block was also connected to the DAQ for writing the readings obtained in each (1/100)th of a second into a file. Here the piezo pile was placed on a motor which was used for studying the vibrations on a long shaft. The input voltages that were given to the opamp where +/ 12V is supplied.

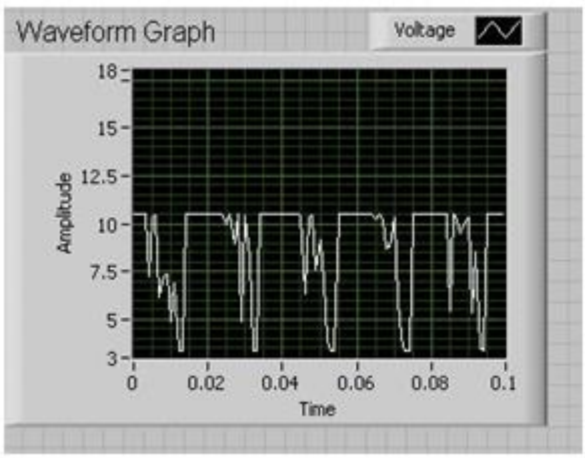

Fig. 5.Wave form from DAQ in labVIEW

5. CONCLUSION

It is conceivable to reap vitality from a solitary piezo electric transducer and heaping those transducers gives us upgraded yield voltage. The capacitor is utilized for separating the AC segment from the amended sign acquired. This yield can be utilized for charging battery. There are exceptionally touchy piezo transducers which are fit for giving yields of Voltage go contrasted with the millivolts yield given by the current transducers. Due to the non-accessibility of such transducers, Opamp utilized here enhances the sign that is profit capable here to storable levels. Utilizing such high proficient piezo transducers will give higher yield voltages of the range 10V to 20V. This will keep away from the utilization of Opamp and the yield obtai ned need not be enhanced. Consequently we can legitimately associate piezo transducers to the rectifier circuits and afterward to the hitter. This circuit can be applied to a wide scope of vibrating bodies.

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