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# Green Energy Harvester Based On Frequency Conversion Method

Emilet Kethsiyal.Y[1]
PG Scholar
IFET College of Engineering, Villupuram, India

Arun Kavi Arasu.S[2]
PG Scholar
IFET College of Engineering, Villupuram, India

Selvalakshmi.V[3]
PG Scholar
IFET College of Engineering, Villupuram, India

Kavitha.M[4]
PG Scholar
IFET College of Engineering, Villupuram, India

***Abstract:*** **Green energy harvester based on frequency conversion method is designed to generate the power from low frequency, such as human walking vibration, vehicle crossing vibration, motor vibration likewise. This system is very useful for generate and harvesting the power from the ambient source, that is doesn't affect the environment. In the last few years it has been an increasing demand of low power and portable energy sources due to the development and mass consumption of portable electronic devices. Further, the portable energy sources must be associated with environmental issues and imposed regulations. These demands support the research in the areas of portable energy generation methods. In this scope, these become a strong candidate for energy generation and storage in future applications. In this context, a sector that has attracted much interest is one in which devices that are able convert mechanical energy into electrical energy. This technique is known as Energy Harvesting and consists of energy capture and storage from ambient sources. This paper works with piezoelectric and electromagnetic transducers, which are able to convert mechanical vibrations into electrical energy. The structure modeled as a free sliding beam with one electrical load. A program was developed to analyze the behavior of this system, as well as the optimal conditions for power harvested. This paper explains the implementation of power generation which is a step towards improving the generating and harvesting the power, vibrating on the particular place. In this system, a computerized system automatically measure the what type of voltage is generated. If the any motion is take place on the rod then automatically that convert to the electrical energy, that voltage is stored in the storage device then that will be used based on the application.**

## I. INTRODUCTION

As low power and wearable electronic devices are more and more present our everyday life. Energy Harvesting, Power Harvesting or Energy Scavenging is about the act of converting ambient energy in electrical energy (electrical power). Normally, the electrical energy converted is stored in a kind of battery to be used later but that don't prevent the energy be used in the same time that is converted too. In this form, the Energy Harvesting may be a solution for source energy in many cases, mainly in remote, inaccessible or hostile environments applications where the connection with the electrical energy network is difficult. Frequently, these devices are small, wireless autonomous, like those used in wearable electronics and wireless sensor networks.

It is seen from the reported energy harvesters that the power density of the device tends to diminish as the operation frequency and the device volume decrease. However, portable and implantable applications need efficient energy harvesters to be operated at low frequencies as the human motion frequencies are in the range of 1–10 Hz. In addition, small size is also essential for these applications. In this study, we introduce a compact energy-harvester structure that generates energy from low-frequency vibrations within a range of 1–10 Hz. The proposed structure uses a green energy based frequency conversion method to increase the performance of the system while eliminating the use of micro electro mechanical system (MEMS) in the structure. This new approach also enables a simpler fabrication process for a possible micro scale implementation. Furthermore, the operation principle of the structure does not rely on a resonant vibration as long as the amplitude of the external vibration is sufficiently high to release the cantilever from the diaphragm, which increases the bandwidth of the energy harvester.

## II. LITERATURE REVIEW

The increasing utilization of the portable, implantable, and wireless systems in medical, industrial, and military applications aroused the need for compact and efficient energy- harvesting devices to be used for powering these systems. The dependence of these devices on external power supplies and batteries are minimized by using energy harvesters that generate energy from ambient sources such as heat, light, and vibration [3]. Among these sources, vibration is particularly important due to its abundance. Some vibration sources in the environment are vehicle motion, human movements, and seismic vibrations. Energy can be harvested from these sources by using piezoelectric, electrostatic, and electromagnetic transduction.

The efficiency of these systems is proportional with the value of the vibration frequency. However, ambient vibrations are mostly at low frequencies (100 Hz), limiting the

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generated power density of these systems for daily applications. In the case of electromagnetic energy harvesters, increasing the generated power density is accomplished by using multiple degrees of freedom, optimizing coil geometry and dimensions [4], or simply designing the generator to operate at high frequencies.

A thorough comparison of energy harvesters can be found in [5]. Most of the reported electromagnetic energy harvesters up to now utilize vibration frequencies larger than 50 Hz in order to achieve high power density levels, introduced a resonant energy harvester that is able to produce from resonance frequency of 322 Hz [6]. This power level is obtained only when the input frequency is matched with the resonance frequency. fabricated a cantilever and coil-based electromagnetic energy harvester with optimized magnet geometry, which can generate energy at 52-Hz input vibration [7].

A next method, called frequency-up-conversion, utilizing the magnetic pull force between a permanent magnet and a magnetic material to up-convert the operation frequency of the harvester, has been proposed. In this method, the magnet moving on a diaphragm with the ambient vibration frequency periodically catches and releases a magnetic piece which is placed on a cantilever for up-converting the vibration frequency, hence increasing the energy harvesting efficiency [9]. The reported energy-harvester prototype operating at 1-Hz input vibration frequency [8]. A micro fabricated version of this device is also reported. However, these two structures require extra magnetic materials for realizing the up-conversion, which not only complicates the fabrication of the structures, but also increases the device volume.

## III. IMPORTANCE OF ENERGY

Nowadays need of power is essential, because of the increase in number of the electric devices and electronic devices. So we are implementing the system for harvesting energy from low frequency vibration. The energy generation may come from any method. That method should not give any negative impact to the environment.

The harvesters should not be in a large size like generators, transducers, micro actuators etc. in this proposed structure we are using MEMS for converting mechanical energy to electrical energy. The size of the MEMS is within a range of 1-100 µm. The size of the proposed structure is portable and implantable as compared to existing system.

## IV. FREQUENCY CONVERTION METHOD

With the increase in the number of power using instruments such as electric and electronic devices the task of power generation is becomes more complex in now a day. Small saving of power is very essential, so from our project we generate the small amount of power. This project presents Green energy harvester based on frequency conversion method for harvesting energy from external low-frequency vibrations within a range of 1-10Hz. The structure consists of a MEMS placed on a diaphragm, a polystyrene cantilever carrying a mechanical barrier which converts low-frequency vibrations to a high- frequency, hence increasing the efficiency of the system. The tested structure generates 3v output by convert a low frequency.

Green energy, being renewable can be generated in many industries where there is continuous source of vibrations such as e.g. sugar factory, automobile manufacturing companies, etc. The fact is, in all these concerns, the vibrations generated by the motor is continuous. The lifetime of rechargeable batteries can also be extended using ambient vibration as the energy source, and storing power on an ultra-capacitor/rechargeable battery providing Generations of Power.

Energy harvesters generate energy from ambient sources such as heat, light, and vibration. Among these sources vibration is particularly important due to its abundance. Vibration is one of the green energy. It is produced in a manner that has less of negative impact to the environment than energy sources like fossil fuel, which are often produced with harmful side effects. Green energy is renewable because it is not depleted easily and is naturally replenished.

## V. OPERATION PRINCIPLE

Fig. 1 illustrates the proposed energy-harvester structure. The structure consists of a clamped-free support-type cantilever beam, a pick-up MEMS attached on the free edge of the cantilever, a motor placed on a diaphragm, and a mechanical barrier arm, which is an extension from the side of the diaphragm, facing the cantilever. The system is designed in a way that the resonance frequency of the cantilever is much higher than the resonance frequency of the diaphragm to realize the frequency up-conversion.

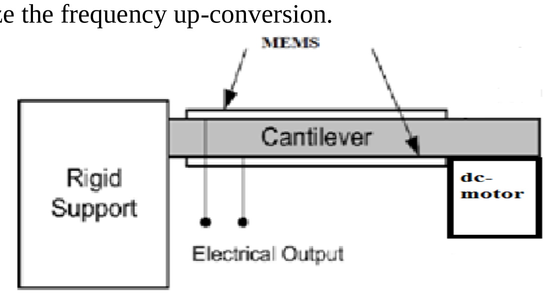


Fig 1. Cantilever with MEMS

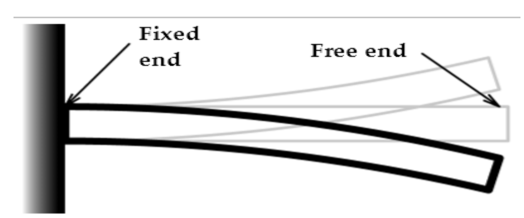


Fig 2 movement of cantilever

Fig. 2 shows the operation principle of the energy harvester. With the presence of a low frequency external vibration, the diaphragm carrying the magnet moves from its rest position starts going upwards or downwards according to the initial acceleration coming from the vibration. During this movement, the barrier arm touches, bends, and releases the cantilever. When the cantilever is released, it starts resonating at its resonant frequency, which is higher than the ambient vibration frequency. The same mechanism occurs when the diaphragm is moving at the opposite direction of its initial movement. As a result, up-conversion is realized twice in each period of the excitation vibration. This causes a change in the relative position of the MEMS with respect to the motor vibration, and voltage is induced across the terminals of the MEMS.

## VI. BLOCK DIAGRAM

The general block diagram of the "Green Energy Harvester Based On Conversion Method" is shown in fig 3

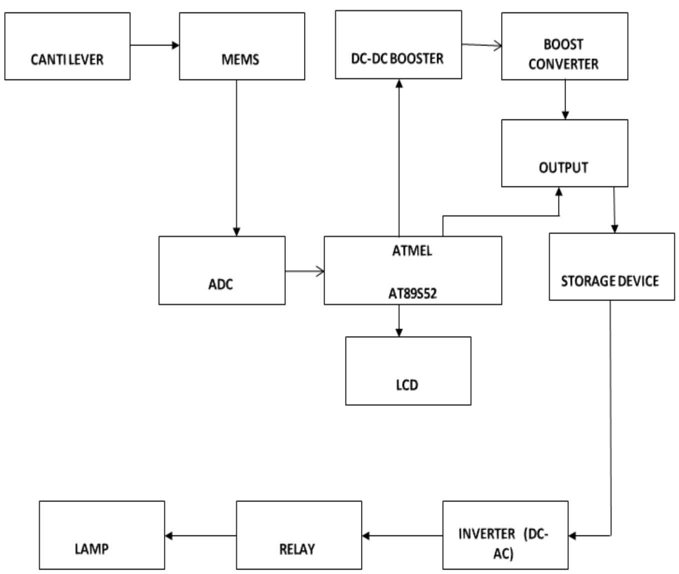


Fig 3. Block Diagram.

**Explanation**

Every vibrating place suited for apply it. We placed this project in speed breaker, the damper, placed in contact with the cantilever beam acts as source of vibration for power generation. MEMS sensor placed on the beam, it will convert the mechanical energy generated from the movement of the beam into electrical energy.

The output of MEMS that analog electrical signal is given to the ADC for analog to digital conversion. This digital form only suited for the microcontroller for analyzing. Then it passed to microcontroller in order to monitor the value of energy generated. That value is displayed by using LCD which measure what type of voltage is crossed.

The output of MEMS is also given to boost controller. The obtained energy is boosted up using Boost Controller and given to DC-DC converter. The output of the DC-DC converter is stored in a storage device. The stored energy is directly used for the mobile charging, otherwise that pass to the inverter, which is inverted to AC voltage and is given to the relay and utilized for other purposes for lighting lamps for example. The voltage control is provided by the microcontroller.

**APPLICATION**

Wireless sensors are becoming increasingly popular because of their wide potential application and ability to be employed in inaccessible and hostile environments. To realize the full potential of wireless sensors requires a self-sustainable power source, and vibration energy harvesting provides a promising solution in this regard. In addition, many other applications that consume low levels of energy could potentially be powered using mechanical vibrations. For example, portable and wireless devices (cell phones, mp3 players, etc) would benefit from longer battery life and the need for less frequent recharging, which could be accomplished by supplementing. These systems are applicable for some places:

1. It is used in the platform (In that place vibration from the pedestrians)
2. In Motor, vibration is used to generate some voltage.
3. Used in speed breaker
4. It provides power supply to RFID reader.
5. Cell phone charger.
6. IC self power supply.

## VII. CONCLUTION

A new green energy harvester based on frequency conversion method for low-frequency vibrations is presented. The proposed structure has a magnet placed on a vibrating diaphragm, a cantilever carrying MEMS, and a mechanical barrier that converts low-frequency vibrations to a higher frequency, which is the resonance frequency of the cantilever. The prototype is able to work over a wide range of external vibration frequencies, since a resonant input vibration is not crucial due to the up-conversion principle as long as the amplitude of the external vibration is sufficiently high to release the cantilever from the diaphragm. In addition to this, higher external vibration frequency values naturally increase the performance of the proposed harvester. The tested structure proved to give 3V by up-converting 1-10-Hz external vibration to 394 Hz. The representative volume of the system is 2.96 cm. The obtained PD is the highest PD obtained for the vibration-based energy harvesters. This shows the feasibility of miniaturizing the device, proving that the proposed structure is a good candidate to be used in powerless micro system applications operating at low-frequency vibration mediums.

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**AUTHORS PROFILE**

**Y.EMILET KETHSIYAL** received the **B.E.** degree in electronics and communication engineering from the JACSI College of Engineering, Nazareth, Anna University, Tirunelveli, India, in 2012.Currently doing **M.E.** in electronics and communication engineering (Applied electronics) in Anna University of technology, Chennai, India. Currently she is carrying her research in the field of Electronics (MEMS), Sensor Network.

**S.ARUN KAVI ARASU** received the **B.E.** degree in electronics and communication engineering from the ES College of Engineering, Villupuram, Anna University, Chennai, India, in 2012.Currently doing **M.E.** in electronics and communication engineering (Applied electronics) in Anna University of technology, Chennai, India. Currently he is carrying her research in the field of Electronics (MEMS), Image processing Sensor Network.

**V.SELVALAKSHMI** received the **B.E.** degree in electronics and communication engineering from the Kurinji College of Engineering & Technology, Trichy, Anna University, Trichy, India, in 2012.Currently doing **M.E.** in electronics and communication engineering (Applied electronics) in Anna University of technology, Chennai, India. Currently she is carrying her research in the field of Electronics (MEMS), Sensor Network.

**M.KAVITHA** received the **B.E.** degree in electronics and communication engineering from the Mother Theresa College of Engineering, cuddalore, Anna University, Chennai, India, in 2012.Currently doing **M.E.** in electronics and communication engineering (Applied electronics) in Anna University of technology, Chennai, India. Currently she is carrying his research in the field of Electronics (MEMS), Sensor Network.